

NEW: W1JR's
VHF/UHF WORLD

ham radio magazine

- measuring noise figure
- verticals over REAL ground
- a simple approach to GOES reception
- EMI/RFI shielding
- V-antenna for two meters
- wide-range ohmmeter

hr
focus
on
communications
technology

WHY POWER FETs BELONG IN YOUR NEXT AMPLIFIER



ICOM IC-04AT

440MHz, PL Tones, Scanning, Plus...

ICOM is proud to announce the latest in 440MHz handheld transceiver technology. The IC-04AT represents the best in a multifunction, multifeature handheld for 440 — 450 MHz.

Features. Features. Features. The IC-04A and IC-04AT cover from 440 — 449.995 MHz. Frequency entry, control functions and the 32 PL tones are controlled by the 16-button pad on the face of the radio. Also included are priority, scanning (both of memories and programmable band scan) and DTMF (04AT only). For scanning, 5, 10, 15, 20, or 25 KHz increments are front panel selectable. Ten memories with internal lithium battery backup give the ultimate in flexibility for channelizing operation of this sophisticated handheld for easy access to most used channels. Thus, the IC-04A(T) may be used to individually bring up any frequency between 440 and 449.995MHz with 5KHz spacing, or favorite frequencies may be stored in the memory and recalled at the touch of a button. The IC-04A(T) has all the features you could want in a handheld.



Compatible Accessories. The IC-04A(T) has the same styling, control features and functions of the IC-02A(T). The IC-04A(T) utilizes the existing accessory line available for the IC-2A



and IC-2AT, plus new accessories such as long-life and high-power battery packs and a boom headset. Multiple battery packs allow the widest flexibility in charging: either from a wall charger, cigarette lighter plug, stand-up desk charger, or through the top of the radio. Twelve volts applied through the top of the radio not only provides operation of the radio at high power, but provides charging of the battery packs at the same time — a feature not commonly found in handheld units.



Built to Last. The IC-04A(T) comes with a sealed case, providing resistance to moisture, dust, and other elements detrimental to the operation of the radio. An aluminum back provides a massive heatsink for the power module allowing the IC-04A(T) to run at a standard 3 or 5 watts (optional battery required). A battery lock is provided to ensure the battery will remain secure, and the unit will continue to operate even if mishandled. A custom LCD readout with S-meter is unique to the ham industry.

Expanding on our line of available accessories, the IC-04A and IC-04AT become the most versatile handhelds in their class. See the IC-04A(T) at your nearest ICOM dealer.



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, ± 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



"Comm-packed."

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

TR-2500

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

TR-2500 FEATURES:

- **Extremely compact size and light weight**
Measures 66 (2-5/8) W x 168 (6-5/8) H x 40 (1-5/8) D, mm (inches). Weighs 540 grams (1.2 lbs) with Ni-Cd pack.
- **LCD digital frequency readout**
Shows frequencies and memory channels, four "Arrow" indicators.
- **Ten channel memory**
Nine memories for simplex or ± 600 kHz offset. "M0" memory for non-standard split frequency repeaters.
- **Lithium battery memory back-up**
(Estimated 5 year life.) Maintains memory when Ni-Cd pack is fully discharged or removed.



- **HI/LOW power selection**
2.5 watts or 300 mw.
- **Memory scan**
Scans only channels in which frequency data is stored.
- **Programmable automatic band scan**
Upper and lower frequency limits and scan steps of 5-kHz and larger.
- **UP/DOWN manual scan**
- **Built-in tuneable sub-tone encoder**
Tuneable (variable resistor) to desired CTCSS tone.
- **Built-in 16-key autopatch encoder**
- **"SLIDE-LOC" battery pack**
- **Repeater reverse switch**
- **Keyboard frequency selection**
- **Extended frequency coverage**
Covers 143.900 to 148.995 MHz in 5-kHz steps.
- **Optional power source**
Using optional MS-1 mobile or ST-2 AC charger/power supply, radio may be operated while charging. (Automatic drop-in connections.)



Actual size

- **High impact plastic case**
- **Battery status indicator**
- **Two lock switches**
Prevent accidental frequency change and accidental transmission.

Standard accessories include:

- Flexible antenna with BNC connector
- 400 mA Ni-Cd battery pack
- AC charger

Optional accessories:

- ST-2 Base station power supply/charger (approx. 1 hr.)
- MS-1 13.8 VDC mobile stand/charger/power supply



TR-3500

70 CM FM Handheld

- 440-449.995 MHz in 5-kHz steps
- TX OFFSET switch keyboard programmable ± 5 kHz to ± 9.995 MHz
- 1.5 W/300 mW HI/LOW power switch
- Auto. squelch position on squelch control
- Tone switch for TU-35B optional programmable CTCSS encoder
- Other features include 10 memories: lithium battery memory back-up, programmable automatic band scan, memory scan, UP/DOWN manual scan, repeater reverse, 16-key autopatch, keyboard frequency selection, slide-lock battery

- VB-2530 2-M 25 W RF power amp. w/cables, mtg. brkt. (TR-2500 only)
- TU-1 Programmable CTCSS encoder (TR-2500 only)
- TU-35B Programmable CTCSS encoder (mounts inside TR-3500 only)
- PB-25 Extra 400 mA Ni-Cd battery
- PB-25H Heavy-duty 490 mA Ni-Cd battery
- DC-25 13.8 VDC adapter.
- BT-1 Battery case for manganese/alkaline AA cells
- SMC-25 Speaker-microphone
- LH-2 Deluxe leather case
- BH-2A Belt hook
- RA-3 m 3/8" telescoping antenna (for TR-2500).
- WS-1 Wrist strap
- EP-1 Earphone

More information on the TR-2500 and TR-3500 is available from all authorized dealers of Trio-Kenwood Communications, 1111 West Walnut Street, Compton, California 90220.

KENWOOD

...pacesetter in amateur radio

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

SAVE \$10.50* with home delivery

SAVE \$10.50* with home delivery

*(One year newsstand cost \$30.00)
Here's my address label, enter my subscription. Payment enclosed
 Bill me later

1 Year 12 issues \$19.50
2 Years 24 issues \$32.50
3 Years 36 issues \$42.50 U. S. prices only

Name _____ Zip _____

Address _____ State _____

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

JANUARY 1984

volume 17, number 1

T. H. Tenney, Jr., W1NLB
publisher

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

Dorothy M. Rosa
assistant editor

Joseph J. Schroeder, W9JUV
associate editor
Susan Shorrock
editorial production

publishing staff

J. Craig Clark, Jr., N1ACH
assistant publisher

Rally Dennis, KA1JWF
director of advertising sales

Dorothy Sargent, KA1ZK
advertising production manager

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 U. S.
funds, via international postal money order
or check drawn on U. S. bank

international subscription agents
are listed on page 98

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, New Hampshire 03048-0498
and at additional mailing offices
ISSN 0148-5989

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



contents

12 power FETs: trend for VHF amplifiers

Daniel Peters, ex DL4VJ,
and Robert S. Larkin, W7PUA

26 measuring noise figure

Albert Helfrick, K2BLA

35 verticals over REAL ground

Mark Bacon, WB9VVA

42 VHF/UHF world

Joe Reisert, W1JR

46 G.O.E.S. reception: a simple approach

John M. Franke, WA4WDL

53 a wide-range ohmmeter

John T. Bailey

65 ham radio techniques

Bill Orr, W6SAI

**72 EMI/RFI shielding: new techniques
part 1**

Vaughn D. Martin

86 weekender: the 2-meter V-antenna

Thomas M. Hart, AD1B

**116 advertisers index 91 ham notebook
and reader service 104 new products**

11 comments 8 presstop

83 DX forecaster 101 product review

98 flea market 6 reflections

114 ham mart 85 short circuit

COVER: Siliconix, Inc.

January 1984 5

REFLECTIONS REFLECTIONS

Lost Weekend

With winter rapidly approaching, this past weekend was supposed to be spent cutting, splitting, and stacking wood for our stoves; operating for a few hours in the contest (CQ WW CW); and compiling the results of the last few questions of the September reader survey. Who could predict that my high tree-supported wire antennas would be belted with almost nonstop gusty winds and twice need repair — and a five-band trap vertical need a midnight pruning? I didn't count the number of times I ran back and forth from the shack to the vertical, but it numbered in the *scores*. (There wasn't much difference in temperature between the bitter cold outside and the shack . . . I hadn't yet cranked up the stove.)

After relaxing from the contest, I looked forward to leisurely compiling the thoughtful responses to the question that asked readers to tell us how they thought *ham radio* might be improved.

I read each and every answer to that question at least twice. Many comments were just what we'd expected. While some were indeed eye-opening, none were shocking. Here's what I found:

About your Amateur interest. The average reader of *ham radio* holds at least an Advanced class license (Extra, 33 percent; Advanced, 39 percent; General, 16.5 percent; Technician, 7 percent; Novice, 1.4 percent; no license, 1.4 percent) and has been licensed for 19 years. (33 readers in our sample have each been licensed for over 51 years.)

You operate mostly on SSB/AM. (CW and FM modes are just about tied for second place.) More than half the time you spend on 80 through 10, though the VHF bands attract the second largest group. A little over half of you build your own equipment; considering the level of interest indicated in construction articles, probably more of you would like to. Of those who build, half build from kits and half from "scratch."

How does this translate into hours spent on all facets of Amateur Radio? According to our poll, half our readers spend at least ten hours per week in operation or related activities.

Over half of you own personal computers. And of the half that don't, a third plan to purchase one within the coming year. What isn't clear is how many of you who own computers use them in Amateur Radio applications. (*Let us know.*)

About *ham radio*. What do readers want from us? Specifically, you asked for more articles on antennas (the #1 favorite subject overall), receivers, and using computers for Amateur Radio. There was a general request — almost across the board — for more construction articles, and almost as much interest in articles of a more theoretical nature. Many different subjects attracted your attention (not surprising in view of your diversified backgrounds, occupations, and interests); we'll use this information to plan future issues.

To which magazines do you subscribe? *ham radio*, of course (98.5 percent, and to a lesser extent, the three other brand names. (This comes as no surprise, considering that it was *our* readership that was polled.)

Which best suits your needs? This question really brought out the diversity of our readership. No, you don't think that *ham radio* is tops in terms of reporting on station activities, contesting, politics, news stories, or nostalgia. You buy the other books for that. That's fine. We at *ham radio* aren't trying to be a something-for-everybody magazine. We're just trying to provide the best technical ham magazine you can obtain. That has always been our charter.

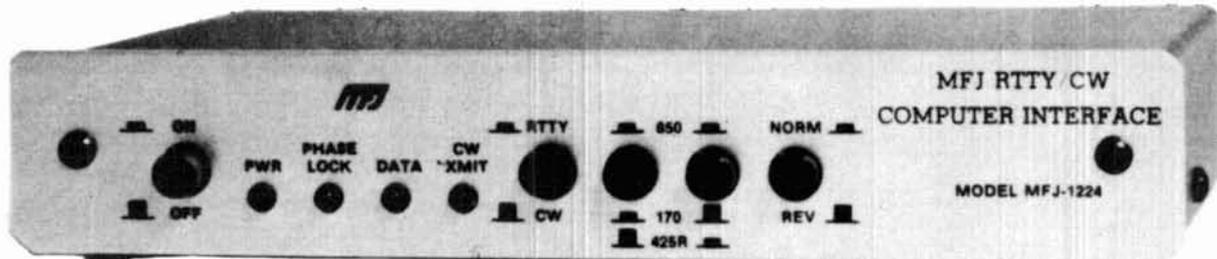
I want to thank all who responded, and especially the hundreds of readers who took the time to expand their views in additional comments and even lengthy letters. (One reader even sent an hour-long audio tape.) The quantity and quality of positive suggestions supplied would be highly gratifying to any editor; as the months and years unfold, I'll do my best to put your advice to work. One major reader request has already been incorporated: starting in this issue, Joe Reisert, W1JR, will contribute a monthly column on VHF/UHF. Joe's many technical and operating accomplishments should be of interest to old and new readers alike.

As this issue went to press, we heard of the untimely passing of Vic Clark, W4KFC, President of the ARRL, over the Thanksgiving weekend. To me, Vic personified Amateur Radio. He was a dedicated ham, a kind person who was always thinking of ways to improve the hobby. He will be missed.

**Rich Rosen, K2RR
Editor-in-Chief**

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 MFJ, Kantronics software and most other RTTY/CW software.



NEW!

MFJ Software plus MFJ Interface for VIC-20 or Commodore 64

(Software cartridge alone, \$49.95.
Order MFJ-1250 for VIC-20.
MFJ-1251 for Commodore 64)

\$129⁹⁵

Powerful RTTY/ASCII/CW software for VIC-20, Commodore 64.
Developed by MFJ. Cartridge plugs into expansion port.
Features split screen display, type ahead buffer, message ports,
RTTY/ASCII/CW send and receive plus much more.
Includes cable to interface MFJ-1224 to VIC-20 or Commodore 64.

\$ 99⁹⁵
MFJ-1224

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.

Powerful MFJ software available for VIC-20 (MFJ-1250, \$49.95) and Commodore 64 (MFJ-1251, \$49.95). Features split screen display, type ahead buffer, message ports, RTTY/ASCII/CW send and receive plus more.

Uses Kantronics software for Apple, TRS-80C, Atari, TI-99 as well as VIC-20 and Commodore 64.

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. 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.

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, RAK software with VIC-20's, or Clay Abrams software with TRS-80C, N4EU software with TRS-80 III, IV. 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.

MFJ-1223, \$29.95, RS-232 adapter for MFJ-1224.

RTTY/ASCII/CW Receive Only SWL Computer Interface



\$ 69⁹⁵
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.

Use MFJ-1250 (\$49.95) software cartridge for VIC-20 or MFJ-1251 (\$49.95) software cartridge for Commodore 64. Use Kantronics software for Apple, TRS-80C, Atari and TI-99.

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 1/2x1 1/4x4 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 outside continental U.S.A. Telex 53-4590.



ARRL PRESIDENT VIC CLARK, W4KFC, PASSED AWAY SUDDENLY November 25. He had complained of chest pains Thanksgiving day, and went to the hospital for examination. He seemed to be doing OK, but was still in the hospital for observation Friday night when a sudden heart attack claimed him. Vic had suffered some health problems in the past few years.

Vic, A "Ham's Ham," Served Amateur Radio With Distinction for most of his life. He had been an ARRL director, played key roles on FCC/Amateur advisory committees and in various International Amateur Radio Union activities, yet always found time to get on the air. A top CW contest operator and DXer, W4KFC's call was for many years invariably found among the top scores in the Sweepstakes and DX frays. Just a week before his death Vic was made a Fellow of the Radio Club of America, "for leadership in Amateur Radio organization, including WARC preparation and implementation." When a League director recently expressed concern that Vic was pushing himself too hard he replied that he wouldn't feel he'd done his part if he didn't die "in the saddle."

Memorial Services Were Held November 30 in Washington, DC; contributions in Vic's memory can be made to the ARRL Foundation c/o ARRL. He's survived by his wife, Hester, WA4PAE, and six children, three of them also Amateurs. W4KFC, a Silent Key at 66.

New ARRL President Is Carl Smith, W0BJW, as automatically provided by the League By-Laws. Succeeding Carl as First Vice President is Larry Price, W4RA. A retired airline captain who learned aerial gunnery from Lt. Barry Goldwater back in 1940, Carl is well known and respected in both domestic and international Amateur circles. His work on the 1979 WARC also led to constructive working relationships with key people at the FCC, as well. No radical changes in ARRL direction are expected under Carl's direction.

ARRL'S WISH FOR VEC COMPENSATION WAS ANSWERED when the House and Senate passed the FCC Authorization (funding) Bill just before Thanksgiving. Smooth political maneuvering by Senator Barry Goldwater, who'd reversed his earlier opposition to any fees in the program, resulted in the fee-permitting amendment being attached to the FCC bill. It was then passed without dissent. FCC Chairman Fowler also supported the pro-fee change.

ARRL Can Now Proceed To Develop Its Own VEC Role; its Executive Committee had put its program on hold pending outcome of the fee question. However, it could still be some time before fees are actually incorporated into the rules. With such delicate questions as fee allocation and acceptable accounting procedures unanswered, the Commission will probably decide that a formal rule-making procedure—usually a matter of months—is called for.

In The Meantime A Number Of Other Organizations including educational institutions have expressed their interest in becoming VECs. It now appears a distinct possibility that, at least in some areas, we could end up with more than one VEC!

10-METER REPEATERS WILL REMAIN LIMITED TO 29.5-29.7 MHZ, at least for the immediate future. Acting on PR Docket 83-485, the Commission decided the interference potential with satellite downlinks and other 10 meter users was too great to justify any change. The ARRL, which initially supported expansion, had filed against any change at this time pending results of the further Notice of Proposed Rule Making on phone band expansion.

Phone Band Expansion Has Been Pushed To The Back Burner, with current FCC resources occupied with the volunteer exam program, Amateur involvement in rules enforcement, and of course the "No-Code" license. Latest Washington readings indicate action on the no-code license is very close, possibly as a "Christmas present" to the Amateur community.

W5LFL DID GET ON THE AIR FROM THE SPACE SHUTTLE, with a full-quieting signal into a hand-held and rubber duckie. At press time the first confirmed QSO was WA1JXN/7 in Montana on orbit 40, though he may also have worked the West Coast on an earlier pass. Lots of media exposure has also been reported. QSL and SWL cards should go c/o ARRL with an SASE.

PRESSURE ON THE 220-MHZ BAND IS STILL INCREASING, with the FCC's Office of Science and Technology now suggesting that the 220-225 MHz allocation be the subject of an FCC Notice of Proposed Rule Making. Though Amateurs are currently the sole users, the band is actually shared with government and land mobile on a co-prime basis.

Band Usage Could Be The Principal Determinant of its future, both in quantity and quality. One way that might help preserve the band would be to make it Amateur Radio's prime high tech "workplace," with, for example, packet radio and various wideband techniques. This is one of the approaches the ARRL is planning to take.

WB6JAC'S CONVICTION FOR TRANSMITTING OBSCENITY on the Amateur bands has been reversed in the U.S. Ninth District Court of Appeals. Though the court did not dispute that Burton had transmitted "obscene" language, it said the government prosecutors had failed to show his actions aroused any "prurient interests!" His convictions for operating without a license still stand. However, such cases may be easier to sustain in the future. Another amendment to the FCC Authorization Bill extends Commission authority over "Dial-A-Porn" telephone businesses since their content is potentially available to children, and that's justification for not providing it First Amendment protection. Since Amateur Radio is operated primarily in homes or family automobiles, the same sanctions could be applied.

Rick Cooper, The Former Exponent Of Unlicensed "HF" Operation, has surfaced again as a result of the Burton reversal. In a rambling letter to the Amateur Radio media, he and his "Communications Attorney Service" promised to support Burton in a lawsuit against "...ARRL, FCC and all radio hams who conspired to deprive Mr. Burton of his constitutional rights...."

OWN THE WORLD WITH THE R3 NO RADIAL VERTICAL 10, 15, 20 METERS

The R3 half wavelength design eliminates the ground radial system required by other verticals. Optimum current distribution gives more efficiency and low angle radiation for DX communications.

R3 brings high performance antenna features to those living in apartments, condominiums or on small city lots. Even if you have plenty of space, R3's combination of neat appearance and DX capability make it ideal for your station. The R3 includes an integral tuner to give a perfect match across 10, 15, and 20 meters. The remote tuning feature allows easy fingertip control as you operate your station.

R3 is a complete antenna system ready to install in virtually any location from ground level to roof top.

FEATURES

3 dB Gain, ref $\frac{1}{4}\lambda$ whip

No Radials

360° Coverage

Integral Tuner with

Remote Control Console and Indicator

24 Volts To Tuner

110 or 220 Volt Operation

75 ft (22.9m) Control Cable Included

Only 22ft (6.7m) High

1 sq ft (.09 sq m) Space

Self Supporting

Stainless Steel Hardware

Mount: Sleeve Type Fits Pipe Up To

1 $\frac{3}{4}$ in (4.5cm) dia

Can Be Easily Stored and Set Up For
Portable or Temporary Operation

Add up the features—you'll find that you can have ALL OF THIS PERFORMANCE without the need to buy tower, rotator and associated hardware. **R3 IS ANOTHER PRODUCT CREATED FOR THE ENJOYMENT OF YOUR HOBBY BY THE WORLD RENOWNED CUSHCRAFT ENGINEERING DESIGN TEAM.**

R3



cushcraft
CORPORATION

THE ANTENNA COMPANY

48 Perimeter Road, P.O. Box 4680

Manchester, NH 03108 USA

TELEPHONE 603-627-7877

TELEX 953-050 CUSHSIG MAN

AVAILABLE THROUGH DEALERS WORLDWIDE

NEC

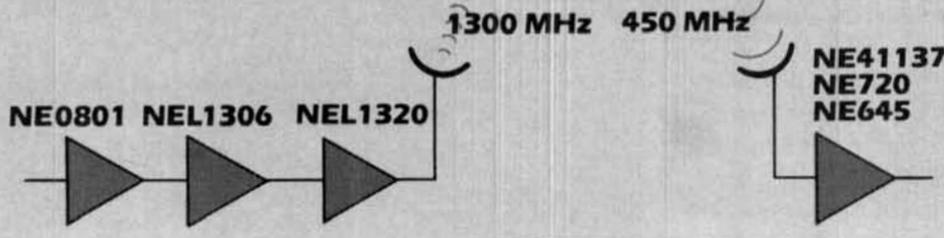
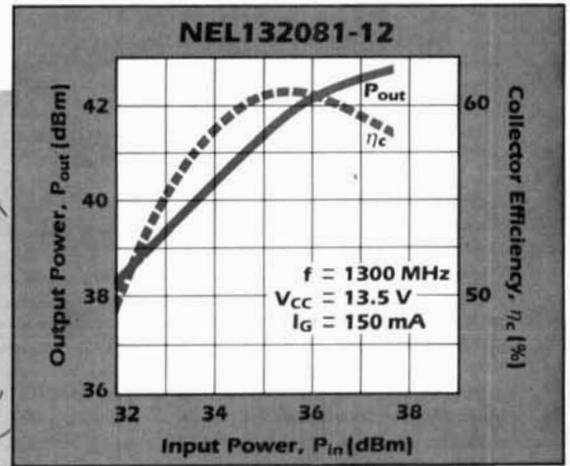
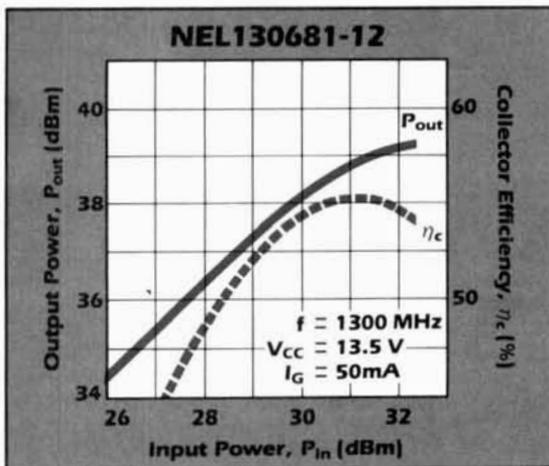
Linear Power Bipolars

NEL1300



- High linear power and gain
 - NEL1306 $P_{1dB} = 38$ dBm typ.
 $G_{1dB} = 7.5$ dBm typ.
 - NEL1320 $P_{1dB} = 43$ dBm typ.
 $G_{1dB} = 6.0$ dB typ.
- 13.5 volt operation
- Pt-Si/Ti/Pt/Au metallization system
- Emitter ballasting
- Silicon nitride passivation

From our latest line of NPN epitaxial power transistors, NEC now introduces the NEL1300 range of linear power bipolar devices. The series is available in a low cost metal-ceramic stripline package offering linear power output levels of 6 watts and 20 watts. Designed primarily for mobile and base station operation in the 1300 MHz band, the series is compatible with single sideband and other popular modulation modes requiring high linearity combined with high output power and gain.



CALIFORNIA EASTERN LABORATORIES, INC.—U.S. and Canada
Exclusive sales agents for NEC Corporation, Microwave Semiconductor Products.

Headquarters, Santa Clara, CA 95050 • 3005 Democracy Way • (408)988-3500 • Tlx. 34-6393 or 171197

In Europe Contact: NEC Electronics (Europe) GmbH • Oberrather Strasse 4 • 4000 Düsseldorf 30 • West Germany
Tel 0211/650301 • Tlx. 841/8581353 or 8587419



comments

10-meter beacon

Dear HR:

The 10-meter beacon described in the September, 1983 issue of *ham radio* ("Comments," page 13) has been moved from Niantic, Connecticut, to just outside of Rochester, New York. It is now about 10 miles (16 km) south of Rochester at 43° 02' N, 77° 41' W, in grid square FN 13 using the Maidenhead Grid Locator system. The power is still 4 watts output and the antenna is a dipole up about 20 feet (6 meters). The beacon, on 28.286 MHz CW, is on the air 24 hours a day.

W. Keith Hibbert, KA1YE
Rush, New York

TOM remembered

Dear HR:

I read your "Reflections" column in October, 1983, *ham radio*. I don't think I've ever been so pleased to read *anything* in Amateur Radio publications.

I was fortunate. I read "TOM" early in my exposure to Amateur Radio. Whenever a bad practice would make an appearance, TOM would be there with the way to get back on the track. It seemed that all Amateurs had tremendous respect for TOM, and as a result, he had a tremendous effect upon the behavior of the majority of licensed operators.

As I remember, I was perhaps one of the first to complain about lists. I

wrote to — was his name Newkirk? — the DX editor of *QST* at the time and registered my protest against what I perceived to be a cancer growing on DXCC. Of course, nothing happened except that as time passed, DXCC became less of an accomplishment. Naturally, if the real competition is removed from DXCC (or any other award), the award becomes less desirable to the true DXer. I wonder what sense of accomplishment one receives from Honor Roll status when he knows that the certificates should be made out in the name of the do-good MC?

I am proud of my DXCC, 5B DXCC, WAZ, etc. I have 308 confirmed and every last one is self-earned! To disprove the equipment dodge, I have only modest equipment, but it has been put together with DX in mind, using a tri-band beam. But I expect that if one wants to work DX, he must equip himself with DX gear just as an automobile racer equips himself. (I don't ever remember TOM saying it was wrong to run legal power — or to use gain antennas.)

With the MC type of DX, you stand in line and take your turn! This should never have been allowed to happen. I blame all of the DX commentators for forgetting that DX is a competition and that the chase is where the fun is. I'm very pleased that *ham radio* has brought the issue out of the closet. Perhaps continued exposure of this practice will make it dry up and disappear. If it is ridiculed sufficiently — and often — I feel sure that many Amateurs will avoid it, and in so doing regain the thrill of DXing.

Walter Camuso, W1ESN
Vero Beach, Florida

avoiding splatter

Dear HR:

W5XW's excellent letter (December, 1983) commenting on the poor waveform of the sidetone of some keyers is correct. A poor waveform

would cause splatter if fed into the audio input of a transmitter. My own homebrewed circuit uses a Twin-T audio oscillator and produces a good waveform output that has been checked on an oscilloscope. And my on-the-air tests have shown that there was far less interference caused than when you yell AHHHHHH into the microphone, or the side bands caused by normal conversation. I did check on a buddy's commercial keyer's sidetone, and it was poor, just as Bob said.

The relay technique I described was not used in the audio input circuit, but was used in the keying circuit because the frequency of the relay was far too low for a good audio signal. It acted just like the dots of my old Vibroplex, when I tested the idea years ago. And as I said, I did prefer the automatic keyer because it gave a steadier output, as would be expected.

The low-duty cycle technique, used with a dummy load, is very effective when tuning up because before you tune for your plate current dip, your plate dissipation can temporarily be quite high, and at times reach dangerous levels. Another good reason for first using a proper dummy load is that when your final amplifier is tuned up, you don't have to touch its controls when you switch to your antenna tuner. This technique naturally eliminates the interaction problem between transmitter and tuner controls that is so often present when you tune up directly without first using a dummy load. The more you use your dummy load, the less QRM you make on the bands.

So to avoid splatter as mentioned by W5XW, do as he suggests, unless your audio side tone output is a good sine wave; just use dots and key your transmitter directly. (And thanks, Bob, for your precautionary letter. I had not been aware of the poor quality of sidetone wave shapes of the kind of units he discussed until he brought it to my attention.)

William Vissers, K4KI
Cocoa Beach, Florida

Note: As this issue went to press, Siliconix announced the sale of the RF portion of its MOSFET power transistor business to the PHI Division of M/A-Com, in Torrance, California. Siliconix will continue to supply these parts until M/A-Com is in full production of the product. — Editor

power FETs: trend for VHF amplifiers

Use these MOSFETS
for better thermal stability,
lower noise, easier matching,
and higher voltage operation

The dull black fins of heatsinks have all but replaced the glow of vacuum tubes as the distinguishing visual feature of power amplifiers designed for Amateur use. Bipolar junction power transistors offer many advantages and have, among amplifier designers, become the device of choice over vacuum tubes in many applications. However, just as bipolar junction transistors have largely replaced vacuum tubes as technology has advanced, it now appears that bipolar transistors are being challenged by field effect transistors (specifically RF power MOSFETs) in the RF power amplifier field.

In this article we will discuss some of the features that make the RF power MOSFET (variously known as VMOS, TMOS, DMOS, etc. by different manufacturers) an impressive RF power amplifier. We will also touch on some of the problems that accompany their use. Measurements made on several actual VHF mobile power amplifiers will serve to illustrate the discussion. The amplifiers examined are 50 and 100 watt 2-meter units and a 100 watt unit for 220 MHz.

advantages

When compared to conventional bipolar transistors, the RF power MOSFET offers the following advantages:

Thermal stability. The current gain (Beta) of a typical bipolar transistor increases with temperature. As a result, the collector current can increase with temperature, which results in still higher temper-

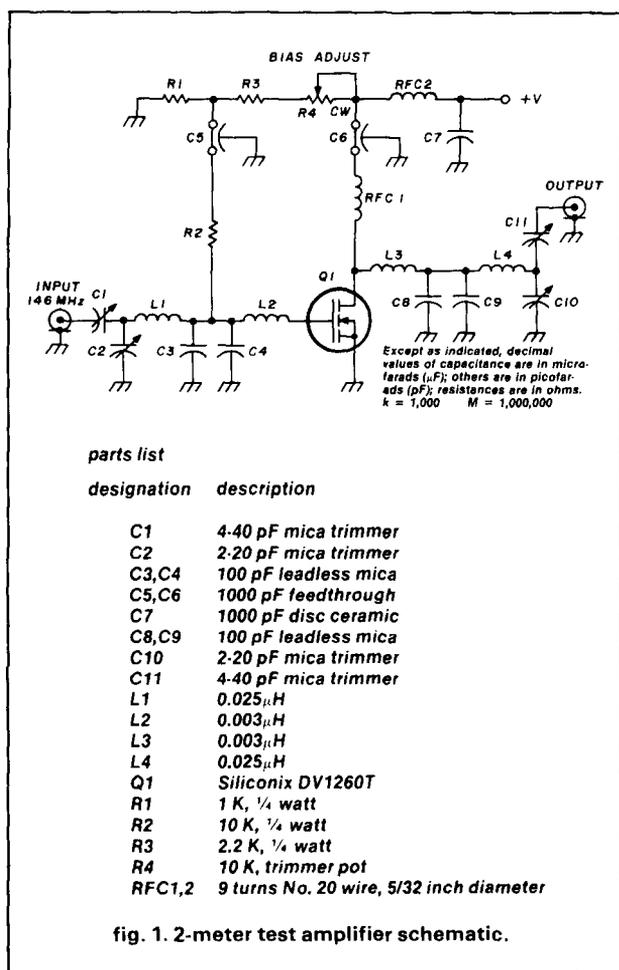
atures and even higher currents, and can lead to thermal runaway. Careful circuit design is required to prevent this problem. On the other hand, at high power levels the transconductance of a power FET decreases with temperature, and an increase in temperature results in a decrease in current, which tends to be self-stabilizing. This stabilization also applies across the chip and serves to prevent destructive phenomena characteristic of a bipolar device: current hogging, hot spotting, and secondary breakdown. Also, no internal source ballasting resistors — with their inherent gain reduction, increased parasitic capacitance, and increased fabrication costs — are required.

Another advantage of this temperature characteristic is the ability to parallel several power FETs without the need for careful device matching. With VHF amplifiers, the number of devices that can be paralleled is limited more by the physical problem of additional parasitic reactances than anything else.

Low noise. A power FET generates far less broadband noise, typically 10 dB better, than a comparable bipolar transistor. This is due partially to the absence of a forward-biased junction and its associated shot noise. This low noise has the potential for significant reduction of transmitter noise levels, which can be beneficial at repeater sites or at any location where other equipment is operating in close proximity.

Low spurious. The transfer characteristic of a typical power FET displays no abrupt changes in shape. This means that when biased for Class AB operation, as in a typical linear power amplifier application, there will be lower high-order inter-

By Daniel Peters, ex DL4VJ, Falcon Communications, Suite 400-550, 2995 Woodside Road, Woodside, California 94062, and Robert S. Larkin, W7PUA, Janel Laboratories, 33890 Eastgate Circle, Corvallis, Oregon 97330



modulation products than in a similarly operated bipolar transistor.

Input impedance. The power FET gate is essentially an MOS capacitor. At low frequencies this results in much higher input impedances than the equivalent bipolar device. At VHF the ratio is less favorable. However, the FET device still tends to look capacitive, as opposed to the inductive reactance presented by bipolar devices, which simplifies the design of the input matching networks.

Reduced feedback. Power FETs have reduced internal feedback paths. The higher input impedance results in gate drive voltages several times as high as typical base drive voltages, with two benefits: first, the voltage induced across the source impedance affects the input voltage of the FET proportionally less than the equivalent voltage across the emitter inductance in a bipolar transistor circuit. Second, the effect of reverse transfer capacitance, already low in the power FET, is further reduced by the lower voltage gain.

Parameter changes. The transfer parameters of the RF power FET are quite insensitive to power level.

This translates into smooth tuning of the input and output, along with continuous input/output curves, and contrasts with bipolar devices that tend to require retuning at each power level. Bipolar devices also tend to have jumps in power output due to parameters changing with power level.

Simplified circuit design. Gate leakage current is in the nanoampere or sub-nanoampere range resulting in essentially no bias power being used. Thus, simple, low-power bias circuits can be utilized. In addition, the negative temperature coefficient of the FET allows the use of bias supplies without the complex temperature compensation schemes common to bipolar designs. In some higher power designs, it is still desirable to use temperature compensation. However, the compensation is to reduce variations in circuit performance with temperature, not to protect the devices.

Higher operating voltage. Although the practical circuits we will consider in this article are oriented toward mobile VHF power amplifiers, the newer high voltage FETs reaching the market present exciting possibilities for base station use. As supply voltage increases, current decreases and impedance levels increase. At a fixed power level, doubling the voltage halves the current and quadruples the impedance. Increased impedance reduces the effect of parasitic inductance elements and makes the internal leads of the transistor a less critical part of the matching networks. Capacitor values in the matching networks become more reasonable and bypassing gets much easier. Finally, increased impedance allows easier broadband transformer design.

Ruggedness. The previously discussed thermal properties of the FET are often mentioned as the reason for their toughness when compared to bipolar devices.

Another equally important factor contributing to this quality is the FETs' voltage ratings. For example, the gate in the Siliconix devices, specified for 13.6 volts service, will withstand at least 30 volts with respect to the source or drain, and the drain will withstand at least 45 volts with respect to the source. Devices with even higher voltage ratings are available.

The result of these high breakdown voltages and favorable temperature characteristics is an amplifier that can withstand considerable abuse. Neither reasonable amounts of excessive input power nor high VSWR loads will cause any problems for the FET.

commercially available RF power MOSFETS

The preceding discussion of the advantages of RF power MOSFETs is relevant only if you can pur-

chase the devices and actually use them in an amplifier. **Table 1** lists some important parameters of a sample of the RF power MOSFETs available from Siliconix, Motorola, and Acrian, respectively. (Other manufacturers offer RF power MOSFETs, so your choice is not limited to these three. Also note that these are only partial lists, and that the selection continues to increase as time passes.)

The purpose of **table 1** is simply to illustrate the ranges of some of the devices available and to list the performance of the particular devices under certain sets of circumstances. The devices are useful under conditions other than those listed. For example, the Motorola devices specified at 28 volts perform very well, although at reduced gain and power levels, at 13.6 volts. The higher power levels listed are PEP ratings. Thermal considerations make steady-state power outputs at higher power levels impractical. Higher power levels require the paralleling of devices, fans, and other parts.

building a test amplifier

The Siliconix DV1260T, described in **table 1**, is a particularly interesting device for use in VHF mobile power amplifiers. The rest of this article will be devoted to examining the use of this device in several practical circuits.

The first step was to build a lab model of a single-transistor 2-meter amplifier in order to verify the Siliconix data and explore possible problems in the areas of stability, DC voltages, gain, and RF match-

ing. The design goal was a 50-watt amplifier usable for both FM and SSB.

Fig. 1, a schematic of the amplifier, reveals a straightforward approach. Both input and output matching networks use double L sections. The double L sections result in lower losses than single section networks. The input network transforms a gate impedance of 1 ohm to 50 ohms. The 1-ohm gate impedance is essentially resistive at these frequencies because the input capacity is near series resonance with the lead inductance. If done in a single L sec-

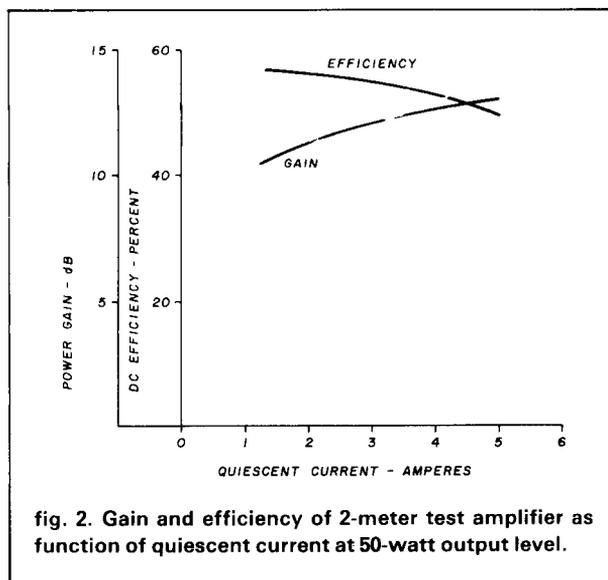


fig. 2. Gain and efficiency of 2-meter test amplifier as function of quiescent current at 50-watt output level.

table 1. Selected RF power MOSFETs available from Siliconix, Motorola, and Acrian.

Siliconix RF power MOSFETs		
device	price	typical performance at 2 meters
DV1220S	\$21.90	20 watts out with 10 dB gain at 13.6 volts
DV1240U	31.03	40 watts out with 9 dB gain at 13.6 volts
DV1260T	44.80	60 watts out with 9 dB gain at 13.6 volts
DV2820S	20.75	20 watts out with 12 dB gain at 28.0 volts
DV2840S	44.20	40 watts out with 12 dB gain at 28.0 volts
DV2880U	84.35	80 watts out with 10 dB gain at 28.0 volts
DV28120T	100.80	120 watts out with 10 dB gain at 28.0 volts
DVD150T	100.80	150 watts out with 12 dB gain at 120.0 volts
Motorola power MOSFETs		
MRF136	16.00	20 watts out with 15 dB gain at 28 volts
MRF171	35.00	50 watts out with 15 dB gain at 28 volts
MRF172	65.00	80 watts out with 12 dB gain at 28 volts
MRF174	88.00	120 watts out with 11 dB gain at 28 volts
MRF150	92.00	150 watts out with 10 dB gain at 50 volts
Acrian power ISOFETs		
VMIL20FT	33.00	20 watts out with 13 dB gain at 28 volts
VMIL40FT	45.00	40 watts out with 13 dB gain at 28 volts
VMIL60FT	65.00	60 watts out with 13 dB gain at 28 volts
VMIL80FT	77.00	80 watts out with 13 dB gain at 28 volts
VMIL120FT	105.00	120 watts out with 10 dB gain at 28 volts

tion, a loaded Q of about 10 is required. This produces a 1 dB loss for coils of reasonable Q . The double L section allows loaded Q s of about 3 and the two sections produce a loss of about 0.5 dB. Incidentally, because the input and output impedance transformations were very similar at the power level of interest, similar components were used for both networks.

Testing of the amplifier was done at supply voltages of both 13.6 and 16 volts. 16 volts was included for potential base station use because the performance of the DV1260T improved a bit at higher voltages. The amplifier was tested at 146 MHz.

An exploration of the effects of quiescent current was made. If the quiescent current is too high, the device will overheat from static dissipation. If the quiescent current is too low, gain and linearity suffer. Fig. 2 shows the gain and efficiency of the amplifier as a function of quiescent current. A quiescent current of 3 amperes was used for most of the remainder of the tests.

Fig. 3 shows the gain of the amplifier as a function of the output level. At 16 volts a gain of over 15 dB is achieved at low power levels, dropping to about 10 dB at 75 watts output. At 50 watts the gain was measured at 12.2 dB. The lower curve shows the expected decrease in gain at 13.6 volts.

Fig. 4 demonstrates the effect of output power level on efficiency. At first glance it might appear that the efficiency is greater at 13.6 volts than at 16 volts. However, we must look at the efficiencies at equivalent points with respect to maximum power output. For example, the amplifier operating at 16 volts and 75 watts has about the same gain and linearity as when operating at 13.6 volts and 50 watts and as might be expected, the efficiency at 16 volts and 75 watts is greater than for 13.6 volts and 50 watts.

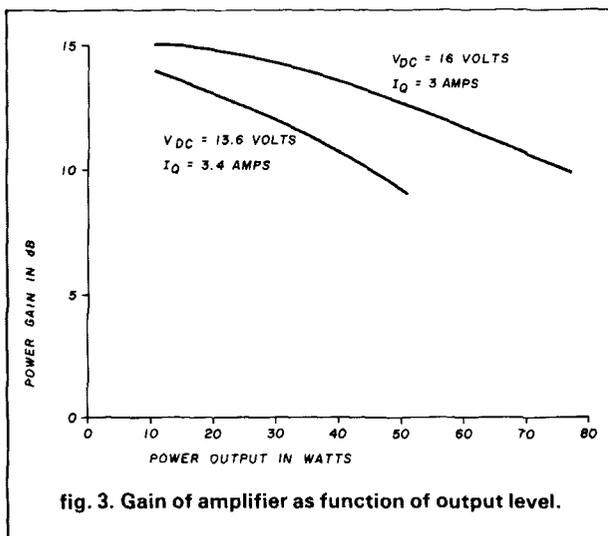


fig. 3. Gain of amplifier as function of output level.

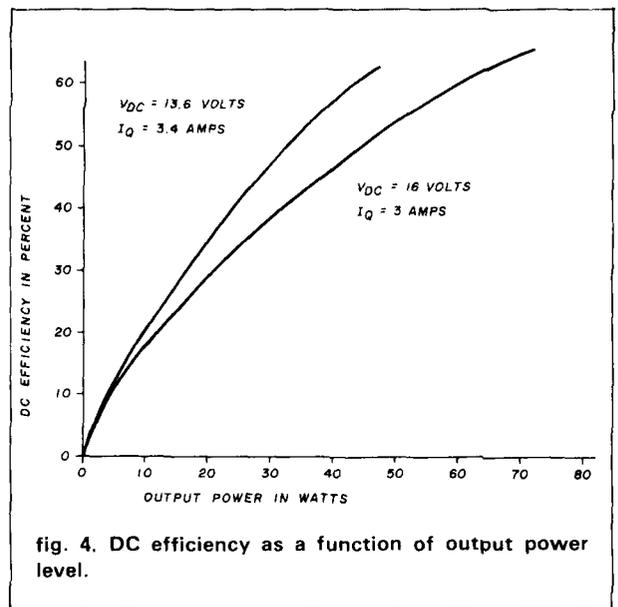


fig. 4. DC efficiency as a function of output power level.

Measured at 25 watts, the test amplifier showed an input VSWR of just under 2. This was with the tuning adjusted for maximum output. This value would seem adequate for working with most Amateur transceivers.

Other tests were run and the following basic conclusions were reached. The DV1260T device performed essentially as claimed by Siliconix. A single device is quite capable of 75 watts when operating at 16 volts and 50 watts when operating at 13.6 volts. Looking forward, a pair of these devices would appear to be suitable for 100 to 150 watts when operating from 16 volts. When operating from 13.6 volts, a capability of 100 watts would seem practical.

a practical amplifier

The next step was to take the test amplifier and turn it into a practical amplifier by adding T/R switching and control circuitry. An amplifier of this power level will be used primarily to boost the power level of the ubiquitous two-meter handheld transceiver (HT) when used in an automobile, so we added a few other features: an adjustable regulated power supply to power the HT and save on batteries, an audio amplifier to boost the HT's sound level, and provision for plugging in a receiver preamplifier. Fig. 5, a schematic of the finished unit, represents a complete handheld transceiver (HT) accessory package. Because this is not intended to be a construction article, the schematics are supplied for functional guidance only; in the interest of brevity we will describe the circuit in terms of features rather than in specific detail. We hope it will serve as a source of ideas to those of you who will design their own FET amplifiers.

The unit was built on two PC boards, an RF board,

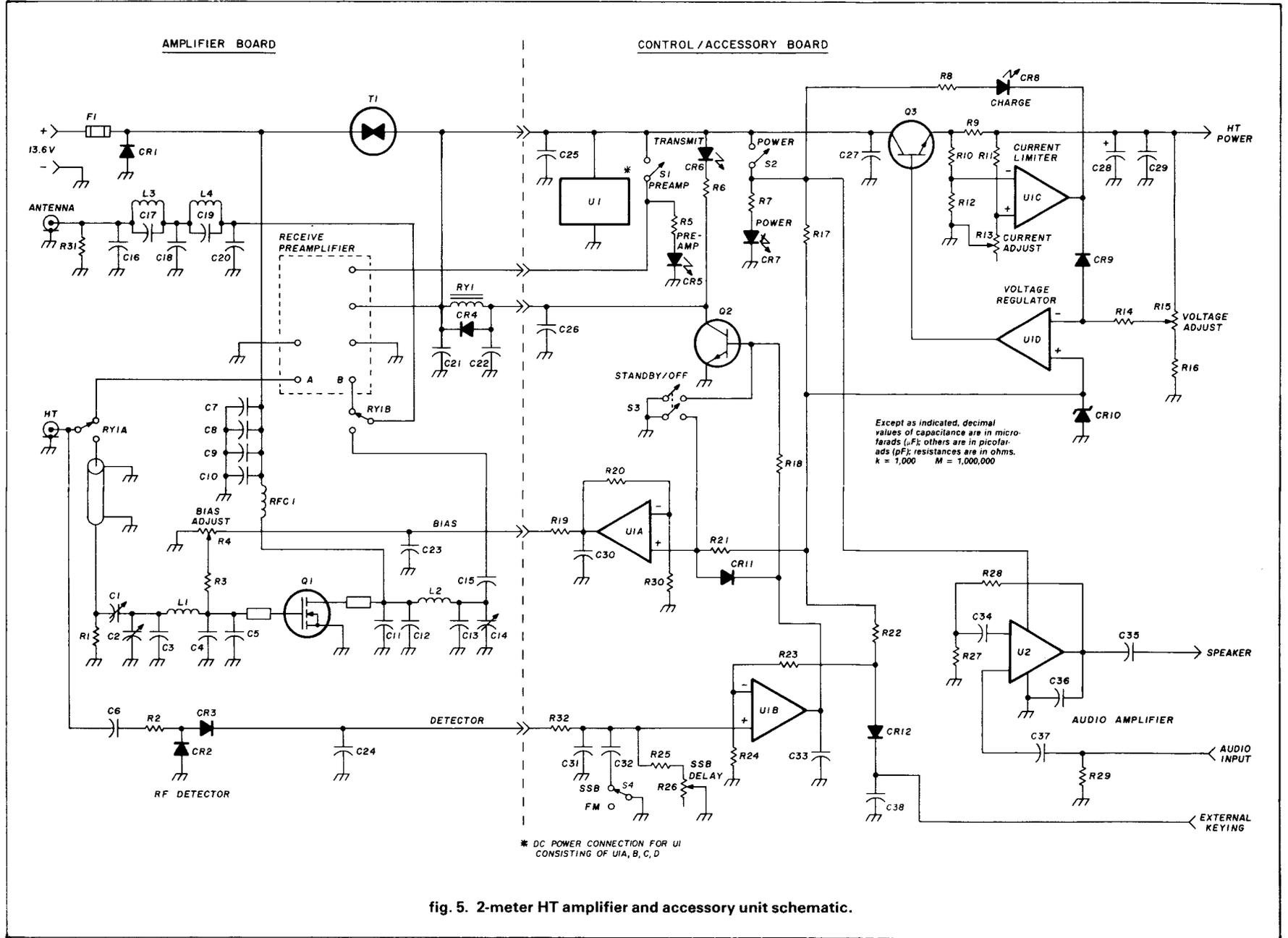


fig. 5. 2-meter HT amplifier and accessory unit schematic.

AEA Brings You The RTTY Breakthrough

NEW MBATEXT™ \$109.95 List / \$89.95* VIC-20 MBATEXT or C-64 MBATEXT



MBATEXT™ is the most advanced MBA (Morse, Baudot, ASCII) software plug-in cartridge available for the VIC-20 or Commodore 64 computer. Compare our outstanding features and price to the competition.

- KEYBOARD OVERLAY instructions to avoid constant referral to the manual
- RTTY and ASCII SPEED ESTIMATE MODE
- BREAK-IN CW MODE
- QSO BUFFER RECORD TOGGLE
- WORD PROCESSOR style insertion, deletion, and correction in TEXT EDIT MODE
- CW AUTO SPEED TRACKING plus SPEED LOCK
- BREAK-IN BUFFER that is easy to use
- Low speed FARNSWORTH CW TRANSMISSION (between 5 and 14 WPM)
- RE-TRANSMIT RECEIVED TEXT DIRECTLY without need of disk or cassette
- DISK, CASSETTE, OR PRINTER storage of message and QSO buffers
- RECEIVE AND TRANSMIT 5-99 WPM MORSE
- 10 SOFT-PARTITIONED™ MESSAGE (OR TEST) BUFFERS
- WORD WRAP
- TIME OF DAY CLOCK
- PRECOMPOSE SPLIT SCREEN OPERATION
- STATUS INDICATORS on screen
- EASY START-UP by simply typing SYS 44444 or SYS 33333
- DEDICATED FUNCTION KEYS for quick operation
- Ability to IMBED CONTROL FUNCTIONS in type-ahead buffer
- WORD OR CHARACTER mode
- SELECTABLE BAUDOT UNSHIFT ON SPACE (USOS)
- SEND/RECEIVE 60, 67, 75, 100, 132 WPM BAUDOT PLUS 100, 300 BAUD ASCII
- RTTY BLANK-FILL and MORSE BT option for idle transmit periods
- AUTOMATIC PTT
- computer control of TONE REVERSE
- MASTER MENU, COMMAND MENU, and OPTIONS MENU makes MBATEXT™ easy to use with no prior experience
- INCLUDES CABLE TO INTERFACE WITH AEA model CP-1 COMPUTER PATCH™
- POWERED BY HOST COMPUTER.

NEW MICROPATCH™

MICROPATCH™ IS A NEW LOW-COST, HIGH-PERFORMANCE Morse, Baudot and ASCII SOFTWARE/HARDWARE computer interface package. The MICROPATCH™ model MP-20 or MP-64 incorporates the complete MBATEXT software ROM (described above) for either the VIC-20 or Commodore 64 computers. All circuitry and software is incorporated on a single, plug-in cartridge module featuring the following:

- TRUE DUAL CHANNEL MARK AND SPACE MULTI-STAGE 4 POLE, CHEBYSHEV ACTIVE FILTERS
- AUTOMATIC THRESHOLD CORRECTION for good copy when one tone is obliterated by QRM or SELECTIVE FADING
- EASY, POSITIVE TUNING with TRIPLE LED INDICATOR
- NOT a low-cost, low-performance phase-locked loop detector!!!
- SWITCH SELECTED 170 Hz or WIDE SHIFT on receive
- 800 Hz multi-stage active CW FILTER
- AUTOMATIC PTT
- RTTY ANTI-SPACE
- demodulator circuitry powered by external 12VDC (not supplied) to AVOID OVERLOADING HOST COMPUTER and for maximum EMI ISOLATION
- EXAR 2206 SINE GENERATOR for AFSK output
- SHIELDED TRANSCIEVER AFSK/PTT INTERFACE CABLE PROVIDED
- PLUS or MINUS CW KEYED OUTPUT
- FSK keyed output.



The Micropatch is structured for easy upgrading to the AEA Computer Patch™ advanced interface unit without having to buy a different software package! Simply unplug the external computer interface cable (supplied with the Micropatch) from the Micropatch and plug it into the Computer Patch.

\$149.95 List \$129.95* MP-20 or MP-64

COMPUTER PATCH™



COMPUTER PATCH™ is the name of our most advanced computer interface equipment for Morse, Baudot, ASCII, or AMTOR operation. The CP-1 will allow you to patch most of the popular personal computers to your transceiver when used with the appropriate AEASOFT™ TU software such as AEA MBATEXT, AMTOR TEXT™, or the MBATEXT RESIDENT ON THE MICROPATCH units. AEA also offers a full feature software package for the Apple II, II plus and IIE; TRS-80 Models I, III and IV; and the IBM-PC. The CP-1 will also work with certain other computers using commonly available software packages.

The CP-1 offers the following advanced and high quality features:

- HANDSOME ALL METAL ENCLOSURE FOR MAXIMUM RF IMMUNITY
- DUAL CHANNEL, MULTI-STAGE ACTIVE MARK AND SPACE FILTERS
- AUTOMATIC THRESHOLD CORRECTION
- RECEIVE 170 HZ FIXED OR 100-1000 HZ VARIABLE SHIFT
- 800 HZ multi-stage CW FILTER
- PRE-LIMITER AND POST-LIMITER FILTERS
- SERIAL RS-232 FIELD INSTALLABLE OPTION
- 117 VAC WALL ADAPTOR SUPPLIED
- PLUS (+) and MINUS (-) CW OUTPUT JACKS
- MAGIC EYE STYLE BAR GRAPH TUNING INDICATOR
- SCOPE OUTPUT JACKS
- NORMAL/REVERSE front panel switch
- MANUAL (override) PTT switch
- VARIABLE THRESHOLD for CW
- ANTI-SPACE RTTY
- KEY INPUT JACK for narrow shift CW ID on RTTY, CW practice, or keyboard bypass.

The CP-1 is made in the U.S. with high quality components including double-sided glass epoxy through-hole plated boards, complete with solder mask and silk screened parts designators.

\$239.95 List \$199.95* CP-1

PACKAGE SPECIALS

\$239.95*

Combine the VIC-20 or COMM-64 MBATEXT™ software with the CP-1 at time of purchase and you receive a SPECIAL PACKAGE PRICE. NOW the best RTTY COMPUTER INTERFACE SYSTEM is available at prices comparable only to vastly inferior systems.

CP-1/20 (CP-1 with VIC 20 MBATEXT) CP-1/64 (CP-1 with C-64 MBATEXT)

*SUGGESTED AMATEUR DISCOUNT PRICE THROUGH PARTICIPATING DEALERS ONLY

For orders and quotes
In Virginia

CALL TOLL FREE 800-336-4799
CALL TOLL FREE 800-572-4201

For information: (703) 643-1063

Store hours: MWF: Noon-8 PM
TThS: 10 AM-4 PM

Order hours: M-F 11 AM-7 PM
Sat 10 AM-4 PM

✓ 127

Send 3 stamps for a flyer.

Dealer inquiries invited.

ege, inc.

13646 Jefferson Davis Hwy.
Woodbridge, Virginia 22191

parts list for 2-meter amplifier/ accessory package

designation	description
C1,C2	2-20 pF mica trimmer
C3	10 pF disc ceramic NPO
C4,C5	100 pF Unelco
C6	1.5 pF disc ceramic NPO
C7,C8	470 pF disc ceramic
C9	1 μ F tantalum
C10	1000 μ F 16 volt
C11	100 pF Unelco
C12	22 pF mica
C13	10 pF disc ceramic NPO
C14	2-20 pF mica trimmer
C15	15 pF mica
C16,C17	10 pF disc ceramic NPO
C18	15 pF mica
C19,C20	10 pF disc ceramic NPO
C21,C22	
C23,C24,C25	470 pF disc ceramic
C23,C24,C25,C26	
C29,C30,C31,C33	470 pF disc ceramic
C27,C28	10 μ F/16 volts
C32	22 μ F/25 volts
C34	100 μ F/16 volts
C35	100 μ F/16 volts
C36	0.22 μ F
C37	4.7 μ F/16 volts
C38	470 pF disc ceramic
CR1	MR750 diode
CR2,CR3	1N4148 diode
CR4	1N4001 diode
CR5,CR6	
CR7,CR8	LED indicator
CR9	1N4148 diode
CR10	5.6 volt Zener
CR11,CR12	1N4148 diode
F1	10 amp fuse
L1	3 turns No. 20 wire 5/32 inch diameter
L2	2 turns No. 20 wire 5/32 inch diameter
L3,L4	2 1/2 turns No. 20 wire 5/32 inch diameter
R1	470 ohm, 1/4 watt
R2	100 ohm, 1/4 watt
R3	10 K, 1/4 watt
R4	10 K, trimmer
R5	560 ohm, 1/4 watt
R6	470 ohm, 1/4 watt
R7	580 ohm, 1/4 watt
R8	270 ohm, 1/4 watt
R9	0.33 ohm, 1 watt
R10,R11	
R12,R13	100 K, 1/4 watt
R14	10 K, 1/4 watt
R15	10 K trimmer
R16	10 K 1/4 watt
R17	560 ohm, 1/4 watt
R18	4.7 K, 1/4 watt
R19	560 ohm, 1/4 watt
R20	82 K, 1/4 watt
R21	100 K, 1/4 watt
R22	47 K, 1/4 watt
R23,R24,R25	10 K, 1/4 watt
R26	100 K trimmer
R27	2.7 ohm, 1/4 watt
R28	270 ohm, 1/4 watt
R29	22 ohm, 1/4 watt
R30	10 K, 1/4 watt
R31	100 K, 1/4 watt
R32	560 ohm, 1/4 watt
RF1	9 turns No. 20 wire 5/32 inch diameter
S1,S2	SPST push-push switch
S3	DPST push-push switch
S4	SPST push-push switch
T1	thermostat, 175° F open
U1	LM324
U2	LM583
RY1	DC DPDT relay

and a control/accessory board. The RF board contains the amplifier and matching networks, a TR relay, a lowpass filter, and a receiver preamplifier. The preamplifier, designed especially for this project by Janel Laboratories, supplies 10 dB of gain for use with those HTs whose receivers need a little bit "extra". It is a plug-in unit and is replaced by a jumper across points A and B when the preamplifier is not needed.

The matching networks perform the same impedance transformations as on the test amplifier. The networks are cascaded L and T sections. Multiple sections are used for the same reasons as explained in the discussion of the test amplifier, above. The inductor for the L sections next to the transistor consists of the transistor leads and a short length of microstripline on the PC board.

The five-pole output lowpass filter has a cut-off

frequency of about 200 MHz. Two filter response "zeros" are introduced at about 292 MHz as second harmonic suppressors. The zeros are the result of capacitors C17 and C19. The second harmonic is more than 65 dB below the fundamental. Higher harmonics are further down and not measurable with the equipment used.

Fig. 6 is the PC board pattern for the front and back of the RF board and fig. 7 is the parts layout.

Fig. 8 shows power output versus power input. It is a little bit less than the output of the test amplifier because of the losses in the relay and lowpass filter.

