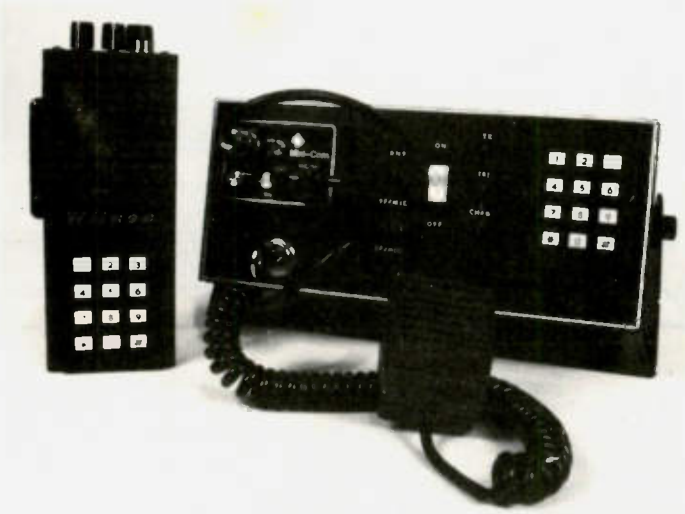
May 1980 $2.50

Antennas!

73 Magazine for Radio Amateurs

0 5
0 74470 65946

FACTORY DIRECT SALE!!
Wilson Electronics



MARK II
Save $105.90

MARK IV
Save $112.90

- At greatly reduced prices.
- Mark II and IV accessories.
- Introducing the new Mobile Amplifier Charger.
- Battery and Five free Xtal pairs of your choice with radio.

Mobile Amplifier Charger and Amplifier Specifications

		POWER (Watts) Useable	In (Typ)	Out (Typ)	AMP* 13.8 Vdc
WMH 440TT	Mobile Amplifier Charger	1-6	4	40	5.0
WMH 480TT	Mobile Amplifier Charger	1-6	4	85	15.6
WA 440	Broad Band Amplifier	1-6	4	40	4.8
WA 480	Broad Band Amplifier	1-6	4	85	15.5
WA 2080	Broad Band Amplifier	10-25	20	90	11.0

MOBILE AMPLIFIER FEATURES

- 5-watt audio amplifier for external speaker.
- Automatic fast/trickle charge.
- Front panel Touch-Tone® Pad which allows generation of DTMF tones.
- Over and under mounting bracket for under dash, floor mounting or base station use.
- A Key-locking feature for security.
- Mobile antenna connect.

(Detach Here)

	MODEL NUMBER		SALE PRICE
☐	MARK II	1 and 2.5 Watt 2m HH	$189.00
☐	MARK IV	1 and 4 Watt 2m HH Radios	212.00
		(Includes battery and 52/52 plus 5 Xtal pairs of your choice)	
☐	BC-2	Desk Battery Charger	31.00
☐	BP-4	Extra Battery Pack	19.00
☐	LC-3	Leather Case	15.00
☐	LC-3P	Leather Case for Touch-Tone® Pad	15.00
☐	TTP	Touch-Tone® Pad (Factory Installed)	48.50
☐	MC-12	Mobile Charger Only	135.00
☐	WMH 440	40W Mobile Amplifier Charger	199.00
☐	WMH 480	80W Mobile Amplifier Charger	271.00
☐	WMH 440TT	40W Mobile Amplifier Charger with Touch-Tone® Pad	240.00
☐	WMH 480TT	80W Mobile Amplifier Charger with Touch-Tone® Pad	309.00
☐	WA 440	40W No Tuning Amplifier for Portable Radios	108.00
☐	WA 480	80W No Tuning Amplifier for Portable Radio	181.00
☐	WA 2080	80W No Tuning Amplifier for Mobile Units	147.00

TO: **Wilson Electronics** ✓81
4288 South Polaris Avenue
Las Vegas, Nevada 89103

master charge — BANKAMERICARD VISA

Ship me all indicated on above chart.

☐ Check ☐ Money Order ☐ MC ☐ VISA

Enclosed is $ ____________

Card Number ____________ Expiration Date ____________

Xtals 52/52 __/__ __/__ __/__ __/__ __/__

Name ____________ Address ____________

City ____________ State ____________ Zip ____________

Signature ____________

Shipping Prepaid — Nevada Residents Add 3½% Sales Tax

Info

Manuscripts

Contributions in the form of manuscripts with drawings and/or photographs are welcome and will be considered for possible publication. We can assume no responsibility for loss or damage to any material. Please enclose a stamped, self-addressed envelope with each submission. Payment for the use of any unsolicited material will be made upon acceptance. All contributions should be directed to the *73* editorial offices. "How to Write for 73" guidelines are available upon request.

Editorial Offices:

Pine Street
Peterborough NH 03458
Phone: 603-924-3873

Advertising Offices:

Elm Street
Peterborough NH 03458
Phone: 603-924-7138

Circulation Offices:

Elm Street
Peterborough NH 03458
Phone: 603-924-7296

Subscription Rates

In the United States and Possessions:
One Year (12 issues) $18.00
Two Years (24 issues) $30.00
Three Years (36 issues) $45.00
Lifetime subscription $240.00

Elsewhere:

Canada—add $2.00 per year unless paid with U.S. currency.

All other foreign—one year only—$26.00 payable in U.S. currency through a U.S. bank (surface mail).

To subscribe, renew or change an address:

Write to *73 Magazine*, Subscription Department, PO Box 931, Farmingdale NY 11737. For renewals and changes of address, include the address label from your most recent issue of *73*. For gift subscriptions, include your name and address as well as those of gift recipients. Postmaster: Send form #3579 to *73 Magazine*, Subscription Services, P.O. Box 931, Farmingdale, NY 11737.

Subscription problem or question:

Write to *73 Magazine*, Subscription Department, PO Box 931, Farmingdale NY 11737. Please include an address label.

73 Magazine (ISSN 0098-9010) is published monthly by 73, Inc., 80 Pine Street, Peterborough NH 03458. Second class postage paid at Peterborough NH 03458 and at additional mailing offices.

Microfilm Edition—University Microfilm, Ann Arbor MI 48106.

W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

1990

Holy Moly! By 1990, I'll be doddering into my 50th year in amateur radio. By then, I should have managed to alienate well over half a million hams, if we can get amateur radio into a growth mode again. As I've said before, whether anyone likes me or not is his problem . . . I love amateur radio and I like most amateurs . . . there are some exceptions . . . and that makes *me* happy.

But, let's take a look at amateur radio today . . . reflect a bit on the changes I've seen over the last few years . . . and then see if I can make some shrewd guesses as to what we have coming up in the future. I'll try not to be as impatient as I usually am about change. I invariably want and expect changes to happen a lot faster than they do.

The mere concept of change sets many people off. And others are continually trying to either stop change or else make things the way they were. It is fruitless to try to prevent change . . . or to try to make things the way they were. You have to accept the fact of change and go with it. Oh, it doesn't hurt to push a bit to make change go in a direction you feel beneficial. But trying to make the ham bands the way they were in 1940, as a small group tried to do back in 1963 with Incentive Licensing, was impossible.

Some ham bands have changed little over the years . . . others have gone through enormous changes. Take six meters, for example. For many years, this was a truly deserted band. I remember being the *only* active amateur on six meters in New York City . . . and that was over a period of several years. In those days, circa 1948-55, everyone was crystal controlled and I could tell immediately exactly who was on the air just by measuring the frequency of the transmission. I kept a chart showing call letters vs. calibration on my frequency meter. There were only perhaps about 20 hams active on six meters within range of Brooklyn at that time. Most of them were in New Jersey, but there were some in upstate New York and even some in Connecticut, such as Ed Tilton in Hartford.

When six was opened to the Techs, it filled up quickly and, on openings, the band was filled solid from the low end all the way up to 51 MHz . . . with sparser population to 52 MHz. Those were the AM days.

Then they opened two meters to Techs and there was a mass exodus. Six never got as quiet as the early 50s, but it is not an active band these days, nor is it likely to become one unless someone comes up with a new activity or mode which will populate it. I see nothing like that in serious prospect, so I suspect that by 1990 we will have a bit more activity than we do at present, but not a lot. We may see more FM activity as more repeaters set up with crossband facilities. This will be channelized. But since six meters offers very little over the two-meter band in range and since most of the repeater activity is on two meters and likely to stay there, there won't be a lot of pressure for six-meter growth.

One of the major factors which will influence the ham bands of 1990 will be the number of active amateurs we have. I see two serious prospects for getting amateur radio off dead center and into a growth mode again. One would be a concentrated effort by the ham clubs to get their license study classes going again, filling them with high-school students . . . and the other would be a relaxing of the rules to permit a no-code license and a resulting flood of CB-type immigrants. I think that I may be able to talk clubs into the former approach to growth . . . I sure hope so.

Presuming that we can get back to a 10% or so growth pattern, we are going to need some new modes of communications which will be far more efficient of spectrum (frequency × time) use. This means that we had better start pressuring the FCC for some rule changes which will untie the hands of ham experimenters and inventors so we can try out various spectrum-saving ideas.

The band which may hold the most rosy prospects for the future will surprise you. I think this will be 160 meters. Yup. You see, as I wrote recently, that was

WANTED: PHOTOS

73 is currently soliciting professional-quality, vertically-formatted color photos and transparencies. The theme, of course, must be amateur radio, but other than that, it's anything goes. Our minimum payment for photos used will be $150.

KENWOOD
. . . pacesetter in amateur radio

TRIO-KENWOOD COMMUNICATIONS INC.
1111 WEST WALNUT / COMPTON, CA 90220

Easy selection.

15 memories/offset recall, scan, priority, DTMF Touch-Tone®

TR-7800

Kenwood's remarkable TR-7800 2-meter FM mobile transceiver provides all the features you could desire for maximum operating enjoyment. Frequency selection is easier than ever, and the rig incorporates new memory developments for repeater shift, priority, and scan, and includes a built-in autopatch DTMF encoder.

TR-7800 FEATURES:

- **15 multifunction memory channels, easily selectable with a rotary control**

  M1-M13 . . . memorize frequency and offset (±600 kHz or simplex).
  M14 . . . memorize transmit and receive frequencies independently for nonstandard offset.
  M0 . . . priority channel, with simplex, ±600 kHz, or nonstandard offset operation.

- **Internal battery backup for all memories**

  All memory channels (including transmit offset) are retained when four AA NiCd batteries (not Kenwood-supplied) are installed in battery holder inside TR-7800. Batteries are automatically charged while transceiver is connected to 12-VDC source.

- **Priority alert**

  M0 memory is priority channel. "Beep" alerts operator when signal appears on priority channel. Operation can be switched immediately to priority channel with the push of a switch.

- **Extended frequency coverage**

  143.900-148.995 MHz, in switchable 5-kHz or 10-kHz steps.

- **Built-in autopatch DTMF (Touch-Tone®) encoder**

- **Front-panel keyboard**

  For frequency selection, transmit offset selection, memory programming, scan control, and selection of autopatch encoder tones.

- **Autoscan**

  Entire band (5-kHz or 10-kHz steps) and memories. Automatically locks on busy channel; scan resumes automatically after several seconds, unless CLEAR or mic PTT button is pressed to cancel scan.

- **Up/down manual scan**

  Entire band (5-kHz or 10-kHz steps) and memories, with UP/DOWN microphone (standard).

- **Repeater reverse switch**

  Handy for checking signals on the input of a repeater or for determining if a repeater is "upside down".

- **Separate digital readouts**

  To display frequency (both receive and transmit) and memory channel.

- **Selectable power output**

  25 watts (HI)/5 watts (LOW).

- **LED bar meter**

  For monitoring received signal level and RF output.

- **LED indicators**

  To show: +600 kHz, simplex, or -600 kHz transmitter offset; BUSY channel; ON AIR.

- **TONE switch**

  To actuate subaudible tone module (not Kenwood-supplied).

- **Compact size**

  Depth is reduced substantially.

- **Mobile mounting bracket**

  With quick-release levers.

See your Authorized Kenwood Dealer now for details on the TR-7800 . . . the remarkable 2-meter FM mobile transceiver!

NOTE: *Price, specifications subject to change without notice and obligation.*

Subject to FCC Approval

MATCHING ACCESSORY:
- KPS-7 fixed-station power supply

Staff

EDITOR/PUBLISHER
Wayne Green W2NSD/1

ASSISTANT PUBLISHER
Jeffrey DeTray WB8BTH

MANAGING EDITOR
John Burnett

ASSISTANT MANAGING EDITOR
Susan Philbrick

NEWS EDITOR
Gene Smarte WB6TOV/1

EDITORIAL ASSISTANTS
Nancy Noyd
Richard Phenix

PRODUCTION MANAGER
Noel Self WB1ARP

ASSISTANT PRODUCTION MANAGER
Robin Sloan

ART DEPARTMENT
Steve Baldwin
James Butler
Robert Drew
Bruce Hedin
Kenneth Jackson
Clare McCarthy
Michael Murphy
Dion Owens
Patrice Scribner
Susan Symonds
John White

BOOK PUBLICATIONS
Jim Perry

BOOK PRODUCTION
Emily Gibbs
Chris Brown N1AUI

PHOTOGRAPHY
Bill Heydolph
Tedd Cluff
Terrie Anderson

TYPESETTING
Barbara Latti
Sara Bedell
Sandie Gunseth
Karen Podzycki

EXECUTIVE VICE PRESIDENT
Sherry Smythe

CORPORATE CONTROLLER
Alan Thulander

EXECUTIVE ASSISTANT
Leatrice O'Neil

ACCOUNTING MANAGER
Knud Keller KV4GG/1

DATA ENTRY
Cathy DeSilva

CIRCULATION MANAGER
Debra Boudrieau

ASSISTANT CIRCULATION MANAGER
Barbara Block

CIRCULATION
Pauline Johnstone

BULK SALES MANAGER
Ginnie Boudrieau

SHIPPING
Mark Dendy
Bill Barry
Bryan Hastings KA1DXZ

RECEPTIONIST
Helen Grammer

ASSOCIATES
Robert Baker WB2GFE
Sanger Green
Dave Ingram K4TWJ
Larry Kahaner WB2NEL
Joe Kasser G3ZCZ
Bill Pasternak WA6ITF
John Schultz W4FA
Peter Stark K2OAW

ADVERTISING
(603) 924-7138
Aline Coutu, Mgr.
Kevin Rushalko
Nancy Ciampa
Marcia Stone
Louise Holdsworth
Jerry Merrifield
Rita Rivard
Hal Stephens
Phoebe Taylor

the most active ham phone band before The War. With the demise of loran and the return of the band to amateur radio, I think 160 will rise again. This is a beauty of a band and it will just have to be popular.

It doesn't take a lot of power or any complex or expensive antennas for this band. You can throw up wire and tune it up. Heck, you can tune up some wire hooked to a window screen and get out. With a hundred Watts or so, you can work half the country at night. And you can work over a twenty-mile radius or so during the daytime.

With the use of sideband, we should be able to go back to the real old days of duplex operation. The only legal impediment to duplex was the rule against transmitting a blank carrier, so by using sideband . . . with a separate transmitter and receiver system and separate antennas . . . we will be able to link up into groups of two to six, or either, all sitting and talking just as if we were in the same room.

The old 160m band, as I recall, ran from 1715 to 2050 kHz. I don't know how much of that we can regain, but I think we should push for as much of it as we can. You can appreciate the size of the old 160 band when you understand that the only other two popular phone bands were 100 kHz wide and 160 was 250 kHz wide . . . and few stations ran over 100 Watts.

Will we see much in the way of changes on 75/80 meters? Well, we haven't seen much in the last 50 years. Oh, we changed from AM to SSB and we added a bit of RTTY around 3620, but not much else has changed. If a ham were to drop out of amateur radio today and come back in 1990, I'll bet that only the model numbers of the rigs would clue him in. (Unless, of course, I am able to make some major changes within the next few years, which I fully intend to attempt.)

Forty meters has changed a lot over the last forty years, but much less in the last twenty. Sideband evolved further since 1960, but it was fairly solid even by 1960, so the changes have not been substantial. In 1940, we had no phone band and no vfos, as I've written about recently. I don't see any such major changes in prospect in the next ten years . . . or even twenty.

We've had two major mode changes in the last 25 years and each took about ten years to grow from beginnings to universal acceptance. The first big one was sideband . . . the other was FM. Single sideband suppressed carrier, SSSC, as it was first called, was a mode which was known and used commercially way back in the 20s, but at that time, you had to get rid of the second sideband and the carrier with antenna filters, throwing away the energy as heat. Obviously, this was incompatible with amateur radio since it was impossible to change frequency.

The first practical SSB system was unveiled in *QST* in the early 50s. After a couple of exploratory articles, *QST* dropped the whole subject. *CQ* picked it up along in 1956 and pushed it hard. By 1960, when *73 Magazine* started and continued the push, SSB was becoming widely accepted. It took a good ten years to go from the rare use of the mode in 1955 to universal acceptance by 1965. Little has really changed with SSB in the last 15 years.

The early days of FM and repeaters were in the early 60s. In 1969, after six years of a no-growth situation in amateur radio, I decided to see if I could get things going again by spreading enthusiasm for repeaters. Hundreds of articles in *73*, a *Repeater Bulletin* publication, and FM symposiums around the country helped get the word out. Within five years, two meters was the most used ham band in the country . . . if not the world.

While I don't see any significant changes coming in sideband, I do think we will be seeing some changes in repeaters as more groups get courage to develop crossband systems to other VHF bands and even to the low bands. I think we have reached a plateau on the number of repeaters needed to handle voice communications, but as computer and digital communications systems evolve, we will, I'm sure, find repeaters gearing to accommodate or even being set up for this specialized requirement. I think we'll begin seeing this coming on strong within the next five years.

The computer revolution will really have to have some impact on RTTY, making it far more popular than it is today. The scarcity and cost of Teletype® machines has held back the growth of interest in RTTY . . . as has the slowness of communications. Interfacing microcomputer systems to our ham rigs may overcome many of the problems and bring about rapid growth of written communications over the air. This may be helped by some sophisticated addressing systems which could virtually eliminate our present traffic system. The use of computers and digital techniques offers some fundamental changes in our prospects of being able to contact specific stations at will.

The techniques for this were known and used thirty years ago, but were not evolved because of the equipment problems. In 1950, we had a net of some thirty or more RTTY stations in and around New York. We had our own repeater on the Municipal Building in Manhattan. We could send specific messages to any station we wanted and get back a confirmation that the message had been received, all with no operator present at the other end. Now, with low-cost computers and digital techniques, this type of communications is becoming practical on a universal basis.

If we can get the FCC to improve our rules so we will be able to use whatever mode we want on any ham frequency, we would be able to switch from voice to RTTY to SSTV at will, without having to move from one end of the band to another. It's nice to talk . . . and it's nice to write, too. If I get talking about cars, I'd like to be able to put a piece of writing over the air for a few seconds and then go back to talking. And if I want to stop and take a few seconds to send a picture now and then, why should I have to move from a RTTY part of the band to an SSTV-allowed channel?

I have a lot of really great recipes which I could send to those interested via RTTY. My spareribs will drive you right out of your mind . . . if you know how to make 'em. But you need this information in writing. I think we will be able to develop these ideas during the next ten years.

A few years back, I was deeply involved with audio and every now and then I run into someone

Continued on page 176

The Question we seem to get most often from our customers:

"WHEN IS ICOM COMING OUT WITH A HAND-HELD?"

ICOM IC-2A SYNTHESIZED 2 METER HAND-HELD

FEATURES YOU'VE WANTED

- 800 T/R Channels. Synthesized.
- 1.5 Watt Output High/Low Power Battery Saving Switch to .15 Watt.
- Separate built in Speaker & Mic. Excellent audio quality.
- Compact. About the size of a dollar bill.
- Variable size NiCd Power Pack, 3 sizes available to suit your needs. (250 MA standard). Makes the IC-2A the most compact synthesized HT on the market.
- ICOM level Receiver Performance-ICOM Quality Receiver in a compact package (.2uv/20db typical)
- Optional Tone Pad, Desk Charger, Speaker/Mic available.
- With slip on/slip off Bottom NiCd Pack, you can vary the size of the HT from about 116 mm high to 175 mm high. Easy to carry extra Snap-on packs with you for extended trips.

Actual size: Cut out and put the ICOM IC-2A in the palm of your hand.

BACK VIEW

±600 khz offset

simplex/duplex

Hi/lo power

TOP VIEW

BNC antenna connector "Rubber Duckie" standard

transmit indicator

squelch

volume control

on/off

5 khz channel selection

10 khz channel selection

speaker/mic jack

ICOM

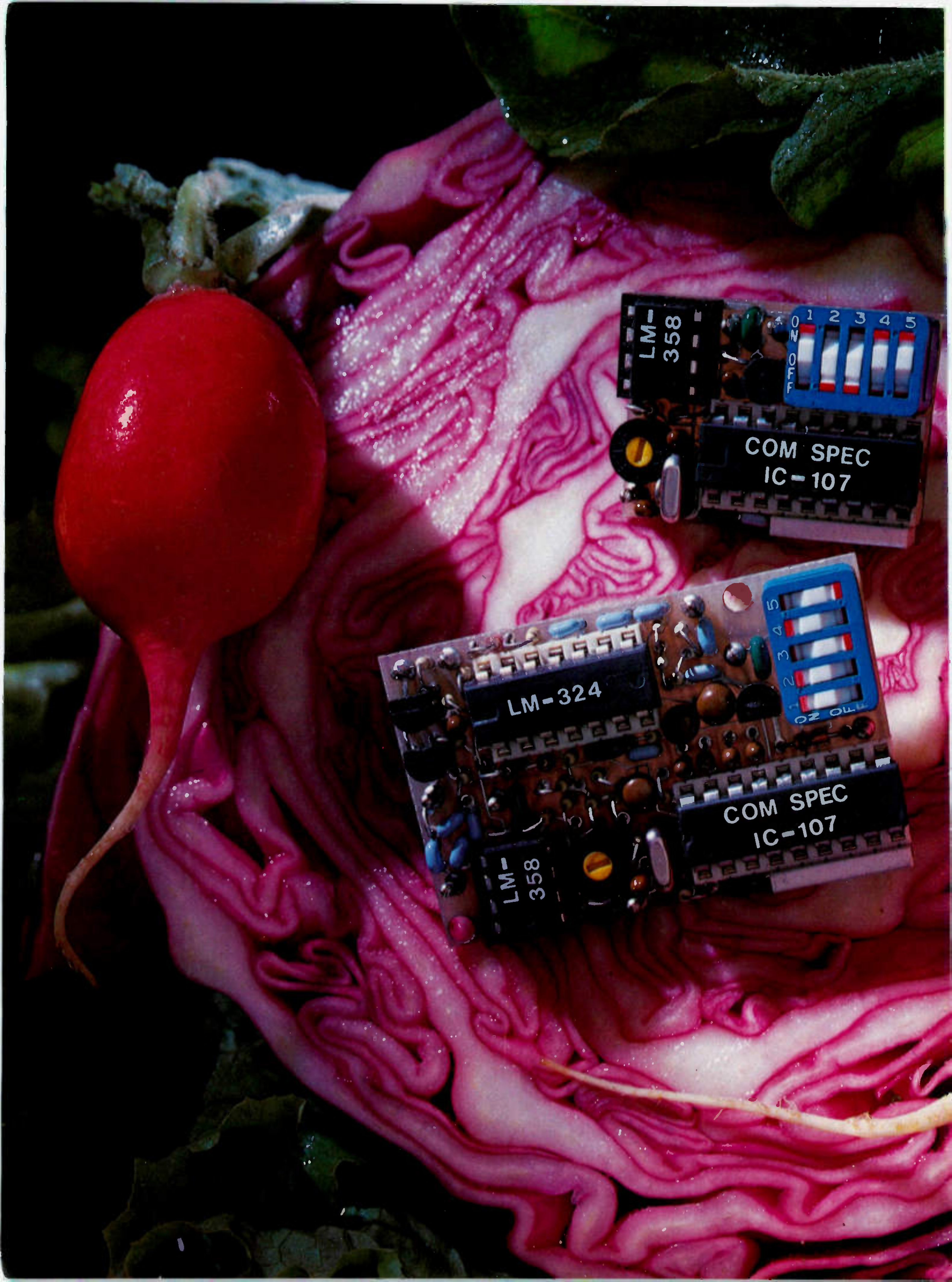
ICOM AMERICA, INC.

2112 - 116th Avenue NE
Bellevue, WA 98004

3331 Towerwood Dr., Suite 307
Dallas, TX 75234

THE ANSWER IS: NOW!

All 800 channels of it!


LM-358
COM SPEC
IC-107
LM-324
COM SPEC
IC-107
LM-358

Looking West

Bill Pasternak WA6ITF
24854-C Newhall Ave.
Newhall CA 91321

Regardless of what letters to the *QST* FM/RPT column might say (*QST*, March, 1980, p. 70), the 220-MHz band in southern California is not a land of totally private repeater operation. True, there probably are more private- and closed-category systems than found on 2 meters, but many are systems that relocated from two meters to make way for open systems. Nor does the level of current activity make it mandatory that such systems relocate again. In my opinion, they would not relocate even if requested to do so. The vast majority of 220-MHz repeaters operate with an open format, but open on 220 holds a different meaning than open on 2 meters.

As I said in this column a long time ago, most of those coming onto 220 are refugees from the abomination that two meters has become. As such, they are aware of the problems that two meters is facing and are dedicated to preventing such problems from ever happening on 220. In this area, to locate most 2-meter repeater owners, you must have an "in" with someone who knows the guy or gal you want to get hold of. Two meters in the southland is the aloof repeater owner who has placed his system into operation and, for the most part, has "walked away" from all but the technical aspects of its operation. Now, I grant that there are exceptions, but, in general, this seems to be the trend. 220 MHz is just the opposite. If I need to get hold of a particular system owner, I need only dial up the system and give a call. If he or she is not around, I can usually get hold of someone who will take and deliver a message. Invariably, I get a call, note, or some form of communication from the person I want to contact.

There is another aspect to operating the 220 FM band out here that takes a bit of getting used to. I call it the "Old 12-4 Routine." The term "12-4"dates back to the days when the almighty "seven six secret service" ruled two-meter FM with a tongue-in-cheek iron hand and means: "I hear you but you are being totally ignored." Basically, it's the concept of never giving a potential troublemaker any audience. If a turkey shows up (and this has happened) and builds for himself an obnoxious reputation, he soon finds that he has not a soul on the band to talk with. It only takes a short time in most cases for the party in question to get the idea that he'd better shape up or ship out. I've operated 220 FM for almost 5½ years and have yet to hear one cussword, yet to hear one derogatory comment about another ham or an on-the-air argument. The people of 220, both system owners and those who use them, will not tolerate such abuses.

From all this, you might get the idea that 220 FM in southern California is kind of boring—far from it. In fact, it's probably the most interesting of all the VHF bands in that it's possible to carry on a worthwhile discussion for hours, over a repeater, no less, and not be interrupted every five minutes by someone wanting to make a call and then shuffling you to the side for an hour once he has his party. If someone "breaks" a QSO, they ask permission from those in QSO to use the frequency or repeater, and once they establish their QSO, they move elsewhere. There's always a "thank you," to boot. It's been years since I've heard this kind of operation on two meters out here in the greater Los Angeles area.

I suspect that the type of respect for one's fellow man that you find on 220 stems from the manner in which the band has been developed and, moreover, from the group which has guided this development the past few years. It's called the 220 MHz Spectrum Management Association of Southern California and is more than just a repeater council. The 220-SMA was founded on the simple principle that everyone who invests in a 220-MHz radio, regardless of the mode he or she prefers, has a vested interest in the development of the spectrum. To that end, the 220-SMA has within its structure representatives of every mode and every special interest, all sharing equally in the responsibility of orderly spectral development. One need not own a repeater to belong to the 220-SMA, and the organization encourages every 220 user to voice his opinion on matters of interest and importance. It's basically a very technically oriented group, as opposed to its two-meter counterpart, TASMA, which is more politically oriented.

Being technical in nature, the 220-SMA tends toward moving very conservatively on all matters, though on occasion when the viability of the spectrum has been threatened by such entities as Class E CB and marine radio, they have been known to become very vocal rapidly. By and large, they favor the conservative approach and any change to the structure of the band is well researched prior to any commitment. An example of this can be seen in the accompanying spectral diagram. It took over 1½ years of research to bring it to the membership for a vote. I was at the meeting where it was voted on. There was only one dissenting vote and that was mailed in. The single person dissenting did not attend the meeting. In preparing the changes, the 220-SMA technical committee met with representatives of all aspects of 220 usership, including many non-FM-oriented groups and individuals. It went out of its way to be sure that every voice which could be located would be heard. In January of this year, the revised band plan was initiated and, for the most part, everyone is happy with it. Moreover, it's a band plan with tomorrow in mind and which ensures spectrum availability for new modes yet to come. I'm sure that ASCII will be prominent among them.

There is no way to compare 220 with 2 meters out here. The similarities that exist are only in mode. That's where it ends. The people of 220 are a very together lot. Technically oriented, for the most part, and intent on building a better tomorrow. It's what two meters could have been if self-centered egotism had not replaced reason and if a fat checking account had not become the criterion for repeater ownership. It's interesting to note that the people of 220 want nothing to do with 2 meters' political problems. Nobody's standing on a podium yelling "user rights," as

Continued on page 182

Band Plan
220 MHz
Southern California Area July, 1979; Revised January, 1980

220.00–220.05	Weak signal (non-relay), 50 kHz (Note 7)	
220.06–220.70	Outputs for two (2) frequency non-repeater systems (Note 1)	33 channel pairs (Note 2)
220.72–220.90	One-way control or auxiliary links, 10 channels (Note 5)	
220.92–221.10	Non-relay direct communication, 180 kHz (Note 3)	
221.12–221.24	One-way control or auxiliary links, 7 channels (Note 5)	
221.26–221.90	Inputs for two (2) frequency non-repeater systems (Note 1)	33 channel pairs (Note 2)
221.92–222.18	Weak signal (non-relay), 160 kHz	
222.20–223.38	Repeater inputs	60 channels pairs (Note 4)
223.40–233.78	Simplex, FM, 20 channels 223.50 National simplex calling	
223.80–224.98	Repeater outputs	60 channels pairs (Note 4)

Notes:
1. 220.00 to 220.50 is restricted to weak-signal use by current FCC regulation. In southern California, weak-signal activity is centered at 222.00.
2. Two-way links or auxiliaries are coordinated with 1.2-MHz separation on even 20-kHz channels.
3. The SMA encourages use of new modes of communication on the 220 band and has allocated the segment 220.92 to 221.10 for this purpose. It is not called simplex because that may imply that the segment is exclusively for FM simplex.
4. Repeaters are coordinated on even 20-kHz increments with 1.6-MHz input-output separation.
5. Control channels are coordinated with multiple users. Channel protection with PL (private line™) tone is required. PL frequencies are coordinated by the SMA.
6. Frequency coordination of control and auxiliary channels is not published by the SMA unless permission is granted by the user.
7. The SMA plans to increase weak-signal subband another 50 kHz (to 220.10) as soon as existing auxiliary links can be moved.

RTTY Loop

Marc I. Leavey, M.D. WA3AJR
4006 Winlee Road
Randallstown MD 21133

In all the years I have been writing this column, I never thought I would have to stoop so low as to use a four-letter word to get your attention. This month, I must! Because that word is the hottest topic in ham RTTY, and to cover it, I will delay the conclusion of my demodulator series by a month or so.

What is the four-letter word? Why, "ASCII," of course! Oh, wait, A-S-C-I- . . . hmmm, so it has five letters, I got your attention, though, didn't I? The point is that the FCC has realized, at last, that the Baudot/Murray code is ancient and has authorized the use of ASCII on ham RTTY frequencies. Docket 20777 has passed, and implementation of the order occurred on March 17, 1980. Specifications for this new mode are detailed in this month's FCC column.

But, before we can work ASCII, we need to understand what ASCII is, why it is better than the code we are now using (assuming that it is!), and how we can best go about putting it on the air. That is the subject of this month's column.

Described several times in this column, the Baudot or Murray code, which all five-level teleprinters use, until now has been the code authorized for amateur use. This code uses five data bits to encode 32 possible combinations, which represent all capital letters and machine functions. A shifted set of 32 additional characters is implemented to support numerals and punctuation. That only limited punctuation and no lowercase letters can be supported is obvious, and this resulted in the development of several alternate schemes. I shall not go into them, except to mention that six, seven, eight, and more bits have been used to define character sets. In 1963, an American Standard Code for Information Interchange was devised. Normally referred to by the acronym "ASCII," this standard defined how seven bits could be encoded to represent 128 possible code combinations. Unlike the Baudot code, in which characters are represented in no particular order, ASCII maintains a strict order, making many code manipulations easy. A commonly used chart, showing the "full" ASCII code, is presented in Fig. 1.

The first two columns contain the so-called "control codes." These are non-printing characters that maintain various functions in line circuits. Although some of them, such as CR, LF, or BEL, are universally observed, even on home computer terminals, others are frequently redefined by the end user. Many terminals, for example, have internal functions and modes controlled by these characters, thus the grouping into "control codes."

b7								0	0	0	0	1	1	1	1
	b6							0	0	1	1	0	0	1	1
		b5						0	1	0	1	0	1	0	1
b7	b6	b5	b4	b3	b2	b1	COL → / ↓ ROW	0	1	2	3	4	5	6	7
			0	0	0	0	0	NUL	DLE	SP	0	@	P	'	p
			0	0	0	1	1	SOH	DCI	!	1	A	Q	a	q
			0	0	1	0	2	STX	OC2	"	2	B	R	b	r
			0	0	1	1	3	EXT	OC3	#	3	C	S	c	s
			0	1	0	0	4	EOT	OC4	$	4	D	T	d	t
			0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u
			0	1	1	0	6	ACK	SYN	&	6	F	V	f	v
			0	1	1	1	7	BEL	ETB	'	7	G	W	g	w
			1	0	0	0	8	BS	CAN	(	8	H	X	h	x
			1	0	0	1	9	HT	EM	)	9	I	Y	i	y
			1	0	1	0	A	LF	SUB	*	:	J	Z	j	z
			1	0	1	1	B	VT	ESC	+	;	K	[	k	{
			1	1	0	0	C	FF	FS	,	<	L	\	l	¦
			1	1	0	1	D	CR	GS	-	=	M	]	m	}
			1	1	1	0	E	SO	RS	.	>	N	^	n	~
			1	1	1	1	F	SI	US	/	?	O	_	o	OEL

Fig. 1. The ASCII code.

Punctuation, numerals, and uppercase letters follow in ascending sequence. Note that by shifting four columns to the left, each control code corresponds with an uppercase letter. The control codes are sometimes referred to in that way, so that BEL is control G or DC1 is control Q. Most ASCII keyboards have a "CTRL" key, which, when held down, shifts the output to produce the corresponding control code.

Although not implemented on older eight-level Teletype® machines and other uppercase-only machines, the last two columns of the ASCII character set contain lowercase letters. Again, note the correspondence with the uppercase set. This makes shifting case easy, and allows most uppercase machines to respond to lowercase with the appropriate uppercase letter.

Similarly to Baudot, serial transmission of ASCII is accomplished with a START bit, eight data bits, and one or two STOP bits. Conventions dictate that at slower baud rates, where mechanical teleprinters are more likely in use, two STOP bits be sent. As the speed of transmission is increased, only one STOP need be sent. Unlike Baudot, data bits are sent from the least significant bit (LSB) to most significant bit (MSB), exactly backwards from Baudot. An example will help clarify. The letter "S" in Baudot is normally represented as 11000. In hex, this would be $18. When transmitted, the sequence is START-1-1-0-0-0-STOP. The ASCII for "S" is 1010011 or $53 hex. But this is transmitted START-1-1-0-0-1-0-1-0-STOP. Now, before you get all bent out of shape about that last "0", let me explain.

If you have been paying careful attention so far, you have noticed that I have sometimes referred to ASCII as "seven bits" and sometimes as "eight bits." Well, there is a reason for this inconsistency. As defined, ASCII uses seven data bits to represent 2 to the 7th (128) characters. As transmitted, however, an eighth, or "parity" bit is added as the MSB. This parity bit may be defined in any of several ways. In many home systems, it is fixed as either a "1" or a "0". Since it is always the same, it may be stripped without concern. Although this solves the "what do I make it tonight" dilemma, it wastes the value of the extra bit. What parity is supposed to do is provide a means of error-checking on a character-by-character basis. Two types of parity are commonly used: even and odd. With odd parity, the parity bit will be added if the number of data bits is even, and with even parity, if the number of bits is odd. To elaborate, whatever the type of parity, that type represents the odd or even state of all transmitted characters. Let's run through a few examples. The letter "A" is 1000001. This has two bits, so, no parity bit is added for even parity, producing 01000001, or one is added for odd parity, producing 11000001. The "C", on the other hand, is 1000011, possessing three (odd!) bits. No bit is needed for odd parity, one is added for even parity. So, even parity = 11000011, and odd parity = 01000011. Simple, yes? No? OK!

Now that you understand parity, look at one more thing. ASCII characters are frequently, as we have done here, represented with their hex equivalent. Thus, "A" is $41, "B" is $42, etc. But, if parity is considered, strange things start happening. Depending on whether fixed, odd, or even parity is used, some very familiar codes can change. Thus, CR, normally $0D, can become $8D, or "A" can change to $C1. Just thought I'd point that out!

So, how will we use ASCII? To tell you the truth, I don't know. The *Federal Register* indicates that ASCII will be handled similarly to current RTTY. Between 3.5 and 21.25 MHz, ASCII will be allowed on F1 (conventional FSK), where F1 is currently authorized. The speed at these frequencies will be limited to 300 baud. In the spectrum ranging from 28 to 225 MHz, ASCII will be permitted at speeds up to 1200 baud, via F1, F2, and A2 (AFSK), again, where those forms of communication are presently authorized. Above 420 MHz, baud rate is limited to 19.6 kilobaud! Modes remain F1, F2, and A2, where authorized. I hope we can all settle on standards and conventions early! At first, it would seem that conventional FSK techniques

Continued on page 174

Leaky Lines

Dave Mann K2AGZ
3 Daniel Lane
Kinnelon NJ 07405

After many, many years of listening, just listening, to the ham bands, I have concluded that it is no longer necessary for me to subscribe to such publications as *Scientific American*, *Science*, *Sky and Telescope*, or any of the others. Nor is it essential to own an encyclopedia or to become an associate member of the American Museum of Natural History or the Smithsonian Institution. I discovered that if you listen to hams long enough, you will learn everything there is to know about any given subject in the universe.

The reason is simple. The ham population consists of experts in every known field of knowledge and discipline in the world. At least that is what I gather from the authoritative manner in which these experts expound on the bands.

Just this very morning, I listened to a prime example of this. The guy doing all the talking was named Floyd, Lloyd, Clyde, or Claude . . . I've forgotten which. And he was holding forth about the Russians.

"They visited the Tesla Museum in Yugoslavia," he said. "And they were highly interested in all the papers Tesla wrote concerning his theories about control of the weather. They spent a great deal of time poring over all those documents.

"But," he announced triumphantly, "it backfired on them." (I got the unerring impression that he was about to disclose something so startling and stunning that it would revolutionize human civilization.) "Just look at the mild winter we've been having here in America, and over there in Russia, they've been getting horrible weather." He laughed diabolically.

It was clear that he sincerely believed that the world's weather pattern for the winter of 1979-80 had been engineered because the Soviets had inadvertently misapplied the theories of Nikola Tesla. Moreover, Floyd, Lloyd, Clyde, or Claude was quite firmly convinced that they had done so because the papers had been deliberately doctored by our CIA or some other American cloak-and-dagger outfit who had been planted there for the specific purpose of fouling the Russians up. (It was something like that old tale about allowing the Japanese to build a naval vessel from altered American plans, and then the damned thing capsized . . . just rolled right over on its back when it was launched.)

He made it abundantly clear that the whole thing had resulted from some alleged undercover operation carried out by American agents, probably for the purpose of engineering a crop failure in the U.S.S.R., for what reason, God only knows . . . that is, God and Floyd, Lloyd, Clyde, or Claude.

He interrupted the QSO. "I'll see you later, Elmer," said he. "I've got to go to collect my unemployment insurance."

Some other joker was expatiating at great length on all those psychics and parapsychologists recently called in to assist police in tracking down murder victims and missing persons. He went through a lengthy enumeration of such cases, in which such psychics had succeeded where all else had failed . . . bloodhounds and detectives hadn't even come close.

Then he went off on an inexplicable tangent, recounting some personal experiences dealing with his own dreams. It seems that whenever he dreams of some individual, that unfortunate party usually succumbs within a month or two.

I have no idea, not the remotest clue, of the explanation of this business of his dreams within the context of the discussion about psychics. Indeed, I'm not sure there is any connection.

He also claimed that in these dreams of his, he was constantly in communication with his own parents, as well as with a large group of other persons "from the other side." According to his allegation, they were forever giving him advice and guidance. And he said, "You mark my word, Charlie . . . one day the world will learn. It's much later than they think."

I don't know why, but a shudder went up my back and I could feel the hairs on the back of my neck rise. I suppose I instinctively knew what was to come next.

Then came the crusher! He asserted that he had actually seen God! Well, not precisely the Deity, but a super-bright light which practically blinded his eyes when it lit up the entire bedroom as though the afternoon sun were streaming in through the windows. His wife had not seen it at all . . . had said to him, "It must have been a dream. Go on back to sleep."

He explained this by saying that his wife had simply not been chosen, as he had been, to witness this great light, so how could she, poor outcast, be expected to know that it had been meant for his eyes alone, as a sort of sign?

