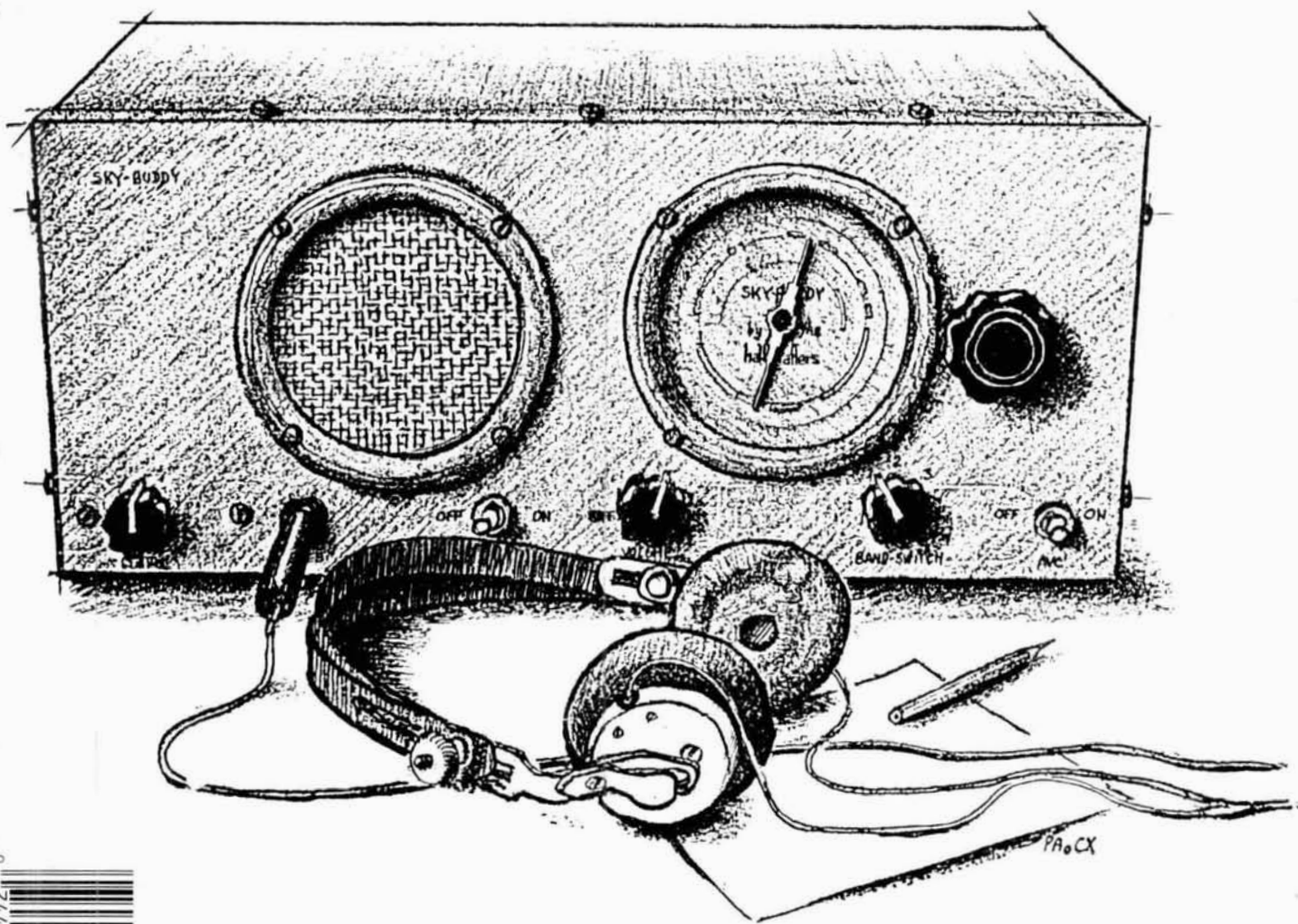


NEW **HAM RADIO**



Was this your first radio?



YOU EXPECT THE WORLD FROM ICOM RECEIVERS

ICOM's IC-R71A and IC-R7000 are the professional's choice for receiving international broadcasts, aircraft, marine, business, emergency services, television, and government bands. These people demand the finest in communications and so do you. ICOM puts the world at your fingertips with the IC-R7000 25-2000MHz* and IC-R71A 0.1-30MHz commercial quality scanning receivers.

Incomparable Frequency Control. Both the IC-R71A and IC-R7000 feature **direct frequency access** via their front keypad, main tuning dial, optional infrared remote control and/or computer interface adapter. **Incredible Flexibility!**

Full Coverage, Maximum Performance. The superb IC-R71A is your key to world-wide SSB, CW, RTTY, AM and FM (optional) communications plus foreign broadcasts in the 100kHz to 30MHz range. It features IF Notch, low noise mixer circuits and a 100db dynamic range. The pacesetter **IC-R7000** receives today's hot areas of interest, including aircraft, marine, public services, amateur, and satellite transmissions in the 25MHz

to 2000MHz* range. It includes **all mode operation** low noise circuits plus outstanding sensitivity and selectivity. The IC-R71A/R7000 combination is your window to the world!



The IC-R71A is a shortwave listener's delight. Its **32 tunable memories** store frequency and mode information, and they are single-button reprogrammable **independent of VFO A or VFO B's operations!** Dual width, an adjustable noise blanker, panel selectable RF preamp, and selectable AGC combined with **four scan modes** and all-mode squelch further enhance the IC-R71A's HF reception!

The IC-R7000 features 99 tunable memories and **six scanning modes**. It even scans a band and loads memories 80 to 99 with active frequencies without

operator assistance! Additional features include selectable scan speed pause delays, wide/narrow FM reception and high frequency stability.

Options. IC-R7000: RC-12 remote control, EX-310 voice synthesizer, CK-70 DC adapter, MB-12 mobile bracket. IC-R71A: RC-11 remote control, EX-310 voice synthesizer, CK-70 DC adapter, MB-12 mobile bracket, FL-32A 500Hz, FL-63A 250Hz and FL-44A filters.

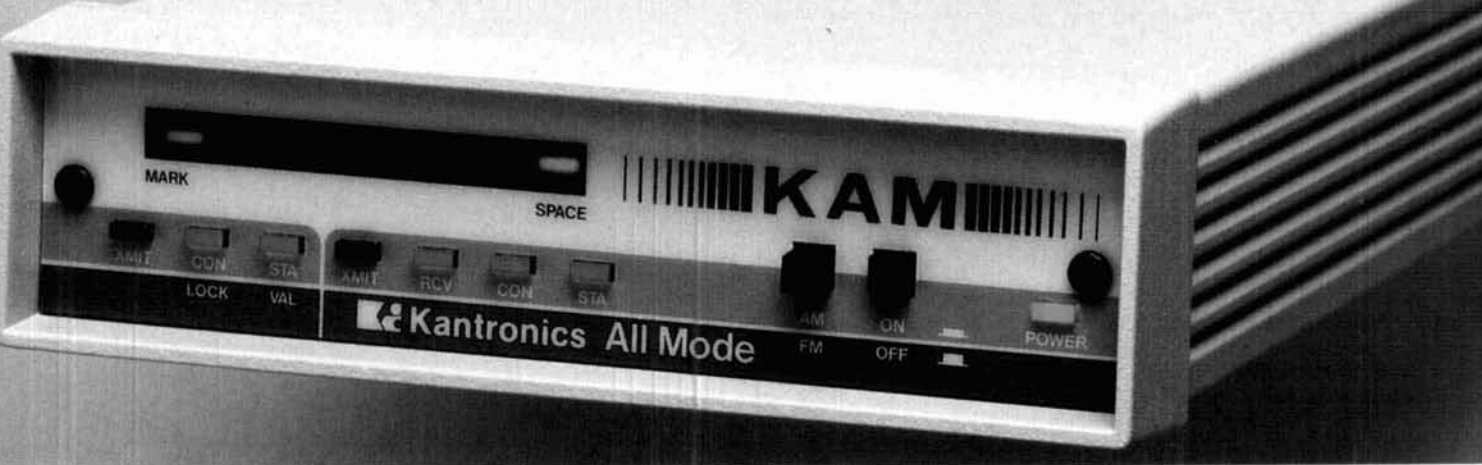
See these quality ICOM receivers at your local authorized ICOM dealer today.

*Specifications of the IC-R7000 guaranteed from 25-1000MHz and 1260-1300MHz. No coverage from 1000-1025MHz.

ICOM America, Inc., 2380-116th Ave. N.E., Bellevue, WA 98004
Customer Service Hotline (206) 454-7619
 3150 Premier Drive, Suite 126, Irving, TX 75063
 1777 Phoenix Parkway, Suite 201, Atlanta, GA 30349
 ICOM CANADA, A Division of ICOM America, Inc.,
 3071 - #5 Road, Unit 9, Richmond, B.C. V6X 2T4 Canada

All stated specifications are subject to change without notice or obligation. All ICOM radios significantly exceed FCC regulations limiting spurious emissions. Receivers 89

ICOM
 First in Communications



If You Want the Most Advanced TNC Today...

In 26 countries around the world, tens of thousands of amateurs know that Kantronics is the leader in bringing tomorrow's technology to their stations today. They also know they will always be among the first to incorporate just-introduced features and modes with Kantronics software and firmware updates.

And, they know that Kantronics is unique in its ability to seek out, develop and incorporate the most advanced features into each of five different TNC models before anyone else. Why? Because every program Kantronics writes, and every unit Kantronics designs and produces are born right here at the factory in the U.S.A.

Meet Your Mailman

In this age of telco LANS, E-mail and FAX,



PBBS is just one of the firsts Kantronics delivered.

you will know you have mail in your **Personal Packet Mailbox™** when your KAM "STA" LED is blinking. New firmware level 2.85 has also added a handy automatic mailbox user-

connect. So save your computer and monitor life by turning them off when you are away, and never miss a beat on the airwaves.

Version 2.85 KAMs have increased Packet Cluster™ compatibility, **KA-NODE™** path preservation, **KA-NODE** recognition of the "NET" nodes and HF baud rates from 50 through 300! And there are three new mailbox commands: *List Mine, Read Mine* and *Kill Mine*.

and Tomorrow...

Will the Real Dual-Port Please Stand Up?

Read our lips. The **KAM™** is the only true **dual-port** when it comes to packet. Your **Personal Packet Mailbox™** is accessible from both HF and VHF! Version 2.85 has dual-port compatibility with RLI/MBL boards and KISS mode for both ports. You can monitor HF and VHF packet operations at the same time. Users can even gateway from HF to VHF (or in reverse) through your KAM.

Kantronics All-Mode™ (KAM) has Packet, WEFAX, ARQ, FEC, RTTY and CW reception. But we have five models to suit your particular taste. **Ask your dealer for the best choice today...and tomorrow.**

Kantronics
RF Data Communications Specialists

1202 E. 23rd Street Lawrence, Kansas 66046
(913) 842-7745

KENWOOD

...pacesetter in Amateur Radio

NEW!

Affordable DX-ing!

TS-140S

HF transceiver with general coverage receiver.

Compact, easy-to-use, full of operating enhancements, and feature packed. These words describe the new TS-140S HF transceiver. Setting the pace once again, Kenwood introduces new innovations in the world of "look-alike" transceivers!

- Covers all HF Amateur bands with 100 W output. General coverage receiver tunes from 50 kHz to 35 MHz. (Receiver specifications guaranteed from 500 kHz to 30 MHz.) Modifiable for HF MARS operation. (Permit required)
- All modes built-in. LSB, USB, CW, FM and AM.
- Superior receiver dynamic range. Kenwood DynaMix™ high sensitivity direct mixing system ensures true 102 dB receiver dynamic range.



- New Feature! Programmable band marker. Useful for staying within the limits of your ham license. For contesters, program in the suggested frequencies to prevent QRM to non-participants.
- Famous Kenwood interference reducing circuits. IF shift, dual noise blankers, RIT, RF attenuator, selectable AGC, and FM squelch.

- M. CH/VFO CH sub-dial. 10 kHz step tuning for quick QSY at VFO mode, and UP/DOWN memory channel for easy operation.
- Selectable full (QSK) or semi break-in CW.
- 31 memory channels. Store frequency, mode and CW wide/narrow selection. Split frequencies may be stored in 10 channels for repeater operation.
- RF power output control.
- AMTOR/PACKET compatible!
- Built-in VOX circuit.
- MC-43S UP/DOWN mic. included.

Optional Accessories:

- AT-130 compact antenna tuner • AT-250 automatic antenna tuner • HS-5/HS-6/HS-7 headphones • IF-232C/IF-10C computer interface
- MA-5/VP-1 HF mobile antenna (5 bands)
- MB-430 mobile bracket • MC-43S extra UP/DOWN hand mic • MC-55 (8-pin) goose neck mobile mic • MC-60A/MC-80/MC-85 desk mics
- PG-2S extra DC cable • PS-430 power supply
- SP-41/SP-50B mobile speakers • SP-430 external speaker • TL-922A 2 kW PEP linear amplifier (not for CW QSK) • TU-8 CTCSS tone unit
- YG-455C-1 500 Hz deluxe CW filter, YK-455C-1 New 500 Hz CW filter



TS-680S

All-mode multi-bander

- 6m (50-54 MHz) 10 W output plus all HF Amateur bands (100 W output)
- Extended 6m receiver frequency range 45 MHz to 60 MHz. Specs. guaranteed from 50 to 54 MHz
- Same functions of the TS-140S except optional VOX (VOX-4 required for VOX operation).
- Pre-amplifier for 6 and 10 meter band.



Complete service manuals are available for all Kenwood transceivers and most accessories. Specifications, features, and prices are subject to change without notice or obligation.

KENWOOD

KENWOOD U.S.A. CORPORATION
2201 E. Dominguez St., Long Beach, CA 90810
P.O. Box 22745, Long Beach, CA 90801-5745

HAM RADIO

NOVEMBER 1989

Volume 22, Number 11

Publisher & Editor-in-Chief:
T.H. TENNEY, JR., W1NLB

EDITORIAL STAFF

Editor:
TERRY NORTHUP, KA1STC

Consulting Technical Editors:
Marty Durham, NB1H
David McLanahan, WA1FHB
Alfred Wilson, W6NIF
Robert D. Wilson, WA1TKH

Associate Editors:
Tom McMullen, W1SL
Joseph J. Schroeder, W9JUV

Production Editor: Susan Shorrock
Copy Editor: Peggy Tenney, KA1QDG
Editorial Assistant: Beth McCormack

Editorial Review Board:

Peter Bertini, K1ZJH
Forrest Gehrke, K2BT
Michael Gruchalla, P.E.
Bob Lewis, W2EBS
Mason Logan, K4MT
Vern Riportella, WA2LQQ
Ed Wetherhold, W3NQN

PUBLISHING STAFF

Assistant Publisher:
J. CRAIG CLARK, JR., NX1G

Advertising Manager:
Marty Durham, NB1H

Advertising Production Manager:
Dorothy Sargent, KA1ZK

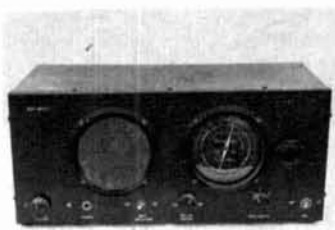
Circulation Manager: Susan Shorrock

Circulation: Therese Bourgault

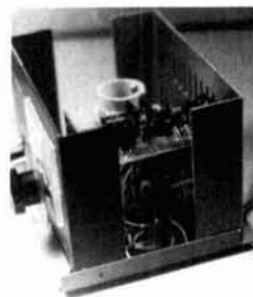
Traffic Manager: Phil Alix, N1FPX

Book Store: Priscilla Gauvin

Cover illustration: Hans Evers, PA0CX



K4KJ, page 43



VE3RF, page 62

FEATURES

- | | |
|---|----|
| WIDEBAND FREQUENCY ANALYZER | 9 |
| <i>Adelbert Kelley, AA4FB</i> | |
| The Weekender: A TRANSMIT CONTROL FOR MOBILE OPERATION | 24 |
| <i>James M. Bryant, G4CLF</i> | |
| A 2-METER CONVERTER WITH Q MULTIPLIER | 33 |
| <i>Norman J. Foot, WA9HUV</i> | |
| FAMOUS EQUIPMENT OF YESTERYEAR | 43 |
| <i>John Nagle, K4KJ</i> | |
| Ham Radio Techniques: ANTENNA MATCHING SYSTEMS | 54 |
| <i>Bill Orr, W6SAI</i> | |
| AN INEXPENSIVE VFO FOR THE YAESU FT-102 | 62 |
| <i>Robert H. Armstrong, VE3RF</i> | |
| The Weekender: COLLAPSIBLE QUAD FOR 10-METER HILLTOPPING | 70 |
| <i>L. B. Cebik, W4RNL</i> | |
| Practically Speaking: TEST EQUIPMENT FOR DIGITAL ELECTRONICS | 76 |
| <i>Joseph J. Carr, K4IPV</i> | |
| A LOW-NOISE DESIGN PRIMER | 80 |
| <i>Bob Lombardi, WB4EHS</i> | |
| Elmer's Notebook: SIMPLE INSTRUMENTS — RF OUTPUT MONITOR | 91 |
| <i>Tom McMullen, W1SL</i> | |

DEPARTMENTS

- | | | | |
|-----------------------|-------|--------------------------|----|
| BACKSCATTER | 4 | FLEA MARKET | 84 |
| EDITOR'S NOTES | 4 | HAM MART | 88 |
| COMMENTS | 6 | DX FORECASTER | 96 |
| HAM NOTEBOOK | 40 | ADVERTISERS INDEX | 98 |
| PRODUCT REVIEW | 42 | READER SERVICE | 98 |
| NEW PRODUCTS | 48,53 | | |

HAM RADIO Magazine (ISSN 0148-5989) is published monthly by Communications Technology, Inc. Greenville, New Hampshire 03048-0498 Telephone: 603-878-1441 FAX: 603-878-1951. **Subscription Rates:** United States: one year, \$22.95; two years, \$38.95; three years, \$49.95; Canada and Mexico: one year, \$31.00; two years, \$55.00; three years, \$74.00. All other countries: one year, \$35.00 via surface mail only. All subscription orders payable in U.S. funds, via international postal money order or check drawn on U.S. bank. **International Subscription Agents:** page 55.

Microfilm copies are available from Buckmaster Publishing Mineral, Virginia 23117. Cassette tapes of selected articles from HAM RADIO are available to the blind and physically handicapped from Recorded Periodicals, 919 Walnut Street, Philadelphia, Pennsylvania 19107.

Copyright 1989 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. Send change of address to HAM RADIO, Greenville, New Hampshire 03048-0498.

Backscatter



A Juxtaposition of Technologies

It's fun to take a look back at the past from time to time to see how technology has changed. Last month we previewed Kenwood's new state-of-the-art HF transceiver, the TS-950S. The TS-950S offers the latest in digital signal processing (DSP) technology and ergonomically designed operator features.

This month John Nagel, K4KJ, takes us back to the early thirties with a retrospective piece on the Sky Buddy and several other Hallicrafters radios of that era. This remarkable juxtaposition of technologies serves to show us how much the science of communication has changed in the fifty or so years since the Sky Buddy was first manufactured. Communications technology has made great strides forward since then. We take these changes for granted, however, and have lost touch with exactly how much radio has changed.

Recently, a newly licensed Novice stopped by to see me. He was looking for some help in getting on the air. He already had a receiver and had just been given a Heathkit DX-35 transmitter. He was flummoxed by the transmitter; he had no idea how to peak a grid, tune and dip the final. He was also missing some crystals (Crystals? Who uses those archaic things?) and was having no luck finding any. Luckily, I had mine from twenty-plus years ago squirreled away and was able to get him set up for 15 and 80 meters.

As we sat watching the unit warm up, I was taken back to my Novice days and remembered fondly how much fun I had in that one year as WN1IGG. After I showed him how to peak the grid and dip the final, he went home to finish setting up his station. I'll give him a call in a few days to see how he's doing. Frankly, I had forgotten how complex station set up could be. Like most of the rest of us, I've been spoiled by the features and convenience of today's transceivers. I'd also forgotten the limits of a crystal-controlled transmitter. Split frequency operation was normal back when I started in radio. Sometimes the station you were working was half the Novice band away. I had only three crystals for the 15-meter Novice band, so I spent many hours either scanning the band looking for someone close by or calling hopefully to someone 5 or 10 kHz (or more) away. Those were fun days.

WARC bands

I recently put up an antenna for 18 and 24 MHz. Gary Nichols, KD9SV, sent me a prototype of a trap dipole he's designed. (The antenna will be featured in an *HR* article early next spring.)

The antenna is very light and installs in almost any location. As I tuned across the 18 and 24 MHz bands, I was amazed at the quality of propagation. I'll be the first to admit that I made no rush to get on any of the WARC bands when they were first authorized. However, I'm beginning to think I made a mistake. I've found a number of my low band cronies there; they've been extolling the virtues of 18 and 24 MHz to me for months. Well, they were right; 18 and 24 MHz are two fun bands. There's plenty of DX to be worked from every corner of the earth. I hope you haven't waited as long as I have to get on. While activity is spotty now, these bands will sound like 15 or 20 meters as more hams find out how good 18 and 24 MHz can be! Imagine, wall-to-wall DX. See you there.

Craig Clark, NX1G

Editor's Notes

It's been just over a year since the "New" *Ham Radio* was introduced and your response has been tremendous. More and more Amateurs are reading *Ham Radio Magazine*.

When we began this new phase in *Ham Radio's* history, our intentions were to apply the high technical standards you expect from *Ham Radio* to the kinds of articles you're interested in *right now*. Recent reader surveys and evaluation cards indicated you had a desire for more short construction articles, practical projects, and weekenders, along with both brief and in-depth technical pieces that have long been a mainstay of the magazine. We've listened to your requests and have spent the last fourteen months working with our authors to bring you just what you've asked for.

This past year has been a good one — so let's keep the momentum going. I'd like to ask those of you who have played a part in shaping *Ham Radio's* new focus to continue sending us the articles your fellow readers have asked to see. I'd also like to urge those of you who haven't yet shared your pet projects with your peers to take this opportunity to become a *Ham Radio* author. We pay well and make every attempt to get your efforts into print as soon as possible. *HR* uses up a lot of material in a year's time, so we need your help to keep our pages both full and interesting. Let us help you share your ideas with an international audience!

Terry Northup, KA1STC

KENWOOD

...pacesetter in Amateur Radio

220 MHz
TH-315A
Here Now!

This HT Has it All!

TH-215A/315A/415A

Full-featured Hand-held Transceivers

Kenwood brings you the greatest hand-held transceiver ever! More than just "big rig performance," the new TH-215A for 2 m, TH-315A for 220 MHz, and TH-415A for 70 cm pack the most features and the best performance in a handy size. And our full line of accessories will let you go from hamshack to portable to mobile with the greatest of ease!

- Wide receiver frequency range. Receives from 141-163 MHz. Includes the weather channels! Transmit from 144-148 MHz. Modifiable to cover 141-151 MHz (MARS or CAP permit required).
- TH-315A covers 220-225 MHz, TH-415A covers 440-449.995 MHz.
- 5, 2.5, or 1.5 W output, depending on the power source. Supplied battery pack (PB-2) provides 2.5 W output. Optional NiCd packs for extended operation or higher RF output available.
- CTCSS encoder built-in, TSU-4 CTCSS decoder optional.
- 10 memory channels store any offset, in 100-kHz steps.
- Odd split, any frequency TX or RX, in memory channel "0".
- Nine types of scanning! Including new "seek scan" and priority alert. Also memory channel lock-out.
- Intelligent 2-way battery saver circuit extends battery life. Two battery-saver modes to choose, with power saver ratio selection.
- Easy memory recall. Simply press the channel number!
- 12 VDC input terminal for direct mobile or base station supply operation. When 12 volts applied, RF output is 5 W! (Cable supplied!)
- New Twist-Lok Positive-Connect locking battery case.
- Priority alert function.
- Monitor switch to defeat squelch. Used to check the frequency when CTCSS encode/decode is used or when squelch is on.



- Large, easy-to-read multi-function LCD display with night light.
- Audible beeper to confirm keypad operation. The beeper has a unique tone for each key. DTMF monitor also included.
- Supplied accessories: Belt hook, rubber flex antenna, PB-2 standard NiCd battery pack (for 2.5 W operation), wall charger, DC cable, dust caps.



Optional Accessories:

- PB-1: 12 V, 800 mAh NiCd pack for 5 W output
- PB-2: 8.4 V, 500 mAh NiCd pack (2.5 W output)
- PB-3: 7.2 V, 800 mAh NiCd pack (1.5 W output)
- PB-4: 7.2 V, 1600 mAh NiCd pack (1.5 W output)
- BT-5 AA cell manganese/alkaline battery case
- BC-7 rapid charger for PB-1, 2, 3, or 4
- BC-8 compact battery charger
- SMC-30 speaker microphone
- SC-12, 13 soft cases
- RA-3, 5 telescoping antennas
- RA-8B StubbyDuk antenna
- TSU-4 CTCSS decode unit
- VB-2530, 2m, 25 W amplifier (1-4 W input)
- LH-4, 5 leather cases
- MB-4 mobile bracket
- BH-5 swivel mount
- PG-2V extra DC cable
- PG-3D cigarette lighter cord with filter



KENWOOD

KENWOOD U.S.A. CORPORATION
2201E Dominguez St., Long Beach, CA 90810
P.O. Box 22745, Long Beach, CA 90801-5745

Complete service manuals are available for all Kenwood transceivers and most accessories. Specifications and prices are subject to change without notice or obligation.

Comments



WE CAN MAKE A DIFFERENCE

There has been a lot of talk about how slowly ham radio is growing and the need for new Amateurs. The talk usually centers on code versus no code, or club activities to recruit new hams. Hams are also urged to get the message out by various PR efforts.

It seems to me that there is a tendency to allow groups or organizations to do the work (i.e., ARRL or clubs) without accepting the responsibility ourselves. At the same time, I hasten to say that such efforts from the ARRL and clubs do have merit — it is just that in the process individual hams do little or nothing.

What I propose is that each one of us recruit just one ham to the ranks of Amateur Radio. Lets see: 400,000 hams $\times 2 =!$

**Bruce Bennett, K2PDJ,
Alexandria Bay, New York**

CHALLENGING YOUTH

Dear HR

The letter by Paul Swearington, W9PJF, (July 89) also expressed my thoughts on why we don't have more people interested in Amateur Radio. I became interested when I saw an article in the old *Pilot* radio magazine. It was on a transmitter using a UV45 tube in a tuned plate tuned grid circuit for use on the ham bands. As a result, the bug bit me. I had to get my license and so I started learning the code. The challenge was learning the code and building a transmitter.

Many of us started on 80 CW, but the challenge was to get on fone. The

75-meter band was restricted to class A hams so 160 was the band we went to. It was a fairly easy step to add a modulator to the CW rig and change a few coils. Most of the rigs were crystal controlled and most were homebrew. Today the step from CW to fone is virtually impossible if you want to have the present state of art, unless you buy a transceiver. The only challenge here might be in raising the money, but after that what? Learning all the knobs and bells can keep them going for awhile, but are they really gaining any real technical knowledge. It is alright for the oldtimers to go this route but it is the younger generation that will be the designers of tomorrow. We need this group to keep this country ahead in electronics and what better learning ground than ham radio.

I would venture to say that most Novices want to get on fone after spending some time on CW. The Novice expansions for fone or no-code license do nothing to improve their technical qualifications if they have to go out and buy a commercially built rig.

I would like to see the 160 band opened up to the Novice and Technician. It would be a band that they could get on fone, albeit on AM. But at least it would be feasible for them to construct receivers and transmitters for this band without having an engineering degree. With the experience and the challenge of building their own equipment, many will go on to build better and more refined equipment. But they need a stepping stone to get there.

I have operated 160 for many years. Before World War II this band was heavily occupied and you could make a contact at almost any time of day or night. Today you may hear a few stations in the evening but they generally are on a net. There is plenty of room and plenty of challenges from homebrew transmitters and receivers to antennas. Or could it be that our younger generation doesn't like challenges?

**Jim Pepper, W6QIF,
Orinda, California**

A young Amateur speaks out

Dear HR

I am a member of the West Branch Amateur Radio Club (Williamsport, Pennsylvania). Our club just recently had its first "discussion" on the "no-code" topic. It was the second meeting I had been to and, being 15 years old, I saw actions that did not please me. The words became heated, and from everything I heard, I gathered that "no-code" is supposed to bring more people into our hobby. Some of our club members mentioned that they knew some "brilliant" people who would be interested in radio, if not for the code. If they are so brilliant, why can't they do the 5 wpm that a 5 year old child can do? Instead of arguing about whether there should be a code free license, let's get off our "butts" and do some advertising! Get the local club to make some signs, announcements on fm radio, arrange a showing of the ARRL promo tape. Most of all, work on the school system. Our hobby is being dominated by adults. We need the kids! Forget about your opinions and like John Muhr, KTOF, said in the August issue, "Get out there and wave the Amateur Radio banner!"

**Nate Meredith, KA3TZZ,
Jersey Shore, Pennsylvania**

(continued on page 90)

KENWOOD

...pacesetter in Amateur Radio

All-mode
tri-bander!

Warp Drive!



TS-790A Satellite Transceiver

The new Kenwood TS-790A VHF/UHF all-mode tri-band transceiver is designed for the VHF/UHF and satellite "power user." The new TS-790A is an all-mode 144/450/1200 MHz transceiver with many special enhancements such as automatic uplink/downlink tracking. Other features include dual receive, automatic mode selection, automatic repeater offset selection for FM repeater use, VFO or quick step channel tuning, direct keyboard frequency entry, 59 memory channels (10 channels for separate receive and transmit frequency storage), multiple scanning and multiple scan stop modes. The Automatic Lock Tuning (ALT) on 1200 MHz eliminates frequency drift. Power output is 45 watts on 144 MHz, 40 watts on 450 MHz, and 10 watts on 1200 MHz. (The 1200 MHz section is an optional module.)

- **High stability VFO.** The dual digital VFOs feature rock-stable TCXO (temperature compensated crystal oscillator) circuitry, with frequency stability of ± 3 ppm.
- **Operates on 13.8 VDC.** Perfect for mountain-top DXpeditions!
- **The mode switches confirm USB, LSB, CW, or FM selection with Morse Code.**
- **Dual Watch** allows reception of two bands at the same time.
- **Automatic mode and automatic repeater offset selection.**
- **Direct keyboard frequency entry.**
- **59 multi-function memory channels.** Store frequency, mode, tone information, offset, and quick step function. Ten memory channels for "odd split."
- **CTCSS encoder built-in.** Optional TSU-5 enables sub-tone decode.
- **Memory scroll function.** This feature allows you to check memory contents without changing the VFO frequency.

- **Multiple scanning functions.** Memory channel lock-out is also provided.
- **ALT—Automatic Lock Tuning—on 1200 MHz eliminates drift!**
- **500 Hz CW filter built-in.**
- **Packet radio connector.**
- **Interference reduction controls:** 10 dB RF attenuator on 2m, noise blanker, IF shift, selectable AGC, all mode squelch.
- **Other useful controls:** RF power output control, speech processor, dual muting, frequency lock switch, RIT.
- **Voice synthesizer option.**
- **Computer control option.**

Optional Accessories:

- **PS-31** Power supply • **SP-31** External speaker
- **UT-10** 1200 MHz module • **VS-2** Voice synthesizer unit
- **TSU-5** Programmable CTCSS decoder
- **IF-232C** Computer interface • **MC-60A/MC-80/MC-85** Desk mics • **HS-5/HS-6** Headphones
- **MC-43S** Hand mic • **PG-2S** Extra DC cable

KENWOOD

KENWOOD U.S.A. CORPORATION
COMMUNICATIONS & TEST EQUIPMENT GROUP
P.O. BOX 22745, 2201 E. Dominguez Street
Long Beach, CA 90801-5745

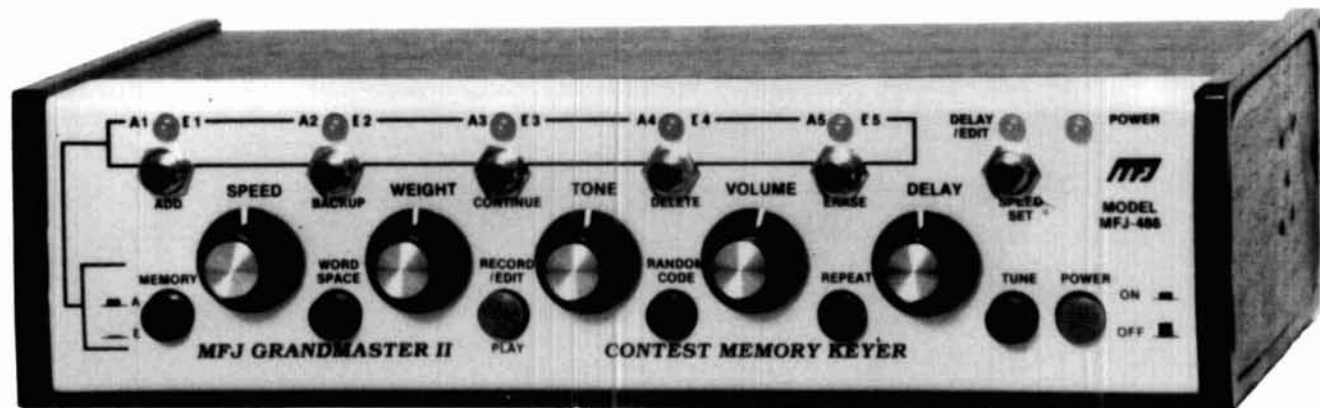
KENWOOD ELECTRONICS CANADA INC.
P.O. BOX 1075, 959 Gana Court
Mississauga, Ontario, Canada L4T 4C2



Complete service manuals are available for all Kenwood transceivers and most accessories. Specifications, features, and prices are subject to change without notice or obligation.

MFJ Grandmaster Memory Keyer

More than user-friendly . . . it's really easy-to-use



MFJ-486

\$189⁹⁵

Made in U.S.A.

Simple . . . intuitive . . . you instantly know which knob to turn, what button to press. It's unmistakable.

That's the MFJ Grandmaster concept -- more than user friendly . . . it's really easy to use.

There's no keypad, no complex keystroke sequences to confuse you.

The new MFJ-486 Grandmaster Memory Keyer™ gives you the best of both worlds -- all the features you'll ever need and the easy-to-use MFJ Grandmaster concept.

Exclusive CW Word Processor™

MFJ's exclusive CW Word Processor™ lets you change a message in memory without having to rekey it all in.

Special function keys make it simple to move around within any message, insert, delete and change your message until it's just the way you want it.

With other memory keyers you have to erase an entire message and rekey it all in to make even the smallest change.

Combine messages into other messages

The MFJ-486 lets you combine frequently used messages into other messages.

You can store QTH, rig/antenna, QSL info and other comments in separate memories.

Then you can easily build a new message by keying in memory numbers wherever you want that info in your message.

MFJ's Custom-Speed™ Control

Customize your speed control to fit you!

By pressing the Speed Set button, you can set your slowest speed to start at 4, 5, 6 -- any speed up to 20 WPM -- and your fastest speed is 20 to 100 WPM.

Matching CW speed to a QSO is best done by ear as you adjust a speed knob.

With keypads you have to figure out the exact speed of your contact and then go through an awkward keystroke sequence.

That's why matching speed with a

keypad is so demanding.

Without MFJ's Custom-Speed™, a wide range speed control is very hard to use because the *slightest* touch causes radical speed changes.

Built-in CW Course

The MFJ-486 gives you a well-organized three step CW course for upgrading and teaching.

The first step gives you random five character groups. After you learn the letters you can add punctuation.

The second step gives you random 1-8 character groups for real-world code practice.

The third step gives you an infinite number of random plain English QSOs in the same format as FCC ham license tests.

When you can copy these random QSOs, you're ready to pass your test and upgrade!

You also get Farnsworth option, answer-replay to check your copy, punctuation on/off and earphone jack for private practice.

Remote Control . . .

for memories and function keys

The MFJ-77 remote control lets you control your message memories and CW Word Processor™ function keys at your key paddle for only . . . \$19.95.

It's a lot more useful than a remote that gives you no editing functions and only lets you control a few memories.

MFJ Keyers are used year after year

Not so long ago there was a glut of keypad keyers. They were novel, and a lot of hams spent their money.

But because they were hard to use they ended up in drawers and closets.

They were soon no longer made.

Most original MFJ keyers are still being used -- day after day and year after year.

Why? Because they're easy-to-use. And that's why more new MFJ keyers are being put on-the-air today than ever.

More for your money

To make it really easy-to-use, it cost more to build the MFJ Grandmaster.

It just takes more hardware -- knobs to turn, buttons to press, LEDs to show

you what's going on. Plus it takes more labor, more software, more everything.

It's a real bargain compared to cheaper-to-build but harder-to-use keypad keyers.

Plus More . . .

You get over 8000 characters in 10 soft-partitioned memories -- far more than you'll ever need.

You also get . . . lithium battery backup, automatic serial numbering, automatic message repeat, beaconing, A or B type iambic keying, manual or automatic word spacing, speaker, earphone jack, easy-to-use front panel controls for speed, volume, tone, weight and delay, tune control, powerful Z-80 microprocessor plus much more. 9x2½x6 inches. Use 12-15 VDC or 110 VAC with MFJ-1312. \$12.95.

One Full Year

No Matter What™ Guarantee

You get MFJ's full one year no matter what™ guarantee.

That means MFJ will repair or replace your MFJ-486 (at our option) no matter what happens to it for a full year.

Others give you a 90 day limited warranty.

What do you do after 90 days when it burns up. Or before 90 days when they say, "Sorry, your limited warranty doesn't cover that?"

Why take chances when MFJ gives you no matter what protection for one full year?

Don't struggle with keypads -- enjoy the easy-to-use MFJ Grandmaster

Don't struggle with a hard-to-use keypad and complicated keystroke sequences.

Choose the memory keyer that's really easy-to-use and has all the features you'll ever need - the new MFJ-486 Grandmaster.

Get yours today . . . you'll love it!

Nearest Dealer/Orders: 800-647-1800

MFJ

MFJ ENTERPRISES, INC.
Box 494, Miss. State MS 39762
601-323-5869; TELEEX: 534590
FAX: 601-323-6551; include s/h

MFJ . . . making quality affordable

WIDEBAND FREQUENCY ANALYZER

Analyzer checks for spurious oscillations and amplitudes, and assists in tuning

By Adelbert Kelley, AA4FB, 2307 S. Clark Avenue, Tampa, Florida 33629

As a result of interest generated by articles I'd read in *QST*¹ and *Ham Radio*,² I decided to build the wideband frequency analyzer shown in **Figure 1**. I needed a test instrument that would show spurs and relative signal amplitudes, and would help me with alignment when I experimented with VHF and UHF circuits. The idea of using the shop oscilloscope for a panoramic display of the signals from 20 to 400 MHz looked attractive. K2BLA's analyzer in *QST* had an ingenious circuit which gave the frequency on a digital display. He used the scaler output of a cable TV converter in a frequency counter that subtracted the oscillator offset, then counted and presented a three-digit readout of the frequency of any signal present at the center graticule in the oscilloscope display. He measured unknowns by tuning the analyzer until the signal crossed the center line.

You can use my analyzer to check circuits for spurious oscillations and amplitude, and assist in tuning. It needn't be tuned precisely to display a signal, doesn't require close coupling, and has a wider frequency range than a grid dip meter.

My unit has the following specifications:

- Frequency coverage of 54 to 900 MHz in two bands with no gaps in coverage.
- A digital readout which displays the frequency of the center graticule of the oscilloscope to + or - 1 digit. It continues to give a useful reading even when the frequency sweep is reduced to zero and only the manual tuning knob is used.
- Two steps of selectivity, good sensitivity, and uniform frequency response. It will display all the FM, TV, Amateur VHF/UHF, and communications services in a metropolitan area when connected to a TV antenna or even a random wire.
- FM audio monitoring to identify unknown stations, and a simple design with parts count at a minimum consistent with good results.

Of course this isn't a spectrum analyzer. As a homebrewer, I don't have the resources to produce a true spectrum analyzer. The unit only approximates a logarithmic ampli-

tude response, which is good enough for me. I use a decade attenuator^{3,4*} to read relative dB amplitudes when I need more accuracy. The voltage versus frequency response of varactor diodes in cable and TV tuners is inherently nonlinear. This matters only if you want to read the frequency off the graticule of the scope. A better method is to rotate the fine tuning until the signal in question is at the center of the graticule, and read out the frequency on the digital display.

TV tuners have been evolving away from switched inductor and capacitor to solid-state varactor tuning. The varactor tuner uses the capacitance change across a silicon diode that takes place when a reverse DC voltage is varied. The capacitance increases as this control voltage is lowered. If a sawtooth waveform of sufficient amplitude and correct average DC is substituted for this DC control voltage, the tuner tunes its frequency range rapidly, and very little circuitry is needed to obtain a panoramic display. The combination of solid state and no moving parts means greater reliability, smaller assemblies, and easy interfacing. This, in turn, results in low cost and high performance.

Tuner construction details

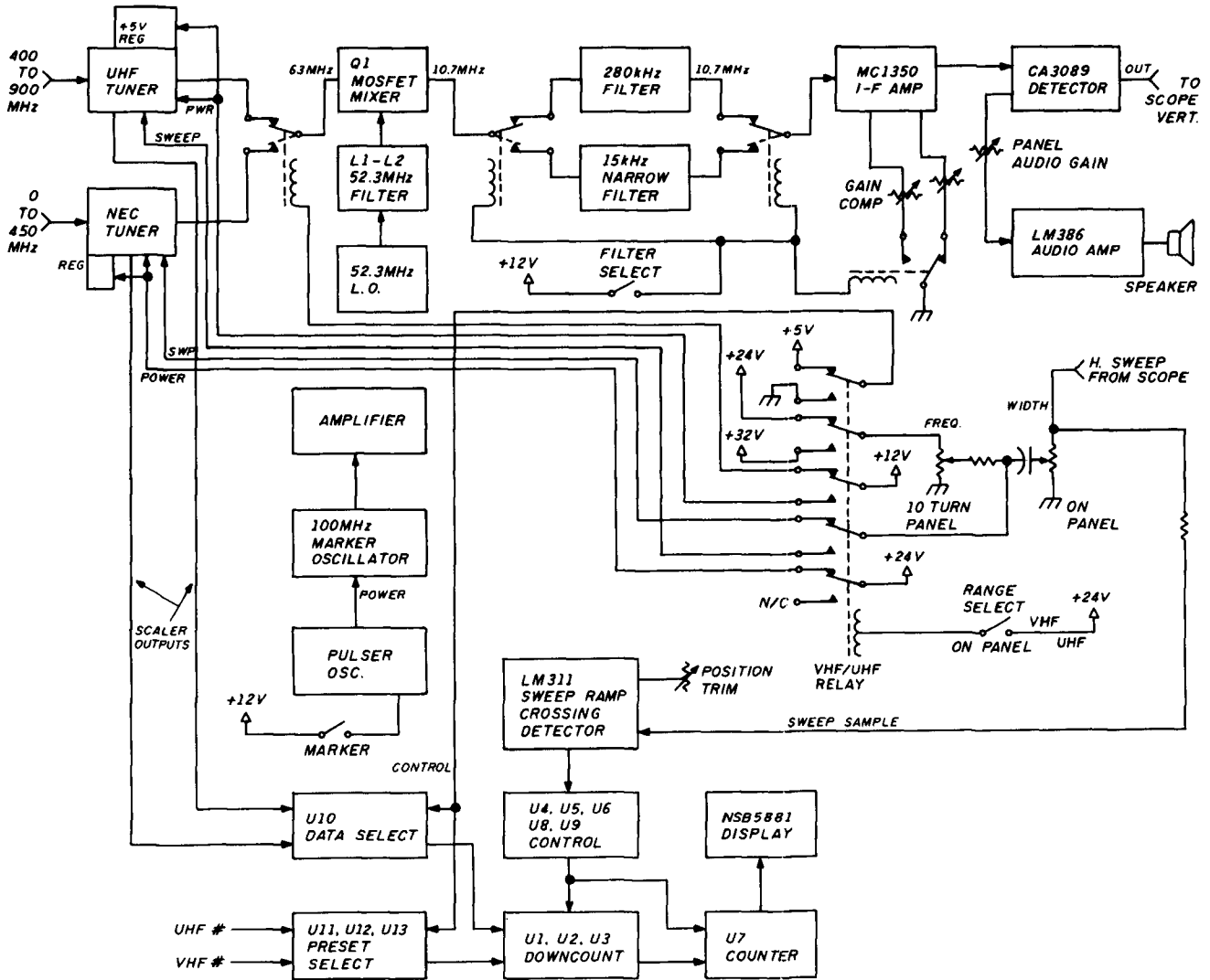
The NEC cable tuner requires no modifications. It's well shielded and appears to have a good frequency response. The 53-channel display was almost flat when I checked our local cable system on the completed analyzer.

I wanted higher frequency coverage than 400 or 450 MHz and had a UHF tuner left over from a previous project,^{5,6} so I decided to try it. However, UHF tuners don't have built-in scalars. I solved this problem by adding an RCA CA3179E chip to the tuner in a circuit that should also be easy to add to any make of solid-state tuner.

Most UHF TV tuners cover channels 14 through 88 only, but the Mitsumi covers more — 500 MHz, actually. It's worthwhile to try to find one. Look for a UES-A55F or UES-A56F. Radio Shack sold one (stock no. 277-220) in 1983, but I

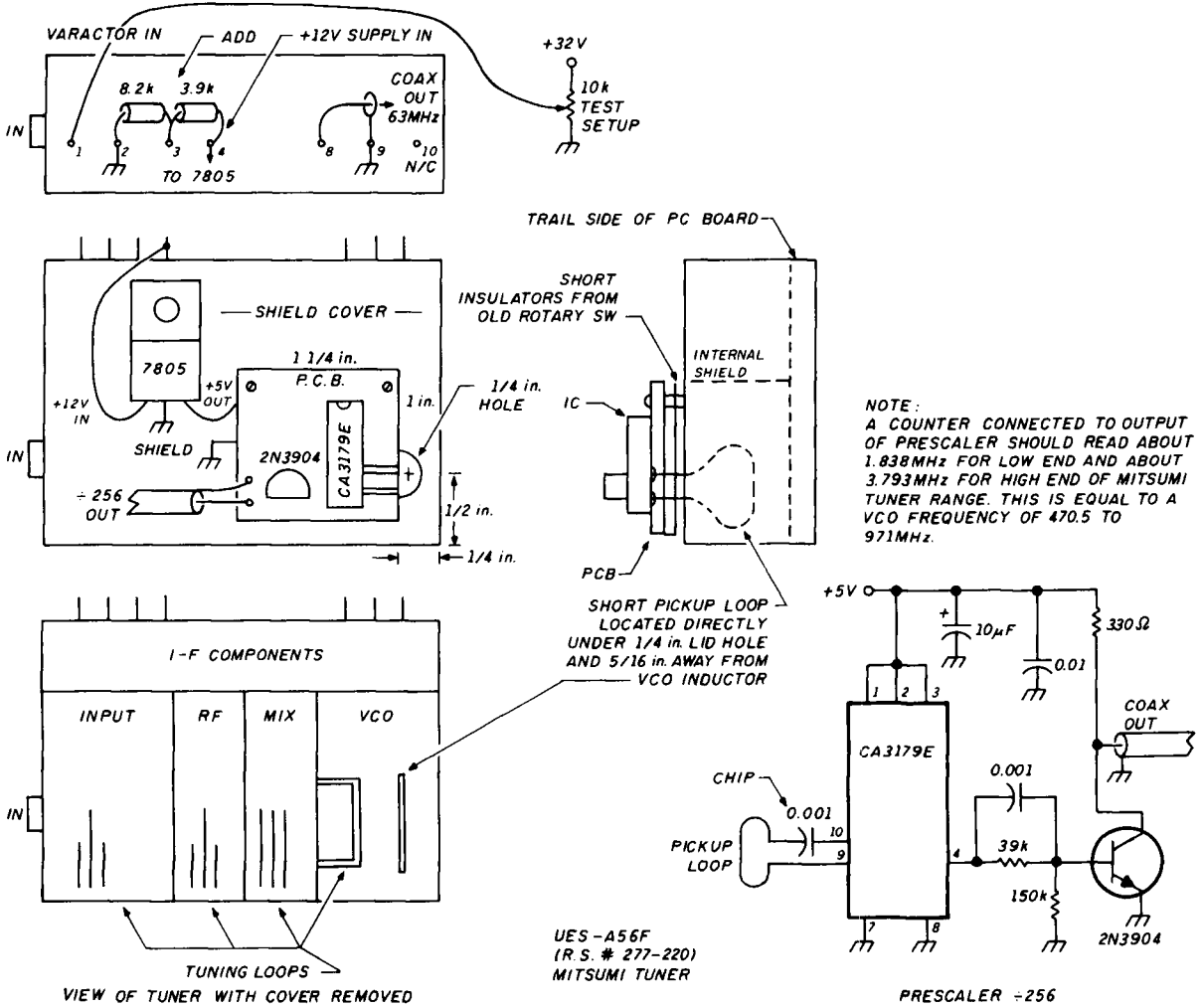
* Available as a kit from Circuit Board Specialists. (303)542 4525

FIGURE 1



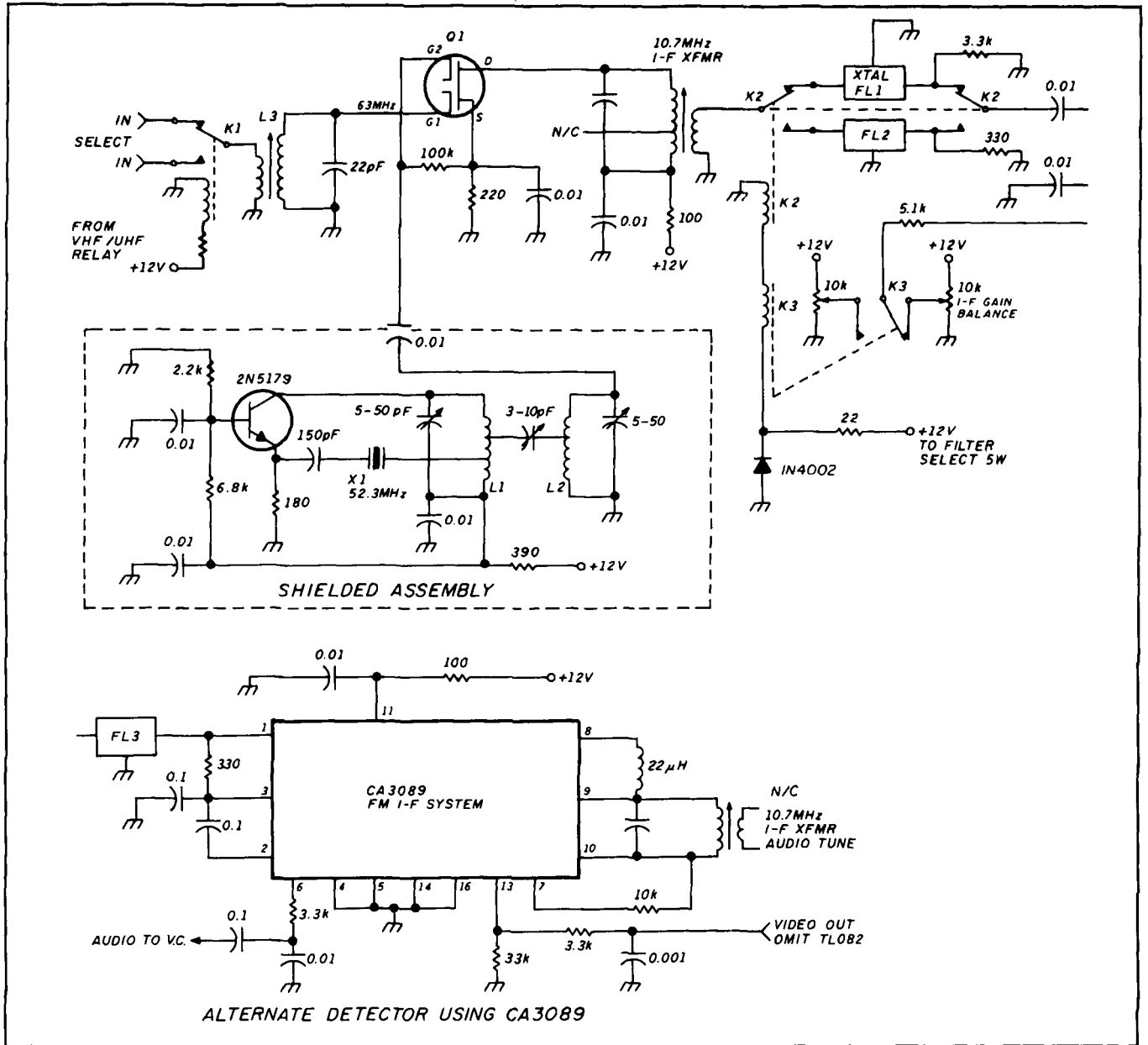
One line diagram frequency analyzer.

FIGURE 2



Mitsumi tuner prescaler installation detail.

FIGURE 3



Spectrum analyzer 10.7-MHz IF assembly.

haven't seen any recently. If you can't locate a Mitsumi, use any available tuner and settle for its top frequency. Modifications covered in Reference 5 outline how to wind a simple transformer on a ferrite bead so you can use the tuner at 63-MHz output. There's also information on how to modify the input so it's unbalanced and shielded. This is easy to do. Many tuners are already fitted for unbalanced input. Use phono plugs and jacks and miniature coax for connections and signal routing. This Mitsumi tuner was designed for an IF output of 44 MHz, and operates well at 63 MHz — the same as the cable tuner.

Figure 2 gives details of the prescaler installation. I mounted it on a small pc board and coupled a short, single-turn pickup loop to the local oscillator in the tuner. Oscillator operation wasn't affected because very little energy is required to drive the CA3179. The CA3179E is readily avail-

able and inexpensive.* If you're adding the scaler to another type of tuner, use the minimum coupling necessary. Make it mechanically secure, and keep the lead lengths short.

Tuner checkout

Attach a 7805 three-terminal regulator to the UHF tuner so it's powered when the tuner is on. Check the operation of the scaler after the scaler installation is complete and the resistors are mounted on the tuner as shown. Connect the tuner to a temporary test source of +12 volts. Then connect the output of the scaler to a frequency counter, and monitor it while you adjust the varactor tuning voltage over the range of 0 to +32 volts. Look for any dropout in count. If any loss occurs, make a minor adjustment to the

* Jameco Electronics, (415)592-8097. Stocks all the ICs and most of the small parts used in this project. \$20 minimum order.

ICOM

IC-726 HF Transceiver

NEW TECHNOLOGY AND SOPHISTICATION IN ONE SMALL PACKAGE

**ALL HF PLUS
SIX METERS!**

ICOM does it again by combining top performance on all HF bands with deluxe six-meter operation in an ultra-compact and easy-to-operate transceiver! Six-meter DXing is terrific and the IC-726 is your key to great all mode action fixed, mobile or portable.

UNCOMPROMISING FEATURES Include: • All mode operation from 160 through six-meters • Shortwave reception from 500KHz to 33MHz plus 46.2 to 61.1MHz • 100 watts SSB and CW • 10Hz digital frequency display • 26 memories tune full range and reprogram independent of VFO use • Three scan modes • Noise blanker

ADVANCED CIRCUIT DESIGNS Feature: • Direct digital synthesizer (DDS) • Dual VFOs • Band stacking registers • Sensitive 105db dynamic range receiver • Panel-selectable RF preamp and attenuator • Built-in controller for optional AH-3 remote antenna tuner for HF operation.

The outstanding IC-726 puts all the exciting DX action of sunspot cycle 22 right at your fingertips, and it is confidently backed with ICOM's no-compromise one year warranty. See this amazing unit at your local ICOM dealer.



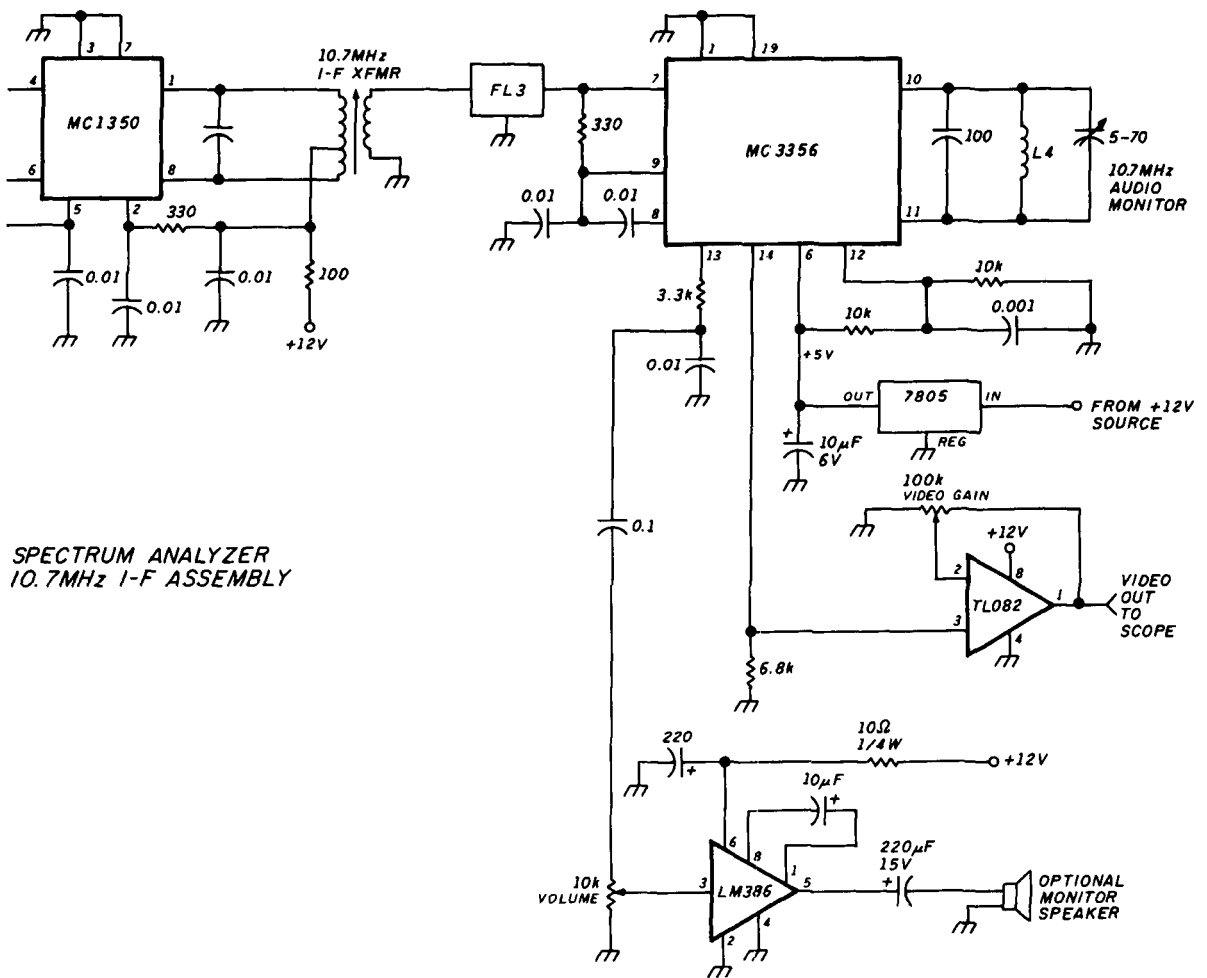
ICOM

First in Communications

ICOM America, Inc. 2380-116th Ave. N.E., Bellevue, WA 98004 Customer Service Hotline (206) 454-7619
3150 Premier Drive, Suite 126, Irving, TX 75063 / 1777 Phoenix Parkway, Suite 201, Atlanta, GA 30349
ICOM CANADA, A Division of ICOM America, Inc., 3071 - #5 Road, Unit 9, Richmond, B.C. V6X 2T4 Canada

All stated specifications are subject to change without notice or obligation. All ICOM radios significantly exceed FCC regulations limiting spurious emissions. 726889

FIGURE 3



SPECTRUM ANALYZER
10.7MHz I-F ASSEMBLY

Spectrum analyzer 10.7-MHz IF assembly continued from page 12.

PARTS LIST

- FL1 15-kHz crystal filter, optional
- FL2,FL3 Murata ceramic filters, 280 kHz
- K1 DPDT miniature relay, contacts parallel, for pc mounting
- K2 DPDT miniature relay, for pc mounting
- K3 SPDT relay
- L1 14T no. 22 tapped at 3 and 10 turns, 52 MHz
- L2 9T no. 22 tap at 6T from bottom, 52 MHz
- L3 Amidon L33-10 1T primary 10T secondary, 63 MHz
- L4 12T no. 22, 10.7 MHz or 10.7 MHz IFT
- Q1 40673 MOSFET
- X1 52.3-MHz overtone crystal HC-18 case
- IFT 10.7-MHz miniature IF transformers, interstage

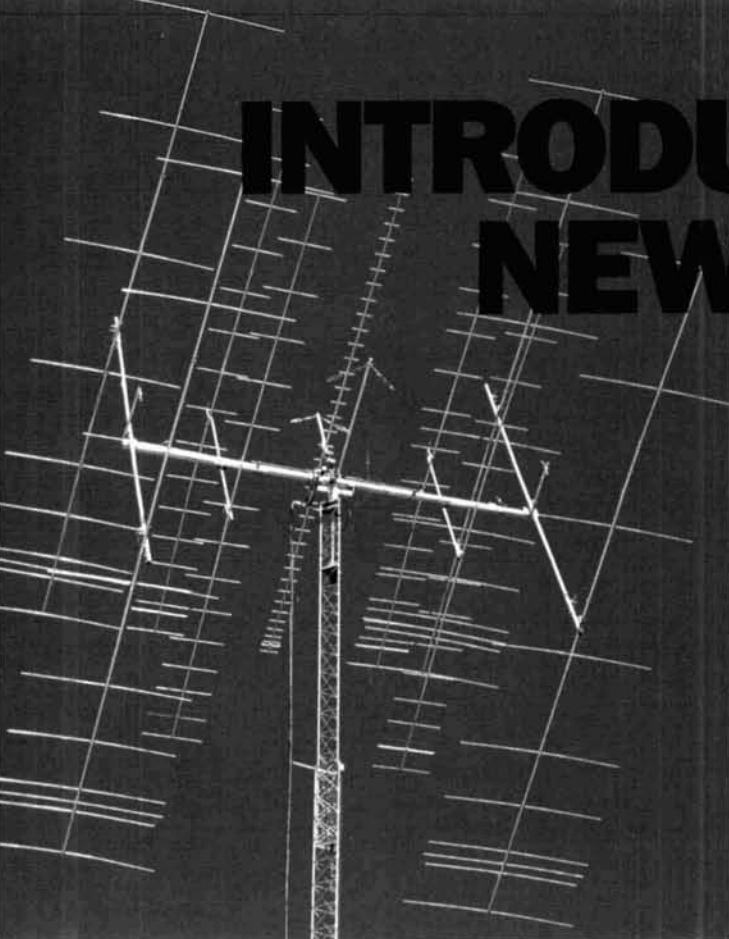
VCO/scaler coupling and recheck until the scaler operation is reliable over the entire varactor voltage range. The VCO frequency is the counter reading multiplied by 256; the signal frequency is the VCO frequency minus the first

IF frequency, 63. You now know the exact tuning range of your tuner. I obtained counter readings of from 1838 to 3.793 MHz, equal to a VCO frequency of 470.5 to 971 MHz. The high end signal frequency was 971 - 63, or 908 MHz; the low end limit was 470.5 - 63, or 407.5 for 63-MHz IF frequency.