The amplifier performs smoothly. Its input/output characteristics exhibit none of the discontinuities or hysteresis common to bipolar power transistors. The tuning is very smooth and the tuning characteristics do not vary much with power level, as with bipolar transistors. Varying tuning, power level, and load VSWR while monitoring spectral output revealed no trace of spurious outputs.

The amplifier is well behaved and fully stable in any operating environment. It is possible to create oscillations by reactively terminating the input with no load on the output. This condition does not occur in normal operation.

A thermostat that opens at 175 degrees Fahrenheit is mounted on the heatsink near the amplifier transistor. Although you should always use more than adequate heatsinks to prevent overheating, there is always the possibility that even a well-protected unit might be covered by something — a carelessly thrown sweater, for example — that could cut off air flow. In such an event, in which overheating would be possible, the thermostat could prevent expensive damage.

The control/accessory board supplies the necessary switching and control circuitry for the amplifier and accessory circuits to increase the utility of the HT in the mobile environment.

An RF detector on the amplifier board supplies a voltage when the HT is keyed. This is sensed by U1B and turns on Q2 which controls the TR relay. U1B also controls U1A, which supplies a regulated voltage for biasing the amplifier. Without bias the amplifier draws no current. A regulated supply keeps the amplifier specifications more constant as the supply voltage varies.

When S4 is in the "FM" position, the application of bias and the closing of the TR relay is essentially instantaneous, following the sensing of an RF signal. When the HT ceases transmitting, the bias is removed and the TR relay opens, also essentially instantaneously. When S4 is in the "SSB" position, C32 is added to the circuit and while it doesn't slow the turn-on significantly, it does slow the turn-off time. This delay, determined by C32 and, R25 and R26, is

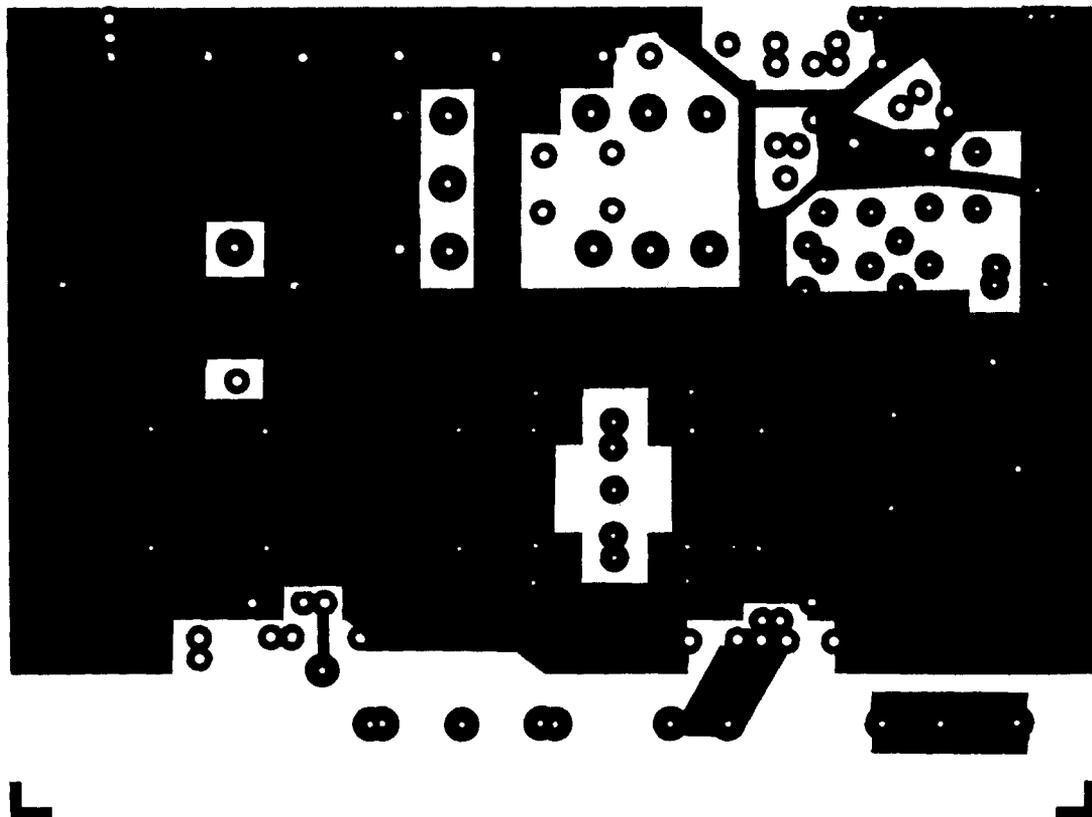
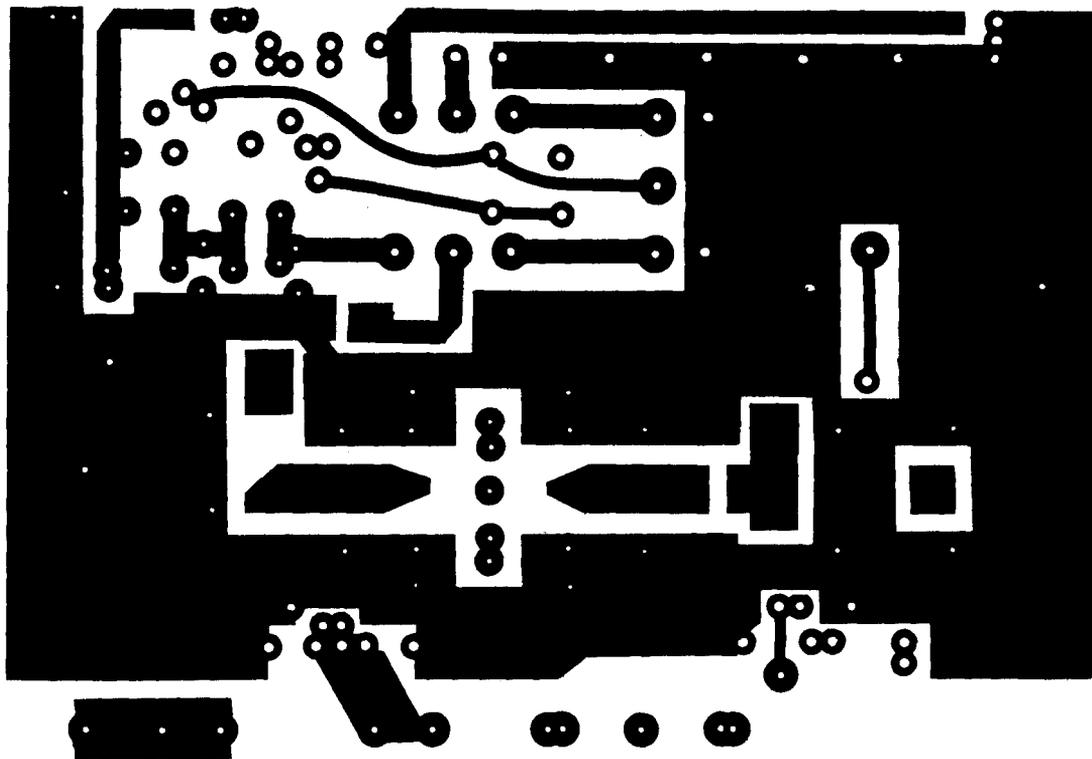


fig. 6. PC board patterns for 50-watt 2-meter amplifier: front (above), back (below).

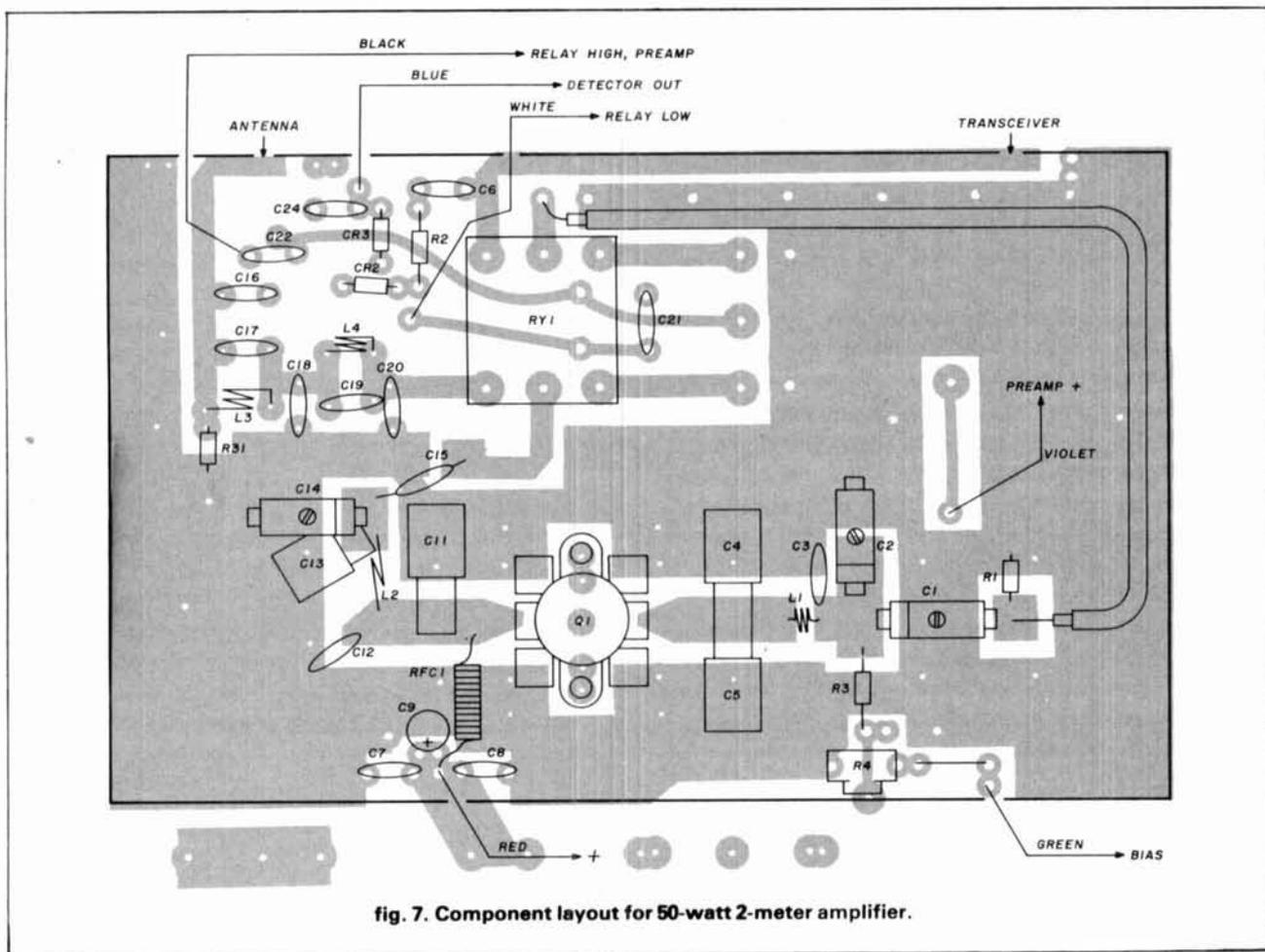


fig. 7. Component layout for 50-watt 2-meter amplifier.

added so that the unit doesn't turn off between words because of the lack of a carrier on SSB.

Most multi-mode amplifiers on the market have this switch. Since the amplifiers are biased for linear operation in both FM and SSB modes, these switches have nothing to do with the linearity of the amplifier and serve only to insert a delay in one RF sensing circuit in the SSB mode to prevent the amplifier from keying in and out between words. The delay is adjustable and a compromise setting must be found. If you set the delay time long enough so that the amplifier doesn't cut in between words, it may take an uncomfortably long time to switch to receive after you let up on the PTT switch.

RF switching is convenient but a better solution is to wire the amplifier for direct keying. An external keying line is supplied on this and most other amplifiers for this purpose.

U1C, U1D, and Q3 form a current-limited voltage regulator to power the HT. This circuit can be used in two different ways. In one, it will power the HT instead of the HT batteries. R15 is adjusted to set the output voltage at the rated voltage of the HT and R13

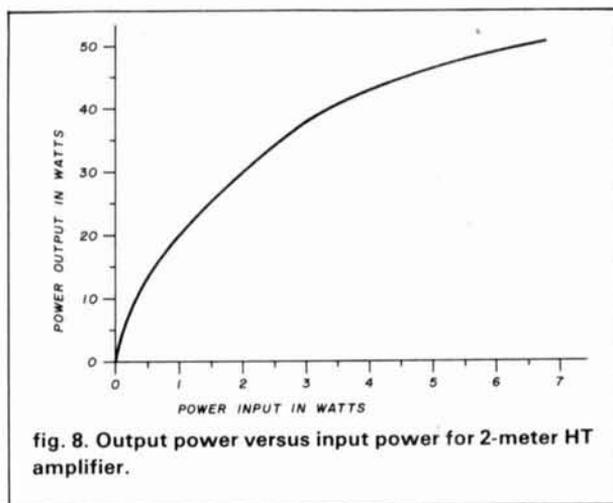


fig. 8. Output power versus input power for 2-meter HT amplifier.

is adjusted so that the output current limits at a little over the transmit current drain of the HT. The power supply can deliver a little over one ampere.

The alternative is to use the power supply as a charger for the HT batteries. For this, adjust R15 to

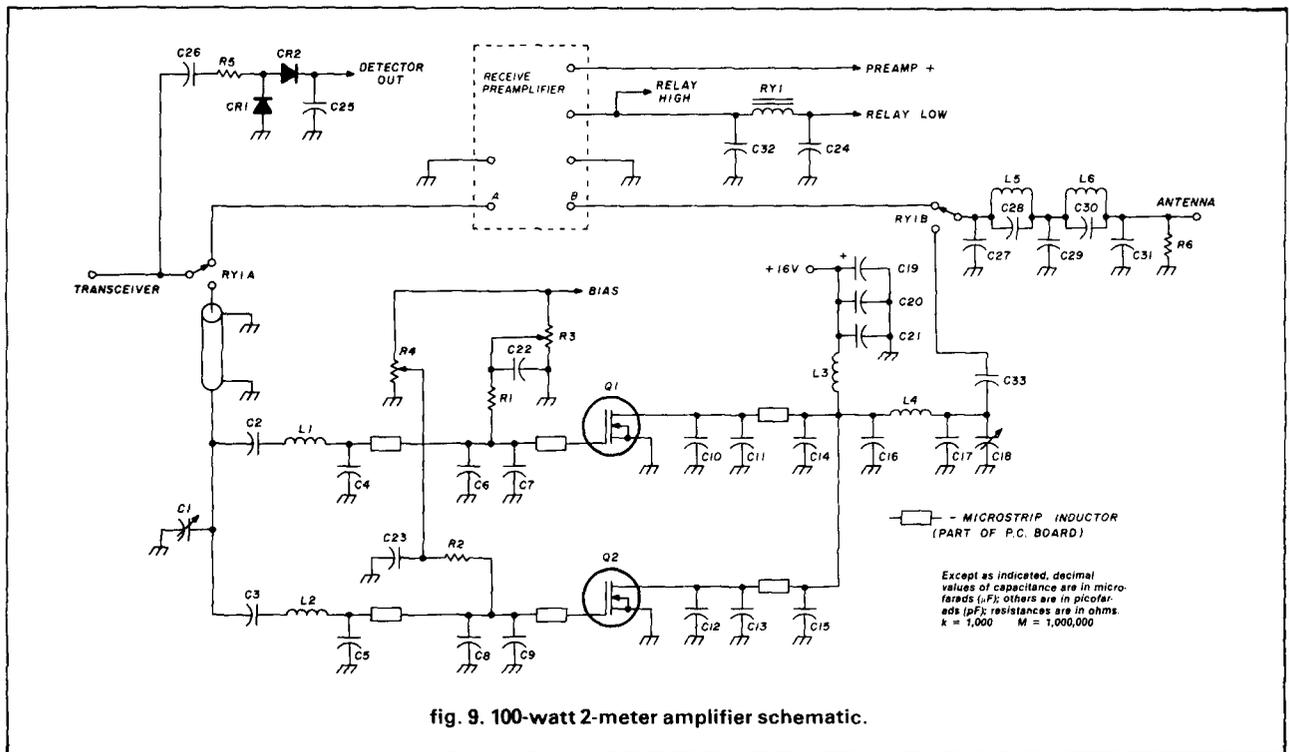


fig. 9. 100-watt 2-meter amplifier schematic.

set the output voltage to the fully charged voltage of the HT batteries and set R13 to the recommended charging current for the batteries. The batteries will be charged at this current until they reach full charge, at which time the power supply automatically switches to constant voltage and reduces the charge rate to whatever is needed to maintain full charge. CR8 will glow when the supply is in the constant current mode, confirming that the batteries are under charge. (See the January, 1983, issue of *ham radio* for an excellent discussion of this subject.)¹ In the first mode, discussed in the previous paragraph, CR8 indicates an overload.

The final major accessory circuit is the one containing U2. This is a speaker amplifier to boost a low HT audio output signal to a level capable of driving a speaker that can deal with the high background noise in a vehicle. The LM383 is capable of supplying sufficient current. However, it is limited to a peak voltage swing of a little less than 1/2 the supply voltage. So use a low impedance loudspeaker if you want to make a lot of noise. The LM383 will typically deliver 4.7 watts to a 4-ohm load with a 13.2 volt supply. It will deliver 7.2 watts to a 2-ohm load, but only 2.4 watts to an 8-ohm load.

Making the control/accessory board separate from the amplifier board provides some flexibility in mounting. When the amplifier is mounted within easy reach of the operator, the control/accessory board mounts in the same cabinet as the amplifier.

designation	description
C1	2.20 pF mica trimmer, Arco 402
C2,C3	22 pF dipped mica
C4,C5,C6,C7,C8,C9,C10,C11,C12,C13	100 pF Unelco J101 type
C14,C15,C16	47 pF Unelco J101 type
C17	24 pF Unelco J101 type
C18	6-60 pF mica trimmer, Arco 404
C19	1 μ F 35-volt tantalum capacitor
C20,C21,C22	470 pF disc ceramic
C23,C24,C25	1.5 pF disc ceramic, NPO
C26	10 pF disc ceramic, NPO
C27,C28	15 pF disc ceramic, NPO
C29	10 pF disc ceramic, NPO
C30,C31	470 pF disc ceramic
C32	560 pF dipped mica
C33	1N4148
CR1,CR2	7 turns No. 20 enameled wire, 5/32-inch ID
L1,L2	5 turns No. 16, 1/4-inch enameled wire, 5/32-inch ID
L3	2 turns 1/8-inch copper wire, 3/16-inch ID
L4	3 turns No. 20 enameled wire, 5/32-inch ID
L5,L6	Siliconix DV1260T
Q1,Q2	10K 1/4 watt
R1,R2	10K linear pot
R3,R4	100 ohm, 1/4 watt
R5	100K, 1/4 watt
R6	DC DPDT relay

When the amplifier is mounted out of reach, such as in the trunk, the control/accessory board is removed from the amplifier chassis, mounted in a small remote control cabinet, and connected by cable.

higher power

The next step was to design a pair of amplifiers using 2 parallel DV1260Ts. The first amplifier was designed for 2 meters and the second for 1-1/4 meters.

As expected, the 2-meter amplifier was similar to the amplifiers just described. At a supply voltage of

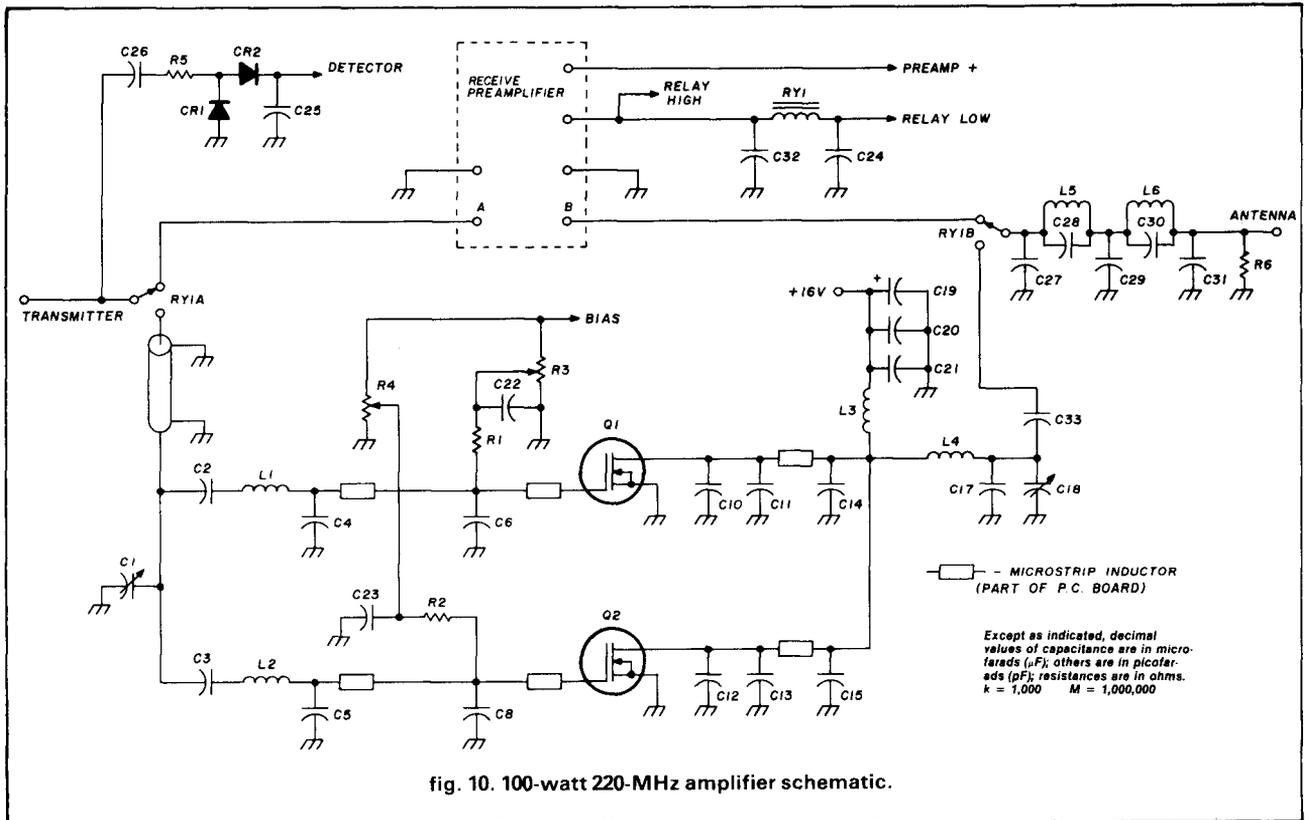


fig. 10. 100-watt 220-MHz amplifier schematic.

16 volts, 100 watts of output was obtained with a little less than 10 watts of input. The gain and efficiency were lower at 13.6 volts. Performance curves are not included because all you have to do is use the single transistor amplifier curves and adapt for the doubling of power.

A single stage amplifier of this gain and power output will most likely be used with a mobile transceiver. A catalog search revealed that most new transceivers have a 25-watt output, so a design which supplied 100 watts output with 25 watts of input was pursued. Fig. 9 shows the amplifier schematic. Only the amplifier portion is shown because the control board is a simplified version of the one described for the single transistor amplifier, less the audio amplifier and the voltage regulator.

The amplifier consists of two single-device amplifiers connected in parallel. Each single-device amplifier is designed to work in a 100-ohm system. The input and output are both matched by a cascade of three L networks. Multiple L networks increase the bandwidth and reduce the circuit losses over that of single L matching networks. For both the input and the output, the inductors for the two L networks closest to the FETs are made from the transistor leads and the PC board traces.

For the input circuit, the highest impedance L network includes capacitors in series with the inductors

parts list for fig. 10

designation	description
C1	6-80 pF mica trimmer, Arco 404
C2, C3	22 pF dipped mica
C4, C5, C10, C11	47 pF Unelco J101 type
C12, C13, C14, C15	100 pF Unelco J101 type
C6, C8	4.7 pF disc ceramic, NPO
C17	2.20 pF mica trimmer, Arco 402
C18	1 µF 35 volt tantalum capacitor
C19	
C20, C21, C22, C23, C24, C25	470 pF disc ceramic
C26	1 pF disc ceramic, NPO
C27, C28	6.8 pF disc ceramic, NPO
C29	10 pF disc ceramic, NPO
C30, C31	6.8 pF disc ceramic, NPO
C32	470 pF disc ceramic
C33	51 pF dipped mica
C7, C9, C16	not used
CR1, CR2	1N4148
L1, L2	5 turns No. 20 enamelled wire, 5/32 inch inside diameter
L3	5 turns No. 16 enamelled wire, 1/4 inch inside diameter
L4	copper strap 1/8 inch x 1/4 inch
L5, L6	2 turns No. 20 enamelled wire, 5/32 inch inside diameter
Q1, Q2	Silicon DV1260T
R1, R2	10 K, 1/4 watt resistor
R3, R4	10 K linear pot
R5	100 ohm, 1/4 watt
R6	100 K, 1/4 watt resistor
RY1	DC DPDT relay

(C1, L1 and C3, L2). This arrangement is used to break up a low frequency resonance (about 35 MHz) that can cause oscillations to occur in a push-pull mode. The use of series capacitors is undesirable from the standpoint of loss and bandwidth, but the degradations are not severe. The amplifier outputs are paralleled at less than the 100-ohm point, mainly as a matter of mechanical convenience.

Tuning ease and spectral purity were similar to the

single transistor amplifier. The second harmonic is about 75 dB below the fundamental. An imbalance between the two sides was noticed while tuning, probably because of variations in input capacity. It was found that a 30 pF mica capacitor could be moved along the input lines until the output was maximized. This seemed to be adequate compensation for the imbalance, since after the capacitor was installed the two sides seemed to behave very symmetrically.

temperature effects

The amplifier was also tested in a temperature chamber over the range of -40 to +60 degrees C. Quiescent current, power output, gain, power bandwidth, and spectral purity were all examined. The quiescent current was very slightly temperature dependent. As expected, the current is higher at lower temperatures. The total variation was only 0.4 amperes across the entire range. The room temperature current was set at 6.0 amperes. In terms of RF parameters, the variations were so slight as to be difficult to measure. The gain appeared to be a few tenths of a dB higher at the low temperatures. Current drawn at the 100-watt point did not vary significantly with temperature. In all cases the spectrum was clean. In short, temperature effects are not a problem for this amplifier.

1 1/4-meter amplifier

The final amplifier to be discussed is a 1-1/4-meter amplifier using two paralleled devices. A schematic of it is shown in fig. 10. Many of its characteristics are quite similar to those of the lower frequency version, but, as might be expected, both the gain and efficiency were lower at this frequency. For example, with a supply voltage of 16 volts, 10 watts input produced 80 watts output, as compared to 100 watts at the lower frequency. An amplifier designed for 25 watts in and 100 watts out ran at 46 percent efficiency at 13.6 volts, as compared to better than 60 percent at the lower frequency. Quiescent current was set at 6 amperes for both the 2-meter and 1-1/4-meter amplifiers.

conclusion

RF power FETs offer a number of significant advantages over bipolar devices; they are easier to handle and allow somewhat simpler circuits. As manufacturers increase the selection and continue to improve specifications, we will see an increasing number of bipolar and vacuum tube designs being replaced with RF power FETs.

reference

1. J. D. Moell, K0OV, "Forget Memory," *ham radio*, January, 1983, pages 62-64.

ham radio

WANT A PLEASANT SURPRISE?



Bob Larry Mary Anthony

Just speak with one of Calverts' courteous salespeople. Call one of us now, toll free, at 800-526-6362.

For your added convenience use your



or



ALL OUR TUBES ARE NEW UNUSED. FULL FACTORY WARRANTY.

0A2	\$ 2.00	6JE6	\$ 8.85	6155	\$ 70.00
2D21	2.45	6JM6	6.45	6252	55.00
3-400Z	85.00	6JS6C	7.95	6360	4.25
3-500Z	85.00	6KD6	8.85	6550A	6.50
3CX400U7	325.00	6L6GC	3.85	6883B/8032A	6.75
3CX800A7	250.00	12A17	2.93	7360	12.00
4-125A	70.00	12AU7	2.63	7735A (VIDICOM)	26.50
4-250A	80.00	12AX7/ECC83	2.64	8072	106.00
4-400A	80.00	572B/T160L (572B)	59.00	8122	104.00
4-1000A	479.00		Can be replaced with 811A at lower cost.	8156	12.50
4CX250B	52.00	807	6.50	8844 (VIDICOM)	26.00
4CX350A	92.00	811A	11.00	8873	210.00
4CX350F	35.00	813	34.00	8874/3CX400A7	206.00
4CX5000A	1060.00	829B	15.00	8875	215.00
4X150A/7034	23.00	832A	12.00	8877/3CX1500A7	460.00
5AR4/GZ34	4.37	5894A	45.00	8908	12.95
5R4WGB	5.00	6146A	6.50	8950	11.50
5Z3	3.50	SK406 Chimney for 3-500Z, 4-400A			52.00
6DJ8/ECC88	2.75	SK506 Chimney for 4-1000A			72.00
6EA8	4.45	SK606 Chimney for 4X150A, 4CX250B, 4CX350F			10.50

SEMICONDUCTORS

MRF245/SD1416	30.00	MRF455	12.50	2N3055	.95
MRF454	18.95	MRF644/SD1088	19.95	2N6084	12.50

COAXIAL CABLE

RG8U (1000 ft.)	175.00	RG58U (1000 ft.)	49.00	RG59U (1000 ft.)	49.00
-----------------	--------	------------------	-------	------------------	-------

CONNECTORS

PL258	10/8.95	UG255U	2.50	M359	1.75
PL259	10/4.95	UG273U	2.25	Type N Twist On	4.75
UG175/176	10/1.60	M358	2.50		

CCTV—Complete Security Camera Package

Camera, from award-winning camera maker, 16mm lens, Mounting Bracket, 9" Monitor, 100 foot Cable, Connectors... Total Cost ONLY \$285.00

Minimum order \$25.00 • Shipping charges extra
F.O.B. East Rutherford, NJ.

Prices and items subject to change or withdrawal without prior notice.

TOLL FREE: 800-526-6362 (except from NJ)

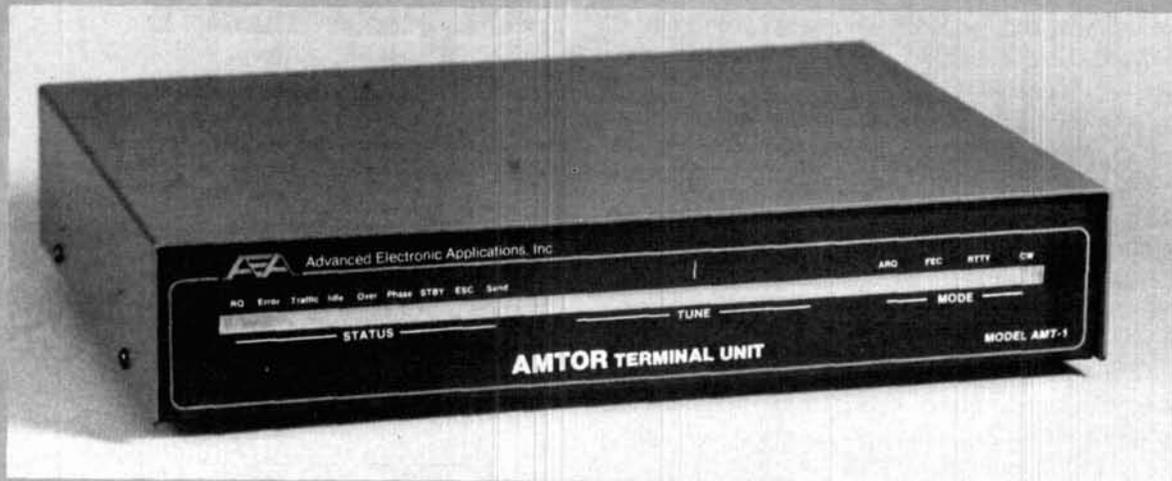
CALVERT ELECTRONICS, INC.

One Branca Road, East Rutherford, NJ 07073
201-460-8800 • TWX 710-989-0116 • Telex 4990274

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

AMT-1

The Definitive AMTOR Terminal Unit



\$499⁹⁵ 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

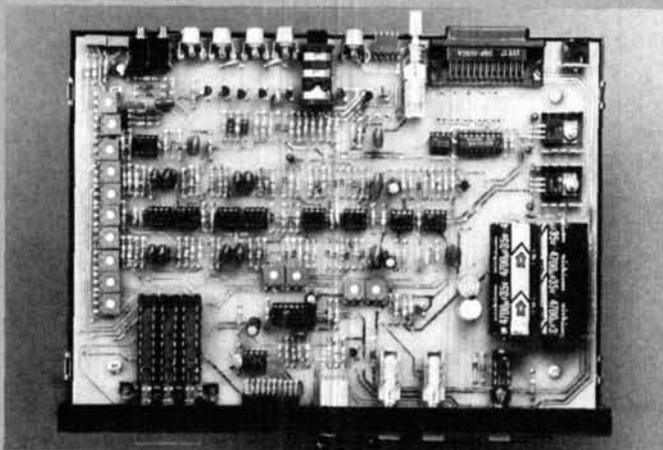
TOLL FREE ORDER NUMBER: (800) 421-6631

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!

measuring noise figure

How noise figure, noise factor, ENR, and hot/cold terminations are interrelated

Most Radio Amateurs and electrical engineers learn early in their careers that the ability of a receiving system to respond to weak signals can be improved, not by the addition of gain, but by the reduction of noise.

It is the signal-to-noise ratio that ultimately renders a radio signal useless, and every amplifier or mixer (stage) in a receiver adds to the noise, thus decreasing the signal-to-noise ratio. The amount of noise added by an amplifier or mixer is given quantitatively as a noise factor which is the ratio of the input signal to noise ratio to the output signal-to-noise ratio:

$$\text{noise factor} = \frac{S_i/N_i}{S_o/N_o} \quad (1)$$

where S_i = input signal power
 N_i = input noise power
 S_o = output signal power
 N_o = output noise power

If the amplifier frequency response is wide, as compared to the bandwidth of the signal, no amplifier or mixer can improve the signal-to-noise ratio of the input signal. That is, if the input signal-to-noise ratio is 20 dB, the output signal-to-noise ratio will be less than 20 dB. A similar expression, the noise figure, is the "decibel" equivalent of the noise factor and is given by:

$$\text{noise figure} = 10 \log_{10} (\text{noise factor}) \quad (2)$$

Thus the signal-to-noise ratio of an input signal is reduced by an amount equal to the noise figure. That is, if a signal with a 20 dB signal-to-noise ratio is

passed through an amplifier with a 5 dB noise figure, the output signal-to-noise ratio is 15 dB.

Because the ability of a receiving system is primarily limited by the noise performance of the first RF amplifier, measuring the noise figure is an important part of the receiver evaluation.

noise measurement difficulties

It would appear from the previous equations that measuring the noise figure of an amplifier should be a simple matter of measuring the signal-to-noise ratio of both the input and output of the unit under test. The difficulty in this method arises from the fact that the measuring equipment has noise contributions of its own, and it would be difficult to determine the signal-to-noise ratio of the input signal.

Another problem arises from the fact that the noise power is proportional to the bandwidth used for the measurement. Modulated signals have various relationships between measuring bandwidth and the measured power depending on the form of modulation. Therefore the signal-to-noise ratio can become a rather unpredictable function of the measuring system bandwidths.

This is the electronic equivalent of comparing apples and oranges. The solution lies in making the signal-to-noise measurement using a noise signal, and comparing it to the system noise. Using this method, the measured power is proportional to the measuring bandwidth for *both* signals and noise.

The device used to generate the noise signals is called a noise generator. It is important that the noise power output from a noise generator be greater than the noise power of a resistor at normal room temperature, otherwise the signal-to-noise ratio of the noise generator will be zero dB and of no value for measuring noise figure. The noise power output of any resistor at normal "room" temperature, 290° Kelvin, is:

By Albert Helfrick, K2BLA, RD1, Box 87, Boonton, New Jersey 07005

$$P_n = KT_oB \quad (3)$$

where P_n = the noise power
 B = the measuring bandwidth
 K = Boltzman's constant
 T_o = 290° Kelvin (17° centigrade)

If the noise power of the noise source is higher than a resistor at 290° K, it is equivalent to the noise power from a resistor at some temperature — say, T' , which provides a noise power output of:

$$P_s = KT'B \quad (4)$$

where P_s = the noise power of the noise source
 T' = the equivalent noise source temperature

The noise power can be generated in several ways. First, a resistor at the higher temperature or some other artificial method such as using the noise current of a solid-state or thermionic diode could be used to generate the equivalent noise power.

A useful expression for the amount of noise power available from a noise source is called the excess noise ratio, ENR , and is given by:

$$ENR = \frac{T' - T_o}{T_o} \quad (5)$$

To measure the noise figure of an amplifier or mixer using a noise source, the amplifier is connected to a power measuring instrument and the noise source is connected. The power output from the device under test is measured. A termination, typically 50 ohms, at a temperature of 290° K is connected to the device under test and again the power output is measured. The ratio of the two power outputs, called the Y -factor, is used to calculate the noise figure. The Y factor is:

$$Y = \frac{P_o'}{P_o} \quad (6)$$

where P_o' is the power output of the device under test with the noise source connected, and P_o is the power output with the 290° K termination. The noise figure of the device under test is:

$$NF = 10 \log_{10} \frac{ENR}{(Y-1)} \quad (7)$$

In theory, this technique is simple; however, the difficulty lies in making an accurate power measurement of the output power. A resistive termination at 290° K has a power output of -144 dBm in a 1 kHz bandwidth and even after amplification by the device under test, the output is relatively small.

In order to increase the power to a point at which a convenient power meter such as bolometer type may be used, additional amplification is required. The noise figure of the amplifier used after the unit under

test (post amplifier) will affect the noise figure measurement, according to the following relationship:

$$NF = NF_1 + \frac{NF_2 - 1}{G_1} + \frac{NF_3 - 1}{G_1G_2} \quad (8)$$

where NF = noise factor of the cascaded system
 NF_1 = noise factor of the first amplifier
 NF_2 = noise factor of the second amplifier
 NF_3 = noise factor of the third amplifier
 G_1, G_2 = gains of the first and second amplifiers, respectively

If the noise figure of the post-amplifiers is low or the gain of the unit under test is relatively high, the effect of the post-amplifier noise figure will be small.

If a signal were a simple sine wave, power could be determined by measuring the voltage with a sensitive voltmeter and determining the power by using the simple relationship $P = E^2/R$, where E is the measured voltage and R is the system resistance usually 50 ohms. *Noise* signals are not simple and require a true power measurement. A bolometer type of power meter provides an accurate true-RMS power measurement for noise figure measurements. A diode-type voltmeter will provide the proper response if the diode is operated in the so-called square-law region. This is the region of the point contact diode characteristics where the rectified output voltage is proportional to the input voltage squared. A crystal detector or diode type voltmeter can be checked for square law response by increasing the RF input by 3 dB and checking for a two-to-one increase in the rectified output or, in the case of a voltmeter, a doubling of the meter deflection.

test set-up

Because the square-law region of a diode does not usually cover a large range of power, it is desirable to include an attenuator between the diode detector and the amplifier under test as shown in **fig. 1**.

To make a noise figure measurement using this set-up, the attenuator is adjusted to give a meter reading in the square-law region of the diode with the amplifier terminated (at its input) with a room temperature termination. This can be checked by increasing the attenuator by 3 dB and observing the meter reading.

The room temperature termination is replaced with the noise source (also called a "hot termination"), and the attenuator is adjusted to provide the same output reading as before. The amount of attenuation added is called the Y factor, in dB, which has to be converted to a pure ratio. This is used with **eq. 7** to calculate the noise figure.

The measurement of noise figure requires a known ENR. Most Amateurs optimize the noise figure of a receiving system using a noise diode by adjusting the

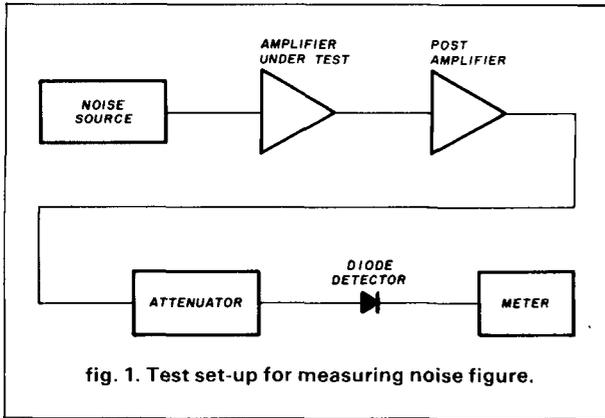


fig. 1. Test set-up for measuring noise figure.

amplifier to give the greatest difference between noise power output with the noise diode on and off. The actual noise figure is not known unless the noise power of the diode is known. Noisy semiconductor diodes do not provide a calculable amount of noise power; commercially available solid-state noise sources are calibrated with a hot-cold noise source.

One very effective method of creating a known ENR is to maintain two identical resistors at a known temperature. Two commonly used temperatures are the temperature of liquid nitrogen at 77° K and the boiling point of water at 100° C or 373° K. The ENR of this system would be:

$$ENR = \frac{T - T_o}{T_o} = \frac{373 - 77}{77} = 3.84$$

or as expressed in decibels: 5.8 dB.

This ENR would be fine for measuring systems with noise figures of a few dB, but it is difficult to maintain the cold termination at 77°K. The cold termination could be at "room temperature" (290°K), and the "hot" termination well above 290°K. One excellent source would be the hot filament of an incandescent lamp. In order to use an incandescent lamp for noise source, the lamp must have a resistance near 50 ohms (hot) and the temperature must be known. Both of these parameters may be determined from the change of resistance versus temperature of tungsten as shown in fig. 2.

As an example, assume that a lamp with a cold resistance of 5 ohms is used for a noise source. In order to increase the resistance to 50 ohms, a tenfold increase is required which corresponds to a temperature of 2000° K which produces an ENR of 7.5 dB. This temperature is typical of an incandescent lamp and can be achieved without resorting to special lamps.

A noise source was constructed using two micro-miniature lamps used for illuminating electronic wristwatches (see fig. 3). The lamp is rated for operation at 1.5 volts at 15 mA, which is convenient because this calculates to 100 ohms hot. To deter-

mine the temperature of the filament, the cold, 290° K, resistance of the filament was measured and the temperature determined from fig. 2. The cold resistance was measured and found to be 16.8 ohms. The hot/cold ratio is 5.9, which corresponds to a temperature of 1300° K.

Two lamps in parallel correspond to a 50 ohm hot source at 1300° K, which is an ENR of:

$$ENR = 10 \log \frac{T - T_o}{T_o}$$

$$= 10 \log \frac{1300 - 290}{290} = 5.42 \text{ dB} \quad (10)$$

Two 1/8 watt 100-ohm resistors were included in the noise source case as the "cold" terminator.

noise source frequency dependence

In order for a noise source to be effective, the impedance must be close to 50 ohms resistive throughout the frequency range of interest. The 100 ohms of the example noise source was determined from the DC operating conditions and does not include the inductive and capacitive components. The complete noise source will have the effects of the coupling

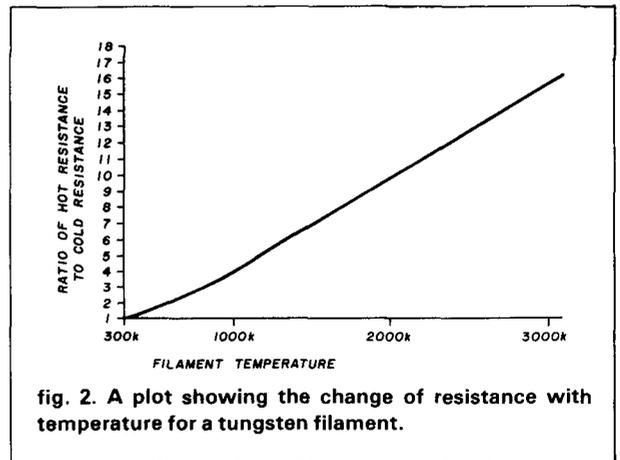


fig. 2. A plot showing the change of resistance with temperature for a tungsten filament.

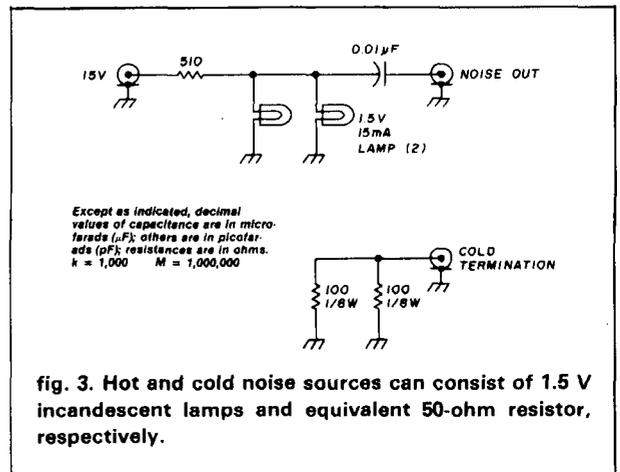


fig. 3. Hot and cold noise sources can consist of 1.5 V incandescent lamps and equivalent 50-ohm resistor, respectively.

hy-gain®

HF BROADBAND VERTICALS WORK THE WORLD

Hy-Gain broadband vertical antennas load the new auto-tune solid state rigs, require minimal space and provide low angle radiation without the expense or the problems of support structures.

18AVT/WBS (80-10 meters) The most successful vertical antenna of all and for good reasons. Broadband performance covers the 40, 20, 15 and 10 meter bands in their entirety. Automatic 5 band switching is accomplished by mechanically superior, highly efficient factory tuned Hy-Q traps with large coils for consistent performance at 2:1 or lower VSWR on 40-10 meter band edges; bandwidth on 80 meters is approximately 40 kHz with VSWR below 2:1. A factory tuned matching network for 50 ohms impedance is dc grounded for lightning protection and reduced precipitation static. The mechanical integrity of this antenna is so stable that performance does not change with the weather. The 18AVT withstands winds to 80 mph (128 km/h) without guying. All stainless steel hardware is included.

14AVQ/WBS (40-10 meters) Offers very similar construction and the same excellent broadband performance as 18AVT over the entire 40, 20, 15 and 10 meter bands; automatic band switching with mechanically superior large-coil Hy-Q traps and very low angle radiation pattern. The smaller, low visibility size also makes the 14AVQ very suitable for roof mounting. The optional 14RMQ roof mounting kit includes base plate, mast and radial/guy wires. All antenna hardware is stainless steel.

18 HTS (80-10 meters, 160 meters with optional loading coil) The superb reliability of the 18 HTS is manifest in installations now over 20 years old. And, with the improvements we made over the years, the 18HTS is now better than ever. Automatic band selection is achieved through a unique stub decoupling system which effectively isolates various sections of the antenna so that an electrical $\frac{1}{4}$ wavelength (or odd multiple $\frac{1}{4}$ wavelength) exists on all bands. For example, outstanding broadband performance on 20, 15 and 10 meters is achieved with an extended $\frac{3}{4}$ wave coilinear. On 80 meters bandwidth is approximately 250 kHz at 2:1 VSWR. With the optional base loading coil exceptional performance is also provided at 160 meters. The galvanized tower requires no guying and withstands winds to 100 mph (160 km/h). A special hinged base allows complete assembly at ground level and permits easy raising and lowering. Includes stainless steel hardware. WARC kits to be available.

Other Hy-Gain vertical multiband antennas are available though not shown here. The 12AVQS (20, 15, 10 meter) is similar to 18AVT above but with VSWR of 1.5:1 or less on all bands. The 18VS (80-10 meter) comes with a base loading coil and may be installed on a short mast driven into the ground. All include stainless steel hardware.

PHASE FOR GAIN

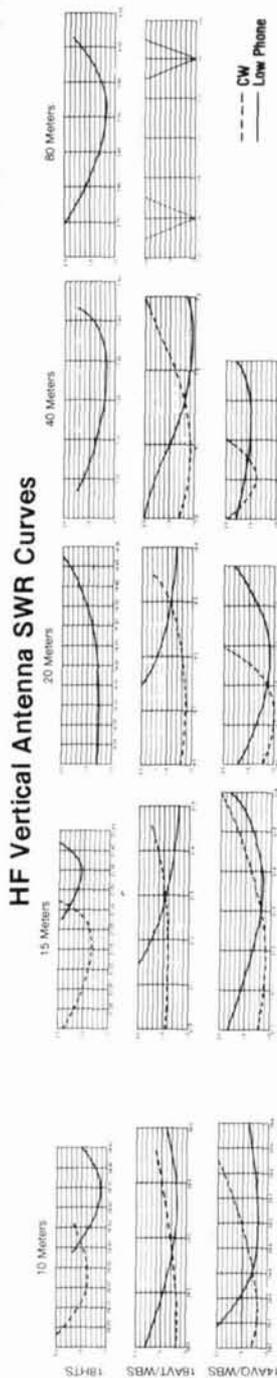
Any two identical Hy-Gain verticals can be phased for excellent gain and directivity. A great system for beam performance on 40, 80 and 160 meters or for 10, 15 and 20 meters where space is limited. Send for our free technical report "Phased Verticals".

Hy-Gain Verticals that work the world
at better Amateur Dealers.

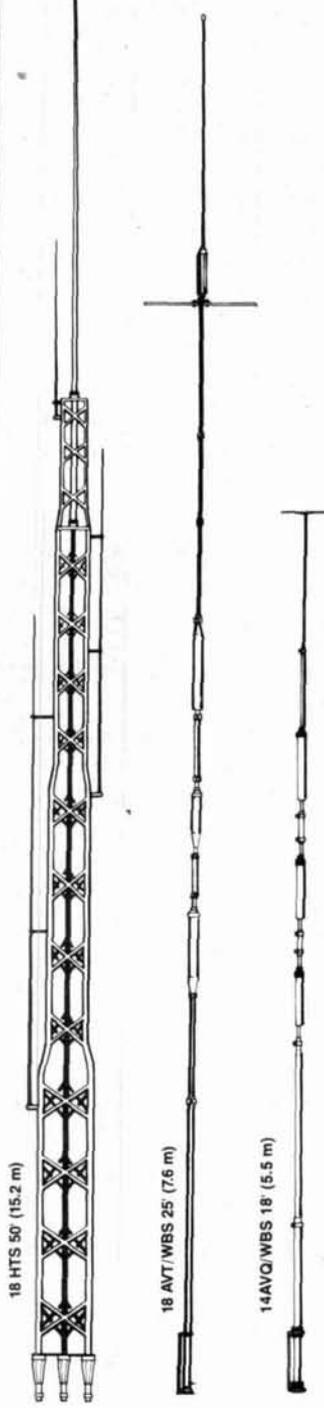
TELEX® hy-gain®

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.



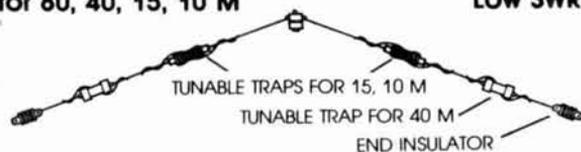
HF Vertical Antenna SWR Curves



SHORT DIPOLES

In selecting an antenna, choose the longest one that will fit your property. It will cost less and have wider bandwidths. All Barker & Williamson dipoles are made from rugged #14 stranded copperweld wire for strength and conductivity. Unless otherwise noted, all antennas will handle the legal power limit. These dipoles may be installed as inverted "V's" or horizontally. The tunable trap antennas are adjusted to any part of a band by sliding a tuning wire on the trap.

Model AS-80 Only 58 ft. long
for 80, 40, 15, 10 M Low SWR



LENGTH	BANDS	DESCRIPTION	MODEL	PRICE
110 ft.	160 - 10 m	Continuous coverage antenna, SWR less than 2 from 1.8 to 30 MHz with no adjustments to antenna. 1.5 KW PEP on SSB, CW; 500 W input on AM, RTTY	AC 1.8-30	\$149.50
120 ft.	160, 80, 40 m	Low SWR on all bands. 1.5 KW PEP on SSB, CW; 500 W input on AM, RTTY.	AS-160	\$ 89.50
110 ft.	80, 40, 20, 15, 10 m	Resonant with low SWR on 80 and 40, somewhat higher SWR on 20, 15, and 10.	370-11	\$ 72.50
90 ft.	80, 40, 15, 10 m	Tunable trap antenna with low SWR on all bands. 1.5 KW PEP on SSB, CW; 500 W input AM, RTTY.	AT-80	\$ 79.50
58 ft.	80, 40, 15, 10 m	Tunable trap antenna with low SWR on all bands. 500 W input all modes.	AS-80	\$ 99.50
55 ft.	40, 20, 15, 10 m	Resonant with low SWR on 40, 20, somewhat higher SWR on 15 and 10.	370-13	\$ 65.00
36 ft.	40, 15, 10 m	Tunable trap antenna with low SWR on all bands. 1.5 KW PEP on SSB, CW; 500 W input on AM, RTTY.	AS-40	\$ 75.50
22 ft.	20, 15, 10 m	Tunable trap antenna with low SWR on all bands. 1.5 KW PEP on SSB, CW; 500 W input on AM, RTTY.	AS-20	\$ 75.50
30 ft.	160 m	Add-on kit to convert an 80 m dipole to 160 m. Loading coils and wire add only 15 ft. to each end of your antenna. (Not for AS-80)	AK-160	\$ 79.50
47 ft.	30 m	Add-on kits to provide 30 m or 20 m coverage to a dipole antenna. Consists of a parallel dipole and spacers.	AK-30	\$ 19.75
33 ft.	20 m		AK-20	\$ 19.75

Add \$3.00 Shipping and Handling

ALL OUR PRODUCTS MADE IN USA



BARKER & WILLIAMSON

Quality Communication Products Since 1932

At your Distributors write or call

10 Canal Street, Bristol PA 19007

(215) 788-5581

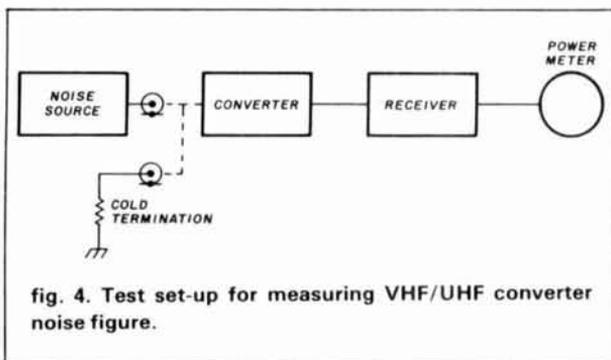


fig. 4. Test set-up for measuring VHF/UHF converter noise figure.

capacitor, the BNC connector and the inductance of the lamp filament. In spite of all of the reactances the return loss as measured on a network analyzer was better than 14 dB up to 1 GHz. Adding a 0.68 pF capacitor improved the return loss to 20 dB to 1 GHz, a very respectable figure for a noise source.

This noise source is suitable for making accurate noise figure measurements to 1 GHz.

The 20 dB return loss of the noise source will allow noise figure measurements to an accuracy better than 0.1 dB.

measuring converter noise

To measure the noise figure of a VHF/UHF converter, the converter is connected to a receiver as shown in fig. 4.

An RF probe connected to one of the later IF amplifiers of the receiver is used as a power indicator. Because the noise figure of the system is a function of the setting of the attenuator, the resulting measurement could be distorted. For measuring a noise figure of 2 dB or less with a gain of 20 dB or more, the error will be less than 0.1 dB.

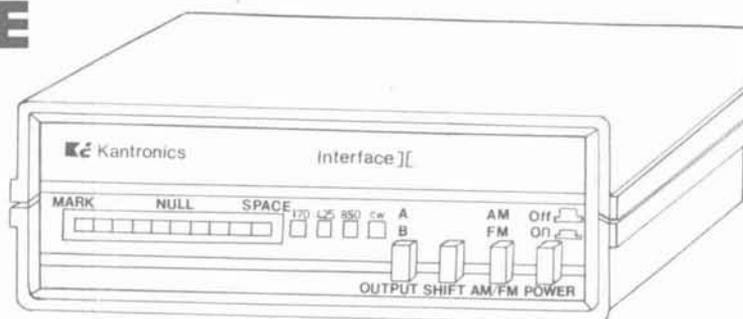
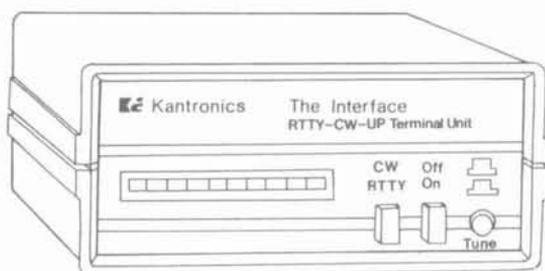
Set the attenuator to 0 dB and terminate the converter with the cold termination. Connecting the converter to the receiver should produce a noticeable increase in background noise. Find a convenient point in the IF amplifier to connect the RF probe. A signal of 100 mW or less is usually in the square law region of the voltmeter. Disconnect the cold termination and connect the hot termination. Adjust the attenuator to provide the same RF voltmeter indications as before; the setting of the attenuator is the Y factor, in dB, and is used in eq. 7 to calculate the noise factor.

Noise figure measurement determines one of the important operating parameters of receiving systems. The introduction of low-cost GaAs FETs has brought about a reduction of noise figure in many VHF and UHF receiving systems. Using a noise source and the techniques described in this article, it is possible to quantitatively evaluate the improvements effected by the latest technology.

ham radio

Blueprint for Success

THE INTERFACE



THE INTERFACE II

 Kantronics

TITLE: THE INTERFACE - INTERFACE II PROPOSAL

THE INTERFACE is the original Kantronics terminal unit that broke through the barrier of multi-computer compatibility. **THE INTERFACE** is an amateur modem for transceiver-to-computer communication. With **THE INTERFACE** and Hamsoft or Hamtext for your computer you can send and receive Morse Code, Radioteletype, and ASCII. **THE INTERFACE** is also compatible with our new software for AMTOR communication, AMTORSOFT. **THE INTERFACE** is our most popular unit combining active filtering, easy tuning, six-computer compatibility, and low price for an unbeatable package.

Suggested Retail \$139.95

INTERFACE II is the new Kantronics transceiver-to-computer interface. **INTERFACE II** features a new highly sensitive front end with mark and space filtering and a unique new tuning system. Even the most discerning operator will be surprised with the **INTERFACE II's** ability to dig out signals in poor band conditions, and our new tuning system even displays signal fading.

X-Y scope outputs and dual interface outputs for VHF and HF connections make **INTERFACE II** compatible with almost any shack. All three standard shifts are selectable and **INTERFACE II** is compatible with the industry standard Kantronics programs: Hamsoft, Hamtext, and Amtorsoft. Step up to state of the art in computer-amateur communications with **INTERFACE II**.

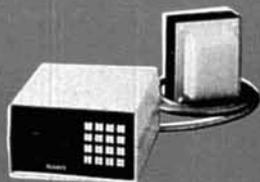
Suggested Retail \$269.95

For more information see your Kantronics dealer, or contact:
 Kantronics 1202 E. 23rd Street Lawrence, KS 66044

MORE FROM PRO-SEARCH™ ELECTRONICS

NOW THREE MODELS OF OUR DIGITAL ANTENNA CONTROL

Your Choice Of Center, North Or South



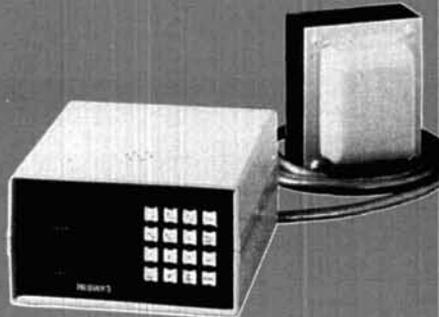
GOOD
PSE-1A, 3A

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 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. The "DX'ER" has 2 memories for storing headings, 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 to this one. It has all the features of the other models, plus 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. 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!