The fellow on the other end of this QSO must have been so moved by the story that he was unable to answer. He was probably dumbstruck with the wonder of it all and totally incapable of reply. Or maybe, like me, he had spun the dial of his receiver to some other frequency.

Last summer, I was listening to a net discussing the ancient civilizations of the world. A couple of fellows got into a lengthy colloquy about Egypt, and one blurted out the astonishing news that he had been present on the very day that Alexander the Great had conquered Egypt in 332 BC. I took it to mean that this had occurred during some previous existence of his . . . he regarded himself as a sort of male Bridie Murphy, I suppose. He also said that he had seen Ptolemy, Cleopatra, and at least four or five different pharaohs.

I was holding my breath . . . anticipating that he would announce that he had accompanied Moses and the Children of Israel out of the Land of Bondage. But he never had a chance to get that far. Someone had the gall and temerity to suggest that perhaps he had visited the "greenhouse" once too often that evening.

"Are you calling me a liar?" challenged the indignant one.

I kept listening, hoping to hear more, but the frequency had become bedlam, rendering all speech unintelligible. Sadly, I tuned my 75S-3B to some nearby frequency where a couple of ordinary mortals were discussing an ordinary topic . . . the relative merits of yagi antennas versus quads.

Some guy in Connecticut was holding forth on a pet theory regarding forward and reflected power. He said that in order to determine the power of a transmitter, one had only to add the indicated reflected power to the forward power. In other words, if your transmitter produces 100 Watts and your bridge shows a reflected power of 20 Watts, you simply add them together, and you are running 120 Watts!

The other fellow pointed out that if this were the case, all one would have to do to develop more power would be to increase his vswr more and more, and the more out of resonance that one could manage to get the antenna, the greater would the mismatch become, resulting in a maximum of reflected power. "According to your theory," he said, "it would be to your advantage to have as high an swr as possible, for that would give you more output than if you had unity match. If that's possible with the aerial you are using, I'd be much obliged if you would send me a drawing of it so that I can build one, too." (By the way, would some kind reader please give me the inside story on why so many hams nowadays have reverted to that old-fashioned word, "aerial"? And while you're at it, see if you can find out why they are now using the word "radio" in place of transmitter, transceiver, and receiver.)

Well, anyway, when this fellow had finished demonstrating how foolish he thought the other guy's theory was, the antenna genius abruptly terminated the QSO. "Sorry," he announced. "I've just gotten the chow call. Gotta sign off."

This was rather odd, for I glanced at the clock and it read half past three in the morning!

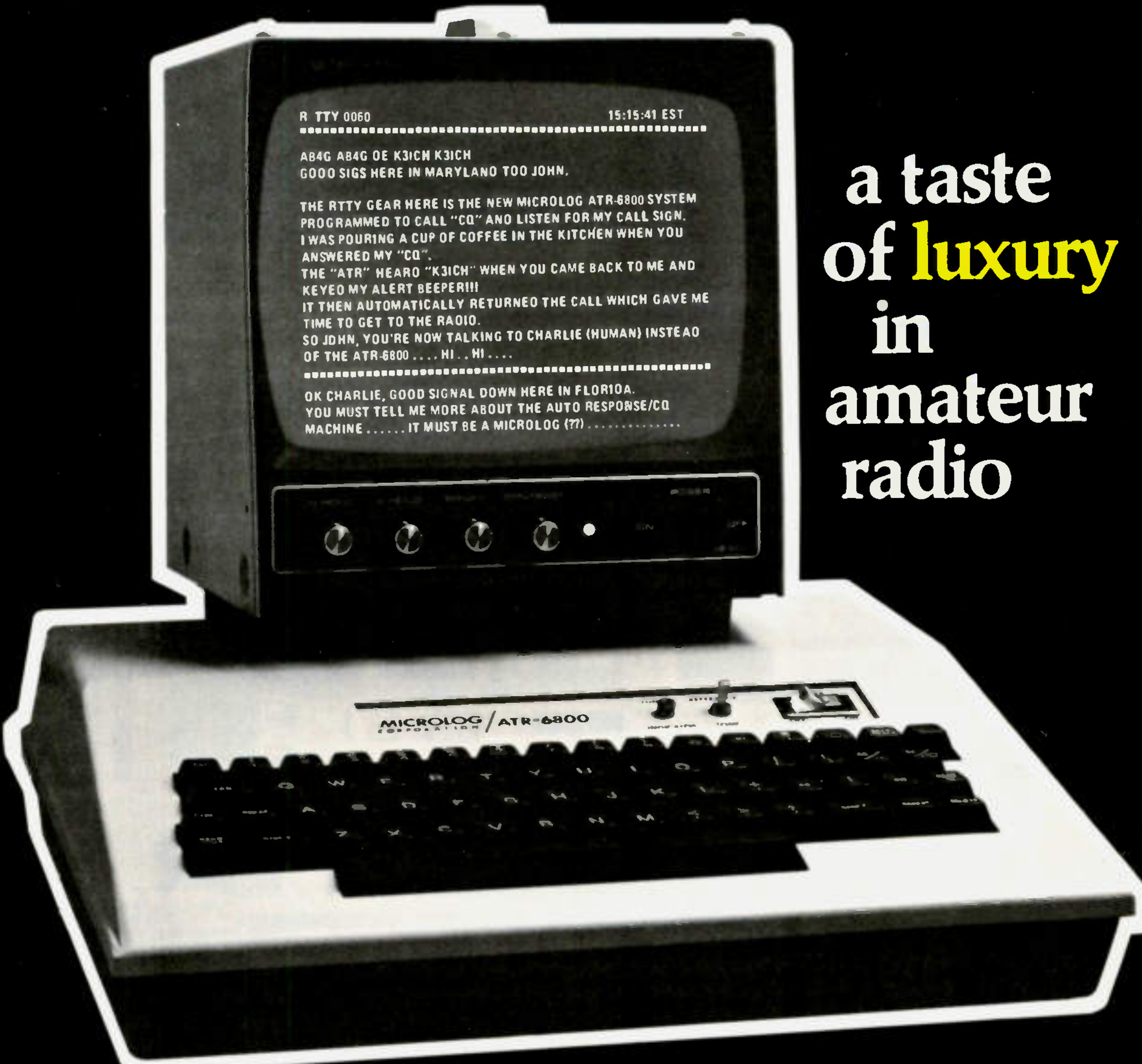
They must keep strange hours in Connecticut . . . at least in that asylum where this fellow is being kept!

I would greatly appreciate hearing from anyone who may be familiar with the particulars of a certain burial which took place in the mid-50s in California. I've been hearing vague dribs and drabs about it, but could never manage to find anyone who knew the whole story.

It seems that a certain ham arranged that a small transmitter would be placed in his

Continued on page 196

ATR-6800



a taste of luxury in amateur radio

The best of both worlds . . . a simple, easy to use video system for CW/RTTY/SSTV and an automatic computer station control.

Learn a few keyboard commands; plug in your transceiver and you're on the air with performance that leaves the others "in the noise." With the program permanently stored in ROM, there's no need to fumble with loading. To get it going, you just turn it on!

The complexity of its operation is up to you; the capability is there when you need it. Use the computer mode to add a new dimension to your station's operation. It virtually obsolete-proofs the system for future developments by allowing direct control or modification of all operating parameters in all modes. With battery backup memory it will remember your ID, stored messages and special programs.

SLOW SCAN TV? Sure, why didn't you say so? It's easy with the ATR-6800, our SSTV program outputs standard tones for sending characters and computer graphics. Compose a full screen and transmit it, just like you would on RTTY!

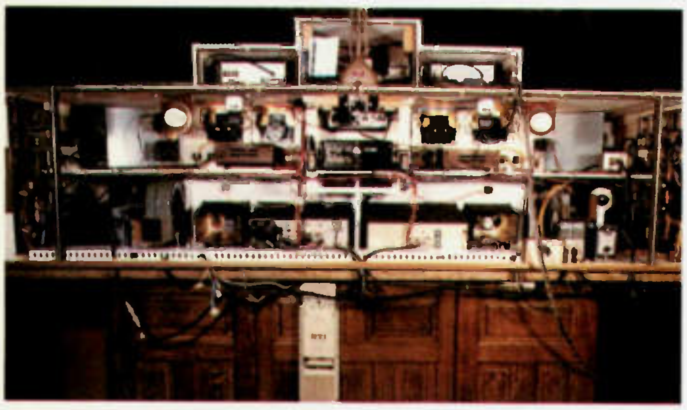
ATR-6800 with 9" monitor. $1995.00

Ask your dealer or drop by. MICROLOG CORPORATION, 4 Professional Drive, Suite 119, Gaithersburg, MD 20760, Telephone (301) 948-5307.

MICROLOG ✓51

INNOVATORS IN DIGITAL COMMUNICATIONS

Faces, Places



One of the Windy City's most prominent hams, Lee J. Knirko W9MOL, was featured in the Chicago Tribune Magazine *last fall. (Photo by Ken Thompson)*

E. J. Kundert W8YEK's "shack" has changed considerably since we ran a photo of his console on our February, 1975, cover. The shack is the CD Communications Headquarters for the city of Delphos OH. For emergency power, Gene uses his Kohler 12K diesel generator installed in the garage, which is started and stopped from the shack. The city of Delphos purchased a Spectrum 2-meter repeater, Phelps Dodge duplexer, and antenna, which is at 250' on a tower in the north end of Delphos. The .72/.12 repeater is under the control of the Tri-County Repeater Association. Since 1975, all equipment has been changed. There is now a mini console on top, which houses two scanners (2 meters and police, fire, etc.) and one CDE control box which operates rotators on two towers through the use of a rotary switch. For two meters, Gene has a self-supporting 64-foot tower; the other tower is motor-driven (40'-70') and its height is controlled from the console. A Teac A-170S cassette deck (not shown) is located in the top left drawer. In the right-hand drawer is a home-brew SSTV keyboard. The switches directly above the Drake Line control the inter-equipment and mode switching. Switching is done via RG-174 and no rf problems have been experienced so far. The power supply for the TR7 is located on a shelf in the kneehole part of the desk. The rear panel is made entirely of Plexiglas™. Air is brought in through the grills on each end of the front of the console, passes over all the equipment, and is exhausted out through a duct and hole in the rear panel. There are two thermostats and two blowers, which, even with the solid-state gear, run quite often (85° F). Since the console was built, the elapsed-time meter has now reached 11,505 hours.

The kids of Community School District 6 in New York City are shown taking part in an excellent amateur radio program administered by Len Latronica WB2KVU in their schools. Over 200 children have already earned their licenses, and teachers, students, and administrators continue to study together for their tickets. Top photo (left to right): Maria Sandoval, Leslie Sydnor WA2KVN, Alexis Skidan WB2RKG, Robert Stein WA2RJY, Ricardo Guzman, Eugene Campbell. Bottom photo: Eugene Campbell (left), Ricardo Guzman (center top), Robert Stein WA2RJY (center middle), Leslie Sydnor WA2KVN (center bottom), Leonard Latronica WB2KVU, Assistant Principal (right). (Photos courtesy of Photo Associates News Services, Inc.)

We've heard of automobile mobile, aeronautical mobile, maritime mobile, motorcycle mobile, and bicycle mobile . . . but a port-a-john mobile?! While it appears some operating time (formerly lost to the tending to of personal needs) might be saved, the propagation probably stinks. (Photo by David W. Hannah W6NBJ)

Jim Oberto WA9YYV of Joliet IL, Mrs. Gertrude Bongovia of Worcester MA, and Wayne Baldner of Ames IA (left to right) teamed up at a trailer resort, Desert Shadows, in Phoenix AZ, at Christmastime to "demonstrate ham radio by sending Christmas radiograms." The residents of the park sent 77 "grams." Many expressed an interest in learning to be a ham, and the three organizing hams now have a Novice class numbering 19 in progress.

Microcomputer Interfacing

Peter R. Rony
Jonathan A. Titus
Christopher A. Titus
David G. Larsen WB4HYJ

In many microcomputer applications, it is necessary to have the computer perform actions at accurately timed intervals. This allows the computer to make accurate measurements of an analog signal at 100 millisecond intervals. The period of 100 milliseconds may be "timed" through the use of a time-delay loop using software commands, or by using an external clock.

While a time-delay software routine may generate a delay of the required accuracy, the computer cannot do anything else while it is performing the timing software steps. This is a serious limitation. Although probably less obvious, the time-delay software steps may be interrupted by some external device and require immediate servicing by the computer. The overall effect is to "lengthen" the time required for the time-delay software steps. The actual time delay is the sum of the time spent in the software steps and time spent servicing the external interrupt.

In most instances in which accurate periods are required, an external circuit is used to time the necessary periods with the least interaction possible between the computer and the external clock. Such clocks are immune to external interrupts and changes in the normal flow of a program. Once started, they continue to time a period until it is completed and the time is up. In this way, the clock runs in parallel with the computer, allowing the computer to perform other tasks and service interrupts while the clock is running. This type of external clock is often called a *real-time clock* because its time is real and cannot be altered or delayed by events that would normally affect a program.

There are several different types of real-time clocks:

a) *The Programmable Real-Time Clock.* The actual period required is preprogrammed within the clock either through hardware or software. Once the clock has been started, it will continue timing until the period has ended. At the end of the period, the clock will signal the computer that the timing task has been completed.

b) *The Free-Running Read-Time Clock.* The clock runs continuously, signaling the computer at the end of each period. The periods are generally of equal length, approximately 10 msec.

c) *The Time-of-Day Clock.* This type of clock will provide the computer with the actual time, i.e., 16:20 hours. This type of clock is not frequently used in small computer systems.

The operation of an 8085-based computer system has been discussed in previous sections. The use of the 14-bit timer contained within the 8155 read/write memory and interface chip was described in terms of its real-time operation. In the 8085-based computer application, the 14-bit counter obtained its timebase from the crystal clock used to control the 8085 chip. An interrupt was used to signal the end of the timing period.

This was an excellent example of a programmable real-time clock. If we assume that a frequency of 1 MHz was used to control the clock, a 14-bit counter could provide us with a total count of 16,384 microseconds, or just over 16 milliseconds. This might be somewhat limiting if periods of several seconds are required, but the scheme is fairly flexible. If longer periods are required, the 14-bit counter could be programmed to time some integer fraction of the period. The computer could then be used to total the number of shorter periods required for the total period to have elapsed. The computer must increment and test a count only when the clock interrupted it. One drawback is that additional software is required; something we tried to avoid by using real-time clocks in the first place. The additional program steps, however, are quite minimal.

In many cases, it would be valuable for the real-time clock to be preset for the clock's basic frequency, i.e., 1 MHz, 10 kHz, etc., as well as for the actual count. If these various intervals were available, the timing of longer periods would be relatively easy and no additional software steps would be required. A simple series of divide-by-ten counters such as the SN7490 or SN74390 could be used to divide a high-frequency clock signal into lower frequencies for use by the real-time clock's counters. Various frequencies could be readily selected through the use of jumper wires on the computer board. A more sophisticated real-time clock scheme can use an electronic switching circuit that allows the computer to select the frequency required. Thus, a programmer could select the basic period and actual count by making software commands to the real-time clock.

The free-running real-time clocks are preset to time a period of predetermined length, 10 milliseconds, for example. This period is timed over and over again, interrupting the computer each time a period has been completed. In many computer systems, a line power frequency of 60 or 50 Hz is used to provide a stable, fixed-length period that may be used equally well. The free-running type of real-time clock is not as independent of the computer as the programmable real-time clock is. Software steps to accumulate the number of periods are still required, and the total timing period may have an error of up to two of the basic frequency periods.

Since the free-running real-time clocks have a regular period, they are often used to signal the processor that it's time to start a software routine that will check various input/output (I/O) devices to determine whether they require some computer service. By using a software table, the computer can check to see what devices are enabled or disabled. It can also determine the frequency at which they must be checked. It's useless to check a 10 character per second teletypewriter every 10 milliseconds, so it's only checked every 80 or 90 milliseconds. A faster device, however, is checked at the end of each 10 millisecond period. Such a scheme allows the computer, and the programmer, to have a great deal of flexibility in the way real-time operations are handled, particularly in situations where the computer is required to perform many real-time operations simultaneously.

In almost all cases, the computer and real-time clock are connected by an interrupt signal. In this way, the clock can immediately signal the computer that the current period has been completed or "timed out." Since interrupts can be quite complex, as we have described previously in our columns, only one real-time clock should be used with a microcomputer. It will be up to the user to determine the priority and thus the importance of the real-time clock. Often the real-time clock is assigned the highest priority.

Ham Help

I need information, schematics, etc., on a Gonset IV 6-meter transceiver. I will pay for reproducing and shipping. Thank you.

Richard McCubbin
535 Church Street
Portland MI 48875

I need a schematic, manual, and parts list for a 23-channel Skyfon OM 423 CB and, also, a schematic to convert same to 10 meters. I will be happy to copy and return. Thank you.

Kenneth W. Underhill
7301 East 11th Street
Indianapolis IN 46219

I am in need of Galaxy III service manuals. I will pay for an original or a copy. Thank you.

H. C. Fields W5SGX
4116 Morgan Circle
Ft. Worth TX 76118

Would you like a QSO with Turkey? I would like to set up schedules with all those who are interested. Send your callsign, address, and mode (CW or SSB), with three IRCs. I will send you a 4-week schedule of when I will call you.

Talat Turgay
PO Box 133
Ankara Turkey

Reader Service—see page 226

321

A SWAN FOR EVERY NEED

Talk State of the art, Versatility, or Economy — SWAN'S famous "world's best" Engineering team has designed a complete line of Transceivers to suit your need.

Take a look at the three hottest new SSB Transceivers this year. They're all made in America and they're all from Swan. Whatever your dreams—from a compact fully synthesized mobile to a full-blown base station with dual PTO's—one of these will bring them to reality today. They're all solid state, all 235 Watts PEP and CW on all frequencies, and most of all they're affordable.

Most Advanced HF Transceiver in the World—ASTRO 150

HF SSB Transceiver featuring "VRS" a knob with a new twist, and over 100,000 fully microprocessor-controlled frequencies on present or envisioned "ham" bands.

☐ High Power — Full 235 Watts PEP & CW, all bands ☐ Truly Synthesized in accurate 100Hz steps ☐ Full CW Break-In with narrow XTAL Filter ☐ Standby Memory — ALL BANDS ☐ True PEP output meter ☐ Model 150 — 80 thru 10 meters ☐ Model 151 — 160 thru 15 Meters

ASTRO 102 BX

100 MX

Most Versatile HF 160M-10M Transceiver in the World—ASTRO 102 BX

Dual PTO's, 235 Watts PEP & CW on all frequencies, IF Passband tuning, with LED position indicators and full break-in.

☐ All solid state ☐ Modern design and styling ☐ Tunable notch filter ☐ 4 Function Meter ☐ Speech Processor ☐ VOX ☐ Adjustable AGC Decay ☐ 2 Position CW Wave Shaping ☐ 16 Pole IF Filter ☐ Crystal CW Filter ☐ PLL Synthesized Band Selection

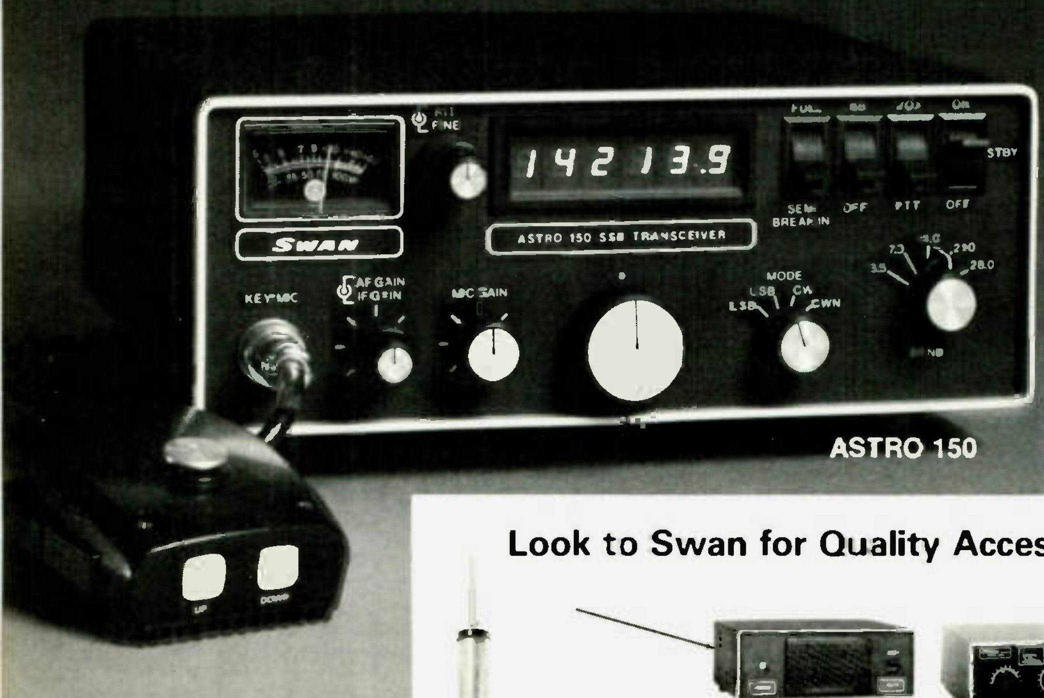
Economy with top SWAN quality and mobility—100MX

235 Watts PEP & CW on all frequencies. The field-proven Rig the whole world's talking about.

☐ All solid-state ☐ Modern design and styling ☐ VOX ☐ Noise Blanker ☐ Semi-CW Break-in ☐ RIT ±1.5KHz ☐ 25 KHz Calibrator, built-in ☐ CW side tone with adjustable pitch and level ☐ Internal speaker ☐ Jack for external counter

SWAN

A division of Cubic Communications, Inc.
305 Airport Rd. • Oceanside, Ca. 92054
(714) 757-7525



ASTRO 150

Look to Swan for Quality Accessories . . . and Service ✓70

LETTERS

GO AWAY

I agree with K4FNE's letter in the November (1979, p. 190) issue of *73*, except that it's not "sour grapes" as your editorial people titled it, but an accurate assessment of the problem.

I find *73 Magazine* technically to my liking, considering the wide variety of my amateur radio pursuits. However, your excesses in ranting about the ARRL, Wayne, have caused me to reconsider renewal of my subscription when it is due in 1980. It is really sad because you have the means to accomplish much for amateur radio with or without the ARRL, but you seem content to take monthly potshots at them, which, in the long term, accomplish nothing. Granted, the ARRL has faults, but it is a strong voice for amateur radio where no other exists, save for some abortive attempts at raising a competing national organization, which, I'm sure, some of your readers will remember.

My feelings can be summarized by quoting the late U.N. Secretary General, Dag Hammarskjold, from his diary, *Markings*: "When shut out of the room you must not peep through the keyhole. Either break down the door, or go away."

Jack C. Parker WØRIB
Bismarck ND

MOBILE MANUALS

From time to time, in Ham Help, I see needs for mobile radio equipment manuals. After 18 years in the mobile radio biz, I changed careers and am in computer components manufacturing. I have an 18-year collection of mobile radio manuals that I no longer need and would love to disseminate into the ham fraternity.

The dates span 1948-79, from the 5V to Micor, Link, Pre-prog through Mastr II, and a lot of off-brands and models. I can supply a list of manuals available (subject to prior sale) for an SASE. I will charge $1 to $3 per manual to cover my mailing costs. I don't need them taking up space in the garage if some hams can put them to good use.

Alan Christian WA6YOB
PO Box 5314
San Jose CA

ANTIMATTER

Paul Lutus' article (February, p. 116) on Albert ($E = mc^2$) Einstein was a lot of fun to read. But, what's he got against antimatter?

If a spaceship in space containing a ball of antimatter fires its engines and accelerates toward the left, then the antimatter will also accelerate toward the left, squishing itself up against the nose cone. From the antimatter's point of view, it looks out the porthole and sees the mass of the universe ganging up on it (accelerating) to its right; therefore, it panics to get away from the mass by moving to its left toward the front of the spacecraft just as it would if the spacecraft were sitting on the Earth.

Barry Dorfman KB6CV
Brentwood CA

2UO/WHO

Congratulations on the 2UO/WHO *New York Times* station article by W3CFC (February, p. 54). It is light reading, historical, with good pictures, and of general interest. Many fellows have called it to my attention over the air.

I am somewhat familiar with the station (and its history) and feel the story is accurately documented. If anyone could give Rex accurate information, certainly Iverson could.

The AWA Museum *almost* got the last WHO SW shortwave transmitter, which I believe is pictured on page 59. We got our bid in two weeks late and were told that they had junked it while cleaning out one of the upper floors of the building!

Bruce Kelley W2ICE
Antique Wireless
Association, Inc.
Holcomb NY

QRP ON TEN

About a year ago, I, along with thousands of other amateurs, took your advice and got on 10-meter AM QRP with converted CB rigs using your recommended band plan. Recently, it seems that the high-powered SSB stations also are using your AM band plan.

Maybe you could explain in *73* what a gentlemen's agreement is or what it used to be. The QRP operators would like to have a few channels above 29 MHz.

AM activity is picking up. In addition to the QRP rigs, many hams are dusting off their old Elmacs, Gonsets, Globe Scouts, Rangers, etc., and rediscovering what amateur radio used to be.

I have worked 20 states, a G2, a G3, a YS1, and a UB5 with 4 Watts and a vertical antenna. I am glad that I took your advice; it is great fun.

I would like to see a calling channel and an emergency channel. Channel 9 would be a good emergency channel since some rigs are set up with channel 9 as a priority channel.

Keep up the good work with *73*. It is a great magazine.

Mike Collins W4ACC
Winchester VA

KUDOS

Please let me take this opportunity to congratulate you for the great article in the February issue of *73* entitled "Albert and his Momentous Theories."

I very proudly took this issue to the office and showed the staff that amateur radio could be more than just rag-chewing and DXing with an exchange of signal reports and weather conditions. An article like this does begin to show that there are a few hams left interested in science at large and not just dots and dashes.

I'm just a bit sorry that I didn't subscribe to *73* a long time ago!

Norman S. Bernat K2GYX
Livingston NJ

STAY THE SLEDGE

A recent article, "In Search of Power Line Interference" (February, p. 66) by Henry Luhrman, contained a lot of practical information on the sources of RFI from power lines, as well as several valuable detection procedures. However, one detection scheme mentioned—hitting the suspected pole with a six-pound sledgehammer—is a potentially dangerous practice.

As Mr. Luhrman has discussed, a probable cause of power-line RFI is loose hardware, as well as cracked insulators. Hitting the base of a suspected pole with a sledgehammer might send an impulse to the defective material, causing a break. At a minimum, the power company's property has been damaged and they would rightfully expect to be reimbursed financially (it is a lot cheaper for them to replace a cracked insulator than it is to pick up conductors that have been burned down). Worse yet: 7,000- to 13,000-volt lines could land on the ham's head!

I urge all hams not to strike, tap, jiggle, or hit any power lines—least of all ones that have defective material.

R. W. Coleman WA4JDD
District Manager,
Florida Power & Light Company
Punta Gorda FL

STAMP PLAN

Many amateurs have responded to my letter in the January issue of *73 Magazine*, regarding an issue of a commemorative amateur radio stamp. WB2FYB advises that such a stamp was issued several years ago in a five-cent denomination, but thinks it is time for a second issue. WB2EUF suggested that it be issued in celebration of the forthcoming band expansions.

The Muskogee Amateur Radio Club is urging that all amateur radio operators write their congressmen, suggesting that they press for the issuance of such a stamp. We are suggesting that the stamp be of the 31¢ denomination, with the American flag prominently displayed, to be used on letters containing QSL cards which are mailed direct to points all over

Continued on page 184

Awards

Bill Gosney WB7BFK
2665 North 1250 East
Whidbey Island
Oak Harbor WA 98277

DX AWARDS FROM CZECHOSLOVAKIA

If you've never seen the beautiful DX awards available to licensed amateurs from the Central Radio Club of Czechoslovakia, then you're in for a real treat. It has been my pleasure this past month to have received the full details of their entire awards program and they are described in the paragraphs to follow.

S6S AWARD

The S6S Award is afforded those amateurs who have a QSO with at least one station located in each of the six continents as defined by the IARU since January 1, 1950. Awards will recognize those contacts of CW, phone, and RTTY, either all-band or single-band achievements. Mixed-mode contacts are recognized.

P75P AWARD

This award is for having worked at least 75 ITU zones as defined by the ITU Geneva Conference of 1959. All contacts must be made since January 1, 1960, and awards are available in three levels of achievement: 1st Class – 70 zones, 2nd Class – 60 zones, 3rd Class – 50 zones. Zones may be determined in accordance with a special map made available by the Central Radio Club for the cost of 3 IRCs. Also, it is important to note that all contacts must be made with "fixed" stations only.

ZMT AWARD

To qualify for the ZMT Award, applicants must have confirmed contact since April 26, 1949, with at least one station located in each of the following 39 areas: OK1, OK2, OK3, HA, LZ, UA1, UA2, UA3, UA4, UA6, UA9, UAØ, UB, UC, UD, UF, UG, UH, UI, UJ, UL, UM, UN, UO, UP, UQ, UR, DM (3 different regions determined by the last letter of the callsign), SP (3 different districts), YO (3 different districts), YU (3 different districts).

ZMT 24 AWARD

For those interested in pursuing the ultimate in DX endurance, the ZMT 24 Award is just for you. The requirements are exactly the same as for the basic ZMT Award detailed above, with the exception that all contacts must be made within a 24-hour period. Sound impossible? Absolutely not, but don't be discouraged if it takes you several attempts using the stopwatch!

100 OK AWARD

Check your QSL cards. If you can find a total of 100 OK stations, then you will qualify for the 100 OK Award. All contacts, however, must be made on or after January 1, 1954. Endorsement stickers are available for every additional 100 stations confirmed, up to a total of 500. Stations may be worked any band, any mode.

OK SSB AWARD

This award requires the applicant to have two-way SSB contact with different Czechoslovak stations totaling 25 points, without a date limitation. 1 point will be scored for QSOs on the 28-, 21-, or 14-MHz bands and 2 points for a QSO on the 7- or 3.5-MHz bands. There are no mode restrictions.

As an added tip to those wishing to pursue these very respectable awards, this editor recommends that you keep a close eye on the Contest Column in *73 Magazine* and consider making a few contacts during the annual OK DX Contest. Dates and times will be announced at least a month in advance of the scheduled event. The Awards Manager of the CRC also mentions that QSOs made during the contest will not require QSL confirmations. There is one stipulation, however: Application must be submitted along with your logbook entry for the OK DX Contest.

All the certificates are issued free of charge only for members of clubs or associations which accept this rule reciprocally. The fee for all others is 10 IRCs for the P75P Award and 5 IRCs for all the other awards offered by the Central Radio Club of Czechoslovakia. General certification rules apply by which contacts may be verified by two amateurs of a local club, a club official or a notary public.

Applications shall include details for each contact, i.e., callsign, GMT, date, frequency, mode, RS(T), and any additional information required for the award. Send to Central Radio Club, Awards Manager, PO Box 69, 113-27 Praha 1, Czechoslovakia.

Right at presstime, I received still another award incentive being offered by CRC. I encourage readers to take a close look at the Slovensko Award.

SLOVENSKO AWARD

The DX Club of Radio Amateurs of Slovakia offers this award to all licensed amateurs who can show proof of contact with stations in the different districts (OKR) of Slovakia (OK3, OL8, OL9, OLØ; districts listed below) after January 1, 1946.

Stations in countries which have a common border with Slovakia must contact 35 districts, 20 districts are required of stations in other European countries, and 10 districts are required for stations outside the European continent.

There are no band or mode restrictions. Applications with a GCR list and award fee of 5 IRCs may be sent to: Central Radio Club, PO Box 69, 113-27 Praha 1, Czechoslovakia.

Districts which qualify are: Banska Bystrica, Bardejov, Bratislava, Bratislava-Vidiek, Cadca, Dolny Kubin, Dunajska Streda, Galanta, Humenne, Komarno, Kosice, Kosice-Vidiek, Levice, Liptovsky Mikulas, Lucenec, Martin, Michalovce, Nitra, Nove Zamky, Poprad, Povazska Bystrica, Presov, Prievidza, Rimavska Sobota, Roznava, Senica, Spisska Nova Ves, Stara Lubovna, Svidnik, Topolcany, Trebisov, Trencin, Trnava, Velky Krtis, Vranov, Zvolen, Ziar nad Hronom, and Zilina.

TEN-TEN INTERNATIONAL NET AWARDS

For those of us who frequent the ten-meter band, a minute doesn't elapse that you don't

hear reference being made to the Ten-Ten International fraternity.

The 10-10 organization was formed in 1962 by a group of amateurs in southern California. To this date, there have been better than 27,000 amateurs join their ranks. The unique awards program for this international group was founded and managed for years by Frank Orcutt W4JO, who is now a silent key.

To qualify for membership into Ten-Ten International and to move up on their awards ladder of achievement, you first must make contact with ten (10) individual Ten-Ten members on the ten-meter band. From each QSO, you must obtain the station's call, 10-10 number, name, and exact QTH. Once this has been achieved, you may submit your list to one of the following area or district vice-presidents, along with your check of US $4.00 (includes fee for the quarterly 10-10 publication): 1—Earle W1NC; 2—Larry WA2SUH; 3—Jim WA3RBQ; 4—Clint K4EKX; 5—Grace K5MRU; 6—Dick W6ANK; 7—Ron WB7ADO; 8—Les W8ATK; 9—Del W9BPU; Ø—John NØADJ; New Zealand—Mac ZL3RK; Australia—Art VK2BXN; Europe—August DK5UG; DX at large—Jim K6PJO

Your application is checked against the 10-10 Net roster and if found correct, you will be issued your very own 10-10 number and Black Cat Certificate.

Once you obtain your 10-10 number, you may begin work toward various "bar" awards. The bar awards are issued in multiples of 100 individual 10-10 contacts. To apply for any bar award, you must not duplicate contacts previously claimed. In each case, submit only 100 contacts per application and no more. Each must show the callsign of the station worked, the 10-10 number, name, and exact QTH.

Award applications must show contacts in 10-10 number sequence. Applications received in any other order will be returned. There is no award fee for "bars"; however, an SASE sent along with your application is appreciated. Send to: Wm. "Bill" Risher WB6OMH, 10542 Loch Avon Drive, Whittier CA 90606.

This same process is repeat-

Continued on page 185

Contests

Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

SENARC TOTEM POLE CONTEST

Starts: 0000 GMT May 3
Ends: 2400 GMT May 4

Sponsored by the Western Washington DX Club of Seattle, Washington, the contest is intended to promote the upcoming ARRL National Convention (SENARC). The convention is to be held in Seattle July 25th through the 27th. Entries must be for single operator, single transmitter. Operate either phone or CW, but not both. Use all amateur bands from 80 through 6 meters.

EXCHANGE:

Signal report and state or country.

SCORING:

All stations located outside the state of Washington will receive 2 points for each contact with a Washington state station and 1 point each for all other contacts. Washington state stations receive 1 point per QSO regardless of location.

ENTRIES & AWARDS:

All entries, consisting of contest logs or copies and claimed score, must be received by May 31st. Address all entries to: Totem Pole Contest, W7FCB, PO Box 499, Issaquah WA 98027. Awards will be presented at the SENARC Convention on July 26th at the Red Lion Inn, Seattle WA.

ERIE QSO PARTY

Starts: 0000 GMT May 3
Ends: 0000 GMT May 5

Sponsored by the Radio Association of Erie. Erie stations sign their calls followed by "ERIE" to alert passersby! Each station may be worked only once.

EXCHANGE:

Erie stations send RS(T) and serial number starting at 001; all others send RS(T) and state.

FREQUENCIES:

Phone – 3980, 7290, 14340, 21420, 28600, 28835.

CW – 3650, 7060, 14060, 21060, 28060.

Novice – 3730, 7130, 21150, 28150.

AWARDS:

An attractive certificate will be awarded to one amateur in each of the ten US call districts and Alaska and Hawaii, one amateur in each of the Canadian districts, and one amateur in any non-US, non-Canadian district working the most Erie hams. The "Worked Erie, Pennsylvania" award will also be given to any station working 10 Erie hams. The Erie amateur working the most stations participating in the contest will receive a special certificate.

ENTRIES:

Send a signed copy of your log with contest QSO callsigns underlined by May 31st to: The Radio Association of Erie, PO Box 844, Erie PA 16512.

DARC CORONA 10-METER RTTY CONTEST

Contest Period:
1100 to 1700 GMT May 10

This is the second of four tests during the year sponsored by the DARC eV to promote RTTY activity on the 10-meter band. Each of the four tests is scored separately. Use the recommended portions of the 10-meter band.

EXCHANGE:

RST, QSO number, and name.

SCORING:

Each station can be contacted only once. Each completed 2-way RTTY QSO is worth 1 point. Multipliers include the WAE and DXCC lists and each district in W/K, VE/VO, and VK. Also count each different prefix as a multiplier. The final score is

Calendar

May 3-4	SENARC Totem Pole Contest
May 3-5	Erie QSO Party
May 10	DARC Corona 10-Meter RTTY Contest
May 10-12	Georgia QSO Party
May 11	Worked All Britain Contest – HF CW
May 17	Dogwood Festival QSO Party
May 17-18	Florida QSO Party
May 17-18	ARRL EME Contest II
May 17-18	Tri-State QSO Party
May 17-19	Massachusetts QSO Party
May 17-19	Michigan QSO Party
May 24-25	CQ Worldwide WPX Contest – CW
May 24-25	Hollywood ARC Anniversary QSO Party
Jun 14-15	ARRL VHF Contest
Jun 14-15	VK/ZL/Oceania RTTY DX Contest
Jun 22	Worked All Britain Contest – LF Phone
Jun 28-29	ARRL Field Day
Jun 28-29	QRP ARC International QRP Field Day Contest
Jul 1	Canada Day Contest
Jul 12-13	IARU Radiosport Championship
Jul 20	Worked All Britain Contest – LF CW
Aug 2-3	ARRL UHF Contest
Aug 9-10	European DX Contest – CW
Aug 31	Worked All Britain Contest – VHF
Sep 13-14	European DX Contest – Phone
Sep 13-14	ARRL VHF Contest
Sep 13-15	Washington State QSO Party
Sep 14	North American Sprint
Sep 27	DARC Corona 10-Meter RTTY Contest
Oct 4-5	California QSO Party
Oct 4-5	ARRL Simulated Emergency Test
Oct 11-12	ARRL CD Party
Nov 1-2	ARRL Sweepstakes – CW
Nov 8-9	European DX Contest – RTTY
Nov 8-9	IPA Contest
Nov 9	International OK DX Contest
Nov 15	DARC Corona 10-Meter RTTY Contest
Nov 15-16	ARRL Sweepstakes – Phone
Dec 6-7	ARRL 160-Meter Contest
Dec 13-14	ARRL 10-Meter Contest

Results

RESULTS OF THE 1979 OK DX CONTEST

1 operator, all bands				
1. N4YF	295	574	41	23,534
2. K2SX	230	386	51	19,686
3. W9RE	228	369	34	12,546
4. KA1EP	287	489	24	11,736
5. W1LQQ	170	253	32	8,096
6. WA4OML	174	332	19	6,308
7. W6UA	123	205	21	4,305
8. K1KI	124	205	16	3,280
9. W3GTN	84	102	29	2,958
10. W5QF	86	141	16	2,256
11. N1RI	71	122	17	2,074
12. W6NNV	58	93	22	2,046
13. WB4WHE	70	105	19	1,995
14. AA6EE	74	93	21	1,953
15. K4BAI	85	162	12	1,944
16. WA4QMQ	73	116	16	1,856
17. W4DGX	24	38	8	304
18. WA2SIT	12	30	3	90
19. W1OPJ	4	6	3	18
1 operator, 14 MHz				
1. W4KMS	52	84	9	756
2. W9QWM	34	34	17	578
3. WØLHS	7	13	4	52
1 operator, 21 MHz				
1. W3CBF	42	86	5	430
1 operator, 28 MHz				
1. N4CCJ	19	31	2	62
Multi-operator, all bands				
1. N4OL	677	1,065	105	111,825

Log for checking purposes: W1CM

the total number of QSOs times the total multiplier.

AWARDS:

Plaques will be awarded to the leading stations in each class with a reasonable score present. Operating classes include Class A for single- or multi-op and Class B for SWLs.

ENTRIES:

Logs must contain name, call, and full address of participant. Also show class, times in GMT, exchange, and final score. SWLs apply rules accordingly. Logs must be received within 30 days after each test. Send all entries to: Klaus K. Zielski DF7FB, PO Box 1147, D-6455 Erlensee, West Germany. The remaining contest periods are on September 27th and November 15th.

GEORGIA QSO PARTY
Starts: 1600 GMT May 10
Ends: 0200 GMT May 12

Sponsored by the Atlanta Radio Club, Inc., the contest is open to all. No restrictions as to mode or operating time. Stations may be single- or multi-op, but only one transmitter is allowed in operation at one time. No crossband or repeater contacts except via OSCAR.

EXCHANGE:

QSO number, RS(T), and state, province, country, or GA county. GA to GA contacts are permitted.

FREQUENCIES:

Phone – 3900, 7245, 14290, 21360, 28600.

CW – 1805, 3590, 7060, 14060, 21060, 28060.

Novice – 3718, 7125, 21110, 28110.

Try 160 meters at 0300 GMT. Try 10 meters on the hour and 15 meters on the half hour during daylight hours.

SCORING:

Count one point per QSO. GA stations multiply QSO total by number of different states, provinces, and DX countries. Others multiply QSO points by number of different GA counties worked (159 max.).