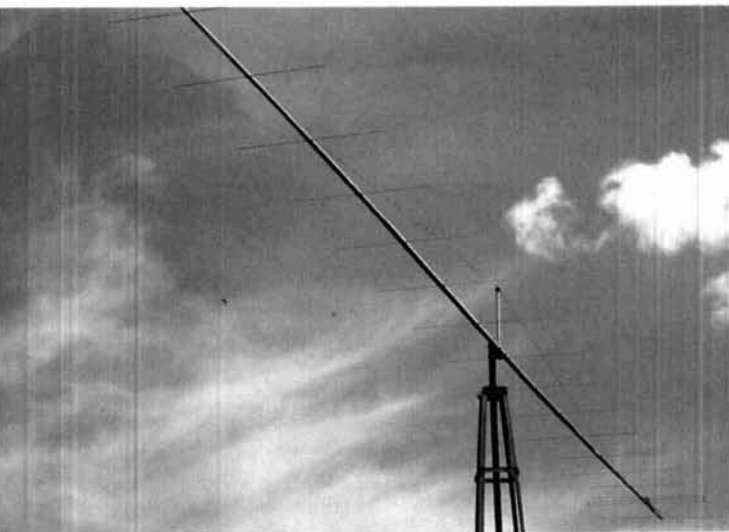
The IF circuit

Figure 3 shows the schematic of the dual conversion IF strip. This is a crystal-controlled, double conversion receiver, which uses either a Motorola MC3356 or an RCA CA3089 FM detector. The AM output of the detector is the analyzer output to the oscilloscope; the FM output gives a speaker monitoring capability. I have built IF strips using both detectors and they work equally well. I would recommend the CA3089 because it's easier to find and doesn't require the TL082 op amp. I installed the narrow 15-kHz filter because I happened to have one in stock. It isn't used often.

INTRODUCING AEA's NEW ANTENNAS



6-meter and 2-meter moonbounce installation. Four 6M-2WL, four 2M-5WL and one 432-13WL antennas in array on self-supporting 89-foot US tower at N7ML.



2M-18XXX installation at N7KQK.

The superior engineering designs, quality and high performance that AEA built its reputation on are now available in its dynamic new line of antennas. Developed and manufactured by Mike Staal K6MYC, president of M² Enterprises and co-founder of KLM antennas, the product line includes an assortment of 2-meter, 6-meter and 440 MHz antennas and accessories for fixed or portable applications. AEA/M² antennas are already recognized for their superior performance by many moon-bouncers.

Features. AEA's new antenna line features computer-optimized antennas with the highest gain for boom-length attainable.

Other features include:

- Machined aluminum driven element housing with built-in "N" connector and O-ring seals including access cover
- Silicone dielectric gel in the cavities to withstand inclement weather
- Parasitic elements insulated through the boom on most units for long-term performance and reliability
- Electronically tuned balun combined with unique driven element design to produce symmetrical patterns
- Swaged and tapered boom plus solid rod elements to reduce windload
- Low windload overhead dacron boom support
- Flexible boom-to-mast mounting for mechanical balance
- Ideal for multiple antenna arrays.

Accessories. To compliment the antenna line, AEA also offers various "H" frame support packages. The MT-3000 heavy-duty elevation mechanism and controller for tilting up multiple yagi arrays. Also welded aluminum power dividers for coupling multiple antennas.

For further information, see your local AEA authorized dealer, or call AEA at (206)775-7373.

Model	6M-5	6M-2WL	6M-2.5WL	2M-5WL	2M-18XXX	2M-6WLHD	2M-CP14	2M-CP22	EB-144	430-16	432-13WL	EB-432
Elements	5	9	11	17	18	20	14	22	N/A	16	39	N/A
Gain	9.4	12.4	13.0	15.0	15.3	16.0	10.0	12.1	1.0	14.3	18.0	1.0
Boom	15'9"	39'6"	50'4"	33'	36'	41'4"	9'10"	18'	N/A	10'	30'3"	N/A
Weight	11/14	31/40	38/47	13/15	14/16	30/37	6/8	12.5/15	1.5/3	4/5	12/13	1.3/3
Windload	2.0	5.0	5.9	2.7	2.9	6.1	1.1	2.5	N/A	0.82	2.5	N/A
F/B	12	25	22	22	25	22	20	20	N/A	20	22	N/A

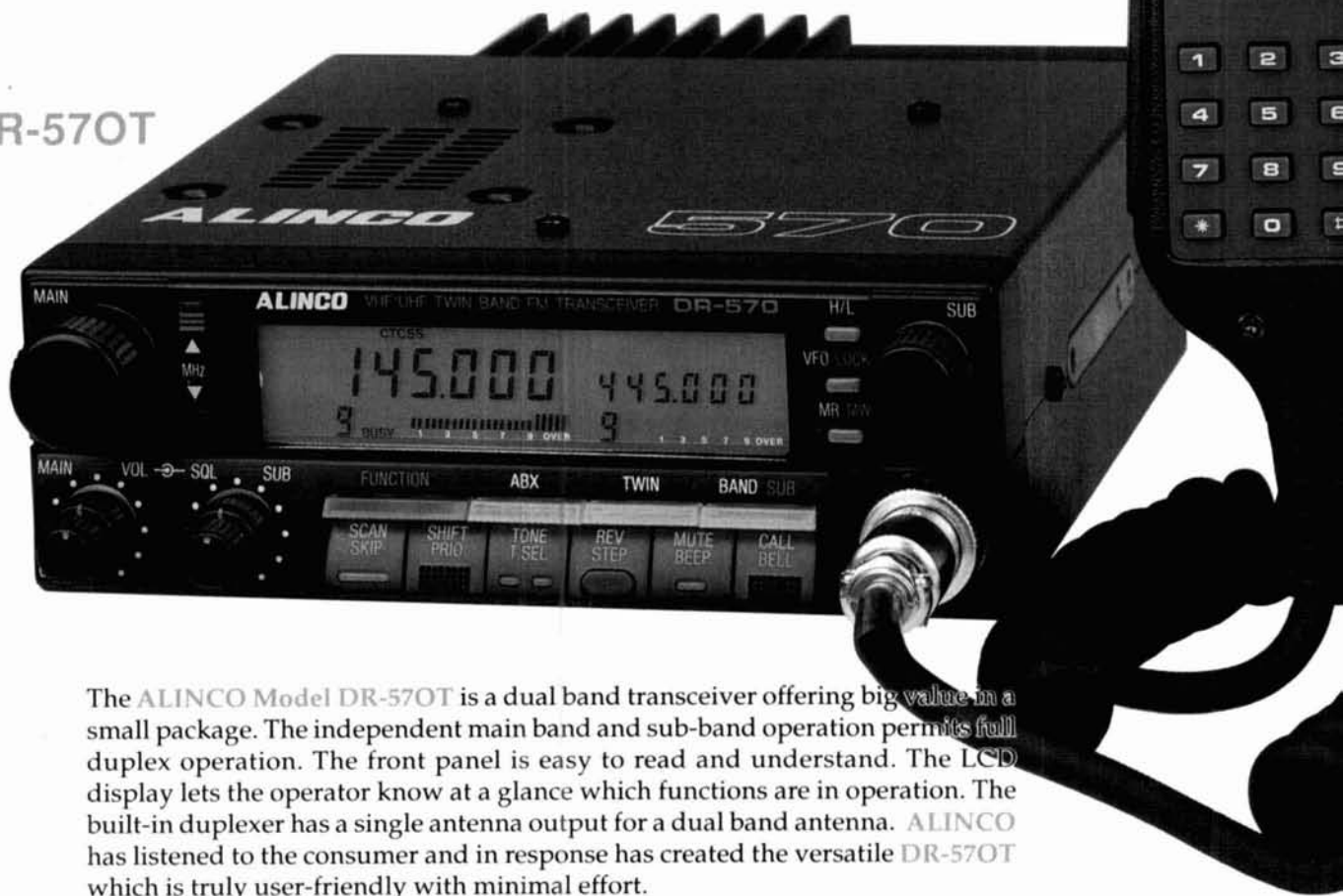
Gain - dBd, gain over a dipole. Boom - Length, feet and inches.
 Weight - Weight in pounds, antenna weight/shipping weight.
 Windload - Windload area in square feet. F/B - Front-to-back ratio, dB.
 6M - Six meters. 2M - Two meters. WL - Wavelength.
 HD - Heavy-duty. CP - Circularly polarized. EB - Eggbeater.

Prices and specifications are subject to change without prior notice. Copyright 1989.

Advanced Electronic Applications, Inc.
 2006-196th St. SW/P.O. Box 2160
 Lynnwood, WA 98036

THE TWIN BANDER

DR-570T



The ALINCO Model DR-570T is a dual band transceiver offering big value in a small package. The independent main band and sub-band operation permits full duplex operation. The front panel is easy to read and understand. The LCD display lets the operator know at a glance which functions are in operation. The built-in duplexer has a single antenna output for a dual band antenna. ALINCO has listened to the consumer and in response has created the versatile DR-570T which is truly user-friendly with minimal effort.

• **ULTRA-COMPACT BODY**
5 7/8" (W) x 2" (H) x 8 1/2" (D)

• **HIGH POWER**

45 watts on 2M and 35 watts on 70 cm.
Approximately 5 watts low power.

• **EXTENDED RECEIVER RANGE**

(130-169.995 MHz) on 2M, 144-147.995 MHz transmit. 440-449.995 MHz on 70 cm. (transmit and receive)

(Specifications guaranteed on amateur bands only. Modifiable for MARS/CAP permits required)

• **SIMULTANEOUS**

Receiving on both bands at the same time
Scanning: intermix scan modes on both bands at the same time

• **INDEPENDENT**

The volume, squelch and control dial are independently adjustable on both bands. You can store the following information on both bands at the same time. Priority function, choice of 37 encoding/decoding sub-tone frequencies, call channel, scan function (program, memory channel, VFO or unique open channel scan), memory skip, bell function, + or - repeater shift.

FULL FEATURES

- **FULL DUPLEX CROSS BAND OPERATION**
Transmit on one band while receiving on the other band - telephone style.

• **AUTOMATIC BAND EXCHANGE (A.B.X.)**

When in the ABX function is active, an incoming signal on the sub-band will activate an automatic exchange between the main band and the sub-band.

• **PRIORITY**

The VFO frequency is monitored for 5 seconds and then shifts for one second to the selected priority channel (In both bands at the same time).

• **DUAL SPLIT SHIFT OPERATION**

Operates odd offset operation

• **BELL FUNCTION**

• **REPEATER REVERSE FUNCTION**

• **CALL CHANNEL FUNCTION**

• **BEEP FUNCTION**

• **20 MEMORIES (10 FOR EACH BAND)**

Each memory channel can store frequency, repeater offset, encode/decode frequency.

• **4 SCANNING MODES**

Program scan, memory scan, band scan and unique open channel scan (opposite to normal busy scan). Scan stops on a busy (or open channel) channel and then resumes approximately 5 seconds after stopping even if the signal is still present.

• **REPEATER OPERATION**

The DR-570T can be used as a cross band repeater.

EASY TO OPERATE FUNCTION

• **LARGE AMBER MULTI-FUNCTION LCD DISPLAY**

Visible in all conditions, it indicates main and sub-band frequencies, frequency step, "on air", "call", "CTCSS", "PRI", "REV", "-", "T", "T", "T" (tone), tone frequency, "MUTE", "LOCK", "ABX", "BUSY", "F", "S/RF meter", "REV"

• **MHz FUNCTION FOR BOTH BANDS**
One MHz is increased or decreased per touch

• **SELECTABLE DUAL AND SINGLE BAND OPERATIONS**

One touch selection with pressing of twin key

• **SELECTABLE BAND MODE (MAIN/SUB)**
One touch selection with pressing of band key

• **ILLUMINATED FRONT PANEL CONTROLS**

• **16-KEY DTMF MICROPHONE**
With memory channel and frequency change up/down buttons.



ALINCO

ALINCO ELECTRONICS INC.
20705 S. WESTERN AVE., SUITE 104
TORRANCE, CALIFORNIA 90501

Tel: (213) 618-8616 • FAX: (213) 618-8758

The sweep circuit

Most of the sweep circuit already exists in any oscilloscope. The circuit is WA2PZO's idea.* Find a point in the oscilloscope wiring where the horizontal deflection waveform has zero DC component. This would be the output of the complementary transistor pair that drives the H deflection plates. Usually there's an unused Z axis jack that you can use to bring this signal out of the scope. Proceed

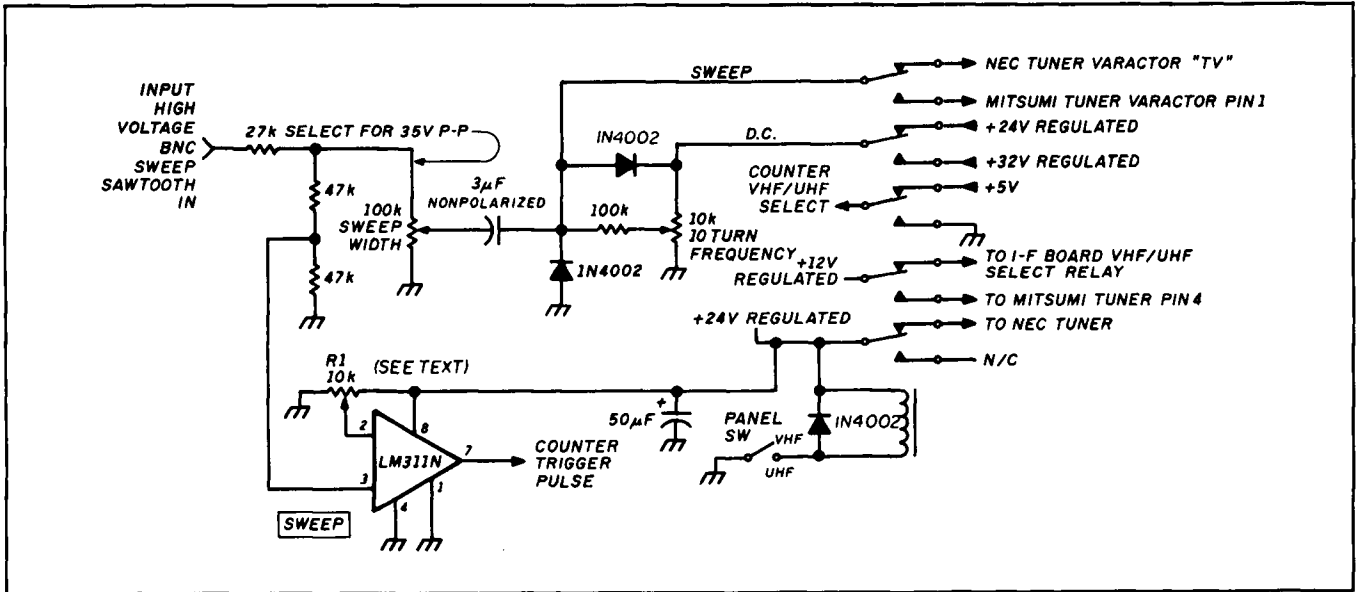
* Science Workshop, Box 310, Bethpage, New York 11714. Carries the NEC cable tuner and some other parts

with care when making this modification. High voltages are present in any oscilloscope. Measure the p-p voltage at this point; it will probably be well over 100 volts.

Figure 4 shows the analyzer's sweep circuit. There should be about 35 volts p-p across the sweep width potentiometer. Change the value of R2 to obtain the correct voltage. A multicontact relay lets you switch the various voltages and change tuners with a single panel switch. The diode clamps in the sweep potentiometer circuit prevent the sweep voltage from exceeding the supply voltage on either band.

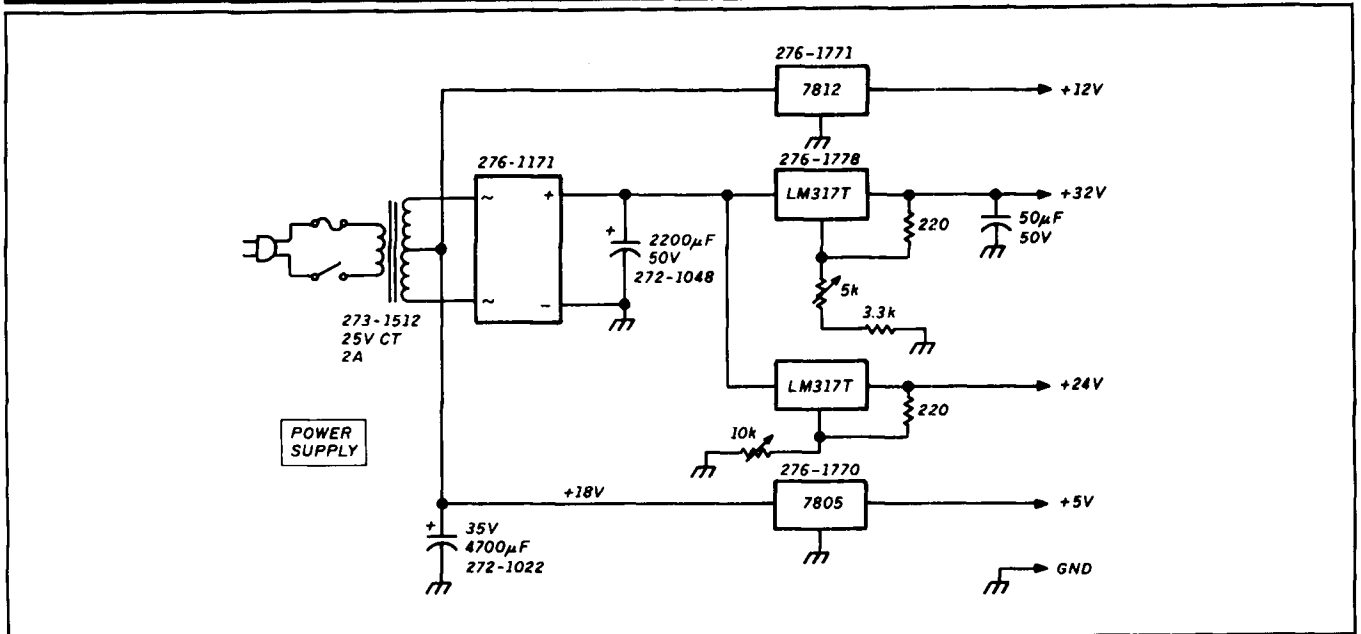
The sawtooth ramp from the oscilloscope is really a

FIGURE 4



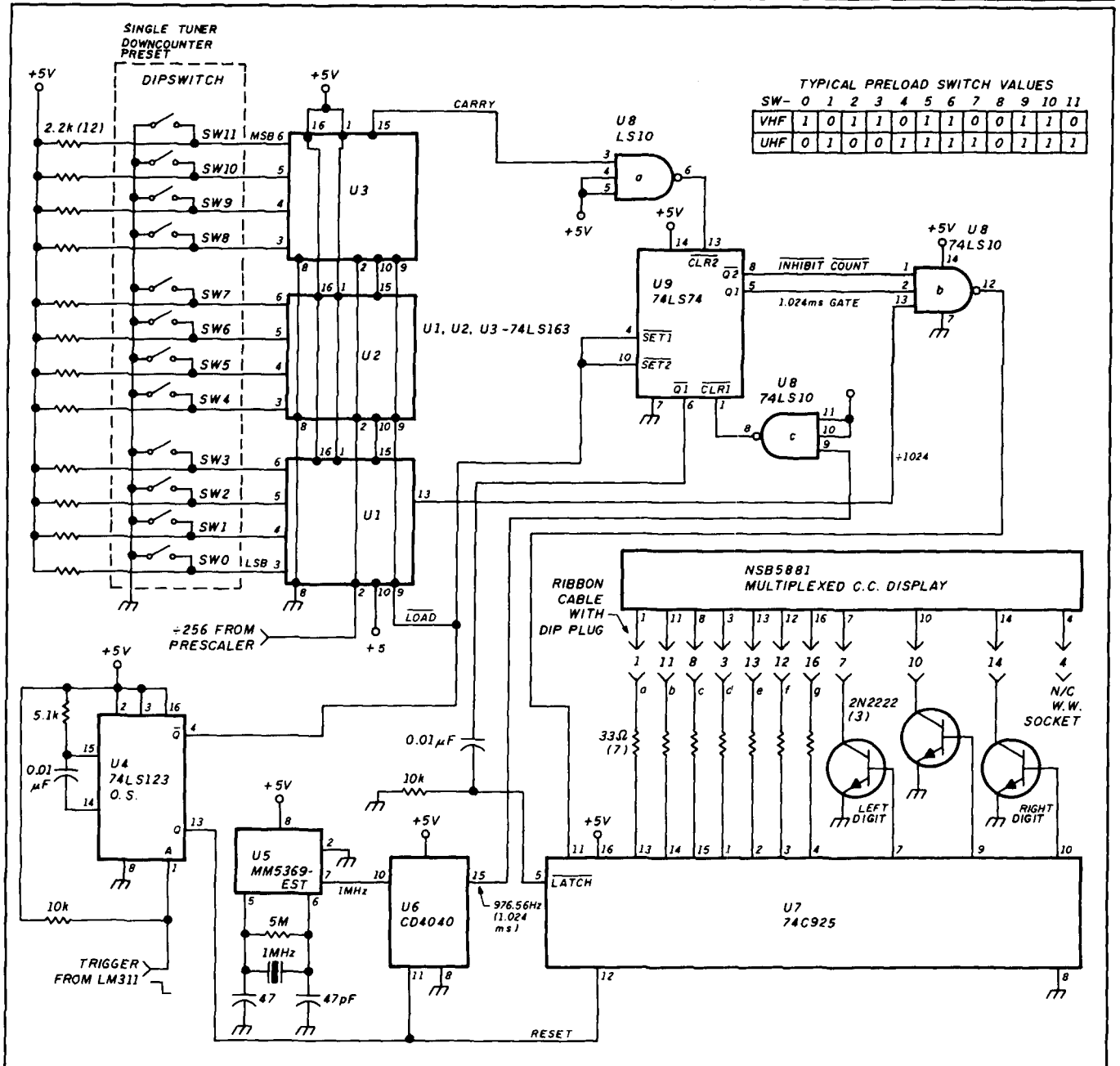
Sweep circuit of the analyzer.

FIGURE 5



Multiple voltage power supply for the analyzer.

FIGURE 6



Basic counter drawing.

rapidly changing DC voltage. The LM311 switches its state at an adjustable point (set by R1) on this ramp, which sets the exact time during the sweep that the frequency display samples the scaler outputs.

The power supply

The analyzer required four voltages: +5, +12, +24, and +32. The easiest way to get these voltages is to use the circuit in Figure 5. I mounted all the power supply components, with the exception of the transformer, on a 2-3/4 x 5" single-sided pc board. Radio Shack stocks most of the parts.

The counter circuit

The timebase of 1.024 milliseconds in the counter is a little unusual. It's in binary instead of the usual BCD because the scalars divide by 256 instead of powers of 10. Consequently, all the rest of the timing values in the counter are binary.

Figure 6 shows the counter circuit. This is the basic circuit, with typical preload switch values for a 12-bit dip switch. I used this circuit while working on the 0 to 400-MHz tuner frequency display. The switches made it easy to adjust the counter to compensate for the unknown frequency offset

Radio Shack—The Technology StoreSM

SUPER VALUES AT THE RADIO SHACK NEAR YOU!

Sale! Tandy® 1000 SL Computer



Save \$300
599⁰⁰ Reg. 899.00
 Less Monitor

Auto-loading MS-DOS, built-in DeskMate software! 1000 SL is America's easiest-to-use PC compatible. Ideal for packet. With CM-5 color monitor, reg. separate items \$1198.95. Now **898.95**

MS-DOS, TM Microsoft Corp

New! Battery "Hotline" Service



Fast Delivery! Hundreds of Types Available!

In addition to our large in-store stock, Radio Shack can now supply almost any currently manufactured battery—even special types for HTs. Batteries are sent directly from our warehouse to our location near you, so there's never a postage charge.

Ham Calculator

39⁹⁵

Built-In Electronic Engineering Functions



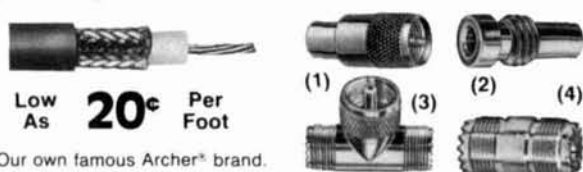
EC-4035 makes upgrade math easy! Computes in and displays with electrical units—V, A, mA, mW, Ω. With case. #65-983

Logic Test Team



- (1) **Logic Probe.** LEDs and tones reveal logic states in digital and microprocessor circuits. Circuit powered. #22-303 **16.95**
- (2) **Logic Pulser.** Teammate for the probe. Produces a single 5 μs pulse or a continuous pulse train at the push of a button. #22-304 **17.95**

Quality Coax Cable and Connectors



Low As **20¢** Per Foot

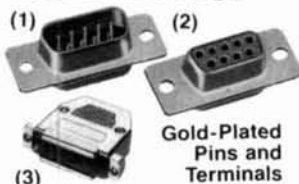
Our own famous Archer® brand.

Cable	Cat. No.	Per Ft.
RG-8 52-Ohm	278-1323	42
RG-8 Mini 52-Ohm	276-1328	25
RG-58 52-Ohm	276-1326	20
RG-59 75-Ohm	276-1327	20

- (1) **Standard PL-259 Plugs.** #278-205 Pkg. of 2/2.79

- (2) **UG-176/U Reducers.** For RG-59, 8M. #278-204 **2/99¢**
- UG-175/U Reducers.** For RG-58. #278-206 **2/99¢**
- (3) **M-358 UHF T Adapter.** #278-198 **3.49**
- (4) **Type PL-258 Dual-Female Adapter.** #278-1369 **1.69**

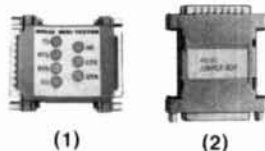
RS-232 Plugs



Gold-Plated Pins and Terminals

Fig.	Description	Cat. No.	Only
1	D-Sub 9 Male	276-1537	.99
2	D-Sub 9 Fem	276-1538	1.99
3	Shielded Hood	276-1513	1.49
...	D-Sub 25 Male	276-1547	1.49
...	D-Sub Fem.	276-1548	2.49
...	Shielded Hood	276-1536	1.99

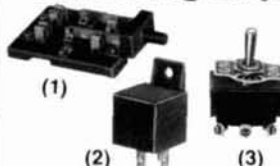
RS-232 Helpers



Find and Fix Problems Fast!

- (1) **RS-232 Tester.** Connect in line and dual-color LEDs help you pinpoint line problems. D-sub 25. #276-1401 **14.95**
- (2) **NEW! Shielded Stunt Box.** Wire the included board to suit your need. #276-1403 **9.95**

Switching Buys



- (1) **DPDT Knife Switch.** 0.5A at 200VDC. #275-1537 **1.29**
- (2) **SPST Automotive Relay.** 12VDC coil. Contacts rated 30 amps. #275-226 **5.99**
- (3) **Heavy-Duty DPDT AC Switch.** Center-off. Rated 10A at 125VAC. #275-1533 **1.89**

Plug & Adapters



- (1) **8-Pin Mike Plug.** TNC and phone patch hookup. #274-025 **2.19**
- (2) **Adapter.** Use mini phones with Ham equipment. #274-348 **1.99**
- (3) **Shielded Adapter.** 1/8" jack to 1/4" plug. #274-325 **1.59**
- (4) **Headphone Adapter.** Adapts mini stereo phones to 3/32" earphone jack on HTs, scanners. #274-381 **1.99**

Communications Add-On Speaker



Instant RX audio improvement for HTs and mobiles! Has 4" speaker, 10-ft. cord, 1/8" plug. #21-549 **13.95**

WWV and VHF Weather Receiver



Really handy! This compact, crystal-controlled radio receives WWV on 5, 10 or 15 MHz plus local VHF weather. Battery powered. #12-148 **39.95**

Light-Duty Antenna Rotator



Our famous Archer TV antenna rotator is just right for many VHF and small HF beams. Built to last! UL listed. #15-1225 **59.95**

100' 3-Cond. Cable. #15-1150 **8.95**

Parts "Hotline"



Over **200,000** Items Available

Your nearby Radio Shack can special-order a wide variety of parts and accessories. No postage charge! Orders sent directly to our store near you.

Over 1000 items in stock! Binding Posts, Books, Breadboards, Buzzers, Capacitors, Chokes, Clips, Coax, Connectors, Fuses, Hardware, ICs, Jacks, Knobs, Lamps, Multitesters, PC Boards, Plugs, Rectifiers, Resistors, Switches, Tools, Transformers, Transistors, Wire, Zeners, More!

Prices apply at participating Radio Shack stores and dealers

Radio Shack

The Technology StoreSM

A DIVISION OF TANDY CORPORATION

TE SYSTEMS**RF POWER AMPLIFIERS**

NEW!

400 WATTS
(144-148 MHz)

TE SYSTEMS new HPA Series of high power amplifiers now available through select national distributors.

All amplifiers are linear (all-mode), automatic T/R switching, and incorporate optional GaAs FET preamp. Amps are usable with a wide input drive level range. Thermal shutdown protection and remote control capability included. All units are designed to ICAS ratings and meet FCC part 97 regulations. Approx. size is 2.8 x 10 x 11.5" and weight is 8 lbs.

Consult your local dealer or send directly for further product information.

TE SYSTEMS**TE SYSTEMS**

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

SPECIFICATIONS

Model	Freq. MHz	Power Input	Power Output	Preamp NF-dB	Preamp Gain-dB	DC +Vdc	Power A	RF Conn.
0550G	50-54	10	280	.6	15	13.6	42	UHF
1450G	144-148	10	400	.6	15	13.6	54	UHF
1452G	144-148	25	400	.6	15	13.6	50	UHF
2252G	220-225	25	250	.7	14	13.6	36	UHF
4450G	420-450	10	180	1.1	12	13.6	39	N
4452G	420-450	25	180	1.1	12	13.6	36	N

Models also available without GaAs FET preamp (delete G suffix on model #). All units cover full amateur band - specify 10 MHz bandwidth for 420-450 MHz amplifier. Continuous duty repeater amps also available.

Amplifier capabilities: 100-200 MHz, 225-400 MHz, 1-2 GHz, Military (28V), Commercial, etc. also available - consult factory.

108-1000 MHZ RADIO DIRECTION FINDING

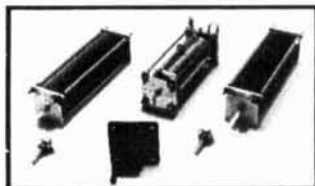
- ★ Interference Location
- ★ Stuck Microphones
- ★ Cable TV Leaks
- ★ ELT Search & Rescue



New Technology (patented) converts any VHF or UHF FM receiver into a sensitive Doppler shift radio direction finder. Simply plug into receiver's antenna and external speaker jacks. Models available with computer interface, synthesized speech, fixed site or mobile - 108 MHz to 1 GHz. Call or write for details.

DOPLER SYSTEMS, INC. P.O. Box 31819 (602) 488-9755
Phoenix, AZ 85046 FAX (602) 488-1295

✓ 174

1500+ WATT TRANSMATCH KIT \$169.95**OTHER KITS****BASIC KIT—INDIVIDUAL ITEMS**

- 1- rotary inductor 28µh.....\$59.00
- 2- 6:1 ball drives.....\$13.00 ea.
- 1- 0-100 turns counter.....\$65.75
- 1- turns counter, economy (Groth).....\$19.95
- 2- variable capacitors
- 25-245 pf 4500 v.....\$44.00 ea.

OPTIONS—

- enclosure (pictured in Sept. 86 CQ).....\$78.00
- 4:1 balun kit.....\$22.50

dials, terminals, chassis, ceramic standoffs, hardware, toroids, amp components, B&W coil stock, etc.

- G3RUH, PSK Packet Modem, Satellite and Terrestrial.....\$111.00
- G3RUH, OSCAR 13 Telemetry Demodulator.....\$144.95
- QRP 20, 5w, 20 meter Transceiver (HR 1/89).....\$124.95
- W1FB 160/80 Pre Amp (QST 8/88).....\$19.95
- K9CW Memory Contest Keyer.....\$109.00
- Yaesu FRG-9600, .1 to 60 MHz Converter.....\$84.95
- 20m CW, 15w Transceiver (H.R. 6/87).....\$159.95
- 50W 75M SSB SCVR.....\$179.95

Factory Wired
Complete Ameritron/Ten-Tec Line.....CALL
B&W PT-2500A Amp.....\$1,670.00
B&W VS 1500A Tuner.....\$388.00
Nel-Tech DVK-100A (Free Repeat Option).....\$240.00
Cary LK 800C.....CALL

RADIOKIT • P.O. Box 973-H Shipping Extra
Pelham, NH 03076 • (603) 437-2722 Catalog \$1.00

VISA/MasterCard

✓ 175

NEW ROTATABLE DIPOLES**12 & 17 METER ANTENNA**

New trap design for high strength and power handling capability. Elements made of 6061-T6 aluminium for high strength. Rotates with a small TV rotator.

INTRODUCTORY PRICE

\$89.95 (Plus \$5 Shipping)**SV PRODUCTS**

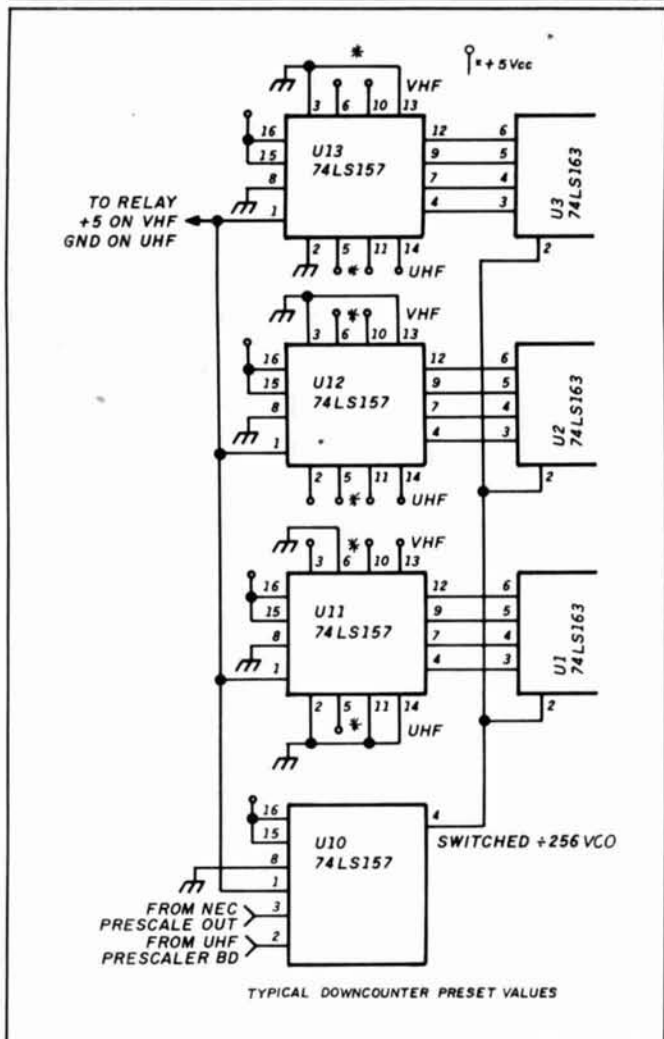
• KD9SV •

4100 Fahlsing Road, Woodburn, IN 46797

219-632-4642

✓ 176

FIGURE 7



Adding automatic preset switching for VHF and UHF to basic counter drawing.

of the local oscillator in the NEC. (I later found it to be 610 MHz.) I determined the correct switch settings for the UHF tuner, and then had to find a way to enter these binary values into the system when switching between tuners.

Data selectors U11, U12, and U13 do this by acting as a 12-pole two-position switch. The circuit in Figure 7 shows the data selectors hard wired so the correct binary switch presets are present at the IC inputs. One section of U10 selects the correct scaler. This is a flexible arrangement which can be used with another brand of cable converter and/or another UHF tuner. Just find the preload values with dip switches, then replace the switches with data selectors.

The counter circuit works as follows. A value equivalent to the oscillator's offset in the tuner is preloaded into U1, U2, and U3 when one-shot U4 is toggled as the LM311 detects center line crossover of the sweep. U4 resets U6 and U7, and sets both sections of U9 — a dual RS flip-flop. At this point, U8 pin 2 is enabled and the count signal is at pin 13, but the gate doesn't pass the signal because pin 1 is low and the NAND gate is inhibited. U6 starts counting clock pulses to establish a 1.024-ms timing interval. U1, U2, and U3 count down from the preset value until they

ARE COMMUNICATIONS

Add HF To Your IC-R7000



With ARE's New —
"2 in 1" Kit
EXCLUSIVE TO
ARE COMMUNICATIONS

500Hz to 2GHz CONTINUOUS receive in one unit. Using the ICR7000 receiver, this kit makes the "2 in 1" ICR7000HF Receiver the most versatile scanner available today. Because of the enormous frequency coverage, the ICR7000HF has 200 mode sensitive channels for increased flexibility.

With excellent strong handling characteristics, using a direct fed Double Balance Mixer, the need for a pre-amp is unnecessary.

Available from stock, the new ICR7000HF kit. Complete with installation instructions.

Only \$149.00 including shipping.

Phone London 0044 1 997 4476 or fax 0044 1 991 2565, quoting your credit card number (Master Card/VISA/American Express) and shipping details for immediate attention.

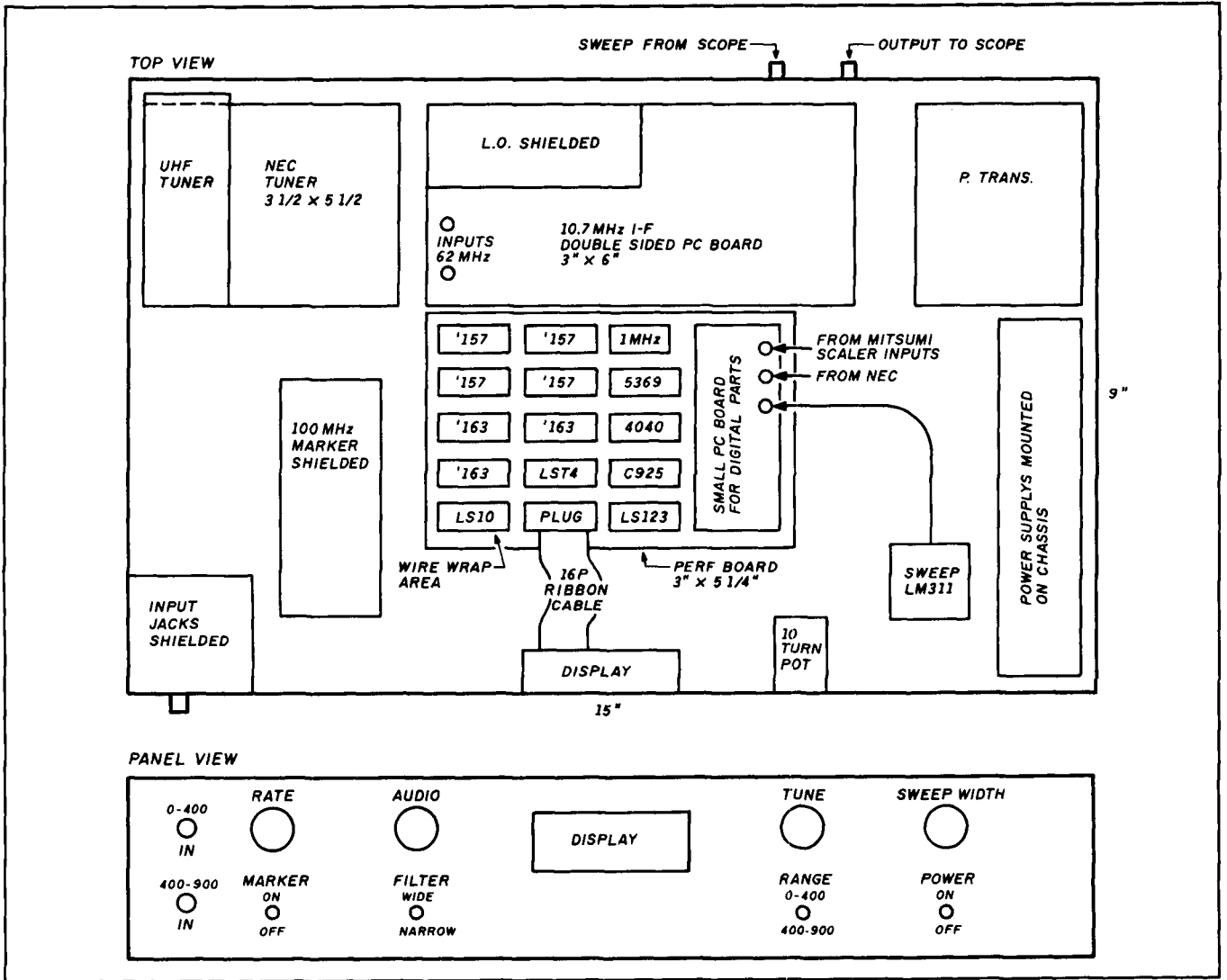
DEALER INQUIRIES WELCOME

SEE OUR REVIEW ON PAGE 42.



ARE Communications Limited, 6 Royal Parade, Hanger Lane, Ealing, London W5A 1ET, England
Fax 44-01-991-2565
Tel 44-01-997-4476

FIGURE 8



Chassis layout. (A) Top view. (B) Panel view.

reach zero, and output a borrow pulse at U3-15. The borrow is inverted and clears one section of U9, enabling U8-1.

U8 starts to pass prescaler pulses, which are divided by 4 in U1. This continues until the 1.024-ms time interval has elapsed. At this point, U6-15 goes high, inverted in U8-8. The section of U9 that has been keeping U8-2 enabled suddenly goes low, and stops the counting in U7. When U9-1 is cleared, U9-6 generates a pulse transferring the new count to U7's latch and display circuitry. U7 displays this value until the next count is completed and transferred into the latches. U7 supplies current to the multiplexed seven-segment display in a standard circuit using transistors to switch digits.

Mechanical construction

The unit is housed in an inverted 15" x 9" x 3" aluminum chassis. The circuit boards are mounted on standoffs similar to those in the TVRO in the Gibson articles.^{5,6}

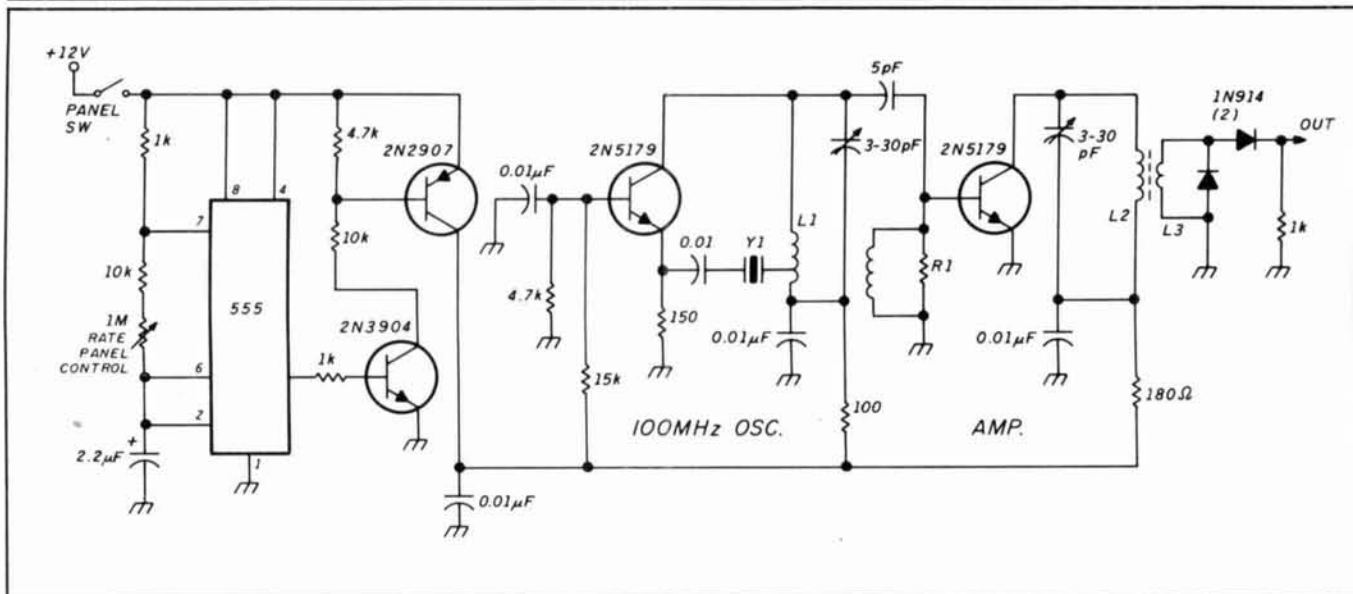
The counter circuit was wire wrapped and the layout is shown in Figure 8. It's advisable to shield the counter assembly completely because of the digital noise. I built the IF/detector circuit on a double-sided pc board because it provided an excellent way to eliminate feedback and reduce shielding problems. I now use wide masking tape as resist, and trim it with an X-acto® knife to make the pc trails.⁷ It's inexpensive and easy to work with.

There are two BNC jacks on the panel for the two signal inputs. I shielded these jacks with scrap pc board material. I used two more BNC jacks at the back of the chassis for sweep in and signal out.

The marker generator

You'll need a marker generator (shown in Figure 9) to verify that the counter is working correctly and to help in initial setup. Even though everything now works properly, I still use the marker generator when I start out to verify that

FIGURE 9



100-MHz marker.

PARTS LIST

- L1 Air wound 7T no. 16 tapped at 1T 1/4" diameter, 1/2" length
- L2 T50 toroid 7T no. 22
- L3 4T no. 22 over L2
- R1 47 ohm 1/2-watt with no. 30 wire wound full
- Y1 100-MHz crystal (Texas Crystals)

All other resistors 1/4 watt
0.01 µF-capacitors are miniature disc

REFERENCES

1. Al Helfrick, K2BLA, "An Inexpensive Spectrum Analyzer for the Radio Amateur," *QST*, November 1985, page 23.
2. Robert Richardson, W4UCH, "Low Cost Spectrum Analyzer with Kilobuck Features," *Ham Radio*, September 1986 page 82.
3. Shriner and Pagel, "A Step Attenuator You Can Build," *QST*, September 1982, page 11.
4. *The ARRL Handbook*, ARRL, 1987, pages 25-43.
5. Stephen Gibson, "The \$100 TVRO Receiver — Satellite Central, part VIII," 73, August 1982, page 60.
6. Stephen Gibson, "The \$100 TVRO Receiver — Satellite Central, part IX," 73, September 1982, page 60.
7. Adelbert Kelley, AA4FB, "How To Make Your Own Printed Circuit Boards," *Ham Radio*, April 1973, page 58.

all is well. I used a circuit which pulses the marker on and off to make it stand out.

The marker generates harmonics of 100 MHz up through 900 MHz. You may have to experiment a little to get the oscillator circuit that works best with your crystal. The one shown is the best of the several I tried. Build the marker last, and use your working analyzer. You'll wonder how you got along without it. *[E]*

HI-PERFORMANCE DIPOLES

Antennas that work! Custom assembled to your center freq. ea. band - advise ht of center and each end - hang as inverted "V" - horizontal, vert. dipole, sloping dipole - commercial quality - stainless hardware - legal power - no-trap, high-efficiency design. Personal check, M.O. or C.O.D. (\$3)

MPD-5*	80-40-20-15-10M max performance dipole 87" long	\$105ppd
MPD-2	80-40M max performance dipole, 85" long 562	95 \$66 ppd
HPD-3*	160-80-40M hi-performance dipole 113" long	\$79 ppd
SSD-6*	160-80-40-20-15-10M space saver dipole 71" long	\$125 ppd
SSD-5*	80-40-20-15-10M space-saver dipole specify L. 42' \$105 52' \$108 ppd	
SSD-4*	80-40-20-15M space-saver dipole specify L. 46' \$93 60' \$ 96 ppd	

*9 bands with wide-matching range tuner.

SASE for catalogue of 30 dipoles, slopers, and space-saving, unique antennas

312-394-3414 BOX 393 W9INN ANTENNAS MI. PROSPECT, IL 60056

✓ 169



Toroid Cores.
Iron Powder
& Ferrite.
Ferrite Beads.
Ferrite Rods.

Free catalog and winding chart on request.

PALOMAR ENGINEERS

Box 455, Escondido, CA 92025
Phone: (619) 747-3343

✓ 170

516F2 SUPPLY

Collins 516F2 Power Supply for S-Line transmitters: gov't surplus. With tubes 5U4 & 5R4, cabinet, and cables. 34 lbs. sh wt.



Used.....\$99.50
(For choice of cabinet emblem, add \$10.00)
516F2 without cabinet and tubes, 23 lbs. sh. #NC-516F2, used\$69.50



516E2 DC Supply, solid-state unit powers S-Line from 24-28 VDC input; 24 lbs. sh. Used.....\$49.50

Prices F.O.B. Lima, O. - VISA, MASTERCARD Accepted
Allow for Shipping - Write for 1989 Catalog
Address Dept. HR - Phone 419/227-6573

FAIR RADIO SALES
1016 E. EUREKA • Box 1105 • LIMA, OHIO • 45802

✓ 171

A TRANSMIT CONTROL FOR MOBILE OPERATION

By James M. Bryant, G4CLF, 16, Church Road, St. Marks, Cheltenham, GL51 7AN, U.K.

Recent editions of the *Highway Code* for Great Britain recommend that drivers do not use hand-held microphones while at the wheel of a car. Many Amateur operators are now using boom microphones attached to a headband, the seatback, or the sunvisor. These microphones leave both hands free for driving.

The driver/radio operator still has the problem of switching his transceiver between receive and transmit. A common solution is VOX or voice operated transmission — a circuit which switches from receive to transmit whenever the operator speaks. While useful, this has several disadvantages in a motor vehicle:

- While a well-designed VOX circuit will reject noise from the receiver of the rig it is being used with, it will still respond to the loud external noises common in a motor vehicle.
- A VOX causes the transmitter to transmit anything the operator says — even if it is addressed to another person in the vehicle (or another driver!). This function makes VOX operation rather inconvenient.
- It may also respond to speech from a broadcast receiver; many operators listen to the car radio while monitoring Amateur frequencies.

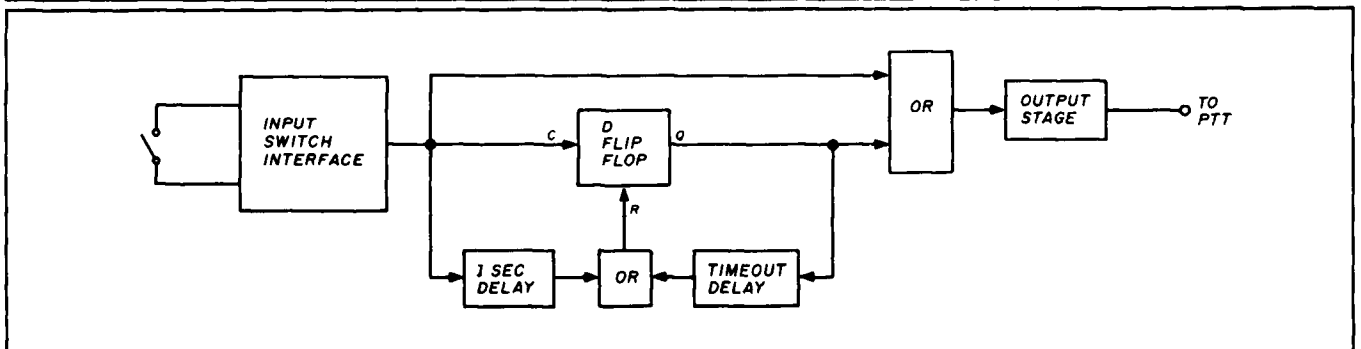
- VOX circuitry needs careful adjustment if it is to respond properly, particularly over a wide range of ambient temperatures.

The circuit to be described is a substitute for VOX. It requires the driver to operate a push-button switch to start and finish a transmission; this only requires the use of his hand for about as long as any of the other vehicle controls. (A foot switch, like an old-fashioned headlamp dip switch, might also be used.) The circuit also has other useful features.

Operating features

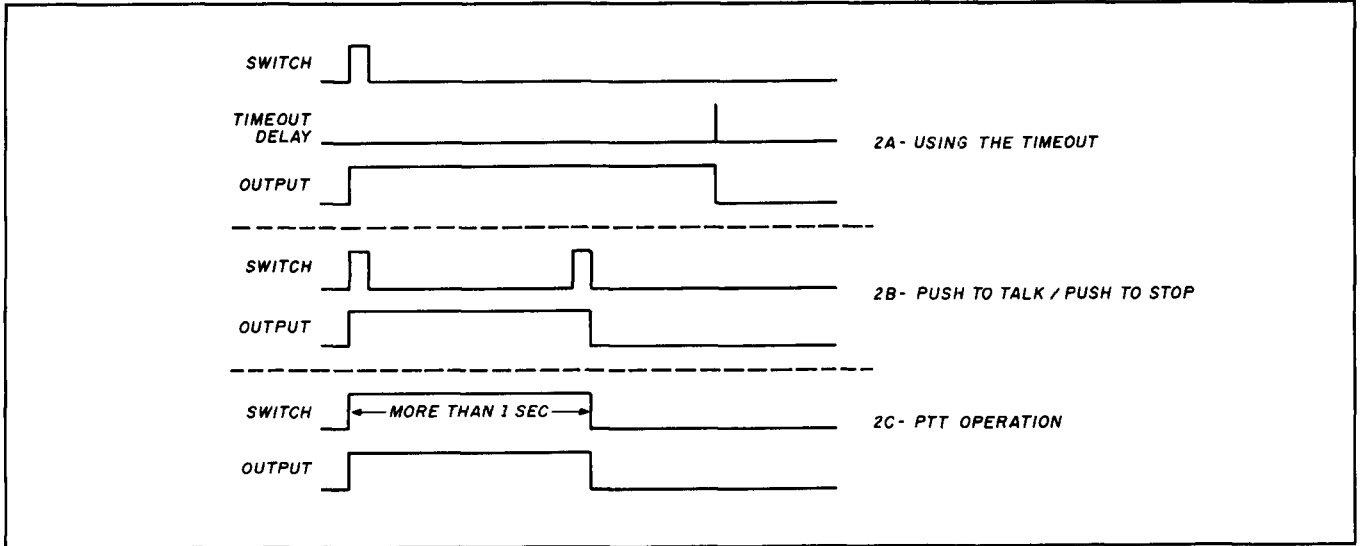
The control consists of a single push-button switch. If it is pushed briefly the transceiver starts to transmit and continues to do so until either the button is pushed for a second time and released, or a preset time interval is exceeded. (This causes the transmitter to time out before a repeater does.) If the button is pushed and held down for more than a second, the transceiver will transmit only until the button is released. This combination is very useful. To make a short call (but longer than a second) the button is used like a conventional push-to-talk (PTT) switch, for longer transmissions it need only be touched once at the start and again at the

FIGURE 1



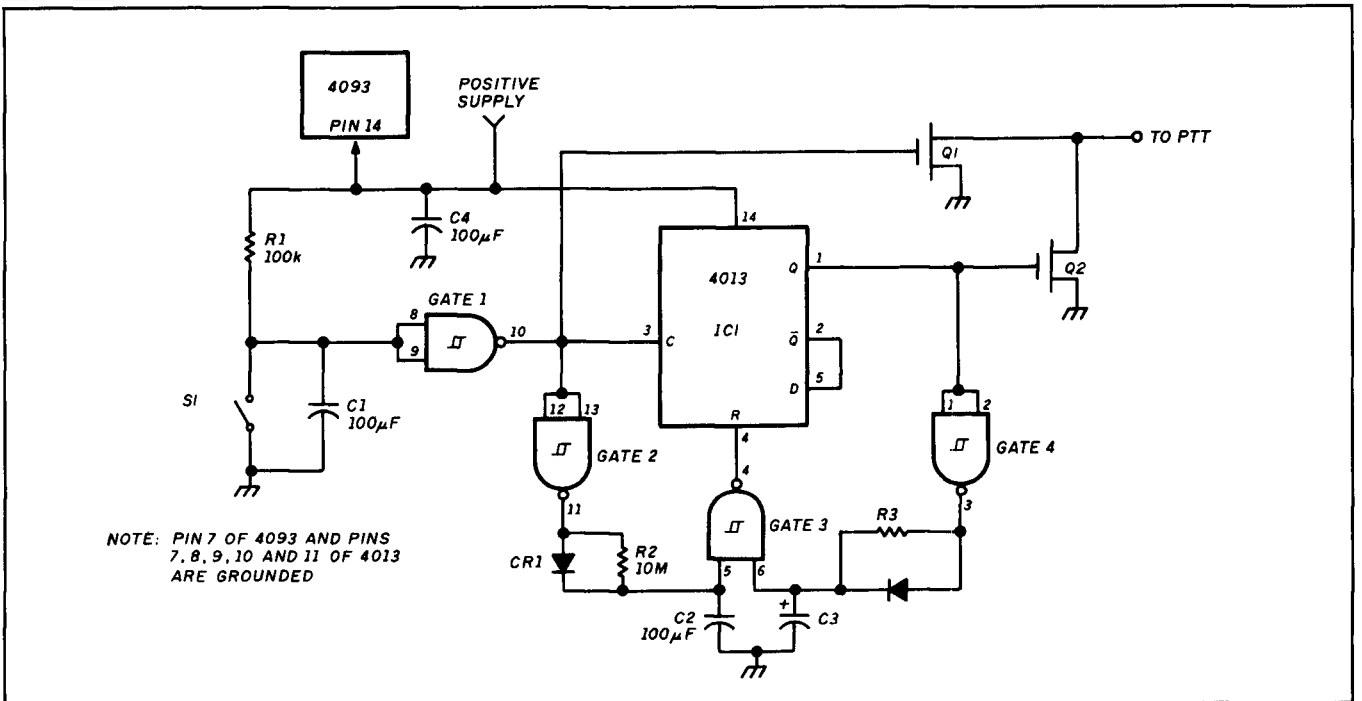
System diagram of control circuit.

FIGURE 2



Waveforms of different modes of operation. (A) Using the timeout. (B) Push to talk/Push to stop. (C) PTT operation.

FIGURE 3



Circuit diagram.

end. If the transmission exceeds a preset time it is ended automatically. The last feature has three benefits:

- It prevents garrulous individuals (like the author) from talking interminably.
- When operating through a repeater with a time-out it prevents one from wasting breath talking and not being relayed.
- If the button is touched accidentally it limits the length of the unintended transmission. This last feature is quite useful as it is by no means uncommon to have repeaters blocked out for a considerable time by a mobile station

who has accidentally gone to transmit with a PTT locking device.

System description

A functional diagram of the control is shown in Figure 1. It consists of a flip-flop, two time delays (one of 1 second and one of whatever timeout delay is required), two gates, and a switch to operate the PTT line of the transceiver being used.

The various modes of operation are shown by the waveforms in Figure 2. In every case the flip-flop changes state when push-button switch S1 is first operated and both time

delays start. The output of the switch and the Q output of the flip-flop go to an OR gate which drives the output switch.

If the switch is released at once, the short time delay is reset and the Q output of the flip-flop holds the output switch closed until the long time delay is complete. The flip-flop is then reset (Figure 2A).

If the switch is pressed again during the delay (Figure 2B) the flip-flop changes state again and the long time delay is reset, but the output switch is held closed by the signal directly from the switch until S1 is released.

If, when S1 is first pressed, it is held down for longer than the first time delay (Figure 2C) the flip-flop is reset when the first time delay is complete, but the output switch is held closed (as in Figure 2B) until S1 is released.

Circuit Description

The system is built around two CMOS devices, IC1 (a 4013 dual D-type flip-flop) and IC2 (a 4093 quad dual-input NAND Schmitt trigger), two VMOS transistors, two diodes, three resistors and four capacitors. The circuit diagram of the controller is shown in Figure 3.

The circuit works because of the use of the 4093. A normal CMOS gate circuit has a linear region where small changes in input produce small changes in output; in other words it acts as an amplifier. A Schmitt trigger, on the other hand, is a "snap-action" device. If the input is changed the output remains unmoving until a threshold is passed, when the output switches to its new value. However, if the input is then moved backwards it must move some distance back (called the "hysteresis") before the output snaps back to its original state. The characteristics of a normal CMOS gate and a Schmitt trigger gate are shown in Figure 4A and Figure 4B, respectively.

CMOS Schmitt triggers have very high input impedance so there will be a delay between the input changing state and the output if they are driven via a resistor/capacitor timing circuit (Figure 5A). If there is a diode in parallel with the resistor, the delay when the diode is conducting will be minimal but the delay when the diode does not conduct will be defined by the resistor as in Figure 5B. You can thus use CMOS Schmitt triggers to make time delay circuits which reset very quickly. Of course, NAND CMOS Schmitt triggers can be used as simple NAND gates.

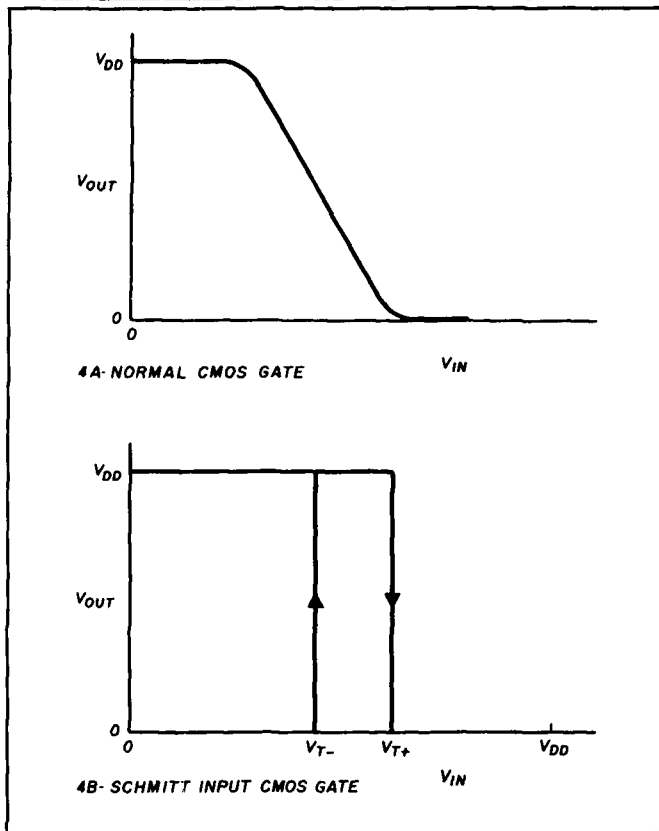
The operation of the circuit in Figure 3 is quite simple. The input to gate 1 of the 4093 is held high by a 100-k resistor (R1) to the positive supply rail. The push-button S1 grounds the input to the gate, which causes its output to go high. Capacitor C1 (100 nF or 0.1 μF) debounces the switch and also prevents RF from the transmitter from affecting it. If S1 is located a long way from the controller, a ferrite bead should be slipped over the wire near the gate to minimize RF pickup.

When the output of gate 1 goes high it drives the clock of flip-flop 1 (flip-flop 2 is not used and all its inputs should be grounded) and its outputs change state. This is because the Q output is fed back to the D input. The output of gate 1 turns on transistor Q1 and the Q output of the flip-flop turns on Q2. Either Q1 or Q2 will switch the PTT line of the transceiver.