Package #1 PSE-1A

#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 2 memories, command positioning, and single button manual movement.

Package Special

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.

Package #2 PSE-1/PSE-3

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.

Package Special

PSE-1 + HAM IV \$502.95
PSE-1 + T2X 548.95
PSE-3 + HDR-300 677.95

✓ 175

Package #3 PSE-2/PSE-4

The "Delux" is the most sophisticated antenna control unit ever made. With the "Delux" you have all the functions of our other units, plus 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-2 + HAM IV \$608.95
PSE-2 + T2X 655.00
PSE-4 + HDR-300 784.00

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.

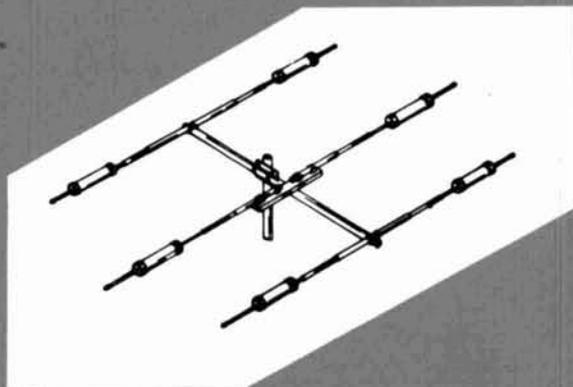


© Copyright 1983

Mosley.....

A BETTER ANTENNA

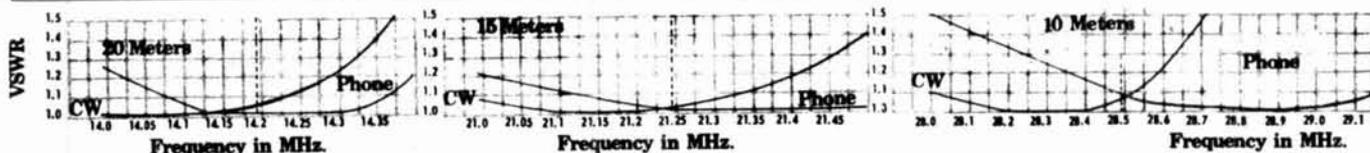
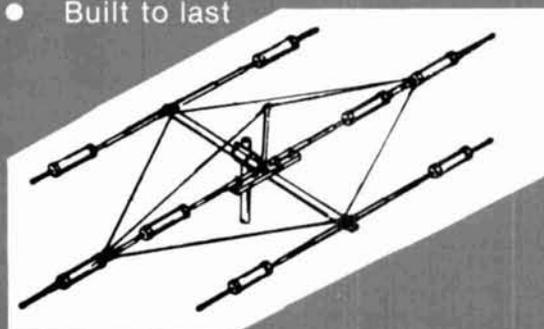
WHY SETTLE FOR LESS? LOOK WHAT THE MOSLEY TA-33 OFFERS



- 3 Element full power
- All stainless steel hardware
- Ease of assembly
- No balun required
- Now a 2 year limited warranty
- Now a standard 2" mast adapter
- Built to last

- Expandable to 30 or 40 meters
- Superb front to back ratio
- Excellent gain

- Outstanding SWR



SPECIFICATIONS:

Forward gain	
Front-to-Back Ratio	
Power rating	1KW
	2KW P.E.P.
Feedpoint Impedance	52 ohm
VSWR HT Resonance	1.5 to 1 or better
Matching System	Mosley
Number of Elements	3
Longest Element	28'
Boom Length	14'
Mast Size	1 1/2" or 2"
Turning Radius	15'6"
Wind surface area (in. sq. ft.)	5.7
Wind load (EIA standard 80 mph)	114 lbs.
Assembled Wt.	39 lbs.
Shipping Wt.	44 lbs.

- Used around the world
- Work CW or phone without tuning or adjusting antenna
- A great antenna for the new solid state rigs

ALL MOSLEY ANTENNAS
AND CATALOGS AVAILABLE
AT QUALITY DEALERS
OR CALL TOLL FREE

1-800-325-4016

ASK ABOUT OUR FALL SPECIAL

Prices and specifications
subject to change
without notice or
obligation.

REMEMBER WHETHER YOU USE TRAPS OR LINEAR LOADING, 8db GAIN IS 8db GAIN
YOUR RECEIVER CAN'T TELL THE DIFFERENCE... MOSLEY... TRAP MASTERS QUALITY STILL SETTING THE PACE...

Mosley Electronics

A DIVISION OF WURDACK & ASSOCIATES INC. 1344 BAUR BOULEVARD ST. LOUIS, MO. 63132 1-314-994-7872

KENWOOD TS-430S



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

ICOM IC-740



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

YAESU -NEW FT-77



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

ANTENNA SALE

CUSHCRAFT		HYGAIN TOWERS		BUTTERNUT		HYGAIN	
A-3	\$210	HG37SS	\$ 649	HF6V	\$109	TH5MK2S	\$318
A-4	\$279	HG52SS	\$ 919			TH7DXS	\$378
R-3	\$269	HG54HD	\$1429		KLM	TH3MK3S	\$218
AV-5	\$96	HG70HD	\$2339	KT34A	\$299	TH3JRS	\$158
214-FB	\$78	HG50MTS	\$ 749	KT34XA	\$449	TH2MKS	\$138
32-19	\$92			144-148LBA	\$ 69	18AVT/WS	\$ 94
40-2CD	\$279	LARSEN	CALL	AEA	CALL	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

Your Ham Tube Headquarters!

TUBES BOUGHT, SOLD AND TRADED
SAVE \$\$\$—HIGH \$\$\$ FOR YOUR TUBES

Call Toll Free 800-221-0860
Tubes

3-400Z	\$85.00	7360	\$10.00
3-500Z	85.00	7735A	27.50
4-400A	80.00	8122	105.00
4CX250B	50.00	8156	12.50
572B	48.50	8643	82.50
811A	12.00	8844	26.50
813	35.00	8873	175.00
6146B	6.50	8874	185.00
6360	4.25	8877	450.00
6883B	6.75	8908	12.50

Semiconductors

MRF 245/SD1416	\$30.00	MRF 644/SD1088	19.95
MRF 454	18.95	2N3055	95.00
MRF 455	12.50	2N6084	12.50

RF Connectors

PL259	10/\$4.95	M358	2.50 ea.
PL258	10/8.95	M359	1.75 ea.
UG175/176	10/1.60	Type "N" Twist on	
UG255/u	2.50 ea.	(RG8/u)	\$4.75 ea.
UG273/u	2.25 ea.	Minimum Order	\$25.00

Allow \$3.00 min. for UPS charges



COMMUNICATIONS, Inc.
2115 Avenue X Brooklyn, NY 11235

Phone (212) 646-6300
SERVING THE INDUSTRY SINCE 1922
Call CECo For Your CCTV Security And Color Production Requirements

TRY IT!

You can help us pick the "Amateur of the Year" at the 1984 Dayton Hamvention.

For details, drop a card to the address below. Do it now!

Nomination deadline is April 1, 1984.

DAYTON HAMVENTION
ATTN: AWARDS COMMITTEE
P.O. BOX 44, DAYTON, OH 45401

See you at the Dayton HAMVENTION...
April 27, 28, 29, 1984.

verticals over *REAL* ground

Ground system geometry
and soil conditions
determine performance

How does the geometry of a radial system or ground screen affect the radiation pattern of a vertical? How do ground and roof mounting differ? How does gain change with the frequency of operation? And do reflections depend on the dielectric constant and conductivity of the ground? This article — complementing our series on vertical phased arrays by K2BT — addresses these and other questions, in one of the clearest presentations on this important subject ever to appear in the Amateur literature. — Editor

Many hams using verticals have wondered how the ground or earth beyond the radial system affects the radiation patterns of their antennas. Much has been written about the need for a good ground screen or radial system to provide a low-loss return path for ground currents. However, not much has been written for Amateurs about how ground reflections affect the performance of a vertical over real ground.

horizontal versus vertical polarization

For dipoles and other antennas putting out predominantly horizontally polarized waves, reflection from a perfectly conducting ground gives a 180 degree phase shift and reflected electric field intensity equal to the incident field. For real grounds the phase shift remains close to 180 degrees and there is

little attenuation of the incident wave. That is why reflection from perfect ground is said to indicate what may be expected of a horizontal antenna over real ground.

The situation is quite different with vertically polarized radiation, which is reflected from perfect ground without phase shift or attenuation. However, only salt water is accurately represented by perfect ground. Any other ground, even saturated, fertilized farmland, provides large phase shifts and attenuations of incident radiation which also strongly depend on the angle of incidence and reflection. At grazing angles of incidence and reflection, the phase shift is 180 degrees and there is no attenuation, just as with horizontally polarized radiation. As the reflection angle increases, the phase shift and reflected field intensity both decrease very rapidly, until an angle is reached where the phase shift is 90 degrees and the reflected field intensity is minimum (maximum attenuation). This angle is called the *pseudo-Brewster angle* and ranges from 1 or 2 degrees for salt water to 30 degrees for rocks or dry sand.¹ At this angle, the radiation pattern of a vertical is affected least by ground reflections. Below the pseudo-Brewster angle, the reflected wave of a ground-mounted vertical partially or wholly cancels the direct wave, while above this angle, ground reflections enhance direct radiation. Generally, the better the ground, the smaller the pseudo-Brewster angle, and the greater the gain from ground reflections.

The radiation pattern of a vertical over infinite, perfectly conducting ground is maximum toward the horizon (takeoff angle of 0 degrees). However, a vertical over real ground has no sky wave radiation

By Mark Bacon, WB9VWA, 2205 File Drive,
Decatur, Illinois 62521

PROTOTYPE FORMING

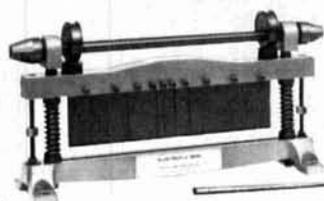
TRIOK

24" SHEAR / BRAKE / ROLL
DUCTILE IRON CASTINGS.

PRICED FROM \$1,125.00



IN-LINE BRAKE



14" PRESS BRAKE
INCLUDING BOX
FORMING DIES.

PRICE \$225.00

(ask about the special combination offers).

SHEAR-NOTCHER

CONTINUOUS .150" SLOTTING,
NO DISTORTION,
STRAIGHT OR TAB NOTCHING.

PRICE WITH TABLES \$58.50



Capacity all units 20 GA Mild Steel or .060" aluminum.
Prices are F.O.B. Los Angeles.

PACIFIC ONE CORPORATION

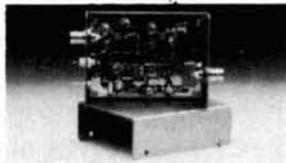


513 Superior Avenue, Suite K315
Newport Beach, CA 92663
(714) 645-5962

174

NEW
FROM
LUNAR

HIGH PERFORMANCE COMMERCIAL QUALITY UHF/VHF CONVERTER KITS



Professionally engineered using the high performance DBM, these kits are designed with the active VHFer in mind. All parts, components and circuit board are of the highest quality. Gold alodined case ensures circuit integrity. Each kit includes easy-to-read, fully illustrated instructions. VHF units use crystal control. UHF converters are tunable. Crystal control UHF models available soon. In the unlikely event of construction problems, complete factory back-up assistance is available from trained technicians.

Typical Specs:

Input freq.	144 MHz
Image rejection	-65 dB
LO specs	+7-10 dBm output
Conversion gain	15 dB
Noise fig (tuned min. N.F.)	1.75 dB
Noise fig (tuned max. gain)	2.4 dB
Harmonics	-50 dBc

MODEL	INPUT FREQ	OUTPUT FREQ	PRICE
RCK 5/10	50	28	\$39.95
5/2	50	144	39.95
2/10	144	28	39.95
2/6	144	50	39.95
1.3/10	220	28	39.95
1.3/6	220	50	39.95
1.3/2	220	144	39.95
ATV	439	60	34.95
ATV P	439	60	39.95

Crystals for VHF models available

Other frequency conversions available. Specify requirements.

\$14.95 ea.

157



2775 Kurtz St., Suite 11,
San Diego, CA 92110
(619) 299-9740



SALE
SPECIAL PRICE

Radio Handbook
TWENTY-FIFTH EDITION
BY WILLIAM L. COLWELL
\$19.95 + \$2.50 s&h

SAVE
50%

Special buy
combined with
price reduction by
publisher equals 50% off old
retail price. Was \$39.95. Special
price \$19.95 (+ 2.50 s&h)

The Radio Handbook has been a best seller for over 45 years. This brand-new edition covers in complete detail all of the latest state-of-the-art advances in electronics. Hams and engineers alike will find this handy, single-source reference an invaluable aid. Chock-full of projects from simple test equipment to complex receivers and amplifiers. Chapters include an explanation of Amateur Radio communications, electronic and electrical theory, tubes and semiconductor devices; a special chapter on RFI and more . . . This invaluable book is a must for every hamshack. Order yours today and save. 1136 pages.

©1982 □21874

\$22.45

(19.95 + 2.50 shipping & handling.)

(603) 878-1441

Ham Radio's Bookstore
Greenville, NH 03048

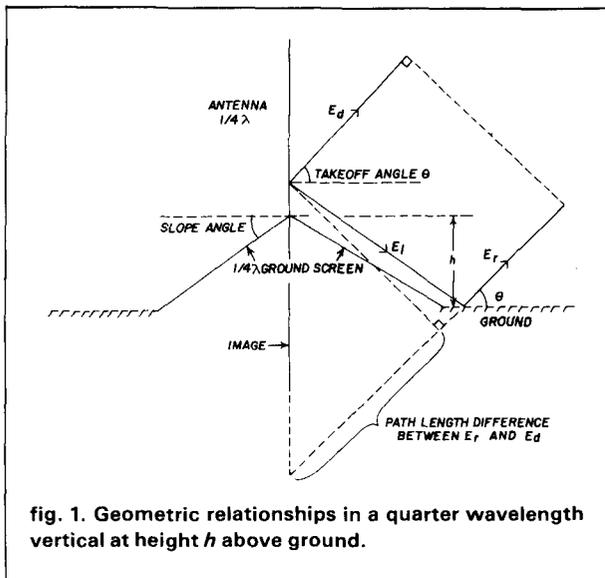


fig. 1. Geometric relationships in a quarter wavelength vertical at height h above ground.

toward the horizon and a lobe of maximum radiation varying from 15 degrees, for exceptionally good soil, to 30 degrees, for completely dry rocks and sand. In practice, then, real ground decreases the gain and significantly raises the radiation or takeoff angle of a vertical.

free space patterns and ground reflections

To keep things simple, we will concentrate on a quarter wave, current-fed vertical with a quarter wave, perfectly conducting ground plane, mounted over real ground. The radiation patterns of practical verticals with sixty or more radials will closely approach the patterns presented here.

The overall approach is to combine the results of the optical theory of reflection with the free space pattern of a particular vertical configuration. This composite picture shows a radiation pattern modified by reflections from ground having a particular conductivity and dielectric constant.

The free space pattern is calculated from the standard electric field intensity formula for a quarter wave vertical with an infinite, perfectly conducting ground plane.² The ground plane defines a collinear quarter wave image "antenna" below the ground screen (fig. 1). In other words, a quarter wave vertical with an infinite ground screen is electrically similar to a half wave vertical dipole except in the feedpoint resistance of the vertical, which at 36 ohms, is just half that of the dipole; its power gain is also 3 dB higher. In our case, the ground screen is a quarter wave in radius instead of infinite. Here the image antenna will be electrically shorter than a quarter wave at takeoff angles θ less than some critical angle defined by the geometry of the system. The progressive shortening

of the image as the radiation angle is lowered modifies the free space pattern from what you get with an infinite ground screen, in which the image has the same length as the antenna at all radiation angles.

Ground reflections are determined from the Fresnel equation for the reflection of vertically polarized electromagnetic waves from a plane surface.³ A set of reflection coefficients, or ratios of reflected to incident field intensities, are calculated for useful takeoff angles in 5 degree increments over ground of a particular conductivity and dielectric constant. If we call the incident-electric field intensity E_i , the reflected field intensity E_r , and the reflection coefficient R , then $E_r = R \cdot E_i$, and E_r is added vectorially to the free space direct field intensity E_d at each takeoff angle to construct a vertical radiation pattern for a vertical over real ground (fig. 1).

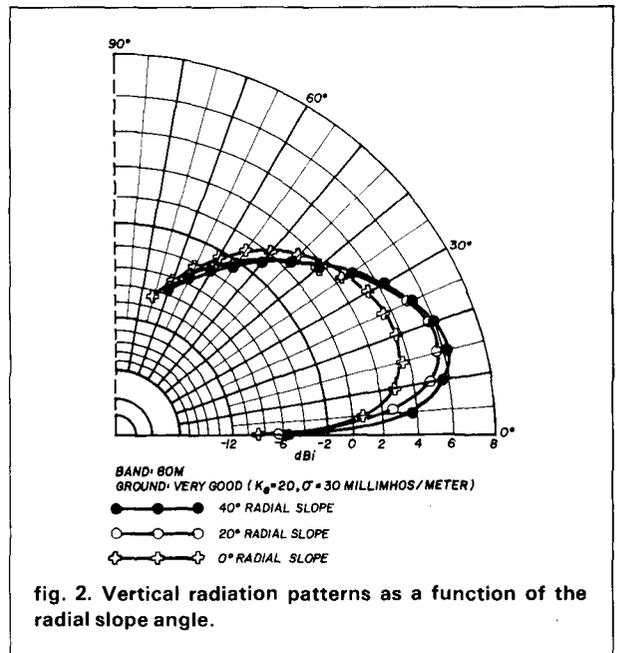
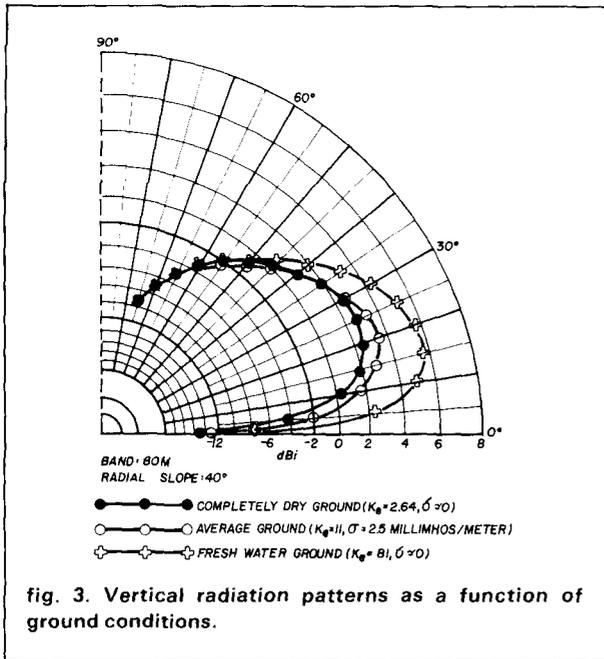


fig. 2. Vertical radiation patterns as a function of the radial slope angle.

ground screen geometry

The radiation pattern of a vertical is strongly influenced by the slope or angle below horizontal of the quarter wave ground screen or radial system. Fig. 2 shows 80-meter vertical radiation patterns of quarter wave verticals, ground mounted over very good ground (e.g., wet, fertilized farmland). The angles of radial slope are 0 degrees (horizontal radials), 20, and 40 degrees. The configuration with ground systems sloping below horizontal correspond to the antenna mounted atop a mound "carpeted" with a ground screen or dense network of radials. Note that the verticals with sloping radials have a significant gain advantage over the horizontal or 0 degree radial configuration — 2.5 dB at a 10 degree



takeoff angle in the case of a 40-degree radial slope. This angle is about the optimum slope. As the slope gets steeper, the gain decreases due to increasing radiation resistance. Other bands besides 80 meters show similar gain increases with sloping radials.

Fig. 3 shows what to expect if you live in a desert or on dry, sandy ground anywhere, or in a city, surrounded by concrete and asphalt. In these settings, the advantage of sloping radials completely disappears. Even over average ground with moderate dielectric constant and conductivity, little is to be gained from a sloping ground screen. Over average or poor ground, the combined phase shift from reflection and from the path length difference between E_i and E_r (fig. 1), is between 90 and 180 degrees for useful takeoff angles; this large phase shift leads to substantial cancellation of E_d by E_r .

The advantage of a sloping ground screen is regained over a fresh water ground, even though the conductivity is insignificant (fig. 3). Compared to very poor ground, a fresh water ground offers a gain of up to 7 dB and compared to average ground, a gain of 4 dB. This is because the high dielectric constant of water provides a good reflecting plane.

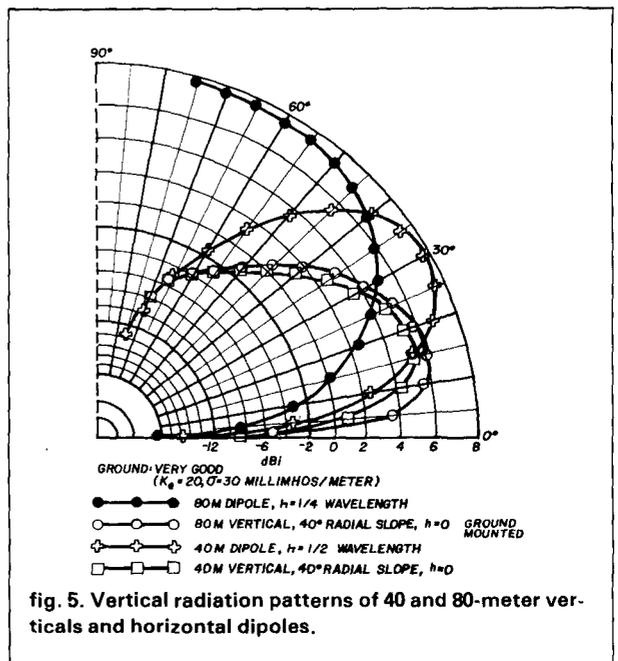
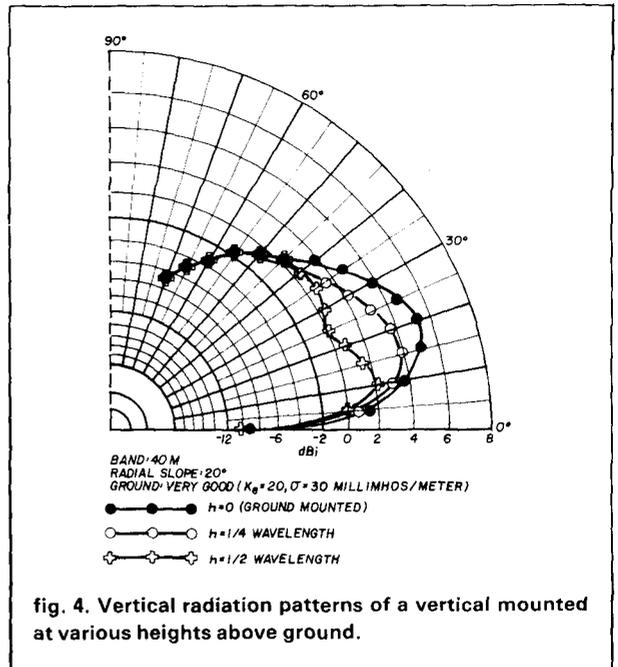
These radiation patterns suggest that it's possible to enjoy a seasonal advantage with sloping radials. Several days of rainy weather can raise both the dielectric constant and the conductivity a great deal, leading to another 2 to 6 dB of reflection gain at takeoff angles below 30 degrees.

roof or tower mounting

Unless a vertical is mounted two to three wavelengths high, putting it up in the air does not increase the gain, as it does with most horizontal antennas. In

fact, about 1 dB at one quarter wavelength high is lost, compared with a ground-mounted vertical (fig. 4). Of course, if your ground-mounted antenna is completely boxed in by cars, buildings, or other obstructions, getting the current loop above the lossy surroundings may still pay off. The gain trends with radial slope seen for ground mounted verticals also appear for elevated verticals.

About half a wavelength above ground at the base is a particularly unfortunate height at which to mount a vertical over most grounds. Fig. 4 shows the 40-meter radiation pattern of a quarter wave vertical



with 20° radial slope, at one half wavelength high. It has up to 5 dB less gain at the most useful radiation angles than the same antenna, ground-mounted over very good ground. Other radial geometries at one-half wavelength show similar losses. Only a vertical over salt water shines at this height, giving about 7 dBi gain at 5 degrees, which is especially good for the bands above 30 meters.

vertical versus dipole

Recently there has been interest in discussing whether the vertical or dipole works better on the various bands.⁴ Fig. 5 compares the 80-meter radiation pattern of a ground-mounted quarter wave vertical having 40-degree ground screen slope, with the broadside pattern of a half wave dipole one quarter wavelength above very good ground. The dipole at about 65 feet (20 meters) is as high as most Amateurs would mount an 80-meter dipole. The vertical shines at takeoff angles below 30 degrees, while the dipole takes over at higher angles. Undoubtedly some 80-meter DX comes in at angles above 30 degrees, as do most short-skip signals. In that case the broadside dipole looks like the better antenna.

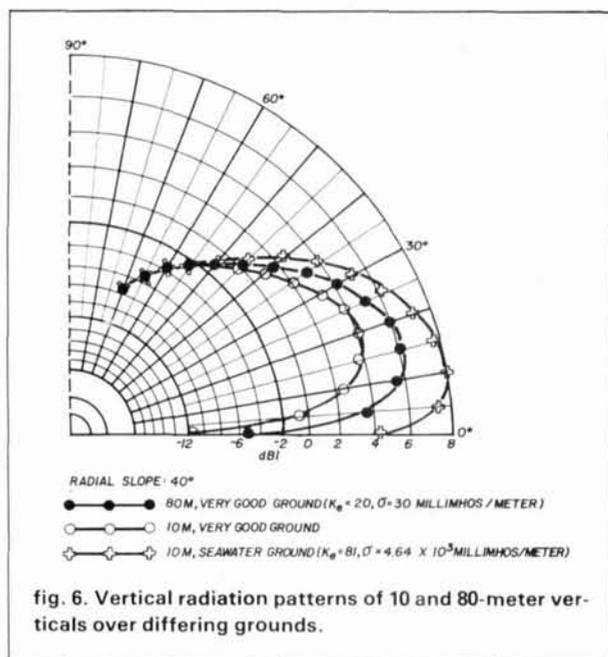


fig. 6. Vertical radiation patterns of 10 and 80-meter verticals over differing grounds.

However, for most really long-hop circuits, the vertical would be the better choice.

calculating vertical radiation patterns

To calculate vertical radiation patterns, first define the following terms:

- E_d direct (free space) field intensity
- E_i field intensity incident on the ground
- E_r field intensity reflected from the ground
- R reflection coefficient, equal to E_r/E_i
- K_e dielectric constant of the ground
- σ conductivity of the ground in millimhos/meter
- λ wavelength in meters
- θ takeoff angle of the direct ray. Also equal to the angle of incidence and reflection (fig. 1)
- ϕ angle of refraction of the transmitted ray
- ρ phase shift due to reflection
- β phase shift due to the path length difference between direct and reflected rays (fig. 1)
- h height of the antenna above ground, in meters
- G_i gain in dBi relative to an isotropic radiator

The electric field intensity E_d or E_r is expressed as a function of the current, which is a standing wave on the antenna (radiator plus image). This current function is integrated over the length of the antenna, including the image, to give the free-space field intensity at a particular θ . If $\theta > \theta_0$, the intensity is E_d and if $\theta < \theta_0$, we call the intensity E_i . E_r corresponds to the ray reflected from the ground.

R is calculated from the Fresnel equation for reflection of vertically polarized radiation from a plane surface:

$$R = \frac{\sqrt{K'_e} \sin \theta - \cos \phi}{\sqrt{K'_e} \sin \theta + \cos \phi}$$

where $\phi = \sin^{-1} \frac{1}{Re\sqrt{K'_e}} \cos \theta$ from Snell's

law, and the complex dielectric constant

$$K'_e = K_e - j(6 \times 10^{-2}) \cdot \sigma \cdot \lambda$$

For each θ , E_d is calculated and for $-\theta$, E_i , the corresponding ray directed downward, is calculated. Then $E_r = R \cdot E_i$ and E_t is determined by adding the E_d and E_r vectors:

$$E_t = [E_d^2 + 2E_d E_r \cos(\rho + \beta) + E_r^2]^{1/2}$$

The gain at a particular takeoff angle is $G_i = 20 \log E_t + A$, where A is a normalization factor which gives the correct gain of the vertical being considered at 0 degrees takeoff angle over infinite, perfectly conducting ground. For example, $A = 5.16$ dBi for a quarter wave vertical with 0 degrees radial slope at ground level over infinite, perfect ground. Thus, various combinations of radial slopes and grounds will all give G_i expressed in dBi.

Hi we're **Hatry Electronics**

CDE **MIRAGE** **B'W**
 AMPHENOL **AMIDON Associates** **DAIWA**
HUSTLER **avanti antennas**
J. W. Miller **BENCHER**
DRAKE **ICOM**
Cushcraft **Bash Books** **MFJ ENTERPRISES, INCORPORATED**
 THE ANTENNA COMPANY
UNR-Rohn **HY-GAIN** **Used Equipment** **callbook INC.**
 Division of UNR, Inc. **Larsen**
Hatry Electronics
The Elect in Electronics
 500 LEDYARD STREET
 HARTFORD, CONN. 06114
 Phone 203-527-1881

On 40 meters, a half wave dipole one half wavelength above very good ground, pitted against a ground-mounted vertical with 40° radial slope, has a broadside gain advantage above 15 degrees (fig. 5). This angle is about the median for New England to western European circuits on 40 meters.⁵ Again, the dipole looks better for most medium and short-skip circuits, while the vertical has a slight advantage for very long hops and band conditions favoring very low radiation angles.

On 10 through 30 meters, a vertical is at more of a disadvantage because its reflection gain drops off faster with increasing frequency than the reflection gain of a dipole. As fig. 6 shows, on 10 meters a ground-mounted vertical with 40 degree radial slope over very good ground has 3 dB less gain at a takeoff angle of 10 degrees and 4 dB less gain at 5 degrees than a similar vertical on 80 meters. A vertical on 10 through 30 meters simply can't compete with a dipole one or more wavelengths high over any ground except salt water. *Between 30 and 40 meters is the point at which the dipole really takes over.*

conclusion

No doubt the long-standing debate will continue over whether a vertical or a dipole is the better antenna. I hope the results presented here will encourage more good A-B comparisons of verticals with other simple antennas. The worldwide system of beacons on 14.100 MHz should aid in these comparisons.

These results also show that ground mounting in the clear is generally the best way to set up a vertical. If the ground beyond the radial system is exceptionally good, the radials can be sloped downward 20 to 40 degrees for another 2 dB or more of reflection gain. Over salt water, a vertical with ground system sloping down to water level and 0.5 miles (0.8 km) of salt water in all directions would be a hard antenna to beat, especially on 10 through 30 meters, where 7 dBi of gain below 5 degrees is what is needed for long hop DX (fig. 6). However, for most grounds the ability of the vertical to launch low angle (below 15 degrees) radiation has often been overrated in the Amateur literature.

acknowledgement

I thank Dick Coombe, K9VPK, for his interest and encouragement throughout this project.

references

1. F. Terman, *Radio Engineers' Handbook*, McGraw-Hill, 1943, page 699.
2. D.R. Corson and P. Lorrain, *Introduction to Electromagnetic Fields and Waves*, Freeman, 1962, page 463.
3. D.R. Corson and P. Lorrain, *Introduction to Electromagnetic Fields and Waves*, Freeman, 1962, page 367.
4. Bill Orr, "Ham Radio Techniques," *ham radio*, October, 1982, page 20; February, 1983, page 79.
5. *ARRL Antenna Book*, 14th Edition, American Radio Relay League, Newington, Connecticut, page 1-10.

ham radio

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.

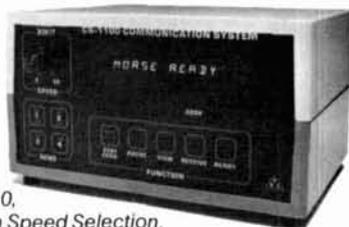
Feature	Benefit
CMOS upprocessor based.	No RFI problems.
Membrane Switch front panel.	Insures reliability.
16 chr Intelligent LED display.	Readable to 12 feet.
Super Narrow Filters.	No tuning required.
Built-in 110 VAC supply.	No extras to buy.
500 chr Buffer (all modes).	Review received text.
Parallel 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

LARSEN ANTENNAS TRAVEL IN THE FAST LANE.



Race car communications demand the best from an antenna under some of the worst conditions. Split second decisions require reliable signals at exceptionally high speeds.

That's why Larsen Antennas are used on race cars at the Indy 500. Because Larsen Antennas are designed to take high speed with minimal signal distortion. Proving they can travel in the fast lane without putting a drag on their performance.

Larsen's precision tapered stainless steel whip provides maximum flexibility while minimizing radiation pattern distortion, giving you a clear consistent signal. And Larsen's

exclusive Kūlrod® plating, gives your antenna high conductivity to assure that maximum power goes into communicating — not heat.

That full measure of performance goes into our product integrity too. With a no nonsense warranty that won't slow you down.

So, whether you're following the racing circuit or a local rescue effort, you'll find Larsen Antennas will keep you ahead of the situation with dependable performance. Ask your favorite Amateur dealer to demonstrate how you can hear the difference with Larsen Antennas. Write for our free Amateur catalog.



Larsen Antennas

IN USA: Larsen Electronics, Inc.
11611 N.E. 50th Avenue P.O. Box 1799 Vancouver, WA 98668 Phone: 206-573-2722

IN CANADA: Canadian Larsen Electronics, Ltd.
283 E. 11th Avenue, Unit 101
Vancouver, B.C. V5T 2C4 Phone 604-872-8517

Kūlrod® is a registered trademark of Larsen Electronics, Inc. in U.S.A. and Canada.



the VHF/UHF challenge

Although I'm usually branded as a VHF/UHF person, I'm really a DX'er and go where the DX goes, be it 160, 20 meters, or 13 cm. (I'm fully equipped for 13 different Amateur bands and operate them all!) So after I made the sought-after DXCC Honor Roll in 1968, I decided that someday I'd probably have every country confirmed on HF (which I did in 1980) and that the best challenges remaining would be on the VHF/UHF bands. I never abandoned the HF bands — as any DX'er will tell you — but I now tend to concentrate my efforts on improving the state-of-the-art on the frequencies above 50 MHz.

a review

It wasn't too many years ago that any Amateur Radio operator venturing above 29.7 MHz had to be ready to "roll his own" rig, so to speak. That's different now. For those so inclined, there has been vast improvement in components and antenna design. You can now purchase commercial equipment for all Amateur frequencies up through 1300 MHz, even to the limits of legal power. This has even been extended to OSCAR and EME (Earth-Moon-Earth). But herein lies the problem: what do you build or buy, how do you hook it up, how do you use it, and more importantly, how do you get the most out of your equipment and keep up with the state-of-the-art?

opportunities

Let's digress briefly and discuss some of the opportunities awaiting us on the VHF/UHF frequencies. This is truly the area for propagation research, and there are records galore just waiting to be made or broken. Disregarding EME and OSCAR for the moment, look at what's happened on 6 meters in the last few years: WAC has been worked by many. Even places like India, Gambia, the Galapagos Islands, Cyprus, and other equally distant places have become workable from North America via F2 propagation.

Then 2 meters opened on the transequatorial path.¹ To our surprise, it wasn't as spotty as expected. In fact, 220 MHz QSOs were finally made and a one-way 70 cm QSO has been verified. Speculation on the existence of a new propagation mode was heard, with hints that FAI (Field Aligned Irregularities) similar to the transequatorial path could possibly exist in the mid-latitudes such as the U.S.A. This was finally confirmed, and QSOs on 2 meters using this mode have been accomplished numerous times; but while it's still possible above 148 MHz, this has yet to be done!

A true Amateur communications satellite, OSCAR 10, is now available to all Amateurs. Then there's EME, the ultimate challenge on Amateur power levels. Worldwide QSOs now take place daily on frequencies from 144 to 2320 MHz. These QSOs are no longer the result of a concerted effort by many individuals pooling their efforts; instead, they're being done by the everyday Amateur who may live

on a 60 by 100-foot lot, but is willing to take on the challenge, do the research, and build up a good station. And while this isn't a task for the timid, many non-technical persons are doing it every day.

Let's look beyond operating and propagation. These discoveries weren't made by accident; *they happened and were exploited because the state-of-the-art gear had been improved.*

benefits

So you say, what's in it for me? *PLENTY.* You too can contribute to the state-of-the-art. There is much to be done: some may contribute labor, helping assemble large antenna arrays; others may assist with parts procurement, machining, research, scheduling, antenna design, receiver design, transmitter design and so on. But there's something here for everyone, and the rewards are numerous: records to be broken, propagation modes to be discovered (this takes time and scheduling), new improved antenna systems (*better mechanical designs as well as electrical parameters*), better receivers with lower noise figure and high dynamic range *at the same time*, and more efficient and cleaner transmitters. (For you HF'ers, have you ever tried to use a frequency adjacent to a station running 100,000 to 1,000,000 watts effective radiated power?) The satisfaction will be enormous. The VHF/UHF frequencies offer a great test bed where you can develop new techniques, circuits, and antennas even if you are restricted to a small or not-so-great location.

summary

Why all the hype? I'm constantly confronted by very competent individuals who are willing to build or buy their own gear to get on the VHF/UHF frequencies but always ask the same questions: "What's the best preamplifier circuit? What's the best antenna for my application? What band should I try?" The answers are not always simple — and often depend on the individual — but there is always one problem common to all the inquiries: where do I find the information I need to put together this gear? The answer is *right here*, because I've been asked by Rich Rosen, the Editor-in-Chief of *ham radio*, to launch this column as a continuing series. Over the coming months I'll try to discuss many of the questions most commonly asked by the newcomer as well as the seasoned VHF/UHF'er. This will be done with concise descriptions, charts, and circuits. After establishing a solid base of factual material over the first few months, I'll then attempt to build on this basis by offering updates, new or state-of-the-art equipment design information, advice on construction of antennas, propagation information and discussion of other subjects that will keep us all up to date. Time and space permitting, we may even include material or ideas expressed by others. Each month I'll also try to list events that are of special interest to VHF/UHF'ers.

Does this seem like the kind of information you're looking for? If so, I'll see you next month.

references

1. Joseph H. Reisert, W1JR, and Gene Pfeffer, K0JHH, "A Newly Discovered Mode of VHF Propagation," *QST*, October, 1978, pages 11-14.

VHF/UHF coming events

Quadrantides Meteor Shower: Predicted peak at 0100 UTC on January 4, 1984.

Best EME weekend: January 20, 21, 1984.

ARRL VHF Sweepstakes Contest: January 14-16, 1984. (See December, 1983 *QST* for further information.)

ham radio

meet Joe Reisert . . .

First licensed in 1951 as **WN2HQL**, Joe Reisert earned his Extra Class license in 1956. He has since held the following call signs: **WA6TGY**, **W6FZJ**, **W1JAA**, and now, **W1JR**. He attained the DXCC Honor Roll in 1968 and presently has 357/315 confirmed. Joe's interest in UHF began in the late 1960's and he made his first 432 MHz contact in 1970; he has since worked all states on 432 MHz and *nine* other bands: 160 through 2 meters (160, 80, 40, 30, 20, 15, 10, 6, and 2 meters). Active in EME operation on 144 through 1296 MHz, he is the former joint holder of the 2304-MHz tropo record of 330 miles set in February, 1974.

Joe's diversified technical interests are best illustrated by his publication of over thirty articles on subjects as varied as the following: a wide-band, low-noise preamplifier; VHF antenna arrays for high performance; a 432-MHz kW stripline amplifier modification; a low-noise VHF/UHF receiver design; a 2-meter transmitter filter for mode J; new modes of VHF propagation; and the PROMIS Microwave data and video link.

ham radio readers can look forward to reading about these subjects and more as Joe Reisert's column continues over the coming months. Welcome aboard, Joe!

K2RR

**SAY YOU SAW IT
IN
HAM RADIO**



THE UHF COMPENDIUM

by K. Weiner, DJ9HO

This 413 page book is an absolute must for every VHF and UHF enthusiast. Special emphasis has been placed on state-of-the-art techniques. Author Weiner fully describes test equipment, alignment tools, power measuring equipment and other handy gadgets. 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 megaelement arrays. ©1980.

KW-UHF Softbound \$23.95

VHF-UHF MANUAL

by G.R. Jessop, G6JP

This new, revised 4th edition is jam-packed with circuits, antennas, converters, cavity amplifiers and much, much more. Practical theory and construction projects cover from 70 MHz to 24 GHz. The chapter on Microwaves has been expanded to 83 state-of-the-art pages. Receiver and transmitters for all VHF and UHF bands are covered in 181 pages. The balance of this book contains information on propagation, tuned circuits, space communications, filters, test equipment, antennas, plus a handy easy-to-use data section. Equipment designed for the British 4 meter band can be adapted fairly easily to the U.S. 6 meter allocation. ©1983, 512 pages, 4th edition.

RS-VH Hardbound \$17.50

VHF RADIO PROPAGATION

by J. D. Stewart

Radio waves at VHF frequencies are quite different from those at HF. J. D. Stewart's book describes propagation mechanisms such as atmospheric ducting, scattering, auroral reflections and ionized meteor trails with a full detailed explanation. You also learn how to observe the Sun and predict favorable propagation conditions. Whether you are just interested in 2 meter FM or are planning an extensive EME operation, this book is a very valuable addition to your Amateur library. ©1982, 112 pages.

21575 Softbound \$4.95

VHF HANDBOOK

by W9EGQ and W6SAI

Contains all the latest information for VHF operation. Antenna design and construction from 50-432 MHz is fully covered with proven practical design information. You also get a complete rundown on FM theory, design and plenty of helpful hints and tips. In the construction section, the authors detail how to build low noise, high performance converters, transceivers, amplifiers and plenty of other pieces of interesting equipment. This book is a must for both the beginner and expert in VHF communications. ©1974, 336 pages, 3rd edition.

RP-VH Softbound \$11.95

Please add \$2.50 for shipping.

HAM RADIO'S BOOKSTORE
Greenville, NH 03048

HAMTRONICS, INC.



USED EQUIPMENT

AMECO

TX-62.....	\$95.00
CN-144.....	\$34.00
621 VFO.....	\$59.00

B & W

374 DL METER.....	\$125.00
6100 XMITTER.....	\$395.00

CLEGG

29 B.....	\$225.00
THOR 6.....	\$175.00
ZUESS.....	\$225.00
22 ER MKII.....	\$179.00

COLLINS

75S1.....	\$395.00
75S3.....	\$649.00
32S1.....	\$595.00
30L1.....	\$795.00
399C VFO.....	\$395.00
312-B4.....	\$325.00

DRAKE

R4-B.....	\$425.00
T4X-B.....	\$449.00
TR4-C.....	\$549.00
2NT.....	\$179.00
TR-6.....	\$695.00

DENTRON

MLA-2500.....	\$795.00
SUPER TUNER.....	\$95.00

GONSET

GSB 100.....	\$295.00
G-50.....	\$149.00

HAMMARLUND

HQ-180.....	\$295.00
HQ-170.....	\$225.00
HQ-215.....	\$269.00



FOR ALL YOUR
HAM NEEDS

CALL TODAY FOR YOUR
PRICE

HALLICRAFTER

SX-101A.....	\$249.00
KEYER HA-1.....	\$49.00
HT-31 LINEAR.....	\$225.00
SX-42 REC.....	\$195.00

HEATH-KIT

HW-100.....	\$289.00
SB-313.....	\$279.00
SB-634.....	\$195.00
SB-310.....	\$295.00
SB-400.....	\$325.00
SB-301.....	\$349.00
SB-200.....	\$495.00
HW-8.....	\$129.00
HR-10-B.....	\$89.00
SB-650.....	\$169.00

ICOM

IC-211.....	\$450.00
IC-720.....	\$725.00
IC-215.....	\$175.00

JOHNSON

CHALLENGER.....	\$79.00
6 + 2 THUNDERBOLT.....	\$895.00
500 WATT MATCH BOX.....	\$75.00
1- KW WATT MATCH BOX.....	\$125.00
VALLIANT II.....	\$295.00

KENWOOD

TS-520-S.....	\$649.00
R-599-D.....	\$349.00
T-599-D.....	\$325.00
7400-A.....	\$295.00

NATIONAL

NCL-2000.....	\$895.00
NC-300.....	\$189.00
NCX-1000.....	\$895.00
NC-303.....	\$249.00

REGENCY

HR-212.....	\$189.00
HR-2 MS.....	\$195.00
HR-2-S.....	\$199.00

STANDARD

SRC-146.....	\$179.00
14-U.....	\$249.00
826-M.....	\$195.00

SWAN

350.....	\$329.00
500-CX.....	\$449.00
750-CW.....	\$695.00
120 W-AC.....	\$149.00
600 R-CUSTOM.....	\$425.00

TEMPO

TEMPO ONE.....	\$395.00
REMOTE VFO.....	\$95.00

TEN-TEC

509 ARGONAUT.....	\$249.00
TRITON IV.....	\$495.00
KR-50 KEYER.....	\$89.00

YAESU

FRG-7.....	\$249.00
FT-101E.....	\$425.00
SPEAKER PATCH.....	\$45.00
FRG-7000.....	\$449.00
FR-DX 400.....	\$295.00
FT 620-B.....	\$395.00

USED TEST EQUIPMENT

MEASUREMENTS MOD 80.....	\$295.00
TEKTRONICS MOD 422.....	\$495.00
TEKTRONICS MOD 535A.....	\$475.00
BECKMAN 5300 COUNTER.....	\$195.00
HEWLETT PACKARD 608D.....	\$295.00
HEATHKIT 1M-25.....	\$95.00
HEATHKIT OL-1 SCOPE.....	\$75.00
HEATHKIT Q METER.....	\$125.00
BOONTON Q METER.....	\$295.00
GRAPH RECORDER.....	\$125.00
JADE HOLLOGRAPH.....	\$75.00
LEADER 505 SCOPE.....	\$475.00
SPECTRUM ANALYZER.....	\$295.00
TS/323/UR FREQ METER....	\$149.00

Equipment availability subject to prior sale. Call for details and specifics.
Listing as of 1 December 1983.



HAMTRONICS, INC.

4033 BROWNSVILLE ROAD, TREVOSE, PA. 19047

(215) 357-1400

AEA Brings you the Breakthrough!

MBA-RC Code Converter

This full function decoder and display unit represents the latest in state-of-the-art decoders. Morse, Baudot, and ASCII. Will perform serial to parallel and parallel to serial code conversions as well as cross mode conversions. Two powerful μ PS, 43 ICs, make up one complete package. Compatible with HF, VHF and UHF bands and RTTY modes. Separate receive filters are ahead of and behind a special signal limited circuit.



CALL FOR YOUR PRICE



AEA Computer Patch CP-1

A Personal Computer + Your Transceiver + AEA's CP-1 = FUN! Get a professional quality RTTY/CW terminal on a beer budget price. Easy to hook up and use. The CP-1 demodulator provides greatly improved performance compared to popular single channel RTTY detectors. With appropriate software and your personal computer, you can have hours of fun.

CALL FOR YOUR PRICE

ISOPOLE™

Models available for: 144 MHz, 220 MHz and 440 MHz. Maximum gain, very low angle of radiation. Covers complete band with SWR less than 1.4-1.

CALL FOR YOUR PRICE

AEA Contester™ CK-2

Here's great gift idea for your favorite ham. Designed with the needs of the active contester in mind — at a price that is affordable. Has an 800 character message memory that can be soft partitioned into as many as 10 sections. Mistakes are easily corrected with unique edit mode. Also has automatic serial number generator.



CALL FOR YOUR PRICE



AEA Moscow Muffler WB-1

Blank the woodpecker — once and for all. No modifications necessary to your equipment. Hooks up in your antenna so synchronous blanker works where most effective, in the RF stage. Will not overload from strong adjacent signals. Also has low noise, broadband 6 dB preamp. WB-1 will typically display 40-50 dB of attenuation. Two pulse rates blanking speeds available — 10 and 16 Hz.

CALL FOR YOUR PRICE

AEA Amtor Terminal Unit AMT-1

AMTOR is fast growing in popularity. Don't you want to join the fun? Computer based, self correcting mode of transmission virtually ensures error-free copy — even with strong interference or weak signals, AMTOR can get your message through. AMT-1 contains everything you need to get on AMTOR with the addition of your radio and personal computer. Will also work on standard RTTY and CW for additional flexibility. Great Christmas gift idea. State-of-the-art FUN.



CALL FOR YOUR PRICE

HAMTRONICS is your complete ham dealer. Looking for something and can't find it elsewhere? CALL HAMTRONICS TODAY



HAMTRONICS, INC.

4033 BROWNSVILLE ROAD, TREVOSE, PA. 19047

(215) 357-1400

G.O.E.S. reception: a simple approach

Inexpensive
surplus components
and scope bring you
satellite weather pictures

Too often Amateurs will not attempt a project because it appears, at first glance, to be far too complex; reception of weather images from the geosynchronous satellites is certainly one such project. After reading several excellent articles on the subject,¹⁻³ I was convinced I'd need at least a four to six-foot dish and a \$400 downconverter in order to build the required equipment. But I decided to try to build the system anyway, using whatever surplus materials I could obtain.

antenna

While I did not — and still do not — have a four or six-foot microwave dish antenna, I did have a small 30-inch dish that had been collecting dust for about fifteen years. Now, the gain difference between a six-foot dish and a thirty-inch dish is determined by the ratio of the dish areas. The six-foot dish has an area 5.76 times the thirty-inch antenna. This translates to a gain difference of 7.6 dB. The focal length of the thirty-inch dish was measured to be 10.8 inches. (The focal length of an existing dish is easily found by dividing the diameter squared by sixteen times the depth.⁴) Next, the F number, or focal ratio,

was calculated. This is simply the focal length divided by the diameter, just as for photographic lenses. The focal ratio for the thirty-inch dish is 0.36.

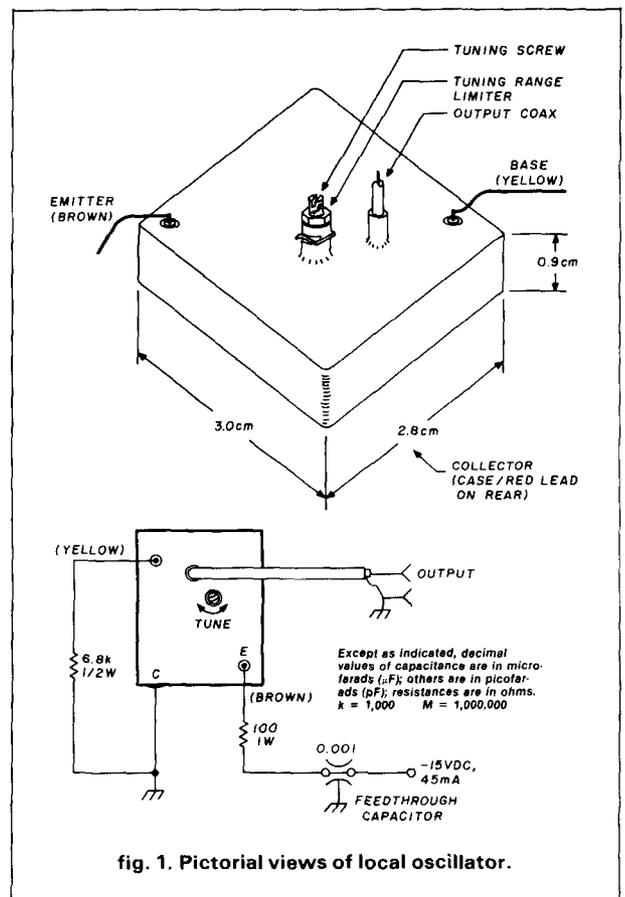


fig. 1. Pictorial views of local oscillator.

By John M. Franke, WA4WDL, 1310 Bolling Avenue, Norfolk, Virginia 23508

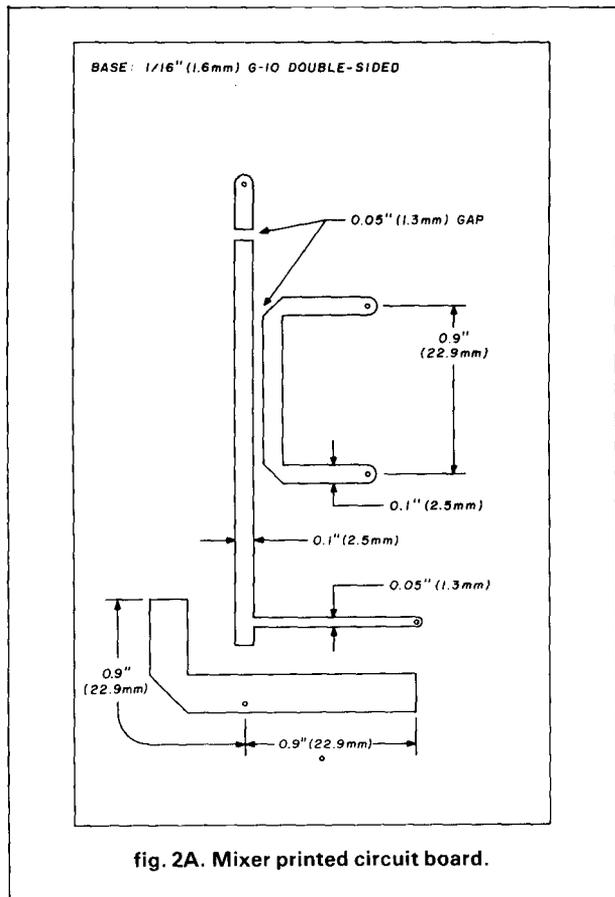


fig. 2A. Mixer printed circuit board.

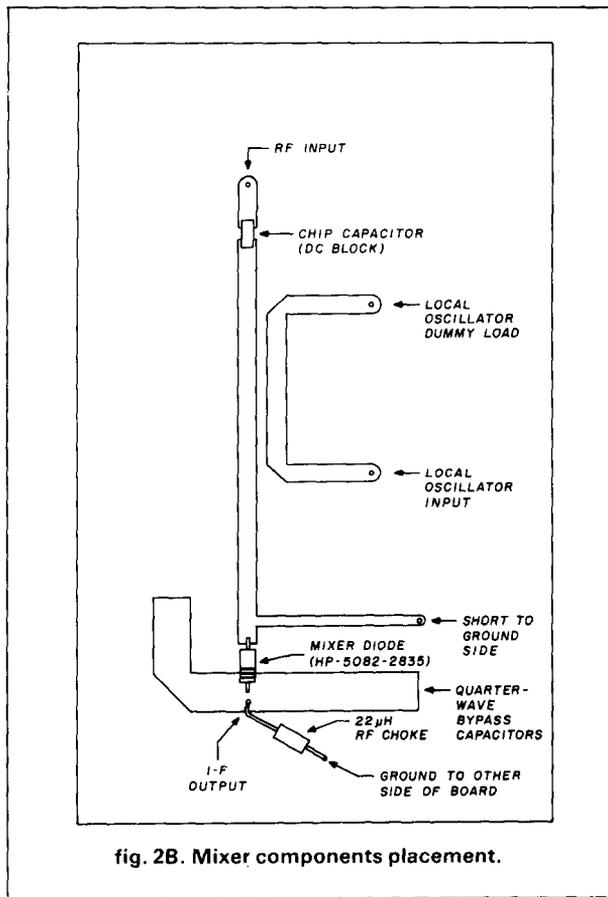


fig. 2B. Mixer components placement.

Once the dish was characterized, I designed the feed, selecting a horn feed because it was the simplest. (After all, this is an Amateur project, not a research program.) I used a piece of five-inch outside diameter aluminum tubing, following an excellent article on waveguide or horn feeds for dish antennas.⁵ I chose RG-58 for the feedline from the antenna to the preamp.

antenna mount

The mount consists of a simple frame made from rack panels and aluminum angle supports. The elevation and azimuth angles for the G.O.E.S.-East satellite were calculated for my station latitude and longitude.⁶

The dish is aligned in azimuth by simply turning the entire mount. A simpler, more compact, mount (see photograph) would be hard to devise. The mount was initially aligned with a compass taking magnetic declination into account. The beamwidth of the antenna is about sixteen degrees; hence, alignment is not critical. The feed can be rotated to adjust for optimum polarization. GOES-East and GOES-West satellites are vertically polarized and GOES-Central is horizontally polarized.

downconverter

The downconverter consists of a mixer and a local oscillator. The local oscillator is a solid-state unit from a weather balloon telemetry transmitter and was purchased at a local hamfest for five dollars. The antenna and modulator were removed and an output connector and bias network added (see fig. 1). Though the solid-state unit is difficult to obtain, Fair Radio Sales still carries a vacuum tube version for under five dollars. Output power from either source is high: 20 to 100 mW. The output frequency is nominally 1680 MHz \pm 20 MHz with a manual tuning control.

The mixer uses a single-ended diode with the local oscillator signal inserted using a directional coupler. Fig. 2 shows the dimensions used with 1/16-inch glass epoxy double-sided printed circuit board material. One side is unetched. The etched side was laid out by first covering the entire copper surface with transparent tape, using a razor blade to trim away the unwanted areas. The areas to be etched away were left covered. (While this is the reverse of most tape techniques, my reasoning will soon become clear.) The board is now sprayed with any color lacquer that is handy; I prefer flat black. The remain-

AMATEUR TELEVISION

FCC & NASA OKs SHUTTLE VIDEO

Want a chance at seeing W5LFL live as he works 2 meters?

It's been great hearing the audio on the various repeaters, but now, if you hold a technician class or higher license, and have a TVRO capable of receiving Satcom IR transponder 13, you can repeat the space shuttle video to your fellow hams using our TC-1 plus. Just connect the composite video and line audio from the Satellite receiver to the video and audio inputs of the TC-1. Depending on your antenna, coverage will be typically the same as 2 meter simplex. Local area hams can receive with just one of our 70 CM downconverters and an antenna.

ATV 70 cm DOWNCONVERTERS

For those who want to see the repeated shuttle video, and other ATV action before they commit to a complete station, the TVC-4 is for you. The TVC-4 contains the TVC-2 module mounted in a cabinet with AC supply ready to go. Tunes 420 to 450 mHz. Just connect 70 cm antenna and your TV set tuned to ch 3 or 4 \$89 delivered.

TVC-4L hotter preamp for fringe areas . . . \$99 delivered.
 TVC-2 wired and tested module. Req. 12 vdc. MRF901 preamp stage. Varicap tuned 420-450 mHz. A low cost start at \$49.
 TVC-2L hotter NE64535 preamp stage \$59 delivered.
 TVC-2G GaAsFet preamp stage. Antenna mounting \$79

CALL OR WRITE FOR OUR CATALOG or more information on ATV antennas, transmit modules, cameras, and much, much more. See chapter 14 pg 30-32 1983 ARRL Handbook.

TERMS: Visa, Mastercard, or cash only UPS CODs by telephone or mail. Postal money orders and telephone orders usually shipped within 2 days. All other checks must clear before shipment. Transmitting equipment sold only to licensed amateurs.

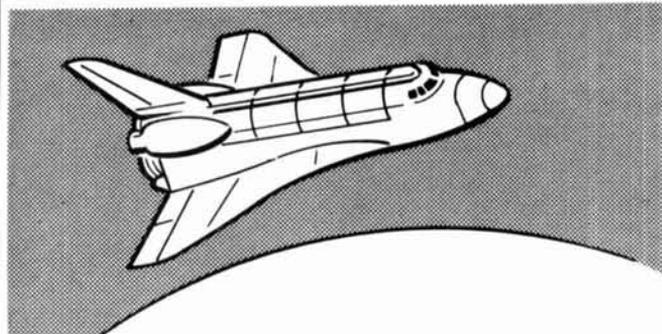
(818) 447-4565 m-f 8am-6pm pst.