AWARDS & ENTRIES:

Plaques awarded to highest-scoring GA and non-GA stations. Certificates to highest station in each state, province, country, and GA county. Special certificates to highest-scoring GA and non-GA Novice and Technician.

Logs should show QSO number, date and time in GMT, station worked, RS(T) sent and re-

Continued on page 196

New Products

> **CORRECTION**
>
> The Maggiore Electronics advertisement which appeared in the March issue was incorrect. Please refer to the Maggiore ad elsewhere in this issue for the correct prices. *73* apologizes for the error.

BTA-1 RTTY CONTROL CENTER

The MS COMM Associates' BTA-1 is a microprocessor-based RTTY control center. With its ASCII-Baudot and Baudot-ASCII conversion capabilities, the BTA-1 has features to satisfy the requirements of the most demanding amateur operator.

The BTA-1 is based upon the Intel 8085 microprocessor family and all functions are operator switch-controlled. The device is designed to enhance the capability of any RTTY station by processing the data passed to and from the station terminal unit (TU).

Automatic conversion between ASCII and Baudot codes is provided and a precision crystal-controlled clock permits the selection of four popular Teletype* speeds. Switches select 60 and 100 wpm, as well as 110 and 300 baud. Custom baud rates are available.

The BTA-1 has a 1024-character FIFO buffer to facilitate speed conversion. The buffer may be pre-loaded with data prior to actual transmission. A three-character LED readout indicates the number of characters in the FIFO at any time and a buffered TTL output is provided to sound an alarm when the buffer is three-quarters full.

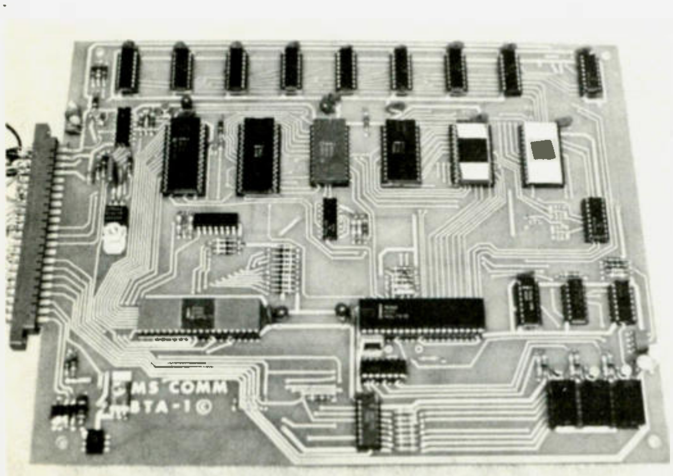
All received and transmitted data is processed by UART devices to ensure minimum distortion. The BTA-1 can interface terminal units with either FSK RS232 (voltage level) protocol or TTL-compatible signals. The Mark level is jumper-selectable. The processor interfaces station printer equipment by driving a 20- or 60-mA loop. TTL inputs and outputs are also provided.

FCC CW ID requirements are handled automatically by the BTA-1. A custom ID message is programmed into the device and is automatically transmitted every ten minutes when the station is on the air. A buffered TTL output drives the station CW ID input. A switch allows the ID to be sent upon demand if desired. While the ID is in progress, data from the station keyboard is diverted to the FIFO buffer for transmission following the ID.

A unique feature of the BTA-1 is its "canned message" capability. With the flip of a switch, the operator can type a message into the memory of the BTA-1. This message is recalled whenever desired by depressing another switch; the message is placed in the buffer following any data already present.

A SELCAL (selective-calling) feature allows the station printer to remain off until a predetermined five-character code is received. A TTL output is provided to turn the printer on (through an external relay) when the correct sequence is received. The printer is turned off when an NNNNN sequence is transmitted. Once again, the SELCAL code is entered by the operator and may be changed at any time!

MS COMM Associates provides the BTA-1 RTTY processor in kit or ready-built and tested form. The processor is contained on a single 8" x 11" PC board with a standard 44-conductor edge connector. All critical IC devices are socketed, as well as the LED display chips. Edge connector and control switches are included with the BTA-1. A comprehensive manual provides interfacing hints and techniques. A QSL brings complete specs and an order form. *MS COMM Associates, Box 225 Slip Road, Greenfield NH 03047.* Reader Service number 479.



MS COMM Associates' BTA-1 RTTY control center.

AZDEN PCS-2000 2-METER FM TRANSCEIVER

One of the newest arrivals on the amateur radio market, the Azden PCS-2000 2-meter radio, is quite a radical piece of gear. It is manufactured by Japan Piezo Company, Limited, which has been around for some time. The company is known in Japan as a maker of audio equipment such as microphones and hi-fi tone arms. Perhaps because of its relative newness in the field of ham radio, its outlook toward our hobby has a unique slant. For example, there is no tuning dial on the PCS-2000; frequency control is accomplished by push-button switches. In fact, the only knobs are the controls for volume and squelch.

In conjunction with other testing labs, I have performed a thorough technical evaluation of this radio. This was no casual once-over, but a rigorous EIA shakedown that took days. The purpose of this exhaustive testing was to determine the suitability of this unit, both electrically and mechanically, for marketing. I do not intend to reel off a long, highly technical treatise here, but rather to discuss the operation of the unit from a hands-on, user-oriented point of view.

Japan has been flooding the American market for several years with everything from ham gear to electronic games. The quality of these products is getting better and better, and in many categories the price is diminishing because of rapid technological advances. This is especially true of microcomputers. The Japanese people also have pride in their work. Many of them work twelve hours a day, six days a week. In the course of the engineering work for the PCS-2000, I had an opportunity

The Azden PCS-2000 separates into two units. The transmitter and receiver circuitry is housed in the larger, heavier cabinet, which can be located conveniently under the passenger seat or in the trunk. The small, light, control head contains the microcomputer. The display LEDs are unusually large (½ inch). The unit is shown in memory channel 5 using a split of + 600 kHz.

to meet with Export Manager Takano and Chief Engineer Fujino. Their seriousness about 2 meters is reflected in the first piece of ham gear they are selling here.

Unusual Features

The first thing that strikes an observer is the 12-button keyboard on the front panel. These twelve keys control the microcomputer, which is responsible for all the scanning and frequency functions of the transceiver. Microcomputers (also sometimes called microprocessors) are now available at a cost so low that they can be used in everyday consumer items. The frequency is chosen by first selecting the MHz digit and then individually setting the digits for 100 kHz and 10 kHz. The digit in the 1-kHz place may be set to either 0 or 5. Hence, the radio covers 800 channels in the range of 144.000 to 147.995 MHz.

There are six memory channels with scan in three modes, called "busy," "vacant," and "free." The "busy" mode is for finding an occupied channel and the "vacant" mode is for locating an empty channel. The scanner runs continuously in the "free" mode, no matter what's happening on any of the channels.

The scanner also will operate in the automatic mode, meaning that it will scan the band in increments of 10 kHz. It does this within a 1-MHz range as chosen by the MHz UP key on the keyboard. For example, if you're on 145.000 MHz and start up the autoscan, the PCS-2000 will move in 10-kHz steps until it reaches 145.990 MHz, return to 145.000 MHz, and continue upward again.

A modification can be performed to change the autoscan so that it will scan from 144.000 to 147.990 MHz in a single sweep; information on this may be obtained from the distributor. (I personally prefer to have it the way it is. Most repeaters are in the upper 2 MHz of the band, and scanning non-FM channels is a waste of time. Each channel is encountered four times as often in the given scanning range with 1-MHz scan width. A short transmission is thus less likely to be missed.)

Whether the microcomputer is scanning the memory channels or the full band, scanning resumes once the transmission

✓Reader Service—see page 226

General Specifications

Frequency Range—144.000-147.995 MHz.
Power Requirements—13.8 V ± 15% negative ground, 0.7-A receive, 5.0-A transmit (high power).
Dimensions—HWD 62 x 158 x 246 mm (2.4 x 6.2 x 9.7 inches).
Weight—Approximately 2.5 kg (5.5 lbs).
Transmitter Output Power—Nominal 25 W (high), 5 W (low).
Receiver Sensitivity—Better than 0.28 μV for 20-dB quieting.
Spurious Emissions—Down more than 60 dB from level of fundamental carrier.

is complete (in "busy") or when a transmission begins (in "vacant). Scanning always will stop immediately when the microphone PTT button is depressed. This makes it impossible to transmit while scanning. (Multiple-repeater saboteurs had better pick another radio!)

The PCS-2000 has a "detachable head." The control part of the radio comes apart from the transmitter and receiver circuitry. This feature will no doubt prove extremely popular since in many of the newer subcompact cars there isn't room for even a small piece of gear without a major comfort sacrifice. Also, if your car is like mine, the dashboard is made out of plastic. On a bumpy road, the mounting bracket for a piece of heavy gear could tear out, sending it tumbling down underneath the brake pedal! But the control head alone is very light, and the chances of it breaking free are quite minimal.

A 15-foot cable, available as an accessory, connects the control head to the main unit. The main unit can go under the passenger's seat or even under the hood or in the trunk. You'll have to wire up a remote speaker if you use this feature, because the internal speaker is in the rear part of the radio. The control head and main unit both have remote speaker jacks.

The PCS-2000 provides the usual simplex, +600, and −600 operating modes. There also is a provision for non-standard offsets. The PCS-2000 comes with a crystal that gives nonstandard offset values of +400 kHz, +1 MHz, and +1.6 MHz. I'll discuss this in greater detail later.

With a minor modification, the frequency coverage can be extended to the range of 142.000 to 149.995 MHz receive and yet a bit further for transmitting. This should interest MARS and CAP enthusiasts. An instruction sheet that describes the necessary changes is provided with each radio.

The microphone for this transceiver is especially interesting. Controls for volume, squelch, frequency (within a 1-MHz range as determined by the front-panel keyboard), and instant memory-channel-1 recall are built right into the thing. In addition, a kit is available for the installation of a touchtone™ pad on the back side!

Microcomputer

Operating the PCS-2000 is an experience that in some ways is like working a calculator. You can spend a week playing with the 12-button keyboard and not make a single transmission, and you still might not be acquainted with everything.

The keys operate on the principle that "the first key wins"—that is, if you hit two keys at almost the same moment, the microcomputer will perform only the function of the first key. If a key is held down, all others are disabled. Transmitting also disables the keyboard. It is difficult to actuate the wrong key by mistake.

The MHz UP key sets the MHz digit of the operating frequency. Pressing this key repeatedly will cause the MHz figure to change from 4 to 5, 5 to 6, 6 to 7, and 7 to 4. While in the automatic scan mode, the MHz figure can be changed by pressing this button and scanning will not be interrupted.

The 100k UP key advances the 100-kHz digit. Each time this key is pushed, the frequency increases by 100 kHz, except that the MHz figure will *not* change. (That is, if the 100-kHz figure is 9, pushing this key will change it to 0, a frequency drop of 900 kHz.) The 100k DOWN key reduces the 100-kHz digit by one figure.

The key labeled 10k UP advances the frequency upward by 10 kHz but will not affect the MHz figure. Holding this key down for more than one second moves the frequency up rapidly in 10-kHz increments. This gives the feeling of tuning a vfo. As you draw near the desired frequency, you can release this key and then actuate it 10 kHz at a time until you're there. The 10k DOWN key works in the same way, but in the other direction. Both of these keys are duplicated on top of the microphone. This feature is extremely useful in mobile operation since it allows you to tune anywhere within a 1-MHz range without reaching for the panel. It's easy to locate these keys by feel.

The four kHz UP and DOWN keys (and the two on the microphone) have an additional common function: to stop the scanner. No matter in what mode the radio is scanning, the scan will stop when any of these keys is pushed. Suppose you're driving along and scanning the range of 146.000 to 146.990 MHz for a busy channel. The scanner comes across a station and stops. You are interested in the conversation and want to keep listening. So you tap the DOWN key on top of the microphone, and the radio will stay put. Otherwise, the scanner will start up again as soon as the carrier disappears.

The AUTO SCAN key will initiate scanning from the displayed frequency in steps of 10-kHz upward continuously without changing the MHz figure. The scan rate is eight channels per second. Hence a 1-MHz range is covered in about 12.5 seconds. Modification instructions are available from the distributor to allow the autoscan to cover the entire 4-MHz range in one sweep. There are advantages to either scan bandwidth, but as I said before, I prefer the 1-MHz segments.

The key labeled ±600 SHIFT will change the offset from simplex to +600 kHz, +600 kHz to −600 kHz, or −600 kHz to simplex. When operating with either repeater offset, the display changes to show the transmit frequency when the PTT button is depressed. However, if the receiving frequency is within 600 kHz of either band edge, any attempt to transmit outside the band using these splits will result in simplex operation. (This microcomputer is foolproof!)

It's important that the OFFSET/SCAN selector, a six-position rotary switch in the upper right-hand corner of the front panel, be to the right of center. If it is left of center, an additional split will be thrown in and you'll sit there trying to figure out why you can't raise a repeater only three blocks away. I'll have more to say about this switch later.

There are six memory channels. The memory address is shown by LEDs under the row of numerals 1 through 6. In the photo, the memory address is at memory channel 5. When scanning memory, the LEDs light up in succession as each channel is passed. The fluctuating display and the sweeping red dot make an impressive sight indeed!

Operation in the memory mode is carried out by means of five keyboard buttons: M ADRS, M SCAN, M1 CALL, M CALL and M WRITE. A detailed description of the interaction of these five keys would get too complicated for this review. It's pretty hard to grasp fully all the memory capabilities even by reading the manual! Far be it for me to recommend that we stop reading instruction manuals (to those few of us that do!), but an integral part of learning the microcomputer operation of the PCS-2000 is just to sit down and play with it. Suffice it to say that each memory channel can be programmed and reprogrammed, and that the unit will hold memory when power is removed.

There are a couple of especially unique and useful memory functions. You actually have access to seven, not just six, channels at a given time, although you can *scan* only six: The frequency in use just prior to entering the memory mode is always instantly available. Let's use an example. Suppose you're on 147.330 MHz and not in the memory mode, and that this frequency is not in any of the memory channels. You call memory channel 3. (It could be any of the six.) You have, in fact, immediate access to *three* different frequencies. Push M1 CALL and you'll go to memory channel 1; hit M CALL and you'll be back on channel 3. Hit the 10k UP or 10k DOWN key and you return to the frequency prior to calling memory—147.330 MHz. These three frequencies can be accessed in any order, as many times as you like, by touching only one key. It is possible to access memory

Continued on page 190

The new Heathkit® Hand-held DMM

–every feature you need at a GREAT LOW PRICE

- Measures voltage, current and resistance
- Easy one-hand operation
- Big, easy-to-read LCD display
- Separate voltage and current inputs for circuit protection
- Single PC board for simple, quick assembly

EASY ONE-EVENING KIT ASSEMBLY only $94^95

Mail Order Price

Top performance and easy operation make the Heathkit IM-2215 your best buy in a solid-state, hand-held multimeter!

The new IM-2215 brings you features you would only expect in hand-held digital multimeters costing much more! Take measurements with outstanding accuracy – DC voltage, ±.25% – AC voltage, ±.5% – DC current, ±.75% – AC current, ±1.5% and resistance, ±.25% (basic)! Alternating high-low resistance test voltage makes measuring semiconductors or in-circuit resistance easy! One-hand operation, a large 3½-digit LCD display and built-in calibration references make the IM-2215 ideal for field use. Includes a pivoting stand to adapt it to bench use. The low-drain circuitry stretches typical alkaline battery life to 200 hours! Battery condition is monitored, and a LO-BAT indicator warns you of the last 20% of battery life.

You can easily assemble the IM-2215 in just one night, with the help of the clear, concise Heathkit assembly manual. And if you need advice or service, experts are as close as your telephone! It operates on 9-volt battery (not included), or on 120 or 240 VAC with optional cords. The latest technology and traditional Heathkit value are now built into a new hand-held digital multimeter weighing only 14 ounces!

Heathkit® If coupon is missing, order from: Heath Company, Dept. 011-654 Benton Harbor, MI 49022

303

ORDER YOURS TODAY!

For fastest delivery, use the Heathkit Hot Line **CALL (616) 982-3411**

Send to: Heath Company, Dept. 011-654
Benton Harbor, MI 49022

For faster service on VISA or Master Charge orders, call (616) 982-3411

Please send me...

___ Heathkit Hand-Held DMM(s) (IM-2215) @ $94.95 plus $1.80 shipping and handling each.

___ Rugged Leather Carrying Case(s) with Belt Loop for IM-2215 (IMA-2215-1) @ $14.95 plus $2.50 shipping and handling each.

___ 120 VAC Outlet Cord(s) for IM-2215 (PS-2350) @ $4.95 plus $1.60 shipping and handling each.

Total before shipping & handling ______ $______

Michigan residents add 4% sales tax ______ $______

Add shipping & handling ______ $______

Total ______ $______

☐ check ☐ money order ☐ VISA ☐ Master Charge: Code # ______

Acct. # ______ Exp. Date ______

Signature ______
(Necessary to send merchandise)

Name ______
(Please Print)

Address ______

City ______ State ______ Zip ______

Prices are mail order and subject to change without notice. GX-375

C. J. Klinert WB6BIH
1126 Division Street
National City CA 92050

Home-Brew Rf Impedance Bridge

—indispensable tool for antenna fans

In the construction and adjustment of HF antennas, an undesirable standing wave ratio may be experienced even though the antenna appears to be operating at resonance. The exact antenna impedance may be unpredictable because of interaction with other objects, or variations in physical configuration as a result of mechanical restrictions. The use of a simple impedance measuring device can eliminate the uncertainty of estimating antenna impedances and allow an intelligent approach to antenna matching. This article describes the construction of a high-frequency rf impedance bridge capable of measuring resistive impedances of 5 to 500 Ohms at frequencies up to 30 MHz. Calibration and operating instructions are included.

Theory of Operation

Fig. 1 shows the simplified schematic diagram for the impedance bridge. The meter compares the voltage at the unknown R with the voltage at the variable R when rf voltage is applied. If the variable R is adjusted for a minimum meter indication, the voltage at the wiper of the variable R is equal to the voltage at the junction of the fixed R and unknown R, and the bridge is balanced. Now the voltage division ratio of the variable R is equal to the voltage division ratio of the other two resistors. Since the fixed R resistance is known and the variable R resistance can be calibrated, the unknown R can be determined. In practice, the dial of the variable R is marked with resistance values while various known-value resistors are substituted for the unknown R when the bridge is balanced.

Design Points

Fig. 2 shows the schematic diagram of the impedance bridge. A 250-Ohm potentiometer is smaller and less expensive than a differential capacitor. The use of two separate diode detectors, D1 and D2, provides convenience of operation, since the zero-center meter will indicate the direction of the null even when pinned. This also eliminates the need for a sensitivity control, since D3 and D4 will limit the voltage across the meter and its series resistor.

The use of two 2-Watt, 100-Ohm resistors for the fixed 50-Ohm element provides for power dissipation. The 250-Ohm value for the potentiometer was also selected for power considerations. A nominal 5-Watt (53-Ohm) input results in a sharp null with moderate component heating. The use of a hot-carrier diode such as the 1N5711 for D1 and D2 may seem indicated, but diodes can be selected for matched characteristics at less expense, and errors can be calibrated out. It was decided not to include reactive measurements in the impedance bridge since this would add expense, increase size, and complicate calibration. If the unknown antenna can be first tuned to a resistive impedance by using a grid-dip oscillator,

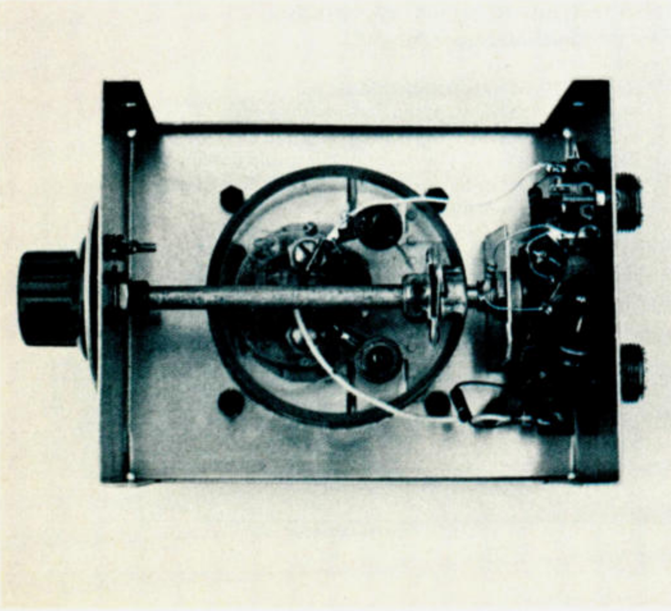


Photo A.

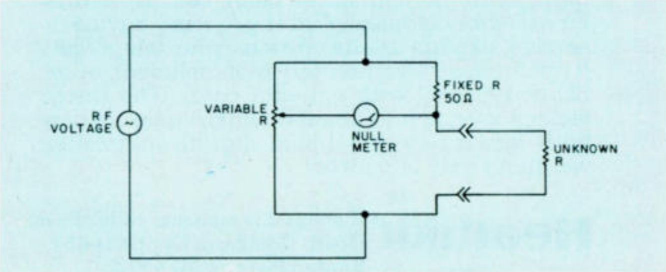


Fig. 1. Simplified schematic diagram.

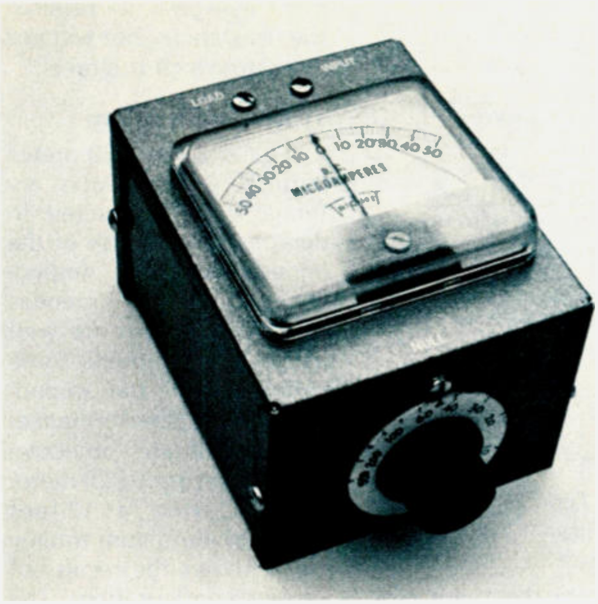


Photo B.

Photo C.

reactive measurements are unnecessary.

Construction

The impedance bridge is built in a California Chassis M-60 aluminum box. The most important mechanical consideration is to provide short connections for the portions of the device. The potentiometer is a Clarostat RV4NAYSD251A, and must be mounted near the two SO-239 connectors. A shaft coupling and extension allow a convenient location for the dial at the front of the meter movement location. A small aluminum bracket is used to mount the potentiometer. The meter is a Triplett 327-PL, 50-uA, zero-center (100-uA, end-scale) movement. The dial can be made from a knob with a large flat washer attached for a scale. The calibration marks are then written on the washer in pencil. A screw-head slot provides the index mark. Fixed resistors are half-Watt carbon unless otherwise indicated in Fig. 2. The capacitors are disc ceramic.

Alignment

Table 1 lists the test equipment used in the preparation of this article. Connect the equipment as shown in Fig. 3. Adjust the rf source for a five-Watt power meter indication. Connect a 50-Ohm (approximately) calibration resistor to the impedance bridge LOAD terminal. Set the impedance bridge NULL potentiometer to each end of its range and verify an impedance bridge meter indication of approximately 50 uA at each end of the meter scale. The most convenient use of the impedance bridge will result if the meter is connected so that a clockwise NULL control setting will cause a positive meter deflection. Change the meter connections if required. If a symmetrical meter indication cannot be obtained while manipulating the NULL control, try changing any of the diodes. Diodes have been found to be shorted, "weak," or accidentally marked with reversed polarity.

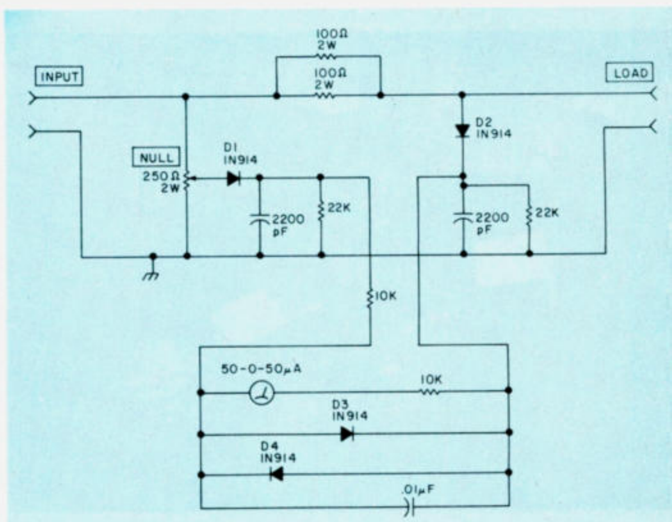


Fig. 2. Schematic diagram. Capacitors are disc ceramic; resistors are ½-Watt unless otherwise indicated. Boxes indicate panel markings. Connect meter polarity so that clockwise rotation of NULL potentiometer causes positive meter deflection.

Name	Application	Model/Part no.
Rf source	Drive impedance bridge and swr bridge	Heathkit HW-32
Swr bridge	Antenna measurements	Heathkit HM-2102
Grid-dip oscillator	Resonate antenna	Heathkit GD-1B
Calibration resistors	Calibrate impedance bridge and swr bridge	2-Watt Carbon, P/N RCR42 (assorted)
Volt ohmmeter	Check Calibration resistors	Micronta 22-204A
Dummy load	Load for rf source (50-Ohm nominal)	Heathkit HN-31
Precision resistor	Resistance calibration standard	P/N RN-, RLR-, RD-, or RBR- prefixes
Power meter	Measure rf source output	Swan WM-1500

Table 1. Equipment requirements. (Selection of these items does not indicate a product endorsement or evaluation of their performance. Use of other equipment may result in perfectly satisfactory results in the procedure.)

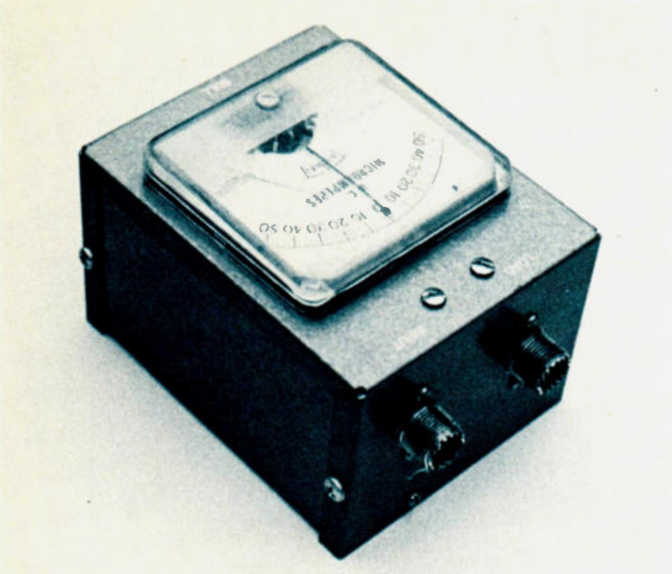


Photo D.

Photo E.

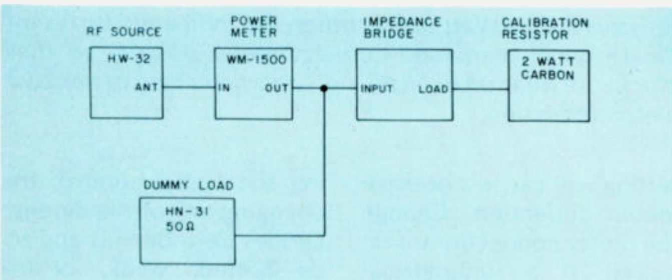


Fig. 3. Test configuration.

Calibration

Calibration is the periodic verification of essential performance parameters. Traceability of all measured values to a higher accuracy standard is essential. Fig. 4 shows a suggested flow of traceability for the impedance bridge. Note that the impedance bridge could be calibrated directly from the carbon calibration resistors. However, some type of testing is required to verify the accuracy of the calibration resistors since it is known that this type of resistor is not extremely stable or very precisely specified. Also note that *periodic* calibration of the impedance bridge is required since it is

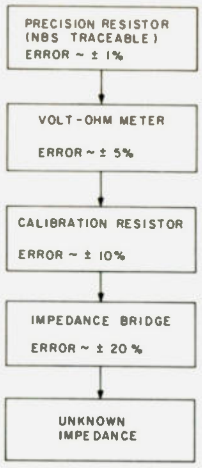


Fig. 4. Typical calibration traceability.

made from the same type of resistor. Check the calibration resistors with a calibrated volt ohmmeter and mark the resistors with their indicated values. Check the volt ohmmeter with a precision resistor. The precision resistor can be any of the marked film or wire-wound resistors. If the resistor is purchased new and undamaged, calibration traceability in the manufacturing process is (hopefully) assured. Part numbers for precision resistors beginning with RN-, RNR-, RLR-, or RBR- are excellent.

Connect the equipment as shown in Fig. 3. Connect a calibration resistor to the impedance bridge LOAD terminal and adjust the impedance bridge NULL control for a zero (center) impedance bridge meter indication. Mark the calibration resistor value on the impedance bridge NULL dial. Repeat this procedure for all resistance values desired.

Note: The swr bridge also can be calibrated by this method. Standing wave ratio is given by: swr = Z_1/Z_2, where Z_1 and Z_2 are the impedances of the source (swr bridge) and the calibration resistor. The larger resistance value is used for Z_1 so that the swr will be a number greater than one. The swr measurement will give the ratio of the resistances, but will not indicate which is larger.

Typical Applications

A shortened 20-meter vertical ground-plane antenna was constructed to demonstrate the use of the impedance bridge. Impedances of vertical antennas of varying length are well known[1] and provide some indication of the impedance bridge's performance.

The ultimate objective was to construct a 20-meter antenna from a 12-foot length of aluminum tubing. Fig. 5 shows the results of various configurations. The following procedure was used to adjust the antenna:

1) Make rough adjustments for antenna resonance by using the grid-dip oscillator coupled to a loop of wire at the antenna base.

2) Make fine adjustments with the swr bridge by varying the rf source frequency and observing where the minimum swr is.

3) Measure the resistive base impedance of the antenna with the impedance bridge.

4) Use the best available means to match the antenna impedance, or,

5) Change the antenna tuning method to change the base impedance and allow application of the matching devices available, and,

6) Repeat steps 1 through 5 until the antenna is matched.

Fig. 5 shows that a perfect match for a 53-Ohm system was not found. To illustrate a simple matching system, ¼-wavelength transmission-line matching sections were applied. The length (in feet) of a ¼-wave coax section is $\lambda/4 = 246(V)/F$, where V is the transmission line velocity factor (0.66 for RG-58 and RG-59) and F is the frequency in MHz.[2] The impedance, looking into the end of a terminated section is $Z = (Z_o)^2/Z_L$, where Z_o is the

✓Reader Service—see page 226

matching-section characteristic impedance and Z_L is the termination impedance at the other end of the section. Manipulation of the equation shows that a good match to a 73-Ohm system can be obtained with a 53-Ohm matching section for the antennas of Fig. 5(b) and (d). This is a popular matching technique for vertical antennas. The Fig. 5(a) antenna could be matched with a 4:1 toroidal transformer (2:1 turns ratio).

To accomplish a match to a 53-Ohm system, two matching sections were used. Fig. 6 shows this approach. This method provides a good match to the antennas of Fig. 5(e) and (c). The Fig. 5(e) approach was finally settled upon since the capacitive top loading allowed the use of a very small base-loading inductance, thus increasing antenna efficiency. A large base inductance will cause loss since it is used at a high-current point. The amount of capacitive and inductive loading was adjusted while keeping the antenna resonant (one was balanced against the other), until the desired base impedance was obtained. Actual measured values are shown in parentheses in Fig. 6.

For the record, the capacity hat for Fig. 5(e) was four 30-inch pieces of 3/8-inch diameter tubing. The inductor was two turns of #18 wire, ¾-inch in diameter, and ¼-inch long. The antenna vertical element was a 12-foot length of 2-inch diameter tube, and radials were made from six 17-foot lengths of #18 wire spread around the roof. The antenna was mounted with two chain-link fence clamps bolted into a piece of plywood nailed to the gable of the roof. The bottom of the antenna was insulated with plastic tape. A California Chassis box was used to cover the base of the antenna, which extended through a hole in the top of the box. The hole was insulated with a free sample of caterpillar grommet from Weckesser. UHF connectors (PL-259, etc.) were used to connect the coax sections for ease of measurement, but connections could be simple splices for permanent use.

Conclusions

The previous exercise may seem pointless, but it serves as a good illustration of typical measurement and matching methods. Anyone would be most inclined to feed the ¼-wavelength antenna with 53-Ohm line and tolerate the 1.5:1 swr. Also, the antenna length could be increased to 0.28-wavelength[1] and tuned with a capacitor to match a 53-Ohm line. The point is that the use of a simple impedance bridge will allow the employment of all these techniques and provide verification of antenna theory application.

The Ben Lowe article[3] provides impedance measurements made with only an swr bridge, and performance of some calculations. It is felt, however, that many amateurs will prefer the use of the impedance bridge to avoid doing the calculations, particularly if many measurements are to be made. Also, many inexpensive ham and CB swr bridges don't have the resolution to make precise swr measurements since they are intended primarily to find 1:1 swr. ■

References

1. *Reference Data for Radio Engineers*, Howard W. Sams & Co., Inc. (ITT), Sixth Edition, pp. 27-8 (Fig. 6).
2. *The Radio Amateur's Handbook*, ARRL, Newington, Connecticut, November, 1978 (1979 edition), pp. 19-1 to 19-6.
3. Ben Lowe K4VOW, "Impedance Measurements Using an Swr Meter," *Ham Radio*, April, 1979, p. 80

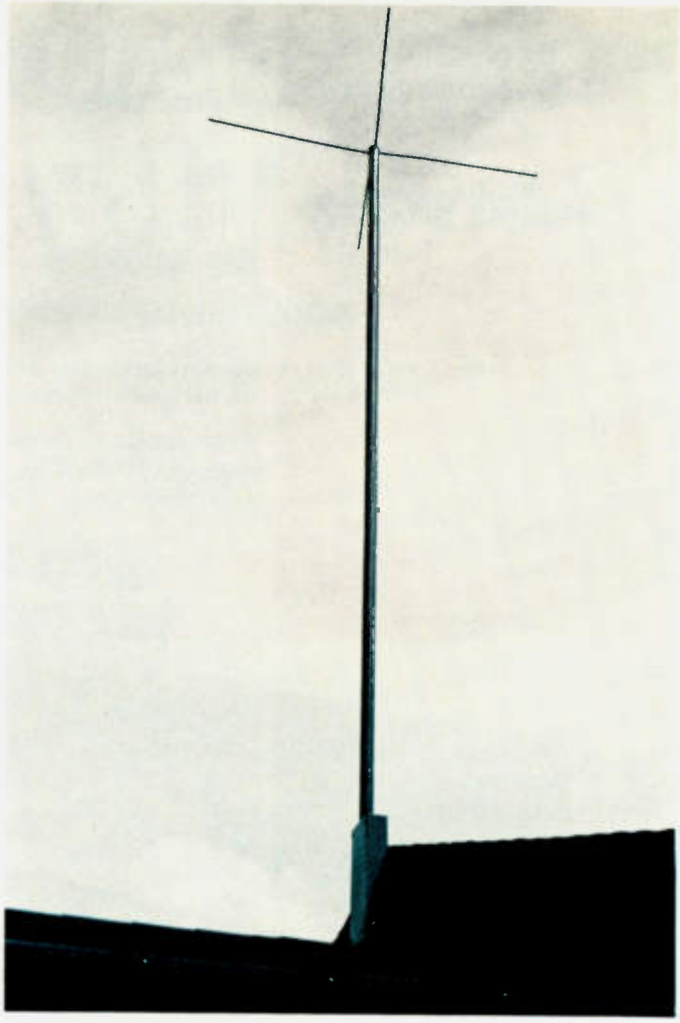


Photo F.

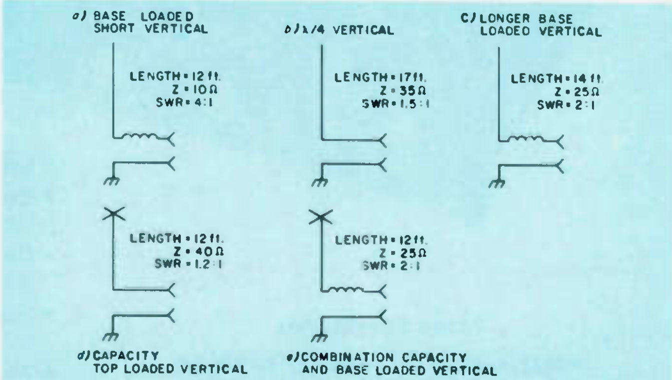


Fig. 5. Antenna measurements. Numbers are measured values; swr is referenced to 53-Ohm (nominal) system; frequency is 14.2 MHz. Measurement setup is shown in Fig. 3.

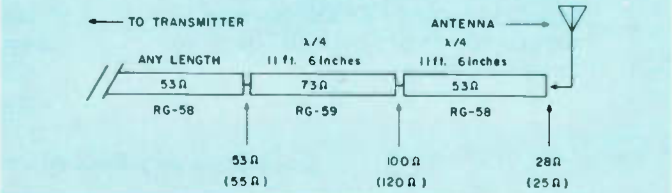


Fig. 6. Coaxial matching exercise. Values in parentheses are measured values; impedances are measured "looking toward" antenna with components to the transmitter end disconnected. Measurement setup is shown in Fig. 3.

✓ Reader Service—see page 226

Harry D. Hooton W6TYH
1420 Shamrock Lane
Lincoln CA 95648

Rotary Beam for 10 or 15: the LB-2

—eliminates nasty matching problems

My first rotary-beam antenna was a two-element, 10-meter "signal squirter" manufactured by the late M.P. Mims W5BDB. During the forty-odd years since then, I have owned many beam antennas, some homemade and some factory-made. Most of my homemade arrays used the gamma-matching system, and I always had problems during the rainy season when moisture collected on the variable capacitor plates. Another problem with both the commercial and homemade arrays was noisy reception, thought to be due to corroded electrical connections after the antenna had been on the tower for several months.

About a year ago, I began experimenting with the design of an "ultimate" antenna—one which would stand up under all kinds of weather conditions and remain in adjustment for long periods of time. At the same time, I carried out a number of experiments aimed at reducing the high noise-level problems on the 15- and 10-meter bands. The end result is the LB-2 array described here. Two of these antennas have been built—one for 15 meters and another for 10 meters. Except for size, the characteristics of the two antennas are identical and the performance of each leaves little to be desired. Although both antennas will be covered, the 15-meter array will be described in more detail.

Design Frequency (In MHz)	Radiator	Director	Spacing	Stub
21.1	Notes 1, 2	21' 4"	5' 1¼"	49"
21.3	Notes 1, 2	21' 1½"	5' 1"	48"
21.4	Notes 1, 2	21' ¾"	5' ¾"	47"
28.2	Notes 1, 3	15' 11½"	3' 10"	37"
28.6	Notes 1, 3	15' 8¾"	3' 9½"	36"
29.5	Notes 1, 3	15' 3"	3' 8"	35"

Notes

1. Radiator length will be determined by resonating and matching adjustments.
2. For 15 meters, start with a radiator (driven element) length of 22' 7" and adjust as required. See text.
3. For 10 meters, start with a radiator length of 17' and adjust as required. See text.
4. Stub dimensions are measured down the stub from the antenna end. These dimensions were taken from the prototype antennas after final adjustments were made. Actual position of shorting bar will depend upon the length of the radiator, since each interacts upon the other. Dimensions apply only to stubs made from ½" tubes spaced 3" on centers (300 Ohms Z_0).

Table 1.

Design

Why a two-element array? In the first place, I am retired and disabled and my budget is limited. Second, because of trees surrounding the ham shack, I am limited also in space. A long-boom, multi-element yagi was simply out of the question. Third, I wanted a low-cost, lightweight antenna that could be built from materials readily available at the local hardware or do-it-yourself builder's supply store, and one which could be turned by a heavy-duty TV antenna rotator. When properly designed and adjusted, the two-element parasitic array, consisting of a driven element and one parasitic director spaced 0.11 wavelengths apart, produces the highest forward gain per unit size of any type of antenna used by amateurs. The antenna described here is spaced for maximum forward gain—about 5.3 dB greater than the signal from a half-wave dipole at the same height above ground. When adjusted for maximum forward gain, the front-to-back ratio of the array is only about 7 to 10 dB.

If you wish a greater front-to-back ratio, adjust the spacing to about 0.125 to 0.150 wavelengths. Although the front-to-back ratio improves with wider spacing between the elements, the forward gain goes down to about 5.0 dB over the dipole. Nevertheless, a 5.0-dB gain will give a considerable boost to your signal on either 10 or 15 meters when it is compared with the signal from a dipole or quarter-wave vertical antenna. When the array is adjusted for the maximum front-to-back ratio, the discrimination between signals off the front and back of the array will be in the order of 15 to 17 dB.