As well as driving the flip-flop, the output of gate 1 is inverted by gate 2 and applied, via a time delay of about 1 second formed by R2 and C2, to one input of gate 3 which drives the reset input of the flip-flop. As long as both inputs to gate 3 are high its output will be low, but if either goes low its output will

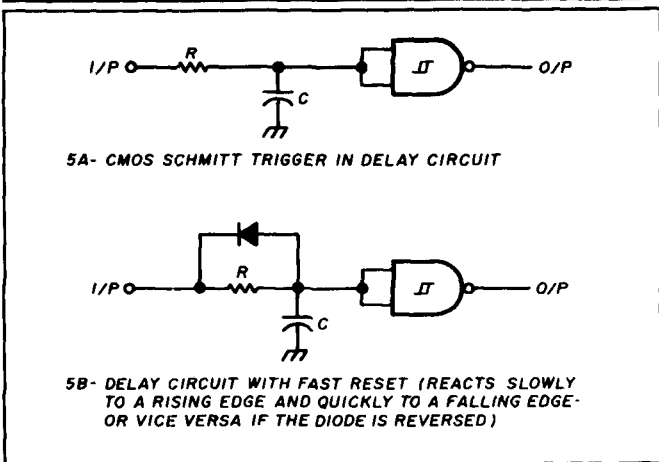
go high and the flip-flop will be reset. The other input of gate 3 is driven, via a time delay formed by R3 and C3, from gate 4 which inverts the signal at Q. R3 and C3 could be driven directly from Q without an inverter, but since gate 4 is otherwise unused it is better to buffer the relatively large C3. The two diodes, D1 and D2, ensure that when the outputs of gate 2 and gate 4 go high capacitors C2 and C3 will recharge quickly.

FIGURE 4



Comparison of transfer characteristics. (A) Normal CMOS gate. (B) Schmitt input CMOS gate.

FIGURE 5



Delay circuits. (A) Schmitt trigger in delay configuration. (B) Delay configuration with fast reset. (Reacts slowly to a rising edge and quickly to a falling edge — or vice versa if the diode is reversed.)

NYE

Takes the fear out of full power antenna tuners, and the guesswork out of PEP measurement with these two MUST SEE PRODUCTS!!

MB-V-A



Discover this durably built, feature packed MB-V-A Antenna tuner. You'll find operating conveniences that make antenna tuning a snap and value engineered to do the job over wide operating ranges. Compare quality, features and the NYE VIKING TWO YEAR WARRANTY.

RFM-003



Get correct easy to read measurements of PEP for SSB, AM, and Pulse along with full time completely automatic SWR display with this unique Power Monitor System. Two models to choose from: The RFM-003 for 3KW indication and The RFM-005 for 5KW.

CHECK THE FEATURES:

- **Pi Network.** Low Pass Pi Network tuning 1.8-30 MHz. Heavy duty silver plated continuously variable inductor with 25:1 vernier dial 7000 volt variable capacitor and 10,000v switch selected fixed capacitors on output side. Tunes 40-2000 ohms loads. Good Harmonic suppression!
- **Automatic SWR.** Hands free metering of SWR. No reset or calibration needed. Separate power meter—300 or 3000 w f.s. automatically switched. Easy to read 2.5" recessed and back-lighted taut band meters.
- **Antenna Switch.** PUSH-BUTTON antenna switching to (4) antennas (2 coax, single wire and twin lead). Coax bypassed on first coax output. We designed this switch to take the power. Rated at 10KV and 20 amps.
- **3 KW Balun.** Trifler wound triple core torroid gives balanced output to twin feeder from 200 to 1000 ohms and unbalanced output down to 20 ohms.
- **Maximum Power Transfer.** Match your transmitter output impedance to almost any antenna system for maximum power transfer. Amplifiers only run at their designed Q when properly matched.
- **Model Options.** MB-IV-A1 includes all MB-V-A features less antenna switch and balun. MB-IV-A2 is identical to MB-IV-A1 with the addition of a triple core balun.
 - 1.8 MHz will not tune on some antennas.
- **(3) Modes** — Peak Average and Peak and Hold with a unique non-drift Sample & Hold Analog memory circuit.
- **(2) Ranges** — Automatically switched power scales to 5 KW.
- **Fully Automatic SWR** — Full time meter displays ratios directly without drift.
- **Built-in ALO** — Protect your amplifier tube investment with this fast acting lockout.
- **Remote Couplers** — Six feet remotes the interchangeable calibrated couplers.
- **True RMS Conversion** — H.F. couplers use forward biased full wave detection.
- **Rugged Construction** — Heavy gauge aluminum construction. Top quality glass epoxy PCB. This meter is built to last.
- **Accuracy** — Guaranteed to $\pm 5\%$ F.S.
- **Warranty** — TWO FULL YEARS.
- **Added Features** — Switchable reverse power all mode metering — Full status LED Display — Adjustable ALO is switchable SWR/REFL power — Heavy duty Nicad batteries charged by the applied RF for the field and a charger is supplied for fast charging and backlighting of the taut band meters for the ham shack.

OTHER NYE VIKING PRODUCTS

Phone Patches — Electronic and Memory Keys — Squeeze Keys — Straight Keys — Code Practice Sets — Low Pass Filters — All Band Antennas and more...

ASK FOR A FREE FULL LINE CATALOG.

TO ORDER, CALL YOUR FAVORITE DEALER

Amateur Electronic Supply
Ham Radio Outlet
Henry Radio
Madison Electronics
EGE
R&L Electronics
rf enterprises
Barry Electronics

C-Comm
Ross Distributing
Quement Electronics
LaCue Communications
Ham Station
*In Europe: Kneisner & Doering,
Braunschweig, W-Germany*



Wm. M. Nye Co. Inc.
1614 130th Ave. N.E.
Bellevue, WA 98005
TEL: (206) 454-4524
FAX: (206) 453-5704

HITACHI SCOPES AT DISCOUNT PRICES

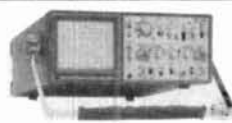


V-212
\$425

List \$595
Save \$170

20MHz Dual Trace Oscilloscope

All Hitachi scopes include probes, schematics and Hitachi's 3 year warranty on parts and labor. Many accessories available for all scopes.



V-425
List \$1,070 **\$849**

- DC to 40MHz
- Dual Channel
- CRT Readout
- Cursor Meas
- DC Offset
- Alt Magnifier
- Compact Size



V-1060
List \$1595 **\$1,359**

- DC to 100MHz
- Dual Channel
- Delayed Sweep
- CRT Readout
- Sweep Time
- Autoranging
- Trigger Lock
- 2mV Sensitivity

	LIST	PRICE	SAVE
V-223 20MHz	\$825	\$725	\$100
V-422 40MHz	\$940	\$740	\$200
V-423 40MHz	\$1,025	\$825	\$200
V-660 60MHz	\$1,295	\$1,145	\$150
V-1065 100MHz	\$1,895	\$1,670	\$225
V-1100A 100MHz	\$2,450	\$2,095	\$355
V-1150 150MHz	\$3,100	\$2,565	\$535

ELENCO PRODUCTS AT DISCOUNT PRICES

20MHz Dual Trace Oscilloscope



\$375
MO-1251

- 6" CRT
- Built in component tester
- TV Sync

FREE DMM

with purchase of
MO-1251/1252 Scope

SCOPE PROBES

P-1 65MHz, 1x, 10x **\$19.95**
P-2 100MHz, 1x, 10x **\$23.95**

35MHz Dual Trace Oscilloscope



\$495
MO-1252

- High luminance 6" CRT
- 1mV Sensitivity
- 6KV Acceleration Voltage
- 10ns Rise Time
- X-Y Operation • Z Axis
- Delayed Triggering Sweep

Top quality scopes at a very reasonable price. Contains all desired features. Two 1x, 10x probes, diagrams and manual. Two year guarantee.

PRICE BREAKTHRU on Auto Ranging DMMs



3 to choose from:
MDM-1180 \$24.95
MDM-1181 \$27.95
MDM-1182 \$29.95

- 3 1/2 LCD Display
- 27 Functions
- Auto /Manual Ranges
- Audible Continuity
- Data Hold (MDM-1182)
- 1% Accuracy (MDM-1181)

True RMS 4 1/2 Digit Multimeter
\$135 M-7000

.05% DC Accuracy
.1% Resistance with Freq. Counter and deluxe case

Multimeter with Capacitance and Transistor Tester
\$55 CM-1500A

Reads Volts, Ohms, Current, Capacitors, Transistors and Diodes with case

Digital Capacitance Meter
CM-1550 \$58.95

9 Ranges
.1pf-20,000ufd
.5% basic accy
Zero control with case

Digital LCR Meter
LC-1800 \$125

Measures
Coils 1uH-200H
Caps .1pf-200uf
Res .01-20M

Bench DMMs

M-3500 \$125 3 1/2 digit .1% accy
M-4500 \$175 4 1/2 digit .05% accy

SOLDERING STATION Temperature Controlled
SL-30 \$99

Digital display
Temp range: 300F-900F
Grounded tip
Overheat protect

Solderless Breadboards

9430 1,100 pins **\$15**
9434 1,100 pins **\$25**
9436 2,170 pins **\$25**
2,860 pins **\$35**
All have color coded posts

AC Clamp-On Current Adapter
ST-265 \$25

0-1000A AC
Works with most DMM

Wide Band Signal Generators

SG-9000 \$129
RF Freq 100K-450MHz
AM Modulation of 1KHz
Variable RF output

SG-9500 with Digital Display and 150MHz built-in Freq Ctr \$249

3 1/2 Digit Probe Type DMM
M-1900 \$39

Convenient one hand operation with batteries and case
Measures DCV, ACV, Ohms
Audible continuity check, Data hold

Function Generator Blox
#9600 \$28.95

Provides sine, tri, squ wave from 1Hz to 1MHz
AM or FM capability

Decade Blox
#9610 or #9620 \$18.95

#9610 Resistor Blox
47 ohm to 1M & 100K pot
#9620 Capacitor Blox
47pf to 10MFD

Digital Triple Power Supply
XP-765 \$249

0-20V at 1A
0-20V at 1A
5V at 5A

Fully Regulated, Short circuit protected with 2 Limit Cont., 3 Separate supplies
XP-660 with Analog Meters \$175

Quad Power Supply
XP-580 \$59.95

2-20V at 2A
12V at 1A
5V at 3A
-5V at 5A

Fully regulated and short circuit protected
XP-575 without meters \$39.95

10MHz XT 100% IBM® Compatible
MODEL PC-1000 \$595

5 Year Warranty

Four-Function Frequency Counters

F-100 120MH \$179
F-1000 1.2GH \$259

Frequency, Period, Totalize, Self Check with High Stabilized Crystal Oven Oscillator, 8 digit LED display

GF-8016 Function Generator with Freq. Counter
\$249

Sine, Square, Triangle Pulse, Ramp, .2 to 2MHz
Freq Counter .1 - 10MHz

GF-8015 without Freq. Meter \$179

150W Power Supply
256K RAM
Expandable to 640K
Monochrome Monitor
Monographic Video Card
Parallel Printer Port

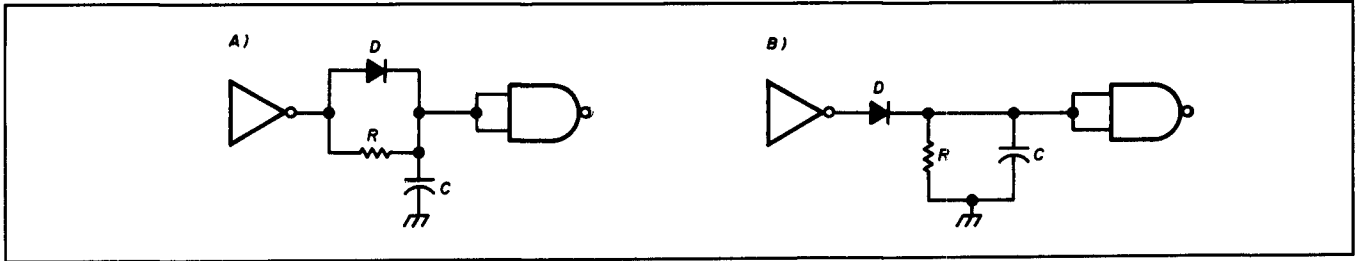
FREE spreadsheet and word processor
3.XXMS DOS and GW Basic add 75.00

WE WILL NOT BE UNDERSOLD!
UPS Shipping: 48 States 5%
(\$10 Max) IL Res., 7% Tax

C & S SALES INC.
1245 Rosewood, Deerfield, IL 60015
(800) 292-7711 (312) 541-0710

15 Day Money Back Guarantee
2 Year Warranty Prices subject to change
WRITE FOR FREE CATALOG

FIGURE 6



Respective current consumption of delay currents. (A) Low standby current. (B) Current flows in R during standby.

There are two subtleties of design in the time delays. One is that the timing resistors R2 and R3 are driven by the gates as shown in Figure 6A. The circuit would also work if they were grounded as in Figure 6B, but the standby current would be several μA instead of a few nA. The other subtlety is that the timing capacitors C2 and C3 are fully charged in their standby state. This is unimportant so far as C2 (a ceramic capacitor) is concerned, but being biased continuously will reduce the leakage current of C3 — a tantalum bead electrolytic.

The circuit will operate from any supply voltage between +5 and +15 volts but its timing is affected by major supply voltage changes. It has negligible current consumption in its standby state and does not require an ON/OFF switch. An alkaline 6-F22 (PP3) battery makes an ideal power source, which should last for several years. During timing periods its consumption may rise to about $50 \mu\text{A}$ and while S1 is pressed it will draw nearly 200 mA.

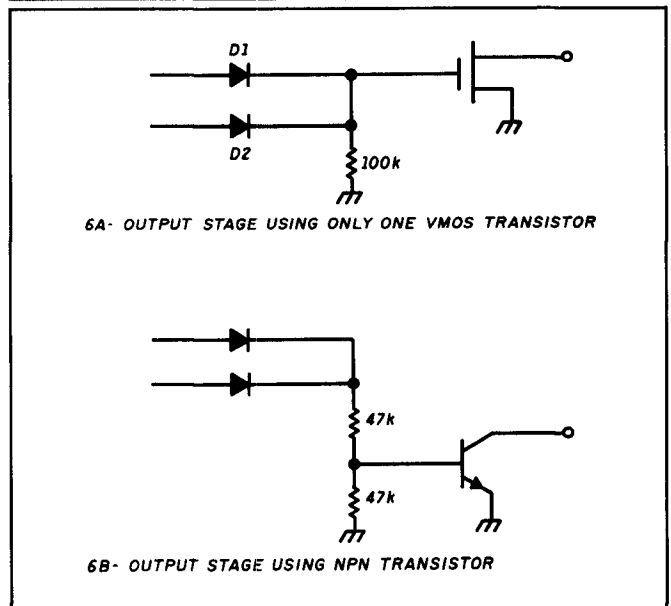
The output switch uses two VMOS transistors with their drains paralleled to give an OR function. They could be replaced by one VMOS device, two diodes and a resistor, as shown in Figure 7A, but this circuit increases the current consumption during switching by about $80 \mu\text{A}$. If VMOS transistors are hard to obtain they may be replaced altogether by an NPN transistor (almost any small-signal type will do), two diodes, and two resistors (Figure 7B) but this will increase current consumption during switching to about $200 \mu\text{A}$.

The output switch will only work with PTT lines that are grounded to operate. The VMOS device recommended, a VN10 from Siliconix, will work with positive voltages up to +50 volts and is capable of sinking 100 mA. If an NPN transistor is used the limit is about 80 percent of its V_{ce0} rating. PTT line currents are generally less than a mA.

Timing

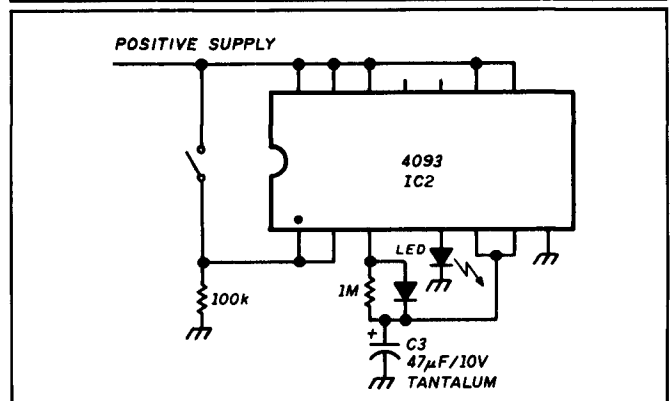
The threshold voltages of 4093 Schmitt triggers vary from device to device. It is not, therefore, possible to give values for R3 for particular delays. Some experimentation is necessary. Using the same 4093 and $47\text{-}\mu\text{F}$ tantalum bead capacitor that you are going to use in your finished equipment, build the circuit in Figure 8. Connect a p.s.u. or battery of the same voltage as the finished project and check that when the switch is closed the LED lights after a delay of a few minutes. Open the switch and leave the circuit powered for several hours for the leakage current in the capacitor to drop (leakage in electrolytic capacitors is always greatest just after they are powered up). Close the switch and time the delay until the LED lights.

FIGURE 7



Alternative output stages. (A) Output stage using only one VMOS transistor. (B) Output stage using one NPN transistor.

FIGURE 8



R3 timing test circuit. (Use same supply voltage as final circuit.)

ICOM

KENWOOD YAESU



IC-781

HF Equipment	List	Jun's
IC-781 Super Deluxe HF Rig	\$5995.00	Call \$
IC-765 New, Loaded with Features	3,149.00	Call \$
IC-735 Gen. Cvg Xcvr	1099.00	Call \$
IC-751A Gen. Cvg Xcvr	1699.00	Call \$
IC-725 New Ultra-Compact Xcvr	949.00	Call \$
IC-575A 10m/6m Xcvr	1399.00	Call \$
IC-726 HF/50 MHz All Mode	1299.00	Call \$
Receivers		
IC-R9000 100 kHz to 1999.8 MHz	5459.00	Call \$
IC-R7000 25-1300 + MHz Rcvr	1199.00	Call \$
IC-R71A 100 kHz-30 MHz Rcvr	999.00	Call \$
VHF		
IC-228A/H New 25/45w Mobiles	509/539	Call \$
IC-275A/H 50/100w All Mode Base	1299/1399	Call \$
IC-28A/H 25/45w, FM Mobiles	469/499	Call \$
IC-2GAT, New 7w HT	429.95	Call \$
IC-2SAT Micro Sized HT	439.00	Call \$
IC-901 Remote Mount Six Band Mobile	TBA	Call \$
UHF		
IC-475A/H 25/75w All Modes	1399/1599	Call \$
IC-48A FM Mobile 25w	509.00	Call \$
IC-4SAT Micro Sized HT	449.00	Call \$
IC-4GAT, New 6w HT	449.95	Call \$
IC-04AT FM HT	449.00	Call \$
IC-32AT Dual Band Handheld	629.95	Call \$
IC-3210 Dual Band Mobile	739.00	Call \$
IC-2500A FM, 440/1.2 GHz Mobile	999.00	Call \$
IC-2400 144/440 FM	899.00	Call \$
220 MHz		
IC-3SAT Micro Sized HT	449.99	Call \$
IC-375A All-Mode, 25w, Base Sta.	1399.00	Call \$
IC-38A 25w FM Xcvr	489.00	Call \$
1.2 GHz		
IC-12GAT Super HT	529.95	Call \$



TS-940S

HF Equipment	List	Jun's
TS-940S/AT Gen. Cvg Xcvr	\$2499.95	Call \$
TS-440S/AT Gen. Cvg Xcvr	1449.95	Call \$
TS-140S Compact, Gen. Cvg Xcvr	949.95	Call \$
TS-680S HF Plus 6m Xcvr	1149.95	Call \$
TL-922A HF Amp	1749.95	Call \$
Receivers		
R-5000 100 kHz-30 MHz	1049.95	Call \$
R-2000 150 kHz-30 MHz	799.95	Call \$
RZ-1 Compact Scanning Rcvr.	599.95	Call \$
VHF		
TS-711A All Mode Base 25w	1059.95	Call \$
TR-751A All Mode Mobile 25w	669.95	Call \$
TM-231A Mobile 50w FM	459.95	Call \$
TH-215A, 2m HT Has It All	399.95	Call \$
TH-25AT 5w Pocket HT NEW	369.95	Call \$
TM-731A 2m/70cm, FM, Mobile	749.95	Call \$
TM-621 2m/220, FM, Mobile	729.95	Call \$
TM-701A 25w, 2m/440 Mobile	599.95	Call \$
TH-75A 2m/70cm HT	TBA	Call \$
UHF		
TS-811A All Mode Base 25w	1,265.95	Call \$
TR-851A 25w SSB/FM	771.95	Call \$
TM-431A Compact FM 35w Mobile	469.95	Call \$
TH-45AT 5w Pocket HT NEW	389.95	Call \$
TH-55 AT 1.2 GHz HT	524.95	Call \$
TM-531A Compact 1.2 GHz Mobile	569.95	Call \$
220 MHz		
TM-3530A FM 220 MHz 25w	519.95	Call \$
TM-321A Compact 25w Mobile	469.95	Call \$
TH-315A Full Featured 2.5w HT	419.95	Call \$



FT-767GX

HF Equipment	List	Jun's
FT-747 GX New Economical Performer	\$889.00	Call \$
FT-757 GX II Gen. Cvg Xcvr	1280.00	Call \$
FT-767 4 Band New	2299.00	Call \$
FL-7000 15m-160m Solid State Amp	2279.00	Call \$
Receivers		
FRG-8800 150 kHz - 30 MHz	784.00	Call \$
FRG-9600 60-905 MHz	808.00	Call \$
VHF		
FT-411 New 2m "Loaded" HT	406.00	Call \$
FT-212RH New 2m, 45w Mobile	499.00	Call \$
FT-290R All Mode Portable	610.00	Call \$
FT-23 R/TT Mini HT	351.00	Call \$
FT-33R/TT 220 MHz HT	373.00	Call \$
FT-73R/TT 70cm HT	355.00	Call \$
UHF		
FT-712RH, 70cm, 35w Mobile	536.00	Call \$
FT-811 70cm built-in DTMF HT	410.00	Call \$
FT-790 R/II 70cm/25w Mobile	681.00	Call \$
VHF/UHF Full Duplex		
FT-736R, New All Mode, 2m/70cm	2025.00	Call \$
FEX-736-50 6m, 10w Module	294.00	Call \$
FEX-736-220 220 MHz, 25w Module	322.00	Call \$
FEX-736-1.2 1.2 GHz, 10w Module	589.00	Call \$
FT-690R MkII, 6m, All Mode, port.	752.00	Call \$
Dual Band		
FT-4700RH, 2m/440 Mobile	996.00	Call \$
FT-470 Compact 2m/70cm Mobile	576.00	Call \$
FT-690 R/II 6m/10w Mobile	497.00	Call \$
Repeaters		
FT-2410 2m Repeaters	1154.00	Call \$
FT-5410 70cm Repeaters	1154.00	Call \$
Rotators		
G-400RC light/med. duty 11 sq. ft.	242.00	Call \$
G-800SDX med./hvy. duty 20 sq. ft.	300.00	Call \$
G-800S same/G-800SDX w/o presets	322.00	Call \$

ASA ALINCO ASTRON Kantronics MFJ concept MIRAGE/KLM TE SYSTEMS

INSTANT CREDIT WITH ICOM PREFERRED CUSTOMER CARD



FAX 213-390-4393

JUN'S BARGAIN BOX (Limited Quantities)



IC-28H
2 Meter, FM, 45W
Mobile Transceiver

LIST \$499.00 **SALE \$399.95**



IC-228H
2 Meter, FM, 45W
Mobile Transceiver

LIST \$539.00 **SALE \$409.95**

SPECIAL ICOM MONTH LEFT OVER SALE!

SE HABL A ESPAÑOL
FREE U.P.S. CASH ORDER
(MOST ITEMS, MOST PLACES)

(213)390-8003

3919 Sepulveda Blvd.
Culver City, CA 90230

NEW!
The classic "Antenna Bible"
now in a thoroughly-revised, much-enlarged
edition

ANTENNAS

2nd edition
by John Kraus, W8JK
Ohio State University

Covers both theory and its applications to practical systems. With changing formulas, tables and references. Over 1000 illustrations.
Modern, complete, a classic, *Microwave Journal*.
917 pages, hardcover. \$51.95
Add \$2.50 per book for shipping and handling U.S., \$5.00 elsewhere.

CYGNUS-QUASAR BOOKS
P.O. Box 85, Powell, Ohio 43065
Tel. 614-548-7895

TOWERS • TELESCOPING CRANK-UP
• GUYED STACK-UP
by ALUMA • TILT-OVERS

Easy to install. Low Prices. Crank-ups to 100 feet.
Over 36 types aluminum towers made—specials designed and manufactured—write for details.

EXCELLENT FOR AMATEUR COMMUNICATIONS

ALUMA TOWER CO.
BOX 2806HR
VERO BEACH, FL 32961-2806
(407) 567-3423 FAX 407-567-3432

U.S. AMATEUR RADIO MAIL LISTS

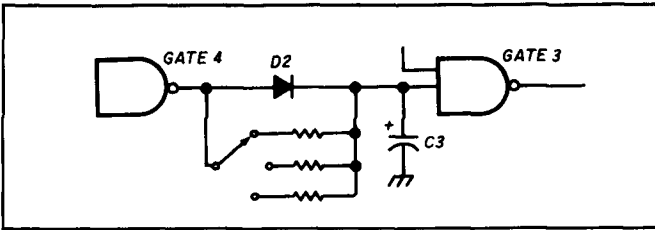
Labels, floppy disks, CD-ROM, mag tape.

- Newly licensed hams
- All upgrades
- Updated each week

BUCKMASTER PUBLISHING
Route 3, Box 56
Mineral, Virginia 23117
703/894-5777 visa/mc 800/282-5628

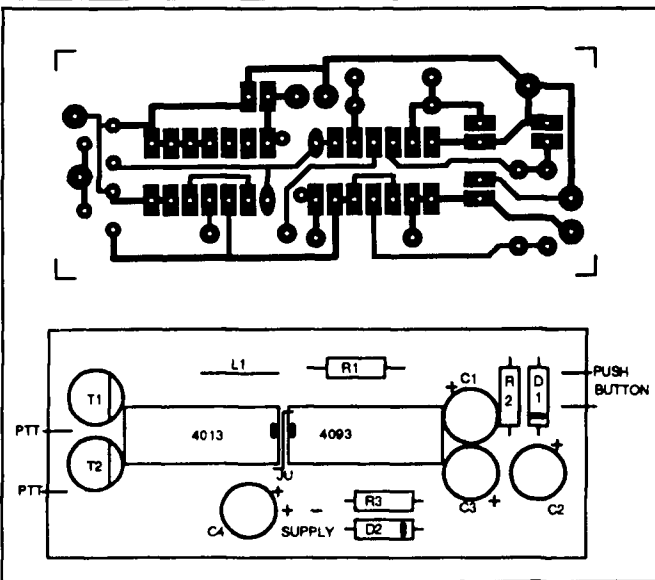
If this time delay is T seconds then the value of timing resistor that you must use for a delay of t seconds is t/T megs. When you have calculated this, replace the 1-meg resistor with the

FIGURE 9



Variable delay option. If R3 is switched it must be switched at the end away from the input to gate 3.

FIGURE 10

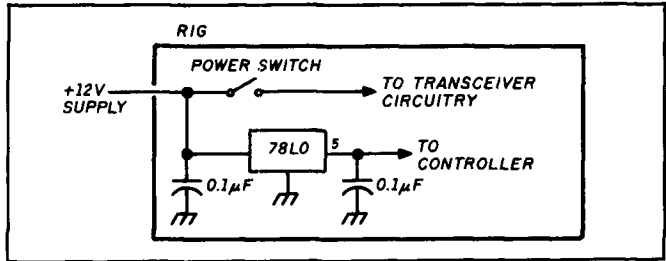


PC board. (A) Foil side. (B) Component placement diagram.

COMPONENT LIST

- Capacitors**
- C1,C2,C4 100 nF (0.1µF) 50 or 63 volt miniature ceramic
- C3 47-µF 10-volt bead tantalum (observe polarity) (if the supply is more the +9 volts use a 16-volt capacitor.)
- Diodes**
- D1,D2 1N914 or 1N4148 or any general purpose silicon diodes
- Integrated circuits**
- IC1 4013 (or CD4013, MC14013, etc.)
- IC2 4093 (or CD4093, MC14093, etc.)
- These are both 4000 series CMOS available from many manufacturers with slightly different letters.
- Resistors**
- R1 100 k
- R2 10 meg
- R3 Several megs (see text)
- All resistors are 1/4 or 1/8 watt 10 percent
- Transistors**
- Q1,Q2 VN10KM or VN10LM (Siliconix) VMOS transistors or any other small N-channel VMOS which can be switched with CMOS/TTL logic)

FIGURE 11



Installing the controller in the rig.

new value and check that it is correct. It is reasonable to find an error of up to 10 percent due to leakage in the capacitor and you may wish to adjust the calculated value to get a more accurate performance (increasing the resistor increases the time delay and vice versa). When you have finished these tests you can build the circuit using the components you have tested.

If you want several different delays you can switch several different values of R3. It is important that the switch is placed at the end of the resistors connected to the output of gate 4 and **on no account** the end connected to the input of gate 3 (Figure 9).

Construction and connection

The circuit is very simple and may be built using almost any construction technique. A circuit board layout and placement diagram are shown in Figure 10; this is by no means necessary. The only important feature of the construction is that leakage currents at the positive terminal of C3 must be avoided.

The circuit and its battery are so small, and need attention so rarely, that they may be mounted almost anywhere. By adding a 75L05 regulator to prevent supply variations, you could mount them inside the rig itself. The power is taken from the unswitched side of the incoming +12 volts DC supply. The circuit timing in this case should be tested at + 5 volts and not with a 9-volt battery (see Figure 11).

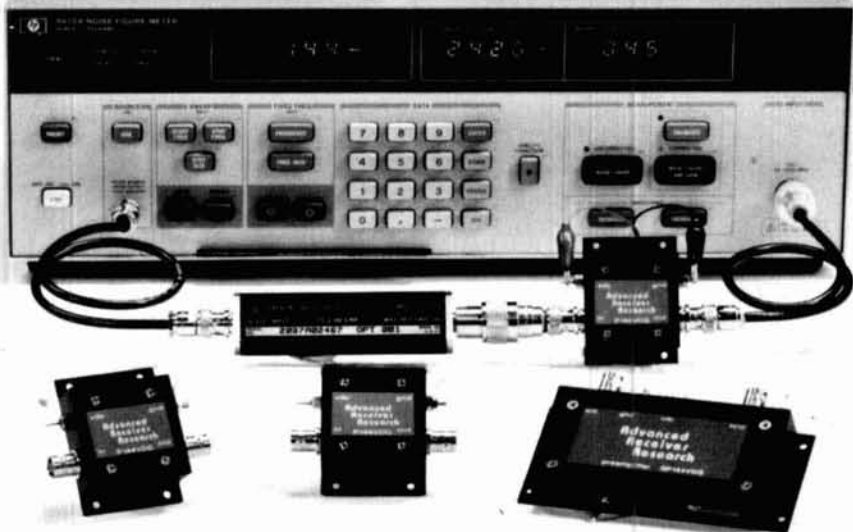
Much more important than the mounting of the circuit is the mounting of the push-button switch S1. I have mounted mine on the transmission tunnel just behind the gear lever. The possibility of a foot-operated switch (to the left of the clutch) has already been mentioned, and many operators have switches on the gear lever itself. Other possibilities include steering column mounted switches (sometimes available from motor accessory shops) or a button on the steering wheel itself, although considerable problems arise from making connections which are not affected by rotation of the wheel.

Conclusion

I have been using this controller for over a year now and find it far more convenient than a VOX. It has proved very reliable in service and a major asset in preventing inadvertent repeater time-outs. [Logo] Reprinted with permission from *Practical Wireless*, July 1989. Ed.

A pc board is available for \$1 75 plus shipping and handling from FAR CIRCUITS, 18N640 Field Court, Dundee, Illinois, 60118 ©James M. Bryant, G4CLF

High Performance vhf/uhf preamps



Receive Only	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
Inline (rf switched)						
SP28VD	28-30	<1.2	15	0	DGFET	\$59.95
SP50VD	50-54	<1.4	15	0	DGFET	\$59.95
SP50VDG	50-54	<0.55	24	+12	GaAsFET	\$109.95
SP144VD	144-148	<1.6	15	0	DGFET	\$59.95
SP144VDA	144-148	<1.1	15	0	DGFET	\$67.95
SP144VDG	144-148	<0.55	24	+12	GaAsFET	\$109.95
SP220VD	220-225	<1.9	15	0	DGFET	\$59.95
SP220VDA	220-225	<1.3	15	0	DGFET	\$67.95
SP220VDG	220-225	<0.55	20	+12	GaAsFET	\$109.95
SP432VD	420-450	<1.9	15	-20	Bipolar	\$62.95
SP432VDA	420-450	<1.2	17	-20	Bipolar	\$79.95
SP432VDG	420-450	<0.55	16	+12	GaAsFET	\$109.95

Every preamplifier is precision aligned on ARR's Hewlett Packard HP8970A/HP346A state-of-the-art noise figure meter. RX only preamplifiers are for receive applications only. Inline preamplifiers are rf switched (for use with transceivers) and handle 25 watts transmitter power. Mount inline preamplifiers between transceiver and power amplifier for high power applications. Other amateur, commercial and special preamplifiers available in the 1-1000 MHz range. Please include \$2 shipping in U.S. and Canada. Connecticut residents add 7-1/2% sales tax. C.O.D. orders add \$2. Air mail to foreign countries add 10%. Order your ARR Rx only or inline preamplifier today and start hearing like never before!

Advanced Receiver Research

Box 1242 • Burlington, CT 06013 • 203 582-9409



✓ 160

VHF COMMUNICATIONS

280 Tiffany Avenue
Jamestown, New York 14701

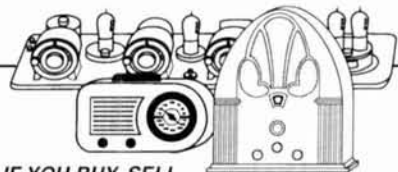
9:00 am - 5:30 pm
weekdays

Weekends and evenings
by appointment.

Western New York's finest... amateur radio dealer!

PH. (716) 664-6345

✓ 161



IF YOU BUY, SELL OR COLLECT OLD RADIOS, YOU NEED...

ANTIQUE RADIO CLASSIFIED

FREE SAMPLE COPY!

Antique Radio's Largest Monthly Magazine Classifieds - Ads for Parts & Services
Articles - Auction Prices-Flea Market Info.
Also: Early TV, Ham Equip., Books, Telegraph, Art Deco, 40's & 50's Radios & more...
Free 20-word ad each month. Don't miss out!

6-Month Trial - \$11.

1-Year: \$20 (\$30 by 1st Class)

Foreign by air - Canada: \$32; Mexico: \$30; Other: \$60.
A.R.C., P.O. Box 802-A5, Carlisle, MA 01741

✓ 159

G5RV MultiBand Antenna

10 thru 160 Meter

Factory Wired & Tested

Introductory Price

\$39.95 Plus \$4 Shipping

Authorized
TenTec
Dealer

K4BWC



Visa & Master Card

OMEGA ELECTRONICS

4209 Live Oak Road
Raleigh, NC 27604
919-832-1025

✓ 158

"ONLINE" U.S. CALL DIRECTORY

Hamcall service gives you all hams via your computer & modem. Updated each month! Only \$29.95 per year. Unlimited use - you pay for phone call.

BUCKMASTER PUBLISHING

Route 3, Box 56
Mineral, Virginia 23117
703/894-5777 visa/mc 800/282-5628

✓ 162

A 2-METER CONVERTER WITH Q MULTIPLIER

Achieve high IMD rejection in dense signal environments

By Norman J. Foot, WA9HUV, 293 East Madison Avenue, Elmhurst, Illinois 60126

My original homebrew 2-meter converter, built in 1984, was designed primarily for reception of weak signals from the Oscar 7 and 10 (and later Oscar 13) Amateur satellites. I used a mast-mounted, low noise 20-dB gain preamplifier to minimize the overall noise figure.

While the loss of the coaxial cable leading into the station was only a few dB, I included an RF amplifier at the converter's input so that future installations could tolerate much higher cable loss without loss of overall sensitivity. Using this converter I made many exciting contacts around the world via Amateur satellites.

2-meter IMD

Lately I've become aware of what at first appeared to be 2-meter repeater signals in the Oscar 13 downlink frequency band. Further investigation showed these to be third-order IMD (intermodulation distortion) products generated inside my converter.

I don't remember encountering IMD interference from 2-meter repeaters until recently. There were probably fewer repeaters four or five years ago. Today, according to a recent repeater directory, there are over 40 repeaters in and around the greater Chicago area. Most of these are within 20 miles of my location.

Figure 1 shows typical 2-meter repeater activity in my region, as viewed on a spectrum analyzer. The repeater density in metropolitan areas like New York or Los Angeles is probably comparable to or greater than that shown in Figure 1.

My converter originally used a 3N201 RF amplifier in the front end, with three high-Q tuned circuits. The gain was quite high and, consequently, IMD was a real problem — despite what would normally be considered reasonably good front end selectivity.

Third-order IMDs are spurious signals generated by non-linear devices. An offending spur is located at a frequency equal to the difference between the second harmonic of one signal and the fundamental of the other. Some of these spurs may fall in the satellite passband. For example, if two repeaters are on at the same time, and one transmits on 146.61 MHz while the other transmits at 146.27 MHz, the third-order interfering signal would appear at 145.93 MHz — inside the Oscar 13 downlink passband.

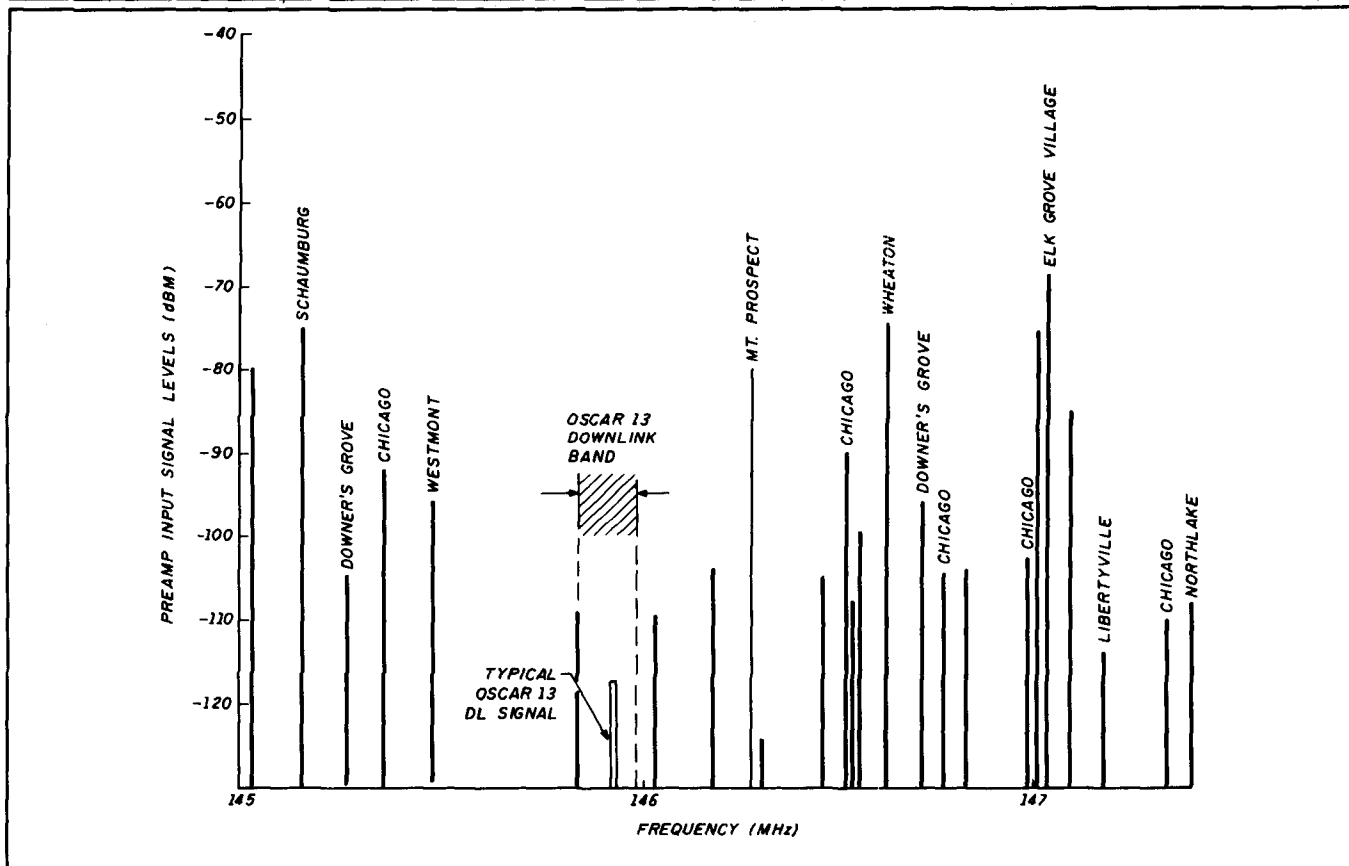
Preamp gain and linearity

A cursory inspection of the repeater frequencies in my area reveals that there are possibly a dozen frequency combinations that can produce IMDs that fall in the 145.825 to 145.975 MHz Oscar 13 downlink passband. These spurs are usually developed in the converter's first mixer. Generally, a preamplifier can handle high amplitude signals without producing significantly strong IMD, but its bandwidth and gain are large. Consequently, it amplifies unwanted (out-of-band) signals and passes them to the nonlinear mixer. My 2-meter preamplifier has 20-dB gain and is very linear, having a two-tone intercept point at about 12 dBm as shown in Figure 2. The possibility that it would cause IMD is remote; however, its bandwidth is very large. (See References 1, 2 and 6 for information regarding the theory of intermodulation distortion.)

Signal analysis

Assume that you have two repeater signals delivered by the downlink antenna, each at -50 dBm levels. They are amplified to -30 dBm by the preamplifier, and possibly to -20 dBm by the converter's RF amplifier. The third-order IMD for this condition was measured on a spectrum analyzer to be 40 dB below either of these signals. This is equivalent to a -90 dBm signal at the antenna, much

FIGURE 1



Typical spectrum of activity. (Downlink antenna at 45 degree elevation.)

stronger than some Oscar 13 downlink signals.

Another factor influencing IMD is downlink antenna directivity. IMD is more noticeable if the satellite is near the horizon, when the downlink antenna may be pointing directly at a repeater.

Once a spurious signal has been generated, no amount of IF selectivity can reduce it. Corrective action boils down to providing the least amount of preamplifier and RF gain consistent with maintaining adequate overall noise figure and minimizing front end bandwidth. It's generally a good idea to retain high preamplifier gain, but minimize RF stage gain. Reducing RF bandwidth is by far the most effective means for reducing IMD signals.

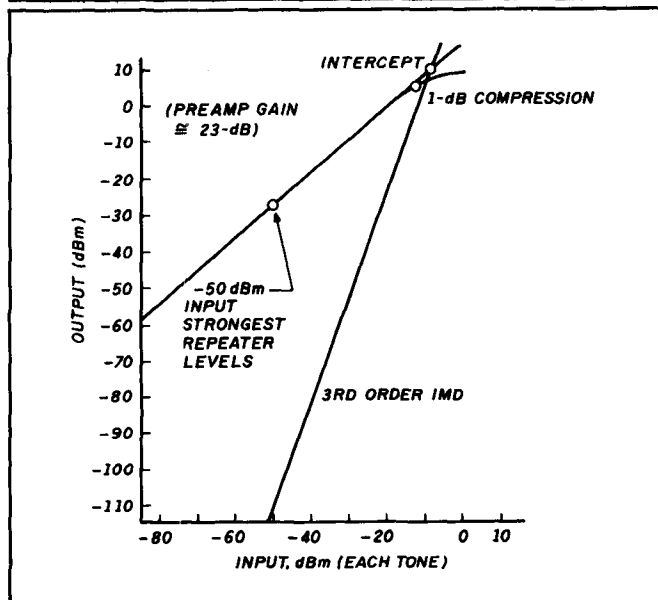
Q multiplier

Recently, I experimented (and had considerable success) with a 2-meter Q multiplier circuit in an attempt to produce an exceptionally narrow RF passband width. By definition, a Q multiplier is a selective amplifier with controlled regeneration. This may sound scary at 145 MHz, but read on.

After having shown by bench tests that repeater or other out-of-band signals could be responsible for IMD interference when given the proper conditions, I decided to build an outboard Q multiplier to perform actual tests using a 2N5486 JFET as the active element.

Preliminary tests showed that the RF bandwidth could be made extremely narrow — almost without limit — up to the point of oscillation. I located the breadboard ahead

FIGURE 2



Preamplifier IMD test.

DX-ing, contests, pile-ups, traffic handling. When you need to command attention, you will with the SB-1000 Linear Amplifier from Heath. And you'll do it for a cost that no one else can match.

From our recent DX-pedition to Taiwan, operators easily controlled pileups with the SB-1000 and nothing more than a dipole antenna. This means that when conditions are tough, you know you can depend on your SB-1000 to lift your signal above the rest. Whether you're using a dipole or stacked monoband beams.

Proven output power

We don't play games by using old rating methods to make you pay for input power you don't get at the antenna. What you do get is 1000 watt output of peak

envelope power on SSB and 850 watts on CW. Even 500 watt output on RTTY.

On the chance that someone might doubt our claims, at hamfests we demonstrate that with only 80 to 100 watts of drive, our SB-1000 develops more output than even the world-famous Heath SB-220!

Designed for today, the SB-1000 offers quiet, compact tabletop operation at rated output. That's only 1.7dB (or about 1/3 of an S-unit) below

the maximum legal power limit.

"I built it myself!"

Because you build the Heathkit SB-1000 Linear Amplifier yourself, you not only enjoy cost savings, you have the unique opportunity of knowing your equipment inside and out.

A top quality amplifier, cost savings, bragging rights, plus industry-recognized Heathkit manuals and technical assistance from our licensed ham consultants, should you ever need it. An offer that's hard to pass up.

See the SB-1000 and our complete line of amateur radio products in the Spring Heathkit Catalog. Call today for your free copy.

1-800-44-HEATH
(1-800-444-3284)

Best to start with.
Best to stay with.

Heath Company

Benton Harbor, Michigan 49022

Top
performance
for less than
80 cents
a watt

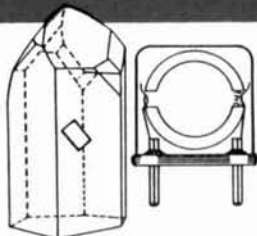


© 1989, Heath Company.
Heathkit is a registered
trademark of Heath Company.
A subsidiary of Zenith
Electronics Corporation.

When performance & price really count...



Reliability & Quality
From Start To Finished Product



**QUARTZ
CRYSTALS/OSCILLATORS FOR
ELECTRONIC — INDUSTRIAL**

- Micro-Processor Control
- Computers/Modems
- Test/Measurement
- Medical

COMMUNICATIONS — REPLACEMENT

- Mobile/2-way/Channel Elements
- Pagers
- Marine
- Aircraft
- Telemetry
- Monitors/Scanners

AMATEURS

- CB
- Hobbist
- Experimenter

**COST EFFECTIVE
MODERATE PRICING
FAST DELIVERY**



The Pulse of Dependable Communications

Crystek offers their new 16 page FREE catalog of crystals and oscillators. Offering state-of-the-art crystal components manufactured by the latest automated technology. Custom designed or "off the shelf," Crystek meets the need, worldwide. Write or call today!

CRYSTEK CORPORATION
DIVISION OF WHITEHALL CORPORATION

2351/2371 Crystal Dr. • Ft. Myers, FL 33907
P.O. Box 06135 • Ft. Myers, FL 33906-6135
TOLL FREE 1-800-237-3061
(813) 936-2109



**Measure Up With Coaxial Dynamics Model
83000A RF Peak Reading Wattmeter**

Take a PEAK with Coaxial Dynamics "NEW" Model 83000A, designed to measure both FWD/RFL power in CW and FM systems simply and quickly. Then with a "FLIP" of a switch, measure "PEAK POWER" in most AM, SSB or pulse systems. Our Model 83000A features a complete selection of plug-in-elements plus a 2 year warranty. This makes the Model 83000A an investment worth looking at. So go ahead, take a "PEAK", you'll like "WATT" you see!

Contact us for your nearest authorized Coaxial Dynamics representative or distributor in our world-wide sales network.



**COAXIAL
DYNAMICS,
INC.**

15210 Industrial Parkway
Cleveland, Ohio 44135
216-267-2233
1-800-COAXIAL
Telex 98-0630

Service and Dependability... a Part of Every Product
See us at Dayton Booths #400-401



✓ 156

NEMAL ELECTRONICS

- Complete Cable Assembly facilities MIL-STD-45208
- Commercial Accounts welcome- Quantity pricing • Same day shipping most orders
- Factory authorized distributor for Alpha, Amphenol, Belden, Kings, Times Fiber

Call NEMAL for computer cable, CATV cable, Flat cable, semi-rigid cable, telephone cable, crimping tools, D-sub connectors, heat shrink, cable ties, high voltage connectors.

HARDLINE 50 OHM

FXA12 1/2" Aluminum Black Jacket.....	89/ft
FLC12 1/2" Cablewave corr. copper blk jkt	1.69/ft
FLC78 7/8" Cablewave corr.copper blk jkt	4.25/ft
NM12CC N conn 1/2" corr copper m/1	25.00
NM78CC N conn 7/8" corr copper m/1	54.00

COAXIAL CABLES (per ft)

1180 BELDEN 9913 very low loss	55
1102 RG8/U 95% shield low loss foam 11ga.....	36
1110 RG8X 95% shield (mini B)	17
1130 RG213/U 95% shield mil spec MCV jkt.....	39
1140 RG214/U dbl silver shld mil spec.....	1.85
1705 RG142B/U dbl silver shld, teflon ins	1.50
1310 RG217/U 50 ohm 5000 watt dbl shld98
1450 RG174/U 50 ohm .100" od mil spec	14

ROTOR CABLE-8 CONDUCTOR

8C1822 2-18ga and 6-22ga	25
8C1820 2-18ga and 6-20ga	39

CONNECTORS-MADE IN USA

NE720 Type N plug for Belden 9913	\$3.95
NE723 Type N jack for Belden 9913.....	4.95
PL259AM Amphenol PL25989
PL259TS PL259 teflon ins/silver plated.....	1.59
PL258AM Amphenol female-female (barrel).....	1.65
UG175/UG176 reducer for RG58/59 (specify).....	.22
UG21DS N plug for RG8,213,214 Silver.....	3.35
UG83B N jack to PL259 adapter, teflon	6.50
UG146A SO239 to N plug adapter, teflon	6.50
UG255 SO239 to BNC plug adapter, Amphenol.....	4.29
SO239AM UHF chassis mt receptacle,Amphenol.....	.89
UG88C BNC plug RG58, 223, 142	1.45

GROUND STRAP-GROUND WIRE (per ft)

GS38 3/8" tinned copper braid	40
GS12 1/2" tinned copper braid	50
GS200 1-1/2" heavy tinned copper braid	2.00
HW06 6ga insulated stranded wire39
AW14 14ga stranded Antenna wire CCS14

Prices do not include shipping, \$3 minimum, Visa/Mastercard \$30 min, COD add \$3.00
Call or write for complete price list. NEMAL's new 40 page CABLE AND CONNECTOR SELECTION GUIDE is available at no charge with orders of \$50 or more, or at a cost of \$4 with credit against next qualifying order.

NEMAL ELECTRONICS, INC. 12240 NE 14th Ave. N. Miami, FL 33161
(305) 893-3924 Telex 6975377 24hr FAX (305)895-8178

PARTS LIST

Capacitors

C1	10-pF dip mica
C2,C5,C10	8-pF dip mica
C3,C6,C11	1 to 12-pF glass piston
C4	<i>gimmick (see text)</i>
C7	1000-pF disc
C8	0.01- μ F disc
C9	39-pF dip mica
C12	0.1- μ F disc
C13	5-pF dip mica
C14,C16	33-pF dip mica
C15	<i>gimmick (see text)</i>
C17	68-pF dip mica
C18	10-pF dip mica
C19	27-pF dip mica
C20	0.001- μ F disc
C21,C22,	
C23	1500-pF feedthrough caps

Resistors

R1	300 ohm 1 watt
R2	560 ohm 1/4 watt
R3,R5	22 ohm 1/8 watt, 5 percent
R4	51 ohm 1/8 watt, 5 percent
R6,R8	10 ohm 1/8 watt, 5 percent
R7	130 ohm 1/8 watt, 5 percent
R9	47 k 1/4 watt, 5 percent
R10	270 ohm 1/4 watt, 5 percent
R11	10-k pot (preferably ten-turn)

Miscellaneous

Q1,Q2	2N5486
L1,L5	2.2- μ H rfc
L2,L3,L6	six-turns no. 16 tinned busbar, 1/8-inch ID soldered to glass piston trimmers
L4	neutralizing coil (see text)
L7,L8	thirteen turns no. 28 enamel copper magnet wire on 1/4-inch OD ceramic Cambion coil forms, close spaced
L9	five turns no. 22 enameled copper magnet wire on 3/16-inch OD Cambion ceramic form
L10	0.33- μ H rfc
X1	117-MHz 5th or 7th overtone crystal
FB1	ferrite bead, Fairite FB-101
J1,J2	BNC connector, UG1094 or equivalent
SRA-1	double-balanced mixer

of my converter, adding an RF attenuator pad at its output to limit overall gain. After I added a potentiometer to control bandwidth, it was obvious that the Q multiplier had indeed reduced the levels of the offending spurious signals. Except under unusual circumstances, the IMD was for all practical purposes eliminated. My next step was to modify the converter to include the Q multiplier in place of the original RF stage.

The converter

Figure 3 shows the overall 145-MHz converter including the Q multiplier, crystal oscillator, mixer, and IF amplifier. The Q multiplier is a variable gain, variable bandwidth RF amplifier. It drives a double-balanced mixer (DBM) through a 9-dB pad. A local oscillator (LO) signal is fed to the DBM through a 3-dB pad from crystal oscillator Q2. The 28-MHz IF output signal is the difference between the 145-MHz signal frequency and the LO frequency. A double-tuned 28-MHz filter feeds the IF output to J2. The converter will provide 144 MHz at an IF of 28 MHz using a 116-MHz crystal. If the converter is dedicated to Oscar 10 and 13 use only, a 117-MHz crystal is recommended; it will produce an IF of 28.825 to 28.975 MHz. Note that the decimal digits of 28 MHz then correspond to the 145-MHz decimal digits, enabling quick determination of the actual downlink fre-

AMATEUR TELEVISION

SMILE! YOU'RE ON TV



Only
\$329

Designed and built in the USA
Value + Quality from over 25 years in ATV...W6ORG

With our all in one box TC70-1, 70cm ATV Transceiver, you can easily transmit and receive live action color and sound video just like broadcast TV. Use any home TV camera or VCR by plugging the composite video and audio into the front VHS 10 pin or rear phono jacks. Add 70cm antenna, coax, 13.8 Vdc and TV set and you are on the air...it's that easy! TC70-1 has >1 watt p.e.p. with one xtal on 439.25, 434.0 or 426.25 MHz & properly matches Mirage D15, D24, D100 amps for 15, 50, or 70 watts. Hot GaAsfet downconverter varicap tunes whole 420-450 MHz band to your TV ch3. Shielded cabinet 7x7x2.5". Req. 13.8 VDC @ .5A Transmitters sold only to licensed amateurs, for legal purposes, verified in the latest Callbook or send copy of new license. Call or write now for our complete ATV catalog including downconverters, transmitters, linear amps, and antennas for the 70, 33, & 23cm bands.

(818) 447-4565 m-f 8am-5:30pm pst.

Visa, MC, COD

P.C. ELECTRONICS

Tom (W6ORG)

2522 Paxson Ln Arcadia CA 91006

Maryann (WB6YSS)

✓ 155

Look at our MOBILE MARK™

"ON WINDOW" Line

VHF (140-175)

- No Hole
- Easy to Mount
- Rugged
- Superior Performance
- Radiator Snaps On and Off
- Competitively Priced

UHF (420-520)

- 3 db gain
- No Hole
- Easy to Mount
- Rugged
- Superior Performance
- Radiator Snaps On and Off
- Competitively Priced



MODEL OW 3-150
140-174 MHz
MODEL OW 3-220
210-250 MHz

- 3 db gain
- No Hole
- Easy to Mount
- Rugged
- Superior Performance
- Swivel Vertical Adjustment
- Radiator Removal Without Loss of Vertical Adjustment
- Competitively Priced



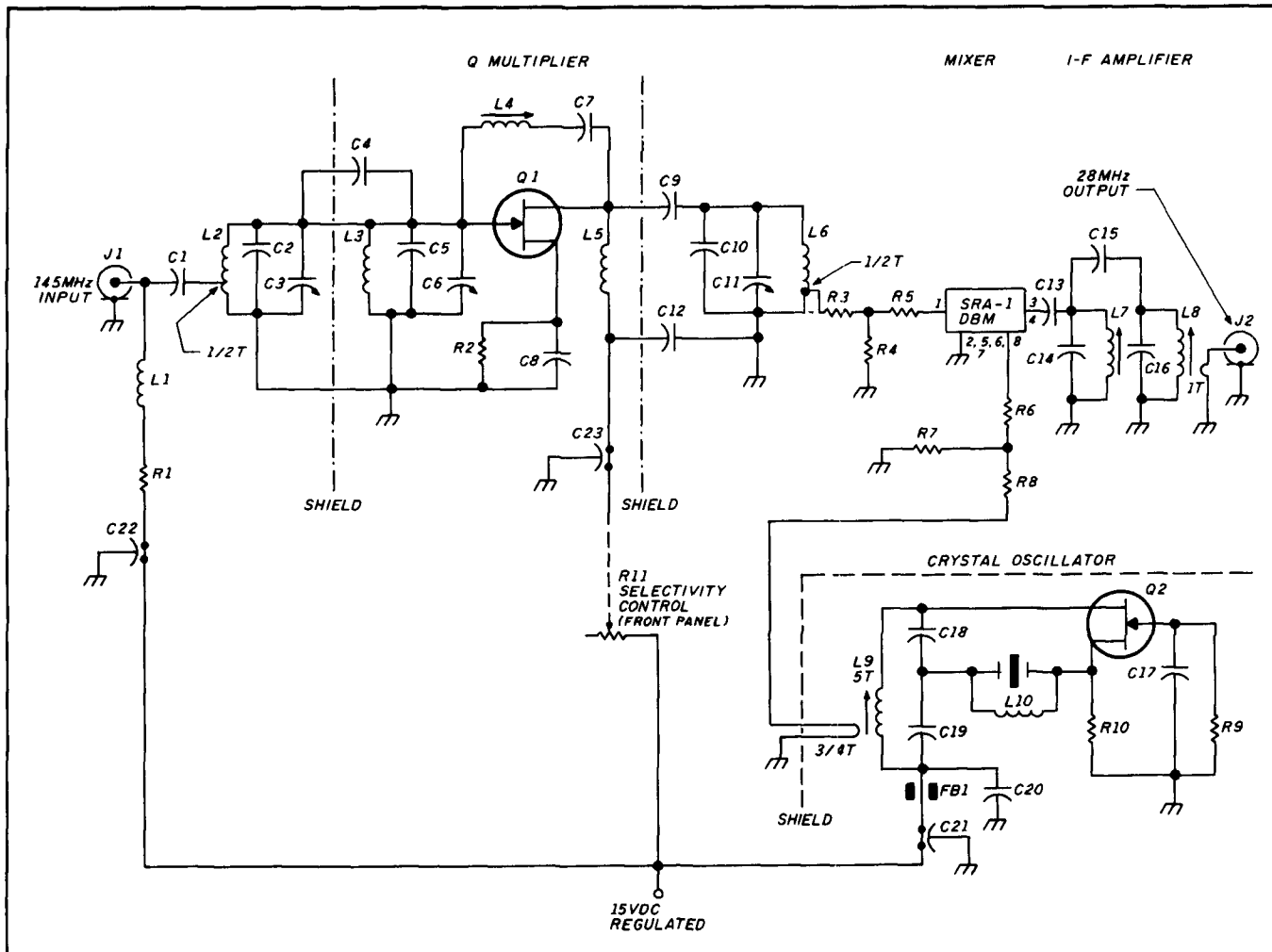
MOBILE MARK™, INC.
COMMUNICATIONS ANTENNAS

3900-B River Road
Schiller Park, IL 60176
312-671-6690



brings imagination and innovation to antennas and has been since 1948 !!

FIGURE 3



Oscar 13 converter.

quency. That is, when the receiver is tuned to a downlink signal at 28.825 MHz, the actual downlink frequency is 145.825 MHz.

The neutralizing circuit consists of variable inductance L4, which tunes out the capacitive reactance of the gate-to-drain capacitance (including strays), as described in **References 3 and 4**. This capacitance totals about 1 pF, depending on the circuit layout. At 145.9 MHz, an inductance of about 1.2 μ H will resonate with this capacitance and stabilize the amplifier. Without this neutralization, the FET will probably oscillate, depending on the loaded Qs of the input and output tuned circuits and input-to-output shielding. To make L4, I wound 18 turns of no. 28 enamel copper wire spaced one wire diameter on a 0.2" diameter fiber glass tube 0.75" long.⁵ The tube was fitted with a low permeability, powdered iron slug for adjustment. I painted the outside of the coil with a thin coat of 5-minute two-part epoxy cement. Although the epoxy sets quickly, it takes several days or more to cure thoroughly.

The mast-mounted low noise preamplifier that precedes the converter is powered by 15 volts DC, which is fed over the center conductor of the interconnecting coaxial cable for remote preamplifier operation. R1 is a 300-ohm 1-watt

limiting resistor, used to avoid a catastrophic failure in the event the cable center conductor should short to ground.

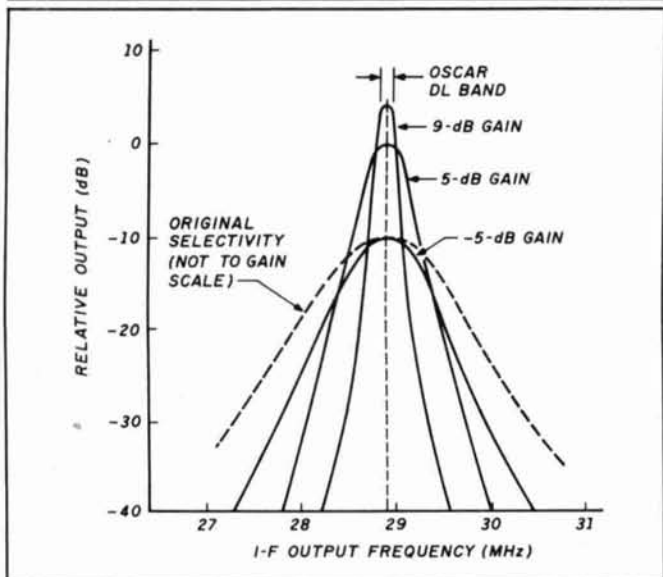
Capacitors C3, C6, and C11 are piston trimmers with the six-turn coils soldered to them directly with short leads. C4 is a fractional pF coupling capacitance made by soldering a short piece of no. 16 copper busbar to the high side of one coil and placing the other side against the high side of the other coil. A piece of Teflon™ sleeving prevents a short.

Gain and bandwidth

The Q multiplier bandwidth is controlled by potentiometer R11 located on the front panel of the receiver. Converter gain varies with the setting of this control and is highest when the bandwidth is narrowest. When the satellite is at apogee (maximum range), I adjust the control for minimum bandwidth (maximum gain). Signal levels are often very high when the satellite approaches perigee, so I increase the bandwidth. This, in turn, decreases signal levels at the mixer. Gain and bandwidth tend to compensate in terms of minimizing spurious signals.

Capacitor C15 is a special handmade capacitor which couples the two tuned circuits at the mixer output. It's made

FIGURE 4



Converter gain and bandwidth.

of two pieces of enamel-coated no. 22 copper wire fed inside a Teflon sleeve and overlapped about 3/8 inch. The far side of each wire is soldered to the high side of the respective coils.

