D 08240

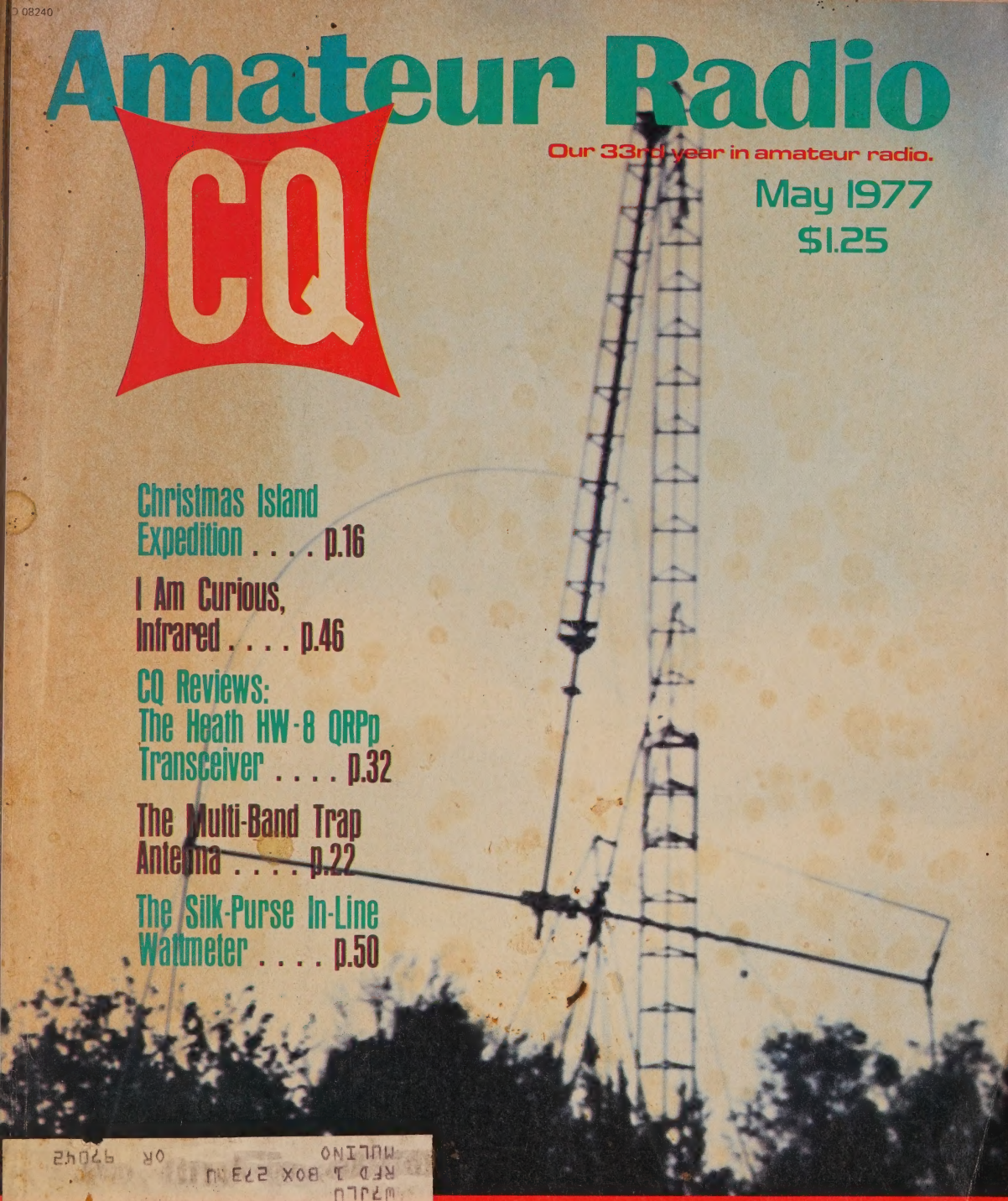
Amateur Radio

CQ

Our 33rd year in amateur radio.

May 1977

$1.25



Christmas Island Expedition p.16

I Am Curious, Infrared p.46

CQ Reviews: The Heath HW-8 QRPp Transceiver p.32

The Multi-Band Trap Antenna p.22

The Silk-Purse In-Line Wattmeter p.50

AMORRRL*B***IG US .CA APR76
R N MORRIS *****
W7JLU
RFD 1 BOX 273 N
MULINO OR 97042

The Radio Amateur's Journal

TS-820



The ultimate transceiver . . . Kenwood's TS-820. No matter what you own now, a move to the TS-820 is your best move. It offers a degree of quality and dependability second to none, and as the owner of this superb unit, you will have at your fingertips the combination of controls and features that, even under the toughest operating conditions, make the TS-820 the *Pacesetter* that it is.

Features

Following are a few of the TS-820's many exciting features.

SPEECH PROCESSER • An HF circut provides quick time constant compression using a true RF compressor as opposed to an IF clipper. Amount of compression is adjustable to the desired level by a convenient front panel control.

IF SHIFT • The IF SHIFT control varies the IF passband without changing the receive frequency. Enables the operator to eliminate unwanted signals by moving them out of the passband of the receiver. This feature alone makes the TS-820 a pacesetter.



TV-506 TV-502 VFO-820 TS-820 SP-520

PLL • The TS-820 employs the latest phase lock loop circuitry. The single conversion receiver section performance offers superb protection against unwanted cross-modulation. And now, PLL allows the frequency to remain the same when switching sidebands (USB, LSB, CW) and eliminates having to recalibrate each time.

DIGITAL READOUT DC-1 • (optional) A digital counter display can be employed as an intergral part of the VFO readout system. Counter mixes the carrier, VFO, and first heterodyne frequencies to give *exact* frequency. Figures the frequency down to 10 Hz and digital display reads out to 100 Hz. Both receive and transmit frequencies are displayed in easy to read, Kenwood Blue digits.

Specifications

FREQUENCY RANGE: 1.8-29.7 MHz (160 - 10 meters)
MODES: USB, LSB, CW, FSK
INPUT POWER: 200W PEP on SSB
160 W DC on CW
100 W DC on FSK
ANTENNA IMPEDANCE: 50-75 ohms, unbalanced
CARRIER SUPPRESSION: Better than 40 dB
SIDEBAND SUPPRESSION: Better than 50 dB
SPURIOUS RADIATION: Greater than -60 dB (Harmonics more than -40 dB)
RECEIVER SENSITIVITY: Better than 0.25uV
RECEIVER SELECTIVITY:
SSB 2.4 kHz (-6 dB)
4.4 kHz (-60 dB)
CW* 0.5 kHz (-6 dB)
1.8 kHz (-60 dB)
*(with optional CW filter installed)
IMAGE RATIO: 160-15 meters: Better than 60 dB
10 meters: Better than 50 dB
IF REJECTION: Better than 80 dB
POWER REQUIREMENTS: 120/220 VAC, 50/60 Hz, 13.8 VDC (with optional DS-1A DC-DC converter)
POWER CONSUMPTION: Transmit: 280 Watts
Receive: 26 Watts (heaters off)
DIMENSIONS: 13-1/8" W x 6" H x 13-3/16" D
WEIGHT: 35.2 lbs (16 kg)

VFO-820 Function switch provides any combination of transmit/receive/transceive with the TS-820. Both are equipped with VFO indicators showing which VFO is in use.

SP-520 Although the TS-820 has a built-in speaker, the addition of the SP-520 provides improved tonal quality. A perfect match in both design and performance.

TV-502 The TV-502 transverter puts you on 2-meters the easy way. Operates in the 144.0-145.7 MHz frequency range with a 145.0-146.0 MHz option. Completely compatible with the TS-820, the TS-520 and most any HF transceiver.

TV-506 Similar to the TV-502 except that it opens up the 6-meter band (50.0-54.0 MHz) to your HF rig.

TRIO-KENWOOD COMMUNICATIONS INC. 116 EAST ALONDRA/GARDENA, CA 90248

KENWOOD
...pacesetter in amateur radio

Call toll-free 800-647-8660
for products by MFJ ENTERPRISES

400% MORE RF POWER
PLUGS BETWEEN YOUR MICROPHONE AND TRANSMITTER



$49.95

LSP-520BX. 30 db dynamic range IC log amp and 3 active filters give clean audio. RF protected. 9 V battery. 3 conductor, ¼" phone jacks for input and output. 2-3/16 x 3-1/4 x 4 inches.



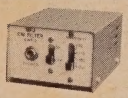
$59.95

LSP-520BX II. Same as LSP-520BX but in a beautiful 2-1/8 x 3-5/8 x 5-9/16 inch Ten-Tec enclosure with uncommitted 4 pin Mic jack, output cable, rotary function switch.

SUPER LOGARITHMIC SPEECH PROCESSOR

Up To 400% More RF Power is yours with this plug-in unit. Simply plug the MFJ Super Logarithmic Speech Processor between your microphone and transmitter and your voice is suddenly transformed from a whisper to a **Dynamic Output.**

Your signal is full of punch with power to slice through QRM and you go from barely readable to "solid copy OM".

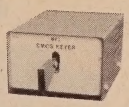


$27.95

CWF-2BX Super CW Filter

By far the leader. Over 5000 in use. Razor sharp selectivity. 80 Hz bandwidth, extremely steep skirts. No ringing. Plugs between receiver and phones or connect between audio stage for speaker operation.

• Selectable BW: 80, 110, 180 Hz • 60 dB down one octave from center freq. of 750 Hz for 80 Hz BW • Reduces noise 15 dB • 9 V battery • 2-3/16 x 3-1/4 x 4 in. • CWF-2PC, wired PC board, $18.95 • CWF-2PCK, kit PC board $15.95



$49.95

CMOS-8043 Electronic Keyer

State of the art design uses CURTIS-8043 Keyer-on-a-chip.

• Built-in Key • Dot memory • Iambic operation with external squeeze key • 8 to 50 WPM • Sidetone and speaker • Speed, volume, tone, weight controls • Ultra reliable solid state keying ±300 volts max. • 4 position switch for TUNE, OFF, ON, SIDETONE OFF • Uses 4 penlight cells • 2-3/16 x 3-1/4 x 4 inches



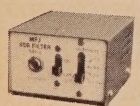
$39.95

NEW

MFJ-16010 Antenna Tuner

Now you can operate all band — 160 thru 10 Meters — with a single random wire and run your full transceiver power output — up to 200 watts RF power OUTPUT.

• Small enough to carry in your hip pocket, 2-3/16 x 3-1/4 x 4 inches • Matches low and high impedances by interchanging input and output • SO-239 coaxial connectors • Unique wide range, high performance, 12 position tapped inductor. Uses two stacked toroid cores

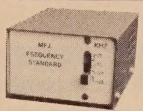


$29.95

SBF-2BX SSB Filter

Dramatically improves readability.

• Optimizes your audio to reduce sideband splatter, remove low and high pitched QRM, hiss, static crashes, background noise, 60 and 120 Hz hum • Reduces fatigue during contest, DX, and ragchewing • Plugs between phones and receiver or connect between audio stage for speaker operation • Selectable bandwidth IC active audio filter • Uses 9 volt battery • 2-3/16 x 3-1/4 x 4 inches

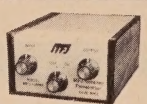


$27.95

MFJ-200BX Frequency Standard

Provides strong, precise markers every 100, 50, or 25 KHz well into VHF region.

• Exclusive circuitry suppresses all unwanted markers • Markers are **gated** for positive identification. CMOS IC's with transistor output. • No direct connection necessary • Uses 9 volt battery • Adjustable trimmer for zero beating to WWV • Switch selects 100, 50, 25 KHz or OFF • 2-3/16 x 3-1/4 x 4 inches

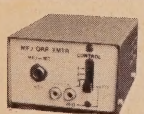


$49.95

MFJ-1030BX Receiver Preselector

Clearly copy weak unreadable signals (increases signal 3 to 5 "S" units).

• More than 20 dB low noise gain • Separate input and output tuning controls give maximum gain and RF selectivity to significantly reject out-of-band signals and reduce image responses • Dual gate MOS FET for low noise, strong signal handling abilities • Completely stable • Optimized for 10 thru 30 MHz • 9 V battery • 2-1/8 x 3-5/8 x 5-9/16 inches



$27.95

MFJ-40T QRP Transmitter

Work the world with 5 watts on 40 Meter CW.

• No tuning • Matches 50 ohm load • Clean output with low harmonic content • Power amplifier transistor protected against burnout • Switch selects 3 crystals or VFO input • 12 VDC • 2-3/16 x 3-1/4 x 4 inches

MFJ-40V, Companion VFO $27.95
MFJ-12DC, IC Regulated Power Supply, 1 amp, 12 VDC $27.95



$15.95

NEW

CPO-555 Code Oscillator

For the Newcomer to learn the Morse code.
For the Old Timer to polish his fist.
For the Code Instructor to teach his classes.

• Send crisp clear code with plenty of volume for classroom use • Self contained speaker, volume, tone controls, aluminum cabinet • 9 V battery • Top quality U.S. construction • Uses 555 IC timer • 2-3/16 x 3-1/4 x 4 inches

TK-555, Optional Telegraph Key $1.95

OUR OFFER TO YOU

Dear Fellow Ham,

Try any MFJ products and if you are not completely satisfied, return it within 30 days for a full prompt refund (less shipping). Call us today **toll free 800-647-8660** and charge your Bank-Americard or Master Charge, or mail your order in today with your check or money order (or use your BAC or MC). Please add $2.00 for shipping and handling.

73, Martin F. Jue, K5FLU

ORDER TODAY. MONEY BACK IF NOT DELIGHTED. ONE YEAR UNCONDITIONAL GUARANTEE.

Order By Mail or Call TOLL FREE 800-647-8660 and Charge It On BANKAMERICARD master charge

MFJ ENTERPRISES P. O. BOX 494 MISSISSIPPI STATE, MISSISSIPPI 39762

Kenwood adds to your pleasure... wherever you go



TR-2200A

A 2-METER STATION THAT GOES WHERE YOU GO

The high performance portable 2-meter FM transceiver endowed with Kenwood's characteristic high level of quality. The TR-2200A provides superior performance for the active outdoorsman . . . portable, mobile or airborne . . . pleasure or emergency. 12 channel capacity (6 supplied). Built-in telescoping antenna can be easily replaced by a "rubber duck" antenna (RA-1 option). Connection for external antenna. External 12 VDC or internal ni-cad batteries. Battery-saving "light off" position. Hi-Lo power switch (2 watts-400 mW). Everything you need is included: batteries, charger, carrying case and microphone. Or mount it in your car as a mobile rig using an MB-1A mounting bracket (option).

TR-7400A

Featuring Kenwood's New and Unique CONTINUOUS TONE CODED SQUELCH SYSTEM • 4 MHz BAND COVERAGE • 25 WATT OUTPUT • FULLY SYNTHESIZED, 800 CHANNELS

Outstanding sensitivity, large-sized helical resonators with High Q to minimize undesirable out-of-band interference, and a 2-pole 10.7 MHz monolithic crystal filter combine to give your TR-7400A outstanding receiver performance. This compact 6.2 pound package measures only 7-3/16" wide, 10-5/8" deep, and 2-7/8" high and is designed to give you the kind of performance specifications you've always wanted to see in a 2-meter amateur rig. High performance specifications of: Intermodulation characteristics (Better than 66dB), spurious (Better than −60dB), image rejection (Better than −70dB) and a versatile squelch system make the TR-7400A tops in its class.

TRIO-KENWOOD COMMUNICATIONS INC. 116 EAST ALONDRA/GARDENA, CA 90248

KENWOOD
...pacesetter in amateur radio

MAY, 1977 VOL. 33, NO. 5

CQ The Radio Amateur's Journal

EDITORIAL STAFF

Alan M. Dorhoffer, K2EEK
Editor

Kim Smith
Assistant Editor

Chris Kelly
Editorial Assistant

CONTRIBUTING STAFF

Frank Anzalone, W1WY
Contest Chairman

John A. Attaway, K4IIF
DX Editor

Herbert S. Brier, W9AD
Novice Editor

Robert Cox, K3EST

Carl Brockman, WA6EPQ
W.W. Contest Directors

Rod Linkous, W7YBX
Assistant DX Editor

William DeWitt, W2DD
SSTV Editor

A. Edward Hopper, W2GT
USA-CA Director

Robert Huntington, W6TCQ
WPX Award Manager

George Jacobs, W3ASK
Propagation Editor

Irwin Math, WA2NDM
Math's Notes

Donald McClenon, W3IN
160 M. Contest Director

Hugh R. Paul, W6POK
Technical Evaluations

William I. Orr, W6SAI
Antennas

Adrian Weiss, K8EEG/Ø
QRPp Editor

Bernie Welch, W8IMZ
WPX Contest Director

BUSINESS STAFF

Sanford R. Cowan
President

Richard A. Cowan, WA2LRO
Publisher/Advertising Sales

Richard A. Ross, K2MGA
Assoc. Publisher

Cary L. Cowan
Accounts

Sarah Greenberg
Controller

Gloria Forsyth
Circulation Manager

PRODUCTION STAFF

Alan M. Dorhoffer, K2EEK
Production Manager

William H. Travis
Art Director

Liz Beener
Assistant Art Director

Sheryl Stern
Harold Perry
Art Staff

K & S Graphics
Illustrations

FEATURES

VK9XX, A DXPEDITION TO CHRISTMAS ISLAND
Bill Rindone, WB7ABK 16

THE MULTI-BAND TRAP ANTENNA, PART IV, CONCLUSION
Joseph M. Boyer, W6UYH 22

28TH ANNUAL ARMED FORCES DAY COMMUNICATIONS TESTS 30

CQ REVIEWS: THE HEATH HW-8 QRPP TRANSCEIVER
Adrian Weiss, K8EEG/Ø 32

MATH'S NOTES: OPERATIONAL AMPLIFIERS
Irwin Math, WA2NDM 38

FILAMENT VOLTAGE: WHY IT IS WHAT IT IS
William I. Orr, W6SAI 39

IN FOCUS: SSTV THEN AND NOW
Bill DeWitt, W2DD 42

I AM CURIOUS, INFRARED
George M. Ewing, WA8WTE 46

THE SILK-PURSE IN-LINE WATTMETER
Adrian Weiss, K8EEG/Ø 50

ANTENNAS: SLOPERS, QUADS AND DELTA LOOPS
William I. Orr, W6SAI 53

NOVICE: MAKING CONTACTS
Herbert S. Brier, W9AD 57

DEPARTMENTS

DX: TWO NEW COUNTRIES
Rod Linkous, W7YBX 60

PROPAGATION: SHORT SKIP CHARTS FOR MAY AND JUNE
George Jacobs, W3ASK 65

AWARDS: STORY OF THE MONTH— FRANCIS H. HELLER, W2CUC
A. Edward Hopper, W2GT 67

CONTEST CALENDAR: CONTESTS FOR MAY AND EARLY JUNE
Frank Anzalone, W1WY 69

ANNOUNCEMENTS ..... 4 ZERO BIAS 9

HAM SHOP 76

Offices: 14 Vanderventer Avenue, Port Washington, L.I., N.Y. 11050. Telephone: 516-883-6200

CQ (Title registered U.S. Post Office) is published monthly by Cowan Publishing Corp. Second Class Postage paid at Port Washington, N.Y. and other points. Subscription Prices one year, $7.50; two years $13.00. Entire contents copyrighted by Cowan Publishing Corp. CQ does not assume responsibility for unsolicited manuscripts. Allow six weeks for change of address. Printed in the United States of America.

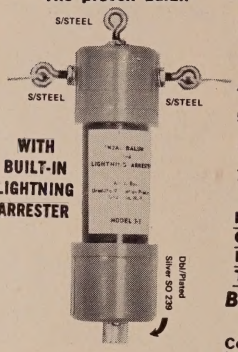
Postmaster: Please send form 3579 to CQ Magazine, 14 Vanderventer Ave., Port Washington, L.I., N.Y. 11050

THE BIG SIGNAL

THE APPROVED LEADING HAM AND COMMERCIAL BALUN IN THE WORLD TODAY.

"W2AU" BALUN $12.95

The proven balun



1. **HANDLES FULL 2 KW PEP AND THEN SOME.** Broad-Banded 3 to 40 Mc.
2. **HELPS TVI PROBLEMS** By Reducing Coax Line Radiation
3. **NOW ALL STAINLESS STEEL HARDWARE.** SO239 Double Silver Plated
4. **IMPROVES F/B RATIO** By Reducing Coax Line Pick-Up
5. **REPLACES CENTER INSULATOR.** Withstands Antenna Pull of Over 600 Lbs.
6. **BUILT-IN LIGHTNING ARRESTER.** Protects Balun —Could Also Save Your Valuable Gear
7. **BUILT-IN HANG-UP HOOK.** Ideal For Inverted Vees, Multi-Band Antennas, Dipoles, Beam and Quads

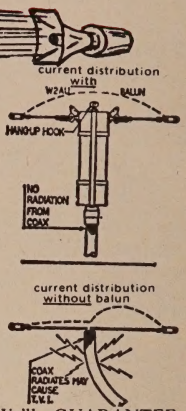
NOW BEING USED EXTENSIVELY BY ALL BRANCHES OF THE U.S. ARMED FORCES, FAA, RCA, CIA, CANADIAN DEFENSE DEPT. PLUS THOUSANDS OF HAMS THE WORLD OVER

They're built to last

BIG SIGNALS DON'T JUST HAPPEN— GIVE YOUR ANTENNA A BREAK

Comes in 2 models. 1:1 matches 50 or 75 ohm unbalanced (coax line) to 50 or 75 ohm balanced load. 4:1 model matches 50 or 75 ohm unbalanced (coax line) to 200 or 300 ohm balanced load.

AVAILABLE AT ALL LEADING DEALERS. IF NOT, ORDER DIRECT



We'll GUARANTEE no other balun, at any price, has all these features.

UNADILLA RADIATION PRODUCTS
Division of Microwave Filter Co. Inc.

Tel: 315-437-6444
TWX 710-541-0493

6743 Kinne St.
East Syracuse, N.Y. 13057

Announcing

• **DeKalb, IL** — The DeKalb Hamfest will be held on May 1, 8 a.m. to 3 p.m. at the Notre Dame Special Education complex on Gurler Road, 3 miles South of Dekalb between Route 23 and S. First St. Tickets are $2 at the door, $1.50 in advance. There is no fee for displays. Talk in: .13/.73 and .94 simplex. Information/Advanced Tickets: Write Howard Newquist, WA9TXW, P.O. Box 349, Sycamore, IL 60178.

• **Rochester, NY** — The 44th annual Rochester Hamfest, combined with the New York State ARRL Convention will be held the weekend of May 20-22 at the Monroe County Fairgrounds, near Rochester, NY. Activities begin on Friday, May 20, at the Rochester Marriott Inn beginning at 7 p.m. The indoor open flea market will open at 7 a.m. Saturday and operate until 5:30 p.m., then reopen at 9:30 a.m. on Sunday. Registration in advance is $3.50. Advanced registration closes May 14. Registration at the gate is $4.00. Ticket orders and information requests should go to: Rochester Hamfest, Box 1388, Rochester, NY 14603. Contact. Harold C. Smith, WA2KND, 716-271-1460, office, or 716-225-5260, home phone.

• **West Liberty, OH** — The Champaign/Logan/Amateurs Radio Club will be holding its annual Flea Market/Hamfest on May 15, 1977, at the West Liberty Lion's Park in West Liberty, OH. Admission is free, Vendors pay $1.00. Door prizes. Festivities start at 10:00 a.m. Talk in on 52 Simplex.

• **Durham, NC** — The 1977 Durhamfest will be held on May 28-29, at the South Square Shopping Center, Durham, NC. Two day flea market under covered parking deck. Seminars, fantastic prizes, bingo and shopping for the family plus much more. Durham FM Assoc. Box 8651, Durham, NC 27707.

• **Fort Vancouver, WA** — The fort Vancouver Hamfair is Sat. May 21st & Sun. May 22nd, to be held at the Clark County Fairgrounds, 7 miles north of Vancouver on 1-5, sponsered by W7AIA, Clark County Amateur Radio Club in cooperation with W7KYC, Portland Amateur Radio Club. Camping, contests, swap & shop, prizes, displays, and many other activities. Registration to Dorman Stafford W7ZDR, Registration Chairman, Fort Vancouver Hamfair, 3509 E 21st St., Vancouver, WA 98661. Make checks payable to Fort Vancouver Hamfair. Talk in on 2 & 75 meters.

• **Trenton, TN** — The Humboldt Amateur Radio club will hold its annual Hamfest on May 22, at Shady Acres City Park in Trenton, TN. Flea Markets, prizes, ladies activities, etc., for further information contact Ed Holmes, W4IG, 501 N. 18th Ave., Humboldt, TN 38343.

DenTron amateur radio products have always been strikingly individual. This is the result, not of compulsion to be different, but of a dedication to excellence in American craftsmanship. This dedication now extends to one of the worlds finest high performance Military amateur amplifiers.

Luxury styling, however, would not be fully appreciated without an exceptional power source. The heart of the MLA-2500 is a heavy duty, self-contained power supply.

Compare the MLA-2500. It has the lowest profile of any high performance amplifier in the world. It's modular construction makes it unique, and at $799.50 it is an unprecedented value.

Very few things in life are absolutely uncompromising. We are proud to count the DenTron MLA-2500 among them. And so will you.

MLA-2500 FEATURES

- 160 thru 10 meters
- 2000+ watts PEP input on SSB
- 1000 watts DC input on CW, RTTY, or SSTV
- Variable forced air cooling system
- Self contained continuous duty power supply
- Two EIMAC 8875 external-anode ceramic/metal triodes operating in grounded grid.
- Covers MARS frequencies without modifications
- 50 ohm input and output impedance
- Built in RF watt meter
- 117 V or 234 V AC 50-60 hz
- Size: 5½" H x 14" W x 14" D.

All DenTron products are made in the U.S.A.

Introducing the new MLA·2500

The linear amplifier beyond compromise.



Amplifier in actual operation.

DenTron Radio Co., Inc.

2100 Enterprise Parkway
Twinsburg, Ohio 44087
(216) 425-3173

Time was when a separate receiver and transmitter comprised an amateur station.

Then came the transceiver—everything in a package. For split-frequency work, you had to have another box—an external VFO.

Now Swan presents the SS747 Untransceiver: separate transmit and receive operation on individual bands through dual VFOs all in a single unit.

A 125-watt-minimum output, cool-operating unit with selectable sideband, all-solid state construction, digital frequency readout, and 3.5-to-30 MHz capability.

The digital counter reads either of the dual VFOs you select with a resolution of ± 100 Hz on six digits of seven segment LED's.

You come up on a frequency fast because broadband tuning eliminates adjustments.

The SS747 will operate on any frequency throughout its range in 500 KHz steps (except IF guard band) with the addition of a frequency synthesizer or with additional crystals.

And you select lower sideband, upper sideband, or CW with sidetone on all frequencies from 3.5 to 30 MHz (optional AM available).

Performance is everything you'd expect from Swan. Like better than ½ microvolt at 10 db S + N/N ratio sensitivity and 300-3000 Hz audio response—the best in the business.

Other features include receiver incremental tuning; panel meter indicating relative power out and receiver signal strength; and infinite VSWR protection.

All circuits are on plug-in printed circuit boards and an accessory like the noise blanker is added internally just by plugging into a board. For instance, a plug-in board lets you use the counter as a piece of test

INTRODUCING THE UNTRANSCEIVER.

equipment for checking external frequency sources up to 150 MHz with 100 Hz resolution.

The SS747 packages the ham rig in one compact unit of unprecedented flexibility. See the new look of amateur radio at your Swan dealer today. Use your Swan credit card. Applications at your dealer or write to us.

Other features include:

- ALC
- Mike gain control
- VOX
- Automatic self adjusting AGC
- CW drive control
- Operates directly from 13.8 (nominal) VDC
- 2.7 KHz IF bandwidth
- Only 12"W x 6"H x 13¼"D, weight 22 lbs.
- Low average 8 amp SSB transmit power drain, 750 ma receive

Accessories

- AM (6 KHz BW)
- CW audio filter (selectable 80 or 110 Hz bandwidth plug-in board)
- Noise blanker
- External frequency synthesizer
- PSU-1 AC power supply
- 10-position crystal oscillator
- Frequency counter board

SS747, std 13.8 VDC unit. **$849.95**
PSU-1 115/230 VAC universal power supply. **$151.95**

(Prices F.O.B. Oceanside, CA)

Dealers throughout the world or order direct from

SWAN® ELECTRONICS
A subsidiary of Cubic Corporation
305 Airport Road, Oceanside, CA 92054
(714) 757-7525



think of yourself as an antenna expert!

—you select your components!

1. Get optimum performance band for band. Choose from medium or high power resonators for your favorite bands.
2. Fold over, 360° swivel mast for quick band change or easy garaging. Select from two versions, fender/deck or bumper mount location.
3. Stainless steel ball mount, 180° adjustable, commercial duty for superior mechanical and electrical performance.
4. Get exceptional reports, broadest bandwidth, lowest SWR. Use with any convenient length 50 ohm coax. Matching devices not required.
5. For convenience, use the Hustler stainless steel resonator spring, and special design quick disconnect.

...and you'll mobile with the experts' foremost choice... HUSTLER®

Get fixed station reports from your mobile—operate 6-10-15-20-40-75 or 80 meters with the experts and join the vast majority using Hustler for nearly two decades.





Model SSM-2 Ball Mount



Model QD-1 Quick Disconnect

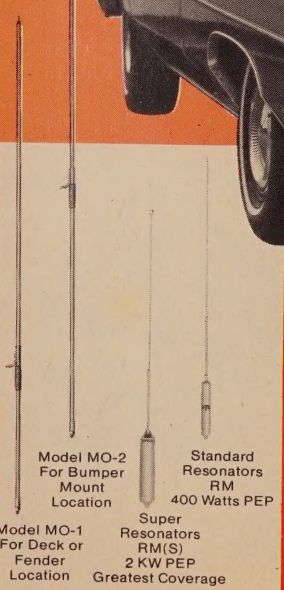
Model RSS-2 Resonator Spring



Model BM-1 Bumper Mount



Model L-14-240 Mil Spec 50 Ohm Feedline



Model MO-1 For Deck or Fender Location

Model MO-2 For Bumper Mount Location

Super Resonators RM(S) 2 KW PEP Greatest Coverage

Standard Resonators RM 400 Watts PEP

HUSTLER ANTENNA PRODUCTS—for sixteen years—original designs—created and manufactured by American ingenuity, labor and materials—used by communicators throughout the world.

Hustler designs are patented under one or more of the following assigned to New-Tronics Corporation 3287732, 3513472, 3419869, 3873985, 3327311, 3599214, 3582951.

"the home of originals"

HUSTLER®

Available from all distributors who recognize the best.

new-tronics corporation
15800 Commerce Park Drive
Brookpark, Ohio 44142
(216) 267-3150

Zero Bias

an editorial

Join tens of thousands of informed, active radio enthusiasts. Subscribe to the oldest independent magazine in the amateur radio world -

CQ

The Radio Amateur's Journal

asy to bear;
'. L. Mencken

ssioned letter from Hank
lew Jersey. Hank's letter
New Jersey newspapers
ver his new antenna. It
ank has become another
. He's being legalized to
derlined in red and the
: for anything, not even
: anxiety and frustration
wall to the point of just
ning. The last thing Hank
aped upon him.
in the same bind? Well if
d with numbers try this
suits being pressed right
g antennas, TVI, and the
hroughout the country.
he individual is hit with
fend on laws that discri-
This hits us all, amateur
e it or not we do have a
n only be solved jointly.
utting up a tower or of
very careful. For the an-
an eyesore, public nui-
in violation of a new law
other obscure thing that
secuted to the full extent
hand this same self-serv-
ome monstrous steel and
:x or allow at whim some
oup to erect criss-crossed
ere they want even on or

. . . going to do about it? I hope the answer is not apathy or disinterest because you're not involved and it's not happening to you at the moment. You are involved and it is happening to you right now!

What can be done? Actually quite a bit can be done. For example at this year's PC 77 show (Personal Communications 77) a new group was announced whose aim and intention is a consolidated effort to fight these punitive and "just" laws through the courts. The Personal Communications Foundation is made up of 24 Lawyers, Judges and law school Professors. They are certainly in a position to understand the entire problem on a nationwide basis and are planning specific legal actions and they will serve as a central clearing house for information in the area of personal communication law. Next month we will publish their initial proposal, specific aims and suggestions. I suggest that you read it carefully and seek ways either individually or collectively through clubs to help them achieve our goals.

In the mean time you can write for information to their President, Jon J. Gallo, Esq., Personal Communications Foundation, 1900 Avenue of the Stars, Twentieth Floor, Los Angeles, California 90067.

Well Hank, I guess this isn't much help to you right now but it is an indication that you're not alone fighting windmills. There are people out there who are working to secure your rights and fighting the good fight. It may not be much consolation to know you are not the only one touched or should I say clubbed by legal caprices or much help in footing the bill for lawyers and possibly fines but hang in there, help is coming.

Why not drop a QSL to Hank today to let him know you're with him and appreciate what he is going through. His QTH is: Hank Greenberg, W2LTP, 313 Bloomingdale Ave., Cranford, New Jersey 07016.

Our Cover

Our cover this month reflects what has been a long and very cold winter for most of the country. Jim Koshmider, K7DXD, lost this one after a heavy windstorm and has already begun work on repairing the damage. Now that the warmer months are here and the antenna season is upon us please exercise caution in either installing or repairing your antenna. It's one thing to be sued over your antenna and something else to be hurt or lose your life over it.

December Recap

Back in my December Editorial I asked some of you to share your good fortune with others less fortunate by donating a pint of blood to the N.Y.U. Medical Center in the name of Sam Weinstein, WB2AMY. Sam as you may recall was a member of the Hall of Science Radio Club and when he died last year he left an outstanding debt of 64 pints of blood used during his illness. I checked with the N.Y.U. Medical Center today and found that 2 pints were donated. I guess 1976 was a bad year all around.

73, Alan, K2EEK

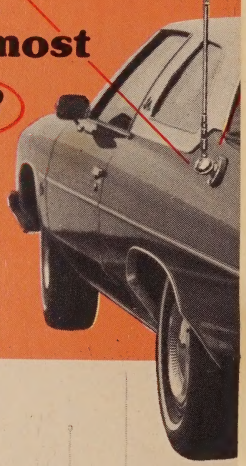
think of yourself as an antenna expert!

—you select your components!

1. Get optimum performance band for band. Choose from medium or high power resonators for your favorite bands.
2. Fold over, 360° swivel mast for quick band change or easy garaging. Select from two versions, fender/deck or bumper mount location.
3. Stainless steel ball mount, 180° adjustable, commercial duty for superior mechanical and electrical performance.
4. Get exceptional reports, broadest bandwidth, lowest SWR. Use with any convenient length 50 ohm coax. Matching devices not required.
5. For convenience, use the

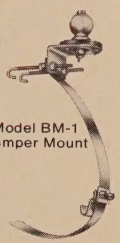
...and you'll mobile with the experts' foremost choice... HUSTLER®

Get fixed station reports from your mobile—operate 6-10-15-20-40-75 or 80 meters with the experts and join the vast majority using Hustler for nearly two decades.





Model SSM-2 Ball Mount



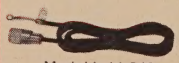
Model BM-1 Bumper Mount



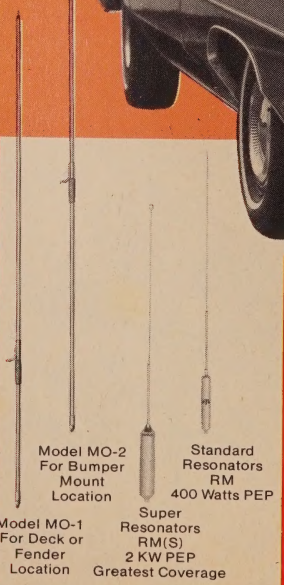
Model QD-1 Quick Disconnect



Model RSS-2 Resonator Spring



Model L-14-240 Mil Spec 50 Ohm Feedline



Model MO-2 For Bumper Mount Location

Model MO-1 For Deck or Fender Location

Super Resonators RM(S) 2 KW PEP Greatest Coverage

Standard Resonators RM 400 Watts PEP

HUSTLER ANTENNA PRODUCTS—for sixteen years—original designs—created and manufactured by American ingenuity, labor and materials—used by communicators throughout the world.

Hustler designs are patented under one or more of the following assigned to New-Tronics Corporation 3287732, 3513472, 3419869, 3873985, 3327311, 3599214, 3582951.

Since CQ 1945

The Radio Amateur's Journal

HALF PRICE!

Yes, I'd like to receive CQ every month at half the newsstand price.

☐ $13 for 24 issues—Save $17

☐ $7.50 for 12 issues—Save $7.50

NAME

ADDRESS

CITY

STATE ZIP

(Foreign subscribers add $3.00 for each year. Foreign subscriptions payable ONLY in U.S. funds by international draft or money order.)

DETACH THIS PAGE, FOLD, AND INSERT INTO ENVELOPE . . .

all distributors who recognize the best.

new-tronics corporation

15800 Commerce Park Drive

Brookpark, Ohio 44142

(216) 267-3150

Zero Bias

an editorial

Injustice is relatively easy to bear;
what stings is justice. - H. L. Mencken

This morning I received an impassioned letter from Hank Greenberg, W2LTP, of Cranford, New Jersey. Hank's letter contained numerous clippings from New Jersey newspapers reporting on Hank's legal battle over his new antenna. It seems that without knowing it Hank has become another casualty in local ordinance warfare. He's being legalized to death. His letter, with passages underlined in red and the numerous clippings don't really ask for anything, not even this publicity but merely reflect the anxiety and frustration of beating your head up against the wall to the point of just screaming and crying out for something. The last thing Hank needs now is some more "justice" heaped upon him.

Is Hank alone or are there others in the same bind? Well if you like statistics and are impressed with numbers try this out for size. There are about 7,000 suits being pressed right now all involving local laws governing antennas, TVI, and the like against amateurs and CBers throughout the country. Some are multiple cases whereby the individual is hit with two or three separate actions to defend on laws that discriminate against the radio enthusiast. This hits us all, amateur and CBer alike, and whether we like it or not we do have a very real common problem that can only be solved jointly.

The next time you think of putting up a tower or of changing that old antenna be very very careful. For the antenna you erect might be deemed an eyesore, public nuisance, blight on the neighborhood, in violation of a new law to be written next week, or some other obscure thing that can be (and most likely will be) prosecuted to the full extent of the law. Of course, on the other hand this same self-serving community can clearly plant some monstrous steel and aluminum tower power pole complex or allow at whim some other commercial or government group to erect criss-crossed power lines, telephone lines anywhere they want even on or through your property.

What are you going to do about it? I hope the answer is not apathy or disinterest because you're not involved and it's not happening to you at the moment. You are involved and it is happening to you right now!

What can be done? Actually quite a bit can be done. For example at this year's PC 77 show (Personal Communications 77) a new group was announced whose aim and intention is a consolidated effort to fight these punitive and "just" laws through the courts. The Personal Communications Foundation is made up of 24 Lawyers, Judges and law school Professors. They are certainly in a position to understand the entire problem on a nationwide basis and are planning specific legal actions and they will serve as a central clearing house for information in the area of personal communication law. Next month we will publish their initial proposal, specific aims and suggestions. I suggest that you read it carefully and seek ways either individually or collectively through clubs to help them achieve our goals.

In the mean time you can write for information to their President, Jon J. Gallo, Esq., Personal Communications Foundation, 1900 Avenue of the Stars, Twentieth Floor, Los Angeles, California 90067.

Well Hank, I guess this isn't much help to you right now but it is an indication that you're not alone fighting windmills. There are people out there who are working to secure your rights and fighting the good fight. It may not be much consolation to know you are not the only one touched or should I say clubbed by legal caprices or much help in footing the bill for lawyers and possibly fines but hang in there, help is coming.

Why not drop a QSL to Hank today to let him know you're with him and appreciate what he is going through. His QTH is: Hank Greenberg, W2LTP, 313 Bloomingdale Ave., Cranford, New Jersey 07016.

Our Cover

Our cover this month reflects what has been a long and very cold winter for most of the country. Jim Koshmider, K7DXD, lost this one after a heavy windstorm and has already begun work on repairing the damage. Now that the warmer months are here and the antenna season is upon us please exercise caution in either installing or repairing your antenna. It's one thing to be sued over your antenna and something else to be hurt or lose your life over it.

December Recap

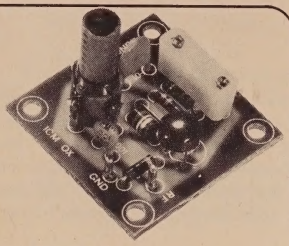
Back in my December Editorial I asked some of you to share your good fortune with others less fortunate by donating a pint of blood to the N.Y.U. Medical Center in the name of Sam Weinstein, WB2AMY. Sam as you may recall was a member of the Hall of Science Radio Club and when he died last year he left an outstanding debt of 64 pints of blood used during his illness. I checked with the N.Y.U. Medical Center today and found that 2 pints were donated. I guess 1976 was a bad year all around.

73, Alan, K2EEK

for the experimenter!

INTERNATIONAL CRYSTALS & KITS

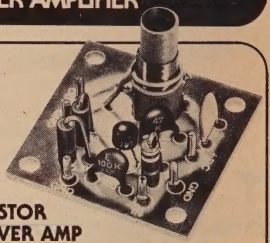
OSCILLATORS • RF MIXER • RF AMPLIFIER • POWER AMPLIFIER



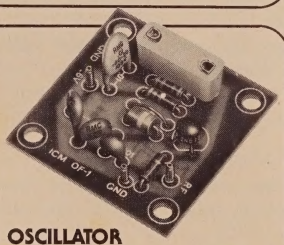
OX OSCILLATOR
Crystal controlled transistor type. 3 to 20 MHz, OX-Lo, Cat. No. 035100. 20 to 60 MHz, OX-Hi, Cat. No. 035101
Specify when ordering.
$3.95 ea.



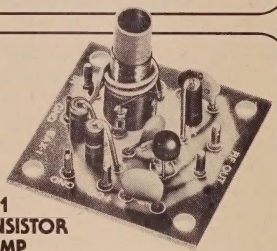
MXX-1
TRANSISTOR
RF MIXER
A single tuned circuit intended for signal conversion in the 30 to 170 MHz range. Harmonics of the OX or OF-1 oscillator are used for injection in the 60 to 179 MHz range. 3 to 20 MHz, Lo Kit, Cat. No. 035105. 20 to 170 MHz, Hi Kit, Cat. No. 035106
Specify when ordering.
$4.50 ea.



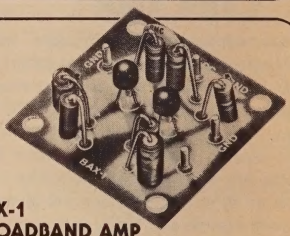
PAX-1
TRANSISTOR
RF POWER AMP
A single tuned output amplifier designed to follow the OX or OF-1 oscillator. Outputs up to 200 mw, depending on frequency and voltage. Amplifier can be amplitude modulated. 3 to 30 MHz, Cat. No. 035104
Specify when ordering.
$4.75 ea.



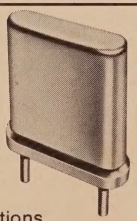
OF-1 OSCILLATOR
Resistor/capacitor circuit provides osc over a range of freq with the desired crystal. 2 to 22 MHz, OF-1 LO, Cat. No. 035108. 18 to 60 MHz, OF-1 HI, Cat. No. 035109
Specify when ordering.
$3.25 ea.



SAX-1
TRANSISTOR
RF AMP
A small signal amplifier to drive the MXX-1 Mixer. Single tuned input and link output. 3 to 20 MHz, Lo Kit, Cat. No. 035102. 20 to 170 MHz, Hi Kit, Cat. No. 035103.
Specify when ordering.
$4.50 ea.



BAX-1
BROADBAND AMP
General purpose amplifier which may be used as a tuned or untuned unit in RF and audio applications. 20 Hz to 150 MHz with 6 to 30 db gain. Cat No. 035107
Specify when ordering
$4.75 ea.



.02% Calibration Tolerance
EXPERIMENTER CRYSTALS
(HC 6/U Holder)

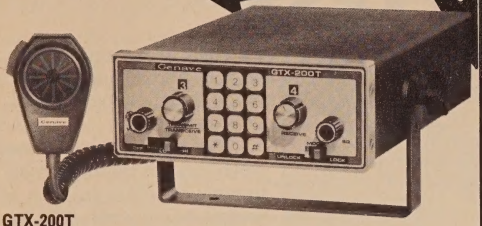
Cat. No.	Specifications	
031080	3 to 20 MHz — for use in OX OSC Lo *Specify when ordering*	$4.95 ea.
031081	20 to 60 MHz — For use in OX OSC Hi *Specify when ordering*	$4.95 ea.
031300	3 to 20 MHz — For use in OF-1L OSC *Specify when ordering*	$4.25 ea.
031310	20 to 60 MHz — For use in OF-1H OSC *Specify when ordering.*	$4.25 ea.

Shipping and postage (inside U.S., Canada and Mexico only) will be prepaid by International. Prices quoted for U.S., Canada and Mexico orders only. Orders for shipment to other countries will be quoted on request. Address orders to:
M/S Dept., P.O. Box 32497,
Oklahoma City, Oklahoma 73132.

ICM

International Crystal Mfg. Co., Inc.
10 North Lee
Oklahoma City, Oklahoma 73102

Genave' amateur radio tomorrow . . . today!



GTX-200T
(incl. 146.94 MHz)
$249.95

Engineered and designed for the quality conscious 2-meter enthusiast

Genave's GTX-200T offers the FM operator up to 100 channel combinations incorporating 10.7 MHz first IF and 455 MHz second IF for outstanding sensitivity, minimizing effects of adjacent channel interference.

ADDITIONAL FEATURES INCLUDE:

- 30 watts output power, nom. 25 watts min. @ 14 VDC input
- Separate controls for independent transmit and receive frequency selection
- Switch for lock-in of pre-selected frequency pairs allows one-knob operation
- Supersensitive dual-gate MOSFET in receiver head end.
- Blacklighted for night operation
- Factory-installed, front panel mount 12 digit tone encoder.

GTX-IT
$299.95
Hand-Held 2-meter FM, 6-channel, 3.5 watts hand-held with factory-installed tone encoder

GTX-I
$249.95
Hand-Held 2-meter FM, 6-channel, 3.5 watts hand-held



Accessories Available

- Nicad battery pack
- Charger for GTX-1 battery pack
- Leather carrying case
- TEIII tone encoder for auto patch

CHECK THESE FEATURES:

- All metal case
- American made
- Accepts standard plug-in crystals
- Features 10.7 MHz crystal filter
- Trimmer caps on TX and RX crystals
- 3.5 watts output
- Battery holder accepts AA regular, alkaline or nicad cells
- Mini hand-held measures 8" high x 2.625" wide x 1.281" deep
- Rubber ducky antenna,
- Wrist safety-carrying-strap included
- 6 channels
- Factory-direct to you!



GTX-2
2-meter FM, 10 channels, 30 watts with pushbutton freuency selector (Incl. 146.94 MHz)
$189.95



GTX-200
2-meter FM, 100 channel combinations, 30 watts (Incl. 146.94 MHz)
$199.95



GTX-10-S
2-meter FM, 10 channels, 10 watts (Xtals not included)
$149.95

TONE ENCODER PAD
Plug-in installation on most amateur transceivers.
TE-II **$29.95** TE-I **$59.95**



HURRY! USE THIS HANDY ORDER FORM OR CALL COLLECT TODAY!
(317) 546-7959

Genave
4141 Kingman Dr., Indianapolis, IN 46226
Phone-in orders accepted (317+546-1111)

NAME_____
ADDRESS_____ CITY_____
STATE & ZIP_____ AMATEUR CALL_____

Payment by:
☐ Certified Check/Money Order ☐ Personal Check
☐ C.O.D. Include 20% Down

Note: Orders accompanied by personal checks will require about two weeks to process.
20% Down Payment Enclosed. Charge Balance To:

☐ BankAmericard #_____ Expires _____
☐ Master Charge #_____ Expires _____
☐ Interbank #_____ Expires _____

IN residents add 4% sales tax: $_____

All orders shipped post-paid within continental U.S.

☐ GTX-200-T	$249.95
☐ GTX-200	$199.95
☐ GTX-10-S	$149.95
☐ GTX-2	$189.95
☐ GTX-1	$249.95
☐ GTX-IT	$299.95

☐ Ringo Ranger ARX-2 6db 2-M Base Antenna	$29.95
☐ Lambda/4 2-M and 6-M Trunk Antenna	$29.95
☐ TE-I Tone Encoder Pad	$59.95
☐ TE-II Tone Encoder Pad	$49.95
☐ PS-I AC Power Supply for use with all makes of transceivers 14 VDC—6 amp	$69.95

and the following standard crystals @ $4.50 each ..... $_____
Non-standard crystals @ $6.50 each: ..... $_____

Add $4 per Radio for Shipping, Handling, and Crystal Netting.