Matching

In addition to the features listed above, I wanted a matching system that would be easy to adjust and one that would remain in adjustment for long periods of time, unaffected by the weather. After much searching and reading, I finally found a description of a "line bazooka" (balun) matching device in the Collins military technical manual, *Fundamentals of SSB*, published in 1959. A similar device was described by William I. Orr W6SAI, in the 19th edition of the *Radio Handbook*, published by Howard W. Sams & Co. This device first attracted my attention as a means of getting rid of the troublesome gamma capacitor. However, it has several other desirable characteristics, as well. As it is a shorted stub less than a quarter wavelength long, it acts as an inductance and introduces an X_L component at the driven element feedpoint. The driven element itself is adjusted to introduce an X_C component across the open end of the stub. The two reactive components tend to oppose each other as the operating frequency is made higher or lower than the array design frequency, producing a broadband effect.

In the array described here, when adjusted for a line swr of 1:1 at 21.3 MHz, the line swr was still less than 1.75:1 at either 21.0 or 21.450 MHz. If you have read about line bazookas in the handbooks, you may get the wrong impression of this device. The quarter-wavelength bazooka is used as a 1 to 1 impedance transfer device. The short line bazooka matches a coaxial line input to the approximately 18 Ohms of impedance at the center of the driven element. It also acts as a balun, since the 53-Ohm input is unbalanced (coaxial line) and the output is 18 Ohms balanced. It also acts as a decoupling device to prevent rf currents from flowing on the outside of the 53-Ohm coaxial transmission line from the antenna to the transmitter. The impedance-transfer ratio of the device, unbalanced to balanced, and its broadbanding effect depend upon the Z_0 of the stub, which, in turn, depends upon the center-to-center spacing between the two ½-inch copper tubes and the position of the shorting bar across the two conductors.

I spent much time experimenting with the size, length, and spacing of the two copper tubes that make up the matching section before the optimum dimensions were found. If the tubes are spaced too closely, the bandwidth will be narrow; if they are spaced too wide apart, the coaxial inner-conductor loop at the open end of the stub begins to exhibit inductive effects in the circuit. The surge impedance of the two ½-inch tubes, spaced 3.0 inches on centers, is about 300 Ohms. If the reader constructs the matching section exactly as described here, he will have no difficulty in making the proper matching adjustments. The most important consideration is to mount the two tubes rigidly so that the same spacing is maintained throughout their parallel lengths. To start, each tube was made 53 inches long. In this array, at the final adjustment at 21.3 MHz, the distance from the open end of the stub at the antenna feedpoint to the position of the shorting bar was 49 inches. After it was made certain that this was the correct dimension with the antenna on the tower, the shorting bar was soldered in place and the unused end of the single tube was cut off. The other tube, however, was left 53 inches long and was fitted with an SO-239 coaxial connector as shown in Fig. 2. The construction and adjustment of the matching stub will be covered later. At this time, let us discuss the construction of the boom and elements.

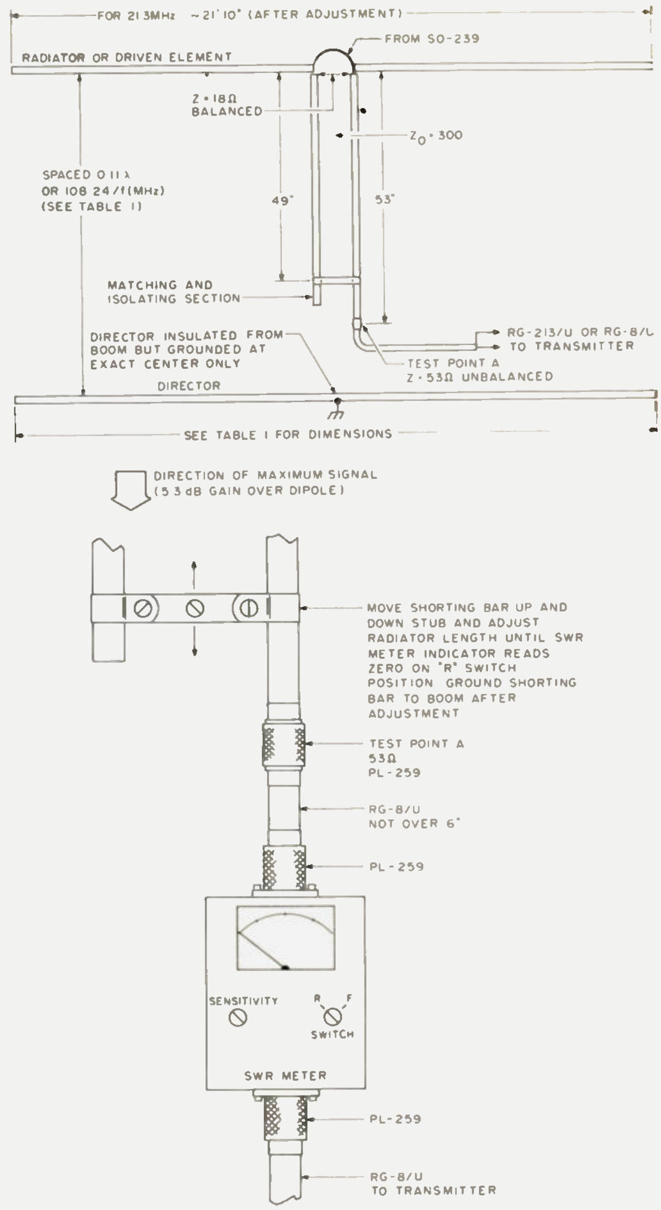


Fig. 1. General layout of the LB-2 array, and the proper connection of the swr meter.

Elements and Boom Construction

The first step is to locate and select the proper size aluminum tubing for the elements and the boom. In California and other states, lightweight and relatively inexpensive aluminum tubing made by the MD Corporation is sold by the Ace Hardware stores. Most of the do-it-yourself builders supply stores sell either the MD tubing or a similar tubing made by Reynolds Aluminum Corporation. This "hobby" tubing comes in either 6- or 8-foot lengths and in various diameters. Although I have seen on display only 1, 7/8, 3/4, 1/2, and 3/8-inch o.d., and 0.055-inch wall thickness tubing in the 6- and 8-foot lengths, I am informed that the Ace Hardware stores will order other sizes made by MD. For telescoping elements,

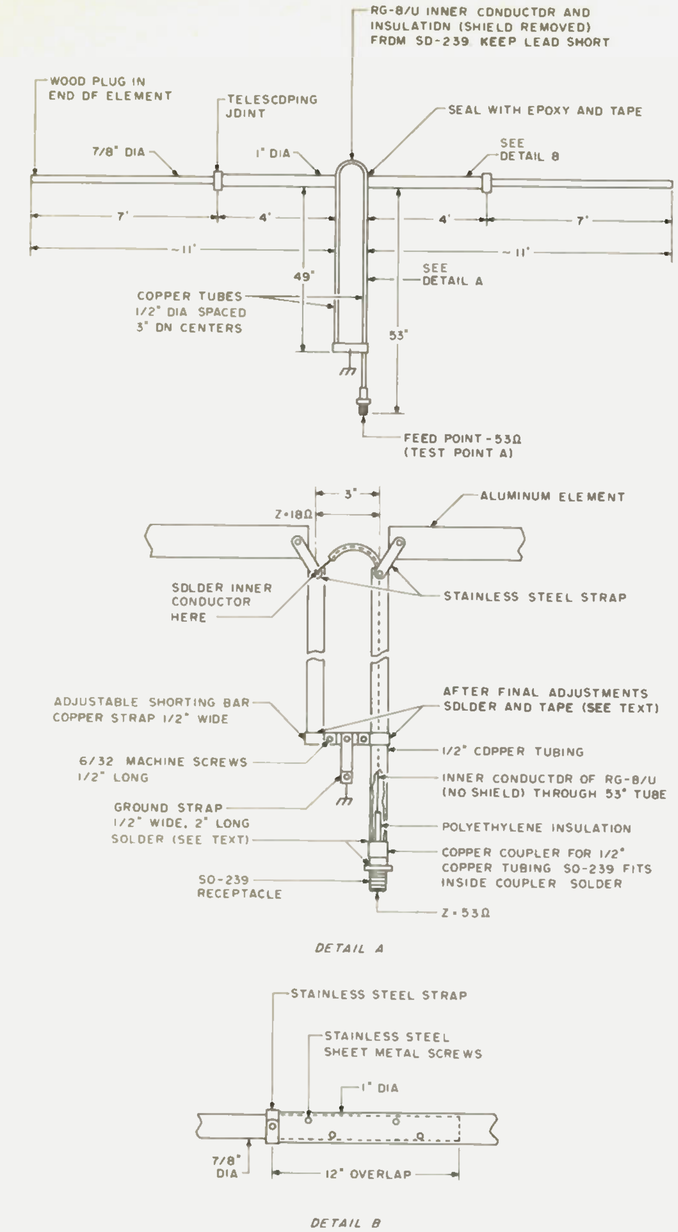


Fig. 2. LB-2 array for 15 meters. Use same matching section for 10 meters but see Table 1 for shorting bar position. General dimensions of driven element are shown. Detail A shows matching section. Detail B shows method for joining element sections.

the ideal wall thickness is 0.058 inches. However, the 0.055-inch wall thickness material will be perfectly satisfactory if the precautions given below are observed.

In the array shown in Fig. 2, a single 8-foot length of 1-inch o.d. tubing is used to make the two halves of the driven element center section. To increase the mechanical strength of the split driven element, a 6-foot length of 7/8-inch o.d., 0.055-inch wall tubing is cut into two sections of equal length and inserted inside the 1-inch diameter sections. To further improve the mechanical strength of the driven element, a hardwood dowel, about 18 inches long, is sanded down to a tight fit and driven into each 7/8-inch section before the driven element is assembled. This arrangement permits the use of heavy-duty standoff insulators with 1/4-inch machine screws through each element section without introducing any appreciable mechanical weakness at the point of mounting.

The two driven element end sections are 7/8-inch o.d. tubes, 8 feet long and with a wall thickness of 0.055 inch. As the adjusted overall length of the driven element will be about 22 feet for 21.3 MHz, there is a telescoping overlap of about 12 inches where each half of the center section and its end piece join. The hobby aluminum tubes are manufactured with a dull oxidized finish that is a poor conductor of electricity at radio frequencies. This finish must be removed from the inside of the larger tubing and from the outside of the smaller tubing where the two pieces join; this is done easily with sandpaper and steel wool. To remove the finish from the inside of the larger tubing, wrap a piece of sandpaper around a wood dowel, or use a round file, and work it up and down inside the tube until the inner surface is bright and clean. The ends of the 1-inch tubes are slit with a hacksaw for a distance of about two inches, as shown. Before inserting one tube inside the other, coat both contacting surfaces with an anti-oxidizing compound and wipe each surface with a clean, dry cloth or paper napkin. Leave only a thin film of the compound on each surface. The compound is sold under various brand names and is available in 5-oz tubes at most electrical supply houses.

During the preliminary adjustments, the two tube sections are maintained in good electrical contact by placing a stainless steel strap-type hose clamp around the slit end of the larger tubing and drawing it tight. After the final adjustments are complete, a half dozen 3/8-inch stainless steel sheet-metal screws are inserted through both tubes and arranged in a spiral around the larger tube for a distance of three or four inches to ensure a permanent electrical and mechanical joint. Finally, all joints are tightly wrapped with plastic vinyl tape to prevent the entry of moisture.

After the final adjustments of the driven element and the shorting bar, the shorting bar is soldered in place with a propane torch. When soldering the copper tube containing the coaxial cable inner conductor, do not use excess heat at the junction, as this might melt the polyethylene insulation and cause the inner conductor to short circuit to ground. To check the inner conductor for a possible short circuit after soldering, disconnect the inner conductor lead at point B and measure between the end of the disconnected lead and ground (boom). The ohmmeter should indicate an open circuit. The main transmission line from the transmitter should be disconnected from the antenna before making this test. The center point of the shorting bar is grounded to the boom through a short length of 1-inch-wide copper strap.

The director element is not split at the center, so a smaller diameter center section is used. In the prototype array, the director center section is a single 8-foot piece of 7/8-inch o.d. tubing. To add mechanical strength and to prevent wind vibration, two 3-foot long wood dowels are sanded down to a close fit and one is inserted in each end of the 7/8-inch tube. When the two dowels are pushed down toward the center, about a foot of clearance is left at each end of the director center section for insertion of the 3/4-inch o.d. end pieces. The ends of the 7/8-inch tube are slit, and both tubes are cleansed of the oxidized coating as described above. Join together the center section and end pieces in the same manner as described above for the driven element.

Please note that the director is mounted on standoff insulators and does not follow the usual "plumber's delight" type of construction where the element is mounted directly on the boom. The insulated director element is then grounded to the boom at the exact center of the element. This type of construction is believed to be one of the reasons for the low noise level of the 15- and 10-meter antennas. The method of mounting the director element on the standoff insulators, however, is somewhat different from that of the driven element. The mounting details are shown in the photograph and drawings.

During the early stages of this antenna project, both the driven element and director lengths, and the spacing between them, were made adjustable. Unless you are building the array for greatest front-to-back ratio, there is no point in having so many variables in the system that it leads only to unnecessary complications in the adjustments. For the maximum-forward-gain version, the optimum director length for 0.11-wavelength spacing between the elements is equal to 450/f, where f is the frequency in MHz. In the 21.3-MHz array described here, the overall director length is fixed at 21 feet and 1 inch. The 0.11-wavelength spacing is also fixed, at 61 inches. The only variables left are the driven element length and the position of the shorting bar on the stub.

The boom is made from 2-inch aluminum irrigation tubing cut to a length of 66 inches. If you cannot find the irrigation tubing in your area, use 1-1/2-inch electrical conduit (EMT) or thin-wall steel TV mast material. After the boom is cut to length, remove all burrs and sharp edges with a file, sandpaper, and steel wool. To add strength to the aluminum tubing boom, a 12 inch long wooden dowel or plug, only slightly smaller than the inside diameter of the tube, is inserted inside the boom and pushed down toward the center. Secure the plug in place with a flathead wood screw driven through the aluminum into the wood. A similar but shorter wood plug is inserted in each end of the boom and secured in the same manner. The purpose of the wood plugs is to permit the use of automotive muffler clamps to secure the element assemblies to the boom without crushing the comparatively fragile aluminum tube. Searching for a source of the wooden plugs, I found a supply of old-fashioned hardwood kitchen rolling pins at a local supermarket. These happened to be of exactly the proper diameter for a snug fit inside the boom. One rolling pin was used for the center plug and the other was cut in half to make the two end plugs.

In addition to the wooden plugs inside the boom, I also used three 8-inch pieces of 2-inch i.d. electrical conduit (EMT) over the aluminum boom—one piece at the central balance point and one at each end of the boom. The inside diameter of the conduit is large enough so that the sections can be rotated by hand. The muffler clamps used for mounting the element assemblies and the rotor mount on the boom are placed around the conduit sections. During the preliminary adjustments, these conduit sections can be secured with a single sheet-metal screw through the conduit and aluminum tubing walls into the wooden plug. When the array is placed on the tower, the conduit sections can be rotated on the boom to level the elements and place them in the same horizontal plane. After the elements have been leveled, secure them in this position by inserting several sheet-metal screws through the metal and into the wood inserts.

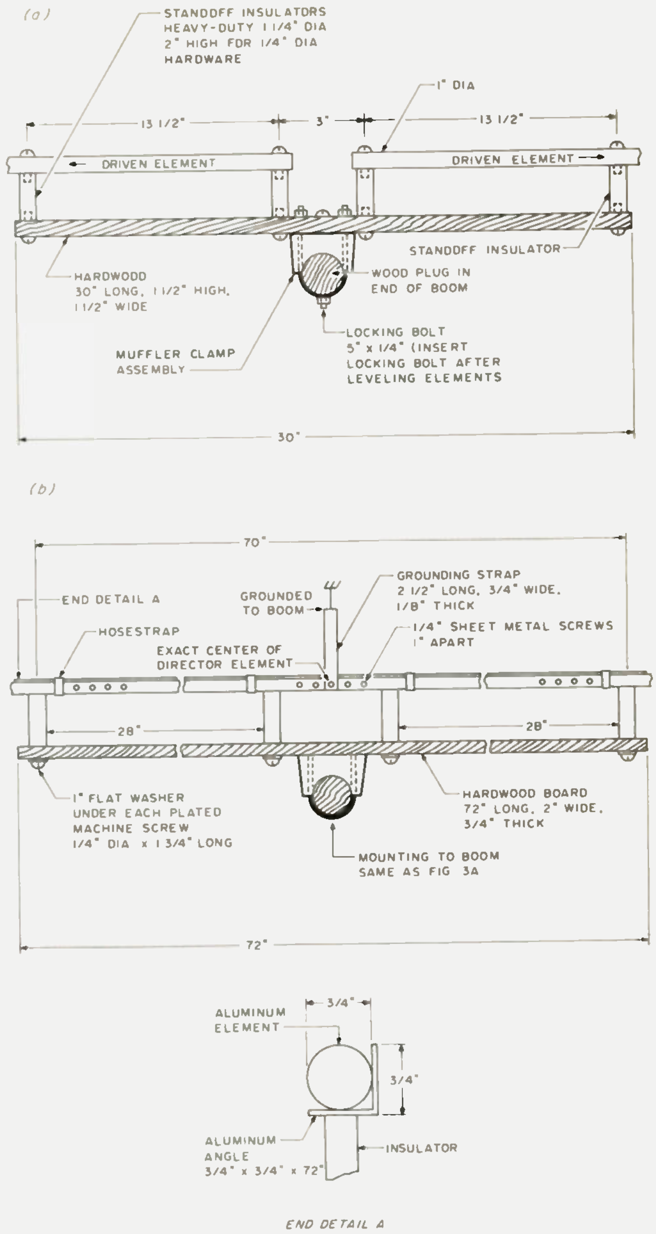


Fig. 3. (a) Driven element mounting details. (b) Director driven element details. Detail A shows element-to-angle construction technique.

Resonating and Matching Adjustments

The preliminary resonating and matching adjustments may be carried out with the array suspended only a few feet above the ground. An 8- or 10-foot wooden stepladder functions very well as a support if the array is lashed to the top and kept level during the adjustments. Place the stepladder and array in an open space, away from buildings, trees, wires, or other antennas. Point the director toward empty space, if possible. Keep the ends of both elements away from any objects, particularly those made of metal. During the adjustments, the presence of your body in the field of the antenna will affect the adjustments and the instru-

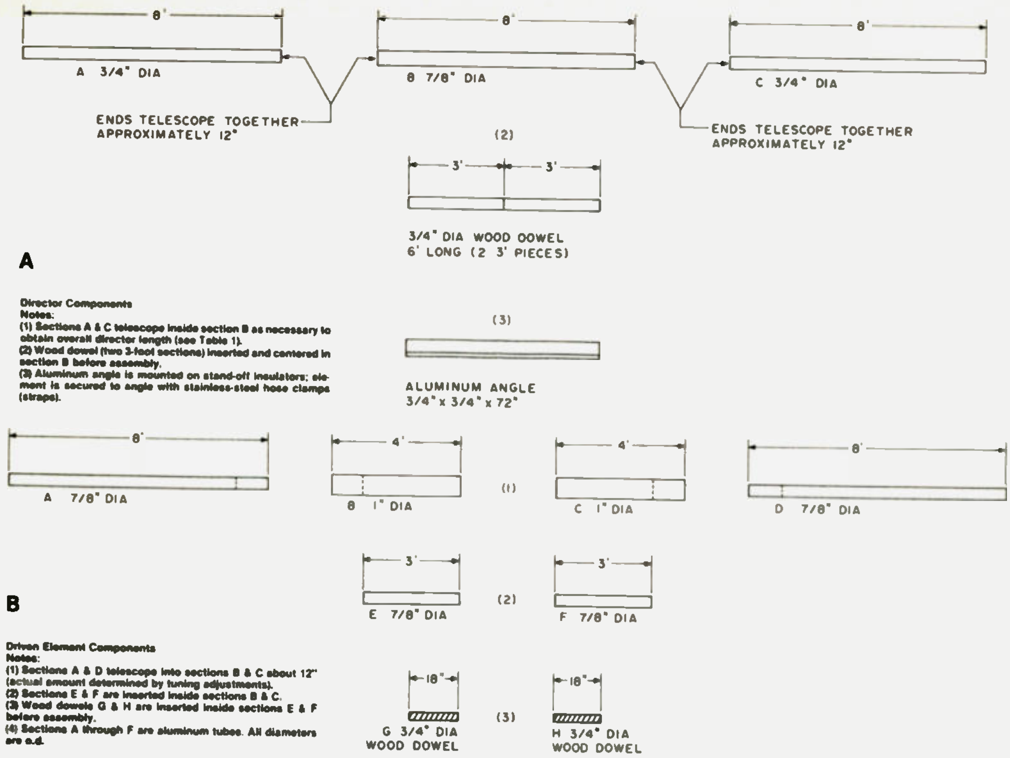


Fig. 4. Components for (a) director and (b) driven element.

ment readings. When adjusting sensitive arrays close to the ground, I usually use two swr meters—one at the point where the transmission line connects to the array and another at a point one-half wavelength down the line from the antenna. To obtain a true reading, walk out of the field of the antenna after making an adjustment and read the swr meter at a distance or at the half-wave point.

To start, adjust the driven length to 476/f, where f is in MHz, not including the 3-inch gap at the center. For 21.3 MHz, the length of each half of the driven element will be about 11 feet, 2 inches. The exact length at this point is not extremely important, but make sure that the two halves are exactly equal to each other. Now, beginning at the end of each 1-inch center tube section, scratch marks one inch apart on the 7/8-inch end sections in the direction of the tips. Four or five marks will be sufficient. Make the same number of marks on each end section. Adjust the shorting bar to a position about 36 inches down the stub from the antenna and tighten it just enough to make good contact with the copper tubes. Connect an swr meter in series with the coaxial line at the point where it joins the stub SO-239 connector. If you have a second swr meter, put in a pair of PL-259 plug connectors exactly 15 feet, 3 inches (for RG-213/U, RG-8/U, and 21.3 MHz) down the line from the SO-239 connector at the antenna, and insert the second meter at this point. Adjust the test signal to the proper frequency.

Adjust the signal level and the swr meter sensitivity to indicate exactly full scale in the "forward" position. Switch the swr meter(s) to indicate the "reverse" or "reflected" signal level. With the array adjusted as described, the reflected signal level probably will be less than full scale, but is not likely to be zero. Now, very carefully adjust each end section by telescoping it into the 1-inch center section the distance of one inch (one mark). Make sure that each end section is telescoped exactly the same amount so that the array will remain in electrical balance. While observing the swr indicator, move the shorting bar up and down the stub for the deepest indicator null. Alternately, adjust the driven element overall length, maintaining electrical balance, and the shorting bar position until the swr meter indicates zero in the reflected signal position. At this point, tighten the two stainless steel clamps around the driven element but do not insert the sheet-metal screws yet.

If it is possible, raise the antenna to about 24 feet above the earth and observe the change, if any, in the swr meter indicator. I use a wooden pole for a tower. An overhanging arm at the top of this pole was fitted with a rope and pulley so that the array could be pulled up to any height above ground. When the array was raised from 8 feet to 24 feet, the line swr at 21.3 MHz changed from 1:1 to 1.4:1. After several trial adjustments of the driven element length, the line swr was reduced to 1.2:1 at 21.3 MHz. The antenna was then lowered to the ground and the sheet-metal screws were inserted in the driven element. The entire joint was then wrapped with plastic vinyl tape. After the antenna was installed on the tower, the shorting bar was adjusted for a 1:1 swr at 21.3 MHz and soldered in place.

Electrical Height

Most amateurs believe that the higher the antenna, the better its performance, especially for DX work. I have found, however, that a height above ground from about a half wavelength to a five-eighths wavelength appears to be best for my location when working European DX. W6TYH is located in the foothills of the Sierras at about 500 feet elevation. In the direction of Europe, the Sierras are about 7,000 feet high. Low-angle radiators, such as vertical arrays, give very poor results toward Europe when compared with the little two-element parasitic arrays. The best signal reports from Europe on the 15-meter band were obtained when the array was about five-eighths wavelength above the earth. To establish the electrical height at five-eighths wavelength, a 1.5-Ampere thermocouple rf ammeter was inserted in series with the 50-Ohm transmission line at the point where it is connected to the SO-239 receptacle. The rf power input to the line at the transmitter was held constant while the array was raised and lowered. The maximum rf current was indicated when the array was about 28 feet above the earth. This also has proved to be an effective height for working European DX across the Sierras. Apparently, the vertical angle of the radiated signal is just right for the wave to clear the high mountain ranges to

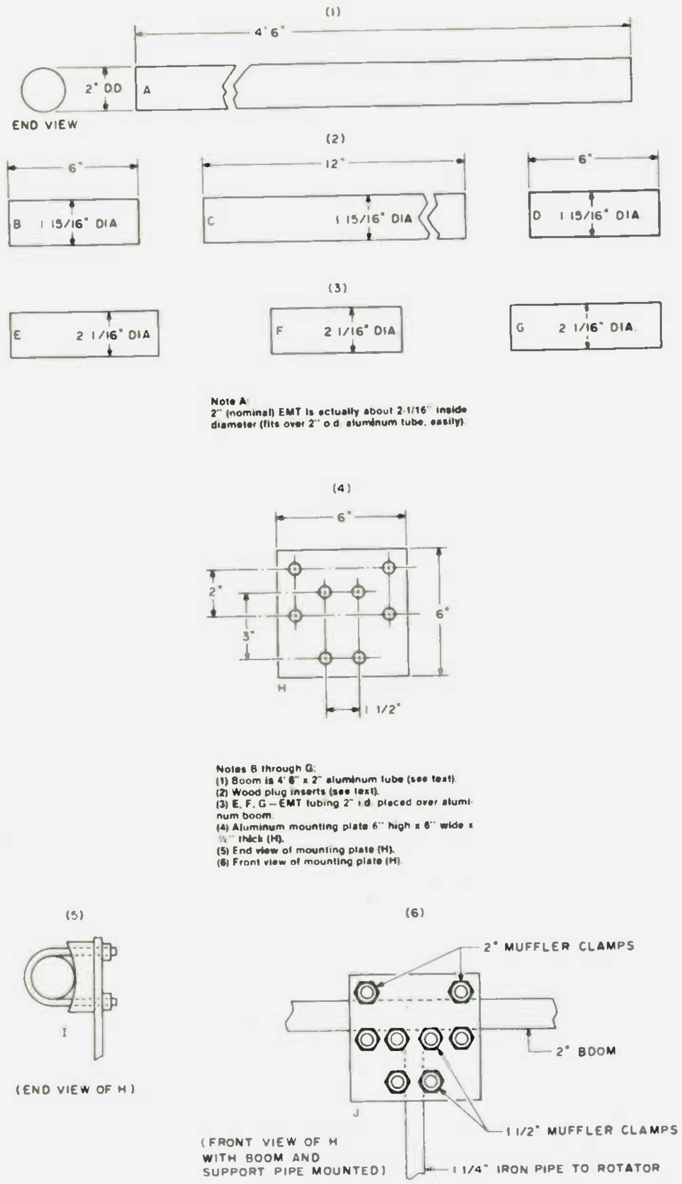


Fig. 5. Boom assembly and mounting details.

Fig. 6. LB-2 15-meter array. The split driven element is at the left in this photo. The director element, right, is insulated from the boom but grounded to it at the exact center to reduce noise pickup. Note coax line connection at end of 53-inch tube. As shown, maximum radiation will be toward the right. Maximum gain (over a half-wave dipole) is 5.3 dB. The rotator (not shown) is an AR-22 heavy-duty TV type.

the north and east.

Operating Performance

After almost half a century of amateur and professional radio communications experience, it requires outstanding performance in an antenna or a piece of ham gear to cause me to become enthused. I can truthfully say that I am delighted with the performance of the little two-element 15- and 10-meter antennas. The real worth of any antenna, as far as I am concerned, is proved by what it will do when I am competing with a dozen other stations for a rare DX contact. Many times when the competition was fierce, the DX station came back to W6TYH, and I have the QSL cards to prove it. During the past few months that the antennas have been in use, I have had good signal reports from all parts of the world. Most of the time, the PEP input to the transmission line was only 175 Watts. The antennas also work very well for reception, a signal standing up from the background noise like the proverbial "sore thumb."

Troubleshooting

This antenna design has been proved to be sound and, if the dimensions and adjustment procedures are carefully followed, absolutely no trouble should be experienced in obtaining top performance from either of the two arrays. However, some of us are like the new bride who burned water trying to boil it, and somebody will get into trouble with the array and write to me.

The most common problem is difficulty in getting the line swr down to 1:1 at the design frequency. In one case, the trouble was caused by harmonics of the test signal appearing in the line. The use of a low-pass filter in the transmission line at the signal source eliminated the problem.

Do not be tempted to change the spacing of the copper tubes in the matching section, or use different diameters from those specified. I have been through all this and it is not only tricky but very frustrating. Remember that this is a balanced driven element and feed system; when adjusting the overall length of the driven element, make sure that both halves are adjusted exactly the same amount. Mount the matching section tubes on standoff insulators about 6 inches above the boom and make certain that each copper tube is spaced the same distance from the boom to equalize the distributed capacitance.

Although it is not likely if the instructions are followed, the driven element might not be resonant at the test frequency. To check, first measure the overall element length, not including the 3-inch gap at the center. Together, the driven element and the shorted stub act as capacitance and inductance, respectively, and resonate at the design frequency. With this type of arrangement, the overall length of the driven element will be about 2 or 3 inches shorter than the length calculated from the above formula. If still in doubt, you can check the resonant frequency of the element and stub combination by coupling a grid-dip oscillator to the inductive stub. The dip, at the resonant frequency, is quite pronounced. The grid-dip oscillator frequency must be monitored with a calibrated receiver.

If you have an RX bridge, use it to measure the array input impedance at the SO-239 receptacle. The input impedance should be exactly 53 Ohms and pure resistance, with the dimensions given and the array properly adjusted. When the array is properly adjusted, you will find that it is very sensitive to body capacitance, especially at the ends of the elements. When the hand is brought to within a foot or so of the driven element or director end, the swr reflected indication should go from zero to full scale. If it does not, the adjustments are not correct.

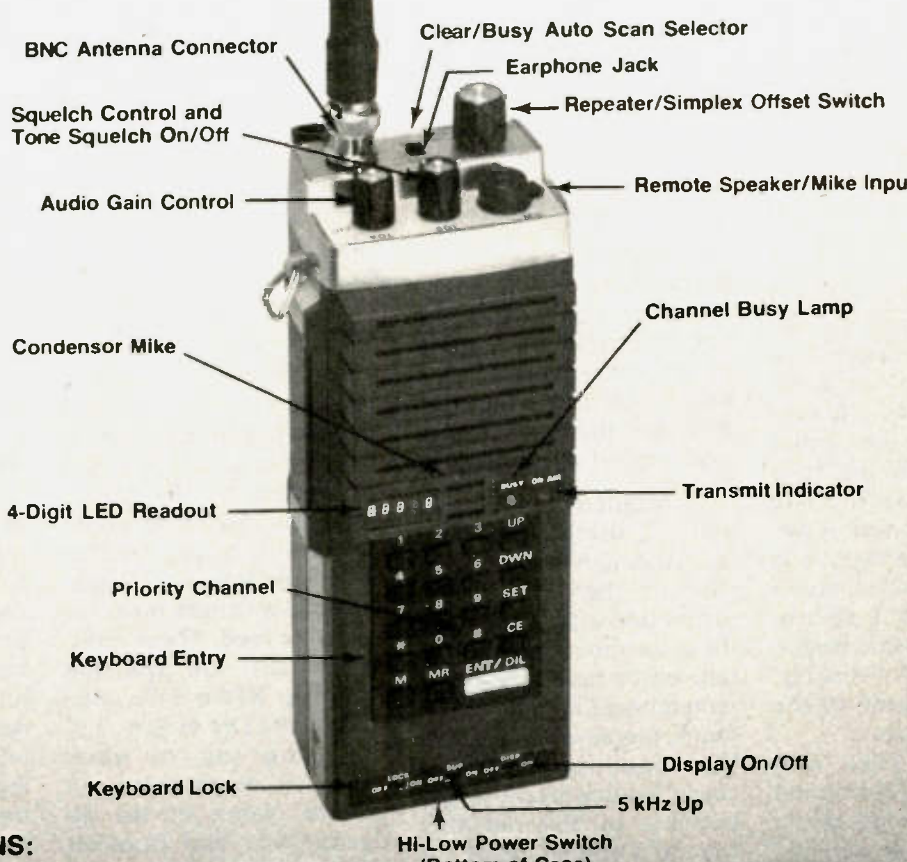
If you still have a problem after making the above checks, write, giving complete details of the trouble. Your letter will be answered promptly if you include a stamped self-addressed envelope. ■

Tomorrow's Technology—Here Today!

THE YAESU FT-207R

The "horse-and-buggy" days of crystal-controlled handies are gone! Yaesu's engineers have harnessed the power of the microprocessor, bringing you 800 channels, digital display, memory, and scanning from a hand-held package. Only with Yaesu can you get these big performance features in such a compact package.

- 4 bit CPU chip for frequency control.
- Keyboard entry of all frequencies
- Digital frequency display.
- 800 channels across 144-148 MHz.
- Up/Down manual scan, or auto scan for busy/clear channels. 10 kHz scanning steps.
- Five channels of memory
- Priority channel with search-back feature.
- Keyboard lock to prevent accidental frequency change.
- Memory backup
- ± 600 kHz or odd repeater splits.
- Display ON/OFF switch for battery conservation.
- Equipped with rubber flex antenna, wallmount battery charger, earphone, shoulder strap, and belt clip.
- Switchable RF output 2.5 watts (minimum) or 200 mW
- Earphone for private listening
- 2 Tone (Touchtone®) Input from Keyboard
- Highly reliable LED frequency display (works in cold temperatures and does not fade with age)



SPECIFICATIONS:

GENERAL

Frequency coverage: 144-148 MHz
Number of channels: 800
Emission type: F3
Batteries: NiCd battery pack
Voltage requirement: 10.8 VDC ±10%, maximum
Current consumption:
Receive: 35 mA squelched (150 mA unsquelched with maximum audio)
Transmit: 800 mA (full power)
Case dimensions: 68×181×54 mm (HWD)
Weight (with batteries): 680 grams

RECEIVER

Circuit type: Double conversion superherterodyne
Intermediate frequencies.
1st IF = 10.7 MHz
2nd IF = 455 kHz
Sensitivity: 0.32 uV for 20 dB quieting
Selectivity: ± 7.5 kHz at 60 dB down
Audio Output: 200 mW at 10% THD

Price And Specifications Subject To Change Without Notice Or Obligation

TRANSMITTER

Power Output: 2.5 watts minimum /200mW
Deviation: ± 5 kHz
Spurious radiation: −60 dB or better
Microphone: Condenser type (2000 ohms)

OPTIONS

LC-C7 Leather Carrying Case
YM-24 Remote Speaker/Microphone
Tone Squelch Unit
NB-P9 Battery Pack
NC-2 Quick Charger

YAESU
The radio. 180

✓83

YAESU ELECTRONICS CORP., 6851 Walthall Way, Paramount, CA 90723 ● (213) 633-4007
YAESU ELECTRONICS Eastern Service Ctr., 9812 Princeton-Glendale Rd., Cincinnati, OH 45246

Jerrold A. Swank W8HXR
657 Willabar Drive
Washington Courthouse OH 43160

The 20-Meter Double Bobtail

I have just discovered a new antenna which I think will be of great interest to many hams who have had trouble with radials but want to use phased verticals. I have never seen such an antenna, so I think this is the first description of a really interesting array.

I started out to make a 20-meter Bobtail in the classic way, because I do not have room for a 40-meter full Bobtail. My yard is only 73 feet wide, and it takes at least 132 feet for a 40-meter version. The antenna I was starting was the one shown in Fig. 1, and has been reported to have a gain of from 7 to 10 dB over a dipole at the same height. The pattern is shown in Fig. 2, and is broadside to the line of the antennas.

My yard is filled with trees, and I was concerned because the east half of the antenna would be running through the leaves of a large apple tree. I planned to use insulated aluminum wire to prevent the leakage into the leaves. I thought of aluminum wire, even size #8, as being light. However, I found that the 66 feet needed would, because of the insulation, weigh four pounds! That is a lot of weight to hang on the top of a pair of flimsy verticals.

I decided to try half of the antenna, which was in the clear, realizing at the same time that there would be no cancellation of the two horizontal wires and that the thing might not work well at all. See Fig. 3.

I installed radiators B and C, using 16½ feet of aluminum tubing, and mounted them on a pipe in the ground with U bolts and the usual mounting plate. It refused to tune properly. I remembered reading that if much metal were used in the mounting it would cause trouble because the bottoms of the radiators were at a voltage point. Of course, if you use wires suspended from wooden poles, as shown in Fig. 1, (D and E) then you will pull the wires down to a stake.

I sent to Sears for some fiberglass fence posts and epoxied two together for a very rigid mount, as shown in Fig. 4.

Sears sells two weights of fence post. The heavy, 48″ green ones, catalog number 32G10434C, cost $1.99 each. They weigh 1 pound 2 ounces apiece (They also have 60″ posts.)

For the coil, I used a 14-MHz coil from an old BC-610 transmitter and a 150-pF capacitor. It tuned the center of the phone band at midscale. It would be possible to use Air Dux or a hand-wound coil and tap up about two turns for the coax feed. These coils, incidentally, are available from Fair Radio Sales, Box 1105, Lima OH 45802.

At the top of each radiator I attached a ground clamp of the alligator type and fastened the end of the wire in the holder on the clamp.

I found that 66 feet of Belden 8000 antenna wire (or antenna wire available from Pace-Traps, Box 234, Middlebury CT 06762) weighed only 9 ounces, or 4½ ounces for 33 feet, if you build the bobtailed Bobtail.

A field-strength meter can be used at the antenna to peak up the tuning, but I evolved a more interesting way, requiring no help at the other end of the coax. I have a pair of 100-mW CB walkie-talkies on channel 15, and I held down the transmit button with a rubber band on one and fastened it to one earphone plugged into my transceiver, which was set at 14.275 MHz. The other I carried out to the antenna, and listened to the noise on 20 meters as I peaked up the tuning capacitor.

There are two other ways of doing this. One is just to plug in a line to the phone jack and carry a headset or speaker out to the antenna, and the other is to use a piece of four-wire rotator cable with two wires connected to the swr bridge and the other two to the keying jack on your transmitter. Set the off-resonance current to a safe level and then peak the tuning up to the center of the desired band. At the antenna, just key the transmitter and quickly dip the tuning capacitor and a series link capacitor for minimum swr.

I did not have a suitable link capacitor, which could be a 400-pF receiving type, so I used an L network to tune the link after I peaked up the tuning coil with my walkie-talkie method.

In the drawing I show some radials, which happened to be in the ground near where I mounted my driven radiator, but I could have just used an eight-foot ground rod, because the

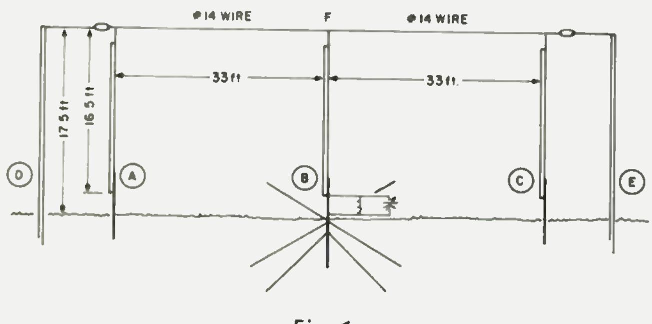


Fig. 1.

Bobtail does not need much of a ground. The high current is a quarter wave above ground and the ground losses are much less than with ground-mounted verticals.

The secret of the Bobtail is in the fact that the current maximum is at a quarter wave above ground, and that is where the maximum radiation is. Ground-mounted verticals have their maximum radiation at about ground level and therefore require a more extensive ground system, and are more affected by surrounding objects.

I found out several amazing things from this experiment. I had rather expected that the antenna array might end-fire, since the other antenna was a half wave out of phase by ordinary phased verticals standards. I listened to a California station which was 20 over 9 on my N/S delta loop, and when I switched to the verticals it was S5. I have my delta loop vertically polarized, and in the daytime I have S9 noise from my power line only 12 feet behind the antenna. When I switched to the Bobtail, the noise was completely gone, nulled out by the side rejection. It was astounding. This improved rejection causes me to believe that the Bobtail is more efficient than the ground-mounted array.

The tuning is not critical, and tuning to the center of the band gives good results.

When I first connected my 20-meter truncated Bobtail I was crestfallen. It was so quiet that I thought it was not working at all. The loss of the power line hiss, the lack of static or any electrical noise, and the weakness of the mostly western stations at night made it seem like the sort of blackout one hears when there is a solar flare and the band is dead. However, signals from the south were strong.

I called a friend who lives about six miles from me, KA8CGE, and he reported the delta loop was about 10 over 9 and the Bobtail was only about S7. I got out my county map and saw that he was west-southwest of me, showing that the pattern was quite narrow—perhaps 60°. See Fig. 2.

I made a test with WA4OLP in Duluth, Georgia, near Atlanta, and he reported that the Bobtail was stronger than the delta loop by about 10 dB.

That night, I called KC4USV at McMurdo Sound, Antarctica, and they gave me a report of 5 by 5 on the delta loop and 5 by 7 on the Bobtail. Remember, this is only a two-element Bobtail, and the three-element version with the cancellation of the horizontal sections could have been about S9. KC4USV was also S7 here, as the propagation was rather poor. Considering that they have a Collins 2-kW station and mine was only a single 3-500Z driven by a Hallicrafters SR160, I thought I was doing rather well.