Q multiplier adjustment


With the bandwidth control one turn less than fully clockwise, adjust the L4 tuning slug to a point just below oscillation. In the process, synchronously tune L2, L3, and L6 for maximum gain. Once set, the slug need not be readjusted. To check for proper setting, advance the bandwidth control fully clockwise and note that the amplifier oscillates.

Bandwidth

Figure 4 illustrates the RF bandwidth of the converter for various settings of the selectivity control, in terms of overall converter gain. The narrowest useful bandwidth is less than 200 kHz, corresponding to an overall converter gain of 9 dB. This setting provides maximum skirt steepness, which gives maximum protection from out-of-band signals. If the bandwidth control is advanced still further, the RF stage will oscillate. This is indicated by receiver quieting. Selecting the narrowest possible bandwidth requires knowledge of the control setting where oscillation starts. To facilitate smooth control, I use a ten-turn Bourns potentiometer. Note the dashed curve in Figure 4 which shows the bandwidth of the original converter for comparison.

Q multiplier benefits

It's clear from this set of curves that the Q multiplier is effective in terms of reducing and controlling front end bandwidth. Since I modified my converter to include the Q multiplier described here, I hear IMD developed in my converter from unwanted signals only on rare occasions and under unusual conditions. In addition, the bandwidth control is a handy means of setting gain to compensate for close-in and far-out satellite conditions.

My current interest is satellite communications, but the converter I've described may also be useful for 2-meter point-to-point communications, or whenever a dense RF environment may cause IMD interference. With the IMD problem now under control, I'm getting a lot more fun out of my satellite communications equipment. 

REFERENCES

1. Joe Reiser, W1JR, "VHF/UHF World," *Ham Radio*, November 1984, pages 97-105.
2. Franz C. McVay, "Don't Guess the Spurious Level," *Electronic Design* 3, February 1, 1967.
3. Jim Fisk, W1DTY, "FET Preamp for 432 MHz," *Ham Radio*, August 1969, page 66.
4. Ernest A. Franke, WA4WDK, "Neutralizing Small-Signal Amplifiers," *Ham Radio*, September 1970, page 40.
5. F.E. Terman, *Radio Engineers' Handbook*, First Edition, 1943, McGraw-Hill, page 55.
6. *RF/IF Signal Processing Handbook*, Vol. 1, 1985/6, Section 2, page 11, Mini-Circuits, P.O. Box 166, Brooklyn, New York.

Electronic Repair Center

Servicing

Amateur Commercial Radio

The most complete repair facility on the East Coast.

Large parts inventory and factory authorized warranty service for Kenwood, Icom and Yaesu.

SEND US YOUR PROBLEMS

Servicing "Hams" for 30 years, no rig too old or new for us.

HAMTRONICS, INC.

4033 Brownsville Road

Treose, Pa. 19047

215-357-1400



PC Slow Scan \$149.95

A complete slow scan television station for your IBM PC or compatible. Send and receive images in up to 10 shades of gray depending upon your graphics card and printer.

Includes:

Demodulator Modulator 75 Page Manual
Software Tutorial Cassette

Requires:

Ham transceiver PC with 640K Parallel Port
Graphics Card Tape Recorder Serial port

Slow Scan Formats: 8,12,17,23,34,36,48,72 sec.



Software Systems Consulting
1303 S. Ola Vista
San Clemente, CA 92672
(714) 498-5784

SYNTHESIZED SIGNAL GENERATOR

MADE IN USA



MODEL
SG-100F
\$429.95
delivered

- Covers 100 MHz to 199.999 MHz in 1 kHz steps with thumbwheel dial
- Accuracy +/- 1 part per 10 million at all frequencies
- Internal FM adjustable from 0 to 100 kHz at a 1 kHz rate
- External FM input accepts tones or voice
- Spurs and noise at least 60 dB below carrier
- Output adjustable from 5-500 mV at 50 Ohms
- Operates on 12 Vdc @ 1/2 Amp
- Available for immediate delivery • \$429.95 delivered
- Add-on accessories available to extend freq range, add infinite resolution, AM, and a precision 120 dB attenuator
- Call or write for details • Phone in your order for fast COD shipment.

VANGUARD LABS

196-23 Jamaica Ave., Hollis, NY 11423
Phone: (718) 468-2720 Mon. thru Thu.

Ham Notebook



A Low Cost Battery Pack For Your Kenwood TH-25AT Handheld

I have a TH-25AT that I use for extended periods of time. Consequently, I need batteries with longevity. I looked into different batteries and discovered Kenwood's PB-7, an 1100 mAh. The capacity looked right, but the PB-7 was too large for my pocket. I continued my search and found the BT-6 empty battery case for \$15.95. I added six 600-mAh NiCd batteries at \$2.25 each.* My homebrew battery pack has the same capacity and is the same size as the PB-6 battery supplied with the HT and cost me just \$29.95.

I used the BT-6 and PB-6 batteries for about a week and found they worked well. However, I had to remove the six batteries from the BT-6 battery case every evening and charge them in my NiCd charger overnight for the next day's use.

I needed an easy way to charge the batteries without removing them from the case, but the Kenwood-supplied BC-9 charger wouldn't slide onto the BT-6 case. I compared the BT-6 case and the PB-6 battery pack and found that the rail on the case next to the + terminal was longer. Using an X-Acto™ knife, I trimmed 0.28 inches to match the rail on the BP-6 battery pack. After I made this modification the BC-9 charger slid on, and I was set for a 15-hour charge without removing the batteries.

Those with a BC-11 charger who'd like to leave the batteries installed in the BT-6 case while charging can try a different modification. Just add two 0.25-inch square copper pads to the back of the case to mate with the contacts in the BC-11 rapid charger.

Modifying the BT-6

Remove the batteries and lay both packs back side up on your worktable. Cut two 0.25-inch square copper pads, smooth the edges with a file, and lay them on the back of the BT-6 case matching the location of the pads on the PB-6 battery. Mark their location and remove the pads. Drill two small holes in the center of the marked area using a bit no larger than no. 22 wire. Next use a no. 10 drill bit to countersink the holes on the outside of the case. Do this by hand only.

Take some no. 22 stranded wire, strip the ends of two wires a small amount, fan out the strands butting them against the center of the copper pads, and solder. Don't let the solder build up. The pads must fit flush to the back of the case. To check your work, pull the wire through the drilled holes to see if the solder area is too large. If it is, you may have to enlarge the countersink a small amount or reduce the solder area. When everything looks right, bond the pads to the case with a small amount of Krazy Glue™. Make sure the glue is dry before going on to the next step.

Route the wires inside the case to the terminals on the pads on top of the case. *Make sure* you are routing the wire from the *positive pad* to the *positive terminal* and the *negative wire* to the *negative terminal*.

Check with a continuity meter to see that the positive lead goes to the positive terminal and the negative lead goes to the negative terminal. After you've confirmed this, install the batteries as marked in the case. Now close the case, being careful not to

pinch the wires. Using a voltmeter, make sure that the right pad is positive and the left pad is negative.

These modifications will let you charge your BT-6 battery pack in 15 hours with the BC-9 wall charger or 45 minutes using the BC-11 rapid charger. I've had this battery and charging system for the last seven months. I find it works very well and meets my needs for a second battery with a compatible charging system for the new Kenwood TH-25AT handheld.

T. H. Jenson, KE6WF

Control by Tones

The use of control tones in Amateur Radio is increasing. Although there are many different tone schemes, there are three systems in common use for Amateur Radio. They are: tone burst, Dual Tone Multi-Frequency, and Continuous Tone Controlled Squelch System (CTCSS).

Tone burst

Tone burst is usually a single burst of 1750 Hz at the beginning of a transmission. It is used extensively in Europe to access repeaters. Although fitted to some VHF equipment, it is not used in New Zealand.

DTMF

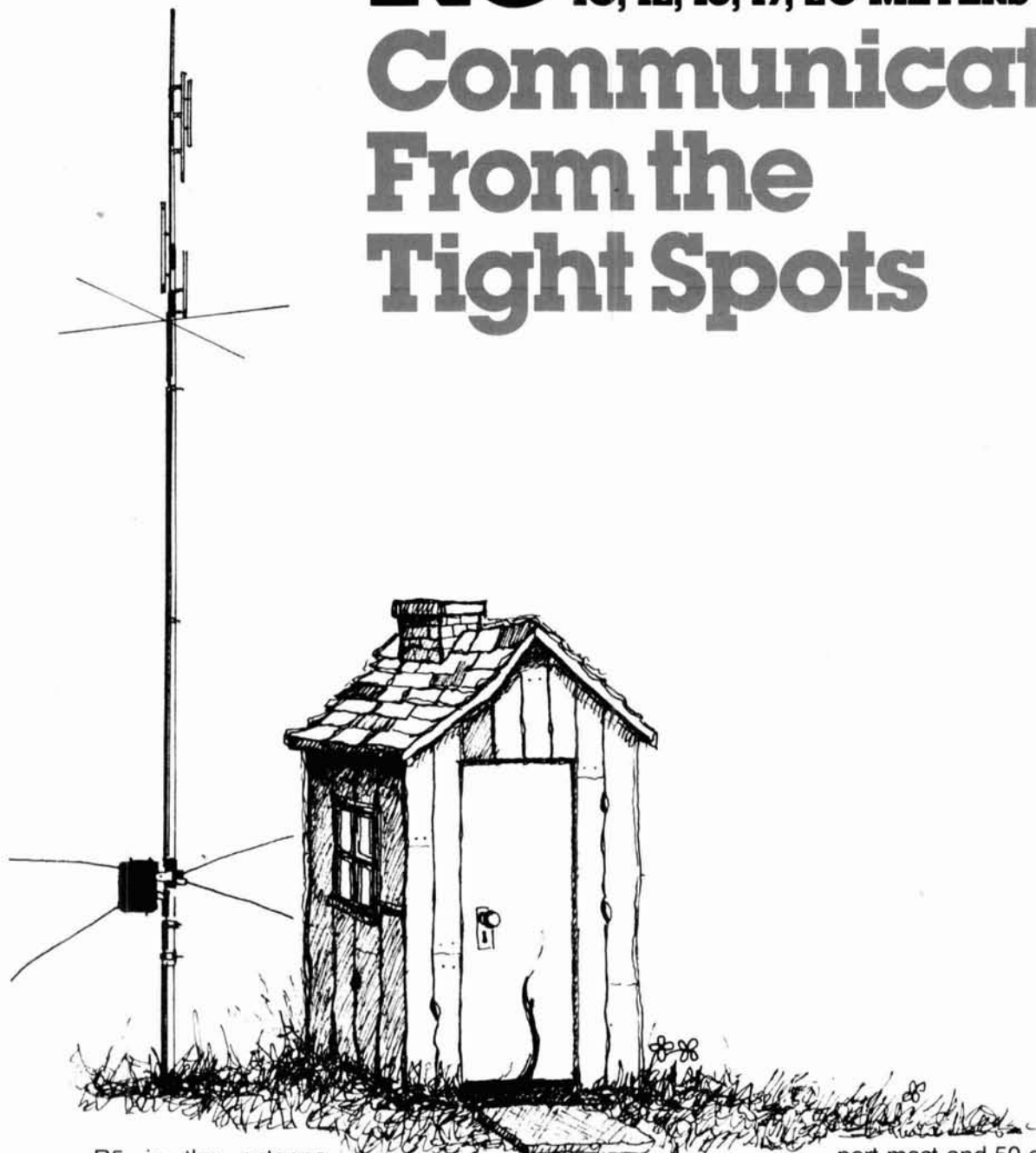
Also known in the United States as Touch Tone®, it is the system used with the push button telephones. These phones have oscillators to generate a pair of tones for each number on the key pad. The standards and available integrated circuits were developed originally for the telephone service. Now the technique is being used widely in Amateur Radio gear to enable operators to control intelligent repeater systems.

A bit of consideration is needed for fellow operators when using DTMF. It

*The 600-mAh batteries can be ordered for \$2.25 each from E.H. Yost and Company, 7344 Tetiva Road, Sauk City, Wisconsin 53583.

R5 10, 12, 15, 17, 20 METERS

Communicate From the Tight Spots



R5 is the antenna designed for space age living, on small city lots, apartments, condominiums or for travel in motor homes. If you have limited space, or galaxies of space, R5 will give the most performance from your transceiver.

R5 electrical halfwave, only 16' 4" tall design allows the antenna to be mounted virtually

anywhere, without compromising performance. It easily handles 1800 watts of power with a solid state matching network giving full band coverage of 10-12-15-17-20 meters.

Easy set-up makes this antenna ideal for portable or fixed installations. It performs without a rotator, or tower. A simple sup-

port mast and 50 ohm cable is your connection to ham friends around the world.



**AVAILABLE THROUGH DEALERS
WORLDWIDE**

48 Perimeter Rd. P.O. Box 4680
Manchester, N.H. USA 03108
Tel. 603-627-7877 Telex 4949472
Fax 603-627-1764

is important to use your callsign and to comply with the radio regulations. It also helps other stations if you outline your intentions. In Wellington I use the following procedure to ask the Belmont 710 repeater for a report on my signal:

1. I dial up the 710 repeater in the normal way.
2. I say, "This is ZL2SX seeking a signal report."
3. I keep transmitting and, using the key pad, I dial 7 1 0 #. Then, without releasing the mic button, I say, "This is ZL2SX testing."
4. Finally, I let the button go and listen for the report.

As repeater systems become more intelligent, the use of DTMF signaling will enable us to "command" the system to do all sorts of fancy and useful tricks. DTMF commands will be used extensively on the National Link to be installed soon.

Dual Tone Multi-Frequency (DTMF) Standard

Frequencies: 697, 770, 852, 941, 1209, 1336, 1477, and 1633 Hz.

Tolerance: Nominal frequency ± 1.5 percent.

Twist: All tones to be within ± 3 dB of each other before transmitter pre-emphasis.

Deviation: The deviation of the 697-Hz tone will be 1.2 Hz.

Amplitude Range: The decoder will operate with tones +2 dB and -10 dB from nominal deviation.

The tones 697 to 941 are called the "low" tones and represent the rows of the keyboard from the top down. The "high" tones represent the keyboard columns from left (1209) to right. As an example, when you push the "8" key an 852-Hz tone and a 1336-Hz tone are sent together, ideally at the same level. Most Amateur Radio key pads have the 1633-Hz column tone needed for the full set of 16 digits (0-9,*,#, A,B,C,D). Most telephones have only 12 key pads, as A,B,C,D have no functions in telephone systems.

Note that the DTMF signals will pass through the link and most repeaters without serious distortion. However, in some applications, DTMF signals may be locally regenerated.

CTCSS

This is known by various trade names: Private Line, Channel Guard, Selectone, and others. With this sys-

tem, the receiver's squelch circuit disables the audio output until the specified subaudible tone is received. This means that your receiver will be quiet until it hears a call from a station using the system. There are 38 standard subaudible tones; encoders and decoders are available for most Amateur VHF and UHF sets. The Wellington VHF Group has been selling units for \$35.

I use this system when I am expecting a call from my wife. Our rigs use the same CTCSS sub tone, and transmit it whenever the rigs are keyed. If we want to monitor for a call from each other but would rather not be distracted by other repeater users, we engage the CTCSS decoder and the radio is quiet until it hears the correct sub tone. It is a very effective system. There are restrictions on some of the tones, as not all repeaters are capable of retransmitting low frequencies.

Continuous Tone Controlled Squelch System Standard

Frequencies: Only EIA Standard tones recommended.

Tolerance: Encoder: nominal frequency ± 0.1 percent.

Decoder: ± 1 percent.

Deviation: 0.5 kHz.

Amplitude Range: The decoder will operate with tones +2 dB and -10 dB from the nominal deviation.

Response Time: For frequencies less than 100 Hz, 350 ms maximum. For frequencies above 100 Hz, 200 ms maximum.

Talk-off: Greater than 20 dB, 300 Hz to 3.4 kHz.

CTCSS may be required for some linking applications. However, the digital voice circuits used in link are designed to notch (more than 10-dB attenuation) tone frequencies up to 100 Hz. It is recommended that tones between 67.0 Hz and 85.4 Hz be used where CTCSS is used for control at a link end. Where users wish to use CTCSS for selective calling, tones between 123.0 and 250.3 Hz are recommended.

An understanding of the various tone control systems has given me more enjoyment in this great hobby of ours. I hope it does the same for you.

David Andrews, ZL2SX

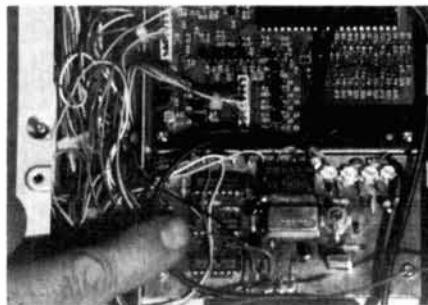
Reprinted with permission from the January/February 1987 issue of *BREAK-IN* magazine. Ed.

HF Add-on For ICOM IC-R7000 receiver

If you own an ICOM IC-R7000, or are thinking about getting one, consider this modification. A.R.E. Communications Ltd, of London, England, manufactures a board that can be installed in the ICOM IC-R7000 to add HF band receive capability. The board also adds 99 HF memory channels.

The HF kit contains a pc board with components, sixteen wires of various colors and lengths, three sections of coaxial cable, mounting screws, wire wraps, and detailed instructions. The instructions are clear and contain numerous well-labeled photos and diagrams.

The pc board mounts firmly to a spot which ICOM provided for placement of one of their accessories. Placing your A.R.E. board here ensures that it will be mechanically secure and electrically sound. It's important to follow the instructions step by step. Even though you install just sixteen wires between the board and the receiver, those connections are made all over the interior of a radio stuffed with components. I persuaded my friend Jay to modify his IC-R7000. Three and 1/2 hours later we had the modification in place and were ready to give the radio the "smoke" test.



Jay and I already knew the 7000 provided good reception on the VHF/UHF bands. After a quick check to be sure those bands were unaffected by the changes, we focused our test on the HF bands. The dimmer switch that used to control the brightness of the display now served as the toggle between VHF/UHF and HF receive capability. The instructions suggested that we use the first 30 memories on HF to store frequencies from 1 MHz to 30 MHz in one 1 MHz steps.

We made our unscientific HF evaluation by comparing the modified ICOM 7000 with a stock Collins KWM-380. Whenever we found an active frequency on the Collins, we could pick it up on the ICOM with similar signal strengths. Jay now has an all-mode receiver that can literally go from DC to 2 GHz for a cost of just \$149 — truly a good investment.

The IC-R7000 HF kit is available from A.R.E. Communications, Ltd., 6 Royal Parade, Hanger Lane, Ealing, London W5A 1ET England. Telephone 01-997-4476 or FAX 01-997-2565.

de N1GCF

Circle #301 on Reader Service Card.

FAMOUS EQUIPMENT OF YESTERYEAR

The Hallicrafters' Sky Buddy, Sky Champion, and Sky Rider Defiant

By John Nagle, K4KJ, 12330 Lawyers Road, Herndon, Virginia 22071



Times have changed! Today when an Amateur wants to buy a new receiver, he begins by reading the specifications. Cost isn't a critical factor most of the time. But it wasn't always that way.

Note the prices as you browse through this issue of *Ham Radio*; numbers between \$1000 and \$2000 are common. Even the used equipment advertised in *HR*'s "Flea Market" has comparable prices. The present generation takes these numbers in stride; however, we members of the older generation are amazed. Many of us remember a time when we had trouble finding \$29.50 to buy a Sky Buddy. What changes there have been in 50 years!

In the first days of store-bought equipment — during the Depression in the early 1930s — you usually started by reading the price list. A fellow knew how much money he had in his wallet, and that was his limit.

The Hallicrafters Company built its reputation offering affordable receivers for the Depression trade. The receivers may not have been the highest performance type available, but they did provide a lot of signal for the money. Many Amateurs, who might not have had a chance to get on the air, had the opportunity with a Hallicrafter.

I'd like to tell you about three Hallicrafters receivers that were popular among Amateurs of the day because of their low cost and correspondingly good performance.

The Sky Buddy

Amateurs remember different pieces of equipment for different reasons. Some remember the performance, while others remember unusual operating features. Some equipment may be especially treasured because it was used in a first QSO, or because the operator could afford to buy it and (as a result) get on the air.

The Sky Buddy, which went for \$29.50, is remembered fondly because it was a good "buddy" to many aspiring Amateurs — especially to those teenagers who bought it

during the Depression. Not many Amateurs had the resources to pay \$185 for an HRO, or even \$100 for an NC-100, but some could afford \$29.50.

I remember my own Sky Buddy well. I was a junior high school student in the St. Louis area in the late thirties, and worked in the school cafeteria an entire semester to earn enough to buy one. I had been using a two-tube regenerative receiver described in the 1939 edition of *The ARRL Handbook* and was able to copy W9BSP's code practice transmissions from Olathe, Kansas, but 160 meters was the only band I could receive. Carrying the Sky Buddy home from the old Walter Ashe radio store on Pine Street was one of the thrills of my adolescence. I connected a 10-foot antenna strung around my bedroom floor, and the first station I heard was a W6 on 20 meters. I don't think any station since then has sounded as loud and clear!

I was also able to receive shortwave broadcast stations, especially those from Europe. Tuning across the SWBC bands in early September 1939, I heard Adolph Hitler announcing the march of the German Army into Poland. Even without the translation, I could tell by the tone of his voice that his speech was not conciliatory! But I wasn't mature enough to realize the effect that broadcast would have on everyone's lives.

The Sky Buddy also played another important role in my Amateur Radio life. I had always been sorry I traded in my Sky Buddy. In fact, I have yet to meet anyone who owned one and let it go who isn't sorry he disposed of it. Well, about 15 years ago I was walking through a hamfest flea market and saw one exactly like the one I had owned, in mint condition. I couldn't resist; I bought it! It was the first acquisition in what has become a collection of over 100 pieces of Amateur Radio equipment from the 1930s. I'm rapidly running out of space to keep my wife. (Wife's note: "You think he jests?")

The original Sky Buddy, first advertised in the September

MADISON ★ ★ ★ SHOPPER

CALL FOR ORDERS
1 (800) 231-3057
1 (713) 520-7330 or
1 (713) 520-0550
FAX 1 (713) 358-0051



New Icom IC 781 Trades wanted
 Kenwood TH215A, TH25AT Trade in your old HT
 TS440 S/AT Call
 New Kenwood TM-731A, mobile Call
 ICOM 228H/TTM 449.00



BW VS 300A 99.00
 Penta 6146B 14.95
 Penta 572B 79.00
 TS 790A Superior 2 Meter 70 cm Rig,
 1.2 GHz Option Available Call
 Icom 765 2695.00
 Kenwood MC-60A + Heil HC-5 cartridge inst. 150.00
 Icom IC-725 799.00
 NYE MB5A Tuner 569.00
 Alpha Delta Transitrapp HV 33.00
 CSI Private Patch V 489.00

TEXAS ORDERS CALL COLLECT.
ALL ITEMS ARE GUARANTEED
OR SALES PRICE REFUNDED.

Ampire VHF, UHF GaAsFET preamps Call
 831SP PL259 Silverplate (Amphenol) 1.50
 82-61 N Male (Amphenol) 3.50
 82-202-1006 N Male (9913) 3.50
 Double Female UHF 1.00
 UG176 RG8X each 40
 Surplus Elbow PL259-SO239 each \$1
 Receiving tubes 50-90% off list price Call
 STUPH
 RF Amp Meters \$15 to \$30 each
 25 pF/10KV Doorknob Cap 5.00
 Throat Mike (new mil. surplus) 5.00
 ANBH-1 600 Ω Headphones (new mil. surplus) 5.00
 New Demo Units for Sale
 Kenwood R-5000 849.00

USED EQUIPMENT

All equipment, used, clean, with 90 day warranty and 30 day trial. Six months full trade against new equipment. Sale price refunded if not satisfied.
 (800) 231-3057

POLICIES

Minimum order \$10.00 Mastercard, VISA, or C.O.D. All prices FOB Houston, except as noted. Prices subject to change without notice. Items subject to prior sale. Call anytime to check the status of your order. Texas residents add sales tax. All items full factory warranty plus Madison warranty.

Bird and Belden products in stock. Call today.



New Kenwood TS 950-SD Call
 Ameco PT 3 Pre Amp 99.00
 Larsen 2-meter on glass 49.95
 Anteco 2M, 5/8, Mag. Mount, Comp 25.00



Kenwood TS 140S Call for trade
 Van Gordon Windom WA2 44.00
 Bird 43, elements/stock Call
 Thousands of panel meters 3.95 up CALL
 Belden 9913, 8267, 8214 Stock Call
 MICA Capacitors Call

MADISON

Electronics Supply
 3621 FANNIN
 HOUSTON, TEXAS 77004

✓ 108

A Receiver for the Connoisseur

JAPAN RADIO
 NRD-525



The Japan Radio NRD-525 combines the high-performance JRC is known for, with a full complement of advanced features. Noted reviewer Larry Magne says, "... the '525 is as close to the optimum shortwave listener's receiver as is in existence.... unquestionably the best overall shortwave listener's receiver on the market today." Contact us for full details. **\$1179.95 (+\$12 UPS)**

Informative Catalogs

HAM CATALOG

This 48 page catalog covers all major lines of ham gear including Kenwood, Icom, Yaesu, AEA, Alinco, MFJ and Kantronics. With prices!

\$1 Postpaid

SWL CATALOG

52 pages of everything that is new for the SWL, including receivers, antennas, RTTY & FAX decoders, books and accessories.

\$1 Postpaid

SCAN CATALOG

This brand new catalog offers the latest in scanners, wideband radios, antennas and accessories. Bearcat, Regency, Icom, Yaesu, etc.

\$1 Postpaid

Universal Radio
 1280 Aida Dr. Dept. HR
 Reynoldsburg, OH 43068
 Toll Free: 800 431-3939
 In Ohio: 614 866-4267

Universal has been serving radio enthusiasts since 1942. Visit our large showroom east of Columbus, Ohio.

500,000 Radio Amateur Call Signs at Your Fingertips

Introducing Buckmaster's HamCall on CD-ROM

Over 500,000 call signs in the U.S. and possessions are available, searchable by call sign, name, address, city, state, Zip code or license class. Using CD-ROM optical disc technology and your micro-computer, you have instantaneous access to the Buckmaster HamCall data base.

\$499.95 per Package plus Shipping (Quantities Limited)

HamCall on CD-ROM is a package that includes the CD-ROM data disc, a Sony CDU-6100 external CD-ROM drive with interface card for IBM PC/AT type computers,* and MS-DOS CD-ROM extensions software.

Publishers Data Service Corporation's new Questar™ retrieval software package is also supplied. This retrieval system enables the user to search the CD-ROM data quickly and efficiently.

Order by calling 1-800: 282-5628



BUCKMASTER
 "Whitehall" Rte. 3, Box 56
 Mineral, Virginia 23117
 703: 894-5777

*Requires 640k RAM, hard disk drive and MS-DOS 3.1 or later version.

From Here



To Here

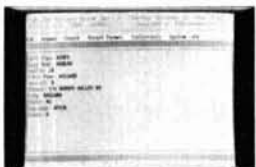


PHOTO A



The original Sky Buddy.

PHOTO B

The SKY BUDDY

FEATURES

- 7 Tubes
- 1 Speaker
- Complete Cover: top, RIA & AC to 145 KC.
- Built-in Speaker
- Phone Jack
- Band-Reverser Switch
- AVC Switch
- Separate Band Normal Dial
- Rear Frequency Oscillator
- Pitch Control

Tube Complement
 6X4 — first detector and amplifier
 6X5 — 6.3V. 500mA
 6X4 — second detector, AVC, 500mA
 6X4 — power output tube
 50 — rectifier

The Sky Buddy is an amateur receiver in every respect, receiving everything on the air from 2.5 Mc. to 14.5 Mc. including the 10, 15, 20 and 100 meter amateur bands. Band One: 1.545 Mc. to 1.800 Mc. — Band Two: 2.175 Mc. to 2.3 Mc. — Band Three: 2.475 Mc. to 2.825 Mc.

The Sky Buddy is an AC set, with conventional Power Transformer Construction. All its components are of the finest quality, and its construction and selective circuitry afford extra-ordinary receiving ability in every class of amateur gear.

The following controls are incorporated in the SKY BUDDY: AF Gain Control, Band Switch, Constant AVC and Band Reverser Switch, with AVC and Band Reverser on each AVC. Phone Jack, Band Reverser Switch, Pitch Control. The Sky Buddy is an integral part of the receiver, making it easy to try. Band Normal is better than A & B. 500mA. Compensation for Band Normal requires slight adjustment. Disconnect for other Division of Marine Approval for 125-125 Volt. 50-60 cycle, AC current only. Can be adapted for 5-volt Battery operation with the addition of Model 301 Electronic Converter. Dimensions of Cabinet: 11 1/2" long, 9 1/2" deep and 9 3/4" high.

THE SKY BUDDY (Model S-19) — Including Speaker and Tubes \$29.50

Hallicrafters' advertisement from the 1939 ARRL Handbook featuring the Sky Buddy S-19.

PHOTO C



The Sky Buddy II, the S-119.

1936 issue of *QST*, was also shown in the 1937 and 1938 editions of *The ARRL Handbook* (see Photo A). It was also known as a 5-T, for five tubes, all glass. Its frequency range was 550 to 18,400 kHz. A restyled version was announced in the May 1938 *QST*. It was known as the S-19, and also covered 550 to 18,400 kHz in three bands, but used four metal tubes plus a rectifier. This version is fairly rare. I've never actually seen one in good condition and would like to hear from someone who has one that I could photo-

graph. Photo B shows a Hallicrafters' advertisement from the 1939 *ARRL Handbook* featuring the S-19.

In 1940, the Sky Buddy was redesigned again. A separate bandspread control was added and its frequency range was expanded to 40 MHz, which included the 10-meter band. This model, called the S-19R, is the one Amateurs generally think of as being "The" Sky Buddy.

There was actually a fourth version of the Sky Buddy — the Sky Buddy II — which came out after World War II. It was really just a glorified broadcast radio, not a real Amateur receiver. Photo C shows the Sky Buddy II circa 1948; it was called the S-119.

The name "Sky Buddy" has an unusual origin. According to Bill Halligan, the founder of Hallicrafters, when the receiver was in the prototype state Hallicrafters was trying to find a snappy name for it. A youngster nicknamed Buddy used to hang out around the Halligan backyard and help Bill with his yard chores. This youngster was so friendly and helpful that Bill named the new receiver after him. Unfortunately, Halligan was not able to remember Buddy's real name. I would be happy to hear from anyone who knows — especially from Buddy himself.

Looking back, I see that the Sky Buddy isn't one of those receivers remembered as having great capabilities — because it didn't. You may think of it affectionately as the affordable model that gave you your start in Amateur Radio, and a lot of pleasant listening.

The Sky Champion

If you were fortunate enough to be able to spend a little more to begin with, or if you'd just been given a raise and could buy a better receiver, the next step up was the Hallicrafters' Sky Champion.

This family of receivers, while not the least expensive, could still be called low cost. The family included two receivers called "Sky Champion," and a third, which was actually the earliest, called "Sky Chief."

The Sky Chief was announced in the September 1936 issue of *QST*, along with the first Sky Buddy. The receiver featured an airplane-type, two-speed tuning dial, then popular for both broadcast and Amateur receivers. It had seven glass tubes (including an RF preselector, magic eye tube, and rectifier), a 5-inch speaker, band switching, and a tone control. Its price was \$49.50, which was moderate for the time. The Sky Chief was less than any competing superheterodyne receiver except, perhaps, the National Company's FB-7 — which didn't have an RF preselector or direct reading tuning dial, and used plug-in coils. Photo D shows the Sky Chief. Its frequency range covered the broadcast band to 18.4 Mc/s (MHz today).

Hallicrafters' products were restyled early in 1938, and the Sky Chief was renamed the "Sky Champion." The tube count was increased to eight, five of which were metal. The magic eye tube was eliminated, and two more working tubes were added. The frequency range was extended to 44 Mc/s to add the 10-meter Amateur band and the 30 to 40 MHz emergency services sector, which was just beginning to be occupied. This version was known as the S-20 and is shown in Photo E.

The S-20 provided an optional external S-meter to replace the magic eye tube as a signal indicator. This cost-saving measure was one of the ways Hallicrafters managed to hold the price down, yet still provide features that helped keep

PHOTO D



The Sky Chief.

them ahead of the competition. For an additional \$6.95 you could buy an external S-meter with a separate meter cabinet styled to match the receiver. The S-meter plugged into a five-prong socket on the rear apron of the receiver, as shown on top of the receiver in **Photo E**.

The RF gain control had a switch which closed in the maximum clockwise position (maximum RF gain) and illuminated the S-meter scale. Try putting an AC voltmeter across pins 1 and 5 of the S-meter socket on the rear apron and operate the switch; you should measure 6.3 volts AC.

These optional S-meters are hard to find. I've only seen one and its style is different from those shown in Hallicrafters' advertisements of the time. I'd like to hear from any collectors who have S-meters with different styling.

The December 1939 issue of *QST* announced a new version of the Sky Champion just in time for Christmas. The circuitry was upgraded to include electrical bandspread, a second tuning knob was added, and both tuning dials were illuminated. The newly developed Dickert automatic noise limiter was also included, increasing the tube count to nine. This version was known as the S-20R (see **Photo F**). The price remained \$49.50, and Amateurs got even more for their money.

The S-20R was a very serviceable receiver. Like many of the receivers of the 1930s, its popularity depended more on its price/performance ratio than on performance alone. The Sky Champion series isn't a good performer on SSB because it uses a diode detector and because its bandwidth is designed for AM phone.

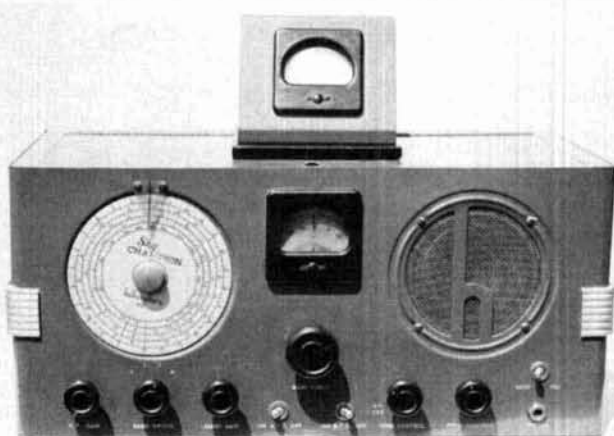
In spite of its simplicity, those who owned and used one remember it fondly. Novices and SWLs lucky enough to find one in good working condition will discover it makes an excellent starting point into radio.

The Skyrider Defiant

As the 1930s came to an end, the Depression eased and many who were hard-pressed in the middle thirties found their economic position improved. A better receiver was within their budget. Or, it may have been that many who were working in the radio business found their skills in greater demand as war came in Europe. Amateur Radio training and experience made Amateurs more sophisticated.

Receivers in the middle price range were becoming more important to both manufacturers and Amateurs. These

PHOTO E



The Sky Champion S-20.

PHOTO F



The Sky Champion S-20R.

receivers had to have enough refinements above economy class to make customers willing to pay more. But if they had too many goodies, they took sales away from the high profit, top-of-the-line equipment.

Receiver design had advanced from an art to a science by the end of the 1930s, and designers were able to offer a wider range of capabilities. Manufacturers were constantly judging ideas for midpriced receivers, evaluating which useful features they could add to a receiver without significantly increasing its cost. Equipment like S-meters and crystal filters became common.

Hallicrafters had established its name because of its policy of giving a lot of signal for a buck. They enhanced this reputation by developing two medium priced receivers: the Skyrider Defiant, the SX-24; and the Super Defiant, the SX-25. The SX-24 was first advertised in the July 1939 *QST*; it was the lower priced of the two at \$69.50, plus \$12 for a matching speaker. It had nine tubes, including one stage of RF preselection and single-ended audio output (see **Photo G**).

In February 1940 Hallicrafters announced the SX-25

PHOTO G



The Skyrider Defiant SX-24.

PHOTO H



The Super Defiant SX-25.

Super Defiant as a replacement for the very popular SX-17. The SX-25 cost \$99.50, including a matching speaker. It had 12 tubes with two stages of RF preselection, an audio phase inverter, and push-pull audio output (see **Photo H**).

In the 1942 Hallicrafters' catalog these receivers were priced at \$74.50 and \$104.50, respectively. Besides an S-meter and crystal filter, which by the late thirties had become common in all but the lowest priced receivers, Hallicrafters added "frequency meter tuning." When the main tuning dial was set to one of four red lines (one for each of the Amateur bands, 80 through 10 meters), the bandspread dial was calibrated accurately in frequency for that band. This was a new concept which Hallicrafters soon adopted in their other receivers.

The two receivers appear quite similar except for their name, Skyrider Defiant or Super Defiant, and their model number, SX-24 or SX-25, embossed on the metal main tun-


ing dial cover. However, there are less obvious differences in the bandswitch and selectivity switches located just below the main tuning dial. On the SX-24, the selectivity positions and the band numbers are silk-screened on the cabinet as are the rest of the control labels. On the SX-25, the labels for these two controls are embossed on the skirted knobs themselves.

Internally, the most striking difference is the additional tuning condenser (capacitor today) gang required for the extra stage of RF preselection. The SX-25 uses two 2-gang capacitors rather than one 4-gang capacitor, possibly because 2-gang capacitors were originally used on another receiver (like a Sky Buddy). It may be that two 2-gang capacitors were simply cheaper than one 4-gang capacitor. Another obvious difference is the increased tube count of the SX-25.

The SX-24 became a casualty of World War II; Hallicrafters didn't produce any of them after the war. The SX-25 was advertised in *The ARRL Handbook* in 1946, but not in 1947. Apparently, Hallicrafters needed a medium-priced receiver they could put into production quickly after the war, and chose the SX-25.

In retrospect, the Defiant family were medium priced receivers whose performance approached that of the high priced sets. They were widely used by Amateurs who could afford more than economy class, but not the luxury line. I believe they deserve more historical interest than they have received to date.

Summary

These low cost receivers have an important place in radio history because they were in a price range which put them within the budget of the majority of the Amateur community. This may be why they remain so popular among collectors and restorers. 

Attention! All amateur photographers and artists...

Over the years many of you have read and responded to our calls for manuscripts. Now I have a new request for those of you whose talents lie in different directions. I'm looking for eye-catching artwork for *Ham Radio* covers. Do you have a picture of an interesting Amateur Radio event, a wild looking antenna, a ham shack with a difference? Do your talents run to drawing or cartooning? Why not let us take a look at your work and see if it has the makings of a good cover piece?

Here are the basics. For those submitting photos, we prefer large-format transparencies or slides taken with 120 film. Shots taken with 35 mm film are sometimes usable, but often are not sharp enough when blown up to cover size. For those submitting drawings, colorful ones are best. But a dramatic black and white picture could also have possibilities.

Don't be shy. Send us what you've got. Hans Evers, PA0CX, a favorite *Ham Radio* artist, was discovered when he included a doodle at the bottom of a manuscript he sent us. Could you be next?

Terry Northup, KA1STC

NEW PRODUCTS

New Dual Band HT

Kenwood offers the TH-75A Dual Band HT which features:

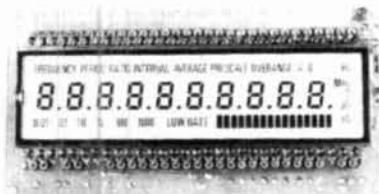
- Dual Watch function
- 1.5 watts on 2 meters and 70 cm; 5 watts when operated on 12 volts DC (or PB-8 battery pack)
- Large dual multifunction LCD display
- 10 memory channels for each band
- Selectable full duplex operation
- Extended receiver range
- Uses the same accessories as the TH-25AT (except soft cases)
- Volume and balance controls, plus separate squelch controls on top panel
- CTCSS encode/decode built in
- Automatic Band Change (ABC)
- Automatic offset selection on 2 meters
- Tone alert system for quiet monitoring
- Automatic battery saver circuit extends battery life.
- Supplied accessories:
Dual band rubber-flex antenna, PB-6 battery pack, wall charger, belt hook, wrist strap, water resistant dust caps.



See your nearest Kenwood authorized Amateur Radio dealer for more details or write: Kenwood USA Corporation, PO Box 22745, 2201 E. Dominguez Street, Long Beach, California, 90801-5745. Suggested retail price: \$549.95.

Universal Timer Counter Module/Panel Meter

Optoelectronics Inc. has introduced a new ten-digit universal counter/timer module with direct frequency response from 0.1 Hz to over 150 MHz. There are up to nine digits of resolution per second. Functions include frequency, period, period average, time interval, time interval average, ratio, prescale, over range, and a 16-segment analog input bar graph.



Module size is 1.8" high x 3.55" long x 0.6" wide, suitable for OEM use in custom instrumentation or in a digital panel meter application. The ten-digit 0.25" character height LCD display has annunciators for function, gate time, range, measurement units, input A/B, low battery, prescale, and 16 bar graph segments.

Other features include an on-board 1 ppm 20 to 40 degree C 10-MHz timebase with calibration adjust trimmer, LCD contrast control pot, CMOS counter inputs (400 mV sensitivity typical), gate light LED, and an eight-bit A/D on board. Four control inputs are for momentary push buttons. The connector is a 14-pin dual 0.025" header. Power requirements are 5 volts DC, 50 mA. The module costs \$225 in single quantities and \$149 in hundreds.

For details contact Optoelectronics Inc., 5821 N.E. 14th Avenue, Fort Lauderdale, Florida 33334. Phone: (800)327-5912 or FAX (305)771-2052. In Florida call (305)771-2050.

Circle #305 on Reader Service Card.

"On-Glass"® Disguise Amateur Radio Antenna From A/S

The Antenna Specialists Company has introduced Model AP-143, an On-Glass disguise antenna for the 2-meter band. The new model uses the "pigtail" configuration of cellular antennas to hide the presence of professional radio equipment inside the vehicle.

The antenna's on-glass design, with capacitively coupled transmission through glass,



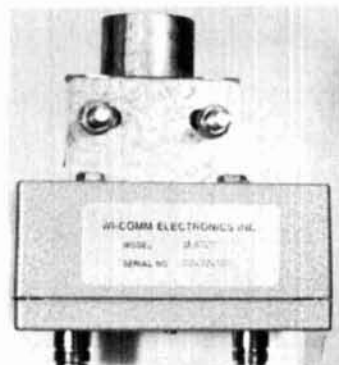
requires no ground plane and permits quick, no-holes installation. The 26-inch stainless steel whip is covered with a black DURA-COAT™ finish for long life. The antenna has a power rating of 100 watts continuous, 150 watts intermittent, and a VSWR of less than 1.5:1.

For details contact The Antenna Specialists Company, 30500 Bruce Industrial Parkway, Cleveland, Ohio 44139-3996. Phone: (216) 349-8400.

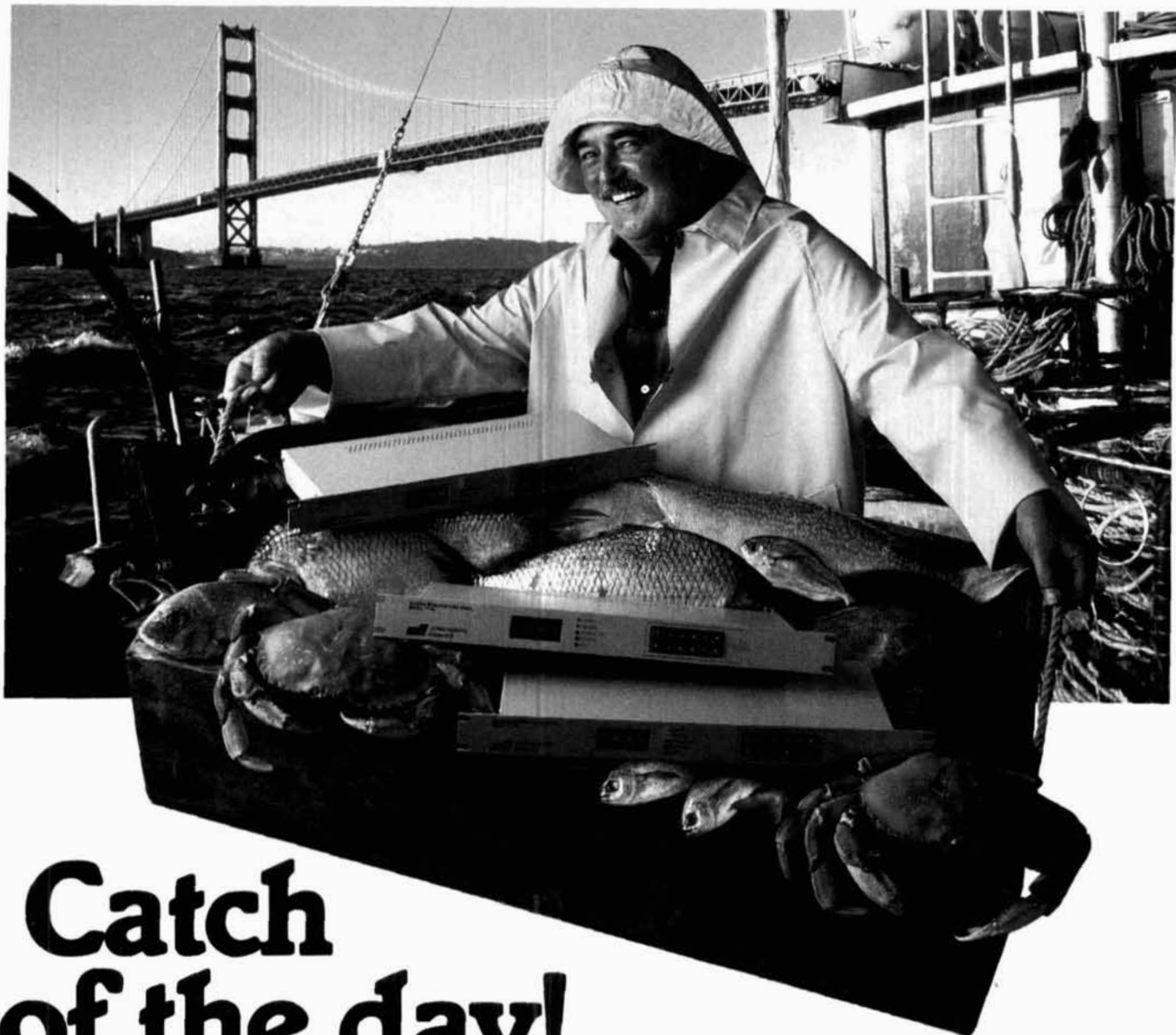
Circle #302 on Reader Service Card.

New Tower-mount Preamp

WI-COMM Electronics, Inc. offers a new tower-mount preamplifier in a weatherproof aluminum housing which covers the band from 10 to 900



(continued on page 53)



Catch of the day!

Have you been trawling the bounding main for a new product? We have just netted it—the TP-38 microprocessor controlled community repeater panel which provides the complete interface between the repeater receiver and transmitter. Scuttle individual tone cards, all 38 EIA standard CTCSS tones are included as well as time and hit accumulators, programmable timers, tone translation, and AC power supply at one low price of \$595.00. The TP-38 is packed like a can of sardines with features, as a matter of fact the only additional option is a DTMF module for \$59.95. This module allows complete offsite remote control of all TP-38 functions, including adding new customers or deleting poor paying ones, over the repeater receiver channel.

Other features include CMOS circuitry for low power consumption, non-volatile memory to retain programming if power loss occurs, immunity to falsing, programmable security code and much more. The TP-38 is backed by our legendary 1 year warranty and is shipped fresh daily. Why not set passage for the abundant waters of Communications Specialists and cast your nets for a TP-38 or other fine catch.



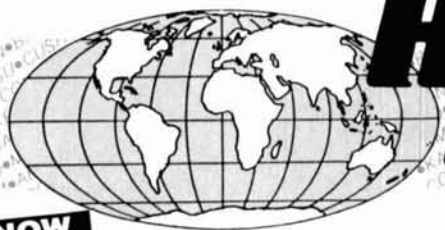
\$595.00 each
\$59.95 DTMF module
\$149.95 Digital CTCSS modu

*Now available with
 Digital CTCSS*

COMMUNICATIONS SPECIALISTS, INC.
 426 West Taft Avenue • Orange, CA 92665-4296
 Local (714) 998-3021 • FAX (714) 974-3420
 Entire U.S.A. 1-800-854-0547



For A HRO 72 Page
Communication Equipment Catalog
Send \$1.00 to any HRO Store



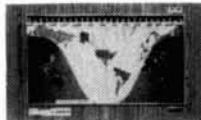
HAM RADIO OUTLET

LARGEST HAM OUTLET IN THE WORLD

NOW

9

STORE BUYING POWER

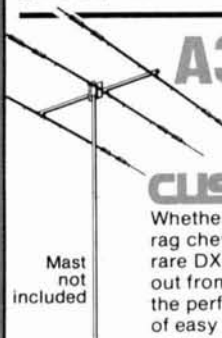


GEOCHRON
GLOBAL
TIME
INDICATOR

SALE

- Detailed illuminated map shows time, time zone, sun position and day of the week at a glance for any place in the world.
- Continuously moving - areas of day and night change as you watch.
- Mounts easily on a wall. Size: 34 1/2" x 22 1/2".

~~\$1295~~ **\$1159.95 DELIVERED IN U.S.**



A3 DX THAT STANDS OUT FROM THE CROWD

10, 15, 20 Meters

cushcraft

Whether busting pileups, rag chewing or hunting rare DX, the A3 stands out from the crowd with the perfect combination of easy assembly, the right size, rugged durability and great performance.

- Boom Length 14 ft., Weight 27 lbs.
- Wind Surface Area 4.36 ft.

Most not included

REG. 399.00

SALE 269.95

Plus Shipping

SALE

concept



VHF/UHF SOLIDSTATE AMPLIFIERS

Contemporary design, quality and a 5 year warranty on parts and labor. 6 months on the RF Final transistors.

All amplifiers have GaAsFET receive pre-amps and high SWR shutdown protection.



MA-40

40' TUBULAR TOWER

~~\$809~~ **SALE! \$629**

MA-550

55' TUBULAR TOWER

~~\$1369~~ **SALE! \$999**

- Handles 10 sq. ft. at 50 mph
- Pleases neighbors with tubular streamlined look

TX-455 SALE! \$1389

55' FREESTANDING CRANK-UP

- Handles 18 sq. ft. at 50 mph
- No guying required
- Extra-strength Construction
- Can add raising and motor drive accessories

Shown with optional MARRI rotor base

TOWERS RATED TO EIA SPECIFICATIONS
OTHER MODELS AT GREAT PRICES
IN STOCK FOR QUICK DELIVERY



MADE IN U.S.A.



OMNI-V

- Optimized for reduced Phase Noise
- Dual VFO's, 100 W Output
- All bands 160-10



TITAN 425

- Pair 3CX800A7 • External Power Supply
- Performance at legal limit
- 3 MS QSK, 1.6 to 22 MHz • Assures "Loaf Along"
- With authorized modification through 29.999 MHz

IN STOCK NOW! FREE SHIPMENT!



Advanced Electronic Applications

PK-232 Multi-mode Data Controller



- NEW IBM Fax Screen Display Program Available
- Transmit/Receive on Six Modes
- CW/RTTY/ASCII/AMTOR/Packet/FAX
- IBM and Commodore terminal programs available
- Radio Ports for HF and VHF

In Stock for Quick Delivery

Free Shipment

Kantronics/KAM



True dual port - simultaneous HF/VHF packet operation

- Personal Bulletin Board
- RTTY/ASCII/AMTOR/CW/Weather Fax
- Programmable MARK and SPACE tones
- Terminal programs for PC compatibles and Commodore
- WEFAX programs for PC, Commodore, and Macintosh

One-year Warranty

CALL FOR LOW, LOW PRICE

FREE SHIPMENT
Most items over \$100
UPS surface

All Major Brands in Stock Now!

Call any of our 800 numbers coast to coast from most parts of the country.

CALL TOLL FREE
IN CALIFORNIA CALL STORE NEAREST YOU

MID-WEST/WEST
ANAHEIM, 9 to 5:30 PST

SOUTHEAST
ATLANTA, 9 to 5:30 EST

MID-ATLANTIC
WOODBIDGE, 9 to 5:30 EST

NEW ENGLAND
SALEM, 9 to 5:30 EST

1-800-854-6046

1-800-444-7927

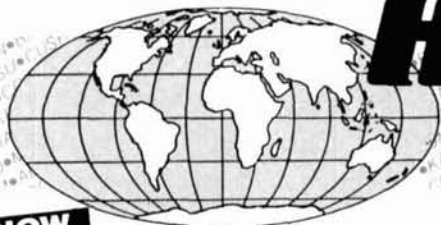
1-800-444-4799

1-800-444-0047



Toll free including Hawaii. Phone Hrs: 7:00 am to 5:30 p.m. Pacific Time. California, Arizona and Georgia customers call or visit nearest store. California, Arizona, Georgia and Virginia residents please add sales tax. Prices, specifications, descriptions subject to change without notice.

For A HRO 72 Page
Communication Equipment Catalog
Send \$1.00 to any HRO Store



HAM RADIO OUTLET

LARGEST HAM OUTLET IN THE WORLD

NOW

9

STORE BUYING POWER

ICOM IC-765



100W GENERAL COVERAGE RECEIVER
HF ALL BAND TRANSCEIVER
Maximum Operation Flexibility

SALE! CALL FOR PRICE

ICOM IC-781



THE ULTIMATE
150 W, ALL BAND
HF TRANSCEIVER

GREAT PRICE!

ICOM IC-900 MULTI-BAND MOBILE



CLOSEOUT
PRICES
TOO LOW
TO PRINT

YOU CAN OPERATE SIX BANDS
WITH ONE CONTROLLER!
2 MTR 25/45W, 440 MHz 10 MTR, 6 MTR,
220 MHz & 1.2 GHz 10 MEMORIES
ARE YOU READY FOR
1.2 GHz OPERATION?

ICOM A Models 25 WATTS
H Models 100 WATTS
IC-275A/275H, 138-174 MHz
IC-375A, 220 MHz
IC-475A/475H, 430-450 MHz



LOW PRICE!

HAM RADIO OUTLET NATIONWIDE TEAM



COAST TO COAST
RAPID DELIVERIES
FROM STORE NEAREST YOU

ICOM HAND-HELD VHF/UHF



MICRO
SIZE

IC-32AT Dual Band Hand Held
IC-2GAT 2 Meter HT 7 WATT
IC-3SAT, 2MTR
IC-4SAT, 440 MHz

ICOM IC-2400A 2m, 440 MHz



VHF/UHF DUAL BAND
FM TRANSCEIVER

ICOM IC-228A/H 2 METER MOBILES IC-448A 440 MHz MOBILE



FM TRANSCEIVER
20 Memories with Memory
Channel Lock-Out.

ICOM IC-725



100W GENERAL COVERAGE RECEIVER
HF ALL BAND COMPACT TRANSCEIVER

GREAT PRICE

All Major Brands in Stock Now!



STORE HOURS 10 AM-5:30 PM
CLOSED SUNDAYS



Bob Ferrero W6RJ
President/Owner
Jim Rafferty N6RJ
VP-National
Sales Manager

ANAHEIM, CA 92801
2620 W. La Palma
(714) 761-3033, (213) 860-2040
Between Disneyland &
Knotts Berry Farm

ATLANTA, GA 30340
6071 Buford Hwy.
(404) 263-0700
Larry, Mgr. WD4AGW
Doraville, 1 mi. north of I-285

BURLINGAME, CA 94010
999 Howard Ave.
(415) 342-5757
George, Mgr. WB6DSV
5 miles south on 101 from SFO

OAKLAND, CA 94606
2210 Livingston St.
(415) 534-5757
Rich, Mgr. WA9WYB
IS-880 at 23rd Ave. Ramp

PHOENIX, AZ 85015
1702 W. Camelback Rd.
(602) 242-3515
Gary WB7SLY, Mgr.
East of Hwy. 17

SALEM, NH 03079
224 N. Broadway
1-800-444-0047
Curtis, Mgr. WB4KZL
28 miles north of Boston exit 1 I-93

SAN DIEGO, CA 92123
5375 Kearny Villa Rd.
(619) 560-4900
Tom, Mgr. KM6K
Hwy. 163 & Claremont Mesa Blvd.

WOODBRIIDGE, VA 22191
14803 Build America Drive
(703) 643-1063 1-800-444-4799
Linda KB4ZYT, Mgr.
Exit 54, I-95 South to US RT 1

VAN NUYS, CA 91411
6265 Sepulveda Blvd.
(818) 988-2212
Al, Mgr. K6YRA
San Diego Fwy. at Victory Blvd.

CALL TOLL FREE

IN CALIFORNIA CALL STORE NEAREST YOU

Call any of our 800 numbers coast to coast from most parts of the country.

MID-WEST/WEST ANAHEIM, 9 to 5:30 PST	SOUTHEAST ATLANTA, 9 to 5:30 EST	MID-ATLANTIC WOODBRIIDGE, 9 to 5:30 EST	NEW ENGLAND SALEM, 9 to 5:30 EST
1-800-854-6046	1-800-444-7927	1-800-444-4799	1-800-444-0047



Toll free including Hawaii. Phone Hrs: 7:00 am to 5:30 p.m. Pacific Time. California, Arizona and Georgia customers call or visit nearest store. California, Arizona, Georgia and Virginia residents please add sales tax. Prices, specifications, descriptions subject to change without notice.

DURA-FLEX® shock mounts silence spring-generated RF noise.

- **DURA-FLEX neoprene elastomer** significantly advances antenna shock absorption technology.
- **Eliminates RF noise** in duplex radio systems from metal-to-metal contact in conventional steel springs.
- **Drastically cuts whip vibration** which can damage or break antennas with steel springs on high-vibration vehicles.
- **Solid brass adaptors** molded into neoprene; braided totally isolated through center cavity.
- **Field-proven** against heat, cold, humidity and abrasion extremes.
- **Models** for roof, trunk or magnetic mounting. 2 meter, 220 MHz or UHF.

the antenna specialists co.



a member of The Allen Group Inc.
30500 Bruce Industrial Parkway
Cleveland, OH 44139-3996
216/349-8400, Telex: 4332133, Fax: 216/349-8407

"helping the world communicate"®

ICOM

- We sell & service all ICOM products & of course, use factory service parts.
- We provide a complete check for performance and function on each radio we sell. Call us for a quotation on your next ICOM purchase.
- Servicing Amateur Radio operators for ten years.
- Send for your free brochure.

10TH ANNIVERSARY

LET US BE YOUR ICOM DEALER
BECAUSE WE KNOW ICOM BEST!

**INTERNATIONAL RADIO
AND COMPUTERS, INC.**

751 South Macedo Blvd.
Port St. Lucie, FL 34983
(407) 879-6868
FAX #(407) 878-8856



FRANKLIN-BELLE PUBLISHERS
The Antenna People Present:

•MAGAZINES•

- **antenneX**—A monthly magazine all about antennas. Read in 40 countries. Second exciting year in publication.....\$15.97

•BOOKS•

- **Rules of the Antenna Game**
By Ted Hart, W5QJR.....\$6.95
- **Small High Efficiency Antennas**
By Ted Hart, W5QJR.....\$19.95
- **Electronics for the Radio Amateur**
By James Lee, W6VAT.....\$19.95

•SOFTWARE (IBM)•

- **Transmitting Loop Antenna CAD** By HartSoft.....\$17.75
- **Transmission Line Antenna CAD** By HartSoft.....\$17.75

TO ORDER—Send Check or MO plus \$1.50 S&H per item (except magazine) Texas residents add 7.5% sales tax, TO

FRANKLIN-BELLE PUBLISHERS
4639 Corona, Suite 12
Corpus Christi, TX 78411
(512) 852-0446

RELY ON JAN FOR 3-WAY HELP:

1. **TECHNICALLY CORRECT CRYSTALS TO YOUR SPECS.**
2. **QUICK TURNAROUND WITH HUGE INVENTORY, PROMPT SERVICE, AND OUR EMERGENCY ORDER PLAN.**
3. **LOW PRICES.**

QUARTZ CRYSTALS FOR
TWO-WAY — INDUSTRY
MARINE — AMATEURS
SCANNERS — CBs
MICROPROCESSORS



SINCE
1965

FOR FREE CATALOG,
CALL OR WRITE:

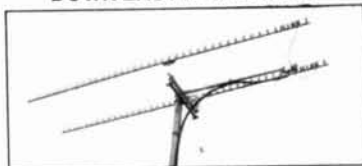
JAN CRYSTALS
P.O. BOX 06017
FORT MYERS, FL 33906
(813) 936-2397



TOLL-FREE: 1-800-JAN-XTAL

FAX ORDERS: 1-813-936-3750

DOWN EAST MICROWAVE



MICROWAVE ANTENNAS AND EQUIPMENT

• Loop Yagis • Power Dividers • Linear Amplifiers • Complete Arrays • Microwave Transverters • GaAs FET Preamps • TROPO • EME • Weak Signal • OSCAR • 902 • 1269 • 1296 • 2304 • 2400 • 3456 MHz

2345 LY	45el	loop Yagi	1296 MHz	20dBI	\$109
1345 LY	45el	loop Yagi	2304 MHz	20dBI	\$89
3333 LY	33el	loop Yagi	902 MHz	18.5dBI	\$109

Above antennas assembled and tested. Kits available.

Add \$8 UPS S/H, \$11 West of the Mississippi

MICROWAVE LINEAR AMPLIFIERS SSB, ATV, REPEATER, OSCAR

2316 PA	1w in 18w out	1240-1300 MHz	13.8V	\$265
2335 PA	10w in 35w out	1240-1300 MHz	13.8V	\$315
3318 PA	1w in 20w out	900-930 MHz	13.8V	\$265
3335 PA	10w in 40w out	900-930 MHz	13.8V	\$320
23LNA	preamp 0.7dB N.F.	1296 MHz		\$ 90
33LNA	preamp 0.9dB N.F.	902 MHz		\$ 90

Add \$5 shipping UPS-48

S/H Systems microwave transverters kits available.



DOWN EAST MICROWAVE
Bill Olson, W3HOT
Box 2310, RR 1, Troy, ME 04987
(207) 948-3741



Repeater Solar Power



The \$289.95 Bullet-Tested QRV Solar Power Supply keeps your repeater on the air 'round the clock or powers your 100W HF station 60 hrs a month. Control circuit speeds charge, protects gel cells & sealed batteries. Fully assembled, QRV portable. Easily expanded.
Add \$10 S&H 1st-51
(801)373-8425

AntennasWest
Box 50062-BS Provo UT 84605

NEW PRODUCTS

(continued from page 48)

MHz. The preamplifier gain is 25 dB, noise figure is 3.1 dB typical, 1-dB gain compression is at +10 dBm minimum, VSWR in/out is 2:1, and powering is +12 to 15 volts. Power is supplied via the output connector by a wideband DC block (bias tee). Standard connectors are type N female. Lightning static protection at the input and reverse polarity protection on the DC supply line are included. Wideband DC block is also available, along with the RX-RX switch (SPDT) and the amplifier bypass switch module (insertion loss 0.15 dB maximum, isolation 50 to 70 dB at 900 MHz, set time 5 ms, through power 10 watt maximum, powering +12 to +15 volts, and VSWR is 1.3:1 typical). The SPDT switch can be used to combine two antennas at the preamp input; the bypass switch module can be used to insert a pad/filter into the signal path.

For additional information contact WI-COMM Electronics, Inc., Box 5174, Massena, New York 13662. Phone: (315)769-8334.

Circle #307 on Reader Service Card.