P.C. ELECTRONICS

Tom W6ORG Maryann WB6YSS



2522 Paxson Lane
Arcadia CA 91006



ATV TRANSMITTER/CONVERTER



\$399 delivered
TC-1 plus

- **OVER 10 WATTS PEP OUTPUT.** Crystal controlled continuous duty transmitter. Specify 439.25, 434.0, 426.25 standard or other 70 cm frequency. 2 freq. option add \$26.
- **BASE, MOBILE, or PORTABLE.** Use the builtin AC supply or external 13.8 vdc. Do parades, Marathons, etc.
- **TWO VIDEO AND AUDIO INPUTS** for camera, TVRO, VCR, or computer. Wide bandwidth for broadcast quality color video and computer graphics. Standard broadcast subcarrier sound which is heard thru the TV speaker.
- **RECEIVE ON YOUR STANDARD TV SET** tuned to channel 3 or 4. Sensitive varicap tuned TVC-2L downconverter covers simplex and repeater freq. over the whole 420-450 mHz 70 cm amateur band.
- **ATTRACTIVE 10.5 x 3 x 9 CABINET.**

International Crystals & Kits **FOR THE EXPERIMENTER**

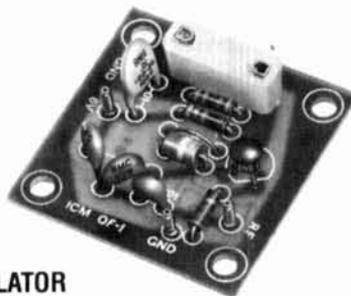


.02% Calibration Tolerance

EXPERIMENTER CRYSTALS

(HC 6/U Holder)

Cat. No.	Specifications
031300	3 to 20 MHz — For use in OF-1L OSC Specify when ordering.
031310	20 to 60 MHz — For use in OF-1H OSC Specify when ordering.



OF-1 OSCILLATOR

The OF-1 oscillator is a resistor/capacitor circuit providing oscillation over a range of frequencies by inserting the desired crystal, 2 to 22 MHz, OF-1 LO, Cat. No. 035108, 18 to 60 MHz, OF-1 HI, Cat. No. 035109. Specify when ordering.

MX-1 Transistor RF Mixer
3 to 20 MHz, Cat. No. 035105
20 to 170 MHz, Cat. No. 035106

SAX-1 Transistor RF Amp.
3 to 20 MHz, Cat. No. 035102
20 to 170 MHz, Cat. No. 035103

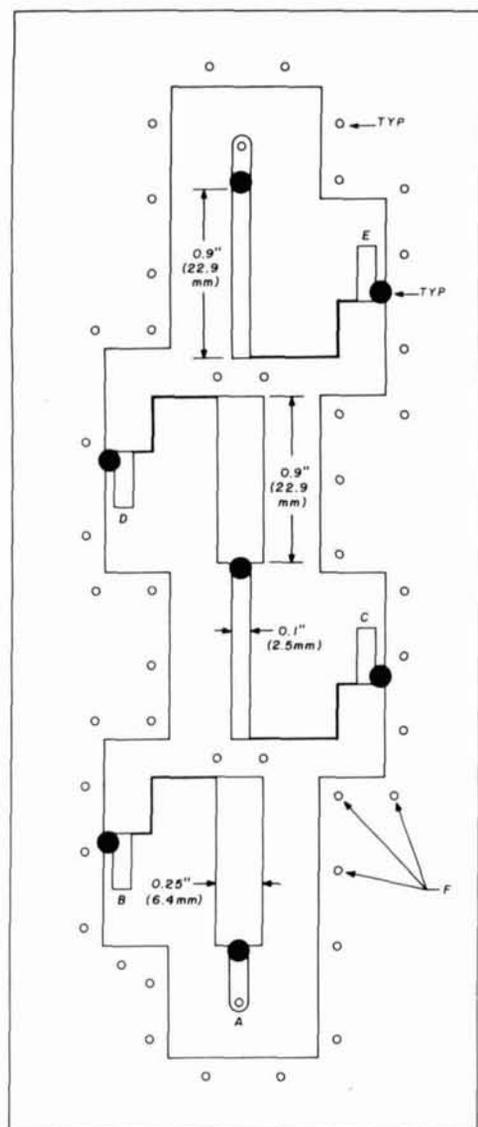
BAX-1 Broadband Amp
20 Hz to 150 MHz, Cat. No. 035107

WRITE FOR BROCHURE



International Crystal Mfg. Co., Inc.
10 North Lee, P.O. Box 26330
Oklahoma City, OK 73126

CONDITIONS OF SALE: Sold on a cash basis. Shipping and postage inside U.S.A. will be prepaid by ICM if full remittance is received with order.
 ORDERING INSTRUCTIONS: Order by catalog number. Enclose check or money order with your order.
 FOREIGN ORDERS: Prices quoted for U.S. orders only. Orders for shipment to other countries will be quoted on request. Prices subject to change. Minimum foreign order \$25.00.



- DENOTES LOCATION OF CHIP CAPACITOR (7 PLACES)
- A RF INPUT
- B BASE OF FIRST STAGE
- C COLLECTOR OF FIRST STAGE
- D BASE OF SECOND STAGE
- E COLLECTOR OF SECOND STAGE
- F SHORTS TO CONNECT UPPER AND LOWER COPPER PLANES (39 PLACES)

fig. 3. Two-stage preamplifier printed circuit board.

ing tape is peeled off carefully. The unwanted areas are now bare and the desired areas are protected by lacquer. The ground side of the board is painted. After drying, the board is etched with ferric chloride.

The finished board is scrubbed with steel wool to remove the paint and wiring is completed. Care must be taken when installing the connectors to make sure that copper is removed from around the center pin-

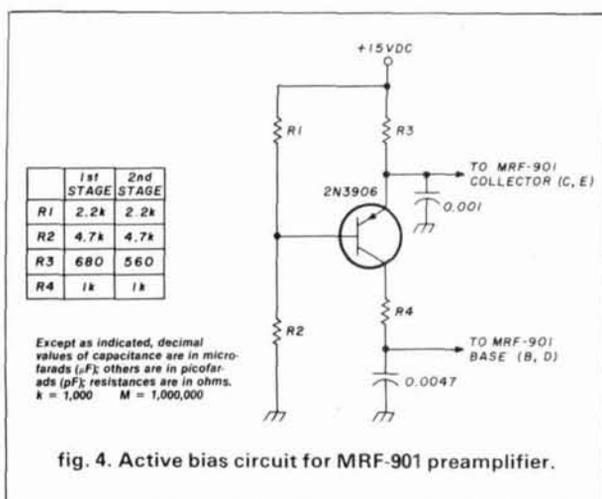


fig. 4. Active bias circuit for MRF-901 preamplifier.

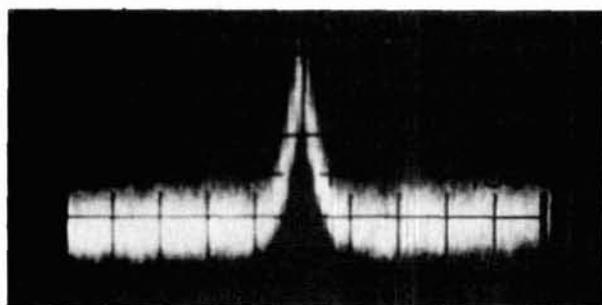


fig. 5. Satellite signal on ART-26 panadapter. Signal-to-noise ratio is approximately 7 dB.

hole on the groundplane side to prevent shorts. (I used SMA connectors, but BNC connectors would also work.) Connectors are placed at each end of the local oscillator coupling line. The end nearest the mixer is the input; a terminator or dummy load is connected to the most distant connector. About 750 microamperes mixer current is normal. This can be measured by lifting the ground end of the choke and inserting a ten-ohm resistor. Measure the voltage drop across the resistor and calculate the current. Too high a resistance reduces the mixer current, giving a false answer. The noise figure is probably around 12 dB.

intermediate amplifier

The IF frequency I used is 30 MHz. This frequency was chosen for two reasons. First, it fell within the range of the difference between the tunable local oscillator and the 1691 MHz signal. Second, it is the center frequency for my ART-26 panadapter, an invaluable tuning aid. (The panadapter cost only five dollars at the same hamfest where I purchased the local oscillator.) In fact, the panadapter was used as my first demodulator by reducing the scan to zero and using slope detection. The IF amplifier used has



fig. 6. Desktop G.O.E.S. receiver. Window blinds cause no loss.

a gain of 60 dB. Any surplus 30 MHz radar IF could be used. A minimum bandwidth of 30 kHz is needed — more is preferred (2 MHz) if a panadapter is used.

detector

I do not have a 30 MHz FM discriminator, so I up-converted the 30 MHz IF to the FM band and used an FM monitor receiver for detection.

preamplifier

Several excellent articles on low-noise amplifiers are available.⁷⁻⁹ I decided to build a two-stage amplifier, designing around the MRF-901 transistor. The layout is shown in fig. 3. The heavy, wide lines are quarter wave transformers and the narrow lines are quarter wave chokes. The board is laid out using tape and spray paint in a manner similar to that used for preparation of the mixer unit. The dual emitter leads pass through the board and are soldered to the groundplane. Because the emitters are grounded, active biasing is used. The circuit in fig. 4 was wired on a small printed circuit board and mounted in the preamp housing. Short leads prevent oscillation. The PNP biasing transistors are wired as constant current generators. The collector current of the MRF-901 is determined by the bias transistor emitter resistor and the collector voltage of the MRF-901 is determined by the base voltage of the bias transistor.

100 pF chip capacitors are used for coupling and bypassing. The overall gain is about 18 dB and the noise figure is better than that of the converter operated alone.

The total cost of the project at this point is about \$18.00.

In the photograph of the panadapter (fig. 5), the signal-to-noise ratio can be seen to be about 7 dB. If the antenna were set up outside, the signal-to-noise ratio would be 10 dB.

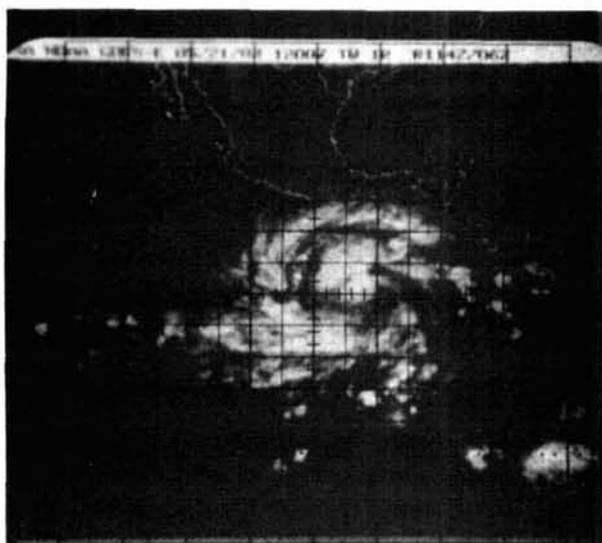


fig. 7. Infrared view of tropical storm "Adolph," May 21, 1983.

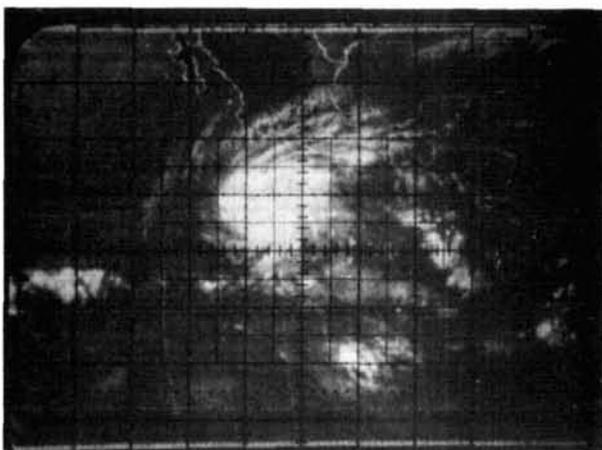


fig. 8. Infrared view of tropical storm "Adolph," May 23, 1983.

display

To photograph the satellite signals, I borrowed a Tektronix oscilloscope and camera (fig. 6), using Polaroid type 667 film (ASA 3000). The photographs (see figs. 7, 8, and 9) were recorded in real time. The horizontal sweep was triggered by a 4 Hz signal from a color burst crystal oscillator. A variable divider chain was used for initial phasing. The vertical sweep was generated with a homebrew 10 bit D to A (digital-to-analog) converter (fig. 10), connected to a counter that counted horizontal sweep pulses. The video was fed, unfiltered and unrectified, to the oscilloscope Z axis.

conclusion

Future work will include moving the antenna out-

side, possibly building a four-foot dish, tape recording the signal and replacing the mixer/local oscillator with an interdigital crystal-controlled unit. In my experience, I've found that the best way to get involved with microwave technology is to use what you have and get on with it; don't be put off by high

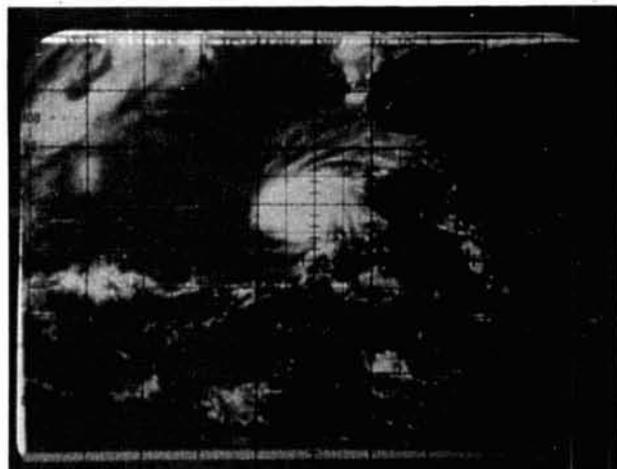


fig. 9. Visible light view of tropical storm "Adolph," May 23, 1983.

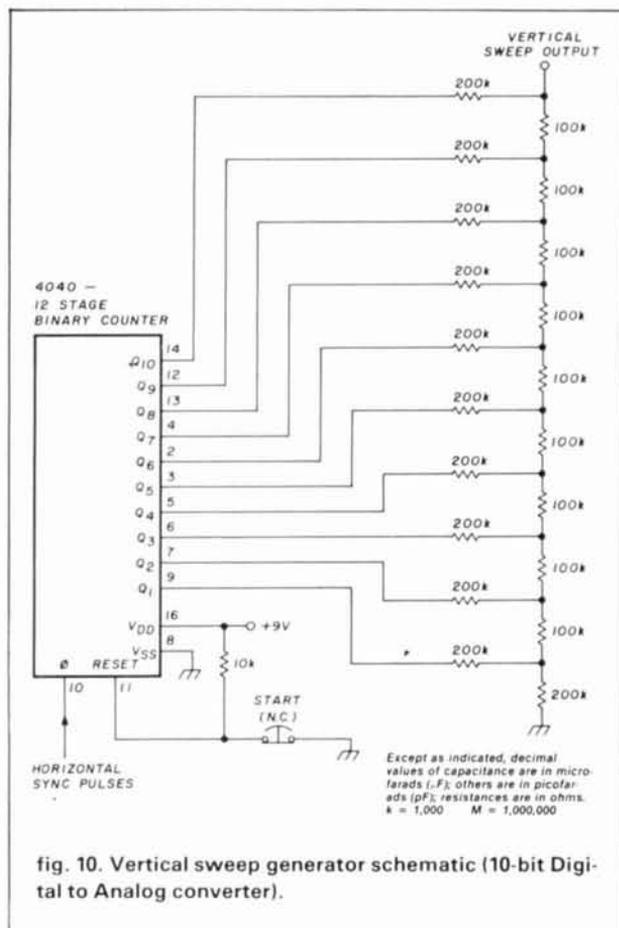


fig. 10. Vertical sweep generator schematic (10-bit Digital to Analog converter).

prices or sophisticated equipment. (Please enclose an SASE with any questions.)

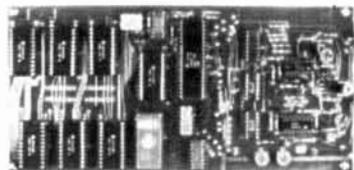
references

1. H. Paul Shuch, N6TX, "A Cost-Effective Modular Downconverter for S-Band WEFAX Reception," *IEEE Transactions on Microwave Theory and Techniques*, Vol. MTT-25, No. 12, December, 1977.
2. Nelson M. Seese, "Ground Stations to Receive G.O.E.S. WEFAX," available from the Office of System Engineering, National Environmental Satellite Service, National Oceanic and Atmospheric Administration, Washington, D. C. 20233 (no charge).
3. Ralph E. Taggart, "Be a Weather Genius — Eavesdrop on G.O.E.S.," *73*, November, 1978, pages 198-204.
4. John M. Franke, WA4WDL, "Finding the Focal Length of Surplus Microwave Dish Antennas," *ham radio*, March, 1974, page 57.
5. Norman J. Foot, WA9HUV, "Cylindrical Feed Horn for Parabolic Reflectors," *ham radio*, May, 1976, pages 16-20.
6. John M. Franke, WA4WDL, "Eye on the Weather?" *73*, November, 1977, pages 3-6.
7. G.H. Krauss, WA2GFP, "VHF and UHF Low-Noise Preamplifiers," *QEX*, December, 1981, pages 3-6.
8. H. Paul Shuch, N6TX, "Solid-State Microwave Amplifier Design," *ham radio*, October, 1976, pages 40-47.
9. G.H. Krauss, WA2GFP, "Low Noise Preamplifiers for 1296 MHz," *QST*, June 1982, pages 36-39.

ham radio

GLB PACKET RADIO CONTROLLER

Now you can get in on the fun on packet radio!



MODEL PK1 (shown with 14K RAM and 8K ROM)

- Low cost!
- Adaptable to any transceiver
- Easy to learn, easy to use
- Nearly 50 commands
- Built-in packet Modem and CW identifier
- Use with teletype machines, computers, terminals
- RS232 serial interface—45 to 9600 baud!
- Uses both ASCII and Baudot
- Vancouver protocol—AX 25 to be released soon
- Stores received messages until requested at a later time
- Operates in connected and general modes
- Activates teletype motor to print messages
- Board accepts up to 14K of RAM
- Model PK1 can be customized for Commercial Systems.

Protocol can be changed by swapping ROM chips. Board designed to accept 6264's for up to 56K of RAM with minor modification.

Dimensions: 4.5 x 9.5 inches; 1" vertical clearance. Power requirement: +12 VDC, approx. 200 ma.

Standard equipment includes 4K of RAM (expandable to 14K).

Model PK1, wired & tested—**\$149.95**
 additional memory, installed & tested (up to 10K) **\$10/2K**
 RTTY adaptor board **\$9.95**

Connecting cables & enclosure—optional

We offer a complete line of transmitters and receivers, strips, preselector-preamps, CWIDers & synthesizers for amateur & commercial use. Request our FREE catalog MC & Visa welcome Allow \$2 for UPS shipping

GLB ELECTRONICS

1952 Clinton St. Buffalo, NY 14206
 716-824-7936, 9 to 4

AEA Brings You The AMTOR Breakthrough

We are pleased to announce three new AMTOR products. Our new software package that will allow you to operate AMTOR with your CP-1 is called AMTORTEXT™. A complete hardware terminal unit and AMTORTEXT software plug-in cartridge for the Commodore 64 computer is called the MICROAMTOR PATCH™. We also have new applications software packages for the AMT-1 and Commodore 64 or VIC-20 computers.

NEW AMTORTEXT™

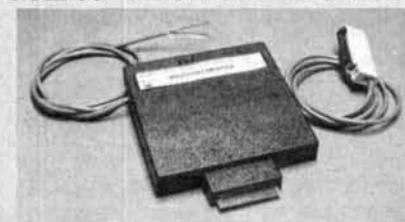
AMTORTEXT™ is a LOW COST software package that will allow the CP-1 and Commodore 64 computer to be used as a multi-mode AMTOR TERMINAL. Compare the outstanding FEATURES and PRICE of the AT-64 (AMTORTEXT for Commodore 64) to the competition:

- KEYBOARD OVERLAY instructions (eliminates constant referral to manual)
- STATUS INDICATORS on screen
- Easy to follow MENU
- ARQ, MODE A- MASTER OR SLAVE
- FEC MODE B
- MODE L (LISTEN TO MODE A)
- SPLIT SCREEN with 2000 CHARACTER TYPE AHEAD transmit buffer
- WORD MODE for error correcting with DEL KEY until space or CR is sent
- REMOTE ECHO shows characters transmitted as they are validated by other station
- easy entry of your SELCALL for automatic response to ARQ calls
- BREAK-IN MODE to interrupt sending station
- LTRS/FIGS REVERSE for assistance in MODE L synchronizing
- TEN MESSAGE BUFFERS OF 256 CHARACTERS EACH
- AMTOR timing synced to host computer internal CRYSTAL OSCILLATOR
- PROGRAMMABLE TRANSMIT DELAY can be saved to tape
- AUTOMATIC PTT
- POWERED BY HOST COMPUTER
- includes INTERFACE CABLE for AEA model CP-1 COMPUTER PATCH™.

The AMTOR software TIMING ROUTINES have been written by Peter Martinez, G3PLX (father of AMTOR) which means you can be sure of having NO SYNCHRONIZING problems with other AMTOR stations adhering to the established international AMTOR standard. PROPER SYNCHRONIZATION is an ABSOLUTE must for AMTOR!

NEW MICROAMTOR PATCH™

\$89.95 List \$69.95* C-64 AMTORTEXT



MICROAMTOR PATCH™ is a NEW LOW-COST, HIGH-PERFORMANCE AMTOR SOFTWARE/HARDWARE computer interface package. The MICROAMTOR PATCH (model MAP-64) INCORPORATES AMTORTEXT software (described above) for the Commodore 64 computer. All circuitry and software is incorporated on a single, plug-in cartridge module featuring the following:

- TRUE DUAL CHANNEL MARK AND SPACE MULTI-STAGE 4 POLE, CHEBYSHEV ACTIVE FILTERS
- AUTOMATIC THRESHOLD CORRECTION for good copy when one tone is obliterated by QRM or SELECTIVE FADING
- EASY, POSITIVE TUNING with TRIPLE LED INDICATOR
- NOT a low-cost, easily "pullable" phaselocked loop detector!!!
- SWITCH SELECTED 170 Hz or WIDE SHIFT on receive
- AUTOMATIC PTT
- demodulator circuitry powered by your 12 VDC

supply to AVOID OVERLOADING HOST COMPUTER and for maximum EMI ISOLATION • EXAR 2206 SINE GENERATOR for AFSK output • SHIELDED TRANSCIEVER AFSK/PTT INTERFACE CABLE PROVIDED • FSK keyed output.

The MicroAmtor Patch is structured for easy upgrading to the AEA CP-1 Computer Patch™ advanced interface unit without having to buy a different software package! Simply unplug the external computer interface cable (supplied with the MicroAmtor Patch) from the MicroAmtor Patch and plug it into the Computer Patch.

\$149.95 List \$129* MAP64

\$239.95 / \$199.95* MAP-64/2

The Model MAP-64/2 incorporates the C-64 MBATEXT™ PROM on the same board with AMTORTEXT for low cost RTTY/CW/ASCII/AMTOR operation.

The **AMT-1** is the DEFINITIVE AMTOR TERMINAL UNIT which all future AMTOR units will be measured against. All you need for full AMTOR operation is a dumb ASCII terminal (or personal computer and emulation software) and a normal HF transceiver and antenna. With the AMT-1 you will receive the following features:

- SENSITIVE FM DEMODULATOR
- FOUR POLE ACTIVE RECEIVE FILTER
- TOTAL CONTROL FROM KEYBOARD or by COMPUTER PROGRAM CONTROL
- 16 LED PANADAPTOR TYPE TUNING INDICATOR
- CRYSTAL CONTROLLED AFSK MODULATOR
- RECEIVE/TRANSMIT standard RTTY
- TRANSMIT MORSE CW
- MORSE RECEIVE field installable option
- AUTOMATIC PTT
- 13 front panel LED STATUS INDICATORS
- all METAL ENCLOSURE for maximum RFI immunity
- operates from your 800 ma 12 VDC power source.

\$589.95 List \$499.95* AMT-1

Applications software for C-64 or VIC-20

AEA also offers an applications software package for the Commodore VIC-20 (model AMT-1/VIC20-1) or 64 computer that is resident on a plug-in PROM CARTRIDGE and includes the INTERFACE CABLE to go between the computer and the AMT-1. KEYBOARD OVERLAY instructions are also included for easy operation without the instruction manual. The COMM-64 program (model AMT-1/C64-1) offers SPLIT SCREEN OPERATION with ten MESSAGE BUFFERS. It also offers UNATTENDED OPERATION with automatic MESSAGE RECORDING and AUTOMATIC STATION IDENTIFICATION.

\$89.95 List \$69.95*

*SUGGESTED AMATEUR DISCOUNT PRICE THROUGH PARTICIPATING DEALERS ONLY

AMT-1



Shown with optional AMT-1 Console Stand, COMM-64 with CRT Monitor and cassette recorder (Not included)

PLEASE SEND AEA CATALOG	
Name	
Address	
City	
State	Zip

Advanced Electronic Applications, Inc.

P.O. BOX C-2160 • LYNNWOOD, WA 98036 • (206) 775-7373 • Telex: 152571 AEA INTL

a wide-range ohmmeter

Measure values
from 0.1 ohms
to 1000 megohms
on seven ranges

The typical VOM or digital multimeter found on most workbenches simply cannot handle the extremes of resistance values most Amateurs encounter in building or repairing sophisticated electronic equipment. The usual upper limit of 20 megohms falls far short of required measurements; the usual lower limits could also be extended.

Because I needed an ohmmeter with a wider range than the one on my workbench, I decided to design and build one. But wide range would not be enough; my meter would have to be low in cost, provide relatively good accuracy, be easy to read, and offer reliable long-term calibration. Low cost was achieved by developing a simple circuit and using some junk-box components; accuracy, by including an analog instrument; easy reading, by using a single scale on a 4-1/2 inch meter, thus avoiding incorrect readings sometimes made with multiple scales; and long-term calibration, by use of a line-operated power supply instead of batteries.

I wanted an upper limit of 1000 megohms and a lower limit of 0.1 ohms. Although the least signifi-

cant bit of a 3-1/2 digit DMM displays increments of 0.1 ohms, the actual resistance could be anywhere between 0.06 and 0.14 ohms for a 0.1 ohm display. On some DMMs the LSB will jump up or down one count which, of course, invalidates very low value measurements.

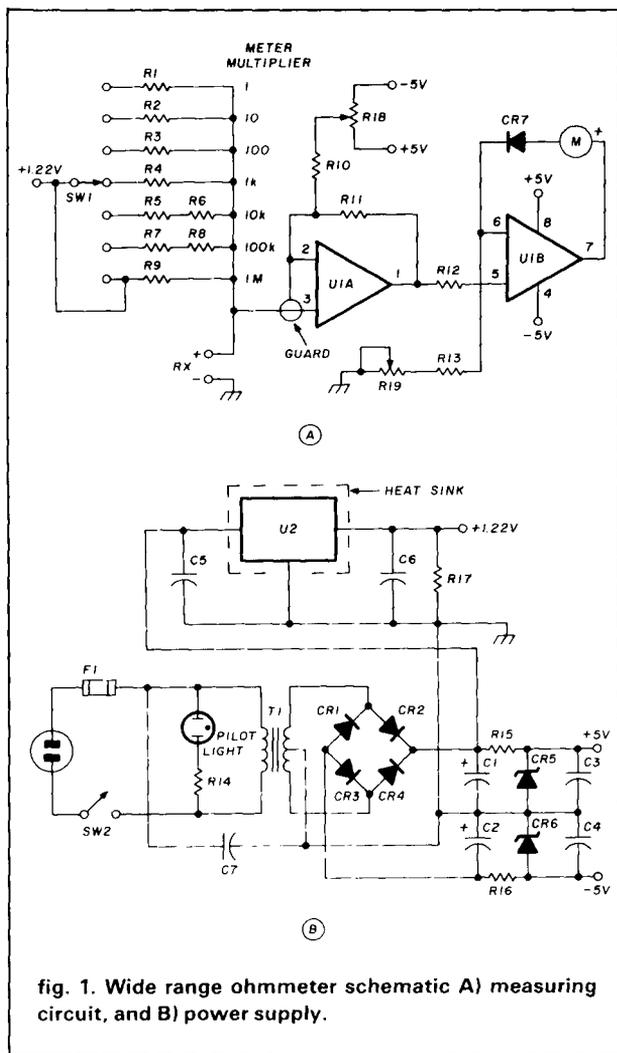
how it works

The circuit shown in **fig. 1** employs a regulated low voltage, 1.22 volts, which is applied to the unknown resistor in series with a switch-selected standard resistor. The voltage drop across the unknown is fed to the input of one section of dual op amp, LF353. This section is connected as a voltage follower. It has the very high input resistance of 10^{12} ohms, which hardly loads down the unknown. Output null is obtained with adjustment of R18. The next stage, the other section of the LF353, provides an adjustable gain of a little more than 1 so that the meter can be calibrated to read full-scale with the unknown terminals open. When an unknown resistor is connected across the terminals, the meter reads down scale, reaching zero when the unknown resistor terminals, $\pm R_x$, are shorted together at the panel.

circuit details

The power supply, using a full-wave bridge rectifier and center-tapped transformer secondary, provides zener-regulated +5 and -5 volts for the LF353. An LM317T voltage regulator supplies the

By **John T. Bailey**, 86 Great Hills Road, Short Hills, New Jersey 07078



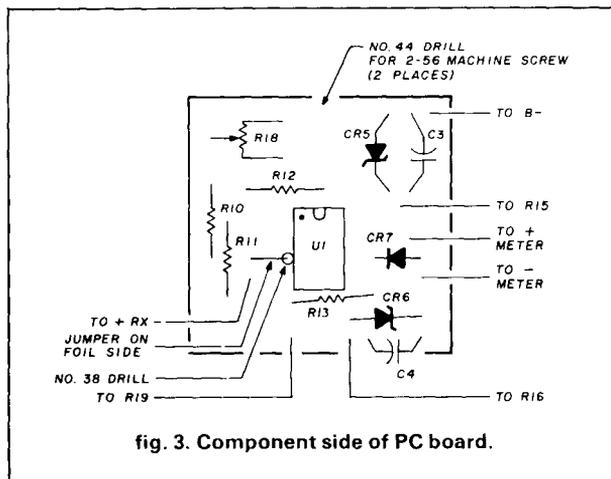
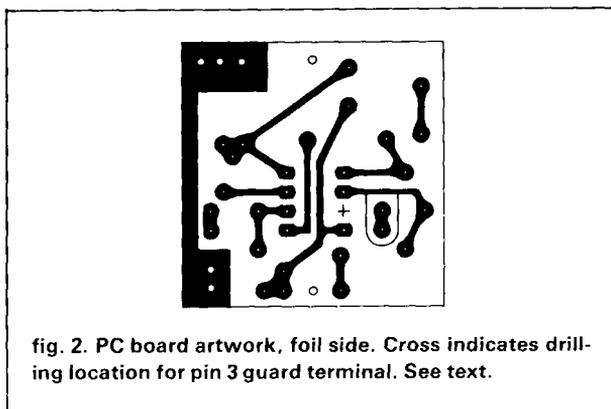
1.22 volts required for the input divider. A heat sink is used on this regulator because of the wattage dissipation on the low range. On this range, with the unknown resistor terminals shorted, 122 mA flow through the 10-ohm standard resistor. Since about 7.5 volts is dropped across the regulator, the worst-case dissipation is 7.5 volts \times 122 mA or about 0.9 watts. R17 provides a minimum load of 25 mA for stable operation of the regulator.

The 10-megohm standard is paralleled across the other range standards for all switch positions, which assures an input ground return for the LF353 at all times when switching ranges. Series resistors are added to the \times 10k and \times 100k ranges to compensate for the 10 megohm shunting. The 1N914 diode in series with the meter prevents reverse deflections of the meter. The standard resistors should be metal film type of \pm 1 percent tolerance.

The null circuitry is conventional for voltage fol-

lowers. For the values shown, \pm 4 mV maximum is developed across R11. If more null compensation is necessary with the particular LF353 used, simply increase the value of R11. The internal resistance of the meter is not critical since it is in the feedback loop. Mine had a resistance of 1200 ohms.

On the high end of range \times 1M, it is important to minimize any leakage resistance across the unknown terminals, \pm Rx, because such leakage would be in parallel with the resistor being measured. The schematic shows only the range resistors and pin 3 of the first LF353 connected to the positive Rx terminal. Since the common ends of the range resistors are not mounted on any terminal strip supports, but rather supported by their leads, only negligible leakage to ground exists. Consequently, pin 3 exhibits a 10^{12} ohm resistance to ground and thereby adds an insignificant shunting effect. Not shown, however, is PC board surface leakage from pin 3 to ground, if pin 3 were soldered (via a socket) to a PC board trace. PC board surface leakage can be minimized by using a guarding technique. This technique consists of a



trace ring that completely circles pin 3 and returns it to a low impedance point of voltage — equal to the voltage on pin 3. This must be done without pin 3 (actually pin 3 of the socket) touching the PC board. Isolation is accomplished by drilling a clearance hole in the PC board so that the socket pin 3 protrudes through the board clearance hole and, with a jumper

wire, is connected to the trace pad inside the guard ring. The guard ring is connected to pin 2. Purists will be quick to point out that the guard ring should be connected to pin 1 because pin 2 has a higher impedance than pin 1. They are correct; this is only a quasi-guard solution, but for this application, it is sufficient.

construction

The power supply components are mounted on a 3-3/4 × 4-1/2 inch (9.53 × 11.4-cm) perfboard which is mounted on the meter studs. The PC board containing the measuring circuit components is mounted on the perfboard with two 1/4-inch stand-off spacers. The range switch, mounted on the front panel, is a 7-station push-button type (I prefer this rather than a rotary type switch.) Fig. 2 shows the foil side of the PC board and fig. 3 shows the arrangement of parts on the component side of the board. Fig. 4 shows the placement of all components as seen in the view of the rear of the ohmmeter while fig. 5 shows the front view.

The meter scale is non-linear, as shown in fig. 6. At midscale the readings are equal to the standard resistors for the various ranges. To draw the scale a simple calculation can be made, knowing the meter's full-scale deflection in degrees. (Mine was 101 degrees.) The formula is:

$$\frac{B}{A + B} \times C = \text{degrees deflection for } R_X = B$$

where A = standard resistor

B = unknown resistor

C = full-scale deflection in degrees

For example, using the × 1k range $A = 10k$ and $C = 101^\circ$, a 4k unknown will read:

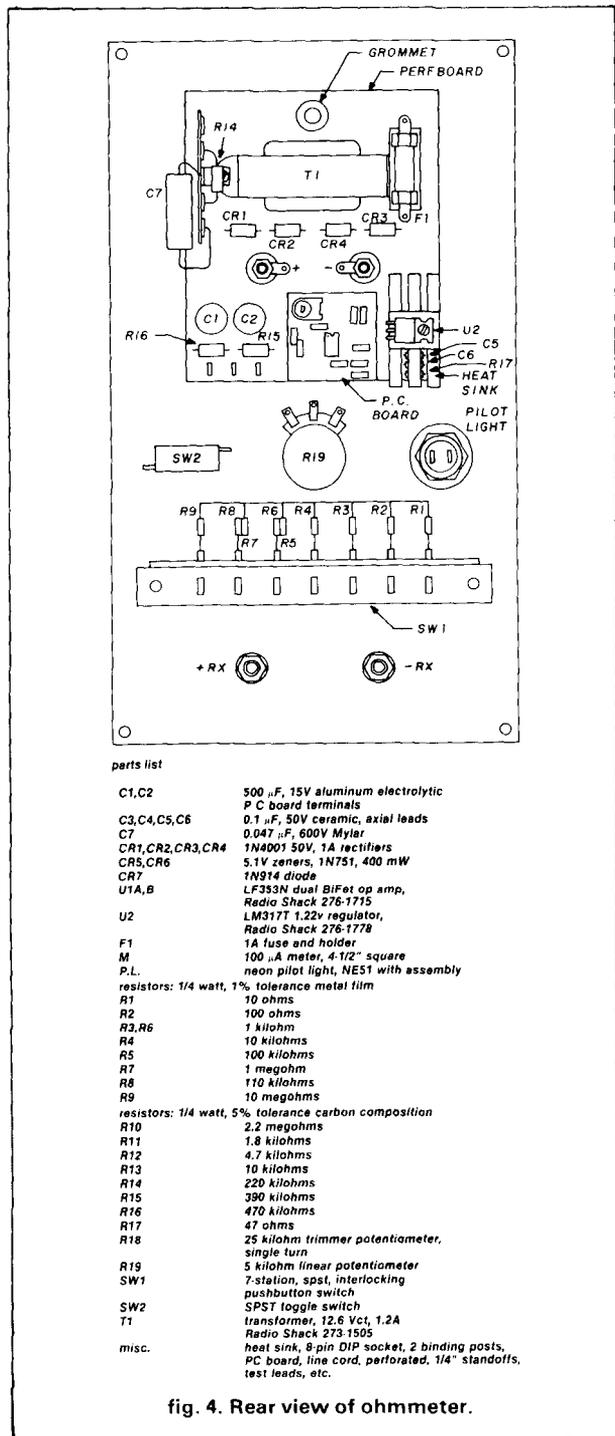
$$\frac{4k}{10k + 4k} \times 101^\circ = 28.86^\circ$$

In building the prototype unit, I decided to mount the gain control on the front panel just in case some slight change in gain would be needed to correct for component value changes with time. So far I haven't found any reason to use it.

I chose to mount the ohmmeter on the back of my workbench in a central position from which four-foot long leads would reach test points where I could read the meter without parallax error.

calibration

Calibration is simple. Adjust the nulling pot for zero output of the voltage follower stage with the input terminals shorted. Then adjust the gain control for full-scale deflection.



More BLOCKBUSTER BARGAINS!!

Parallel, TTL Input I/O "Selectric"™ TYPEWRITER / PRINTER

TESTED AND OPERATIONAL!



\$329.00 ea.

I/O Selectric

Add \$20 for Packaging and Handling. Pay shipping on Delivery.

SAVE!!! Untested version of the above, otherwise whole & complete. May require some service. **\$279.00 ea.**

Removed from working systems, these fantastic machines have built-in driver and decoder circuitry and take TTL level, 6-bit character plus 4-bit function input signals. Easily driven by most any micro. Use as a typewriter (with add'l repeat circuitry) or as a KSR I/O printer or both. Requires 115 60Hz for typewriter motor, 5 VDC for TTL and 24 VDC for solenoids. Table Top style case. Each Selectric I/O machine is complete and in operational condition. Includes schematics, data case, platen and ribbon.

Type Element **\$21.00ea.**

Diablo Daisy Printer HI-Type II



1355-WP Word Processing Daisy Printer

- Pre-owned, TESTED & Operational!
- Uses Xerox Metal Wheels or Plastic Wheels
- Original OEM Interface (Diablo Interface)
- Requires ±15V (or 5A & 5VDC @ 5A)
- Positional access to 1.120 "Horiz." 1.48 "Vertical"
- USED BY XEROX, WANG, & OTHERS
- Heavy Duty Printwheel Motor and 15" Frame

These fabulous daisy printers feature 35-40cps, 10 & 12 pitch as well as proportional space, and plotter capabilities. Only a power supply and interface are required for full printer capability. Fully tested and operational, ready to interface for the interface of your choice. Platen and I/O data included.

- Forms tractor for the above **\$ 99.00**
- Spare P.C. Board Set (6 P.C. Cards) **\$279.00**
- Spare Printwheel carrier assembly **\$329.00**
- Serial & Parallel Interface for Above **\$295.00**
- Power Supply **\$ 79.00**

Just
\$549.00 ea.
Add \$15.00
for Packaging and Handling

We Offer New & Used FLOPPY DRIVES, DISK DRIVES, PRINTERS & MORE at BARGAIN PRICES!!

Write or Call for Our Latest Flyer NOW!!!

Selection is a registered trademark of IBM Corporation.

✓ 123

Computer
Products &
Peripherals
Unlimited

WAREHOUSE: 18 Granite St., Haverhill, Mass. 01830
MAIL ORDERS: Box 204, Newton, New Hampshire 03858

617/372-8637

Sorry No Collect Calls
MasterCard & VISA Accepted



LATE NEWS..

Get the news
As it happens



Westlink Report is *your* source for information on all the late breaking stories in the exciting world of Amateur Radio. Westlink Report summarizes the news that will impact the future of Amateur Radio. Westlink digs into its stories and gives you the latest from Newington, summarizes the actions of the FCC, reports on the important international news, keeps you fully informed about space and AMSAT news and much, much more.

Subscribe to Westlink Report today. Be informed. Don't be surprised by the latest developments in this fast paced hobby.

26 issues just \$22.50 per year U.S., Canada, Mexico.
\$42.50 per year Air Mail.

THE WESTLINK REPORT

11119 Allegheny Street
Sun Valley, CA 91352

✓ 198

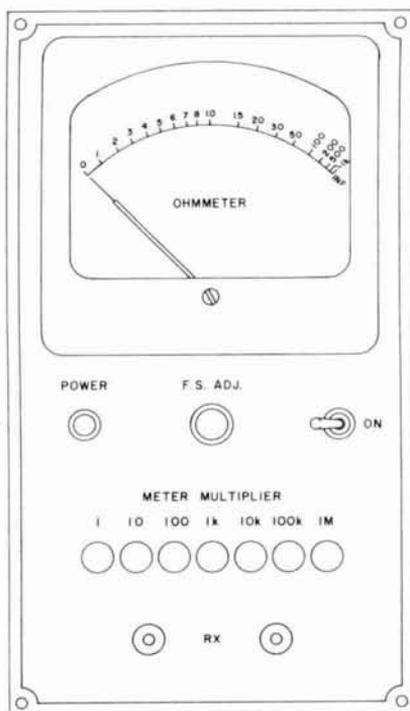


fig. 5. Front panel view of ohmmeter.



fig. 6. Typical meter scale layout.

operation

Switch on the power; the meter should deflect to full-scale. Connect the test leads across the unknown resistor, selecting the range which gives a reading below half-scale because the divisions are larger on the lower part of the meter dial.

If, on the $\times 1M$ range, jitter occurs at full-scale with the test leads not connected to an unknown, reverse the line plug. When using the $\times 1$ range the resistance of the test leads introduces a small error which can be measured and subtracted from any fractional ohm measurement. Simply note the reading obtained with the test leads shorted at their tips. Then subtract this reading from the unknown resistor reading.

ham radio

new!

JPC/AZDEN®

4000 SERIES FM TRANSCEIVERS

10 METERS & DOWN



**COMMERCIAL-GRADE
QUALITY AT AMATEUR PRICES**

EXCLUSIVE 1 YEAR LIMITED WARRANTY! COMPARE!



PCS-4000
2-m FM Transceiver

THE 4000 SERIES



PCS-4300 70-cm FM Transceiver



PCS-4500 6-m FM Transceiver



PCS-4800 10-m FM Transceiver

COMING SOON
PCS-4200 1 1/4-m FM Transceiver



✓ 106
PCS-300
2m Handheld
FM Transceiver
142-149.995 MHz

- **WIDE FREQUENCY COVERAGE:** PCS-4000 covers 142.000-149.995 MHz in selectable steps of 5 or 10 kHz. PCS-4200 covers 220.000-224.995 MHz in selectable steps of 5 or 20 kHz. PCS-4300 covers 440.000-449.995 MHz in selectable steps of 5 or 25 kHz. PCS-4500 covers 50.000-53.995 MHz in selectable steps of 5 or 10 kHz. PCS-4800 covers 28.000-29.990 MHz in selectable steps of 10 or 20 kHz.
- **CAP/MARS BUILT IN:** PCS-4000 includes coverage of CAP and MARS frequencies.
- **TINY SIZE:** Only 2"H x 5.5"W x 6.8"D. COMPARE!
- **MICROCOMPUTER CONTROL:** At the forefront of technology!
- **UP TO 8 NONSTANDARD SPLITS:** Ultimate versatility. COMPARE!
- **16-CHANNEL MEMORY IN TWO 8-CHANNEL BANKS:** Retains frequency and standard simplex or plus/minus offsets. Standard offsets are 600 kHz for PCS-4000, 1.6 MHz for PCS-4200, 5 MHz for PCS-4300, 1 MHz for PCS-4500, and 100 kHz for PCS-4800.
- **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; auto-resume can be overridden if desired. 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 power 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 (except in PCS-4800).
- **PL TONE:** Optional PL tone unit allows access to private-line repeaters. Deviation and tone frequency are fully adjustable.
- **TRUE FM:** Not phase modulation. Unsurpassed intelligibility and audio fidelity.
- **HIGH/LOW POWER OUTPUT:** 25 or 5 watts selectable in PCS-4000; 10 or 1 watt selectable in PCS-4200, PCS-4300, PCS-4500, and PCS-4800. Transmitter power is fully adjustable.
- **SUPERIOR RECEIVER:** Sensitivity is 0.2 uV or better for 20-dB quieting. Circuits are designed and manufactured 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, rugged built-in speaker, mobile mounting bracket, remote speaker jack, and all cords, plugs, fuses, and hardware are included.
- **ACCESSORIES:** CS-7R 7-amp ac power supply, CS-4.5R 4.5-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

DEALER INQUIRIES INVITED

TOLL FREE... 800-327-3102

Telephone (305) 233-3631

Telex: 80-3356

MANUFACTURER:

JPC/AZDEN

JAPAN PIEZO CO., LTD.

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

Telex: 781-2822452



TRADE IN YOUR OLD RTTY TU FOR A NEW FLESHER TU-470

The Flesher Corporation dares to make an offer you can't refuse. Now you can move up to a high quality RTTY terminal unit without throwing away money you have already invested. Your present name brand RTTY terminal unit is worth up to full retail value* when you trade up to a Flesher TU-470 priced at \$499.95. Most RTTY/CW software works with the TU-470 without modification. So while the offer lasts, call our toll free number for more information and a no-obligation estimate of your trade-in value. But act soon; this offer won't last long.

*LIMITED TO \$200.00



SUGGESTED RETAIL
PRICE ONLY **\$499.95**
(Add \$4.50 for UPS
shipping and handling in
U.S.A. plus \$1.75 for all
COD orders.

Visa, Mastercard, COD, or check accepted.



Here are just a few of the many fine features the TU-470 offers:

- TTL & RS-232c compatible I/O for computer remote control
- RTTY communication rates up to 300 baud
- Two tone RTTY detection with six pole active filters
- Three popular RTTY shifts
- Built-in 20 or 60 mA loop
- Signal balance circuit for single tone detection
- Threshold control
- Anti-space
- Mark hold
- Scope outputs
- Independent reverse shift controls for REC and XMIT.
- Six pole active filter CW demodulator
- Remote controlled bi-polar keying outputs for CW and PTT.

Flesher Corporation

507 Jackson • P.O. Box 976 • Topeka, Kansas 66601

For more information and sales CALL 1-800-HAM-RTTY
For service and technical CALL 1-913-234-0198

RF POWER ENGINEER

R & D TECHNICIAN

ETO is growing. We're applying microprocessor-controlled rf power to medical imaging and radio communications in major new multi-year programs.

If you have proven ability in HF/VHF power and seek challenge with prompt rewards, we may have the perfect opportunity for you.

Excellent salary and benefits include profit sharing and Rocky Mountain living.

Please send resume to

ETO
Box 888
Canon City, CO 81212
Phone (303) 275-1613

An equal opportunity employer.

FREE! CABLE LOSS CHART IN WINTER CATALOG

NEMAL ELECTRONICS COAXIAL CABLE SALE POLYETHYLENE DIELECTRIC

★ RG-8/U 96% shield Mil Spec	(\$29.95/100) or 31"/ft
RG11U 96% shield 75 ohm mil spec	25"/ft
RG-55B/U double shield (RG-58 size) 50 ohm	45"/ft
★ RG58U mil spec 96% shield	(\$9.95/100) or 11"/ft
RG62A/U 96% shield mil spec 93 ohm	12"/ft
RG174/U min 50 Ω mil spec	10"/ft
RG213 noncontaminating 96% shield mil spec	36"/ft
RG214/U double silver shield 50 ohm	\$1.55/ft
RG214/U tinned copper	65"/ft
RG217/U double shield 50 Ω 5/8" OD	85"/ft

LOW LOSS FOAM DIELECTRIC

RG-8X (Mini 8) 95% shield	(\$14.95/100) or 17"/ft
★ RG8U 80% shield	(\$17.95/100) or 21"/ft
RG-8/U 97% shield 11 ga (eq. Belden 8214)	31"/ft
RG58U 80% shield	07"/ft
RG58U 95% shield	10"/ft
RG59/U 100% foil shield TV type	10"/ft
RG59/U 70% copper shield	09"/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)	\$2.95
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. (cut-off)	\$1.25

shipping

Cable — \$3.00 per 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

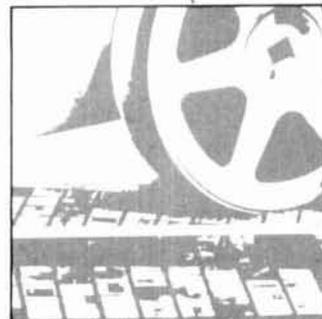
Dept. H, 12240 N.E. 14th Ave., N. Miami, FL 33161
Telephone: (305) 893-3924



✓ 171

✓ 133

This Publication is available in Microform.



University Microfilms International

Please send additional information

for _____
Name _____
Institution _____
Street _____
City _____
State _____ Zip _____

300 North Zeeb Road
Dept. PR
Ann Arbor, MI 48106

Call TOLL FREE 1-800-238-6168

(In Tennessee, Call 901-683-9125)

For The Deal You Want—On The Brands You Know!

 **KENWOOD**

 **ICOM**

 **DRAKE**



**WE
TRADE!**

 **TEN-TEC**

Call Marshall!

Deal with M.A.E. and Have A Good Day!

AUTHORIZED DEALER FOR: Kenwood, ICOM, Drake, Ten-Tec, Mirage, MFJ, AEA, B&W, Astron, Hustler, Cushcraft, Larsen, Hy-Gain & Santec.
PLUS CURRENT USED GEAR.

Memphis Amateur Electronics

1465 Wells Station Rd., Memphis, TN 38108

Monday–Friday, 9–5
Saturday 9–12 (Central Time)

**Bind 'em
and
Find 'em**



Keep those valuable issues of Ham Radio like new. Prevent smears, tears and dog ears. Bind 'em together and enjoy for years to come. You'll be happy you did!

HAM RADIO BINDERS

Beautiful buckram bound, rich brown material with gold embossing. These binders will really dress up your collection of Ham Radio. Year stickers included.

HR-BDL **\$6.95 ea.**
3 for \$17.95

Please add \$2.00 for shipping and handling.

HAM RADIO'S BOOKSTORE
GREENVILLE, NH 03048

DESIGN EVOLUTION IN RF P.A.'s



**Now with
GaAs FET
Preamp**

- 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 97 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. Specify 10 MHz Bandwidth for 420-450 MHz Amplifier.

★SEND FOR FURTHER INFORMATION★

**TE
SYSTEMS**

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

IC-471A

The New Deluxe 430-450 MHz
Base Transceiver from ICOM



WRITE OFFSET INTO
MEMORY

NEW DISPLAY

32 CHANNEL
MEMORY

1 MHz UP/DOWN
FOR FAST QSY

32 full function memories / subaudible tones / PLL locked to 10 Hz / two color fluorescent display / RIT readout / scanning / new size.

32 Memories. Each memory holds frequency, mode, offset direction, offset frequency and subaudible tone for easy return to an off used frequency or for remembering a new repeater or simplex frequency.

Subaudible Tones. Subaudible tones are selected by rotating the main tuning knob. These tones may then be stored into memory along with the frequency, offering ease of operation.

Phase Lock Loop. Extremely low noise and good signal to noise ratio PLL design allows the IC-471A to lock to 10 Hz for extreme accuracy.

New Display. ICOM's new easy-to-read two color fluorescent transceiver situation display shows frequency, mode, offset direction, VFO in use, memory channel, and RIT offset direction and amount.

Scanning. Scanning of memories, programmable band scan, and mode scanning are available and easy to use.

New Size. Only 11 1/4" W x 4 3/8" H x 10 3/4" D the IC-471A is styled to look good and engineered for ease of operation.

IC-4AT
UHF/FM
Handheld

IC-45A
UHF/FM Mobile



NEW
440 MHz
Repeater

**IC-RP3010
FM Repeater**

Now a 10 watt 440 MHz FM repeater from the leader in VHF communications. The IC-RP3010 features high stability crystal controlled channels CTCSS system, ID'er, remote control through a DTMF decoder and microprocessor controlled circuitry.

 **ICOM**
The World System

ICOM IC-751

The New Standard of Comparison

NEW
Competition
Grade
Transceiver!



ICOM is proud to announce the most advanced amateur transceiver in communications history. Based on ICOM's proven high technology and wide dynamic range HF receiver designs, the IC-751 is a competition grade ham receiver, a 100kHz to 30 MHz continuous tuning general coverage receiver, and a full featured all mode solid state ham band transmitter, that covers all the new WARC bands. And with the optional internal AC power supply, it becomes one compact, portable/field day package.

Receiver. Utilizing an ICOM developed J-FET DBM, the IC-751 has a 105dB dynamic range. The 70.4515MHz first IF virtually eliminates spurious responses, and a high gain 9.0115MHz second IF, with ICOM's PBT system, gives the ultimate in selectivity. A deep IF notch filter, adjustable AGC and noise blanker (can be adjusted to

eliminate the woodpecker), audio tone control, plus RIT with separate readout provides easy-to-adjust, clear reception even in the presence of strong QRM or high noise levels. A low noise receiver preamp provides exceptional reception sensitivity as required.

Transmitter. The transmitter features high reliability 2SC2904 transistors in a low IMD (-38dB @ 100W), full 100% duty cycle (internal cooling fan standard), 12 volt DC design. Quiet relay selection of transmitter LPF's, transmit audio tone control, monitor circuit (to monitor your own CW or SSB signal), XIT, and a high performance speech processor enhance the IC-751 transmitter's operation. For the CW operator, semi break-in or full QSK is provided for smooth, fast break-in keying.

Dual VFO. Dual VFO's controlled by a large tuning knob provide easy access to

split frequencies used in DX operation. Normal tuning rate is in 10Hz increments and increasing the speed of rotation of the main tuning knob shifts the tuning to 50Hz increments automatically. Pushing the tuning speed button gives 1KHz tuning. Digital outputs are available for computer control of the transceiver frequency and functions, and for a synthesized voice frequency readout.

32 Memories. Thirty two tunable memories are provided to store mode, VFO, and frequency, and the CPU is backed by an internal lithium memory backup battery to maintain the memories for up to seven years. Scanning of frequencies, memories and bands are possible from the unit, or from the HM12 scanning microphone. In the Mode S mode, only those memories with a particular mode are scanned; others are bypassed. Data may be transferred between VFO's,

from VFO to memories, or from memories to VFO.

Standard Features. All of the above features plus FM unit, high shape factor FL44A, 455 Khz SSB filter, full function metering, SSB and FM squelch, convenient large controls, a large selection of plug-in filters, and a new high visibility multi-color fluorescent display that shows frequency in white, and other functions in white or red, make the IC-751 your best choice for a superior grade HF base transceiver.

Options. External frequency controller, external PS15 power supply, voice synthesizer, computer interface, internal power supply, high stability reference crystal (less than ± 10 Hz after 1 hour), HM12 hand mic, desk mic, filter options:

SSB: FL70
CWN: FL52A, FL53A,
FL32, FL63
AM: FL33

 **ICOM**
The World System

DAYTON Hamvention®

- ★ TECHNICAL FORUMS
- ★ ARRL AND FCC FORUMS
- ★ GIANT 3-DAY FLEA MARKET
Starting Noon Friday
All Day Saturday and Sunday
- ★ NEW PRODUCTS AND EXHIBITS
- ★ GRAND BANQUET
- ★ ALTERNATIVE ACTIVITIES
- ★ ELECTRICAL SAFETY FORUM
- ★ SPECIAL GROUP MEETINGS
- ★ YL FORUM
- ★ PERSONAL COMPUTER FORUM
- ★ CW PROFICIENCY AWARDS
- ★ AMATEUR OF YEAR AWARD
- ★ SPECIAL ACHIEVEMENT AWARDS

April 27, 28, 29, 1984

Hara Arena and Exhibition Center — Dayton, Ohio

Meet your amateur radio friends from all over the world at the internationally famous Dayton HAMVENTION.

Seating will be limited for Grand Banquet and Entertainment on Saturday evening so please make reservations early. Harry Dannals, W2HD, Past President ARRL, will be featured speaker.

If you have registered within the last 3 years you will receive a brochure in January. If not, write Box 44, Dayton, OH 45401.

Nominations are requested for Radio Amateur of the Year and Special Achievement Awards. Nomination forms are available from Awards Chairman, Box 44, Dayton, OH 45401.

For special motel rates and reservations write to Hamvention Housing, Box 1288, Dayton, OH 45402. **NO RESERVATIONS WILL BE ACCEPTED BY TELEPHONE.**

All other inquiries write Box 44, Dayton, OH 45401 or phone (513) 433-7720. ALL Flea Market spaces will be sold in advance ONLY. NO spaces sold at gate. Entrance for set-up available starting Wednesday. Special Flea Market telephone (513) 223-0923.

Bring your family and enjoy a great weekend in Dayton.

Sponsored by the Dayton Amateur Radio Association, Inc.

ADMISSION

\$7.50 in advance, \$10 at door.
(Valid for all 3 days)

BANQUET

\$14 in advance, \$16 at door.

FLEA MARKET SPACE

\$15 in advance.
(Valid for all 3 days)

Checks for advance registration to
Dayton HAMVENTION
Box 2205, Dayton, OH 45401

Computer Books

Commodore 64 and VIC-20



Commodore 64/VIC-20 Computer Programs for Beginners, by Howard Adler, three-dozen all-new programs practical for home, classroom, office, 96 pages, available October, ISBN 0-86668-033-0 **\$8.95**

VIC-20 and Commodore 64 Computer Program Writing Workbook, by Howard Adler, useful collection of software-writing coding forms, graphics grids, BASIC instruction for VIC and Commodore 64, ISBN 0-86668-811-0 **\$4.95**

101 Programming Tips & Tricks for the VIC-20 and Commodore 64, by Howard Adler, collection of practical efficient program-writing hints, secrets, techniques, shortcuts, easy-to-use instructions, includes 101 ready-to-run programs, 128 pages, ISBN 0-86668-030-6 **\$8.95**

34 VIC-20 Computer Programs for Home, School & Office, by Howard Adler tested ready-to-type-and-run software for classroom, business, home, all new for VIC, Commodore 64, 96 pages, ISBN 0-86668-029-2 **\$8.95**

TRS-80 Color Computer

Color Computer Graphics, by Ron Clark, complete guide, loaded with instruction, how to make the most of video graphics, many complete programs, 128 pages, ISBN 0-86668-012-8 **\$9.95**

101 Color Computer Programming Tips & Tricks, by Ron Clark, learn by doing instructions, hints, secrets, shortcuts, techniques, insights, includes 101 ready to run programs, 128 pages, ISBN 0-86668-007-1 **\$7.95**

55 Color Computer Programs for Home, School & Office, by Ron Clark, practical ready to run software with colorful graphics, 128 pages, ISBN 0-86668-005-5 **\$9.95**

55 MORE Color Computer Programs for Home, School & Office, by Ron Clark, handy companion volume packed with different useful type and run software, 112 pages, ISBN 0-86668-008-X **\$9.95**

Apple Computers

101 APPLE Computer Programming Tips & Tricks, by Fred White, secrets, hints, insights, learn by doing instruction, techniques, includes 101 ready to run programs, 128 pages, ISBN 0-86668-015-2 **\$8.95**

33 New APPLE Computer Programs for Home, School & Office, by Fred White, practical ready to type in and run software, 96 pages, ISBN 0-86668-016-0 **\$8.95**

APPLE Computer Program Writing Workbook, by Fred White, 96 pages, 8 1/2x11, ISBN 0-86668-813-7 **\$4.95**

Please add \$2.00 for shipping and handling.