ACCESSORIES FOR GTX-1 and GTX-1T

☐ PSI-18 Optional Nicad battery pack	$29.95
☐ PS-2 Charger for GTX-1(T) battery pack	$39.95
☐ GLC-1 Leather carrying case	$12.95
☐ TE-III Tone Encoder (for use with GTX-1)	$49.95

NEW FROM HY-GAIN 2-METER BEAMS THAT LAST LONGER. WORK HARDER. AND COST LESS.

Introducing a whole new generation of Hy-Gain 2-Meter beams.

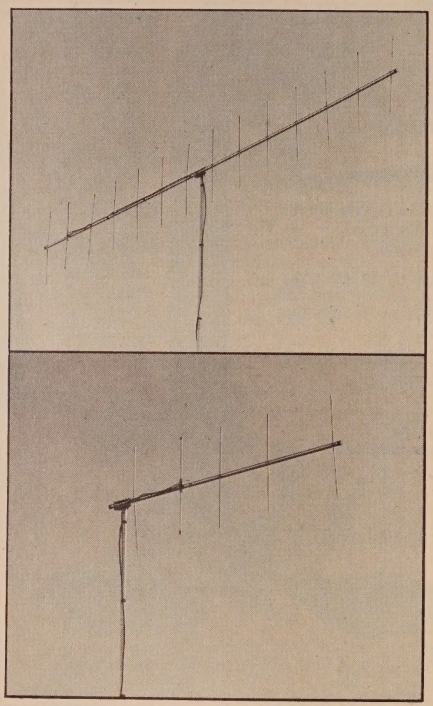
Completely redesigned for greater strength and corrosion resistance. So they last longer.

Newly engineered for greater performance and maximum efficiency. So they work harder, your transceiver works better.

And built better. So you pay less for the performance you want.

Our new 2-Meter beams give you the kind of performance you expect from the world's largest manufacturer of quality antennas. Yet, thanks to Hy-Gain technology, they weigh less, have lower wind loading and are UPS shippable.

They use an exclusive new element to boom mounting system that's mechanically stronger and electrically more efficient. All can be vertically or horizontally polarized. And all are constructed of the finest aluminum and ZMI hardware.



Hy-Gain 214 14-element close spaced beam with extremely high forward gain and narrow beam width. **$26.95**

Also available with 8-element optimum spacing, **Hy-Gain 208. $19.95**

Hy-Gain 205 5-element optimum spaced end mount beam with high forward gain and broad frequency response. **$16.95**

Also available with 3 elements, **Hy-Gain 203. $12.95**

See the new generation of Hy-Gain 2-Meter beams at your amateur radio dealer. Or write Hy-Gain; 8601 Northeast Highway Six; Lincoln, NE 68505.

hy-gain®

WE KEEP PEOPLE TALKING.

Hy-Gain reserves the right to change prices, designs and/or specifications at any time without notice.

SPECIFICATIONS	214	208	205	203
Mechanical				
Boom length	186″	148 ¾″	75″	43½″
Longest element	39½″	40¼″	39 ⅝″	40¼″
Turning radius	95″	75 ⅛″	73″	43½″
Wind survival	80 mph	80 mph	80 mph	80 mph
Mast diameter	1¼-1⅝″ O.D.	1¼-1⅝″ O.D.	1¼-1⅝″ O.D.	1¼-1⅝″ O.D.
Boom diameter	1¼″ O.D.	1¼″ O.D.	1¼″ O.D.	1¼″ O.D.
Wind load area	1.65 ft² max.	1.26 ft² max.	.740 ft² max.	.496 ft² max.
Net weight	5.5 lbs	4.1 lbs	2.9 lbs	2.2 lbs
Electrical				
Forward gain	13.0 dBd*	11.8 dBd*	9.1 dBd*	6.1 dBd*
Front-to-back ratio	20 dB	20 dB	20 dB	20 dB
Maximum SWR	2:1	2:1	2:1	2:1
Band width	2 MHz	2 MHz	4 MHz	4 MHz
Maximum power	250/500 PEP	250/500 PEP	250/500 PEP	250/500 PEP
Impedance w/balun	52 ohms	52 ohms	52 ohms	52 ohms
½ power beam width	35° vertical 35° horizontal	43° vertical 36° horizontal	60° vertical 45° horizontal	95° vertical 60° horizontal
Stacking distance	82″ min.	82″ min.	82″ min.	82″ min.

*Hy-Gain antennas are gain rated against a standard dipole antenna (dBd) instead of a theoretical isotropic source (dBi). This is a more honest and realistic means of comparing forward gain.

© 1977 Hy-Gain

Now...more than ever---
the TEMPO line means solid value



Tempo VHF/ONE

the "ONE" you've been waiting for

No need to wait any longer — this is it! Whether you are already on 2-meter and want someting better or you're just thinking of getting into it, the VHF/ONE is the way to go.

• Full 2-meter band coverage (144 to 148 MHz for transmit and receive. • Full phase lock synthesized (PLL) so no channel crystals are required. • Compact and lightweight — 9.5" long x 7" wide x 2.25" high. Weight — About 4.5 lbs. • Provisions for an accessory SSB adaptor. • 5-digit LED receive frequency display. • 5 KHz frequency selection for FM operation. • Automatic repeater split — selectable up or down for normal or reverse operation. • Microphone, power cord and mounting bracket included. • Two built-in programmable channels. • All solid state. • 10 watts output. • Super selectivity with a crystal filter at the first IF and E type ceramic filter at the second IF. • 800 Selectable receive frequencies. • Accessory 9-pin socket. • $495.00

TEMPO SSB/ONE

SSB adapter for the Tempo VHF/One

• Selectable upper or lower sideband. • Plugs directly into the VHF/One with no modification. • Noise blanker built-in. • RIT and VXO for full frequency coverage. • $225.00

TEMPO/fmh



So much for so little! 2 watt VHF/FM hand held 6 Channel capability, solid state, 12 VDC. 144-148 MHz (any two MHz), includes 1 pair of crystals, built-in charging terminals for ni-cad cells, S-meter, battery level meter, telescoping whip antenna, internal speaker & microphone.

$199.00

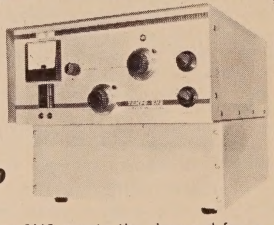
FMH-MC for Marine & Commercial service also available.



TEMPO/CL 146A

. . .a VHF/FM mobile transceiver for the 2 meter amateur band. It is compact, ruggedly built and completely solid state. One channel supplied plus two channels of your choice FREE

144 to 148 MHz coverage • Multifrequency spread of 2 MHz • 12 channel possible • Metering of output and receive • Internal speaker, dynamic microphone, mounting bracket and power cord supplied. A Tempo "best buy" at $239.00.



TEMPO 6N2

The Tempo 6N2 meets the demand for a high power six meter and two meter power amplifier. Using a pair of Eimac 8874 tubes it provides 2000 watts PEP input on SSB and 1000 watts input on CW and FM. Completely self-contained in one small desk mount cabinet with internal solid state power supply, built-in blower and RF relative power indicator. $795.00

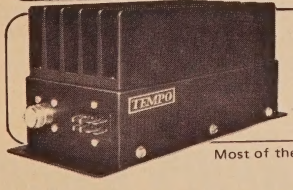
The Tempo 2002.. 2 meters only $695.00
The Tempo 2006.. 6 meters only $695.00



TEMPO CL 220

As new as tomorrow! The superb CL-220 embodies the same general specifications as the CL-146A, but operates in the frequency range of 220-225 MHz (any two MHz without retuning). At $299.00 it is undoubtedly the best value available today.

TEMPO 100AL10 | **SOLID STATE VHF LINEAR AMPLIFIER.** 144-148 MHz. Power output of 100 watts (nom) with only 10 watts (nom) in. Reliable and compact.



TEMPO

VHF/UHF AMPLIFIERS

Solid state power amplifiers for use in most land mobile applications. Increase the range, clarity, reliability and speed of two- way communications.

VHF (135 to 175 MHz)				UHF (400 to 512 MHz)			
Drive Power	Output	Model No.	Price	Drive Power	Output	Model No.	Price
2W	130W	130A02	$199	2W	70W	70D02	$270
10W	130W	130A10	$179	10W	70W	70D10	$250
30W	130W	130A30	$189	30W	70W	70D30	$210
2W	80W	80A02	$169	2W	40W	40D02	$180
10W	80W	80A10	$149	10W	40W	40D10	$145
30W	80W	80A30	$159	2W	10W	10D02	$125

FCC Type accepted models also available.

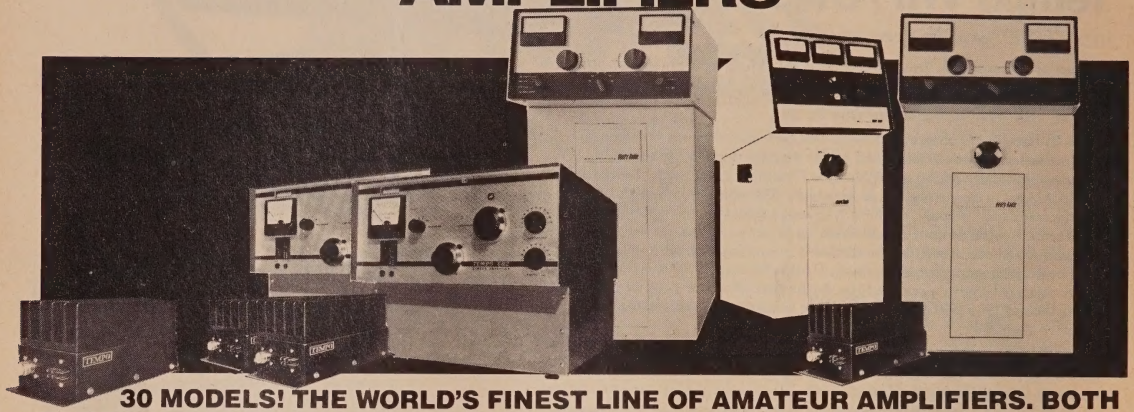
Most of the above products are available at dealers throughout the U.S.

Henry Radio

11240 W. Olympic Blvd., Los Angeles, Calif. 90064 213/477-6701
931 N. Euclid, Anaheim, Calif. 92801 714/772-9200
Butler, Missouri 64730 816/679-3127

Prices subject to change without notice.

ONLY HENRY RADIO OFFERS THE WORLD'S MOST COMPLETE LINE OF AMPLIFIERS



30 MODELS! THE WORLD'S FINEST LINE OF AMATEUR AMPLIFIERS. BOTH VACUUM TUBE AND SOLID STATE...FOR HF, VHF AND UHF...FIXED STATION AND MOBILE...LOW POWER AND HIGH POWER. NEVER BEFORE HAS ONE COMPANY MANUFACTURED SUCH A BROAD LINE OF AMATEUR AMPLIFIERS

2K-4...THE "WORKHORSE"
The 2K-4 linear amplifier offers engineering, construction and features second to none, and at a price that makes it the best amplifier value ever offered to the amateur. Constructed with a ruggedness guaranteed to provide a long life of reliable service, its heavy duty components allow it to loaf along even at full legal power. If you want to put that strong clear signal on the air that you've probably heard from other 2K users, now is the time. Operates on all amateur bands, 80 thru 10 meters Move up to the 2K-4. Floor console...$995.00

3K-A COMMERCIAL/MILITARY AMPLIFIER
A high quality linear amplifier designed for commercial and military uses. The 3K-A employs two rugged Eimac 3-500Z grounded grid triodes for superior linearity and provides a conservative three kilowatts PEP input on SSB with efficiencies in the range of 60%. This results in PEP output in excess of 2000 watts. It provides a heavy duty power supply capable of furnishing 2000 watts of continuous duty input for either RTTY or CW with 1200 watts output. 3.5-30 MHz ....$1395.

4K-ULTRA
Specifically designed for the most demanding commercial and military operation for SSB, CW, FSK or AM. Features general coverage operation from 3.0 to 30 MHz. Using the magnificent new Eimac 8877 grounded grid triodes, vacuum tune and load condensers, and a vacuum antenna relay, the 4K-ULTRA represents the last word in rugged, reliable, linear high power RF amplification. 100 watts drive delivers 4000 watts PEP input. Can be supplied modified for operation on frequencies up to about 100 MHz. ...$2950.00

TEMPO 6N2
The Tempo 6N2 brings the same high standards to the 6 meter and 2 meter bands. A pair of advanced design Eimac 8874 tubes provide 2,000 watts PEP input on SSB or 1,000 watts on FM or CW. The 6N2 is complete with self-contained solid state power supply, built-in blower and RF relative power indicator. ...$895.00

TEMPO 2002
The same fine specs and features as the 6N2, but for 2 meter operation only. ...$745.00

TEMPO 2006
Like the 2002, but for 6 meter operation. ...$795.00

TEMPO VHF/UHF AMPLIFIERS
Solid state power amplifiers for use in most land mobile applications. Increases the range, clarity, reliability and speed of two-way communications. FCC type accepted also.

Model	Drive Power	Output Power	Price	Model	Drive Power	Output Power	Price
LOW BAND VHF AMPLIFIERS (35 to 75 MHz)							
Tempo 100C30	30W	100W	$159.	Tempo 100C10	10W	100W	$149.
Tempo 100C02	2W	100W	$179.				
HIGH BAND VHF AMPLIFIERS (135 to 175 MHz)							
Tempo 130A30	30W	130W	$189.	Tempo 80A02	2W	80W	$159.
Tempo 130A10	10W	130W	$179.	Tempo 50A10	10W	50W	$ 99.
Tempo 130A02	2W	130W	$199.	Tempo 50A02	2W	50W	$119.
Tempo 80A30	30W	80W	$149.	Tempo 30A10	10W	30W	$ 69.
Tempo 80A10	10W	80W	$139.	Tempo 30A02	2W	30W	$ 89.
UHF AMPLIFIERS (400 to 512 MHz)							
Tempo 70D30	30W	70W	$210.	Tempo 40D01	1W	40W	$185.
Tempo 70D10	10W	70W	$240.	Tempo 25D02	2W	25W	$125.
Tempo 70D02	2W	70W	$270.	Tempo 10D02	2W	10W	$ 85.
Tempo 40D10	10W	40W	$145.	Tempo 10D01	1W	10W	$125.
Tempo 40D02	2W	40W	$165.	Linear UHF models also available			

TEMPO 100AL10 VHF LINEAR AMPLIFIER
Completely solid state, 144-148 MHz. Power output of 100 watts (nom.) with only 10 watts (nom.) in. Reliable and compact ...$199.00
TEMPO 100AL10/B BASE AMPLIFIER ...$349.00

please call or write for complete information.

Henry Radio

11240 W. Olympic Blvd., Los Angeles, Calif. 90064 213/477-6701
931 N. Euclid, Anaheim, Calif. 92801 714/772-9200
Butler, Missouri 64730 816/679-3127

Prices subject to change without notice.

ICOM INTRODUCES THE REVOLUTION IN VFO TECHNOLOGY



Introducing the IC-245, 144-148 MHz FM Transceiver

The VFO Revolution goes mobile with the unique, ICOM developed LSI synthesizer with 4 digit LED readout. The **IC-245** offers the most for mobile on the market. The easy to use tuning knob moves accurately over 50 detent steps and assures excellent control as easily as steering the vehicle. With its optional adapter, the **IC-245** puts you into all mode operation on 12V DC power with a compact dash-mounted transceiver. In FM, the synthesizer command frequency is displayed in 5 KHz steps from 146 to 148 MHz, and with the side band adapter the step rate drops to 100Hz from 144 to 146 MHz. For maximum repeater flexibility, the transmit and receive frequencies are independently programable on any separation. The **IC-245** even comes equipped with a multiple pin Molex connector for remote control.

The **IC-245** is a product of the revolution in VFO design, from its new style front panel, to its excellent mechanical rigidity and Large Scale Integrated Circuitry. Your **IC-245** will give you the most for mobile.

SPECIFICATIONS

GENERAL	
Frequency Coverage	**144.00 to 148.00 MHz*
Modes	*FM (F3)*
	**SSB (A3J), CW (A1)*
Supply Voltage	*DC 13.8V±15%*
Size (mm)	*90H x 155W x 235D*
Weight (kg)	*2.7*
TRANSMITTER	
TX Output	*F3 10W*
	**A3J 10W (PEP), A1 10W*
Carrier Suppression	*40 dB or better*
Spurious Radiation	*−60 dB or less below carrier*
Maximum Frequency Deviation	*±5 KHz*
Microphone Impedance	*600 ohms*
RECEIVER:	
Sensitivity	**A3J, A1 0.5 microvolt input gives 10 dB S+N/N or better F3 0.6 microvolt or less for 20 dB quieting S+N+D/N at 1 microvolt input, 30 dB*
Squelch Threshold	*−8 dB or less (F3)*
Spurious Response	*−60 dB or better*
SYNTHESIZER:	
Frequency Range	*144 MHz to 148 MHz*
Step Size	*5 KHz for FM*
	**100 Hz or 5 KHz for SSB*
Stability	*per C in the range of −10 to +60 C, ±0.0000145% per C*

* Valid with SSB Adapter only

THE BEGINNING OF THE ICOM VFO REVOLUTION!

VHF/UHF AMATEUR AND MARINE COMMUNICATION EQUIPMENT

Distributed by:

ICOM

ICOM WEST, INC.
Suite 3
13256 Northrup Way
Bellevue, Wash. 98005
(206) 747-9020

ICOM EAST, INC.
Suite 307
3331 Towerwood Drive
Dallas, Texas 75234
(214) 620-2780

ICOM CANADA
7087 Victoria Drive
Vancouver B.C. V5P 3Y9
Canada
(604) 321-1833

This story picks up where Bill left off in our September issue. Bill operated as ZK2AQ and A35NN from Tonga and Niue Islands then set sail for Xmas Island in the Indian Ocean.

VK9XX EXPEDITION TO CHRISTMAS ISLAND

BY BILL RINDONE*, WB7ABK

Enroute from Niue to Western Samoa, I reflected on the ZK2AQ operation and decided to take a critical look at the expeditions beam antenna.

Don Schliesser, W6MAV, president of the Northern California DX Foundation had contacted me at ZK2 and advised that the foundation was interested in our propagation research. The NCDXF has been instrumental in aiding several DX oriented radio expeditions and their participation was certainly welcome at a critical point in time. By agreement the foundation was going to ship a linear to Singapore and if other equipment was to be needed or replaced this was definitely the time to find out.

*3049 Doris Ct., Lake Oswego, Oregon 97034



Flying Fish Cove. Here's a view of "downtown Xmas Island" as seen from near VK9XI, the islands club station.

Phil Williams, 5W1AU, along with Pete 5W1AZ, met me at the airport in Apia and by the time we arrived at Phil's home the gray of evening had set in. Determined to check out the beam, we assembled it in the dark and then climbed the tower with the antenna cradled between Phil and I, finally securing it at the forty foot mark. The project consumed the better part of the evening, providing me with sufficient confidence in the array and supplying the islands mosquito population with a fine three course banquet. At one point a fight developed between a few of the more aggressive dive bombers over who had the landing rights at the forty foot mark. Phil settled the argument by momentarily slipping, seeing that we were also capable of flight in at least one direction, the mosquitoes retreated to a lower level to regroup.

After completing the task at hand we sat around and sipped Cointreau over ice, while thanking Lee, KH6BZF, for the Macadamia nuts. Not bad for a Pacific pacifier. A good nights sleep under netting, with the gentle tradewinds blowing, made me feel like a new man and ready to tackle the noon flight to Sidney.

Three days with Les, VK2AFG, resulted in the issuance of VK9XX and we were again airborne headed for Singapore and a rendezvous with the once a month charter flight down to Xmas Island.

Presently there are two Christmas Islands in the world. One lying in the Line Islands of the Eastern Pacific, approximately 1200 miles south of Hawaii, and used extensively during the Pacific A-Bomb tests. The Christmas Island of our story lies 250 miles south of Java in the Indian Ocean and was first sighted during the early 1600's, most notably on Christmas Day 1643 by Capt. Mynors of the British East India Company. The first recorded landing was made in 1688 by William Dampier. In 1886 Capt. MacLean of the *H.M.S. Flying Fish* visited the island and discovered the anchorage which today is known as Flying Fish Cove. One year later a landing was made by *H.M.S. Egeria* and samples of rock were removed which proved to be pure lime phosphate. This important economic discovery resulted in the annexing of the island by Britain in 1888.

The first settlement was established shortly afterwards by George Clunes-Ross who had originally settled 530 miles to the west on Cocos-Keeling Island. During World War II the island was evacuated except for a small detachment of soldiers, who built a mock wooden aircraft to help dissuade the Japanese from an invasion. Ironically this act probably precipitated the bombing which came two days prior to the Japanese landing. At the time of the bombing, Mathew, ZC3AC, was in the radio shack handling traffic. Upon hearing the whistling, of what proved to be a direct hit, he lunged out the door and dove into the adjacent swimming pool. Narrowly escaping the subsequent explosion.

Following WWII, Britain resumed control of the island and from January 1, 1958 it was administered as a separate crown colony. On Oct. 1st, some nine months later, it became an Australian Overseas Territory leased to the British Phosphate Commission.

Giving you the islands history is one thing, getting there proved to be another.

To gain access to the island you need a special visa issued by the Australian High Commission. To obtain this visa you have to submit an affidavit from one of the 300 European residents on the island stating that they are extending a personal invitation to you for a visit, and that during your stay they will be totally responsible for your shelter, sustenance, and actions. There are no hotels or other lodging available and visits are only permitted to relatives and close personal friends. At long last, I had found an inhabited island which had yet to see its first tourist!

Not knowing anyone on the island, I contacted an old friend, Jim Rumble, VK6RU. Jim maintains a weekly schedule with VK9XI, the club station on the island, and has been its patron for a good many years. He advised that there were two licensed amateurs currently on the island and that he would mention my desire on his next sked.

It was further suggested that I write Craig Woodford, VK9XW, a personal letter and outline my reasons for wanting to visit Christmas Is. Murphy took over at this point and the once a month mail flight failed to deliver my letter. It arrived on a slow freighter, months too late for its intended purpose. In the meantime, thru the efforts of Jim, Craig and Don Hall, 9V1SH, amateur radio was to succeed where the mails had failed.

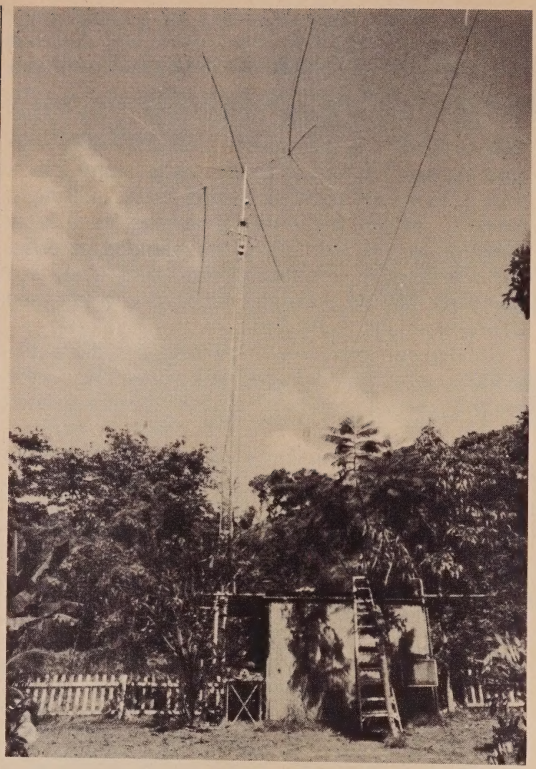
Arriving in Singapore, I learned that the anticipated charter flight was carrying workers who were returning to Xmas and that a pecking order existed for any available seats. First crack went to management and visiting dignitaries. Second choice would be given to returning or newly hired Malaysian



The VK9XX operating position with the author at the ready.

workers. Next came dependents—the wives and children of those already mentioned. Then space was to be allotted to visiting clergy, etc. Should there be any remaining space it would fall to freight, and then—you guessed it—any visitor crazy enough to want it, provided they had managed to meet all the requirements previously mentioned. The flight could carry 86 passengers and with three days to lift off, there were 85 on the list! The charter agent in Singapore was shrewd and after a few minutes a meeting of the minds had been reached. There would be no 86th passenger on the list, only 200 pounds of freight . . . me! The fare was soon paid and the bargain was sealed. My trutsty TS-520 was still in its carrying case and ready to go.

Having met with apparent success on the charter matter, I then approached the Australian High Commission and presented my documents. The clerk advised that they would be submitted and a "decision" regarding the visa made. It was recommended that I return the next day at 1:00 p.m., at



The VK9XX "shack" and 4 element cubical quad.

which time I was advised to return at 4:00 p.m., at which time I was told to wait.

During my "wait" a young chap, dressed in Levi's and sporting a beard, wandered in carrying a coil of RG-8U slung over his shoulder. The story unfolded that he had been installing an amateur station aboard a yacht in the harbor. I naturally inquired as to whether I could be of any help. It seems they had just installed a vertical antenna with forty radials and they were getting ready to fibre glass them to the deck. Their real concern was as to whether the ends of *all* the radials had to be draging in the water! Now I was sure that I was a long way from home. I explained the lack of necessity in his monumental project and then he confided in me that they had a few additional problems. No one on board had a license or call sign, nor had any of them ever been on the air. CQ was an alien term and none of them knew how to establish a contact.

He explained that they were sailing thru the Anambas Islands and then over to the Spratly Group, so I suggested they borrow the 1S2A call sign and stop long enough in the Spratlys to make a few contacts. I was to hear them a few weeks later signing 1S2A! It's a long way from Sardinia to the Spratlys, and when they heard the pile up that followed their CQ, I am sure they desired a more obscure call sign than either IS or 1S.

Finally the High Commission approved my request and I was all set to go. The following day found us slowly winging south over the Molucca Strait, with its thousands of islands which help comprise the country of Indonesia. Java Head soon passed to starboard and a short time later we circled the cloud enshrouded, lush green landscape of Xmas Island. It was evident, from the air, that the steep cliffs ringing the island continued to drop straight away underwater and unlike the coral islands of the Pacific, there was neither a reef nor any apparent shallow water. Suddenly, through the clouds, the air strip burst into a view as we banked sharply and dove for the deck. This flight commenced a new air charter contract and neither the plane nor the pilot had ever been here before. This became more apparent as we slammed into the uphill strip. Both the passengers and the spectators were pleasantly surprised when we failed to blow the tires out. I had watched the spare aircraft tires being loaded at Singapore with the destinctive "Xmas Island" written on the sides. In retrospect, I wondered if they had known something that I hadn't.

Soon after "landing," we were directed to the flight apron and instructed to shut down by the paddle waving controller. This was to be my introduction to Craig Woodford, VK9XW, who, aside from his normal island duties, is responsible for directing incoming and outgoing flights from the ground. I was definitely surprised when the first person up the boarding stairs asked for me by name.

The small building which served as an airport was packed with those awaiting relatives and in the ensuing moments, Craig explained that the passenger list had been flashed ahead and that my name had not been on it. With a month between flights he had concluded that I had either been unable to make connections, or, as was more likely, failed to obtain space on the flight. I never did fully explain the arrangement made with the flight broker!

Craigs lovely wife, Lois, and their two children, Joyce and Jeffrey, escorted me to Flying Fish Cove, while Craig wrapped up the flight details and sent the charter plane on its return run. The cove seemed idyllic in nature and with Craigs arrival we were soon in the midst of a Malaysian meal, which still only qualifies as indescribable.

The biggest surprise waiting for me was to be the sixty foot high, four element cubical quad. It really packed a signal and was certainly responsible for getting us into some of the tougher propagational areas. As a confirmed DX-nut, I politely excused myself and set about installing the station

in a small galvanized shed which was normally used as Craig's workshop.

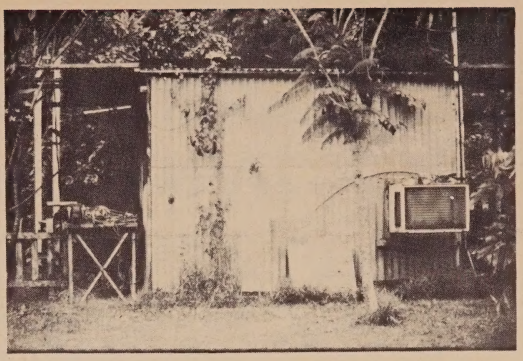
At 16:16 zulu on April 8th, 1976 VK9XX was activated. At a little past 3:00 a.m. I shut down for a quick forty winks. Dawn found us again active and durinng the ensuing days over 5400 contacts in 121 countries were established. The openings and paths were quite interesting from a propagational viewpoint and bear looking at:

Local Time	G.M.T.	MHz	
11:45- 2:00 p.m.	04:45-07:00	14	YV/HK to YS
2:00- 6:45 p.m.	07:00-11:45	28	Eu.-Asia-Africa
2:00- 6:45 p.m.	07:00-11:45	21	Eu.-Asia-Africa
6:45- 7:00 p.m.	11:45-12:00	3.5	JA
7:00- 8:30 p.m.	12:00-13:30	14	Eastern U.S.A.
8:30- 8:45 p.m.	13:30-13:45	3.5	W6-W7
8:45- 9:15 p.m.	13:45-14:15	7	W6-W7
9:15-11:30 p.m.	14:15-16:30	14	W6-W7
11:30-12:00 p.m.	16:30-17:00	14	Europe
12:00-12:30 a.m.	17:00-17:30	3.5/7	JA
12:30- 1:00 a.m.	17:30-18:00	14	Europe
1:00- 1:45 a.m.	18:00-18:45	21	KP4 to HK
1:45- 5:00 a.m.	18:45-22:00	14	Europe
5:00- 6:00 a.m.	22:00-23:00	3.5/7	Europe

With its equatorial position at 12° south, I experienced superb seasonal openings on the high bands due to trans-equatorial propagation. In case you think 10 Meters is dead everywhere during the low of the sunspot cycle, the following stations were worked during a two hour period; FR7BB, UL7PBY, 9X5PT, VK6CF, 9V1SH, ZE8JL, OE6DK/YK, JY9CS, UH8HAS, UD6DKY, RH8EAE, 4Z4PX, UI8ADN, 5Z4QQ, 9H4H, several ZE/ZS, VK's, JA's UA/RA, and twenty different, common, european countries. Conditions were, needless to say, superb and greatly added to our enjoyment of the operation.

At ZK2AQ we had the performing ants—at Xmas it was to be the Geckos. Geckos are small territorial lizards about 6 inches long, which inhabit most of the islands of the world. In the "shack" there was one window about three foot square located next to the operating position. The window had been territorially divided eight ways by the Geckos, who resided in the shack. At night the operating light would attract moths and the sight of eight Geckos stationed at their positions awaiting the evening meal was a sight to behold, especially since they were all on the outside, which gave me a view from their bottom side! Occasionally a moth would strike the center of the window and all of my friends would snap to attention, patiently waiting to see which direction it would move.

The moth, in time, would move from the disputed area and as soon as it was clearly in some ones territory, the owner would dart forward at lightning speed and devour his tidy morsel. As chief provider I felt compelled to operate until all hands were



A close-up view of the shack. Note the air conditioning unit which made long hours of operation possible.

satisfactorily full. My friends exhibited their accord in a rather strange manner, as upon returning each morning, I would have to dust their droppings off of the operating position. I guess they felt the need to return what I had given them, even if it was in a different form. I had always wondered how government beaureaucrats first came up with the same idea!

During my stay, Craig erected a delta loop for 80 Meters and we managed QSO's as far east as W5 land. A number of W6's and W7's also made the grade on both c.w. and s.s.b. At 1:00 a.m. local time we regularly experienced a wild, over the pole opening on 21 MHz which allowed us to continue our practice of working stateside Novice stations. "First VK", was the usual comment and I often wondered what their reaction was when they checked and found that they had worked something rarer than "VK." Occasionally, on this opening, I would only find ragchewing KP4's on s.s.b. which we would attempt to break for a contact. One YL, KP4, read us the riot act for breaking in on her contact with another YL, that is after she QRX'd us for ten minutes. Rarity and desirability is truly, only in the eye of the beholder.

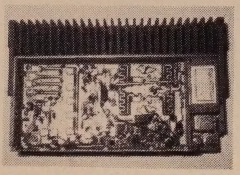
On Easter morning I arrived at the operating position to find that I had been preceded by a three inch elf, who was sporting a chocolate Easter egg. The Easter Bunny does indeed range far and wide, certainly adding a bit of nostalgia to my day. Easter, surprisingly, is the biggest holiday celebrated on the island, and this one proved no exception. Amongst the festivities were sail boat races and a childrens fishing derby. Some of the fish were bigger than the contestants, others so small that you wondered whether they really swallowed the hook. So the morning went, and by afternoon I was back at the same old 20 meter stand.

That evening, Phil, W7SGN, was waiting on schedule with my XYL in his shack. It was Easter morning at home and this was the first conversation I had had with my wife since leaving home, six

GREGORY ELECTRONICS
The FM Used Equipment People.

GENERAL ELECTRIC EXECUTIVE AND MASTR II STRIPS





G.E. MASTR EXECUTIVE Series RECEIVER Strips,

less xtal, not checked out, (schematic available upon request with purchase)
4ER46, 25-33 MHz or 33-42 MHz, wide band
4ER48, 132-150 MHz, wide band
4ER50, 450-470 MHz, narrow band

SPECIAL SALE PRICE
$50.00

G.E. MASTR II U.H.F. POWER AMPLIFIER CHASSIS.

A broad banded amplifier, 12 volt D.C. powered, requires approximately 3 watts R.F. driving power for rated output (not checked out)
G.E. Part #19C320620 Series
450-470 MHz, 40 watts
470-494 MHz, 40 watts
494-512 MHz, 40 watts

SPECIAL SALE PRICE
$75.00

master charge
BANKAMERICARD

GREGORY ELECTRONICS CORP.
249 Route 46, Saddle Brook, New Jersey 07662
(201) 489-9000

weeks earlier. Afterwards, with my spirits buoyed, I returned to the pile. A buzz-saw out of Asia had come on. Building into a frenzy, it soon covered 200 kilocycles at up to 40db over S-9! If you have never experienced this, on a first hand basis, it is almost beyond comprehension. It certainly felt strange to sit on 14.200 and take calls on 14.325, however, it was the closest frequency that was anywhere near clean.

All the statistics indicated that the greatest need for VK9X lay in the W123 and 8 districts, so I concentrated first and foremost on those areas. Propagation wise, the W4's lasted the longest on our east coast opening. Correspondingly, I held them at bay until as many of the others as possible were in the log. At times the 4's wanted to shoot me when I called first for W1, then W2 and W3, and then skipped by the 4's. Upon returning stateside the word was even out in some quarters that I didn't like W4 stations and wouldn't work them unless there was nothing else on, and then only as a last resort! However, by using this technique, I managed to get the contacts into the areas where they were most needed and satisfy the desire for Xmas, even in W4 land. In order to work the eastern U.S.A., I had to beam straight through Europe. Getting them to hold their fire, when I was "forty over nine" in Europe, was no mean feat.

One thing became evident during the expedition regarding the chaps on the other end. Most were courteous and respectful, amongst the most exemplary were the JA's, VK's and Europeans. While they stood quietly by, we pulled out 989 east coast W contacts. During that span of time I can only hope that no one recorded the comments made on s.s.b. between the W's on the other end. If it were played for the '79 WARC it could only result in disdain from other nations attending. Obviously, most were gentlemen, however, the percentage of mouthy caustic remarks between operators slurred before the ears of the world made me reticent to admit my own nationality. It is particularly regretful that we must rank so far down amongst the operators of the world. It is interesting that this applied to s.s.b. only, and that the c.w. operators from the states were near the top in courtesy.

Regarding some of the more interesting contacts, I would have to mention JT1AT, JT1BB and JTØUEF all calling at the same time in my first Mongolian pileup.

As time to leave drew near, we tallied the countries at 121 worked and we were pleased that many who needed the contacts had made it through. Among the more jubilant were W1DAL, who had been trying schedules with Craig for several months, and W3HNK who registered his #300 on the "last plateau." Although we tried hard to accommodate, some did not make it. Hal, PY1ZAE and friends tried for eleven days, and although we listened many times, the path was not there. It opened only once to PY, for a period of twenty minutes at 2:00 a.m. Brazilian time, PY2OB and PY2GYQ were there waiting.

Finally it was time to pull the station down and depart. Having cleaned the band we were chatting with an old friend, Dick Shanks, W6BZE. Having an idiosyncrasy regarding last contacts, we were pleased to close out with Dick and duly announced that we were permanently closing down. We did continue to listen on the frequency for about two minutes, when a VE commented to his friend that he had "overslept and just missed" me. His friend tried to console him with the thought that "there will always be another one." Unconsoled, he alluded to the fact that it would "be a long time till then." We cracked the mike and, having eavesdropped, addressed him by name. "Good morning, John. How goes it with you?" "Just fine, and with you?", came the reply. "Not too bad. My you have a nice signal," said I. At this point his curiosity peaked, "who is this?" "Bill, BAKER-ITEM-LOVE-LOVE, and you're five by nine in the log. VE7BQ from VK9XX." So it was that we concluded our operation from Christmas Island.

Kuala Lumpur was an overnighter and the following day found me with Udo, HS1ALB in Bangkok, Thailand. . . . Ah, but, thats another story. ■



The world's first digitally tuned 80M-10M SSB transceiver

with over 40,000 frequency synthesized channels.

• Ultra-stable frequency synthesizer • Large LED readout • 200 Watts PEP input • *All* solid state including electronic tuning • Front end filtering • Built-in TVI filtering • Modular construction • WWV Receiver, Squelch, Noise blanker, VOX, Speech processing are standard • Full metering.

Discover a whole new world of communications with the CIR ASTRO 200 . . . the Ham SSB Transceiver that has established a new plateau of sophistication for the serious enthusiast.

The built-in digital synthesizer with LED readout gives you over 40,000 crystal controlled channels in the 80 through 10 meter bands with 100Hz resolution. Just press a momentary switch and tune your frequency with no moving parts.

Calibrate it with WWV at the turn of a switch for absolute accuracy. No more crystal calibration.

And, as for frequency drift, the ASTRO 200 is ten times better than VFO types. Total filtering sets the ASTRO 200 above all others for TVI and harmonic suppression. Selectable USB or LSB allows you complete flexibility, and extended band coverage covers many MARS frequencies. CW operation features include semi break-in CW with adjustable delay and side tone . . . no key click or CW chirp.

CIR offers a complete range of accessories including fixed station console and external frequency synthesizer for crossband DX work.

This extremely compact transceiver is only 2.8″ high by 9.5″ wide by 12.3″ deep including heat sink. With all of these features incorporating rugged militarized type construction, it has no equal for SSB and CW operation.

Be the first to learn more about the exciting new CIR ASTRO 200 . . . ham radio's next generation transceiver. Available in March. Write or phone for complete details.

CIR
TRANSCEIVERS

CIR Industries, Inc., 1648 N. Magnolia Avenue, El Cajon, California 92020 U.S.A., Phone (714) 449-7633, Telex 69-7989

Conclusion—Getting it all together.

The Multi-Band Trap Antenna—Part IV

BY JOSEPH M. BOYER*, W6UYH

Part I appeared in February, Part II in March, and Part III in April. In this, the concluding part, the author completes his analysis of the Morgan trap antenna.

The Twenty Meter Band

When we shift to the next lower frequency band, twenty, we are savvy to what happens in the antenna now: on 14.175 MHz, *both* the ten and fifteen meter band traps are non-resonant, so two traps are now acting as series "loading coils" in the monopole. But we know these $X_{s(10)_{20}}$ and $X_{s(15)_{20}}$ reactive values. At the same time our first conductor section $h°_{(10)_{20}}$ is now 14.175/*28.850* × 90° equals 44.220 degrees long electrically in *both* our monopoles. However, those two different length $h°_{(15)}$ conductors just obtained have to each be multiplied by the common M factor 4.175/*21.225* = 0.668. Doing this gives us $h°_{(15)}$ equals 12.145 degrees for the skinny $K_{m(1)}$ monopole and $h°_{(15)}$ equals 9.928 degrees in our fatter $K_{m(2)}$ monopole. Starting our climb up the monopole again to find out what the needed $h°_{(20)}$ conductor length must be, we again split our steps into two columns, first listing our known data:

*Antenna Consultant
17302 Yukon, Suite 63, Torrance, CA 90504

$a'_1 = 4.245 \times 10^{-3}$ ft.
$K_{m(1)_{20}} = 480.540\Omega$
$h°_{(10)_{20}} = 44.220°$
$h°_{(15)_{20}} = 12.145°$
$X_{s(10)_{20}} = 142.946\Omega$
$X_{s(15)_{20}} = 258.345\Omega$

$a'_2 = 1.667 \times 10^{-1}$ ft.
$K_{m(2)_{20}} = 260.310\Omega$
$h°_{(10)_{20}} = 44.220°$
$h°_{(15)_{20}} = 9.928°$
$X_{s(10)_{20}} = 142.946\Omega$
$X_{s(15)_{20}} = 258.345\Omega$

$\lambda_1 = h°_{(10)_{20}}/360° = 44.220°/360° = 0.1228\lambda$
$X_1 = \tan h°_{(10)_{20}} = \tan 44.220° = 0.9731\Omega$

$$X_2 = X_1 + \frac{X_{s(10)_{20}}}{K_{m(1)_{20}}} = 0.9731 + \frac{142.946}{480.540}$$

$$X_2 = 0.9731 + 0.297 = 1.271\Omega$$

$$\lambda_2 = \frac{(\tan^{-1} X_2)°}{360°} = \frac{(51.796)°}{360°} = 0.1439\lambda$$

$\lambda_1 = 44.220°/360° = 0.1228\lambda$
$X_1 = \tan 44.220° = 0.9731\Omega$

$$X_2 = 0.9731 + \frac{142.946}{260.310}$$

$$X_2 = 0.9731 + 0.549 = 1.522\Omega$$

$$\lambda_2 = \frac{(56.697)°}{360°} = 0.1575\lambda$$

(Right here, everybody take a firm grip, as we are going to shinny up the known lengths of $h°_{(15)_{20}}$:)

$$\lambda_3 = \lambda_2 + \frac{h^\circ_{(15)20}}{360^\circ} = 0.1439 + \frac{12.145^\circ}{360^\circ}$$

$$\lambda_3 = 0.1575 + \frac{9.928^\circ}{360^\circ}$$

$\lambda_3 = 0.1776\lambda$
$X_3 = \tan(\lambda_3 \times 360)^\circ = \tan 63.936^\circ$
$X_3 = 2.0445\Omega$
$\lambda_3 = 0.1851\lambda$
$X_3 = \tan(\lambda_3 \times 360)^\circ = \tan 66.628^\circ$
$X_3 = 2.3140\Omega$

(Hold it there: stay in reactance because we must now climb around the non resonant fifteen meter trap:)

$$X_4 = X_3 + \frac{X_{s(15)20}}{K_{m(1)20}} = 2.0445 + \frac{258.345}{480.54}$$

$X_4 = 2.0445 + 0.538 = 2.5821\Omega$

$$X_4 = 2.3140 + \frac{258.345}{260.310}$$

$X_4 = 2.3140 + 0.992 = 3.3060\Omega$

(Having reached the base of our unknown length section $h^\circ_{(20)}$, we may now use the lazy man's move to obtain the length of $h^\circ_{(20)}$ in one additional step:)

$h^\circ_{(20)} = (\text{cotan}^{-1}\ X_4)^\circ = (\text{cotan}^{-1}\ 2.5821)^\circ$
$h^\circ_{(20)} = 21.170^\circ$
$h^\circ_{(20)} = (\text{cotan}^{-1}\ 3.3060)^\circ$
$h^\circ_{(20)} = 16.829^\circ$

We now see how two non-resonant traps in series, but of fixed reactance value, affect our two monopoles differently due to the K_m effect of the conductor radii. Such effect also applies, of course, to ordinary coil-loaded short monopoles. Notice that in the "computer steps", when you have to climb up an intervening antenna *conductor* of know electrical length, you stay in height λ at the conductor base, then shinny up it by adding *its length* $h_n^\circ/360^\circ$ to its base point height λ. However, when you must climb above a trap you add the X value obtained at the *bottom end* of the trap to *its actual reactance* X_s divided by the monopole K_m (as the X_s/K_m step normalizes trap reactance, you climb around a trap by adding trap reactance to antenna reactance—both in normalized form).

We may use a "score board" in this monopole climbing process to do two things: first, to keep track of our moves in the design and, second, to be able to actually "watch" things happen along the Morgan antenna. Nothing does a better job of "etching" an understanding of antenna function in terms of impedance behavior on our minds (even a pro's) than studying such a "score board". Naturally, our score board is the one invented by P. H. Smith[5], and it is shown in fig. 2.0. It is identical to the one used in our part I work, except that the impedance R+jX at its center is now 1.0+j0 instead of 50+j0 ohms. Due to this, all impedance on the chart is normalized so it may be used for a transmission line of *any* characteristic impedance Z_o or K_m. Here we will use it to *simultaneously* represent our $K_{m(1)}$ and $K_{m(2)}$ characteristic impedances. Because we are now familiar with normalized impedance and reactance, only a word is needed to understand the data presented in fig. 2. Each of our climbing steps along our two twenty meter monopoles are shown in normalized form, along the left hand side sector of the chart. As we are not letting our monopoles radiate or have ohmic loss (R_r = RΩ = 0 ohms), all reactance is shown as points along the inside rim edge (+jX) as in part I. All heights λ along the monopole at increasing distance from the base are listed on the Wavelengths Toward Generator (W.T.G.) outermost distance scale. Again the chart is printed "upside down".

The short radial lines projecting outside the chart represent our steps for the skinny $K_{m(1)}$ wire monopole; those projecting inward into the chart are for our fatter $K_{m(2)}$ monopole. Notice that both the outward and inward pointing lines touch both the W.T.G. distance scale and also the inside rim reactance scale. Also, observe that both monopoles are "neck-to-neck" at the top of the $h^\circ_{(10)20}$ conductor section, but don't stay that way farther on up the antennas. Finally, over on the right hand side sector of the chart, the *climbing down* steps are shown as a check *after* we've found $h^\circ_{(20)}$ to make sure we end up at $jX_{in(1,2)}$ = j0 ohms on $f_{o(20)}$. On the band edges, our part I work tells us now that at the f_{low} band edge that circumferential distance from λ_1 on the right down to the monopole base would come out *short* of j0, to end up a short distance on the *right hand* capacitive reactance region of input impedance $-jX_{in}$. Conversely, at f_{high}, that same arc distance would inch *beyond* j0, to end in the inductive $+jX_{in}$ region. Finally, we remember that to get those normalized reactances $jX_{in(1,2)}$ "out" of the chart, we just multiply them either by $K_{m(1)}$ or $K_m(2)$ to convert them to *actual values* of reactance (or impedance). Then, to get v.s.w.r. in a fifty ohm feed coax, we'd just add R_r (and RΩ if we wish) to these *actual reactance* values and plot them on a 50+j0 ohm Smith chart to get v.s.w.r. in such cable versus operating frequency.

Now that the gang is getting experienced in climbing up the monopole on any band, this OM will leave the QSO while the gang works out the remaining conductor lengths for forty and eighty, and QRX for a traffic sked. However, we'll be back on 3.750 MHz at 1600 hours GMT to compare a final list of calculated conductor lengths for each monopole with those obtained by the fraternal brothers.

[5]P. H. Smith, "Transmission Line Calculator," *Electronics, 12,* pp. 29-31, January, 1939. Note: Printed pads of Smith chart blank forms are available from General Radio, West Concord, MA 01781. The 50 ohm and normalized types are most useful to amateurs.