Midland LMR Announces Data-Capable Syn-Tech™ Mobile Models

Midland LMR's new data-capable Midland Syn-Tech two-way FM mobile radios incorporate direct FM modulation (factory installed only) and are identified by the addition of a letter "D" suffix to the model number. They are the 110 watt 40-54 MHz models 70-052CD and 70-056CD (dash mount and trunk mount), the 40 watt 148-174 MHz models 70-340BD and 70-440BD, the 30 watt 450-470 MHz models 70-530BD and 70-630BD, and the 15 watt 800 MHz models 70-915D and 70-970D.

For more information contact Midland LMR, Marketing Department, 1690 N. Topping, Kansas City, Missouri 64120 or call 1-800/MIDLAND (1-800-643-5263), extension 1690.

Circle #304 on Reader Service Card.

New Function Added to MFJ-815B SWR/Wattmeter

MFJ Enterprises, Inc. offers a new peak reading function in the MFJ-815B lighted Cross-Needle SWR/Wattmeter for \$69.95.

The MFJ-815B lets you monitor SWR, forward, and reflected power at a glance. You can select from two power ranges for forward and reflected power (2000 watts forward and 500 watts reflected or 200 watts forward and 50 watts reflected). It shows you SWR from 1:1 to 8:1.



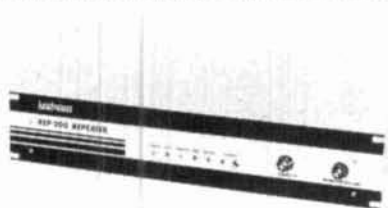
The MFJ-815B covers 1.8 to 30 MHz with 10 percent accuracy. It comes with MFJ's full 1-year No Matter What™ guarantee. The meter light requires 12 volts DC or 110 volts AC with the MFJ-1312. The price is \$12.95.

For more information contact MFJ Enterprises, Inc., PO Box 494, Mississippi State, Mississippi 39762. Phone: (601)323-5869.

Hamtronics New Computer-Controlled REP-200 Repeater

Hamtronics new REP-200 Repeater has all the features of their earlier units plus a microprocessor-controlled COR, CWID, autopatch, and DTMF decoder/controller with over 45 functions — including built-in testing features. It is available for 10, 6, and 2 meters; 220, 440, and 902 MHz; and for the high and UHF commercial bands.

The COR, CWID, DTMF controller, and autopatch are all on one board, along with new signal and power distribution circuitry. Four pc boards have been combined into one module, with IC sockets for easy service. Surface mount



capacitors are used in many places to reduce size and enhance performance.

Rugged welded RF partitions are an integral part of the compact new chassis, with Perm nuts to seal the covers for optimum shielding. The rack panel is only 3-1/2 inches high.

All interconnections are done through the controller board to eliminate cable harnesses. External cables for power, telephone, monitor speaker, and auxiliary receiver are made with push-on terminals which plug directly into the controller board. There are more front panel indicators; color-coded LEDs indicate status of all major functions.

On the 2 meter and adjacent commercial band, a new 25-watt RF output option is avail-

able. In the unlikely event that isn't enough power for your application, you can add our accessory 100-watt PA. On UHF, choose from 10 watts with basic repeater or up to 65 watts with add-on PAs. On 900 MHz, choose 10-watt basic repeater or 40 watts with add-on PA.

For more information contact Hamtronics, Inc., 65-F Moul Road, Hilton, New York 14468-9535. Phone: (716)392-9430, FAX (716)392-9420.

VHF/UHF Dual Band FM Transceiver from ICOM

ICOM introduces a new FM dual band mobile transceiver. The IC-2400A has independent frequency readouts and volume and squelch controls for complete dual band operation. Features include:

- High power output
- Full duplex capability
- 40 memory channels
- Two bands simultaneous receive

The IC-2400A uses ICOM's exclusive SET mode for simple operation. An optional PL tone encode/decode squelch pocket beep unit is also available. The suggested retail price is \$899.

For details contact ICOM America, Inc., 2380 116th Avenue N.E., PO Box C-90029, Bellevue, Washington 98009-9029.

Circle #303 on Reader Service Card.

Handy New Tool from Nema!

Nema Electronics International has introduced a new ratchet crimping tool. It offers full cycle ratchet operation with machined dies, and features a pin holder and wire locator. Part number CT2320 accommodates wire sizes from 20 to 30 gauge.



For additional information contact Nema Electronics International Inc., 12240 NE 14th Avenue, North Miami, Florida 33161. Phone: (305)899-0900 or FAX (305)895-8178.

Ham Radio Techniques

By Bill Orr, W6SAI

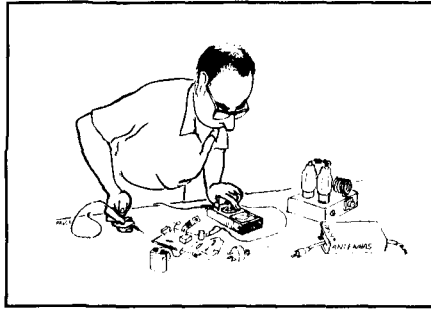
ANTENNA MATCHING SYSTEMS

Last month I discussed some unusual circuits capable of matching a coax line to a Yagi antenna. This column deals with an adaptation of the L-network, commonly called the "Beta" or "Hairpin" match. It's a simple and easily constructed matching device that any home builder can use with his beam antenna.

Generally speaking, the feedpoint impedance of a Yagi (regardless of the number of elements) falls between 15 and 25 ohms. The problem is to reach a reasonable match between these impedances and a 50-ohm coax line.

The picture is complicated by the fact that when matching is achieved at the design frequency of the antenna, it deteriorates when the antenna is operated off frequency. The L-network, however, is "user friendly" (low Q) and provides a good match across the HF Amateur bands, in spite of the impedance gyrations of the driven element. Some matching schemes will not do that.

When the line impedance is greater than the feedpoint impedance of the antenna (as is the general case), the L-network takes the forms shown in Figure 1. Only two components are required — an inductor and a capacitor. It's possible to eliminate the series-connected component by making the driven element take its place. This is accomplished by detuning it slightly to introduce a value of series reactance equal to that of the missing network component. If the driven element is longer than the resonant length, its feedpoint reactance will be inductive (positive). If it's shorter than resonance, the reactance will be capacitive (negative). In this case, the shortened element will be used.

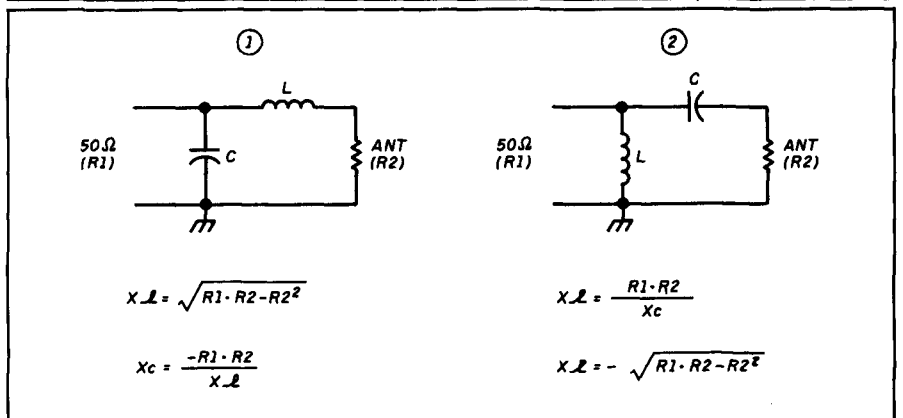


Using the reactance match

In most cases, the driven element of the Yagi is shortened to exhibit a series capacitive reactance. A shunt inductor provides the positive reactance of the proper value. The shunt inductor can be a coil, or it may be a "hairpin" of wire (see Figure 3A and 3B). Most commercial beams using this matching scheme prefer the hairpin over the

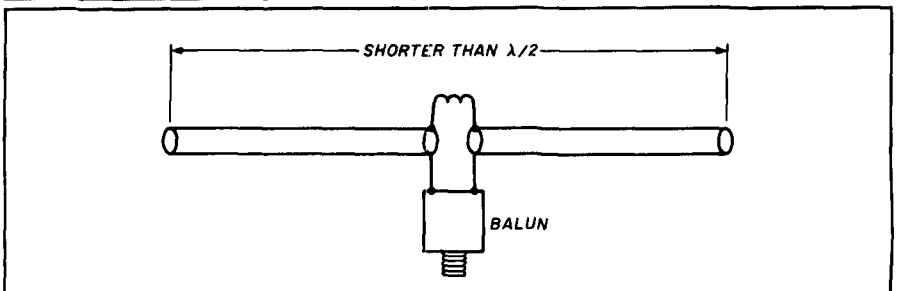
Because the feedpoint of the Yagi is balanced with respect to ground it's necessary to use a balun with the matching network, as shown in Figure 2.

FIGURE 1



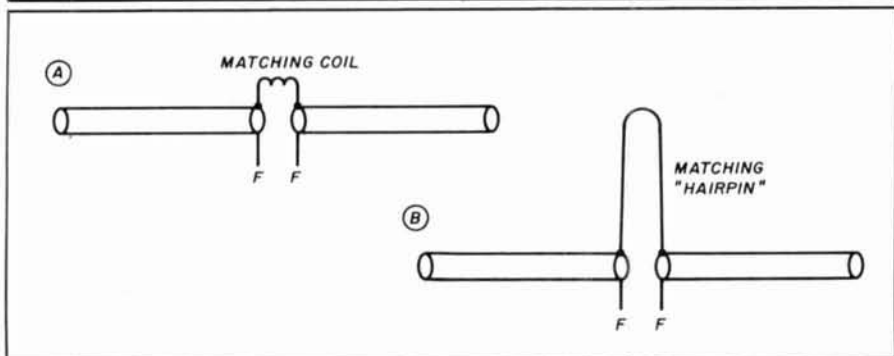
Basic single-ended L-networks to match feedline (R1) to antenna (R2) when line impedance is greater.

FIGURE 2



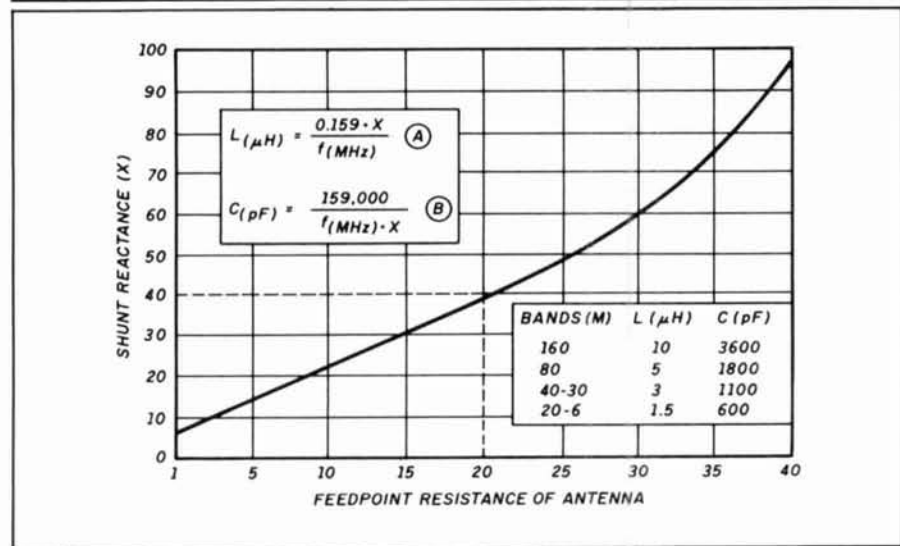
Balanced driven element is matched to coax by shortening it and using a parallel inductor at the feedpoint. A balun is used to match the antenna to unbalanced coax.

FIGURE 3



The shunt inductor may be either a coil or "hairpin."

FIGURE 4



Shunt reactance values required for various values of feedpoint resistance. Typical baluns are listed in the chart.

inductor because the inductance (length) of the hairpin can be adjusted easily. The two approaches are equally effective.

The homebrewer, on the other hand, may find the coil inductor easier to build than the hairpin. I prefer the coil because it's cheap, easy to wind, and can be adjusted at the center of the element — which is within easy reach from the top of the tower. (I don't like the idea of hanging out over open space to adjust the shorting bar on a hairpin match!)

In any event, the only adjustments you need to make in either system are to the length of the driven element and the inductance of the coil, or hairpin.

A practical matching circuit

The L-network parameters are summarized in Figure 4. The X-axis of the

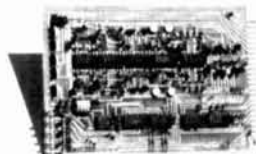
graph represents the feedpoint impedance of the Yagi driven element, and the Y-axis the value of shunt reactance necessary to achieve a match to a 50-ohm line.

For example, assume a Yagi has a feedpoint value of 20 ohms. The corresponding value of shunt reactance, as shown by the dashed lines, is 40 ohms. The actual inductance of the coil is determined by the formula. The driven element must be shortened, or "equalized," to provide the capacitive portion of the network.

Equalizing the driven element

To make this matching system work, the driven element must be slightly detuned (equalized) to provide the necessary reactance at the feedpoint. What does this mean in practice?

THE MULTIPLE RECEIVER SOLUTION



4 Channel Signal-to-Noise Voter

- Expandable to 32 Channel by Just Adding Cards
- Continuous Voting
- LED Indicators of COR and Voted Signals
- Built-in Calibrator
- Remote Voted Indicators Pinned Out
- 4 1/2 x 6 Double Sided Gold Plated 44 Pin Card
- Remote Disable Inputs
- MORE

Built, tested and calibrated with manual

\$350.00

Telephone interface now available
For more information call or write:

DOUG HALL ELECTRONICS
Voter Department
815 E. Hudson Street
Columbus, Ohio 43211
(614) 261-8871

✓ 140

THE RF CONNECTION

"SPECIALIST IN RF CONNECTORS AND COAX"

Part No.	Description	Price
321-11064-3	BNC 2 PST 28 volt coaxial relay, Amphenol Insertion loss: 0 to 0.75GHz, 0.10dB Power rating: 0 to 0.5GHz, 100 watts CW, 2 kw peak Isolation: 0.1 GHz/45dB, 0.2 GHz/40dB, 0.4 GHz/35dB	\$25 used tested
83-822	PL-259 Teflon, Amphenol	1.75
PL-259/ST	UHF Male Silver Teflon, USA	1.50
UG-21D/U	N Male RG-8, 213, 214, Amphenol	3.25
UG-21B/U	N Male RG-8, 213, 214, Kings	4.00
9913/PIN	N Male Pin for 9913, 9086, 8214 fits UG-21D/U & UG-21B/U N's	1.50
UG-21D/9913	N Male for RG-8 with 9913 Pin	3.95
UG-21B/9913	N Male for RG-8 with 9913 Pin	5.75
UG-146A/U	N Male to SO-239, Teflon USA	6.00
UG-83A/U	N Female to SO-239, Teflon USA	6.00

"THIS LIST REPRESENTS ONLY A FRACTION OF OUR HUGE INVENTORY"

THE R.F. CONNECTION
213 North Frederick Ave. #11
Gaithersburg, MD 20877

(301) 840-5477

VISA/MASTERCARD: Add 4%
Prices Do Not Include Shipping

✓ 141

Foreign Subscription Agents for Ham Radio Magazine

Ham Radio France
SM Electronic
20 bis, Ave des Clairons
F-89000 Auxerre
France

Ham Radio Canada
C.A.R.F.
P.O. Box 356
Kingston, ON
Canada K7L 4W2
Prices in Canadian funds
1 yr. \$38.00, 2 yrs. \$67.00
3 yrs. \$90.00

Ham Radio Japan
Katsumi Electronic Co., Ltd.
27-5 Ikegami
4 Chome, Ota-Ku
Tokyo 146, Japan
Telephone (03) 753-2405

Ham Radio England
c/o R.S.G.B.
Lambda House
Cranborne Road
Potters Bar
Herts EN6 3JW
England

By definition, when an antenna is detuned from one frequency it becomes resonant at another. For example, assume the driven element of a Yagi is resonant at 14.2 MHz, has a feedpoint resistance of 20 ohms, and you want to match it to a 50-ohm coax line. A frequency run of the antenna will resemble the SWR curve of Figure 5. At the resonant frequency, the minimum SWR value is 50/20, or 2.5:1. The

SWR gradually increases as the antenna is operated off frequency (Figure 5, curve A).

A Beta match is used at the feedpoint to reduce the SWR. The correct value of inductance is determined from the table and an appropriate coil is placed across the feedpoint. An SWR plot of the antenna is run across the 20-meter band and compared with the plot run without the coil. The driven ele-

ment and inductor combination are now resonant at 13.8 MHz instead of 14.2 MHz and minimum SWR is about 1.5:1 (Figure 5, curve B). Adding the matching inductor has lowered the indicated resonant frequency of the driven element by 400 kHz. Resonance is now outside the 20-meter band! The final step is to shorten the driven element to restore resonance at 14.2 MHz. Once you've done this, the minimum SWR at the resonant frequency will be very close to unity (Figure 5, curve C). Squeezing or expanding the coil turns a bit will drop the SWR curve "in the slot."

This procedure determines the correct length of the driven element indirectly, providing the required value of negative reactance at 14.2 MHz in order to make the matching system work as it should.

Is equalization necessary?

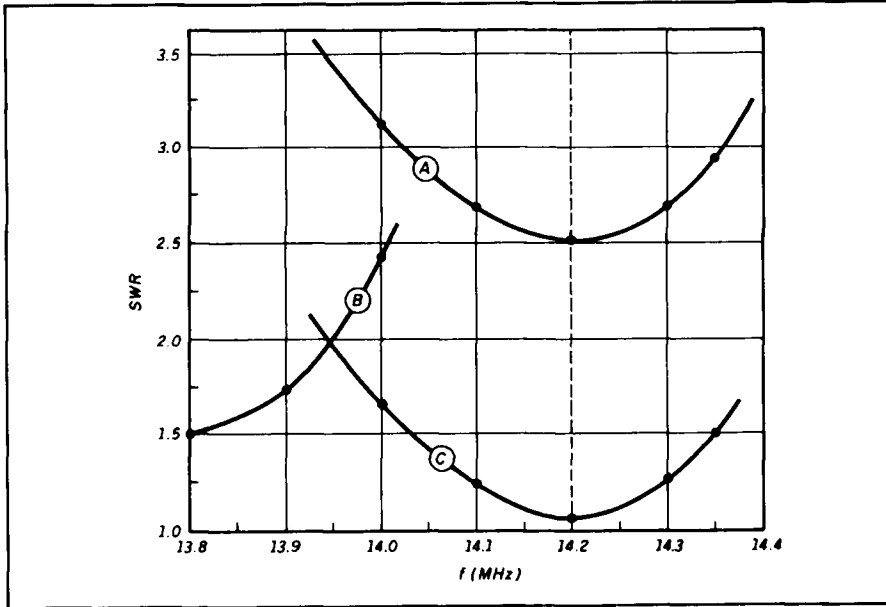
Equalization is necessary, especially with regard to solid-state transmitters that don't like to load into a transmission line having a high value of SWR. The amount of equalization required for the matching system to work depends upon the ratio of antenna feedpoint resistance to the coax line impedance. The greater the ratio, the more equalization (less coil inductance) required.

The problem is to determine the degree of shortening required to equalize the driven element. Very little information exists about the reactance change per unit of length for a Yagi driven element of a certain diameter. The reactance change is a function of frequency, element diameter, and taper. It generally amounts to a foot or more at 14 MHz, and correspondingly lesser amounts for the higher frequency bands. I challenge the readers of this column to come up with a computer program that relates reactance change of a half-wave element to the aforementioned parameters!

The adjustable Beta match

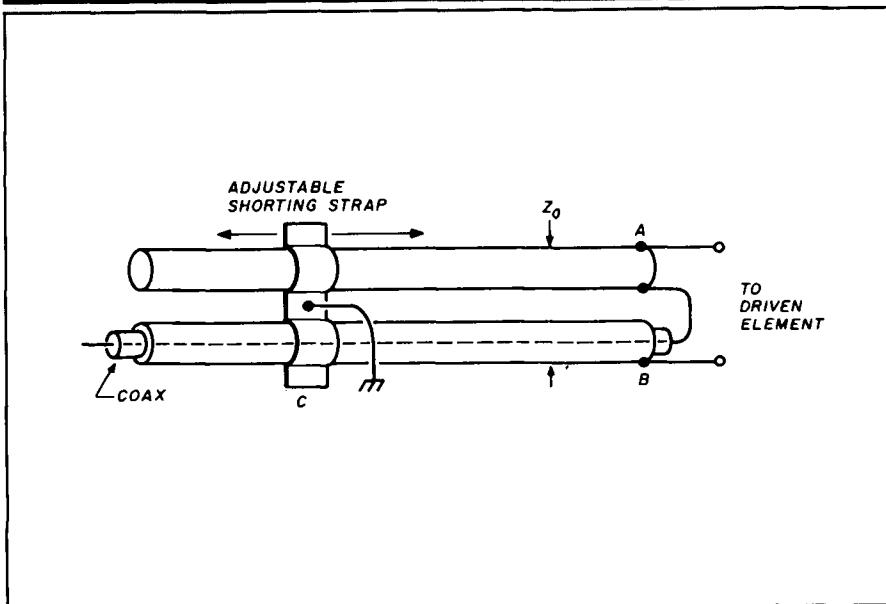
This relative of the hairpin match combines an adjustable impedance transformer with a balun. It's usable with antenna feedpoint impedances between 10 and 40 ohms. Basic operation follows that which is outlined for the hairpin match. The device is the parallel reactance portion of the L-network (Figure 6). The series reac-

FIGURE 5



Curve A shows SWR with a feedpoint resistance of 20 ohms. Curve B shows the SWR with parallel inductance added. Curve C shows the SWR with the driven element equalized.

FIGURE 6



Matching balun is constructed by passing coax down inside of one leg. The inner conductor is cross-connected to the other leg at the balanced feedpoint.

INTRODUCING OUR NEW COMPUTER-CONTROLLED REP-200 REPEATER

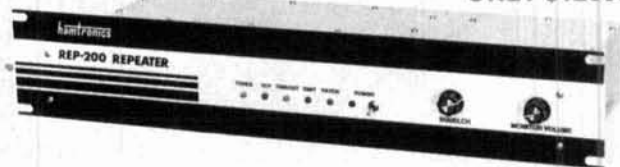
If you always thought a computer-controlled repeater had to be expensive, LOOK AGAIN! You could easily spend this much just for a controller.

As always, Hamtronics strives to give superb performance at modest cost! In this case, a premium repeater with versatile computer control, autopatch, and many dtmf control features at less than many charge for a bare-bones repeater!

We don't skimp on rf modules, either! Check the features on R144 Receiver, for instance. GaAs FET front-end, helical resonators, sharp crystal filters, hysteresis squelch.

We completely re-thought the whole idea of what a repeater should be, to give the best features at the lowest cost.

ONLY \$1295!



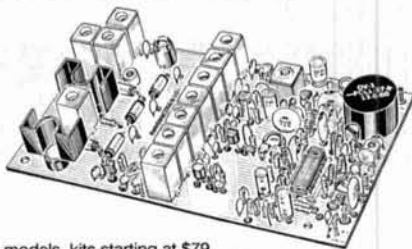
- Available for the 10M, 6M, 2M, 220MHz, 440MHz, 902MHz ham bands. FCC type accepted models also available for vhf and uhf commercial bands.
- Rugged exciter and PA, designed for continuous duty.
- Power output 15-18W (25W option) on 2M or hi-band; 15W on 220MHz; 10W on uhf or 902MHz.
- Accessory add-on PA's available with power levels up to 100W.
- Five courtesy beep types, including a pleasant multi-tone sequence.
- AUTOPATCH: either open or closed access, toll-call restrict, auto-disconnect.
- Reverse Autopatch, two types: auto-answer or ring tone on the air.
- DTMF CONTROL: over 45 functions can be controlled by touch-tone. Separate 4-digit control code for each function, plus extra 4-digit owner password.
- Owner can inhibit autopatch or repeater, enable either open- or closed-access for repeater or autopatch, and enable toll calls, reverse patch, kerchunk filter, site alarm, aux rcvr, and other options, including two auxiliary external circuits.
- The cwid message, dtmf command codes, and owner-specified default parameters for cor and cwid timers and tones are burned into the eeprom at the factory.
- Cw speed and tone, courtesy beep and tail timers, and courtesy beep type can all be changed at any time by owner-password-protected dtmf commands.
- Many built-in diagnostic & testing functions using microprocessor.
- Color coded led's indicate status of all major functions.
- Welded partitions for exciter, pa, receiver, and controller. PEM nuts for covers.
- 3-1/2 inch aluminum rack panel, finished in eggshell white and black.
- Auxiliary receiver input for independent control or cross linking repeaters.

There are many other features, too numerous to mention. Request catalog for full details.

HIGH PERFORMANCE XMTRS & RCVRs FOR REPEATERS, AF & DIGITAL LINKS, TELEMETRY, ETC.

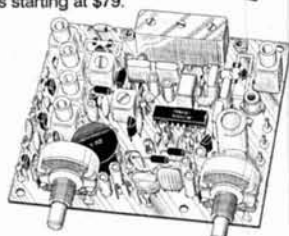
FM EXCITERS: kits \$99, w/t \$169. 2W continuous duty. TCXO & xtal oven options available. FCC type accepted for com'l uhf & hi bands.

- TA51 for 10M, 6M, 2M, 150-174, 220MHz.
- TA451 for uhf.
- TA901 for 902-928MHz, 0.5W out (w/t only, \$169).
- VHF & UHF AMPLIFIERS. For fm, ssb, atv. Output from 10W to 100W. Several models, kits starting at \$79.



FM RECEIVERS: kits \$139, w/t \$189.

- R144/R220 FM RECEIVERS for 2M, 150-174, or 220MHz. GaAs FET front end, 0.15uV sensitivity! Both crystal & ceramic if filters plus helical resonator front end for exceptional selectivity: >100dB at ±12kHz (best available anywhere!) Flutter-proof hysteresis squelch; afc tracks drift.
- R451 UHF FM RCVR, similar to above
- R901 902-928MHz FM RCVR. Triple-conversion, GaAs FET front end.
- R76 ECONOMY FM RCVR for 10M, 6M, 2M, 220MHz, w/o helical res. or afc. Kits \$129.
- Weather satellite & AM aircraft rcvrs also available.



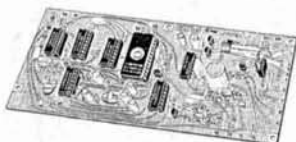
If you prefer a plain-vanilla or kit repeater, you couldn't find a better value than our original REP-100 REPEATER

Same fine rf modules as REP-200 but with COR-4 Controller. Can add autopatch, dtmf decoder, CTCSS, either now or later. Kit only \$675, w/t \$975.

ACCESSORIES

COR-3 REPEATER CONTROLLER kit. Features adjustable tail & time-out timers, solid-state relay, courtesy beep, and local speaker amplifier\$49

CWID kit. Diode programmed any time in the field, adjustable tone, speed, and timer, to go with COR-3\$59

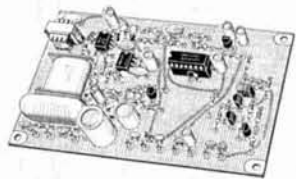


NEW COR-4 kit. Complete COR and CWID all on one board for easy construction. CMOS logic for low power consumption. Many new features. EPROM programmed; specify call ..\$99



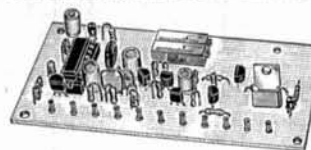
NEW TD-3 SUBAUDIBLE TONE DECODER/ENCODER kit. Adjustable for any tone. Designed especially for repeaters, with remote control activate/deactivate provisions\$24

TD-2 TOUCH-TONE DECODER/CONTROLLER kit. Full 16 digits, with toll-call restrictor, programmable. Can turn 5 functions on/off. Great for selective calling, too!\$79



AP-3 AUTOPATCH kit. Use with above for repeater autopatch. Reverse patch & phone line remote control are std. \$79

AP-2 SIMPLEX AUTOPATCH Timing Board kit. Use with above for simplex operation using a transceiver\$39



MO-202 FSK DATA MODULATOR kit. Run up to 1200 baud digital signals through any fm transmitter with full handshakes. Radio link computers, telemetry gear, etc.\$39

DE-202 FSK DEMODULATOR kit. For receive end of link.\$39

9600 BAUD DIGITAL RF LINKS. Low-cost packet networking system, consisting of new MO-96 Modem and special versions of our 220 or 450 mHz FM Transmitters and Receivers. Interface directly with most TNC's. Fast, diode-switched PA's output 15 or 50W. Call for more info on the right system for your application!

GaAs FET PREAMPS

at a fraction of the cost of comparable units!

LNG-(*)

ONLY \$59
wired/tested



FEATURES:

- Very low noise: 0.7dB vhf, 0.8dB uhf
- High gain: 13-20dB, depends on freq
- Wide dynamic range - resist overload
- Stable: low-feedback dual-gate FET
- *Specify tuning range: 26-30, 46-56, 137-150, 150-172, 210-230, 400-470, or 800-960 MHz.

LNW-(*)

MINIATURE GaAs FET PREAMP



ONLY \$24/kit, \$39 wired/tested

- GaAs FET Preamp similar to LNG, except designed for low cost & small size. Only 5/8" x 1-5/8" x 3/4". Easily mounts in many radios.
- *Specify tuning range: 25-35, 35-55, 55-90, 90-120, 120-150, 150-200, 200-270, or 400-500 MHz.

LNS-(*)

IN-LINE PREAMP

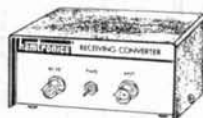


ONLY \$79/kit, \$99 wired/tested

- GaAs FET Preamp with features similar to LNG series, except automatically switches out of line during transmit. Use with base or mobile transceivers up to 25W. Tower mounting brackets incl.
- *Specify tuning range: 120-175, 200-240, or 400-500 MHz.

HELICAL RESONATOR PREAMPS

Preamps with 3 or 4 section helical resonators reduce intermod & cross-band interference in critical applications. MODEL HRA-(*) \$49 vhf, \$94 uhf. *Specify tuning range: 142-150, 150-162, 162-174, 213-233, 420-450, 450-470.



RECEIVING CONVERTERS

Low noise converters to receive vhf and uhf bands on a 10M receiver. Choice of kit with case & BNC jacks, kit with pcb only, or w/t unit in a case. Other models available for other in/out ranges & atv. Request catalog for complete listings. VHF input ranges avail: 136-138, 144-146, 145-147, 146-148, 220-222, 222-224; kit less case \$39, kit w/case \$59, w/t in case \$89. UHF input ranges avail: 432-434, 435-437; kit less case \$49, kit w/case \$69, w/t in case \$99. 902-928 MHz converts down to 422-448 or 430-450 range. Same price as uhf.

TRANSMITTING CONVERTERS

XV2 for vhf and XV4 for uhf. Models to convert 10M ssb, cw, fm, etc. to 6M, 2M, 220, 432, 435, and for atv. 1W output. Kit only \$79. PA's up to 45W available. Request catalog for complete listings.

OUR 27TH YEAR!

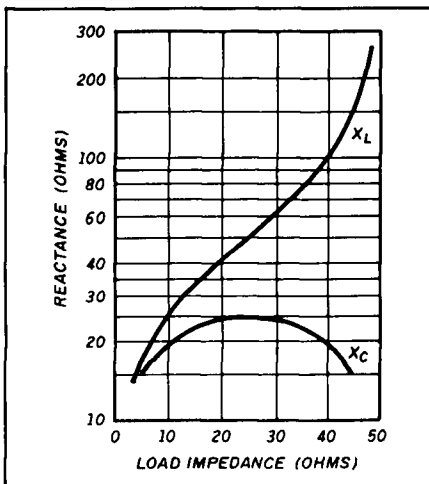
hamtronics, inc.

65 MOUL RD. - HILTON NY 14468-9535
Phone: 716-392-9430 -- FAX: 716-392-9420

Hamtronics is a registered trademark. Copyright 1989, Hamtronics, Inc. All rights reserved.

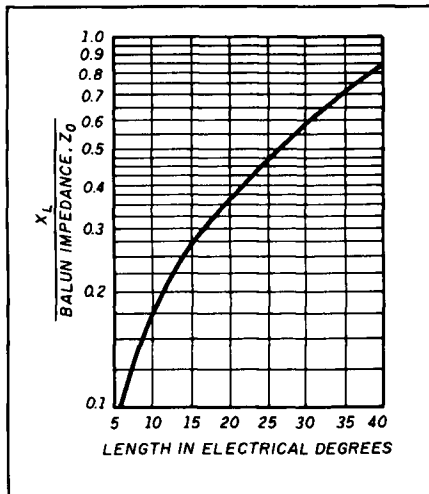
- For complete info, call or write for FREE 40-page catalog. Send \$2 for overseas air mail. For casual interest, check reader service; allow 3-4 weeks.
- Order by mail, fax, or phone (answering machine off hrs).
- Min. \$3 S&H charge for first pound plus add'l weight & ins.
- Use VISA, Mastercard, check, or UPS C.O.D. (\$3 fee).

FIGURE 7



Inductive and capacitive values for antenna equalization when 50-ohm coax line is used.

FIGURE 8



Electrical length of balun in degrees as a function of inductive shunt element (XL) to balun impedance (Zo).

tance is attained by shortening the driven element.

The network is converted to a balun as shown in the drawing. Points A and B of the linear balun are balanced to ground. The unbalanced coax line is brought into the balun through one of the balun tubes, with the center conductor of the coax crossing over at the antenna end of the balun to contact the opposite balun tube. This device provides both excellent balance and transformer action when you adjust the shorting bar at the opposite end of the balun and the length of the driven element.

Balance is achieved by permitting the outer shield of the coax line to assume the potential of the balun tube

as it passes from the grounded end (C) to the terminal end (B). Cross connecting the center conductor to the opposite balun leg at A ensures the desired 180-degree phase reversal is achieved.

Once the transformation ratio and the values of series and parallel reactance have been determined, the balun is designed from transmission line formulas. The relationship between the balun parameters and the driven element is given in Figures 7 and 8. A plot of the ratio

$$\frac{X_L}{Z_0}$$

in terms of line length for 20 meters is provided in Figure 9.

You can build a practical balun of 3/8-inch diameter thin wall copper tubing. A center conductor of RG-8A/U or RG-213 coax will just pass through the tubing when the braid and vinyl jacket have been removed. Using a center-to-center spacing of 3 inches for the tubes, you'll form a balanced line having a characteristic impedance of about 325 ohms.

Designing the Beta match

Assume the coax is 50 ohms and the Yagi feedpoint resistance at resonance is 20 ohms. In Figure 7, the value of X_c is -245 ohms and the value of X_l is 41.5 ohms. Figure 8 shows that the ratio of X_l to balun impedance is $41.5/325=0.127$, as read on the Y-axis. The balun length, as read on the X-axis, is about 7.5 electrical degrees. To get

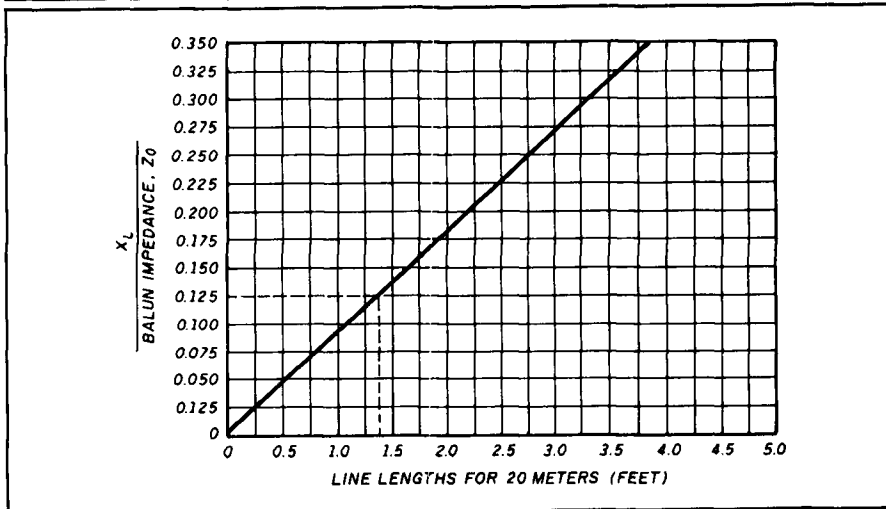
the answer directly in feet, use Figure 9 for the 20-meter band. In this example, the balun length is about 1.4 feet, or 17 inches, for a ratio of 0.127 (read on the Y-axis).

The series reactance value (X_c) of -245 ohms is achieved by shortening the driven element. It would be nice if this value could be computed, rather than determined by the heuristic (cut-and-try) technique. As I mentioned before, it's about a foot for 20 meters.

Elevated radials work! Good news for 160-meter DXers!

In my April and October 1988 columns I reported on the work of Doty, Adler, and others in computing and testing the practicality of using a few above-ground radials in place of buried radials, or a ground screen for low frequency vertical antennas. The May 24, 1989 issue of *Radio World*¹ reports that in November 1988 a full-scale AM antenna system was tested in Newburgh, New York under the direction of Clarence M. Beverage of Communication Technologies, Inc. The test frequency was 1580 kHz. The facility consisted of a 120-foot guyed tower with the base insulator 15 feet above ground. An elevated ground system consisting of six quarter-wave radials was used. The tests were conducted under a special field test authorization provided by the FCC.

FIGURE 9



Balun conversion chart for 20 meters. Balun length in feet may be determined if feedpoint resistance, shunt reactance, and balun impedance are known.

here is the next generation Repeater
2 meters - 220 - 440

MARK 4CR

The **only** repeaters and controllers
with REAL SPEECH!

No other repeaters or controllers match Mark 4 in capability and features. That's why Mark 4 is the performance leader at amateur and commercial repeater sites around the world. Only Mark 4 gives you Message Master™ real speech • voice readout of received signal strength, deviation, and frequency error • 4-channel receiver voting • clock time announcements and function control • 7-helical filter receiver • extensive phone patch functions. Unlike others, Mark 4 even includes power supply and a handsome cabinet.

NEW OPTION

RS-232 for Repeater Control
using MODEM or Packet TNC

Create messages just by talking. Speak any phrases or words in any languages or dialect and *your own voice* is stored instantly in solid-state memory. Perfect for emergency warnings, club news bulletins, and DX alerts. Create unique ID and tail messages, and the ultimate in a real speech user mailbox — only with a Mark 4.



Call or write for specifications on the
repeater, controller, and receiver winners.



MICRO CONTROL SPECIALTIES

Division of Kendecom Inc.
23 Elm Park, Groveland, MA 01834 (508) 372-3442

FAX

508-373-7304

138

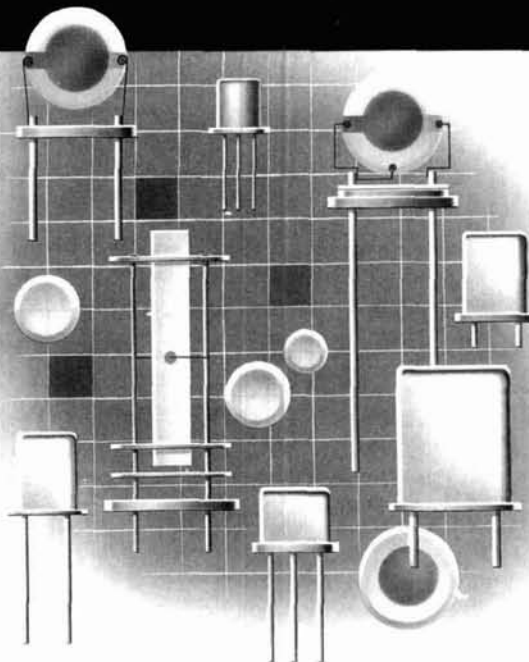
CUSTOM CRYSTALS

Crystals for many applications

For over 37 years, ICM has manufactured the finest in quartz crystals for every conceivable purpose.

A wide selection of holders are available to fit most any requirement. Our computer database contains crystal parameters for thousands of equipment types.

Need crystals for communications, telemetry, industrial, or scientific applications? Let ICM's sales department assist you to determine which type of crystal is best for you.



Can we solve your crystal problem?

For special purpose crystals, special holders, special sizes, call our crystal sales department. We will be pleased to provide recommended data.



International Crystal
Manufacturing Co., Inc.

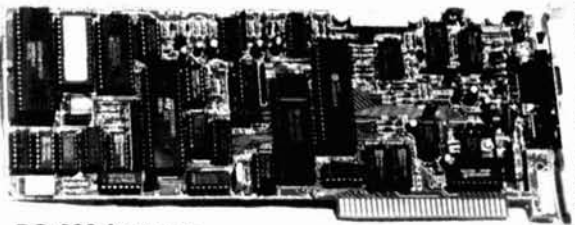
P.O. Box 26330, 701 W. Sheridan,
Oklahoma City, OK 73126-0330
Phone (405) 236-3741
Telex 747-147
Facsimile (405) 235-1904



PacComm

- Advanced Technology
- Enduring Value

New! PC-320 / TNC-320 PACKET CONTROLLERS



PC-320 features . . .

- Dual modems for optimal VHF and HF operation.
- Appears as regular PC serial port (COM 1-4) - operates with any terminal program just like an external TNC.
- Dual Powered - operates from PC or external power. Continues complete operation even when the PC is turned off!
- Personal Message System - the most advanced personal mailbox available... included at no extra charge.
- Displays on-screen HF tuning indicator and simulated LEDs.

Announcing the next generation of packet controllers for the serious operator!

The new inboard PC-320 (shown), is designed to work with all PC/XT, PC/AT, and Tandy 1000 series computers. The TNC-320 outboard controller offers many of the same high quality features!

PC-320

\$209⁹⁵

TNC-320... **\$194.95**

(Wired & Tested / 1 Year Warranty)

For complete info & specifications Call (813) 874-2980. To Order, Call

Toll Free: 1-800-223-3511

Major Credit Cards Accepted!

PacComm • 3652 West Cypress Street • Tampa, Florida 33607

Please send PC-320 TNC-320 More Information FREE Catalog

Name _____ Call _____

Address _____

State _____ Zip _____ Card# _____ Exp. Date _____

MONEY BACK GUARANTEE! Add \$4.00 shipping handling per order. FL residents add 6% sales tax. Major Credit Card give number, expiration and signature. FAX: 813-872-8696

✓ 133

BLACK DACRON® POLYESTER ANTENNA ROPE

- UV-PROTECTED
- HIGH ABRASION RESISTANCE
- REQUIRES NO EXPENSIVE POTTING HEADS
- EASY TO TIE & UNTIE KNOTS
- EASY TO CUT WITH OUR HOT KNIFE
- SIZES: 3/32" 3/16" 5/16"
- SATISFIED CUSTOMERS DECLARE EXCELLENCE THROUGHOUT U.S.A.

LET US INTRODUCE OUR DACRON® ROPE TO YOU • SEND YOUR NAME AND ADDRESS AND WE'LL SEND YOU FREE SAMPLES OF EACH SIZE AND COMPLETE ORDERING INFORMATION.

Dealer Inquiries Invited



MANUFACTURED BY: 2472 EASTMAN AVE., BUILDING 21
VENTURA, CALIFORNIA 93003
(805) 658-7903

✓ 136



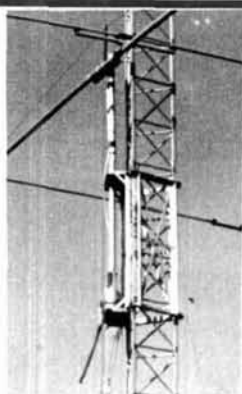
R-7000 Widespan Panadaptor

Panadaptor especially designed for the R-7000 receiver. For use with a standard scope. Variable span width from 1 to 10 Mhz. Uncover unknown elusive signals. Complete with all cables, & 90 day warranty. \$349.95 Shipped. Pa. res. add 6%.

GTI Electronics

RD 1 BOX 272
Leighton, Pa. 18235
717-386-4032

✓ 137



ENJOY THE BEST DX

Martin Towers And Hazer

Never climb again with this tower and elevator system. MARTIN TOWERS are made of aluminum and specifically engineered for use with THE HAZER. All bolted construction, no welds. Easy to install hinge base, walk up erection, next plumb with leveling bolts in base. Mount antennas and rotor on HAZER in vertical upright position, then winch to top of tower for normal operating position. Guy wires fasten to HAZER or above HAZER at top of tower. Safety lock system operates while raising or lowering. Never can fall. Photo above shows HAZER midway on tower.

SPECIAL tower package prices include everything but rotor and antenna: 50' M-18 alum. tower kit form, hinged base, concrete footing section, HAZER kit, Phillystran guy wires, turnbuckles, earth screw anchors, 10' mast, thrust bearing, tool kit, rated at 15 sq ft antenna load @ 70 MPH. \$1925.95 FOB Boonville.

50' M-13 alum tower, same pkg as above	\$1637.95
40' M-13 alum tower, same pkg as above	1463.80
30' M-13 alum tower, same pkg as above	1294.25
HAZER 2 for Rohn 25 - Hvy duty alum. 12 sq ft wind lid	311.95
HAZER 3 for Rohn 25 - Std alum. 8 sq ft wind load	223.95
HAZER 4 for Rohn 25 - Hvy galv stl 16 sq ft wind load	291.95

Satisfaction guaranteed. Call today and charge to Visa, MasterCard or mail check or money order.

GLEN MARTIN ENGINEERING, INC.
Rte 3, Box 322
Boonville, MO 65223
(816) 882-2734 FAX 816-882-7200



✓ 134

NEW SUPER LONG PLAY TAPE RECORDERS

12 Hour Model — \$119.00*
USES D-120 TAPE

Modified Panasonic Slimline, high quality, AC-DC Recorders provide 6 continuous hours of quality recording & playback on each side of cassette for a total of 12 hours. Built-in features include • Voice level control, • Digital counter, etc. TDK DC 120 Cassette Furnished.



PHONE RECORDING ADAPTER

Records calls automatically. All Solid state connects to your telephone jack and tape recorder. Starts recording when phone is lifted. Stops when you hang up. \$28.50*
FCC APPROVED



VOX VOICE ACTIVATED CONTROL SWITCH

Solid state. Self contained. Adjustable sensitivity. Voices or other sounds automatically activate and control recorder. Uses either recorder or remote mike. \$28.50*
*Add for ship & hdg. Phone Adapter & Vox \$1.50 ea. Recorders \$4.00 ea. Cal. Res. add tax. Mail order, VISA, M/C, COD's OK. Money Back Guarantee. Qty. disc. avail. Dealer Inquiries Invited. Free data.



AMC SALES INC. Dept. 9335 Lubec St., Box 928, Downey, CA 90241 Phone (213) 869-8519

✓ 135

QRV Slinky

Indoor Antenna

for Apartment, Motel, Attic, & Portable Use

Small • Simple • Fast • Versatile • Effective • Complete with 18 ft Decorator white feedline & all transparent mounting hooks, line, and suction cups for installation anywhere.

Suspend in attic, basement, bedroom, hallway, staircase—horizontal, vertical or bent. (Inl. - \$1.00)

Extend in a minute. Zip out of sight in an instant.

Work all bands 40-10 w/ \$19.95 80-meter \$6.95
a 15' indoor antenna - \$39.95 Add-on

AntennasWest Box 3062, Priddy, UT 84668 801-373-8425

Field measurements run on the antenna showed that the radiated field was equal to that obtained from a 105-foot tower and a traditional ground system of 120 quarter-wave buried radial wires. The observed data confirmed theoretical data as computed through the use of a mathematical modeling technique called the "Method of Moments."

This is good news for low frequency operators partial to vertical antennas! The elevated radial system is thought to provide superior performance when compared with the buried ground system because it allows the collection of electromagnetic energy in the form of displacement currents, rather than induction currents in the earth. In addition, the elevated ground system is less susceptible to changes in ground conditions caused by variation in moisture content in the earth.

It was determined that a frequency of 1200 kHz would require radial elevation of 20 feet and that 680-kHz operation would require elevation of 35 feet. Accordingly, 160-meter operation would allow a radial height of somewhat less than 15 feet. I hope the FCC will authorize the use of above-ground radials in the broadcast service quickly. Meanwhile, what are you waiting for? **hr**


REFERENCES

1. *Radio World*, a controlled-circulation publication of Industrial Marketing Advisory Services, Inc., 5827 Columbia Pike, Suite 310, Falls Church, Virginia 22041.

PRESENTING

THE K1FO 12 ELEMENT 144 MHz YAGI

Model FO-12-144



ELECTRICAL SPECIFICATIONS:
 Measured gain 12.6 dBS
 E-Plane beamwidth 34 deg
 H-Plane beamwidth 37 deg
 Side-lobe attenuation
 1st E-Plane -18 dB
 1st H-Plane -15 dB
 SWR 1:1.3 typical
 F/B ratio 22 dB
 Impedance 50 ohm

MECHANICAL SPECIFICATIONS:
 Length 17ft 4in
 Boom 1.375" 6061 T-6 Aluminum
 Elements 1/4" Aluminum rod
 Wind Survival 120+ MPH
 Mast up to 2" diameter
 Element Insulators Black Delrin
 Stainless Steel hardware
 (except 1/2 bolts)
 Coax connector N-Type

\$134.95

ALSO AVAILABLE
 FO-16-220, FO-22-432, FO-25-432, FO-33-432, FO-11-440
 POWER DIVIDERS STACKING FRAMES

We supply those hard to find parts for the home builder
 1/4" Delrin insulators \$15/100, Stainless keepers \$13/100
 Add \$5 UPS SH for each antenna
 \$7 west of Mississippi
 PA residents add 6% state sales tax

RUTLAND ARRAYS

1703 Warren Street • New Cumberland, PA 17070
 (717) 774-5298 7-10 P.M. EST
 Dealer inquiries are invited

ATV CONVERTERS • HF LINEAR AMPLIFIERS

DISCOVER THE WORLD OF FAST SCAN TELEVISION



AMATEUR TELEVISION CONVERTERS

ATV2 420-450	\$44.95 Kit
ATV3 420-450 (GaAs-FET)	\$49.95 Kit
ATV4 902-928 (GaAs-FET)	\$59.95 Kit

AUDIO SQUELCH CONTROL for ATV

SIL	\$39.95 Kit
-----	-------------

2 METER VHF AMPLIFIERS

35 Watt Model 335A	\$79.95 Kit
75 Watt Model 875A	\$119.95 Kit

Available in kit or wired/tested

HF AMPLIFIERS per MOTOROLA BULLETINS

Complete Parts List for HF Amplifiers Described in the MOTOROLA Bulletins.

AN758 300W \$160.70	EB63 140W \$88.65
AN762 140W \$93.25	EB77A 300W \$139.20
AN791 20W \$83.79	EB104 600W \$448.15
AN770H 20W \$93.19	AR305 300W \$383.52
AR313 300W \$403.00	

NEW!! 1K WATT 2-50 MHz Amplifier

POWER SPLITTERS and COMBINERS

2-30MHz	\$69.95
600 Watt PEP 2-Port	\$79.95
1200 Watt PEP 4-Port	\$89.95

100 WATT 420-450 MHz PUSH-PULL LINEAR AMPLIFIER - 5SB-FM-ATV

KEB67-PK (Kit)	\$220.25
KEB67-PCB (PC Board)	\$18.00
KEB67-I (Manual)	\$5.00

For detailed information and prices, call or write for our free catalog.

We ship worldwide.



CCI Communication Concepts Inc.

508 Millstone Drive • Xenia, Ohio 45385 • (513) 426-8600
 FAX (513) 426-3811



WE SHIP WORLDWIDE

UNIVERSAL DIGITAL FREQUENCY READOUT

YK-1 (Wired/tested) \$149.95

REPEATER CONTROLLER

RC-1000 (Wired/tested) \$239.95

HEAT SINK MATERIAL

Model 90 Heat Sink (6.5x12x1.6) \$22.00
 CHS-6 Copper Spreader (6x6x1/4) \$18.00

We also stock Hard-to-Find parts

CHIP CAPS - Kemet/ATC

METAL CLAD MICA CAPS - Unesco/Semco

RF POWER TRANSISTORS

MINI-CIRCUIT MIXERS

SBL-1 (1-500MHz) \$6.50

SBL-1X (10-1000MHz) \$7.95

ARCO TRIMMER CAPACITORS

VK200-20/4B RF Choke \$1.20

56-590-66-3B Ferrite Bead \$1.20

Broadband HF Transformers \$1.20

Add \$3.50 for shipping and handling.

"The Epitome of Excellence"



Elevate the status of your repeater with the RC-850 Repeater Controller.

Ever heard a really great repeater? One that sounds superb? Is fun to use? And benefits its users through its wealth of interactive features? Chances are, it's controlled by an ACC RC-850 Repeater Controller. Because more discriminating repeater owners choose ACC controllers for their systems than any other. And the 850 leads the industry in performance.

The '850 is extensively programmable, using interactive Touch-Tone entry and voice response, or a computer terminal. All *remotely!* From access codes to its operating schedule, nearly everything can be easily changed.

The patch supports local and radio-linked phone lines. A three-tiered system offers flexibility in call routing, assignment of privileges and control. The 250 autodial slots support even the largest groups.

The Touch-Tone activated mailbox lets users leave messages for each other. The *system* will leave you messages if you miss a reverse patch or alarm. Paging support includes all popular tone formats so users can always be available without having to listen.

Multi-band linking extends your repeater's range, ties your repeater to others for emergency and public service activities, and lets you benefit from the elevation of your repeater site for working all bands. Individual user codes offer secure access to selected functions to bar unauthorized use.

The top-of-the-line '850 distinguishes itself as a stellar performer on hundreds of repeaters. And it can do the same for you. Learn more about how to enrich your repeater system by contacting us directly.



advanced computer controls, inc.

2356 Walsh Avenue, Santa Clara, CA 95051 (408) 727-3330

AN INEXPENSIVE VFO

FOR THE YAESU FT-102

The basis of this circuit is a solid-state Franklin oscillator

By Robert H. Armstrong, VE3RF, 55 Birchview Road, Nepean, Ontario, Canada K2G 3G3

How would you like an external VFO for your Yaesu FT-102 that doesn't require any modifications or cost a small fortune? Mine uses the transceiver's digital readout, works on either or both transmit and receive, and drifts so little you'll need a frequency standard to measure it. Interested? Read on.

How it all started

In 1982 I bought a Yaesu FT-102 as a Christmas present (for myself). I got the AM/FM board and some crystal filters for CW and SSB, but I couldn't go the extra \$500 or more for an external VFO. Not only was there not a "plain vanilla" VFO available, but the \$500 one had memories, scanning functions, and a veritable calliope of bells and whistles. Besides, I couldn't see any real need for split frequency at that time.

Everything went beautifully until the 10-meter band started to open up this past year. I suddenly discovered that the 10-meter FM band required 100-kHz splits, and I didn't have that capability. I remembered an ad for the FV-102DM external VFO, which stated that the correct operating frequency was always displayed on the FT-102 digital readout. If I could do that I wouldn't need a fancy dial on the external VFO.

Fortunately, I had purchased a technical supplement for my FT-102 when they were available, although at the time I thought the price (about \$25) was atrocious. Since then I've installed all the relevant mods, repaired the receiver preamp switch, and replaced a defective meter.

Digging into my supplements, I discovered the connections for the external VFO plug, and learned that I could indeed use the internal digital readout to display the fre-

quency of an external VFO. This plug is an eight-pin DIN plug, type B (P1 in the schematic). There are two types of eight-pin DIN plugs. Naturally, according to Murphy's Law, I got the wrong one first. The correct plug is the nonsymmetrical one. (See **Figure 1**). Notice also that the pin numbering is not what one would consider normal — not me anyhow.

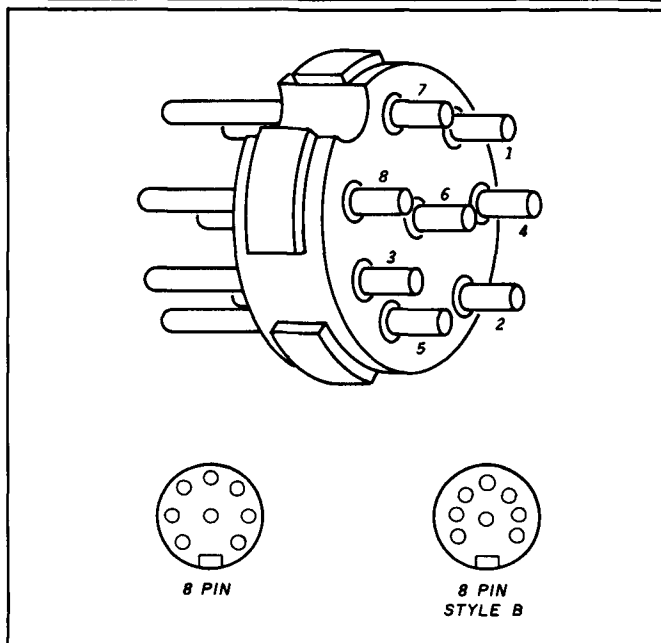
Developing the ideal VFO

Armed with all this technical information on how to connect the external VFO plug, I started looking for a suitable circuit. My ideal was preferably without coil taps, and certainly without parallel capacitors — too big to be air spaced, which could ruin the tuned circuit Q. I wasn't having much luck, until I came across the circuit for the Franklin oscillator in the *RSGB Handbook*. This is reproduced in **Figure 2A**.

The Franklin oscillator has no large capacitors paralleling the tuned circuit, and no taps on the coil. Only a pair of small coupling capacitors connects the coil to the oscillator circuit. It's an astable oscillator (multivibrator to us old-timers). The tuned circuit is in parallel with one of the crossed feedback lines, where it offers a high impedance across the line at the resonant frequency, and a low impedance at all other frequencies.

This looked interesting so I built an FET circuit on a proto-board, scaling the drain resistors to work with an 8-volt supply. The circuit is shown in **Figure 2B**. Note the similarity to the original tube circuit. I had to increase the coupling capacitors to 10 pF to ensure reliable oscillation at that voltage. This oscillator delivered 1.3 volts p-p at about 1000-ohms impedance. This was too high for the FT-102, which requires 200 mV p-p at 50 ohms. I followed it with a Darlington emitter follower to lower the impedance and a lowpass filter simi-

FIGURE 1



Eight-pin DIN plug showing pin numbering. Type B is the correct plug.

TABLE 1

Function of the pins of the FT-102 rear panel connector marked EXT VFO and RCVR — A.

This connector is an eight-pin DIN type B female connector. It is called J7 on the schematic diagram of the complete FT-102 transceiver, and is in the upper left corner of the diagram. Attached to pin 1 of J7 is an unlabeled DPDT switch. It operates when a connector is inserted into J7. It removes the 8-volt DC bias from the internal VFO signal, turning off the diode-switching circuit which normally accepts the internal VFO signal. If you plug a blank DIN connector into J7, the digital display blanks out. The 8-volt input to the internal VFO is connected to pin 1 of J7 when a connector is inserted.

J7 pin functions

1. Internal VFO enable input. Eight volts must be applied to pin 1 to enable the internal VFO when a plug is inserted.
2. Twelve volts output from the transceiver. The maximum available current is 300 mA.
3. Output, 500 kHz. Adds 500 kHz to digital display when required. An example is the 28.5 to 29-MHz band (not used).
4. TX 12 volts. Twelve volts is supplied to this pin by the transceiver in the transmit mode.
5. CW 8 volts. Eight volts is supplied to this pin by the transceiver in CW mode (not used).
6. External VFO input. Requires 200-mV p-p at 50 ohms impedance.
7. Chassis ground.
8. Sample of VFO input selected (not used).

lar to the one Yaesu uses for the internal oscillator. The overall output is about 220 mV p-p at 50 ohms.

Power and control circuitry

The VFO is powered from the FT-102. A 12-volt source is available on pin 2 of the external VFO connector (see

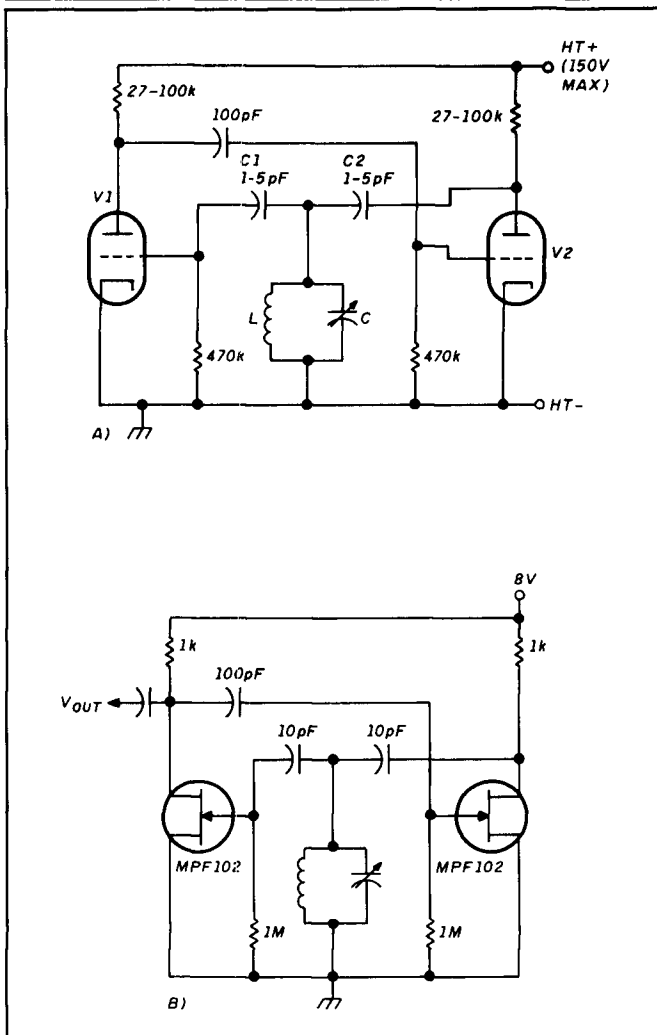
Table 1). The VFO measured current is 55 mA, well within the available 300-mA maximum. A 7808 voltage regulator reduces the 12 volts supplied to the 8 volts desired. This is a bit of "overkill;" the 7808 will handle better than 1 A, so it doesn't need a heat sink. You can replace the 7808 with an LM317 adjustable regulator. The LM317 may be easier to find, and requires only two external resistors to program it. This circuit is shown at the bottom of the schematic in Figure 3.

The FT-102 has another 12-volt output available on transmit only. This powers an SPDT relay which switches the 8-volt supply to provide both a receive-only and a transmit-only voltage. These switch the VFO diode circuits in the FT-102 and are selected with the front panel EXTERNAL/INTERNAL toggle switches. I could have done this with CMOS logic, but I had the relay on hand. The complete circuit of the VFO is shown in Figure 3.