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



✓ 138

NEW PRODUCT ANNOUNCEMENT

QUAD BAND BEAMS

7-14-21-28 MHz
 THE NEWEST INNOVATIVE ADDITIONS to the TET LINE
 FEATURE TRUE MULTI-ELEMENT PERFORMANCE ON 4, NOT 3, BUT 4 BANDS. ALL ON A SINGLE BOOM!!



HB443DX



HB433DX

All the usual TET multi-band beam features are included in these two models, including wide bandwidths, increased gain, low SWR, light weight and superior mechanical construction and easy assembly.

Happy
 New Year
 from the
 gang at
 Lunar

Preliminary Specifications:

Active Elements 7 MHz
 14 MHz
 21 MHz
 28 MHz
 Gain 7/14/21/28
 FB Ratio 9/14/21/28
 Power
 VSWR 7.0 - 7.1
 7.1 - 7.25
 14.0 - 14.5 21.0 - 21.45 28.0 - 29.0
 Boom Length m/ft.
 Max. Element Length m/ft.
 Weight kg/lb
 Introductory Price

HB443DX

3
 4
 4
 4
 6.2/9.8/9.1/8.8
 12.4/21.8/22.3/20.1
 1KW CW
 6.0/19.8
 9.25/30.5
 18.0/39.6
 \$450.00

HB433DX

2
 3
 3
 3
 2 1/8.2/8.7/7.3
 0/21.7/22.3/20.2
 1KW CW
 2.0:1 or better adjustable
 2.0:1 or better adjustable
 1.5:1 or better
 4.0/13.2
 9.25/30.5
 14.6/32.1
 \$325.00

DISTRIBUTED BY:

TET ANTENNA SYSTEMS

AVAILABLE FROM YOUR LOCAL DEALER:
 OR:



2775 Kurtz Street, Suite 11
 San Diego, CA 92110-3171
 Telephone (619) 299-9740
 Telex 181747
 Louis N. Anciaux WB6NMT

MICROWAVE VIDEO RECEIVER



34+ dB GAIN • FREQUENCY 2.1 to 2.6 GHz
ABSOLUTELY WATERPROOF
COMPLETE • READY TO INSTALL
1 YEAR WARRANTY
\$124.95 — INCLUDES:
TAX - SHIPPING - HANDLING

SEND CHECK - MONEY ORDER - OR
 CERTIFIED FUNDS TO:
K & S MICRO ELECTRONICS
 1920 WEST GRANADA
 PHOENIX, ARIZONA 85009

FOR LOWEST PRICES ON
 QUANTITY ORDERS CALL:
(602) 253-8605

INDIVIDUAL COMPONENTS AVAILABLE
 FAST-EXPERT REPAIR ON ALL TYPES ✓ 153

CB-10 FM SPECIAL



- Hy Gain 40-Channel Board
- 40-Channel Switch
- Volume & Squelch Control
- FM Detector Module
- Full Instructions Included

\$14.95 Add \$2.00 shipping & handling BOARD ONLY \$6.95

QRP TRANSCEIVER SET — \$34.95

VHF CONVERTER SET — \$24.95

Add \$2.00 For Shipping & Handling — Send For FREE Brochure

SEND \$2.00 FOR FULL MANUAL WITH CIRCUIT DIAGRAMS
 MANY OTHER MODULES AVAILABLE

MORNING DISTRIBUTING CO.

P.O. BOX 717, HIALEAH, FLA. 33011 ✓ 166



SANTEC presents the smarter handhelds

FOR 144 VHF, 220 VHF & 440 UHF

SANTEC Handhelds just got a little smarter, with new computer-control software designed by U.S. Hams who are also professional programmers. Now SANTEC Handhelds, which were the first to offer you varactor diode tuning in a handheld, first to offer you thick-film technology, first to provide 3.5W as a selectable handheld option and first to give you the time of day on a handheld read-out, have made another user-friendly leap forward in the logical progression of computer-controlled handhelds.

Now three SANTEC Handhelds can lock out selected memory channels from the memory scan, allowing you to check your favorite frequencies much faster, without interruption from less commonly used ones or from unprogrammed memory channels. SANTEC Handheld's new operating programs now allow you to store variable offset values in all 10 user-written memory channels; and, as always with SANTEC Handhelds, your stored offset automatically comes back when you select a channel through the memory mode, and the plus or minus indication shows on the LCD display.

Other new features are the provision in Memory 9 for split memory offset operation, for those really unusual offset situations, and the capacity for hardware storage of a special PL tone for each memory channel (requires an optional encoder, available December, 1983). The new SANTEC Handhelds will also accept the keyboard input of all frequencies as either short, fast 4-digit numbers or the familiar 6-digit versions: your SANTEC Handheld is smart enough to know what you want, either way.

The handhelds with the most now have more for you. Don't you dare settle for anything less: get your hands on a SANTEC Handheld today!

Shown above is just one of the three new smarter handhelds from SANTEC: the ST-142 VHF, the ST-442 UHF and the ST-222 VHF. Owners of earlier SANTEC models ST-144, ST-440 and ST-220, please write for information on how your SANTEC Handhelds can be upgraded to the new state of the art in handheld transceivers.



© 1983, Encomm, Inc.
2000 Avenue G, Suite 800, Plano, Texas 75074
Phone (214) 423-0024 • TLX 79-4783 ENCOMM DAL

Repairs, Parts & Services Available... 

✓ 128 Export orders invited.

All stated specifications are subject to change without notice or obligation.



The Smarter Handhelds, clockwise from upper left: ST-142 VHF Transceiver; ST-442 UHF Transceiver; ST-222 VHF Transceiver, operating from the ST-4QC Quick-Charge Battery Charger & Power Supply; ST-LC Leather Case and Strap; ST-MC Mobile Charger; MS-505 Remote Speaker; ST-500B3 Rechargeable 500 mAh NiCd Battery Pack; ST-EC External Charge Adapter; SM-3 Speaker Mic; ST-HA-1/HBM-1 Head Set Boom Mic & Adapter.

ham radio TECHNIQUES

Bill O'Neil
W6SAI

antenna "neutralization"

As one cynic put it, "It's hard to be loud on 40 meters when you live on a city lot." Many mini-antennas have been designed for 40 meters (and for 80 meters, too) and some of them seem to work. However, they all pale into insignificance when measured against a full-size beam antenna.

So where does that leave the majority of hams who can't erect a big three-element 40-meter Yagi on a 150-foot tower? The only answer for them is to use a mini-antenna that works.

One knowledgeable Amateur who has wrestled with this problem is Les Moxon, G6XN,¹ who concluded that mini-beams constructed with close spacing (to conserve boom length) could never be optimized because the elements were overcoupled. His solution to this problem was to eliminate the excess coupling by means of a neutralization technique (fig. 1).

When Les was visiting in the San Francisco Bay area recently, I had the opportunity to speak with him about the technique. By the time he left, my head was abuzz with interesting ideas for mini-beam antennas for the low-frequency bands.

Alas, inertia and lack of free time prevented anything from being done. However, my good friend George Badger, W6TC, grasped the idea,

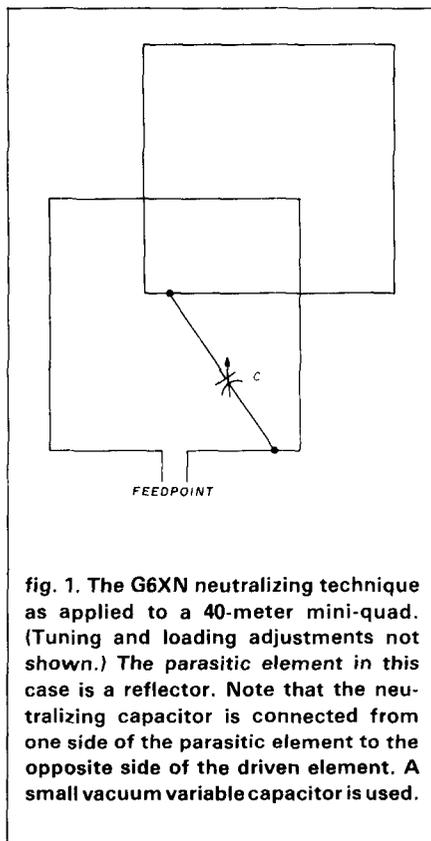


fig. 1. The G6XN neutralizing technique as applied to a 40-meter mini-quad. (Tuning and loading adjustments not shown.) The parasitic element in this case is a reflector. Note that the neutralizing capacitor is connected from one side of the parasitic element to the opposite side of the driven element. A small vacuum variable capacitor is used.

combined it with some original thinking, and developed a mini-quad antenna for 40 meters that provides both good gain and excellent front-to-back ratio.

George had built a compact 40-meter quad that worked, after a fashion. Gain over a dipole was questionable, and the array didn't seem to

have any front-to-back ratio. Bandwidth was very sharp, and the antenna operated over only a small segment of the 40-meter band before the SWR on the transmission line became too high for proper transmitter operation.

He solved the bandwidth problem with a simple tuning device for the quad loops, but the gain and front-to-back problems remained unsolved until G6XN proposed the antenna neutralization method.

Without going into construction details, the neutralization concept is shown in (fig. 1). It can be applied equally well to a close-spaced Yagi array (fig. 2). In essence, a capacitor is cross-connected from a driven element to a parasitic element and then adjusted for best front-to-back ratio of the antenna. Maximum forward gain and best front-to-back ratio seem to occur at the same setting of the capacitor. The tap point of the capacitor on the antenna elements seems to be less critical than the value of the capacitor. For W6TC's quad, the capacitance value is optimized for best performance.

Does the neutralization scheme work? W6TC's five-band DXCC proves that you *can* be loud on 40 meters when you live on a city lot! I'll provide more details on this interesting antenna development at a later date. Meanwhile, there's no

reason why you can't experiment with antenna neutralization on your mini-beam. I'd be interested in hearing from readers who try this unusual technique.

the coax jungle

Sometimes a little knowledge is worse than none at all. I've heard a lot of plausible stories about coax cables and I know that plenty of junk coax is being sold to unsuspecting buyers. But I didn't realize what a "jungle" exists with regard to the millions of miles of coax cable sold each year to hams, the military, industry, CBers, and others. The military, at least, usually knows what it gets for its money, as flexible coax cables are bought to a strict specification (MIL-17D or E). But how about the rest of us?

This all came to a head when I measured the loss of my coax transmission line running from station to antenna. According to all the published charts, my line loss at 14 MHz should be about 0.8 dB per hundred feet. My measurements, done with laboratory-type instruments, showed a loss of nearly 1.35 dB. What was the problem? Was the cable growing old? Or was it inferior cable to begin with? What should be the expected life of a coax cable? Five years? Twenty years? Forever?

a long phone call

Why not go directly to the coax cable manufacturer? One day, I did just that. I called one of the largest cable manufacturers in the United States and spoke at length to one of the production engineers who was an expert on coax cable manufacture.

I first asked about "military specification" cable. He said that if you want the best cable, that was the type to buy, but that it was also the most expensive because of the exhaustive tests the cable must pass before it gains military approval.

My unseen friend mentioned that there were perhaps a dozen large, top-notch coax cable manufacturers in the United States and about the

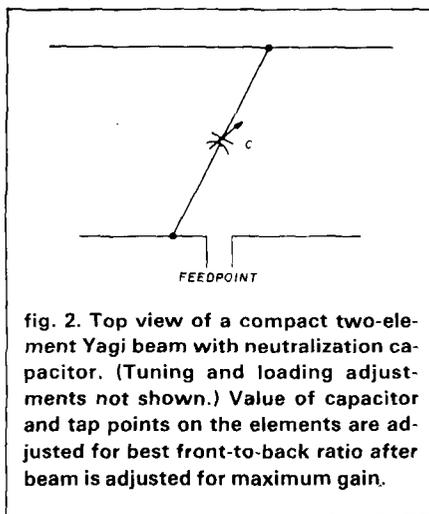


fig. 2. Top view of a compact two-element Yagi beam with neutralization capacitor. (Tuning and loading adjustments not shown.) Value of capacitor and tap points on the elements are adjusted for best front-to-back ratio after beam is adjusted for maximum gain.

same number of smaller, but good manufacturers. And finally, there were numerous "garage shop" operators who made up coax on demand to *any* specification. "After all," he said, "a coax cable machine isn't that expensive."

Part of the cost of the cable is the exhaustive tests and inspections demanded by the military; sometimes the cost of certification exceeds the cost of manufacturing. If you don't have to meet military specifications, the costs drop sharply...especially if you use second-hand cable machinery.

Consider RG-8/U cable, which is not in military use today. (Military gear is designed for 50-ohm termination, and the old style RG-8/U and newer RG-8A/U cables were 52 ohms.) "Of course, if you want," said the cable company spokesman, "we'll manufacture RG-8/U or RG-8A/U to a military specification, but we've had no call for that."

RG-8/U and RG-8A/U were replaced by RG-213/U (50 ohm) cable made to MIL-C-17D or E specifications. The specifications call for an inner conductor made of seven strands of bare copper wire, each strand 0.0296 inch in diameter. The dielectric is first-grade polyethylene, with no dirt or pinholes in it. One untinned copper braid jacket is used, providing greater than 90 percent coverage. He pointed out proudly that his particular

non-military RG-8A/U had 97 percent coverage. The outer jacket was polyvinylchloride IIa, noncontaminating material. And the cable sold for well over 70 cents a foot in small quantities.

"What about coax that sells for about 30 cents a foot?" I asked. Well, that was a long story. Plenty of price-cutting is going on, but it is possible to manufacture an inferior grade of coax that looks pleasing to the casual observer. He had seen cheap cable with less than 60 percent braid coverage for sale. Moreover, the size of the braid wire was reduced from B.S. No. 36 to B.S. No. 36.5 or B.S. No. 37. ("You can buy wire *any* diameter you want," he emphasized.)

The next price-cutting technique is to use a less expensive jacket, such as used on the older RG-8/U cables. These jackets gradually contaminated the copper shield and he classified this old material as PVC-1. He'd seen cable like this one on the market.

Another cost-cutting step in making a cheap cable is to reduce the diameter and number of wires in the center conductor, and to also decrease the twist, or turns-per-inch, of the conductor. And, finally, a low grade of polyethylene insulation can be used. Some cheap cables use *all* these cost-cutting techniques.

During the manufacturing process, costs could be shaved if no attention were paid to the concentricity of the cable. Letting the center conductor "wander" a bit meant that less cable was rejected in final inspection and an older cable-making machine could be used for the job.

When the cable was completed, it might look like the *real thing*, but losses would be higher and cable life would be shorter than that of high-quality cable, and the impedance would probably wander well away from 50 ohms.

The engineer sighed. "I think much of the cable on the ham and CB market is sub-par quality; as long as price is the determinant, that's the way it's going to be."

To summarize, he rapidly summed up his observations for me:

Avoid the risk of buying low quality electronic equipment!



Call today
and put your purchase
on your
Master Card or Visa.

OSCILLOSCOPES

	LIST	SALE
Hewlett Packard 1220A 15 MHz, 2 MV/DV, 2 channel	\$990	\$595
Philips 3212 25 MHz, dual trace	1,100	750
Philips 3226 15 MHz, dual trace	1,175	750
Philips 3233 10 MHz, dual beam	1,650	595
Tektronix 335 35 MHz, dual trace	2,870	1,900
Tektronix T922 15 MHz, dual trace	1,090	680
Tektronix T935 35 MHz, dual trace	1,720	900
Tektronix T935A 35 MHz, dual trace, delayed sweep	1,720	950

CRT/TERMINALS

	LIST	SALE
Data Media DT801 80/132 col., advanced video, buffer, RS-232-C	1,695	850
Digital Electronic Corp. VT100 132 col., U/L, RS-232-C, composite video	1,945	1,400
Hazeltine H1500 80 col., U/L, reverse video, RS-232-C	1,225	495
Hazeltine H1510 80 col., U/L, reverse video, RS-232-C, protected fields	1,355	795
Hazeltine H1520 80 col., U/L, reverse video, RS-232-C, protected fields, printer port	1,675	950
Lear Siegler ADM-3A 80 col., upper case only	595	395
Lear Siegler ADM-3A0UL 80 col., U/L	670	395
Lear Siegler ADM-31 Interactive display, printer port	1,095	595
Lear Siegler ADM-42 80 col., U/L, editing, protected fields, printer port, 8 pg. memory	2,670	895

PRINTERS

	LIST	SALE
Computer Devices 1203S Portable, KSR, 80/132 col., acoustic coupler, thermal	2,285	1,440
Digital Electronics LA34-AA 132 col., KSR, impact, options available	1,270	850
Lear Siegler 210A 132 col., 180 cps, bidirectional, RS-232-C	2,500	395
Teletype 4320-AAA 110-300 bps, full/half duplex, 30 cps, RO, RS-232-C	1,442	650
Texas Instruments 733 ASR, 80 col., U/L, auto send receive, coupler, dual cartridges	3,350	395

Limited Quantity

► Choose from over 20,000 pieces of electronic equipment that carry not only a full warranty, but also a 5 day return privilege.

► Call Metric Resources and buy high technology products from the leading manufacturers, at the lowest prices.

► Metric Resources is the sales division of the world's largest electronic test equipment rental company, Leasametric.

► This means that you can now buy equipment from the Leasametric rental inventory, guaranteed to meet the manufacturer's original specifications.

Texas Instruments 735 80 col., portable, 30 cps	2,115	295
Texas Instruments 745-2 80 col., U/L, coupler, 30 cps	1,395	725
Texas Instruments 763 80 col., U/L, 20K character memory, 30 cps, full/half duplex, RS-232-C	2,695	395
Texas Instruments 765 Same as 763, with coupler	2,995	750

MODEMS

	LIST	SALE
Anderson Jacobson AJ1245 Coupler/Modem 0-1200 bps, Bell 103/202 compatible, originate only, half duplex	695	150
Anderson Jacobson AJ1255 Coupler/Modem RTA phone, auto answer	895	450
Anderson Jacobson AJ242A Coupler 0-450 bps, originate only, Bell 103/113 compatible	295	60
Anderson Jacobson AJ245 Modem 0-450 bps, originate only, Bell 103/113 compatible	245	95
Bizcomp 1031-03 Modem 300 bps, originate/auto answer, Bell 103-113 compatible, auto repeat dial	395	150
Gandalf LDS100C Line Driver 19,200 bps, asynchronous	225	120
Vadic VA355P Modem 0-300 bps, Bell 103/113 compatible, originate/auto answer	375	230
Ventel AC103-1 Coupler 300 bps, originate, Bell 103/113 compatible	295	50
Ventel MD212-1 Modem 300/1200 bps, originate auto answer, Bell 103/113 compatible	850	295

Metric Resources
A DIVISION OF LEASAMETRIC

9246 GAITHER ROAD
GAITHERSBURG, MD 20877



(800) 368-2764

In Maryland call (301) 840-0020

TERMS AND CONDITIONS

- The primary source of equipment for sale by Metric Resources is from the inventory of Leasametric, Inc., and has been rented prior to sale unless otherwise specifically listed as "new in the box".
- Every instrument sold is professionally calibrated and is guaranteed to meet the manufacturer's original specifications.
- Warranty is 90 days on electronic test equipment and 30 days on data terminals and electro-mechanical equipment, unless otherwise noted.
- Payment terms are 1% discount for cash payment within 10 days, net 30 days, F.O.B. Metric Resources Inventory Center.
- All equipment offered is subject to prior sale.
- Prices quoted are for sales within the Continental United States and are subject to change without notice. All state and local taxes are the responsibility of the purchaser.

163

Mail to: **METRIC RESOURCES** A Division of Leasametric
Dept. HR, 9246 Gaither Road • Gaithersburg, MD 20877

Yes! I'm interested in ordering the following equipment:

Charge to my: MasterCard No. _____

VISA No. _____

Or call Toll Free **800-368-2764** to place your order.

I don't have an immediate need, but put me on your mailing list to receive your catalog and future mailings.

Name _____

Company _____

City _____

State _____ Zip _____

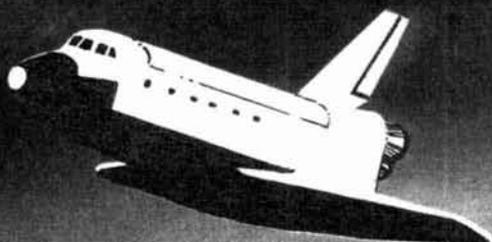
Phone No. _____

Plan Now To Attend The Most "OUT OF THIS WORLD" Event In The History Of Ham Radio!

COME TO THE ARRL 1984 NATIONAL CONVENTION IN NEW YORK, the world's greatest city, at the New York Statler July 20-22. Along with the convention's fantastic parties, technical and operating seminars, League committee meetings, banquet, DX gatherings and manufacturers' displays, you and your family can enjoy all there is to do in New York, the cultural capital of the world!

FOR A TRULY "OUT OF THIS WORLD" EXPERIENCE we'll be celebrating both the 15th Anniversary of man's first moon landing AND the first off-world amateur radio operation during the STS-9 Spacelab-1 mission. Our special guest will be astronaut **DR. OWEN GARRIOTT, W5LFL**, first ham to operate from space! You can meet W5LFL in person, at the Moon Landing Anniversary Party on Friday evening, July 20th, AND hear him speak at the Banquet on Saturday evening, July 21st.

IMAGINE, THE MOST IMPORTANT ARRL NATIONAL EVER HELD...AND YOU CAN BE THERE! Register now to assure your room and banquet reservations. For detailed information and registration forms, SASE to Mike Troy, AJ1J, R.R. 4 - Box 19C, Pound Ridge, NY 10576.



Ad prepared by WB2GMK Advertising

OVER 70 BRANDS IN STOCK
 DRAKE
 ICOM
 TEN-TEC
 BIRD
 LAND-MOBILE RADIO
 HYGAIN-ARRL
 BEARCAT • MORGAIN • MANY MORE
 B&W-CODE

Full Service Shop • Spectrum Analysis • Antennas
 New and Used Equipment • CW-SSB-FM, Etc. • Towers
 FCC Study Guides • Code Tapes • Books • Accessories

AMATEUR RADIO

SPECTRONICS

SHORTWAVE SCANNERS

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

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

MASTERCARD

THE 1ST

2300 MHz A5 Transmitter and Accessories

Now you can actually transmit Fast Scan TV on the 2300 MHz Ham Band. Gizmo's 25 mw exciter is the first commercially manufactured transmitter for this band.

All units preassembled, tested and have a 30-day money back guarantee.

- 2300 MHz 25 milliwatt exciter \$49.95
- 4.5 MHz subcarrier generator \$19.95
- AM Video Modulator \$19.95

Buy all three and save \$5
 Regularly \$89.95 Just \$84.85

Gizmo also has a 70 MHz 50 milliwatt upconverter for \$149.95

Please allow enough for shipping. Any excess will be refunded. ✓ 136

GIZMO ELECTRONICS
 PO Box 1205
 Pittsburgh, KS 66762
 (316) 231-8171

Kansas residents add 3.5% sales tax.

DIRECTION FINDING?

- ★ Doppler Direction Finding
- ★ No Receiver Mods
- ★ Mobile or Fixed
- ★ Kits or Assembled Units
- ★ 135-165 MHz Standard Range



- ★ Circular LED Display
- ★ Optional Digital Display
- ★ Optional Serial Interface
- ★ 12 VDC Operation
- ★ 90 Day Warranty

New Technology (patent pending) converts any VHF FM receiver into an advanced Doppler Direction Finder. Simply plug into receiver's antenna and external speaker jacks. Use any four omnidirectional antennas. Low noise, high sensitivity for weak signal detection. Kits from \$270. Assembled units and antennas also available. Call or write for full details and prices.

DOPPLER SYSTEMS, 5540 E. Charter Oak, (602) 998-1151
 Scottsdale, AZ 85254

**SAY YOU SAW IT
 IN
 HAM RADIO**

1. Be careful of RG8/U, RG-8A/U, or "RG-8/U type" cable. It has no controlling military specifications. RG-8A/U made by a reputable manufacturer — with its name and type number on it in addition to the RG nomenclature is probably OK...but it is almost as expensive to buy as the premium stuff.

2. Look up the specifications for the cable you intend to buy, and examine the cable before you buy it. Does it have the proper number of center strands? Is the inner dielectric uniform with no blemishes or spots? Does it have complete, or nearly-complete, braid coverage? Does it have a noncontaminating jacket? And most important of all, is it made by a known, reputable manufacturer? Be suspicious of underpriced cable because "there ain't no free lunch."

3. If you are starting out fresh, buy RG-213/U cable (50 ohms) which also has the manufacturer's name and type number on it instead of RG-8/U type cable (52 ohms). It may be nitpicking, but today's RG-213/U cable standard is 50 ohms. It is a military-approved, properly-manufactured cable. Again, make sure it is made by a reputable manufacturer. You can then be certain the cable is what it is claimed to be and know that it has been tested.

long life for your coax

Once having bought good cable, how does the owner get maximum life from it?

1. Keep the cable off the ground and make sure it can dry off after a rain. Because modern outer jackets are slightly hygroscopic, moisture can penetrate the jacket material, reach the outer braid, and cause corrosion.

2. Try to keep the cable out of direct sunlight; ultraviolet rays are damaging over time. For prolonged exposure to strong sunlight, the cable outer jacket should be a high molecular weight polyethylene with imbedded carbon black (expensive!).

3. Support the cable every ten feet or less. Don't let it sag on a long run.

4. Don't let the coax cable whip around in the wind. Repeated flexing is not conducive to long cable life.

5. Seal the ends of the cable. Use type-N (waterproof) fittings instead of the cheap, plentiful PL-259 plugs. Coat the terminations with non-acid type silicone rubber sealant. ("If it smells vinegary, that indicates acetic acid in the sealant. Don't use it.")

6. Don't step on the cable or otherwise flatten it. And don't bend it around a sharp radius. The minimum recommended bend radius is equal to ten times the outer diameter of the cable. (That's about a 5-inch radius for RG-8A/U and RG-213/U.)

how long will it last?

I'd heard it said that coax cable should be replaced every few years, so I asked my friend if that was so. He replied that all cables deteriorate at greater or lesser rates depending upon use and abuse. Cable failure occurs when one or more specifications of the cable no longer meets the needs of the user. Sometimes the impedance of the cable changes; sometimes the cable loss becomes intolerable; sometimes the velocity of propagation changes to a degree.

I told the engineer that my RG-213/U, which was about 15 years old, had increased in loss by a measurable amount over the years and asked whether I should scrap it and buy new cable.

"That's up to you," he replied. "Coax cable doesn't fall apart all at once like the One Horse Shay. Deterioration is gradual. If you don't mind the increased loss, why spend the money to replace the cable? If you require every watt, you'd better get rid of it."

"Then this story of a five-year life, or a fifteen-year life for coax is unsubstantiated?" I asked. "That's right," he replied. He said he thought the story had begun because in the past, some branches of the military had

routinely junked coax cable after it had been stored for a number of years. He didn't think that was true today.

"Well, if I were operating on 80 meters," he added, "I wouldn't worry too much about the grade of coax I had. Losses are relatively low at that frequency even on old, junky cable. At 20 meters, however, I would start to pay attention to cable loss. And at 2 meters, I would examine the coax I bought very carefully. I would measure the velocity of propagation of each section if I made matching transformers, and I would check cable loss every year or so. As you go higher in frequency, you can't be too careful!"

His parting shot was to remind me that large quantities of imported cable which have recognized U.S. markings but whose manufacturing specifications are unknown are now entering the market. "Have fun when you buy your next length of coax cable," he chided as we hung up.

free brochure

I have reprinted the EIMAC brochure covering the design of Pi and Pi-L networks for linear amplifier service. Write to me at EIMAC, 301 Industrial Way, San Carlos, California 94070 and ask for bulletin AS-30. (Two first-class stamps or two IRCs would be appreciated.) And for full information on the design and construction of linear amplifiers, I recommend the 22nd edition of the *Radio Handbook*, available through Ham Radio's Bookstore, Greenville, New Hampshire 03048 (\$21.95 postpaid).

new EIMAC 3CX800A7 power tube

A free data sheet on the new EIMAC 3CX800A7 power tube is available from Varian EIMAC, 301 Industrial Way, San Carlos, California 94070.

reference

1. Les Moxon, G6XN, describes his antenna neutralization technique in his book, *HF Antennas for All Locations*, available from Ham Radio's Bookstore, Greenville, New Hampshire 03048 (\$14 postpaid).

ham radio

THE MOST AFFORDABLE REPEATER

ALSO HAS THE MOST IMPRESSIVE PERFORMANCE FEATURES

(AND GIVES THEM TO YOU AS STANDARD EQUIPMENT!)



JUST LOOK AT THESE PRICES!

Band	Kit	Wired/Tested
10M, 6M, 2M, 220	\$680	\$880
440	\$780	\$980

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, and remote base.

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 ± 12 KHZ. 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 (UP TO 50W WITH OPTIONAL PA).

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

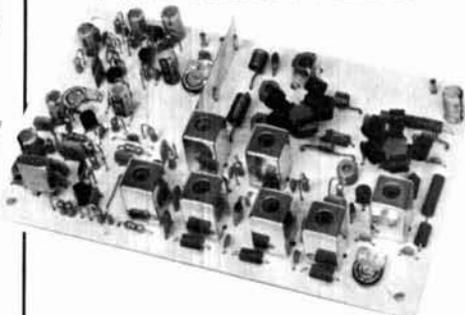
HIGH-PERFORMANCE RECEIVER MODULES



R144 Shown

- **R144/R220 FM RCVRs** for 2M or 220 MHz. 0.15uV sens.; 8 pole xtal filter & ceramic filter in I-f, helical resonator front end for exceptional selectivity, more than -100 dB at ± 12 kHz, best available today. Flutter-proof squelch. AFC tracks drifting xmtrs. Xtal oven avail. Kit only \$138.
- **R451 FM RCVR** Same but for uhf. Tuned line front end, 0.3 uV sens. Kit only \$138.
- **R76 FM RCVR** for 10M, 6M, 2M, 220, or commercial bands. As above, but w/o AFC or hel. res. Kits only \$118. Also avail w/4 pole filter, only \$98/kit.
- **R110 VHF AM RECEIVER** kit for VHF aircraft band or ham bands. Only \$98.
- **R110-259 SPACE SHUTTLE RECEIVER**, kit only \$98.

TRANSMITTERS



- **T51 VHF FM EXCITER** for 10M, 6M, 2M, 220 MHz or adjacent bands. 2 Watts continuous, up to 2 1/2 W intermittent. \$68/kit.



- **T451 UHF FM EXCITER** 2 to 3 Watts on 450 ham band or adjacent freq. Kit only \$78.
- **VHF & UHF LINEAR AMPLIFIERS.** Use on either FM or SSB. Power levels from 10 to 45 Watts to go with exciters & xmtg converters. Several models. Kits from \$78.
- **A16 RF TIGHT BOX** Deep drawn alum. case with tight cover and no seams. 7 x 8 x 2 inches. Designed especially for repeaters. \$20.

ACCESSORIES



- **CORKITS** With Audio mixer, speaker amplifier, tail & time out timers. Kit only \$38.
- **CWID KITS** 158 bits, field programmable, clean audio, rugged TTL logic. Kit only \$68.
- **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 Autopatch. Only \$90
- **AUTOPATCH KITS.** Provide repeater autopatch, reverse patch, phone line remote control of repeater, secondary control via repeater receiver. Many other features. Only \$90. Requires DTMF Module.



- **HELICAL RESONATOR FILTERS** available separately on pcb w/connectors.
 - HRF-144 for 143-150 MHz \$38
 - HRF-220 for 213-233 MHz \$38
 - HRF-432 for 420-450 MHz \$48

hamtronics®

NEW LOW-NOISE PREAMPS

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
LNA 50	40-70	0.9 dB	20 dB	\$39
LNA 144	120-180	1.0 dB	18 dB	\$39
LNA 220	180-250	1.0 dB	17 dB	\$39
LNA 432	380-470	1.0 dB	18 dB	\$45
LNA 800	470-960	1.2dB	15 dB	\$45

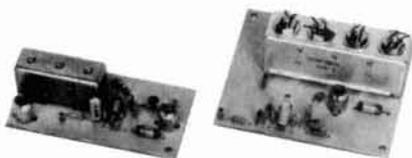
ECONOMY PREAMPS

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 \$18
- P30W, VHF Wired/Tested \$33
- P432K, UHF Kit less case \$21
- P432W, UHF Wired/Tested \$36

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
HRA-220	213-233 MHz	\$49
HRA-432	420-450 MHz	\$59
HRA-()	150-174MHz	\$69
HRA-()	450-470 MHz	\$79

- Call or Write for **FREE CATALOG**
- (Send \$1.00 or 4 IRC's for overseas mailing)
- Order by phone or mail • Add \$3 S & H per order (Electronic answering service evenings & weekends)
- Use VISA, MASTERCARD, Check, or UPS COD.

RECEIVING CONVERTERS TRANSMIT CONVERTERS



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

VHF MODELS	Antenna Input Range	Receiver Output
Kit with Case \$49	28-32	144-148
Less Case \$39	50-52	28-30
Wired \$69	50-54	144-148
	144-146	28-30
	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

UHF MODELS	Antenna Input Range	Receiver Output
Kit with Case \$59	432-434	28-30
Less Case \$49	435-437	28-30
Wired \$75	432-436	144-148
	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 \$88.

SAVE A BUNDLE ON VHF FM TRANSCEIVERS!

FM-5 PC Board Kit - **ONLY \$178**
complete with controls, heatsink, etc.
10 Watts, 5 Channels, for 2M or 220 MHz.



Cabinet Kit, complete with speaker, knobs, connectors, hardware. Only \$60.

While supply lasts, get \$60 cabinet kit free when you buy an FM-5 Transceiver kit. Where else can you get a complete transceiver for only \$178

REPEAT OF A SELLOUT!

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 transceive. 2 Watts output vhf, 1 Watt uhf.

	Exciter Input Range	Antenna Output
For VHF,	28-30	144-146
Model XV2	28-29	145-146
Kit \$79	28-30	50-52
Wired \$149	27-27.4	144-144.4
(Specify band)	28-30	220-222*
	50-54	220-224
	144-146	50-52
	50-54	144-148
	144-146	28-30

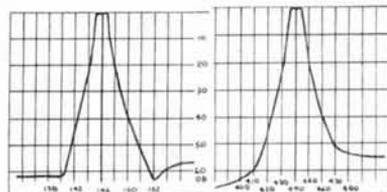
	Exciter Input Range	Antenna Output
For UHF,	28-30	432-434
Model XV4	28-30	435-437
Kit \$99	50-54	432-436
Wired \$169	61.25	439.25
	144-148	432-436*

*Add \$20 for 2M input



VHF & UHF LINEAR AMPLIFIERS. Use with above. Power levels from 10 to 45 Watts. Several models, kits from \$78.

LOOK AT THESE ATTRACTIVE CURVES!



Typical Selectivity Curves of Receivers and Helical Resonators.

IMPORTANT REASONS WHY YOU SHOULD BUY FROM THE VALUE LEADER:

1. Largest selection of vhf and uhf kits in the world.
2. Exceptional quality and low prices due to large volume.
3. Fast delivery, most kits shipped same day.
4. Complete, professional instruction manuals.
5. Prompt factory service available and free phone consultation.
6. In business 21 years.
7. Sell more repeater modules than all other mtrs. and have for years. Can give quality features for much lower cost.

hamtronics, inc.

65-C MOUL RD. • HILTON NY 14468
Phone: 716-392-9430

Hamtronics® is a registered trademark

EMI/RFI shielding: new techniques

part 1

Electronic pollution raises new interest in plastic shielding

This two-part primer on plastics discusses their use in suppressing the undesired effects of EMI/RFI (emitted electromagnetic interference and received radio frequency interference). Part 1 examines methods of EMI/RFI suppression; part 2 reviews the various methods of testing shielding effectiveness that employ RF techniques familiar to most Amateurs. Before delving into a discussion of methods of EMI/RFI suppression, let's see just what this interference is, what its adverse effects are, and why there seems to be a sudden surge of interest in this area despite what appeared to be little or no concern in years past.

Intense foreign competition has caused American

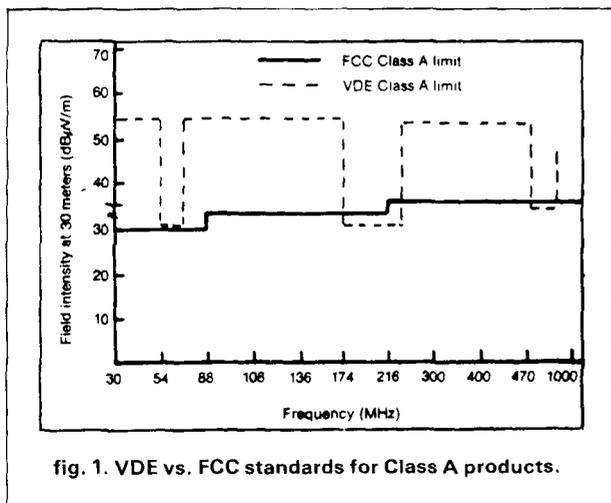


fig. 1. VDE vs. FCC standards for Class A products.

manufacturers of electronic equipment to cut costs dramatically; as a result, metal cases have often been replaced with less expensive plastic cases. Plastics are basically insulators; consequently they provide virtually no EMI shielding unless they are specially treated.

electronic pollution

Ten years ago there was only a small fraction of the number of electronic devices now available to consumers: electronic watches, calculators, home computers, video tape recorders and games, electronic toys, CB radios, microwave ovens, thermostats and home security devices, and a variety of controls on new cars. All of these devices emit electromagnetic radiation. In addition, the emphasis on portability in many of these items means that prolonged battery life through power reduction techniques — such as using switching voltage regulated rather than linear voltage regulated power supplies — has assumed far greater importance. Granted, the switchers are about twice as efficient as the linears, but because of their inherent mode of operation, i.e., switching current into an inductor, they are veritable EMI generators. Consequently, shielding becomes essential.

pollution effects

According to FCC chairman Mark Fowler, the number of electronic interference complaints now exceeds 80,000 per year.¹ For example, communications at an East Coast airport were hampered by interference from a "noisy" cash register in a drug store a mile away. In a western state, police communications at 42 MHz were disrupted by interference from coin-operated video arcade games. A home computer was found to affect its owner's TV as well as sets through-out the neighborhood. A fleet of new passenger buses designed for urban use were delivered, but during a test drive a driver tried to brake as

By Vaughn D. Martin, 114 Lost Meadows,
Cibolo, Texas 78108

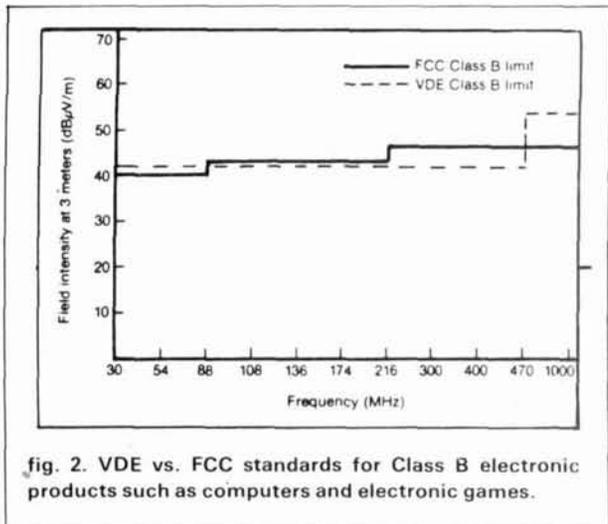


fig. 2. VDE vs. FCC standards for Class B electronic products such as computers and electronic games.

he went downhill and was astonished to discover he had no brakes until he reached bottom. Why? Because the microprocessor-controlled anti-skid devices controlling the brakes had been rendered useless by a commercial TV station's signal lobed in the direction of that particular hill. Once the electronic housings in the buses were shielded, their brakes worked.

background on FCC rule-making

On April 23, 1976, the FCC began a rulemaking proceeding (referred to as Docket 20780, Part 15, Subpart J) for setting realistic limits on VHF and UHF frequency emissions. The law included six categories: class, definitions, emission limits, verification, certification, labeling, and dates of compliance in dealing with radiated EMI/RFI in electronic and electrical industrial devices. In January 1979, a major computer manufacturer petitioned the FCC to relax some of these proposed standards. In response, the FCC relented on a few minor changes and rescheduled the July 1, 1980 compliance date. Other proposals presented are under consideration as well. While class A products (industrial electronic devices) are of interest, most concern seems to be focused on class B products: personal computers, electronic games and similar consumer items. (Certain inexpensive electronic games operating at frequencies less than 495 kHz are exempt from the new FCC ruling.)

Emission limits on class B devices are about three times as stringent as those placed on class A industrial products. Note in **figs. 1 and 2** how class A and B limits compare with the West German or generally accepted European standard, the VDE. The German post office has placed half-page ads in newspapers pointing out that items not meeting the specifications contained in the VDE regulation will not have a government proof number. Purchasers of devices

without such numbers are liable to prosecution for electronic pollution; therefore, if an American product is to be marketed in West Germany it must be very EMI-proof. But the FCC is tightening up on emissions. For example, as of October 1, 1983, all manufacturers of class A and B products became subject to the FCC's request for random sampling of

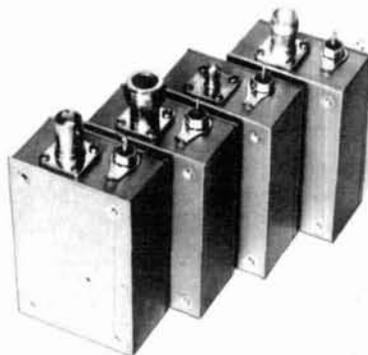


fig. 3. Typical small enclosures designed for EMI shielding.

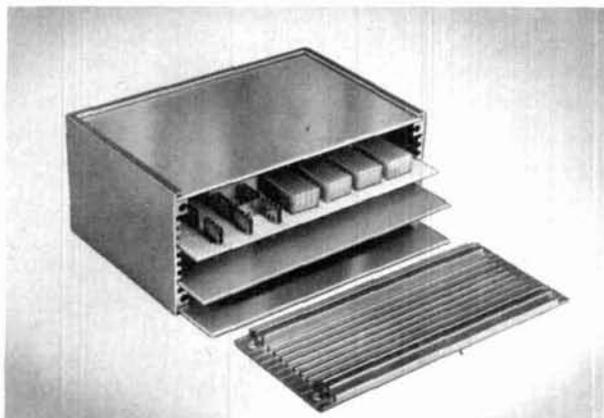


fig. 4. A metal case made with tightly fitting sides and end plates for EMI containment.

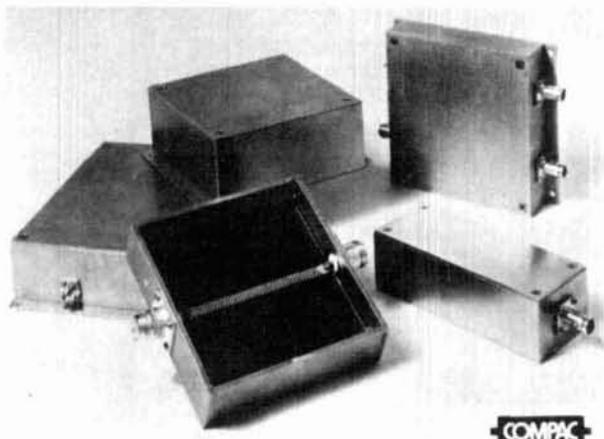


fig. 5. Nickel-plated EMI shielded cases.

COMPAC

table 1. Methods of EMI shielding and/or containment. (A) lists the shielding effectiveness (SE) parameters of various particle coatings, while (B) provides alternate methods of shielding.

(A):

coating*	coating thickness (mils)	sheet resistance ohms/sq.mm at 1 mil	typical attenuation (dB)
plastic	125.0	0	0
aluminum/panel (for reference)	62.5	0	65-100
silver paint	1.0	0.01	65-70
silver/graphite (two coats)	0.2/1.0	0.01/100	54-77
copper	2.0	2.00	20-65
copper/graphite (two coats)	2.2	8.0/100	27-62
graphite	2.0	20.00	30-60
nickel	2.0	1.00	65

(B)

alternate methods of shielding

1. Conductive elastomeric materials
2. Conductive particle sprays and paints
3. Pressure sensitive adhesive backed tapes
4. Laminated heatsinks with paths for conducted EMI suppression
5. Wire mesh in strips and sheets
6. Zippertubing™ of coverings for cables that suppress conducted EMI and EMP (electromagnetic pulses)
7. Conductive composite fillers (covered in Part 2 of this article)

*Information supplied by PacTec Corp., Philadelphia, Pennsylvania

products to check compliance with established standards.*

the consequences of budget cutting

There is a twist to this story: a directive from FCC chairman Mark Fowler to Commissioner Anne Jones directed her to comply with the President's desire to cut their office's budget by 12 percent. In order to

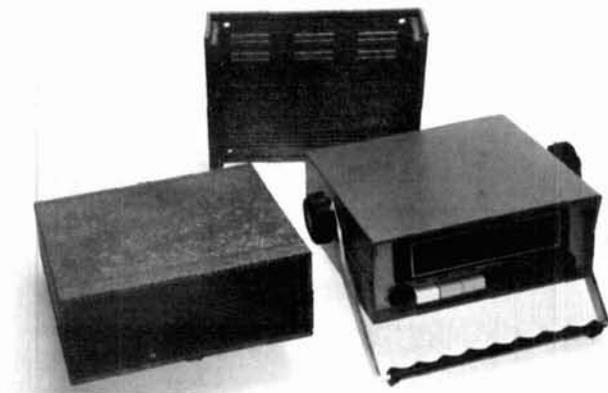


fig. 6. Plastic cases impregnated with conductive fillers to suppress EMI.

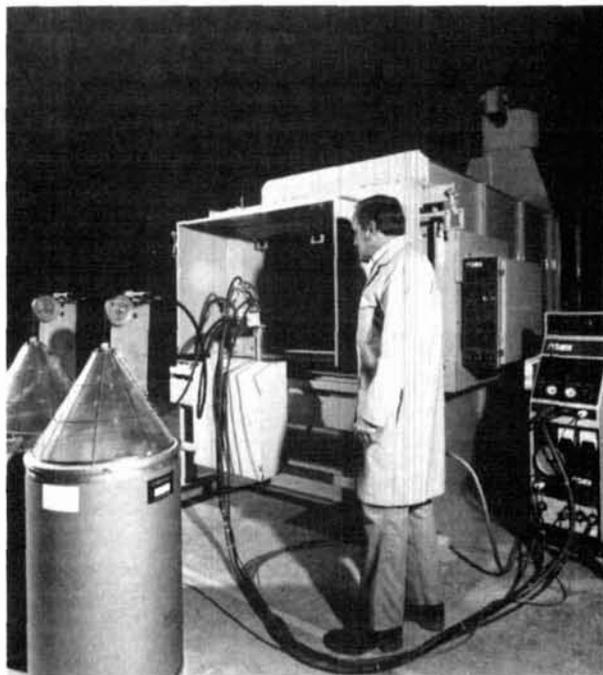


fig. 7. An X-Y axis programmable molten zinc sprayer.

*Any questions should be directed to your local FCC field office or to Art Wall, Office of Science and Technology, Federal Communications Commission, Washington, D. C. 20554.

THE BEST!

... Since 1920

Whether sending QSL's or locating old friends, the new 1984 CALLBOOKS are a "must" for the active amateur. Respected for accuracy since the beginnings of amateur radio, the U.S. and Foreign CALLBOOKS list the address information for over 800,000 hams around the world in an easy-to-use format. Not simply a reprint of license records, CALLBOOK listings are taken from our own extensive master files, updated continuously to bring you the latest information available.

As an added service, optional supplements will keep your 1984 CALLBOOKS up to date throughout the year. Published March 1, June 1, and September 1, each supplement contains all activity for the preceding 3 months. Thousands of new licenses, call changes, and address changes are listed in each issue.

The 1984 CALLBOOKS are loaded with extra features for rag-chewers and DX'ers alike. Order your copies now. See your dealer or order directly from the publisher.

**COMPARE!
YOU CAN'T BEAT CALLBOOK VALUE!**

- 425,000 current U.S. Listings • 400,000 current Foreign Listings • Great Circle Bearings
- Then & Now call changes • Silent Keys • Census of Amateur Licenses in all countries
- Standard Time Charts • International Postal Information • World-wide QSL Bureaus
- Table of Amateur Prefix Allocations • Prefixes of the World • Plus many other features.

Publication: December 1, 1983

	Including shipment to U.S.A. points	Illinois residents, incl. tax & shipping	Including shipment to foreign countries
<input type="checkbox"/> Single 1984 U.S. Callbook	\$23.00	\$24.05	\$24.50
<input type="checkbox"/> Single 1984 Foreign Callbook	22.00	22.99	23.50
<input type="checkbox"/> SPECIAL OFFER: Order both 1984 Callbooks at the same time for shipment to one address.	41.95	43.99	43.45
<input type="checkbox"/> Set of 3, 1984 U.S. Supplements	12.00	12.60	12.00
<input type="checkbox"/> Set of 3, 1984 Foreign Supplements	12.00	12.60	12.00

Name _____ Amount enclosed _____

Address _____

radio amateur
callbook

925 Sherwood Dr., Box 247,
Lake Bluff, IL 60044, USA

Tel: (312) 234-6600



comply with the directive, the FCC may decide to close its Laurel, Maryland, test lab. If this happens, will the FCC then contract out its work to an independent laboratory? And if it does, will total impartiality be guaranteed? With the compliance-auditing arm of the FCC eliminated, will manufacturers disregard the new FCC rulings and eliminate metallized plastic cases and power line filters in an effort to produce their products more cheaply?

shielding enclosures

In the absence of effective government regulation, what can Amateurs do on their own?

Surprisingly, the most cost-effective way to solve the electronic pollution problem isn't careful circuit design, but rather the use of well-shielded enclosures. While there are many ways to accomplish this (see **table 1**), all are essentially the same in that they

are variations of treating enclosures. (The emissions previously referred to are naturally radiated emissions; conducted emissions are covered later, but suffice it to say for now that conducted emissions are best prevented by adequate filtering of power lines and other lines or cables leaving or entering the "box.")

Metal enclosures were the first to offer efficient EMI shielding. Today many companies still produce metal enclosures: Compac, for example, offers its RFT series, which includes built-in SMA, TNC, N, and BNC interchangeable RF connectors, (see **fig. 3**). Other manufacturers such as Vector Electric produce a series of aluminum Multi-Mod enclosures with tightly overlapping sides and end plates for EMI containment (see **fig. 4**). Like most metal cases, however, these are more expensive than plastic ones and generally offer less decorative, less protective outer finishes than plastic cases.

table 2. Companies specializing in EMI shielding.

shielding manufacturers/ company addresses	type products manufactured					
	metal cases	foil	mesh	applied coatings	magnetic devices	tubing for cables
Adhesives Research Inc. Glen Rock, Pennsylvania 717-235-4860	—	yes	—	—	—	—
Advance Process Supply Chicago, Illinois 312-829-1400	—	—	—	—	yes	—
Compac Deer Park, New York 516-667-3933	yes	—	—	—	—	—
Perfection Mica Co. Magnetic Shield Division Bensenville, Illinois 312-766-7800	—	—	—	—	yes	—
Stackpole Corp., Electronic Components Division St. Marys, Pennsylvania 814-781-1234	—	—	—	—	yes	—
Tafa Metallisation, Inc. Bow, New Hampshire 603-224-9585	—	—	—	yes	—	—
Technit Inc. Cranford, New Jersey 201-272-5500	—	—	yes	yes	—	—
Vector Electronics Co., Inc. Sylmar, California 213-365-9661	yes	—	—	—	—	—
Zippertubing Company Los Angeles, California 213-321-3901	—	yes	yes	—	yes	yes

ALL ITEMS ARE
GUARANTEED OR SALES
PRICE REFUNDED
PRICES F O B
HOUSTON
PRICES SUBJECT TO
CHANGE WITHOUT
NOTICE
ITEMS SUBJECT TO
PRIOR SALE

MADISON

Electronics Supply

1508 McKinney
Houston, Texas 77010
*Call For Quotes
713-658-0268

We stock what we advertise,
and much more.



AMATEUR COMPUTER ACCESS.

MicroPatchm
model MP-20/MP-64 ... \$129.95
The lowest priced unit available

AEA CP1 ... 189.95
CP1/VIC 20 mbatext... **Special**
CP1/COMM64 mbatext **Hot Deal**

Software ... 10% off Amateur
Discount Prices

Kantronics Interface ... 119.95
with HAMTEXT ... 199.95

Kantronics AMTOR ... 79.95

MFJ 1224 plus new 1250
or 1251 software for
VIC20/COMM64 ... 129.95

HAL CWR6850 Teletreader ... 699.00

New Hot **AEA MicroPatch**
COMM 64 or VIC20 ... **CALL**

VHF/UHF MIRAGE B23 ... 79.00
B3016 ... 199.00
B1016 ... 249.00
D1010N ... 289.00
New A1015 ... **CALL**

KDK 2030 ... 259.00
ST144UP ... 269.00

New Santec ST142 ... **CALL**
ST7 ... 209.00

Accessories in stock

TR7950, TM201A ... **CALL**
TW4000A ... **HOT PRICE**

OSCAR FT726R ... 699.00
SU726 ... 95.00
430 Module ... 225.00
FT290/FT790 Combo ... 699.00
TR2500 ... **CALL**
FT208RA/FT708R ... 269.00
TenTec HT ... 279.00
HT 1200 ... 209.00

HF

Signal One Millspec ... 5995.00
Accessories available.

Rockwell-Collins
KWM380 ... **Factory Order**

ACCESSORIES

TS930S ... **CALL**
TS430S ... **DISCOUNT**
TS530S ... **GREAT BARGAIN**
TS830S plus free goods ... **BUY!**

Tentec Corsair ... 1020.00

Argosy ... 529.00

Drake TR5 ... 499.00

YAESU FT980 ... 1299.00

FT77 ... 499.00

FT757GX ... 749.00

FT102 ... 879.00

NYE MB-V 3kw Tuner ... 479.00
MB4-2 ... 399.00
MB1-2 100 watt ... 185.00

GE Tubes ... **STOCK**

Robot 1200c high resolution
color SSTV ... 1139.00
450c Color SSTV ... 789.00
800c/800ch RITY/CW ... 789.00
400c kit ... 469.00
800c kit ... 155.00

Heil Sound ... 10% OFF

Microwave Modules ... **SOON**

BIRD 43 - Elements ... **STOCK**
Call for other BIRD items!

FEATURE

New **Santec ST142** ... 299.95
Same accessories as ST144up

W6TG Hearing Aids
Preamp board ... 29.95

ANTENNAS

Cushcraft Proline ... **STOCK**
Cushcraft turnstile ... \$29.95
Cushcraft D40 Rotable dipole ... 149.95

Oscar 416TB ... 58.00
A14420T ... 74.00
A14TMB ... 29.00
As a package ... 159.00

Belden 9913 Solid center Coax,
foil + Braid shield ... 42¢/Ft.

KT34A ... 308.00
2MI3LBA ... 79.00
144-148-13LBA ... 78.00
420-470-18C ... 59.00
A14410T ... 49.00

Antenna specialists AP151.3G ... 33.00
432-16LB ... 59.00
68TV ... 129.00

Explorer 14 ... **CALL**
TH7DX ... **DISCOUNT**

HF6V ... 125.00
G7144 ... 108.00
DB plus Enterprises, 2 El Quad ... 279.00

Alpha Delta ... 10% off

W1JC, 160/30, 160/40M dipole
110' Long ... 69.95

B&W AV25 Vertical Notrap ... 85.00

Q5-QRM, coax
Dipole, Comm. Grade 75M ... 69.95
40M, Coax dipole ... 59.95

Belden 8214 ... 40¢/Ft.
9258 RG8X ... 19¢/Ft.
8267 RG213 ... 49¢/Ft.

Amphenol 8261 N Male ... 3.00
8315P PL259 Silverplate ... 1.25
UG176 ... 30¢
HIQ dogbone insulator ... 50¢

ACCESSORIES

Triplite 12V20A supply ... \$99.00

Big Ham Clocks
Dual LCD 12/24 hr ... 29.95

Books: Gliner, Radio Pub, Radio Callbook,
ARRL, SAMS, AMECO, TAB, RIDER

AEA MM2 ... 149.00
CK2 ... 129.00
KT2 ... 99.00
BT1 ... 79.00

Sherwood, Fox Tango ... 10% off
Alpha Delta ... **ASK**
Janel, Vibroplex ... 10% off
Coax Seal ... 2.00
QSL Holder ... 2.00

Bugcatcher
All band antenna coil ... 45.00
Single Band Coil ... 39.00

Valor HF mobile antennas ... 20.00 ea.

Anteco 5/8 Mag. mt. ... 25.00
Bencher ZA1A/ZA2 ... 21.00

Paddles
Single Paddle ST2 ... 54.00
Single Paddle ST1 ... 49.00

ICOM BLOWOUT

Due to heavy buying, we have extra ICOM
stock. Look below at these prices!

IC490A ... \$519.00
IC451A ... 595.00
EX182 ... 21.00
EX203 CW AUDIO ... 30.00
FL63 ... 39.00
FL30 ... 46.00
FL45 ... 46.00
FL52 ... 77.00
FL53 ... 77.00
HM10 ... 31.00
MB12 ... 15.00
R70 - 720A interface ... 95.00

PARTS

CDE 001/20Kv doorknob cap ... \$1.95
Sprague 100Pf/500V Feedthru ... 1.95
Sprague 500Pf/30Kv doorknob cap ... 16.00

14, 20, 24 pin 600 Mil dip sockets,
solder tail ... 40¢
14, 16 pin 300 Mil ... 10¢
20, 24, 40 Pin 600 Mil ... 25¢
3n201 ... 10¢
Caps to .01 Pc ... 10¢
Rec Tubes new surplus ... 1.00 ea.

SWL CORNER

Bearcat DX1000 ... 499.00
R70 ... **CALL**
R2000 ... **SPECIAL**
R1000 ... **BUY!**
McKay Dymek ... **STOCK**

USED, GUARANTEED

90 day warranty & 6 month trade in, full value,
for new gear.

FT101ZD/Filter ... 595.00
TS520 or TS520S ... 395.00 ea.
75A4/KWS1 or 32S1/75S1 Parts ... **CALL**
CX11A, clean ... 3395.00
CX7A ... 695.00
TS830S ... 695.00

HOT & NEW

Free upgrade book or call directory with
new HF rig purchase. Tired of counting on
"satisfaction" from your present dealer?
Try us! Don't hesitate to call for a little
radio advice, we always try to steer you
in the right direction.

Trades welcome.

POLICIES

MasterCard, Visa, C.O.D Welcome

Note: Many companies use your money
until the item is shipped. We hold charge
cards, checks, until shipment. Call us
anytime on the status of your order. All
prices FOB Houston, subject to change,
prior sale. Used gear sales price refunded
if not satisfied.

160

AEA	Belden	Bugcatcher	ETO-Alpha	Heil
Alliance	Butternut	Antennas	Finco	ICOM
Alpha Delta	Bird	Bencher	Fox Tango	IRL
Amphenol	Cushcraft	Dowkey	Gliner	Hustler
Anteco	CDE	Drake	GE Tubes	HyGain

1-800-231-3057

McKay-Dymek	Rohn	Signal One
Nye	Rockwell-Collin	Sprague
Radio Callbook	Tentec	Vibroplex
Rider	Triax	Santec
Robot	TAB	W6TOG
	TCG	Surplus
	Triplet	Yaesu
		SAMS

ADVANCED
CONSUMER
ELECTRONICS

TUNE IN THE WORLD...

...WITH THE ICOM IC-R70 OR THE KENWOOD R-2000 COMMERCIAL-GRADE RECEIVERS
WITH THE DYMEK DA-100D ALL-WAVE RECEIVING ANTENNA.