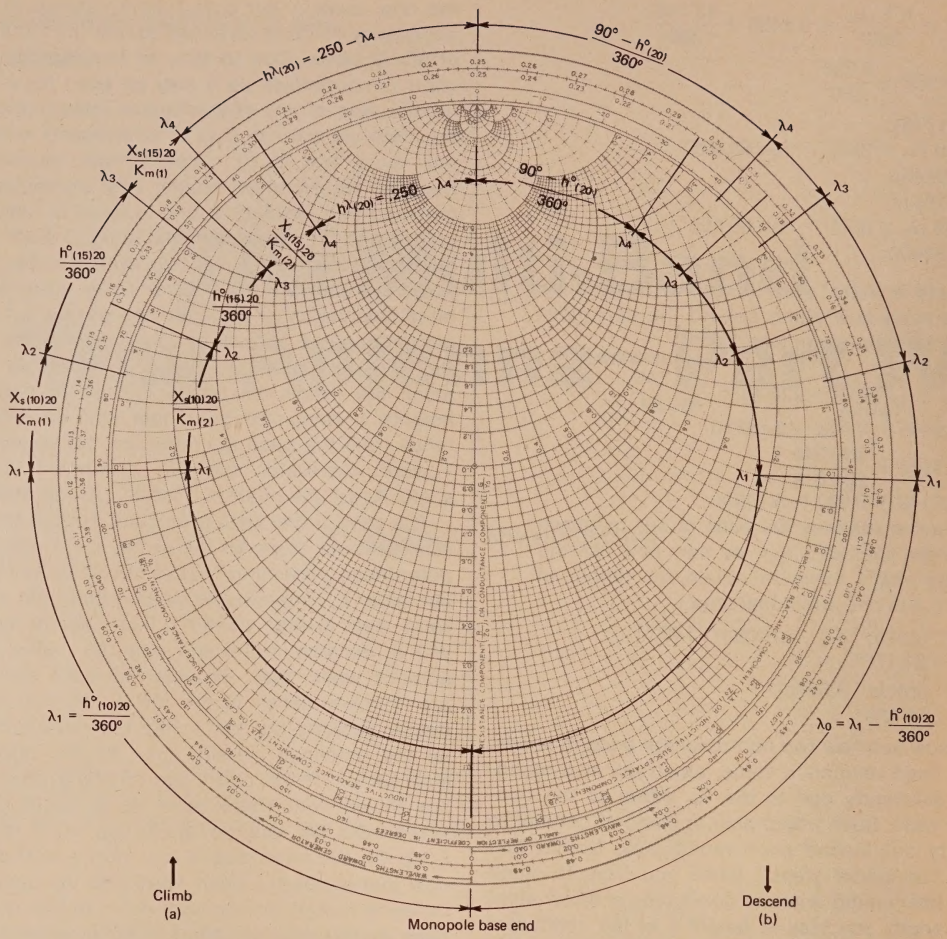


Fig. 2—Normalized Smith impedance chart showing analogue design steps for twenty meter band monopole portion of ten to eighty meter Morgan multi-band antennas. Analogue characteristic impedance $KM_{(1)20}$ is 480.54 ohms for #10 gauge wire; $Km_{(2)20}$ is 260.31 ohms for four-inch diameter conductor. See text.

Eighty Meters

Well we see everybody finally reached the base end of conductor $h°_{(80)}$ and used the lazy man's step to find its electrical length for each of the two monopoles. Our paper Morgan antenna design is complete, so let's all relax, compare notes, and chew the fat. The conductor lengths we obtained from a table. Each needed conductor length is listed in electrical degrees and electrical wavelengths at the band f_0 *at which it was first found.* The list should look like the one given below, which is *based solely* on use of the particular band trap parameters selected at the start of design.

$a_1' = 4.245\times10^{-3}$ ft.
$h°_{(10)} = 90.000°$;$h\lambda_{(10)} = 0.2500\lambda$

$a_2' = 1.667\times10^{-1}$ ft.
$h°_{(10)} = 90.000°$;$h\lambda_{(10)} = 0.2500\lambda$

$h°_{(15)} = 18.186°$;$h\lambda_{(15)} = 0.0505\lambda$
$h°_{(20)} = 21.170°$;$h\lambda_{(20)} = 0.0588\lambda$
$h°_{(40)} = 33.900°$;$h\lambda_{(40)} = 0.0942\lambda$
$h°_{(80)} = 34.346°$;$h\lambda_{(80)} = 0.0954\lambda$
$h°_{(15)} = 14.866°$;$h\lambda_{(15)} = 0.0413\lambda$
$h°_{(20)} = 16.829°$;$h\lambda_{(20)} = 0.0467\lambda$
$h°_{(40)} = 27.881°$;$h\lambda_{(40)} = 0.0774\lambda$
$h°_{(80)} = 29.972°$;$h\lambda_{(80)} = 0.0833\lambda$

In comparing calculated conductor lengths to those above, the gang need not be concerned about small differences in lengths obtained in their work; it's ok if agreement is within say ± 1.0 degrees or so, for reasons we will see shortly. If we go back and add up *all conductor* electrical lengths in a given Morgan monopole band section, we see that they do not total up to 90.00 electrical degrees; however, in each case if we then *add* the electrical lengths contributed by *each trap in that band,* the

total antenna electrical length then *does equal 90.00* degrees and produces "forced" resonance except on Ten meters. We now see that it is the trap "coil loading" effect *plus* the influence of the conductor related to K_m which produces substantial *conductor shortening* in *electrical degrees*.

Although such antenna conductor "shrinkage" is inevitable in a lumped LC trap multi-band antenna, we shall shortly see that we can't let this conductor miniaturization *go too far* if we wish to obtain optimum on-the-air performance from our Morgan antenna.

Conversion From Electrical To Physical Conductor Length

Now it was said that the conductor lengths we obtained by using the antenna analogue steps came out in electrical degrees at the band f_0. This means that the $h\lambda(\ )$ lengths listed apply to dimensions of wavelength λ_0 in free space. Any real antenna conductor of finite physical diameter d = 2a will be actually shorter in physical length than the free space wavelength dimension given, in inverse proportion to the conductor diameter. Unfortunately, space does not permit a discussion of the very interesting theory behind such conductor shortening effect. Here, we can only give the steps needed to convert those calculated conductor lengths from electrical to physical length.

(a) Starting at ten meters, then moving progressively to the center of the next lower ham band, compute the free space wavelength $\lambda_0 = 984.00/f_0$ (MHz) in feet.

(b) Multiply your particular conductor radius (ft) by two to get its physical diameter d = 2a in feet.

(c) Divide your conductor diameter into the λ_0' for the ham band being considered.

(d) Use this λ_0'/d' number obtained from step (c) to enter the Wavelength in Diameter horizontal bottom scale of fig. 3.0.

(e) Move up the chart at the entered value until you intercept the graphed curve of the figure.

(f) Move horizontally at that found height on the curve to find the conductor length correction factor P calibrated along the left hand side scale of the figure.

(g) The corrected physical conductor length in feet for that particular band is then: $S = P \times h\lambda(\ ) \times \lambda_0$.

As an example, take the $h\lambda_{(10)} = 0.250\ \lambda$ length given for each monopole at ten meters:

$\lambda_0'_{(10)} = 34.107$ ft.

$d' = 2x\ 4.245 \times 10^{-3}$ ft.

$d' = 8.49 \times 10^{-3}$ ft.

$\lambda_0'_{(10)}/8.49 \times 10^{-3} = 4,017.$

$\lambda_0'_{(10)} = 34.107$ ft.

$d' = 2x\ 1.667 \times 10^{-1}$ ft.

$d' = 3.33 \times 10^{-1}$ ft.

$\lambda'_{0(10)}/3.33 \times 10^{-1} = 102.$

We see immediately that the λ/d scale in fig. 3.0 ends at a maximum value of 3,000. This means that even on ten meters, the λ/d value obtained for a number 10 gauge wire is so large that we do not need to make a correction between its electrical and physical length* in *practical* antenna design. We just let P = 1.0 to get the conductor length S in feet for the skinny $K_{m(1)}$ monopole. For number 10 gauge wire, the λ_0'/d' ratio gets increasing larger at the lower frequency bands so no correction is needed at lower freqencies either. The fatter monopole, however, gives a λ'_0/d ratio of only 102. Entering figure 3.0 at this value, we "eyeball" a P factor of about 0.89 on ten meters. Therefore, our four-inch diameter (twice the value of *a*) tubing monopole of $K_{m(2)}$ comes out as $S' = 0.89 \times 0.250 \times 34.107$ ft = 7.6 feet in length to form a resonant $\lambda/4$ monopole.

But we had to "eyeball" a value off the chart, which implies that we might have been a bit foolish in using even three decimal place accuracy in our design calculation steps. Actually, we were not being foolish: we should always try to obtain accuracy in design calculations based on theory. Later we'll see how to get our calculated values "right on" when we make our Morgan antenna play.

The Real World Of Antennas

Up to now we have been climbing up and down our Morgan antenna, designing it with the idea that our band traps function like ideal lumped LC circuits. But earlier it was said that ideal circuits have zero electrical size in λ at the operating frequency!

*Amateur antenna handbooks give a length correction factor of about 0.950 to apply to antenna conductors. This factor applies *only* to the conductor-shortening effect produced by antenna end insulators. It is valid, but it is an entirely different length correction than discussed here.

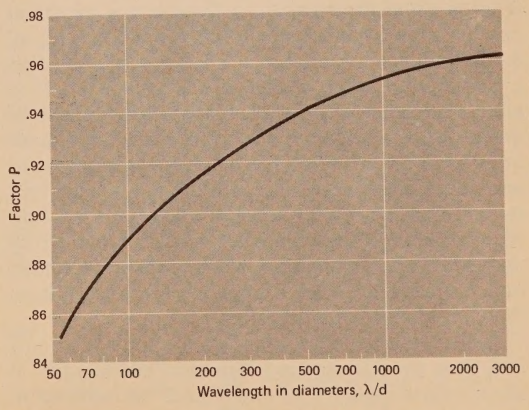


Fig. 3—Curve for conversion from free space wavelength hλ to physical length s' of antenna conductors as function of wavelength to diameter ratio.

If we constructed even the ten meter band trap with its 25 picofarad capacitor and 1.22 microhenry coil we'd find it was not exactly microscopic in size. The eighty meter band trap would constitute a good handful. Here is what happens when we use such traps in a real Morgan antenna:

First, that hunk of trap conductor geometry sitting on the top of a resonant monopole section of the Morgan has a substantial capacity over to the ground plane (or to the other side of a doublet) and will act like a top "capacity hat" on the monopole. This throws that monopole section out of resonance, by making it too long electrically from "top loading"; here is the reason we made a conditional remark about obtaining *natural* $\lambda/4$ monopole resonance on ten meters. There will also be an additional capacity existing from each of the coil turns and from the capacitor frame and plates over to the conductors connected above *and* below the resonant band trap. Such capacity can reduce the "isolation" effect of the trap in "cutting off" the rest of the Morgan above it, so that some *energy* can be coupled to the rest of the antenna. The effect is very complicated and subtle, and dependant upon what the actual impedance is existing at the *upper terminal* of the trap at that frequency. When substantial, this effect can excite a "long wire" mode in the upper parts of the Morgan to generate spurious high angle radiation pattern lobes. Such effect, if present, influences the gain performance of the Morgan primarily at the higher frequency bands of coverage.

Now, what if we played games with the trap parameters? Ok, let's do. The first thing we would find is that our instinctive desire for extremely high trap Q is somewhat misleading. Increasing coil Q does increase Z_p at in-band frequencies *very close* to the trap resonant frequency f_o. Yet even at the frequency limits of a given active ham band, Z_p falls back down to impedance values presented by lower Q traps *using the same L to C ratio.* For example, our ten meter band trap of 100 Q falls to a Z_p of 3.7×10^3 ohms at 28.00 MHz. A trap having the same L and C, but using a 300 Q coil will still fall to almost an identical Z_p at 28.00 MHz. Well, does that mean we were stupid in asking for super high Q air or vacuum condensers? No, because when we go to less ideal condensers we insert a condenser loss R_C and coil loss R_L of unequal value into the trap parallel circuit. This changes the Z_p/f curve in an undesirable manner, as well as adding to ohmic loss. Incidentaly, Z_p at f_o changes in proportion to the Q ratio in compared traps.

What about changing the L to C ratio? Well now that does produce a major effect in the Morgan. If we *increase* capacity C, the trap Z_p is reduced in magnitude at f_o (which is not too important) and also reduces the magnitude of reactance X_s of the trap in lower frequency bands. Now this trap reactance decrease is in proportion to how much we increase capacity ratio in the compared traps. However, if we *lower* the capacity C, we increase the magnitude of the non-resonant trap reactance X_s. This can cause problems. We have clearly seen the shortening effect produced by the trap X_s on the conductor length. A substantial reduction in trap C can really shorten conductor electrical length. At first thought, we might think this a great idea: boy, a miniaturized height, all band antenna!

Unfortunately, Mother Nature is always standing over us with a big club in her hand waiting to bash our technical heads in. Only conductors and their current distribution contribute to antenna radiation, and thus R_r magnitude; traps don't! When conductor electrical length shortening becomes substantial, the radiation resistance R_r of the active Morgan monopole section falls to values less than the 36 ohms of a naturally resonant $\lambda/4$ monopole. We see that with our antenna operating in a fixed ohmic loss environment, the $R\Omega$ remains constant but R_r now moves down closer to it in value. The antenna radiation efficiency is,

$$\text{Efficiency} = \frac{R_r}{R_r + R\Omega} \times 100 \quad \text{Percent.}$$

From this relation we see that the amount of input power to the antenna which is converted to radiated signals decreases in such miniaturized height antenna case. But say we went all out and used a $\lambda/2$ diameter wire ground plane at f_o, with a lot of wire radials and had a QTH in the middle of a salt marsh! Then $R\Omega$ goes down, but that lower value of R_r now will decrease the antenna frequency bandwidth in terms of impedance variation for a given conductor K_m. If one is a devoted c.w. or phone man, reduced bandwidth may not mean much. However, commercials can lay down super dense and large diameter wire ground planes: few hams can. Therefore, small R_r value antennas pose difficulties in ham radio unless certain newer type antennas of military origin are employed. We can't get into a QSO about those at this time. Therefore, in a Morgan of good on-the-air performance we should choose trap L to C ratio to keep the total antenna height from being sharply reduced, even though the idea may appear attractive.

Putting A Morgan On The Air

One of the gang breaks in at this point and says, "If all those weird things go on in the actual antenna from effects which we didn't or couldn't figure in, what good does all this fancy antenna design buy us?" Good question! What careful preliminary antenna design does is to place us squarely in the right ball park in terms of dimensions of conductors, trap parameters and so forth. We then face the same problem seen by pro's who must make real antennas play in a real world QTH. We "prune" to make the antenna perform correctly, guided by our

common sense and what we know technically about the way the antenna functions from our study of antenna theory. This approach is one hundred decibels better than the blind groping of the old cut-and try-school! Now let's make our Morgan play.

Say we have chosen the fatter conductor Morgan because its calculated design results look better on paper. We build our traps* and carefully "tweak" them on the bench to the f_o of each band, using a *loosely* coupled grid-dip oscillator and the shack receiver as a frequency meter for the g.d.o. signal. We then cut our tubing to the corrected lengths found, put down a radial wire ground plane either on the soil or on a roof location, and install a low mass ceramic base insulator. Here is what we then do to compensate experimentally for all the "weird" effects:

(1) Stretch out a length of coax reaching from the rig in the shack to the antenna installation location. Connect one end of such coax to the receiver in the shack, and station a friend there to track the T4 note of the g.d.o. on the calibrated receiver dial. On the other end of the coax solder a temporary wire pig tail to the inner conductor to act as a pick up antenna for the g.d.o. signal. Ground the shield of the coax to a radial wire.

(2) Erect *only* the $h°_{(10)}$ conductor section on the base insulator, holding it to a vertical position with a temporary "glas line" guying system. Solder a jumper wire from a lug connected to the base of section $h°_{(10)}$ (terminal #1) to a ground radial wire directly below. Fire up the g.d.o. and shack receiver in the ten meter band and make sure the g.d.o. signal can be heard on the remote receiver. The b.f.o. helps.

(3) Install the ten meter trap at the top of the conductor section, but do not bother trying to tune it at this time. We now have a top "capacity hat" ten meter monopole.

(4) *Lightly* couple the g.d.o. to the monopole base grounding wire and find the dip in the ten meter band. Invariably, it will be on the low frequency side of f_o. Wobble frequency of the g.d.o. slightly to make sure the friend in the shack identifies it in the QRM from other signals. Then, in small steps, guided by how close the dip was from f_o, prune the length of the ten meter conductor section until the dip falls closely on 28.850 MHz. Let the man in the shack give you frequency: don't use the g.d.o. dial for such data.

*In a Morgan monopole you have to use a non-conducting member to carry mechanical stress around the gaps in the conductor needed for insertion of the band traps. Marine junk yards are a source of husky Navy-type cylindrical insulators of high-quality ceramic removed from old ship antennas. They come in diameters up to several inches, and may be several feet in length. Use them as a core around which to build the trap. The ends of an insulator are inserted in the upper and lower antenna conductor.

(5) Install the $h°_{(15)}$ conductor section in place above the trap, and connect it to the other trap terminal. Again use a glas line guy set to hold it in place if necessary. Now bring the g.d.o. dip back on f_o solely by tuning the ten meter band trap. Coil turn bending or turn pruning may be needed. An air padder variable is nice here, but be sure plate spacing is adequate for power input level. As a low loss dielectric weather housing is a must around good quality band traps, make sure you put such cover *back in place* before the man at the receiver lets you know you have reached the ten meter f_o.

(6) Shift the g.d.o. and shack receiver to the fifteen meter band. Install the fifteen meter trap as a "top capacity hat" at the top of the $h°_{(15)}$ conductor section. Repeat steps (3) to (5) on the fifteen meter band, as well as on each lower frequency band of coverage until the Morgan is resonant on $f_o{}_{(80)}$.

When you have finished, and have the Morgan working correctly on all its bands of coverage, do not ruin all your good work by installing a set of conventional wire guys even if such wire guys are broken into short sections by compression egg insulators. It's capacitive effect on the Morgan will cause a shift of the antenna resonance. Instead use glas line rope for the final guying system. Even with it, however, install an egg compression insulator at both the antenna attachment end and about midway down the length of the guy to prevent influence on the antenna in a down pour of rain. You might find it interesting to then carefully measure the v.s.w.r. reaches the magic 2:1 circle. Carefully log this data, and compare it to the results obtained when climbing down your paper Morgan on the Smith chart at the band limits. Good DX hunting. ■

Changing QTH?

Moving is often exciting, hectic and confusing. It's packing, shipping, saying goodbye to friends and leaving them behind. Don't say goodbye to CQ and leave us behind for the new folks to read. Give us about 6 weeks notice and CQ will be there about the same time you get the last carton unpacked. You won't miss a single great issue.

Attach Current Mailing Label

New Address

Name _____ Call _____

Address _____

City _____

State _____ Zip Code _____

cut out, paste on post card and mail to

CQ MAGAZINE
14 Vanderventer Avenue
Port Washington, N.Y. 11050

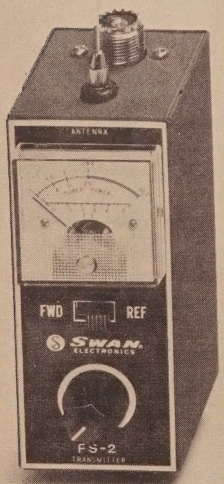
CHOOSE TOP NOTCH RIG PERFORMANCE FROM THIS SHOWCASE OF SWAN METERS.

Swan precision meters are designed and built to help you make sure you're putting out all the watts your rig can deliver.

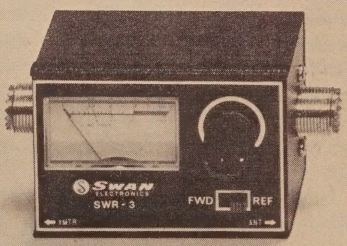
And Swan meters are priced so low they'll probably pay for themselves in improved rig performance and signal power.



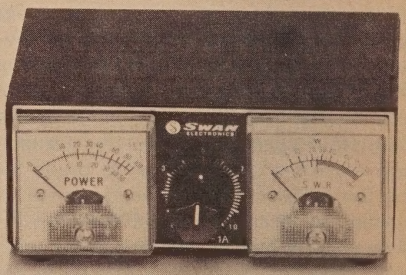
At last. A precision wattmeter for the 2-meter man. The upper-band man needs accurate output measurements, too. Now our WM6200 gives them to him with ±7% accuracy output power at 50 to 150 MHz. Two scales to 200 watts. Reads SWR on expanded range scale.
WM6200 In-Line Wattmeter **$59.95**



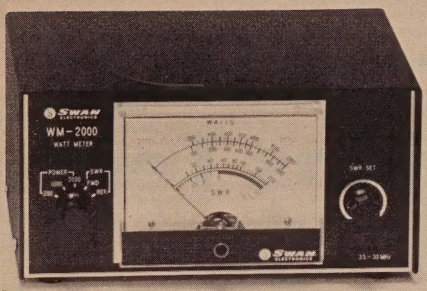
Measure power coming and going. Measure SWR and get maximum power to your antenna. Then get your antenna pattern right by measuring relative radiated power. A one-two power punch at a knockout price. **FS-2 SWR and Field Strength Meter** **$15.95**



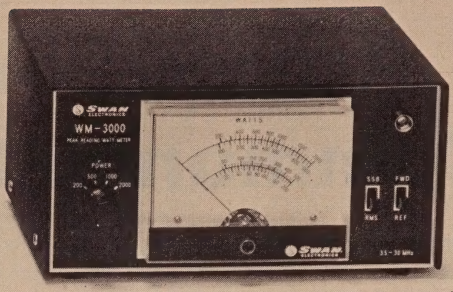
Easy-on-the-pocket pocket SWR. Mighty mite SWR meter with high accuracy, SWR-3 indicates 1:1 to 3:1 SWR at 50 ohms on frequencies from 1.7 to 55 MHz. Precision PC board directional coupler makes it a solid value at a rock-bottom price. **SWR-3 Pocket SWR Meter** . . . **$12.95**



SWR bridge bridges the price barrier. This little jewel gives you relative forward power and SWR on two 100 microampere meters at a remarkably low price. Rear mounted coax connectors for easy, neat installation. Capable of handling 1000-watt signals on frequencies from 3.5 to 150 MHz. With low insertion loss, it's great for mobile operations, too. **SWR-1A Relative Power Meter and SWR Bridge** **$25.95**



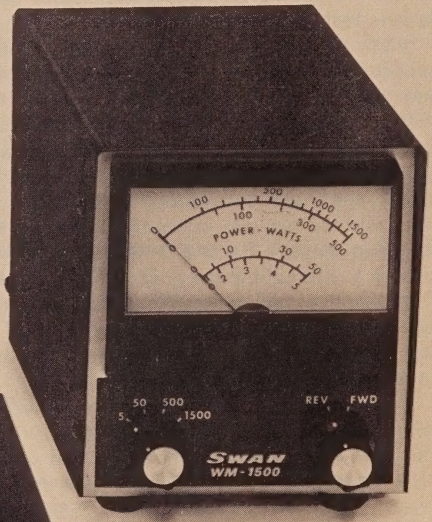
All-the-law-allows in-line wattmeter. With three scales to 2000 watts, new flat-frequency-response directional coupler for maximum accuracy and a price anybody can afford, this meter has become an amateur radio standard. 3.5 to 30 MHz with expanded range SWR scale.
WM2000 In-Line Wattmeter . . **$59.95**



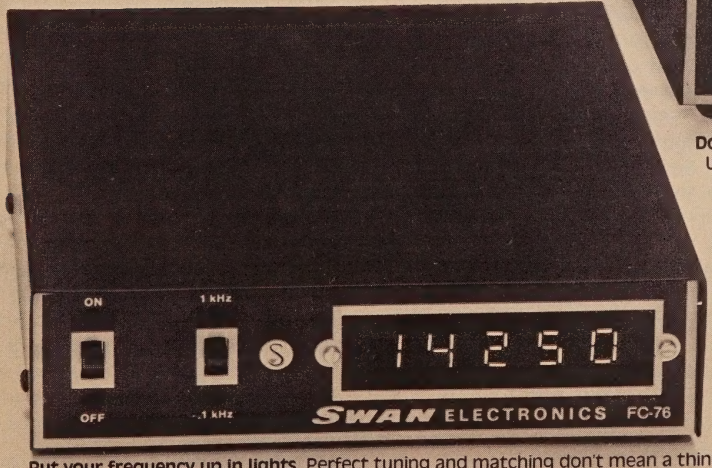
This wattmeter tells the truth about SSB. True peak envelope power of your voice modulated signal is what you want to know most about your SSB transmission, and that's where our WM3000 shines. Flat response forward or reflected power from 3.5 to 30 MHz on scales to 2000 watts in RMS or PEAK at the flip of a switch. **WM3000 Peak/RMS Wattmeter** **$79.95**



Sniffs out radiated power wherever it is. This little unit is so compact it could measure relative radiated power in your pocket. Telescoping antenna and a frequency range of 1.5 MHz all the way to 200 MHz.
FS-1 Field Strength Meter **$10.95**



Double-duty in-line wattmeter. Use this meter for output power measurement and troubleshooting, too. Better than 10% full scale accuracy from 2 to 30 MHz, and you can go to 50 MHz with only slightly reduced accuracy. Four scales to 1500 watts and selector for forward or reflected power.
WM1500 In-Line Wattmeter . . **$74.95**



Put your frequency up in lights. Perfect tuning and matching don't mean a thing if you're not on frequency. This counter tells the story on big, bright 5-digit LED display. Reads to ±100 Hz or ±1 KHz between 5 KHz and 40 MHz. Signal levels to 50 millivolts so you can use as a test meter, too. **FC-76 Frequency Counter** **$169.95**

Swan products available at:

ABC COMMUNICATIONS

EVERETT, WA
6920 Evergreen Way,
353-6616

SEATTLE, WA
17550 15th NE
364-8300

BELLEVUE, WA
12001 NE 12th St.
Briarwood Center
455-0224

28th Annual Armed Forces Day Communications Tests

This years observance of Armed Forces Day marks the 28th anniversary of an annual event reflecting the long-standing good relations between the amateur radio fraternity and our military radio stations.

As in years past, events scheduled for Saturday, May 14th emphasize the continuing climate of mutual assistance and warm esteem.

A featured highlight of Armed Forces Day 1977 will be the traditional military-to-amateur communications tests.

These tests give amateur operators their yearly opportunity to demonstrate their technical skills and receive proper recognition for their expertise.

The proceedings include crossband operations in continuous wave (c.w.), voice (s.s.b.), radioteletypewriter (RTTY) and slow scan television (SSTV).

QSL cards will be awarded to amateurs achieving a verified two-way contact with any of the participating military stations. It will not be necessary to send a QSL card to the military station contacted.

Certificates will be sent to those amateurs who receive and accurately copy the Armed Forces Day message from the Secretary of Defense, as transmitted in both c.w. and RTTY.

Interception by short wave listeners (s.w.l.) is not acknowledged by QSL cards. However, anyone with the required equipment and ability can qualify for a certificate by copying the Secretary's message.

The 1977 Armed Forces Day slogan is "PEACE THROUGH READINESS," with the emphasis on the vital role our armed forces play in the defense and preservation of our great nation.

This responsibility has always been shared by the amateur radio community, ever ready to devote their time, effort and skill toward a beneficial working relationship with the U.S. military communications community.

The military-to-amateur crossband operations will be conducted from 21/1300 UCT to 22/0245 UCT. Military stations NPL, NMH, NAM, NPG, WAR and AIR will transmit on military frequencies, and listen for amateur stations transmitting in those portions of the amateur band indicated below. The operators at the military stations will specify that portion of the amateur sub-band they are listening.

Station	Military Frequency (kHz unless otherwise noted)	Emission	Appropriate Amateur Band in (MHz)
NPL, Naval Communications Station San Diego CA	14.389 (1500Z-2100Z)	SSTV	14.225-14.250
	7.370 (1500Z-2100Z)		7.16-7.19
NMH, Coast Guard Radio Station, Alexandria VA	14.470	SSTV	14.225-14.250
	7.346.5		7.16-7.19
WAR (Army Radio Washington DC)	4001.5	c.w.	3.5-3.75
	4020	l.s.b.	3.775-4.0
	4030	RTTY	3.65-3.775
	6997.5	c.w.	7.0-7.15
	14405	c.w.	14.0-14.2
	20994	u.s.b.	21.25-21.45
NAM (Naval Communications Station Norfolk VA)	3385	c.w.	3.5-3.75
	4040	l.s.b.	3.775-4.0
	6970	l.s.b.	7.15-7.3
	7301	c.w.	7.0-7.05
	14385	u.s.b.	14.2-14.35
	14400	c.w.	14.0-14.1
NPG (Naval Communications Station San Francisco CA)	4001.5	l.s.b.	3.775-4.0
	4005	c.w.	3.5-3.65
	4010	c.w.	3.65-3.75
	6989	c.w.	7.0-7.075
	7301.5	l.s.b.	7.15-7.3
	7347.5	RTTY	7.0-7.1
	7365	c.w.	7.075-7.150
	13922.5	RTTY	14.0-14.15
	14356	u.s.b.	14.2-14.275
	14375	c.w.	14.0-14.1
	14389	u.s.b.	14.275-14.35
	20983	c.w.	21.0-21.2
	20998.5	u.s.b.	21.27-21.4
	*49.995 MHz	a.m./u.s.b./c.w.	50.0-51.0
	*143.995 MHz	a.m./u.s.b./c.w.	144.0-146.0
	**148.40 MHz	f.m./RTTY	146-148
	**148.95 MHz	f.m./RTTY	146.0-148.0
	*222.0 MHz	a.m./u.s.b./c.w.	221.0-222.5

*To be operated from Mt. Vaca
**To be operated from Mt. Diablo

Manufactured & Guaranteed by
MOR-GAIN
2200C South 4th Street
Leavenworth, Kansas 66048
a/c 913-682-3142

MOR-GAIN

BANKAMERICARD
MASTER CHARGE
are available.

Fully Air Tested – Thousands Already in Use

EXCLUSIVE 66 FOOT, 75 THRU 10 METER DIPOLES

=16 40% Copper Weld wire annealed to it handles like soft Copper wire – Rated for better than full legal power AM/CW or SSB-Coaxial or Balanced 50 to 75 ohm feedline – VSWR under 1.5 to 1 at most heights – Stainless Steel hardware – Drop Proof Insulators – Terrific Performance – No coils or traps to break down or change under weather conditions – Completely Assembled ready to put up – Guaranteed 1 year – ONE DESIGN DOES IT ALL.

NOTES
1. Models prefaced '**' will be available 1/77.
2. All models above are furnished with crimp/solder lugs.
3. All models can be furnished with a SO-239 female coaxial connector at additional cost. The SO-239 mates with the standard PL-259 male coaxial cable connector. To order this factory installed option, add the letter 'A' after the model number. Example: 40-20 HD/A.
4. 75 meter models are factory tuned to resonate at 3950 kHz. (SP) models are factory tuned to resonate at 3800 kHz. 80 meter models are factory tuned to resonate at 3650 kHz. See VSWR curves for other resonance data.

MODEL	BANDS (Meters)	PRICE	WEIGHT (Oz/Kg)	LENGTH (Ft/Mtrs)
40-20 HD	40/20	$49.50	26/.73	36/10.9
**40-10 HD	40/20/15/10	59.50	36/1.01	36/10.9
80-40 HD	80/40 + 15	57.50	41/1.15	69/21.0
75-40 HD	75/40	55.00	40/1.12	66/20.1
75-40 HD (SP)	75/40	57.50	40/1.12	66/20.1
75-20 HD	75/40/20	66.50	44/1.23	66/20.1
75-20 HD (SP)	75/40/20	66.50	44/1.23	66/20.1
75-10 HD	75/40/20/15/10	74.50	48/1.34	66/20.1
75-10 HD (SP)	75/40/20/15/10	74.50	48/1.34	66/20.1
**80-10 HD	80/40/20/15/10	76.50	50/1.40	69/21.0

**NO TRAPS—NO COILS—
NO STUBS—NO CAPACITORS**

MOR-GAIN HD DIPOLES . . . • One half the length of conventional half-wave dipoles. • Multi-band, Multi-frequency. • Maximum efficiency – no traps, loading coils, or stubs. • Fully assembled and pre-tuned – no measuring, no cutting. • All weather rated – 1 KW AM, 2.5 KW CW or PEP SSB. • Proven performance – more than 15,000 have been delivered. • Permit use of the full capabilities of today's 5-band xcvrs. • One feedline for operation on all bands. • Lowest cost/benefit antenna on the market today. • Fast QSY – no feedline switching. • Highest performance for the Novice as well as the Extra-Class Op.

(WRITE OR PHONE FOR FULL INFORMATION OR CONTACT YOUR FAVORITE DEALER)

AIR (Air Force	4025	l.s.b.	3.775-4.0
Radio	7305	l.s.b.	7.15-7.3
Washington, D.C.)	7315	c.w.	7.0-7.3
	14397	u.s.b.	14.2-14.35

C.w. Receiving Test

The "c.w." receiving test will be conducted at 25 words per minute for any person capable of copying International Morse Code. The "c.w." broadcast will be a special Armed Forces Day message from the Secretary of Defense to all participants. A ten minute CQ call for tuning purposes will begin at 22/0300 GMT. The Secretary of Defense message will be transmitted precisely at 22/0310 GMT from the following stations on frequencies listed.

Transmitting Station	Frequencies (kHz unless otherwise indicated)
WAR—Army	4030, 6997.5, 14405
NAM—Navy	3385, 7301, 14400
NPG—Navy	4005, 6989, 14375, 49.995, 143.995 MHz
AIR—Air Force	7315

RTTY Receiving Test

The radioteletypewriter "RTTY" receiving test will be transmitted at 60 words per minute. A ten minute CQ call for tuning purposes will begin at 22/0335 GMT. The special Armed Forces Day message from the Secretary of Defense will be transmitted at 22/0345 GMT. This test is to exercise the technical skill in aligning and adjusting of equipment by the operator, and serves to demonstrate the growing number of amateurs becoming skilled in this method of rapid communications. Transmission will be from the following stations on frequencies listed.

Transmitting Station	Frequencies (kHz unless otherwise indicated)
WAR—Army	4030, 6697.5, 14405
NPG—Navy	4010, 7347.5, 13922.5, 148.410 MHz
AIR—Air Force	7315

Submission Of Test Entries

Transcriptions should be submitted "as received." No attempt should be made to correct possible transmission errors.

Time, frequency and call sign of the station copied as well as the name, call sign (if any) and address, including zip code of the individual submitting the entry must be indicated on the page containing the test. Each year a large number of acceptable copies are received with insufficient information or the necessary information is attached to the transcription and was separated, thereby precluding the issuance of a certificate.

Entries should be postmarked no later than May 25, 1977 and submitted to the respective service copied.

Stations copying NAM and NPG should send their entries to:

Armed Forces Day Test
Chief, Navy-Marine Corps MARS
Building 17
8th St. & So. Courthouse Rd.,
Arlington, VA 22204

Stations copying WAR should send their entries to:

Armed Forces Day Test
Commander, United States Army
Communications Command
ATTN: CC-OPS-OM
Fort Huachuca, AZ 85613

Stations copying AIR should send their entries to:

Armed Forces Day Test
Air Force Communications
Service/DOYF
Richard Gebaur Air Force Base
Missouri 64030

CQ's Ham Shop is a good source of antique and hard to get items. It's a free service for CQ subscribers. Why not start collecting now?

This month Ade Weiss not only reviews the Heath HW-8 but also answers many of the questions you have sent in concerning this QRP transceiver.

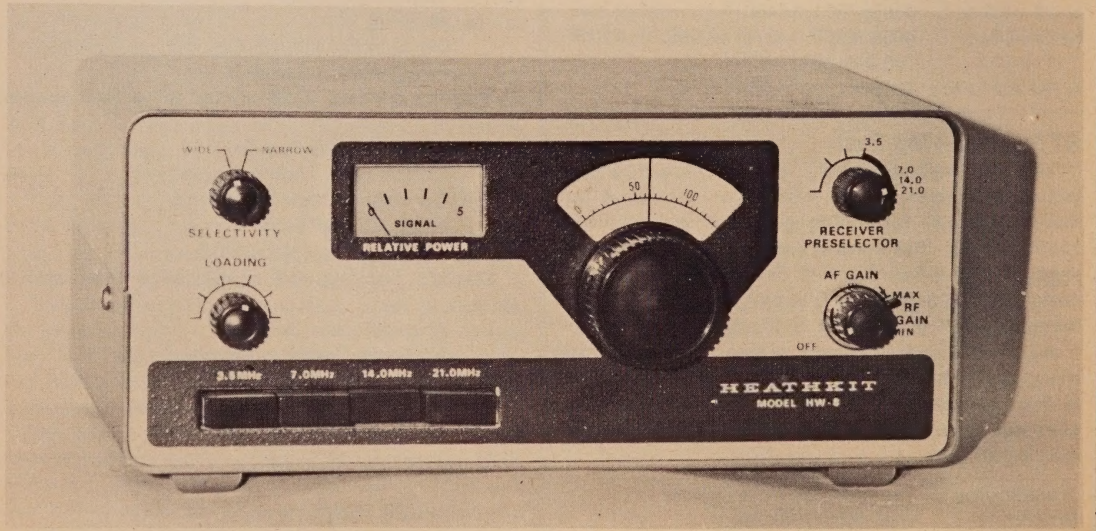
CQ Reviews: The Heath HW-8 QRPp Transceiver

BY ADRIAN WEISS*, K8EEG/0

QRPp has become an established facet of amateur radio for many reasons—the challenge of low power operation, portability, compactness, operability under any conditions—and its ranks represent a small but significant part of the amateur market. Until less than a decade ago, QRPp'rs had to homebrew their rigs because of a lack of commercial QRPp gear. Since then, the successes of the Argonaut (over 2000 in use today) and the HW-7 have demonstrated the existence of a QRPp market, as well as drawing thousands of non-homebrewers into QRPp.

Heath's initial entry into the QRPp market with the HW-7 was welcome, despite the fact that this transceiver was limited to operation on three bands and was beset with many significant problems, such as susceptibility to cross-modulation and a.c. hum, microphonics, lack of selectivity, touchy preselector tuning, and so forth. Even though the HW-7 contributed to the popularization of QRPp, it had a negative impact of associating QRPp with

*83 Suburban Estates, Vermillion, SD 57069



Front view of the HW-8. Concentric a.f. gain and r.f. gain knobs have a tendency to "stick" unless the plastic edge of the small a.f. gain knob is trimmed away, and lubricated with #20 oil or similar. The front panel and top/bottom shells are attached to the main inner box for a very sturdy mechanical unit. The pushbutton bandswitch adds to the ease of operation.

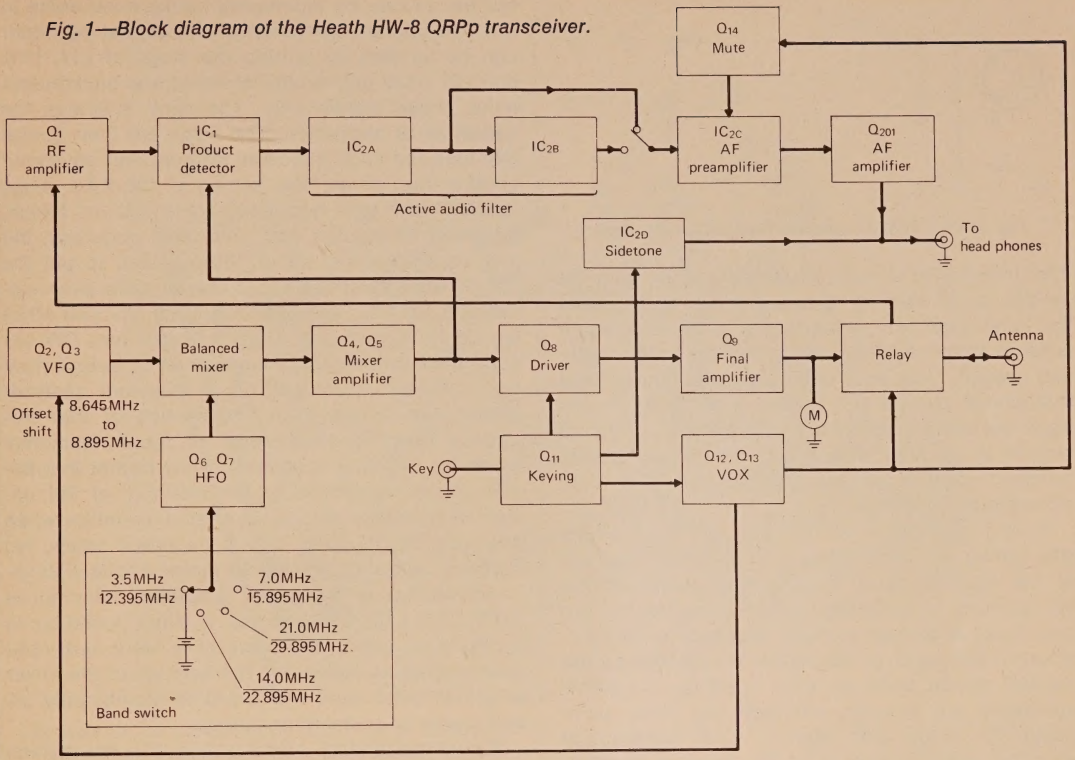


Fig. 1—Block diagram of the Heath HW-8 QRPp transceiver.

sub-standard equipment. Hence I approached this review with some scepticism—could the HW-8 be that much better than the HW-7? Now I am gratified to say, that, *YES,* it is that much better! The HW-8 is not merely a modified version of the HW-7; it is a totally new design that will fulfill the need for an effective low-power transceiver of moderate cost for years to come.

I was impressed with the HW-8 from the moment that I first glanced at the schematic. Now, after assembling the kit and operating it for about two months, I am even more impressed with it than at first. In a word, the HW-8 is fantastic! It represents a "no short-cuts, no holds barred" effort to design and produce a truly effective transceiver that is worthy of Heath's long-established reputation as a leader in the amateur equipment field. Outstanding features include a heterodyne v.f.o. system, a simple, but clean transmitter circuit, and most important, a direct conversion receiver which exhibits remarkable sensitivity and good selectivity, and which, in my opinion, achieves the maximum potential of the simple direct conversion technique. Fig. 1 shows the HW-8 block diagram for reference in the following discussion.

Heterodyne V.F.O.

The v.f.o. (Q2) is a Hartley oscillator with emitter follower (Q3) which produces an output in the 8645-8895 kHz frequency range. An excellent stability figure is achieved through the use of 7 temperature compensating capacitors in the oscillator tuned circuit. Initial warm-up drift is minimal, and the unit stabilizes within a few minutes. The application of drive voltage from the keying line to a 5pf/switching diode shunted between Q2 emitter and ground during transmit periods produces a transmit frequency offset of about −750 Hz, which places the transmitted signal nearly at zerobeat with a received signal that is centered in the 750 Hz audio filter. The operator must approach a received signal from the upper side in order to observe the proper transmit-receive frequency relationship. While no RIT (receiver incremental tuning) is included in the HW-8 circuit, its addition should be a simple matter.

Output from the v.f.o. is coupled to a passive balanced mixer through a toroidal transformer at the emitter of Q3 and mixed with outputs from the heterodyne crystal oscillator (Q6, Q7) at 12,395 kHz, 15,895 kHz, 22,895 kHz, and 29,895 kHz, in order to produce outputs to the receiver and transmitter in the 80-15 meter bands respectively. The proper signal from the v.f.o./h.f.o. mixer is selected and amplified by the mixer amplifier (Q4) and capacitively coupled to the base of Q5, a buffer stage.

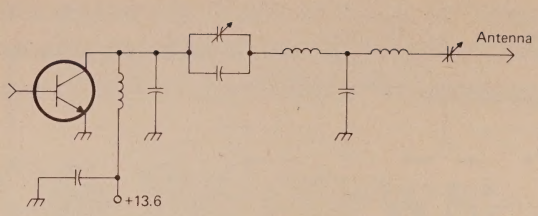


Fig. 2—The HW-8 final amplifier output network.

The drive signal to the transmitter is taken from the emitter of Q5 through a coupling capacitor, while the local oscillator signal to the product detector is taken from a voltage divider between Q5 emitter and ground. Very light interstage coupling is used throughout, so that very little, if any, "pull" results from the adjustment of various stages. All tuned circuits in the h.f.o. and mixer amplifier are diode-switched with a single B+ voltage that runs throughout the circuit.

Tuning and alignment of the oscillator circuits was simple and undertaken initially without the use of test equipment. All circuits functioned with the inductances adjusted as delivered by Heath. The only tricky alignment problem was putting the v.f.o. where it belonged on 40 meters (suggested by the manual as the band for v.f.o. spotting and bandspreading adjustments, although any other band could be used), and aligning v.f.o. bandspread with the precalibrated dial. The process involves alternately adjusting L9 (v.f.o. inductance) and C302B (main tuning capacitor trimmer) to achieve proper bandspread and correspondence with dial calibration. Because the output from the frequency generating system is a *difference* rather than *summed* product, the v.f.o. tunes "in reverse," *i.e.*, maximum capacitance of C302 produces a signal at the high end of the band, rather than at the low end. About 20 minutes was required to adjust for proper bandspread so that the dial was off only about 3 kHz at the upper end. At this point, the sticky slug in L9 made any closer accuracy quite difficult to attain. This is quite decent calibration accuracy across a 250 kHz spread.

Adjustment of the h.f.o. and mixer amplifier requires the use of a v.t.v.m. with r.f. probe. However, nearly-optimum adjustments can be attained without the v.t.v.m. By monitoring background noise in a set of phones, operation of the crystal oscillator can be verified by turning the slugs of L17, L19, and L21 *CCW* until a click is heard and background noise drops significantly. The click indicates the cessation of oscillation. The slugs are then turned *CW* until the click indicates turn-on, and advanced another turn or so. The setting of the h.f.o. slugs "pulls" the crystal frequency about 500 Hz; hence, for exact band-edge dial calibration accuracy, the slug for each band should be adjusted to put the "0" point at zerobeat with a crystal calibration signal at 3.50, 7.0, 14.0, and 21.0 MHz. L17 (3.5 MHz) should be turned only about one-half turn *CW* beyond the turn-on point; observation of output from the h.f.o. at 12,395 kHz on a spectrum analyzer shows that 3rd-5th order harmonics of that frequency jump to within 6dB of the fundamental when the L17 slug is advanced any further into the coil. These contribute to the intensity of the unwanted harmonic outputs from the transmitter when operated on 3.5 MHz, as will be noted below. No problem exists on the 40-15 meter bands though.

	0KHz	100KHz	200KHz
80	0.65V_{rms}	1.18V_{rms}	0.71V_{rms}
40	1.19	1.81	1.40
15	1.13	1.14	1.12
	0KHz	**50KHz**	**100KHz**
20	1.36	1.38	1.35

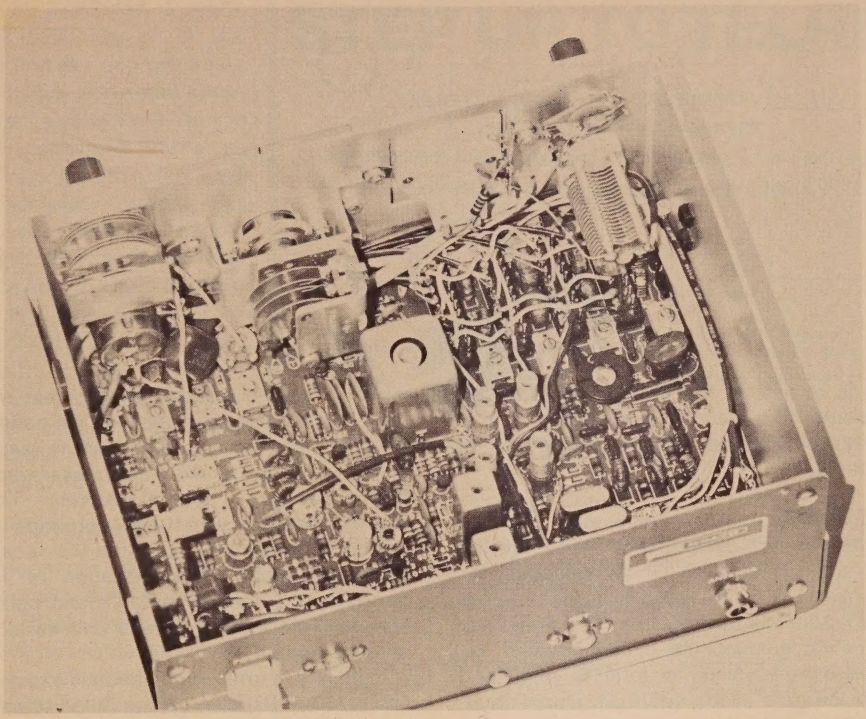
Table I—Outputs from the mixer amplifier.

Adjustment of the mixer amplifier inductances (L13, L14, L15, L16) causes a slight variation in background noise, and these coils were near-optimum setting as delivered. The settings of the mixer amplifier slugs were not found to significantly affect purity of transmitter output.