Mechanical construction

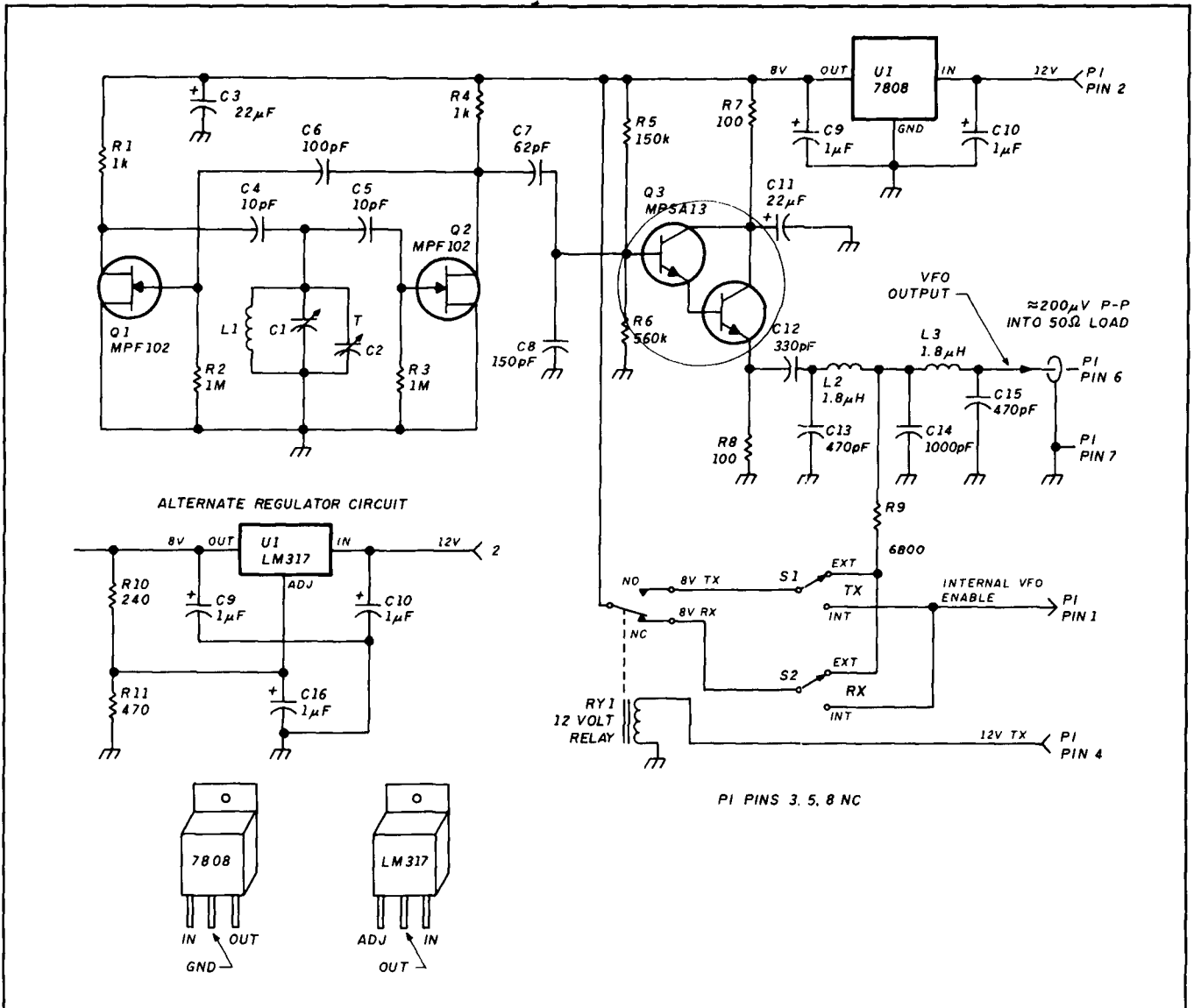
- **Tuned circuits.** Now that I'd designed the VFO, I had to build it. I measured a military surplus coil on a 1-3/8 inch

FIGURE 2



Original diagram of the Franklin oscillator reproduced from the RSGB Handbook (A). The same circuit modified for FETs is shown in B.

FIGURE 3



Schematic diagram for the FT-102 external VFO.

ceramic form; it had $6.8\ \mu\text{H}$ inductance. I used an FM-tuning capacitor that had been in the junkbox for a couple of years. It had three sections which, when connected in parallel, produced 30-pF capacitance change. This enabled a frequency shift that exceeds the required 5.0 to 5.5-MHz VFO frequency range slightly. A 150-pF air-spaced, screwdriver-adjusted trimmer capacitor completes the tuned circuit.

- **Circuit board assembly.** Keeping as much room as possible around the coil, I mounted the tuning and trimmer capacitors in one end of the cabinet and assembled the electronic parts on top of them. I don't usually build pc boards for my projects as they are one-of-a-kind things. I used a universal circuit board and assembled this circuit at the right side of the cabinet. You don't need to take any special precautions. Just be sure to make the assembly as mechanically stable as possible.
- **Reduction gear and tuning capacitor.** One aluminum bracket holds the 3:1 reduction gear for the dial; another

ties from this to the back of the case as a support for the tuning capacitor. I bent both brackets to fit the cabinet by hand and assembled them with nuts, bolts, and lock-washers. My leads are as short and direct as possible. All ground leads in the oscillator circuit are connected to a common ground at the frame of the tuning capacitor. I used an insulated coupling between the tuning capacitor and the dial to avoid hand capacitance effects. The coil is raised to the center of the clear space with spacers, in keeping with the idea of having everything clear of the coil by a distance at least that of the coil diameter. This is necessary to obtain a high-Q tuned circuit.

- **Dial readout.** If you look at Photo A, you'll notice that the dial reads backwards. This is because the VFO frequency is subtracted from other frequencies in the FT-102. If you have a double shaft tuning capacitor, arrange it to have maximum capacitance at the clockwise end of the dial. This will make it read forward. The dial consists of a paper scale behind a plastic plate. The

Panasonic
RFB-65
SWL Receiver
with SSB

The Price **\$279**

MA. ★

TEL-COM★

Electronic Communications

NEW ENGLAND'S FACTORY-
AUTHORIZED SALES & SERVICE

FOR

KENWOOD  **ICOM**

Also displaying the popular accessories needed to complete a HAM STATION . . .

- ARRL PUBLICATIONS • AEA PRODUCTS • AMPHENOL
- ALPHA DELTA • ASTRON • AUSTIN ANTENNAS • AVANTI
- BELDEN • BENCHER • B & W • DAIWA • ALINCO
- HUSTLER • KLM • LARSEN • MIRAGE • ROHN
- TELEX/HY-GAIN • TOKYO HY-POWER LABS
- TRAC KEYS • VIBROPLEX • WELZ • ETC.

OPEN SIX DAYS A WEEK   WELCOMED

Telephone 508/486-3400, 3040

675 Great Rd., (Rte. 119) Littleton, MA 01460

1/4 miles from Rte. 495 (Exit 31) toward Groton, Mass.

NEW!
PK-232 BMX

New Features
including mailbox

\$349.95

129



WEATHER SOFTWARE

ACCU-WEATHER FORECASTER is a menu driven program that allows the user to tap into Accu-Weather's extensive computerized database. In addition to Accu-Weather's forecasts, you can get hourly updates from National Weather Service Offices nationwide.

Maps, graphs, pictures, charts, and narrative descriptions are just part of what can be downloaded to your MS-DOS computer. To save telephone and hook-up charges, tell your computer first exactly what information you want. Then call ACCU-WEATHER; the computer will download the files you want and save them to disk. Information can be obtained for the entire United States or a specific geographical region.

Several different services are available from ACCU-WEATHER. Price varies with the service and time of day that the computer is accessed. Add \$3.50 for shipping and handling.

- MC-IBM \$89.95
- MC-MAC \$89.95

Please enclose \$3.75 shipping & handling

**HAM
RADIO BOOKSTORE**

GREENVILLE, NH 03048

603-878-1441



Make the
most of your
general
coverage
transceiver
with
*Monitoring
Times!*

Every month Monitoring Times brings everything you need to make the most of your general coverage transceiver: the latest information on international broadcasting schedules, frequency listings, international DX reports, propagation charts, and tips on how to hear the rare stations. Monitoring Times also keeps you up to date on government, military, police and fire networks, as well as tips on monitoring everything from air-to-ground and ship-to-shore signals to radioteletype, facsimile and space communications.

ORDER YOUR SUBSCRIPTION TODAY before another issue goes by. In the U.S., 1 year, \$18; foreign and Canada, 1 year, \$26. For a sample issue, send \$2 (foreign, send 5 IRCs). For MC/VISA orders (\$15 minimum), call 1-704-837-9200.

MONITORING TIMES

Your authoritative source,
every month.

P.O. Box 98 A
Brasstown, N.C. 28902

128

BATTERIES "R" US...

You've bought our replacement batteries before...
NOW YOU CAN BUY DIRECT FROM US, THE MANUFACTURER!



ICOM
 CM2, PB2 7.2v @ 500MAH
 CM5, PB5 10.8v @ 500MAH
 SUPER
 7S 13.2v @ 1200 MAH \$63.95
 8S 9.6V @ 1200 MAH \$59.95
 (base charge only-1" longer)
 ICOM CHARGERS AVAILABLE SOON

NOVEMBER SPECIAL

Replacement for
 ICOM BC-35 Rapid
 Charger for all
 ICOM BATTERIES —
 Normally \$68.95

This month \$59.95!

Look for
DECEMBER'S special.



YAESU/MAXON
 FNB-10 7.2v @ 600MAH
 FNB-12 12v @ 500MAH
 FNB-10(S) 7.2v @ 1000MAH
 NEW
 FNB-12 12v @ 500MAH
 FNB-12(S) 12v @ 600MAH
 the above is equivalent to FNB-11
 (1/2" shorter)
 *same size case as FNB-12
 NOW
 P4W 11V @ 500MAH - \$20.95
 FNB-2 11v @ 500MAH - \$20.95



CUSTOM MADE BATTERY PACKS & INSERTS
 Made to your specifications.
 Introductory Offer!
KENWOOD INSERTS
 PB-21-\$13.75, PB-25-\$20.00,
 PB-26-\$20.00
ICOM INSERTS
 BP-5-\$23.00, BP-3-\$17.45,
 BP-7, BP-8

Prices subject to change without notice.



MasterCard and Visa
 cards accepted. NYS
 residents add 8 1/4%
 sales tax. Add \$3.50
 for postage and
 handling.



**SOURCE FOR ALL YOUR COMMUNICATION
 BATTERY REPLACEMENT NEEDS.**

W & W ASSOCIATES

29-11 Parsons Boulevard, Flushing, N.Y. 11354

WORLD WIDE DISTRIBUTORSHIPS AVAILABLE. PLEASE INQUIRE.

**MADE IN
 THE USA**

Send for
 free catalog
 & price list!

In U.S. & Canada Call Toll Free (800) 221-0732 • IN NYS (718) 961-2103 • Telex: 51060 16795 • FAX: (718) 461-1978

✓ 150

Hi Pro Repeaters ELCO

MAGGIORE ELECTRONIC LAB.

Manufacturers of Quality Communications Equipment

- Repeaters
- Links
- Remote Base
- VHF, UHF
- Receivers
- Transmitters
- Antennas



- Standard and Computerized Controllers
- Standard and Computerized Auto Patches
- Duplexers

Hi Pro 'E' EXPANDABLE REPEATER SYSTEM

- A NEW CONCEPT IN REPEATER DESIGN, THE Hi Pro "E" IS AN EXPANDABLE REPEATER WITH THE FOLLOWING FEATURES: A BASIC REPEATER WHICH WOULD INCLUDE A COMPLETE RECEIVER, TRANSMITTER, COR, FRONT PANEL CONTROLS AND INDICATORS, LOCAL SPEAKER AND MIC JACK AND CAPABLE OF FUTURE EXPANSION. ALL HOUSED IN AN EXTREMELY RUGGED, ENCLOSED, 19-INCH RACK MOUNTABLE CABINET.
- THIS SYSTEM CAN BE EXPANDED AT TIME OF PURCHASE OR CAN BE AN AFTER-PURCHASE ADD ON. THE ADD ONS ARE—HIGHER POWER, 110/220 VAC POWER SUPPLY, IDENTIFIER, AUTO PATCH, OR COMPUTER CONTROLLERS. IN ADDITION TO THESE ADD ONS AN ADDITIONAL RECEIVER AND TRANSMITTER CAN BE MOUNTED INTERNALLY FOR USE AS CONTROL LINKS, REMOTE BASE OR DUAL BAND OPERATION, ETC.
- AN EXTENSION PANEL IS AVAILABLE FOR LOCAL MONITORING OF THE REPEATER AND CONTAINS ALL NECESSARY METERING, STATUS LIGHTS AND INDICATORS. ALL ADD ONS ARE AVAILABLE FROM THE COMPANY AND ARE COMPLETE INCLUDING INSTRUCTIONS.

MAGGIORE ELECTRONIC LAB.

600 Westtown Rd.

West Chester, PA 19382

Phone (215) 436-6051



Telex 499 0741 MELCO
 FAX 215-436-6268

WRITE OR CALL FOR OUR COMPLETE CATALOG

PARTS LIST

Capacitors

- C1 Tuning capacitor, should be air spaced, approximately 50 pF maximum (see text)
C2 Trimmer capacitor, air spaced, 150 pF maximum
C3,C11 22- μ F tantalum, 10 volts
C4,C5 10-pF silver mica
C6 100-pF mica preferred, ceramic otherwise
C7 62-pF mica or ceramic (see text)
C8 150-pF mica or ceramic (see text)
C9,C10,C16 1- μ F tantalum, 10 volts, Radio Shack 272-1434
C12 330-pF mica or ceramic
C13,C15 470-pF mica or ceramic
C14 100-pF mica or ceramic

Inductors

- L1 6.8 μ H, 16 turns of no. 16 tinned copper wire on 1-3/8 inch diameter ceramic form, coil length 1-1/8 inches
L2,L3 1.8 μ H, 13 turns of no. 24 enameled wire on FT 50-61 core.

Resistors (all 1/4 watt)

- R1,R4 1000
R2,R3 1 meg
R5 150 k
R6 560 k
R7,R8 100
R9 6800
R10 240, R10 and R11 required only if LM317 voltage regulator is used
R11 470

Miscellaneous

- Q1,Q2 MPF-102 or 2N3819 N-channel JFET, Radio Shack 276-2035
Q3 MPSA30 Darlington transistor, Radio Shack 276-1631 is an assortment of six Darlingtons
U1 7808 voltage regulator, substitute LM317 (see Figure 4), LM317 is Radio Shack 276-1778
RY1 SPDT contacts, 12-volt coil, Radio Shack 275-241 or 275-213 (DPDT)
S1,S2 SPDT toggle switches, Radio Shack 275-625
P1 Eight-contact DIN plug (type B), Armaco type DD 8281 (should be available from Yaesu as a replacement part for the FV-102DM synthesized VFO), Yaesu USA, 17210 Edwards Road, Cerritos, California 90701.

The cable to the P1 plug requires one shielded and three unshielded leads. I made it about 2 feet long.

The cabinet I used is a Hammond type 1426KB. It measures 4" high by 6" wide by 5" deep. You can order this cabinet from: Hammond Manufacturing Company, 394 Edinburgh Road, Guelph, Ontario, Canada N1H 1E5, or 1690 Walden Avenue, Buffalo, New York 14225

PHOTO A



Front view of the VFO with the cover removed showing the DIN plug and the circuit diagram inside the lid.

PHOTO B



Left-side view of the VFO showing component placement.

pointer is a no. 16 tinned copper wire attached to the vernier drive mechanism.

- **External VFO calibration.** Toggle switches S1 and S2 select either internal and/or external VFO for transmit and receive. It's only necessary to provide rudimentary calibration on the external VFO. I placed only the 100-kHz marks on the dial for frequency selection, as the exact frequency is displayed on the FT-102 digital readout. See Photos B and C for internal parts placement.

Parts substitution

If you're like me, you'll want to change a few things. Very few of the parts are critical. Perhaps the most important are the two 10-pF capacitors that couple the frequency-determining tuned circuit into the oscillator. These should be the best capacitors you can get. I used silver mica, but ceramic disc capacitors would probably do. The tuning capacitor and trimmer are both air-spaced capacitors; nothing less should be used for these. I used tantalum bypass capacitors because they are good high frequency caps. The 1- μ F capacitors at the regulator should be

mounted as close to the regulator as practical because the regulator contains a high gain amplifier that will oscillate if not well bypassed.

I wound L2 and L3 on ferrite cores salvaged from a Jerrold CATV amplifier. Realizing that these wouldn't be reproducible, I got an FT50-61 core and wound another on it. It required 13 turns of no. 24 enameled wire for 1.8 μ H. The universal pc board I used is similar to Radio Shack's 276-158.

SATELLITE ESSENTIALS

Satellite TV is still full of the wonderment that made it so popular in the early '80s. The tinkerers are there, the programming is there, and never has the cost of becoming a dish owner been so low.

So, how do you find out about this exciting entertainment?

Through publications devoted specifically to satellite TV, that's how!

OnSat

America's Weekly Guide To Satellite TV

OnSat is unsurpassed for the most up-to-date listings of satellite programming. Dr. Dish, Mailbag, and the Transponder Service Watch are all geared to help you make the best use of your satellite TV system. A sample issue can be obtained for only \$1.

STV GUIDE

The Complete Monthly Guide To Satellite TV

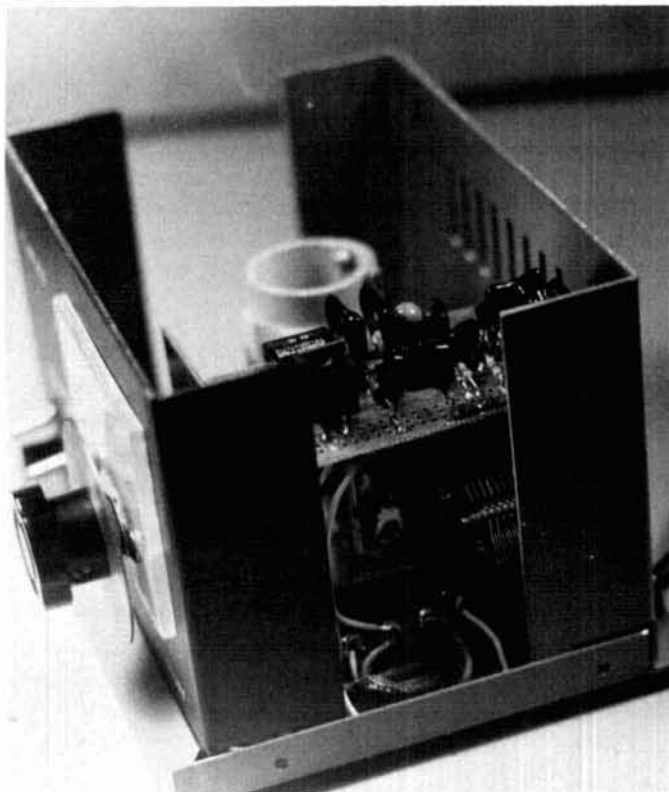
STV Guide contains over 300 pages of programming information, product reviews, home troubleshooting, and information about satellite TV. A sample issue can be obtained for only \$2.

Both OnSat and STV Guide contain listings for over 120 channels and Prime Time Grids for over 50 channels. Subscribe to either the weekly OnSat or the monthly STV Guide for only \$48 per year.

To start receiving the best in satellite TV guides and information, call toll-free (800) 234-0021. VISA® and MasterCard® accepted.

STV Guide/OnSat
PO Box 2384 • Shelby, NC 28151-2384

PHOTO C




Right-side view of the VFO showing trimmer capacitor mounted at rear of cabinet.

Testing and calibration

The two capacitors at the oscillator output (C7 and C8) form a voltage divider to reduce the oscillator output. Make C8 larger if you have too much output, or smaller if there's too little output. Measure the output at pin 6 of the DIN plug, loaded with a 50-ohm resistor, or plugged into the FT-102. It should be approximately 200-mV p-p.

Calibration is simplicity itself. Warm up the FT-102 on the 40-meter band with the external VFO attached for at least five minutes. Switch the RX switch on the VFO to the external position and set the tuning capacitor to maximum capacitance. Adjust the trimmer until the FT-102 digital readout reads slightly lower than 7000 kHz. Tune the VFO to the other end of its dial. The frequency should read slightly more than 7500 kHz. A reading lower than this would indicate that there's not enough variation of capacitance in the tuning capacitor; a much higher frequency would mean there's too much variation. Mine tunes from 6955 to 7525 kHz. You could also use a digital frequency counter to read the frequency.

Remember that it's backwards, so a VFO frequency of 5500 kHz corresponds to 7000 kHz, and 5000 kHz corresponds to 7500 kHz. If your counter requires more than the 200 mV at the output, there's more than 1 volt available at the drain of Q2 — although the counter may change the oscillator frequency by a few hertz.

When you've finished your work, but before you button up the cabinet, glue a schematic diagram inside the lid of the case. In five years time, you'll have forgotten all the circuit details and will need the diagram for servicing. 

● ● ● ● ●

Factory Authorized Dealer & Service For

KENWOOD YAESU ICOM

**Call Us For
Great Prices & Great Service**

TOLL FREE ORDER LINE 1-800-344-3144
Continental U.S. & Texas

KENDAM, INC. **THE HAM CENTER** SAN ANTONIO TEXAS
SALES AMATEUR RADIO SERVICE

5707A Mobud San Antonio, Texas 78238 (512) 680-6110
FAX (512) 647-8007

✓ 121

SMART REPEATER & LINK CONTROLLER

- DTMF MUTING
- INTELLIGENT ID'ER
- AUXILIARY OUTPUTS
- EASY TO INTERFACE
- REPEATER & LINK COURTESY TONES
 - LOW POWER, 22ma @12V
- TELEMETRY RESPONSE TONES
- ALARM MONITOR INPUT
- SYNTHESIZED LINK/REMOTE BASE CAPABILITY WITH OPTIONAL PI-10/S SYNTHESIZER BOARD

SRC-10 — \$149.00/PI-10/S — \$39.00

REPEATER/LINK AUDIO MIXER INTERFACE

- FIVE AUDIO INPUTS
- THREE ADJUSTABLE AUDIO OUTPUTS
- CTCSS DECODER ON UAI-20 ONLY
- CONTROLLED DTMF ROUTING
- LOW POWER, 19ma @ 12V
- EASY TO INTERFACE
- LINK MONITOR-MIX/MONITOR MUTE CONTROL

UAI-10 — \$44.00/UAI-20 — \$89.00
**ASSEMBLED & TESTED
ONE YEAR WARRANTY**

CREATIVE CONTROL PRODUCTS

3185 Bunting Avenue
Grand Junction, CO 81504
(303) 434-9405

VISA

✓ 122

LOGWRITE™

Bring your station into the computer age with LOGWRITE, the menu driven, user friendly logging program written by Ed Troy (NG3V). LOGWRITE is the perfect accessory for the complete ham station. It simplifies your operation and gives you the competitive edge in contesting and DX'ing. LOGWRITE works with all IBM PC's and compatibles.

LOGWRITE's unique split screen feature allows for simultaneous logging and text processing. Logging features include:

- Instant call sign or prefix search
- Print, Edit, or View records
- Plenty of room for notes & addresses
- Automatic time/date stamping

Text processor features automatic word wrap, backspace correct, and scrolling. Throw away your pen and paper!

To order your copy of LOGWRITE, complete with instruction manual, send \$24.95 (Pa. residents add \$1.50 sales tax) to:

Aerospace Consulting
P.O. Box 536, Buckingham, PA 18912

Or call (215) 345-7184 to order with Visa/Mastercard. (Please specify 3.5 or 5.25 inch floppy.)

✓ 123

WE SHIP WORLDWIDE

Barry Electronics Corp.

WORLD WIDE AMATEUR RADIO SINCE 1950
Your one source for all Radio Equipment!

BARRY ELECTRONICS



Gobble Up Our Thanksgiving Savings

SEE You November 12th—Radio Central's HAMEXPO '89, Seiden, NY

KENWOOD



TS-440S2AT, R-5000, R-7000, TS-1940 S/AT, TM-271A/K31A, TM-2570A/250A/30A, TR-751A, Kenwood Service Repair, TM-731A, TS-1718/11A, TM-3530A, TH-205AT, TH-215A, TM-621A, TM-331A, TS-1405, TS-8805, RZ-1, TS-790A

Butwig ANT. Products
NEL-TECH DVK-100 Digital Voice Keyer
FLUXE 77, 83, 85, 87 Multimeters

Media Mentors—
Amateur Radio Course

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

MICROLOG-ART 1, Air Disk, SWL, Morse Coach

Professional Soldering Station
48 Watts
\$79

METRON KW HF Mobile Amplifier
Stocked

Alpha Delta Products
Stocked

EIMAC
3-500Z
572B, 6J56C
12BY7A &
6146B

BIRD
Wattmeters &
Elements
In Stock

AEA 144 MHz
AEA 220 MHz
AEA 440 MHz
ANTENNAS

KITTY SAYS: WE ARE NOW OPEN 7 DAYS A WEEK.
Saturday & Sunday 10 to 5 P.M.
Monday-Friday 9 to 6:30 PM Thurs. to 8 PM
Come to Barry's for the best buys in town.



ONV Safety belts-in stock

FT-767GX, FT-757GXII, FT-747GX, FRG-8800, FT-736R, FRG-9600, FT-1020, FT-4700RH, FT 212/712RH, FT-470

YAESU FT-2973/33 FT11-811 FT11-811 FTH-1903/1123 FTH-2005/7005

ICOM IC2AT/12AT IC20AT/32AT IC29GAT IC-ADU116

Landmobile HT's ICOM UHF HT's V100 U1000 MAXON MOTOROLA YAESU FTH-2005/2007 UNIDEN REGENCY KING MARINE K2M W/ AMP M730 AVIATION COM AGO H 1 TAD

AMPLIFIERS STOCKED: RF Concepts Mirage TE Systems



IC-32AT Motorola Radius P-100 TH-75AT FT-470

ALINCO DJ-500T, DR-110T

FREQUENCY COUNTERS: INBU-15GHZ

COMMERCIAL & HAM REPEATERS STOCKED: WRITE FOR QUOTES

Kantronics KAM KPC II, KPC-2400, KPC-IV, KAM

MOTOROLA AUTHORIZED DEALER
KACHINA COMMUNICATIONS DEALER

AUTHORIZED
SONY
DEALER

DIGITAL FREQUENCY COUNTERS
OPTOELECTRONICS model 1300 H/A, 0-1300MHz/2210 H, 0-2200 MHz

Long range Wireless Telephones for export in stock

BENCHER PADDLES
BALUNS, LOW PASS FILTERS
IN STOCK

MIRAGE AMPLIFIERS
ASTRON POWER SUPPLIES
Belden Wire & Cable, Int'l Wire
OPTO KEYERS STOCKED

MAIL ALL ORDERS TO: BARRY ELECTRONICS CORP., 512 BROADWAY, NEW YORK CITY, NY 10012 (FOUR BLOCKS NORTH OF CANAL ST.)

**New York City's LARGEST STOCKING HAM DEALER
COMPLETE REPAIR LAB ON PREMISES**

“Aquí Se Habla Español!”
BARRY INTERNATIONAL TELEX 12-7670
MERCHANDISE TAKEN ON CONSIGNMENT FOR TOP PRICES
Monday-Friday 9 A.M. to 6:30 P.M. Thursday to 8 P.M.
Saturday & Sunday 10 A.M. to 5 P.M. (Free Parking)
IRT/LEX: Spring St. Station. Subways: BMT-Prince St. Station. IND-F: Train-Bwy Station.
Bus: Broadway #6 to Spring St. Path-9th St./6th Ave. Station.

COMMERCIAL RADIOS STOCKED: ICOM, Motorola, MAXON, Standard, Yaesu. We serve municipalities, businesses, Civil Defense, etc. Portables, mobile's, base's, repeaters.

ALL SALES FINAL

For the best buys in town call: 212-925-7000
Los Precios Mas Bajos en Nueva York
WE SHIP WORLDWIDE!



IC-R71A, 751A, 781, 28AH, 36A, 48A, Micro214, R-7000, IC-765, IC-375A, 275AH, 3210A, 475AH, 735, IC-901, IC-228H, IC725, IC-2400A

SMART PATCH

CES Simplex Autopatch 510-SA W/ Patch FM Transceiver To Your Telephone Great For Telephone Calls From Mobile To Base Simple To Use 510SA/SDP-50

PRIVATE PATCH V, Duplex 8000

TUNERS STOCKED: NYE MBV-A 3 Killowatt Tuner



MFM-989C

Covercraft, Coaxial Stocked

SHORTWAVE RECEIVERS STOCKED

Ten-Tec Tuner 238

COMET ANTENNAS STOCKED

HEIL EQUIPMENT IN STOCK

SANGEAN Portable Shortwave Radios

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

New TEN-TEC Corsair II, PARAGON, OMNI V

SIX Towers, Antennas, Mobile Radio mounts stocked, call.

AMERITRON AUTHORIZED DEALER

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



✓ 123

COLLAPSIBLE QUAD FOR 10-METER HILLTOPPING

By L. B. Cebik, W4RNL, 2414 Fair Drive, Knoxville, Tennessee 37918

Ten meter activity is at a peak and the availability of small rigs like the HTX-100, the President, and the Ranger make wilderness portable operation more interesting than ever. Of course the weak link in the system is almost always the antenna. Mobile antennas are inefficient. Beams are too large for easy transport, even when they're broken down. Dipoles have to be hung. This usually means mounting them low to the ground, unless someone is willing to climb a tree.

The collapsible one-element quad described here provides most of the features hilltoppers want in an antenna:

- The quad loop shows high efficiency and, as a bonus, relative immunity from the effects of surrounding objects.
- Even at a 10-foot elevation, the quad shows a good bidirectional pattern.
- The antenna width is less than 9 feet and ideal for erecting in tight spaces (like between two cars).
- The antenna goes from storage to use (and back again) in less than 10 minutes — including rig tune-up.
- The quad collapses without disassembly into a package about 8" x 6" x 5-1/2' for easy transport.
- Except for a female coax connector (SO-239) and a scrap of plastic, all parts for the antenna are available from the hardware store.

Electrically, there's nothing new in the collapsible quad. It's cut to the textbook formula that defines the quad's length in feet as 1005 divided by the frequency in megahertz. With a target frequency of 28.5 MHz, the overall loop is about 35-1/4' long or about 8'9" on a side. A quad loop at least a half wavelength above ground has a feedpoint impedance of about 120 ohms, a factor I'll discuss later.

Building the collapsible quad

The traditional way to build a quad is to use an X support with a single piece of wire around the perimeter. The hilltopper uses a different mechanical scheme. As **Figure**

1 shows, the antenna uses a PVC center support, aluminum L-stock horizontal elements, and wire vertical elements. The PVC pipe mounts over standard TV masts.

The PVC center support consists of two 5' pieces of rigid PVC plumbing pipe. The top piece is 1" diameter; the bottom piece is 1-1/4" diameter. This gives you an outside diameter of 1-5/16" for the top piece and an inside diameter of 1-3/8" for the bottom piece. They nest easily and loosely.

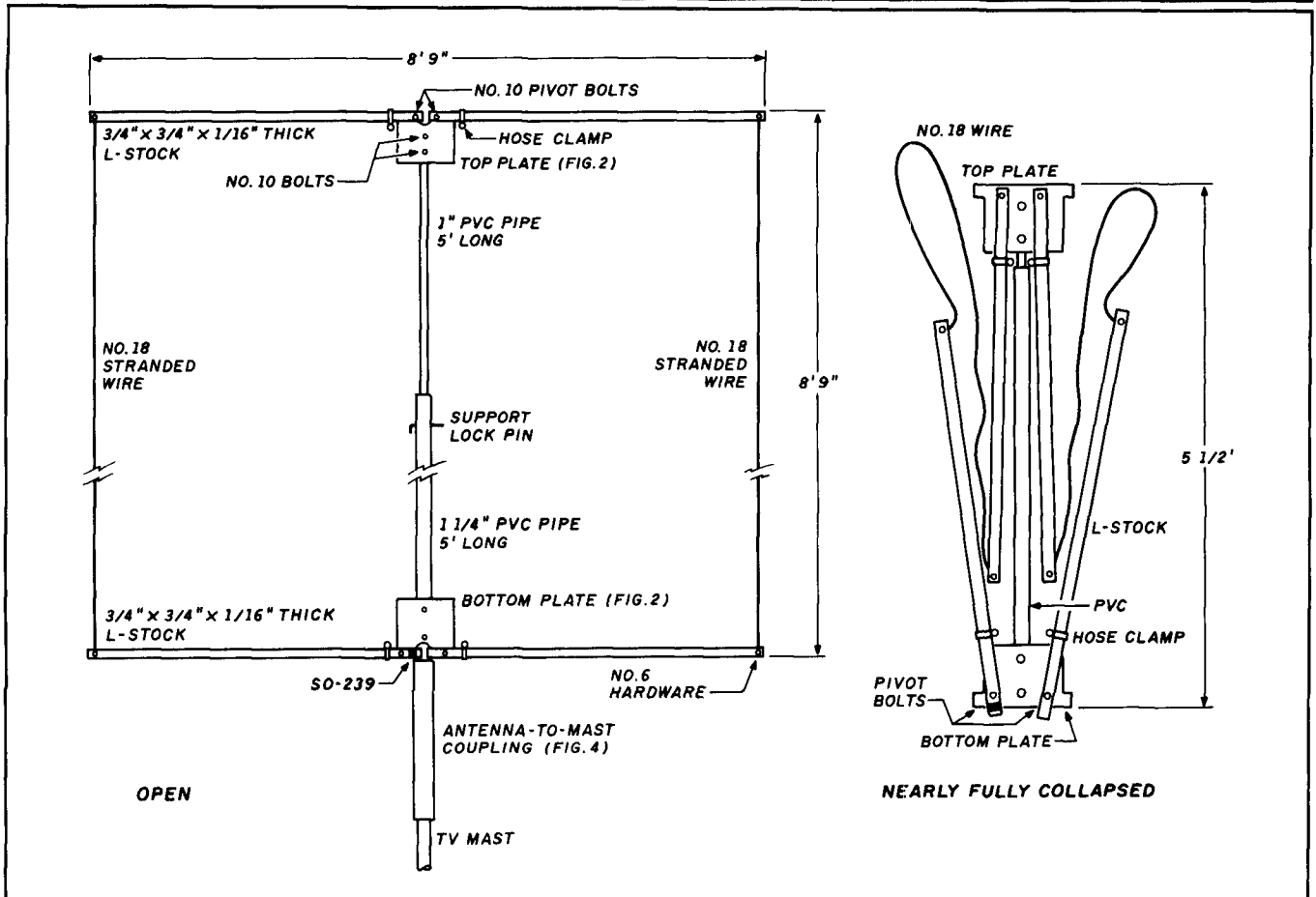
Mount an acrylic plate cut to the dimensions shown in **Figure 2** on each PVC section. A pair of no. 10 bolts and nuts per plate provide more than enough strength to hold the plates securely. I cut my plates from 3/16" scrap taken from a protector designed to go under an office chair. Use care when cutting the 1" x 3/4" wings to prevent stress cracks. Drill a small (1/8" to 3/16") hole at the inside corner and then cut to the corner. If you use a sabre saw, work slowly to prevent the hot plastic chips from binding the cut closed.

Drill the plate-to-PVC holes about 1-1/2" from the top and bottom of the plate. Drill holes for no. 10 hardware which will form the pivot points for collapsing the antenna elements in line with the wings. One-inch hose clamps slip over the L stock elements and onto the plastic wings to lock the horizontal elements in place. Squeeze the clamps to partially shape them to the odd element configuration.

Because each horizontal element is 4' 4-1/2" long, use 4 pieces of 3/4" x 3/4" x 1/16" thick aluminum L stock. I used 8' sections (Ease, Inc. no. 2207) and have enough left over for a 6-meter quad loop. Mount each element to the plate with no. 10 hardware, leaving a 1/8" gap between them. Make a bridge piece for the top section from no. 18 wire, ring connectors, and no. 6 hardware. Note the orientation of the L stock. The flat side of the L should face toward the center of the antenna, not outward. This provides good strength in the direction of tension from the side wires.

At the center of the bottom element, use a chassis punch

FIGURE 1



Overall view of the quad loop, open and collapsed.

to cut a 5/8" diameter hole in one of the pieces for a modified SO-239. Be sure to leave enough room between the SO-239 threads and the L stock wall for the screw-on sleeve of the male connector. Cut off two opposing mounting hole corners from the female coax connector and file the cut edges smooth. Using the two remaining mounting holes, mount the connector to one side of the bottom horizontal element. On the prototype the connector is outside the no. 10 pivot hardware. If you widen the pivot points on the bottom section plate, there may be room to mount it close to the center gap between the two element pieces. Drill the other L stock section at the gap for no. 6 hardware. Make a no. 18 wire bridge and put a ring connector on one end. Solder the other end to the coax center pin.

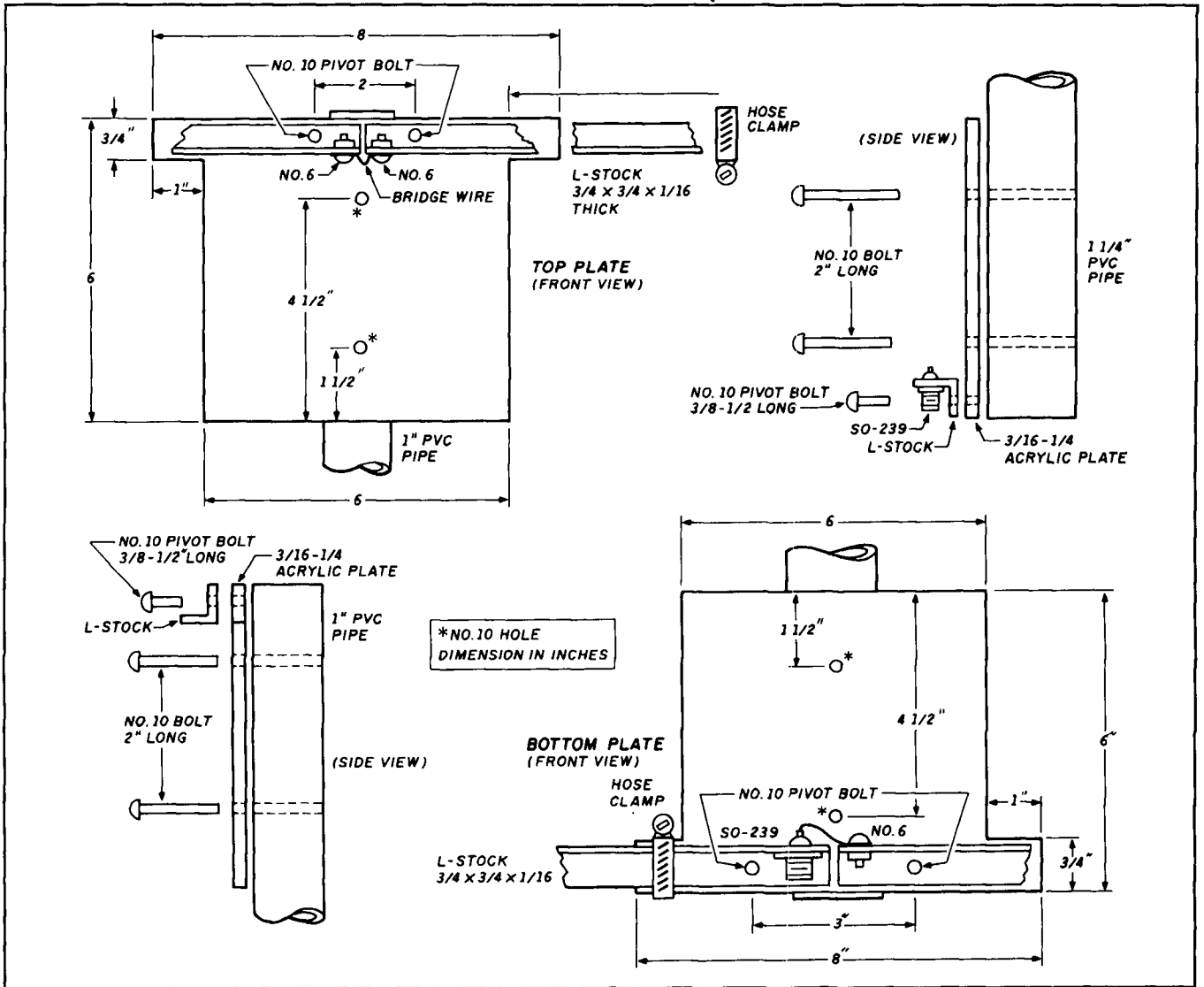
Cut two pieces of wire (no. 18 insulated stranded wire works well), each 8'9" long. Solder ring connectors to each end. Drill the vertical side of the L stock at each corner for no. 6 hardware. Be sure the hose clamps are attached to the four pieces of L stock. Slide the top PVC section inside the bottom section, then connect the vertical wires to each side.

To complete the basic antenna, drill a hole through the two PVC sections at the center. Lay the antenna on a flat surface like a driveway or a basement floor. Extend the horizontal elements and lock them by tightening the hose clamps over the wings and securing the pivot hardware.

PARTS LIST

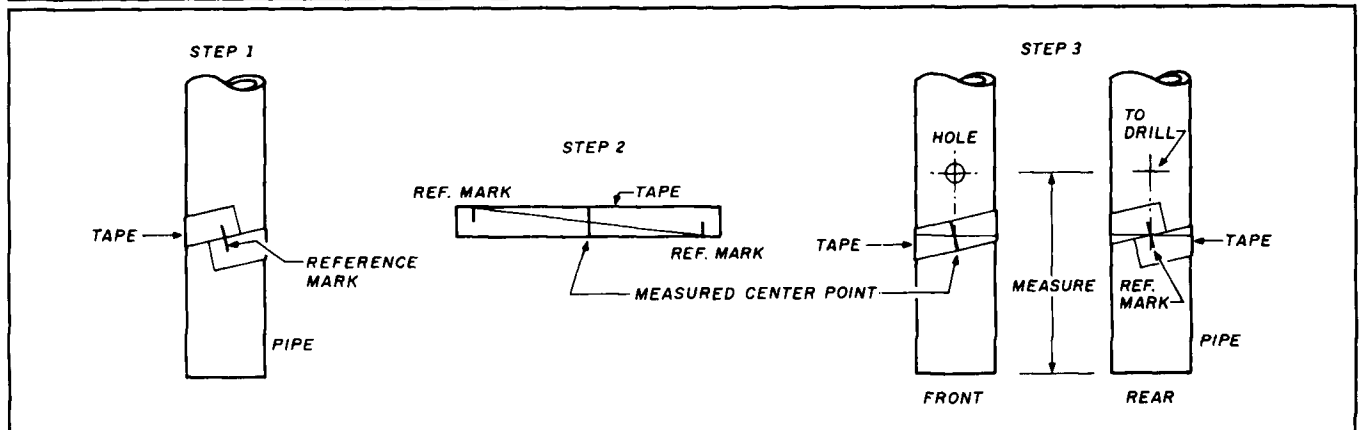
Number Required	Item	Source
4	3/4" x 3/4" x 1/16" thick aluminum L stock (angle stock), each piece at least 5' long	hardware store
4	stainless steel hose clamps, 1" diameter	hardware store
2	acrylic plates, 3/16" (or more) thick, 6" x 6", with 3/4" x 1" wings	scrap
18'	no. 18 stranded copper wire, insulated	Radio Shack
1	5 feet of 1" PVC-1120 rigid pipe	hardware store
1	5 feet of 1-1/4" PVC-1120 rigid pipe (Note: small additional lengths are needed for the antenna-to-mast coupling described in the text.)	hardware store
5	no. 10 bolts, at least 2" long, with nuts	hardware store
4	no. 10 bolts, 3/8" long, with nuts (pivots)	hardware store
7	no. 6 machine screws, 3/8" long, with nuts	hardware store
2	no. 4 machine screws and nuts for coax connector	hardware store
7	ring connectors	Radio Shack
1	SO-239 female coax connector (modified)	Radio Shack
2	5 foot TV masts	Radio Shack
1	1-1/4" inside diameter crutch tip	hardware store
45'	1/8" to 3/16" diameter rope	hardware store

FIGURE 2



Top and bottom acrylic plate detail.

FIGURE 3



A simple method for drilling PVC pipe.

Extend the PVC sections until there's light tension on the L stock as the wire side elements reach their limit. Mark the inner pipe at this point. Make a vertical alignment mark on both pieces so the final product will be a flat plane.

Drill a hole through both pipes to fit a bolt or other pin. I use an old L-shaped Allen wrench a bit over 1/8" in diameter. Using a drill press will assure that you'll have well-centered holes. For free-hand holes, drill through one side of each PVC pipe only, preferably at the alignment mark. Using the larger pipe, wrap a piece of masking tape around the pipe at a slight angle so that the left edge of one end meets the right edge of the other, as shown in **Figure 3, Step 1**. Make a mark across the two edges. Remove the tape and spread it on a plate. Measure the exact center between the two marks, as shown in **Step 2**. Now follow **Step 3** and replace the tape, aligning the center mark with the first hole you drilled. The drill line is where the other marks meet on the other side of the pipe. Measure the distance from the pipe end of the first hole and mark an equal distance on the reverse side. The cross hairs mark the point to drill. Use a very short bolt to hold the first inner and outer holes together and drill through the second outer hole to complete the passage for the pin.

Opening and closing the completed antenna

Place the completed antenna on the floor to practice opening and closing. To open the antenna for use, bring each L stock element to the horizontal. Slide the hose clamps over the plastic plate wings and tighten. Tighten the no. 10 pivot hardware. Make sure the no. 6 hardware is secure at the wire ends and bridge connections. Extend the nested PVC pipe section until the center holes are aligned and plug in the pin. All that remains is to connect the coax and put the antenna on a mast.

Reverse the process to collapse the antenna for transport and storage. Assume that you have removed the coax and dismounted the antenna from its mast. Loosen the hose clamps and slide them off the wings. Loosen the no. 10 pivot hardware and swing the horizontal elements to align with the PVC pipe. Remove the pin through the pipes and nest the sections together as far as they will go (to the plate bottoms). Use the side wires, tie wraps, or other binders to wrap each end of the collapsed assembly. The antenna is now ready for transport.

Mounting the antenna

Mounting the antenna to a mast requires a bit of thought and preparation. There are undoubtedly many schemes that will work. For hilltopping, I use two 5' sections of TV mast to elevate the bottom of the antenna 10 feet off the ground. I keep the swaged end of the masts down and have installed a crutch tip to the end that touches the ground to keep dirt out of the mast. I can use up to two more sections with simple rope guying.

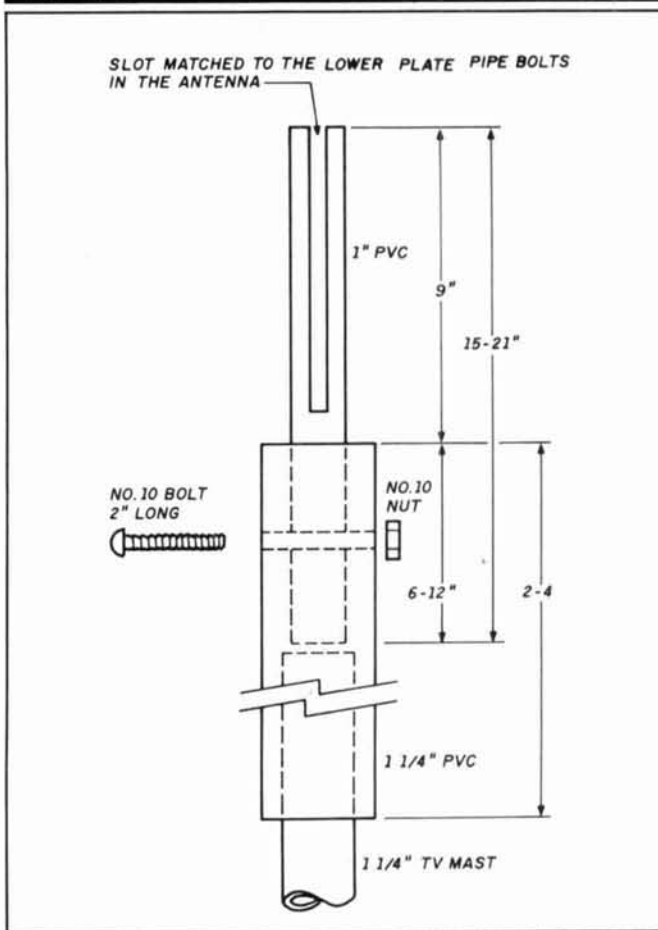
The mast-to-antenna support section shown in **Figure 4** serves two purposes. The slotted upper section of 1" PVC fits over the bolts that hold the plate to the bottom section of antenna PVC. The 9" slot holds well for hilltop operations, but wouldn't be suitable for taller masts subject to higher winds.

The 3' length of 1-1/4" PVC slips over the top of the TV

mast. It's long enough to provide a secure mount and to allow redirection of the antenna by the "armstrong" method. Because the antenna shows a bidirectional pattern, even when close to the ground, it's important to be able to turn the antenna 90 degrees. You can add a rubber grip or handle to the bottom end of the PVC for easier turning.

Guying is simple with just 10 feet of mast. I loop three 15 foot 1/8" ropes over the top of the bottom plate. This anchors the antenna to the mast in light breezes. If the antenna is mounted between cars, I make loops to hold bungee cords hooked to fender wells or door handles. On open ground I tie the guy ropes to metal tent pegs. My YL, N4TZP, and I can assemble and erect the entire system

FIGURE 4



Mast-to-antenna support section.

in 10 minutes as nothing weighs more than about 5 pounds. Higher installations require more elaborate systems using guy rings and secure fastenings.

My simple mounting and guying system has survived 15 mile-per-hour breezes without difficulty. Anything above that level would kill my urge to operate on a hilltop, anyway.

Tuning the antenna

A quad can't resist the offset of its normal feedpoint impedance close to the ground. At heights above a half

NUTS & VOLTS

MAGAZINE

P.O. Box 1111-H
PLACENTIA, CA 92670
714-632-7721



Ham Radio
Computer Hardware
Computer Software
Plans-Kits
Schematics
Test Equipment
CB Gear
Satellite TV
Video
Components
Antique Electronics
Cable TV
Publications
Repairs-Services
New Products
Events Calendar

IF YOU ARE INTO ELECTRONICS AND SAVING MONEY IS IMPORTANT TO YOU, THEN YOU OWE IT TO YOURSELF TO TRY NUTS & VOLTS MAGAZINE. DISCOVER WHY THOUSANDS OF SMART PEOPLE NATIONWIDE TURN TO NUTS & VOLTS EACH MONTH TO MEET THEIR ELECTRONIC NEEDS. WHETHER YOU'RE BUYING, SELLING, OR JUST TRYING TO LOCATE THOSE UNIQUE OR HARD-TO-FIND ITEMS, FIND OUT HOW NUTS & VOLTS CAN HELP!

SUBSCRIBE TODAY!

CHECK MONEY ORDER VISA MC

Name _____

Address _____

City _____

State _____ Zip _____

Card No. _____ Exp. Date _____

CALL FOR ADVERTISING INFORMATION
DISTRIBUTOR INQUIRIES INVITED

Subscription Rates

U.S. FUNDS REQUIRED

3rd Class Mail - USA

One Year \$12.00
Two Years \$21.00
Lifetime \$60.00

1st Class Mail

One Year - USA . . . \$20.00
Canada & Mexico . . \$22.00

Air Mail

Foreign - 1 Year . . . \$55.00

Includes one FREE 40-word
Classified Ad

A National Publication For The Buying And Selling Of Electronic Equipment

✓ 118

OPTO Iambic Keyer

\$59.95
\$3.00 S/H*



• Ultra compact 5" x 5 1/4" x 1 1/2" • OPTO isolated output • Battery or DC powered • Full function Iambic Keyer • Adjustable speed and weight • One Year Ace Systems Warranty

VISA - CALL TO ORDER - **MasterCard**
(814) 965-5937

Ace Systems

RD # 1 Box 83, Wilcox, PA 15870
- We Stock Bencher Paddles -

Authorized Ace Dealers:
Barry Electronics • KJI Electronics

*Continental U.S. Only. PA Residents Add 6% Sales Tax.

DEALER INQUIRIES INVITED

✓ 120

HEWLETT PACKARD SIGNAL GENERATOR

HP-606A 10 kHz-65 MHz



\$200.

Rebuilt and in Original
Government Package

Limited Quantity-ORDER TODAY

N.E. LITSCHÉ

P.O. Box 191

Canandaigua, NY 14424-0191

716-394-9099 716-394-0148

FAX 716-394-8329

✓ 119

HAM LICENSE PREPARATION

WRITTEN TEST STUDY GUIDES

All word-for-word questions, multiple choices . . . answers. Choose Novice, Technician, General, Advanced or Extra Class Answer explanations supplied!

\$4.95 Each version + \$1.50 shipping.

All five manuals: \$22.95 postpaid.

HAM RADIO Q & A MANUAL

All 1,932 questions, multiple choices and answers found in every ham license exam, Novice through Extra Class.

\$9.95 Shipped postpaid.

MORSE CODE TEST PREPARATION

Set contains two 2-hr. cassette tapes
Code Teacher, 0-5 WPM \$9.95
General Code, 3-15 WPM \$9.95
Extra Code, 12-21 WPM \$9.95
Plus \$1.50 shipping per set.

All Manuals/Code Tapes: \$49.95

New \$Part 97 Ham Rules: \$ 2.95

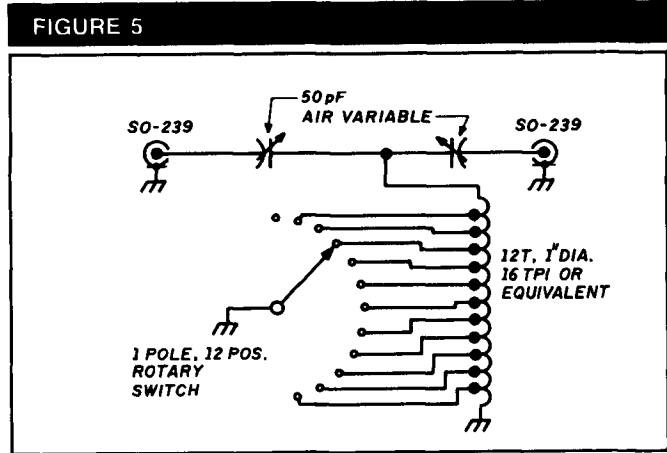
Order shipped same day received!
Credit card phone orders: 10 a.m. - 2 p.m.

W5YI MARKETING

P.O. Box #565101 - Dallas, TX 75356
Tel: (817) 461-6443 - 24 hours

wavelength, the quad norm of 100 to 120 ohms permits the use of a simple matching section with 50-ohm output transmitters. A 5'7" length of RG-59 will perform the transformation. At lower heights, however, the section becomes useless.

Because the coax (RG-58) is only about 20 feet long its losses with a low power rig are small, even with SWRs above 3:1. This is why I use the simple homebrew T-circuit matching unit shown in Figure 5. The capacitors are 50-pF MAPC types with shafts. The coil is 12 turns of 1" diameter, 16 turns-per-inch miniductor type stock. A 12-position switch taps the coil at each turn. The tuner is in a 4" x 5" x 6" aluminum case salvaged from another project, but a smaller case would work. I keep an old SWR meter attached to the



Simple T-match circuit for the collapsible quad.

tuner with a double male connector. Tune-up is a quick process because my HTX-100 has a 5-watt output position, and there's a high safety margin if the initial settings are way off base. I have the quad settings marked on the case. Changes of location require only the smallest tweaking of the capacitors to eliminate reverse voltage readings.

The proof of the system is in the operation. A recent trip to Signal Mountain, Tennessee, to participate in the Chattanooga Choo Choo Net, produced excellent results. The W4RNL/N4TZP station (with the assistance of WA4TKN) received excellent signal reports. We could work almost everything the big beams on the mountain could. By pointing northeast-southwest toward Knoxville (120 miles away) we heard WA4TJW check out due to local thunderstorms. Turning more east-west brought a number of W5's to workable levels. The station went from car to on-the-air in 10 minutes (including setting up a small table with folding legs). After the session it took us 10 minutes to load the antenna back into the car.

Experiences like these have confirmed the soundness of developing a hilltop antenna which is more efficient than the usual mobile whip, and more free-standing than the usual dipole. The collapsible quad loop inexpensively fills a gap in the range of antennas available for portable 10-meter operations.

Engineering Consulting's computer controlled Ham Shack. See system variables, control & reprogram all via packet!

Ultra Comshack 64 Repeater Controller
HF & VHF Remote Base* Autopatch* CW Practice* Rotor Control* Voice Meters* Paging* Logging* Polite ID's* Packet Voice B.B.S.

Model CS64S \$359.95
Includes: Interface, disk, cables, Manual!

Ultra Options

NEW! Add Duplex Remote Base operation & monitor mode from any telephoneTLCN.....\$159.95
External relays; 3 DPDT relays +5 Open Col. Trans. Sw.....CS 8...\$89.95
*Rotor control D.C. to digital display & Voice; for all rotors....HMT...\$59.95
*Packet & BBS; Voice Meters & Alarm Inputs; 8 On/Off. PK8 \$159.95
*Slave Packet interface & cable Links PK8 to 2nd C64....PK1...\$89.95
*EPROM Autotool CART, custom with your system.....CART...\$109.95
*C64 & 1541 12V. Switching supply crystal controlled ...DCPS...\$129.95
*Manual (REFUNDED) MN1...\$20.00

Controller Features
*Change variables remotely from touchtones or Packet
*Unlimited voice vocabulary!
*Alarm Clock, auto execute
*Individual 4 digit user codes
*Disk & Printer logging of users, tel #'s, lapsed time
*18 Rotating Polite ID's
*16 External relay controls
*2-tone & sub tone Paging
*CW Practice with voice
*Security mode, T.tone mute
*Voice announces each user call sign when logging on

Autopatch & Reverse
*1000 (18 digit) tel #'s stored
*Quick dial & quick answer
*Directed, general page
*Selected restricted patch
*Telephone control input
*Dual Combined Remotes
*18 Macro/Scan memories
*Scan up/down; 100Hz steps
*Monitor & lock modes
*Operate splits, combine HF & VHF radios as Dual VFO's
*Automatic mode selection
*Talking S Meter; Voltmeter
*Voice Beacon rotating msg

Computer Control YAESU FT-727R
C64 OR IBM Mini Cat
Allows H.T. to scan 100 Channels & programs
H.T. for field use! Digital "S" Meter; comment fields; auto resume & delay; Scan Lock-outs; Loads FT727 in 15 sec. Hardware, cables, & disk included for C64 or IBM
Model 727 \$49.95

Touchtone Decoder
4 digit sequence; & QUAD expansion 4 relay option
2"x3" TSDQ
8/20 V & audio in; Field Program 50,000 Codes; Mom. & Latching; DPDT Relay; Wrong digit reset; LED for digit valid & latch; inc. 24 Pin connector
QUAD option adds: four 2 Amp. relays; 5 digit master on/off control for each relay.
TSDQ \$89.95 QUAD \$99.95

Decode-A-Pad
Touchtone to RS232 300 Baud Interface
Use with all computers
Decodes 16 touchtones
Includes Basic program
DAP \$99.95

12 Volt C64 SWITCHER
Crystal 60Hz 9VAC 5V 2A. C64 & 1541
DCPS \$129.95

AUDIO BLASTER IC02;04;2AT;FT-727R
411;209;470;73;23;U16
Module installs inside all H.T.'s; 1 watt audio amp! When it needs to be loud! Installs in 15 Min. Used by police, fire!
Model AB1S \$24.95

New C64 "Packet Talker"
Stores messages on disk for up to 300 users; touchtone commands recall & speak your stored messages on repeater or packet freq. Works with all Packet TNC's; Converts all packet messages to VOICE!
Inc. disk & Interface PKTA \$189.95

ENGINEERING CONSULTING
583 CANDLEWOOD ST.
BREA, CA. 92621
TELEPHONE: 714-671-2009
FAX: 714-255-9884

We accept: C.O.D.'s
MasterCard, VISA, Disc
American Express
*add \$3.00 SH. U.S.A.
*Ca. residents add 6%

NEW BOOKS —1990 EDITIONS—

1990 RADIO AMATEUR CALLBOOKS

NORTH AMERICAN EDITION

Fully updated and edited to include all the latest FCC and foreign government call signs and addresses for Hams in North America. Includes plenty of handy operating aids such as time charts, QSL bureau addresses, census information and much more. Calls from snowy Canada to tropical Panama. Now is the time to buy a new Callbook when you'll get the most use out of your investment. ©1989.

CB-US90

Softbound \$27.95

INTERNATIONAL EDITION

QSLs are a very important part of our hobby. All sorts of awards, including the coveted DXCC, require confirmation of contact before the award can be issued. Of special interest, addresses are being added daily for Hams in the USSR and other countries. While in no means complete, it's a start and will be of tremendous help in getting QSLs. Handy operating aids round out this super book value. ©1989

CB-F90

Softbound \$29.95

BUY'EM BOTH SPECIAL

Reg. \$57.90 Only \$52.95 SAVE \$4.95

Callbooks available early December.

THE 1990 ARRL HANDBOOK

Revised and updated with the latest in Amateur technology, now is the time to order your very own copy of the world famous ARRL HANDBOOK. In addition to being the definitive reference volume for your Ham shack, there are plenty of projects for every interest in Amateur Radio — from antennas for every application to the latest state-of-the-art projects — you'll find it all in the 1990 HANDBOOK. Over 1100 pages! ©1989.

AR-H890

Hardbound \$22.95

Available Early November

MORE NEW BOOKS

1990 EQUIPMENT BUYER'S GUIDE edited by Peter O'Dell, WB2D, CQ Magazine

Here's the latest listing of equipment available from all of the different manufacturers. Full of hand-to-have information, facts and tidbits. Great reference to have when you are shopping around for a new rig. ©1989.

CQ-EDP

Softbound \$4

PACKET RADIO IS MADE EASY by Buck Rogers, KA4BT

Noted CQ Magazine columnist, KA4BT leads you step-by-step on how to set up a packet station. First defines and explains all the workings of packet communications. Gives you interconnection instructions for most radios, computers and MFJ TNCs. Also includes a glossary of packet terms and definitions that are very useful to all levels of packet interest. ©1989.

MFJ-PRME

Softbound \$9.95

SPACE ALMANAC by Tony Curtis, K3RXK

Complete database almanac is an unbelievable value! 955 pages jammed full of just about every bit of information you could want — including: space stations, shuttles, unmanned satellites, rockets and astronauts to name just a few areas covered. Also includes plenty of reference tables, charts, maps, diagrams, drawings, photos and much more. 35+ pages on Ham Radio in space. ©1989.

AS-SA

Please enclose \$3.75 shipping & handling

\$19.95

HAM RADIO'S BOOKSTORE

Greenville, NH 03048
603-878-1441 FAX (603) 878-1951



Practically Speaking

Joseph J. Carr, K4IPV

TEST EQUIPMENT FOR DIGITAL ELECTRONICS

In the past the Amateur operator with a technical bent dealt exclusively with what today is known as "analog electronics," i.e., RF, audio, and control circuits. But the digital revolution has touched Amateur Radio too, bringing us computerized and digitized ham gear. The modern HF transceiver is microprocessor controlled, as are many other bits of Amateur equipment. In this month's "Practically Speaking" I'll look at digital test equipment and highlight an affordable logic analyzer.

Once you get above the complexity level of a few chips, digital systems become quite a bit harder to "wring out" on the bench. It's difficult to service or analyze digital computer hardware because it's hard to get a good look at circuit operation as it sequences through its routine. Many things happen simultaneously — too many things to view on a simple oscilloscope (even a four-channel model). Sometimes you must view a large number of sequential operations (and their results) to find a problem. It might also be necessary to examine a data stream to determine what's actually going on. The logic analyzer provides the solution to these problems. This instrument examines multiple logic lines simultaneously and reports on their status. Until recently, logic analyzers have been expensive instruments and somewhat beyond the reach of most people. The Heath Company now offers equipment that may help. Although the company is recognized by most Amateurs for its kit-built ham gear and low cost test equipment, Heath also makes a considerable line of digital instruments and the Heath/Zenith line of personal computers.

The Heathkit IC-1001 shown in **Photo A** is a kit-form digital logic analyzer with a surprising number of capabilities. It can examine and report

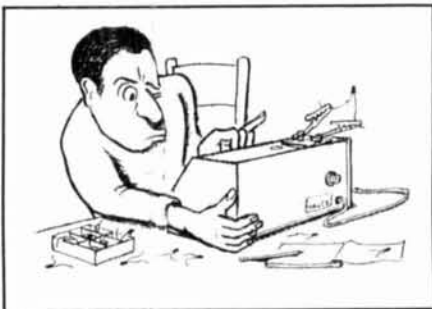


PHOTO A



The Heathkit IC-1001 Logic Analyzer.

digital logic activity on up to 16 digital input lines simultaneously. This capacity is sufficient for most 8 and 16-bit microcomputer applications. The IC-1001 is an inexpensive box that interfaces with any Heath/Zenith terminal or any IBM PC compatible. You need special software (included) to use an IBM PC as the terminal (DOS 2.0 or higher required). The interface to the terminal or the computer is via an RS-232 (DB-9 connector style) asynchronous serial communications port.