I believe that this antenna could be current fed by running coax up the quarter-wave radiator of tubing and feeding the top wire at point F. I tried it that way first, actually, but it failed to tune correctly. After I had taken it down in disgust, I realized that previously I had disconnected one of the verticals, a fiberglass Columbia Products antenna top section, at one foot from the top to make it tune better as a ground-mounted vertical. I had clipped the center wire through the insulation, and thus had only the top 12 inches connected instead of the complete 16½-ft. antenna. It had been so much trouble that I had no desire to completely remount the array, and just went to the voltage feed. Now I believe that the other way will work. This would

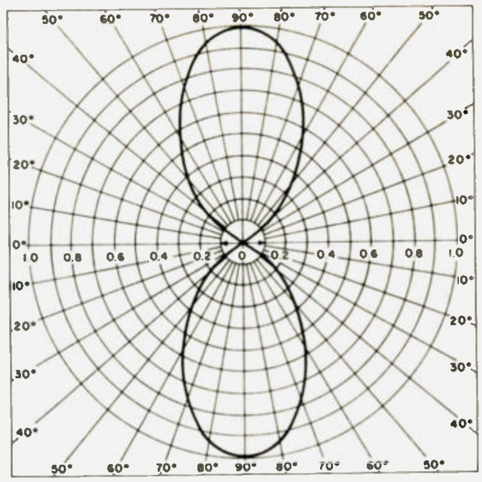


Fig. 2.

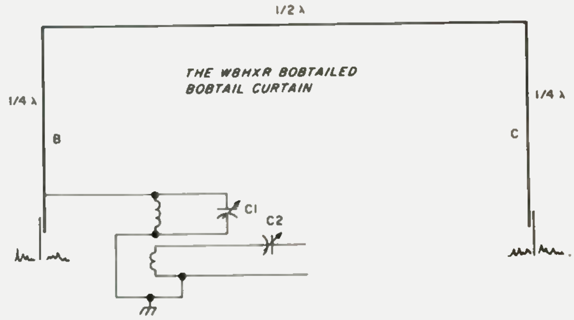


Fig. 3.

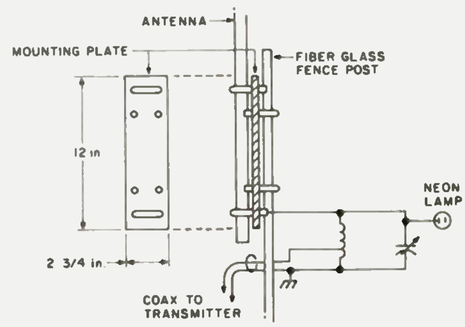


Fig. 4.

make the antenna tuner unnecessary.

I did not intend this article to be one which extolled the well-known but seldom-used Bobtail, but my accidental discovery that two elements worked so well made me realize that here is the answer to the problems of 40-meter phased verticals. Since the full 40-meter Bobtail takes more room than the average ham has available, and since the ground-mounted verticals take such a large radial ground system, using only two of the verticals in the "bobtailed Bobtail curtain" seems the answer to a dream. The high position of the high current section should make the signal at least an S-unit better than the ground-mounted verticals, and in the many years I spent with two phased verticals running phone patches for Antarctic stations, I never had so completely nulled out noise on the sides of my antenna, nor had such rejection of west-coast stations as well as those in between.

WA7NHU gave me over

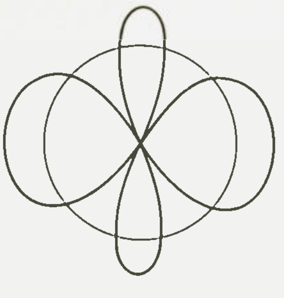


Fig. 5.

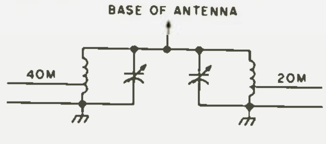


Fig. 6.

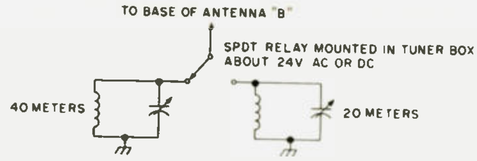


Fig. 7.

S9 on the delta loop and could not read me when I went to the Bobtail. Both were firing south/north. He is in Hereford, Arizona, and is so enthused that he is going to put up a full 40-meter Bobtail firing into Europe, and if it works, he plans to add a parasitic reflector and director. I wish I had that kind of space.

There are certain disadvantages: It cannot be rotated or changed to end fire. It would be best to have an inverted V or something for when you want to work stations not in the beam, or have two Bobtails. But if you have one firing in a direction where you want the best signals, then the two-way figure 8 will be good.

It is not a short-range antenna unless there is short skip. However, the fact that there is no cancellation of the horizontal section on a two-element array probably means that there will be high angle reception in the near distance.

The good results are not from gain in itself, but in the lowered angle of take-off, compared to a dipole. This advantage shows up on paths in excess of 2500 miles. Close-in there often is no great improvement.

About a week after I tried the two-element shortened Bobtail, I decided that I really wanted an antenna which would fire east/west since I had more interest in those directions than north/south.

I could not put up an antenna in that direction because trees and my house were in the way. I decided, therefore, to move the verticals back where they would not be in the trees, and space two elements 66′ apart, a full wave, which would give me the pattern shown in Fig. 5. This would give me a nice lobe E/W and a narrow one N/S. This I did, with the following results:

About 0750 UTC I heard JA3KWJ/AC2 in Botswana. He had a pileup going and I could not hear him on the delta loop, but he was about S4 on the Bobtail. I gave several calls and he came back to me and gave me a 5-9.

The next day, August 15, at about the same time, I heard ZL2ASX calling CQ, and went back to him. We had about a 20-minute chat, and he said that I was S2 on the delta loop, which I had now turned so it was E/W for comparison. He said that I was S5, three S-units stronger, on the Bobtail. Conditions were quite poor, but there was no fading and we were both Q5.

Then at 0900 UTC I called KC4USV at McMurdo Station, Antarctica. Conditions were very poor, but the band was completely silent, so we conversed for 22 minutes. He said that I was not moving his meter, but that I was solid copy. The delta loop had stronger audio than the Bobtail. I was surprised until I checked the pattern. McMurdo is about 15° west of south, and is probably just outside the south lobe in the null.

I also found that Florida stations were weak on the Bobtail but strong on the delta loop. This rather confirms the pattern. Miami bearing is 167°; Atlanta is 187°.

I wish I could turn my array to fire NE/SW off the ends, but I can't. At least I have found an antenna which bears further investigation. I have decided that I will now add a center radiator and make it a full Bobtail as in Fig. 1. At least I can work South Pole Station and part of the South Pacific, and north, I can work into India, Pakistan, Mongolia, Central Russia, and the North Pole area.

I just couldn't resist trying out the full Bobtail, especially since I hear rumors of China showing up. The long range of the antenna means little or no interference from strong western or eastern stations, as I will null out or skip over most of them.

Of all the high-gain antennas, this is the simplest to construct for 20 meters that I have ever found.

So, I moved my Bobtail north about 6 feet to clear the trees and added a third element, so it is now as shown in Fig. 1. I tried it for only two days, and conditions are only fair, but I found some interesting results.

Last night I worked KC4USV, and while he was only about S5 to me, he gave me S8. The skip had moved west and was good into Grand Rapids, Michigan, where W8YCI reported him as 30 over 9. However, Pete at McMurdo said I was phone-patch quality.

Earlier in the day, I worked Tony WB4KKL on Captiva Island, Florida, and as I was 40 over 9, he would not believe I was barefoot. This was at 4:20 pm local time. I put on the linear for a few seconds, and he said I was 52 over 9. We talked about antennas for an hour.

At 0740 UTC, I worked G5CAX in Potton, 50 miles north of London, and compared the E/W delta loop with the Bobtail. I was 5/5 on the delta loop and 5/7 on the Bobtail, showing that the pattern is wide enough N/S for a good signal at 48°.

I plan to leave it this way for several weeks for a better evaluation.

There is one other thing I believe is worth trying. The 40-meter version should also work on 20, with a four-lobe pattern as shown in Fig. 5, with two coils, using separate feedlines, and without a relay as in Fig. 6. The coils should not react any more than a multiband dipole does.

With two half-wave verticals on 20 at one wavelength spacing this should be a really hot item. By orienting the array to fire northeast, there should be good lobes in all four DX directions on 20.

If some younger ham with some space should try this out, I am sure that *73* could use an article on the results. After 60 years of hamming, my mind still dreams up antennas but my energy reserve is getting lower. They certainly are fun, though. If you try the relay method in Fig. 7, the relay should have good insulation, as the rf voltage at that point is high.

A small wastebasket or plastic jar can be turned upside down over the coil and capacitor to protect them from rain and snow, and the bottom left open. The bases of my verticals are about 10 inches from the ground, but that is not critical. The ground lead should be as short as possible. Any leads from the coil become part of the antenna.■

David W. Cutter WB5SFB
1403 Bush Avenue
Alexandria LA 71301

Simple Switcher

—a remote antenna switch with no control wires

A remote antenna switch may be just what you need to solve your antenna switching problems. Even better, how about one with no control cables? Let me explain.

The idea of having a dc voltage and an rf voltage on the same antenna feedline at the same time may seem impossible to you. But, as I learned, this can easily be accomplished and there can be many applications. By using the antenna feedline as the control cable, you can supply a low voltage to power an antenna-mounted preamp or control relays mounted on an antenna. In this article, I will describe my remote antenna switch, which uses the antenna coax feedline to carry a dc control voltage for the antenna switching relays.

When I was designing my triband quad, I decided not to use a balun, but to feed each antenna with a separate feedline to the transmitter. This seemed to be a good idea until I added up the cost of all the coax cable! (And this was supposed to be one of those inexpensive projects.) So, again, it was back to the drawing board. The problem was how to feed three antennas with only one feedline.

Then this was mentioned to me: Why not send 12 volts dc through the coax, mount a relay on the antenna boom, and do all the antenna switching at the antenna? I hadn't known that I could put a dc voltage on my coax and transmit at the same time, but it sounded like a good idea. That way I could connect each antenna's quarter-wave matching section into the relay box and use only one run of coax down the tower to the transmitter.

After more talking and reading, I saw a circuit in *The Radio Amateur's Handbook* that would do just what I wanted. My switch is a little different than the one described in the *Handbook*, but the principle is the same.

The theory behind the switch is simple. See Fig. 1. A power supply is needed to provide a positive and negative 12 volts dc and is connected in the feedline between the transmitter and the antenna (Fig. 2). At

Photo A. Power supply unit.

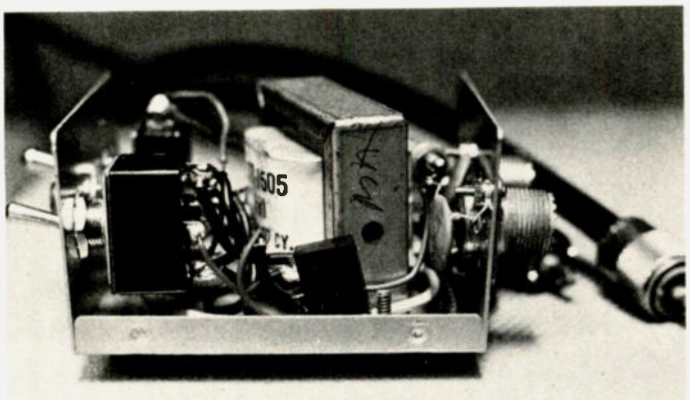


Photo B. Cover removed.

the antenna end of the coax is the relay box with two relays that switch the three antennas. See Fig. 3. A diode is used in the relay box to act as a gate to activate the correct relay. Rf chokes are used in the power supply and relay boxes to keep the rf out of the power supply and off the relay power terminals. Disc capacitors also are used in each box to isolate the antennas and transmitter from the 12 volts dc.

Construction Hints

The construction of each unit is very simple and straightforward. The power supply is housed in a 2" x 3" x 4" cabinet. Things will be a little cramped, but with a little care, everything will fit. The transformer is a 117/12.6 V, 1.2 A Radio Shack no. 273-1505. The full-wave bridge rectifier is an ECG 169. A pilot light is a nice feature to have so that you won't forget to turn the unit off. The capacitors are small .01-uF discs, and the rf chokes I used were 1 mH.

The relay unit is housed in a 2" x 2" x 4" metal box. The relays, the most expensive parts, are two Radio Shack 12-volt dc DPDT no. 275-206s with 3-Amp contacts. (SPDT relays will work, but I couldn't locate any.) These relays are mounted in a plastic case which makes it easy to epoxy them in the metal box. When assembling the unit, seal the box to make it watertight, but put a small hole in the bottom for ventilation.

Operation

Once the project is completed, be sure to check out the unit with a dummy load to make certain that each relay does work. This might save you an extra trip up the tower. When connecting the antenna to the outputs, connect the most often used antenna to output A. That way, the unit will be off most of the time and when the unit is turned on with switch S1, switch S2 is used to select antenna B or C.

My antenna switch has performed well for over two years and makes a neat installation. My transmitter runs 100 Watts, and I have had no trouble with the relay contacts. They probably will handle more power if you are careful not to switch antennas while transmitting.

Now that you have the basic concept of how this system works, you can apply it to solve your own antenna switching problems. This same unit could be used to select verticals or other antennas. In a future project, I am going to apply this same principle to power an antenna-mounted preamp. I am sure that there are many other applications using this concept, and I would be interested in hearing about them.

Thanks to Cliff WB5KCQ for his technical assistance on my projects.■

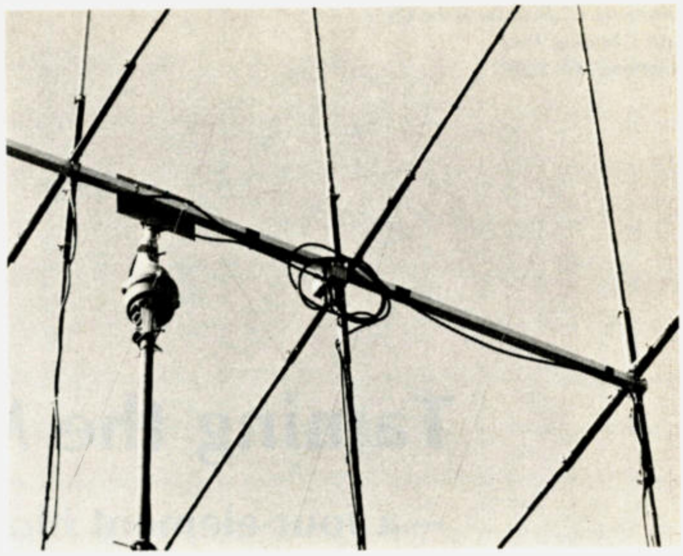


Photo C. Antenna mounted relay unit. Each antenna's ¼-wave matching section is connected to the bottom of the box. Only one run of coax is needed to connect the relay unit to the transmitter.

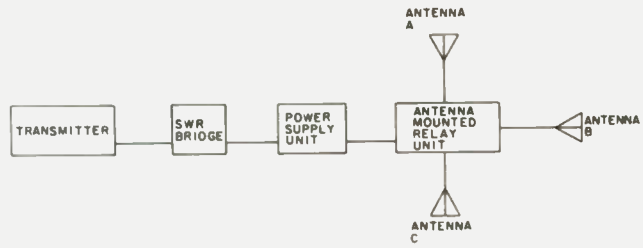


Fig. 1. Block diagram.

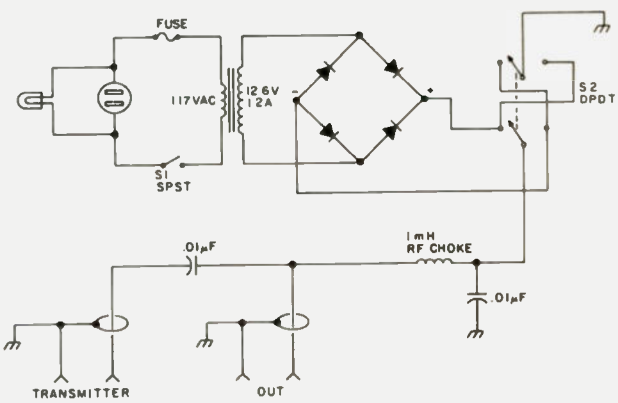


Fig. 2. Power supply.

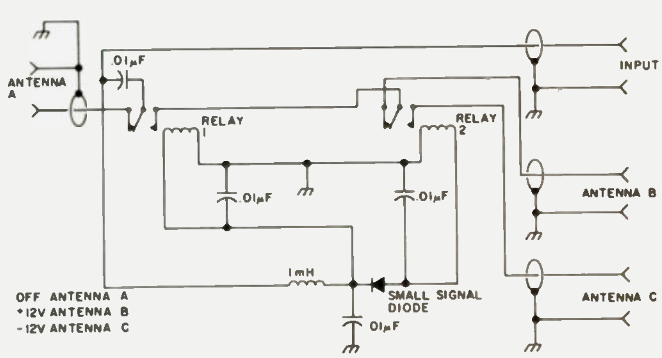


Fig. 3. Antenna-mounted relay box.

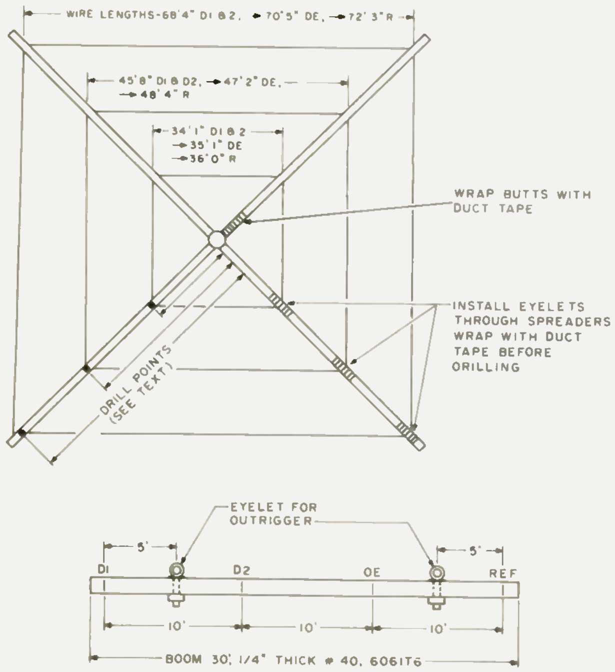
Anthony W. DePrato WA4JQS
205 Cherokee Trail
Somerset KY 42501

Taming the Monster Quad

—a four-element blockbuster you can build

It has been a long time since I have written an article for any amateur magazine, but after many on-the-air inquiries as to how my antenna performs and how I overcame various problems which seem to plague so many hams with multi-element quads, I decided to write a construction article.

For years I had used a four-element monobander, and after the loss of two towers, I decided to try the quad antenna. My first try was with two-elements on an eight-foot boom, but it did not compare with my four-element beam. Next, I used a four-element quad on a 20-foot boom. However, my beam still worked better. I was plagued with a low front-to-back ratio, high swr, and interaction between bands. So out came the books for many hours of research. The results were a quad with high forward gain, high front-to-back ratio, no interaction, and low swr with a wide bandwidth. (The following specifications as to gain are approximate but can be considered accurate by amateur standards.)



Four-Element Triband Quad:

boom length—30 feet;
element spacing—10 feet, all equal;
gain—13 dB;
front-to-back ratio—30 dB;
wire size—#14 enameled copper;
five-percent difference factor between elements;
design frequency—14.250, 21.300, and 28.600 MHz.

Directors 1 and 2 are the same size. I used the formula $975/f_{MHz}$. The frequency and wire lengths are 14.250 MHz—68'4", 21.300 MHz—45'8", and 28.600 MHz—34'1".

For the driven elements, I used $1005/f_{MHz}$. The frequency and wire lengths are 14.250 MHz—70'5", 21.300 MHz—07½", and 28.600 MHz—35'1".

For the reflectors, I used $1030/f_{MHz}$ to obtain wire lengths of 14.250 MHz—72'3", 21.300 MHz—48'4", and 28.600 MHz—36'0".

Spreaders:

I used one-piece fiberglass spreaders 13-feet long and screwed eyes through the arms to run the wire (see Fig. 1). This lets the arms move in the wind and not break the wire, and also lets the wire draw and sag with temperature changes and not bow the arms. A note of interest: Bamboo can be used but should be wrapped with two-inch-wide duct tape and then sprayed with krylon® or varnish.

Placement of the screw eyes is done by taking the wire length in feet for each band, dividing the result by four, and inserting that number into the formula $A = C/\sqrt{2}$, where A is the distance along the spreader from the center of the boom to the drill point and C is the length of the element divided by four.

Example: Find drill point for 20-meter driven-element wire:
14.250 MHz = 70'5"
70.5 divided by 4 = 17.625 = C
Using $C = \sqrt{2}$, $A = 17.625\sqrt{2}$, $= 17.625/1.414$, $= 12.46'$ or 12'5" from center.

Below are the drill points

for each element:

Directors 1 and 2:
14.250—12′1″
21.300—8′1″
28.600—6′0″

Driven element:
14.250—12′5″
21.300—8′3″
28.600—6′2″

Reflectors:
14.250—12′8″
21.300—8′6″
28.600—6′5″

These figures are to be used if you measure from the center of the boom out. To measure from butt of the arms, add 1 3/8″ to each figure. This way the arms may be drilled before attachment to the boom spreaders. Each hole should be wrapped with duct tape after drilling, then a small nail can be used to punch a hole in the tape. Each spreader should be sprayed with krylon® or other type of coating to increase its life and prevent the eyelets from rusting. I also wrapped the butt ends with duct tape for added strength.

Feeding the Quad

I decided to use ¼-wave stubs after burning up a one-kw ring transformer. It's no fun waiting two weeks for a new transformer before you can operate! I used 72-Ohm coax, but kW-rated twinlead can also be used.

Below are the lists of lengths for both coax and twinlead using the formula $L = 246(VF)/f_{MHz}$, where VF is the velocity factor of the transmission line used.

Stubs: RG-11A/U coax, Z = 72 Ohms, VF = 0.66. Length to match driven elements: 14.250—11′4″, 21.300—7′6″, and 28.600—5′6″. For 1-kW twinlead, Z = 72 Ohms and VF = 0.71, 14.250—12′3″, 21.300—8′2″, and 28.600—6′1″.

The stubs should be cut as close to the lengths shown as possible, a PL-259 and barrel connectors installed on one end, attached to 52-Ohm coax to the shack. I tuned each 52-Ohm feedline to the shack using my noise bridge and R-4C so I would have little swr on my feedlines.

One problem many hams have is how to string the spreaders. I drove a 2″-diameter, 4′-long pipe into the ground and attached the arm supports to this pipe. I then drove 2 wooden 3′ stakes into the ground for each arm to keep them straight. By using this type of jig, each element can be wired, removed, and then placed on the boom. I covered all nuts with General Electric clear silicone rubber, and then I sprayed them with krylon®.

Conclusion

After the antenna was installed, measurements were made. The swr was 1.6:1 at its highest point on any band, with very flat response across each band. I can operate either the CW or phone portions with the swr never going above 1.6:1. I have been using the antenna for about two years and have yet not to make it through the pileups. The work involved is well worth the time, considering the results obtained. My next antenna will be a two-element 40-meter quad.

I would like to thank Barry WA4POH. Without his help and encouragement, this project would have been scrapped. Barry also put up a quad like mine and is very pleased. ■

References

Radio Handbook, 20th edition, Orr
Antennas, Kraus
Cubical Quad Antennas, Orr
ARRL Handbook, 78 edition
ARRL Antenna Book, 78 edition

✓Reader Service—see page 226

Irvin J. Kirch W9YFG
34 Hoss Road
Indianapolis IN 46217

For Cheapskates Only: A No-Frills Tilt-Over

—requires a friend with a welding rig

After pricing all types of tilt-over towers and masts and coming to the conclusion that I must have been at the airport when my ship came in, I decided that if I were ever going to have a tilt-over mast, I'd have to home-brew one.

A good friend of mine had obtained several tilt-over light standards

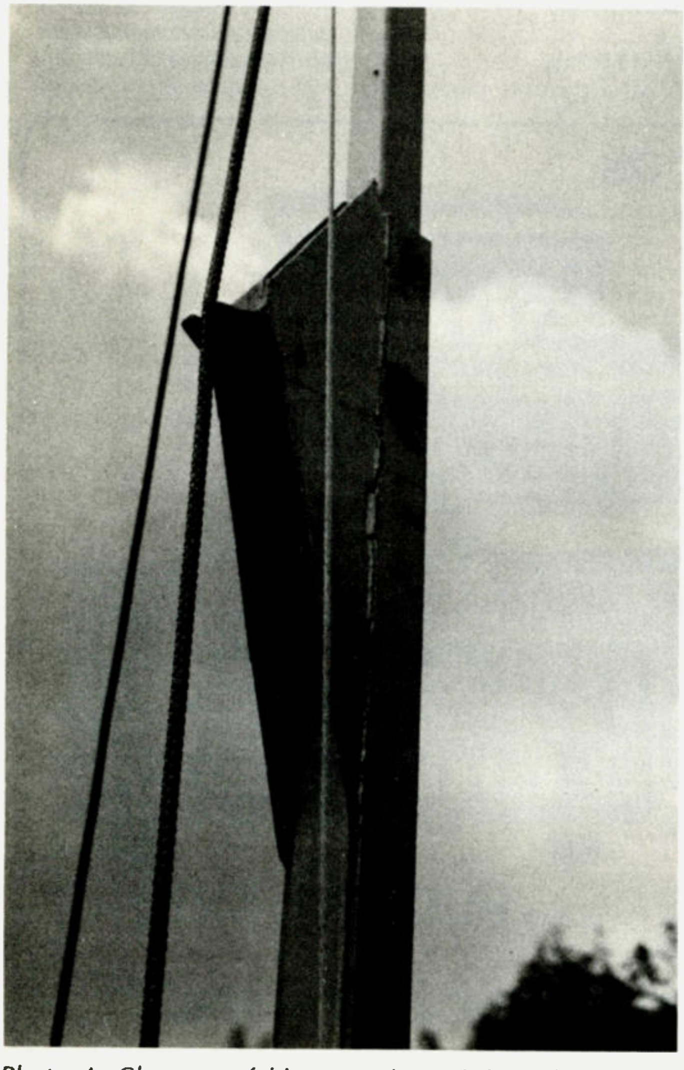


Photo A. Close-up of hinge section reinforced with ¼" boiler plate. Mast is in upright position.

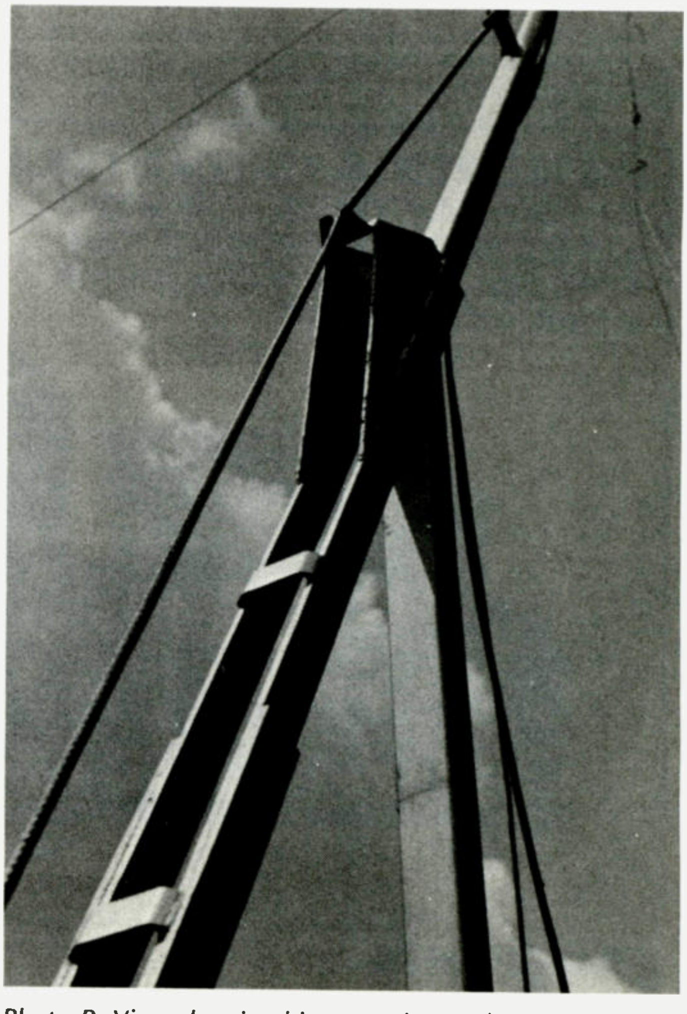


Photo B. View showing hinge section and ½" reinforcing rod which travels down the back of the mast and terminates near the bottom of the 6" channel iron. Mast partially tilted over.

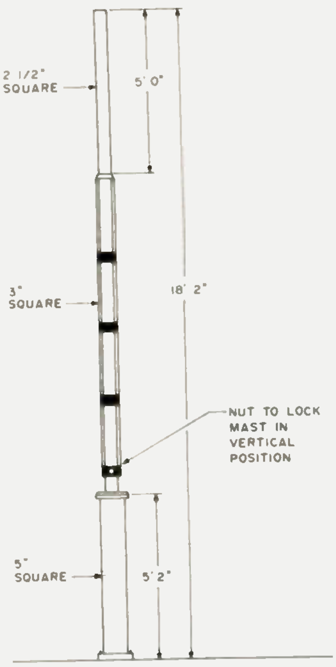


Fig. 1. Before conversion.

Fig. 2. Back view.

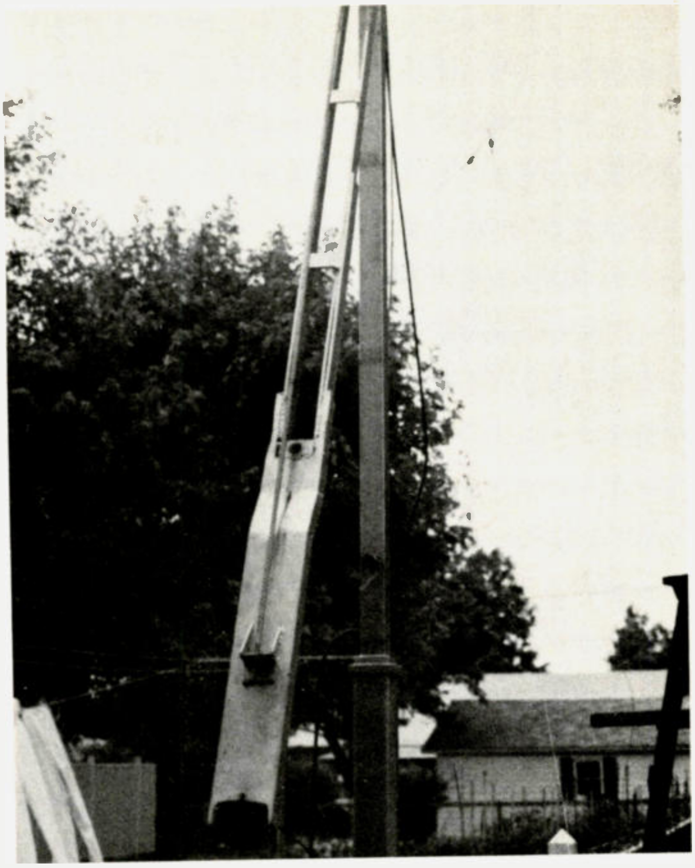


Photo C. View showing 6" channel iron welded to the bottom of tilt-over section to increase fulcrum point.

(Fig. 1) from one of the major oil companies when they closed service stations in the area. After utilizing all but one, he graciously declared it "surplus." After spending several hours removing the old paint and some accumulated rust, I contacted a nearby ham, Harold Stark K9UBL, an expert machinist and welder. He had constructed his own tilt-over mast from heavy-duty pipe, and volunteered to do the necessary welding along with figuring stress points on our mast. All additional materials, with the exception of the boat winch, were purchased at the local junk yard. The finished mast is shown in photos.

A twelve-foot piece of 2" pipe was telescoped into the 2½"-square section of the light standard and welded in place. Two holes were drilled near the top of the 2" pipe, over which nuts were welded. These nuts receive two ½" cap screws which secure the 1½" pipe that telescopes into the 2" section. The cap screws allow for varying the height of the mast. The 1½" section is ten feet long and telescopes two feet into the 2" pipe. The rotator sits atop the 1½" pipe.

Since the added load of pipe and antenna were more than the mast was originally designed for, Harold reinforced the hinge section (Fig. 3) with two pieces of ¼" boiler plate. A piece of 6" channel iron was welded to the bottom end of the tilt-over section to increase the fulcrum point. To offset any bending of the mast as it is raised and lowered, a piece of ½" reinforcing rod was welded to the 2" section of pipe where it travels down the back of the mast, and terminates near the bottom of the 6" channel iron. The end of the rod is threaded to receive a nut. This allows for varying the tension on the upper section of the mast.

A J.C. Penney boat winch was bolted to the bottom section, and just

✓Reader Service—see page 226

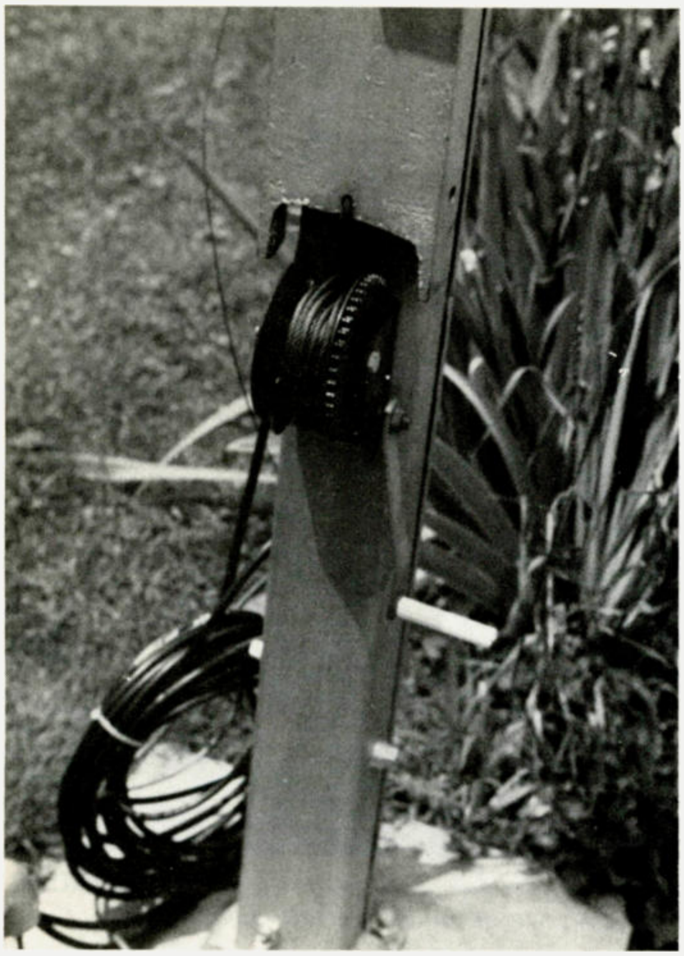


Photo D. Close-up of winch, bottom of 6″ channel iron, and base bolted to concrete base.

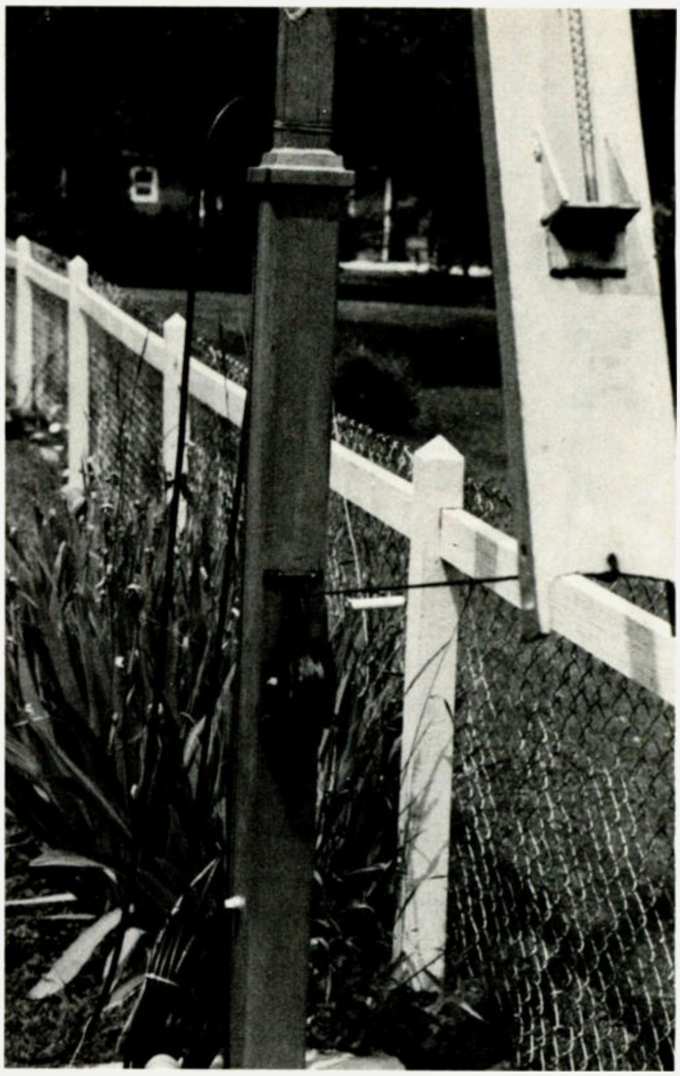


Photo E. Close-up of 6″ channel iron showing how reinforcing rod fastens to channel iron and is threaded to receive nut. Also shows slot in base section to receive pulley over which cable travels.

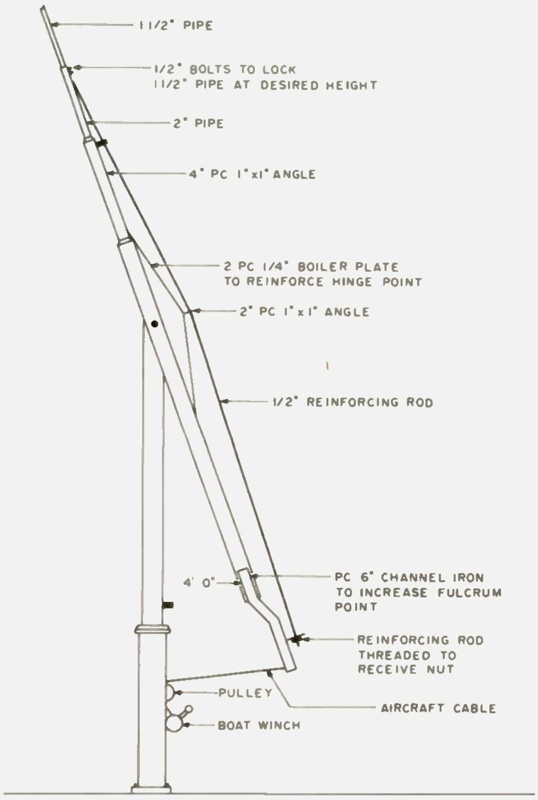


Fig. 3. Side view.

above the winch a slot was cut to receive a pulley. The aircraft cable passes over the pulley and onto the drum of the winch.

Due to space limitations, I am able to guy the mast in only two directions. At present, our ten-meter quad is sitting at thirty-two feet. Space permitting, I would feel that it was safe to raise it to thirty-nine feet. We had it at thirty-nine feet for several months last fall and had no trouble whatsoever tilting it over to work on the quad. However, with winter approaching, and the possibility of another blizzard like the one we had last winter, I became gun-shy and lowered it to thirty-two feet. I am happy to report that we made it through the winter with no problems despite heavy icing and strong winds.

I also have the center of my forty- and eighty-meter dipoles attached to the top of the mast just below the quad. These are raised and lowered by means of a pulley.

Anyone interested in putting up one of these masts should keep his eyes open for a tilt-over light standard. They are used in most service stations and shopping centers. Good sources of supply are the major oil companies and electrical contractors. With the future of gasoline being so bleak, they may become as plentiful as politicians. ■

✓ Reader Service—see page 226

Bill Walker W5GFE
W. T. Box 656
Canyon TX 79016

VHF Signal Diffraction

—why the highest antenna may not be the best

My QTH is down in a hole in the ground, and while it's not a big hole, it is still sufficient to cause problems on two-meter simplex when I try to communicate on RTTY with friends in Amarillo.

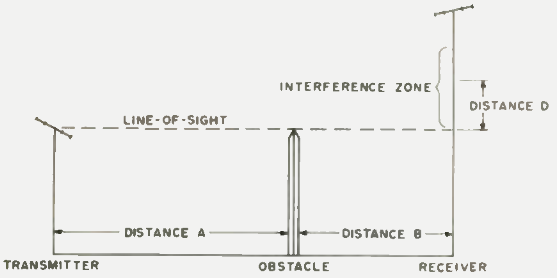


Fig. 1.

Having contemplated and rejected the "Superman approach,"[1] I searched for other solutions. As I climbed up my tower to recover last year's quad (which the West Texas wind had turned into a three-and-one-half-element birdcatcher), I happened to carry my handie-talkie with me. I tried in vain to hit the repeater from the top of my tower and then sadly started the climb to the ground. I had descended but a few feet, however, when the little transceiver squalked to life. "What gives?"