ICOM IC-R70

News, music, and political opinions from around the world are accessible from your home. Listen to music or information from the Near East, Western Europe, South America, even Russia, Vietnam and China! Tune in to the U.K.'s BBC, and broadcasts from Canada, Israel and Japan, many of which are in English.



Kenwood R-2000

Even if you've never used Short Wave before, the ICOM IC-R70 and the Kenwood R-2000 are a snap and yet are full-fledged Commercial-Grade Short Wave Receivers that outperform units costing twice as much. Couple the IC-R70 or the R-2000 with a Dymek DA-100D Wide Range All-Wave Receiving Antenna and the world is literally at your fingertips. This workhorse outdoor antenna mounts anywhere, atop houses, buildings, mobile homes, etc. It operates on either AC or DC and is equipped with dozens of features to maximize performance. ICOM, Kenwood and Dymek from Harvey at competitive prices ready to take on the world.

HARVEY ELECTRONICS

25 W. 45th St., N.Y., N.Y. 10036
(212) 921-5920

For orders call Joe Chin
"KB2MU" 1-800-223-2642

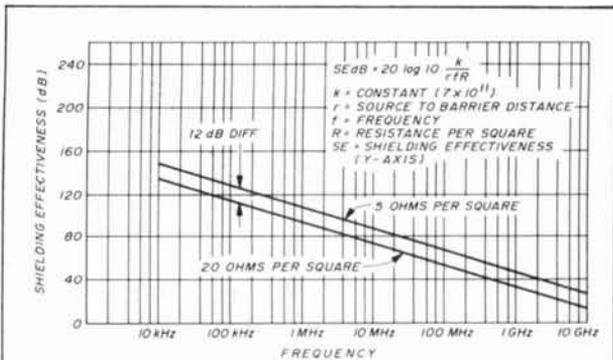


fig. 8. Shielding effectiveness vs. frequency—shielding effectiveness is proportional to the resistivity of thin film coatings, and increases with frequency.

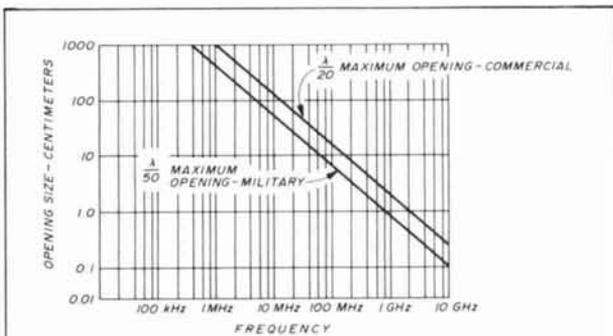


fig. 9. Hole size vs. radiated emissions frequency. Additional shielding materials are not required in a commercial enclosure if hole size is less than 1/20 wavelength, or 1/50 wavelength for military enclosures.

Fortunately, plastic cases can be treated to resist EMI as effectively as metal cases. This treatment process takes one or more of four forms: (1) the cases can be lined with a metal-plated or foil wire mesh screen (see fig. 5); (2) the cases can be painted or sprayed with conductive-particle plastic sprays; (3) the cases can be manufactured with conductive fillers impregnated in the plastic itself (see fig. 6); or (4), the cases can undergo a treatment process for the direct deposit of metals (see fig. 7).

The arc spray coating shown in fig. 7 is a particularly interesting method used at Tafa Metallisation. Despite the fact that similar methods of using high temperature oxy-fuel plasma may damage some plastic surfaces, this method is so gentle that when molten zinc is applied to the surface of fresh fruit, the fruit will not be scorched. This seemingly impossible task is accomplished with a metal sprayer that looks very much like a paint sprayer but differs in that two small rods of metal stock are fed to the heat source and melted by an arc welding technique. This is accompanied by cool compressed air blowing fine

atomized particles of molten metal onto the surface to be treated. This allows the plastic's surface to remain below 125° F (50° C), despite the fact that zinc itself requires a minimum temperature of 770° F (410° C) to even begin to melt. A 0.003 inch (0.0762

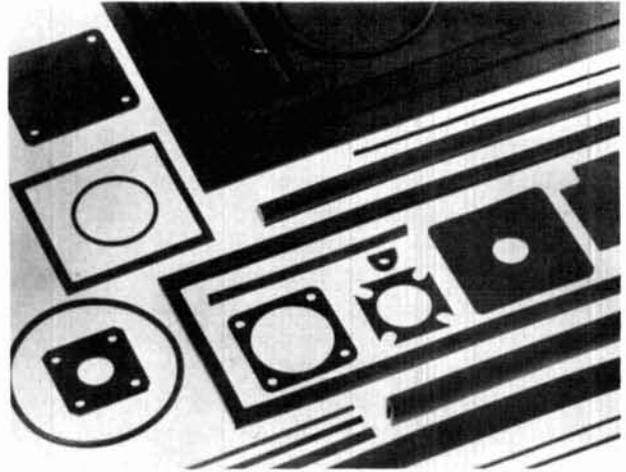


fig. 10A. Gaskets impregnated with conductive materials.

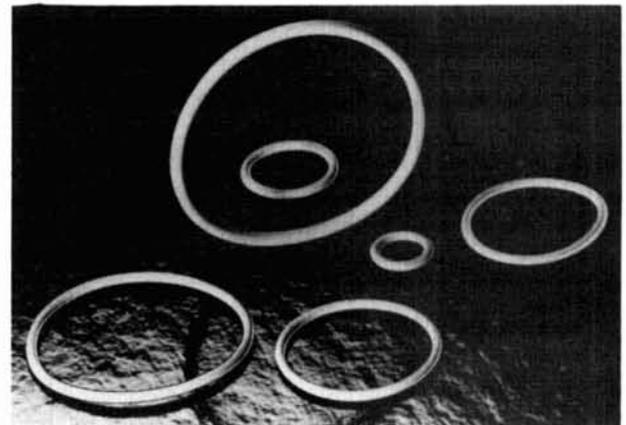


fig. 10B. Rubber grommets containing conductive particles.

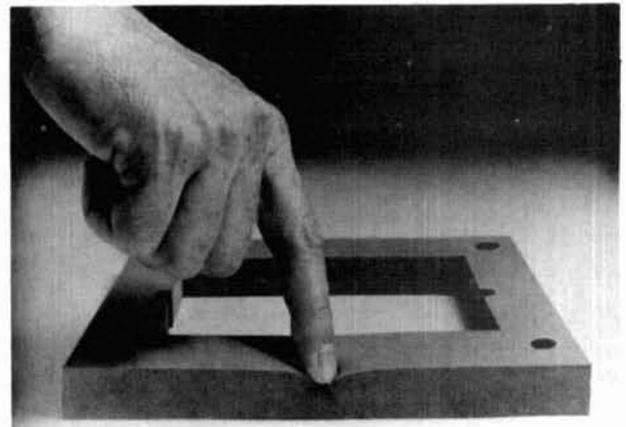


fig. 10C. A foam rubber cushion containing conductive particles.

mm) coating of zinc over a one-square foot surface requires about 3 ounces of zinc at an approximate cost of 19 cents. A 0.002 to 0.005-inch (0.0508 - 0.127 mm) — thick coating of zinc affords a resistivity sufficient for 50 to 90 dB of attenuation to radiation in the sub 100 MHz to 10 GHz range. This is important because EMI problems are essentially broadband in nature, so that shielding methods are devised for effectiveness against the highest potential frequency.

This arc spray coating is classified as either thin film (under 2.5 microns) or thick film (above 2.5 microns in thickness). Thin film coatings work particularly well at higher frequencies (see **fig. 8**) and provide shielding as a function of their resistivity. These resistive thin film coatings contain minute particles of silver, nickel, or carbon. Surface conductivity is therefore "adjustable" according to the type of spray selected, with mixtures using from 20 to 80 percent conductive materials to provide high conductivity. This is much more than commercial applications require (60 dB at 100 MHz). These coatings are quite fragile, though, and require an additional thin dielectric coating to avoid scratching or "fingerprinting" the freshly sprayed plastic surfaces. A scratch can be the "crack" in the box that permits EMI to escape.

specialized EMI problems

So far we have discussed the containment of EMI using various techniques, but have perhaps labored under the inaccurate assumption that any tight box will contain EMI. Generally, a tight box will contain EMI, but most pieces of equipment must have openings. These take the form of holes in the front panel through which the control shafts (potentiometers, variable tuning capacitors, and such) protrude. Additionally, LED or LCD displays or even a CRT often prove to be troublesome with their even bigger openings; larger pieces of equipment may have blowers, fans, vents, and louvers open to the outside environment. The cases themselves also often have discontinuities in seams or joints. Covers, gaskets, access ports, display windows, shaft holes, cables, and connectors all make it difficult to achieve optimum EMI/RFI integrity.

There is a relationship between their diameter and the frequency of radiated emissions (see **fig. 9**). The gaskets and rubber grommets that fit around these holes make the gap between the control shaft and the outside world much tighter (see **fig. 10**). In addition, these grommets are also often treated with conductive materials such as nickel, cobalt, iron, silver, or graphite. Many gaskets are made of wire mesh or conductive elastomers (supple, rubberlike plastic sheets — see **fig. 11**). Less supple metallic gaskets

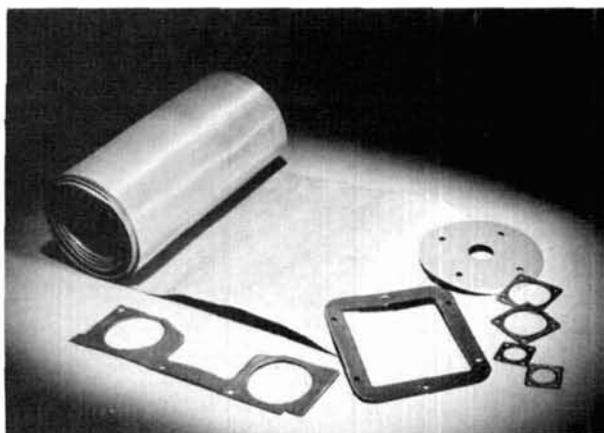


fig. 11. Supple elastomer sheets in roll form.

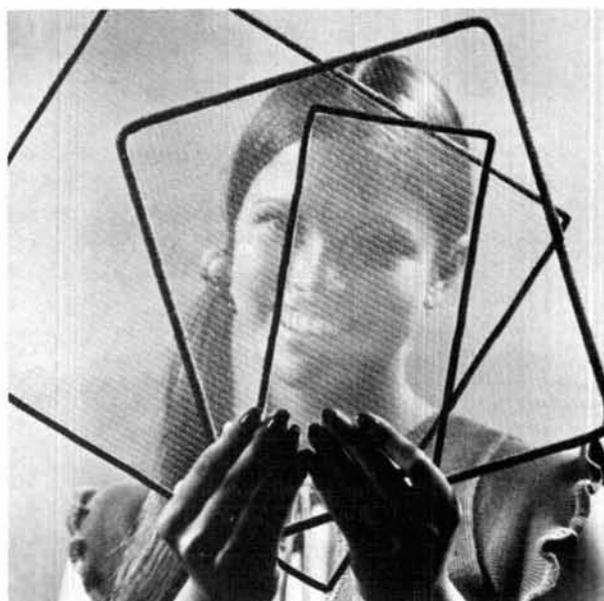


fig. 12. Glass impregnated with screens to contain EMI.

are therefore limited to straight-edge runs or openings with large radii. **Table 2** lists companies and products offered in this general area of EMI shielding. There are mechanical fittings made of wire mesh combined with silicone rubber or neoprene for cores that are both water- and gas-tight. There are also metallic tapes made with sticky or adhesive backs that can be applied to seams in an enclosure from which EMI might radiate. Glass that is relatively clear but has nonetheless been impregnated with conductive EMI constraining particles, (**fig. 12**), would be ideal in any application using a CRT.

references

1. Dr. Theodore J. Cohen, N4XX, "CQ Interviews: Mark S. Fowler, Chairman, FCC," *CQ*, March 1982, page 18.

ham radio

The small dish that captures all the entertainment.

 **WILSON
MICROWAVE
SYSTEMS, INC.**



Only Wilson Microwave Systems can give you the versatility of hand-held control of the total satellite television spectrum at such a remarkably low price.

Total System Design.

From the solid steel antenna to the state-of-the-art electronic receiver and hand-held control unit, Wilson gives you the most complete, integrated system you can own.

At Wilson Microwave Systems, we put the world of entertainment in the palm of your hand.



BUILT BY YAESU

**1 year warranty on receivers
4 year limited warranty on dish**

NOW ONLY

\$1695.00 F.O.B. Nampa, ID

Includes: 110° LNA - Polarizer I - 100' Cable
Wilson MD9 Dish - YM1000 Receiver

**Dealerships
Available**

Antenna is shown with optional LNA cover.

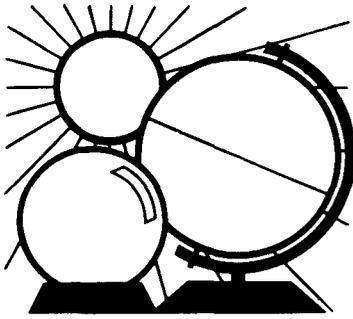
Distributed by

NAMPA SATELLITE SYSTEMS

312 12th Avenue South • Nampa, Idaho 83651

(208) 466-6727

In State Wats 1-800-654-1319 • Out of State Wats 1-800-654-0795



DX FORECASTER

Garth Stonehocker, KØRYW

last-minute forecast

Midwinter DX conditions are expected to be very good this first month of 1984. The higher frequency bands (10-30 meters) are expected to provide long skip and transequatorial openings on the 7th and possibly on the 20th. The lower bands (30-160 meters) are expected to provide excellent conditions throughout the month, with short skip during the daytime, between the above dates, and longer skip openings at night when the geomagnetic field is quiet. Geomagnetic ionospheric disturbances can be expected about the 1st, 10th, 18th, and 27th; the 5th, 13th, and 23rd are also possible disturbance dates, though with somewhat lower probability.

For EME and meteor burst communicators, the lunar perigee is on the 19th and a full moon appears on the 18th.

updating the foF2 formula

In the September, 1983, *DX Forecaster*, formulas were given for determining a mid-latitude local-noon foF2 (F2 layer critical frequency) from solar radio flux or sunspot numbers. The foF2 is the most variable of the propagation parameters that help define the maximum usable frequency (MUF) for a path between you and the DX QTH ($MUF \cong 2.5 \text{ foF2}$). Keep in mind that the MUF is about the optimum frequency for working that DX. These formulas are meant to be used for predicting "long term" (base) values of foF2 (for a few weeks or a month).

Changes in foF2 correlate with the

daily solar flux changes over the previous three days. Delay in correlation (onset of foF2 change) depends on the magnitude of the flux change. Consequently these daily flux values can be used to update or "fine tune" the "long term" foF2 values discussed before. Furthermore, the rate of change of foF2 is only 30 percent the rate of change in solar flux and is used to alter the "long term (base) value."

but what about today?

To determine today's foF2, use your recorded values of the flux over the previous few days, noting how much it has varied. This variation, when multiplied by 0.3, equals the incremental increase (or decrease) in the long term value or base value of foF2. If you want a forecast of the foF2 that may be expected to occur several days ahead, use the last days' flux change. Small flux changes (up to 5 or 10 units) do not cause the ionosphere to change very much, so do not work too far back in time. The cause of the delay is the time the electrons take to drift or diffuse upward into the F2 region after being produced below 180 km by the solar flux (ultraviolet).

The flux — foF2 correlation is quite good in winter and equinoxial months. For lower latitudes the correlation is even better; for higher latitudes and summer months, correlation is poorer. The solar flux correlation with lowest usable frequency or absorption of the signal (signal strength) is *immediate*, with no delay experienced. Remember this correlation when using the lower frequencies in or near daytime.

band-by-band summary

Ten meters will occasionally be open, providing F2 long skip by the transequatorial one-long hop propagation mode (TEM). The openings will follow the sun during the day and into late evening. Geomagnetic disturbances will *enhance* this mode, as will high solar flux. Openings may favor southern Africa, South America, and Australia.

Fifteen meters can experience the same TEM modes as 10 meters with the openings being more frequent. World-wide DX is prevalent from after sunrise until well after sunset during the periods of high solar flux (listen to WWV at 18 minutes after the hour for reports on solar and geomagnetic conditions).

Twenty and thirty meters will be open most days and into the night to some areas of the globe with 1000-2500 mile long skip and some short-skip of 1200 miles near midday. Both propagation modes follow the sun across the sky; east, south, then west.

Thirty and forty meters are the transition bands, providing all-night propagation as well as some short-skip conditions during the daytime. Most areas of the world can be worked from darkness hours till just before sunrise. Hops shorten on these bands to about 2000 miles, but the number of hops can increase since signal absorption is low during the night.

Eighty meters offers ample opportunity for much DX work. Several stations have worked over 300 countries on this band. The band operates much like 40 meters except that the hop distances shorten to about 1500 miles. Noise from distant thunderstorms is low enough to make these bands a joy to work this time of year. The path direction follows darkness across the earth (east, south, then west).

One-sixty meters, similar to 80 meters, will provide multihop opportunities, though each hop shortens to 1000 miles.

ham radio

GMT	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300
-----	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------

JANUARY	WESTERN USA																	
	PST	N	NE	E	SE	S	SW	W	NW	ASIA FAR EAST	EUROPE	S. AFRICA	S. AMERICA	ANTARCTICA	NEW ZEALAND	OCEANIA AUSTRALIA	JAPAN	
4:00	20	20	20	15	10	15	10	10	20	20	20	20	20	20	20	20	20	20
5:00	20	20	20	15	10	15	10	10	20	20	20	20	20	20	20	20	20	20
6:00	20	20	30	15	10	15	10	10	20	20	20	20	20	20	20	20	20	20
7:00	20	30	30	15	10	15	10	10	20	20	20	20	20	20	20	20	20	20
8:00	20	30	30	15	10	15	10	10	20	20	20	20	20	20	20	20	20	20
9:00	20	30	30	15	10	15	10	10	20	20	20	20	20	20	20	20	20	20
10:00	20	30	30	15	10	15	10	10	20	20	20	20	20	20	20	20	20	20
11:00	20	30	30	15	10	15	10	10	20	20	20	20	20	20	20	20	20	20
12:00	20	30	30	15	10	15	10	10	20	20	20	20	20	20	20	20	20	20
1:00	20	30	30	15	10	15	10	10	20	20	20	20	20	20	20	20	20	20
2:00	20	30	30	15	10	15	10	10	20	20	20	20	20	20	20	20	20	20
3:00	20	30	30	15	10	15	10	10	20	20	20	20	20	20	20	20	20	20
4:00	20	30	30	15	10	15	10	10	20	20	20	20	20	20	20	20	20	20

MST	MID USA																
	N	NE	E	SE	S	SW	W	NW	ASIA FAR EAST	EUROPE	S. AFRICA	S. AMERICA	ANTARCTICA	NEW ZEALAND	OCEANIA AUSTRALIA	JAPAN	
5:00	30	20	15	10	15	10	10	20	30	20	15	10	15	10	10	20	20
6:00	30	20	15	10	15	10	10	20	30	20	15	10	15	10	10	20	20
7:00	30	30	15	10	15	10	10	20	30	20	15	10	15	10	10	20	20
8:00	30	30	15	10	15	10	10	20	30	20	15	10	15	10	10	20	20
9:00	30	30	15	10	15	10	10	20	30	20	15	10	15	10	10	20	20
10:00	30	30	15	10	15	10	10	20	30	20	15	10	15	10	10	20	20
11:00	30	30	15	10	15	10	10	20	30	20	15	10	15	10	10	20	20
12:00	30	30	15	10	15	10	10	20	30	20	15	10	15	10	10	20	20
1:00	30	30	15	10	15	10	10	20	30	20	15	10	15	10	10	20	20
2:00	30	30	15	10	15	10	10	20	30	20	15	10	15	10	10	20	20
3:00	30	30	15	10	15	10	10	20	30	20	15	10	15	10	10	20	20
4:00	30	30	15	10	15	10	10	20	30	20	15	10	15	10	10	20	20

EST	EASTERN USA																
	N	NE	E	SE	S	SW	W	NW	ASIA FAR EAST	EUROPE	S. AFRICA	CARIBBEAN S. AMERICA	ANTARCTICA	NEW ZEALAND	OCEANIA AUSTRALIA	JAPAN	
7:00	30	20	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
8:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
9:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
10:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
11:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
12:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
1:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
2:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
3:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
4:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
5:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
6:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
7:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
8:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
9:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
10:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
11:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
12:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
1:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
2:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
3:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
4:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
5:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
6:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
7:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
8:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
9:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
10:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
11:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
12:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
1:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
2:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
3:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
4:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
5:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20
6:00	30	30	15	15	15	10	10	20	30	20	15	10	15	10	10	20	20

The italicized numbers signify the bands to try during the transition and early morning hours, while the standard type provides the MUF during 'normal' hours.
 *Look at next higher band for possible openings.

RF TRANSISTORS

FRESH STOCK - NOT SURPLUS

2-30 MHz					
Pin	Net	Match/Pr	Pin	Net	Match/Pr
MRF412	\$18.00	\$39.00	MRF455	\$13.50	\$30.00
MRF421	27.00	58.00	MRF455A	13.50	30.00
MRF450	12.50	28.00	MRF458	18.00	40.00
MRF450A	12.50	28.00	MRF492	20.00	43.00
MRF453	15.00	33.00	SRF2072	15.00	33.00
MRF435A	15.00	33.00	SRF2769	15.00	33.00
MRF454	16.50	36.00	CD2545	18.50	40.00
MRF454A	16.50	36.00	CD3424	19.00	41.00

High Gain Matched Pairs & Quads Available

Pin	Net	Pin	Net
MRF406	\$14.50	MRF475	\$ 5.00
MRF422	39.50	MRF476	3.50
MRF433	14.50	MRF477	13.00
MRF435	42.00	SD1407	37.00
MRF449	14.50	SD1487	28.00
MRF454A	14.50	S10-12	14.50

VHF & UHF TRANSISTORS

Type	Mount	Rating	MHz	Net/Pr
MRF238	(S)	30W	145-175	\$13.00
MRF240	(S)	40W	145-175	15.00
MRF245	(F)	80W	130-175	27.00
MRF247	(F)	80W	130-175	27.00
MRF492	(F)	70W	27-50	20.00
SD1416	(F)	80W	130-175	29.50
SD1477	(F)	125W	130-175	37.00
SD1441	(F)	150W	130-175	83.50
2N6081	(S)	15W	130-175	7.75
2N6082	(S)	25W	130-175	9.75
2N6083	(S)	30W	130-175	9.75
2N6084	(S)	40W	130-175	12.00
2SC1955	—	1W	130-175	15.00
2SC2289	—	5W	130-175	20.00
MRF641	(F)	15W	430-470	18.00
MRF644	(F)	25W	430-470	21.50
MRF646	(F)	45W	430-470	24.50
MRF648	(F)	60W	430-470	33.50

Technical Assistance and cross-reference information on CD, PT, RF, SRF & SD PIN's. Call our Engineering Dept. (619) 744-0728 WE SHIP SAME DAY C.O.D. or VISA/M.C. Minimum Order \$20.00 Add \$3.50 Shipping RF Parts Catalog Avail. OEM & Quantity Discounts ORDERS ONLY 800-854-1927 ✓ 196

short circuit optical FM receiver

In the article by Poon and Pieper, "Construct an Optical FM Receiver," on page 53 of the November, 1983, issue, error was inadvertently introduced in editing. The text should read as follows:

"The deflection angle ϕ_d (measured outside the cell) between the incident beam of light and the first order light (beam) equals

$\lambda_0/\Lambda = \lambda_0 \cdot f/V_s$ where f is the frequency and V_s is the velocity of sound.

Incident light is most efficiently diffracted when the incident angle equals

$\lambda_0/2\Lambda_c$ where Λ_c refers to the center of the band."

hy-gain®

NEW! ONE GREAT MICROPHONE IN FOUR FAVORITE FLAVORS

Our finest electret transducer suspended in a housing acoustically engineered for optimum voice communications. Improved audio from any voice—more punch and great to hear. Selectable Hi/Lo Z. Universal Battery powered FET Preamp delivers "Heavy Duty" Output—will fully modulate any rig. Immune to RFI.

PRO-COM 250

PRO-COM 350



- Built to last.
- Super soft earcup and head cushions.
- Noise cancelling mic. superb VOX action.
- Isolates you from surrounding noise and vice versa.
- Swing the boom up and you have a great pair of earphones for CW.

- The ultimate in comfort.
- Noise cancelling mic. great VOX action using built-in earphone or station loudspeaker.
- Use headband supplied or clip to eyeglass bow.

PRO-COM 352-IC

PRO-COM 400



- Special Pro-Com 350 with connectors to plug into ICOM Ham Hand Helds.
- Uses DC from transceiver.
- PTT switch with belt clip.

- First notable advance since the dynamic transducer. A new standard of great sound.
- Die cast metal—you won't tip this one over.
- No "Handling" noise.
- Switching for VOX operation or Manual PTT with lock-on.
- Shielded hi-flex cord.

FS-1 Foot Switch

HS-1 Hand Switch In line push-to-talk switch

See them at your favorite Telex/Hy-Gain Distributor

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.

UHF POWER AMP

AM-6155/GRT (ITT 3212) 225-400 Mhz RF amp, 50W output from 4-10W input using Eimac X651Z; silver-plated cavity in removable drawer. Requires 115/230 VAC & 20 VDC. 7x19 1/2x18", 75 lbs. sh. Used-not tested, excellent condition: \$149.50



R-392 RECEIVER, 0.5-32 Mhz AM-CW in 32 bands; mechanical digital tuning, 2-4-8 KHz bandwidth; 100 KHz calibrator. 25 tubes; requires 24 VDC 5 amps. 11 1/2x14 1/2x11", 60 lbs. sh. Used-repairable. \$135. Chkd., \$200. Manual, partial repro: \$15. LS-166 speaker, \$10.95. 24 VDC 6 AMP Supply, for R-392—no connector, used: \$25. 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 ✓ 131

SAY
YOU SAW
IT IN
ham radio!

1983-1984

AMATEUR RADIO

CALL DIRECTORY

THE BARGAIN AT \$14.95 Plus Shipping

A no frills directory of over 435,000 U.S. Radio Amateurs. 8 1/2 x 11, 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.

Dealer / Club inquiries welcome

Send your order—enclosing check or money order in U.S. dollars to:

Buckmaster Publishing

Whitehall

Mineral, VA 23117 U.S.A. ✓ 115



the 2-meter V-antenna

I am always on the lookout for new antennas for HF and VHF applications because they represent projects that can be assembled on a weekend at minimum cost, with maximum enjoyment. Recently, the V antenna came to my attention as a possible 2-meter portable radiator.

The V antenna (see fig. 1) consists of two long wires spreading apart from one end in an angle of less than 90 degrees at the apex (known as the apex angle). The maximum direction of radiation bisects the angle, requiring careful placement for best results. The leg length determines the overall gain and directivity of the system as well as the apex angle. I chose a leg length of 2.25 wavelengths and a 65-degree apex angle resulting in a 15-foot long wire antenna for 2 meters. (Charts are available if you wish to use a different leg length.)¹

To determine the length in feet for a frequency of 146.9 MHz, I used the following expression:

$$L = 984(N - 0.025)/F$$

where L = length in feet

N = number of wavelengths

F = frequency (MHz)

Solving for:

$$L = 984(2.25 - 0.025)/146.9$$

$$L = 14.9 \text{ feet} = 14 \text{ feet } 11 \text{ inches}$$

construction

I used No. 22 gauge stranded insulated hookup wire for the antenna for several reasons. The wire is very flexible and does not end up in a tangle during storage. More importantly, the wire is available at any electronic supply store and is not expensive.

By Thomas M. Hart, AD1B, 32 Westwood Terrace, Westwood, Massachusetts 02026

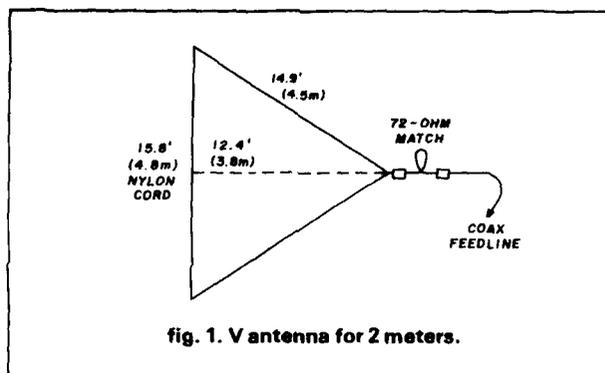


fig. 1. V antenna for 2 meters.

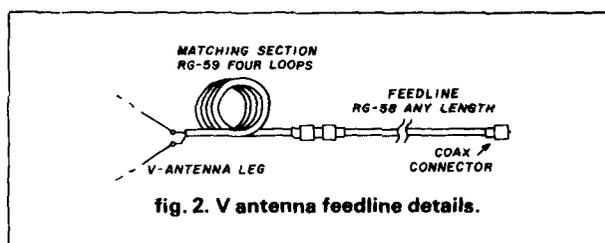


fig. 2. V antenna feedline details.

A recent article by Bill Orr² discussed the problem of feeding V antennas. I found his solution quite satisfactory for 2 meters. A 50-ohm coax line services the system, matched by a 1/4-wavelength section of 75-ohm coax.

The length can be found using the following:

$$L = 246(V)/F$$

where V = velocity factor

F = frequency (MHz)

L = length (feet)

$$L = 246(0.66)/146.9$$

$$= 1 \text{ foot } 1 \text{ inch for RG-59 (73 ohm)}$$

The Orr article recommends forming the matching section into four loops to "decouple the outside of the line from the antenna currents."

The completed antenna, run as a horizontal V, loaded well (SWR 1.1:1) and enabled me to easily access the desired repeaters. So, if you are interested in a different solution to the perennial antenna problem, try this conversation piece. In terms of efficiency, the reference texts indicate that a V with 2.25 wavelength legs has a theoretical gain of 4.5 dB over a halfwave dipole. The V antenna will provide a substantially better signal than the usual 1/4-wave coat-hanger vertical.

references

1. *The Radio Amateur's Handbook*, ARRL, 1980, pages 20-7 to 20-9.
2. William I. Orr, W6SAI, "Ham Radio Techniques," *ham radio*, July, 1983, page 42.

ham radio

ASTRON POWER SUPPLIES

• HEAVY DUTY • HIGH QUALITY • RUGGED • RELIABLE •

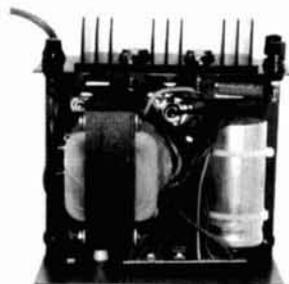
RS and VS SERIES

SPECIAL FEATURES

- SOLID STATE ELECTRONICALLY REGULATED
- FOLD-BACK CURRENT LIMITING Protects Power Supply from excessive current & continuous shorted output.
- CROWBAR OVER VOLTAGE PROTECTION on all Models except RS-4A.
- MAINTAIN REGULATION & LOW RIPPLE at low line input Voltage.
- HEAVY DUTY HEAT SINK • CHASSIS MOUNT FUSE
- THREE CONDUCTOR POWER CORD
- ONE YEAR WARRANTY • MADE IN U.S.A.

PERFORMANCE SPECIFICATIONS

- INPUT VOLTAGE: 105 - 125 VAC
- OUTPUT VOLTAGE: 13.8 VDC \pm 0.05 volts (Internally Adjustable: 11-15 VDC)
- RIPPLE: Less than 5mv peak to peak (full load & low line)



INSIDE VIEW - RS-12A



MODEL RS-50A



MODEL RS-50M



MODEL VS-50M

RM-A Series



MODEL RM-35A

19" X 5 1/4" RACK MOUNT POWER SUPPLIES

Model	Continuous Duty (AMPS)	ICS* (AMPS)	Size (IN) H X W X D	Shipping Wt. (lbs.)
RM-35A	25	35	5 1/4 x 19 x 12 1/2	38
RM-50A	37	50	5 1/4 x 19 x 12 1/2	50

RS-A SERIES



MODEL RS-7A

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H x W x D	Shipping Wt (lbs)
RS-4A	3	4	3 3/4 x 6 1/2 x 9	5
RS-7A	5	7	3 3/4 x 6 1/2 x 9	9
RS-7B	5	7	4 x 7 1/2 x 10 3/4	10
RS-10A	7.5	10	4 x 7 1/2 x 10 3/4	11
RS-12A	9	12	4 1/2 x 8 x 9	13
RS-20A	16	20	5 x 9 x 10 1/2	18
RS-35A	25	35	5 x 11 x 11	27
RS-50A	37	50	6 x 13 3/4 x 11	46

RS-M SERIES



MODEL RS-35M

- Switchable volt and Amp meter

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H x W x D	Shipping Wt (lbs)
RS-12M	9	12	4 1/2 x 8 x 9	13
RS-20M	16	20	5 x 9 x 10 1/2	18
RS-35M	25	35	5 x 11 x 11	27
RS-50M	37	50	6 x 13 3/4 x 11	46

VS-M SERIES



MODEL VS-20M

- Separate Volt and Amp Meters
- Output Voltage adjustable from 2-15 volts
- Current limit adjustable from 1.5 amps to Full Load

MODEL	Continuous Duty (Amps) @13.8VDC@10VDC@5VDC	ICS* (Amps) @13.8V	Size (IN) H x W x D	Shipping Wt (lbs)
VS-20M	16 9 4	20	5 x 9 x 10 1/2	20
VS-35M	25 15 7	35	5 x 11 x 11	29
VS-50M	37 22 10	50	6 x 13 3/4 x 11	46

RS-S SERIES



MODEL RS-12S

- Built in speaker

MODEL	Continous Duty (Amps)	ICS* Amps	Size (IN) H x W x D	Shipping Wt (lbs)
RS-7S	5	7	4 x 7 1/2 x 10 3/4	10
RS-10S	7.5	10	4 x 7 1/2 x 10 3/4	12
RS-10L(For LTR)	7.5	10	4 x 9 x 13	13
RS-12S	9	12	4 1/2 x 8 x 9	13
RS-20S	16	20	5 x 9 x 10 1/2	18

RAMSEY

THE FIRST NAME IN ELECTRONIC TEST GEAR



NEW FROM RAMSEY 20 MHz DUAL TRACE OSCILLOSCOPE

Unsurpassed quality at an unbeatable price, the Ramsey oscilloscope compares to others costing hundreds more. Features include a component testing circuit that will allow you to easily test resistors, capacitors, digital circuits and diodes • TV video sync filter • wide bandwidth & high sensitivity • internal graticule • high quality rectangular CRT • front panel trace rotator • Z axis • high sensitivity x-y mode • very low power consumption • regulated power supply • built-in calibrator • rock solid triggering • high quality hook-on probes

\$39995

high quality hook-on probes included



RAMSEY D-1100 VOM-MULTITESTER

Compact and reliable, designed to service a wide variety of equipment. Features include • mirror back scale • double-jeweled precision moving coil • double overload protection • an ideal low cost unit for the beginner or as a spare back-up unit.

\$1995

test leads and battery included

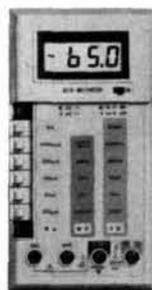


RAMSEY D-2100 DIGITAL MULTITESTER

A compact easy to use unit designed to operate like a pro. Featuring • 3 1/2 digit LCD • low BAT. indicator • all range overload protection • overrange indication • auto-polarity • transistor tester • dual-slope integration • vinyl carrying case

\$5495

hfe test leads, battery & vinyl carrying case included



RAMSEY D-3100 DIGITAL MULTIMETER

Reliable, accurate digital measurements at an amazingly low cost • In-line color coded push buttons, speeds range selection • abs plastic tilt stand • recessed input jacks • overload protection on all ranges • 3 1/2 digit LCD display with auto zero, auto polarity & low BAT. indicator

\$5995

test leads and battery included



CT-70 7 DIGIT 525 MHz COUNTER

Lab quality at a breakthrough price. Features • 3 frequency ranges each with pre amp • dual selectable gate times • gate activity indicator • 50mV @ 150 MHz typical sensitivity • wide frequency range • 1 ppm accuracy

\$11995

wired includes AC adapter

CT-70 kit \$99.95
BP-4 nicad pack 8.95



CT-90 9 DIGIT 600 MHz COUNTER

The most versatile for less than \$300. Features 3 selectable gate times • 9 digits • gate indicator • display hold • 25mV @ 150 MHz typical sensitivity • 10 MHz timebase for WWW calibration • 1 ppm accuracy

\$14995

wired includes AC adapter

CT-90 kit \$129.95
OV-1 0.1 ppm Oven Time base 59.95
BP-4 nicad pack 8.95



CT-125 9 DIGIT 1.2 GHz COUNTER

A 9 digit counter that will outperform units costing hundreds more. • gate indicator • 24mV @ 150 MHz typical sensitivity • 9 digit display • 1 ppm accuracy • display hold • dual inputs with preamps

\$16995

wired includes AC adapter

CT-125 kit \$149.95
BP-4 nicad pack 8.95



CT-50 8 DIGIT 600 MHz COUNTER

A versatile lab bench counter with optional receive frequency adapter, which turns the CT-50 into a digital readout for most any receiver • 25 mV @ 150 MHz typical sensitivity • 8 digit display • 1 ppm accuracy

\$16995

wired

CT-50 kit \$139.95
RA-1 receiver adapter kit 14.95



DM-700 DIGITAL MULTIMETER

Professional quality at a hobbyist price. Features include 26 different ranges and 5 functions • 3 1/2 digit, 1/2 inch LED display • automatic decimal placement • automatic polarity

\$11995

wired includes AC adapter

DM-700 kit \$99.95
MP-1 probe set 4.95



PS-2 AUDIO MULTIPLIER

The PS-2 is handy for high resolution audio resolution measurements, multiplies UP in frequency • great for PL tone measurements • multiplies by 10 or 100 • 0.01Hz resolution & built-in signal preamp/conditioner

\$4995

wired includes AC adapter

PS-2 kit \$39.95



PR-2 COUNTER PREAMP

The PR-2 is ideal for measuring weak signals from 10 to 1,000 MHz • flat 25 db gain • BNC connectors • great for sniffing RF • ideal receiver/TV preamp

\$4495

wired includes AC adapter

PR-2 kit \$34.95



PS-1B 600 MHz PRESCALER

Extends the range of your present counter to 600 MHz • 2 stage preamp • divide by 10 circuitry • sensitivity: 25mV @ 150 MHz • BNC connectors • drives any counter

\$5995

wired includes AC adapter

PS-1B kit \$49.95

ACCESSORIES FOR RAMSEY COUNTERS

Telescopic whip antenna—BNC plug \$ 8.95
High impedance probe, light loading 16.95
Low pass probe, audio use 16.95
Direct probe, general purpose use 13.95
Tilt ball, for CT-70, 90, 125 3.95



PHONE ORDERS CALL
716-586-3950

TELEX 466735 RAMSEY CI

TERMS: • satisfaction guaranteed • examine for 10 days; if not pleased return in original form for refund • add 6% for shipping and insurance to a maximum of \$10.00 • overseas add 15% for surface mail • COD add \$2.50 • orders under \$10.00 add \$1.50 • NY residents add 7% sales tax • all kits have a 90 day parts warranty. All wired units have 1 year parts and labor warranty.

RAMSEY

RAMSEY ELECTRONICS, INC.
2575 Baird Rd., Dept. HR
Penfield, N. Y. 14526

We now have available a bunch of goodies too good to bypass. Items are limited so order today

716-586-3950

Call your Phone Order in Today. TERMS: Satisfaction guaranteed or money refunded. C.O.D. add \$2.50. Minimum order \$6.00. Orders under \$10.00 add \$1.50. Add 6% for postage, insurance, handling. Overseas add 15%. N.Y. residents add 7% tax.

**MINI KITS - YOU HAVE SEEN THESE BEFORE NOW
HERE ARE OLD FAVORITE AND NEW ONES TOO.
GREAT FOR THAT AFTERNOON HOBBY.**

<p>FM MINI MIKE</p>  <p>A super high performance FM wireless mike kit! Transmits a stable signal up to 300 yards with exceptional audio quality by means of its built in electret mike. Kit includes case, mike, on-off switch, antenna battery and super instructions. This is the finest unit available!</p> <p>FM-3 Kit \$14.95 FM-3 Wired and Tested 19.95</p>	<p>Color Organ</p> <p>See music come alive! 3 different lights flicker with music. One light each for high, mid-range and low. Each individually adjustable and drives up to 300 W. runs on 110 VAC</p> <p>Complete kit, ML-1 \$8.95</p>	<p>Video Modulator Kit</p> <p>Converts any TV to video monitor. Super stable. Tunable over ch. 4-6. Runs on 5-15V accepts std. video signal. Best unit on the market! Complete kit VD-1 \$7.95</p>	<p>Led Blinky Kit</p> <p>A great attention getter which alternately flashes 2 jumbo LEDs. Use for name badges, buttons, warning panel lights, anything! Runs on 3 to 15 volts. Complete kit, BL-1 \$2.95</p>	<p>Super Sleuth</p> <p>A super sensitive amplifier which will pick up a pin drop at 15 feet! Great for monitoring baby's room or as general purpose amplifier. Full 2 W rms output runs on 6 to 15 volts. uses 8-45 ohm speaker. Complete kit, BN-9 \$5.95</p>
	<p>FM Wireless Mike Kit</p>  <p>Transmits up to 300' to any FM broadcast radio, uses any type of mike. Runs on 3 to 9V. Has added sensitive mike preamp stage</p> <p>FM-1 kit \$3.95 FM-2 kit \$4.95</p>	<p>Whisper Light Kit</p> <p>An interesting kit, small mike picks up sounds and converts them to light. The louder the sound, the brighter the light. Includes mike, controls up to 300 W. runs on 110 VAC. Complete kit, WL-1 \$6.95</p>	<p>Tone Decoder</p> <p>A complete tone decoder on a single PC board. Features: 400-5000 Hz adjustable range via 20 turn pot, voltage regulation 567 IC. Useful for touch-tone burst detection. FSK, etc. Can also be used as a stable tone encoder. Runs on 5 to 12 volts. Complete kit, TD-1 \$5.95</p>	<p>Siren Kit</p> <p>Produces upward and downward wail characteristic of a police siren. 5 W peak audio output, runs on 3-15 volts, uses 3-45 ohm speaker. Complete kit, SM-3 \$2.95</p>
<p>Universal Timer Kit</p> <p>Provides the basic parts and PC board required to provide a source of precision timing and pulse generation. Uses 555 timer IC and includes a range of parts for most timing needs.</p> <p>UT-5 Kit \$5.95</p>	<p>Mad Blaster Kit</p> <p>Produces LOUD ear shattering and attention getting siren like sound. Can supply up to 15 watts of obnoxious audio. Runs on 6-15 VDC.</p> <p>MB-1 Kit \$4.95</p>	<p>60 Hz Time Base</p> <p>Runs on 5-15 VDC. Low current (2.5ma). 1 month accuracy. TB-7 kit \$5.50 TB-7 Assy \$9.95</p>		

CLOCK KITS

Your old favorites are here again. Over 7,000 Sold to Date. Be one of the gang and order yours today!



Try your hand at building the finest looking clock on the market. Its satin finish anodized aluminum case looks great anywhere, while six .4" LED digits provide a highly readable display. This is a complete kit, no extras needed, and it only takes 1-2 hours to assemble. Your choice of case colors: silver, gold, black (specify).

Clock kit, 12/24 hour, DC-5 \$24.95
Clock with 10 min. ID timer, 12/24 hour, DC-10 \$29.95

For wired and tested clocks add \$10.00 to kit price. SPECIFY 12 OR 24 HOUR FORMAT

SATELLITE TV KIT



image rejection, fully tunable audio to recover "hidden" subcarriers, divide by two PLL demodulator for excellent threshold performance, tight tracking AFC to assure drift free reception, and of course, full 24 channel tunable coverage.

Build your satellite TV system around the R2B, close to ten thousand others already have and now it's available in kit form at a new low price. Order yours today.

THE POPULAR SAT-TEC RECEIVER IN KIT FORM!

NEW, LOWER PRICES!

Featured in a Radio Electronics magazine cover story (May 82), the reliable R2B Sat-Tec TV receiver is now operating in thousands of locations. The R2B is easy to build, pre-etched, plated boards with screened component layout assures accurate component placement and the critical IF section and local oscillator are pre-assembled and aligned! All parts are included for the R2B, attractive case, power supply, descriptive operating manual, as well as complete assembly instructions. Features of the receiver include: dual conversion design for best

A complete Satellite TV System requires a dish antenna, LNA (low noise amplifier), Receiver and Modulator.

R2B Receiver Kit \$295.00
R2B Receiver, Wired and Tested \$385.00
120" K. LNA \$295.00
RM3 RF Modulator \$49.95
Prices include domestic UPS shipping and insurance.

PARTS PARADE

IC SPECIALS

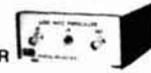
<p>LINEAR</p> <p>301 \$.35 324 \$1.50 380 \$1.50 555 \$.45 556 \$1.00 565 \$1.00 566 \$1.00 567 \$1.25 741 \$2.00 1458 \$.50 3900 \$.50 3914 \$2.95 8038 \$2.95</p>	<p>TTL</p> <p>74S00 \$ 4.40 7447 \$.65 7475 \$.50 7490 \$.50 74196 \$1.35</p>	<p>Resistor Ass't</p> <p>Assortment of Popular values - 1/4 watt. Cut lead for PC mounting. 1/2" center. 1/2" leads. bag of 300 or more \$1.50</p>	<p>Crystals</p> <p>3.579545 MHZ \$1.50 10 000000 MHZ \$5.00 5.248800 MHZ \$5.00</p>
<p>CMOS</p> <p>4011 \$.50 4013 \$.50 4046 \$1.85 4049 \$.50 4059 \$9.00 4511 \$2.00 4518 \$1.35 5639 \$1.75</p>	<p>SPECIAL</p> <p>1NC90 \$15.00 10116 \$1.25 7208 \$17.50 7207A \$ 5.50 7216D \$21.00 7107C \$12.50 5314 \$ 2.95 5375AB/G \$ 2.95 7001 \$ 6.50</p>	<p>Switches</p> <p>Mini toggle SPDT \$1.00 Red Pushbuttons N/O 3/\$1.00</p>	<p>AC Adapters</p> <p>Good for clocks, micad chargers, all 110 VAC plug one end.</p> <p>8.5 vdc @ 20 mA \$1.00 16 vdc @ 160mA \$2.50 12 vdc @ 250mA \$3.00</p>
<p>FERRITE BEADS</p> <p>With info and specs \$5/\$1.00 6 Hole Barium Beads \$3/\$1.00</p>	<p>DC-DC Converter</p> <p>-5 vdc input prod. -9 vdc @ 30ma -9 vdc produces -15 vdc @ 35ma \$1.25</p>	<p>Slugs Tuned Coils</p> <p>Small 3/16" Hex Slugs turned coil. 3 turns 10 for \$1.00</p>	<p>AC Outlet</p> <p>Panel Mount with Leads. 4/\$1.00</p>
<p>READOUTS</p> <p>FND 359 4" C.C. \$1.00 FND 507.510 5" C.A. 1.00 MAN 72/HF730 33" C.A. 1.00 HP 7651 43" C.A. 2.00</p>	<p>Crystal Microphone</p> <p>Small 1" diameter, 1/4" thick crystal mike cartridge. \$7.5</p>	<p>Coax Connector</p> <p>Chassis mount BNC type \$1.00</p>	<p>9 Volt Battery Clips</p> <p>Nice quality clips 5 for \$1.00 "N" Rubber Grommets 10 for \$1.00</p>
<p>TRANSISTORS</p> <p>2N3904 NPN C-F \$15/\$1.00 2N3906 PNP C-F \$15/\$1.00 2N4403 PNP C-F \$15/\$1.00 2N4410 NPN C-F \$15/\$1.00 2N4916 FET C-F \$4/\$1.00 2N5401 PNP C-F \$5/\$1.00 2N6028 C-F \$4/\$1.00 2N3771 NPN Silicon \$1.50 2N5179 UHF NPN \$3/\$2.00 Power Tab. NPN 40W \$3/\$1.00 Power Tab. PNP 40W \$3/\$1.00 MPF 102 2N5484 \$.50 NPN 3904 Type T-R \$0/\$2.50 PNP 3906 Type T-R \$0/\$2.50 2N3055 \$.80 2N2646 JLT \$3/\$2.00</p>	<p>Parts Bag</p> <p>Ass't of chokes, disc caps, tantal resistors, transistors, diodes, MICA caps etc. am. bag (100 pcs) \$1.00 lg. bag (300 pcs) \$2.50</p>	<p>LEDs - your choice, please specify</p> <p>Mini Red, Jumbo Red, High Intensity Red, Illuminator Red \$8/\$1 Mini Yellow, Jumbo Yellow, Jumbo Green 6/\$1</p>	<p>Connectors</p> <p>6 pin type gold contacts for mA-1003 car clock module price 75 ea.</p>
<p>25 AMP 100V Bridge \$1.50 each</p> <p>Mini-Bridge 50V 1 AMP 2 for \$1.00</p>	<p>Varactors</p> <p>Motorola MV 2209 30 PF Nonlinear cap 20-80 PF - Tunable range - \$0.50 each or 3/\$1.00</p>	<p>Shrink Tubing Nubs</p> <p>Nice precut pcs of shrink size 1" x 1/4" shrink to 1/8" Great for splices \$0/\$1.00</p>	<p>Opto Isolators - 4N28 type</p> <p>Photo Reflectors - Photo diode + LED \$1.00 ea.</p>

Audio Prescaler

Make high resolution audio measurements, great for musical instrument tuning, PL tones, etc. Multiplies audio UP in frequency, selectable x10 or x100 gives 01 Hz resolution with 1 sec gate time! High sensitivity of 25 mv, 1 meg input z and built-in filtering gives great performance. Runs on 9V battery, all CMOS.

PS-2 kit \$29.95
PS-2 wired \$39.95

600 MHz PRESCALER



Extend the range of your counter to 600 MHz. Works with all counters. Less than 150 mv sensitivity. specify -10 or -100.

Wired, tested, PS-1B \$59.95
Kit, PS-1B \$44.95

30 Watt 2 mtr PWR AMP

Simple Class C power amp features 8 times power gain. 1 W in for 8 out, 2 W in for 15 out, 4W in for 30 out. Max output of 35 W, incredible value, complete with all parts, less case and T-R relay.

PA-1, 30 W pwr amp kit \$22.95
TR-1, RF sensed T-R relay kit 6.95

Power Supply Kit

Complete triple regulated power supply provides variable 6 to 18 volts at 200 ma and +5 at 1 Amp. Excellent load regulation, good filtering and small size. Less transformers, requires 6.3 V, 1 A and 24 VCT. Complete kit PS-3LT \$6.95

RF actuated relay senses RF (1W) and closes DPDT relay

For RF sensed T-R relay TR-1 Kit \$6.95

OP-AMP Special

BI-FET LF 13741 - Direct pin for pin 741 con. input z, super low 50 pa input current, but 500,000 MEG power drain

50 for only \$9.00 10 for \$2.00

Regulators

78M \$1.25
79M \$1.25
723 \$.50
309K \$1.15
7805 \$1.00

7812 \$1.00
7815 \$1.00
7905 \$1.25
7912 \$1.25
7915 \$1.25

Mini TO-92 Heat Sinks

Thermalloy Brand 5 for \$1.00
To-220 Heat Sinks 3 for \$1.00

Molex Pins

Molex already precut in length of 7. Perfect for 14 pin sockets. 20 strips for \$1.00

CDS Photocells

Resistance varies with light, 250 ohms to over 3 meg. 3 for \$1.00

NCG WORLD BAND COMMUNICATIONS



Just
Slightly
Ahead



15M

Tested and Proven 15 Meter Mobile Transceiver USB and CW

Power-High 10 watts, Low 2 watts
VFO Tuning, Noise Blanker
Fine Tune ± 1 kHz
Digital Frequency Counter
13.8 VDC @ 3A Neg. Ground
9.5" L x 9" W x 2.5" H
All this PLUS the freedom of DXing

160/10M

ALL NEW, with the features you have been waiting for
HF 160-10 meters SOLID STATE Transceiver 200 watt PEP
All 9 HF Bands ready to go
AC/DC Power supply built in
3-Step Tuning 1 kHz/100Hz/25Hz
4 memories, Auto Scan
Automatic Up/Down Tuning Advanced Systems
Dual VFO, Solid State-Adjustment Free, IF Tuning, IF Offset
Noise Blanker, Mic. Compressor
VOX, CW Side tone, AC 120V DC 13.8 RTTY-Fax operation
USB-LSB CW (Narrow CW filter optional).



1275 North Grove Street
Anaheim, CA 92806
(714) 630-4541

Mail Order COD
Visa Master Charge
Cable: NAT COLGLZ

Prices and specifications subject to change without notice or obligation
Calif. Res. add Sales Tax

✓ 168

TOWERS by ALUMA

HIGHEST QUALITY
ALUMINUM & STEEL

60 Ft. Alum. TELESCOPING (CRANK-UP)
Crank-Up GUYED (STACK-UP)
Model T-60-H

TILT-OVER MODELS
Easy to install. Low Prices.
Crank-ups to 100 ft.

EXCELLENT FOR
AMATEUR COMMUNICATIONS

Mobile Trailer Type



40" Steel
Crank-Up
Model SH0-40

Mobile Truck Type



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

Fixed Base



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

ALUMA TOWER COMPANY

BOX 2806HR
VERO BEACH, FLA. 32960-2806
(305) 567-3423 TELEX 80-3405

SURPLUS SALES of NEBRASKA

CALL OR WRITE FOR LATEST CATALOG

VACUUM CAPACITORS SWITCHES CAPACITORS
VACUUM RELAYS FUSES/BREAKERS RESISTORS
RF CONNECTORS DISPLAYS RELAYS
INDUCTORS IC'S CONNECTORS
TUBES DIODES TRANSISTORS
RECTIFIERS

JANUARY SPECIALS

Dipped Silver Mica Capacitors MIL-SPEC, 500V, 5%	Monolithic Ceramic CK Series, MIL-SPEC 50V, 100V, 200V 10%	
1-100pf	\$0.15	\$0.15
110-500pf	\$0.25	\$0.15
510-1000pf	\$0.30	\$0.15
1100-2000pf	\$0.50	\$0.20
2200-5000pf	\$0.70	\$0.20
0.0051-01uf	\$0.80	\$0.25
0.012-02uf	\$1.00	\$0.30
0.022-03uf	\$2.00	\$0.30
0.033-05uf	\$3.50	\$0.40
0.056-1uf	\$4.50	\$0.55
0.12-33uf	--	\$0.60
0.39-82uf	--	\$1.00
1uf	--	\$1.50

COLLINS PARTS SPECIALISTS ✓ 187

Phone (402) 733-9190 6-10 PM CST
2412 Chandler Rd., Bellevue, NE 68005

SAY YOU SAW IT
IN
HAM RADIO



July 28 thru Aug. 10, 1984

Our 25th year

TAKE A VACATION WITH
A PURPOSE THIS YEAR

Join students from around the world at
OAK HILL'S
SILVER ANNIVERSARY
Session

Over 25 years of successful teaching experience
means upgrading is as easy as 1-2-3.

Your vacation is spent in the beautiful Blue
Ridge Mountains of Virginia with expert in-
structors in friendly surroundings and with ex-
cellent accommodations.

Oak Hill also has a ham lab set up for all to use.

Courses offered are:
Novice to General
General or Tech to Advanced
Advanced to Extra

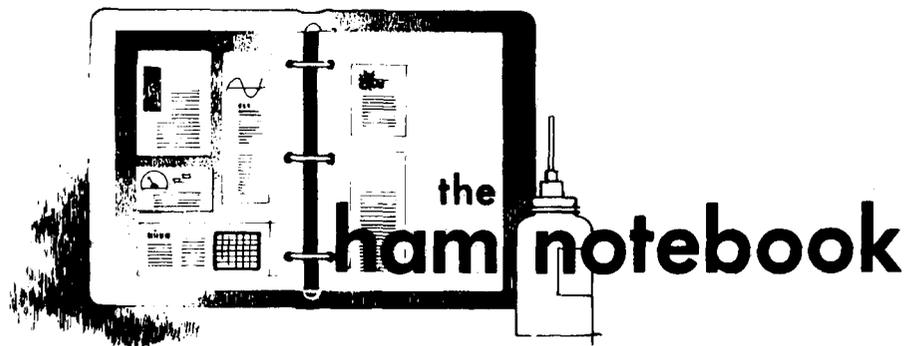
Learn — don't just memorize the answers to
the exam questions.

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 circuits for repeaters

Unmanned repeater operation requires the use of remote control circuits. Figs. 1, 2, and 3 illustrate three popular circuits that enhance repeater operation: the autopatch phone line interface, the phone auto answer and ring indicator, and the TouchTone™ sequence decoder. All three are constructed of easy-to-find components.

autopatch phone line interface

Fig. 1 is a schematic diagram of a repeater-to-phone line interface for use as an autopatch. Its function is to provide for the receiver-to-phone line and phone line-to-transmitter link, with both using an opamp for gain. Q1 and Q2 control which audio path is active; when the receiver squelch sense line goes above 1 volt, Q1 conducts. This enables the receiver audio

to pass the phone line. At the same time, Q2 turns off and the phone-to-transmitter audio is disabled. The receiver squelch input, therefore, must provide a high (above 1 volt) when an input is present. When the receiver squelch sense input goes below 0.5 volts, Q1 turns off and Q2 conducts, passing phone-to-transmitter audio and disabling the receiver audio path.

R1 adjusts the receiver-to-phone line audio and R2 adjusts the phone-to-transmitter audio level. R3 is an optional adjustment to allow for passing phone audio to a TouchTone™ decoder.

Transformer T1 isolates the electronics from the phone line and thereby maintains a balanced phone line. Relay RL1 acts as the on/off hook interface for the patch. When RL1 is energized, the phone line will be seized and audio can be passed to and from the phone line to the repeater receiver/transmitter. A low on the "line seize" will energize RL1. Make sure that diode CR2 is in place as shown; otherwise damage to the circuit that energizes RL1 could occur when the relay is turned off.

Diode CR3 and the 100k resistor force the audio circuits to pass receiver-to-phone audio and disable the phone-to-transmitter audio when the autopatch is not in use. This prevents any audio which might be produced from the autopatch circuit from going to the repeater transmitter. Several different types of op amps can be used. In this case, LF353 is used. In choosing a different op amp, the primary consideration should be one of stability.