The IC-1001 has 2K of RAM and can store up to 2046 16-bit binary words. If you use a terminal unit, you can display 24 words at a time. If you use an IBM PC, the monitor will display up to the entire 2046 memory simultaneously. Displays include: address relative to trigger word, state, timing, hexadecimal or octal equivalent, and ASCII equivalent. All the standard baud rates used in personal computer applications (as well as most other digital applications) can be accommodated: 300, 600, 1200, 2400, 4800, 9600, and 19200 BAUD.

Under program control, you can specify the target trigger word that the

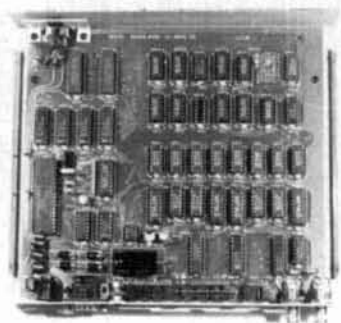
IC-1001 is to recognize. The logic polarity (positive logic is normal, but you sometimes find negative logic) is selectable. There are also two modes — non-delay and delay. In the non-delay mode the analyzer will display data that occurred both before and after the trigger word (selected by the operator). In delay mode, you select the number of "qualifying clocks" that must occur following the trigger word before the IC-1001 starts storing the received data. Up to 50,000 clock cycles can be programmed into the delay mode.

Construction

The IC-1001 Logic Analyzer is a kit. An experienced kit builder can put it together in one day or two evenings. The layout (shown in **Photo B**) is very clean and easy to work with. The kit is built on a single pc board mounted in a 1.75 x 9.25 x 8.5 inch lowboy cabinet. An external transformer plug supplies power to the IC-1001 from the 115-volt AC power lines. The unit weighs just 2.9 pounds.

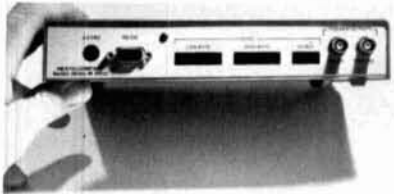
Because the IC-1001 is a newer Heathkit, the small parts (resistors, diodes, etc.) are attached to a paper "machine gun" belt in the sequence called for by the instructions. (Heath used to jumble everything together in brown paper bags for you to sort out.)

PHOTO B



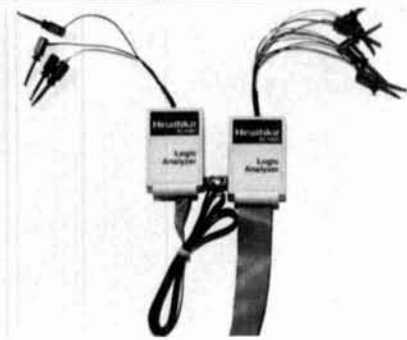
Internal view of the IC-1001 showing the printed circuit board layout. Note the clean design.

PHOTO C



Rear panel of the IC-1001 contains all of the connections to the environment.

PHOTO D



PODs are used for connecting the IC-1001 to the circuit under test.

Although my hands are mildly arthritic and a bit plump, I found nothing hard about building the IC-1001. It's rare that I find no fault with the assembly of a kit, but I'm at a loss to find something negative to say about the IC-1001.

Using the IC-1001

The IC-1001 logic analyzer has a clean-cut front panel (see Photo A) with just an ON/OFF switch. The rear panel shown in Photo C contains all of the interconnections between the IC-1001 and its environment. The AC power connector on the left side is connected to the transformer wall plug that supplies power to the unit (the DC power supply is internal). The RS-232 serial port connector is the small DB-9 type that has become popular in recent years. (The 9-line "sort of" RS-232 has taken the place of the older 25-line RS-232 system.) A pair of trigger outputs is also provided. These BNC connectors output a signal, but one signal occurs at the trigger word while the other occurs after the specified delay.

There are three digital input ports on the read panel of the IC-1001. One is a clock input and the others are for the

data word. The "high" byte accommodates the upper 8 bits of a 16-bit line, while the "low" byte accommodates the lower 8. These inputs link to the external circuitry being tested through a set of builder-assembled POD devices (see Photo D). These data line cables have a "hook plunger" clip on the ends to hook into the circuit being tested.

The Heathkit IC-1001 is a useful easy-to-build piece of digital test equipment. I've used mine for about six months and I'm a satisfied customer. For more information about the IC-1001 Logic Analyzer (priced at \$279.95) contact The Heath Company, Benton Harbor, Michigan, 49022.

Other instruments

As is true in most areas of electronics practice, the oscilloscope (see Photo E) is the most useful instrument for many digital troubleshooting jobs. The oscilloscope will display one or more time-varying signals. You read amplitude along the vertical axis and time along the horizontal.

For digital work, select a model with a high frequency vertical bandwidth (20 MHz or better) and more than one channel. The most common form of 'scope may be the dualbeam (which really means two channel). For a bit more money you can get up to four channels. For lower frequency work, it's possible to convert a dual channel 'scope into a four-channel model using an external switching circuit.

Low capacitance probes are a must. In fact, they are a must for most types of testing or measurement. These probes do not capacitively load the circuit under test. This means they produce a better rendition of the waveform in the circuit. The standard 1:1 and

10:1 switchable probes offered by most oscilloscope manufacturers are low cap types.

Oscilloscope probes are not just used for measurement. At a major university medical center on the East Coast, patients in the Intensive Care Unit (ICU) were monitored by a computer located in another building. Because this was in the early seventies and microcomputers and small minicomputers weren't yet invented, a relatively large computer was needed for the task. (ICUs today often run on IBM PCs.) The analog data was converted to a digitized format in the hospital ICU and transmitted across the street by a crude early form of modem.

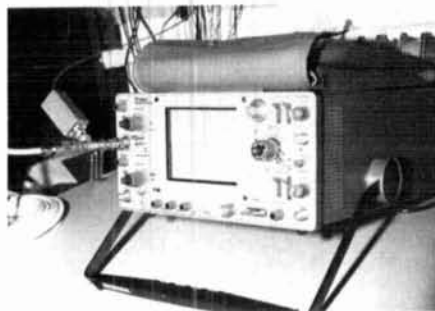
At the computer room in the basement of the nearby building, the modem tones were demodulated to digital signals for input to the computer. Unfortunately, they were highly erratic and error warnings were common. The technician would try to find the problem, but it cleared up when he connected the low cap probe to the modem output. Thinking it was the cable plus the 'scope input capacitance, he tried shunting an equivalent value disk ceramic across the same point, but to no avail. Only the 'scope probe worked. That oscilloscope probe remained inside that computer rack for another 18 months when the experimental program was finished.

If you go to any well-equipped parts distributor or look in the catalogs of companies that sell test equipment, you'll find a series of logic probes for sale. These devices are handheld instruments that look a bit like fat oscilloscope probes, but don't connect to other instruments. There seem to be two or more distinct types. One probe, for instance, supplies either a logic level transition or a pulse when the button is pressed. These pulses (or levels) can be used to stimulate a digital circuit. A logic level can be generated by a circuit like the one in Figure 1A, while a brief pulse can be generated by the one in Figure 1B.

The other kind of logic probe is a pulse catcher. This device remains dormant until it receives a pulse. It then latches in one of its two stable states and produces an LED output indication. You can build a pulse catcher (of sorts) from a reset-set (R-S) flip-flop as shown in Figure 1C.

The circuits in Figures 1A, 1B and

PHOTO E



The oscilloscope is still the best friend of the servicer!

Don't really replace a logic probe for convenience, but they do make dandy little construction projects. If you want to construct an experimental digital breadboard, you can build in these circuits to make your work a little easier. These breadboards use a kind of IC strip socket with a lot of holes arranged in parallel rows and columns, laid out in the 0.3-inch x 0.1-inch standard DIP pattern. Number twenty-two hookup wire is pressed into the holes in the socket to make interconnections. These strip sockets are available from most parts distributors. Use as many IC strip sockets as you need to mount the chips. Provide +5 volts DC at 1 A, ±12 volts DC at 0.5-A DC power supplies, and a few pulse generators and catchers, and you'll be in business.

An oscillator that can be used as a clock or clock replacement in digital circuits is another useful piece of test equipment. If you want to make a digital oscillator, use a 555 IC timer connected in the astable mode (and connected to a +5 volt DC power supply). Or, if you have a square wave generator, you can make it into a suitable clock by providing a TTL output. On my Heath IG-18 (an oldie) I provided the output by using a CMOS 4050 chip (operated from +5 volts DC) as a TTL output buffer (Figure 2). The input of one stage of the 4050 is connected in parallel with the square wave output. The output level control must be set to something over 3 volts peak for the circuit to work properly. I added a separate BNC jack on the front panel for the TTL output so I wouldn't ruin the regular bipolar ±10 volt square wave output.

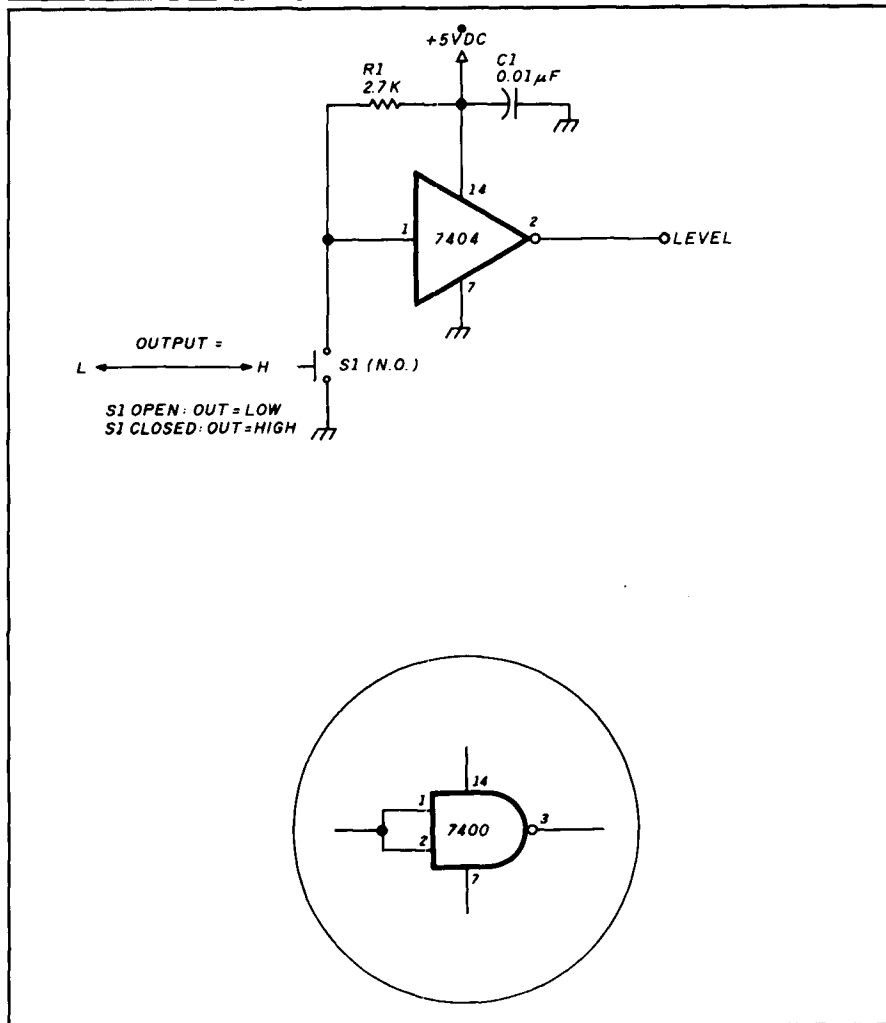
Now let's shift gears a little bit.

Why can't I ham it up in the hospital?

A reader collared me at the swapfest operated by the ham club at Goddard Space Flight Center in Greenbelt, Maryland. He had been hospitalized for surgery in the same hospital where I was once employed as a bioelectronics and biomedical engineer. He was perplexed and annoyed that the hospital authorities wouldn't let him keep his 2-meter, 5-watt handheld transceiver. He wanted to know why they were so narrow minded. Because I helped formulate some of the hospital rules involving radios about a decade ago, I was able to give a little insight.

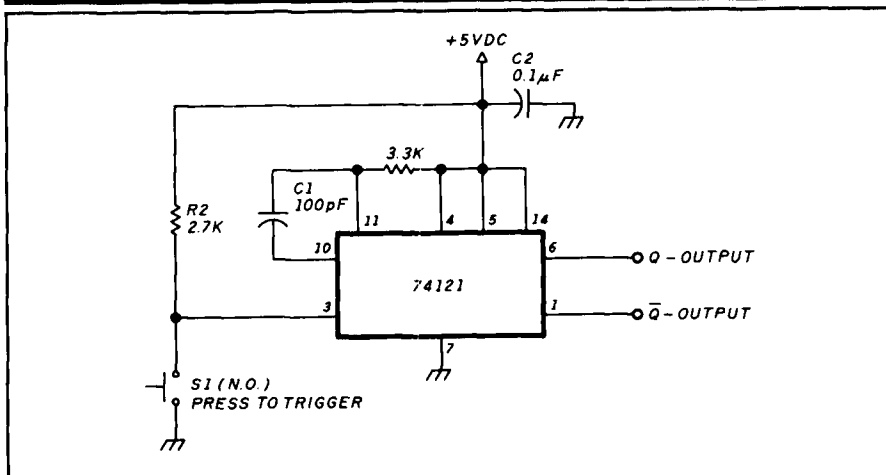
Modern hospitals are complex

FIGURE 1A



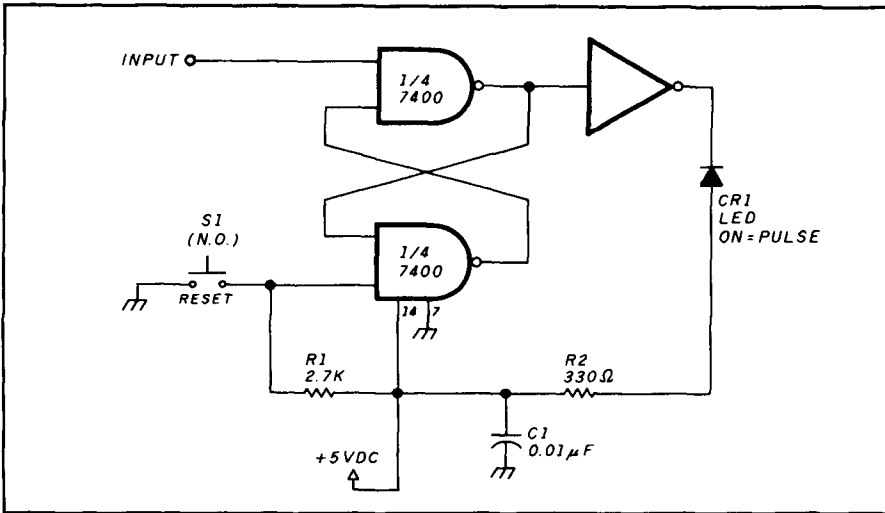
TTL level generator uses a 7404 TTL hex inverter (five sections of the 7404 are available for other uses). If an inverter is not available, then one can be made by shorting together the two inputs of a 7400 NAND gate.

FIGURE 1B



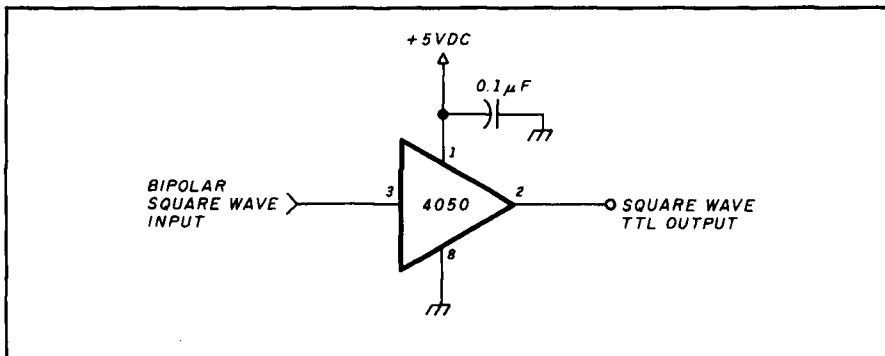
A 74121 TTL one-shot chip outputs both Q and NOT-Q 100-nS pulses when the pushbutton is pressed.

FIGURE 1C



Pulse catcher is an R-S flip-flop with an output indicator. Initially press S1 to reset the circuit. Thereafter, when a pulse is received it will turn on the LED.

FIGURE 2



A CMOS 4050 is used to convert bipolar squarewaves to TTL-compatible squarewaves.


places with a large array of electronic instruments for monitoring and treating patients. Some of these instruments are EMI sensitive. While a TVI complaint in your neighborhood isn't an earth-shattering event, a nonworking patient monitor in the coronary care unit or telemetry unit can cost someone his life.

Very early one morning in the mid-seventies I was trying to troubleshoot a problem. An electrocardiograph (ECG) VHF telemetry signal was riding in on the wrong channel, obscuring the signal of the patient to whom it was assigned. I traced the problem to EMI from the local oscillator of an FM broadcast receiver. The FM radio whip was only a foot or so from the 17-inch telemetry whip hanging from the ceiling, where it was connected to a 60-dB wideband VHF preamplifier. The prob-

lem was an old-fashioned intermod situation.

We banned FM radios at the nurses' station that night. While we could have gotten away (technically, that is) with banning the single offending station on the FM dial, it seemed more reasonable to just ban the radios altogether. During that same era, incidently, the airlines banned FM radios on flights. It seemed that the FM LO could also interfere with avionics gear.

While I sympathize with the sick ham (when I was "in" for a gall bladder operation in 1986 I had to live by my own rule), it seems that the rule is here to stay in most hospitals.

That's all for this month. I can be reached at POB 1099, Falls Church, Virginia 22041 and would like to have your comments and suggestions for this column. 

2x4Z BASE REPEATER ANTENNA

THE HIGHEST GAIN
DUAL BAND
BASE/REPEATER ANTENNA
HIGH POWER 200 WATTS

CENTER FREQUENCY
146.500 MHz
446.500 MHz

GAIN:
VHF - 8.2dB
UHF - 11.5dB
VSWR - 1.-1.2 or less

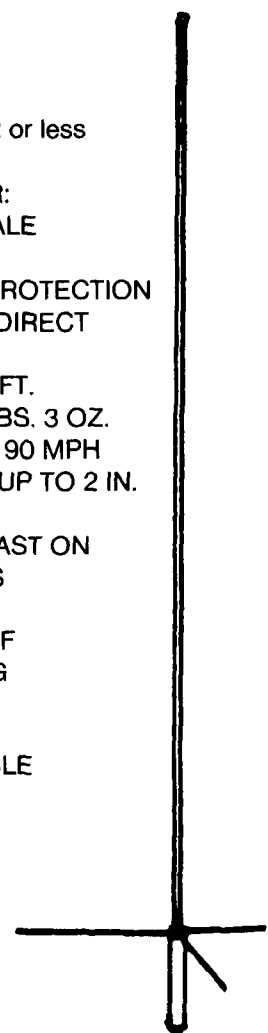
CONNECTOR:
N TYPE FEMALE

LIGHTNING PROTECTION
GROUNDED DIRECT

LENGTH: 16 FT.
WEIGHT: 5 LBS. 3 OZ.
WIND LOAD: 90 MPH
MOUNTING: UP TO 2 IN.
MAST
CAN SIMULCAST ON
BOTH BANDS

WATERPROOF
CONNECTING
JOINTS

UPS SHIPPABLE



AMATEUR SPECIAL



1275 NORTH GROVE ST.
ANAHEIM, CALIF. 92806
(714) 630-4541
CABLE: NATCOLGLZ
FAX (714) 630-7024

A LOW-NOISE DESIGN PRIMER

Some ideas on improving receiver noise

By Bob Lombardi, WB4EHS, 1874 Palmer Drive, Melbourne, Florida 32935

Noise. Throughout the history of Amateur Radio, noise has been one of our biggest problems. Few topics have had quite so much written about them in the Amateur literature or in professional circles. Because of this coverage, newcomers to the field may feel overwhelmed by the references available. In what follows, I've attempted to cover the subject in enough depth to allow you to complete some designs and feel comfortable with the subject. There are a couple of types of noise that are the most frequent contributors to receiver noise problems; I'll start by treating them separately.

Thermal noise and the universe

The discovery that any component above absolute zero in temperature generates thermal noise proportional to its temperature is attributed to Ludwig Boltzmann, one of the great physicists of the nineteenth century. Boltzmann's relationship shows that the noise voltage generated depends on the temperature of the component, its resistance, and the bandwidth in Hz that you measure in, or:

$$E = (ktBR)^{1/2} \quad (1)$$

where t is temperature in degrees Kelvin, B is bandwidth in Hz, R is resistance, and k is Boltzmann's constant (1.381×10^{-23} Joules/K degree).

In terms of power:

$$P = \frac{E^2}{R} = ktB \quad (2)$$

A 50-ohm resistor measured at 20 degrees C in a 1-Hz bandwidth delivers a power level of 3.98×10^{-21} watt. It's customary in receiver work to refer to power levels with respect to 1 mW, and this power is -174 dBm. Of course no receiver could better that mark, but the 1-Hz bandwidth is almost never used in real life. Because power increases directly with bandwidth, the level goes up 10 dB for every times 10 increase in bandwidth. In a 2-kHz bandwidth, for example, the power level goes up by 33 dB, to -141 dBm. This is close to the case for a typical SSB signal.

This level is roughly 7.9×10^{-21} watt, or $0.020 \mu\text{V}$ in 50 ohms. A typical "good" HF receiver will claim $0.50 \mu\text{V}$ sen-

sitivity, but although this may seem poor when compared with the thermal noise value, it's actually better than you need. The noise that we often refer to as QRN is the reason.

There are many sources of QRN: the sun, certain astronomical sources, the din of distant thunderstorms, and a myriad of urban and suburban noise sources. The noise level at the receiver input from these sources determines the receiver's useful sensitivity. Table 1 shows typical numbers used in the design of HF radio links!

The numbers in this table are normalized for bandwidth; just add this number to the thermal noise floor described earlier to reach the usable sensitivity. For example, at 30 MHz in a typical suburban location you would add 38 dB to the SSB noise floor of -141 dBm to get -103 dBm. This translates into $1.58 \mu\text{V}$ in 50 ohms. Suddenly that $0.5 \mu\text{V}$ sensitivity seems generous. Furthermore, the noise at lower frequencies is even higher and storms create even more noise.

Noise from the receiver and noise figure (NF)

All electronic amplifiers currently available produce some noise along with their amplification. This noise takes several forms including shot, popcorn, and schottky noise. The exact nature of each type of noise is related to the physics of the devices used and is not really important here. For now it's enough to know that such noise exists and is unavoidable — at least to some degree.

Most hams have heard the term noise figure before, especially those who operate VHF/UHF in the weak signal modes. The definition of noise figure used by Friis in 1944²

TABLE 1

Frequency MHz	Typical numbers used in the design of HF radio links.			
	Location			
	Quiet Rural	Quiet Suburban	Noisy Suburban	Noisy Urban
10	40	42	48	62
20	22	30	40	55
30	17	28	38	51
50	13	20	31	46
144	0	0	9	22

is perhaps the simplest and the best. According to Fris, the noise figure of a network is the signal to noise ratio of the input divided by the signal to noise ratio of the output, expressed as a decibel ratio, or:

$$NF = 10 \text{ Log } \frac{S/N_{in}}{S/N_{out}} \quad (3)$$

This means the noise figure is the decrease or degradation of the signal to noise ratio as the signal goes through the network. Notice that this implies at least a two port network with one output and one input.

Because noise figure is a property of two port networks, it isn't the right term to use for the characterization of oscillators or terminations. Terminations have their noise level set entirely by Boltzmann's *k*T. Oscillators will produce noise along with the desired signal, but this is best expressed as a carrier to noise ratio.

Mixers, on the other hand, are three port networks and do have a noise figure. The noise present on the local oscillator also comes into play here; LO noise adds directly to the noise already present on the desired signal, degrading the S/N ratio even more. The common double balanced mixer is a passive network, and so has its insertion loss as its noise figure.

LO C/N (carrier to noise) ratio is more of a concern today than it was before the advent of the PLL synthesizer. Synthesizers can be quite poor from the standpoint of noise sidebands — a problem that was almost unheard of in the era of crystal oscillators. I'm sure many of you have noticed that when the ham down the block gets a shiny new rig, the noise floor of the universe jumps up every time he transmits.

Finally, note that noise figure is independent of gain or modulation.

Cascades of amplifiers, each contributing gain and noise, result in a change of noise figure from that of the front end noise figure. The method of calculating cascade noise figure is simple, but it requires a little manipulation. The noise figure must be converted to its ratio by taking the antilog of NF/10 (I'll call this *F*) and the gains of the stages must also be expressed as ratios, not in dB. Given this:

$$F_{system} = F_1 + \frac{(F_2 - 1)}{G_1} + \frac{(F_3 - 1)}{G_1 G_2} + \dots + \frac{(F_n - 1)}{(G_1 G_2 \dots G_{n-1})} \quad (4)$$

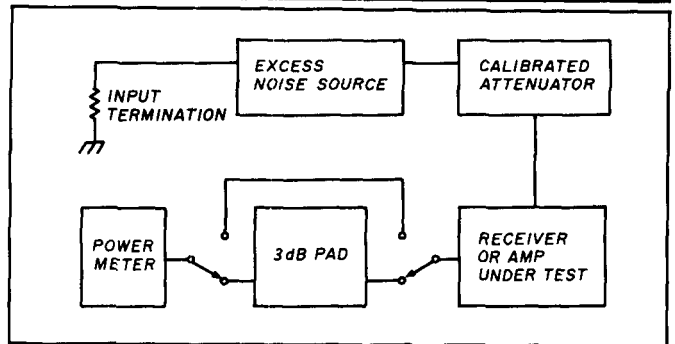
where the subscripts 1, 2, ..., *n*, denote the stage number proceeding from the front end, stage 1, back. It should be obvious that if the front end is high in gain and low in noise figure, it essentially sets the system noise figure. Furthermore, regardless of gain, you can never be better than the front end.

Measuring NF

While measurement of noise figure is done commercially with specialized (read that expensive) test equipment, it's possible to measure it with methods accessible to the Amateur.

The most straightforward method is the twice power or 3-dB method. You need a noise source with a known excess noise ratio to perform this test. Probably the biggest problem is knowing your excess noise ratio — the amount of noise that the source puts out over an equivalent resistor at the same temperature. Reverse biased zener diodes are frequently used to generate noise; they can provide 30-dB of excess noise ratio. Surplus vacuum tube noise sources

FIGURE 1



Test setup for measuring NF.

are available from time to time and are usually characterized, or can be.³ In this method, shown in Figure 1, only three steps are required:

- Set a convenient power level reference at the power meter with the noise source "out" or "cold." The power meter can be measuring actual detected RF power on a microwattmeter or audio power at the receiver speaker terminals.
- Insert the 3-dB pad and turn on the source.
- Vary the attenuation until the reference is obtained.

At this point, the attenuated excess noise ratio of the source is the noise figure of the receiver. The noise figure is the excess noise ratio (ENR) minus the attenuator setting in dB.

Ideally, the calibrated attenuator would be a continuously variable type, but a step attenuator will do if you can find one with small enough steps. Lacking that, precut lengths of cable will make calibrated attenuators that are easy to coil up and keep around. You'll need different lengths for each band of interest, lots of connectors, and cable that you can trust to meet some attenuation versus frequency curves. If you don't have this type of cable, you'll need a way of measuring the attenuation directly (e.g., your microwattmeter).

Minimum Discernible Signal (MDS) and Noise Figure (NF)

Noise figure is an excellent figure of merit for receivers. Unfortunately, it doesn't tell the complete story. The minimum discernible signal (MDS) is another important number. MDS, just as its name implies, is the weakest signal that the receiver can detect at some level of readability. The low NF alone doesn't do much good if the receiver can't hear below a millivolt. You'll recognize this as another way of stating sensitivity, although the results are usually stated as dBm in 50 ohms. A poor MDS means that there is insufficient gain in the receiver, usually at the IF, because the front end will amplify anything that hits it.

Designing for Low NF

The selection of the front end device is the best place to start in a low noise design. It should come as no surprise that FETs are generally capable of better noise performance than bipolars. GaAsFETs, silicon MOSFETs, and JFETs are good choices for hams in the VHF and above spectrum, as they are readily available and reasonably priced. The newer HEMTs (High Electron Mobility Transistors) are really HEMFETs and may be the "new wave" in microwave design.

WHAT'S THE BIGGEST ISSUE IN HAM TV TODAY?

THE NEXT ISSUE OF AMATEUR TELEVISION QUARTERLY

- ACCURATE reporting
- TECHNICAL information
- VALUABLE content
- QUALITY production

SUBSCRIPTIONS:

1 Year \$15 U.S., \$20 Canada, \$25 Elsewhere

1545 Lee Street, Suite 73
Des Plaines, Illinois 60018
(312) 298-2269

W6SAI BOOKS

published by Bill Orr, W6SAI and Stu Cowan, W2LX

BEAM ANTENNA HANDBOOK

Completely revised and updated with the latest computer generated information on BEAM Antenna design. Covers HF and Yagis and 10, 18 and 24 MHz WARC bands. Everything you need to know. 204 illustrations. 268 pages. ©1985. Revised 1st edition. **IRP-BA** Softbound \$11.95

ALL ABOUT VERTICAL ANTENNAS

Theory, design, construction, operation—are fully covered. Here's what this exciting book covers: Horizontal vrs vertical—which is best? Top loaded and helical antennas, 5 high efficiency Marconi antennas for 80 and 160, verticals and TVI—Is there a problem? The effects of ground on vertical antennas and a how to make an effective ground system, the Bobtail beam, construction data for 25 different antennas, matching circuits of all descriptions—which is best, plus P-L-E-N-T-Y more! 1st edition. 192 pages © 1986

IRP-VA

Softbound \$10.95

RADIO HANDBOOK 23rd Edition

Here are some of the highlights of this exciting new edition: New easy-to-use charts for Chebyshev and elliptic filter configurations, new data on power MOS-FETS, how to use state-of-the-art OP-AMPS, and home computer RTTY to name just a few examples. New projects include: GaAsFET preamps for 902 and 1296 MHz, easy-to-build audio CW filter, Economy two 3-500Z, 160 meter amplifier, multiband amp using two 3CX800A7's, and a deluxe amplifier with the 3CX1200A7 tube. New antenna projects include: efficient Marconi design for 160 and 80 meters, computer generated dimensions for HF-Yagis, and a 2 meter slot beam. Get your copy today. 23 edition © 1986

22424

(Reg. \$29.95)

Hardbound \$26.95

THE RADIO AMATEUR ANTENNA HANDBOOK

A wealth of projects that covers verticals, long wires, beams as well as plenty of other interesting designs. It includes an honest judgement of gain figures, how to site your antenna for the best performance, a look at the Yagi-Quad controversy, baluns, slopers, and delta loops. Practical antenna projects that work! 190 pages. ©1978. 1st edition.

IRP-AH

Softbound \$11.95

Please enclose \$3.75 for shipping and handling.

**HAM
RADIO**

BOOKSTORE

GREENVILLE, NH 03048

(603) 878-1441

FIGURE 2

```

10 REM Noise figure program that solves the Cascade NF equation
20 REM demo driver for Ham Radio Magazine
30 REM Bob Lombardi, W4BHS July 1989
40 PRINT***** System Noise Figure and Gain Analysis *****
50 PRINT
60 INPUT "Enter number of stages": NUMBER
70 DIM STAGE (NUMBER, 3)
80 FOR I=1 TO NUMBER
90 INPUT "Enter stage NF (in dB), and gain (in dB)": STAGE(I,1), STAGE(I,2)
100 STAGE(I,1)= 10*(STAGE(I,1)/10)
110 STAGE(I,2)= 10*(STAGE(I,2)/10)
120 STAGE(I,3)=1
130 NEXT I
140 FOR J= 2 TO NUMBER
150 STAGE(J,3)= STAGE(J-1,3)*STAGE(J-1,2)
160 NEXT J
170 FSYS = STAGE(1,1)
180 FOR I=2 TO NUMBER
190 FSYS = FSYS+ (STAGE(I,1)-1)/STAGE(I,3)
200 NEXT I
210 PRINT:PRINT:PRINT
220 PRINT "System NF is "; 10*LOG(FSYS)/LOG(10); " dB."
230 PRINT "system gain is"; 10*LOG( STAGE(NUMBER,2) * STAGE(NUMBER,3) )/LOG(10);
" dB."
    
```

Listing of BASIC program for solving cascade noise figures.

I'm not aware of these devices being available to hams. Bipolars have made recent progress in this area, and are often a reasonable choice.

Once you've chosen the front end, use Equation 4 to optimize the rest of the receiver chain. I've included a simple BASIC program (Figure 2), based on Equation 4, to calculate the system gain and NF of a cascade of gains and losses. (The program is in GWBASIC for the IBM PC and clones, but you should be able to translate it to other machines with no trouble.) It's often helpful to add more gain at a more modest NF before the first mixer, especially if it's a double balanced one. Remember that passive circuits like pads or filters have conversion loss, so their through loss is used as their NF and negative gain in the equation.

The data sheets for the device you've chosen frequently provide some bias information and input impedance for minimum NF. These data have a habit of either being at the wrong frequency, or just plain incomplete. Many times a designer chooses a device simply because its data sheet is more complete than others and leaves less room for guesswork.

Biassing the device for the desired collector or drain current is relatively straightforward,⁴ but should not be ignored. The bias must be stable for all variations expected in operating conditions, like the temperature extremes of a mast mounted preamp.

Matching to the device is done via manual methods, Smith Chart,⁵ or computer (or both*). It's best to leave some adjustability in the design of the matching network to allow for part-to-part variations, and to use the highest Q (lowest loss) components that you can get.

An example of a simple circuit design is included in Appendix A to show these ideas in a more concrete form.

Designing for low noise is easier than correcting for it later. Consider the ideas and references presented here before trying your next receiver design. **77**

REFERENCES

1. Reference Data for Engineers: Radio, Electronics, Computer and Communications, 7th Edition, Howard W. Sams Company, Inc., 1985, pages 34-39
2. H.T. Friis, "Noise Figure of Radio Receivers," *Proceedings of the IRE*, July 1944, pages 419-422.
3. G.P. Jessop, *VHF/UHF Manual*, Radio Society of Great Britain, 1983, pages 11-22.
4. Chris Bowick, *RF Circuit Design*, Chapter 6, 1982, Howard W. Sams Company, Inc., pages 117-120.
5. Op. cit., Chapters 4 and 5.

*Various Amateur and commercial software packages are available to perform this function.

Appendix A Design Example

Design a low noise amplifier to operate at 432 MHz with an NF of 1.5 dB or less.

The data sheets for the AvanteK AT-41472 show that the device is capable of a typical NF of 1.3 dB when biased for a collector current of 10 mA. This will yield a stage gain of 14 dB (typical). Since the S parameters are supplied at 400 and 500 MHz, I'll interpolate a set of S parameters for 432 MHz linearly. (Knowing that the actual device will likely vary from these, I'll build in some adjustment.)

When $V_{ce} = 8$ volts and $I_c = 10$ mA:

S11		S21		S12		S22	
mag.	ang.	mag.	ang.	mag.	ang.	mag.	ang.
0.32	-44	7.46	99	0.052	71	0.66	-20

Step 1: Bias the device:

Assumptions are $V_{ce} = 8$ volts, $I_c = 10$ mA, $V_e = 2.5$ volts, $h_{fe_{dc}} = 30$, $V_{cc} = 12$ volts.

$$R_e = \frac{V_e}{I_e} = \frac{2.5}{0.01} = 250 \text{ ohms (249 standard)} \quad (1)$$

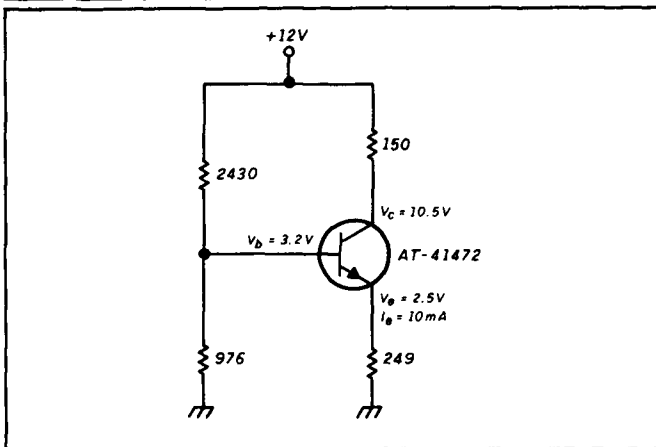
$$V_c = 2.5 + 8.0 = 10.5 \text{ volts}$$

$$R_c = \frac{12 - 10.5}{0.010} = 150 \text{ ohms} \quad (2)$$

$$R_{bb} = \frac{3.2 \text{ volts}}{3.33 \text{ mA}} = 960 \text{ ohms (976 standard)} \quad (3)$$

$$R_{bt} = \frac{12 - 3.2 \text{ volts}}{(3.33 + 0.33)} = 2404 \text{ ohms (2430 standard)} \quad (4)$$

FIGURE 3



DC biasing of the device.

The complete DC bias is shown in Figure 3.

Step 2: Match the impedance of the input and output.

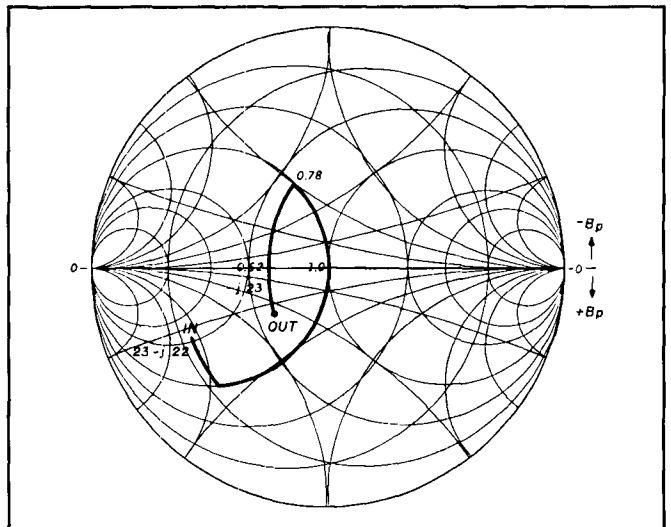
Although the data sheet for this transistor doesn't show an optimum source impedance for lowest NF, the data shows that the NF in a 50-ohm system is very close to the optimum NF. Consequently, I'll design for matching a 50-ohm source and load. Figure 4 is the Smith chart used to find the matching networks.

Figure 5 is the final version of the amplifier. Note that both input and output were matched by simple L networks. The

470-pF caps are used as RF coupling/DC blocks and the emitter bypass. The cap at the emitter should be a chip cap, and should be mounted as close as possible to where the emitter leaves the case. The coils, though small, are buildable using small diameter air-wound inductors and minimal leads.

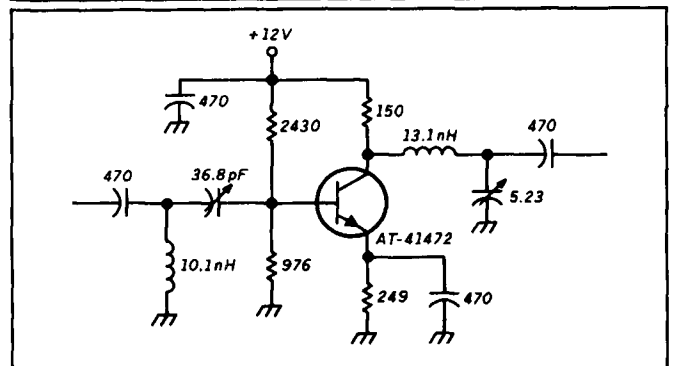
Although I didn't build this circuit, I did verify that it passes computer simulations. My purpose here is not to present a working LNA design, but to demonstrate the design process. According to a professional CAD program, the amplifier has a gain of 13.26 dB at 432 MHz. I couldn't analyze the noise figure due to limitations in the manufacturer's data, but the resultant gain and input impedance agree closely with the data sheet's prediction for gain at minimum NF. The procedure is essentially the same if the source impedance for optimum noise figure isn't 50 ohms, with the exception that you match to the different value.

FIGURE 4



Smith Chart plot of the complex matching impedance.

FIGURE 5



Complete circuit with matching networks.



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.

BEGINNER'S RADIO CLEARINGHOUSE. On a space available basis, we are going to offer you, OUR SUBSCRIBER, free of charge, a chance to find a home for your used equipment with a new Ham. Please send us a short description of what you want to sell along with price, name, address and phone number. We'll run it once in a special section of the classified ads under the heading of BEGINNER'S RADIO CLEARINGHOUSE. Please limit your ad to 20 words or less.

CUSTOM MADE EMBROIDERED PATCHES. Any size, shape, colors. Five patch minimum. Free sample, prices and ordering information. HEIN SPECIALTIES, Inc., 7960 SW Manitou Trail, Glen Arbor, MI 49636. (616) 334-4385.

IBM-PC SOFTWARE FOR PK-232. New CompRitty II is the complete RTTY/CW program for IBM-PC's and compatibles. Now with larger buffers, better support for packet units, pictures, much more. Virtually any speed ASCII, BAUDOT, CW. Text entry via built-in screen editor! Adjustable split screen display. Instant modes/speed change. Hardcopy, diskcopy, break-in buffer, select calling, text file transfer, customizable full screen logging, 24 programmable 1000 character messages. Ideal for MARS and traffic handling. Requires 256K PC or AT compatible, serial port, RS-232C TU. \$65. Send call letters (including MARS) with order. David A. Rice, KC2HO, 144 N. Putt Corners Rd, New Paltz, NY 12561.

WANTED: MX-2995 dual trace plug-in preamplifier for OS-117 oscilloscope. Must be in good working condition. C.A. Carhoun. Call collect (508) 486-8454 weekends.

WANTED: CW, SSB, AM crystal filters for Heathkit SB300 series, Drake R4C, also SB series or R4C for parts. N5LB, 13 Traminer Drive, Kenner, LA 70065 (504) 466-8318.

ENGINEERING/RADIO TECHNICIAN WANTED. Responsible for design and construction of 220 MHz equipment for medical research. Please send resume to: Vicki Chestnut, NIM Inc, 3401 Market Street, #330, Philadelphia, PA 19104.

LET THE GOVERNMENT FINANCE your small business. Grants/loans to \$500,000. Free recorded message: 707-448-0270. (KHS).

ICOM, KENWOOD & YAesu OWNERS: Informative separate Newsletters. 10th year. USA bulk (\$10.50). F.C. (\$12.50). Canada (\$13.00). Elsewhere (\$14.00 & \$18.00). Free catalog. Send 45-cent SASE. International Radio Computers, Inc., 751 South Macedo Blvd, Port St. Lucie, FL 34983. Tel (407) 879-6868.

MORSE TERMINAL for Radio Shack Color Computers with interface cables \$42.95. Free Catalog. Dynamic Electronics, POB 896, Hartselle, AL 35640. (205) 773-2758.

WIRE ANTENNAS and accessories. Antennas from \$10. Coffee cups, call sign plaques. SASE for list. W8EV Products, 205 W. First St, Arcanum, Ohio 45304.

COLLINS KWM/HF390 Repairs and discount accessories Kirby, K7WOC. (713) 320-2324.

CCTV VIDEO CAMERAS: Color Sanyo VCC3700 \$395.00, Panasonic B29W \$219.00, others, Digital Vision PC B&W Video Digitizer \$249.00, Color \$399.00. Sampson Engineering, PO Box 550363, Dallas, TX 75355-0363. (214) 328-2730.

WANT TO KNOW the latest FCC news, operating tips, tech talk, free ads? Get America's #1 club publication monthly, lowest dues figure in U.S. for 61 services and benefits. Join the Triple States Radio Amateur Club. Send \$3.50 for six months to: TSRAC, Box 240, RD 1, Dept HR, Adena, OH 43901.

R-390A Parts List SASE. CPRC-26 Infantry Manpack Radio, compact, 6 meter FM, receiver-transmitter sections, case, antenna, crystal, handset: \$22.50 apiece complete, \$39.50/pair. Patrol Seismic Intrusion Device ("PSID") TRC-3: \$42.50 apiece, \$147.50/set of four. Military-spec TS-352 volt-ohm/multimeter, leads, information: \$12.50. Add \$4.50/piece shipping, \$9 maximum. Baytronics, Box 591, Sandusky, OH 44870.

HEATHKIT HW-99 Novice 50-watt CW Transceiver. \$259. N8HXY (616) 536-7734.

DIGITAL AUTOMATIC DISPLAYS. Any Radio. Be specific. Large 45 cent SASE. GRAND SYSTEMS, POB 2171, Blnne, WA 98230.

AVANTEK ATF10135, \$12.00, MMIC's, P.C. board, SASE: WA3IAC, 7148 Montague St, Philadelphia, PA 19135.

100 QSL CARDS \$8. \$3 thereafter. Grid square printed free. Shipped postpaid. Guaranteed correct! Free samples. Shell Printing, KD9KW, Box 50B, Rockton, IL 61072.

"HAMLOG" COMPUTER PROGRAM. Full features, 17 modules. Auto-logs, 7-band WAS/DXCC. Apple \$19.95 IBM, CP/M, KAYPRO, Tandy, C128 \$24.95. HR-KA1AWH, POB 2015, Peabody, MA 01960.

FREE Ham Gospel Tracts. SASE. Steve Forst, N3FTT, 5133 Gramercy, Clifton Heights, PA 19018.

FOR SALE: Tektronics oscilloscope model 2235. Like new condx \$1000.00. Robot 1200C slow scan TV converter \$k700 or BO. K4KWY (615) 698-3338 Days or (404) 937-3593 nights.

WANTED: Ham equipment and other property. The Radio Club of Junior High School 22 NYC, Inc. is a nonprofit organization, granted 501(c)(3) status by the IRS, incorporated with the goal of using the theme of Ham Radio to further and enhance the education of young people nationwide. Your property donation or financial support would be greatly appreciated and acknowledged with a receipt for your tax deductible contribution. Meet us in person during the Radio Club of America's annual banquet, November 17, in Manhattan at the NY Athletic Club and learn more about "Education Thru Communication". Please write us at PO Box 1052, New York, NY 10302. Round the clock hotline: (516) 674-4072.

450 MHz SPECTRUM ANALYZER. Adapted from Nov 85 QST article by Al Helfrick, K2BLA. Features: Three digit LED center frequency digital readout, 12 position calibrated Scan Width, 1 kHz to 50 MHz, switchable bandwidth; Wide 3 300 kHz, Narrow 1 10 kHz. Use your low frequency scope for the display portion. Switchable 10 kHz video filter. Variable IF attenuator, LOG output calibrated in 10 db steps. For complete kit, order #450-KIT \$459.95 plus \$4.50 s/h. For assembled and tested unit, order #450-AST, \$799.95 plus \$6.50 s/h. Calif residents add 6% sales tax. Foreign orders add 15% for shipping. A & A Engineering, 2521 W. LaPalma, #K, Anaheim, CA 92801. (714) 952-2114.

DRAKE TR-7. General coverage TX and RX—1.5 to 30 MHz, NB-7, FA-7, 500, 1800, 6000 Hz filters. PS-7 power supply, RV-7 VFO, MS-7 speaker, WH-7 wattmeter, MN-7 tuner with B-1000 balun, 7077 microphone. All manuals plus TR-7 service manual. All "A" mids done by Drake in August 1987 \$1000.00. I ship lower 48. Cliff, POB 241, Electric City, WA 99123.

YAGI BUILDERS. 6061-T6 tube traps. Good for 1500 PEP. SASE for details. No collect calls. Brown Engineering, Inc, 5501 SW 25th Court, Hollywood, FL 33023. (305) 989-4658.

WANTED: Schematic/Manual for my "Precision Series: ES-500A Cathode Ray Oscillograph" N8HXY (616) 536-7734.

FREE FUEL DELIVERIES daily. Arco Genesis G-100 five watt photovoltaic panels. 350 MA at 15 volts. New injection rib design \$79.95 plus \$3 shipping. Michael Bryce, WB8VGE, 2225 Mayflower NW, Massillon, Ohio 44647.

HANDICAPPED NOVICE needs HF equipment donated—anything please. KA3OUE, (412) 531-7443 anytime.

IMRA International Mission Radio Association helps missionaries. Equipment loaned. Weekday net, 14.280 MHz, 1-3 PM Eastern. Nine hundred Amateurs in 40 countries. Rev. Thomas Sable, S.J., University of Scranton, Scranton, PA 18510.

WANT: 300T and 500T tubes. KF6WM, 45300 Royal, King City, CA 93930.

INTERESTED IN QRP? \$1 brings 8-page information brochure plus sample of The QRP Quarterly. Joe Sullivan, WA1WLU, 267 Sutton St, North Andover, MA 01845.

ANALOG AND RF CONSULTING for the San Francisco Bay area. Commercial and military circuits and systems. James Long, Ph.D., N6YB (408) 733-8329.

FOR SALE: One Kenwood Transceiver (brand new) model TS-440S equipped with auto tuner and voice synthesizer. Paid over \$1600.00. Will take best offer. Have other interest. Ed Summerill, W9HVZ.

RTTY JOURNAL—Now in our 36th year. Read about RTTY, AMTOR, PACKET, MSO'S, RTTY CONTESTING, RTTY DX and much more. Year's subscription to RTTY JOURNAL, \$10.00, foreign slightly higher. Order from: RTTY JOURNAL, 9085 La Casita Ave., Fountain Valley, CA 92708.

RUBBER STAMPS: 3 lines \$5.00 PPD. Send check or MO to G.L. Pierce, 5521 Birkdale Way, San Diego, CA 92117. SASE brings information.

ELECTRON TUBES: Receiving, transmitting, microwave... all types available. Large stock. Next day delivery, most cases. DAILY ELECTRONICS, PO Box 5029, Compton, CA 90224. (213) 774-1255.

RECONDITIONED TEST EQUIPMENT \$1.25 for catalog. Walter, 2697 Nickel, San Pablo, CA 94806.

COMING EVENTS

Activities — "Places to go . . ."

SPECIAL REQUEST TO ALL AMATEUR RADIO PUBLICITY COORDINATORS: PLEASE INDICATE IN YOUR ANNOUNCEMENTS WHETHER OR NOT YOUR HAMFEST LOCATION, CLASSES, EXAMS, MEETINGS, FLEA MARKETS, ETC, ARE WHEELCHAIR ACCESSIBLE. THIS INFORMATION WOULD BE GREATLY APPRECIATED BY OUR BROTHER/SISTER HAMS WITH LIMITED PHYSICAL ABILITY.

COLORADO: November 5. Rocky Mountain Radio League Hamfest, Jeffco Senior Center, 6842 Wadsworth Blvd, Arvada. 9 AM to 3 PM. Admission \$2. Tables \$7. Check to FMRL, please SASE. Contact Dan Duryea, KB0J (303) 458-5444 days. Fred Brachle, N0FIK, 8230 Reed Ct, Arvada, CO 80003 (303) 425-5791 evenings. Handi accessible.

WISCONSIN: November 4. The 5th annual "6.91 Friendly Fest" sponsored by the Milwaukee Repeater Club, Serb Hall, 51st and Oklahoma Avenue, Milwaukee. 8 AM to 1 PM. Tickets \$4. 4' tables \$5. Save a dollar on each—SASE with payment before October 29 to Milwaukee Repeater Club, PO Box 2123, Milwaukee, WI 53201.

SOUTH CAROLINA: November 11. Fall Hamfest sponsored by the Sumter ARA, Sumter County Exhibition Center, 700 W. Liberty St, Sumter. 9 AM to 4 PM. Tickets \$4/advance; \$5/door. Handi accessible. Contact SARA, PO Box 193, Sumter, SC 29151-0193. Ted Krape, KB4FIQ. (803) 773-5189.

ILLINOIS: November 12. Rockford Hamfest/Computer Fair, sponsored by the Rockford ARA, Junction of IL Rt 173 and Forest Hills Road. 8 AM to 3 PM. Tickets \$3/advance; \$4/door. Advance reservations with SASE to Rockford Hamfest, PO Box 10003, Rockford, IL 61131. For information Paul Klein, K9VJJ (815) 226-4696.

INDIANA: November 12. 17th annual Fort Wayne Hamfest sponsored by the Allen County Amateur Radio Technical Society. New Allen County War Memorial Coliseum Exposition Center in Fort Wayne. Doors open 8 AM. Tickets \$3.50/advance; \$4/door. For more information write AC-ARTS, PO Box 10342, Fort Wayne, IN 46851.

CONNECTICUT: November 12. SCARA Indoor Ham Radio and Computer Flea Market, North Haven Park and Recreation Center, 7 Linsley Street, North Haven. Sellers admitted at 7 AM. Buyers 9 AM to 3 PM. Tables \$12/advance; \$15/door. General admission \$3 per person. Talk in on 146.01/61. Reservations for tables must be received with check by November 2, 1989 and no reservations by phone. For information or reservations SASE to: SCARA Flea Market, PO Box 81, North Haven, CT 06473 or call between 7 PM and 10 PM Brad at (203) 265-6478.

ALABAMA: November 18. 12th annual Montgomery Hamfest sponsored by the Montgomery ARC, Garrett Coliseum, South Alabama State Fairgrounds, Federal Drive. 8 AM to 3 PM. Free admission. Free parking. All indoors. For information write Hamfest Committee, 2141 Edinburg Drive, Montgomery, AL 36116 or phone Phil at (205) 272-7980 after 5 PM CST.

OHIO: November 19. Auctionfest '89 sponsored by the Massillon ARC, Massillon K of C Hall, Cherry Road. 8 AM to 5 PM. Admission \$3.50/advance; \$4/door. Free parking. Auction starts 11 AM. For advance registration and information contact MARC, PO Box 73, Massillon, OH 44648. Please SASE.

PENNSYLVANIA: November 19. 2nd annual Tri-State Hamfest and Computer Fair, The Meadows, Washington. Sponsored by the Washington Amateur Communications, Cylonssoft Electronics and The Meadows Race Track. 8 AM to 3 PM. All indoors. Admission \$1.00. Children under 12 free. For information Walt Piroth, N8BKW.

OHIO: November 26. 4th annual Swapfest sponsored by the North Coast ARC, North Olmsted Community Cabin, 28114 Lorain Road, North Olmsted. 9 AM to 2 PM. For information the North Coast ARC, PO Box 30529, Cleveland, OH 44130.

HAM RADIO MAGAZINE

Great Magazine At a Special Price.

The Perfect Holiday Gift!

HAM RADIO Magazine is the perfect gift for the hard-to-buy-for Ham friend or for yourself! If you act now, you can take advantage of these special low Holiday rates.

Each monthly issue is stuffed full of the kind of construction articles and projects you are looking for. In addition, you get four super special issues. January is the Annual Construction Issue — full of projects for all levels of Amateur interest. May means antennas — from DC to daylight. Summer doldrums are relieved with July's VHF/UHF issue. In November, the Receiver issue brings to you the latest in state-of-the-art design and construction techniques for winter projects.

HAM RADIO Magazine is growing by leaps and bounds. Reader satisfaction is at an all time high and thousands have joined the HR ranks in the last year alone!

Send a gift to that special Ham friend or renew your subscription today. Take advantage of these special low Holiday rates before they expire January 1, 1990.

**An attractive gift card will be sent
if your order is received before December 5, 1989**



Please enter my one year gift/renewal subscription(s) to HAM RADIO Magazine as follows:

First gift/renewal \$19.95 SAVE \$3
Two or more \$15.95 SAVE \$7

**FIRST
SAVE \$3**

Name _____ Call _____
Address _____
City _____ State _____ Zip _____

**SECOND
SAVE \$7**

Name _____ Call _____
Address _____
City _____ State _____ Zip _____
 NEW RENEWAL

**THIRD
SAVE \$7**

Name _____ Call _____
Address _____
City _____ State _____ Zip _____
 NEW RENEWAL

Start Renew my Subscription to HR
 Enclosed is a check or money order
Charge: Mastercard VISA


Card # _____ Expires _____
My Name _____
Address _____
City _____ State _____ Zip _____

**HAM
RADIO
MAGAZINE**
GREENVILLE, NH 03048

CALL TOLL FREE
800-341-1522
M-F: 8-9 EST. • Sat: 9-5
DATATEL 800™
ORDERS ONLY

FOR EXTRA FAST SERVICE, CALL TOLL FREE
TO ORDER YOUR GIFT SUBSCRIPTIONS OR BOOKS

Prices U.S. only. Foreign prices upon request.



TDS
ATV

- Complete Monitoring of Video and Audio before and during Transmit.
- FM, AM, or both Modes of operation.
- VU Meters for Audio and Video Monitoring.
- Band Change any time and still use the main Control Unit.
- Low Loss coax is NOT required for any Band.
- Built in White Clipper
- AGC in the MIC Amp.
- SMOOTH TOUCH Control on all Switches.
- EASY TO Use
- Many More FEATURES.

CALL or WRITE For Full Information.
T.D. Systems
6419 Rock Springs
Arlington, Texas 76017
(817) 483-4994

116

HAM RADIO BOOKSTORE
GREENVILLE, N.H. 03048
(603) 878-1441

NEW BOOKS

UHF COMPENDIUM Part III and IV

Edited by K. Weiner, DJ9HO

This is one of the most long awaited books in Amateur Radio. It represents over two years of work and contains more than theory — it's chock full of practical, tested designs from some of Europe's most noted hams. Subjects covered include: notch filters, antennas and IF pre-amps, transistor drivers, transmit and receive converters, power amplifiers and much more. This book is guaranteed to be a best seller. Order yours today (this book is imported and supplies will vary due to shipping delays). 1989 1st Edition.

KW-UHF3

Softbound \$29.95

1989-1990 ARRL REPEATER DIRECTORY

Includes all the latest repeater listings available. Lists 13,000 repeaters, 2,200 digipeaters, and 475 beacon stations from 14 MHz to 24 GHz. Get your copy of this new book today.

AR-RD

Softbound \$4.95

ARRL CODE TAPES

Four new sets of code practice tapes from the ARRL. Each set consists of two 90 minutes cassettes and gives you almost 3 full hours of practice. Great way to study when you can't get on the air.

AR-1 5-10 WPM

\$9.95

AR-2 10-15 WPM

\$9.95

AR-3 15-22 WPM

\$9.95

AR-4 13-14 WPM

\$9.95

THE FABULOUS RADIO NBD

by Brandon Wentworth, K6UJ

Here is the story of one of WWI's most important radio stations. Written from the first hand stories and actual experiences of the men who operated NBD. Includes technical descriptions of the equipment and antennas. Great history reading.

1984 1st edition, 34 pages.

BH-NBD

Softbound \$4.95

NEWNES Radio Amateur and Listener's Pocket Book

by Steven Money, G3FZX

Unique collection of useful information for the Radio Amateur and hi-tech listener. Full of hard-to-find information. Includes codes, symbols, formulae, frequencies, in addition to AMTOR packet and SSTV. Handy "pocket book" size. 1987 1st edition. 160 pages.

CRC-RA

Hardbound \$19.95

WIRELESS ANTENNA HISTORY

A vertical design primer

by Walter Schulz, K3OOF

Starts with a well written history of radio's beginnings. Nine chapters cover radio from the first pioneers through the beginnings of radio astronomy. The vertical primer is a complete section on how to design, build and optimize a vertical antenna. Full of explanations and handy hints not found elsewhere. 1988 1st edition. 140 pages.

GL-00F

Softbound \$16.95

HINTS AND KINKS for the Radio Amateur

edited by KBCH & AK7M

This is the twelfth collection of ideas taken from QST's most popular column, Hints and Kinks. Other's hands on experience can save you hours with suggestions on how to build a better mousetrap. Includes ideas on station accessories, operating cw, computers, antennas, shop secrets and much more! Great new edition! 1989 12th edition.

AR-HK

Softbound \$4.95

N6RJ'S SECOND OP MANUAL VERSION

Now available in slide rule format for non-computerized hams! Fully up dated with all the latest prefixes, zones, postage and other information. GET YOURS TODAY! 2nd edition. 1989.

CB-20P

\$9.95

Please enclose \$3.75 for shipping and handling

(continued from page 84)

OPERATING EVENTS
"Things to do . . ."

November 6-12: The Butte, Montana, ARC will operate special event station W7FO to celebrate the 100th birthday of Montana's Statehood. Sugg Freq 3.890, 7.280, 14.280, 21.370 and 28.470. For a Centennial Certificate send 9x12 SASE to Butte ARC, PO Box 4036, Butte, MT 59701.

November 10-12: Veteran's Day Special Event Station sponsored by the Armored Force Amateur Radio Net, 0001Z Nov 10 to 2400Z Nov 12 to honor all Veterans who are now Silent Keys. Work any of 304 members to receive a certificate. Sugg. Freq: Phone—3.920, 7.283, 21.375, 14.250, 28.640. Novice 28.450. CW—7.0650, 7.125. Send #10 SASE to WB1DWR, 16 Berkeley Circle, Newington, CT 06111.

YOUTH LINK NET. Open to all Hams under age 18. Saturdays at 2000 UTC, 28.425 MHz. For more information contact Net Control, George Manning, WB5NMH, 602 Glendale St, Burkburnett, TX 76354.

FREE 1989-90 Florida two meter repeater directories are currently being distributed by the Hernando County Amateur Radio Assn. of Brooksville, FL. Ask for one at any official Florida Welcome Center or SASE to Repeater Directory, Hernando County AR, POB 1721, Brooksville, FL 34605-1721.

LICENSE EXAMS: Middlesex Amateur Radio Society (MARS) has scheduled the following exams: October 10 and December 12—United Methodist Church, 381 Main Street, Portland, CT. 6:45 to 9 PM. November 18—Portland Public Library, 20 Freestone Avenue, Portland, CT. 1 to 5 PM. To pre-register call Ed Kerns, KN9Y (203) 342-3400. Walk-ins allowed. The Middlesex ARS meets every Tuesday evening at 7 PM at the United Methodist Church. All are welcome.

LAUREL ARC monthly (except December) Amateur exam sessions for all license classes. No fee is charged. Pre-registration is required. Call (301) 725-1212, Maryland Radio Center, 8576 Laureldale Drive, Laurel, MD 20707.

NORTH COAST ARC 1989 LICENSE EXAMS. 12:30 PM, Saturdays October 14, December 9. N. Olmsted Community Cabin, S of Lorain on W. Park. Novice thru Extra. Walk-ins allowed. Talk in 145.29 repeater. For information Dan Sarana, KB8A, 15591 Rademaker Blvd, Brookpark, Ohio 44142. 267-5083 or Pauline Wells, KA8FOE, Rick Wells, KB8CI, 777-9460/779-8999.

AMATEUR RADIO CLASSES: For those people interested in obtaining a Novice (basic level) Ham license or upgrading to Tech/General, the Chelsea Civil Defense, in cooperation with ORA Radio Club, will sponsor Amateur Radio Communications classes evenings at Chelsea High School starting MARCH 7, 1989. For more information write Frank Masucci, K1BPN, 136 Grove Street, Chelsea, MA 02150. Please enclose your telephone number.

THE MIT UHF REPEATER ASSOCIATION and the MIT Radio Society offer monthly HAM EXAMS. All classes Novice to Extra. Wednesday, NOVEMBER 22, 7 PM, MIT Room 1-150, 77 Mass Avenue, Cambridge, MA. Reservations requested 2 days in advance. Contact Ron Hoffmann at (617) 484-2098. Exam fee \$4.50. Bring a copy of your current license (if any), two forms of picture ID, and a completed form 610 available from the FCC in Quincy, MA (617) 770-4023.