If a v.t.v.m. and r.f. probe is available, the manual alignment instructions can be followed. A variation in output levels from the h.f.o. at TP1 in the 0.3-0.6Vrms range is normal; my unit showed a range from 0.45Vrms on 80 meters to 0.2Vrms on 15 meters. The actual level does not influence transmitter output level. Outputs from the mixer amplifier measured at TP2 showed considerable variation across the 80 and 40 meter bands, as given in Table I. These variations are reflected in variations in transmitter output, especially across the 80 meter band (about 300mw maximum variation), so, if the operator prefers operation in one section of the band, the mixer amplifier inductance can be peaked at the center of that section of the band for maximum output there.

Transmitter

The driver-final features a straightforward circuit with a MPSA20-2N4427 line-up. The final output networks (shown in fig. 2) were computer designed for the SB-104 and incorporated into the HW-8. Each network is mounted directly on the p.c. board beside its respective pushbutton bandswitch element for zero-lead length, and is mechanically selected. The transmitter is keyed by the application of B+ to the driver stage from the keying switch (Q11). The break-in stage (Q12, Q13) provides drive voltages for the antenna relay, receiver muting, and transmit offset. It includes an adjust-



Top view of the HW-8. Sturdy heavy-gauge aluminum inner chassis enclosure and outer shell and front panel combination can be seen (top shell removed in photo). Front panel controls (L-R): Two section preselector tuning capacitors with a.f.-r.f. gain, dual potentiometer below, main v.f.o. tuning capacitor and sturdy mounting bracket, with Jackson Brothers vernier drive mounted on front panel; relative power meter and sampling circuit; loading capacitor. P.c. board: receiver input tank circuits (toroids/trimmers) left front 3rd; v.f.o. inductance (L9) and circuitry—big shield can in center of board; driver-final-right front 3rd; 4 bandswitch elements with output network toroids/trimmers between them. Product-detector/audio circuits rear left 3rd, with final audio amp on small p.c. board at left rear wall; heterodyne osc/mixer amplifier center rear.

able break-in delay of considerable range so that the HW-8 will serve well in both a contest (rapid QSK) and casual communications situations. This is another instance where Heath resisted the temptation to cut corners at the cost of reduced operational flexibility. Finally, a sidetone oscillator with adjustable volume is keyed directly by the external keyer. The overall operation of the keying system is smooth, although the antenna relay is noisy.

Transmitter outputs are well within acceptable levels of harmonic purity except on the 80 meter band. On each band, cleanest output coincides with maximum transmitter output tuning. When observed on a Tektronix 1401A Spectrum Analyzer and 323 Scope, 7 MHz harmonic products were down a minimum of 44dB from the fundamental; 14 MHz harmonics were a minimum of 34dB down; and 21 MHz harmonics were down a minimum of 36dB. Each of these bands showed very few impurities. 3.5 MHz output was a different case. At best, 3.5 MHz output was rich in harmonics spread out every 4 MHz or so from 26-60 MHz, and from 90-150 MHz. Many were only about 24dB or so below the fundamental with the loading control adjusted for maximum output. The upper range responded markedly to very small adjustments of the loading capacitor C303. Again, careful adjustment of the loading capacitor produced cleanest output with maximum output. A TVI check revealed that 3.5 MHz output could cause noticeable TVI, so it is recommended that a low-pass filter be inserted between HW-8 and antenna if the rig is operated on this band and an antenna tuner is not used. Except for the problem encountered on 3.5 MHz output, HW-8 outputs are very clean.

Transmitter r.f. power outputs were measured as follows (13.4Vcc): 3.5 MHz — 2.0w, 7 MHz — 1.8w, 14 MHz — 1.6w, and 21 MHz — 1.2 watts. These represent quite useable levels with simple antennas. During the test period, stations were readily worked on 40-20-15 meters all over the country with a 14AVS vertical. On 80 meters, the 14AVS was fed through an antenna tuner connected to the coax center conductor and worked against ground, and stations on both coasts were worked with varying degrees of difficulty. The 14AVS represents a mini-

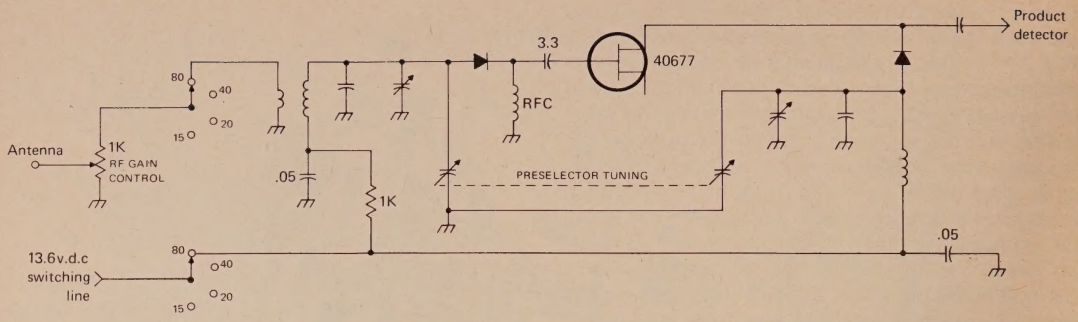


Fig. 3—The basic HW-8 receiver r.f. amplifier circuit.

mal antenna at best in this configuration. Reports and comments from stations contacted on the air consistently indicated that HW-8 keying sounds distinct and clean.

Receiver Circuit

The HW-8's superb performance with respect to sensitivity and immunity to cross-modulation and front-end overload is the double-tuned r.f. amplifier. See fig. 3 for the basic circuit. The signal from the antenna r.f. gain control is link-coupled to a parallel tuned tank which, in turn, is very lightly coupled to the gate of the 40673 r.f. amplifier. B+ to the 40673 drain output is fed through another parallel tuned tank circuit. Both input and output inductances are toroids which are tuned and peaked by individual trimmer capacitors. One section of the preselector tuning capacitor (C301A) is used exclusively to peak the 80 meter input inductance across the band. Input tank circuits are broad enough on the other bands to require no preselector peaking. The other section of the preselector tuning capacitor peaks the r.f. amplifier output tank circuits, which, again are broad on 20 and 15 meters. All eight r.f. amplifier tuned circuits are diode-switched by the B+ line running throughout the circuit for that purpose. Excellent isolation is achieved with this approach.

The balanced product detector uses an MC1469G in a conventional circuit, producing audio output for filtering and amplification by IC2. An LM3900 provides two stages of an active audio filter centered at 750 Hz with a 6 dB bandwidth of 375 Hz in the "narrow" selectivity position. Some gain is realized in the "narrow" position, and the filter exhibits no "ringing". The third section of IC2 is an audio preamplifier stage, while the final section functions as a sidetone oscillator with adjustable volume and an approximately 750 Hz tone. Transmitter zerobeat with an incoming signal can be closely approximated by tuning the signal to zerobeat with the sidetone note. Final audio amplification is provided by an outboard audio stage using an MPSA20 located on a separate p.c. board mounted on the sidewall of the inner cabinet. Far more audio output is available than needed to drive a set of high impedance phones; in fact, it is sufficient to drive a 2 inch 8 ohm speaker when matched through a 1.2K: 8 ohm transformer. The receiver muting transistor switch (Q14) grounds the input to the audio preamplifier to mute the receiver during transmit periods. The cessation of the muting period lags a fraction of a second behind the removal of the muting voltage and switching of the antenna relay.

Immunity to cross-modulation is excellent. A local QRO (250 watts) c.w. station failed to affect the receiver 5 kHz off-frequency, except for his key-clicks. The only difficulty experienced was caused by a local kw s.s.b. station about two blocks away. It was possible to copy him S6 with no antenna whatever on the HW-8. With an antenna connected, however, he caused cross-modulation across the entire 40 meter band. This is no shortcoming of the HW-8, as the same effect was noted on the Argonaut. Sensitivity is excellent. Heath specs claim that an 0-2uv signal provides a readable signal. However, lab tests indicated a slightly lower sensitivity figure, perhaps because of a noisy IC2. On 3.5, 7, and 14 MHz, it was possible to locate a 0.19uv signal, but it was down in the internal noise. On these bands, an 0.3uv signal produced a Q5 completely usable signal in the phones. However, 21 MHz sensitivity was extremely poor, requiring about 10 uv to produce a usable signal. After completely checking all possibilities of malfunction (none existed), the sensitivity was brought up to a usable level by increasing the input link to L4 to 3.5 turns. This is a simple process. The wax in which the toroid is imbedded is removed simply by melting it with the tip of a soldering gun. Then both ends of the original link are carefully desoldered from the two terminals next to the red "dot", and the link is removed. A piece of #28 is then wound to form a 3.5t link, and assembly can proceed. With the new link, a 0.5uv signal could be located, and a luv signal produced a usable signal in the phones.

Only one problem was encountered, and that in-

volved, in all likelihood, a faulty IC2. Upon initial turn-on of the completed unit, an approximately 2 KHz oscillation was noted about 10dB above the noise level. During transmitter alignment, the sidetone volume jumped to a very loud level, and excessive current shut down the current-limited supply being used. The problem was finally traced to the sidetone section of IC2, and cured by connecting a 25mf electrolytic from the IC2, pin 12, end of R73 to ground. Heath notes that this is the first time they've heard of this problem, and it is probably traceable to a faulty IC2.

Receiver Performance

The performance of the HW-8 receiver is outstanding. During the test period, I was continually impressed with its usable sensitivity. I was consistently able to copy DX stations on 80 and 40 meters (with the 14AVS) from many parts of the world, including Europe, Africa, S. America, VK-ZL, and an F08 on 80 meters. An r.f. gain control permits a smooth adjustment of the input signal. However, the concentric a.f. gain and r.f. gain knobs stick unless the edge of the small plastic knob is trimmed away and then lubricated. Preselector tuning is broad and easy to adjust. The two-stage active audio filter, which is similar to the MFJ CWF-3, provides two levels of selectivity, switched from the front panel, and contributes significantly to the effectiveness of the unit.

The main v.f.o. tuning capacitor is driven through a Jackson Brothers vernier for a tuning ratio of 50 KHz per half-turn of the large 1.5 inch knob. While this is rather tight, one easily becomes accustomed to it. Tuning is very smooth with no noticeable "backlash," and has the feel of a "big receiver." Audio output is relatively distortion free almost all the way up.

Assembly

The entire HW-8 circuit, with the exception of the outboard audio amplifier, is located on a single, large p.c. board. It is in the "medium density" class, and presents only a few areas where solder bridges are a danger. The excellent instruction manual, along with the silk-screened outline and value of each part on the p.c. board, make the assembly of the HW-8 easily within reach of the beginner. Assembly by this reviewer required about 16.5 hours from opening the box to reception of the first signal. About 17.5 hours produced the completely aligned unit and the first QSO. X-ray blow-ups of the p.c. board aid greatly in troubleshooting any difficulty. Incidentally, the troubleshooting chart provided in the manual is virtually worthless.

Mechanically, the HW-8 is very solid. Cabinetry consists of an internal four-sided frame of heavy-gauge aluminum, and an outer shell as seen in the accompanying photo. It should withstand brutal treatment without any ill-effects, which makes the HW-8 very well suited for rough usage in mountain climbing, backpacking, shooting rapids, and so forth. The Relative Power Meter is very helpful in tuning, although it would be more valuable if wired as an in-line output power meter through the addition of a Bruene type bridge.

Conclusion

The HW-8 is the simple QRPp transceiver "come of age." It would be very difficult for the homebrewer to produce an equivalent transceiver at the price of the HW-8 kit. With the appearance of the HW-8, QRPp'rs have a choice of two excellent commercial units in two price ranges—the Argonaut at

(Continued on page 80)

STEP UP TO TELREX

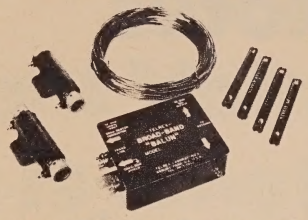
WITH A

TELREX "BALUN" FED—"INVERTED-VEE" KIT

THE IDEAL HI-PERFORMANCE

INEXPENSIVE AND PRACTICAL TO INSTALL LOW-FREQUENCY

MONO OR MULTIPLE BAND, 52 OHM ANTENNA SYSTEM



Telrex "Monarch" (Trapped) I.V. Kit
Duo-Band / 4 KWP I.V. Kit $62.50
Post Paid Continental U.S.

Optimum, full-size doublet performance, independent of ground conditions!
"Balanced-Pattern", low radiation angle, high signal to noise, and signal to interference ratio!
Minimal support costs, (existing tower, house, tree).
A technician can resonate a Telrex "Inverted-Vee" to frequency within the hour!
Minimal S/W/R is possible if installed and resonated to frequency as directed!
Pattern primarily low-angle, Omni-directional, approx. 6 DB null at ends!
Costly, lossy, antenna tuners not required!
Complete simplified installation and resonating to frequency instructions supplied with each kit.

For technical data and prices on complete Telrex line, write for Catalog PL 7

COMMUNICATION SYSTEMS SINCE 1921 **telrex** Laboratories
ASBURY PARK, NEW JERSEY 07712 U.S.A.

a monthly feature by

IRWIN MATH, WA2NDM

Math's Notes

A look at the technical side of things

Back in November, December and January of 1974 we did a series on the operation and application of Operational Amplifiers. Since that time we have gotten a steady stream of requests for additional circuits to use with these versatile devices. As a result, this month we are presenting several applications that we hope will answer a good deal of the requests as well as offer new "building blocks" for the many experimenters reading this column. All circuits use the industry standard 741 available from Motorola as the MC1741, Fairchild as uA741, National Semiconductor as the LM741, etc. Most circuits will also work with almost any other several purpose operational amplifier.

Fig. 1 is a solution to the most common question we have received, "how do I boost the output from my op-amp?" Since the output of most operational amplifiers is only a few milliamperes, driving high current loads is not possible with the amplifier alone. In the schematic, a PNP and NPN complimentary pair of transistors, and a few parts, have been added to the basic op-amp circuit as a Class B type amplifier. With zero output from the op-amp, both diodes in the base circuits of the transistors are forward biased and the transistors are slightly conducting. When the output goes positive, the PNP transistor cuts off and the diode in the base circuit of the NPN is reverse biased. This causes current flowing through the 10K resistor to flow into the base of the NPN and it conducts. Similarly, when the output goes negative, the same situation occurs in the PNP circuit. By proper choice of output transistors and the valve of the 10K resistors, almost any output current can be produced. Remember however, maximum potential output current will be equal to the Hfe of the output transistor multiplied by the maximum possible current that can flow through the 10K resistor. For very high output currents, a complementary darlington output transistor pair such as the Motorola MJ3001/MJ-2501 series should be used.

*5 Melville Lane, Great Neck, NY 11020.

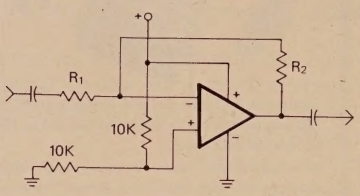


Fig. 2—Operation of an Op-Amp on a single supply. The two 10K resistors set the operating point at half the supply voltage while the two capacitors isolate the d.c. voltages from input and output.

Another very common question we have gotten is how to operate an op-amp with a single polarity power supply. Since the op-amp is basically a d.c. device, the internal circuitry has been designed to operate from positive and negative polarity supplies in order to properly handle positive and negative d.c. signals. If you must use a single supply with a d.c. application, then I would suggest the use of one of the new current differencing amplifiers such as the National LM3900 and Motorola MC3301 series. These devices are especially made to be used with only a single polarity supply while still retaining many of the features of split-supply units. If your application is an a.c. one however, then the circuit of fig. 2 will be useful to you. Here, the reference input is connected to a resistance divider which places it at one-half the supply. Therefore, with zero input, the output d.c. level is ½ the supply level. By using coupling capacitors how-

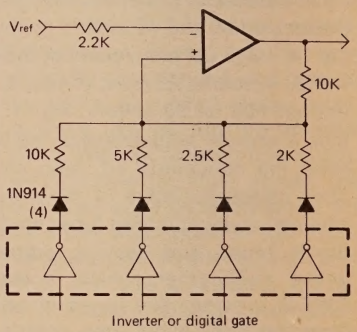


Fig. 3—A digital to analog converter. The above is a simple D/A converter that will give a very good account of itself if high precision resistors are used. See text for details.

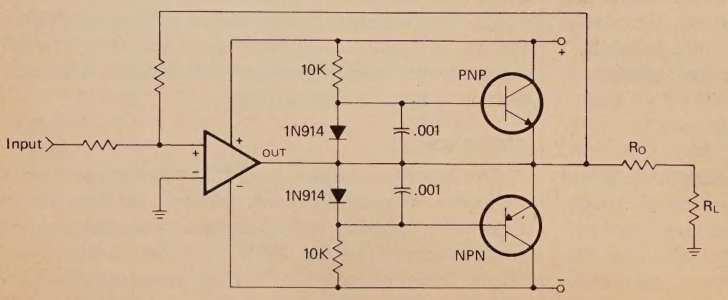


Fig. 1—A power output stage for use with an Op Amp. Note that the feedback resistor is returned to the final output point for the best stability and linearity. Also, R_o is added to protect the transistors from an output short circuit.

(Continued on page 72)

fil·a·ment (fil′ə-mənt), *n.* [Fr.; LL. *filamentum* < *filare*, to spin < L. *filum;* see FILE (container)], 1. a very slender thread or fiber. 2. a threadlike part; specifically, the fine metal wire in a light bulb or vacuum tube, which becomes incandescent when heated by an electric current. 3. in *botany*, the stalk of a stamen bearing the anther.

Filament Voltage: Why It Is What It Is

BY WILLIAM I. ORR*, W6SAI

Vacuum tube standardization got its real start with the entrance of the United States into World War I. Tube replacement, quantity production and interchangeability were the requisites and knotty problems existed: bases were far from standard, and various values of filament voltages were in use among the early tube manufacturers.

In 1916 the U.S. Navy standardized on a four contact base used by DeForest audions. Three pins were on the bottom, and a bayonet pin was used for the fourth contact (a filament connection). By 1917 the four pin base was originated by the Western Electric Co. and adapted by the Signal Corps. The early VT-1 used a rolled metal shell with a composition insert for this design. The small transmitting tubes had a base variation: the position of the bayonet pin was rotated 40 degrees so that transmitting and receiving tubes could only be inserted in their proper sockets.

Following the formation of the Radio Corporation of America in 1919, vacuum tubes became available for general use and a variation of the Signal Corps tube base was used employing a brass shell with a porcelain insert. This base was modified in 1924 to a moulded bakelite base having four brass pins, plus a bayonet pin in the side.

The early RCA base made a bottom contact to the pin which gave trouble from time to time and in 1924 a side contact arrangement was approved, taken from a European design. The Westinghouse WD-11 base was an offspring of this idea. A new, standardized four prong base, utilizing longer pins was introduced at the same time and this became the industry standard, the bayonet pin being dropped a few years later when the radio equipment requiring it became obsolete.

The WD-11 base style and others of this period gradually faded into obscurity, leaving the four pin base as the "grandfather" of the soon-to-be-developed multi-pin bases.

*48 Campbell Lane, Menlo Park, CA 94025

Filament Voltages

Early deForest audions required filament voltages in the range between 4 and 15. A uniform filament voltage was not utilized in these early tubes as filament temperature was controlled by means of filament voltage control to regulate sensitivity or amplification.

Prior to World War I, the U.S. Navy was using 5 volt Edison cells for radio work and established a maximum upper limit of 4.5 volts for their tubes. The most popular tubes used during the War period were the CG-886 (4 volts at 0.75 amps), the CW-933 (2.4 volts at 1.1 amps), the SE-1444 (3.65 volts at 0.65 amp) and the CG-890 (3.6 volts at 1.1 amps).

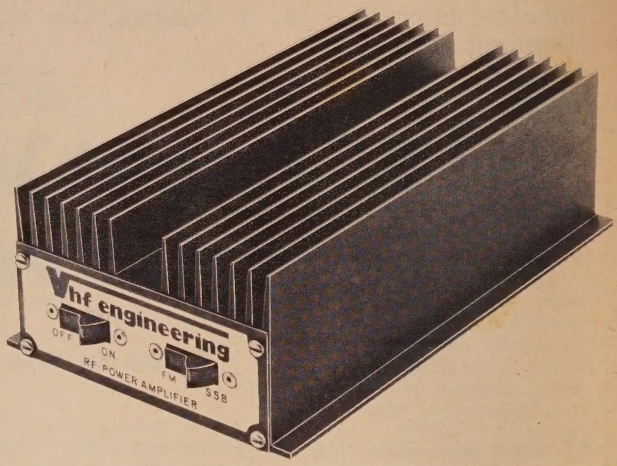
Early in the War the U.S. Signal Corps chose a two-cell lead storage battery for general use which provided a terminal voltage between 4.2 and 3.6. Allowing for voltage drop in power leads, the Signal Corps standardized on an average voltage of 3.6. The most widely used tube during this period was the VT-11 (3.6 volts), followed by the VT-1. The latter tube had a filament voltage of 2.4, the remainder of the voltage being absorbed by a series resistance.

With the formation of RCA, it was decided that the 6 volt storage battery operation was preferred for widely distributed tubes and a filament voltage of 5 was adopted, allowing the extra voltage for circuit loss and adjustment.

(Continued on page 80)

The BLUE LINE IS HERE!

Don't sacrifice maximum power output and high efficiency for linearazation. The BLUE LINE offers you the best of both designs. The BLUE LINE amplifiers are engineered using the latest state of the art stripline technology. This design technology means efficient broad band output with a very high degree of mechanical stability.



vhf engineering is the only name you have to remember when it comes to VHF or UHF amplifiers, just look at the variety available.

MODEL	FREQUENCY	EMISSION	POWER INPUT	POWER OUTPUT	WIRED AND TESTED PRICE
BLB 3/150	45- 55MHz	CW-FM-SSB/AM	3W	150W	TBA
BLC 10/70	140-160MHz	CW-FM-SSB/AM	10W	70W	139.95
BLC 2/70	140-160MHz	CW-FM-SSB/AM	2W	70W	159.95
BLC 10/150	140-160MHz	CW-FM-SSB/AM	10W	150W	259.95
BLC 30/150	140-160MHz	CW-FM-SSB/AM	30W	150W	239.95
BLD 2/60	220-230MHz	CW-FM-SSB/AM	2W	60W	159.95
BLD 10/60	220-230MHz	CW-FM-SSB/AM	10W	60W	139.95
BLD 10/120	220-230MHz	CW-FM-SSB/AM	10W	120W	259.95
BLE 10/40	420-470MHz	CW-FM-SSB/AM	10W	40W	139.95
BLE 2/40	420-470MHz	CW-FM-SSB/AM	2W	40W	159.95
BLE 30/80	420-470	CW-FM-SSB/AM	30W	80W	259.95
BLE 10/80	420-470	CW-FM-SSB/AM	10W	80W	289.95

Don't forget our popular PA-2501 and PA-4010 at $74.95 (wired and tested) $59.95 (Kit)

FEATURES

- High efficiency means low current drain.
- Broad band design (no tuning).
- Direct 12 volt DC operation.
- Indicator lamps for On/Off and FM/SSB.
- Relay switching (allows you to put amplifier in or out of circuit at the flip of a switch).
- Insertion loss of less than 1 dB.
- One year limited warranty on parts and labor.

Export prices slightly higher. Prices subject to change.

AVAILABLE AT THESE DEALERS:

CALIFORNIA
C & A Electronic Enterprises, Carson, CA
CDS Electronics & Hobbies, Merced, CA
Electronic Enterprises, Rio Linda, CA
SON Electric, Fresno, CA
Sequoia Stereo, Inc., Eureka, CA
Tele-Com Electronics, San Jose, CA
Westcom, San Marcos, CA
ZacKit Corporation, Vallejo, CA

COLORADO
Listening Post & Electromagnetics, Durango, CO
Communication Specialties, Aurora, CO

FLORIDA
Amateur Wholesale Elec's., Miami, FL
West Indies Sales Co., Ltd., Miami FL

ILLINOIS
Klaus Radio, Inc., Peoria, IL
Spectronics, Inc., Oak Park, IL

INDIANA
Aptron Lab, Bloomington, IN
Lectracom, Inc., Bourbon, IN

IOWA
Bob Smith Electronics, Fort Dodge, IA
Quad City Ham & C.B. Sales, Davenport, IA

KENTUCKY
Cohoon Amateur Supply, Trenton, KT

LOUISIANA
Frank L. Beier Radio, Inc., New Orleans, LA

MASSACHUSETTS
Tufts Radio Electronics, Medford, MA

MICHIGAN
Harry G. Crofts, Northville, MI
Adams Distributing Co., Detroit, MI
Radio Supply & Engineering, Detroit, MI

MISSISSIPPI
Communications Services, Philadelphia, MS

MISSOURI
Alpha Electronic Labs, Columbia, MO

NEVADA
Vegas Radio, Las Vegas, NV

NEW YORK
Airex Communications Corp., Freeport, NY
Barry Electronics, New York, NY
CFP Enterprises, Horseheads, NY
Delmar Electronics, W. Babylon, L.I., NY
Loffler Electronics, Ogdensburg, NY
VHF Communications, Jamestown, NY

NORTH CAROLINA
Vickers Electronics, Durham, NC

OKLAHOMA
Derrick Electronics, Inc., Broken Arrow, OK
Radio Store, Inc., Oklahoma City, OK

SOUTH DAKOTA
Burghardt Amateur Center, Watertown, SD

TEXAS
AGL Electronics, Dallas TX
Teco Electronics, Garland, TX
Signal Engineering, Houston, TX

VIRGINIA
Radio Communications Co., Roanoke, VA

WASHINGTON
A-B-C Communications, Seattle, WA

WEST VIRGINIA
Communication Systems Co., Ripley, WV

WISCONSIN
Amateur Electronic Supply, Milwaukee, WI
Communications Elec's., Fond du Lac, WI

CANADA
Bytown Marine Limited, Ottawa, Canada K2H 7V1
Traeger Distributors Ltd., Richmond, B.C. V7J1K4

PUERTO RICO
Edison Electronics, Inc., Santurce, PR

EXPORT
COSYSCO, Inc., Sodus, NY

In other areas contact VHF Engineering direct. Allow 6 to 8 weeks for delivery.

WE HONOR master charge THE INTERBANK CARD

vhf engineering

DIVISION OF BROWNIAN ELECTRONICS CORP.

320 WATER STREET • BINGHAMTON, N.Y. 13901 • 607-723-9574

BANKAMERICARD

Vhf engineering

THE WORLD'S MOST COMPLETE LINE OF VHF-FM KITS AND EQUIPMENT

RECEIVERS



RX28C	28-35 MHz FM receiver with 2 pole 10.7 MHz crystal filter	59.95
RX50C Kit	30-60 MHz rcvr w/2 pole 10.7 MHz crystal filter	59.95
RX144C Kit	140-170 MHz rcvr w/2 pole 10.7 MHz crystal filter	69.95
RX144C W/T.	same as above – factory wired and tested	114.95
RX220C Kit	210-240 MHz rcvr w/2 pole 10.7 MHz crystal filter	69.95
RX220C W/T	same as above – factory wired and tested	114.95
RX432C Kit	432 MHz rcvr w/2 pole 10.7 MHz crystal filter	79.95
RXCF	accessory filter for above receiver kits gives 70 dB adjacent channel rejection	8.50

RF28 Kit	10 meter RF front end 10.7 MHz output	12.50
RF50 Kit	6 meter RF front end 10.7 MHz output	12.50
RF144D Kit	2 meter RF front end 10.7 MHz output	17.50
RF220D Kit	220 MHz RF front end 10.7 MHz output	17.50
RF432 Kit	432 MHz RF front end 10.7 MHz output	27.50
IF 10.7F Kit	10.7 MHz IF module includes 2 pole crystal filter	27.50
FM455 Kit	455 KHz IF stage plus FM detector	17.50
AS2 Kit	audio and squelch board	15.00

TRANSMITTERS



TX144B Kit	transmitter exciter – 1 watt – 2 meters	$ 29.95
TX144B W/T.	same as above – factory wired and tested	49.95
TX220B Kit	transmitter exciter – 1 watt – 220 MHz	29.95
TX220B W/T.	same as above – factory wired and tested	49.95

TX432B Kit.	transmitter exciter 432 MHz	39.95
TX432B W/T	same as above - factory wired and tested	59.95
TX150 Kit	300 milliwatt, complete 2 meter transmitter, less crystal and mike	19.95

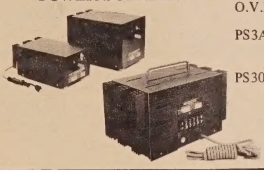
POWER AMPLIFIERS



PA2501H Kit	2 meter power amp – kit 1 w in – 25w out with solid state switching, case, connectors	59.95
PA2501H W/T	same as above – factory wired and tested	74.95
PA4010H Kit	2 meter power amp – 10w in – 40w out – relay switching	59.95
PA4010H W/T	same as above – factory wired and tested	74.95
PA144/15 Kit	2 meter power amp – 1w in – 15w out – less case, connectors and switching	39.95

PA144/25 Kit	similar to PA144/15 kit except 25w out	49.95
PA220/15 Kit	similar to PA144/15 for 220 MHz	39.95
PA432/10 Kit	power amp – similar to PA144/15 except 10w and 432 MHz	49.95
PA140/10	10w in – 140w out – 2 meter amp – factory wired and tested	179.95
PA140/30	30w in – 140w out – 2 meter amp – factory wired and tested	159.95

POWER SUPPLIES



PS15C Kit	15 amp – 12 volt regulated power supply w/case, w/fold-back current limiting and overvoltage protection	79.95
PS15C W/T	same as above – factory wired and tested	94.95
PS25C Kit	25 amp – 12 volt regulated power supply w/case, w/fold-back current limiting and overvoltage protection	129.95
PS25C W/T	same as above – factory wired and tested	149.95

O.V.P.	adds over voltage protection to your power supplies, 15 VDC max	9.95
PS3A Kit	12 volt – power supply regulator card with fold back current limiting	8.95
PS3012	new commercial duty 30 amp 12 VDC regulated power supply w/case, w/foldback current limiting and over voltage protection, wired and tested	239.95

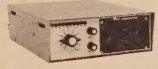
REPEATERS



RPT28 Kit	repeater – 10 meter	TBA
RPT28	repeater – 10 meter, wired & tested	TBA
RPT50 Kit	repeater – 6 meter	TBA
RPT50	repeater – 6 meter, wired & tested	TBA
RPT144 Kit	repeater – 2 meter – 15w – complete (less crystals)	465.95
RPT220 Kit	repeater – 220 MHz – 15w – complete (less crystals)	465.95
RPT432 Kit	repeater – 10 watt – 432 MHz (less crystals)	515.95

RPT144	repeater – 15 watt – 2 meter – factory wired and tested	695.95
RPT220	repeater – 15 watt – 220 MHz – factory wired and tested	695.95
RPT432	repeater – 10 watt – 432 MHz – factory wired and tested	749.95
DPLX144	2 meter, 600 KHz spaced duplexer, wired and tuned to frequency	399.95
DPLX220	220 MHz duplexer, wired and tuned to frequency	399.95

TRANSCEIVERS



TRX 144 Kit	case and all components to build 15 watt 10 channel scanning 2 meter transceiver (less mike and crystals)	219.95
TRX 220 Kit	same as above except for 220 MHz	219.95
TRX 432 Kit	same as above except 10 watt and 432MHz	254.95

SYNTHESIZERS



SYN II Kit	2 meter synthesizer, transmit offsets programmable from 100 KHz - 10 MHz, (Mars offsets with optional adapters)	169.95
SYN II	same as above, wired and tested	239.95

WALKIE TALKIES



HT 144B Kit.	2 meter, 2w, 4 channel, hand held receiver with crystals for 146.52 simplex	129.95
NICAD	battery pack, 12 VDC, ½ amp	29.95
NICAD	battery charger	5.95
Rubber Duck	2 meter, with male BNC connector	8.95

OTHER PRODUCTS BY VHF ENGINEERING

CD1 Kit	10 channel receive xtal deck w/ diode switching	6.95
CD2 Kit	10 channel xmit deck w/switch and trimmers	14.95
CD-3 Kit	UHF version of CD-1 deck, needed for 432 multi-channel operations	12.95
COR2 Kit	complete COR with 3 second and 3 minute timers	19.95
SC3 Kit	10 channel auto-scan adapter for RX with priority.	19.95
Crystals	we stock most repeater and simplex pairs from 146.0-147.0 (each)	5.00
CWID Kit	159 bit, field programmable, code identifier with built-in squelch tail and ID timers	39.95
CWID	wired and tested, not programmed	54.95
CWID	wired and tested, programmed	59.95
Microphone	2,000 ohm dynamic mike with P.T.T. and coil cord	9.95

master charge

VHF ENGINEERING

DIVISION OF BROWNIAN ELECTRONICS CORP.

320 WATER ST. / BINGHAMTON, N.Y. 13901 / Phone 607-723-9574

BANKAMERICARD

a monthly feature by

BILL DEWITT, W2DD

In Focus

Television on the Amateur bands

Looking Forward And Backward At Picture Transmission Systems

At this writing (late February), the SSTV Seminar at the Dayton Hamvention beckons to all slow scanners anxious for news of the latest innovations in the SSTV field. Year after year, new technology has been disclosed at this "convention within a convention". With this thought in mind, I found an article in an old magazine most intriguing.

It was in the April 1926 issue of *Radio Age,* "The Magazine of the Hour", that an article titled "Amateurs Take Up Radio Vision—New Field Opened by Jenkins' Invention" appeared. The author was S.R. Winters. The cover of *Radio Age* and a picture from the article are shown in the accompanying photographs by yours truly (see figs. 1 and 2).

C. Francis Jenkins had just invented a "duplex photogram machine" which could send and receive by radio or wire, copies of messages, letters, sketches, maps, pictures etc. It was a facsimile system having line reproduction capability —with no tonal scale possible except as represented by line structure.

*2112 Turk Hill Road, Fairport, N.Y. 14450.

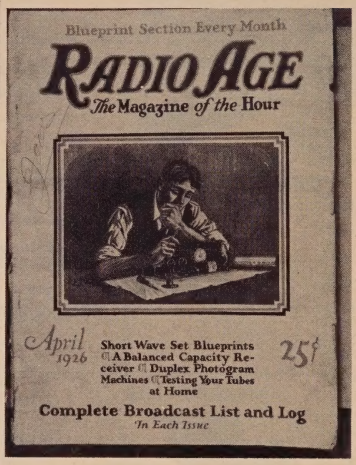
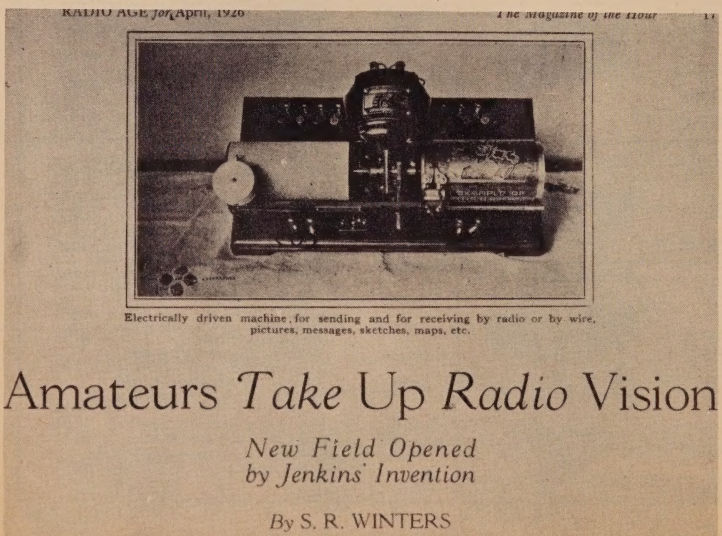


Fig. 1—A puzzled builder labors over the next connection on the cover of Radio Age for April, 1926. This issue also carried an article on "How To Build A Short Wave Set" by a chap named Arthur Collins, 9CXX.



The thrust of the article was that "now" two leading radio amateurs were going to experiment with this equipment over the 7 miles between their homes. It was also indicated that in time, they would be able to exchange pictures with hams in far away Australia.

The intrepid hams who were about to become appliance operators with their commercially made "photogram machines" were John L. Reinartz, 1QP, and George H. Pinney. Reinartz was already famous for his high frequency work, especially in connection with the McMillan Arctic Expedition.

Well, that was 51 years ago, and in my humble opinion, facsimile has never become what you'd call a front runner among the many facets of ham radio.

Winter's article was really great in many respects. It contained a prediction by Jenkins that "radio vision" would some day make it possible for us to view the Olympic Games in Europe, and that peoples of other nations would be enabled to see the inaugural ceremonies of a President of the United States! It predicted a central distributing system from which news items and movies would emanate (although this was related to a "movie house" showing of such features).

The one jarring fault in the whole story was Winter's understandable but misplaced optimism concerning the acceptance and use of facsimile by hams. Winters foresaw "an irresistible fascination in this unbroken

Fig. 2—C. Francis Jenkins, famed for his many inventions in the motion picture field invaded a new territory with his "Photogram Machine". It was NOT the Robot 400 of 1926!

ground of experimentation". He felt that Jenkins' invention would "usher in radio vision to the (then) 20,000 amateur stations.

Don't get me wrong, I *know* that many hams have operated facsimile over the years, but it certainly has had limited acceptance.

So, what's the point? Picture transmission systems have come a long way (baby) in the last 50 years. But there are many factors that determine which systems will survive. It would be interesting to trace the factors involved in this case, to see what really happened.

Meantime, isn't it great to be around RIGHT NOW while a healthy, growing, feasible, effective slow scan system is providing its "irresistible fascination" for more and more hams all over the world?

P.S. I wonder if John Reinartz and George Pinney ever delivered a report on their experimentation with the "photogram machines"!

Slow Scan Par Excellence In Chicago—WA9PDJ

It's hard to imagine a more complete or deluxe SSTV station than that of Bernie Burke, WA9PDJ. Bernie's full time occupation is running Burke Motors Inc., a Ford Agency, but slow scan keeps him busy during his non-working hours.

As you might guess after a quick look at the accompanying photographs, WA9PDJ is equipped to televise just about anything from postage stamps to people. (Those cameras mounted on vertical supports should give you some useful ideas.)

Here's how Bernie described the details of his equipment in a recent letter:

"1. Cameras are mounted on modified photo copy stands with parallel arms. One camera has a 12.5mm Macro lens, the other, a 25mm Macro lens. Both cameras can swivel up to the vertical position and turn just as if on a tripod—for live shots. In the vertical position it is possible to fill the screen with objects from one to fourteen inches square."

"2. A single desklamp with aluminized reflector is used for lighting desk top subjects."

"3. Switching allows selection of Camera 1 or Camera 2, or Broadcast video to either of the Robot 400s. A tape recorder can also be switched to either converter. The scope can be switched to either 400 and used for tuning and analyzing the picture."

"4. To show 35mm slides, a slide duplicator attachment is screwed

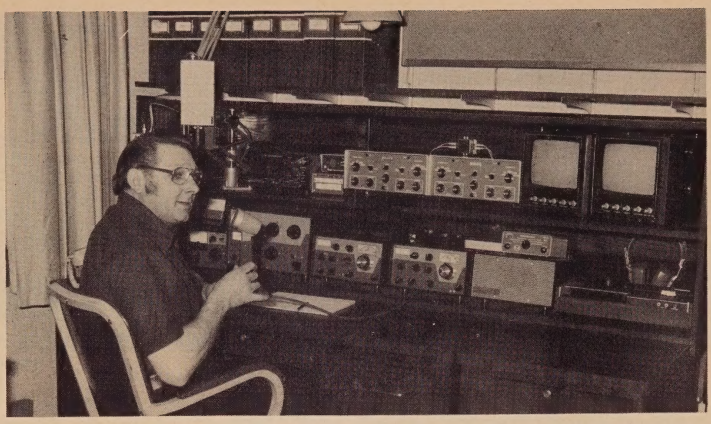


Fig. 3—Bernie Burke, WA9PDJ looks in complete control of all that SSTV gear. (I'd like to swap a slightly used Johnson Pacemaker for that cute little scope—W2DD.)

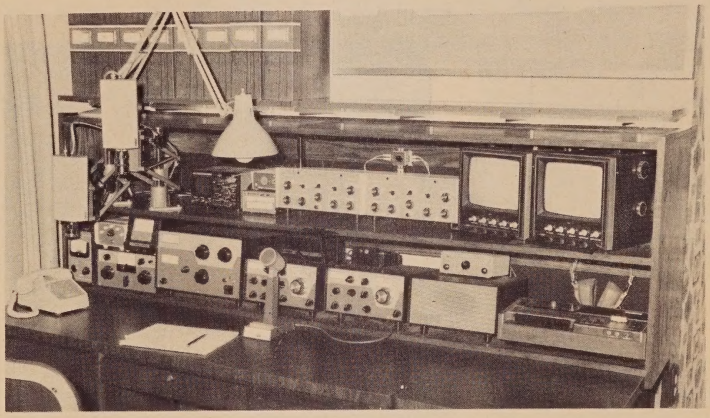


Fig. 4—An outstanding feature of Bernie's set-up is the nifty means of operating either camera in the vertical or horizontal position. See text for details.

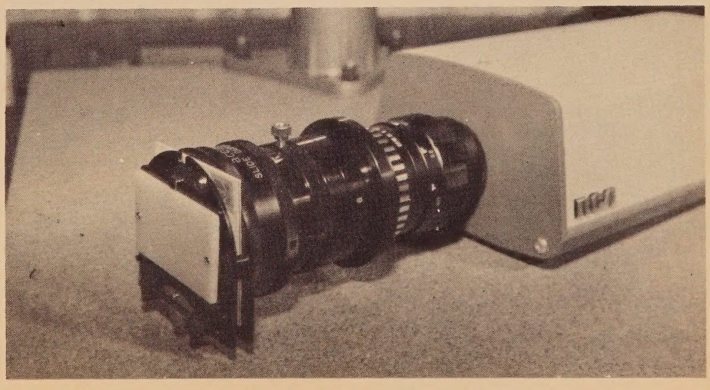


Fig. 5—Easily attached slide duplicator device is used by WA9PDJ to transmit 35mm. slides.

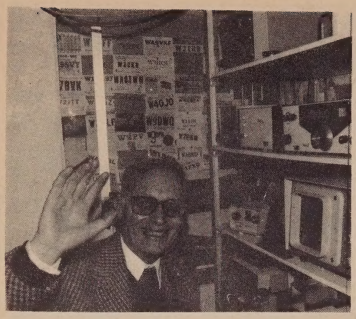


Fig. 6—That's Jean Nicolas, F6BDJ, backed up by a wall full of DX cards.

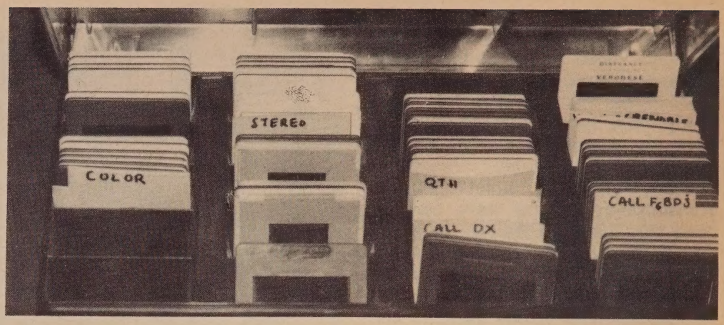


Fig. 7—A neat file box system used by F6BDJ to keep his 35mm slides in order for quick selection.

into the front of the 25mm camera lens as shown in fig. 5. The slide is backlit through a translucent screen on the slide duplicator. The front of the slide duplicator slides in and out permitting cropping slides to the square SSTV format if desired."

within reach so that you can show small items of interest to others without relocating the camera. This convenience is what is needed to get SSTV out of its hackneyed format rut!

The slide duplicator device used by Bernie is another convenience item. More details about such duplicators are shown in the pictures of F6BDJ's gear. Read on, *s'il vous plait!*

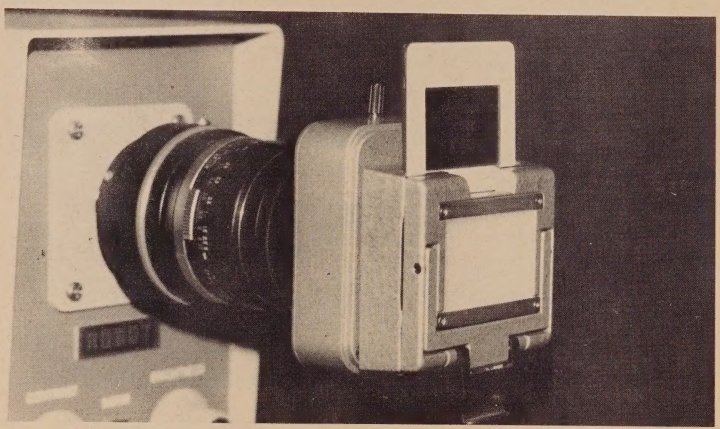


Fig. 8—With the slide duplicator device screwed into the SSTV camera lens, all you need is some backlighting.

I find Bernie's camera mounting arrangement quite intriguing because it solves two problems. First, it eliminates the space needed for a tripod, and secondly, it gets the camera

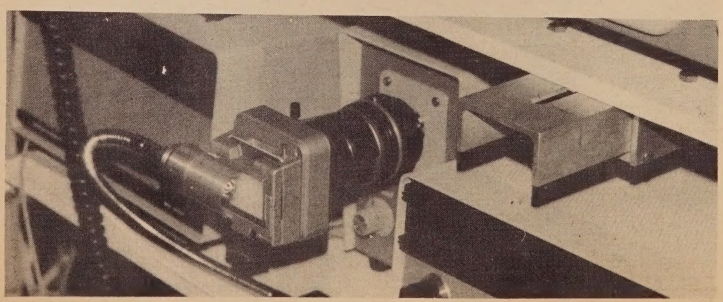


Fig. 9—Jean uses a low powered cylindrically shaped lamp to illuminate his 35mm slides for transmission.

Big Signal From Grenoble, F6BDJ

Jean Nicolas, F6BDJ, who operates a pharmacy in Grenoble, is one of France's best-known SSTV operators. Always trying something new, Jean has pioneered in color and color stereo SSTV picture transmissions. In fig. 6, you can see Jean surrounded by DX QSLs and ham gear.

I mentioned a few months ago that F6BDJ uses color slides to a very large extent as starting material for his SSTV transmissions. See fig. 7 for a look at the neat file box system used by Jean to make it easy to quickly select the wanted message or picture. Like WA9PDJ, he uses a slide "duplicator" device to image his slides on the SSTV camera vidicon. In fig. 8, you can see how the slides fit into the holder on the duplicator.

A low powered cylindrical lamp is used to illuminate the slides. This is shown in fig. 9. An "opal" glass diffuser on the duplicator eliminates any "hot spots". You can get a reasonable idea of how the duplicator attaches to the camera lens from fig. 10.

Jean has a simple but effective way of applying the red, green, and blue filters needed for his color transmissions. See fig. 11.

If *you* have a good inventory of slides (particularly close-ups!), why not follow the route chosen by WA9PDJ and F6BDJ for a large part of their picture transmissions? Get out your 35mm camera, make up a few slides with your name, location, and other "standard fare" and you'll be all set to go!

Pennsylvania SSTVer Does Top-Notch PR Job For Amateur Radio!

Down in Lewes, (NOT Lew*is*!) Pa., Elmer Boyer, W3YAH has been doing a terrific job on ham radio public relations. Elmer decided that some-

thing needed to be done to make the public aware of the difference between Ham Radio and CB. SO, HE DID IT!

Through Elmer's efforts, a local newspaper called "The Whale" carried nearly a full page story describing all phases of ham radio in a very affirmative way.

Credit should be given to Grayson Smith, the feature writer who did such a fine job on this story. He did a very complete and coherent story that would be hard to beat! Rumor has it that he became so enthusiastic that he's going to become a ham!

Cooperating with W3YAH in this fine job of PR were: Lloyd Sherman, W3CDY; Dick DeWitt, W3WD; Earl Henson, W3ZNF; Ed Hill, W3FEG; and Hal Low, WA3WIY.

Elmer is an inveterate early-morning slow scan operator. He's on the low end of 75 every morning with early risers W3LDS, W3ATV, K3KNT, and a few others (between 6:30 and 7:30 EST).

The accompanying photograph of Elmer's well-equipped station makes me wonder just where he is going to put an SSTV keyboard he's building. (See fig. 12.) Good luck, Elmer!