As it turned out, I was able to communicate with the Amarillo repeater, some twenty miles away, from a point not at the top of my tower, but somewhat lower down.

Never one to look a gift horse in the mouth, I mounted the new antenna on the side of the tower where the signal was strongest and then repaired to my desk and home computer to find out what in the

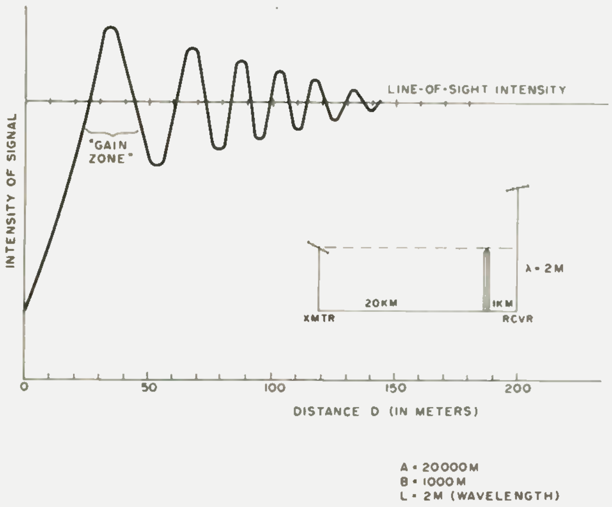


Fig. 2.

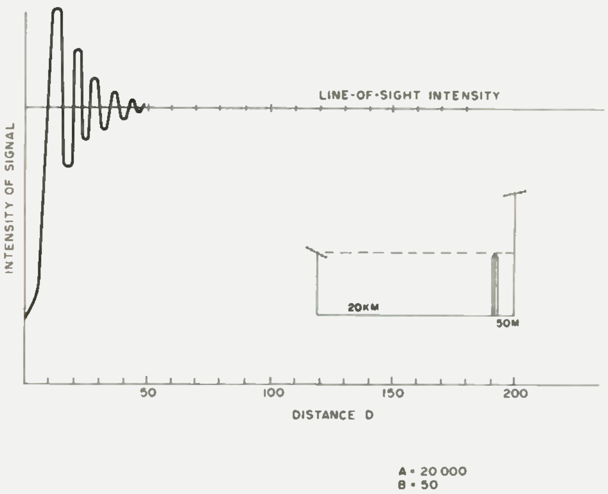


Fig. 3.

world was going on. What I learned may be of benefit to other hams in similar situations.

The answer I arrived at has to do with a phenomenon known as "diffraction" which many VHF operators have encountered in one form or another, often while driving in urban areas. Fundamentally, what happens is that when a light or radio wave front passes by a sharp, straight edge, the waves "interfere" with each other. See Fig. 1. This interference can take place in either a "constructive" or a "destructive" manner, causing the waves either to reinforce or destroy each other. At the places where reinforcement takes place, we realize an increase in signal—gain, if you will.

Oh, well, ho-hum. I guess that is what is happening on my tower. The top of the tower happens to be in a place where the interference is destructive, thus attenuating the signal from the repeater, while only a few feet down the tower the interference is constructive, resulting in readable signals. So, no problem; I will just lower the antenna into the zone of constructive interference and be done with it.

"What did I just say?!" Lower an antenna? Waydaminute! Back to the old APPLE, quick. Any old physics book will do. The APPLE models the system nicely and results in the very interesting graph shown in Fig. 2, which displays signal strength as a function of the distance, D. (See Fig. 1 again.) The horizontal line depicts the line-of-sight strength of the signal. Wow! I can, by proper placement of the antenna, realize a gain over the line-of-sight path. This gain is theoretically about 1.4 dB, and under marginal conditions this could make a difference.

The various graphs show different placements of the knife edge in relation to the transmitting and receiving stations. They show clearly that it may be possible to place an antenna in such a position that it can take advantage of the gain "offered" by an obstacle such as a hill or building and thus allow communication over paths which would otherwise not be productive.

The graphs are based on a wavelength of 2 meters, but since they were computed using formulae developed for light waves, they must be used mainly as a guide. There should be a slight difference in the way light and radio waves behave, although it should not be large. It is possible, by a judicious placement of the base of the antenna

```
   3  X1 = 0;Y1 = 0
   4  HGR
   5  HPLOT 279,53 TO 0,53
   6  HPLOT 0,159
  15  INPUT "HOW FAR IS IT FROM TRANSMITTER
      TO OBSTACLE ";A
  20  INPUT "HOW FAR IS IT FROM OBSTACLE
      TO RECEIVER ";B
  25  INPUT "WHAT IS THE WAVELENGTH ";L
  30  FOR L0 = 0 TO 250
  40  V = L0/SQR(B•L•(A + B)/(2•A))
  50  GOSUB 1000
  60  PRINT L0; TAB(12);V; TAB(25);(X + .5)↑2 + (Y + .5)↑2
  70  GOSUB 2000
  75  NEXT L0
  80  END
1000  X = 0:Y = 0
1010  FOR I = 0 TO V STEP V/200
1020  X = X + COS(3.14159/2•I•I)•V/200
1030  Y = Y + SIN(3.14159/2•I•I)•V/200
1040  NEXT I
1050  RETURN
2000  IT = (X + .5)↑2 + (Y + .5)↑2
2010  X1 = L0
2020  Y1 = 158 – 158•IT/3
2030  HPLOT TO X1,Y1
2050  RETURN
```

Program listing.

tower, to maximize the size of the zone of constructive interference.

Examination of the graphs also shows that there is more than one zone of constructive interference where gain is realized over the straight line path. One would have to be careful to place the antenna in the zone of greatest signal. The graphs show also that there is no use going any higher on the tower after a certain point is reached. Instead, moving lower on the tower may bring you into a zone of constructive interference and thus allow you to carry out communications over difficult paths.

The graphs are shown for several representative situations. The computer program takes advantage of the HIRES capabilities of the APPLE, but could be modified for other machines. The mathematics of the situation are not entirely trivial and require numerical integration of Fresnel integrals. ■

References

1. "Predicting Radio Horizons at VHF," *QST*, June, 1978.
2. Jenkins and White, *Fundamentals of Optics*, 3rd edition, McGraw-Hill, New York, 1957.

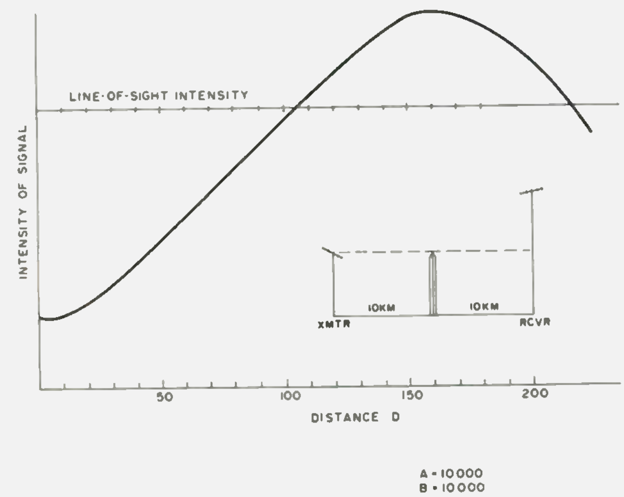


Fig. 4.

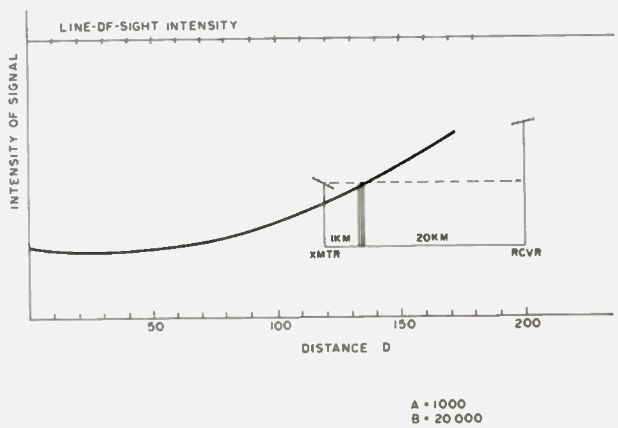


Fig. 5.

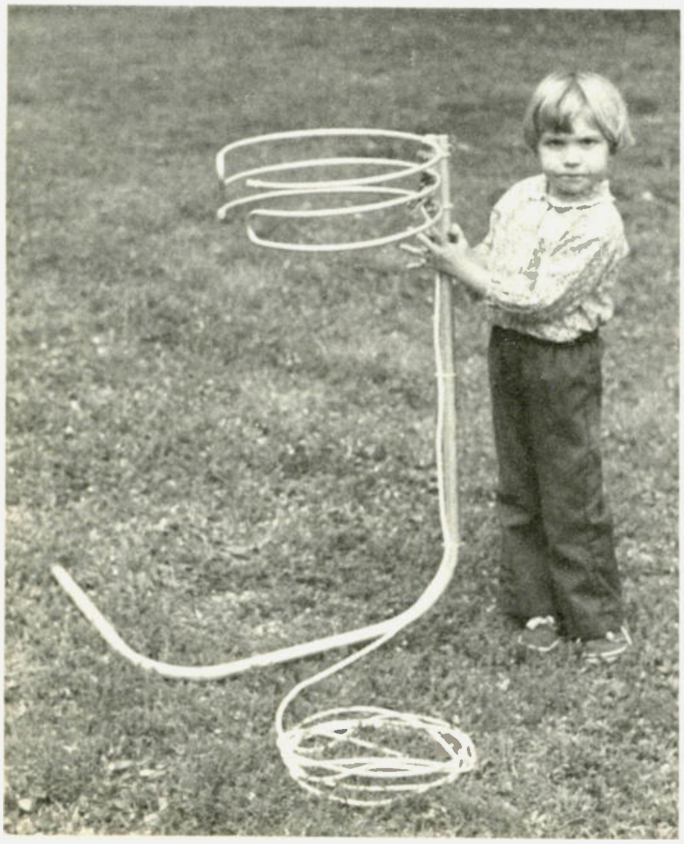
David R. DeSpain W9NMX
716 Union
Alton IL 62002

Wear Your Halo with Style

—Mork would love it

If you haven't tried 2-meter SSB from a mobile, you haven't experienced the latest in mobiling. The new multi-mode rigs allow you to operate through the repeaters and simplex on FM, then switch over to SSB for distances impossible to communicate over on FM. Forty miles mobile-to-mobile and eighty to one hundred twenty from mobile to base are common. Two-meter SSB is on the increase due to the availability of the multi-mode rigs and the efforts of SWOT (Side-Winders On Two). Listen on 144.200 for calling and local QSOs and on 144.250 for the SWOT nets. Remember: If the band is in good shape, move off the calling frequency for rag chewing.

On a recent vacation, I wanted to take my KLM Echo II along. I had a Hi-Par halo antenna, but no means of mounting it on the XYL's car. The luggage rack seemed like a likely place to start, perhaps by clamping a piece of plywood to the luggage rack and mounting a floor flange on it, but there should have been an easier way.



The final realization was much simpler than I could have hoped for. A piece of electrical conduit with two bends and four worm-gear hose clamps were all of the materials required (except for the coax, halo, and connectors, of course). An electrician's tubing-bender was used to put two bends in the conduit at approximately two-foot intervals. Note that the bends are not exactly 90 degrees, but are such that the mast is vertical. Minor adjustments are possible if you don't bend the tubing too far. The hose clamps were used to clamp the mast to the luggage rack, the antenna was mounted on the mast, and the coax was attached. When you try it yourself, mount the antenna on the mast, attach the coax, *then* clamp the mast to the luggage rack, and save yourself a lot of stretching and straining. Do as I say, not as I do.

The station wagon with the 5/8-wavelength antenna and halo, plus the broadcast antenna, was dubbed the "Mork-to-Ork Radio Link" by my sister-in-law, Sarah, upon seeing it for the first time. I will admit that it probably looks better to me than to a non-ham, but it is solid, rattle-free, and clear of the rear door, which a bumper mount would not be. ■

Call 1-203-667-0811

ORDER YOURS TODAY!

USED EQUIPMENT

ALLIED
A-2517 Xcvr. w/PS/Spkr $399

COLLINS
75S-3B Rcvr. 649
75S-3 Rcvr. 449
KWM-2 (Round) Xcvr. w/516F2 PS 1199
516E-1 DC Supply 69

CLEGG
FM-27B 2 Meter Xcvr. 169

CTG
Magnum Six Processor (Kenwood) 59

DRAKE
R-4B Rcvr. 349
2C Rcvr. 189
T-4X Xmtr. 329
T-4XB Xmtr. 369
AC-4 Power Supply 89

DENTRON
HF-200A Xcvr. w/HF-ACS P/S & Spkr., Mike 499
GLA-1000 Amp. 199
Clipperton "L" Amp. 450

ELECTRONIC RESEARCH CORP.
SL-55 Audio Filter 49

HALLICRAFTERS
SX-101A Rcvr. w/Spkr. 179
SX-111 Rcvr. 129
FPM-300 Xcvr. 349

HEATHKIT
SB-303 Rcvr. 259
HW-104 Xcvr. w/PS, Spkr. CW Filter, N.B., Mike 549
SB-634 Console 159
SB-614 Scope 159
HW-8 Xcvr. 99
SB-110 6 Meter Xcvr. w/HP-23B 329

ICOM
IC-245 2 Meter Xcvr. $249
IC-3PA D.C. Supply 49

KENWOOD
TS-600 6 Meter Xcvr. 499
TS-820S Xcvr. 799
TS-520S Xcvr. w/CW Filter 549
DG-5 Display 129
TR-7625 2 Meter Xcvr. 299

NATIONAL
NCX-5 Xcvr. w/P.S./Spkr. 359
NC-200 Xcvr. w/P.S. 249

SWAN
NCX-5 Xcvr. w/P.S./Spkr. 359
NC-200 Xcvr. w/P.S. 249

SWAN
600 R Rcvr. 350
250 6 Meter Xcvr. w/117XC P.S./Spkr. 289

TEN-TEC
Triton II Xcvr. w/CW Filter 399
Triton IV Xcvr. w/CW Filter 499
540 Xcvr. 499
544 Xcvr. (Digital) w/CW Filter 599
Omni D (B-Series) w/NB, 217, 218 Filters 899
252M Power Supply 99
252 Power Supply 69
252G Power Supply 69

TEMPO
Tempo One w/AC One P.S./Spkr. 399

WILSON
WE-800 2 Meter Port. w/TTP 339

YAESU
FT-301SD Xcvr. w/CW Filter, Processor 499
FT-101EE Xcvr. 499
FT-901DE Xcvr. w/FM Option "Demo" w/warranty 999
FTdx-560 Xcvr. 449
FV-400S VFO 69
SP-401 Spkr. 19

NEW EQUIPMENT SPECIALS

AZDEN
PCS-2000 2 Meter Xcvr. $299

ATLAS
RX-110 Rcvr. 169
MM-110 Mobile Mnt. 27
215X W/N.B. 499

ALLIANCE
HD-73 99

CUSHCRAFT
ATB-34 249
A-3 169
ATV-5 89
ATV-4 69
ATV-3 39
32-19 77
214B 59
214FB 59
617-6B 169
A50-5 59
A147-4 23
A147-11 34
A147-20T 58
ARX-2 34

ETO ALPHA
76A and 374A 1979 Prices!

HYGAIN
TH3Jr 139
TH3MK3 189
TH5DX 219
TH6DXX 269
12AVQ 35
14AVQ/WB 58
18AVT/WB 87

ICOM
IC2A List: $229.50 Call for Price
IC2AT List: $249.50 Call for Price

KENWOOD
120S, 180S, 520SE, TR7625, TR2400 Call for Price

ROHN
25G Towers & Accessories 20% - 25% Off

ROBOT
Model 400 $649

SWAN
TB-3HA Tribander 159
10-40V Vertical 89

YAESU
FT-7B Xcvr. 569
CPU-2500R/K 399
YO-901 w/Bandscope 449

ANTENNA PACKAGES
Cushcraft ATB-34 Tribander w/ Alliance HD73 Rotor 339
Cushcraft A-3 Tribander w/ HD-73 Rotor (Alliance) 259
Hygain TH3Jr Tribander w/ Alliance HD-73 Rotor 229
Hygain TH3MK3 Tribander w/ Alliance HD-73 Rotor 279
Hygain TH5DX Tribander w/ Alliance HD-73 Rotor 309

BIRD
Model 43 "On Sale" Call for Price

DENTRON
DTR-2000L 1199
ClippertonL 639
DTR-1200L 609
GLA-1000B 359
DTR-3KA Call for Quote
MT-3000A 359
AT-3K 239
AT-1K 139

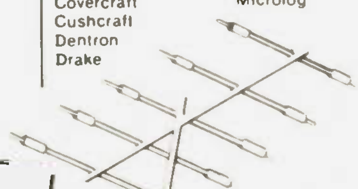
DRAKE
TR7/DR7 Xcvr. List: $1495 Call for Quote

ICOM
255A $389 List Call for Quote
260A $489 List Call for Quote
551 $449 List Call for Quote
551D w/PS20 $849 List Call for Quote
251A $699 List Call for Quote

YAESU
FT-207R $399 List Call for Quote
FT101ZD $895 List Call for Quote
FT-901DM $1459 List Call for Quote
FT-107 $1045 List Call for Quote
FT-707 "In Stock" Call for Quote

We Sell and Service the Following New and Used Equipment:

Alda, Alliance, Ameco, ARRL, Atlas, Bencher, Bird, B & W, Callbook, CDE, CES, Covercraft, Cushcraft, Dentron, Drake, DSI, ETO Alpha, Ham Key, Hustler, Hy-Gain, ICOM, JW Miller, KDK, KLM, Larsen, MFJ, Microlog, Mirage, Mosley, Murch, PIPO, Robot, Rohn, Saxton Wire, Shure, SST Electronics, Swan, Telex, Ten Tec, TET Antennas, Trac, Unadilla, VHF Engineering, Vibroplex, Wilson, Wilson Commercial, Yaesu



KENWOOD

WE TAKE PHONE ORDERS OR SHIP C.O.D.

Call or Write for your super quote today!

✓75

master charge THE INTERBANK CARD

VISA

WE EXPORT (Sub-Dealers wanted in foreign countries)

THOMAS COMMUNICATIONS

95 Kitts Lane, Newington, Conn. 06111
"Near ARRL Headquarters"

Connecticut Residents Call: 203-667-0811
OPEN MON-FRI 10-6 • THURS 10-8 P.M. • SAT 10-4
EASY DIRECTIONS: Rt. 15 South — 2 blocks past McDonald's (Berlin Turnpike)

SUB-DEALER INQUIRIES INVITED! (Send letterhead for complete package)

✓Reader Service—see page 226

Byron H. Kretzman W2JTP
431 Woodbury Road
Huntington NY 11743

Curtain Raiser

—simple Sterba curtain antennas

The mere mention of the Sterba curtain antenna evokes visions, or memories, of huge multi-element, broadside antenna arrays once used by the Voice of America, Radio Free Europe, RCA, Mackay Radio, and Press Wireless too many years ago. The objective of these antennas was to concentrate the radiated power in a specific, desired direction. In other words, to get "gain."

For amateur radio use, the directivity and gain objectives need some definition, which, naturally, will be different for different amateurs. For amateur radio use on 20 meters, the bi-directional Sterba curtain does not need to be huge and complicated, nor does it need to be erected at unreasonable heights. W2EEY made the point that because the curtain's vertical radiation pattern is low and the horizontal pattern is broad, the result is a more effective antenna, with gain, that can be erected in a limited space using simple supports, like trees.[1]

For both 20 and 10 meters, the objective at W2JTP was primarily broad directivity to the west coast (not DX), reduced pickup for receiving from W4-land, and reasonable gain. (Another existing antenna, a fixed wire triangle beam, is used to work Florida.) Simplicity and low cost also were important considerations.

The first Sterba curtain at W2JTP was put up for 20 meters, 12 years ago, and is still in operation. As shown in Fig. 1, it is only one wavelength long (about 68 feet) and is one-half wavelength high (about 34 feet). The bottom wires are only 10 to 12 feet above the ground although W2EEY recommends a 1/4- to 5/8-wavelength height. The height at W2JTP was governed by two trees available more or less in the right places for both directivity and height.

Construction

A Sterba curtain is easily constructed using #18 or #17 electric fence wire. This is a copper-clad steel wire, unbelievably strong for its size. It is readily available from Montgomery Ward or Sears Roebuck. A 5,000-foot reel is quite small and not too expensive. Don't try to build the transposed phasing sections with this wire, however, unless you want an experience in frustration. (It is impossible to make them hang straight.) Prefabricated open wire, 450-Ohm transmission line was used instead. This is made of #18 solid copper wire spaced 1-1/8", with the plastic spreaders about 10 inches apart. It is made by Saxton Products of Congers, New York (catalog #C4-100-12), and was purchased from Lafayette Radio in a 100-foot roll. The eight insulators were made from pieces of oak, each 4 inches long and about ¾" square, boiled in paraffin. The feedpoint insulator was made from a scrap piece of printed circuit board, without foil. All connections are soldered, by the way.

A plastic clothesline pulley was installed on each tree about 45 feet above the ground. Halyards were made from ¼" nylon rope. The halyards are continuous loops, handy should a wire break. (It isn't necessary to re-thread the pulley then.) The main reason behind the use of nylon rope is that it stretches. This effectively puts a very necessary "spring" on the antenna to keep it taut and to keep it from breaking when those trees sway

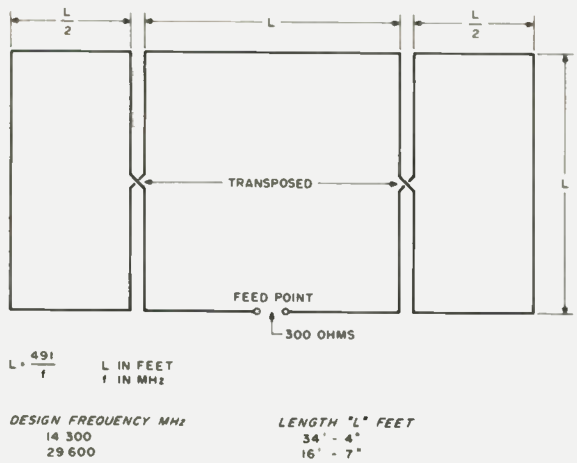


Fig. 1. Sterba curtain schematic diagram.

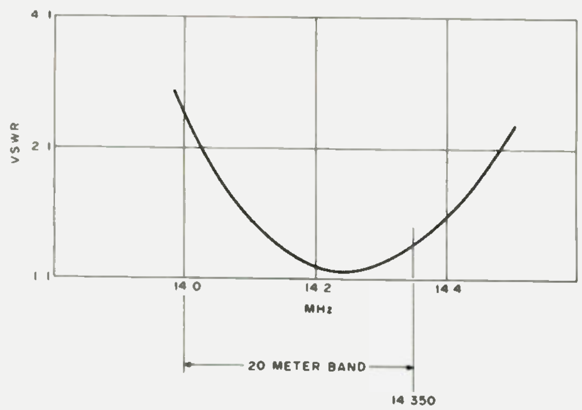


Fig. 2. Measured vswr of 20-meter Sterba curtain.

in the wind.

The antenna is fed with 300-Ohm TV twin-lead, a short length, because it is very light—it won't weigh down the antenna at the feedpoint. About 25 feet from the antenna, a coaxial balun, ½-wavelength long, made from RG-59/U, transforms the 300 Ohms to the desired 75-Ohm coax connection to the rig.

Performance

The antenna element lengths were adjusted until the array resonated at 14,300 kHz. From this the formula was derived. The vswr curve of Fig. 2 was measured with the usual standing wave ratio bridge. The input impedance, at the feedpoint, was measured with an rf impedance bridge, the Antennascope of W2AEF,[2] a grid-dip oscillator, and a digital frequency counter to read the gdo frequency.

The horizontal pattern is quite broad, as predicted by W2EEY, and the pickup off the ends is not significant. Coax relays are used to switch the rig between the Sterba curtain, the Florida triangle beam, and a reference dipole. The gain is apparently about 6 dB, also as predicted by W2EEY.

Now that 10 meters has come alive again, the national FM simplex frequency of 29.60 MHz[3] also has come alive, with cross-country contacts commonplace. Using the formula and the configuration of Fig. 1, a Sterba curtain for 29.60 MHz was put together in one evening. Stretched (again with nylon rope) between a convenient tree and the house, the 10-meter Sterba curtain was erected. The bottom wires vary from about 7 to 12 feet above the ground. A short length of TV 300-Ohm twin-lead runs from the antenna feedpoint to a 4-foot stake where a ½-wavelength coax balun transforms the 300 Ohms to 75 Ohms. RG-59/U is then run underground to the house and rig. Performance? Great! The gain makes my 150-Watts output look like 600. Stations called now come back.

Modifications

How can we improve our 2-section Sterba curtain? Again, "improve" must be defined. If we want more gain, more sections can be added, making a longer array.[4] This will increase the gain at the expense of beamwidth—the beam gets sharper[5] with more sections, which is fine if we are building it for a point-to-point operation. The feed impedance goes down, too, with added sections. (That 300-Ohm feedpoint is darn convenient!)

One possibility yet to be investigated, on 10 meters, is the addition of a reflector array, about 0.2 to 0.25 wavelength behind. (The bidirectional feature of the array described is not important at this station.) Of course, this complicates construction, as 0.2 wavelength at 10 meters is about 6 feet. Gone would be the simplicity and ease of erection of the antenna described. Would it be worth the additional effort to get a few more dB forward? This must be decided, first. ■

References

1. Schultz, J., "A Curtain Going Up," *73 Magazine*, August, 1966, p. 66.
2. Scherer, W. M., "Antennascope-54," *CQ Magazine*, June, 1954, p. 23, July, 1954, p. 17.
3. Herman, S., "Try FM on 29.6 MHz," *73 Magazine*, November, 1978, p. 184.
4. Cousins, G., "A Sterba Curtain for the Low Bands," *CQ Magazine*, November, 1962, p. 47.
5. Staff, "A 'Super DX Antenna' for FM Reception," *Radio Magazine*, February, 1942, p. 11.

Who Needs a Rotator?

—how to do without

Jerrold A. Swank W8HXR
657 Willabar Drive
Washington Courthouse OH 43160

A quad makes a fine DX antenna and, like most beams, it requires a rotator if you want to find DX. But there is a good way to eliminate the rotator and still get many of the DX stations. This is especially good for a 40 meter or 20 meter monoband quad.

Cut one element for a driven element and the second element as a director. Run a length of coax to the driven element, either RG-8/U or RG-58/U as you prefer.

Then run another length of coax to the director; RG-58/U will do, but make it a multiple of a half wave at the design frequency. Bring it into the shack and connect a coil across it to tune it as a reflector. Across the coil connect an SPDT toggle switch, so the coil can be shorted out.

A half wavelength of transmission line will repeat the impedance at the end in the shack to the end in the quad. In fact, you can use 300-Ohm twin-lead for the switching line, as long as you remember to correct for the velocity factor.

When you throw the switch, it will short the coil and, at the same time, close the director loop and make it a director, thus instantly reversing the directivity of the quad.

Face it southwest and it will reverse to northeast, covering most of the DX world. ■

Robert M. Richardson W4UCH
Drawer 1065
Chautauqua Lake NY 14722

A Tribander for the Attic

—work 10, 20, and 40 with this compact antenna

This three-band, small-attic antenna is put together much like Gypsy chicken pot pie. Instead of first stealing a chicken, you first steal the XYL's broom handle which will be used for the trap coil forms. The rest of the materials are equally exotic: a few feet of no. 18 zip cord for the trap capacitors, some scrap plastic for insulators, and about 100 feet of no. 16 copper wire. For purists, a 1:1 balun such as the Van Gorden Engineering unit,[1] at $9.95 ppd., reduces possible TVI by providing a good balanced match from 50- or 75-Ohm coax. Including balun, this multi-band antenna may be built for less than $13.00. Typical maximum swr on all three bands (28.5-29.0 MHz on 10 meters) is less than 1.5:1, except with snow on the roof, and then does not exceed 3:1 even after a heavy snowfall.

Fig. 1 illustrates the layout for a small 21'-long attic. If you are fortunate enough to have a longer attic, by all means install segments C, D, and E horizontally in the same plane as A and B for a slight, but measurable, gain of approximately 1 dB on 40 meters. Test equipment required to optimize this antenna on your favorite frequencies on each band consists of a grid-dip oscillator and swr bridge. If you do not have a GDO, just follow directions, as both the first and second traps are high inductance/low capacitance units with resultant wide bandwidths.

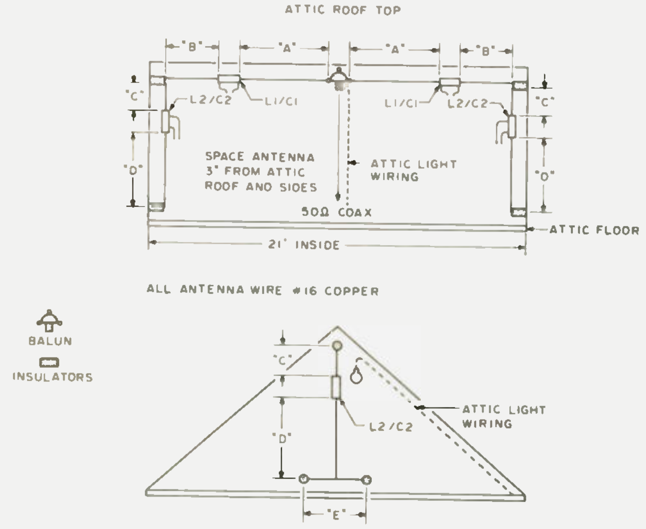


Fig. 1.

The antenna segments with traps are resonant as follows: Segment A is resonant on 10 meters, segment A+B+C on 20 meters, and segment A+B+C+D+E on 40 meters.

Trap L1/C1 is parallel resonant at 28.7 MHz, offering a high impedance and thus isolating the rest of the antenna at 10 meters and providing a loading inductance for shortening the 20-and 40-meter segments. Trap L2/C2 is parallel resonant at 14.2 MHz and presents a high impedance, thus isolating the rest of the antenna at 20 meters and providing a loading inductance for shortening the 40-meter segments, D and E.

Construction Detail

L1 is a 3-inch length of 7/8" diameter broomstick using 5 feet of no. 16 double cotton-covered (DCC) copper wire space-wound with 19½ turns as shown in Fig. 2. No. 16 DCC copper wire should be used if available, but ordinary bare bus bar wire may be used if you carefully wind and space the turns on L1 and L2 to ensure that there are no shorts. C1 is a 10½-inch length of no. 18 zip cord. Grid-dip L1/C1 and adjust to 28.7 MHz. L2 is a 6-inch length of 7/8" diameter broomstick using 12 feet of no. 16 DCC copper wire, slightly closer than space-wound with 46 turns, as shown in Fig. 3. C2 is a 17¾-inch length of no. 18 zip cord with one end trimmed 6½" short and attached to L2 as shown in Fig. 3. Lengths of each antenna segment illustrated in Fig. 1 are:

Segment	Length
A	96″
B	24″
C	22″
D	46″
E	20″

Tuning

As the lengths of all loaded segments interact with each other, this multi-band antenna should be tuned exactly as follows or you will surely come to grief! Using your GDO, tune traps L1/C1 and L2/C2 individually, unconnected to anything, while they are balanced on a glass mayonnaise jar (empty) at least 8″ above your wood workbench or desk. This is to avoid obtaining misleading GDO readings due to stray capacitance. Start with both C1 and C2 an inch longer than specified and trim off ¼″ between GDO readings until the GDO null (max dip) is exactly at the desired frequency. Also, use your station receiver to check your GDO frequency reading, as all GDO readouts are only approximate and may be as much as 1 or 2 MHz off actual frequency when coupled to the trap under test.

After the traps are tuned with the GDO, leave them alone. Install the entire antenna system as illustrated in Fig. 1. Using *very low power* from the station transmitter, with the swr bridge in the coax line, check swr at 28.5 MHz, 28.7 MHz, and 29.0 MHz. Swr should be less than 2:1 if the antenna is installed correctly. There must be *no* electrical power/lighting wiring parallel to or close to any of the antenna segments if you wish top performance. An overhead attic light is OK if installed close to the balun at the center of the antenna and the light's wiring is run down the inside of the roof, 90 degrees to the plane of the antenna, as shown in Fig. 1.

If you wish to change the center frequency on 10 meters, add or subtract approximately 3/8″ per 100 kHz. After 10 meters is satisfactory, check the 20-meter swr at 14.0 and 14.3 MHz, and, if necessary, shorten or lengthen segment C for minimum swr at the desired frequency. After 20 meters, adjust the width of segment E for minimum swr on your favorite 40-meter frequency. A few inches either way will make a considerable difference as segment E is, in effect, a capacity hat for the 40-meter dipole.

Harmonics

Being a multi-band antenna, this system is an extremely efficient harmonic radiator. If there is any question in your mind about your transmitter's harmonic output, you would do well to include a coax antenna tuner between the transmitter and coax for your own sake, your fellow amateurs, your neighbors, and the FCC. The MFJ Enterprises model 900 coax antenna tuner, at $49.95, will resolve any problem in this line you might otherwise have.

15-Meter Option

Although I do not operate 15 meters, the second method described here was satisfactorily developed for a young friend who does operate on that band. There are two obvious ways to include 15-meter coverage in this antenna system, if desired. The first method uses a separate 10-meter trap with ½ the turns of L1 and double the length of zip cord C1. The 15-meter trap, placed about 14″ out from the new L1, is tuned by additional capacity across the old L1 (now the 15-meter trap). Both segments B and C are shortened accordingly. The second method, and surely the simplest, is another dipole from the balun in parallel with the original antenna system. It should be slanted so that the outside ends are drooped 2′ below segment B, and, most importantly, not less than 12″ away from segments C and D to avoid disastrous interaction/detuning of the original system. Ordinary plastic clothesline can be used to support the drooped 15-meter dipole at point X. See Fig. 4 for details.

Conclusion

Squeezing a normally 66′-long 40-meter dipole/three-band antenna into your 21′-long attic is not really difficult, expensive, or very time-consuming if logically pursued. It can be built and tuned in a short

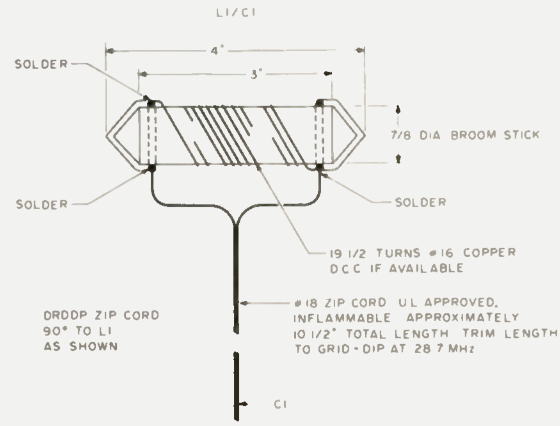


Fig. 2.

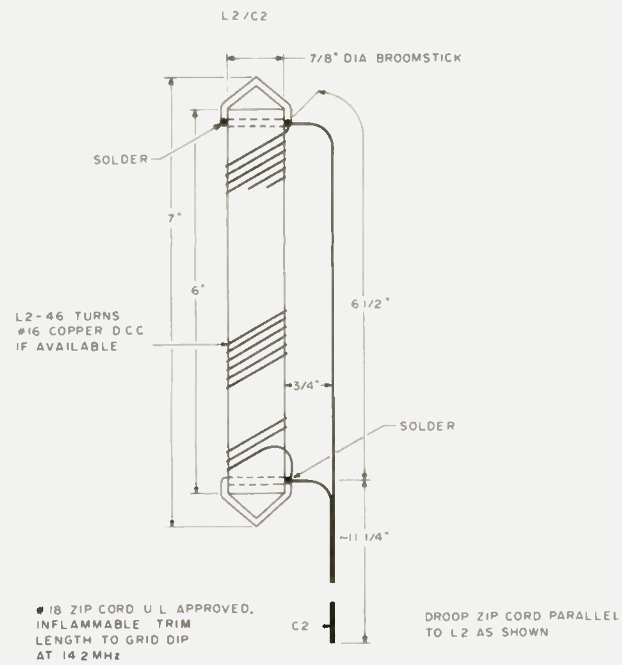


Fig. 3.

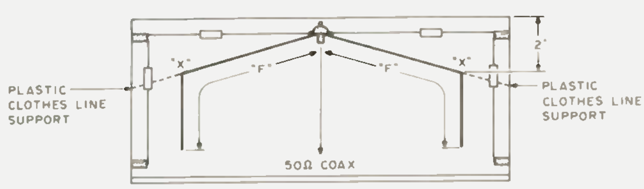


Fig. 4. 15-meter dipole option. Start with each segment "F" at 11′6″. Trim one inch at a time for minimum swr at your favorite 15m operating frequency. Do not allow drooped ends of "F" closer than 12″ to either L2/C2 or segment D, to avoid detuning other bands.

weekend. When a given band is open for F2 propagation, it will serve you nearly as well as any triband beam, being only about 6 dB down. The difficult part is when you wish to turn the antenna 90 degrees from the direction your attic is pointing. Let's save that solution for a future article!

One point of caution. The no. 18 zip cord capacitors are safe up to about 100 Watts PEP output. Also, use only Underwriters Laboratories (UL) approved inflammable zip cord. Be sure to test a short piece with a match. If it burns, get a refund and try again. Beyond the 100-Watt PEP output level, you would do well to substitute pieces of RG-8/U coax as the C1 and C2 tuning capacitors. Surely you do not wish to mimic the Chinese roast pork recipe: "First put a porker in the house; then burn the house down."

Most every antenna article usually ends with a typical cliche: "How I worked the High Lama of Tibet with one Watt to my gamma-matched W4UCH coat hanger." I will not disappoint you. While tuning up this little 21-foot multiband miracle, using a nearly 20-year-old 100-Watt Hallicrafters HT-37 at reduced power, my first two contacts were: Tony CT2CP in the Azores on SSB and Mario I5CZP in Siena, Italy, on CW.[2] This is not remarkable unless one knows that we had over a foot of snow on the roof and Mario was running only 5 Watts.■

References

1. Van Gorden Engineering, P.O. Box 21305, South Euclid OH 44121—"Hi-Q Balun," 1:1 ratio, $9.95 postpaid.
2. Richcraft Engineering, Box 1065, Chautauqua NY 14722. TRS-80 Morse Transmit/Receive Program, $15 ppd.

The **SCR4000 UHF FM Repeater** incorporates all of the many desirable repeater control, test and operating features which have been requested by our customers over the past several years. It includes the latest 'State of the Art' transmitter and receiver boards which were specifically designed for UHF Repeater application. The rest of the unit is basically the same as our tried and proven SCR1000 VHF Repeater, *which has an excellent reputation for performance and reliability throughout the world!* **Only the very finest quality 100% 'Commercial Grade' designs & components are used throughout.**

Of course, all of our Repeaters are available with a complete line of options and accessories . . . such as: Full Autopatch/Reverse Patch/Land-Line Control; Touch-Tone Control of various repeater functions; "PL" - CTCSS; "Emergancy Pwr. I.D."; various Courtesy Tone and Timer units, etc. **PLUS**—the finest Duplexers, Cabinets, Antennas, Cables, etc.

The SCR4000 and SCR1000 are sold factory direct only or through Foreign Sales Reps—at prices which are only about ½ that of the "big two" names in 2-way radio! ***Get your order in A.S.A.P.!***

COMMERCIAL MOBILE & BASE TRANSCEIVERS

"Professional Communications Line"

new

PCL250 25 W. Mobile Unit

- *"Super Rugged" Housing Solid ⅛" Thk. Aircraft Aluminum!*

- 136-174 MHz & 220-240 MHz (450 soon).
- 6 channels.
- 0.35 uV Rcvr.
- 6 or 8 Pole Crystal Fltr.
- Beautiful Audio—RX & TX.
- Very Reasonable Price!

PCL300 30 W. Base Station

- Built-in AC Power Supply.
- Front Panel Status Indicator Lights.
- Optional Rcvr. Scanning Function Available.

- Very attractive woodgrain housing.

SPECTRUM COMMUNICATIONS ✓68

Write or call for Data Sheets, prices, etc. • Export orders—Contact our International Dept.

1055 W. Germantown Pk., Dept. S5 • Norristown PA 19401 • (215) 631-1710

Toroid Cores

- All the popular sizes and mixes.
- Fast Service. Same day shipment via first class mail or air.
- No minimum order.

IRON POWDER TOROIDS:

CORE SIZE	MIX 2 .5-30 MHz u = 10	MIX 6 10-90 MHz u = 8.5	MIX 12 60-200 MHz u = 4	SIZE OD (in.)	PRICE USA $
T-200	120			2.00	3.25
T-106	135			1.06	1.50
T-80	55	45		.80	.80
T-68	57	47	21	.68	.65
T-50	51	40	18	.50	.55
T-37	42	30	15	.25	.45
T-25	34	27	12	.37	.40

RF FERRITE TOROIDS:

CORE SIZE	MIX Q1 u = 125 .1-70 MHz	MIX Q2 u = 40 10-150 MHz	SIZE OD (in.)	PRICE USA $
F-240	1300	400	2.40	6.00
F-125	900	300	1.25	3.00
F-87	600	190	.87	2.05
F-50	500	190	.50	1.25
F-37	400	140	.37	1.25
F-23	190	60	.23	1.10

Chart shows uH per 100 turns.