EXTRA! EXTRA!



Digital Digest
From The Publisher's Shop

Published Bi-Monthly

Read All About Your Favorite Modes Of Digital Communications!

★ **Subscribe Today!** ★

Digital Digest
4063 N. Goldenrod Road
Winter Park, FL 32792

\$16.00 Per Year
U.S. \$22.00 Elsewhere

Payable in U.S. Funds Only / Check or M.O. Preferred

Amplifier Repair

Alpha - Ameritron - AMP - Henry
Dentron - Heathkit - TenTec - Etc.

35 Years Experience as the
Service Manager with a
major manufacturer

Authorized
TenTec
Dealer

K4BWC



Visa & Master Card

OMEGA ELECTRONICS
4209 Live Oak Road
Raleigh, NC 27604
919-832-1025

184

HAM MART

Ham Radio's guide to help you find your local Amateur Radio Dealer

CALIFORNIA

A-TECH ELECTRONICS
1033 Hollywood Way
Burbank, CA 91505
(818) 845-9203

New Ham Store and Ready to Make a Deal!

JUN'S ELECTRONICS
3919 Sepulveda Blvd.
Culver City, CA 90230
(213) 390-8003
(800) 882-1343 Trades
Habla Espanol

COLORADO

ALLIED APPLIANCE & RADIO
4253 South Broadway
Englewood, CO 80110
(303) 761-7305
1 (800) 321-7305 (Orders only)
Rocky Mts Amateur/Shortwave Specialists,
Ten-Tec, Yaesu, JRC-NRD, Sony, MFJ,
KLM, and other fine gear. New and used.
Visa/MC. Antennas, books, discount prices too!

COLORADO COMM CENTER
525 East 70th Ave.
Suite One West
Denver, CO 80229
(303) 288-7373
(800) 227-7373
Stocking all major lines
Kenwood Yaesu, Encomm, ICOM

CONNECTICUT

HATRY ELECTRONICS
500 Ledyard St. (South)
Hartford, CT 06114
(203) 527-1881
Call today. Friendly one-stop shopping
at prices you can afford.

DELAWARE

AMATEUR & ADVANCED
COMMUNICATIONS
3208 Concord Pike
Wilmington, DE 19803
(302) 478-2757
Delaware's Friendliest Ham Store.

DELAWARE AMATEUR SUPPLY
71 Meadow Road
New Castle, DE 19720
(302) 328-7728
(800) 441-7008
Icom, Ten-Tec, Microlog, Yaesu, Kenwood,
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 Mon.-Fri. 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 Mon.-Fri. 9-5:30, Sat. 9-3

HAWAII

HONOLULU ELECTRONICS
819 Keeaumoku Street
Honolulu, HI 96814
(808) 949-5564
Kenwood, ICOM, Yaesu, Hy-Gain, Cush-
craft, AEA, KLM, Tri-Ex Towers, Fluke,
Belden, Astron, etc.

IDAHO

ROSS DISTRIBUTING COMPANY
78 South State Street
P.O. Box 234
Preston, ID 83263
(208) 852-0830
Mon. 9-2; Tues.-Fri. 9-6; Sat. 9-2
Stock All Major Brands
Over 7000 Ham Related Items on Hand

ILLINOIS

ERICKSON COMMUNICATIONS, INC.
5456 N. Milwaukee Avenue
Chicago, IL 60630
(312) 631-5181
Hours: Mon. - Fri. 9-5:30, Sat. 9-3

INDIANA

THE HAM STATION
220 N. Fulton Avenue
Evansville, IN 47710
(800) 523-7731
(812) 422-0231
ICOM, Yaesu, Ten-Tec, Cushcraft, Hy-Gain,
AEA & others.

MARYLAND

MARYLAND RADIO CENTER
8576 Laureldale Drive
Laurel, MD 20707
(301) 725-1212
(800) 447-7489
Kenwood, ICOM, Ten-Tec, Kantronics. Ful
service dealer.
Mon.-Fri. 10-8, Sat. 9-5

MASSACHUSETTS

TEL-COM, INC.
675 Great Road, Rte. 119
Littleton, MA 01460
(508) 486-3400
(508) 486-3040
The Ham Store of New England
You Can Rely On.

MISSOURI

MISSOURI RADIO CENTER
102 NW Business Park Lane
Kansas City, MO 64150
(800) 821-7323
Missouri: (816) 741-8118
ICOM, Kenwood, Yaesu
Same day service, low prices.

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

NEW HAMPSHIRE

RIVENDELL ELECTRONICS
8 Londonderry Road
Derry, N. H. 03038
(603) 434-5371
Hours Mon.-Sat. 10-5; Thurs. 10-7
Closed Sun/Holidays

NEW JERSEY

ABARIS SYSTEMS
276 Oriental Place
Lyndhurst, NJ 07071
(201) 939-0015
Don WB2GPU
ARRL, Astatic, Astron, B&W, Belden,
Bencher, Hustler, Kenwood, Larsen, RF
Concepts, Tonna and much, much more!
Tues.-Fri. 10AM-7:30PM
Thurs. 10AM-9:00PM
Sat. 10AM-4:00PM
Visa/MC

KJI ELECTRONICS
66 Skytop Road
Cedar Grove, NJ 07009
(201) 239-4389
Gene K2KJI
Maryann K2RVH
Distributor of: KLM, Mirage, ICOM, Larsen,
Lunar, Astron. Wholesale - retail.

HAM MART

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
280 Tiffany Avenue
Jamestown, NY 14701
(716) 664-6345
Open 8:00 AM till 5:30 PM
Evenings, Saturday and Sunday by appoint-
ment. Western New York's finest Amateur
dealer. Featuring ICOM "The World System."

OHIO

AMATEUR ELECTRONIC SUPPLY
28940 Euclid Avenue
Wickliffe, OH 44092 (Cleveland Area)
(216) 585-7388
Ohio Wats: 1 (800) 362-0290
Outside Ohio: 1 (800) 321-3594
Hours Mon.-Fri. 9-5:30, Sat. 9-3

DEBCO ELECTRONICS, INC.
3931 Edwards Road
Cincinnati, OHIO 45209
(513) 531-4499
Mon.-Sat. 10AM-9PM, Sun. 12Noon-6PM
We buy and sell all types of electronic parts.

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 Trevoze Electronics
4033 Brownsville Road
Trevose, PA 19047
(215) 357-1400
Same Location for over 30 Years

TEXAS

K COMM dba THE HAM STORE
5707A Mobud
San Antonio, TX 78238
(512) 680-6110
(800) 344-3144
Stocking all major lines. San Antonio's Ham
Store. Great Prices — Great Service. Factory
authorized sales and service.
Hours: Mon.-Fri. 10-6; Sat. 9-3

MADISON ELECTRONICS SUPPLY
3621 Fannin
Houston, TX 77004
(713) 520-7300
Christmas?? Now??

MISSION COMMUNICATIONS
11903 Aleif Clodine
Suite 500 (Corner Harwin & Kirkwood)
Houston, Texas 77082
(713) 879-7764
Now in Southwest Houston—full line of
equipment. All the essentials and extras for
the "ham."

WISCONSIN

AMATEUR ELECTRONIC SUPPLY
4828 W. Fond du Lac Avenue
Milwaukee, WI 53216
(414) 442-4200
Wisc. Wats: 1 (800) 242-5195
Outside Wisc: 1 (800) 558-0411
Mon.-Fri. 9-5:30, Sat. 9-3

Dealers:

YOU SHOULD BE HERE TOO!
Contact Ham Radio now for
complete details.

VHF-UHF POWER DIVIDERS



RF power dividers provides the best way to feed in-phase 2 and 4 antenna arrays to maximize system gain and at the same time reduce losses to a minimum. Covering 144 thru 1296 MHz, this series of VHF/UHF power dividers are premier RF devices designed for a long service life with low SWR and broad operating bandwidth.

Extruded aluminum body with a durable enamel finish in addition to silicon sealing at connector flanges results in a ruggedized unit for all array installations. Available with N-type connectors only, these units are unconditionally guaranteed for 2 years.

MODEL	CONFIG.	PRICE
144-2P	(2 ports)	\$54.00
144-4P	(4 ports)	\$61.00
220-2P	(2 ports)	\$53.00
220-4P	(4 ports)	\$60.00
430-2P	(2 ports)	\$51.00
430-4P	(4 ports)	\$59.00
902-2P	(2 ports)	\$51.00
902-4P	(4 ports)	\$59.00
1296-2P	(2 ports)	\$52.00
1296-4P	(4 ports)	\$60.00

SHIPPING NOT INCLUDED

STRIDSBURG ENGINEERING, CO.

P.O. Box 7973 • Shreveport, LA 71107 • USA
Phone: (318) 865-0523

5-1000 MHz PREAMPLIFIERS

	NF	G	P(1 dB)	\$
WLA20M*	2dB	15dB	0dBm	73
WLA21M	3	13	8	57
WLA22M	4	11	12	61
WLA23M	4	22	12	87
WLA24M	3	23	18	109
WLA25M	5	11	20	82
WLA26M	6	21	24	199

Add \$4 for S&H; *BW 1-500 MHz



WILAM TECHNOLOGY, Div. of

WI-COMM ELECTRONICS INC.
P.O. Box 5174, MASSENA, N.Y. 13662
(315) 769-8334

Ace Systems



**OPTO
Keyer**

\$39.95
\$3.95 S/H*

• Safe OPTO Isolated output • Built-in side tone
2 1/4" speaker • Battery or DC powered • Positive
keying to 30 volts max. • Unique "POWER/LOGIC"
LED • One Year Ace Systems Warranty

VISA - CALL TO ORDER - MasterCard
(814) 965-5937

Ace Systems

RD # 1 Box 83, Wilcox, PA 15870

Authorized Ace Dealers:
Barry Electronics • KJI Electronics

*Continental U.S. Only. PA Residents Add 6% Sales Tax.

"DEALER INQUIRIES INVITED"

(continued from page 6)

True believer

Dear HR

Congratulations on your editorial in the September 1989 issue of *Ham Radio*. You have presented a balanced, concise viewpoint which is also well written.

While I was not especially keen on your magazine, you are making a believer out of me! Recent issues have been very informative, and I now look forward each month to receiving my copy.

Keep up the good work.

Marvin J. Fein,
Newport Beach, California

QSL cards available

Dear HR

The American Amateur Radio Club of Korea has in hand 55 pounds of QSL cards, some as much as 10 years old. These were recently released to KARL by the Postal Department. If you were (or know someone who was) a United States Forces Korea "HL9" during the past 10 years, a SASE to: American Amateur Radio Club of Korea, P.O. Box 153, APO San Francisco, California 96206, will get your cards. Don't forget to include your HL9 callsign and the dates it was valid.

Charles H. Kelley,
W5SPK/HL9CK, PSC Box 5349,
APO San Francisco, California
96366-0006.

NEW OSCAR

BRIDGES HAMISPHERE

- Coming soon to a shack near you.
- Signals from space.
- Catch some free.
- We know how.
- You can too!
- Join AMSAT
- Free brochure for SASE

AMSAT
PO BOX 27
WASHINGTON, DC 20044

✓ 110

AMIGA-Commodore
Chips . . . Parts . . . Upgrades

6526	\$12.25	8362 (DENISE)	\$56.95
6567	\$15.95	8370 (F AGNUS)	\$59.85
6510	\$10.95	8364 (PAULA)	\$56.95
6581	\$11.95	8386 (GARY/5719)	\$17.25
PLA	\$12.95	A501	
901 ROMS	\$11.25	UPGRADE RAM	\$139.50
8520-A1	\$17.95	8372 Agnus Update	\$113.50
		and many others	Kickstart 1.3 ROM . . . \$29.95

COMMODORE DIAGNOSTICIAN II
Just out - A newly revised/updated version of the Commodore Diagnostician which sold over 10,000 copies world-wide. The Commodore Diagnostician II locates faulty chips on all Commodore Computers plus 1541 drives and has different sections such as "Cross Reference #s". This diagnostic tool had a fantastic full page review in March '88 "Computer Shopper Magazine". Cost is \$6.95 prepaid to North America.

Amiga Upgrades - New! Amiga III "Faller AGNUS" Chip \$372 \$113.50 with instructions.

SEND FOR CATALOG ON EXCLUSIVE NEW PRODUCTS

THE GRAPEVINE GROUP, INC.
35 Charlotte Drive, Wesley Hills, N.Y. 10977
1-800-292-7445 • (914) 354-4448
FAX (914) 354-6696

Dealer Prices Available Prices Subject To Change

✓ 185

1989 U.S. CALL DIRECTORY
(on microfiche)

Call Directory - by callsign \$8
Name Index - by last name \$8
Geographic Index - by state/city \$8

All three - \$20
\$3 shipping per order

BUCKMASTER PUBLISHING
Route 3, Box 56
Mineral, Virginia 23117
703/894-5777 visa/mc 800/282-5628

✓ 126

THE PSOTRON
COMPACT ANTENNAS FROM 160-10 METERS

**NO TUNERS!
NO RADIALS!
NO RESISTORS!
NO COMPROMISE!**

**FOUR EXCELLENT REVIEWS JUST
DON'T HAPPEN BY CHANCE.
CALL US FOR A FREE CATALOGUE.**

*See review in Oct. 73, 1984 *Sept. 73, 1985
*March 73, 1986 *Dec. 88. CQ

BILAL COMPANY
137 Manchester Dr.
Florissant, Colo. 80816
(719) 687-0650

✓ 125

Elmer's Notebook

Tom McMullen, W1SL

SIMPLE INSTRUMENTS — RF OUTPUT MONITOR

The RF output monitor can be used as a piece of test equipment for relative measurements, or as a station accessory that will constantly monitor the output of your transmitter. Construction is easy; it's basically a modified section of coaxial cable and an RF detector circuit. Similar circuits have been described in various publications before, but it's such a useful device that it's worth another look.

How it works

Before I get into the details of the device, let's take a look at the theory that makes it work. Everyone's familiar with the transformer shown in **Figure 1**. As with most transformers, it has a primary and a secondary winding. Current flowing through the primary induces current into the secondary, which can be applied to a load or measured with a meter. In many circuits, like household power lines and audio output circuits, the transformer is a part of the load, and whatever is hooked to the secondary winding is also part of that load. In **Figure 1** I've placed a load in series with the transformer primary. The transformer then responds to the amount of current that flows through the load by inducing more or less current into the secondary windings. If the load current changes, the voltage measured at the secondary will follow. By calibrating the meter carefully, you can determine the amount of power flowing through the load.

Notice that there's no iron core shown in the transformer in **Figure 1**. This should be a tip-off that the transformer is working somewhere in the radio frequency range, rather than at audio or power frequencies. From here it's an easy step to a device that will



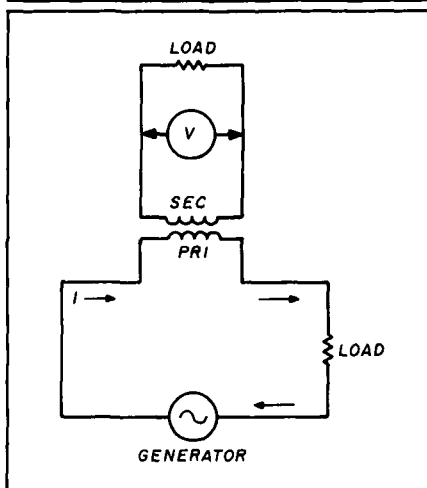
Figure 3). That is really the essence of this simple test device. It's an RF transformer that produces a secondary current flow in response to the amount of current flowing in the primary circuit, which includes the load. This can be an antenna or dummy load, depending on which is hooked to the end of the coax. Now, let's build one.

Construction

As long as you're working at frequencies in the 3.5 to 50-MHz range, there's nothing really critical about the construction. Just follow good construction practices. For frequencies of 25 to 50 MHz, a piece of RG-8/U (or similar) cable approximately 4 to 6 inches long will suffice. You'll need a couple of connectors (your choice) to fit on the ends of the cable, as well as a diode and some other parts. If you can find them, I suggest using connectors that have a "funnel" type hood that connects to the shield braid — it makes a very neat job.

The idea is to assemble the section of coaxial cable with a fitting on each

FIGURE 1

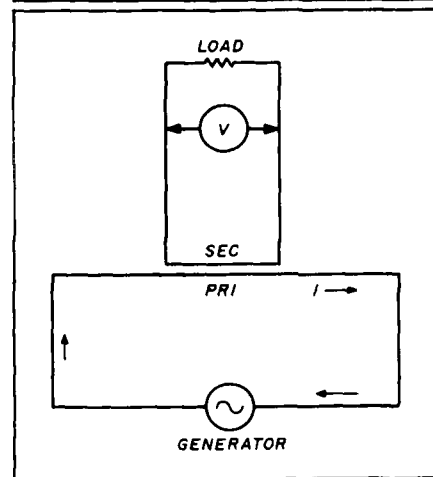


In the familiar transformer representation, current flowing in a primary winding induces current into a secondary winding. The current in the secondary can be detected with a meter or applied to a load.

monitor the power being dissipated in an RF load (like an antenna).

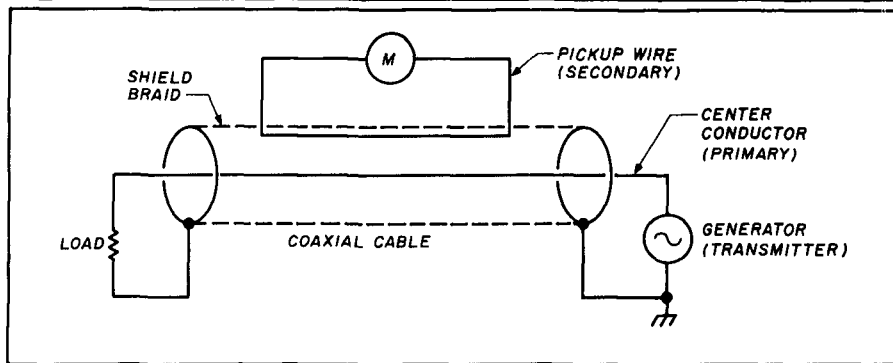
Figure 2 shows a similar RF transformer complete with primary and secondary "windings," although they don't necessarily look like windings. If we remember that even a straight piece of wire will produce a magnetic field when current flows through it (did you ever perform the good old experiment with a piece of bell wire, a lantern battery, and a compass?), then it makes sense that any current flowing in the center conductor of the coaxial cable will induce a current in the "secondary" wire that's very close by inside the metal shield braid (see

FIGURE 2



A radio-frequency transformer can be simplified to a single-wire primary which induces a current in a single-wire secondary.

FIGURE 3



When the single-wire primary "winding" is the center conductor of coaxial cable, the secondary can be a single wire placed inside the braid to intercept the magnetic field surrounding the primary.

end and to place a small insulated wire inside the shield braid, bringing the ends out to a diode rectifier and a metering circuit (see **Figure 4**). You can connect the fitting on one end of the cable, including the braid. Leave the other end bare for the moment. Remove all the vinyl covering from the cable and "bunch up" the braid so the weave is open enough to feed the piece of insulated wire in under the braid through a couple of small holes in the weave. Keep the wire far enough from the ends of the braid that the final soldering operation won't melt the insulation. When the wire is in place, stretch the braid out again to cover the center conductor and dielectric insulation, and install the fitting on the other end. If you can't find the hoods, "tease" the

braid into a couple of pigtails and solder them to lugs that fasten to the flanges with screws and nuts. It's a good idea to cover the braid with a layer or two of plastic electrical tape to hold everything in place.

You can ground one end of the small wire to the coaxial fitting or to a chassis if you're building this assembly into an enclosure of some kind. Connect the other end of the wire to the anode end of a diode — use a small stand-off insulator to hold things in place. The cathode end of the diode can go directly to a microammeter for low power uses, or through a resistor to monitor higher power levels. You can experiment to find values that work with whatever transmitter power output you need. Several resistors and a switch, as used in the

meter described in last month's column, will make the unit more versatile.

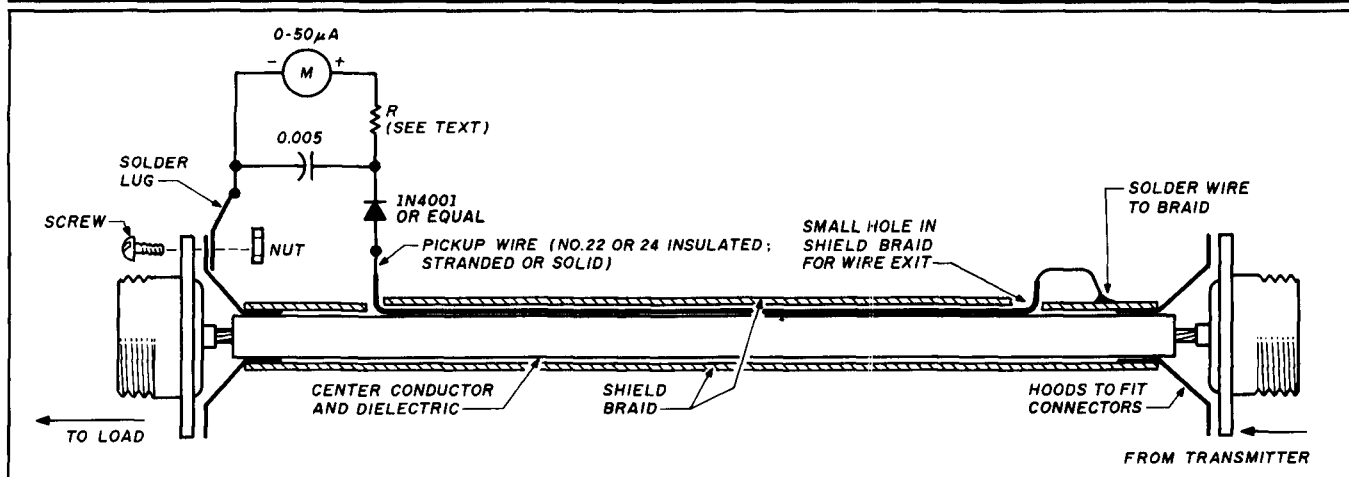
If you'd like something a bit more high tech than a common meter, you might try one of those integrated circuits that drive a bunch of LEDs in a "light-bar" arrangement. You'll find them at many electronic supply stores and in catalogs — including Radio Shack and Jameco. Just follow the instructions that come with the IC and LED assembly, and you'll have a power monitor that shows relative power output whenever you key your transmitter. The LEDs will even follow your voice when you use SSB.

Simple instrument, simple tasks

One thing to remember about this device is that it's not a true power output monitor. It shows *relative* output only. You could, if you're a dedicated experimenter and really fussy, use an accurate wattmeter and a good dummy load and work up a calibration chart for the meter. The catch is that it would be good for only that frequency and into a dummy load. When you change bands the meter reading will change, and any mismatch at the antenna will also change the reading to some degree.

This device is not intended to accurately indicate reflected power (or SWR). It will show some indication if you turn it around and take the end connected to the transmitter and connect it to the antenna feed line instead,

FIGURE 4



Construction of the monitor section. The pick-up wire (secondary winding) is threaded under the shield braid through small holes at each end. A layer of electrician's tape or heat-shrink tubing over the completed assembly will hold everything in place. The resistor value can be from 100 to 47 k or more, as required for the power level you use. The capacitor bypasses RF to keep it out of the meter circuit; a 0.005 μF disk ceramic rated at 50 volts or more will do.

THE ULTIMATE IN PC FAX



PC HF FACSIMILE 4.0 \$99

A complete facsimile reception system for the IBM PC or Compatible. Receives up to 16 intensity levels.

Includes:

- | | |
|----------------------|----------------------|
| Demodulator Software | 80 Page Manual |
| Frequency List | Tutorial Cassette |
| | Interpretation Guide |

Features:
Print on Epson, or HP Laser Jet
Disk Save, Zooming, Image processing
Unattended Image Capture and much more

PC GOES/WEFAX \$250

Designed to receive images directly from U.S. and Soviet meteorological satellites. Includes all of the above feature plus a complete orbital tracking system and resolution of up to 256 gray levels.

Software Systems Consulting
1303 S. Ola Vista, San Clemente, CA. 92672
(714)-498-5784

✓ 111



FULLY
REVISED

BEVERAGE ANTENNA HANDBOOK

by Vic Mizek, W1WCR New Edition

W1WCR has spent countless hours developing new antenna ideas and optimizing the SWA (Steerable wave antenna.) Mizek delves deep into the secrets of the single wire Beverage with helpful hints and tips on how to maximize performance based upon wire size, height above ground, overall length and impedance matching. Also includes information on center fed Beverages constructed out of several wire types. **SMALL LOT OWNERS** — Beverage for you too! Called the Micro-SWA, it is just 60 ft long. You get excellent directivity and null steering capabilities. Transformer design information for both termination and feedline matching is completely revised. 1987 80 pages

VM-BAH Softbound \$14.95

Please enclose \$3.50 shipping & handling

HAM RADIO BOOKSTORE
GREENVILLE, NH 03048 603-878-1441

ANTENNA SOFTWARE New Releases

MN 2.00 analyzes free-space antennas 2-3 times faster than before, with twice as many analysis segments available. New plotting features enhance pattern shape and detail. Better plot printouts. Analyze almost any antenna made of wire or tubing, in free space or over realistically-modeled earth. Compute forward gain, F/B, beamwidth, sidelobes, current, impedance, SWR, take-off angle, and patterns. Compute the interaction among several nearby antennas. MN includes libraries of antenna and plot files, a file editor, and extensive documentation. \$75.

YO 2.00 features a powerful new gain-F/B-SWR tradeoff mechanism, optimization across a frequency band, control of all sidelobes, and full EGA color. Better designs, nicer plots. YO optimizes Yagi designs by automatically adjusting element lengths & spacings for maximum forward gain, maximum F/B, and minimum SWR. YO is extremely fast, and can compute several trial designs per second. YO includes models for gamma, T, hairpin, and beta matches, element tapering, mounting plates, and frequency scaling. A Yagi library, file editor, and extensive documentation are included. \$90.

Upgrade from previous versions for \$50 & \$60. Add 6% for California & foreign orders. For IBM-PC.

Send check or international money order to:
Brian Beezley, K6STI, 507-1/2 Taylor, Vista, CA 92084

MAKE CIRCUIT BOARDS THE NEW, EASY WAY



WITH TEC-200 FILM

JUST 3 EASY STEPS:

- Copy circuit on TEC-200 film using any plain paper copier
- Iron film on to copper clad board
- Peel off film and etch

SATISFACTION GUARANTEED
convenient 8 1/2 x 11 size

5-Sheets for \$3.95
10 sheets only \$5.95

add \$1.25 postage — NY res. add sales tax

The MEADOWLAKE Corp.

DEPT. X, P.O. Box 497
I Northport, New York 11768

✓ 107

Quick Interconnect



POWERPOLE

• Fool-Proof • Fast • Genderless • Color coded • 30A Silver • Reliable • Switch from mobile to shack in seconds. Interchange power supplies and rigs in moments. Interconnect battery, charger, controller, solar panel, generator, backup / conventional power instantly in any combination. Create custom multi-pole connectors in seconds w/ lego-like stacking. Easy crimp/solder, assembly. No special tools required.

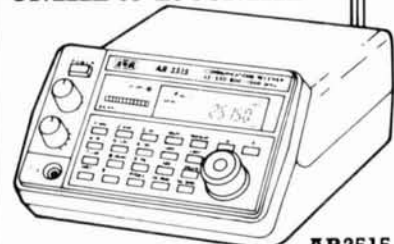
Sold in Sets of 2
Red-Black pairs 10 sets \$19.95 20 sets \$36.95 Add \$3 info Sample \$2 P&H

Antennas West Box 50062, Provo, UT 84605 801-373-8425

✓ 109

New from AOR

2000 Channels
5MHz to 2000MHz



AR2515

- Covers 5MHz to 2000MHz in AM/FM/Wide FM modes Continuous coverage
- 2000 Channel Memory 1984 Scan Frequencies & 16 Search Groups
- Scan/Search speeds up to 36 channels or increments per second
- Built in RS 232 computer interface
- 25 Day Satisfaction Guarantee Full Refund if not Satisfied
- Size 3 1/2" H x 5 1/2" W x 7 1/4" D Wt. 2 lb 10 oz
- Supplied with AC & DC power cords Telescopic antenna

Total Price: Freight Prepaid (Express Shipping Optional) *Upgrades of AR2002's to AR2515 specs Available

\$695.00



COMMUNICATIONS

10707 E. 106th St. Indpls., IN 46256



Toll Free 800-445-7717

Visa and MasterCard (COD slightly higher)

In Indiana 317-849-2570 Collect FAX (317) 849-8794



✓ 127

EVERY ISSUE of HAM RADIO now available on microfiche!

The entire run of *Ham Radio Magazine* (March, 1968 thru last year) is ready to ship to you in one, easy to use format.

Our 24x microfiche is easy to read and very compact. We offer a hand held reader for \$75, and a desk model for \$200. Libraries have these readers.

As a bonus, you will receive *Ham Radio Horizons* (3/77 thru 12/80) free.

Everything is included, front cover to back - ads too!

Annual updates will be offered for \$10.

Send \$185 payment (visa/mc accepted) to:

BUCKMASTER

BUCKMASTER PUBLISHING

Route 3, Box 56

Mineral, Virginia 23117

703/894-5777 visa/mc 800/282-5628

SUPER PERFORMANCE BATTERIES

UPDATED SUPER ICOM

SUPER ICOM BP-7S, 13.2 volts, 1200ma triple the capacity of the Icom BP-7. 5w output.

SUPER ICOM BP-8S, 9.6 volts, 1200ma. 50% more capacity than the Icom BP-8.

Both are rapid base charge only, or slide in wall charger. 4 inches high, BP-7S or BP-8S. \$65.00

SUPER KENWOOD

SUPER KENWOOD PB-25S/PB-26S, 8.4 volts, 900ma, double the capacity of the PB-25/PB-26 for the 2500/2600/3500/3600. Charge with either the standard wall charger or drop in charger. 3 inches high. \$65.00



Exact replacement FNB-2 Nicad pack for Yaesu FT-404R/207R/208R/708R \$22.50

SPEAKER/MICS

Icom HM-9 \$35.00
Yaesu MH12A2B \$31.00

SUPER YAESU

SUPER YAESU FNB-4SH, 12 volts, 1000ma, double the capacity of the Yaesu FNB-4. 5 watt output. Rapid charge only. \$71.00

SUPER YAESU FNB-3S, 9.6 volts, 1200ma, triple the capacity of the Yaesu FNB-3. 3.5 watt output. Rapid or wall charge. \$65.00

Both are perfect for the 03, 09 and 727 series radios and are 4 inches high.

Inserts for:

Kenwood PB-25, 25H, 26 \$25.00
Icom BP-3 \$18.95
Icom BP-5 (500ma) \$24.95
Icom BP-7 (500ma) \$29.50
Icom BP-8 \$29.50

Full line for Yaesu 411/811/470, FNB-10/11/12/14 available.

Add \$4.00 shipping & handling for first pack. CT residents add 8% tax.

Complete line of NICAD packs for Icom, Kenwood, Yaesu, Tempo, Santec, Azden, Cordless Telephones, Alkaline, Nicad & Gell-Cells. All NICAD packs include 1 year guarantee. Commercial Radio Packs available. For all your battery needs, write or call today for a complete catalog. Dealer inquiries invited.

MADE BY HAMS FOR HAMS

PERIPHERAL Inc.

149 Palmer Road • Southbury, CT 06488

(800) 634-8132 In CT (203) 264-3985 FAX: (203) 262-6943




but this reading may or may not mean anything. The reason is that the capacitance between the pick-up wire and the center conductor will always couple some RF energy into the secondary wire. True VSWR indicators are constructed to minimize or eliminate pickup because of this capacitance. The device will, however, be a very useful indicator of how things are working at either end of the feedline. If something drastic happens to either the antenna or the transmitter, you'll see a change in indication — and that's what this gadget was designed to show.

Other frequencies

I've had reasonably good results with this type of device at 144 MHz by using a 4-inch length of coax between fittings, and type "N" connectors rather than the usual SO-239/PL-259 types. At frequencies higher than this, the pick-up wire becomes a significant portion of a wavelength, and the extra wire in that short length of coax puts an "impedance bump" in the line. Amateur publications have described similar devices that use strip conductors made from pc board material. These work well at VHF and UHF. You can obtain improved readings at the lower ranges (3.5, 7, 10, and 14 MHz) by using a coax length of 6 to 8 inches between connectors.

If you want to build the RF transformer section into a metal box along with a meter or the LED indicators, it won't hurt to bend the coaxial section into a "U" shape so the connectors are accessible on either the front or back of the enclosure.

I've seen this type of device built with the secondary wire placed in a small groove cut into the coax cable dielectric. This increases the sensitivity slightly, but the tradeoff is that the secondary wire disturbs the impedance of the cable to a larger degree than does the simpler type of construction. If you're working at very low power ranges, it may be worth a try. 

LOW BAND DX'ING by John Devoldere ON4UN

Now Available! The new, 2nd edition of the definitive book on Low Band DX'ing. Based upon years of practical on-the-air experience, learn the secrets of how ON4UN has been so successful on the low bands. Extensive coverage is given to transmit and receive antennas with clear concise explanations and plenty of illustrations—dipoles, inverted V's, slopers, phased arrays and Beverages—they're all in this book. Also covered: propagation, transmitters, receivers, operating, software and an extensive Low Band bibliography. Going to be a best seller! Get yours today. © 1987 2nd Edition 200 pages

AR-UN Softbound \$9.95

NEW

ON4UN PRACTICAL YAGI DESIGN (MS-DOS) by John Devoldere, ON4UN

This comprehensive Yagi design program is based upon tested antennas, not theoretical un-proven models. Contains 100 different HF antennas, designed, tested and optimized by ON4UN. Also contains a number of classic designs by noted antenna experts W2PV, W6SAI and others. Includes mechanical design of elements and of the rotating mast. You can also add to the database your own designs. Fully detailed "Read me" file is designed to help the user get maximum results from the program. ©1989.

ON-YAGI (MS-DOS) \$69.95

Please enclose \$3.75 shipping & handling

**HAM BOOKSTORE
RADIO**

GREENVILLE, NH 03048

(603) 878-1441
FAX (603) 878-1951

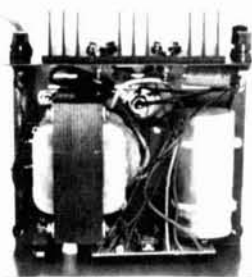


LOW BAND DX-ING COMPUTER PROGRAMS

by John Devoldere, ON4UN, for

Just about every interest or need is covered—from antenna design and optimization to general operating programs. Antenna programs include: shunt and series input L network design, feedline transformer, shunt network design, SWR calculation, plus 11 more! General Ham programs include: sunrise/sunset, great circle distances, grayline, vertical antenna design program, sunrise calendar plus 9 more! The best value in computer software available today. © 1986.

UN-Apple IIe/Ic \$39.95 ea.
 UN-MS (MS-DOS) \$39.95 ea.
 UN-CPM/Kaypro \$39.95 ea.
 UN-C-128 (COMMODORE) \$39.95 ea.
 UN-MAC (MACINTOSH) \$49.95



INSIDE VIEW — RS-12A

ASTRON POWER SUPPLIES

• HEAVY DUTY • HIGH QUALITY • RUGGED • RELIABLE •

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-3A, RS-4A, RS-5A.
- 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)
- Also available with 220 VAC input voltage



MODEL RS-50A



MODEL RS-50M



MODEL VS-50M

RM SERIES



MODEL RM-35M

19" \times 5 1/4" RACK MOUNT POWER SUPPLIES

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN)		Shipping Wt. (lbs.)
			H \times W \times D		
RM-12A	9	12	5 1/4 \times 19 \times 8 1/4		16
RM-35A	25	35	5 1/4 \times 19 \times 12 1/2		38
RM-50A	37	50	5 1/4 \times 19 \times 12 1/2		50
• Separate Volt and Amp Meters					
RM-12M	9	12	5 1/4 \times 19 \times 8 1/4		16
RM-35M	25	35	5 1/4 \times 19 \times 12 1/2		38
RM-50M	37	50	5 1/4 \times 19 \times 12 1/2		50

RS-A SERIES



MODEL RS-7A

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN)		Shipping Wt. (lbs.)
			H \times W \times D		
RS-3A	2.5	3	3 \times 4 1/4 \times 5 3/4		4
RS-4A	3	4	3 3/4 \times 6 1/2 \times 9		5
RS-5A	4	5	3 1/2 \times 6 1/4 \times 7 1/4		7
RS-7A	5	7	3 3/4 \times 6 1/2 \times 9		9
RS-7B	5	7	4 \times 7 1/2 \times 10 3/4		10
RS-10A	7.5	10	4 \times 7 1/2 \times 10 3/4		11
RS-12A	9	12	4 1/2 \times 8 \times 9		13
RS-12B	9	12	4 \times 7 1/2 \times 10 3/4		13
RS-20A	16	20	5 \times 9 \times 10 1/2		18
RS-35A	25	35	5 \times 11 \times 11		27
RS-50A	37	50	6 \times 13 3/4 \times 11		46

RS-M SERIES



MODEL RS-35M

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN)		Shipping Wt. (lbs.)
			H \times W \times D		
• Switchable volt and Amp meter					
RS-12M	9	12	4 1/2 \times 8 \times 9		13
• Separate volt and Amp meters					
RS-20M	16	20	5 \times 9 \times 10 1/2		18
RS-35M	25	35	5 \times 11 \times 11		27
RS-50M	37	50	6 \times 13 3/4 \times 11		46

VS-M AND VRM-M SERIES



MODEL VS-35M

- 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)			ICS* (Amps)	Size (IN)		Shipping Wt. (lbs.)
	@13.8VDC	@10VDC	@5VDC		H \times W \times D		
VS-12M	9	5	2	12	4 1/2 \times 8 \times 9		13
VS-20M	16	9	4	20	5 \times 9 \times 10 1/2		20
VS-35M	25	15	7	35	5 \times 11 \times 11		29
VS-50M	37	22	10	50	6 \times 13 3/4 \times 11		46
• Variable rack mount power supplies							
VRM-35M	25	15	7	35	5 1/4 \times 19 \times 12 1/2		38
VRM-50M	37	22	10	50	5 1/4 \times 19 \times 12 1/2		50

RS-S SERIES



MODEL RS-12S

- Built in speaker

MODEL	Continuous Duty (Amps)	ICS* Amps	Size (IN)		Shipping Wt. (lbs.)
			H \times W \times D		
RS-7S	5	7	4 \times 7 1/2 \times 10 3/4		10
RS-10S	7.5	10	4 \times 7 1/2 \times 10 3/4		12
RS-12S	9	12	4 1/2 \times 8 \times 9		13
RS-20S	16	20	5 \times 9 \times 10 1/2		18

DX Forecaster

Garth Stonehocker, KORYW



WINTER DX SEASON

November through February is the winter DX season for most of us. Signal strengths are roughly 15-dB stronger on paths to Europe from the United States due to lower absorption of signal energy by ions in the D region. In this season the Northern Hemisphere D and E regions receive less energy (thus less ionization) because the sun is in the Southern Hemisphere. On any propagation path, absorption increases with the number of signal transits of the D region and varies inversely with frequency. In working DX to use the higher frequency bands to obtain more distance per hop, which results in fewer transits and less signal loss. But don't make a habit of counting on this; signals traveling a high-latitude path may be poor for several days at a time. This is known as the winter anomaly.

Along with lower signal attenuation, QRN decreases as fewer local thunderstorms pass through your QTH during the winter months. The sun's southerly location also affects the distant land mass thunderstorm generators. As the large thunderstorms near the equator move farther south, their noise decreases by about 6 to 8 dB. This is particularly noticeable on the 160, 80, and 40-meter bands.

How do these two winter DX season signal propagation parameters affect your receiver input? The weakest receiver input that can be amplified and detected is a function of the input signal to noise ratio, S/N. For receivers used in the HF bands the ratio limitation is usually the atmospheric noise received at the antenna input. The preceding paragraph indicates that there's a decrease of noise in this season. Thus your receiver input S/N denominator, N, should decrease by

about 6 to 8 dB. As was mentioned earlier, the signal attenuation from less absorption should increase the signal by about 15 dB during the winter months. Your receiver input S/N numerator, S, should see this. Therefore, a total increase of 20 to 23 dB is available for digging out the weaker DX — making this time of the year better than any other. Do you have an unfulfilled WAC goal, or a friend you'd like to talk to in a third world country where they use low power transmitters? Now is the season; go for it!

Last-minute forecast

Expect DX conditions on the higher frequency bands to be best the first, second, and last weeks of November. Solar flux with accompanying MUFs should be high at these times. Look for good transequatorial openings in late evenings too. These openings may be enhanced around the 7th, 17th, and 27th because of the possibility of disturbances then. November is often quiet geomagnetically, but anything can happen at sunspot maximum. The lower bands, mainly nighttime, are expected to perform best during the third and fourth weeks — including Thanksgiving weekend. It's time to sit by the fireside, away from the cold dark night, and DX a little.


The Taurids meteor showers will occur from October 26th to November 22nd, with a maximum count of ten per hour from the 3rd through the 10th of November. Lunar perigee is on the 12th and a full moon falls on the 13th.

Band-by-band summary

Ten and 12 meters, the highest day-only DX bands, are nearest the MUF for Southern Hemisphere paths. They will be open most days during the 8 to 12 hour period after local noon for the solar flux available this November. These bands open on paths toward the east and close toward the west. The paths are up to 4000 km (2400 miles) in single-hop length and, on occasion, double that during evening transequatorial openings.

Fifteen and 17 meters, day-only DX bands open most of each day, have lower signal strengths and greater multipath variability than 10 and 12 meters. This variability will be best when the MUF is resting just above these bands until it drops below (a transition period that occurs after sunrise and just before sunset). Transequatorial openings will occur with distances similar to 10 and 12 meters.

Twenty, 30, and 40 meters are both daytime and nighttime DX bands. Twenty is the maximum usable band for DX in northerly directions during the day. It provides nighttime paths for the day-only bands, in combination with 30 meters. Forty meters becomes the main over-the-pole DX daytime band, with some hours covered by 30 meters. This path and east-west paths may be affected by 1 to 20 dB of anomalous absorption during a few days of the month.

Eighty and 160 meters, the night-only DX bands, exhibit short skip propagation during daylight hours, then lengthen at dusk. These bands follow the darkness path, opening to the east just before local sunset, swinging more to the north-south near midnight, and ending up in the Pacific areas for a few hours before dawn. Remember the DX window of 3790 to 3800. 

WESTERN USA

QRT	PST	N	NE	E	SE	S	SW	W	NW
0000	4:00	17	30	12	10	10	10	10	12
0100	5:00	15	30	15	10	10	10	10	15
0200	6:00	17	30	15	12	10	10	10	15
0300	7:00	20	30	17	15	10	10	10	17
0400	8:00	30	30	17	15	12	12	15	20
0500	9:00	30	30	17	15	12	15	15	20
0600	10:00	30	30	17	17	15	15	15	30
0700	11:00	30	30	17	17	15	15	17	30
0800	12:00	30	30	17	17	15	17	17	30
0900	1:00	30	30	20	17	17	17	17	30
1000	2:00	30	30	20	17	17	17	17	30
1100	3:00	30	30	20	17	20	17	17	30
1200	4:00	30	30	17	20	17	17	17	30
1300	5:00	30	20	10	10	17	17	17	30
1400	6:00	30	15	10	10	15	20	20	30
1500	7:00	30	15	10	10	10	17	15	30
1600	8:00	30	15	10	10	10	15	15	30
1700	9:00	30	17	10	10	10	12	20	30
1800	10:00	30	17	10	10	10	10	15	30
1900	11:00	30	20	10	10	10	10	12	30*
2000	12:00	30	30	10	10	10	10	10	15
2100	1:00	30	30	10	10	10	10	10	15
2200	2:00	30	30	10	10	10	10	10	12
2300	3:00	30	30	12	10	10	10	10	12

OVEMBER

MID USA

MST	N	NE	E	SE	S	SW	W	NW
5:00	30	30	15	10	10	10	10	12
6:00	30	30	15	12	10	10	10	15
7:00	30	30	15	15	10	12	10	17
8:00	30	30	17	15	12	12	12	20
9:00	30	30	17	15	12	12	15	20
10:00	30	30	17	17	15	15	15	30
11:00	17	30	17	17	15	15	15	30
12:00	15	30	17	17	15	17	17	30
1:00	17	30	20	17	17	17	17	30
2:00	20	30	20	17	17	17	17	30
3:00	30	30	20	17	20	17	17	30
4:00	30	30	17	20	17	17	17	30
5:00	30	20	10	15	17	17	17	30
6:00	30	15	10	10	15	20	20	30
7:00	30	15	10	10	10	17	17	30
8:00	30	17	10	10	10	15	15	30
9:00	30	17	10	10	10	15	15	30
10:00	30	20	10	10	10	12	15	30
11:00	30	30	10	10	10	10	12	20
12:00	30	30	10	10	10	10	12	20
1:00	30	30	10	10	10	10	10	17
2:00	30	30	10	10	10	10	10	15
3:00	30	30	12	10	10	10	10	15
4:00	30	30	15	10	10	10	10	12

EASTERN USA

EST	N	NE	E	SE	S	SW	W	NW
7:00	30	30	17	12	10	10	10	20
8:00	30	30	17	12	12	15	15	20
9:00	30	30	17	15	12	15	15	30
10:00	30	30	17	15	15	17	17	30
11:00	30	30	17	15	15	17	17	30
12:00	30	30	17	17	15	17	17	30
1:00	30	30	17	17	17	17	17	30
2:00	30	30	20	17	17	17	17	30
3:00	30	30	20	17	17	17	17	30
4:00	30	30	17	17	17	17	17	30
5:00	30	17	10	17	17	20	20	30
6:00	17	15	10	12	20	20	20	30
7:00	17	15	10	10	15	15	17	30
8:00	20	15	10	10	12	15	12	30
9:00	30	15	10	10	10	15	12	30
10:00	30	15	10	10	10	17	15	30
11:00	30	15	10	10	10	15	15	30
12:00	30	15	10	10	10	12	17	30
1:00	30	17	10	10	10	10	15	30
2:00	30	20	10	10	10	10	12	30
3:00	30	30	10	10	10	10	10	17
4:00	30	30	10	10	10	10	10	15
5:00	30	30	15	10	10	10	10	15
6:00	30	30	15	10	10	10	10	15

ADVERTISER'S INDEX AND READER SERVICE NUMBERS

Listed below are the page and reader service number for each advertiser in this issue. For more information on their products, select the appropriate reader service number make a check mark in the space provided. Mail this form to ham radio Reader Service, I.C.A., P.O. Box 2558, Woburn, MA 01801.

Name _____ Call _____
 Address _____
 City _____ State _____ Zip _____

*Please contact this advertiser directly. Please use before Dec. 31, 1989.

We'd like to see your company listed here too. Contact Martin Durham at 603-878-1441 to work out an advertising program tailored to suit your needs.

B & W PRESENTS A WINNING COMBINATION



1500W

MODEL PT2500A LINEAR AMPLIFIER

The Barker & Williamson PT2500A Linear Amplifier is a completely self-contained table-top unit designed for continuous SSB, CW, RTTY, AM or ATV operation, intended for coverage of all amateur bands between 1.8 MHz and 21 MHz. Two type 3-500z glass envelope triodes provide reliability and rapid turn-on time.

FEATURES INCLUDE:

- Full 1500 watt output
- Pi-network input for maximum drive
- Pressurized plenum cooling system
- DC antenna relay for hum-free operation
- Illuminated SWR and power meters
- Vernier tuning for accurate settings
- Pi-L output for greater harmonic attenuation

Ruggedly constructed of proven design, this amplifier reflects the manufacturer's critical attention to details—such as the silver-plated tank coil for maximum efficiency. Cathode zener fuse and internal/external cooling are among the protective and safety devices employed. Input and output impedances are 50 ohms.

Dimensions: 17" wide x 19" deep x 8 1/2" high
 Weight: 80 lbs. (shipped in 3 cartons to meet UPS requirements)

Price: \$2175.00 FOB factory. Price includes one year limited warranty. Call or write factory for complete specifications.



1500W

MODEL VS1500A ANTENNA COUPLER

The Barker & Williamson VS1500A antenna coupler is designed to match virtually any receiver, transmitter or transceiver in the 160 to 10 meter range (1.8 to 30 MHz) with up to 1500 watts RF power to almost any antenna, including dipoles, inverted vees, verticals, mobile whips, beams, random wires and others, fed by coax cable, balanced lines or a single wire. A 1:4 balun is built in for connection to balanced lines.

FEATURES INCLUDE:

- Series parallel capacitor connection for greater harmonic attenuation.
- In-circuit wattmeter for continuous monitoring.
- Vernier tuning for easy adjustment.

Front panel switching allows rapid selection of antennas, or to an external dummy load, or permits bypassing the tuner.

Dimension (Approx.): 11" wide x 13" deep x 6" high

Weight: 6 1/2 lbs.

Price: \$499.00 FOB Factory. Fully warranted for one year.



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

READER SERVICE #	PAGE #	READER SERVICE #	PAGE #
___127 - Ace Communications, Monitor Div.....	93	___182 - Kantronics.....	1
___114 - Ace Systems.....	89	___176 - KD9SV.....	20
___120 - Ace Systems.....	74	* - Kenwood USA Corporation.....	2, 5, 7, CIV
___131 - Advanced Computer Controls.....	61	___119 - N.E. Litsche.....	74
___160 - Advanced Receiver Research.....	32	___108 - Madison Electronics Supply.....	44
___179 - AEA.....	15	* - Maggiore Electronic Laboratory.....	66
___123 - Aerospace.....	69	___134 - Glen Martin Engineering, Inc.....	60
___178 - Alinco Electronics Inc.....	16	___107 - The Meadowlake Corp.....	93
___165 - Aluma Tower Co.....	30	___181 - MFJ Enterprises.....	8
* - Amateur Television Quarterly.....	82	___138 - Micro Control Specialties.....	59
___135 - AMC Sales, Inc.....	60	___104 - Missouri Radio Center.....	99
* - Amidon Associates.....	69	___154 - Mobile Mark Inc.....	37
___110 - AMSAT.....	90	___128 - Monitoring Times.....	65
___146 - The Antenna Specialists Co.....	52	___184 - NCG.....	79
___109 - Antennas West.....	52, 60, 93	* - Nema Electronics.....	36
___159 - Antique Radio Classified.....	32	___118 - Nuts & Volts.....	74
___172 - ARE Communications.....	21	___168 - Wm. M. Nye Co. Inc.....	27
___105 - Astron Corp.....	95	___158 - Omega Electronics.....	32
* - Barker & Williamson.....	98	___184 - Omega Electronics.....	86
* - Barry Electronics.....	69	___103 - OPToelectronics.....	100
___125 - Bilal Company.....	90	___155 - P.C. Electronics.....	37
* - Brian Beezley, K6STI.....	93	___133 - Pac-Comm Packet Radio Systems, Inc.....	60
___166 - Buckmaster Publishing.....	30	___170 - Palomar Engineers.....	23
___162 - Buckmaster Publishing.....	32	___106 - Periphex Inc.....	94
___149 - Buckmaster Publishing.....	44	___175 - Radiokit.....	20
___126 - Buckmaster Publishing.....	90	___177 - Radio Shack.....	19
* - Buckmaster Publishing.....	93	___115 - Ramsey Electronics, Inc.....	87
___167 - C&S Sales.....	28	___141 - The RF Connection.....	55
___156 - Coaxial Dynamics Inc.....	36	___132 - Rutland Arrays.....	61
___130 - Communication Concepts, Inc.....	61	___111 - Software Systems.....	39
___148 - Communications Specialists.....	49	___152 - Software Systems.....	93
___122 - Creative Control Products.....	69	___112 - Stridsburg Engineering Co.....	89
___157 - Crystek Crystals.....	36	___124 - STV/OnSat.....	68
___151 - Cushcraft Corporation.....	41	___136 - Synthetic Textiles, Inc.....	60
___164 - Cygnus-Quasar Books.....	30	___116 - TD Systems.....	86
* - Digital Digest.....	86	___173 - TE Systems.....	20
___174 - Doppler Systems.....	20	___129 - Tel-Com.....	65
___140 - Doug Hall Electronics.....	55	* - Universal Radio.....	44
___143 - Down East Microwave.....	52	___153 - Vanguard Labs.....	39
* - Engineering Consulting.....	75	___161 - VHF Communications.....	32
___171 - Fair Radio Sales.....	23	___150 - W & W Associates.....	66
___145 - Franklin-Belle Publishers.....	52	* - WSYI Marketing.....	74
___185 - The Grapevine Group Inc.....	90	___169 - W9INN Antennas.....	23
___137 - GTI Electronics.....	60	___113 - Wi-Comm Electronics Inc.....	89
___147 - Ham Radio Outlet.....	50, 51	* - Yaesu USA.....	CIII
* - Ham Radio's Bookstore.....	65, 75, 82, 86, 93, 94		
___139 - Hamtronics, NY.....	57		
* - Hamtronics, PA.....	39		
* - Heath Company.....	35		
___183 - ICOM America, Inc.....	CII		
___180 - ICOM America, Inc.....	13		
* - ICM.....	59		
___142 - International Radio and Computers Inc.....	52		
___144 - Jan Crystals.....	52		
___163 - Jun's Electronics.....	30		
___121 - KComm, The Ham Center.....	69		

PRODUCT REVIEW/NEW PRODUCT

___302 - The Antenna Specialists Co.....	48
* - Hamtronics, NY.....	53
___303 - ICOM America, Inc.....	53
* - Kenwood USA Corporation.....	48
___306 - MFJ Enterprises.....	53
___304 - Midland LMR.....	53
* - Nema Electronics.....	53
___305 - OPToelectronics.....	48

**ORDER
TOLL-FREE
1-800-821-7323**

**Dependable Service
At The Right Price . . . Everytime**

MasterCard—VISA—Discover

Missouri Radio Center

KENWOOD



TS-940 "DX-CELLENCE"

- All Band, All Mode Transceiver
- Direct Keyboard Entry
- Engineered for the DX-Minded and Contesting Ham
- Its Got It All!

YAESU



FT-767GX HF/VHF/UHF BASE STATION

- Add Optional 6m, 2m & 70cm Modules
- Dual VFO's
- Full CW Break-in
- Lots More Features

ICOM **NEW!**



IC-765 NEW HF TRANSCEIVER

- Built-in Automatic Antenna Tuner and Power Supply
- 99 Memories • 100 W Output
- 160-10M/General Coverage Receiver
- Band Stacking Registers

uniden



HR-2600

- Mobile 10 Meter Transceiver
- SSB/AM/FM/CW
- 25 Watts PEP
- New FM Offsets & PL

KENWOOD



TS-140S AFFORDABLE DX-ING!

- HF Transceiver With General Coverage Receiver
- All HF Amateur Bands
- 100 W Output
- Compact, Lots of Features

YAESU



FT-736R VHF-UHF BASE STATION

- SSB, CW, FM on 2 Meters and 70 cm
- Optional 50 MHz, 220 MHz or 1.2 GHz
- 25 Watts Output on 2 Meters, 220 and 70 cm
- 10 Watts Output on 6 Meters and 1.2 GHz • 100 Memories

ICOM **NEW!**



IC-725 NEW ULTRA-COMPACT HF TRANSCEIVER

- USB/LSB/CW, AM Receive
- Optional Module for AM Transmit and FM TX/RX
- 160-10M Operation • 100 W Output
- Receive 30 kHz to 33 MHz
- 26 Memories with Band Stacking Registers

ASA **CP-100**



Complete Terminal Unit for Morse, Baudot, ASCII, AMTOR

**NOW 1/2 PRICE
CLOSEOUT SPECIAL
ONLY \$169. DELIVERED**

Software Available
Call Now—Don't Delay

KENWOOD **NEW!**



TM-231A

2 METER FM MOBILE

- 50 Watts Output
- 20 Multi-Function Memories
- Selectable CTCSS Tone Built-in
- Operate 4 Mobile Rigs with Optional IF-20 Interface and RC-20 Controller

Kantronics



KT-Series Mono-Band Radios

10-15-20-30-40-80M MODELS

SAVE BIG \$\$

Best Price and Complete Selection
Call Today!

ICOM

IC-2GAT IC-4GAT

2 Meter & 440 Handhelds

- IC-2GAT
RX 138-174 MHz
TX 140-150 MHz
7 Watts
- IC-4GAT
440-450 MHz
6 Watts



ASTRON



- RS7A . . . \$51 • RS35M . . \$167
- RS12A . . . \$75 • VS35M . . \$179
- RS20A . . . \$92 • RS50A . . \$209
- RS20M . . \$112 • RM50M . \$235
- VS20M . . \$129 • RM50M . \$259
- RS35A . . \$149 • VS50M . . \$245

KENWOOD

SALE! TH-25AT

POCKET-SIZED AND POWERFUL

- Frequency Coverage: 141-163 MHz (Rx), 144-148 MHz (Tx)
- Front Panel DTMF Pad
- 5 Watts Output
- 14 Memories
- TH-45AT Available for 440 MHz



ALINCO SUPER SALE

ALD-24T
2m/70cm
Dual Band
Mobile



\$449.00 Delivered
25W, 21 Memories, Dual VFO's
At an Unbeatable Price!

ICOM

IC-32AT
SUPER DUALBAND
FM HANDHELD

- 5 Watts on Both Bands
- Receive 138-174 MHz
440-450 MHz
- Stores Standard and Odd Offsets



MFJ SALE MFJ

LARGEST STOCK OF ALL
YOUR MFJ FAVORITE
ACCESSORIES
CALL TODAY FOR
BEST PRICE



Extra Savings on the MFJ-1278
Multi-Mode Data Controller

102 N.W. Business Park Lane Kansas City, MO 64150
Send SASE For Used List

Call Toll Free—9am - 6pm Mon.-Fri. 9am - 2pm Sat.
In Missouri Call—816-741-8118

MOST ORDERS SHIPPED SAME DAY

• DAIWA • HUSTLER

HYGAIN • ICOM •

KANTRONICS • LARSEN • MFJ • MIRAGE/KLM • NYE VIKING • RF CONCEPTS • UNIDEN • YAESU

OPTOELECTRONICS



You Have Counted on Us for 15 Years

You have counted on OPTOELECTRONICS Hand Held Frequency Counters to be the best quality, to be affordable and reliable. We have been there for you with Frequency Counters that are compact and ultra sensitive.

And more and more of you are counting on us, technicians, engineers, law enforcement officers, private investigators, two-way radio operators, scanner hobbyists, and amateur radio operators, just to name a few.

Hand Held Series Frequency Counters and Instruments

MODEL	2210	1300H/A	2400H	CCA	CCB
RANGE: FROM TO	10 Hz 2.2 GHz	1 MHz 1.3 GHz	10 MHz 2.4 GHz	10 MHz 550 MHz	10 MHz 1.8 GHz
APPLICATIONS	General Purpose Audio-Microwave	RF	Microwave	Security	Security
PRICE	\$219	\$169	\$189	\$299	\$99
SENSITIVITY					
1 KHz	< 5 mv	NA	NA	NA	NA
100 MHz	< 3 mv	< 1 mv	< 3 mv	< .5 mv	< 5 mv
450 MHz	< 3 mv	< 5 mv	< 3 mv	< 1 mv	< 5 mv
850 MHz	< 3 mv	< 20 mv	< 5 mv	NA	< 5 mv
1.3 GHz	< 7 mv	< 100 mv	< 7 mv	NA	< 10 mv
2.2 GHz	< 30 mv	NA	< 30 mv	NA	< 30 mv

ACCURACY ALL HAVE +/- 1 PPM TCXO TIME BASE.

All counters have 8 digit red .28" LED displays. Aluminum cabinet is 3.9" H x 3.5" x 1". Internal Ni-Cad batteries provide 2-5 hour portable operation with continuous operation from AC line charger/power supply supplied. Model CCB uses a 9 volt alkaline battery. One year parts and labor guarantee. A full line of probes, antennas, and accessories is available. Orders to U.S. and Canada add 5% to total (\$2 min, \$10 max). Florida residents, add 6% sales tax. COD fee \$3. Foreign orders add 15%. MasterCard and VISA accepted.

Orders to U.S. and Canada add 5% to total (\$2 min, \$10 max). Florida residents, add 6% sales tax. COD fee \$3. Foreign orders add 15%. MasterCard and VISA accepted.

OPTOELECTRONICS INC.

5821 N.E. 14th Avenue • Fort Lauderdale, Florida 33334
 1-800-327-5912 FL (305) 771-2050 FAX (305) 771-2052



*For More Information, call 1-800-999-2070



DSP
Digital Signal Processing

Digital Signal Processing



Without DSP

With DSP

TS-950SD
"DX-clusive" HF Transceiver



The new TS-950SD is the first Amateur Radio transceiver to utilize Digital Signal Processing (DSP), a high voltage final amplifier, dual fluorescent tube digital display and digital meter with a peak-hold function.

• **Digital Signal Processor.** DSP is a state-of-the-art technique that maximizes your transmitted RF energy. Your signal stands out because it is much more pure than your competition! You can even tailor your transmitted CW or voice signal waveshape!

• **Dual Frequency Receive Function.** The TS-950SD can receive two frequencies simultaneously. The sub-receiver has independent controls for frequency step size, noise blanker, and AF gain and its own digital display!

• **New! Digital AF filter.** Synchronized with SSB IF slope tuning, the digital AF filter provides sharp characteristics for optimum filter response.

• **New high voltage final amplifier.** 50V power transistors are used in the 150W final section, resulting in minimum distortion and higher efficiency. Full-power key-down time exceeds one hour.

• **New! Built-in microprocessor controlled automatic antenna tuner.** The new antenna tuner is faster and you can store the settings in memory! (Manual override is also possible.)

Transmit the ultimate signal.

• **Outstanding general coverage receiver performance and sensitivity.** Kenwood's Dyna-Mix™ high sensitivity direct mixing system provides incredible performance from 100 kHz to 30 MHz. The Intermodulation dynamic range is 105 dB.

• **Multi-Drive Band Pass Filter (BPF) circuitry.** Fifteen band pass filters are available in the front end to enhance performance.

• **High performance IF filters built-in.** Select various filter combinations from the front panel. For CW: 250 and 500 Hz, 2.4 kHz for SSB, and 6 kHz for AM. Filter selections can be stored in memory!

- Kenwood Interference reduction circuits. SSB Slope Tuning, CW VBT (Variable Bandwidth Tuning), CW AF tune, IF notch filter, dual-mode noise blanker with level control, 4-step RF attenuator (10, 20, or 30 dB), switchable AGC circuit, and all-mode squelch.
- Built-in TCXO for highest stability.
- Built-in electronic keyer circuit.
- 100 memory channels. Store independent transmit and receive frequencies, mode, filter data, auto-tuner data and CTCSS frequency.
- Digital bar meter.

Additional Features: • Built-in interface for computer control • Programmable tone encoder • Optional VS-2 voice synthesizer • Built-in heavy duty AC power supply and speaker • Adjustable VFO tuning torque • Multiple scanning functions • MC-43S hand microphone supplied

KENWOOD U.S.A. CORPORATION
COMMUNICATIONS & TEST EQUIPMENT GROUP
P.O. BOX 22745, 2201 E. Dominguez Street
Long Beach, CA 90801-5745
KENWOOD ELECTRONICS CANADA INC.
P.O. BOX 1075, 959 Gana Court
Mississauga, Ontario, Canada L4T 4C2

KENWOOD
...pacesetter in Amateur Radio

Optional Accessories
• VS-2 Voice synthesizer
• SP-950 External speaker w/AF filter
• SM-230 Sta-

tion monitor w/pan display
• SW-2100 SWR/power meter
• TL-922A Linear amplifier (not for QSK)



Specifications, features and prices subject to change without notice or obligation. Complete service manuals are available for all Kenwood transceivers and most accessories.