Pictures We Couldn't Resist Department!

Included in the newspaper article mentioned above was a photo supplied by John Hartman, WA3ZBI, of Elizabethtown, Pa. John has a dog named Ralph. Ralph likes to operate CW and doesn't mind having his picture taken, as you can see from fig. 13. Ralph is getting interested in SSTV, so keep an eye out for him, he may show up on 20 or 75 any day now! (Now you know who they're calling when THEY SAY, "Charlie Queen, DOG-XRay!")

Get Into The Picture With A Mirror!

Want your face to appear in strange (or funny) places? You can have fun with a mirror and a little imagination. Ray Lamy, W2PBU, an active A-5 operator in Kenmore, N.Y. uses a small mirror to include his own countenance in pictures of his equipment.

Ray sets up a mirror on top of (say) his receiver in such a way that his face is reflected into the television camera lens along with the hamgear.

As pointed out by Walt Bieda, W2ELF, who pased this idea along to me, there has to be some means of illuminating your face.

Do you get the idea? There you are, with the camera essentially in back of you—it's pointed over your shoulder at your receiver and transmitter. *But,* sitting on top of the receiver is a mirror so positioned that it reflects your face into the TV camera.

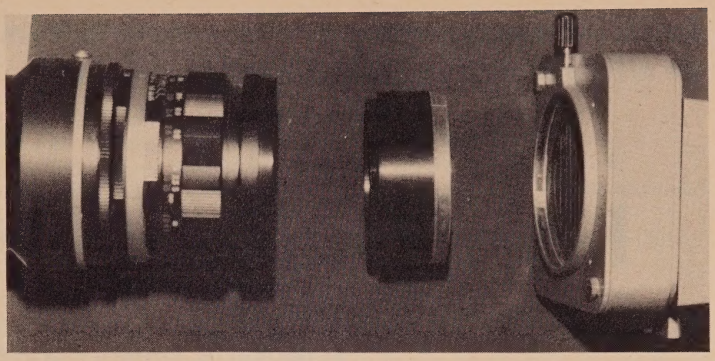


Fig. 10—More details of the slide duplicator used by F6BDJ.



Fig. 11—When F6BDJ transmits color SSTV he uses this simple means of applying the various filters.

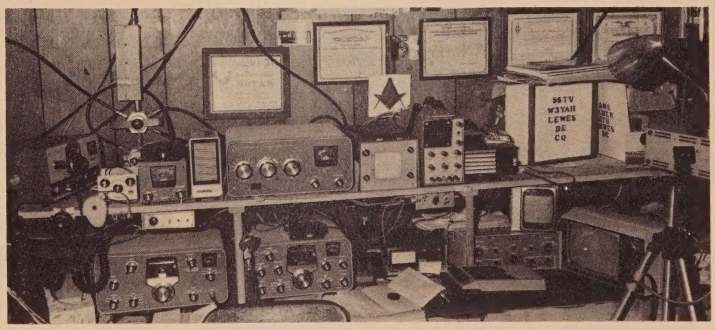


Fig. 12—Heathkit Heaven plus a Robot 400, what more could any ham ask for? This well-equipped station of W3YAH approaches W4MS for hours on the air—and that's *hard to do!*

Scan Converter News From DL-Land

Thanks to G3WW, W3LY, and W4MS, here are the details on DL2-RZ's SSTV scan converter which is expected to be on the market well in advance of this publication.

Wolker Wraase, DL2RZ, demonstrated what I believe was a prototype of this scan converter at the SSTV Convention in England last Fall.

(Continued on page 73)

Here's some food for thought about one of those machines we all see around and take almost for granted.

I Am Curious, Infrared

BY GEORGE M. EWING*, WA8WTE

One of the penalties we pay for living in a high technology culture is that people tend to specialize in a given field, or even a narrow area within that field, and are sometimes blissfully unaware of advances in state of the art that are taken for granted in the next lab across the hall, or in a schoolroom across the street. One such development is the infrared copy machine sold around the country by 3M and other companies.

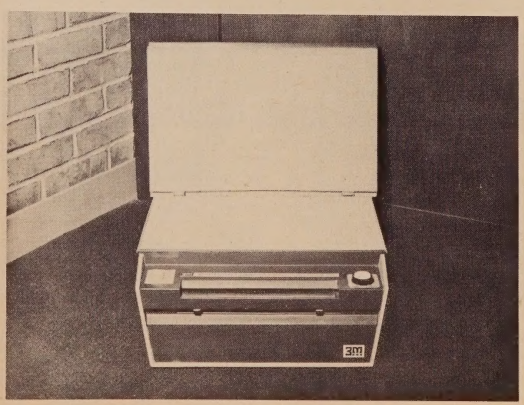
The main function of these devices, as everyone is aware, is to copy business letters, cartoons, and kidnap notes on heat-sensitized paper. The main point of this article is to give a few creative examples of things an amateur or electronics hobbyist can do with the machines besides just copy funny little marks on paper.

You can probably finagle access to one of the machines where you work, at school, or at a library or most small businesses. Cheap, simplified versions of the copiers are now available for home use for under fifty bucks, and anyone with the kind of technical imagination to build complex repeaters, slow-scan, or facsimile gear can probably build one with an oatmeal box, heat lamp, and timing motor after studying the guts of a Thermofax® or other commercial copier.

Basically, the things work by running a sandwich of heat-sensitized paper and the material to be copied past a heat lamp on a roller or clear plastic belt. The black type of drawings get hotter than the more reflective white paper they are printed on, and the copy sheet gets hotter and blackens over the same areas.

Soon after the basic copy machines were developed, special purpose materials were developed using the same principle. Of particular interest was the development of sensitized acetate plastic films that could be made to blacken or change color, allowing busy school teachers to make transparencies for use in the ubiquitous classroom overhead projector, which previously had required hand lettering with colored tapes and felt markers, or cumbersome, stinky diazo processes. Infrared sensitized mimeo and spirit duplicator masters were also a great help, but let's confine the discussion to the transparency films for a while, as there are

*510 Sheridan Drive, Sault Ste. Marie, MI 49783



A 3M Model 581 transparency maker. This machine will make transparencies from loose pages or bound volumes.



A 3M "Secretary" model transparency maker. This machine will make transparencies, stencils, and photocopies from loose sheets up to 8½" x 14".

many variations (see Table 1) and they are, or should be, of interest to amateurs.

How To Get It

Nearly any business supply store or distributor of school and audio visual supplies can get the stuff for you, but they may not want to bother with quantities of less than a hundred sheets. A club or repeater group could split the cost of a box, but don't overlook other possibilities. Try your local school office education department, or college bookstore. Bookstores in universities that have teacher-training departments will often sell a sheet or two at a time to students who need a couple of transparencies for an assignment, but don't want to lay out thirty bucks for a boxful. The cost usually runs from a quarter to fifty cents for an 8½" × 10½" (216mm × 267mm) sheet, but can be cheaper in quantity. There are dozens of variations of the stuff, but my favorite is good old 3M type 127, which is becoming obsolete, and is being replaced by 3M type 588. Generally, the thicker the film (.0035" or thicker is best) the easier the stuff is to work with. See what you can scrounge, and don't forget churches, the military, and companies such as insurance firms and income tax accounting people who use lots of audio-visual aids to train salesmen and accountants. What the heck, try a public library. You can also borrow the electronics magazines you want to copy from.

So you've tracked down a dozen sheets of film and have wangled access to a machine someplace. So what do you *do* with the stuff? What's all this have to do with working DX through a pileup, putting up better antennas, and falling off same while the DXpedition is operating from North Mapdot Island, stuff a red-blooded amateur *enjoys*?

Example #1: Circuit Boards— P.C. Piracy Made Simple & Fast

Suppose you are leafing through a magazine like this one, and find a construction project complete with full size PC board templates. If you just happen to have darkroom chemicals, Kodalith, a light table, etc. ready to go, you can copy the board in short order. On the other hand, you can take the template from the magazine page, sandwich it with #127, and have a finished mask *in about 15 seconds!* Of course you still have to expose the board and etch it, drill the holes, and mount the parts. If the layout in the magazine is positive, (copper in black) you will have to use a positive resist; if the layout is negative (foil in white) as is the case with many magazines in recent times, you can use the more common negative resist. Negative thermal films *are* available, but the ones I have tried so far were tricky to use and did not give as good a result as type 127.

If you have a friend's magazine or a library copy, and don't want to remove the page, you can use one of the 2-part machines that use an intermediate sheet and can copy through a glass plate from a bound volume, or you can make a Xerox-type paper copy first, and then sandwich *it* with the transparency film. Some of the infrared machines, such as the 3M model 411, are designed to work both ways,

Some Useful IR Films

8½" × 10½" (216mm × 267mm)

3M #127 .0035" positive black on clear (being replaced by #588)

3M #137/237 .0025" positive black on clear

3M #133 .0015" positive black on clear

3M #129 .0025" positive black on colored sheet (pink, blue, green, yellow)

3M #888 .0025" positive colored line on clear (red, blue, green, purple)

3M #777 (same as #888 but .005 acetate)

3M #125 .005" positive frosted white image on clear sheet

3M #239 two-part film used in some machines to make transparencies directly from a bound book or magazine. 8½ × 10½.

Valiant IMC Films These are similar to the 3M products and have similar code numbers

VBL-127 is similar to 3M #127 and 3M #588

VBL-129 is similar to 3M #129, and so forth.

VST-5 is a different process, using a carbon transfer to make a positive black transparency on .005" acetate.

VTC-450 (8½" × 11") and (8½" × 14") copy paper.

VLF-811 (8" × 10") Thermal laminating film for covering charts, maps, etc. (There is probably a 3M #811 film also, but it is not listed in the catalog I have handy)

CTM-811 combination spirit master and transparency film 8½" × 11"

VDT-811 and **VDT-814** Thermal spirit master, 8½" × 11" and 8½" × 14" respectively.

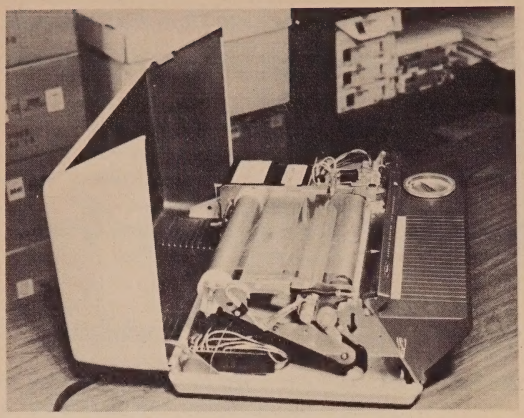
TMS 814-9 & **TMS 814-4** 9 and 4 hole thermal mimeo masters, respectively.

VMF-814 and **VNS-814** Mylar film and nylon screen carriers, useful for feeding films through the machine.

Nearly identical films are available under other brand names.

Labelon and Arkwright market a film that seems similar to 3M #588. There is also a two-part film that makes *color* transparencies from printed photographs, but I have no experience with it. *Negative* color films are also made, but hard to find. The samples I've seen were soft and waxy, probably not suitable for circuit boards.

Table I—Some useful infrared sensitized films. This is just a sample; many more are available.



The insides of the "Secretary" model with cover removed. The clear plastic belt carries the material to be copied sandwiched with the sensitized film over the rollers and past the infrared heat lamp.

but *read the manual.*

I should point out at this stage that type 127 will make excellent transparencies from ordinary pencil sketches. Simply draw the circuit (either positive or negative, as desired) on clean white paper with a #1½ or #2 pencil, being careful with the shading to avoid gaps in the copper later. This takes no more trouble than drawing directly on the board with resist ink, with the advantage you can put the transparency in a file folder and use it again later. (Since the stuff does tend to blacken with prolonged exposure to sunlight, you should store the things in a cool, dry place.) One acquaintance of mine borrowed the actual circuit board from a friend's HT kit before it was assembled, made a paper copy by laying the shiny, tinned G-10 board on the window of a Library copy machine, doctored the resulting paper with an exacto knife and pencil, and then ran the paper through with a sheet of film,

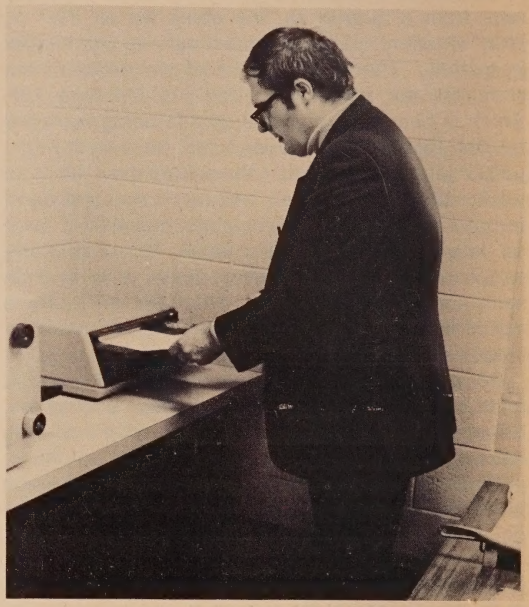


Feeding a circuit board layout cut from a magazine page and a piece of film (about ⅓ sheet to save material) through the "secretary" machine.

yielding a mask ready to expose, with an added multi-channel crystal deck in the bargain!

If you try this, make sure the library machine doesn't reduce or expand the scale of the layout, as the Xerographic machines use an optical system and a camera, as opposed to the direct-contact sandwich in the infrared machines. Shrinking an IC socket or edge connector a few per cent could lead to frustration later!

There are IR films available that make mimeograh stencils just like the transparencies. This is great for printing club newsletters, QSL cards, and custom log sheets, but there's another bonus. Make a mimeo stencil of a circuit board (positive) and mount it carefully on a *fine* mesh silk screen



Feeding an infrared mimeograph master through the 3M "Secretary"

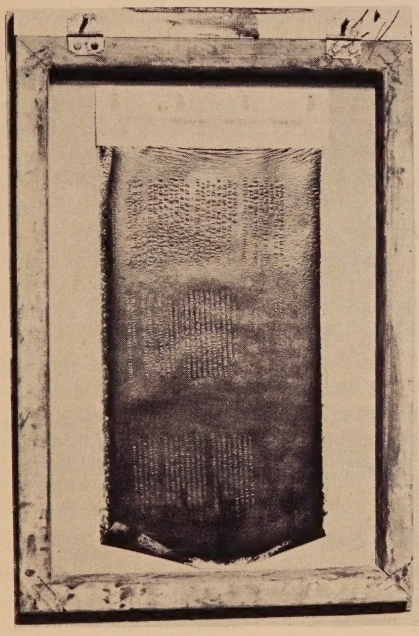
frame. *You can then mass produce boards by squeegeeing resist directly onto plain copper board!* There are drawbacks, though. The resolution is not so good as with photo etched processes, and may not be usable for fine detail such as the aforementioned IC sockets. It is also tricky when you have large areas of copper, as large black areas on the original tend to stick to the film and tear the stencil when the backing is peeled. Still, the process has definite possibilities. One batch of simple code oscillator boards for a scout troop were made successfully this way, though you should inspect the boards carefully before etching, using a scriber or resist pen as needed.

Example #2: Meters and stuff

Since the finished transparencies are permanent,

waterproof, etc. the films are very useful for duplicating meter faces for equipment, tuning dials, and decals for front panels. Simply borrow the meter face needed from a friend or magazine article. Duplicate it on film and trim to fit with scissors or a razor blade. The thicker films are better for this, and don't forget some of the more exotic colored films (see table).

Oddball and homemade meter scales can be drawn up with a pencil, as in Example #1, and then duplicated in acetate. Now you can take those surplus meter movements that are calibrated in Gigawatt/seconds or Snurghs per Kolcek and put them to use. Watch out for hot dial lamps, though. After a few weeks, a vintage SX-24 dial that had been replaced in this manner developed a black

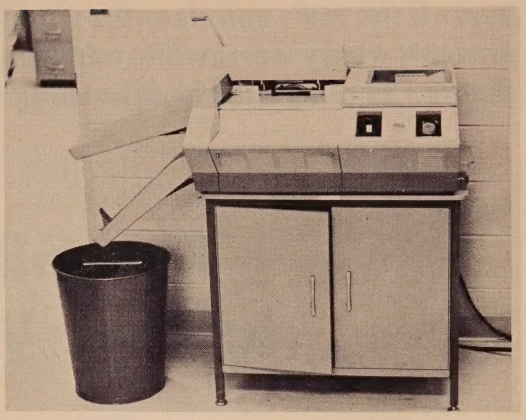


A completed infrared mimeograph master set up on a silk-screen frame. This system allows duplicating club newsletters, posters, repeater maps, etc. if you don't have access to a regular mimeo machine. You can also mass produce simple circuit boards, bumperstickers, club tee shirts, etc.

spot over the hot dial lamp, blacking out the U. P. Michigan evening net on 3920 kHz.

Example #3 Overlays

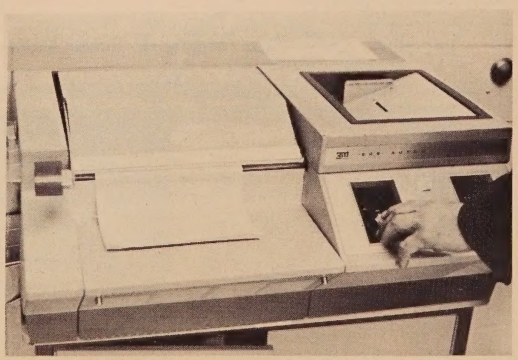
There are dozens, if not hundreds of things around a hamshack that are better on clear acetate than on paper. An obvious item here is polar projection grids of the earth for plotting beam headings, great circle DX paths, OSCAR orbits, and so forth. You can scribble on the sheets with crayons, grease pencils, or any of the specially made col-



A 3M model 209 copier for making opaque paper duplicates from bound volumes or loose sheets. These can in turn be used to make transparencies or duplicating masters on other machines. The stop plate on the lower chute can be removed to allow botched copies to drop directly into the circular file.

ored markers designed for writing on the stuff. Most of these erase with a damp cloth and soapy water, alcohol, or some other specified solvent. With the previously mentioned mimeo and spirit master films, a hundred copies of any diagram, contest log, or repeater coverage map can be run off for a class or club meeting. There is even a special film, type 811, that makes an overhead transparency and a spirit master (both positive) in a single pass. Call letter and name tag overlays, bumper stickers (backed up with colored paper) and mobile window numerals are fun to make for hamfests and picnics, though they may blacken after a few weeks in the sun. Remember, you don't have to use an entire sheet at once; scraps can be saved for other projects, so long as they're not too small to feed through the machine.

(Continued on page 75)



Copying a circuit diagram directly from a magazine page on the model 209.

Dust off the tools and clear the workbench. Ade Weiss presents a very worthwhile addition to your shack that can be completed in an evening or two.

The Silk-Purse In-Line Wattmeter

BY ADRIAN WEISS*, K8EEG/0

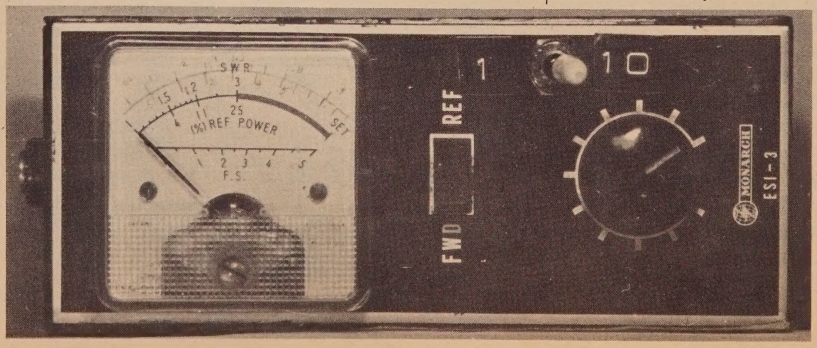
It has become generally recognized that output power rather than input power is a more reliable standard for transmitter performance and more scientific with respect to power considerations. In an earlier paper, I described a simple but accurate instrument which provides the means for measuring the power output capability of a transmitter accurately in the h.f. spectrum.[1] For the amateur who is convinced that knowing the power output from his transmitter is the important thing, a useful addition to the station is an instrument which makes it possible to monitor the power delivered to the feedline during operation. This paper describes such an instrument which is adapted from a readily available and economical s.w.r. bridge currently on the market for around fifteen dollars.

Breune Circuit

The bridge circuit used here (see fig. 1) has been discussed elsewhere in detail, and the reader is referred to those papers.[2] The chief advantage of the Breune circuit is that it is not frequency sensitive. Its calibration will be accurate over a wide frequency spectrum, such as the entire amateur h.f. spectrum, if the values of L2, the voltage divider capacitors C1-2 and C3, and the resistances of R1-2 are chosen properly. R1-2 and CR1-2 should be matched for best results. Generally, R1-2 must be small compared to the reactance of L2 so as to avoid any significant effect the L2 current which is induced by the transmission line current flowing through L1. The lower frequency limit of the bridge is set by the R1-R2/L2 ratio, and the cutoff is at the point where the value of R1-R2 becomes significant with reference to the reactance of L2 at that frequency point. Thus, if the builder wishes to use this bridge with accuracy on 160 meters, R1-R2 should be on the order of 100 ohms.

"Sow's Ear" Modifications

While no claim of originality is made for the bridge circuit, the construction approach presented here should be of interest to many amateurs because it adapts a common, economical, strip-line type s.w.r. bridge, more or less a "sow's ear" which the following modifications transform into the proverbial "silk purse." This type of s.w.r. bridge is



View of the modified s.w.r. meter. Notice that the new scale is directly over the old scale. A range switch is added to select the proper coverage, either 0-1 or 0-10 watts output.

*83 Suburban Estates, Vermillion, SD 57069

[1]*Weiss, "A Simple and Accurate rf Power Meter,"* ham radio, *October, 1973, 26.*

[2]*Breune, "An Inside Picture of Directional Wattmeters,"* QST, *April, 1959, 24; DeMaw, "In-Line RF Power Metering,"* QST, *December, 1969, 11.*

useless as a power meter because it is frequency sensitive. In other words, any calibration of the meter for power indications will hold true only for the frequency of calibration. Excursions of even a few hundred kHz will result in error.

Fortunately, these garden variety strip-line bridges include a fine, jeweled movement microammeter in the 100-200ua range, which is perfect for measuring power levels down to the milliwatt level. Likewise, styling is attractive and functional. Modification is simply a matter of removing the entire original sensing circuit, and installing the Breune circuit p.c. board. Only two major physical operations are necessary.

First, the coax receptacles are moved from the ends to the rear panel. This change is not really necessary, but results in a more practical arrangement, with input and output coax lines coming to the instrument from the rear rather than from each side. The holes for the coax receptacles are centered ¾ inch from the top, and 1½ inch and 2⅝ inches from the "sensitivity" control end of the enclosure. This positioning of the receptacles will permit adequate space for the mounting of the p.c. board. Next, if the builder desires to incorporate the flexibility of two fixed ranges of calibration as shown in fig. 1, a small hole for mounting a miniature SPDT switch that chooses between the 1 and 10 watt ranges (or any other) should be drilled in the front panel, as shown in the front view photo. The original FORWARD-REFLECTED switch and SENSITIVITY controls are retained.

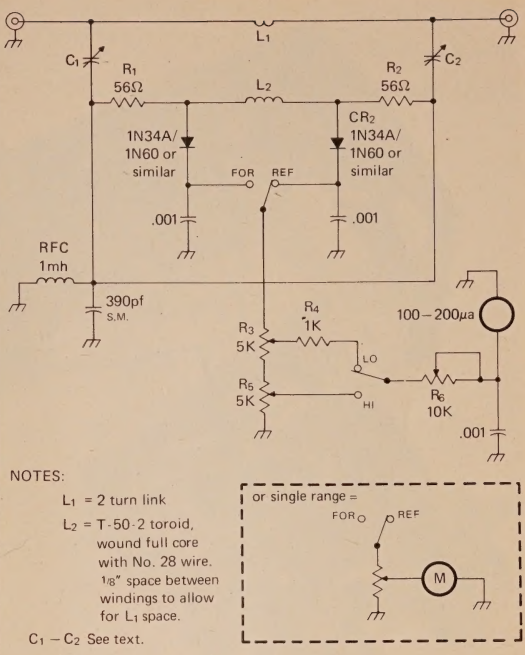


Fig. 1—Diagram of the Breune bridge circuit. The chief advantage of this circuit is that it is not frequency sensitive.

P.C. Board

Fig. 2 shows a full size p.c. board template. Circuit symmetry is important for the proper operation of the circuit, and p.c. board construction is perfect for this requirement. For QRPp ranges, everything, including L1-L2 can be mounted on the p.c. board.

However, if the builder wishes to use the wattmeter at levels above about 15 watts, it is advisable to shield the sensing circuit from the transmission line pickup part of the circuit (L1-L2 in this case). For QRO levels, L2 must be mounted off-board and separated from the board by means of a shield, which can be formed from soft aluminum

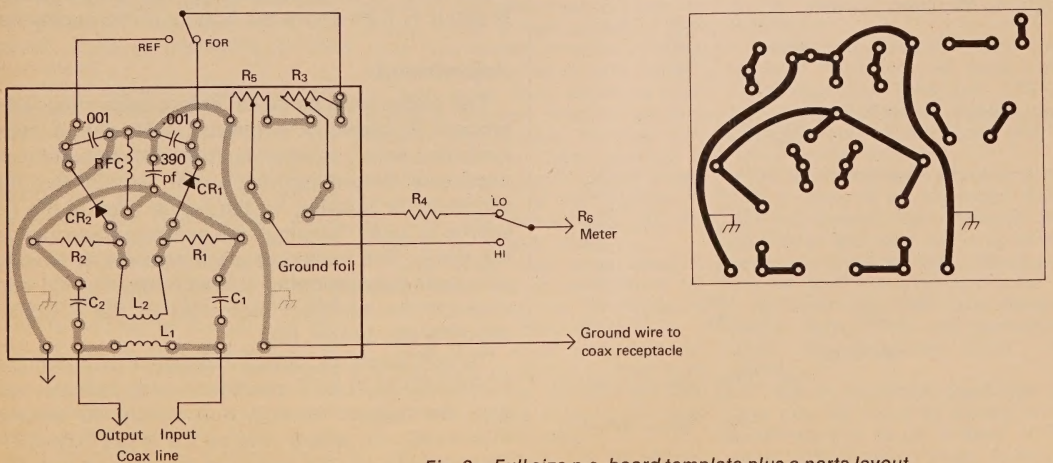
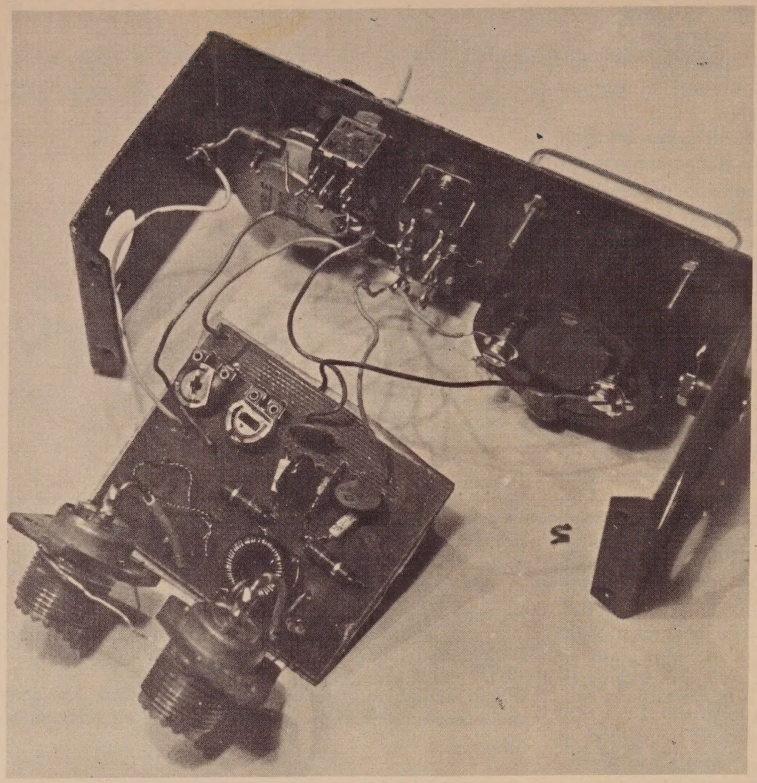


Fig. 2—Full size p.c. board template plus a parts layout.



Details of the p.c. board. Note the short leads to the coax receptacles, gimmick capacitors, and the connections to the front panel.

stock. The L1 winding is eliminated, and a short piece of coax carrying the transmission line current can be run through the L2 core for pickup.

RFC is a subminiature Miller type 70F103A1. The builder can wind his own RFC by using Amidon jumbo beads, as discussed in another paper. R3-R5 are subminiature potentiometers of the p.c. board mounting type. They mount directly in the holes shown in fig. 2, and are used to adjust maximum meter deflection in each power range. The LO-HI SPDT switch selects either range. As can be seen from the photo of the p.c. board, the nulling capacitors C1-C2 are actually "gimmick" capacitors. Two six-inch pieces of plastic covered hookup wire are wound tightly together to form the two plates of a capacitor. During adjustment of the bridge, the free end of the gimmick capacitor is clipped an eighth inch at a time until the proper capacitance is achieved. Be careful that clipping the twisted pair does not short them.

Before mounting, the bottom of the completed p.c. board should be insulated with masking or electrical tape to avoid accidental shorting. The board is suspended from two stiff #18 wire leads soldered to the coax receptacles. The length of these leads to L1 is adjusted so that the p.c. board is about ⅛ inch above the bottom of the enclosure.

$$SWR = \frac{1 + \sqrt{\frac{P_{REF}}{P_{FOR}}}}{1 - \sqrt{\frac{P_{REF}}{P_{FOR}}}}$$

solved for SWR vs POWER RATIO:

$$\frac{P_{REF}}{P_{FOR}} = \left(\frac{SWR - 1}{SWR + 1}\right)^2$$

gives the following ratios:

P_{REF}	P_{FOR}
= 25%	= 3:1 SWR
= 18.4%	= 2.5:1 SWR
= 10.9%	= 2:1 SWR
= 7.8%	= 1.8:1 SWR
= 5.3%	= 1.6:1 SWR
= 2.8%	= 1.4:1 SWR
= 1.7%	= 1.3:1 SWR
= .83%	= 1.2:1 SWR
= .23%	= 1.1:1 SWR

EXAMPLE:

$$\frac{P_{REF}}{P_{FOR}} = \frac{1.75 w.}{7 w.} = 25\% \text{ ratio or SWR } 3:1$$

$$= \frac{.25 w.}{4.7 w.} = 5.3\% \text{ or SWR } 1.6:1$$

Table I—Points for directly reading s.w.r. (by comparing Watts Forward and Watts Reflected).

Adjustment

The bridge must be nulled before calibration. This process is simple. A non-reactive 50 ohm dummy load, and an r.f. source, such as a transmitter, are necessary. Before applying power, be sure that the sensitivity is adjusted for the power level of the r.f. source to avoid "pinning" the needle and damaging the meter. The nulling process consists of feeding r.f. power through the circuit and adjusting C1 and then C2 for minimum indication in the direction opposite the current flow.

To null, apply r.f. power and switch between the FORWARD-REFLECT positions—one position will give the highest reading, and should be labeled FORWARD. Or, simply reverse the leads from CR1-CR2 at the FOR-REF switch to correspond with the

(Continued on page 74)

a monthly feature by

WILLIAM I. ORR, W6SAI

Antennas

Design, construction, fact, and even some fiction

Pendergast was sitting on the floor in front of his power supply rack. The red warning light was off, the safety switches had been thrown and a tangle of clip leads connected test meters with the inner circuitry partially hidden behind the large plate transformer. He looked up as I came in the operating room and waved a hasty greeting.

"Problems?" I asked, as I looked over his shoulder.

"Yep", he responded. "The 2 ampere circuit cutout in the six thousand volt supply isn't working. I can only draw about 1500 mills of plate current before it kicks out."

"Let's see", I mused. "Six thousand volts at fifteen hundred milliamperes is . . ."

"Only into a dummy load", sniffed my friend. "Anyhow, I'm still down in the second or third layer when it comes to DX."

"Too bad", I replied. "Maybe you need a good antenna to make up the difference. Or, maybe its the operator!"

"Phooey," said Pendergast, pushing his test equipment to one side. I'll get back to this later. Have you gotten anything interesting in the mail lately?"

I placed a pile of papers on Pendergast's operating table. "I'm sure you'll be interested in some of this material. For instance, I received a very interesting letter from Ernie, K4RD. He's got two slopers on his tower and has been running some tests on 80 meters (fig. 1). One wire runs 45 degrees north, and the other runs 240 degrees west — almost back-to-back. From W4-land, the first wire is pointed at Europe and the second one at New Zealand. Since the tower is between the wires, Ernie figures that there would be little interaction between them and he could switch back and forth to get some information as to directivity of the wires."

*48 Campbell Lane, Menlo Park, CA 94025.

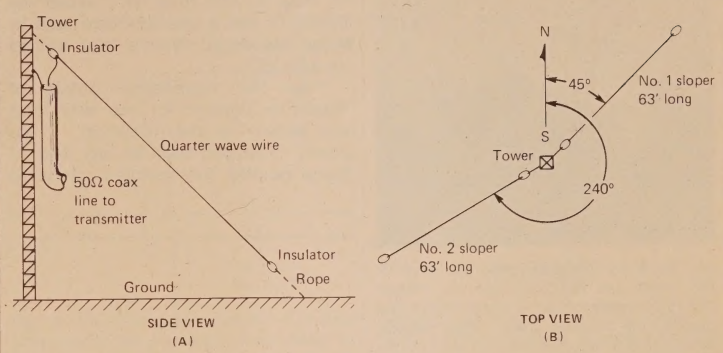


Fig. 1—The sloper antennas of K4RD for 80 meter s.s.b. Number 1 sloper is "aimed" at Europe, Number 2 sloper is "aimed" at New Zealand. The wires are each 63 feet long and make an angle of about 45 degrees with the tower. Each sloper is fed at the top of the tower with a 50 ohm line. The shields of the lines are grounded to the tower. The feed point is about 63 feet above ground.

"How did it work out? Did he find any directivity?", asked my friend.

"Very interesting", I replied. "On tests to New Zealand, antenna number 2 (the 240 degree wire) ran from 10 dB to 20 dB stronger than the number 1 wire. On tests into Europe, however, the number 1 wire was about 10 dB better than the number 2 wire. A test at right angles to both wires (into Central America) showed both antennas to be roughly equal."

"After many tests, switching back and forth between antennas on both transmit and receive, Ernie is convinced that the tower exhibits a shielding effect, which causes a very pronounced null at 180 degrees to the wire. The forward lobe, on the other hand, is very broad".

"How were the wires hung?", asked my friend as he reached for his antenna notebook, preparing to write down the information.

"Both wires were hung from the 63 foot level on the tower. Each wire was 63 feet long, trimmed for 3800 kHz. The included angle to the tower was about 45 degrees.

"Ernie goes on to say the slopers are better than an inverted-V in the same location by an average of one S-unit and the inverted-V is better than a dipole hung in the same place by another S-unit."

Pendergast looked closely at the letter. "What a location!", he exclaimed. "Ernie is about 500 yards from the ocean, and about three feet above sea level. And everybody knows what a good DX location Florida is!"

"Jealousy is a terrible thing", I remarked. "Just look at those less lucky than you. Take Jim, K7DXD. Look at fig. 2. This is a picture of his three-element, triband Quad after a heavy windstorm!"

"He's already got this job down and is going to an expanded Quad (the X-Q design). Each spreader will be sixteen feet long, made up of the usual fiberglass spreader telescoped into an aluminum extension tube."

An eager look crept over Pendergast's face. "Tell me something about the expanded Quad", he asked.

"Well, as you know, Quad-type arrays may be made up having sides a half-wave in length instead of the usual quarter-wave design. A simple beam antenna of this type is the old *Lazy-H* beam, popular in pre-war

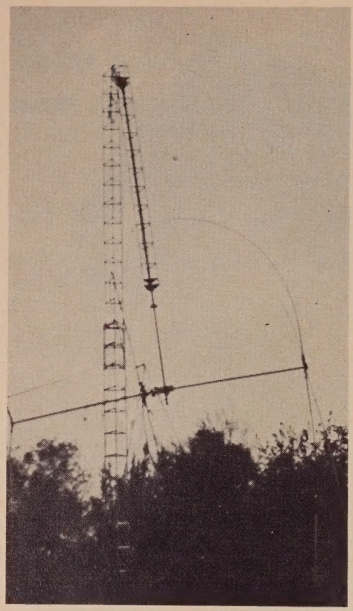


Fig. 2—Never underestimate the force of the wind! Jim (K7DXD) lost his triband (10-15-20 meter) Quad in a windstorm that buckled his crank-up tower. Many towers, while rated to be "guy-less" should nevertheless be guyed at the midpoint and top, especially when a large array is used. Jim's already replacing the tower with a heavy duty job, and is thinking of a 4-element Quad!

years (fig. 3A). The gain of this wire beam is about 5.5 dB over a dipole. The measured gain is the sum of the gain figures for both horizontal and vertical stacking. The *Lazy-H* can be coaxial-fed with a quarter-wave stub and a 4-to-1 balun. The proper phase relationship between the dipoles is achieved through a transposed half-wave phasing line between the upper and lower bays of the array.

"Now, just as with the Quad, the element tips of the Lazy-H can be bent back upon themselves for size reduction as shown in fig. 3B. A high degree of field cancellation takes place around the vertical wires and radiation from these folded sections is considerably reduced. The gain of this enlarged loop antenna is just about 5 decibels. And that's an impresive figure when compared with the gain of the regular Quad loop, which is between 1.5 and 2.0 decibels."

"What about the center phasing line? That looks like a messy affair", grumbled Pendergast, as he copies the sketch into his notebook.

"Well, you can remove the line now, since the upper section of the array is driven by the lower section, and the outer tips are connected together (fig. 3C). The center of the upper section is left open since the two top wires of the array are out of phase with each other at this point. And that's the layout of the X-Q driven loop."

"Can you place parasitic loops in front of, and in back of, the X-Q loop?"

"Certainly," I replied. A two element X-Q array should show a gain of about 9.5 decibels over a dipole, as shown in fig 3D. That's a lot of gain for such a compact antenna."

"How do you feed it?", asked my friend. "I see a quarter-wave stub in these drawings. What's that got to do with it?"

"The low impedance points of maximum current for the X-Q loop are shown in the drawing", I replied. "You can feed at any one of these points. The handiest place to feed the loop, however, is at the center of the bottom section, but this is a high impedance, low current point. It's possible to connect a quarter-wave stub, or transformer, at the center point to provide a convenient, low impedance feed point. The low impedance feed point at the bottom of the stub, or transformer, can be connected to a coaxial line, via a balun. Or, more simply, you can break the loop at one corner and feed it directly, through a balun."

"What about the parasitic element?", asked Pendergast.

"The common design of the X-Q uses a reflector. It is identical in size to the driven element, except that a shorted stub, somewhat longer than a quarter wavelength, is used to tune the parasitic for maximum forward gain. Or, the parasitic element can be tuned as a director, if the stub is somewhat shorter than a

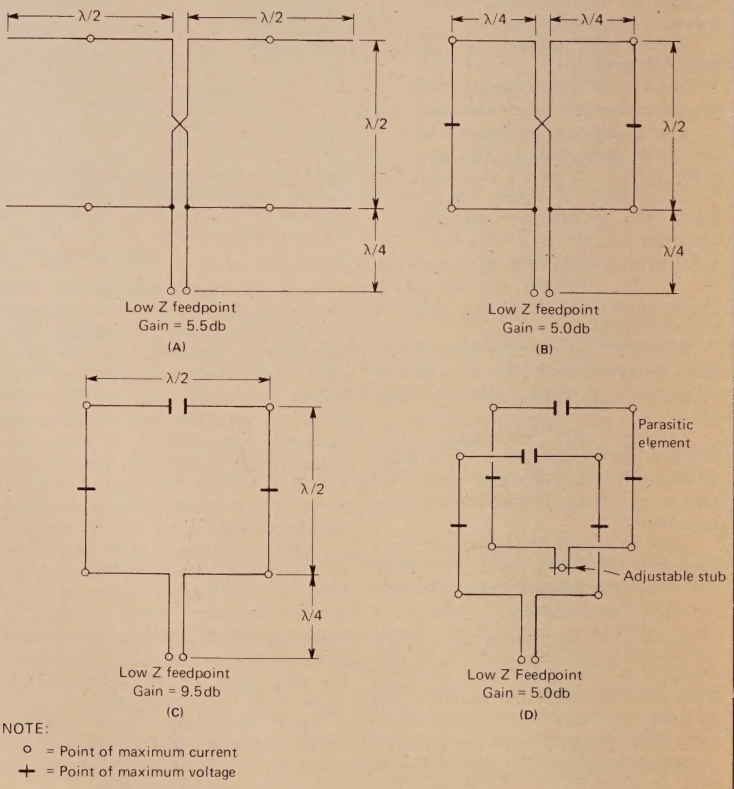


Fig. 3—Evolution of the expanded Quad (X-Q). At (A) is the basic "Lazy-H" beam composed of two half-waves in phase over two half-waves in phase. (B) The ends of the elements are folded back and connected at the points of high voltage. (C) The transposed feedline is removed. (D) A parasitic element is added to form an X-Q beam. Since the bottom of the fed-loop is at a high potential point, a quarter-wave stub is used to transform the feedpoint to a low impedance of about 200 ohms. (Drawing from 'All About Cubical Quad Antennas", Orr. Radio Publications, Inc., Box 149, Wilton, CT 06897. Price $4.75 plus 35 cents postage and handling.)

quarter-wavelength.

"Maximum gain occurs with an element spacing of about 0.125 wavelength. A front-to-back ratio of about 22 decibels is obtainable at this spacing."

"Well", said Pendergast, frowning at his drawings, "It looks to me that a 10 meter X-Q array is easy to build, as its no bigger than a normal 20 meter Quad. And the construction of a 15 meter X-Q is not out of the question. A four element X-Q beam for 10 meters would give nearly 12 decibels power gain, and that's a lot of scrunch!"

"Correct", I agreed. "Now that the 10 meter band is coming back, I think that the X-Q antenna might become a popular beam for that band. I've made up a table of dimensions for a two element array (fig. 4) for those experimentally-minded antenna experts who may wish to try this device."

I reached into a large envelope I was carrying. "I have a couple of items that might interest you", I said. "First of all, here's a sketch of an 'invisible' antenna used by Seth, ON8US in Brussels, Belgium. He lives in an eight story apartment house, but no antennas are permitted on the building."

"So he fed a fishing line down a vent pipe from the roof to his apartment. He tied a weight on the top end of the line. Then he ran a second fishing line from the apartment window to a nearby tree."

"Seth then tied one end of a dipole to the weight on the line that ran down the vent pipe. The other end of the dipole was fixed to the middle of the line running to the tree. He then hauled the dipole up into position as you can observe in fig. 5."

"The foxy idea is that if *point C* of the dipole support wire can slide along the lower line, the dipole can be pulled in against the building when it is not in use. All that is required is that the lower connection permit the dipole to slide along the support line that runs to the tree".

"Very neat", observed Pendergast. "The idea is adaptable to a dipole, or a trap dipole, if you want multiband operation."

"Well, ON8US used transparent nylon fishing line for the supports, so I doubt if you could put much weight into the dipole", I observed.

"I like that", said Pendergast. "That fellow has class!"

"One more idea before we wrap this up", I exclaimed. "Geting back to the many variations of the Quad antenna, I saw a neat design for a

Table of dimensions for X–Q antenna

Band	Side length (L)	Element spacing (S)	Parasitic stub (P) director	Parasitic stub (P) reflector
40	66'8"	17'0"	32'0"	37'6"
20	33'5"	8'6"	15'11"	18'9"
15	22'3"	5'8"	10'7"	12'6"
11 (Citizens)	17'5"	4'6"	8'4"	9'9"
10	16'6"	4'3"	7'10"	9'3"
6	9'4"	2'5"	4'5"	5'3"

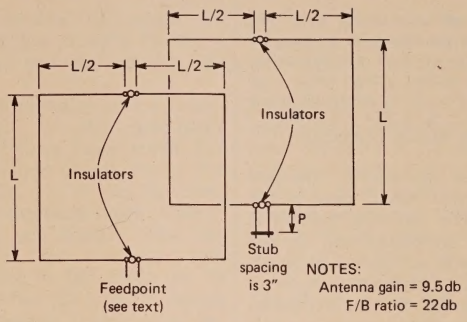


Fig. 4—Chart of dimensions for X-Q beam. Elements are made of wire supported by fiberglass or bamboo arms. A ten meter X-Q beam is about the same physical size as a 20 meter Quad. Antenna may be fed with quarter-wave open wire stub and balun for match to 50 ohm transmission line. (Drawing courtesy of Radio Publications, Inc.)

Quad-type antenna in *Amateur Radio*, the July, 1976 issue. That's the publication of the *Wireless Institute of Australia*. The article was by VK5NO and described a 'double-delta' Quad design (fig. 6). This is a single loop design."

"Two delta loops, each with sides one-half wavelength long, are mounted with their bases parallel and with their apexes at a common point vertically above the center point of the base rectangle. At the common apex point the delta sides from diagonally opposite corners are connected together, thus placing the

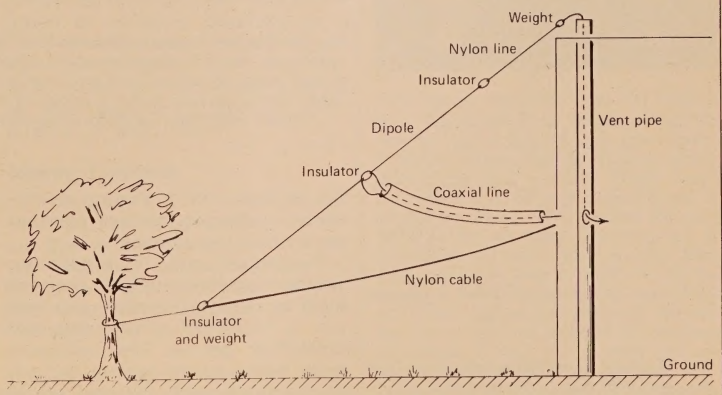


Fig. 5—The "invisible" apartment house antenna of ON8US. The dipole is supported by transparent nylon fishing line and runs between a vent pipe on the apartment roof and a "cable" strung between the apartment and a nearby tree. A nylon line runs down the vent pipe. It is weighted on the top end so that it plays out automatically when the lower end is released. The lower end of the dipole slides along the "cable". By loosening the top end and pulling on the coaxial line, the dipole is brought up against the apartment when not in use.

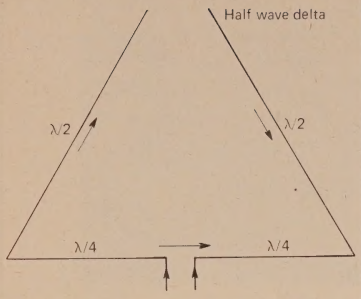


Fig. 6—The half wave delta loop. The feedpoint opposite the apex is low impedance. This large loop exhibits power gain over the more-common delta loop whose sides are about one-third wavelength long. (Fig. 6, 7 and 8 courtesy of the Wireless Institute of Australia).

wires in series connection. The feed point is midway along one of the base sides. The radiation pattern is bidirectional, perpendicular to the base sides, with a figure-8 pattern."

"This is an expanded version of the delta loop (fig. 7). Two expanded loops are connected together so that they are out-of-phase, in the manner of the W8JK beam. The antenna would presumably be more effective if the planes of the deltas were parallel and vertical rather than sloping inward towards the apex, but this would complicate construction.

"Feed impedance is close to 200 ohms, so a 50 ohm line and a 4-to-1 balun are used. To achieve lowest s.w.r., the length of wire is pruned. Ideally, all sides should be pruned equally, but VK5NO pruned only one delta to achieve a low value of s.w.r. and that did the trick, with no apparent effect on antenna performance. The final step was to place 15 meter elements inside the 20 meter elements for two band performance."

"What is the spacing between the loops at the base?", inquired Pendergast, sketching the antenna into his notebook.

"According to VK5NO, the dimension X in the drawing is 12 feet for the 15 meter band and 18 feet for the 20 meter band. Varying this dimension changes the feed point impedance of the antenna".

Pendergast said, "I imagine the way to build this is to have a central mast to support the apex, and then run a horizontal boom out, with crossarms on it. The crossarms could serve as the bottom sections of the beam, with the rest of the elements made out of wire" (fig. 8).

"That sounds like the way to do it", I agreed. "Why don't you build one up and see how it works?"