Ferrite Beads slip over 18 ga. wire **$2.00 per doz.**

Wide Band Chokes, Ferrite ¼" dia. **95c ea.**

EXPERIMENTERS KITS

Iron Powder Toroids

Includes:
1 ea. T25-12, T80-2, T106-2.
2 ea. T25-6, T37-6, T50-2, T50-6.
3 ea. T68-2

Price $7.50

RF Ferrite Toroids

Includes:
1 ea. F23-Q1, F23-Q2, F87-Q1.
2 ea. F37-Q1, F37-Q2, F50-Q1.

Price $10.00

TO ORDER: Specify both core size and mix for toroids. Packing and shipping 50 cents per order USA and Canada. Californians add 6% sales tax.

Fast service: Free brochure and winding chart on request.

Palomar Engineers

Box 455, Escondido, CA. 92025
Phone: (714) 747-3343

DELUXE MESSAGE MEMORY KEYER

"BRAND NEW"
$89.95

Features: **Model TE-284**

- State-of-the-Art CMOS Circuitry
- Three choices of Message Storage
  - A. Two (50 character each) message storage
  - B. Four (25 character each) message storage
  - C. One 50 character and two 25 character message storage
- Records at any speed-plays at any speed
- Memory operating LED
- Use for daily QSO or contests

PLUS:
- Self-completing dots and dashes
- Both dot and dash memory
- Iambic Keying with any squeeze paddle
- 5-50 w.p.m.
- Speed, volume, tone, tune and weight controls
- Sidetone and speaker
- Low current drain CMOS battery operation-portable
- Deluxe quarter-inch jacks for keying and output
- Keys grid block and solid state rigs
- WIRED AND TESTED FULLY GUARANTEED—LESS BATTERY

MESSAGE MEMORY KEYER

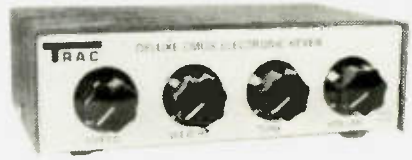
Features:
- Advanced CMOS message memory
- Two (50 char each) message storage
- Repeat function
- Records at any speed—plays back at any speed
- Longer message capacity Example send CQ CQ CQ DX de WB2YJM WB2YJM K—then play second message on contact—de WB2YJM QSL NY NY 579 579 Paul Paul K
- Use for daily QSOs or contests

Model # TE201

$69.95

PLUS:
- State-of-the-art CMOS keyer
- Self completing dots and dashes
- Both dot and dash memory
- Iambic keying with any squeeze paddle
- 5-50 wpm
- Speed, volume, tone, tune and weight controls
- Sidetone and speaker
- Low current drain CMOS battery operation—portable
- Deluxe quarter-inch jacks for keying and output
- Keys grid block and solid state rigs
- WIRED AND TESTED FULLY GUARANTEED—LESS BATTERY

"BRAND NEW"



Model # TE144
59.95

Features: Deluxe CMOS Electronic Keyer
- State-of-the-art CMOS circuitry
- Self completing dots and dashes
- Both dot and dash memory
- IAMBIC keying with any squeeze paddle 5-50 wpm
- Speed, weight, tone, volume tune controls & sidetone and speaker
- Semi-automatic "bug" operation & straight keying—rear panel switch
- Low current drain CMOS battery operation—portable
- Deluxe quarter inch jacks for keying and output
- Keys grid block and solid state rigs
- Wired and tested—fully guaranteed—less battery

Model # TE133

$49.95

Features CMOS ELECTRONIC KEYER
- State-of-the-art-CMOS circuitry
- Self completing dots and dashes
- Dot and dash memory
- Iambic keying with any squeeze paddle
- 5-50 WPM
- Speed, volume, tone, weight & tune controls, sidetone and speaker
- Low current drain CMOS battery operation
- Deluxe quarter inch jacks for keying and output
- Handsome eggshell white base—woodgrain top
- Compact and portable 1-7/8 x 4-1/4 x 6-1/4
- Grid block & solid state keying
- Wired and rested—fully guaranteed—less battery

MODEL TE122—same as TE133 less wgt, tune, solid state keying $36.50

AT YOUR DEALER OR SEND CHECK OR MONEY ORDER. (plus $2.00 s/h NY res add tax)

TRAC ELECTRONICS, INC
1106 RAND BLDG.
BUFFALO NY 14203 76

John L. Webster 8P6KX/9Y4JW
Maxwell Coast Road
Christ Church
Barbados, West Indies

Hurricane!

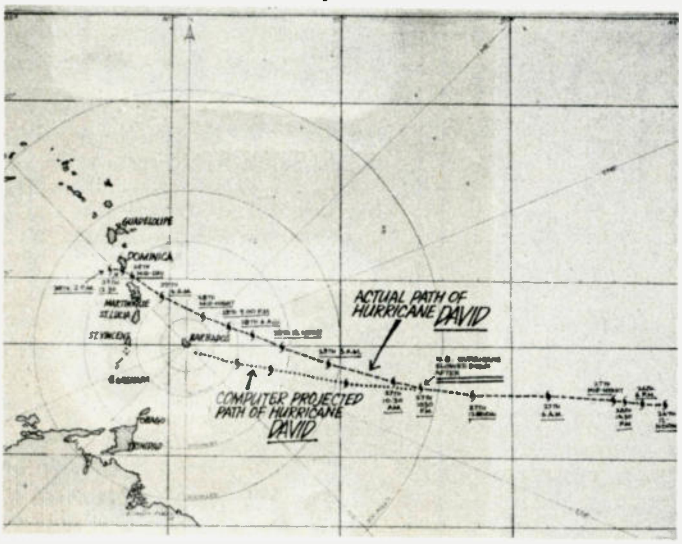
—when David ravaged Dominica, hams were at their best

Every year at the onset of the hurricane season, the Barbados Central Relief Organisation (CERO) has an emergency practice session. The Amateur Radio Society of Barbados (ARSB) is one of the groups which has been requested by CERO to participate in these emergency exercises. The ARSB has been given the responsibility of providing and maintaining communications links between CERO HQ at Central Police Headquarters and various strategic government locations, and external communications, if necessary.

One Sunday morning early in June, 1979, the annual practice was held with the hams taking up their positions as requested. Few people thought that in two and a half months they would be repeating the exercise not as a practice, but this time for real!

On Sunday, August 26, 1979, the Barbados hams on their net frequency of 7.185 MHz were advised by John Schilsky 8P6JH of the existence of a tropical depression located at 12° N, 44° W, moving west at 20 knots. At that speed and direction it was predicted that it would reach Barbados by the morning of Tuesday, August 28th. This information had been received

Photos by the author.



from WSL, which broadcasts weather information to maritime stations on CW on 8.514 and 13.025 MHz.

Continued monitoring of WSL by Chris Law 8P6LI revealed that the tropical depression had reached hurricane intensity and had been named David. At 6:00 am on Monday, August 27th, it was located at 11.8° N, 49.0° W and was moving west at 14 knots.

As Monday wore on and further reports became available, it was apparent that David would not reach Barbados before sometime on Tuesday night, as it continued to reduce its forward speed.

Shortly after 7:00 am on Tuesday, August 28th, the Barbados net frequency of 7.185 MHz became essentially an emergency frequency, as Barbados was then in the direct path of the hurricane according to strong indications from the computer analysis of the storm's movements so far. Photo A shows both the actual path and the computer-predicted path of David.

Stations from across the Caribbean area checked into 7.185 MHz to advise that they were standing by to offer any assistance they could. The net continued throughout the day until propagation made it imperative to switch to the 80-meter band—3.805 MHz. Internal communications in Barbados were maintained on 2 meters—146.94 MHz simplex.

Needless to say, everyone was rushing around securing property and household effects and making last-minute purchases in anticipation of what appeared to be a very grueling time ahead—David had been described as the worst hurricane of the century to come in this direction.

Shortly after 12:00 noon, Charlie Briggs 8P6GB advised the net that David had been centered at 13.1° N, 56.7° W, or 200 miles east of Barbados. This report indicated that at last David had started the slight northward drift in its forward movement for which the people of Barbados had been praying.

By 7:00 pm on the night of Tuesday, August 28th, the Barbadian hams had either moved into their locations or were prepared to move to them as soon as possible after the passage of the hurricane. These locations included the Bridgetown Deep Water Harbour, Red Cross Headquarters, Government House, Police Headquarters, Ministry of Agriculture, Ministry of Communications and Works, the hospitals, Grantley

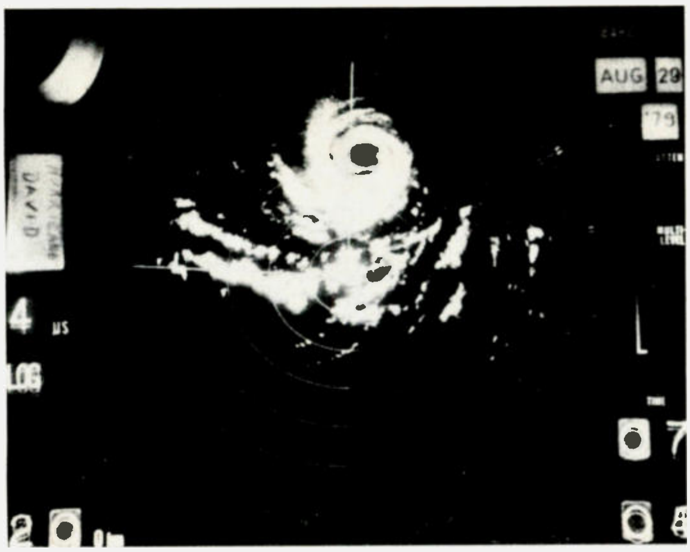


Photo B. Radar photograph of David taken by the Caribbean Meteorological Institute in Barbados at 3:04 am on the morning of August 29, 1979. Each circle on the photograph represents 40 km, and Barbados is at the center. It can be seen that the majority of rainfall associated with David was confined to the southern semicircle in an area extending approximately 80 km. The eye is clearly visible and is about 25-30 km in diameter. The photograph confirms that Barbados was barely missed by David, with the fringes passing only about 20 km to the north.

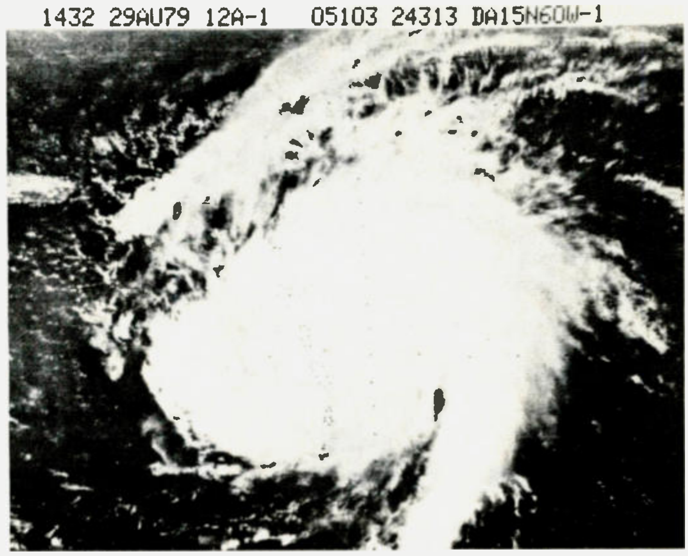


Photo C. Satellite photograph, 1-km resolution, taken at 10:30 am on August 29, 1979, by a US geostationary weather satellite. The photograph has been computer processed so that dotted outlines of the islands are superimposed on hurricane David. David's eye can be seen clearly NE of Martinique and SE of Dominica, both of which were experiencing winds in excess of 150 km/hr at this time.

Adams International Airport, Cable & Wireless, Government Headquarters, and the Caribbean Meteorological Institute (CMI). Hams also were standing by on the nighttime emergency net frequency of 3.805 MHz across the Caribbean area from Venezuela in the south to the Virgin Islands in the north.

Later that night as further meteorological reports and advisories were received, it became apparent that Barbados was going to be spared, and by midnight the "all clear" was given for Barbados.

Radar photographs taken by the CMI in Barbados confirmed that David was due north of Barbados at about 3:00 am, Wednesday, August 29th (see Photo B). These photographs, which are formed by reflections of the radar signal from moisture (rainfall) associated with the hurricane, show the eye to have been approximately 25-30 kilometers in diameter, and verify that the fringe of the main rain band and rough weather missed Barbados by only about 20 kilometers.

Damage to Barbados was negligible, with only the odd tree having been uprooted and one or two electricity supply poles blown over in the north of the island. At my QTH in the south of Barbados, the lowest barometric pressure recorded was 29.65 inches, at approximately 3:00 am. This coincides with the radar photograph showing that David was due north of Barbados and closest to it at that time. There was little rainfall, and this was invariably associated with squalls when the winds gusted to 40-50 km/hr. These squalls continued for several hours after dawn broke in Barbados on Wednesday. Barbados had been very fortunate, but for Dominica trouble was only just beginning.

Amateur radio operators from Martinique reported strong winds and a falling barometer at 6:40 am that morning. Pete Brand J7DP advised at 7:30 am that strong winds already were being experienced in Dominica. Martinique reported at 8:50 am that the center had been located half an hour earlier to be about 75 km northeast of Lementine airport, which itself was experiencing winds of 85 km/hr, but that winds of 170 km/hr had been experienced in northeast Martinique.

This type of information continued to be passed on 7.185 MHz until 9:10 am when the first word of damage was received from Margaret Harris J7DE. She reported from Dominica that winds were very strong, trees were falling, and galvanized sheets from house roofs were flying through the air. This was confirmed shortly afterward by her husband, Austin J7DAJ, who estimated the windspeed at 130 km/hr. (See Photo C.)

Fred White J7DAY also reported very high winds around 10:00 am and kept giving reports to the net about the tremendous destruction being wrought around him as everything worsened. Fred abruptly disappeared from the net about 11:15 am when his antenna was finally blown away.

In an interview with Fred several days later, he was able to give his story. (See Photo D.)

"I did not make much preparation for the hurricane; I had never experienced one before and did not expect it was going to be like it was. We just put some bags on the doors and so on, took down my antenna tower, and put away most things that could fly around, hoping that it would just be some wind that would pass. Electricity was cut off at about 8:00 am [Wednesday, August 29] around the time that the winds started to blow strongly. However, my equipment has a power supply to allow it to operate on battery power, so I removed the battery from my Land Rover and used it to power the equipment.

"I continued to give a step-by-step description of what I saw around me as the winds got higher, until they reached about 100 mph

Photo D. Fred White J7DAY takes a break from the emergency traffic to flash a smile. Fred operated out of Police HQ, Roseau (Dominica), for over two weeks, handling all types of emergency and relief traffic for the Government and people of the island. Standby generators located in the basement of the building supplied power for his equipment.

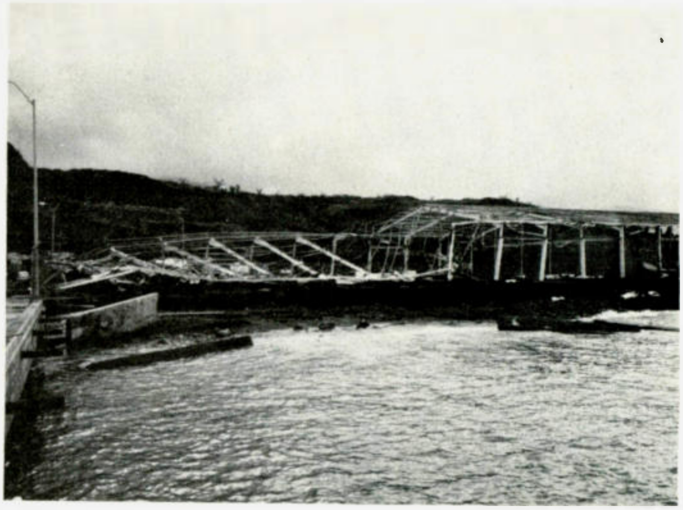


Photo E. A twisted pile of junk is all that remains of one of the main warehouses at the deep-water port.

around 11:15 am and my antenna was blown away. I then put my equipment into cases to try to protect it from the rain. Shortly after, I heard the top of my house breaking away and my cousin—who was on the top floor—was calling for help. He was not hurt but afraid, and I told him to come down below, which he did. Things were flying all about outside by this time, and it was dangerous to be outside. We put some boards and things on a bed so that in case of debris falling from the top of the house we might hopefully survive. After the roof ripped off, some of the floorboards which were covering the downstairs also ripped off, and water flooded inside the house. We then took refuge under the bed, where we remained lying in a pool of water two inches deep for three to four hours.

"As soon as the wind eased up a little later, I thought that the first thing to do was to get into the cellar of a neighboring wall house where we could be safer, and maybe from there I could get my equipment back on the air, as it was still safe in the cases. Carrying my equipment, I jumped through a window, along with my wife and cousin, and ran under that house, where I tried to set up the rig. However, when I looked outside for trees to which to tie the antenna, I could not find any—all around was totally flat.

"I located whatever wire I could find and twisted the bits together to make an antenna 70-80 feet long, using sticks to support it about one foot above the ground. This makeshift antenna allowed me to get on the air at about 5:00 pm Wednesday. I managed to contact Allan 9Y4LG in Trinidad and spoke with him for about three minutes, just long enough to let them know that I still had my equipment but that as far as my eyes could see everything was flattened, and I would be back on later when the winds had fully subsided and I was able to make a better antenna.

"It was around 7:00 pm when I completed a better antenna and got the center about 10 feet high with a piece of stick off one of the broken-down houses. This antenna allowed me to communicate without as much danger to my rig as the first one. A message was relayed to Radio Antilles by one of the hams in Montserrat that contact had been made with me, and my address was given so that I could be contacted. This information was broadcast over Radio Antilles—which is very well received in Dominica and to which most Dominicans were usually tuned, unlike Radio Barbados which can hardly be heard.

"Around 10:30 pm, a reporter from Radio Antilles and some other guys came to me and said that they and the Prime Minister had heard the broadcast and he had sent them to me to broadcast the following message: *The Prime Minister has declared a state of emergency in Dominica. A general state of disaster has been declared for the entire island. The Prime Minister is requesting all islands to supply medical and any type of assistance which they are able to provide to the island. It is feared that there are 60,000 people homeless. Two persons are so far known to have perished. Hospital has been partly demolished.*

"After sending this message, I went off the air to conserve my battery power and spent the night in the same cellar with 30-40 other people, two of whom were hurt, although not seriously.

"Next morning around 6:00 am [Thursday, August 30], some policemen came to move me to Police Headquarters in Roseau, so I sent my equipment with them while I went to try and find some coaxial cable so that I could put up a proper antenna. I arrived at Police Headquarters at 8:00 and managed to get my equipment operating from about 12:00 noon. From this point on, I worked for 24-48 hours continuously passing information relating to requirements for aid, speeches by the Prime Minister and other ministers, and reports by newsmen in the island. The speeches and news reports were relayed to Radio Antilles via other hams, who then broadcast them for reception by Dominicans. Radio DBS, which normally operated out of Roseau, was very severely damaged and was not functional. I had to operate almost continuously until I got some help from outside. I think it was from 8P6GB from Barbados, late on Friday evening."

Hurricane David battered Dominica for about five to six hours, with the eye passing over the southern part of the island during a twenty minute period be-

Photo F. Aerial photograph taken on Friday, August 31st, showing severely damaged warehouses on the outskirts of Roseau.

Photo G. View overlooking the Kingshill area, in the vicinity of J7DAY's QTH. There was nearly complete and total destruction of the houses in this area and to the south of Roseau.

ginning Wednesday at about 12:30 pm. After the passage of the eye, the winds, which have been reliably estimated in excess of 240 km/hr, returned suddenly with renewed vengeance from the opposite direction—from a westerly direction. This whipped up waves 9 to 15 meters high, and these waves pounded the west coast, causing extensive damage both to properties and to the roadway which runs at water's edge in most places.

Around 5:00 pm on Wednesday, most people began to emerge from the wreckage of their homes to be confronted with an utterly depressing scene. In five to six hours, the island had been completely devastated. It was estimated that out of a population of 85,000 souls, 60,000 were made homeless; miraculously, only 40 deaths were recorded.

Damage to property was extremely severe, resembling photographs that I have seen of severely bombed-out areas in Vietnam. Large steel-framed buildings had been reduced to twisted heaps of junk. (See Photos E and F.) The entire power distribution grid was destroyed, with hardly an electricity supply pole still standing, and the water supply had been disrupted. Roadways were impassable almost everywhere, being blocked either by debris, fallen trees and poles, or swept away by the sea. The island, which largely is covered by dense tropical rain forest, appeared as though swept by fire. Almost the entire forest was completely stripped of foliage, leaving just broken and uprooted stumps of the trees (photos G through J).

I have always found it to be a beautiful green island, but on arrival there two days after David, I was overcome by a wave of great sorrow. The forest was quite brown and denuded, and wherever you went the picture was the same—total destruction of everything around—and you kept wondering how this newly-independent nation could ever pick up the pieces and make a new start.

However, that was our reason for being involved—to help them begin to pick up the pieces and make that new start. Over the following days, Barbados, due to its geographical position, good airport and seaport, infrastructure, excellent communications links with the rest of the world, and, most importantly, its well-organized and prepared Central Emergency Relief Organisation, became the center of all relief operations for Dominica.

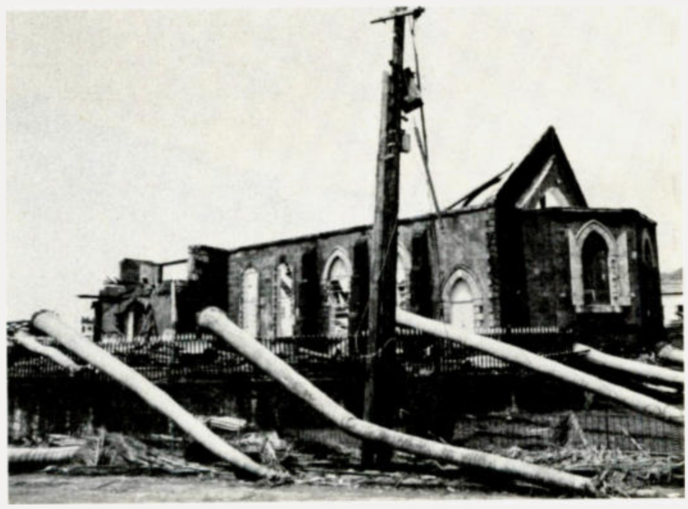


Photo H. Ruins of the Roseau Anglican Church; miraculously, the stained-glass windows survived the wrath of David

The ARSB, because of the emergency situation, obtained permission at 7:45 pm on Wednesday, August 29th, to handle third-party traffic and phone patches relating to Dominica. This set the stage for several weeks of really serious relief work by the hams. That night, acting on the information relayed by J7DAY from the Prime Minister of Dominica, the hams in Barbados contacted the Barbados Government and all embassies stationed in Barbados. These included those for the US, Canada, the UK, and some European countries.

The British High Commission advised later that night that the British Frigate *HMS Fife*, which was in the area and had a helicopter on board, had been instructed to change course for Dominica, where her men would render what assistance they could. The hams were advised that they should make radio contact with the *Fife*; calls were made throughout the night and next morning but she never came up on the ham bands—this remains a mys-

Photo I. Typical post-David view of the now denuded but once lush rain forest that once covered most of Dominica and flanked the roadway between the airport and Roseau, the capital.

Photo K. The Cessna 182 preparing to take off from the Massacre Bypass. The hams from Barbados used this method of transportation to get into Roseau while the road across the island was still blocked. The opening of the canefield airstrip, located in the right background, brought an end to this hazardous exercise. Fortunately, the only damage resulting to aircraft using this roadway was a burst tire on the Cessna at touchdown, which grounded it for two days until spares arrived, and some wing damage to another aircraft on takeoff. The latter was probably caused by a pole like the one seen overhanging the roadway in this photo, but the pilot was able to make a successful landing in nearby Martinique even though the flaps on his right wing were torn away and flapping in the wind.

Photo J. Decapitated coconut trees at a coconut estate on the west coast of Dominica. Official estimates indicate that 4,500 acres of coconuts were left in this condition by David and that it will take six to seven years to bring this crop back into production.

tery to the hams to this day.

The *Fife* arrived in Dominica by noon the following day—Thursday—but was unable to berth due to heavy seas. Men and equipment were ferried ashore by the helicopter, where they immediately assisted Dominicans with cleaning of the main streets in Roseau and in the repair of the hospital buildings and equipment, all of which had been badly damaged. Actually, the *Fife* provided through her distillation plants the only source of potable water available in Dominica for two or three days, until other methods of purification could be established. This was necessary since the normal water supply had been disrupted and the rivers—of which there are 365 in Dominica—had become polluted from the death of many animals. It took about a week before water was again flowing in pipes to the main housing areas, and much longer before it was in those to the rural areas.

Throughout Thursday, all types of emergency and priority traffic flowed on 7.185 MHz into and out of Dominica. Most of this traffic was for Barbados or Montserrat. Montserrat became very important to Dominicans, because on that island is located a commercial broadcasting station—Radio Antilles—which broadcasts on the AM band. Radio Antilles became a vital link in making information available to the Dominican public. This was especially so since damage to Radio DBS kept it off the air. In addition to the emergency traffic, journalists in Dominica were allowed to pass their reports to the news services via ham radio.

However, it was impossible at this stage for health and welfare traffic to be handled, and Fred J7DAY was working continuously, unassisted. There are not many hams in Dominica and, unfortunately, of the few that exist only Fred (apparently) was able to carefully pack away his equipment and make it and himself available to his country in this time of need. Most of the other hams either had their equipment damaged, had no power, or were so shocked at the disaster that they were unable to assist.

It was at this stage, after midday on Thursday, that I decided to volunteer to go to Dominica. Charlie Briggs 8P6GB did so also. Our offer was accepted by J7DAY that night, and we then had to find a way into Dominica. Enquiries revealed that Barclays Bank, which maintains a twin-engined aircraft for use in the Caribbean area, had made a landing that morning at Melville Hall Airport. This was the first aircraft to land in Dominica after the disaster; it took a rather heroic effort by the pilot, Mike Littlepage, as the winds were still very unpredictable, there was no air traffic control, and there was little indication of what the landing strip was like. Nevertheless, Mike made a successful landing, and through his efforts the world was made aware that the airport was serviceable.

There was still, however, a serious problem in that the airport is in the north of the island and Roseau, the capital, is in the south, separated by a distance of some 36 miles. Most of the road is a rough, narrow road in dense tropical rain forest (see Photo I). This meant that most of the roadway was blocked by landslides and fallen trees, and supplies and personnel arriving at the airport could not be taken by ground transportation into the capital until the roads were cleared. This clearing process took some five days, with crews working around the clock using bulldozers and chain saws from both the Roseau and airport ends.

Barclays Bank agreed to fly us into Dominica and on Friday, the 31st, at 1:45 pm, we departed from Grantley Adams International Airport and headed for Dominica, along with an aging Heathkit SB-100 transceiver.

On arrival at Melville Hall Airport three quarters of an hour later, we expected to be flown in to Roseau by the helicopter from *HMS Fife*. This was not possible, however, as the helicopter was otherwise occupied shuttling injured persons and medical supplies to and from the airport.

Following some discussions with officials at the airport, we were introduced to an American missionary who had been living in Dominica prior to David. He had a small single-engined Cessna aircraft in which he had already made several flights that morning to the other side of the island, landing on a roadway known as the "Massacre Bypass," some three miles from Roseau. On these flights, he had shuttled people back and forth—mainly journalists and their camera crews. He offered to take two of us and our equipment across. However, as darkness was fast approaching and I was not very familiar with Dominica, it was decided that Charlie and another guy, a Dominican who had come down with us from Barbados, would be taken with the equipment. In this way, Charlie should be able to find the QTH from which we would operate, and I would return to Barbados that night to make another attempt for Roseau next morning.

As we left Dominica for Barbados, we flew along the west coast and were really shocked at the extent of the damage. Our pilot made several approaches on the Massacre Bypass, and it was decided to bring in a Cessna 182 the following day in addition to the twin-engined aircraft. This small plane could be used to shuttle the wives and children of Barclays Bank staff from the Bypass to Melville Hall, from whence they would be flown to Barbados in the larger aircraft.

Later that night, after Charlie had made his way to one of the Barclays Bank manager's houses which had largely survived the onslaught of David, he passed the following information concerning the landing strip on the Bypass: "[it is] 350 paces long, 7 paces wide, with a slight left-hand bend on landing from the north—several potholes. Bridge on the southern end; road severely eroded by the sea on northern end. Telephone poles hanging over the road slightly at southern end."

I was flown in to the Bypass next afternoon on the second landing of the Cessna 182, after a very long delay at Melville Hall caused by severe congestion I counted over twenty aircraft ranging from small Cessnas to large C-130 transports, all jammed together on the small park-

Photo L. There was never any problem in finding wires for antennas or running emergency power lines. One just walked into the street and cut off what was needed. Here the author can be seen obtaining wire from a fallen pole with which to erect his antennas.

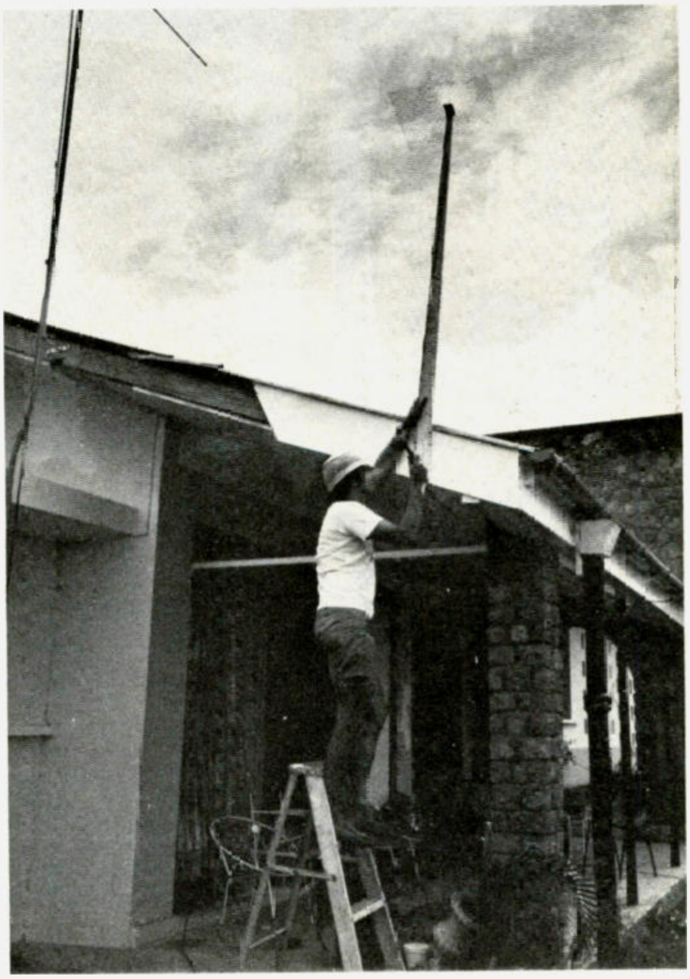


Photo M. Erection of a 2-meter quarter-wave vertical with a chicken-wire ground plane.

Photo N. John L. Webster 8P6KX/9Y4JW operating J73N (formerly 8P6GB/J7). He spent two weeks in Dominica from the 1st to the 14th of September.

Photo P. Operating QTH of 8P6GB/J7 (J73N). The CB half-wave ground-plane vertical, which was very successfully used on 20 meters unaltered, and the 20-, 40-, and 80-meter dipoles may be seen.

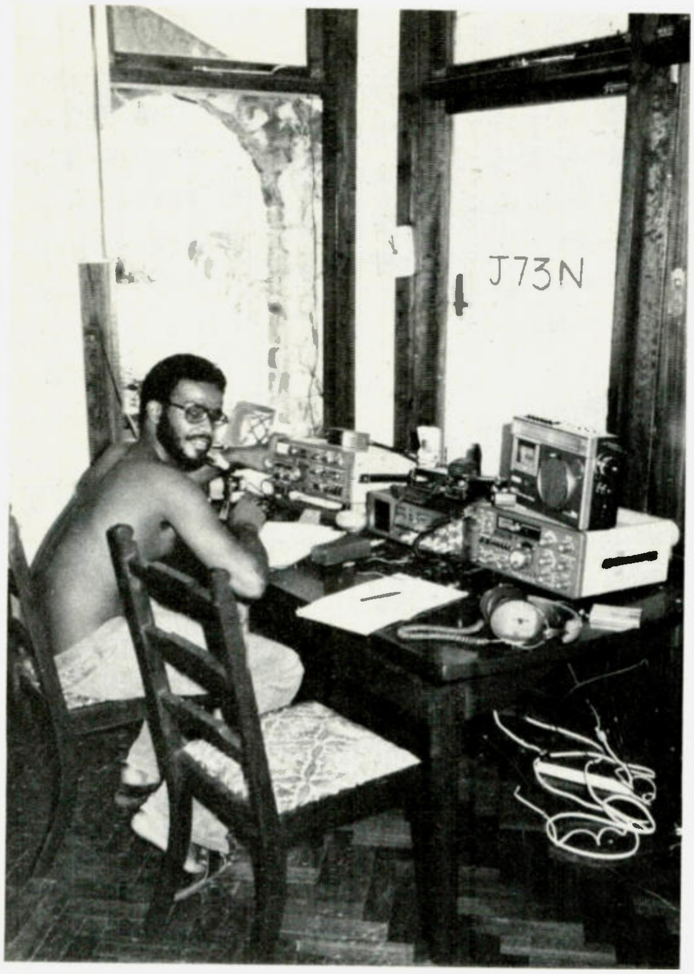


Photo O. Charlie Briggs 8P6GB/9Y4CEB, the third operator of J73N

ing apron. This naturally created a traffic jam, and the passengers on one commercial flight which landed during this time had to disembark in the center of the runway.

The landing on the Bypass was one of the most frightening moments of my life, and I've never felt so relieved as when I was able to step out of that aircraft on to firm ground! (See Photo K.)

After consultation with Fred, it was decided that we would handle health and welfare traffic mainly, on frequencies of 3.835 MHz at night and 7.220 MHz during the day. Fred would continue to operate on the main emergency frequencies of 3.805 MHz and 7.185 MHz. We would shift to these frequencies if and when Fred required a break. Internal communications between Fred and us were maintained via CB equipment on channel 9 for the first four or five days until we were able to obtain some VHF equipment. At this stage, we switched to 2m—146.52 simplex—for internal communications.

Charlie and I arranged a program so that we could operate 24 hours a day in shifts. (See Photos L and M.) We operated as 8P6GB/J7, but this was changed after a week of operation to J73N, as all emergency stations assumed Dominican callsigns. (See Photos N, O, and P.) Our 24-hour operation continued until early in the morning of Monday, September 2nd, when we suddenly realized that our receiver had lost all sensitivity and our transmitter also had developed some problems. Apparently, our aging SB-100 decided that 72 hours of continuous operation was the final straw and had packed up on us.

What does one do in such a situation to get spares? We were really at a loose end, but word was passed to the engineers on board the *HMS Fife* who were able to supply us with most of the required components. However, before we could install them, John Ackley KP2A offered us, and we accepted, the loan of a Kenwood TS-820S. John, of the American Virgin Islands, is a pilot and owns a light aircraft; he arrived in Dominica about September 1st and brought with him a considerable amount of radio equipment. John actually ended up outfitting the three main amateur radio stations—Fred, himself, and us. KP2A was set up in Red Cross HQ and handled mainly health and welfare and other Red Cross traffic. John was often on 20 meters working into the US. (See Photo Q.)

Our health and welfare traffic was disseminated in the following manner. *HMS Fife*, by September 1st, had started regular broadcasts to Dominica on the frequency normally used by Radio DBS—595 kHz—us-

Photo Q. John Ackley KP2A of the US Virgin Islands set up as J73A in Red Cross HQ.

Photo R. Elsa Webster 8P6MH/9Y4LL operating the station 8P6GB/J7. Elsa was the only female operator to come into Dominica during the early relief effort, and she spent five days there.

ing the ship's transmitters. As these transmitters were not designed for continuous usage, the broadcasts were unconventional. Transmissions began every hour on the hour, and for the first 10-20 minutes, health and welfare enquiries, including those we had received and passed to them by a runner, and other messages, were broadcast. This was followed by music until twenty-five past the hour, at which time the same transmissions were made in *patois*—a corruption of the French language spoken in Dominica.

After 50 minutes of transmission, the station would go off the air for ten minutes to allow the transmitters to cool and to make any necessary adjustments. Meanwhile, engineers of the *Fife* repaired the station at Radio DBS, permitting it to resume transmissions about one week after David. Even after Radio DBS resumed transmissions from their normal QTH, however, we continued to disseminate our health and welfare traffic in this manner.

Charlie was relieved by my XYL, Elsa (see Photo R), who is also a ham, licensed as 8P6MH, 9Y4LL, and ex-VP2DL. She took over for five days from September 3rd while he had a break in Barbados. During this period, we had one of our finals fail (a 6146B), once again putting us off the air for some time. However, Fred was able to return to the ruins of his home and locate a replacement amongst the rubble and get us back on the air.

During the two weeks that we operated out of Dominica, power for our equipment was supplied for the first week by small portable, 300-Watt Honda gasoline generators—see Photo S. These proved adequate until we tried to provide lighting as well. At this point, we often used to FM somewhat on our transmissions as the light presented too great a load to the generators. During our second week we were provided with a 1.6-kVA diesel generator which, in addition to powering our equipment and lights, was also able to power a refrigerator which allowed us to have cold drinks—quite a luxury under the circumstances.

I should emphasize here that it was largely through the efforts of Barclays Bank that we were able to go into Dominica and render what assistance we could. Barclays took us there and back on their own aircraft, provided us with the power generators, fuel, and food supplies, and even housed us in Dominica.

Photo S. The author refueling a portable standby generator of the type used by the Bajan (Barbadian) hams, in Dominica, to power their equipment. These small 300-Watt Honda generators allowed continuous radio operation for about six hours on a half gallon of gas. They were used for about a week prior to Barclays Bank providing a 1.6-kVA diesel generator, shown in the background. This larger generator allowed the operation of a refrigerator and lights at night, in addition to radio equipment.

As the relief effort progressed, other hams made their way to Dominica, each to make his own contribution. I have already mentioned KP2A and his invaluable contribution to the relief effort.

Bob WØDX from the US was an early-comer who, I believe, walked a considerable distance from the airport to Roseau with his equipment. He operated out of Police HQ, near Fred.

Another outstanding contribution was made by Stanley VP2ABC from Antigua. Stanley maintained a radio link between Fred at Central Control in Roseau and the airport for some time prior to the passage of hurricane Frederic.

Frederic was the hurricane which followed closely on David's heels which threatened Dominica for some time, causing vir-

Photo T. Emergency supplies from the US being unloaded from a US Marine "Jolly Green Giant" helicopter at Windsor Park, the main sports field in the capital. These helicopters ferried supplies from the airport to the capital even after the roadway was reopened, until an adequate stockpile was established. The boxes to the right of the photograph were a shipment of VHF equipment sent by the IARU to assist in internal communications.

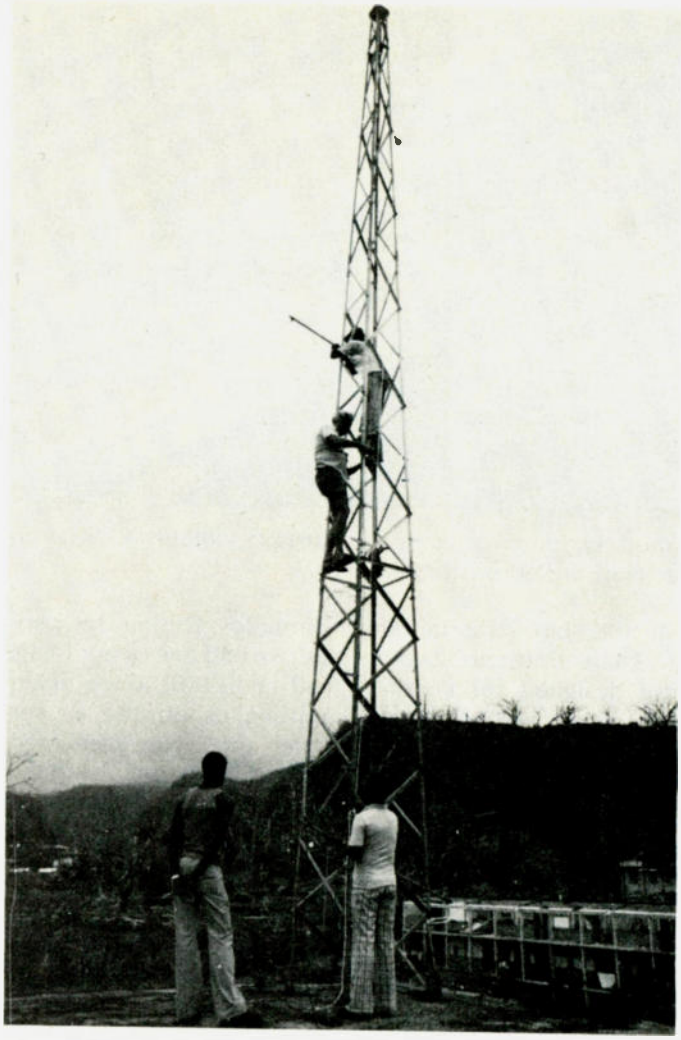


Photo U. J7DAY and KP2A, both up in the tower, erect home-brew antennas for use with the VHF gear sent by the IARU. They are assisted by VP2ABC, to the right, from a safer location. The tower was located on top of the police HQ building. In the background may be seen the devastated botanical gardens and a damaged school.

tual panic, until it veered northward, missing Dominica but bringing considerable flooding in the north of the island, especially at the airport. This flooding resulted in damage to relief supplies that had arrived at the airport and were being stored there. Also, when the river adjacent to the airport overflowed its banks, one of the large US "Jolly Green Giant" helicopters (like the one shown in Photo T) was swept into the sea and severely damaged.