This circuit has been used by many repeater groups with much success. Problems which might be encountered are primarily with dialing phone numbers. This autopatch circuit will provide for a very flat audio response with low noise and distortion. However, with the typical HT or mobile rig, it is often found that the rolloff characteristics will produce imbalance in the high to low group levels in the TouchTone™ audio. The phone company is becoming more and more

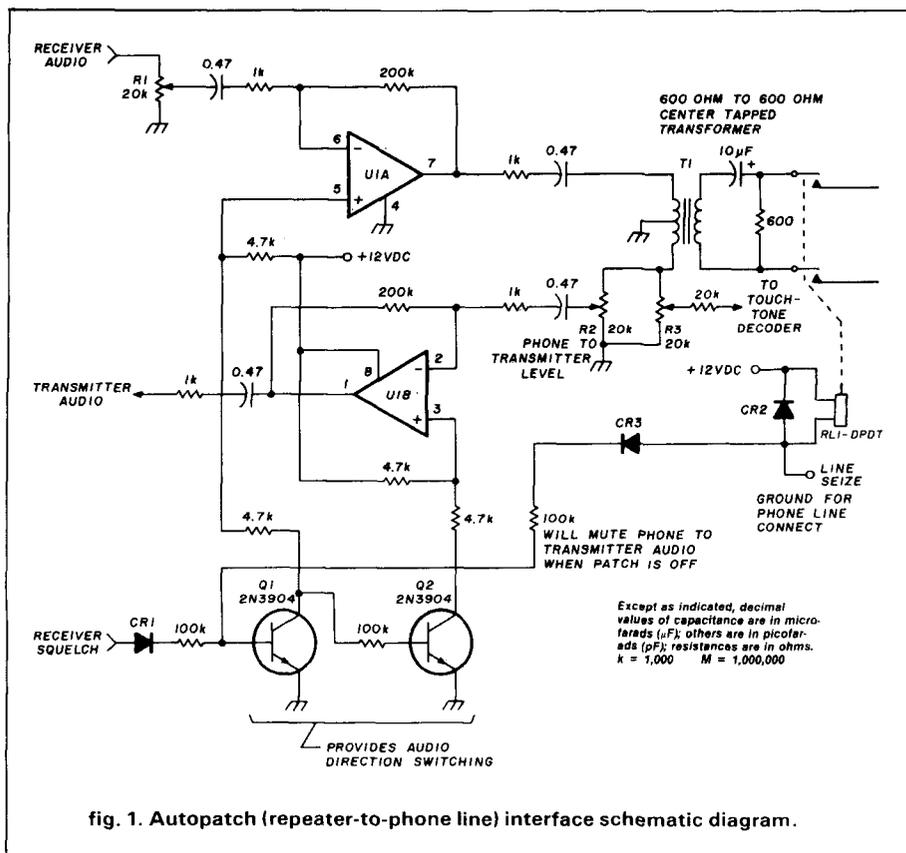


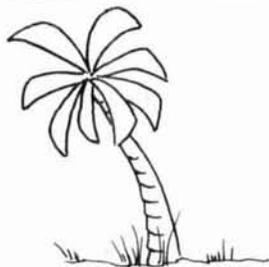
fig. 1. Autopatch (repeater-to-phone line) interface schematic diagram.

24th
ANNUAL

TROPICAL HAMBOREE

FEBRUARY 4 - 5, 1984

FLAGLER DOG TRACK . . . MIAMI, FLORIDA



- Technical Forums
- DX Forum & Dinner
- ARRL Programs
- RTTY Forum
- FCC Exams
- Organizational Meetings
- New Product Exhibits
- Hamboree Dealer Specials
- Mammoth Swap Shop
- Personal Computer Forum
- QCWA Homestyle Hospitality
- International Displays

FREE OVERNIGHT RV PARKING AT HAMBOREE SITE
SPECIAL HOTEL RATES AT HEADQUARTERS HOTEL
WRITE FOR OUR BROCHURE WITH FULL INFORMATION

Registration: \$4.00 Advance . . \$5.00 Door (Valid both days)
Swap Tables, 2 Days: \$14.00 Advance . . \$16.00 Door (plus regis. ticket)
(Advance price deadline, January 31st)

Make checks payable to: DADE RADIO CLUB, INC., P.O. Box 350045, Miami, FL 33135

Exhibit Booth Information: **Mrs. Evelyn Gauzens, W4WYR, Chairman**
2780 N.W. 3 Street, Miami, FL 33125
Telephone: 305-642-4139



**The
HAM SHACK**

808 N. Main Street • Evansville, IN 47711

NOW STOCKS YAESU



BRAND NEW FROM YAESU, the FT-757GX represents the latest in state-of-the-art design. Fully featured and fully equipped. The FT-757GX is an all band, 160-10 meters inclusive, AM/FM/SSB/CW transceiver. The 757GX runs a full 100 watts across all bands. It also has dual VFO's and 8 memory channels for frequency storage. AM and FM modules as well as a 600 Hz CW filter and a keyer module are built in and come at no extra cost. The FT-757GX can also be interfaced with your personal computer using Yaesu's "CAT" system. Accessory PS available soon.

Call Ham Shack today for more information and your price on this and the rest of the Yaesu radio line.

 (812) 422-0231 

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.

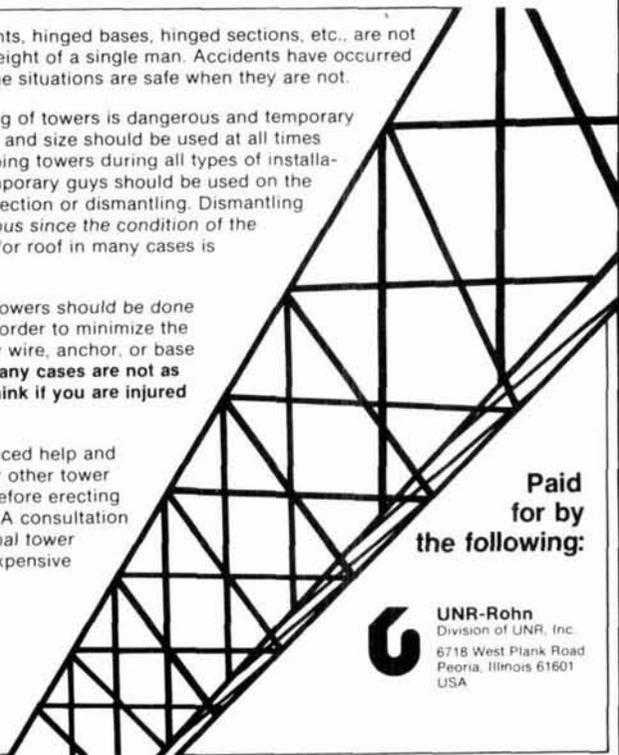
The dismantling of some towers should be done with the use of a crane in order to minimize the possibility of member, guy wire, anchor, or base failures. **Used towers in many cases are not as inexpensive as you may think if you are injured or killed.**

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



almost immediately and the tone generator to give a warbling tone. However, if C1 is inserted, a single pulse will be given for each ring. Thus, the phone will be answered on the eighth ring and the tone generated will be constant while the ring is taking place.

The "clear" input to U2 clears the ring counter when a logic high is present on this line. This input should be connected to the decoder logic, enabling a caller or repeater user to force the disconnect of the phone when desired.

TouchTone™ sequence decoder

Fig. 3 is a schematic diagram of a TouchTone™ sequence decoder circuit. Its purpose is to take active low inputs from a TouchTone™ decoder and react to a proper sequence of digits. The proper sequence is determined by which TouchTone™ digits the user connects to the sequence decoder inputs TT1, TT2, TT3, and TT4. The function of this circuit is most useful for repeater builders that require some sort of logic control such as enabling and disabling functions on the repeater.

The circuit operates on the principle of requiring the digits to arrive in a proper sequence, preventing a function from being activated should a random sequence be entered. For example, if TT1 = TouchTone™ digit 1, TT2 = digit 2, TT3 = digit 3 and TT4 = digit 4, then the code for forcing the output to a logic high is 123. To force the output low the code is 124. If the sequence is dialed in any other order, the sequence decoder will not react to it (for example, dialing 213 will do nothing).

U1 is a "one-shot" which reacts to a pulse from the TT1 input by forcing its Q output, pin 13, to a high for a time determined by R1 and C1. Larger values keep high longer. Using the given values Q remains high for 4 seconds. If TT1 is strobed again during this period the 4-second period will restart. However, if TT1 is not

strobed again, Q will revert back to a logic low. When the Q output is in the low state, no sequence decoding can take place. U1 acts as both a timer and a first digit seeker. After the first digit is dialed the remaining digits of the code must be dialed within 4 seconds. U2A decodes the second digit of the sequence. Upon dialing the second digit, the Q (\bar{Q} not) goes low, enabling the TT3 and TT4 inputs of U3. If TT3 is dialed next, pin 3 of U3 will go low, producing a latched output on U2B's Q output, pin 9. If TT4 is dialed as the third digit, the Q output will be forced low.

Pin 9 of U2B is a latched output and will remain in its state as long as power is maintained or until the proper sequence is dialed forcing Q to another state. Of course if an "ON" code is dialed and the state of the decoder is ON, no change will take place.

C2 and R2 force the Q output of U2B to a low on power up. This feature is most desirable in cases where power may be lost and no one is around to reset the circuit to the desired state, which is the case in most unmanned repeater sites. However, if the desired output state is a high on power up, the user should use the \bar{Q} output. In this case the ON/OFF codes are reversed from the above description.

As shown, the ON/OFF codes are three digits each. However, if only a two-digit code is desired, removing the A part of U2 and connecting U1's \bar{Q} pin 4 output to pins 1 and 4 of U3 will produce a two-digit decoder with the ON code being TT1 and TT3.

The OFF code becomes TT1 and TT4. If more than three digit codes are desired, all one must do is add D-type flip-flops after U2A and before U3 connecting U2A's Q (not \bar{Q}) to the added flip-flops D input and its \bar{Q} output to U3. For each added flip-flop the code is increased by one digit.

The suggested digits for setting up the codes is determined primarily by how the decoder is to be used. In the case where TouchTone™ might be

used for other functions such as dialing numbers on an autopatch, it is most desirable to make sure that a telephone number will not produce the same sequence of digits as a controlling code. Thus, if a controlling code were 123 and a phone number of 844-1235 is dialed, the sequence decoder would react. This can be prevented by making sure that at least one of the digits in a code is not a 0 through 9. Thus, one should use a # or a *, or A, B, C, or D, if 16 digit TouchTone™ pads are desired, for at least one digit of a code.

Ron Wright, N9EE

CLOSE OUT SPECIAL SAVE 50%

1983 Call Directories

The low-cost answer to your call and QTH questions.

AMATEURS LISTED BY AREA AND CALL SIGN

It's finally been done. A complete directory of all licensed Radio Amateurs in the U.S. at three-quarters the price of the other well-known book. Information taken from latest FCC list available. This book is a full 8½" x 11" and is very easy to handle. Generic in appearance but, **oh what a value!** Over 410,000 licensed Amateurs listed.

©1983

BM-CD

Softbound \$10.45

Regularly \$14.95

(\$7.45 + \$3.00 shipping)

Two More Call Directories

Here are two other call directories never before available. See who the other Amateurs are in your area. Find those old friends you lost track of many years ago. Perfect for your club or your own library.

AMATEURS LISTED BY GEOGRAPHICAL LOCATION

Lists Amateurs in each town in U.S. ©1983.

BM-GA

Softbound \$15.50

Regularly \$25.00

(\$12.50 + \$3.00 shipping)

AMATEURS LISTED BY NAME

An alphabetical listing of all U.S. Amateurs.

©1983

BM-AL

Softbound \$15.50

Regularly \$25.00

(\$12.50 + \$3.00 shipping)

HAM RADIO'S BOOKSTORE
Greenville, NH 03048

John J. Meshna Jr., Inc.

19 Allerton Street • Lynn, MA 01904 • Tel: (617) 595-2275



SELF STANDING COMPUTER TERMINALS

We acquired a small number of these beautifully made computer terminals which were made by a major U. S. computer manufacturer. We do not know all the details about them at press time but we can tell you that these terminals cost someone at least \$2,000.00 each. They lose, you win! The terminals feature the following: 3 separate microprocessors for powerful capabilities, 106 key ASCII keyboard for changing the parameters of the installed EAROMs, 16K RAM, 48K ROM, serial RS-232 asynchronous data communications (synchronous optional), selectable baud rates of 75-38.4K BPS, high resolution, 12" green screen, composite video monitor, 80 x 25 line display with expandable character font (40 x 25), scrolling display, built in reverse video option, light weight, self contained, tightly regulated, switching power supply and much more than can be fit in this space. The terminals can be configured in daisy chain format around a central host computer. All units are new or are in like new condition & are checked for completeness prior to shipping. The terminals are sold untested. Each one comes with operator's manual.

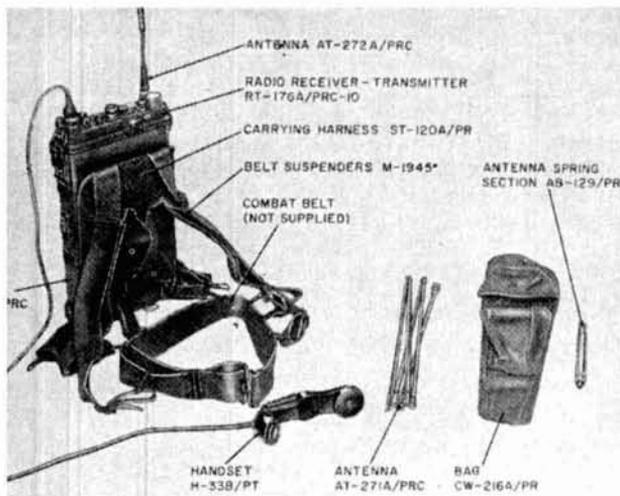
UPS shpg. wt. 55 lb. Stock no. MT-686 \$289.00

We offer the following as options: schematic pac. 3 lb. \$10.00

USRT for synchronous data comm. w/ installation data \$10.00

25' RS232 cable 1 male & 1 female DB25 connector \$20.00

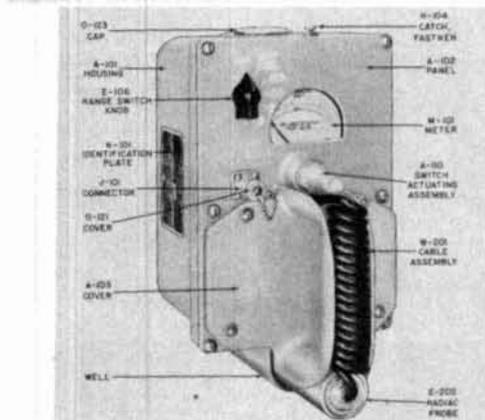
For further info. send \$3.00 for a brochure on this terminal which is applicable to your order for and MT 686.



U. S. RECEIVER TRANSMITTER RT 176/PRC 10 RADIOS

Through a very lucky purchase, we just got a small quantity of new, unused PRC 10 radios. They are just beautiful. Any collector would be proud to have one of these babies in his possession. These radios came bulk packed to us just the way they were shipped from the factory to Uncle Sam. They were never released into the field. We are selling these as complete sets. The picture below shows all accessories that will be shipped with each unit.

RT 176/PRC 10 feature: voice communication, tuneable range of 38-55 MC, super heterodyne FM front end, .9 watt xmtr., range of 5 miles (may vary depending on antenna used & siting conditions), & total wt. w/ accessories of only 16 lb.. Each set will include at no extra cost operators manual, schematic, & 4300 KHz. calibration xtal. They do not come w/ batteries, but they are available commercially. We are selling these as complete sets as shown below for \$100.00 / set. Shpg. wt. 18 lb. The quantity is limited, so act fast.



PDR-27 NAVY RADIATION METER

Just released by the US Navy. They appear to be in excellent condition and include the fitted aluminum transit case. Batteries not furnished but are available in most electronic supply houses. 4 ranges 0.5 to 500 mr/hr. Removable hand probe, detection of Beta and Gamma radiation. With today's world conditions and perhaps proximity to a nuke power station, it might provide a little insurance to own one of these instruments. With no facilities to check or test, we offer AS IS, visually OK Schematic provided with each. We have some accessories and offer as an option although not required for operation.

Shipping wgt. 22 lb. PDR-27 Rad Meter \$50.00

PDR-27 phones \$7.00

Approx. 100 page Instr. Book \$10.00

Hi Sensitivity GM tube \$10.00

Low Sensitivity GM tube \$5.00

The above listed tubes are already installed in the meter.

We are offering these as spares if desired.

PHONE ORDERS accepted on MC, VISA, or AMEX

No COD's. Shpg. extra on above.

Send for free 72 page catalogue jam packed w/ bargains.

ANNUAL LAS VEGAS PRESTIGE CONVENTION

SAROC™



HACIENDA RESORT HOTEL Las Vegas, Nevada

JANUARY 12-13-14-15, 1984

Cocktail Party hosted by **hamradio** MAGAZINE Friday evening for all **SAROC** exhibitors and **SAROC** Advance or Regular paid registered guests. Ladies' Program on Saturday included with **SAROC** Advance or Regular paid registration at no additional charge for ladies who register. Two HACIENDA RESORT HOTEL Breakfasts or Brunches in the Sunburst room are included with each Advance or Regular paid registration; one on Saturday and one on Sunday. Technical sessions, EXHIBITS, and SWAP TABLES open on Friday and Saturday to all **SAROC** paid registered guests. One SWAP TABLE available free to **SAROC** non-commercial guests holding Advance or Regular paid registration. **SAROC** is hosted by Southern Nevada Amateur Radio Club. **SAROC** Advance registration is only \$17.00 per person, if postmarked before January 1, 1984. After January 1, 1984, **SAROC** Regular registration is only \$19.00 per person.

SAROC fee of \$2.00 per person for those who want to attend only **SAROC** technical sessions, visit EXHIBIT and SWAP TABLE area. No admission to any function without a **SAROC** paid registration and wearing the **SAROC** registration badge in plain view. **SAROC** coupon book and cellophane badge holder may be picked up at **SAROC** registration desk. Send check or money order to **SAROC**, P.O. Box 945, Boulder City, NV 89005-0945. Refunds will be made after **SAROC** is over to those requesting same in writing and postmarked before January 12, 1984. Special **SAROC** HACIENDA RESORT HOTEL room rate is \$35.00 (plus .50 for telephone and room tax), per night, single or double occupancy. HACIENDA RESORT HOTEL accommodations request via mail to HACIENDA RESORT HOTEL, P.O. Box 15566, Las Vegas, NV 89114 or call toll free 1 (800) 634-6713. Either way they request a FIRST NIGHT'S DEPOSIT TO BE ASSURED A RESERVATION. **SAROC** 1985 scheduled Jan. 10-13.

----- Clip and mail ASAP to **SAROC**, P.O. Box 945, Boulder City, NV 89005-0945. -----

Enclosed is \$ _____ check or money order (no cash) for _____ **SAROC** Advance Registration(s) @ \$17.00 each: after Jan. 1, 1984 **SAROC** Regular Registration is \$19.00 each.

OM _____ Call _____ License Class _____
Please type or print

YL _____ Call _____ License Class _____
Please type or print

Address _____ City _____
Please type or print

State _____ Zip _____ Telephone No./AC _____

Yes, I want a SWAP Table space (limit one free table per registered guest for Friday and Saturday).

I have attended **SAROC** _____ times. Yes, I plan to attend Ham Radio Magazine Cocktail Party.

I am interested in Antenna, ARRL, Cocktail Party, Computers, CW, DX, FCC, MARS, RTTY, TV, other _____

I receive: CQ, Ham Radio Magazine, QST, QCWA, RTTY, 73, Westlink, Worldradio, other _____

SAROC™

P.O. BOX 945, BOULDER CITY, NEVADA 89005-0945

PRECISION PROCESSING



The E-CLIPS Model III

Provides total dynamic range control with very low distortion

- Selectable processing modes—envelope compression or peak limiting
- Variable high and low frequency response equalization
- Five segment LED display
- Easy to install and use with any transmitter/transceiver

✓ 109

Introductory price—\$189.95 ppd.

For brochure with complete technical specifications contact:

ANALOG TECHNOLOGY

P.O. Box 8964 • Fort Collins, CO 80525

BASIC PROGRAM MANUAL FOR AMATEURS

Programs Design: Quads, beams, trap dipoles, antenna wind load, filters, pads, striplines, op amps, microwave, RF coils, calc. Ohms law, L. C. power, log QSO's, global distances and much more.

All for **\$9.95** (INCLUDES SHIPPING AND HANDLING)

ATTENTION YAESU FT-207R OWNERS



AUTOMATIC SCAN MODULE

15 minutes to install; scan restarts when carrier drops off; busy switch controls automatic scan on-off; includes module and instructions.

Model AS-1 \$25.00

BATTERY SAVER KIT

Model BS-1 \$14.95

- No more dead batteries due to memory backup
- 30% less power drain when squelched
- Simple to install, step-by-step instructions and parts included
- 4 mA memory backup reduced to 500 μ A
- 45 mA receiver drain reduced to 30 mA
- Improved audio fidelity and loudness

✓ 129

ENGINEERING CONSULTING

P.O. BOX 216 DEPT. H
BREA, CALIFORNIA 92621

TUNE IN THE WORLD OF HAM-TV!

Amateur Radio operators in the 1980's are discovering the fascinating "World of Amateur Television". Be it Fast Scan TV (FSTV), Slow Scan TV (SSTV), Facsimile (FAX) or somewhere in between. Video communications modes are growing at an exciting pace!

New advancements are taking place in High-Resolution/Color SSTV and the use of personal computers for ATV graphics. SSTV—FAX—RTTY communications. Interest is even growing in MICROWAVE and TVRO applications.

AS ATV MAGAZINE™ has supported these modes of Amateur Specialized Communications since 1967 — over 17 years! And now, under guidance of the UNITED STATES ATV SOCIETY, HAM-TV will continue to grow rapidly. Interested?

Send SASE for "free" information brochures today!

Special six month TRIAL subscription only \$10.00

One year subscription (12 issues) of the "USATVS Journal" \$20.00

Sample issue available for \$2.50 ppd.

AS ATV MAGAZINE™

P.O. BOX H
LOWDEN, IOWA 52255

A DIVISION OF QED PUBLICATIONS, INC.

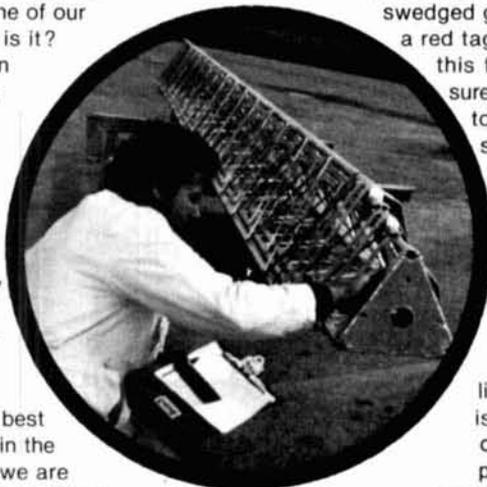
✓ 112



This tower is ready for shipment to one of our customers, or is it? If we were an ordinary tower company, this tower would have already been sent.

We are not an ordinary tower company and that is why this tower did not go out.

We have the best quality control in the business and we are not afraid to say so. That is why when John Pasillas



found a 1/8" clearance on the swedged guide, he placed a red tag of rejection on this tower and made sure it was corrected to 1/16" before he stamped his final approval for shipment.

Every employee at Tri-Ex knows that the reputation you establish in an industry is what will make or break his company. That is why

Tri-Ex has been in business continually since 1955.

When you purchase your tower from Tri-Ex, you can be assured that all welds have been done by certified welders, all construction and galvanizing has met ASTM standards, all towers have been constructed in precision jigs, all steel has been tested for carbon content and tensile strength.

When it goes to shipping, John is ready.

When you decide on Tri-Ex you have many models to choose from.

STACKED:

Light, medium, heavy duty 10 feet and up.

CRANK UPS:

Light, medium, heavy duty 25 feet to 88 feet standard.

SPECIAL TOWERS:

Sky needle, Clementower 37 feet to 180 feet & higher

Introducing Tri-Ex's new DX-86 — 86 feet tall, 25 square feet in a 50 mph wind.

Call you local dealer for details.

FOR ADDITIONAL INFORMATION WRITE TO:



TOWER CORPORATION

7182 Rasmussen Ave.
Visalia, Calif. 93291

P.O. Box 5009

Visalia, California 93278

(209) 651-2171

✓ 192

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.

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

TRAVEL-PAK QSL KIT — Converts post cards, photos to QSLs. Stamp brings circular. Samco, Box 203-c, Wynantskill, New York 12196.

QSL the Best! Full color \$20 for 200. As low as \$7. Free catalog. Rusprint, Box 7575, Kansas City, MO 64116. Credit card order line 1-800-531-7373.

COUNSELORS: Connecticut brother-sister camp. Completely equipped with ham radio station. Program includes electronics, kit building, code and communications. June 25-August 22. Send resume: Lloyd Albin (N2DMQ) Ken-Mont and Ken-Wood Camps, 2 Spencer Place, Scarsdale, NY 10583.

NEED TO CONTACT James Navarchi concerning Yaesu gear. C.T. Huth, 146 Schonhardt St., Tiffin, OH 44883.

COLLECTORS: Collins Phase Locked Master oscillator type 0-243A/FRT24. Freq. range 2-4 MHz. Resolution 5 Hz. Has 100 kHz reference xtal in temp stabilized oven. 19" rack mount 10 1/2" high x 13" deep. Would consider trading for RF test equipment. Ron Stopelli, 486 Wyecroft Road, Oakville, Ontario, Canada L6K 2G7.

Foreign Subscription Agents for Ham Radio Magazine

Ham Radio Austria
Karin Ueber
Postfach 2454
D-7850 Loerrach
West Germany

Ham Radio Belgium
Sierochouse
Brusselsesteenweg 416
B-9218 Gent
Belgium

Ham Radio Canada
Box 400, Goderich
Ontario, Canada N7A 4C7

Ham Radio Europe
Box 2084
S-194 02 Upplands Vasby
Sweden

Ham Radio France
SM Electronic
20 Bis, Ave des Clariens
F-89000 Auxerre
France

Ham Radio Germany
Karin Ueber
Postfach 2454
D-7850 Loerrach
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 Loerrach
West Germany

Ham Radio UK
P.O. Box 63, Harrow
Middlesex HA3 6HS
England

Holland Radio
143 Greenway
Greenside, Johannesburg
Republic of South Africa

PROFESSIONAL QUALITY circuit boards at ham prices. Catalog \$1.50. Dynacal Industries, Box 296, Meadowlands, PA 15347.

SUPER CQWW AND ARRL CONTEST PROGRAMS. TRS-80 Model I, III, (IV in III mode). Completely machine language. Automatic identification of country and zone (CQ) from call letters. Dupe speed 12000+ contacts per second. Screen displays zones still needed (CQ), total points, zones, countries, etc. Automatic CW generator with 2 buffers. Log print program prepares logs and dupe sheets. Log preparation program for hand logs. Similar features to above. QSL label program for both. CQ WPX now being written. FREE fact sheet and sample printouts. K4SB, 3496 Velma Drive, Powder Springs, GA 30073.

VLF-LF preamps, coupler, Loran-C boards. SASE. Burhans Electronics, 161 Grosvenor St., Athens, Ohio 45701.

QSL CARDS: \$1.75/500 p.p.d. Free catalog. Bowman Printing, 743 Harvard, St. Louis, MO 63130.

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.

SIERRA 164 Wattmeter 0-500 W 0-250 MHz \$75; Motorola WWV receiver \$35; RCA CX-35 mobile and base test set \$25; VHF HT's, four Dumont HH-300 5 channel 150-170 MHz w/ncads and charger, perfect for volunteer fire department. All for \$650. K6KZT, 2255 Alexander, Los Osos, CA 93402.

RECLAIM SILVER from electronics scrap. Write RALTEC, 25884F Highland, Cleveland, OH 44143.

WANTED: Manual for Lavoie oscilloscope model LA-265A. Original or photocopy. State cost. WE4O, 4257 Via Alta Drive, Mobile, Alabama 36609.

CABLE CONVERTERS, decoders Catalog \$1 refundable. APS, POB 263 HR, Newport, RI 02840.

FOR SALE: TI Silent 700 model baudot printers. KSR's and RO's. New and used, working. Schematics and tech info available. Freight COD. KSR's \$150.00. RO's \$100.00. D. Regan, PO Drawer R, College Park, MD 20740.

RTTY-EXCLUSIVELY for the Amateur Teleprinter. One year \$7.00. Beginners RTTY Handbook \$8.00 includes journal index. P.O. Box RY, Cardiff, CA 92007.

WANTED: Pre-1950 bugs and spark keys for my collection. Vibroplex, Martin, McElroy, Marconi, DeForest, etc. K5RS, Neal McEwen, 1128 Midway, Richardson, TX 75081.

IMRA International Mission Radio Assn. helps missionaries — equipment loaned, weekday net, 14.280 MHz, 2-3 PM Eastern. Br. Frey, 1 Pryer Manor Rd., Larchmont, NY 10538.

QUICK-FIND Callsign log. Quickly know if and when you worked that call, and if you want to work it again! \$2.00, full price, Quick-Find, 2725-H Sandicrest, Cantonment, Florida 32533.

HAM HOLIDAY Sri Lanka. Write to Spangles Travels, 84 Tempers Road, Mount Lavinia, Sri Lanka. Enclose 5 IRCs.

FEW LEFT, RCA 7094 tubes, new, \$45.00 each. Pair \$80.00. Shipping \$6.00. Jim Morgan, WA1W, 5012 Perrine Drive, Jacksonville, Florida. (904) 771-3462.

TENNA TEST — Antenna noise bridge — out-performs others. accurate, costs less, satisfaction guaranteed. Send stamp for details, W8URR, 1025A Wildwood Road, Quincy, MI 49082.

WANTED: Lafayette HA250A, 100 watt linear, 6-15 meters with HA-255 PS. Working or repairable. Mike, KA0RGU. (303) 465-4608.

WANTED: Cash paid for used Speed Radar equipment. Write or call: Brian R. Esterman, P.O. Box 8141, Northfield, Illinois 60093. (312) 251-8901

HALLICRAFTER Receivers S38D \$30, S38E \$35; transmitters HT-18 \$25; HT-32A \$150; HT-37 \$125; linear HT-41 \$150. All very clean. K6KZT, 2255 Alexander, Los Osos, CA 93402.

WANTED: Old RCA, Western Electric tubes. (713) 728-4343. Maury Corb, 11122 Atwell, Houston, Texas 77096.

FOR SALE: Swan 500C with five accessories \$400. Icom 211 \$300. Galaxy Comm 1C with p/s \$150; Collins R390A PTO unit \$30. D. Johanson, 431 Jupiter Lakes Blvd. #2127A, Jupiter, Florida 33458.

WANTED: Early Hallicrafter "Skyriders" and "Super Skyriders" with silver panels, also "Skyrider Commercial", early transmitters such as HT-1, HT-2, HT-8, and other Hallicrafter gear, parts, accessories, manuals. Chuck Dachis, WD5EOG, The Hallicrafter Collector, 4500 Russell Drive, Austin, Texas 78745.

SELL: Kenwood Twins. E. Alline, NE5S, 773 Rosa, Metairie, LA 70005.

VERY in-ter-est-ing! Next 4 issues \$2. Ham Trader "Yellow Sheets", POB356, Wheaton, IL 60189.

IBM-PC ASCII/BAUDOT/CW. SASE for details. E. Alline, NE5S, 773 Rosa, Metairie, LA 70005.

ANNIE'S EASY. Analyze dipoles, slopers, verticals, inverted-vees and arrays; any orientation, position, phasing, weight or combination with Annie Antenna Analysis Software. Include REAL GROUND (conductivity, dielectric constant). Superb hires plotting. Annie's incredibly friendly and with 100% machine language, she's FAST! For Apple II + (language card required) or Ile, DOS3.3, \$49.95 + \$2.00 postage, NY add sales tax. Include full name and call. S.A.S.E. for info. Commercial, library, etc., call for quote (315) 622-3641. Sonnet Software, Dept. HR, 4397 Luna Course, Liverpool, NY 10388.

COLLECTORS: Have Radio Craft/Radio Electronic Magazines from 1937 through 1955. Almost consecutive. Make offer. W6RFM, 1241 West 13 Ave., Escondido, CA 92025.

HIGH POWER quality amplifier parts. SASE for list. Brian Edward, N2MF, 100 Bradford Hgts. Rd., Syracuse, NY 13224.

KEYBOARD and instruments cases. Send for free information. Bel-Tek, PO Box 125H, Beloit, WI 53511.

DISKS CONTROL — Data 5 1/4" SS/DD 35/40 track \$22 plus s&h 3%, minimum \$3.00; checks allow clearing time; MasterCard/Visa, include number and expiration date; mainland U.S. only via UPS; no APO/FPO/COD's; NJ residents add 6% tax; prices subject to change without notice. Outprint, 44 Forrest Road, Randolph, NJ 07869.

WANTED, MILITARY SURPLUS RADIOS. We need Collins 618T, ARC-72, ARC-94, ARC-102, RT-712/ARC-105, ARC-114, ARC-115, ARC-116, RT-823/ARC-131, or FM-622, RT-857/ARC-134 or Wilcox 807A, ARC-159, RT-1167 or RT-1168/ARC-164, RT-1299/ARC-186, RT-859/APX-72, APX-76, ARN-82, ARN-84, ARN-89, APN-153, APN-155, APN-171, MRC-95, 718F-1/2, HF-105, Collins antenna couplers 490T-1, 490T-2, 490T-9, CU-1658A/ARC, CU-1669/ARC, 490B-1, 690D-1, CU-1239/ARC-105. Top dollar paid or trade for new Amateur gear. Write or phone Bill Slep, 704-524-7519, Slep Electronic Co., Hwy. 441, Otto, NC 28763.

Coming Events ACTIVITIES

"Places to go..."

South Bend, INDIANA: Hamfest Swap & Shop, January 8, first Sunday after New Year's Day at Century Center downtown or U.S. 33 Oneway North between St. Joseph Bank Building and arc river. Industrial history Museum in same building. Carpeted hal acre room. Tables \$3 each. Four lane highways to door from all directions. Talk in freq: 52-52, 99-39, 93-33, 78-18, 69-09, 145.43 145.29.

MICHIGAN: The Cherryland Amateur Radio Club's 10th annual Swap and Shop, February 11, 8 AM to 1 PM, Immaculate Conception School Gym, Traverse City. Register at door. Talk in or 146.25/85. For information call KBYVU, Jerry Cermak at (616) 947-4848.

NEW YORK: Yonkers Electronics Auction sponsored by the Yonkers ARC, Sunday, January 22, 9 AM to 3 PM, Lempko Hall 556 Yonkers Avenue. Admission \$3.00 each. Children under: free. Auction starts 10 AM. New and used equipment. Club commission on successful sales 10% on first \$100, 5% on remainder. Unlimited free coffee all day.

OHIO: Mansfield Mid-Winter Hamfest/Auction, Sunday, February 12, Richland County Fairgrounds, Mansfield. Doors open 10 public 8 AM. Tickets \$2.00 advance, \$3.00 at door. Tables \$5.00 advance and \$6.00 at door. Half tables available. Talk in or 146.34/94. For information, tickets/tables SASE to Dean Wrasse KB8MG, 1094 Beal Road, Mansfield, Ohio 44905. (415) 589-2415.

OHIO: Cincinnati ARRL '84 State Convention and Flea Market Show, Sunday, January 15, Better Living Building, Virginia State Fairgrounds, Richmond, 8 AM to 4 PM. General admittance \$4.00. Flea market space \$3.00, tables \$3.50 additional. Booth for commercial exhibitors. Contact N4DDM (804) 272-8206. Richmond Frostfest, Box 1070, Richmond, Virginia 23208.

VIRGINIA: Frostfest '84, Winter Amateur Radio and Comput Show, Sunday, January 15, Better Living Building, Virginia State Fairgrounds, Richmond, 8 AM to 4 PM. General admittance \$4.00. Flea market space \$3.00, tables \$3.50 additional. Booth for commercial exhibitors. Contact N4DDM (804) 272-8206. Richmond Frostfest, Box 1070, Richmond, Virginia 23208.

THE SATELLITE EXPERIMENTER'S HANDBOOK

Now, under one cover, here is all you need to communicate through or pick up the signals from orbiting satellites. Whether your interest is in Amateur Radio, weather or TV-broadcast spacecraft, you'll find what you're looking for in *The Satellite Experimenter's Handbook*.

Since the first OSCAR (Orbiting Satellite Carrying Amateur Radio) was launched in 1961, thousands of ham radio operators, scientists, educators and satellite enthusiasts from around the world have used these "birds" for pleasure, education and experimentation. You can join them! And if you're already into satellite communications, you'll find a wealth of practical information on all aspects of these spacecraft—from satellite design to ground-station equipment and antennas.

Whether you're a beginner, an experienced satellite enthusiast, a teacher or a scientist, you'll find *The Satellite Experimenter's Handbook* to be indispensable. \$10 U.S., \$11 in Canada and Elsewhere. Copies available soon. ARRL, 225 Main St., Newington, CT 06111.

ORDER TODAY! ✓ 107

**NEW
NEW
NEW
NEW
NEW
NEW**

OPERATING EVENTS

"Things to do..."

JANUARY 8-9: Rats Nest and Crooked Stick IV, an antenna experimenter's sprint contest. 2100Z January 8 to 0100Z January 9. Frequencies: CW 21.060 to 21.200 MHz. SSB 21.350 to 21.450 MHz. Rats Nest & Crooked Stick Antenna: 100 ft. max. of single conductor wire. Feedline will not count if it is coaxial cable. Antenna is limited to 20 ft. high. Transmitter Power: 250 watts or less DC input). Exchange: Name, QTH, type of antenna, I.A.R.C. member or not. Contest entries must be submitted by February 1, 1984. For more information: SASE to Issaquah ARC, Bob Farnworth, KB7NV, 6822-131st Avenue S.E., Bellevue, WA 98006.

FEBRUARY 2-8: The Michigan Technological University ARC and the Copper Country Radio Amateur Association announces a radio celebration of our Winter Carnival festivities in the northernmost part of Michigan's Upper Peninsula. A certificate will be issued to all Amateurs who make contact with any participating team in the Copper Country between 0000 February 2 through 0000 February 8. Frequencies: RTTY - 3.630, 7.090, 14.095, CW 3.705, 7.085, 14.085, 21.085, 21.185. Phone - 3.930, 7.285, 14.305, 21.385, 28.685. On CW listen for CQ Winter Carnival. Send your QSL with 3-20¢ stamps for p&h to: Howard Junkin, 48FHF, 106 W. South Avenue, Houghton, MI 49931.

FEBRUARY 4-5: Vermont QSO Party sponsored by the Central Vermont ARC (W1BD), 2100Z Feb. 4 to 0700Z Feb. 5 and 1100Z to 2400Z Feb. 5. Frequencies: Phone - 3910, 7230, 14260, 14320, 21360, 28570, 50110, 144.2. CW - 3530, 3730, 7030, 7130, 14060, 21060, 21160, 28060. RTTY - 3620 & 090 other RTTY sub-bands. Exchange: VT stations send QSO number, 2 letter county designator. Others send QSO number and state or province. Scoring: VT 1 point per phone contact, 2 points per CW or RTTY. Times states plus provinces plus ARRL countries. Others 1 point per phone contact, 2 points per CW or RTTY times number of VT counties. A station may be worked 3 times per band, once each on phone, CW or RTTY. Separate awards to Vermont and non-Vermont stations. Send logs/facsimiles, name, address, Vermont county NLT March 1, 1984 to: D. Nevin, K1U, W. Hill, Northfield, VT 05663.

FEBRUARY 4-6: New Hampshire QSO Party, sponsored by the NH ARA, 1900Z Feb. 4 to 0700Z Feb. 5 and 1400Z Feb. 5 to 2000Z Feb. 6. Exchange signal report and QTH. Suggested frequencies: Phone 3.935, 3.975, 7.235, 14.280, 21.380, 28.575, 50.115, 145.015. CW 1.810, 3.555, 7.370, 7.055, 7.130, 14.055, 21.055, 21.130, 28.055, 28.130. RTTY 3.625, 7.085, 14.085, 21.085, 28.085. Logs must be postmarked by March 15, 1984. Include large SASE for results. Mail to: Pete Cantara, K11M, 194verhill Street, Hudson, NH 03051.

ALL BAND TRAP ANTENNAS!



PRE-TUNED - 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 ohm test lead and 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 - skippers - in attic, 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 - \$99.95
40-20-15-10 - 2 trap - 54 ft. - Model 100BUC - \$99.95
20-15-10 meter - 2 trap - 26 ft. - Model 100TBUC - \$97.95

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 ✓ 197

WESTERN ELECTRONICS
Dept. AR-1 Kearney, Nebraska, 68847

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 freq. 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 ✓ 194

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: Elektronkladen, Wilhelm - Meilies Str. 88, 4930 Detmold 18, West Germany
In Japan: Toyomura Electronics Company, Ltd., 7-9, 2-Chome Sota-Kanda, Chiyoda-Ku, Tokyo, Japan



Clean up the radio/computer clutter.

For less than \$250 you can make your investment in yourself pay off!

Chances are you have spent a couple thousand dollars on setting up a computer system that gets a lot of your work done. But sometimes it gets to be work to work at it.

I know that when I have to move two program manuals and a pencil holder to boot up the disk drive, it is work. When there is an unlabeled floppy (that I am going to identify some day) on top of the monitor and the business check-book is on top of the printer . . . and I will remember (I hope) before the next "report" comes through . . . that is work.

I found the annoyance of my own "computer clutter" was even worse than the extra work the disorder created. And that is when I started looking for some practical furniture for my computer set up. Since I had already spent a lot of money on the system itself, I was really dismayed when I found out how much it would cost to get a decent-looking desk or even a data table for my equipment. \$400 . . . \$500 . . . even more for a sleazy unit that looked like junk! In fact, it was junk! And it took a long time for me to find something that was really worth the money . . . and more.

A lot of my working day is spent with my computer, and I will bet a lot of your time is too. So I figure a "home" for my system—a housing that is good looking as well as efficient to work at—will pay off two ways:

1. Less work: an efficient and orderly layout will save me time and energy.
2. Personal satisfaction: good quality furnishings look better; they just plain feel better to work at too.

So imagine how good I felt to find the "Micro-Office" Work Center! These are fine pieces of computer system furniture that make my office-at-home as pleasant a place to work as it ought to be. And the



MICRO-OFFICE WORK CENTER

biggest and best surprise is the low, low price for such good quality.

Here is what you get—all for only \$249.50 plus shipping.

- Mar-resistant work surface. Your choice of oak or walnut grained. Work surface height is adjustable to your keyboard, your chair, your height.
- Two shelves plus work surface extender. Both shelves tilt to lock in position so that monitor faces you—in a position that does away with screen glare squinting and neck craning forever. Retainer bar keeps equipment from sliding off shelf. Snap-in bookends hold reference manuals and programs.
- Strong, sturdy and steady. All-steel welded frame construction is concealed by top-quality wood grain surfaces with finished trim. Adjustable floor levelers included. The work center is really a piece of fine furniture.
- There is no risk in buying from us either. We will make a full refund of purchase

price plus shipping charges if you return the workcenter within 30 days for any reason whatsoever. In addition, the product is warranted for any defects in materials or construction for a full year from date of purchase. This is a no-risk investment in your own productivity and work efficiency that will pay off for years to come—even if you do not yet have a microcomputer of your own.

- Take your choice for your own work center decor:

Order 48-inch unit in walnut, #2KPO-945, or in oak, #2KPO-947. Only \$249.50 for each unit plus \$20.00 shipping charge. On orders for two or more units at the same time, shipping charge applies to only the first unit ordered. Shipment made UPS, so we cannot ship to post office box. Illinois residents please add \$15 per unit sales tax. Please allow 10 extra days for personal checks to clear. Sorry—at these special offer prices we cannot ship c.o.d. or bill direct.

CALL TOLL FREE TODAY WHILE SUPPLIES LAST: 1-800/323-8064.
In Illinois call 1-312/251-5699. Or mail check with order to:

Micro-Mart Distributors

Dept. HR • 1131 Central Street • Wilmette, IL 60091



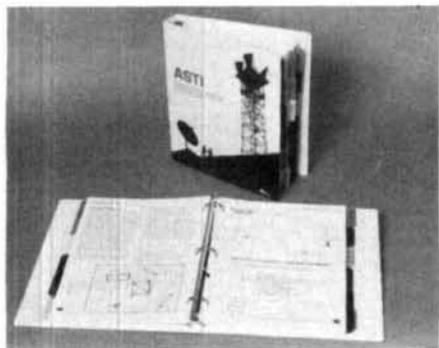
book and product

REVIEWS

ASTI

TI, Terrestrial Interference, is one of the most important problems facing users of the satellite service. Commercial and home TVRO owners have found that because of the relative newness of the technology they are using, there is little available in the way of information on terrestrial interference and how to avoid it.

Recognizing TI as a major problem, the folks at Microwave Filter set about the task of putting together a how-to book that would help identify and define problems and then set about the task of eliminating them. This book — *The Avoidance/Suppression Approach to Eliminating Terrestrial Interference of TVRO Earth Stations*, by Glyn Bostick, Tom Fannetti and William Johnson, is based upon the actual experience of the authors in their efforts to reduce the problems caused by TI. The authors also obtained a significant amount of input from the fledgling TVRO industry through symposiums and technical meetings held around the country.



During the early days of the TVRO industry, the common solution for a TI problem was to change the location of the system. But, now due to the explosive growth of the industry and high costs, this is not always a practical solution to the TI problem. Because of siting or budgetary limitations, it is often necessary to locate systems in less than optimal sites. Thus was born the ASTI project. The answers on how to reduce or eliminate TI and maximize system performance are found in ASTI.

Chapter 1 lays the ground work for TI avoidance and provides a brief summary of the rest of the book. Chapter 2 provides the reader with an illustrated summary of TVRO operation as it applies to the distribution of TV programming. Chapter 3 is a soup-to-nuts description of how TVRO works, starting with the uplink, trans-

ponder operation, and TVRO installation. This is most important because a complete understanding of the system is necessary to recognize how and where susceptibility will come. With that information in mind, chapter 4 details and describes potential TI sources by function and frequency. Chapter 5 deals in the symptoms of TI. Plenty of photos are provided so the reader can relate his unknown problem to known and quantified problems.

Chapters 6 through 11 deal with the actual site selection, antenna/LNA and other components in the system. Complete coverage is given to ensuring that the system is engineered properly, the first time through, to reduce TI problems to an absolute minimum. Some of the methods of TI suppression discussed are a bit severe, such as pits, fences, and other forms of artificial microwave barriers. However, some are absolutely necessary to eliminate the really thorny TI problems. The authors have gone to a great deal of trouble to discuss and eliminate some misconceptions that exist about TI shielding. In some cases, microwave shields are more expensive than they should be because of a lack of solid technical information. The authors give a complete description of the optical principles that control microwave radiation. And upon this framework, how innovative solutions can be derived to solve TI problems. Chapters 12 and 13 deal with how to eliminate unavoidable TI; Chapter 12 discusses what filters are available, their ability to counter TI, and their application at critical points in the system. Chapter 13 deals with "worst case" situations and takes full advantage of the authors' practical field experience in TI reduction.

Finally, chapter 14 deals with SMATV techniques for satellite and master TV systems. Techniques are outlined for avoiding and suppressing the interference that often comes from this kind of system hybridization.

This book is an absolute *must* for the professional TVRO and satellite earth station community. I would also recommend ASTI to home TVRO owners as an invaluable resource book. Even for those who do not now have a TI problem, construction of TI-producing systems continues daily. A trouble-free system today could become an unusable system tomorrow. The retail price for *ASTI*, \$125.00, may sound a bit high but is quite reasonable in light of the wealth of information found within the book. (Besides, when you've spent more than \$4,000 to install a TVRO system, the price of *ASTI* seems inexpensive, compared to a microwave technician's time in troubleshooting a TI-plagued system. MFC also provides an ASTI update service for \$60/year that will keep you fully informed on all the latest TI problems and solutions.

For more information on *ASTI*, contact MFC at 6743 Kinne Street, East Syracuse, New York 13057.

N1ACH

Circle #301 on Reader Service Card.

Keithley Model 130-A digital multimeter

The latest addition to Keithley's product line, the Model 130-A Digital Multimeter, reached my desk the other day for review. I have been looking over quite a few multimeters over the last several months for *ham radio* and I must admit that upon opening the box, I found the Model 130-A to be the most aesthetically pleasing that I have seen. Functionwise, color has



little to do with performance. Ergonomically, however, a well designed, color-coordinated piece of test equipment will eliminate eye strain and fatigue that can reduce a test technician's overall performance.

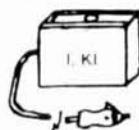
Another interesting ergonomic feature is that the unit is designed to comfortably fit into your hand. Should the need arise to change scales or units to be measured, when the unit is in your left hand, it can be done easily and conveniently with the left thumb. This allows the user to hold the probes in position while the scales are being changed. Keithley also provides a handy carrying case with a belt loop. The small size means that you can stow the Model 130-A into your tool box without displacing too many tools.

The display for the Model 130-A uses an easy-to-read, 3/5 inch VCD readout. The large readout combined with work stand makes the 130-A digital multimeter right at home in your workshop, as well as being an invaluable tool for field service.

Keithley also has a full line of accessories for the Model 130-A that includes a temperature probe that will measure from -55 to 150 degrees C, high voltage probe that is rated up to 40 kV, a 50 ampere shunt, a clamp-on AC current probe, and of particular interest to Radio Amateurs and other RF people an RF voltage probe for measuring voltages from 100 kHz to 250 MHz.

The Model 130-A is rated at a maximum common mode voltage of 500 volts and is de-

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 Santec

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.

✓ 141

HANDI-TEK

P.O. BOX 2205, LA PUENTE, CA 91746

signed and operated from 0 to 50 degrees C. It is powered by a single 9 volt battery which is rated at 100 hours usage with carbon zinc cells and 200 hours usage with an alkaline cell. The unit is 7.1 x 3.1 x 1.5 inches (178 x 78 x 38 mm) and weighs a mere 10 ounces (283 grams). It is priced at \$145 and comes with battery, test leads, and instructions.

specifications

DC volts	200 mV to 1000 V (±0.25% + 1d)
AC volts	200 mV to 750 V (±1% + 3d) 45 - 500 Hz
Resistance	100 n ohms to 20 M ohms (± Avg. 275%)
DC amps	2 mA to 10 A (± Avg. 75%)
AC amps	2 mA to 10 A (± Avg. 2.4%)

This is an excellent product and will be right at home in either your ham shack or on-the-job. For more information, contact Keithley Instruments, 28775 Aurora Road, Cleveland, Ohio 44139.

Circle #302 on Reader Service Card.

de KA1JWF

15, and 20 meters, respectively; a worst-case VSWR of less than 2.0:1 from band edge to band edge; and an average F/B ratio of 16 dB on 10/20 meters and 19 dB on 15 meters. It handles maximum legal power and is at DC ground potential including coaxial inner conductor.

para-sleeve system

The driven element consists of three sections: a center element and a closely spaced front and rear sleeve. The para-sleeve system (patent pending), basically an open-sleeve dipole, uses a trapped 15 and 20 meter driven element and two parallel elements for 10 meters. A Hy-Gain balun provides the balanced-to-unbalanced transformation while maintaining DC continuity between the antenna and cable inner and outer conductors.

construction

I enjoy assembling kits that are complete, have a well-written and diagrammed manual, and have been engineered for trouble-free assembly. In designing this kit, the staff at Hy-Gain must have carefully thought through each step, anticipated problem areas, and corrected for them as needed. Construction is simple; I have to admit that my two children (ages 7 and 9) built most of the antenna — and were usually one step ahead of me. All parts fit as described and were of good quality (stainless steel for the brackets and hardware).

Of course, the usual common-sense techniques are called for. Read through the manual carefully; clear a space in which to work; read the manual; unpack, count, and identify parts; read the manual, and proceed. You might have noticed that I've said "read the manual" three times; Hy-Gain recommends this as a good number. (I have personally seen "experts" assemble antennas incorrectly because they "knew" what to do.)

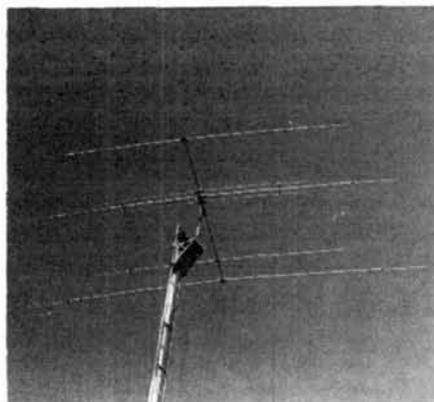
At one point in construction I was ready to pick up the phone and call Hy-Gain for two missing aluminum sections until I discovered that the manufacturer conserves packing space by telescoping some sections within others. In one particular case, the ID/OD dimensions were so close as to make the inner piece "disappear."

There are quite a few repetitive steps in constructing this antenna that lend themselves to production line procedures: compression clamp assembly, element-to-boom bracket assembly, etc. This is where my young workers excelled. The manufacturer suggests that at least five hours be allowed for assembly, and though we weren't in a race, I believe we beat that figure by at least half an hour. One of my children remarked, "Don't worry, Dad, we'll have you on the air by tonight." (Visions of climbing towers by moonlight had overtaken me.)

Final assembly is simpler if you drive a temporary 5-foot length of mast into the ground and attach the boom and boom-to-mast brackets to it. This permits eye-level installation of

Explorer 14

The Explorer 14 is a three-band (10, 15, and 20 meters), four-element (two parasitics), Yagi antenna that provides complete band coverage without retuning. Telex/Hy-Gain, the manufacturer, was able to achieve this performance by incorporating a multi-section driven element and separate reflectors for 10 and 15/20 meters. (The single director uses 15



and 20 meter traps). It is relatively light (45 pounds, 20.4 kg), can be installed by one person (see **installation**), does not require any length/spacing readjustments after initial preset and is fed directly by 50-ohm coaxial cable — there's no gamma match to adjust. Its small size (14-foot boom) is an attractive feature for those who must be concerned with neighborhood aesthetics, while mechanically it accounts for only 7.5 square feet of wind surface area. Important specifications include a maximum gain of 8.8, 8.0, and 7.5 dBi for 10,

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 ✓ 172

U.S.A. SUBSCRIPTIONS
\$ 7.00 - 1 YEAR 3RD CLASS MAIL
\$12.50 - 1 YEAR 1ST CLASS MAIL
\$25.00 - LIFETIME - 3RD CLASS MAIL

VISA MasterCard
With Free Classified Ad

NUTS & VOLTS
HAM GEAR
COMPUTERS
SOFTWARE
SCANNERS • OPTICS
TEST EQUIPMENT
MICROWAVE
SATELLITE
AUDIO VISUAL
NEW PRODUCTS
COMPONENTS • KITS
ANTIQUE ELECT.
PUBLICATIONS
PLANS • SERVICES

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

✓ 186

parts and easy alignment of elements after assembly. This, naturally, is the best time to check and double-check all dimensions, (not when it's 100 feet in the air and 20° below zero).

I felt that there was a little too much play in the sleeve spacer clamping arrangement due to the use of 5/8-inch clamps — the next size smaller might have been better. Also, since no readjustment of element lengths and spacings is ever called for, assembly would have proceeded even faster if the manufacturer had marked the boom and color-coded the element sections. But then again this additional step is easily done, and by leaving it to the assembler, the manufacturer probably keeps cost down.

Installation

I had remarked earlier that the antenna was relatively light. To prove it, I mounted the Explorer 14 to a fifty-foot push-up TV mast. It withstood high winds and remained intact until disassembled several months later. I don't recommend TV mast installation to the timid — it takes some resolve and a bit of muscle. Mine settled at the 42-foot level with only a few feet overlap of mast sections and four sets of polypropylene guys. The manufacturer recommends that it be mounted at least 30 feet above roofs or metallic structures if a low VSWR is to be achieved. I agree completely. Normal tower mounting procedures and precautions are simply described in the manual.

Performance

The antenna test "range" at K2RR in Milford, New Hampshire, consisted of at least one completely open acre with no other antennas or structures (metal or otherwise) closer than 1½ wavelengths at the lowest operating frequency — 14.0 MHz. The Explorer 14 was mounted at 42 feet above a low conductivity ground (New Hampshire isn't called the Granite State for nothing). The antenna used for A-B comparison exhibited at least 1 dBd gain toward Europe at a fairly low angle (estimate between 20 and 30 degree takeoff angle). A simple coaxial relay allowed for rapid comparison.

Initial tests involved verification of the manufacturer's VSWR specifications for the entire three bands. The test setup included a bird wattmeter and a SWR bridge (used separately). At the input to a 100-foot run of new 52-hm coaxial cable (Belden 8214), a VSWR of 1.0:1 was not exceeded at any frequency on 10, 15, or 20 meters and at many points was below 1.5:1.

Both the gain and front-to-back evaluations were qualitative, unfortunately, but in all forward gain tests the received signal strength was greater from the Explorer 14 than from the reference antenna when both were aligned in the preferred direction. Since a bi-directional reference antenna was used, a rapid qualitative front-to-back evaluation was possible. Signals were weaker from off the back of the beam than from the standard antenna, as was expected. To provide accurate gain and F/B

figures, a calibrated test setup and better knowledge of the reference antenna and site are required.

30 and 40-meter add-on

The Explorer 14 can be operated on 30 or 40 meters as well with the addition of the Hy-Gain QK-710 conversion kit. The add-on kit includes a 20-meter trap, additional tubing, stainless steel hardware, and another well-illustrated and written manual. Depending on which of the two kits you choose, the driven element assembly resonates on either 30 or 40 meters

industry leaders such as California Amplifier and Scientific Atlanta. The result of their effort is an in-depth exploration of such topics as equipment selection for minimizing TI susceptibility, use of natural and artificial shielding, system filtering, and many other cost effective techniques! Send this coupon now to receive our free brochure on ASTI, and get TI out of the picture!



BANISHED.

TERRESTRIAL INTERFERENCE.



ASTI is the first complete professional handbook on the avoidance, diagnosis and suppression of microwave *terrestrial interference* (TI) at TVRO earth stations. This 250 page comprehensive volume was compiled by an engineering team headed by Glyn Bostick, President of Microwave Filter Company, with valuable input from many



YES! Send me the Free brochure on the ASTI Handbook!
 YES! Send me the ASTI Handbook. My payment of \$125 is enclosed: Check Money Order
 VISA American Express Master Card
 Card No. _____ Exp. Date _____
 Name _____ Phone _____
 Company Name _____
 Address _____
 City/State/Zip _____

MFC
 MICROWAVE FILTER COMPANY, INC.
 6743 Kinne St., East Syracuse, NY 13057

Or call our toll free number!
 Toll Free 1-800-448-1666 - TWX 710-541-0493
 NY/Hi/AK/Canada (Collect) 315-437-3953

(besides 10, 15, and 20 meters). It adds 3.5 or 6 pounds, to the overall weight of the Explorer 14 using the 30 or 40 meter kit, respectively. It provides rotary dipole performance with the advantage of a single coaxial feed still only required for *four* band operation. (The add-on kit was not available at time of testing.)

field testing

In "field testing" the Explorer 14, I established a one-month goal to contact at least 100 countries during *non*-contest periods. It actually took only three weeks (June 18 - July 9)

DRAKE R-4/T-4X OWNERS AVOID OBSOLESCENCE

PLUG-IN SOLID STATE TUBES!
Get state-of-the-art performance.
Most types available

INSTALL KITS TO UPGRADE PERFORMANCE!

Basic Improvement, Audio Low Pass Filter, Audio IC Amplifier

TUBES \$23 PPD KITS \$25 PPD

OVERSEAS AIR \$7

TEXANS TAX 5%

SARTORI ASSOCIATES, W5DA

BOX 2085

RICHARDSON, TX 75080

214-494-3093

✓ 182

WARC for FT-101/901

Modernize any model of the original FT-101 Series by adding *all three* WARC bands for RX and TX!

- Use 10 MHz now; be ready for the others.
- Increase resale value of your rig.
- Easy installation, detailed instructions.
- Includes all crystals, relays, etc.
- Tested, fool-proof design for all but 'ZD.

FT-101 WARC Kit #4N **ONLY \$25.**

FT-901 WARC Kit #4J (30M only) **ONLY \$10.**

Shipping \$3 (Air \$5). Florida sales tax 5%.

GO FOX TANGO — TO BE SURE!



Order by Mail
or Telephone

✓ 134

For other great Yaesu modifications get the top-rated FT Newsletter. Still only \$8 per calendar year (US), \$9 Canada, \$12 Overseas.

FOX TANGO CORPORATION

Box 15944 H. W. Palm Beach, FL 33416

(305) 683-9567

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 dreaded 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

to accomplish this. An abbreviated list of some of the "catches" is listed below. (A complete list is available; send SASE).