Pendergast sighed. "First of all, I have to get this power supply back together again, or I'll be low man on the DX totem pole. I'll have to use my exciter and intermediate amplifier. And who ever heard of working DX with only 500 watts p.e.p.?"

"Remember, it is ninety percent operator and ten percent station", I replied. "You seem to be rewriting the saying. Well, no matter. The energy shortage will catch up with you sooner or later. And then you'll have to learn to work DX with low power—say maybe a kilowatt or so". ■

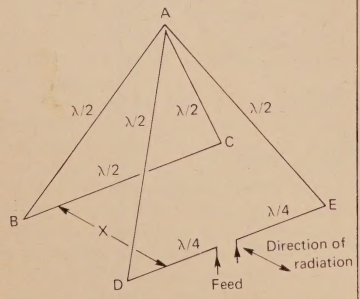


Fig. 7—Two expanded delta loops are mounted with their bases parallel and horizontal and their apexes at a common point vertically above the center point of the base rectangle. At the common apex point the delta sides from diagonally opposite corners are connected together. The feedpoint is at the middle of one of the base sides. The antenna is bidirectional perpendicularly to the base sides.

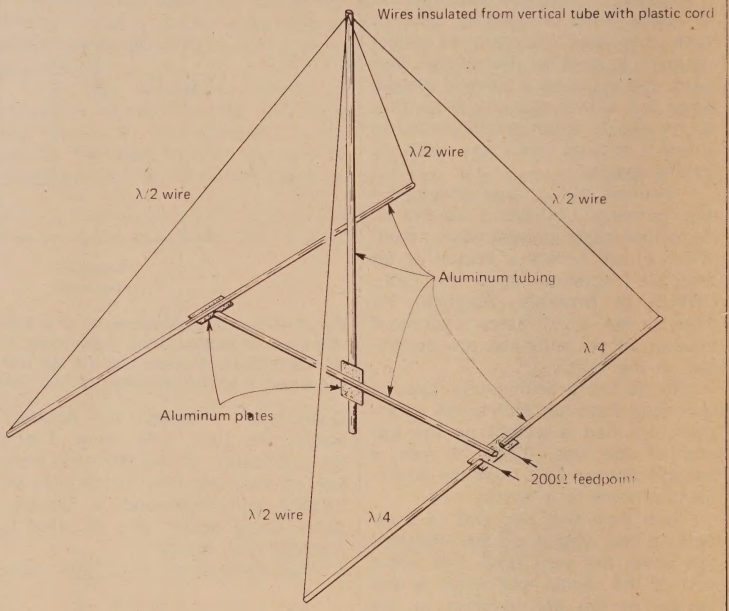


Fig. 8—The mechanical arrangement of the VK5NO expanded Quad. The two base elements are made of aluminum tubing supported by a horizontal boom in the manner of a Yagi beam. A vertical aluminum mast supports the apex, which is insulated from the mast. One of the base tubes is broken at the center for the feedpoint, which is approximately 200 ohms. The beam is fed with a 50 ohm coaxial line and a 4-to-1 balun.

FREE CLASSIFIED ADS IN CQ

a monthly feature by

HERBERT S. BRIER, W9EGQ

Novice

"How to" for the newcomer to Amateur radio

Is this frequency busy?

Do we need a new Q signals meaning "Is this frequency busy?" Some recent letters to this column says "Yes." The claim is that with such a signal, an operator could transmit "Q---?" on a frequency before calling CQ, another station, or starting a net on the frequency. If someone answers "Yes," the caller can shift frequency and try again. A number of operators in the amateur phone bands habitually ask "Is anybody using this frequency?" whenever shifting to a new frequency. Sometimes, it is not unusual to query a number of apparently unoccupied frequencies to be told each time that the frequency is occupied. On the other hand, getting no response is no guarantee that the frequency is free. As often as not it seems that after querying the frequency without response and calling CQ, you hear a voice on the frequency saying something like, "O.K. But someone with a wooden receiver came on asking if anybody was using the frequency and then opened up with a long-winded CQ. Boy! If he couldn't hear your signal, he wouldn't pay any attention to me, either. Oh well. He's got as much right to the frequency as we do, I guess."

On 14 MHz c.w. a few months ago, however, while listening for a station to call or for a frequency to call CQ on, I found 14,027 kHz open, Whammo! when I stood by after calling CQ, several signals were sending "lid," "jerk," others were sending "QSY," and still others were apparently trying to tell me something. Although I could not copy any of them well because of the mutual interference they were generating, I got the message that the frequency was no place for a peaceful man and moved up the band a few kHz and worked someone.

Later I discovered I had stumbled across a frequency where a DX-pedition station was supposed to appear to give the world's DX'ers a new country, and the station was late!

That was a situation that a Q-signal meaning "Is this frequency busy?" might have been useful. But we do not have to invent one for the purpose. "QRL——?" fits the need very well. Without the dash, "QRL?" means "Are you busy?" With the dash, it means, "Is —— busy," with the user filling in the blank as he wishes; therefore "QRL freq?" means "Is this frequency busy?" And the one-letter answer on c.w. is "C" (Yes) or "N" (No.). How valuable an operating tool it is is open to some question, however.

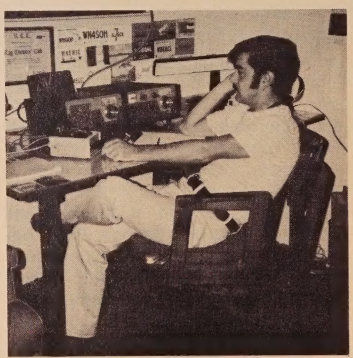
Practically all amateur frequencies for which propagation conditions are favorable are always busy during the popular operating hours. And except for those handling communications pertaining to emergencies covering life and property, no amateur has any more or less legal right to operate on any frequency his license authorizes than any other amateur or group of amateurs operating as a "net" or individually. As a result, the name of the game in making contacts in the amateur bands is doing so while causing the minimum interference to each other.

Making Contacts

There are only two fundamental methods of making contacts on the air. One is to transmit your call letters on the air and indicate that you will answer calls from other stations. The other is to respond to these "general calls" or "CQ's."

An operator wishing to contact anyone in range may tune his transceiver or receiver around the band until he finds a frequency with room for one more signal on it and calls "CQ" "CQ CQ CQ DE WA9ABC WA9ABC WA9ABC CQ CQ CQ DE WA9ABC WA9ABC WA9ABC CQ CQ CQ DE WA9ABC WA9ABC WA9ABC K." He then listens for replies usually very close to his transmitting frequency. Sometimes he hears several stations responding. When that occurs, it is usually a good idea to concentrate on one of the callers and hope to work the others another time. Other times, he may hear other stations calling CQ or calling and working other stations. Or the frequency seems as quiet as it did before his CQ, which could persuade him to try another one.

Let us try to guess why the sample CQ above might not be answered.



Rick Adams, WB6FSP, 6155 Via Casitas Ave., Carmichael, Calif. 95608, earned his Novice license a year ago after taking a Novice course given by Armond Noble, W6AJY. He uses a Drake TR-4C transceiver and a RV4C in conjunction with a ground-mounted 14-AVQ vertical antenna. WB6FSP has 45 states confirmed and is staying up very late to work the other five. Rick, of course, likes to work DX, but he is also a great ragchewer and has a RCC certificate. But he feels the most interesting part of amateur radio is the interesting people it leads you to meet. We are sending Rick WB6FSP a one-year subscription to CQ Magazine for sending us this prize-winning picture in our Monthly Photo Contest. If you would like to try your luck, send a clear picture of yourself at your station accompanied with some details of your radio career to Photo Contest, c/o Herbert S. Brier, W9AD, CQ Magazine, 409 South 14th St., Chesterton, Ind. 46304.

*409 So. 14th St., Chesterton, Ind. 46304.

PROTECT YOUR HAM SHACK

HOME ALARM

Complete Kit Features:

* Deluxe closed circuit panel mounted in steel enclosure
* 8 inch steel underdome bell mounted in steel tamper proof box
* 3 open circuit heat sensors (135 deg.)
* 3 sets magnetic door contacts
* 300 feet self adhesive window foil
* 500 feet of 2 conductor twisted pair 20 gauge wire
* Key operated shunt switch for remote disarming of system
* Assorted contacts and hardware
* Complete instructions, American made 90 day guarantee, Professional material

$129.95

FINEST

VEHICLE ALARM

Available Featuring:

* Advanced current sense circuitry
* Loud siren (115 DB)
* No door switches or fender mounted cutoff switches necessary
* No holes left in car if unit is removed
* Automatic cutoff for false alarms (required by some noise abatement laws)
* Mercury tilt switch prevents jacking or towing (protects your tires)
* Automatic 15 second entry and exit time delay. Alarm is turned on and off from inside the car with a hidden switch
* Complete detailed instructions, no special tools or skills required, installs quickly, American made, 90 day guarantee

$79.95

POSTPAID, N.Y. residents please add 8% tax POSTPAID, N.Y. residents please add 8% tax

HOWTRONICS CORP. DEPT C, 3210 AVENUE H, BROOKLYN, N.Y. 11210
many other items also available

First, very possibly no one in range was interested in working another WA9 at the moment, even though the signal was perfectly readable. Second, the CQ was too long. At five words per minute, the example would take over three minutes to send; and at 15 w.p.m. it would take over a minute. And many CQ's are longer than the example. Unfortunately, CQ's longer than a minute are largely self-defeating; because, after a minute, many amateurs tend to listen for something more interesting or to call CQ himself. This is one reason why long CQ's often seem to start out in the clear and end covered up by interference. Third, maybe the sending was not too good. Too many of us have a tendency to run the characters in our call signs into a meaningless jumble of dots and dashes. Many operators have trouble trying to copy good sending and have no interest in trying to copy poor sending.

On an active band, it is usually better to make a series of short calls —"CQ CQ CQ DE WA9ABC WA9ABC K"—or even a single "CQ DE WA9ABC K," pausing between bursts for replies, rather than making long calls. If you do not raise someone the first time, you can repeat as often as you like. Short calls have a built-in advantage. By calling CQ on the clearest frequency available, your signal has a minimum of interference to overcome, and the signals answering your CQ share the same advantage as long as conditions on the frequency remain unchanged. But conditions often change very suddenly, and the previously-interference-free frequency is overflowing with strong signals that are not interested in working you.

Modern amateur transceivers and receiver-transmitter combinations are usually designed for effortless switching from the "receive" mode to the "transmit" mode simply by sending a single dot or dash on the station key. This action automatically mutes the receiver and turns on the transmitter. The latter then keys normally until the operator pauses in his sending to shut off the transmitter and unmute the receiver again. The length of time that the transmitter "holds in" after the least dot or dash is sent can be varied from a few milli-seconds to several seconds. With this feature, c.w. contacts can become conversations instead of alternate monologues. When either operator pauses in his sending, the other can send "BK" (break) and reply immediately.

Mobile and Portable Designator Now Unnecessary

Effective November 26, 1976, amateurs are not required to give the FCC prior notice of extended mobile or portable operation nor are they required to indicate when they are operating mobile or portable. Such indication is not forbidden, however. Alien amateurs operating in the United States are still required to notify the FCC when they intend or are likely to operate away from their permanent location for periods in excess of 48 hours. All amateurs are still required to have a permanent address through which the FCC can reach them promptly if necessary. Also the new rules do not relieve an amateur who changes his permanent address of the necessity of applying for a change of address before starting operation from the new location and within four months of the actual move.

Sponsors of amateur operating activities in which the actual locations of the participants are important are rewriting their rules to require contestants to sign "portable" or "mobile" when operating out of their own call areas.

A new form 610—application for individual amateur new and modified licenses—are now available. It is longer than the old form 610 but easier to understand. Do not worry if you get an old form; they will still be used until the stock is exhausted.

News And Views

As of October 1, 1976, the U.S. Amateur population was 283,000, compared to 258,000 a year ago, and still climbing.

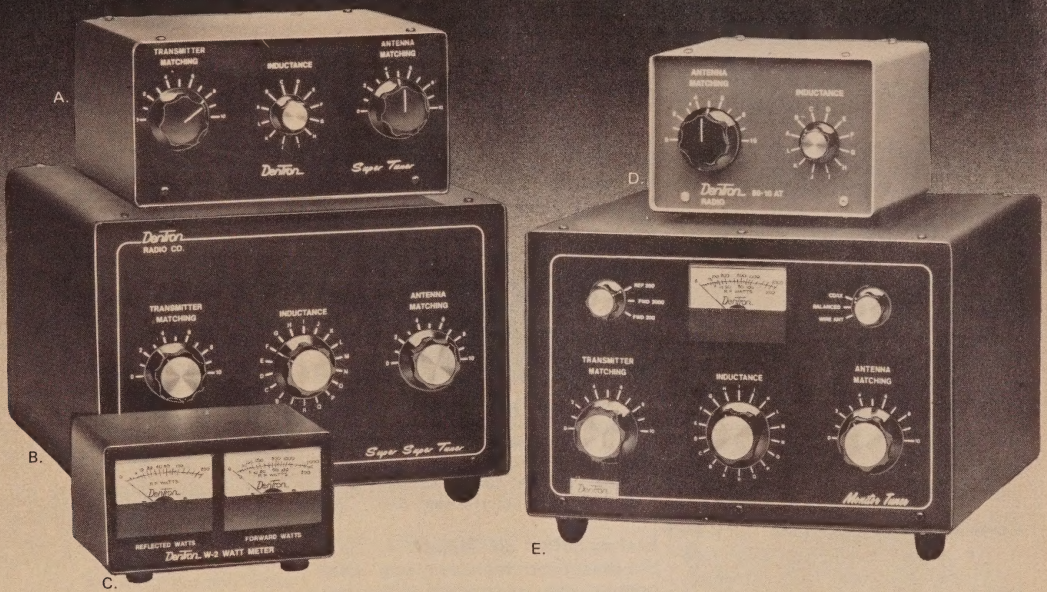
Kenneth R. Caplin, WB6RRE, 922 Baywood Dr., Newport Beach, Ca. 92260, was last on the air 18 years ago as Novice WV2RKM/5 while attending Oklahoma U. in Norman, Okla. The interest has been there all the time, but time wasn't. Recently, I spent some time at Henry Radio in Anaheim listening to CB radio. Their short distance contacts made me remember hearing Texas, New York, and California on my old Hammarlund HQ-145C receiver. I started to study for a new Novice ticket and got WB6RRE. This ticket will not expire; I plan on getting at least an Advanced before I stop. Code is simple. I can copy 18 w.p.m., but I have a little problem with theory, yet. The new sophisticated equipment available today is unreal! It makes my old B&W 5100B transmitter look and feel like an anchor! I am interested in a Kenwood 820 or a Heath SB-104. With an antenna coupler, I think I can overcome the handicap of living in an apartment complex that does not allow outside antennas. Sneaky, but the only way I can go.

We are down to the bottom of the last page already! As always, you are invited to send your pictures, your tales of woe, and about the problems you had getting on the air. We like to hear from our friends! The address is: Herbert S. Brier, W9AD, Novice Editor, CQ, 409 South 14th St., Chesterton, Indiana 46304.

73, Herb, W9AD



Does Your Transmitter Love Your Antenna?



If you're fighting the constant battle of limited band width, high SWR ratios, inefficient low-pass TVI filter operation due to high SWR you're not alone.

DenTron makes the Problem Solvers.

The DenTron tuners give you maximum power transfer from your transmitter to your antenna, and isn't that where it really counts?

Our Super Tuners (A. B. & E.) are the only tuners on the market that match everything between 160 and 10 meters. Whether you have balanced line, coax cable, random or long wire the DenTron Super Tuners will match the antenna impedance to your transmitter.

NEW: The Monitor Tuner (E.) was designed because of overwhelming demand. Hams told us they wanted a 3 killowatt tuner with a built-in wattmeter, a front panel antenna selector for coax, balanced line and random wire. So we engineered the 160-10m Monitor Tuner. It's a life time investment at $299.50

The DenTron 80-10 AT (D.) is a random wire, 80-10 meter tuner which is ideal for portable operation or apartment dwellers.

Every serious ham knows he must read both forward and reverse wattage simultaneously for that perfect match. So upgrade with the DenTron W-2 Dual in line Wattmeter. (C.)

The flexibility we build into our Tuners make any previous tuner you might have owned obsolete.

A. Super Tuner 1KW PEP	$129.50
B. Super Super Tuner 3 KW PEP	$229.50
C. W-2 Wattmeter	$ 99.50
D. 80-10 AT 500 W PEP	$ 59.50
E. Monitor Tuner 3 KW PEP	$299.50

All DenTron products are made in U.S.A.

DenTron Radio Co., Inc.
2100 Enterprise Parkway
Twinsburg, Ohio 44087
(216)425-3173

Dedicated to Making Amateur Radio MORE FUN!

a monthly feature by
ROD LINKOUS, W7YBX

DX

News of communications around the world

DX columns are different things for different people. For me, this is a forum for the wide wonderful world of DX; a place for your and my thoughts on this fascinating part of our amateur radio hobby. In this column and those to come, I hope to share a view of DX from this vantage point, to offer stimulus for thought, and to tell about some of the fascinating people who make up the real world of DX. Often it may provoke. It is offered with the intent of improving. Due to the volatility of DX operating information, relating time sensitive information will probably be in the past tense.

Consistently Inconsistent

The announcement of two new countries (Comoro and Mayotte) brings mixed emotions: one is of elation at the fact there is another pair of new countries to chase, and the feeling that maybe the government bureaucrats have something with their rigid operating procedures.

Establishment of the Comoro Islands, D6A, and Mayotte, FH8, as new countries previously the Comoro Islands, FH8, took effect July 6, 1976. These new countries are not unlike the establishment of Tuvalu, VR8, (from the Ellice, Gilbert and Ocean Islands, VR1) on January 1, 1976. But this time, the seemingly same criteria was interpreted differently. In the Tuvalu case, the Gilbert and Ocean islands were NOT made a new country at the same time Tuvalu was recognized.

It seemed when most of the amateur community has a good chance to work the pair, the DXCC ruling results in TWO new countries. If the pair is tough for the majority, the DXCC ruling results in ONE new country. It seems the rules for this situation are flexible to the point of misuse.

Another case in point is the country pair of Sable, VX, and St. Paul, VY, islands versus the Pribilof Islands off the Alaskan coast. Sable and St. Paul are separately administered in a similar sense at ITU, 4U1ITU; Mt. Athos, SV; and San Marino, M1 or 9A. Yet the Pribilof Islands which are not part of the state of Alaska, are under the separate administration of the United States federal government. However, this does not qualify them for separate country status. Under U.S. Public Law 89-702 (The Fur Seal Act of 1966) the Pribilof Islands are under the administration of the federal Commerce Department, which puts them in the same category as Sable and St. Paul islands. May be it is unfortunate they are not in the same ocean.

One more for the case book: the Republic of the Seychelles, S79. When the island nation became one, Aldabra, Desrouches and Farquahr were deleted from the countries list. No new countries resulted. The Republic of the Seychelles, S79, is a bigger country now but not new in the eyes of the DXCC countries list. Maybe if it became smaller in the process we might have had another new country. The ruling on the Seychelles is in keeping with the Tuvalu precedence but contradicts the Comoro and Mayotte case. In the context of the Comoro and Mayotte precedence, all four countries should have been deleted and a new one recognized: the Republic of the Seychelles, S79.

This item is to stimulate your thoughts on a very involved but im-

*5632 47th Ave. S.W., Seattle, Washington 98136



Who needs a state-of-the-art commercial station to work DX? Sylvio Jarkiewicz, SP2FAP, ran his 150 watt home brew station to recently grab KG6SW (Saipan) for a new one.



The top Italian amateur on the 2×SSB DX Honor Roll is Dr. Alfonso Porretta, I0AMU. He too needs the new D6A and FH8, but not for long. The other three evasive ones are: China, BY; Clipperton, FO; and Kingman Reef, KP6.

The CQ DX Awards Program

S.S.B.	C.W.
471...I5BWJ	251...GM4DKO
472...I8SRP	252...W7OK

C.W. Endorsements

250...WA5VDH 150...DJ1YH

S.S.B. Endorsements

310...VE3MJ 300...VE2WY 300...VE3MJ
310...W6RKP 300...VE3GMT 200...WB5HVY

Complete rules and application forms for the CQ DX Awards program can be obtained by sending a business size, No. 10, envelope, self-addressed and stamped to: "CQ DX Awards", 5632 47th Avenue S.W., Seattle, Washington 98136, U.S.A.



Bob Pierce, WB0CGJ, of Lakewood, Colorado did it the hard way; 150 countries via QRP. All that wall paper with low power.



Yama, JA1SGU, at the controls of 8J2-HAM, the special commemorative station on the occasion of the second All Japan Hamvention at the foot of Mt. Fuji. Those who use the JARL QSL bureau should thank Yama for the excellent service as he is the bureau manager. He is active 80 through 10 meters, usually on c.w. (Photo JH1VRQ)

portant subject. If the DX segment of our hobby is to maintain its high status it MUST retain its high standards. It appears the DXCC rules are rules. Yet, do the decision makers realize consistency is not an idealistic goal of rule making but an imperative requirement. Not unlike common law, a DXCC ruling establishes precedence. Once a rule is formulated, it should be applied across the board with uniform impartiality. Uniformity without external influence is a vested responsibility not easily executed.

Maybe the government bureaucrats aren't efficient, but they are consistent. Unfortunately, if the bureaucrats ran the DXCC we would have a Baldwin's Reef in every ocean and in each of the seven seas; that is if they could find enough sea mountain tops.

If we have thrown the ball into the weeds, then it is time to go get the ball and throw it back into play. I believe DXing is one facit of amateur radio well worth the effort.

The Big Feat

There was real significance in the WAZ Awards box published in the January *CQ*. The accomplishment hidden in the single small entry is by no means a minor feat. Working 100 countries on 80 meters s.s.b. is certainly a challenge. John Devoldere, ON4UN, has over 275 countries on that band alone. The ultimate challenge is to work 40 stations with one in each of the 40 world zones for WAZ; this is really working the world. To the thousands still after one or two remaining zones on any band, 80 meter WAZ seems like the impossible dream. Yet another amateur got the job done and earned 80 Meter SSB WAZ certificate number 2—the big voice from southern California avocado ranch, Dale Hoppe, K6UA.

The CQ WPX Program

Mixed

563...I1PLN
564...W6NT
565...DJ1ND

S.S.B.

963...G3ZBA
964...I6AYS

C.W.

1560...JA3EQC
1561...W6NT
1562...SP5FLA
1563...SP9BBH
1564...DM2CJN
1565...DM2BTO

WPNX

92...AB5RPU
93...WN3YMA

Endorsements

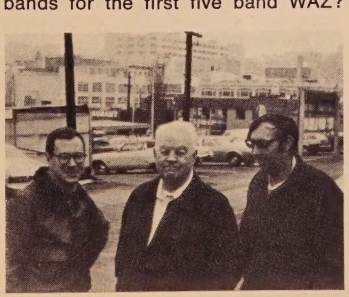
MIXED: 1102 WB4SIJ, 849 YU2ODS, 848 I3ANE, 700 W9EVD, 454 W6NT, 421 I1PIN, 400 DJ1ND.
SSB: 964 WB4SIJ, 962 UB5WE, 902 F2YT, 950 WA2EAH, 663 YU1ODS, 605 W6YVK, 467 JA3WBK, 441 I6AYS, 400 WA7OBH, 316 G3ZBA.
CW: 1372 W8LY, 1002 K8MFO, 914 WA2HZR, 701 DM2BTO, 648 YU1ODS, 600 W9EVD, W1OJP, 500 VE3GCO, 450 SP9BPF, 433 W6NT, 402 VE3HLC, 400 OK3IF, 350 K2UPR, 342 DM2CJN, 308 SP9BBH, 300 JA3EQC, SP5FLA.
10 Meters: W4CRW
15 Meters: W4CRW, I3ANE, DM2BTO
20 Meters: ZD8TM, W4CRW, SP6FER, WA7OBH, DM2BTO
40 Meters: W4CRW, VE3GCO, DM2BTO
80 Meters: W4CRW, SP5FLA, I3ANE, VE3GCO, OK3IF, DM2BTO
160 Meters: W4WSF
Africa: W4CRW, I3ANE
Asia: I3ANE, W4CRW, YU1ODS, DM2BTO
Europe: YS1JWD, ZD8TM, W4CRW, SP9BPF, SP5FLA, SP9BBH, I3ANE, I6AYS, DJ1ND, OK3IF, YU1ODS, K2UPR, DM2BTO
No. America: W4CRW, YU1ODS
Oceania: W4CRW
So. America: I3ANE, W4CRW

Complete rules for WPX can be found in the May, 1976 issue of CQ Magazine. Application forms may be obtained by sending a business size, self-addressed, stamped envelope to "CQ WPX Awards", 5014 Mindora Dr., Torrance, CA 90505, U.S.A.

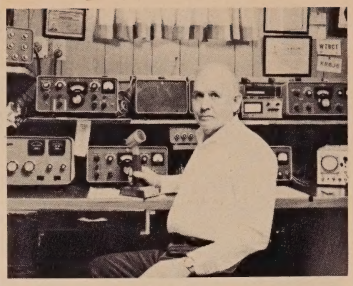
CONGRATULATIONS DALE!

Dale is not a newcomer as many of you recall the days of W6VSS (Very Strong Signal). He passes on some advice. Dedication coupled with years of planning and hard work will yield one of the most coveted of all DX awards "THE CQ 80 METER SSB WAZ." The route to success is one of devotion, persistence, schedules and untold hours on an uncompromising band. It will not be without disappointments and long waits for those QSL cards.

Dale: how about the other four bands for the first five band WAZ?



Terry Barham, DU3BS, (left) and Danny Douglas, VS6DD, (right) met Bill Bennett, W7PHO, at the Seattle Dog House for lunch. Terry and Danny "Dollar" were on their way through to new assignments. (Photo W7BCT)



Jim Barrows, W7BCT, of Bothell, Washington recently qualified for the difficult single band WAZ award on 20 meters. Jim's XYL Ramona WA7UFS, is also on the bands and now has her advanced class license.

Anyone else interested in a 5BWAZ? Write us.

CQ DX Honor Roll

This month's Honor Roll has every characteristic of a roller coaster; down four (Comoro, FH8; Aladabra, VQ9; Desrouches, VQ9; and Farquahr, VQ9) and up two (Comoro, D6A, and Mayotte, FH8). The new top rung of the Honor Roll ladder is 319. After auditing all the Honor Roll records, the effect was down four for most. For those who fell off the Honor Roll, check your recent QSL cards and submit an update.

It was interesting to note during the Honor Roll audit that the four most wanted countries are: China, BY; Clipperton, FO; Iraq, YI; and Malpelo, HK0. Mt. Athos, SV; Bouvet, 3Y; and Albania, ZA, were close behind.

The new calls in this month's listing includes: N6AV (ex WA6GLD) and W4UG (ex W4NJF).

CQ DX Awards Checkpoints

The awards program gained another teammate: Don Brickley, W7OK. Most of you know Don and have received many a new QSL card for the countries he manages. Don can be reached at Box 95, Las Vegas, Nevada 89101. He joins checkpoints: DL3RK, G3FKM, I8KDB, VE3GMT, W1AM, W2GT, K2FL, W4UG, W4WSF, W4KNW, K4AEB, K5YMY, WA5ZNY, K6AHV/W6RJ, W6EJJ, W6TCQ, W8IMZ, WA8TDY, W9DWQ and W0SFU. Welcome aboard Don.

SEA-Q-DX Convention

The 1977 ARRL Northwestern Division convention will be held in Seattle, Washington on 29 to 31 July. This seems out of place in a DX column. Normally it would be, but the theme of the convention is noteworthy. This is a multiple conven-



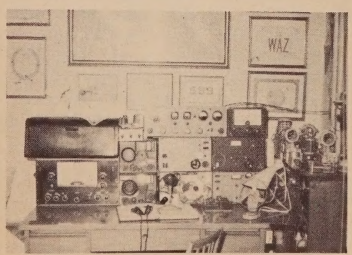
The amateur behind the big 40 meter c.w. signal from Liechtenstein as HB0NL is Frank Acklin, HB9NL. He is a great c.w. operator who is also speedy with the QSLs.

tion. The annual Northwest DX convention will be held in conjunction with the event. It even made the convention title *(SEA*ttle-QCWA-*DX).* The DXers have a big part of the program. The main banquet speaker is Hank Myer, W3ACE or ex EP3AM et al. Hank is to speak on living DX. The DX main speaker is John Devoldere, ON4UN, the master of 80. John will spend the period discussing, what else, 80 meter DX and his new book "Success on 80 Meters." The antenna man himself, Rush Drake, W7RM, will be on dock to tell how to put up bigger and better antennas to stay.

A visiting DXers list reads like Fresno North. The list of Japanese DXers is already growing long.

The 80 Meter Sport

Working DX on this band is a real challenge. Not only to actually accomplish the communications feat, but to tolerate the environment takes endurance. It is not just the static crashes, high noise levels and compromising antennas but some of the



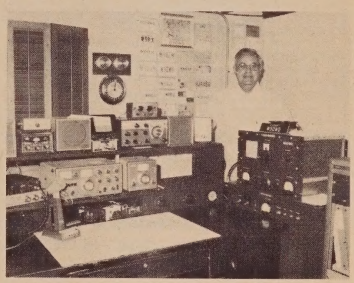
The impressive record of Emil Holm, OK1AEH, is the envy of many. Emil has over 100 countries on 3.5 and 7 MHz c.w. from his Praha QTH. The wall paper illustrates only a few of his many awards.

operating habits. Does this look familiar?

> **"Operating Ethics:** Fair play and good sportsmanship in operating are required of all amateurs working towards the ..... In the event of specific objections relative to continued poor operating ethics, an individual may be disqualified from the ....."

The quote is in the fine print of almost every DX award program rules including DXCC. But listening to the 80 meter pileups the other night, I'm not sure anyone reads the fine print. Sportsmanship according to Webster's dictionary is the "skill of a sportsman." A sportsman is "one who exhibits qualities especially esteemed by those who engage in the sport."

There are some qualities in the 80 meter sport that are especially esteemed by this writer. Helping your fellow DXers heads the list.



The CQ DX Awards checkpoint for the Northern Illinois DX Assn. is Ed Goodbout, W9DWQ. From this station, Ed has 312 countries on 2×SSB. First licensed in 1938, Ed has held other calls and is an avid DXer. Ed operates from his summer cottage in Wisconsin as WB9TJC.

Help comes in many forms. One form is not jumping in the pileup just to flex your r.f. muscles and work the same station or country for the umphteenth time.

Some seem not to realize that rarity is relative. To a DXer in Florida, Surinam, PZ, on 80 is not uncommon. Yet to a VE7, working Surinam on 80 is a real accomplishment considering the pileup in which he must excel. Likewise, Western Samoa, 5W, to W6-land is not the same as to W2-land.

The 80 meter DXers who stay out of the pileups when they have already confirmed the country are the real unsung heros of 80. To them I take off my hat and say thanks from those who still need the one you let us chase.

Another big help are the big guns

The WAZ Program
Single Band WAZ
20 Meter C.W.

15...ON4KK

S.S.B. WAZ

1359...JA1JXU

C.W.—Phone WAZ

4043...JF1PJK
4044...WA4OPW
4045...K3LWM
4046...ON6BC
4047...I3ZJQ
4048...JA8KB
4049...W6MA
4050...JA3HZT
4051...YU3EP
4052...W2NCI
4053...YU1NFR

Phone WAZ

526...W8IHD

The complete rules for all WAZ awards are found in the May, 1976 issue of *CQ*. Application blanks and reprints of the rules may be obtained by sending a business-size, self-addressed, stamped envelope to the DX Editor, P.O. Box 205, Winter Haven, FL 33880.

who bring order to chaos. There are several rarer countries whose only active stations speak just their native tongue and deplore pileups. If it were not for some of the DX mcees, the country would be worked by only a few. A couple of the mcees of note are: Otto Degner, W5LKN and Sam Canter, W6TSQ. To them, this months kudos. For the Alligator Award of the month (mostly mouth and tiny ears) the list is too long to single out credit for a few. In which group do you have nominees?

Tricks of the DX Trade

In my last column, I started relating some of the lesser known rules of DXing. Rules are just part of the tricks; the others are hints. Some of the hints are applicable to all. Most hints will help everyone to get a new country or two.

In the columns to come I hope to share some of the rules and hints that make up the tricks of the DX trade. They are offered in hopes that others may profit from our successes and avoid our mistakes.

Rule one is **PERSISTENCE.** Rule two is **LISTEN.** This one rule can benefit beyond one's wildest expectations. Unfortunately the elusive rare DX station comes and goes as others are rag chewing somewhere else on the band. Often on the same band at the same time.

Here are some more Hints and Rules:

Rule 41. Watch the DX nets. Many of the not so rare DX stations check into the DX nets to handle traffic and to get away from the pileups. Often the wait for your turn is worthwhile.

Hint 60. The buddy system (or four ears are better than two). Not everyone has a friend who enjoys DX with equal fervor. Most of us have at least one buddy who is working his way up the DX ladder. Try sharing your need list with him/her in exchange

CQ WPX Award Of Excellence

W4WSF, John C. Kanode, 1 Jan. 1977, with 160 Mtr. bar.
K6JG, Pete Billon, 1 Jan. 1977.
WA5VDH, Rick Roderick, 1 Jan. 1977.
WA2EAH, John Yodis, 1 Jan. 1977.
W6TCQ, Bob Huntington, 1 Jan. 1977.
W4CRW, Bob Sommer, 9 Jan. 1977.
VE3GCO, Garry Hammond, 10 Jan. 1977.

for his/her need list. Even if his list is much longer than yours, you'll be pleasantly surprised when you alert him to a new one. It is often better to give than to receive. He may hear the one you need when you are doing something else, like rag chewing up the band. With mutual alerting, your on-the-air-time per new country should be reduced. This is especially effective for those with limited time or when temporarily committed to other projects.

Hint 61.4. The one ringer. One of the best selective DX alerting systems is the telephone. In some instances a phone call is disruptive—like after midnight. A simple solution is a local phone ring code between you and your buddy. The one ringer is an excellent technique. By mutual agreement, one ring indicates meet me on a particular band. The agreement should recognize that no response can be common. *(Tnx to W7YTN)*

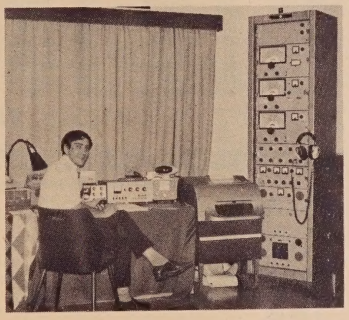
Rule 80. Keep track of DX activity. When you have passed the mid point to the Honor Roll, each new one gets harder. A trick the Honor Roller uses is to start a file on each needed country. Especially important is the current activity if any. Most rarer DX operators are creatures of habit. They usually work the same frequencies and times. They often have single band capability and their operation fits the work schedule. So start a sheet on each station with its reported operating habits. Small 4 by 6 cards work well. Pay attention to trends and repeated events. It is easier to show up at the right time and place than take DXing by chance.

Hint 81. Check the DX contest results. Many countries are on the air just for the DX contests. Even when some rarer DX stations operate intermittently, they will spend considerable effort during certain contests. Last years results may give a good insight to a particular DXer's operating mode and habits.

Hint 81.3. Work the DX contests. Even though you may not enjoy contesting, many new countries can be added during a very short period. Most DX contesters run top quality stations and they work the pileups fast. Be selective, but do not ignore one of the best means to get a new one. Who knows, you might even enjoy it.

Hint 125.2. SASE stands for Self Addressed Stamped Envelope. When a QSL manager receives your card with a SASE his work is easier and you get a quicker response. Unfortunately many forget the stamp. (Without the stamp it is a SAE) Occasionally the enclosed SASE is not addressed. Check your SASE to make sure it is legible and complete.

Hint 125.4. Place the SAE or SASE in the outgoing envelope correctly. Most mail receivers use letter openers. Improperly placed enclosed envelopes get cut in two when the outer envelope is opened. Place the



Geoff Smith, A9XBD, operates this impressive station from Bahrain. His recent CQ DX 2×SSB award is one of many accomplishments. Geoff warns of extreme delay in receiving QSLs via surface mail, many taking seven months. His XYL, Anne, handles the cards. Geoff is ex: A4XVE, G4AJJ, MP4BHY, MP4QHY, 3B8-DQ and 4W1GS. He is currently active on all but 40 meters.

enclosed envelope so the folded edge is away from the outer envelope top.

Rule 126. Every QSLer should have a rubber stamp with his name and address. Return of mail to you is enhanced if the postal service can read the address. The cheapest means is a rubber stamp. The self inking rubber stamps are available through most stationery stores and printers. Be sure to add the country (i.e. USA) for foreign mail use.

DX Hot Spot

At the time of this writing the Caribbean has so many DXpeditions in being that the pileups are competing against each other. The Colvins, Lloyd and Iris, are slowly but



The CQ DX Awards checkpoint in Italy is John Paul Nucciotti, I8KDB. John Paul is one of Europe's top DXers whose wall displays a 5BDXCC. He is a Senior Project Engineer for the electrical power systems in Naples.

surely exhausting the rarity of the Caribbean islands. With the severe winter season in the eastern United States, they got a lot of help. Highly transportable transceivers and reasonably priced air fares make the Caribbean inviting to all of us. Before you join the gang in the Caribbean, check the licensing rules as the DXpedition may be over before the license is issued. Many articles have appeared recently on Caribbean licensing.

DX Club—1977 Style

One important role the local DX club plays is that of hospitality. When visiting foreign DXers drop by to meet the local gang, organization can save a lot of embarrassment. Most clubs have an unofficial greeter who meets and introduces the guest DXer around. Unfortunately this sometimes is the case when the DX club meets. In this day of a mobile society, foreign visitors are commonplace. If your DX club does not have a Hospitality Committee, recommend one. This is one club job assignment that can be rewarding and educational.

To the many foreign DXers and those who will visit the Northwestern



One of Germany's best QSLers is Fritz Bach, DK1OU. Fritz is a recent recipient of CQ DX award.

2 METER CRYSTALS IN STOCK

FOR THESE RADIOS ON STANDARD ARRL REPEATER FREQUENCIES

Clegg HT-146
Drake TR-22
Drake TR-33 (rec only)
Drake TR-72
Genave
Heathkit HW-2021 (rec only)
Heahtkit HW-202
Icom/VHF Eng
Ken/Wilson
Lafayette HA-146
Midland 13-505
Regency HR-2
Regency HR-212
Regency HR-2B
Regency HR-312
Regency HR-2MS
S.B.E.
Sonar 1802-3-4, 3601
Standard 146/826
Standard Horizon
Swan FM 2X
Tempo FMH
Trio/Kenwood
Trio/Kenwood TR2200
Trio/Kenwood TR7200

KENSCO COMMUNICATIONS Dept. 30776
Box 469
Quincy, MA 02169
(617) 471-6427

master charge | BANKAMERICARD

MILITARY SURPLUS WANTED
Space buys more and pays more. Highest prices ever on U.S. Military surplus, especially on Collins equipment or parts. We pay freight. Call collect **now** for our high offer. 201 440-8787.
SPACE ELECTRONICS CO.
div. of Military Electronics Corp.
35 Ruta Court, S. Hackensack, N.J. 07606

GOING 160-190 KHZ?
NOW you can uncover the whole 100-600 KHz band with YOUR receiver. CONVERTER has 20dB gain, antenna matching and 3.5-4 MHz output. ALL parts, coils, printed circuit, case etc, instructions, airmail, send $19.80 NOW.
CAMBRIDGE KITS 45 (CR) Old School Lane, Milton, Cambridge, U.K.

United States, the Western Washington DX Club in Seattle, wishes to introduce their Hospitality committee: co-chairmen Gene Eggebraten, W7GVF and Don Walters, W7JEG. As the WWDXC will be the host for the Northwestern DX convention in Seattle as part of ARRL Northwestern Division convention, they wish to invite visiting DXers to meet their members.

If your club has a Hospitality Committee, let us know so that we may pass the information along.

The local DX alert net on 2 meters is one method a visiting DXer lets his presence be known. In a previous column a list of DX alert nets were given. Here are a few more:

CQ DX Honor Roll

The CQ DX Honor Roll recognizes those DXers who have submitted proof of confirmation with 275 or more countries for the mode indicated. The top SSTV DXers are also listed. The ARRL DXCC Country List, LESS DELETED COUNTRIES, is used as the country standard. Total number of current countries on the DXCC as of this listing is 319*. Honor Roll listing is automatic when submitting application or endorsement for 275 or more countries. To remain on the CQ DX Honor Roll, annual updates are required. Honor Roll updates may be submitted anytime.

CW

W6PT	317	W4YWX	308	W4IC	301	W4BQY	296	W6NJU	284
K6EC	313	W2GT	307	W6ISQ	301	W6JG	295	WA6EPQ	282
W6ID	312	W8LY	305	WØAUB	298	VK3AHQ	292	K1SHN	279
ON4QX	311	W9DWQ	303	K6LEB	298	WA8DXA	287	DJ7CX	276
W8KPL	309	N6AV	302	DL3RK	297				

SSB

W2TP	317	W3DJZ	310	WA2EOQ	304	OZ3SK	296	K1KNQ	286
K2FL	316	W6EL	310	K6YRA	303	WØSFU	296	W6HUR	286
W4EEE	316	W6KTE	310	VE2WY	303	W2CNQ	295	W9OHH	286
TI2HP	315	F9RM	309	VE3GMT	303	WAØCPX	295	DJ7CX	285
WA2RAU	315	SM6CKS	309	WA3IKK	303	W4WSF	294	G3KYF	284
DL9OH	314	W6YMV	308	K3GKU	302	W6TCQ	294	K1SHN	284
G3FKM	314	WA6AHF	308	K4MQG	302	I5WT	293	WB2RLK	282
IØAMU	314	I8YRK	307	ZL1AGO	302	VE7WJ	293	YV1LA	282
W3CWG	314	IØZV	307	OE2EGL	301	K6AQV	292	SP5BSV	281
W6RKP	314	K9WEH	307	W6NJU	301	WA2HSX	292	WAØKDI	281
W3NKM	313	ZL3NS	307	ZS6LW	301	WB6DXU	292	WB6PNB	281
W9ILW	313	F2MO	306	I4ZSQ	299	HP1JC	291	XE2YP	281
W4SSU	312	I6FLD	306	W6KZS	299	W0YDB	291	OE1FF	280
W4UG	312	K6EC	306	W9KRU	299	W9YRA	290	OE3WWB	280
W6EUF	312	K6JG	306	YV1KZ	299	DL6KG	289	WA4WTG	280
W6REH	312	SM5SB	306	EA4LH	298	VE7CE	289	DL1MD	279
W9DWQ	312	SM6CWK	306	W9QLD	298	W6FW	289	OK1MP	279
I8AA	311	W9JT	306	F9MS	297	K4HJE	288	WB4SIJ	279
VE3MJ	311	KH6BB	305	XE1AE	297	YS1O	288	W3CRE	278
W3AZD	311	W2QK	305	G3DO	296	DK2BI	287	VE7HP	277
I8KDB	310	W4IC	305	G3TJW	296	W6FET	287	XE1KS	276
IT9JT	310	K4RTA	304	K8DYZ	296	G3RWQ	286	W9MIJ	275
VE3MR	310	K6WR	304	N6AV	296				

SSTV

W8YEK 108

*FH8 — Comoro, VQ9 — Aldabra, VQ9 — Desrouchs, and VQ9 — Farquahr were deleted; D6A — Comoro, and FH8 — Mayotte were added since last Honor Roll.

Lake Cook DX Assn
Waukegan, Illinois
147.96

Northern Illinois DX Assn
Elmhurst, Illinois
147.36

Northern Florida DX Assn
St. Johns, Florida
147.795/147.195

National Capitol DX Assn
Washington, D.C.
147.42

Southern New England DX Assn
Cumberland, Rhode Island
147.66/147.06 or 147.44

Southeastern DX Club
Stone Mountain, Georgia
147.50

South Florida DX Assn
Plantation, Florida
147.93/147.33

Willamette Valley DX Club
Portland, Oregon
147.75/147.15

73 and good DX, Rod, W7YBX

QSL Information

CT4AT—To W1JFL
D2AAI—To W7VRO
D6AA—To FH8CE
D6AB—To F6CXT
DKØGD/ST—To DL9IL
FB8WE—To F6APG
FB8WJ—To F6APG
FB8XO—To F6CRT
FH8GV—To F8FI
FOØGC—To WA6AHF
FW8CO—To F6AXY
FY7AQ—To WB4BUP
HH2EL—To K6KII
HL9TJ—To K6VA
HL9WI—To WA5ZWC
ISØLYN—To WA1VSJ
JA1TES/5A—To JA1TES
JW7FD—To LA5NM
JW8KT—To LA5NM
JX2FL—To LA4YF
K7VPF/VP2A/KV4/VP2D—(U.S. To K7VPF; DX To JA1RUR)
KA1IJ—To W7BUN
KC4AAC—To W7ODK
KC4AAE—To WØ0W
KG4JS—To WB5HGS
LU1BR—To LU8AJG
OH3PE/OH0—To OH3PE
OH3XT/OH0—To OH3XT
OHØXZ—To OH3XZ
PAØSPD—To W4JVU
PJ8KG—To YASME
S79R—To G3LQP
TN8L—To K1LHT
TU4AK—To W7VZX
VC9UM—To VE4VV
VE2ZN/SU—To VE2YM
VK9ZM—To VK4ABW
VKØAC—To VK2ZQK
VKØLD—To VK2RS
VP1KS—To DK1KS
VP2D/K7VPF—(U.S. To K7VPF; DX To JA1RUR)
VP2DD—To W2BZL
VP2EEQ—To YASME
VP2LDT—(U.S. To K7VPF; DX To JA1RUR)
VP2LDU—To JA1KSO
VP2SZ—To WB8ODA
VP2VDK—To KP4BDL
VP5CNL—To W8CNL
VP5M—To WB4QKE
VR1AF—To W7QK
VRØCX—To HB9AJA
WA6EGL/VQ9—To W4FLA
WB4ZKG/KC6—To WA7ZTL
WB6UAG/FM0—To WA6AKK
WB9EWH/VQ9—To WA4FVT
ZD8C—To KP4EKI
ZF1RD—To W4BAA
ZS3KC—To WA4MAV
3AØFY—To F9UW
3D2RM—To WB5MXO
4M2YV—To YV2YV
4S7CF—To VE3BOZ
4S7JK—To DL7JK
4W9QR—To DK2PP
5H3JR—To W2SNM
5T5CJ—To W4BAA
7XØBI—To YO8AHL
8PØA—To WA4RRB
9D5A—To WA6AHF
9L1JH—To W4BAA
CT9AT—P.O. Box 15, Helsinki, 40 Finland 00401
PYØA—Box 383, Curacao, Netherlands Antilles
SVØWA—c/o SV0WY, APO NY 09223
ZD8AA and **ZD8W**—Vic Walz, 107 Leonard St., Dumfries, VA 22026

a monthly feature by

GEORGE JACOBS, W3ASK

Propagation

The science of predicting radio conditions

It's still too early to tell for sure, but there is more and more evidence which points to June or July of last year as the date sunspot cycle 20 came to an end and a new cycle began. The Swiss Federal Observatory at Zurich reports a monthly sunspot number of 16 for January, 1977. This results in a smoothed sunspot number of 13.2 centered on July, 1976. This is a slight increase from the 12.6 level recorded for June.

In addition to this small increase in solar activity, the *number* of spots from the new cycle were as numerous as those from the old cycle during July, with new cycle spots increasing steadily since then. Add to this the very small, but steady increase in solar flux levels since last July, and it's beginning to look like the new cycle is underway.

Solar scientists will have to sift through the data to establish the exact starting date for the new cycle, but if it turns out to be July, 1976, then Cycle 20 lasted 11.8 years and ended with the highest minimum ever observed. We'll have more to say about the new cycle, Cycle 21, a little later this year.

A smoothed sunspot number of 18 is forecast for May, 1977.

Twenty meters should continue to be the best band for DX propagation during the month. Opening shortly after sunrise, expect good DX conditions to one area of the world or another, throughout most of the day and well into the evening hours on this band. Conditions should peak for an hour or two after sunrise and again during the late afternoon hours, with openings possible to most areas of the world. When conditions are HIGH NORMAL, or better, expect the band to remain open, often with exceptionally strong signals to many areas of the world, well after sundown and into the hours of darkness. A considerable improvement is also expected in short-skip openings between distances of approximately 350 and 2300 miles. Quite often, particularly during the afternoon hours, optimum conditions may exist for both short and long skip, with stations a few hundred miles away QRMing DX stations.

Expect some fairly good DX openings on **15 meters** during the daylight hours, particularly towards southern and tropical regions when conditions are HIGH NORMAL or better. Best time to check for DX is during the afternoon hours. An increase in short-skip openings, between approximately 600 and 2300 miles, can be expected during May.

An occasional DX opening towards deep South America, or into the South Pacific area may be possible on **10 meters,** particularly during the afternoon hours when conditions are HIGH NORMAL, or better. Frequent short-skip openings between distances of about 750 and 1400 miles, however, should be possible on many days.

Shorter hours of darkness and higher static levels in the northern hemisphere mean less DX on **40, 80** and especially **160 meters.** But some fairly good openings are still expected on **40 meters,** and to a lesser extent on **80 meters,** from about an hour or two after sundown, through the hours of darkness, and until sunrise.

If you're very patient and can stand the increased static levels, look for some DX openings on 160 meters as well, during the hours of darkness, and particularly during the sunrise period.

Good daytime short-skip openings are expected on **40 meters,** ranging between 150 and 750 miles, and extending out to the one-hop limit of 2300 miles during the hours of darkness. On **80 meters,** look for excellent short-skip openings during the daylight hours, ranging between 50 and 250 miles. During the hours of darkness, the short-skip range should increase to about 1800 miles, and considerably further when static levels subside. Expect short-skip openings up to about 1000 miles on **160 meters** during the hours of darkness, with a chance for longer openings during periods of low static.

V.H.F. Ionospheric Openings

Sporadic-E ionization usually increases considerably during May, and some fairly frequent **6 meter** short-skip openings should be possible. These are most likely to occur over distances between approximately 1000 and 1400 miles. Although sporadic-E openings can happen at any time of the day or night, the best time to check is between 10 a.m. and 2 p.m., and again between 6 and 10 p.m., local daylight time.

During periods of intense and

LAST MINUTE FORECAST

Day-to-Day Conditions Expected For May, 1977

Propagation Index	*Expected Signal Quality* (4)	(3)	(2)	(1)
Day				
Above Normal: 4, 31	A	A	B	C
High Normal: 5-6, 9, 12, 14-15, 22-23, 29	B	B	C	D
Low Normal: 3, 7-8, 11, 13, 16, 20-21, 24, 26, 30	B	C	D	E
Below Normal: 1-2, 10, 17, 19, 27-28	C	D	E	E
Disturbed: 18	D-E	E	E	E

Where *expected signal quality is:*

A—Excellent opening, exceptionally strong, steady signals greater than S9+30 dB.

B—Good opening, moderately strong signals varying between S9 and S9+30 dB, with little fading or noise.

C—Fair opening, signals between moderately strong and weak, varying between S3 and S9, with some fading and noise.

D—Poor opening, with weak signals varying between S1 and S3, and with considerable fading and noise.

E—No opening expected.

HOW TO USE THIS FORECAST

1. Find *propagation index* associated with particular band opening from Propagation Charts appearing on the following pages.
2. With the *propagation index*, use the above table to find the expected signal quality associated with the band opening for any day of the month. For example, an opening shown in the charts with a propagation index of (3) will be fair to poor (C-D) on May 1st and 2nd, fair (C) on the 3rd, excellent (A) on the 4th, good (B) on the 5th and 6th, etc.

For updated information dial Area Code 516-883-6223 for DIAL-A-PROP, subscribe to bi-weekly MAIL-A-PROP, P.O. Box 86, Northport, NY 11768.

*11307 Clara St., Silver Spring, MD, 20902

POWER

measurements with off-the-air safety



Model 334A
Dummy Load/Wattmeter

1000 Watt Rating, DC to 300 MHz, intermittent CW

52-ohm, non-inductive load, oil cooled

4 calibrated ranges:
0 to 10 W, 0 to 100 W,
0 to 300 W, 0 to 1000 W

See your dealer or write direct.

B&W **Barker & Williamson**
Canal Street • Bristol, PA 19007

NOVICE-GENERAL CODE COURSES

GET YOUR HAM LICENSE. LEARN TO RECEIVE CODE ONCE AND FOR ALL. QUICKIE 1 OR 2 CASSETTE METHODS OFTEN DON'T WORK DUE TO INSUFFICIENT PRACTICE MATERIAL. THIS NEW METHOD SUCCESSFULLY USED BY PEOPLE FROM 10 TO 65 YEARS OLD INCLUDES NOVICE TRAINING SCHEDULE, REFERENCE MATERIALS, CHECKING SHEETS TO VERIFY ACCURACY.

STANDARD 2 TRACK MONAURAL CASSETTES PROVIDE 60 MINUTES EACH OF SCIENTIFICALLY PREPARED CODE PRACTICE (LETTERS, NUMBERS, PUNCTUATION, CODE GROUPS, WORDS). CASSETTES ARE DESIGNED TO MINIMIZE LEARNING PLATEAUS.

0-6 WPM (Novice License) 6 CASSETTES $19.95
0-8 WPM (Novice License) 7 CASSETTES 22.95
7-14 WPM (General Class License) 3 CASSETTES 9.95
First class postage required per CASSETTE 0.40

HERRMAN CO.
DEPARTMENT F BOX 110 1, LARGO, FLA. 33540

widespread sporadic-E ionization, two hop openings considerably beyond 1400 miles may be possible for brief periods on **6 meters,** and short-skip openings between approximately 1200 and 1400 miles may also be possible on **2 meters.**

If the very intense sporadic-E ionization in the North Atlantic region observed last summer repeats itself again this year, look for occasional multi-hop openings between the east coast of North America and western Europe on **10 meters.**

The *Eta Aquarids* meteor shower should intersect the earth's atmosphere between May 4 and 6. This should be a major shower, reaching maximum intensity during the early morning of May 5, with an average of 20 meters an hour. Chances are good for meteorburst short-skip openings during the three day period of this shower.

Not much auroral activity expected during May, although some may occur during periods of radio storminess. Check the "Last Minute Forecast" at the beginning of this column for those days that are likely to be BELOW NORMAL or DISTURBED during May.

73, George, W3ASK

HOW TO USE THE SHORT-SKIP CHARTS

1. In the Short-Skip Chart, the predicted times of openings can be found under the appropriate distance column of a particular Meter band (10 through 160 Meters), as shown in the left hand column of the Chart. For the Alaska and Hawaii Charts the predicted times of openings are found under the appropriate Meter band column (15 through 80 Meters) for a particular geographical region of the continental USA, as shown in the left hand column of the Charts. A ** indicates the best time to listen for 10 meter openings; * best times for 160 meter openings.

2. The *propagation Index* is the number that appears in ( ) after the time of each predicted opening. On the Short-Skip Chart, where two numerals are shown within a single set of parenthesis, the first applies to the shorter distance for which the forecast is made, and the second to the greater distance. The index indicates the number of *days* during the month on which the opening is expected to take place, as follows:
(4) Opening should occur on more than 22 days
(3) " " " between 14 and 22 days
(2) " " " between 7 and 13 days
(1) " " " on less than 7 days
Refer to the "Last Minute Forecast" at the beginning of this column for the actual *dates* on which an opening with a specific propagation index is likely to occur, and the signal quality that can be expected.

3. Times shown in the Charts are in the 24-hour system, where 00 is midnight; 12 is noon; 01 is 1 A.M.; 13 is 1 P.M., etc. On the Short-Skip Chart appropriate *daylight* time is used at the *path midpoint.* For example, on a circuit between Maine and Florida, the time shown would be EDT; on a circuit between N.Y. and Texas, the time at the midpoint would be CDT, etc. Times shown in the Hawaii Chart are in HST. To convert to daylight time in other USA time zones, *add* 3 hours in the PDT zone; 4 hours in the MDT zone; 5 hours in CDT zone, and 6 hours in the EDT zone. *Add* 10 hours to convert from HST to GMT. For example, when it is 12 noon in Honolulu, it is 15 or 3 P.M. in Los Angeles; 18 or 6 P.M. in Washington, D.C.; and 22 GMT. Time shown in the Alaska Chart is given in GMT. To convert to *daylight* time in other areas of the USA, *subtract* 7 hours in the PDT zone; 6 hours in the MDT zone; 5 hours in the CDT zone and 4 hours in the EDT zone. For example, at 20 GMT it is 16 or 4 P.M. in N.Y.C.

4. The Short-Skip Chart is based upon a transmitted power of 75 watts c.w. or 300 watts p.e.p. on sideband; The Alaska and Hawaii Charts are based upon a transmitter power of 250 watts cw or 1 kw p.e.p. on sideband. A dipole antenna a quarter-wavelength above ground is assumed for 160 and 80 meters, a half-wave above ground on 40 and 20 meters, and a wavelength above ground on 15 and 10 meters. For each 10 db gain above these reference levels, the *propagation index* will increase by one level; for each 10db loss, it will lower by one level.

5. Propagation data contained in the Charts has been prepared from basic data published by the Institute For Telecommunication Sciences of the U.S. Dept. of Commerce, Boulder, Colorado, 80302.

CQ Short-Skip Propagation Chart
May & June, 1977
Local Daylight Savings Time At Path Mid-Point

Band (Meters)	*Distance Between Stations (Miles)*			
	50-250	*250-750*	*750-1300*	*1300-2300*
10	*Nil*	08-09 (0-1) 09-13 (0-2) 13-17 (0-1) 17-21 (0-2) 21-23 (0-1)	08-09 (1) 09-13 (2) 13-17 (1-2) 17-21 (2) 21-23 (1) 23-07 (0-1)	08-09 (1-0) 09-21 (2-0) 21-23 (1-0) 23-07 (1-0)
15	*Nil*	07-09 (0-1) 09-13 (0-2) 13-17 (0-1) 17-21 (0-2) 21-00 (0-1)	07-09 (1-2) 09-13 (2-3) 13-17 (1-2) 17-19 (2-3) 19-21 (2) 21-00 (1) 00-07 (0-1)	07-09 (2-0) 09-13 (3-1) 13-17 (2-1) 17-19 (3-1) 19-21 (2-0) 21-07 (1-0)
20	*Nil*	07-09 (0-2) 09-12 (0-3) 12-17 (0-4) 17-19 (0-3) 19-23 (0-2) 23-07 (0-1)	07-08 (2) 08-09 (2-3) 09-12 (3-4) 12-17 (4) 17-19 (3-4) 19-20 (2-4) 20-21 (2-3) 21-23 (2) 23-07 (1)	07-08 (2) 08-09 (3-2) 09-15 (4-2) 15-17 (4-3) 17-20 (4) 20-21 (3) 21-23 (2) 23-07 (1)
40	08-10 (0-2) 10-16 (1-4) 16-18 (2-4) 18-20 (1-3) 20-22 (0-2) 22-08 (0-1)	08-10 (2-4) 10-15 (4-2) 15-16 (4-3) 16-19 (4) 19-20 (3-4) 20-22 (2-3) 22-08 (1-2)	08-09 (4-3) 09-10 (4-2) 10-15 (2-1) 15-16 (3-1) 16-19 (4-2) 19-20 (4) 20-22 (3-4) 22-01 (2-4) 01-03 (2-3) 03-08 (2)	08-09 (3-1) 09-10 (2-1) 10-16 (1-0) 16-19 (2-1) 19-20 (4-3) 20-01 (4) 01-03 (3) 03-06 (2) 06-08 (2-1)
80	08-10 (4) 10-18 (4-3) 18-20 (4) 20-22 (3-4) 22-00 (2-4) 00-06 (2-3) 06-08 (3-4)	08-10 (4-1) 10-16 (3-0) 16-18 (3-1) 18-20 (4-2) 20-00 (4) 00-06 (3-4) 06-08 (4-3)	08-09 (1) 09-10 (1-0) 10-16 (0) 16-18 (1-0) 18-20 (2-1) 20-22 (4-3) 22-02 (4) 02-06 (4-3) 06-08 (3-2)	08-09 (1-0) 09-18 (0) 18-20 (1-0) 20-22 (3-2) 22-02 (4-3) 02-06 (3-2) 06-08 (2-1)
160	06-09 (4-1) 09-10 (2-0) 10-19 (1-0) 19-21 (3-1) 21-23 (4-2) 23-06 (4-3)	06-09 (1) 09-19 (0) 19-21 (1-0) 21-23 (2-1) 23-01 (3-2) 01-04 (3) 04-06 (3-2)	08-09 (1-0) 09-21 (0) 21-23 (1) 23-01 (2-1) 01-04 (3-2) 04-07 (2) 07-08 (1)	08-21 (0) 21-01 (1) 01-04 (2) 04-06 (2-1) 06-07 (1) 07-08 (1-0)

ALASKA
Openings Given In GMT

To:	*15 Meters*	*20 Meters*	*40 Meters*	*80 Meters*
Eastern USA	*Nil*	00-02 (1) 02-04 (2) 04-05 (1) 12-14 (1)	07-10 (1)	*Nil*
Central USA	00-02 (1)	01-03 (1) 03-05 (2) 05-06 (1) 13-15 (1)	08-12 (1)	*Nil*
Western USA	00-03 (1)	00-02 (1) 02-04 (2) 04-06 (3) 06-07 (2) 07-08 (1) 14-15 (1) 15-18 (2) 18-20 (1)	08-09 (1) 09-14 (2) 14-15 (1)	10-14 (1)

HAWAII
Openings Given In Hawaiian Standard Time

To:	*15 Meters*	*20 Meters*	*40 Meters*	*80 Meters*
Eastern USA	12-15 (1)	06-08 (1) 10-14 (1) 14-16 (2) 16-18 (3) 18-19 (2) 19-20 (1)	19-20 (1) 20-23 (2) 23-00 (3) 00-01 (2) 01-02 (1)	21-00 (1)
Central USA	12-14 (1) 14-16 (2) 16-17 (1)	06-07 (1) 07-09 (2) 09-14 (1) 14-16 (2) 16-17 (3) 17-18 (4) 18-19 (3) 19-21 (2) 21-22 (1)	19-20 (1) 20-21 (2) 21-01 (3) 01-02 (2) 02-04 (1)	20-21 (1) 21-00 (2) 00-02 (1) 22-01 (1)*
Western USA	13-17 (1)** 09-14 (1) 14-17 (2) 17-18 (1)	05-06 (1) 06-07 (2) 07-09 (3) 09-11 (2) 11-16 (3) 16-18 (4) 18-20 (3) 20-21 (2) 21-23 (1)	18-19 (1) 19-20 (2) 20-22 (3) 22-02 (4) 02-04 (3) 04-05 (2) 05-07 (1)	19-20 (1) 20-22 (2) 22-03 (3) 03-04 (2) 04-05 (1) 22-03 (1)*

See explanation in "How To Use Short-Skip Charts" which appears in the box at the beginning of this column.

* Indicates best time for 160 Meter openings.

** Indicates best time for 10 Meter openings.

Note: The Alaska and Hawaii Propagation Charts are intended for distances *greater* than 1300 miles. For shorter distances, use the preceding Short-Skip Propagation Chart.

a monthly feature by

A. EDWARD HOPPER, W2GT

Awards

News of certificate and award collecting

The "Story of The Month" for May, courtesy of Frank is:

Francis H. Heller, W2CUC
All Counties #154, 7-21-76

"Mount Holly, N.J. was my place of birth and the date was June 8, 1908, I was the eldest of 8 children, 2 brothers and 2 sisters are still living. My Grandparents had a small farm at the edge of town and on my way to visit them, when I was about 14, I noticed a huge, long 4 wire flat top antenna about 50 feet in the air and a small shack in the yard. My Grandfather knew the family so I had my first chance to see a wireless station which belonged to William Ford, now W2RQC. About that time I found a small old booklet with the title, I believe, *"How to build a wireless station,"* also a catalog of wireless telephone sets, parts and other goodies, it had pictures of sets using DeForest Audion tubes mounted on the front panel—that was exciting.

"I took the small booklet to school and hid it in my geography book so I could read it without losing any more time. My next step was building a crystal set using a cats whisker and I used my Mothers rolling pin to wind the coil on, that little trick brought me 9 lashes on the seat of my pants, but the coil was made and it could never again be a rolling pin. After finding where I could get the Galena crystal and a head phone (one, not a set), I put up an antenna and lo and behold, I heard WOO the John Wanamaker Store in Philadelphia.

"I ran home from school every day to hear the Wanamaker Grand Organ. Next I heard KDKA, Pittsburgh and WGY, Schenectady. I read an ad in a magazine on how to get a crystal set for selling 25 boxes of handkerchiefs, which I did, but that set was not as good as my homebrew set, but I still have it.

*P.O. Box 73, Rochelle Park, NJ 07662.

Special Honor Roll
(All Counties)

#163—Charles E. Gagnon, Jr., W1LQQ 1-18-77.

#164—Thomas E. Storm, Sr., WA0YJL 1-24-77.

#165—Herbert E. Skidmore, W5RDV 1-24-77

"I started a paper route and did odd jobs to get money to build a one tube set using a WD 11 tube and honey comb coils, then a 3 tube set with a 3 circuit tuner. I next tried building the wireless transmitter from the little booklet plans and instructions, but instead of making the spark coil, I found a Model T Ford spark coil, it worked fine but it seemed that I was not the only one around with a receiving set, so there was my first case of BCI, and my Father made me take the transmitter apart.

"Shortly I got out of school and went to work as an electricians helper for about 2 years. I had to walk or ride my bike several miles to get to and from work, so I bought a Model T Ford junker and rebuilt it, so now I had wheels (as the expression is now) and along came GIRLS, so the radio work came to a stand still for awhile.

"My Dad worked in textile designing and got me started in that work when I found I could make more money than doing electrical work (that was then, not NOW). I studied textile designing but didn't follow through with it. I became interested in radio again and built a regenerative set with detector and 2 stages of audio with which I copied everything, including press, for code practice. I met two friends, W3BNI (later W2BNI) Elmer Bintliff, now a silent key, and W3AIO, Les Darrell still active in Baltimore, they both helped me to get my first license as W3CUC in November 1932.

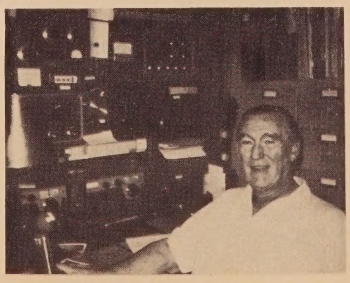
"I built a Hartley oscillator using a 201A tube, then a TNT using a 210 tube, then to a larger rig using a 210 osc. and a Western Electric 211D and a home built transformer that put out 1600 volts, but the old 211D didn't last long, it arced over inside and was gone. Conditions were getting bad about this time, the depression hit hard and I guess I forgot to say I was married now and we had 2 children. Everybody was busy tring to find enough work to keep going and survive. I attended the Philadelphia Wireless School and later started a radio appliance repair shop. I closed the shop after that fateful day of December 7, bringing on World War II.

"I went to work for RCA in Camden, N.J. and one year later I enlisted in the U.S. Army Air Force as a radio specialist for three years.

"I left the service in late 1945 and went back to work for RCA in Camden and opened my repair shop on a part time basis, built a kw rig and was back on the air as soon as we were permitted. About this time the FCC changed our call area and I became W2CUC. I read in *QST* that the next day was the last day to take the exam for the Class A license for

USA-CA Honor Roll

3000		2000		1000	
W5RDV	183	K7WUR	269	WA2PCF	432
2500		**1500**		**500**	
WA6CPP	232	K7WUR	316	DL70R	1155
		CT1UE	317		



Frank Heller, W2CUC.



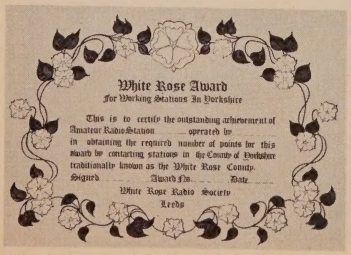
World Wide DX Association Award: Rules page 77, CQ, December '76 or write W5AT.

phone operation, so W2BNI and I took our lunch hour from RCA and went across the river to Philadephia and passed the exam, we weren't on fone but the Class A would no longer be available.

"I was taking some evening courses at Rutgers and was not too active but the bug hit again and I went back at it in a big way. Later I joined CHC and QCWA and discovered I had about 900 counties but I soon gave up counties and certificates to chase DX. I soon found out that much DX was located in the low ends of the bands, so I went to Philadelphia and got my Extra license in 1968. By 1972 I had collected 5BDXCC #192, 5BWAS #121, WAZ and about 270 DXCC.

"I retired from RCA in June 1973 and thus had more time for hamming, and one afternoon I ran across the County Hunter Net, so from July '73 to July '76 I got the rest of them to make All Counties #154. During May and June I kept looking for the last 3 needed counties, then May 29, Ralph, W9JR gave me Grainger, Tennessee; June 30, Willie, K5WQW went out of his way to give me Moore, also in Tenn. On July 1, Skip, WA0WOB went out of his way to give me Hardin, Illinois for the very last one!

"I wish to thank all the Mobile Operators, Fixed stations and Net Controls for making it possible. I still experiment and build gear, make the printed circuit boards for my projects, do some repair jobs but nothing too large, but it gives me a few pennies to spend on radio (my Wife calls it my first love). In the winter I work 160 meters where I have 30 countries and 45 states confirmed. I have worked 50 countries on QRP (5 watts). I also do some RTTY and operate 2 meters and have plans for Oscar 6 and 7 work. I am giving up repair work, I have enough to do mowing the lawn, house repairs and the 'Honey-do' jobs my Wife gives me and my hobby—RADIO"



The White Rose Award.

Awards Issued

Charlie Gagnon, W1LQQ, made USA-CA-3000 and *All Counties* endorsed All S.S.B.

Dr. Tom Storm, WA0YJL, also qualified for *All Counties.*

Herb Skidmore, W5RDV, who designs antennas for Radio Shack, was pleased to get them *All!*

Paul Schuett, WA6CPP (WA7PEI, KQ6ITU) added USA-CA 2500 to his collection, endorsed All S.S.B.

Carol Kimber, K7WUR picked up USA-CA-1500 and 2000, endorsed All S.S.B.

Cesar Santos, CT1UE was issued USA-CA-1500, endorsed All S.S.B., #2 1500 to CT1.

Lew Zell, WA2PCF won USA-CA-1000 endorsed All S.S.B., and increased the endorsement of his USA-CA-500 to include All 75 and All Mobiles.

Dietmar Knorr, DL7OK applied for USA-CA-500, endorsed All S.S.B.

Awards

The Stratford ARC Award: The Stratford Amateur Radio Club (Canada) is pleased to announce a special certificate award in honor of the Stratford Festival Theatre's 25th Season. It features a screened sketch by VE3JF of the world renowned Stratford Festival Theatre. The rules are:

1. Time period January 1, 1977 to December 31, 1977.
2. Eligibility—All properly licensed Radio Amateurs and SWLs.
3. Mode—Any mode properly endorsed by respective federal communications authorities.
4. Required contacts—Any two Perth County stations using the special prefix VF3 on the amateur radio bands 160 through 10 meters. Any six Perth County stations using the special call prefix VF3 on the amateur bands 6 and 2 meters. The same station may be worked more than once providing contacts are made on two separate amateur bands.
5. Send QSL cards with proper log information along with 50¢ or two IRCs to The Stratford Amateur Radio Club, Box 541, Federal Bldg. Stratford, Ontario, Canada N5A 6T7.



Tokyo 100 Award: Rules page 65 CQ, March '77.

Here is a list of stations who will be using the VF3 call prefix in 1977—ADX, AGW, AMG, BGI, BNM, CCX, CPX, CLS, CWL, DFN, DYL, DQR, DWC, EQQ, EMU, EXZ, ESB, FOK, FTN, FTU, GGP, GCO, HH, HOM, HOO, HDX, HKU, HLL, HYA, HYZ, JF, KBS, LSS, NWS, PE.

The White Rose Award: Issued for working stations in Yorkshire (old county), also available to s.w.ls. To obtain the Award, 50 points are required (DX stations outside Europe need 30 points), which may be worked as follows: 10 points for working the Club Station of the White Rose Radio Society, G3XEP or G8LVQ. 5 points for working a member of the White Rose Radio Society. 3 points for working other stations in Yorkshire, and there is no time limit. Send verifiable log data or GCR list, signed by a recognized Amateur Radio Association plus 10 IRCs or $2.00 or one pound to The White Rose Society, 83 Town Street, Armley, Leeds 12, England. No QSLs



The Stratford ARC Award.

a monthly feature by

FRANK ANZALONE, W1WY

Contest Calendar

News/views of on-the-air competition

An event that happened three months ago hardly seems topical although this is being written only a couple of weeks after the CQ 160 contest in January.

In a contact with one of the s.s.b. boys just before the contest, I got a very negative answer when I asked him if he would be participating over the week-end.

He was very incensed that it was a c.w. only activity and that s.s.b. was not included. Called it discriminatory, that both CQ and ARRL did not see fit to include the phone boys in their 160 contests.

Speaking for ourselves, and I am sure I can include the ARRL, we did not intentionally discriminate against the phone boys when we organized the 160 contests.

In our case since ours is a DX contest we felt that c.w. was a more practical mode for 160 DX operation. Can you imagine what a fiasco it would be if we had a c.w./phone going at the same time.

Since there are only two 160 c.w. contests a year I can hardly see justification for this gripe. A phone only contest however might be in order.

In this particular case I think it was not so much a feeling of being left out but that the nightly get-together on 1815 kHz was being disrupted. *C'est la vie.*

We would not have this problem if the 160 band was divided into two segments, c.w. and phone, like the other bands. But that would be too simple.

Incidently we had a good one. Heavy QRN on Friday night made the going rough, but Saturday night things quieted down and the DX peaked up beautifully. I foresee many record breaking scores.

73 for now, Frank, W1WY

Calendar of Events

May	1-2	Connecticut QSO Party
May	7-8	Vermont QSO Party
May	7-9	Georgia QSO Party
May	14-15	Massachusetts QSO Party
May	14-15	Kansas QSO Party
May	14-15	Michigan QSO Party
May	14	World Telecomm. Phone
May	21	World Telecomm. C.W.
*May	21-22	USSR "CQ—M" Contest
May	21-22	New York State QSO Party
June	3-6	CHC/FHC/HTH QSO Party
June	11-12	RSGB National Field Day
June	11-12	ARRL VHF QSO Party
June	18-19	All Asian Phone Contest
June	25-26	ARRL Field Day
July	2-3	DL Group QRP Contest
July	9-10	IARU Radiosport Champ.
July	16-17	VHF Space Net Contest
July	16-17	10-10 Net Summer QSO Party
Aug.	27-28	All Asian C.W. Contest

*Not official

Connecticut QSO Party

Starts: 2100 GMT Saturday, April 30
Ends: 0200 GMT Monday, May 2

This party is again sponsored by the Candlewood ARA. The same station may be worked on each band and each mode for QSO credit.

Exchange: QSO no., RS(T) and QTH. County for Conn., ARRL section, province or country for others.

Scoring: One point per QSO, 2 points if its a Novice, 5 points if its with W1QI.

Conn. stations multiply total QSO points by ARRL sections and VE provinces worked. Others use Conn. counties for their multiplier. (max. of 8) Conn. to Conn. QSOs permitted.

DX contacts count for QSO points but only one additional multiplier can be claimed.

The club station W1QI will be active, c.w. on odd hours, s.s.b. on even hours.

Frequencies: C.w.—40 kHz up from bottom of each band. S.s.b.—3925, 7250, 14300, 21375, 28540. Novice—3725, 7125, 21125, 28125.

Mobiles and portables are required to give their location.

Awards: Certificates go to the highest scorer in each ARRL section, VE province and Conn. county. In addition a special WACC certificate will be awarded to stations working all 8 Conn. counties.

Mailing deadline for logs is June 1st to: Candlewood A.R.A., c/o Fred Porter, W1VH, 169 Carmen Hill Road (Nr. 2) New Milford, Conn. 06776

Vermont QSO Party

Starts: 2100 GMT Saturday, May 7
Ends: 0100 GMT Monday, May 9

Sponsored by the Central Vermont ARC this activity offers a good opportunity to work this comparatively rare state.

The same station may be worked on each band and mode for QSO and multiplier credit, and mobiles in each county change.

Exchange: QSO no., RS(T) and QTH. County for Vermont, ARRL section for others.

Scoring: Vermont stations score 1 point for each contact and multiply total by number of ARRL sections and counties worked. All others score 3 points for each Vermont station worked and multiply total by sum of Vermont counties worked *on each band.* (14 per band possible)

Frequencies: 3555, 3909, 3932, 7055, 7290, 14055, 14325, 21055, 21375, 28160, 28600, 50260, 50360, 144-144.5, 145.8 (Try c.w. on odd hours, phone on even hours GMT)

Awards: Certificates to the top scoring stations in each ARRL section, DX country, and 2nd, 3rd and 4th places in Vermont. Also multi-operator and mobile stations operating in Vermont. There are Trophies for the top scoring single operator in Vermont and out-of-state.

Contacts made in the Party may be credited for the W-VT Award for working 13 out of the 14 Vermont counties.

Mailing deadline is June 15th to: Peter Kragh, W1AYK/K2UPD, 170 Summit Ave., Ramsey, N.J. 07446. Include a s.a.s.e. with entry.

Georgia QSO Party

Starts: 2000 GMT Saturday, May 7
Ends: 0200 GMT Monday, May 9

This is the 16th annual party sponsored by the Columbus ARC. There are no time or power restrictions

*14 Sherwood Rd., Stamford, Conn. 06905

European 1976 Contest Results

Trophy Winners

Single Operator

C.W.	Trophy Winners	Phone
YU3EY	Europe	DM2DUK
D2AAI	Africa	9G1JX
UV9AX	Asia	4Z4MQ
W3LPL	N. America	W2GXD
PJ2VD	S. America	LU8AJG
KH6IJ	Oceania	

Multi-Operator

YU1BCD	Europe	UK3ABB
4J6A	Asia	UK9AAN
WA1ABV/1	N. America	K2IGW
	S. America	PY1ZBJ

Special Plaques

C.W.	Phone
UK2BAS	YU1BCD
UK9AAN	DL7AV
ZL3GO	I3PRK
	W2GXD

Single Operator

C.W.

U.S.A.

W3LPL	**506,996**
(Opr. WA3HRV)	
K3YUA	**488,755**
W2GXD	**384,150**
K1JHX	**296,014**
W1PL	**281,664**
K4YFQ	**224,114**
W9DD	**188,100**
K8HLR	**165,862**
W7IR	**102,258**
WA2MBM	102,256
WB4OGW	81,224
W4DHZ	61,004
AD4BAI	52,722
W3GRF	51,840
AA1LKX	50,856
AD6SDR	**50,648**
WA9SNT	48,392
WB9LHI	46,080
K4POL	43,456
AA6EPQ	42,054
W4BV	35,316
AC3ARK	31,680
W1HX	30,750
W2KHT	29,103
W4HOS	24,930
K4JD	22,559
W6BIP	19,952
AD9WEH	15,008
WAØKDI	**14,672**
W6MAR	14,456
AC#IUB	13,398
AC9OHH	13,040
WA8TDY	11,750
AA6GLD	10,608
AD5VTA	**10,252**
WB3BKD	6,528
W6YMH	5,922
W8DSO	5,676
AB4WHE/4	5,292
AC7LNG	4,294
WB4JYB	4,248
W6DGH	3,914
W1OPJ	3,600
WBØGQB	3,492
AA8EDC	3,420
WB8KOD	3,026
W2CUQ	2,240
WB9NME	2,014
AC9QWM	1,344
AC6KYA	1,120
AC4WSF	740
AC1CNU	270
AC4MLA/m	126

Canada

VE3KZ	**264,614**
VO1KE	**164,610**
VE1AIH	**82,232**
VE3EJK	53,600
VE3ECP	11,700
VO2BD	**10,476**
VE6MP	**10,300**
VE3BR	4,680
VE6AVO	2,988

Multi-Op.

WA1ABV/1	**419,328**
K2IGW	156,125
WA1STN	**144,448**
AA5ZWC	**70,077**

Phone

W1ZM	**544,050**
(Opr. WA2CLQ)	
W2GXD	**340,704**
WA3HRV	**306,294**
AC4WSF	**57,600**
WØZLN	**33,120**
WA1STN	29,224
WB9LHI	**25,536**
WB2JJN	20,736
AC8SQ	**14,592**
WB9NKH	14,504
W6AM	**13,144**
WA9BWY	11,440
WA2DHJ	9,891
WB4EDD	8,791
WA3DMH	8,120
W2LEJ	7,410
WB3BKD	4,536
WA2PAT	2,624
W4KMS	2,356
K500U	2,304
WB3AHN	2,050
W3GCQ/m	1,620
W6DGH	1,568
W6MAR	1,144
AB4WHE	40
AB4WFT	36
K5DEC	8

Multi-Op.

K2IGW	**153,750**

RTTY

WAØYDJ/4	**18,232**
K6WZ	**12,400**
WØMT	4,920
VE2QQ	4,662

Multi-Op.

W1MX	**57,400**

Trophy Winners

CT1EQ, DJ4KW/4X, WAØYDJ/4, W1MX, I1PYS.

and the same station may be worked on each band and mode, Georgia mobiles each county change. (Oscar counts as one band)

Exchange: QSO no., RS(T) and QTH. County for Ga.; state, province or country for others. Ga. to Ga. contacts permitted. Repeater QSOs not permitted except Oscar.

Scoring: Each QSO counts 2 points. Ga. stations multiply total by number of different states and VE provinces worked. Out-of-state stations use Ga. counties for their multiplier. (max. of 159) Dx may be worked for QSO points but have no multiplier value. Novices should clearly indicate same on their log.

Frequencies: C.w. — 1805, 3590, 7060, 14060, 21060, 28060. Ssb—3900, 3975, 7245, 14290, 21360, 28600. Novice—3718, 7125, 21110, 28110. Try 160 at 0300, 10 on the hour and 15 on the half hour during daylight hours.

Awards: Certificates go to the highest scorer in each state, province, country and Georgia county. Also 2nd and 3rd place awards where warranted, and to novices both in and out-of-state. There are Plaques for the top single and multi-operator Ga. stations, top out-of-state, and top Ga. mobile and portable operating outside own county.

Your log should show date and time in GMT, exchange sent and received, band, mode and a column for the multiplier. A summary sheet showing the scoring and the usual signed declaration are also requested. A check list for high QSO totals.

Mail by June 6th to: Columbus A.R.C., c/o Jeanne J. Hunting, K4RHU, 2701 Peabody Avenue, Columbus, Georgia 31904. Include a large s.a.s.e. if a copy of the results are desired.

Massachusetts QSO Party

Starts: 1200 GMT Saturday, May 14
Ends: 2200 GMT Sunday, May 15

This year's party is again sponsored by the South Shore Repeater Association.

The same station may be worked once on each band. Phone and c.w. are considered separate bands. No cross-band or repeater contacts are permitted. Mass. stations may work each other for QSO points but not a section multiplier.

Exchange: RST(T) and QTH. County for Mass., ARRL section or DX country for others.

Scoring: Two points for each completed QSO. Mass. stations multiply total QSO points by (Mass. counties + ARRL sections + DX countries) worked. Out-of-state stations multiply total QSO points by different Mass. counties worked. (max. of 14)

Frequencies: C.w. — 1810, 3560, 7060, 14060, 21060, 28060. Phone—1820, 3960, 7260, 14290, 21390, 28590, 50.110, 146.52. Novice—3720, 7120, 21120, 28120.

Awards: Suitable awards will go to all top scorers, both in Mass. and out-of-state.

Mailing deadline is June 30th to: South Shore Repeater Assoc., c/o R. J. Doherty, W1GDB, RFD #1, 14 Pine St., Sandwich, Mass. 02563. Include a large s.a.s.e. for results and awards.

Kansas QSO Party

Starts: 2000 GMT Saturday, May 14
Ends: 2400 GMT Sunday, May 15

The Central Kansas ARC organized this one, and is picking up the tab and sending the results to all entries. No. s.a.s.e. required.

The same station may be worked on each band and mode for contact credit.

Exchange: Signal report and QTH. County for Kansas, state, province or country for others.

Scoring: Kansas stations multiply total QSOs by the sum of states, VE provinces and DX countries worked. All others multiply total Kansas contacts by the number of Kansas counties worked. (max. of 105)

Frequencies: C.w.—55 kHz up from bottom of each band. Phone—25 kHz above the Advanced/General dividing line.

Awards: To the top scorers in each state, VE province and DX country. There are awards for top Kansas stations and special recognition for portable operation in rare counties.

Logs go to: Robert Davis, K0FPC, 1857 South 4th, Salina, Kansas 67401

Michigan QSO Party

Starts: 1800 GMT Saturday, May 14
Ends: 0200 GMT Monday, May 16

This year's party is again sponsored by the Oak Park ARC. Phone and c.w. have been combined into one contest. The same station may be worked on each band and mode, portables/mobiles in each county change, and contacts between Mich. stations are permitted for QSO and county credit.

Exchange: RS(T), QSO no. and QTH. County for Mich., state or country for others.

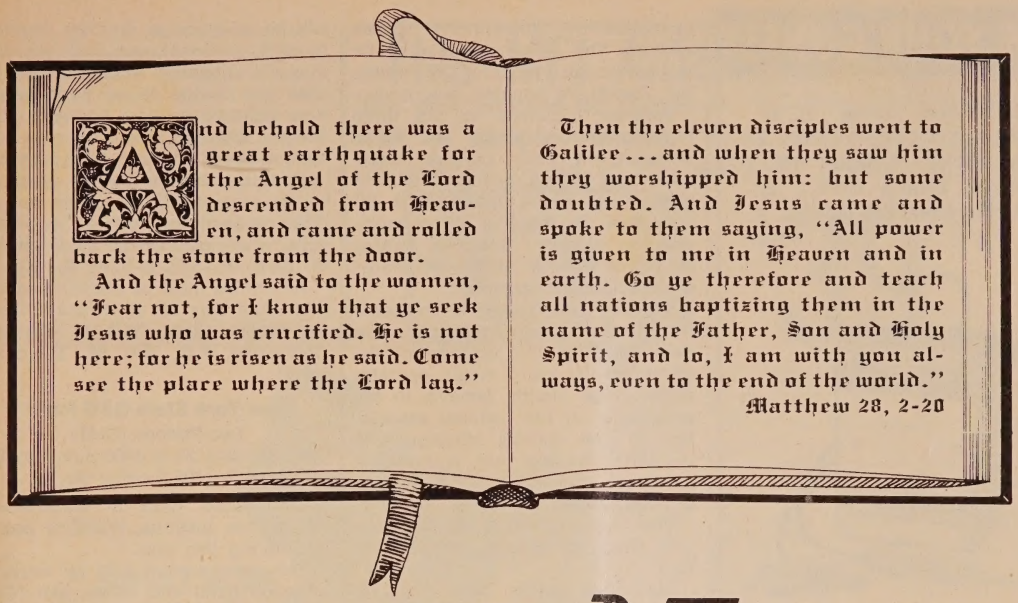
Scoring: For Mich.—1 point per QSO times (states + countries + Mich. counties) worked. KH6 and KL7 count as states, VE as a country.

Out-of-state—1 point for each Mich. QSO, 5 points if its a Mich. special events station. Multiply QSO points by Mich. counties. (max. 83)

VHF score same as above but add multiplier from each band for total multiplier.

Frequencies: C.w. — 1810, 3540, 3725, 7035, 7123, 14035, 21035, 21125, 28035, 28125. Phone—1815, 3905, 7280, 14280, 21380, 28580. VHF — 50.125 and 145.025. Try 15 on the hour, 10 on the half hour.

Awards: Certificates go to the leaders in each state, country and Mich. county. There are Plaques and



We would like to share the message and joy of Christ risen this Easter.

DenTron Radio Co., Inc.
2100 Enterprise Parkway
Twinsburg, Ohio 44087
(216)425-3173

Trophies for high Mich. score, out-of-state, VHF, and aggregate Club in Michigan. (Single operator stations only)

Party contacts do not count toward the Mich. Achievement Award unless one fact about Mich. is communicated.

A summary sheet is requested showing the scoring and other pertinent information and a signed declaration that rules have been observed.

Mailing deadline June 20th to: Mark Shaw, WA8EDC, 3810 Woodman, Troy, Mich. 48084

Michigan Achievement Award

Contacts made during the QSO Party may be credited for this award if the following requirements are fulfilled.

1. Michigan—Submit log with information, name and addresses if possible, of 15 or more contacts made to out-of-state or DX stations, with information regarding Michigan.
2. Out-of-state including Canada—Submit log information, name and addresses if possible, of at least 5 Michigan stations contacted, who relate facts about Michigan.
3. DX stations—Work at least one Michigan station, with log information and name and address and relate fact about Michigan given by the station worked.
4. Contacts must be made during Michigan Week, May 14-21.

Applications for certificates must be postmarked no later than July 1, 1977 and sent to: Governor William Milliken, Lansing, Mich. 48902

World Telecomm. Contest

Phone: 0000-2400 GMT. Sat., May 14
C.W.: 0000-2400 GMT Sat., May 21

This activity is sponsored by the Brazilian Ministry of Communications to commemorate "World Telecommunications Day." (May 17th)

Its a world wide contest, the object being to contact as many stations as possible in other ITU Zones. Scoring will be based on all band operation. Single operator and multi-operator, fixed or maritime.

Exchange: RS(T) plus your ITU Zone.

Scoring: QSO points as follows:

	10/15/20	40	80/160
Same country	0	0	0
Other countries same zone	1	1	2
Other Zones same continent	2	3	4
Other continents	3	5	6

Final Score: Total QSO points



with
JAN QUARTZ CRYSTALS
for
• CB Synthesized • CB Standard
• General Communications
• Industry • Two-Meter
• Monitor • Scanners
• Marine VHF • Amateur Bands

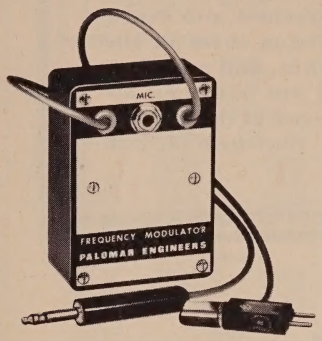
Dependable USA Mfg. for
• Frequency Control
• Frequency Stability
• High Performance

Write or phone for more details Send 10¢ for our latest catalog

JAN CRYSTALS
2400 Crystal Drive
Ft. Myers, Florida 33901
all Phones (813) 936-2397

FM YOUR GONSET

Or your Clegg 22'er, Ameco TX-62, Polycom 2 or PC-62, Johnson 6N2, Heath Seneca VHF-1, or Hallicrafters SR-34.



Why throw away that old AM 2-meter rig? Why spend $300 for a new FM transceiver when you have a working AM rig gathering dust? The Palomar Engineers FM'er plugs in (no rewiring or modification required) and puts your old AM transmitter on FM.

The adapter contains a preamp, clipper, filter, driver and modulator to give clear, crisp FM. Sounds as good or better than a brand new transmitter. Frequency adjust for netting is built in. Receive by slope detection.

Works with the Gonset Communicator I (Gooney Bird), II, III, IV, GC-105 and other rigs listed. For 2-meter band only. Requires HC-6/U crystal and 9-v transistor battery (not supplied).

Get on FM at a tenth the cost of a new rig. Use the plug in Palomar Engineers FM'er that has been proven in daily use by MARS and Civil Defense nets nationwide. Send for free brochure.

Order direct. $37.50 postpaid U.S. and Canada. Specify transmitter model. California residents add sales tax.

PALOMAR ENGINEERS
BOX 455, ESCONDIDO, CA 92025
Phone: (714) 747-3343

multiplied by different ITU Zones worked. The same station may be worked on each band for QSO points but Zones are counted only once.

Awards: Diplomas to the three highest scorers, single and multi-operator, in each country. Gold, silver and bronze medals to the top three world single operators. A silver plate to the top three multi-operator stations. Separate awards for phone and c.w. Additional awards if participation warrants.

The ITU Trophy goes to the country with the highest aggregate score determined by the average of the scores of the top 5 single operator entries. The Trophy remains in the possession of the national association of that country affiliated with the IARU, for one year. It is retired by the country winning it 3 times in a 5 year period.

(The U.S. has still to win this Trophy. Come on fellows, get with it. Ed.)

Mail logs before June 30th to: L.A.B.R.E., U.I.T. Contest Co-ordinator, P.O. Box 07-0004, 70.000-Brasilia, Brazil.

USSR "CQ - M" Contest

Starts: 2100 GMT Saturday, May 21
Ends: 2100 GMT Sunday, May 22

Official announcement had not been received at the time of this writing, however the dates have been verified so we will repeat last year's rules and hope no changes have been made.

Its a world wide contest. Contacts can be made on c.w. or s.s.b., 3.5 thru 28 MHz. The same station may be worked once only per band but not both modes.

Categories: Single operator both single and all band. Multi-operator, single transmitter, all band only. And a s.w.l. division.

Exchange: RS(T) plus a 3 figure QSO number. The USSR boys RS(T) plus number of their region.

Points: Contacts between stations on the same continent 2 points, different continents 5 points. Own country may be worked for multiplier credit but no QSO points.

The s.w.l. get 1 point for reporting one exchange, 3 points if both exchange numbers are reported.

Multiplier: Is determined by the number of countries or regions worked on *each band*. The USSR "R-150-S" list is the standard, which essentially is the same as the DXCC plus some additional regions.

Final Score: Total QSO points from all bands times the country/region multiplier from each band.

Awards: Certificates and badges will be awarded to the Top scorers in each continent, and each country in each category. A special certificate and badge to all participants who make 50 or more contacts with Soviet stations. There is also a special award for the contest leaders.

Contest contacts may be credited for the many USSR awards in lieu of QSL cards if the request is made with your log. (R-150-S, R-100-O, W-100-U, R-15-R, R-10-R, R-6-K)

All entries must be postmarked no later than July 1st to: Krenkel Central Radio Club, "CQ-M" Contest Committee, P.O. Box 88, Moscow, USSR

New York State QSO Party

Two Periods (GMT)
1600 Sat. May 21 to 0400 Sun. May 22
1200 to 2400 Sunday May 22

The Radio Club of Rensselaer Polytechnic Institute, W2SZ is again sponsoring this one.

The same station may be worked on each band and mode, and N.Y. may work other N.Y.ers for QSO and multiplier credit. Mobile/portables may be worked in each county change.

Exchange: RS(T), QSO no. and QTH. County for N.Y.; state, provinces or country for others.

Scoring: One point per QSO. N.Y. stations multiply total by number of states, provinces and countries worked. Others use N.Y. counties for their multiplier. (max. of 62)

Frequencies: C.w. — 1810, 3560, 7060, 14060, 21060, 28060. Phone—3900, 7275, 14285, 21375, 28575. Novice—3725, 7125, 21125, 28125.

Indicate each new multiplier as worked. Check sheets are required for stations making over 100 contacts.

Awards: Certificates to the highest scorer in each state, province, DX country and N.Y. county.

Mailing deadline is June 30th to: Barry Kutner, WB2LYB, 741 Plain Road, Westbury, N.Y. 11590. Include a large s.a.s.e. for results. ■

Math's Notes *(from page 38)*

ever, these d.c. levels are ignored and the circuit amplifies a.c. signals in the conventional manner with R_1 and R_2 setting the gain.

In fig. 3 we have an interesting way to control the gain of an operational amplifier by means of a digital signal. A circuit such as this could be very useful in a programmable amplifier or power supply or other mini-computer controlled application. The circuit uses a non-inverting op-amp configuration where



WHAT ELSE IS THERE TO THINK ABOUT?

DON'T MISS THE NEXT ISSUE . . .

Subscribe NOW!

IMPORTANT: BE SURE TO ENCLOSE YOUR CHECK OR MONEY ORDER.

FIRST CLASS
PERMIT No. 392
Port Washington, N.Y.

BUSINESS REPLY CARD

NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

POSTAGE WILL BE PAID BY

CQ Magazine

14 Vanderventer Avenue
Port Washington, N.Y. 11050

the gain control resistors are controlled by the output of a digital gate or inverter. When the gate is high, the diode is reverse biased and the respective resistor is out of the circuit. Similarly, when the gate is low, the resistor is in the circuit. The particular circuit shown will control the gain in the BCD sequence of 1-2-4-8 and, by driving the op-amp with 1.0 volt DC could make a very simple digital to analog converter.

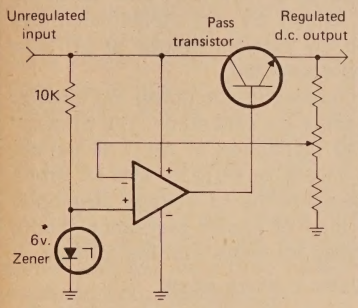


Fig. 4—The use of an Op-Amp in a series regulator. The resistors in the regulated output chain are chosen to effect the range of the regulator.