5H3SG	5Z4PR	UI80AA
UF6FER	UK8BAA(UH8)	UL7VBA
UK50AA(U0)	Y11BGD	AP2ZA
C30LAB	A92F	VU2GI
UD6BR	SV1NA	3B8DB
J28DN	XT2AW	UJ8AP
A4XHZ	TU2AZ	

conclusion

The Explorer 14, model number EX-14, provides low VSWR broadband Yagi performance on 10, 15, and 20 meters. It allows the constructor to build it once, on the ground, without need of laborious readjustments for different mode operation. It is light enough for one-man installation, though an additional helping hand or two would be highly welcomed. Upon dismantling, no hardware showed any signs of corrosion — all the more surprising considering the acidic pH of New Hampshire rain. If you enjoy putting kits together and want a good performing no-tune Yagi, this definitely is one way to go.

For further information contact Telex/Hy-Gain, 9600 Aldrich Avenue, South, Minneapolis, Minnesota 55420.

K2RR



new Hamtronics® catalog

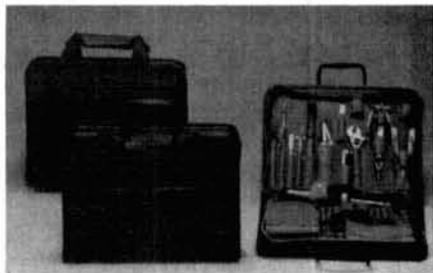
The new 1984 Hamtronics mail order catalog of supplies for VHF/UHF/OSCAR enthusiasts and two-way radio shops is now available. This 36-page, two-color catalog features many new products, including an expanded line of FM repeaters and accessories such as power amplifiers, DTMF tone decoder/controllers, and autopatches. Also included are the popular lines of FM and AM receivers, FM transmitters, VHF and UHF transmitting and receiving converters, space shuttle receivers, 800 MHz scanner converters, preamps, and other products.

For a free copy, contact Hamtronics, Inc., 65F Moul Road, Hilton, New York 14468. (For overseas mailing, please send \$2.00 or 4 IRCs.)

Circle #303 on Reader Service Card.

technician's tool kit

The JTK-86 "Premier," new from Jenser Tools, is a full-service technician's tool kit in a compact zipper case. It includes a selection of tools rarely found in zipper case kits, such as a complete 13-piece 1/4 inch drive socket set with ratchet, spinner handle and extensions; a Vise-Grip locking plier; a 9-blade fold-up hex key set, and an 11-blade feeler gauge.



The JTK-86 is available in a vinyl or leather case with handles or in a case of rugged Cordura nylon with three roomy outside pockets for meters, test leads, or service manuals. Two pockets measure 5-1/2 x 9 x 2-1/4 inches, and the third measures 10-1/2 x 9 x 2-1/4 inches.

The JTK-86 "Premier" Jensen's finest zipper case kit, is available with or without a Fluke 8021 Digital Meter or a Triplett 310 VOM.

For more information or a free catalog of other Jensen kits and cases, write Jenser Tools, Inc., 7815 S. 46th Street, Phoenix, Arizona 85040.

Circle #305 on Reader Service Card.

720-channel handheld receiver

FDK International Corporation has begun to market what is said to be the world's first PLL-synthesized 720 channel hand-held AM airband receivers, the ATC-720/SP series. Designed for air traffic control and Amateur purposes, the series ATC-720/SP series employs PLL-synthesized circuitry for accurate frequency selection of 720 channels between 118-136 MHz in 25 kHz steps. The light weight (11 ounces; 315 gr.) and small size (6-5/8 x 2-1/4 x 1-3/4 inches; 169 x 58 x 43 mm) of the ATC-720/SP allows the user maximum portability in operating fields. Supplied with flex rubber antenna, Ni-Cd battery pack, and AC-charger, the ATC-720/SP features an adjustable squelch level to eliminate background noise on the AM mode. Low battery consumption allows 6 hours of continuous operation. A BNC aerial connector DC-charger and shoulder case are available as optional accessories.

For information, contact FDK International Corporation, 10-2, Kaji-cho 2-chome, Chiyodaku, Tokyo 101, Japan.

Circle #304 on Reader Service Card.

new handhelds

The new IC-02A and the IC-02AT two-meter handhelds are now available from ICOM. These compact multifeatured handhelds are the same compact size as the IC-2A series, but have features found on no other Amateur handheld.

The IC-02A and the IC-02AT are designed to be compatible with all existing IC-2A accessories plus new accessories that will make them unique. An important feature of the IC-02A series is that it features 32 PL tones built into the unit as standard. These tones are programmable from the front panel pad, and may be used with any frequency selected, or may be stored in memory and recalled along with the frequency at any time.

Any frequency on 5 kHz spacing in the 2-meter ham band may be called up in the IC-02A. All frequency entries as well as control functions for memory, scanning, etc., are selected by the 16-button pad on the face of the radio. Included are priority watch, scanning of both memories and programmable band scan, and DTMF on the IC-02AT model. The unit features ten memories which store frequency, PL tone, offset and offset direction, and an internal lithium battery backup. The priority channel is a unique feature to the IC-02A and IC-02AT, as well as the custom LCD readout with an S-meter function, unique to the ham industry.



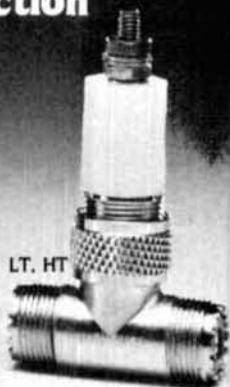
The IC-02A series will run at 3 watts with the standard BP3 battery pack, or at 5 watts with an optional high power battery pack. A long-life battery, 8.4 volts at 800 mA, will be available to double the working time of the standard 3-watt output unit. Batteries may be charged a variety of ways.

The IC-02A series has an environmentally sealed case with "O" ring seals to protect it

Get lightning and static protection for receivers, transceivers, amplifiers...



R-T, HV Mark II Series
(also available with N-type connectors)



with Transi-Trap™ Surge Protectors

Protect sensitive solid state and tube-type components from high-surge voltages produced by nearby lightning strikes, high wind and static build-up. Even distant storm fronts can cause damaging surges without warning or time for grounding.

Standard air-gap devices are ineffective due to their erratic performance. Transi-Trap's replaceable Arc-Plug™ cartridge utilizes a special ceramic gas-filled tube with precisely tailored firing speed and level, safely by-passing surges to ground. Fires thousands of times.

Transi-Trap Protectors are the first devices in the industry designed with "isolated ground" — keeps damaging arc-energy off the chassis and routes it directly to ground.

Don't hook up your coax without one!

The 200 W models are most sensitive, best for RCVRs and XCVRS. 2 kW models designed for amplifiers. For maximum protection use both, with 200 W model between XCVR and AMP. All models include Arc-Plug cartridge.

UHF "T-type" Connectors:

MODEL LT, UHF-type, 200 W output at 50 ohms	\$19.95
MODEL HT, UHF-type, 2 kW output at 50 ohms	\$24.95

Super Ruggedized Super Low Loss

Models (0.1 dB at 500 MHz), for use through VHF/UHF, with UHF connectors:	
MODEL R-T, 200 W output at 50 ohms	\$29.95
MODEL HV, 2 kW output at 50 ohms	\$32.95

At your Alpha Delta dealer. Or order direct in U.S.; add \$2 for postage and handling. MasterCard and VISA accepted. Ohio residents add Sales Tax.



See Data Sheet for surge limitations.

ALPHA DELTA COMMUNICATIONS, INC.

P.O. Box 571, Centerville, Ohio 45459 • (513) 435-4772



UP YOUR ERP



For HT owners operating inside a vehicle and wanting increased T/R range, RF PRODUCTS has the low cost solution.

Remove your BNC antenna from the HT and mount on the RF PRODUCTS BNC magnet mount, install the magnet mount on the roof top and connect the BNC co-ax connector.

The magnet mount (part no. 199-445) has 10 feet of small (5/32") co-ax with BNC connector attached and is priced at \$15.95 (including shipping by UPS to 48 states).

TO ORDER - send \$15.95 money order or cashiers check only
Fla. residents add 5% tax, for air UPS add \$1.50

The RF PRODUCTS Magnet Mounts are one of the few magnetic antenna mounts available that can be repaired should the co-ax cable be damaged. The co-ax cable connector includes a shrink tubing strain relief for long life at the connector/cable flex point (an RF PRODUCTS exclusive on all cable assemblies).

Eight other models available with three each choice of antenna connectors, co-ax types and transceiver connectors (BNC, 1-1/8-18, 5/16-24 & RG-122U, RG-58A/U, mini 8X & BNC, PL-259, type N).

RF PRODUCTS

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



NEW! \$1295 pair

HAM-TAGS Tough ABS custom frames. Your call on each vehicle. Available with call at top or bottom of frame, and frame front plate (check your state). \$1.50 shipping.



BHC, INC.
1716 WOODLAND
HOUSTON, TX 77019
(713) 522-5755



113

Yeah, Herb, I saw it advertised in Ham Radio Magazine this month.



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

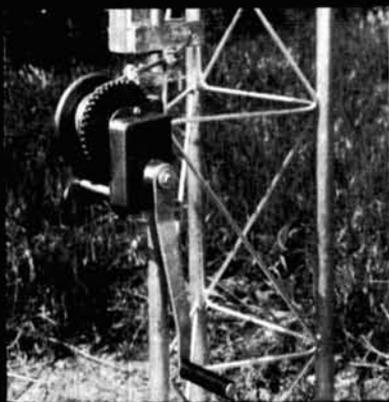
Chet Lambert, W4WDR

1704 Sam Drive • Birmingham, AL 35235

(205) 854-0271

Sample Copy — \$1.00

124



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.



against dirt and moisture. A heavy-duty aluminum back provides heatsinking for the 2 watts of power. A power connector is supplied on the top of the unit. Twelve volts applied there will power the unit as well as charge the battery pack.

For further information, contact ICOM America, Inc., 2112 116th Avenue, N.E., Bellevue, Washington 98004.

Circle #306 on Reader Service Card.

WARC bands kit for Yaesu FT-101

A new kit which provides receive/transmit capability on all three WARC bands for all models of the FT-101 except the ZD is now available from Fox Tango Corporation. While only the 10 MHz band has been authorized for use to date, little additional effort or expense will be needed to add all the bands while the circuit changes for 10 MHz are being made. In addition to making the old 101 ready when the new bands become available, the added capability increases the trade-in value of the set. Based on a tried and tested design by G3LLL, the WARC bands kit is complete with all needed crystals, relay, switch, and detailed instructions for moderately easy installation.

For further information, contact the Fox Tango Corporation, Box 15944H, West Palm Beach, Florida 33416.

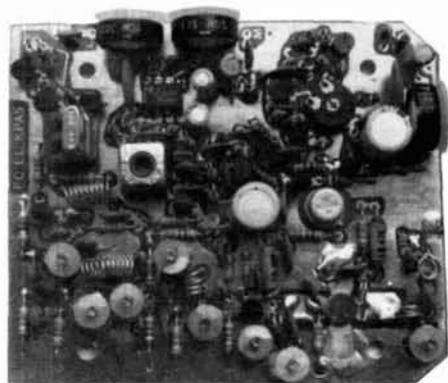
Circle #307 on Reader Service Card.

mobile ATV module

P.C. Electronics has released a 1-watt AM UHF ATV transmitter module board (Model KP5A) which, when mounted in an aluminum box atop a portable color camera, allows the camera operator to move freely. Coverage of up to a mile is typical under most conditions; 50 miles has been done from an airplane. Applications include video from radio-controlled model airplanes or robots, computer video, base station remotes, weather radar video, or any application in which cables would be impractical.

The KP5A is a wired and tested board capable of full color and sound. It comes standard with one crystal on either 439.25 (east) 434.0 (west), or 426.25 MHz. Its power requirement

is 13.8 VDC at 280 mA. The board size is only 4 x 3.25 inches (10.16 x 8.26 cm); its price is \$159. Additional crystals are \$15 each. Buyers must hold an Amateur license of Technician class or higher.

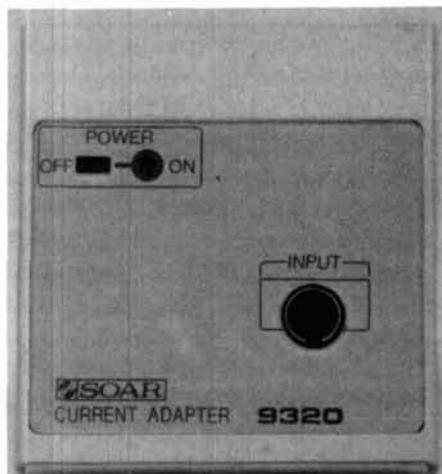


For further information, contact P.C. Electronics, 2522 Paxson Lane, Arcadia, California 91006.

Circle #308 on Reader Service Card.

three new adapters

Three new adapters designed to work with all DMM's having a 10 megohm or better DC input resistance and a 200 mV DC range are available from North American Soar. Model 9320, shown above, is a combination AC and DC current adapter complete with a clamp-



around Hall effect sensor. It can measure AC current to 150 amperes and DC current to 200 amperes without breaking into the line; it's priced at \$79.00, with battery.

Model 9310 is a temperature adapter priced at \$79.00, battery included. Switch-settable to read degrees in centigrade or Fahrenheit, it will work with all "K" type bimetal sensor probes.

Continuing
MILLEN Tradition of
Quality - Durability - Performance...

SOLID STATE and TUBE-TYPE **DIPPERS**

No. 90651-A GRID DIP METER
1.7 to 300 MHz. standard.
\$210.00



No. 90652
SOLID STATE DIPPER
\$210.00 No power cord

Complete with carrying case and 7 coils

CAYWOOD
ELECTRONICS, INC.



**Exclusive Manufacturer of
MILLEN Equipment**

P. O. Drawer U
Malden, MA 02148-0921

(617) 322-4455

Custom Mailing Lists on Labels!

Amateur Radio Operator NAMES

Custom lists compiled to your specifications

- Geographic by ZIP and/or State
- By License Issue or Expiration Date
- On Labels of Your Choice

Total List: 435,000 Price: \$25/Thousand

Buckmaster Publishing

Whitehall, Mineral VA 23117

116

P.C. BOARDS
AND ART SERVICES

FACE
PLATES

ENCLOSURES

WRITE OR CALL
For Literature or Quotes

Let us quote you on any stage of your product from proto types to production.

FABTRON DIV.
P.O. Box 925
Columbia, TN 38401
(615) 381-1143

130

High
Performance

vhf/uhf preamps

EME
Scatter
Tropo
Satellite
ATV
Repeater
FM Equipment
Radio Telescope

NEW GaAsFETs!

	Freq. Range (MHz)	N.F. (dB)	Gain (dB)	1 dB Comp. (dBm)	Device Type	Price
P28VD	28-30	<1.1	15	0	DGFET	\$29.95
P50VD	50-54	<1.3	15	0	DGFET	\$29.95
P50VDG	50-54	<0.5	24	+12	GaAsFET	\$79.95
P144VD	144-148	<1.5	15	0	DGFET	\$29.95
P144VDA	144-148	<1.0	15	0	DGFET	\$37.95
P144VDG	144-148	<0.5	24	+12	GaAsFET	\$79.95
P220VD	220-225	<1.8	15	0	DGFET	\$29.95
P220VDA	220-225	<1.2	15	0	DGFET	\$37.95
P220VDG	220-225	<0.5	20	+12	GaAsFET	\$79.95
P432VD	420-450	<1.8	15	-20	Bipolar	\$32.95
P432VDA	420-450	<1.1	17	-20	Bipolar	\$49.95
P432VDG	420-450	<0.5	16	+12	GaAsFET	\$79.95

**Advanced
Receiver
Research**

Box 1242 • Burlington CT 06013 • 203 582-9409

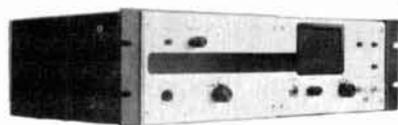
Preamps are available without case and connectors; subtract \$10. Other preamps available in the 1 - 800 MHz range. Prices shown are postpaid for U.S. and Canada. CT residents add 7-1/2% sales tax. C.O.D. orders add \$2. Air mail to foreign countries add 10%.



103

THE AFFORDABLE REPEATER

FROM THE MANUFACTURER OF COMMERCIAL & MILITARY EQUIPMENT MADE IN USA AT OUR MIAMI, FLORIDA PLANT



\$699.*

Basic Price

FEATURES:

- Several Frequency Ranges
30-50 MHz, 132-172 MHz,
200-240 MHz, 380-480 MHz.
- Sensitivity .3 Microvolt 12 DB S/N
- Power Output 30 Watts.
- Four Pole IF Filter.
- Complete separate transmitter and Receiver
- 13.6 VDC or 115/220 UAC Power Supply.
- 19" Rack Mounting.

OPTIONS

- Helical Filter Installed \$65.00.
- 8 Pole Filter Installed \$20.00.
- Cooling Fan Installed \$30.00.
- Duplexer
- Deluxe Cabinets
- Timer
- Tone Panel

OTHER PRODUCTS

- Simplex and Full Duplex
- VHF/UHF Mobiles and Bases
- Rural Radio Telephone
- Auto Patch
- HF SSB Transceiver
- Catalogues available upon request

DEALER INQUIRIES INVITED

ITS International Telecommunications Systems Florida Inc.

8416 N.W. 61 ST. / MIAMI, FLORIDA 33166
TEL: (305) 593-0214 / TELEX: 525834

Model 9330 is a capacitance measuring adapter with two sets of input connectors, banana jacks for large or in-circuit devices, and pin-insert jacks for direct device capacitor tests. Priced at \$44.00 with battery, this device can measure capacitance from 2 nF through 200 μ F on six ranges.

For more information, contact North American Soar Corporation, 1126 Cornell Avenue, Cherry Hill, New Jersey 08002.

Circle #309 on Reader Service Card.

solar systems

Photowatt International, Inc., a leading manufacturer of "total" solar electric systems, offers a laminated solar panel module rated at 55 watts, 16.5 volts at 3.4 amps that features 5-inch silicon cells. Other modules ranging in power from 7 watts to 35 watts are available. The Solar Eclipse Series modules have a power output of 7, 12, and 25 watts and are laminated in a durable bronzed frame with charcoal gray Tedlar backing. Modules are wired for either 6 or 12-volt applications.

Photowatt also manufactures a photovoltaic regulator used for system control. These power control units are the only regulators that offer current and voltage meters, low-battery indicator, lightning protection, and additional components to protect the PV systems. The PCU's are in NEMA 3R, rain-tight, lockable enclosures. Ground and pole mount support frames are available for one to ten modules per structure. Batteries, wires, hardware, J-boxes, accessories and installation instructions are also supplied. Customized photovoltaic systems are available for immediate shipment. Computer sizing quotations are available upon request to match customer's specific PV power requirements.

For details, contact Photowatt International, Inc., 2414 West 14th Street, Tempe, Arizona 85281.

Circle #310 on Reader Service Card.

hand keys and keyer paddles

Guild, one of the most respected names in musical instruments and related electronics, recently became the sole distributor for the Hi-Mound line of iambic keyer paddles and hand keys.

Hi-Mound paddles feature silvered contacts with full spacing and tension adjustments on all

GOT SOMETHING TO SELL?

Try a classified ad in Amateur Radio's #1 magazine, *ham radio*.

Non-commercial ads \$.10 per word. Commercial ads \$.60 per word. No agency discounts allowed. 15% discount allowed for ads run 6 consecutive months without change. 33% discount allowed for ads run 12 months without change. Payable in advance. Deadline 15th of 2nd prior month.

From something simple to something exotic, *ham radio* readers are interested. And results prove that they BUY!

Send your ad in today. Send payment with order or give us your MasterCard or VISA and we'll charge your account for you.

Name _____
Address _____
City _____
State _____ Zip _____
Card Number _____
Expires _____ MasterCard VISA

HAM RADIO MAGAZINE
Greenville, NH 03048

150

APPLIED INVENTION

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

GaAs FETS by MITSUBISHI

2M - Ku Band Very low noise and medium power	1.4
MGF 1100 Dual Gate GaAs FET 2.5dBm @ 4GHz	\$ 7.35
MGF 1202 (1402 chip in a 1200 package)	\$ 9.70
MGF 1404 GUARANTEED 0.55dBm @ 4GHz	\$66.60
MGF 1402 0.4 dBm @ 4.32, 1.1 dBm @ 4GHz	\$14.00
MGF 1412 GUARANTEED 0.8, 0.9 or 1.0 dBm @ 4GHz S21	-\$34.75
MGF 1801 10GHz linear PO 150mW	\$40.75

MITSUBISHI X BAND

Hybrid Integrated Circuits with tunable Dielectric Resonator (0.12MHz²/C) GaAs FET Oscillators

FO-1010X 10.4GHz 15mw out UER100 Flange	\$39.37
FO-1210Y 11.5 or 12.0 GHz UER120 Flange	\$39.37
FO-UP11KF Complete Heterodyne Rx 10.468 GHz LO	\$36.22

Can be used for 12.5 GHz terrestrial and ODS

FO-DP13KF Doppler Module 10.525 GHz UER100 Flange	\$43.05
X Band 15 dBG die cast horn antenna (UER100)	\$17.85
GaAs FET Preamp 1.7-2.1 GHz 2.0-2.35 GHz 20dBm	\$49.00

AT THE SOURCE FOR RETICON Universal Audio Active Filters

RS620 digitally programmed switched capacitor audio filter	\$ 7.85
RS621 dual section resistor programmed SCF	\$ 6.51
RS622 quad section resistor programmed SCF	\$11.07
Out performs National MF-10 Application notes	\$ 2.00

OPTOELECTRONICS from MITSUBISHI and SIEMENS

CW LASER DIODES, HIGH OUTPUT IRLEDs, PIN PHOTO DIODES CALL

MITSUBISHI BIPOLAR POWER TRANSISTORS FOR 900/1296

2SC2931 2 3 4 (1.4 to 30 Watts PO) CALL

MHF 901 Substitute 2SC2876, Ft=7GHz 2.2dBm @ 1GHz	\$ 1.50
HEC 64535 direct replacement Siemens BFQ74	\$ 9.66

LEADLESS DISK CAPS 100 220 470 880 pF 10% \$ 2.50

MICROWAVE CHIP CAPS

Very low loss VITRAMON P7800 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	\$ 2.50
A-B type FWSN 1000pF discoidal Feedthru	\$ 0.75

STRIPLINE SHUTTLE TRIMMERS (VOLTRONICS) 0.1 2.5 0.5 9 0pF

\$ 3.34

HI-Q SEALED CERAMIC PISTON TRIMMERS (VOLTRONICS) 0.6 9 0pF

\$ 3.58

SAPPHIRE TRIMMERS

Johanson 0.4 2.5pF \$ 9.47

For WA2GFP preamp Sprague 0.6 4.5pF \$ 9.47

Thermo Electric Heat Pumps & Sub-Minature Cryogenic Refrigerators CALL

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

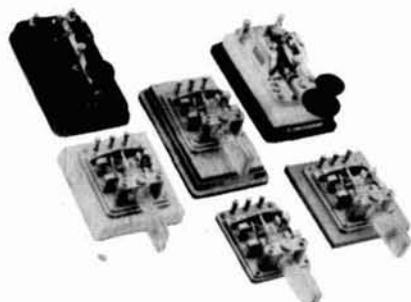
E.F. JOHNSON SMA's

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
SAH * ITEMS (UPS) \$3.75 ALL OTHER ITEMS \$2.50 (1st CLASS)
NY STATE RESIDENTS ADD 7% SALES TAX

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

models. Three of the iambic paddles have heavy, slip-resistant bases (one of solid marble), while the fourth is a paddle assembly which can be mounted on the base of your choice or built into an existing keyer. The hand keys, in addition to retaining the classic look, also have silvered contacts and a unique tension adjusting system.



A clear plastic dust cover is included with each key, and all are protected by Hi-Mound's one-year warranty, backed by Guild.

For more information, contact Guild at 225 West Grand Street, Elizabeth, New Jersey 07202.

Circle #311 on Reader Service Card.

SSB/FM microphones

A new cardioid unidirectional microphone especially built for SSB and FM communications is available from Heil, Ltd.

Two models are available. The HM-5 features a die-cast metal base and heavy-duty flexible goose-neck stand. The MM-5 is a comfortable hand-held unit for use in mobile or fixed operations.

Both feature Heil's new HC-3 cartridge and offer enhanced intelligibility and articulation and clean, natural reproduction of voice transmissions. Sensitivity is measured to -70 dB; response, 300-4000 Hz; impedance, 2000 ohms.

For more information, contact Heil, Ltd., Marissa, Illinois 62257.

Circle #312 on Reader Service Card.

count on these

Two new series of turns-counting dials for panel control of precision potentiometers are now available from Beckman Electronic Technologies Group (BET). Ten new analog dials, series 2650 and 2660 Duodial[®] are available in the popular 1/8", 1/4", and 6 mm shaft sizes in either a black housing with white numerals or in an anodized case with black numerals. The 7/8" dials count up to 15 turns.

The eight new digitals, series 2100 and 2200 Digidial[®] are available in either the popular 1/4" or 6 mm shaft size and are available with a clear or black anodized housing. They count up to ten turns and are available in eight three- or four-digit models.

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
Los Precios Mas Bajos en Nueva York...

KITTY SAYS: WE ARE NOW OPEN 7 DAYS A WEEK.
Saturday & Sunday 10 to 5 PM
Monday-Friday 9 to 6:30 PM Thurs. to 8 PM
Come to Barry's for the best buys in town. For
Orders Only Please Call: 800-221-2683



ICOM
IC-R70, IC-751, IC-730, IC-745, IC-25A/H, IC-37A
IC-45A, IC-271A, IC-2KL, IC-471A, IC-290H, IC-120

Barry gives the best in Commercial & Ham Gear
So-to One and All-A Happy and Healthy New Year!

We are now an Authorized
KENWOOD
Dealer

ROCKWELL/COLLINS
KWM-380
VoCom/Mirage
Tokyo Hy-Power
Amplifiers &
S/B HT Gain
Antennas IN STOCK

Computer Interfaces
stocked: MFJ-1224
AEA CP-1, Kantronics
Big Ham Clock/Ham Tags

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

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

BIRD
Wattmeters &
Elements
In Stock

AEA 144 MHz
AEA 440 MHz
ANTENNAS

FT-ONE, FT-980, FT-102, FT-77, FT-707, FT-230R FT-757GX
FT-726R, FT-720RU, FT-290R, FRG-7700, FT-203R

YAESU ICOM Lang Mobile HT
FT-208R IC2AT Wilson Mini Com II
FT-708R IC3AT Yaesu FTC 2203, FT 4703
FTC-1903 IC4AT Icom IC M12 (Marine)
IC0AT Tempo II

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
AES Simplex Autopatch STD SA With Patch FM
Transceiver To Your Telephone. Great For
Telephone Calls From Mobile To Base. Sample
To Use \$319.95

SANTEC
ST-222/UP
ST-142/UP
ST-442/UP
NEW IMPROVED
MURCH Model MFJ Models
UT2000B 900, 940R, 941C, & 961D

Repeater in Stock:
Spectrum SCR-1000, 4000, & 77
ICOM IC-RP 3010 (440 MHz)
ICOM IC-RP 1210 (1.2 GHz)

Complete Butternut Antenna
Inventory In Stock!
ROBOT 450C-800C-1200C
Color Mod Kits
Long-range Wireless
Telephone for export
in stock

**BENCHER PADDLES &
Vibroplex Keys In Stock!!**
New TEN-TEC
2591 HT, Corsair In Stock
DENTRON IS BACK IN STOCK!

MAIL ALL ORDERS TO BARRY ELECTRONICS CORP., 512 BROADWAY, NEW YORK CITY, N.Y. 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 USED EQUIPMENT
STORE HOURS: Monday-Friday 9 to 6:30 PM
Parking Lot Across the Street
Saturday - Sunday 10 to 5 p.m. (Free Parking)
AUTHORIZED DIST. MCKAY DYMEK FOR
SHORTWAVE ANTENNAS & RECEIVERS
IRTILEX: Spring St. Station
Subways: BMT "Prince St. Station"
IND "F" Train Bwy. Station
Bus: Broadway #6 to Spring St.

ORDER LINE
CALL
800-221-2683

We Stock: AEA, ARRL, Alpha, Ameco, Antenna Specialists, Astrac,
Astron, B & K, B & W, Bach, Bencher, Bird, Butternut, CDE, CES, Collins,
Communications Spec. Connectors, Covercraft, Cubic (Swan), Cushcraft,
Daiwa, Dentron, Digimax, Drake, ETO (Alpha), Eimac, Encomm, Heil
Sound, 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, Sarton, Shure, Swan, Telex, Tempo, Ten-Tec,
Tokyo Hi Power, Trionys TUBES, W2AU, Waber, Wilson, Yaesu Ham and
Commercial Radios, Voccom, Vibroplex, Curtis, Tri-Ex, Wacom Duplexers,
Repeaters, Phelps Dodge, Fanon Intercoms, Scanners, Crystals, Radio
Publications.

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

**Homebrew
Headquarters**

KIT \$49.95 ¹⁷⁸
Plus \$2.50 Shipping & Handling

"SMART" SQUELCH FOR SSB
73 MAGAZINE 8/82

Detects human voice but ignores noise, steady tones and Russian woodpecker
Works for voice signals below noise level
Ideal for net activities
Audio operated — no receiver modification
Connects between audio output and speaker

Other Kits:
R-X Noise Bridge (hr 2/77)
General Coverage Reception Drake R-4C Receiver (QST 5/81)
2 Meter Converter (73 4/82)
40 Meter QRP Transceiver (hr 1/81)
Fun-Mitter (73 2/81) Fun-Ceiver (73 7/81)
Fun-Oscillator (73 2/82) Fun-Amp (73 5/82) and others

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

1983-84 CATALOG 50¢

RADIO WAREHOUSE

Division of HARDIN Electronics

NO FRILLS — JUST LOW PRICES

• **KENWOOD**

TS 430 HF \$Call TR 2500 2m 285.00 TW 4000 UHF/VHF \$Call

• **YAesu**



FT 980 HF \$Call

2AT 2M \$219

• **ICOM**

IC-751 HF \$Call

EPSON RX-80 \$395.00 GEMINI-15 \$495.00

EPSON FX-80 565.00 C. Itoh 8510 495.00

For information on our other lines ...

CALL TOLL FREE

1-800-433-3203



IN TEXAS CALL 817-496-9000

5635 EAST ROSEDALE

FT. WORTH, TEXAS 76112



Both series feature a positive locking mechanism that prevents accidental changes due to shock or vibration. They mount directly on the potentiometer shaft to prevent backlash and are designed to compliment the Beckman Helipot® potentiometer.



For complete information, contact Beckman Instruments, Inc., Beckman Technologie Group, 2500 Harbor Boulevard, Fullerton, California 92634.

Circle #313 on Reader Service Card.

new cable

Nemal Electronics has just introduced a new cable for both the home and commercial satellite TV market. This new cable eliminates the separate control and RF cables and bundle them together into a single easy-to-handle covered package. Nemal's new SCC-921859 cable is covered with a high-strength, non-corroding vinyl outer jacket suitable for either direct burial or laying on the ground. Inside there is one Mil-Spec RG-59 RF cable with a 9 percent copper braided shield. There are five No. 22 copper strand wires and two No. 2 wires that are shielded with drain for sensitive signal activator circuits. Finally, two heavy-duty No. 18 wires are included for motor control. By eliminating the number of separate wires the chances of accidental system damage are reduced. Installation time is also reduced because of the ease and convenience of running one cable rather than several. The price is tentatively set at 75 cents per foot and \$495.00 per thousand feet.

For more information, contact Nemal Electronics, 12240 NE 14th Avenue, North Miami Florida 33161.

Circle #314 on Reader Service Card.

The Traveller Dipole Antenna

Is a highly portable continuously adjustable half wave antenna designed for the use on any frequency between 3.0 to 30 MHz. Very easy adjustment. No coil, no traps. It consists of a two reel (one at each end) - two housing assembly, both built of aviation grade aluminum. Each reel contains 72 feet (22 mts.) copper wire. Light, strong, dependable and very simple. Includes 2 nylon ropes to tie to any mast (tree, fence, etc.). The center insulator is a 1:1 impedance ratio balun with SO239 connector. Power handling capabilities - 2KW PEP or 1KW 100% amplitude modulate.

Price: \$96.75 + shipping

International Union Corporation 7291 N.W. 12th St. - Miami, FL 33126 (305) 591-3655 / 6

CALL LONG DISTANCE ON 2 METERS

Only 10 watts drive will deliver 75 watts of RF power on 2M SSB, FM, or CW. It is biased Class AB for linear operation. The current drain is 8-9 amps at 13.6 Vdc. It comes in a well constructed, rugged case with an oversized heat sink to keep it cool. It has a sensitive C.O.R. circuitry, reliable SO-239 RF connectors, and an amplifier IN/OUT switch. The maximum power input is 15 watts.



Our products are backed by prompt factory service and technical assistance. To become familiar with our other fine products in the amateur radio market, call or write for our free product and small parts catalog.

Model 875
Kit \$109.95
Wired & Tested \$129.95



CCI Communication Concepts Inc.

2648 North Aragon Ave. • Dayton, Ohio 45420 • (513) 296-1411



RING IN THE SAVINGS!



SAVE \$70!

Price slashed on KENWOOD TM-201A mobile FM transceiver!

Covers 142-149 MHz and offers 25 watts of FM power, dual digital VFO's, 5 memories with memory scan, programmable band scan and bright yellow LED display. State-of-the art receiver with GaAs FET RF amplifier. Complete with 16 key autopatch up/down mike and high quality external speaker. Power requirement: 13.8V DC.

299.95 List Price 369.95 Item No. KENTM201A Add 2.96 shipping & handling

KENWOOD TR-2500 handheld 2-meter FM transceiver

Compact, handheld transceiver with LCD readout, 10-channel memory, programmable band scan and keypad for autopatch or direct frequency entry. Covers 144-147.995 MHz and provides 2.5 or 0.3 watts of RF power. Complete with flexible antenna, rechargeable battery and AC charger. Dimensions: 6 1/2" x 2 1/4" x 1 1/4".

269.00 List Price 329.95 Item No. KENTR2500 Add 1.98 shipping & handling

PB-25H Heavy Duty Battery Pack for TR-2500 39.95



SAVE \$60!



SAVE \$210!

Lowest price ever on KENWOOD TS-530 HF transceiver!

Built-in power supply, speaker, 6-digit fluorescent frequency display and covers 160-10 meters, including WARC. Offers 220W PEP and 180W DC on all bands. Other features include IF shift tuning, adjustable noise blanker, VOX capability and built-in speech processor. Requires 120V AC @ 50/60 HZ. Limited quantities!

589.00 List Price 799.00 Item No. KENT530S Add 7.44 shipping & handling

Price reduced on KENWOOD TS-830S HF transceiver!

This feature-packed rig covers 160-10 meters, including WARC and delivers 220W PEP and 180W DC on all bands. It has independently adjustable IF shift and variable bandwidth tuning, RIT/XIT, fluorescent display and much more! Requires 120V AC @ 50/60 Hz.

749.95 List Price 949.95 Item No. KENT830S Add 7.83 shipping & handling

SP-230 External speaker for TS-830S/530S transceivers. Add 1.98 shipping. I.N. KENSP230 71.95



Long's Electronics



MAIL ORDERS: 2700 CRESTWOOD BLVD. B'HAM AL 35210 • SHOWROOM: 3131 4TH AVE. SO, B'HAM AL 35233

ENJOY TV FROM SPACE!

Complete TVRO System With 10 foot Parabolic Antenna

\$1395

Item No. SAT44311
Shipped Motor Freight Collect

What the system will do:

Receives up to 60 satellite TV channels including movies, sporting events, news, other TV stations and much more!

What the system includes:

1. 10 ft. parabolic antenna made of reflective metal bonded with fiberglass. Breaks down into 4 sections for compact shipment.
2. Polar mount. Features azimuth and elevation adjustments for precise tracking. Available with earth or slab mounts.
3. LNA mount complete with rotor. Enables LNA to be remotely positioned for correct polarity. Control console included. Extension tubes extra.
4. KLM Sky Eye V satellite receiver. Features the latest in single conversion electronics, large signal strength meter, video invert and variable audio tuning. Downconverter and built-in RF modulator included.
5. Amplica low noise amplifier. Rated at 120° K, uncooled. Uses GaAs FET transistors for maximum performance. Cast aluminum, weatherproof housing.
6. Scalar feed horn. Provides 0.5 dB more gain than conventional types. Virtually eliminates system noise.

NOTE: LNA-to-downconverter cable included. Other interconnecting cables between components sold separately.



NOTE: Prices good only while current supply lasts. Price subject to change without notice. Hurry, quantities are limited!

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

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



Ham Radio's guide to help you find your loc

California

C & A ROBERTS, INC.
18511 HAWTHORN BLVD.
TORRANCE, CA 90504
213-370-7451
24 Hour: 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
Habla Espanol

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, Microlog, Yaesu,
Azden, Santec, KDK, and more.
One mile off I-95, no sales tax.

Florida

AMATEUR ELECTRONIC SUPPLY
1898 DREW STREET
CLEARWATER, FL 33575
813-461-4267
Clearwater Branch
West Coast's only full service
Amateur Radio Store.
Hours M-F 9-5:30, Sat. 9-3

AMATEUR ELECTRONIC SUPPLY
621 COMMONWEALTH AVE.
ORLANDO, FL 32803
305-894-3238
Fla. Wats: 1 (800) 432-9424
Outside Fla: 1 (800) 327-1917
Hours M-F 9-5:30, Sat. 9-3

AMATEUR RADIO CENTER, INC.
2805 N.E. 2ND AVENUE
MIAMI, FL 33137
305-573-8383
The place for great dependable
names in Ham Radio.

Illinois

ERICKSON COMMUNICATIONS, INC.
5456 N. MILWAUKEE AVE.
CHICAGO, IL 60630
312-631-5181
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.

Michigan

ENCON PHOTOVOLTAICS
Complete Photovoltaic Systems
27600 Schoolcraft Rd.
Livonia, Michigan 48150
313-523-1850
Amateur Radio, Repeaters, Satellite,
Computer applications.
Call Paul WD8AHO

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
Hours M-F 9-5:30, Sat. 9-3

JUN'S ELECTRONICS
460 E. PLUMB LANE — 107
RENO, NV 89502
702-827-5732
Outside Nev: 1 (800) 648-3962
Icom — Yaesu Dealer

New Hampshire

POLCARI'S ELECTRONICS CENTER
61 LOWELL ROAD
HUDSON, NH 03051
603-883-5005
Southern New Hampshire's only Ham
Store. Call today for quotes.

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.

Dealers: *YOU SHOULD BE HERE TOO!*
Contact Ham Radio now for complete details.

Amateur Radio Dealer

ROUTE ELECTRONICS 17
777 ROUTE 17 SOUTH
PARAMUS, NJ 07625
201-444-8717

Drake, Cubic, DenTron, Hy-Gain,
Cushcraft, Hustler, Larsen, MFJ,
Butternut, Fluke & Beckman
Instruments, etc.

New York

BARRY ELECTRONICS

512 BROADWAY
NEW YORK, NY 10012
212-925-7000
New York City's Largest Full Service
Ham and Commercial Radio Store.

VHF COMMUNICATIONS

915 NORTH MAIN STREET
JAMESTOWN, NY 14701
716-664-6345

Call after 7 PM and save! Supplying
all of your Amateur needs. Featuring
ICOM "The World System." Western
New York's finest Amateur dealer.

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
Hours M-F 9-5:30, Sat. 9-3

UNIVERSAL AMATEUR RADIO, INC.

1280 AIDA DRIVE
REYNOLDSBURG (COLUMBUS), OH
43068
614-866-4267
Featuring Kenwood, Yaesu, Icom,
and other fine gear. Factory author-
ized sales and service. Shortwave
specialists. Near I-270 and airport.

Pennsylvania

HAMTRONICS,

DIV. OF TREVISE ELECTRONICS
4033 BROWNSVILLE ROAD
TREVISE, 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,
Larsen, Hustler, Belden, Antenna
Specialists, W2AU/W2VS, AEA, B&W,
Amphenol, Saxton, J.W. Miller/Daiwa,
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, Dentron, 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
M-F 9-5:30
Sat 9-3

**SAY
YOU SAW
IT IN
ham radio!**

FREE CATALOG!

Features Hard-to-Find Tools
and Test Equipment



Jensen's new catalog features hard-to-
find precision tools, tool kits, tool cases
and test equipment used by ham radio
operators, hobbyists, scientists, engi-
neers, laboratories and government
agencies. Call or write for your free copy
today.

JENSEN 7815 S. 46th Street
TOOLS INC. Phoenix, AZ 85040
(602) 968-6231

152

1296 & PHASE III
MAKI UTV 1200 - \$499⁹⁵
MAKI 20W AMP - \$430⁰⁰

MICROWAVE MODULES
432 / 435 TRANSVERTERS
432 / 1296 YAGI - 18 + dB

0-10 TRACKING PROG.
TIMEX / ZX - 16K
Vic-Basic \$12.95
Also Avail. w/RS & STS

See the Timex / ZX AUTOTRAK
ROTOR CONTROLLER AT DAYTON '84
SASE for full details

SPECTRUM WEST

5717 NE 56th, SEATTLE, WA
206-382-2132 185 98105

BUY
HIGH QUALITY
CUTTERS & PLIERS
DIRECT FROM
MANUFACTURER!
LOW PRICES—SEND FOR CATALOG!
Use this magazine's "reader service"
card and we will enclose an extra **10%**
DISCOUNT CERTIFICATE.

SCANDEX INC.
87 Crescent Rd.
Needham, MA 02194 183
(617) 449-1550

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

- | | |
|-----------------------------------|-----------------------------------|
| ACI _____ 101 | K&S _____ 153 |
| AEA _____ 102 | Kantronics _____ 154 |
| ARR _____ 103 | Keithley _____ 302 |
| Alpha Delta _____ 104 | Kenwood * _____ |
| Aluma _____ 105 | Larsen _____ 155 |
| Amateur-Wholesale _____ 106 | Long's _____ 156 |
| ARRL _____ 107 | Lunar _____ 157, 158 |
| Amidon _____ 108 | MFJ _____ 159 |
| Analog _____ 109 | Madison _____ 160 |
| Applied Inv. _____ 110 | Memphis Amateur Elec. _____ 161 |
| ARRL National Convention * _____ | Meshna _____ 162 |
| Astron _____ 111 | Metric _____ 163 |
| ATV Mag. _____ 112 | Micro-Mart * _____ |
| BHCo _____ 113 | Microwave Filter _____ 164, 301 |
| Barker & Williamson _____ 114 | Mirage _____ 316 |
| Barry * _____ | Missouri Radio _____ 165 |
| Beckman _____ 313 | Morning _____ 166 |
| Buckmaster _____ 115, 116 | Mosley _____ 167 |
| Butternut * _____ | Motorola Semiconductor _____ 315 |
| California Eastern Lab. _____ 117 | NCG _____ 168 |
| Calvert Elec. _____ 118 | W. H. Nail _____ 169 |
| Caywood _____ 119 | Nampa _____ 170 |
| Ceco _____ 120 | Nemal Elec. _____ 171, 314 |
| Comm. Concepts _____ 121 | NAS _____ 309 |
| Comm. Spec. _____ 122 | Nuts & Volts _____ 172 |
| CPU _____ 123 | Oak Hill Academy ARS * _____ |
| Comp. Trader _____ 124 | P. C. Elec. _____ 173, 308 |
| Cushcraft _____ 125 | Pacific One * _____ |
| Dayton Hamvention * _____ | Photowatt _____ 310 |
| Doppler _____ 126 | Pro-Search _____ 175 |
| EGE _____ 127 | RF Products _____ 176 |
| ETO * _____ | Callbook _____ 177 |
| Encomm _____ 128 | Radiokit _____ 178 |
| Eng. Cons. _____ 129 | Radio Warehouse * _____ |
| Fabtron _____ 130 | Ramsey _____ 179, 180 |
| Fair Radio _____ 131 | Random Access _____ 181 |
| Falcon _____ 132 | SAROC * _____ |
| FDK Int. _____ 304 | Sartori _____ 182 |
| Flesher _____ 133 | Scandex _____ 183 |
| Fox-Tango _____ 134, 307 | Spectronics * _____ |
| GLB Elec. _____ 135 | Spectrum Int. _____ 184 |
| Gizmo Elec. _____ 136 | Spectrum West _____ 185 |
| Guid _____ 311 | Spi-Ro Dist. _____ 186 |
| Ham MasterTapes _____ 137 | Surplus Sales of Nebraska * _____ |
| H. R. B. _____ 138 | TE Systems _____ 189 |
| Ham Shack * _____ | Telex * _____ |
| Hamtronics, N.Y. _____ 139, 303 | Telex/Hy-Gain * _____ |
| Hamtronics, PA _____ 140, 144 | TimeKit _____ 190 |
| Handi-Tek _____ 141 | Transleteronic _____ 191 |
| Harvey _____ 142 | Tri-Ex _____ 192 |
| Hatry Elec. _____ 143 | Tropical Hamboree * _____ |
| Heil _____ 312 | UNR-Rohn _____ 193 |
| Henry Radio _____ 145 | Vanguard _____ 194 |
| Icom _____ 146, 147, 148, 306 | Vector Radio _____ 195 |
| I. C. M. _____ 149 | Westcom _____ 196 |
| I. T. S. _____ 150 | Western Elec. _____ 197 |
| Int. Union _____ 151 | Westlink _____ 198 |
| Jensen _____ 152, 305 | Yaesu _____ 199 |

* Please contact this advertiser directly.

Limit 15 inquiries per request.

January 1984

Please use before February 29, 1984

Tear off and mail to
HAM RADIO MAGAZINE — "check off"
 Greenville, N. H. 03048-0498

NAME _____

CALL _____

STREET _____

CITY _____

STATE _____ ZIP _____

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 _____ 90.00	
	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 _____ 49.50	
	705A _____ 10.00	
	811A _____ 13.50	
	813 _____ 40.00	
	829B _____ 40.00	
	832A _____ 38.00	
	833A _____ 145.00	
	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	
	5899 _____ 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 _____ 19.95	
	MRF-454/A _____ 19.95	
	MRF-455/A _____ 19.95	
	2N6084 _____ 15.00	

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"


TRANSLETERONIC INC.
 1365 39th STREET, BROOKLYN, N. Y. 11218H
 Tel. 212-633-2800/Wats Line 800-221-5802
 TWX 710-584-2460 ALPHA NYK.

Advertisers iNdex

Acquis Communications, Inc. _____	82
Advanced Electronic Applications _____	52
Advanced Receiver Research _____	107
Alpha Delta Communications _____	105
Aluma Tower Co. _____	90
Amateur-Wholesale Electronics _____	57
American Radio Relay League _____	99
Amidon Associates _____	97
Analog Technology _____	99
Applied Invention _____	108
ARRL National Convention _____	68
Astron Corp. _____	87
ATV Magazine _____	97
BHCo _____	106
Barker & Williamson _____	30
Barry Electronics _____	109
Buckmaster Publishing _____	85, 107
Butternut Electronics _____	111
California Eastern Laboratories _____	10
Calvert Electronics _____	23
Caywood Electronics, Inc. _____	107
Ceco Communications _____	34
Communication Concepts, Inc. _____	110
Communications Specialists _____	1
Computer Products and Peripherals Unlimited _____	58
Computer Trader _____	106
Cushcraft _____	9
Dayton Hamvention _____	34, 62
Doppler Systems _____	68
EGE, Inc. _____	17
Ehrhorn Technological Operations _____	58
Encomm, Inc. _____	64
Engineering Consulting _____	97
Fabtron Division, Rhoades National Corp. _____	107
Fair Radio Sales _____	85
Falcon Communications _____	119
Flesher Corp. _____	58
Fox Tango Corp. _____	104
GLB Electronics _____	51
Gizmo Electronics _____	68
Ham MasterTapes _____	120
Ham Radio's Bookstore _____	36, 43, 58, 59, 62, 82, 85, 94, 99, 104, 106
The Ham Shack _____	92
Hamtronics, N.Y. _____	70, 71
Hamtronics, PA _____	44, 45
Handi-Tek _____	102
Harvey Electronics _____	78
Hatry Electronics _____	40
Henry Radio _____	24, 25
Icom America, Inc. _____	Cover II, 60, 61
International Crystal Manufacturing, Inc. _____	48
International Telecommunications Systems _____	108
International Union Corp. _____	110
Jensen Tools, Inc. _____	115
K & S Electronics _____	63
Kantronics, Inc. _____	31
Trio-Kenwood Communications _____	2, Cover IV
Larsen Electronics _____	41
Long's Electronics _____	112, 113
Lunar Electronics _____	36, 63
MFJ Enterprises _____	7
Madison Electronic Supply _____	77
Memphis Amateur Electronics _____	59
John J. Meshna Jr. Co., Inc. _____	95
Metric Resources Co. _____	67
Micro-Mart Distributors _____	100
Microwave Filter, Inc. _____	103
Missouri Radio Center _____	34
Morning Distributing _____	63
Mosley Electronics _____	33
NCG _____	90
W. H. Nail Co. _____	111
Nampa Satellite Receiver Systems _____	81
Nemal Electronics _____	58
Nuts & Volts _____	102
Oak Hill Academy ARS _____	90
P. C. Electronics _____	48
Pacific One Corp. _____	36
Pro-Search Electronics _____	32
RF Products _____	105
Radio Amateur Callbook _____	75
Radiokit _____	85
Radio Warehouse _____	109
Ramsey Electronics _____	88, 89
Random Access, Inc. _____	40
SAROC _____	96
Sartori Associates _____	104
Scandex, Inc. _____	115
Spectronics _____	68
Spectrum International _____	82
Spectrum West _____	115
Spi-Ro Distributing _____	102
Surplus Sales of Nebraska _____	90
TE Systems _____	59
Telex Communications _____	29, 85
TimeKit _____	111
Transleteronic, Inc. _____	116
Tri-Ex Tower Corp. _____	97
Tropical Hamboree _____	92
UNR-Rohn _____	92, 106
Vanguard Labs _____	99
Vector Radio _____	111
Westcom Engineering _____	85,
Western Electronics _____	99
Westlink Report _____	56
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 February 29, 1984

January 1984

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.

An industry first!

Enjoy the advantages of RF Power MOSFETs



MOSFET technology in American made mobile power amplifiers. Built for those who demand quality.

4101 Complete 2 meter HT accessory—All mode RF amplifier, 2W in = 25W out, 50W out maximum; regulated power supply for HT; 4W speaker amplifier; optional RX preamplifier \$215

4102 Complete 2 meter HT accessory—All mode RF amplifier, 2W in = 100W out; regulated power supply for HT; 4W speaker amplifier; optional RX preamplifier. \$325

4103 All mode 100W 2 meter amplifier—For 1W to 25W transceivers. 2W in = 30W out, 10W in = 90W out. Optional RX preamp. \$225

4104 All mode 100W 220 MHz amplifier—For 1W to 25W transceivers. 2W in = 25W out, 10W in = 70W out. Optional RX preamp. \$235

4105 Amplifier remote control—Controls 4103 or 4104 amplifiers mounted away from operating position. Complete with 16' cable. \$32

4109 2 meter RX preamp—Plugs in to a Falcon 2 meter amplifier. \$36

4110 220 MHz RX preamp—Plugs in to a Falcon 220 MHz amplifier. \$39

Coming Next Month

4116 2 meter receiver preamp—For improving receiver sensitivity of transceivers. Switches out on transmit. No transceiver modification.

4117 Twin 40 dB RF coupler—Two attenuators bridge a thru line. Connect signal generators, spectrum analyzers, etc., without the fear of accidental damage from transmitter power.

4118X Splice Kote—Heat shrink tubing with special thermo-plastic inner coating. Weather seals coaxial fittings.

Protected territories offered to selected dealers

FALCON
COMMUNICATIONS

(415) 851-8779
P.O. Box 620625,
Woodside, CA 94062

Actual slow motion frames from Ham MasterTapes



1. Larry, N2NY, Lee, KA2RNV, Virginia, N2EGJ



2. Lee discharges cap



3. In slow motion it's dazzling



4. Wow. Can we see it again?

**You've never seen this, like this,
before this!**

**And you can see it—in color—again and again
when you own the N2NY Ham MasterTapes.**

Ever see a cap discharge in slow motion? You will on Ham MasterTapes. Ham MasterTapes can perform the dozens of complicated demonstrations necessary for a beginner's understanding of Ham Radio Theory.

Finally, a step-by-step course in Ham Radio Theory is available on color videotape. The Larry Horne N2NY Ham MasterTapes video course is a unique, effective teaching technique expertly produced by New York's leading professionals in studio and field videotape.

- Video Graphics highlight important details.
- Carefully worked-out demonstrations on video avoid the problem of getting complex gadgets to work on command in front of a class.
- Working examples of every ham radio component, device, or system covered in the FCC guide can be clearly understood.

The N2NY Ham MasterTapes give you a basic grasp of concepts that build theory background—not only for passing the FCC tests, but for understanding electronics.

The hobby has long needed better, clearer, high-tech teaching aids to help newcomers into our wonderful world of Ham Radio.

These six-hour tapes cover completely all the material needed to understand Novice and Tech/General Theory and operations, and include the new 200-question FCC syllabus used beginning September 1983.

Only \$199.95. Order direct and specify Beta or VHS format. Call or write: Larry Horne, N2NY or

Virginia Hamilton, N2EGJ at
Ham MasterTapes
136 East 31st Street
New York, N.Y. 10016 212-673-0680.

Ham MasterTapes™

THE N2NY HAM RADIO COURSE ON VIDEOTAPE

© 1983 N2NY Productions, Inc.



INTRODUCING . . .

THE FT-980 CAT SYSTEM !!!



Join the computer revolution in Amateur Radio with the Computer Aided Transceiver
 . . . the new FT-980 from Yaesu Electronics!

- 8-Bit microprocessor for greater operating flexibility.
- High-voltage, all solid state transmitter PA for excellent linearity.
- Keyboard entry of frequencies into any of twelve independent VFO/memory registers.
- Amateur band transmit plus general coverage receive capability.
- Full CW break-in with quiet solid state switching.
- CW Spot switch on front panel.
- Digital frequency display with resolution to 10 Hz. Digital readerboard-type coarse frequency sub-display.
- Keyboard entry of sub-bands for Novice, General, or Advanced Class operators. Separate sub-bands may be programmed on each memory.
- Up/Down scanning plus instant ± 5 kHz/step QSY from front panel.
- SSB/CW/AM/FSK/FM operation built in. CW and AM Wide/Narrow selection using optional filters.
- Wide dynamic range and noise floor maintenance provided by husky front end design and IF filter gain balancing.
- 10 Hz synthesizer steps. Quick frequency change via keyboard or scanning controls.
- IF Notch filter at 455 kHz for interference rejection.

- Audio Peak Filter for narrow band CW signal enhancement.
- RX Audio Tone Control for signal laundering in AF line.
- Variable IF Bandwidth and IF Shift using cascaded filters.
- Memory storage of both frequency and operating mode.
- Pushbutton Memory Check feature for verification of memory frequencies without actually changing operating frequency in use.
- Pushbutton Offset Check feature for verification of memory-to-VFO frequency difference.
- Variable Pulse Width Noise Blanker.
- IF Monitor with front panel volume control.
- RF Speech Processor.
- Dual metering of Vcc, Ic, ALC, Compression, Discriminator Center, Relative PO, and SWR (Calibrated).
- Selectable AGC: Slow/Fast/Off.
- Separate RX-only antenna jack.
- Three FSK shifts built in.
- Optional Electronic Keyer Module.
- Optimization of audio passband for mode in use, for preservation of noise figure with changing bandwidth.
- Computer interface optional module available mid-1983, for remote transceiver control from personal computer terminal.

For a detailed brochure covering the FT-980 CAT System, call or write your Authorized Yaesu Dealer.

Price And Specifications Subject To
 Change Without Notice Or Obligation

YAESU
The radio.



0183R

✓ 199

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

Watts to see...



Big LCD, Big 45 W, Big 21 memories, compact.

TR-7950/7930

Outstanding features providing maximum ease of operation include a large, easy-to-read (direct sunlight or dark) LCD display, 21 multi-function memories, automatic offset, programmable priority channel, memory and band scans, built-in lithium battery memory back-up, built-in 16-key autopatch encoder, and a choice of a hefty 45 watts output (TR-7950), or 25 watts output (TR-7930).

TR-7950/TR-7930 FEATURES:

- **NEW, large, easy-to-read LCD digital display**
Easy to read in direct sunlight or dark (back-lighted). Displays transmit/receive frequencies, memory channel, repeater offset, (+, S, -), sub-tone number (F-0, 1, 2, 3), tone, scan, and memory scan lock-out. Includes LED S/Rf bar meter, and LED indicators for REVERSE, CENTER TUNING, PRIORITY, and ON AIR.
- **21 NEW, multi-function memory channels**
Stores frequency, repeater offset, and optional sub-tone channels. Memories 1 through 15 for simplex or ± 600 kHz offset. Memory pairs 16/17, and 18/19 are paired for non-standard repeater offset. Memories "A" and "B" set upper and lower scan limits, or for simplex or ± 600 kHz offset. In MEMORY mode, a circle of light appears around the memory selector knob. When the memory selector knob is rotated in either direction to channel 1, an audible "beep" will sound.
- **Choice of 45 or 25 watts output**
The TR-7950 provides a hefty 45 watts output, while the TR-7930 features a more modest 25 watts. A HI/LOW power switch allows power reduction to approx. 5 watts.

- **Long-life lithium battery memory back-up**
Built-in lithium battery has an estimated 5 year life.
- **Automatic offset**
The microprocessor is pre-programmed for simplex or ± 600 kHz offset, in accordance with the 2 meter band plan. "OS" key allows manual change in offset.
- **Programmable priority alert**
The PRIORITY channel may be programmed in any of the 21 memories. With ALERT switch "ON," a dual "beep" sounds when a signal is present on the PRIORITY channel. An OPER switch allows an easy move to the PRIORITY channel.
- **Programmable memory scan lock-out**
"LO" key for programming scan to skip selected memory channels, without erasing the memory.
- **Programmable band-scan width**
The lower limit may be programmed into memory "A," and the upper limit into memory "B."
- **Center stop during band-scan, with indicator**
Stops in center of channel during band-scan, with center tuning indicator.
- **Scan resume selectable**
Scan stops on busy channel. Selectable automatic time resume-scan (approx. 5 sec., adjustable), or carrier operated resume-scan. A scan delay of approx. 1.5 seconds built-in.
- **Scan control using up/down microphone**
Momentarily pressing UP or DOWN button on microphone tunes one step in the selected direction, on memory or on 5-kHz step tuning. Holding the button for about 2 seconds starts UP or DOWN automatic scan action. Scan start also possible using "SC" key on keyboard. Scan may be cancelled by momentarily pressing the PTT switch, or by pressing both UP/DOWN buttons simultaneously.

- **Programmable sub-tone channels**
Optional TU-79 3 frequency sub-tone unit provides keyboard selectable sub-tone channels, which may be stored in memory.
- **Built-in 16-key autopatch, with monitor**
The keyboard functions as a 16-key autopatch encoder during transmit. DTMF tones appear in the speaker output when a key is pressed during transmit.
- **Front panel keyboard control**
Used for selecting frequency, offset, programming memories, controlling scan, and autopatch encode. Keyboard lighting is provided.
- **Extended frequency coverage**
Covers 142.000-148.995 MHz, in 5-kHz steps.
- **Repeater reverse switch**
Locking-type switch, with indicator.
- **"Beeper" amplified through speaker**
- **Compact, lightweight design**
- **Easy-to-install adjustable-angle mobile mounting bracket**

Optional accessories:

- TU-79 three frequency tone unit.
- KPS-12 fixed-station power supply for TR-7950.
- KPS-7A fixed-station power supply for TR-7930.
- SP-40 compact mobile speaker.

More information on the TR-7950 and TR-7930 is available from all authorized dealers of Trio-Kenwood Communications, 1111 West Walnut Street, Compton, California 90220.

KENWOOD

pacesetter in amateur radio

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