Our final circuit for this discussion is the use of the operational amplifier in a power supply. The high gain of those devices can make the fabrication of a very well regulated supply easy. Fig. 4 is the schematic of such a supply. Here the op-amp is used as a high gain comparitor comparing the output voltage to a reference zener. Since almost no current is drawn from the zener, regulation is excellent and load and line regulations of ¼% are easily achieved. The thing to bear in mind with this circuit is that the maximum output current that can be delivered to a load is dependant on the current gain of the pass transistor. With a darlington transistor such as the ones previously mentioned, amperes can be handled.

I sincerely hope that the circuits given help to solve many of the problems that you have written to me about and, if you do have specifc requests, please let me know. We do eventually try to present all information desired by our readers.

73, Irwin, WA2NDM

In Focus *(from page 45)*

Priced at DM 2,450, Volker's new product is called the Model SC-420. It's features include: Slow-to-fast and fast-to-slow conversion; Permanent storage of a received picture or a fast scan picture from a regular TV camera; Received pictures can be stored and sent back out of the memory; Digital solid state 65K memory (16 shades of gray); SSTV picture display on any standard TV monitor; SSTV picture transmission from any standard TV camera; a cursor shows which part of the stored picture is being transmitted; Manual or automatic frame snatch with remote control supplied; Switch for positive/negative; ½ positive/neg. and ¼ positive/neg.; Built-in test pattern generator.

A rather exciting accessory for the SC-420 is the "Electronic Pencil," Model LG-420. This device permits you to "write or draw" on the screen of your TV monitor. The text of your "writing" will then be converted to SSTV for transmission. This could be useful for sending diagrams, etc. in addition to more playful pursuits, such as adding mustaches to pretty girl's faces! Judging by the interest shown in a demonstration of the "Electronic Pencil" capability by John Vanden Berg, VE3DVV, at last year's Dayton Hamvention, the LG-420 should find quick acceptance by SC-420 buyers.

Want more information? Write to Volker Wraase, Postfach 6622 23 Kiel 14, Federal Republic of Germany.

This MFJ Antenna Tuner...

lets you operate all bands — 160 thru 10 Meters — with a simple random wire. Use virtually any transceiver — up to 200 watts RF power OUTPUT.



$39.95

Imagine being able to operate all bands — anywhere, with virtually any transceiver — using a simple random wire and an antenna tuner small enough to carry in your hip pocket. Size is only 2-3/16 x 3-1/4 x 4 inches.

Operate from your apartment with a makeshift wall to wall antenna. Tune a simple vertical for low angle, DX operation. Operate from your motel room with a wire dropped from a window. Tune out the SWR on your mobile whip. Enjoy ham radio on a camping or backpack trip with a wire thrown over a tree. Prepare for an emergency. Take it on a DX expedition or use it for Field Day.

Match both high and low impedances by interchanging input and output. SO-239 coaxial connectors are used.

The secret of this tiny, powerful tuner is a 12 position variable inductor made from two stacked toroid cores, and a quality capacitor manufactured especially for MFJ.

Try it — no obligation. If not delighted, return it within 30 days for a refund (less shipping). This tuner is unconditionally guaranteed for one year.

To order, simply call us toll free 800-647-8660 and charge it on your BankAmericard or Master Charge or mail us a check or money order for $39.95 plus $2.00 for shipping and handling.

Don't wait any longer to operate on all bands. Order today.

MFJ ENTERPRISES
P. O. Box 494
Mississippi State, MS 39762
Call Toll Free ... 800-647-8660

Final - Final

That winds it up for the May issue. Hope to see many of you in Dayton! Many thanks for your continued interest and the photographs—*please* keep them coming! Same old address, 2112 Turk Hill Road, Fairport, N.Y. 14450.

Regards, Bill DeWitt, W2DD



Fig. 13—Here's RALPH, the wonder dog! He prefers CW, hates keyboards, wants to get into SSTV. According to John Hartman WA3ZBI, he passed the Novice exam on the first round, skipped Tech, and the General, then went for the Extra. He would have passed with flying colors but the examiner wouldn't let him use his typewriter!

$1

That's all it takes to get a copy of the USA-CA Record Book delivered to your door. Order one or two today and start collecting counties for one of amateur radio's most prized awards, USA-CA.

CQ MAGAZINE
14 Vanderventer Ave.
Port Washington, N.Y.
11050



In-Line Wattmeter *(from page 52)*

switch's labeling. Adjust the meter to full scale deflection in the FOR position, switch to REF, and clip away at the gimmick capacitor at the r.f. drive side of the sensing circuit until the REF meter reading is nulled.

Next, reverse all connections and repeat the process, *i.e.,* reverse the dummy load and r.f. source ports. The REF position should give the highest reading when power is applied. Clip the gimmick at the r.f. drive side again until a null is obtained in the FOR position. Repeat the process until the best nulls are obtained. If the resistances of R1-R2 and CR1-CR2 have been closely matched, full scale readings should be the same for both directions in the above process, assuming that the r.f. drive level is constant. There should be no problem in attaining a complete, or nearly complete, null at QRPp power levels, while it may be impossible to completely null the bridge at QRO levels due to the sensitivity of the sensing circuit.

Calibration

The circuit shown in fig. 1 is designed for two fixed ranges of calibration determined by R3 + R5 across which the sample voltage is developed. In the LO position, the sensitivity is highest, permitting measurement of power levels down to about 50 milliwatts. R6, the original sensitivity control, is left in the circuit at minimum resistance. If the need arises for measuring powers in excess of the HI range, the resistance of R6 can be increased until the meter can handle that particular power level. Of course, this variable range cannot be calibrated accurately, but settings vs. power range can be marked for full-scale deflection at various power levels if desired. The chief advantage of including R6 in the circuit is that the instrument can be used as an s.w.r. bridge at QRO levels, and hence its flexibility is not limited by the modification described herein. In my version, ranges of 0-1 watt and 0-10 watts were selected.

Some means of measuring the power fed through the meter is necessary for calibration. The r.f. wattmeter/dummy load mentioned in ref. 1 is perfect for the job. Or, a v.t.v.m. or FETv.m. with r.f. probe can be used to measure the r.f. voltage developed across a dummy load of known resistance (about 50 ohms), and solved for watts with the formula:

$$\text{Watts} = \frac{(\text{volts, rms})^2}{\text{Resistance (dummy load)}}$$

OR:

$$\text{Watts} = \frac{(0.707\ \text{Volts, peak})^2}{\text{Resistance (dummy load)}}$$

The manufacturer's manual will indicate whether the v.t.v.m. calibration is in a.c. volts *rms* or a.c. volts *peak*. Then the formula can be transposed to calculate several desired calibration points:

$$\text{Volts } rms = \sqrt{\text{Watts} \times \text{R}}$$

OR:

$$\text{Volts } peak = 1.414 \sqrt{\text{Watts} \times \text{R}}$$

A c.w. signal must be used during calibration (and not a two-tone s.s.b. signal).

In my version, a new calibration scale was added to the existing s.w.r. scale. The plastic cover is removed carefully by disengaging the small notches at the center of each side of the meter, and then lifting the plastic cover off. A regular compass with a sharp #2 pencil point is used to carefully inscribe a new arc on the meter face while holding the foot of the compass at the center or the jewel movement screw. Then r.f. powers of a predetermined level are fed through the bridge, and the needle pointer position marked with the pencil. Of course, a new face could me made from gummed label paper and stuck over the existing face. Once the new scale is calibrated and rechecked, the plastic meter cover is replaced with care. I made no attempt to recalibrate the s.w.r. scale, although it is not entirely accurate with the new circuit. Table I provides points for directly reading out in s.w.r. by comparing Watts Forward and Watts Reflected.

Results

Aside from the feeling of satisfaction gotten by turning a sow's ear into a silk purse, the meter has been very valuable in monitoring output power. I

recommend one for every QRPp operator. The total cost and the time involved represent a considerable savings over commercially available QRPp wattmeters. It is an evening project that will repay itself many times over.

Infrared *(from page 49)*

Example #4 More Overlays

Remember, this stuff is versatile. Lettering can be clipped from newspapers, scrounged from decals, typed on any typewriter face, or lettered with a stencil or template. More possible uses:

Make nomographs for figuring impedances, antenna element lengths, reactances, what have you. Take the instruction book from any kit project or construction article, copy the *component* side layout on a sheet of film, reverse it, and stick it on the foil side of the finished board. Then you can see exactly where C-132 should be mounted, without having to count down "twelve holes and three solder blobs down from the S-shaped thingie in the corner, and two more over." Watch out for that hot soldering iron, though.

Make flying spot scanner slides for fast or slow scan TV.

Make a giant slide of your call letters and shine them on a cloud with a slide projector (magic lantern, OT's) to summon Batman or frighten CB-er's in passing truck convoys.

Make calibration grids for CRT's. You can fudge up any kind of scale you want for a homebrew oscilloscope, even several overlapping scales in different colors. Such things are useful with intelligent, (or even stupid) computer terminals. You can make overlays for playing games like "spacewar" and 3-D tic-tac-toe. I use an overlay on my Psycor 340 for playing Nim and estimating word counts in science fiction stories. A (*!) marker in the 250th character spot warns me as the cursor dot approaches, preventing needless beeping of the keyboard alarms when operating late at night.

When backlit with a dial lamp or LED, the colored films make good masks for digital displays in clocks, counters, etc. I typed the legend "RPM × 10" in IBM Delegate typeface, and used a scrap of colored film to make a faceplate for a digital tach for a car. The lettering is a fair match for the 1968 Plymouth Dashboard Gothic, and a green LED fed through a dropping resistor from the dashboard rheostat works just fine.

One clever use was a callsign nametag, featuring an illuminated portrait of Leonard Nimoy with a halo of random blinking LED's pinned on a fan at a recent science fiction convention. (SF conventions are like hamfests, except they call the swap'N' shops "Huckster Rooms," and there are more naked ladies, apes, and snakes around, and not so many Heath Twoer's and S-38's for sale.)

The durability of the heavier gauge films makes them very appropriate for making specialized slide rules and calculators. A circular scale more than two feet long could fit on a standard size sheet, and could be copied from a template printed on one page of this magazine. (hint) Considering the large amount of electronic and optical parts that are around, especially photodiodes, fiber optics, and LED arrays, it seems that that ought to be a reasonable way to store programs for frequency synthesizers, microcomputers, repeater I.D.s and patching systems, and so forth. Intricate programs could be distributed as black dots on a printed magazine or newsletter page, and transferred to acetate in seconds. It would sure beat soldering diodes into a matrix, or looking up endless digital codes in a book and then keying them in from a keyboard.

Note also, that the electrostatic copiers do also have many specialized uses, and there are undoubtedly many interesting things that can be done with them.

Hopefully people with more experience will come up with additional uses for these materials, though a good deal of experimenting may be necessary to give reliable results. Don't forget copyright laws and other legal niceties in the rush to duplicate every circuit board in sight; even with common sense restraining outright piracy, the possibilities are almost without limit. ■

VERTICAL ANTENNA HANDBOOK



Compiles 22-years worth of material from the pages of *CQ* on vertical antenna theory, design, installation, construction. Covers verticals arrays, feeding and matching, short verticals, ground effects, multi-band and single-band verticals, answers the most common questions about vertical antennas. 6" X 9" 136 pages. **$5.00**

Please send me _____ copies.

Name _____ Call _____

Address _____

City _____

State _____ Zip Code _____

CQ Magazine
14 Vanderventer Avenue
Port Washington, N.Y. 11050

HAM SHOP

FREE TO CQ SUBSCRIBERS

Advertising Rates: Non-commercial ads are 10 cents per word including abbreviations and addresses. Commercial and organization ads are 35 cents per word. Minimum charge $1.00. No ad (non-subscriber) will be printed unless accompanied by full remittance. Free to CQ subscribers (maximum 3 lines per month). Recent CQ mailing label must accompany ad.

Closing Date: The 10th day in the third month preceding date of publication. Because the advertisers and equipment contained in Ham Shop have not been investigated, the Publisher of CQ cannot vouch for the merchandise listed therein. Direct all correspondence and ad copy to: CQ Ham Shop, 14 Vanderventer Ave., Port Washington, New York 11050.

SELL: Autek Research QF-1 Audio Filter, 2 mo. old, new $52.95. Sell for $42.00 pp. Dennis Spranger, Rt. 1, Box 67, Eland, WI 54427.

WANTED: Small size Prop Pitch motor in good condition. Erv Rasmussen, W6YPM, 164 Lowell St., Redwood City, CA 94062.

WANTED: Heath monitor scope-also 12V power supply for Heath HA-14 Mobile KW. Sell: Hmbrw Electronic Keyer, Vibroplex. FB $25. Gary Kaser, WA8KME, P.O. Box Lawton, Mich. 49065.

WANTED: Any information available on the following equipment: Servo Corp. of America Model R5200 Receiver. Panadeptor Radio Products Inc. Model PCA2 T-200 Panadeptor. Tele-Signal Telegraph terminal Model 2230. Central Electronics 20A Exciter. John W. Schwerdtfeger, WA5VEH, 5361 Westminster, Austin, TX 78723.

SELL: AC an DC supplies for Kenwood TS—900. Make offer. Sid Yodis, W2KLW, 43 Beacon Ave., Albany, NY 12203.

FOR SALE Attention ATV'ers — Video Tape Recorders For Sale. Time lapse and reel time machines. All in working condition. Send S.A.S.E. for prices, models, etc. to DICTOGRAPH SECURITY SYSTEMS, 26 Columbia Turnpike, Florham, N.J. 07932. ATTN: Room 113/Dave Griffiths.

SELL: Operational CW System $320.00 Drake 2C Receiver and 2NT Transmitter Ten-Tec 200 VFO and KR-20 Keyer, Antenna, Filter. R.W. Lussier, 284 Windsor Pl, Brooklyn, NY 11218. 212/499-4439.

3-500Z New ful warrenty. $55.00 ppd. Ted Marinich, W1DIH/8, 102 Bell St., Weirton, W. Va. 26062.

THE JUNK BOX: Surprisingly interesting to hams an experimentors. 75¢ coin sample copy. THE JUNK BOX, P.O. Box 872, Peabody, Mass. 01960. U.S.A.

QSL's - Something completely different. Samples: 50c (Refundable) W5UTT; Box No. 1171-E,; Garland, Texas 75041.

PERSONALIZED BADGES with Mane, Call sign. $1.50 Postpaid. MAC'S SHACK; Box No. 1171-E Garland, Texas 75041.

STARVED ROCK RADIO CLUB HAMFEST-June 5, Princeton, Illinois. S.A.S.E. for info, after April 1. SRRC/W9MKS, RFD No. 1, Box 171, Oglesby, Illinois 61348.

TECH MANUALS for Govt. surplus gear - $6.50 each: Sp-600JX, URM-25D, SG-3/U, TS-173/UR, TS-174/U, LM-21, OS-8B/U. Thousands more available. Send 50¢ (coin) for 22 page list. W3IHD, 7218 Roanne Drive, Washington, DC 20021.

SELL: Hallicrafters SR-150 80-10m, XCUR w/AC speaker and DC mount and supply, Mint $275. John Webb, 3117 W. Illinois, Midland, TX 79701.

SELL: HRO-60, $120. HQ-160, $120. HP-35, $50, and SR-56, $60, calculators. J.L. Torzewski, K9UKX, 51625 Chestnut Rd., Granger, IN 46530.

HALLICRAFTERS CRX107: $20;MN4, Turner new $80; chrome Vibroplex new, $30. 275W matchbox w/SWR, $85. DIO4 G stand, $25. SB640 VFO, $100. FOB Art Ford, 56 Gildare Dr., East Northport, NY 11731.

GONSET GSB 100 Transmitter CW-PM-AM-V and L SB, 10-80 meters, 100 watts, $150. Fred R. Woelpern, K6ZTG, 8874 Wheeler Ave., Fontana, CA 92335.

CALL LETTER LICENSE PLATES wanted for collection. Will pay shipping. Art Phillips, WA7NXL, Rt. 4, Box 720, Flagstaff, AZ 86001.

SELL: Hallicrafter SX 28 Sup Sky Rider. RC and SPK6 Band, .55-42 MC col. item, $100. Pic Uponly, Space Tubesand, S meters. TEL-212- FA4-2569. J. Blair, 4323 Bronx Blvd., Bronx, NY 10466.

SELL: RCUR BC-342N, $45.6X Transceivers HE-45, $20. 3 AMPAC Line Filters, .75 each. J.C. Duschenchuk, 255 Stewart Ave., Bethpage, NY 516-PE1-3868.

SIGNAL/ONE Newsletter and related info. SASE for details. LM380 audio module, wired and tested on PC board $15.00 ppd. 6N2 and VFO. Perfect for OSCAR-$100. Bob Sullivan W0YVA/4, P.O. Box 6216, Arlington, VA 22206.

DRAKE R4B and 10xtals perfect, $315. RD-92A Fax $50. Spec 2 Synthesized 144-148. 10W amp and 12/110 VPS builtin, $325. Stamp for 150 item list, computers, RTTY, Photog, Ham, Test, Hi-fi, etc. T. Perera, K2-DCY, 11 Squire Hill Rd., N. Caldwell, NJ 07006.

MIKES: Shure Mod. 55 and Mod. 556S, $25 each. Motorola (Golran) combined Service manuals and parts list, Pub. 1937. Good cond. but discolored, $25.00. Will trade. John P. Hamilton, WB9OEQ, 6050 North Oakly Ave., Chicago, IL 60659.

RADIO SHACK Patrolman 10 receiver, Cost $250. Covers 160 to 2m and UHF. Good for Beginners in radio. $75 Phone (305) 752-0954. Matt Barton, 3381 NW 100th Ave., Coral Springs, FL 33065.

WANTED: Wilson DB-65 or DB-54 or Swan TB-4H antennas and CW filter for TS-520, TR-7400A or TS-700A. F.H. Kauppi, Rt. 1, Box 171, Gilbert, Minn 55741.

WANTED: Good used Atronics Visual Code Reader Model KCR101. Mark Steffen, P. 121 RR1, Hudson, IL 61748.

HEATH HP-1144 power supply/SB-604 speaker, used 15 hours, mint condition. Pick up, $115. PhD, V.A. Brown, 5220 Carlingford, Riverside, CA 92504.

SLOW SCAN TV setup, reasonable. Send for list equipment excess my needs with self addressed envelope. C.E. Spitz, W4API, Box 4095, Arlington, VA 22204.

SELL: (40) G.E. Mfd. 375 volt capacitors. $3 each, Hunter Bandit 2000A factory wired clean $285. Hewlett-Packard Wave Analyzer Model 300A O-16kc, clean, $85. Rectilinear Recording Milliametr 1500 ohms 5 ma. input needs cleaning, $35. You ship. P.C. Gutz, K0TDO, 511 So. 13th St., Ft. Dodge, Iowa 50501.

COM 1V 6m $120, SR34AC, $175, 753, 752, 751, Cal $230, XV160 $150, VHF62 $50. RME6900 $200, MAG6 $110, G66B $50. J. Bedlovies, K1LGM, 30 Ridge St., Milford, CT 06460.

WANTED: Collins 30S-1 amplifier, top price paid. R. Emerson, 1740 Fairfield Ave., Reno, NV 89509.

SIGNAL ONE CX7 A, mint cond. CW2 Filter plus RIT, warrenty and manual, $1155. Roger Mace, 8600 Skyline Drive, Los Angeles, CA 90046.

WANTED: Donation, clean 1975 or 1976 ARRL Handbook for Korean Amateur Radio League. M. Bae, Box 246, Flagtown, NJ 08821.

SB-33 Transceiver, recent factory overhaul, Mobile Mount, Spare Finals. $149.00 plus shipping. Heinlein, 107 Wyoming St., Boulder City, NV 89005.

WANTED: FV101 VFO, state condition and price. Peter Posnikoff, RR1, Port Hope, Ontario, Canada LIA 3V5.

WANTED: "Proceedings I.R.E." Sept. 1930, July 1931, Aug. 1931, March 1938. "Journal I.E.E." June 1934, March 1944. "Mar. Rev." 67 Sept-Dec 1937. Peter Posnikoff, VE3BB, RR1, Port Hope, Ontario, Canada LIA 3V5.

DeForrest SP-1 Receiver. Detector in one cabinet, tuner in another. Good working condition, $50 plus UPS. Roy L. Taylor, W5RJ, 3612 Oakhaven, Fort Worth, TX 76119.

SELL OR TRADE: Tempo one, AC/PS speaker. Three 27mhz syrstals. 10 weeks old, like new, or will trade for KLM 2700, TS-700A. Bobby Benningfield, Rt. 1, Elkhorn, KY 42733.

SWAP: US Mint plate blocks and sheets never hinged, for ham gear. J.P. Snow, W9MHS, 4539 Bartlett Ave., Shorewood, WI 53211.

SELL: 28ASR excel ccondx., paper, tape, ribbons, $600. Joe Schwartz, WB2ZKU, 43-34 Union St., Flushing, NY 11355.

COLLECTORS AND SWAPPERS: Vintage Telegrapy apparatus. Wish to correspond. M. W. Flynn, WB4ZOJ, 17A Atlanta View, Lithia Springs, GA 30057.

S.A.S.E. My crystal list. Jess B. Lebow Jr., K8LJQ, 355 Mower Rd., Pinckney, MI 48169

COLLECTOR'S ITEM: maytag gas engine, circa 1935, 2 cylinders opposed, air-cooled, offer. Zenith Transoceanic rcvr., $25 or whatever. Robert L. Ludlum, W6NHT, 1700 Pine St., Martinez, CA 94553.

SELL: Ampex Solid State CCTV Camera. F1.4 Lens. Electronic Eye, $150. Alfred J. Parker, WA8VFK, 314 So. Western Ave., Springfield, OH 45506.

WANTED: Heath SB-101, SB-102, HW-101 or HW-100 xceiver, non-working but repairable. Send price and condx, first letter. John, WB9-ZMG, 1709 N. Chicago Ave., Arlington Hgts., IL 60004.

INTERNATIONAL NUCLEAR CORP. model TVM-2 video modulator with manual, new. Displays somposite video through IF strip of any TV set, $60. G. Alfred Dodds Jr., 874 Pepperwood Lane, Brunswick, OH 44212.

HRO 500 (National, Reconditioned, 10/'76), $1000. 51J2, $200. KWM-1, 516F-1,312B, $200. James W. Craig, Box 615, Portsmouth, NH 03801.

SELL: Palomar 3 kw pep Input Balvn. Excellent condition, $12. David Schwartz, 1183 Southeast St., Amherst, MA 01002.

SELL: Collins s line, $700. 32S-1 with power supply and 75S-3. In excellent condition. I will pay shipping. Wanted: Comdel speach processor. Jack Bone, KL7GKY, P.O. Box 934, Sitka, Alaska.

BATTERIES: Small 67V "B" carton/10, $2.50. Mercury 1.4 - 32V, up to $1.00, plus shipping; 400V Assorted "B" and Mercury $5.00 PPD. J Lisaius, 116 Orton Rd., W. Caldwell, NJ 07006.

SELL: SB 303 with manuals $250. HW 202 FM Transceiver xtals 94/94 52/52 25/85 40/100 28/88 - HWA-202-1 AC power supply, manuals, $225. Stanley Kaczynski, 24 Marvin Ave., Uniondale, NY.



Gift Horse Bonanza!

CQ

You've followed the signs for years, but we're here to tell you that there is a pony out there just waiting for you. Hitch your wagon to CQ's Gift Horse (but don't look in his mouth) and cash in on our FREE CLASSIFIED ADS.

CQ subscribers can place ads in HAM SHOP on a noncommercial basis absolutely FREE. Here's your chance to buy, sell or swap your way into that ultimate station or just pick up some spending money. Why spend $5 to sell a $10 item somewhere else when there isn't enough room to describe the item in the first place and about $2 of the $5 just goes for your name and address.

Just follow those hoof prints today and get in on the greatest deal amateur radio has to offer.

CQ HAM SHOP
14 Vanderventer Ave.
Port Washington, N.Y. 11050

Please run this in the next available issue of CQ: _____

_____

_____

Name _____ Zip _____

Address _____ City _____ State _____

WANTED: Diagram, manual plus cw pitch knob for natioanl NC105. R.W. Randall, K6ARE, 1263 Lakehurst Rd., Livermore, CA 94550.

WANTED: Roller Coils, Help!!! B. Rice, WA7RFH, Gooding, RFD 2, Idaho 83330.

DIGITAL MULTIMETER: Factory Heath Model IM-1202, with manual. Solid State "Vacume tube Multimeter", $60.00. George E. Clark, M.D., W6GAW, 1741 La Coronilla Dr., Santa Barbra, CA 93109.

TRADE OR SELL: Valuable Collection of Mint US Plate Blocks and Covers also 50 year collection of Famous Autographs. Trade for gear or sell. L.B. Fuqua, W4WBD. Maple St. Box 6, Eddyville, KY 42038.

SELL: Collins 75A4 Receiver SN number 4070, excellent condition, 4 Filters, 4:1 Venier Tuning, $395. Bob Hynes, WB2GPN, 2306 Hartford Dr., Glendora, NJ 08029.

AMECO CONVERTERS: 50, 144, 220, mhz w/ps, $85. ARC-5 xmtrs 50, 144, 220 mhz fone and mcw, 25 wts., ant. relays, $60. Robert F. Voelker, 101-23 Lefferts Blvd., Richmond Hill, NY 11419.

WANTED: HG-10B VFO in working condition, under $30. T. Mydosh, WA2FWE, 99 Glann Rd., Appalachin, NY 13732.

WANTED: Millen number 60672 Antenna Bridge and book. Send condition and price to: L.D. McCombs, 2228 W. Southgate, Whichita, KS 67217.

SELL: Hewlett Packard 200C Audio Osc., $35. 211A Sq. Wave Gen., 212A Pulse Gen., $75 each. V.A. Brown, PhD, 5220 Carlingford, Riverside, CA 92504.

WANTED: Philmore 6V6/6L6 xmtr. circa 1950. Natioanl SW54. G.W. Egbert, W0MMM, 17333 Tramonto Dr., Pacific Palisades, CA 90272.

2-Meter crystals, $3.50 each, for all popular rigs. In stock. Immediate delivery. Send cash or money order, we pay postage. Rolin Distributors, P.O. Box 436, Dunellen, N.J. 08812.

CUSTOM EMBROIDERED EMBLEMS, your design, low minimum, Emblems, Dept. 10, Littleton, New Hampshire 03561.

Rome Ham Family Day June 5, 1977. Over 5000 Square Feet of Air Conditioned Display Area. Everyone Welcome. For info, Write P.O. Box 721, Rome, NY 13440. Dealer inquires Invited.

FREE CATALOG. Calculators, digital, thermometers, ultrasonics, kits, stobes, ni-cads, LED'S, transistors, IC'S, Unique components. Chaney's, Box 27038, Denver, Colo. 80227.

QUAD SPIDERS as per article on Tri-band quad in December 1976 CQ magazine. $12.95 plus $2.00 handling and shipping; W.R. Brown. 206 Sylvan Drive, Ozark, Al., 36360.

SELL: 771TMS Tristao Tower, 354H Triex Tower, 20M-536 Telrex Beam, 20M326 Telrex Beam and Ham-M Rotator. Will sell seperately. S.A.S.E. for prices and details. Frank Melcher, 521 N. West St., Anaheim, CA 92801, W6CY.

WANTED: All types of Ham Gear which is in good condition and with books or new enough to get parts for. Most wanted are Kenwood Twins A's or D's. I'm going to blow the whole lifes WAD on Ham Radio. Make it your Best offer first! Joe Leai, WA1VJZ, 203/347-2407.

ATLAS 210X and 200 PS Portable Ae Power supply brand new, still in the box. You pay postage. $680.00 firm. Ken Diebel, 1207 Louisa, Rayville, LA 71269.

RIG BUILDERS- Send SASE for list. Hi Power goodies. New List. R. Mace, 8600 Skyline Dr., Los Angeles, CA 90046.

SELL: Johnson Viking Valliant, $87. Valliant II, $133. Heath HW-22A w/HP 13A, $109. HB 2M trans 90 wts, xtal-vfo AM-FM, $39. Motorola 2 way ¾M xcrv T43G-1, $32. All w/books. R.E. Myers, K3HWL, RD 1, Oakview Drive, Meadville, PA 16335.

WANTED: Olson Mini-Camera/Intercom. Sell: A few new Cartrivision catridges ideal video date $4 each. List my excess, SASE. C.E. Spitz, W4API, 1420 South Randolph St., Arlington, VA 22204.

TRADE: Excellent Drake DC-4 for 2M FM handheld. Wanted: Kenwood TS-700A and fiberglass quad antenna and non working Collins S-Line. F.H. Kauppi, Rt. 1, Box 171, Gilbert, MN 55741.

Wanted: One million Q.S.L. cards needed. Send Q.S.L. cards to: Philip Steven Kurkland, 357 East 201 St., Apt. 1-F, Bronx, NY 10458.

WANTED: Goniometer, 2 fixed coils, 1 rotatable for LF and BCB reception use. R.E. Lamb, Box 454. Leander, TX 78641.

WANTED: Collins DL-1, Mint condx. Albert Hrubetz, W5QEE, 5330 Meaders Lane, Dallas, TX 75229.

WANTED: Bird 43 Wattmetter Elements. C. Duval, K7HWW, 33727 Brownlea, Sterling Hgts., Mich 48077.

WANTED: SPDT, DPDT, and Cross-over relays w/N series connectors, and SP4T and SP-6T coax switches w/N connectors. Charles T. Huth, 1233 1/2 W State St., Fremont, OH 43420.

WANTED: Prop-Pitch ir other heavy duty rotators and Fiberglass poles for quad antenna. Mike Wetzel, 7880 Shelbyville Rd., Indianapolis, IN 46259. 317/862-5137.

WANTED: Back issues of 73 Magazine, March 1974 and May 1975. R.I. Vaughan, W5ARJ, 403 Helen Marie, Kingsville, TX 78363.

READER SERVICE

To obtain literature from advertisers, simply check the number next to the name of each advertiser listed below

MAY, 1977

1 Barker & Williamson
2 CIR Industries Inc.
3 Cambridge Kits
4 Dentron
5 Eimac, Div. of Varian
6 Genave
7 Gregory Electronics
8 Henry Radio
9 Herrman Co.
10 Howtronics Corp.
11 Hy-Gain
12 International Crystal Mfg. Co.
13 Jan Crystals
14 Kensco
15 Kenwood
16 MFJ
17 Mor-Gain
18 New-Tronics
19 Palomar Engineers
20 Space Electronics Inc.
21 Swan Electronics
22 Telrex
23 Unadilla Radiation
24 Unarco-Rohn
25 VHF Engineering
26 Varian
27 Yaesu Musen USA Inc.

CQ Reader Service
14 Vanderventer Ave.
Port Washington, N.Y. 11050

Name .....Call .....

Street Address .....

City .....State .....Zip .....

ADVERTISER'S INDEX

Barker & Williamson 66
CIR Industries Inc. 21
Cambridge Kits 64
Dentron. 5, 59, 71
Eimac, Div. of Varian. . . Cov. IV
Genave 11
Gregory Electronics 20
Henry Radio. 13, 14
Herrman Co.. 66
Howtronics Corp. 58
Hy-Gain. 12
International Crystal Mfg. Co. . 10
Jan Crystals 71
Kensco 64
Kenwood. . . . . Cov. II, 2
MFJ 1, 73
Mor-Gain 31
New-Tronics. 8
Palomar Engineers 72
Space Electronics Inc. 64
Swan Electronics. 6,7,28,29
Telrex 37
Unardilla Radiation 4
Unarco-Rohn 79
VHF Engineering. 40, 41
Varian. . . . . Cov. IV
Yaesu Musen USA Inc. . . . Cov III

Medical: Any licensed amateur radio operator in the medical or paramedical field should join MARCO (Medical Radio Council). Contact: Stan Carp, M.D., K1EEG, 44 Main St., Saugus, MA 01906, (617) 233-1234.

WANTED - Barker and Williamson HDVL coils, base and link. Bill Orr, EIMAC, 301 Industrial Way, San Carlos, CA 94070.

LOOKING FOR old Lionel trains. Interested only in "O" Gauge, excellent to like-new condition. Primary interest is locomotives prior to 1952, but will consider complete sets or more recent models. Am willing to buy outright for cash or swap radio gear to meet your needs. Write Dick Cowan, WA2LRO, c/o CQ Magazine, or call 516/883-6200.

Sale: Atlas 210B complete with 110/220 V AC Console. Excellent condition. $550 PP. With mods (R.I.T., etc.) as per my Feb. CQ article and latest factory updates. Great rig. Only reason for sale is that am now in CN8 and CN8 will not issue license. Schultz, K3EZ, Box "L", FPO New York 09544.

SELL: 4-1000 A used, $30. Raytrack kw plate tank coil for 80 & 40 plus kw bandswitch $16. UTC S-50 kv c.t. 300 ma, new, pick-up only, $75. OZ-PAK small (2kw) $20. R. Ross, 95 Norwood Ave., Northport, NY 11768.

The book "CQ YL" has been updated again with a new supplement bringing the YLRL Officers section up to date through 1977, plus a report on the 7th International YLRL Convention held in Houston in June '76. If you have a copy of "CQ YL" and would like to add the new supplement (the pages are "slotted" so they can be inserted directly into the book's spiral backbone), drop a note with your request to author/publisher W5RZJ, Louisa Sando, Rio Grande Blvd., N.W., Albuquerque, N.M. 87114. Please enclose $1.00 to cover cost of printing and mailing. The one and only book about YLs in ham radio, "CQ YL" contains 23 chapters, over 600 photographs. Order your autographed copy, or a gift copy, from W5RZJ, $3.50, postpaid.

WANTED ANTIQUE GLASS- Looking for old milkglass, purple slag carmel and greentown, too. Tell me what you have - I pay the highest prices. Write: Jack Schneider, c/o Cowan Publishing, 14 Vanderventer Ave., Port Washington, LI NY 11050.

FOR SALE: Heath HW-16 novice band transmitter & HG-10B VFO both in excellent condition - $140.; Hallicrafters HA-1 T0 Keyer & Autronic Paddle to be sold as a set only - $60. Collins KWM-2 with 516F2 Power Supply & Speaker, excellent condition - $650., Collins PM-2 Portable Power Supply - $75.; Hammarlund SP-600 Receiver - $100. K4IIF, Box 205, Winter Haven, FL 33880. (813) 324-4122.

MAGAZINES FOR SALE: CQ/73/QST/HAM RADIO, issues at 20 cents each (including USA shipping) from Lockheed Ham Club, 2814 Empire, Burbank, CA 91504. Send list and check. Available issues and any refund due will be sent promptly.

WANTED: Allied-A2516-Receiver. Radio Amateur: John Savonis, W1DBS, 410 Blake Rd., New Britain, CT 06053.

WANTED: SB-610 in xlnt condition with manual. Sell or swap: Heathkit IO-12, IO-21, O'Scopes; IG-82 Gen. All Gud with manuals, $125. WB6SCQ, 7063 Del Rosa Ave., San Bernardino, CA 92404.

SELL: Zenith "Transoceanic", mint, $65. Messiner deluxe signal shifter. All coils, $35. Jess W. Speer, W5SQJ, 1400 Melrose Dr., Norman, OK 73069.

WANTED: Glass antenna insulators, must be in good condition for collection. Carge sizes only. Wanted: Swan MB-40 or MB-80, top shape only, please send descrip. A.M. Kasevich, W1CDC, 43 Dover Rd., Manchester, CT 06040.

SELL: QST Jan. 1952 to Dec. 1975, $60 or best offer plus shipping. E.W. Thatcher, K6EC, 3803 Liggett Drive, San Diego, CA 92106.

Awards (from page 68) . . . . . .

necessary. Most active White Rose Stations (5 points each)—Richard G4DZI, Diana, G4EZI, Sidney G3ZBA, Evan, G4DWD, Bill G4FLF, Ivor G3-KWT, Tony G4DXA, Harry G4EZS, Dave G4EZX, Angus G4ESS, Dick G3LKK, Mike G4ECZ and Alan G3-MJT.

1977 Cape Town Festival Award: Available to all licensed amateurs for contacts during the period of 0000 SAST 2nd April 1977 to 2400 SAST 30th April 1977 (2200 GMT 1 April-2200 GMT 30 April), ZS stations required to work ZS1CTF or ZS1CTM plus 10 other ZS1 stations. DX stations required to work ZS1-CTF or ZS1CTH plus 2 other ZS1 stations. QSL cards not required for this Award. Submit an extract of your log certified by either your local awards manager, or two licensed amateurs. Any mode or combination of modes may be used. Any band or combination of bands may be used. Closing date for applications is 31 July 1977. The fee for the Award is SA Rand 1-00 or U.S. $2.00. Send applications and fee to: Derek Siegel, ZS1DP, SARL CT Branch, P.O. Box 5100, Cape Town, 8000, South Africa.

Notes

For County Hunting, QSL Manager for CT1QZ is WA1UVX via the W6-CCM QSL Bureau.

Donald E. Birch, *All Counties* #54, dated 4-1-71 with Story and photo *CQ* April 1970, is now K7NN, ex-K7NEQ.

A nice letter from Bill Todd, K4-ISE (All Counties #46 with Story & photographs in *CQ* November '68). He has retired (?) and is now running the Space Coast KOA Kampgrounds at 820 Barnes Blvd., Rockledge, Florida 32955. Bill sends along his best to All.

Don't forget to make plans for the MARAC-ICHN 1977 Convention June 30, through July 3 at the Holiday Inn (downtown) in Rochester, Minnesota. All County Hunters are welcome, you do NOT have to be a member of MARAC. All details may be obtained from Bob Hanson, W0KMH, 9 Hillside Court, Northfield, Minnesota 55057.

And please don't forget to write and tell me—How was your month?

73, Ed., W2GT

CQ for Pennies A Day . . .

That's right for about 2c a day you can subscribe to CQ. At $7.50 a year you will be amazed at how much CQ can add to your knowledge and enjoyment of Amateur Radio.

How You Can Convert Your Rohn 25G Tower to a FOLD-OVER

CHANGE, ADJUST OR JUST PLAIN WORK ON YOUR ANTENNA AND NEVER LEAVE THE GROUND.

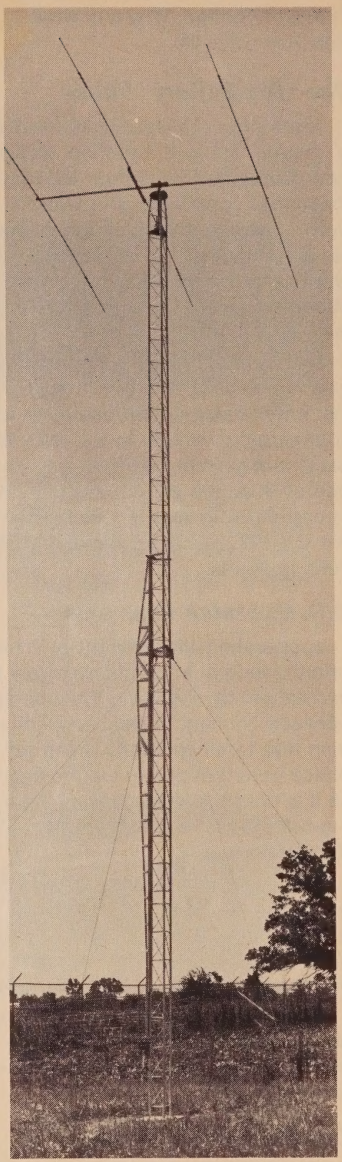
If you have a Rohn 25G Tower, you can convert it to a Fold-over by simply using a conversion kit. Or, buy an inexpensive standard Rohn 25G tower now and convert to a Fold-over later.

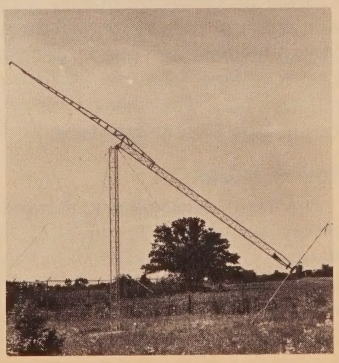
Rohn Fold-overs allow you to work completely on the ground when installing or servicing antennas or rotors. This eliminates the fear of climbing and working at heights. Use the tower that reduces the need to climb. When you need to "get at" your antenna . . . just turn the handle and there it is. Rohn Fold-overs offer unbeatable utility.

Yes! You can convert to a Fold-over. Check with your distributor for a kit now and keep your feet on the ground.

AT ROHN YOU GET THE BEST

Unarco-Rohn
Division of Unarco Industries, Inc.
P.O. Box 2000, Peoria, Illinois 61601





Filament Voltage: Why It Is What It Is *(from page 39)*

The "Dry Battery" Tubes

When dry cells were used for the filament supply, a greater voltage variation existed between new and discharged cells than between the charge and discharge conditions of a wet cell battery. In addition, a low value of filament current was important for long battery life. As a result, battery filaments were often operated in series and the filaments of such tubes were sometimes rated by current, rather than by voltage.

The earliest dry cell tube to be used to any extent was the N tube, manufactured by Western Electric Co. It was designed for operation through a filament voltage range of 0.85 to 1.1 volts, the recommended maximum current being ¼ ampere. With the formation of RCA, the WD-11 was marketed, designed for operation from one dry cell. This was followed by the UV-199, designed for operation from three dry cells in series.

A.C. Operated Filaments

In operating the filament of a tube from a.c., the prime concern is to achieve a low hum level, which is obtained by operating the tube at the proper ratio between filament current and voltage. The filament hum due to electrostatic disturbance is in opposite phase from that due to electromagnetic disturbance so it is possible to achieve minimum hum by achieving the proper voltage/current ratio in the filament: about 1.5 volts.

In general, a filament voltage below 1.0 is impractical, as fractional turns are required on the power transformer to obtain an accurate voltage. A voltage of 1.5 was finally chosen as an acceptable compromise, as used in the type 26 tube.

Filament voltage for tubes operating at a higher signal level was not so critical as with respect to hum and voltages of 2.5 and 7.5 were chosen for the type 45 and 50.

The Heater-Type Tube

When an indirectly heated cathode is used, the hum factor is not as pronounced as with the directly heated filament and due to geometric design of the tube a voltage range of 1.5 to 5 could be used. A voltage of 2.5 was finally chosen and standardized for the type 27 and later tubes of this family.

Power Tubes

The use of an 8 volt lead storage battery for transmitting equipment during the War determined the filament voltage of power tubes used by the Signal Corps. The first standardized tube was the CW-931 manufactured by the Western Electric Co. which operated at a filament voltage of 6.5 to 7.0. The military version of this tube was the Signal Corps VT-2. The Navy CG-1162 (Signal Corps type VT-14) was manufactured by the General Electric Co. and operated at a filament voltage of 7.5. This voltage was perpetuated by RCA with the introduction of the UV-202 in 1921.

The "50 Watt" Tube

The filament voltage of the so-called "50 watt" tube was determined by the use of a six cell, 12 volt lead storage battery in U.S. Navy aircraft. Such a battery has a terminal voltage of 10.8 volts when discharged. A 10 volt filament was incorporated in the CW-1818 manufactured by Western Electric Co. and in the CG-1444 manufactured by the General Electric Co. The use of the 10 volt filament was continued by RCA with the introduction of the UV-203 in 1921.

Higher Power Transmitting Tubes

During the War, the U.S. Navy used a CG-916 high power tube manufactured by the General Electric Co. for operation from a 24 volt lead storage battery. The filament had a very short life and when RCA initiated a post-war line of power tubes, the 24 volt filament was rejected. In 1921, 11 volts was a standard for sign-lighting lamps, and transformers for this voltage were readily obtainable. This minor factor determined the choice of filament voltage for tubes of the 204A category. With the development of higher power tubes in later years, multiples of this voltage (22 and 33) were used.

Source Material

Data for this article was obtained from, "Standardization in Radio Vacuum Tube Field," W. C. White, Proceedings of the I.R.E., Volume 18, Number 3, March, 1930. ■

CQ Reviews: The Heathkit HW-8 QRP Transceiver *(from page 37)*

about $320, and the HW-8 at about $130. In each instance, the buyer will get a unit worth every cent of the investment. I look forward to many hours of enjoyment with this transceiver, and highly recommend it[1]. It is a pleasure to operate, and Heath deserves applause for producing it.

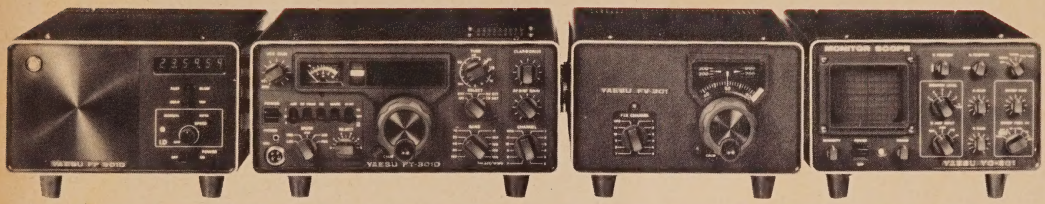
HWA-7-1 Power Supply

The HWA-7-1 power supply designed to power the HW-8 produces 13.6vdc at 600ma, and is adequate for the task. Regulation is rather poor (3% no-load to 600ma), but output is well-filtered and it powered the HW-8 adequately. Other low-price supplies currently on the market will do as well or better. ■

[1]QRPp Calling Frequencies: 3540, 7040, 14065, 21040, 28040 kHz usually produce other QRPp stations for 2-way QSO's with low power.

YEARS AHEAD WITH YAESU!

YOUR DREAM STATION COME TRUE!



YAESU FT-301D, FT-301, FT-301SD, or FT-301S Transceivers and Accessories — 40 or 200 watts P.E.P. — L.E.D. Digital or Dial Readout

■ FP-301D AC Supply/Speaker/Digital Clock/Automatic CW I.D. ■ FT-301D Transceiver, Digital Readout/All Solid State/Broadbanded, No Tuning or Loading/160 thru 10 Meters/All Modes, USB, LSB, FSK, CW. & AM/200 Watts PEP Input ■ FV-301 VFO, Split Frequency or Crystal Control/1 KHz Readout ■ YO-301 Monitor Scope/All Mode Monitoring/Range 1.8 to 54 MHz/Two-Tone 1800-1900 Hz Generator.

AND, MORE YAESU PRODUCTS YOU CAN COUNT ON!

YC-500 SERIES COUNTERS



YC-500E Accuracy 0.02 PPM, YC-500S, 1 PPM, YC-500J, 10 PPM/6 Display Digits/Readout Range 10 Hz to 500 MHz/AC Operation Stepped from 100 to 234 VAC, DC, 12 to 14.5 VDC. Professional Instruments at Amateur Prices!

YC-600 DIGITAL DISPLAY FOR 101 & 401 SERIES



YC-601 Displays Transmit and Receive Frequencies on Bright Green Digital Display Tubes/Covers 1.8 to 30 MHz with WWV-JJY Position/Plugs into 101 or 401 Series/Cable Supplied.

SEE YOUR AUTHORIZED YAESU DEALER NOW AND GET OUR NEW 1977 FULL LINE AMATEUR RADIO CATALOG

Yaesu Electronics Corp., 15954 Downey Ave., Paramount, CA 90723 ● (213) 633-4007

Eastern Service Ctr., 613 Redna Terrace Cincinnati, OH 45215 ● (513) 772-1500

YAESU
The radio.

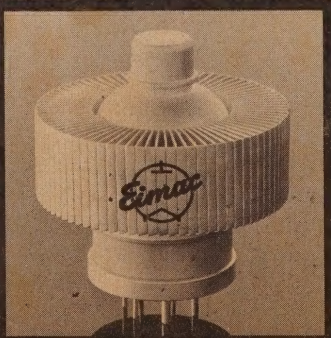
EIMAC.

Meteor-burst leadership for over 30 years.

1946 EIMAC was there when radio amateurs first studied and utilized vhf meteor-reflected propagation. EIMAC 35Ts and 100THs did the job.

1947-1975 EIMAC was there when radio amateur and military circuits used meteor propagation for reliable communication. EIMAC 4CX250Bs and 4CX1000As did the job.

1977 EIMAC is at hand as Western Union International establishes world's first data acquisition system based upon meteor-burst technology. EIMAC 8877s are doing the job.



Again, a unique radio amateur study and investigation leads to improved communication techniques. EIMAC is proud to have taken part in these experiments.

For complete information on EIMAC products or the 8877, send your QSL card to Varian, EIMAC Division, 301 Industrial Way, San Carlos, California 94070. Telephone (415) 592-1221. Or contact any of the more than 30 Varian Electron Device Group Sales Offices throughout the world.

varian