After the passage of Frederic, Stanley was taken by helicopter to most of the outlying villages in the central and southern parts of the island. On each occasion he radioed back very detailed reports. He also was able to deal with health and welfare enquiries relating to these districts.

The International Amateur Radio Union (IARU) sent a shipment of VHF gear for use in the relief effort (see Photo T). It included a VHF Engineering 2m repeater and about a dozen Genave GTX-2 2m transceivers, some with portable battery packs. These were used to link all the local amateur radio stations, the hospital, and Radio DBS to Central Control at Police HQ. Due to the very rugged and difficult terrain in Dominica, 2 meters does not prove to be very effective over any great distances, but in the absence of telephones it serves a very useful purpose around the city and nearby villages, and will continue to do so for some time (photo U).

During the period of relief that followed the devastation of Dominica by hurricane David, hams across the Caribbean area rallied together, passed thousands of messages, and made dozens of phone patches. Although a great many hams participated, I would like to single out a few who made outstanding contributions and greatly assisted with the smooth running of the relief effort.

At the top of the list are Ron 8P6BN (Photo V) and Richard 8P6FW (Photo W), who worked around the clock from the beginning and were together responsible for most of the phone patches made. Arthur 8P6AA as Emergency Coordinator of the ARSB did much of the work behind the scenes, along with Toby 8P6AK who is president of the ARSB. Allan 8P6AH, although away from Barbados for about one week directly following David's ravaging of Dominica, on his return was always around and handled some of the clearest patches we made. Also, Allan's witty character kept the spirits of all high.

Out of Antigua, we had Hya VP2AYL, who was the only YL operator, other than my XYL, participating in the emergency. Hya was noted for her relay of detailed weather forecasts for the Caribbean region from the Antigua Met Station. These weather forecasts were rebroadcast over Radio DBS.

From Montserrat there were VP2MO and VP2MC, both of whom were important links in passing information to Radio Antilles.

However, in spite of all notable efforts by these and many other amateurs both in and outside the Caribbean region, it was most distressing at times to witness interference by unconcerned amateurs. This interference generally took the form of some sort of QRM on the emergency frequencies, but also included those amateurs who, even though advised that only

Photo V. Ron Armstrong 8P6BN, along with 8P6FW (Photo W), did yeoman service during the relief effort.

Photo W. Richard Gale 8P6FW, together with 8P6BN, handled most of the phone patches.

emergency traffic was being handled, persisted in trying to get their health and welfare enquiries through. The exercise has shown that many amateurs are not capable of passing and receiving messages.

A true ham is illustrated in the words of Fred White J7DAY, himself, who, when asked by a fellow ham about his personal situation replied, "The first thing I tried to save was the rig, because I knew if it got damaged, there would be no communication outside. Actually, everything is lost on my side, and hopefully something can be done, sometime, but after I have taken all the emergency traffic here, then I'll start thinking of myself."

Fred's efforts have been acknowledged by the Government of Dominica, and at the island's first Independence Celebrations on November 3, 1979, Fred was presented with his country's highest honor, the Sisserou Award.

I would like to express my gratitude to the Editor of the *Bajan Magazine*, Mr. Trevor Gale, for allowing me to use information presented in an earlier story by me, titled "Unsung Heroes," published in the November, 1979, issue of *Bajan*. ■

Russ Rennaker W9CRC
1011 Linda Drive
Kokomo IN 46901

A "Short-Yard" Antenna for 40/75

—fits where others won't

The problem of space in which to erect an antenna is, I suppose, as old as ham radio itself. My first antenna consisted of four wires strung between two sixty-foot telephone poles two hundred feet apart—but that was in 1920, and I just happened to live on a farm with plenty of space.

Few city lots today will accommodate a half-wave horizontal antenna for seventy-five meters, however; some even have trouble with forty meters.

Being in that category myself, I began looking around for some way to operate on seventy-five that didn't include running a wire over to my neighbor's TV tower. The first solution that comes to mind, of course, is a ground-mounted vertical. That's fine and I enthusiastically recommend that method, but a base-insulated tower is not easy to manage and an aluminum tube sticking up in the air sixty-odd feet is not the easiest thing in the world to keep up there.

Having a forty-meter vertical already in operation, I came up with the following idea, requiring only about thirty feet of horizontal space. Fig. 1 is self-explanatory, perhaps, but here is a simple verbal explanation.

I ran a copper wire up alongside the forty-meter aluminum tubing, insulated from the tubing at both extremities, and tied the bottom point to the inner conductor of the coax cable at the same place it is connected to the aluminum tubing. The coax braid is already strapped to the ground for the forty-meter vertical, of course. The horizontal part can be tied off, with an insulator at the end of the wire, to anything that is available—a house, shed, barn, or favorite tree. Actually, it really does not have to be exactly horizontal. The outer end can be higher or lower than the end fastened to the forty-meter antenna. I tried several different angles, and, except for affecting the resonant length, it didn't seem to make any difference.

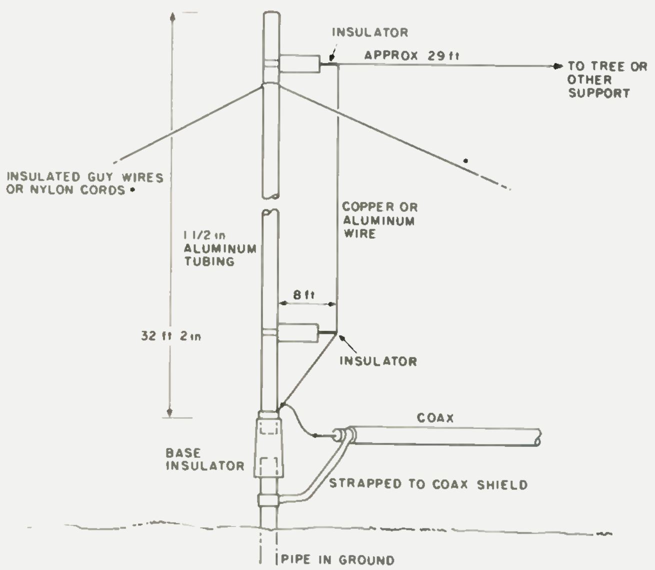


Fig. 1. A "short-yard" 75-meter antenna.

The length of the forty-meter tubing may have to be altered somewhat to bring it back into resonance where you want it, but I found very little difference after I put up the wire alongside. Of course, the horizontal portion will have to be trimmed to the portion of the seventy-five-meter band where you wish to work; you'd want to do that anyway.

I found the performance of the forty-meter vertical unaffected and that of the seventy-five-meter wire as good as any half-wave horizontal I've ever used.

This is an ideal "short-yard," combination forty- and seventy-five-meter antenna, but if you don't operate forty—or perhaps have a forty-meter beam—this same arrangement can still be used for seventy-five meters with slight modification. In that case, the horizontal wire is electrically fastened to the tubing at the top, eliminating the insulators and the wire running down to the bottom of the tubing. The coax remains connected in the same manner as with the two-antenna combination.

Another method might be to use your beam tower to support the seventy-five-meter wire. In this case, the inner conductor of the coax would be connected to the wire only and not to the tower—the vertical portion of the wire would have to be insulated from the tower as it was in the first instance. You would want to fasten the horizontal portion of the wire at about the thirty-foot level of the tower, give or take a few feet, remembering that the higher on the tower you go, the shorter the horizontal portion will have to be (the idea being that from the coax connection to the far end of the wire, the electrical length should be a quarter wave of the operating frequency). Like most antennas, it should be trimmed to the frequency you mean to operate on. ■

(Receiver Section) FT-107 TRANSCEIVER SPECIFICATIONS (Transmitter Section)

Sensitivity: 0.25 uV for 10dB S/N, CW/SSB, FSK
1.0 uV for 10dB S/N, AM
Image Rejection: 60dB except 10 meters (50dB)
IF Rejection: 70dB
Selectivity: SSB 2.4 kHz at −6dB, 4.0 kHz at −60dB.
CW 0.6 kHz at −6dB, 1.2 kHz at −60dB.
AM 6 kHz at −6dB, 12 kHz at −60dB
Variable IF Bandwidth
20dB RF Attenuator
Peak/Notch Audio Filter
Audio Output: 3 watts (4-16 ohms)
Accessories: FV-107 VFO (standard not synthesized)
FTV-107 VHF (UHF Transverter)
FC-107 Antenna Tuner
SP-107 Matching Speaker
FP-107 AC Power Supply

Power Input: 240 watts DC SSB/CW
80 watts DC AM/FSK
Opposite Sideband Suppression: Better than 50dB
Spurious Radiation: −50dB.
Transmitter Bandwidth 350-2700 hz (−6dB)
Transmitter: 3rd IMD −31dB neg feedback 6dB
Transmitter Stability: 30 hz after 10 min. warmup
less than 100 hz after 30 min.
Antenna Input Impedance: 50 ohms
Microphone Impedance: 500 ohms
Power Required: 13.5V DC at 20 amps
100/110/117/200/220/234V AC at 650 VA

YAESU ✓83
The radio.

Price And Specifications Subject To Change Without Notice Or Obligation

1179R

YAESU ELECTRONICS CORP., 6851 Walthall Way, Paramount, CA 90723 ● (213) 633-4007
YAESU ELECTRONICS Eastern Service Ctr., 9812 Princeton-Glendale Rd., Cincinnati, OH 45246

Antenna Fans: Try the Skeleton Slot

—an improved driven element for VHF/UHF

One of the problems with simple yagi antennas is obtaining wide bandwidth while keeping the swr low over an entire band. Usually, one has to compromise and dimension the antenna for a particular portion of a band.

The main reason that the swr changes across a band is that the lengths and spacings of the elements used in the antenna do not change as the transmitted frequency is changed. These physical arrangements, along with the wavelength change due to frequency alteration, cause changes in the mutual coupling to the driven element, and the feedpoint impedance of the driven element also is changing, and this contributes also to changes in the feedpoint impedance.

One classic approach to solving this problem has been to make the driven element a folded dipole. The inherently wider bandwidth characteristic of the folded dipole element, as compared to a simple dipole, prevents the driven element impedance changing as much as the electrical length of that element changes. However, G2HCG has gone a step further and developed a driven element configuration which not only has broad bandwidth by itself, but when used in a yagi is far less affected by the influence of frequency-dependent electrical length changes of other elements in the yagi. To top it off, the overall gain of the yagi may also be slightly increased by his form of driven element. Although his form of driven element is popular in G-land, it has not yet been used much here. Those amateurs who have simple, multi-element yagis and desire to increase the bandwidth characteristics will find this new form of driven element very applicable.

The skeleton slot-driven element, as it is called, derived from experiments concerning a true slot antenna. A true slot antenna, as shown in Fig. 1, is not what most of us would visualize as being a "real" antenna. It is, as the name indicates, a slot cut out of a sheet of metal. The slot thus formed radiates much like a conventional dipole. If one makes the slot wider, it is similar to making the length-to-diameter ratio of a conventional dipole smaller. In other words, the dipole length remains the same, but the diameter of the elements increases. This will increase the bandwidth. In the case of properly-dimensioned slot antennas, very large bandwidths can be achieved in the UHF range.

The skeleton slot resulted from experiments to determine how small the sheet of metal could be made and still retain the characteristics of a slot antenna. The final result was to demonstrate that a "skeleton" made of tubing, and dimensioned as shown in Fig. 2 (a), acted much like a slot antenna. The antenna of Fig. 2 (a) can be visualized as shown in Fig. 2 (b), i.e., as two ½-λ antennas spaced 5/8 λ where the ends of each ½-λ section are bent.

The final practical form of the antenna is shown in Fig. 2 (c) along with practical dimensioning information for the VHF bands. If the antenna, used as a driven element in a yagi, is constructed of the tubing sizes normally found in VHF beams, the feedpoint impedance is approximately 300 Ohms. So, one can use twinlead as a feedline for low-power installations or use a conventional 4:1 balun at the antenna for a 75-Ohm coaxial cable transmission line.

Further practical experiments with the skeleton slot as a driven

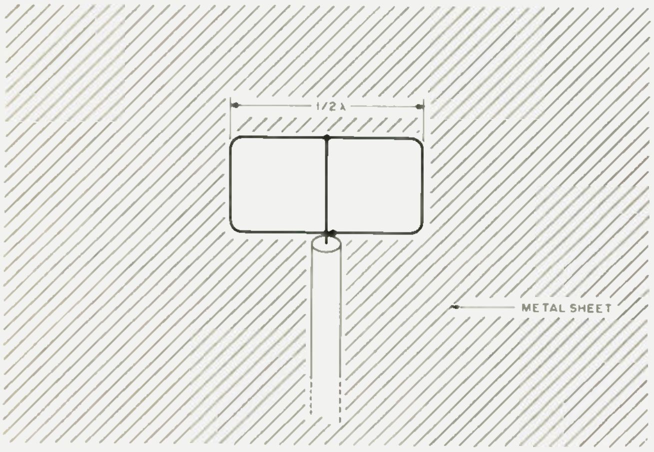


Fig. 1. The true slot antenna doesn't look like an antenna at all. It is a dimensioned slot cut in a large piece of sheet metal.

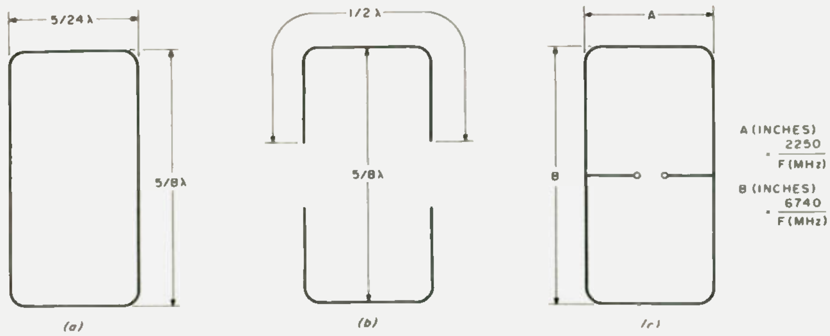


Fig. 2. (a) The original skeleton slot. (b) Showing how it might be visualized as stacked dipoles. (c) Showing practical dimensions.

element showed that it worked best if bent slightly forward, as shown in Fig. 3 (a), at an angle of about 11 degrees from the vertical. Also, when using the skeleton slot as a driven element, the parasitic reflector elements in a yagi should be changed so there are two: each one at the approximate height of each horizontal member of the skeleton slot, as shown in Fig. 3 (b). The reflector and director elements can retain their normal dimensioning. There is some slight increase in forward gain using the skeleton slot as the driven element. This is probably due to the fact that the skeleton slot itself acts as two stacked dipole radiators, and also from the effect of the added reflector elements. The gain increase can be about 2 dB.

It is difficult to say how much the bandwidth of a given VHF antenna will be increased by the use of the skeleton slot as the driven element. Increases in bandwidth of up to twice that using normal dipole elements are possible. Of course, this would be an increase in bandwidth in regard to keeping the swr low. It doesn't mean that the antenna would retain its forward gain characteristics over the entire bandwidth. Nonetheless, the ability to load into this antenna and get some gain at an increased bandwidth may well make the skeleton slot modification worthwhile.

Although the skeleton slot antenna has its main application at VHF frequencies, it also might have some applicability at HF frequencies as a wire antenna. The dimensions might suit some situation where only a small distance is available for the horizontal portion of the antenna on a given band, but height is available. One idea that suggests itself is to try the antenna on a tower using arms extending from the tower to form the horizontal portions of the antenna. Even on 7 MHz, only two approximately 13-foot-long arms would be required. Constructed of wire and used on the HF bands, the feedpoint impedance of the antenna might rise severalfold. This is because the dimensions of the antenna become so much larger than the diameter of the wire that would be used to construct it. Nonetheless, the idea is an interesting one, and such an antenna fed with a resonant transmission line might perform very well. ■

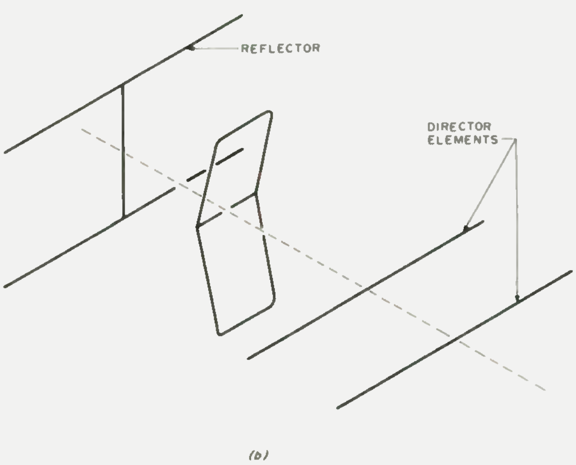


Fig. 3. (a) There is a small forward tilt to the skeleton slot. (b) This is how the skeleton slot would be used in a yagi, with a modified reflector.

✓Reader Service—see page 226

John A. Carlson DA1TM/WD9HBB
PSC Box 5177
APO NY 09132

The Capacitive Coaxial Ground Wire

—could this be the end of TVI?

Have you been awarded the WAS or the WAC awards? Now, don't confuse these awards with the Worked All States or Worked All Continents awards. I'm referring to the Worked All Stereos and Worked All Consoles awards. Well, the two awards I am referring to are not the most popular awards being issued these days, especially with your neighbors. I was the unhappy recipient of both of them not too long ago.

An amateur friend of mine found the problem, made a simple modification, and I am happy to say that these two awards will adorn my shack no longer. Want to know what the modification was? Well, I'm about to tell you, and as I do, I'm going to tell you a little bit about my problems.

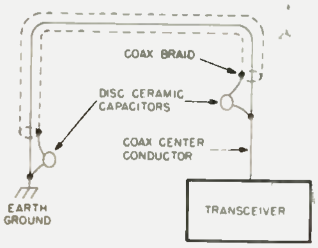


Fig. 1.

I recently had the fantastic experience of setting up my very own shack. Being an American GI stationed in Germany, it took me about two months to get my German call after passing the US General Class test a year ago April. During this two month period, I ordered and received all my equipment and was ready to set up my shack. With the help of some friends, I put up my beam, ran the coax, and was ready to plug in the transceiver.

When we got ready to hook up the ground wire for the transceiver, we discovered that this would necessitate running about 30 feet of wire out the window and down the side of the building to the ground rod. You see, I live on the second floor of a four story apartment building. No problem, though; we had plenty of good copper wire. With the ground wire hooked up, we were all ready to put the station in operation. I plugged in the rig, tuned it up, and started making contacts.

Boy, this amateur radio has got to be the greatest hobby in the world! As fate would have it, however, there came a menacing knock on the door. It was a couple of very irate neighbors who in no uncertain terms informed me that I was completely wiping out their TVs and stereos, including a gunshot scene from "Starsky and Hutch" and the cannon shots at the beginning of the *1812 Overture*.

I was completely shocked and, to say the least, a little discouraged. I pacified the neighbors and went to work immediately to find out the source of the interference. I was using a match box and a low-pass filter, and all the equipment was connected and operating correctly, so what could be causing the problem? I had used up all my electronics expertise just passing the test and setting up my shack, so I shut the rig off and decided I had better get some additional help.

I called my good friend Bill Pardue AA4AG/DA1KV, who holds an Extra Class license, and explained my problem. If anyone could find the source of the interference, he could. He came right over and checked out the entire station. Everything looked good until he came to my ground wire. At about 30 feet, the ground wire was resonant at 10, 15, 20, and 40 meters. He suggested we check it with a field-strength meter. As Bill operated the rig, I went outside with my field-strength meter. I set the sensitivity about half-way as I rounded the corner of the building. I got to about four feet from the ground wire and the needle of the meter was already pegged out. I yelled the results to Bill, who was listening through the window.

"Disconnect the ground wire," he shouted back.

I knew we couldn't run the rig without a ground wire, and I didn't have the slightest idea what Bill had in mind, but I disconnected the ground wire and Bill threw the other end out the window. About five minutes later, I saw some coax coming out of the window. Bill yelled to hook the center conductor of the coax to the ground rod. As the end of the coax came within reach, I noticed a capacitor had been soldered between the center conductor and the braid. I hooked the center conductor to the ground rod and stood back while Bill started transmitting again. With the sensitivity set where I had had it before, I checked the field strength again. Nothing. I moved closer and closer and still no reading. Finally, with the sensitivity set at full and the antenna of the field-strength meter touching the ground wire, I was able to get the needle to move a little.

Back in the shack, Bill explained the operating principles. The center conductor acts as the ground, but in case some rf is radiated, it is absorbed by the braid and bled back to the center conductor (ground) through the capacitors. Because the path of the least resistance is through the center conductor, no rf will be induced through the capacitor to the braid. Only the rf that is radiated from the center conductor will reach the braid, and thus the braid acts as an extremely effective shield.

The type of coax used is not important, but the capacitors must be 1000-pF disc ceramic rated at 1.4 kV. The illustration will show you exactly how to install the capacitors.

If this story sounds familiar and you have been awarded the WAS and WAC by your neighbors, your ground wire might very well be the culprit. This ground wire worked for me, and it might work for you. ■

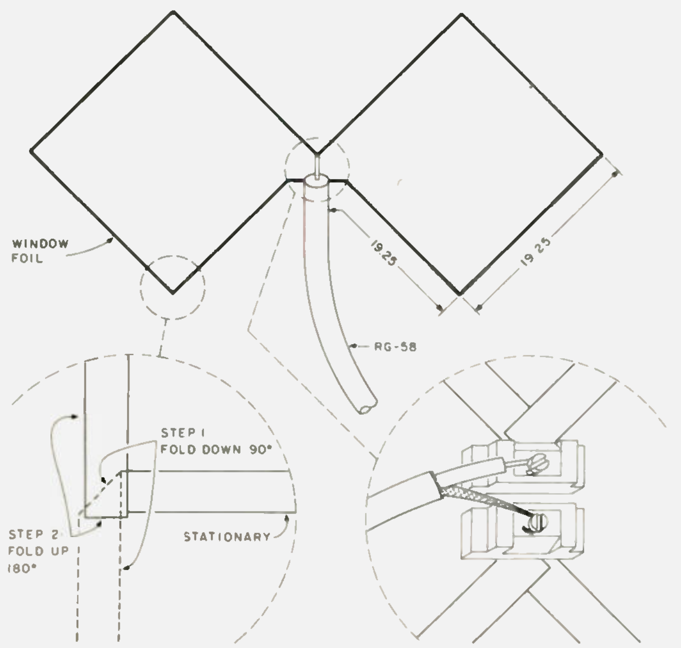
B. E. Patronski WB2MYT
38 Camner Ave.
Lancaster NY 14086

Stick 'Em Up

—install this 2m Bi-Loop anywhere

I needed a simple antenna for 2 FM, one that wouldn't take up to much space or be obvious to the landlord. Remembering the fact that basic antenna designs are fairly independent of frequency, I thought that a traditional HF antenna, scaled down, might just fit my requirements.

The end result is the antenna illustrated here. In essence, it consists of two full-wave loops fed in parallel—an adaptation of W7CJB's Bi-Loop.[1] The radiating elements are made from adhesive-backed burglar alarm window foil. This stuff is easy to get at Radio Shack and is inexpensive. Also, it doesn't pull off big chunks of paint when you want to remove it.



Feedline connection is made with burglar-alarm window foil connectors, of course (see detail). Continuity is ensured by overlapping the foil about one-half inch and puncturing with a needle. You should jab it about a half-dozen times at each splice. Wall (or window) area needed is about 2¼' x 4½', and the antenna can be covered with a large picture or map for camouflage.

With the antenna stuck on an inside wall on the second story of a frame dwelling (aluminum-backed insulation and all), the feedline vswr is 2:1, and I have solid simplex QSOs with my brother eleven miles away (I'm running 1½-Watts output). The antenna in free space, theoretically, has 8 dB of gain when compared to a half-wave dipole and 6.8 dB over my old 5/8-wavelength ground plane.[1,2] The loops seem quite broadband, possibly because of the length/width ratio of the elements. Polarization is vertical with the configuration shown. Comparative signal reports from KA2AFS (my brother Hank's station) indicate superiority to the ground plane.

One final note: Window foil of this type is made primarily from lead. This material seems to have no derogatory effect, in spite of its low conductivity as compared to copper. ■

References

1. Davey, "Try a Bi-Loop Antenna," 73, April, 1979.
2. Miller, "How to Determine Antenna Gain," *Popular Electronics*, July, 1979.

Archie McKay WA4LLE
702 West Cranford Ave.
Valdosta GA 31601

Old Fishermen Never Die

—they just learn to raise dipoles

You really don't have to be a lineman for the county to get that dipole strung. Sometimes it helps to be a fisherman, or a man with fishermen for friends.

After years of throwing—and hanging—soft-drink bottles in pine trees, a few of us tried bows and arrows. But a Coke bottle hanging from a limb is better than a pierced heart, especially if it belongs to a neighbor.

The answer is fairly simple, with compensation allowed for Murphy: Throw a small weight over that tall tree with a spinning rod. (That's a fishing stick, for the uninitiated.)

What's that you say, Bippy? Never used one? Take heart; the same five-year-olds who proved code is easy to master regularly throw with a spinning outfit.

With a spinning reel, you don't have to have perfect aim. Using a spinner is simply a matter of coordinating your thumb (which releases the brake) and wrist (which is the lever for tossing the weight).

Here in the south, pine trees are the main "towers" for stringing dipoles. But, obviously, any tall tree will work. Using a spinner and a proper weight, we have had dipoles off the ground in under 15 minutes from scratch.

What weight to use is really a matter of choice, although the beginner will usually put on too much weight. For example, my Zebco One spinning reel with a six-foot rod responds well to a weight from three to six ounces.

Sources of weights are plentiful around most shacks. If all else fails, try three ten-penny nails wrapped in electrician's tape. A better weight might be fishing sinkers with "eyes" or a fishing plug with the barbs removed. Some sporting-goods stores sell practice lures which are barbless and great for throwing.

Now that you have the weight and spinner, it is time to consider the line to use. Usually I carry from 10- to 25-pound test line in my spinner, for bass, and that works well.

Spot your two trees (or one in the case of a sloper), attach the weight, and throw over the crown of the tree from the inside, i.e., between the two trees to be used. With some practice, you can put a weight over the crown with the line lying softly on the branches on the inside but with the line running straight down the trunk on the outside. So much for the aesthetics.

Once the weight is over the tree and within reach, most of the battle is won. Simply remove the weight, attach stronger line, and pull it over by reeling in your line. Chalk line used by plumbers and brickmasons is good, although it ages and weathers rather rapidly. I often use monofilament nylon line, which is very small, yet handles from 200 to 300 pounds of dead weight pull.

If you wish to use larger line to support the antenna, simply snake the smaller line over first and tie the larger line on the end. You can progress through several changes of line size this way in minutes—much like sailors do on large ships when docking.

Yes, there are some drawbacks.

Unless you are an accomplished fisherman, stay away from open-face reels. Use a spinner and lessen the chance of a snarled line.

If the weight goes over the tree but refuses to descend all the way down the other side due to the weight of the paid-out fishing line, resist the temptation to snatch it back. Pay out more line and lay the spinner on the ground. Then go inside and work the bands for an hour. When you return, Mother Nature's gentle wind, with some help from gravity, will have your weight safely on the ground.

There are many advantages to the spinning method. There are no arrows to lose, no heavy weights which reach only halfway to the top, and one big added bonus. Consider what brings down most dipoles in moderate to heavy winds. They are tied to large limbs or trunks, and when the trees sway in different directions, no dipole-support line can withstand such pressure.

Using a spinner and going over the crown of the tree gives you the advantage of this situation. Limbs at or near the crown are small, soft, and pliable. With each end of the dipole supported over the crown of a tree, the crowns will actually bend *toward* the antenna during opposing winds.

It beats trying to climb a tree, for those of us beyond age 20 or 30.■

✓Reader Service—see page 226

Bill Smith K3LF
RD #2, Cold Spring Creamery Road
Doylestown PA 18901

Rich Williams WB3CTZ
Bristol Road
Warminster PA 18974

Breakthrough! A Computerized Antenna Rotator!

—KIM-1 can do!

One evening, Rich WB3CTZ and I were discussing various improvements we had made to our ham shacks which had resulted in greater operating convenience. One thing that we felt still could be improved was the operation of Rich's Ham II rotator. There was no simple way to get around the normal system of looking up the bearing, holding the brake release down while operating the motor control, and watching the bearing indicator. Finally, a decision must be made to release the motor control at the correct time. When this scenario is repeated many times during a contest, it consumes a considerable amount of valuable time. A thirty-hour contest might require as much as one hour of time devoted to operating the antenna (an average of 45 seconds per operation and four operations per hour).

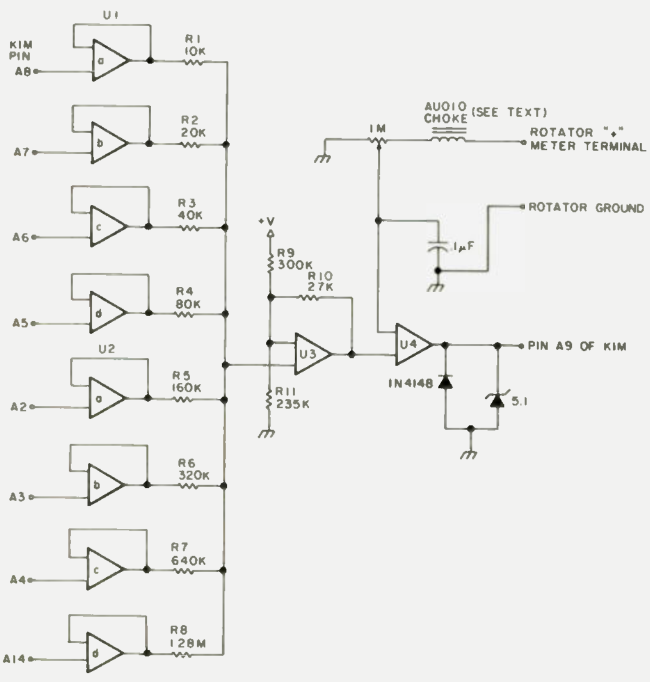


Fig. 1. A/D converter. U1, U2—quad op amp (RS 276-1711); U3, U4—741 op amp.

About this same time, we were trying to come up with a good application for our newly-purchased KIM-1 microprocessor. We had told our wives how great micros were but had not been able to show them much more than the old standby, Lunar Lander. We decided to work out a method of using the KIM to control and operate the Ham II rotator, thereby eliminating two problems at one time, to everyone's delight. The result was so overwhelmingly successful we thought that other hams might benefit from it.

The system we came up with consists of an A/D converter (so that the KIM will be able to read the bearing of the antenna), a relay-operated interface to operate the controls of the rotator, and the software. Operation of the system is very simple. After the program is read into the KIM, a simple calibration is conducted. From then on, the KIM does the work. You punch in the bearing and push the ST (start) key. The KIM will turn on the power to the rotator, operate the brake release, turn on the motor to turn the antenna to the desired heading, turn off the motor at the correct time, wait until the antenna has coasted to a stop, set the brake, and turn off power to the rotator control. At all times the selected bearing is displayed digitally on the KIM display.

There are many error checks and fail-safe devices built into the program to prevent the operator from doing something wrong. All switches in the rotator control unit have been paralleled so that manual operation can be used at any time. The system has been found to be reliable and very accurate. Our initial design goal was an accuracy of two degrees, but as far as we can determine, the antenna stops at the exact bearing punched into the KIM (as indicated by the meter on the Ham II).

The I/O Device

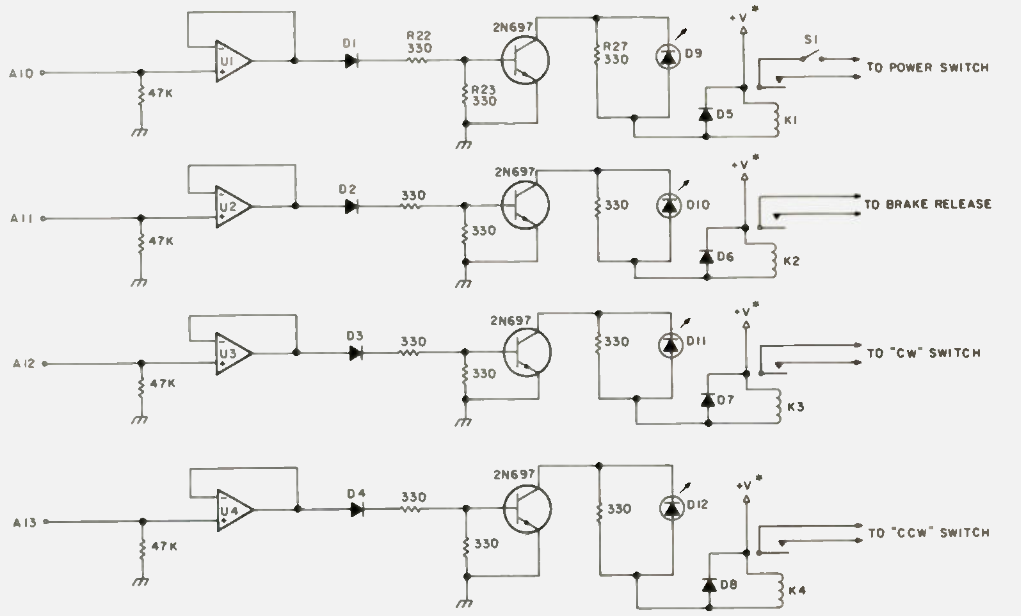


*Fig. 2. Relays and relay driver. U1-U4—741 op amps or equivalent; D1-D8—1N4148; K1-K4—12-V dc relays (see text). *Install on/off switch on V+ line to disable relays.*

The I/O device is two separate circuits. One is nothing more than a home-brew A/D converter and the other is a number of relays and relay drivers to operate the various controls of the rotator.

The A/D converter in Fig. 1 probably could be replaced with a commercial unit. I took the home-brew route to maintain my image of doing things the hard way. Besides, I thought it would be instructive and rewarding.

Operation of the A/D converter is not difficult. U1, U2, and U3 generate a voltage determined by the digital word at the output of the KIM. The higher the digital word, the higher the voltage generated. U4 compares this voltage to the voltage to be measured from the rotator. When the two voltages are equal, the comparator sends a signal to the KIM (U4 output changes state). The voltage from the rotator is directly proportional to the bearing of the antenna. For the KIM to determine where the antenna is pointing, all it has to do is keep changing the digital word at the input of U1 and U2 until it gets the highsign from the comparator. In our system, what actually happens is that the KIM calculates what the digital word would be for a desired heading and then turns the antenna until the rotator voltage is equal to the voltage generated by the digital word.

U1 and U2 are quad op amps set up as voltage followers. The outputs will follow the digital word at the inputs (0 or 5 volts) and act as a current source. R1 through R8 make up a voltage divider whose output will be somewhere between 0 volts and 5 volts. Since there are eight inputs to the voltage divider, there are 256 different voltages possible which may be generated. Our unit generates voltages with a resolution of 18.35 millivolts between 0 volts and 4.7 volts.

U3 is a summing amplifier for the voltage and also is used to "zero" the system. We found that our KIM produced about 40 millivolts when its outputs were low. This was equivalent to about 3 degrees of antenna rotation. We found that we could compensate for this slight offset using U3 and resistors R9, R10, and R11. The values of these resistors were found experimentally by using potentiometers and adjusting them until the output of U3 was exactly 0 volts when all inputs to U1 and U2 were held low by the KIM. The values shown should work very well with most machines.

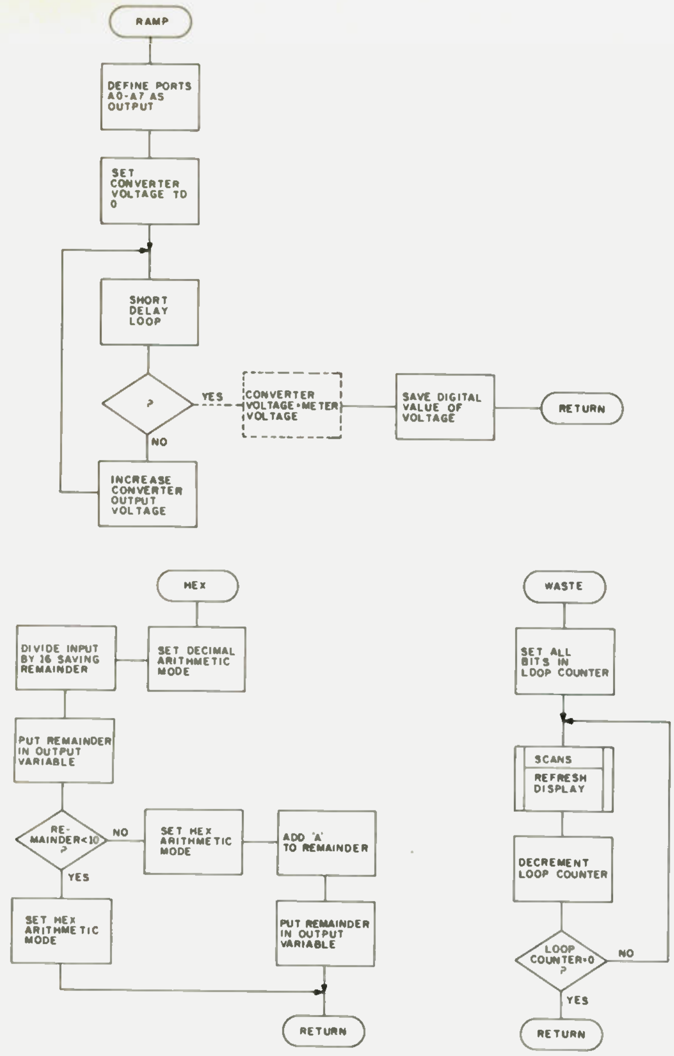
The output of the summing amp is fed to the noninverting input of the comparator, U4. The voltage from the rotator, which is directly proportional to the antenna bearing, is fed to the inverting input of the comparator. Whenever the voltage from the rotator is higher than the voltage generated by the KIM, the output from the comparator will be low. The diode on the output of the comparator prevents the output from going to V−, which it will try to do when it is in the low output state. Similarly, the zener prevents the output from going over 5 volts in the high state. This protection is important since the output of the comparator is connected to the KIM to tell it when the antenna voltage is equal to the voltage generated by the A/D converter.

I recommend checking out the operation of the comparator carefully before hooking it to the KIM to be sure that the voltage does not go above 5 volts or to some negative value. This is the only place in the system where a voltage is fed into the KIM. All other connections are outputs from the KIM.

All connections to the KIM are as shown in Figs. 1 and 2, with the exception of the power supply. The connection to the antenna rotator control is made through the 1-megohm pot wired as a voltage divider and a filter choke to filter 60-cycle hum. We found that the voltage across the meter in the Ham II was about 22 volts at full scale, decreasing to 0 volts in a linear fashion. By wiring the 1-megohm pot as shown in Fig. 1, we could set the full-scale voltage to the desired value of 4.7 volts which would take full advantage of our A/D converter.

We also found several volts of ripple which was averaged out by the meter. To eliminate this ripple, we used the choke-capacitor filter shown in Fig. 1. The choke came from a "boat anchor" in the basement and probably any audio-type choke will be sufficient. A slight amount of hum at the input to the comparator will cause the KIM to turn off the rotator motor early regardless of the direction in which the antenna is turning. Each 13 millivolts of ripple is equivalent to one degree of rotation. In our unit, the ripple is small enough that the antenna comes to rest at just the right place. Murphy must have been out to lunch the day we chose our choke!

The four relay driver circuits shown in Fig. 2 are identical. One is for the on/off switch, one for the brake switch, and one each for the two motor switches.



Subroutine flowcharts.

As the relay drivers operate similarly, I will describe only the one used for the power switch. The output from the KIM is hooked to the non-inverting input of buffer amplifier U1, a 741 op amp, wired as a voltage follower. The 47k-Ohm resistor from the input of the buffer to ground will keep stray signals and noise from activating the relays. Without these resistors, we found that a 2-microamp signal would operate the circuit and trigger the relays. The output of the buffer amp is fed through diode D1 to the transistor, which operates as a switch. D1 will not conduct until it is forward biased to .7 volts. This is necessary to prevent relay activation from the 40-millivolt potential at the output of the KIM when it is in the low state.

Resistors R22 and R23 limit the current drawn from the buffer amp and bias the transistor to operate as a switch. I used 330-Ohm resistors since I had quite a few on hand, although other values would work just as well. The transistors are junk-box specials. Any NPN transistor with a gain of 30 or more which can handle the current for your relays will work very well. The relays must be able to handle the current drawn by the rotator motor and brake. The Ham II required 5-Amp relays. We got a very good deal on relays from Poly Paks. They are 5-Amp relays and require 10 volts at 100 milliamps to operate.

Delay	Location
Power on to brake release	02C6
Brake release to rotation	02D6
Stop rotation to apply brake	0322
Apply brake to power off	0332

Table 1. Rotator timing delays.

Diode D5 protects the transistor from any spikes developed in the relay coil when the transistor is turned off. It effectively shunts any voltage greater than Vcc to the V+ line. I guarantee that you will zap any transistor that is not protected by such a diode.

LED D9 and resistor R27 may be omitted and the relay hooked directly to the collector of the transistor. We had it set up without these two parts at first, but found it very unnerving to hear the relays clicking and not know which ones or exactly what was happening. The LED will turn on when the relay is energized, indicating which relay is operating. This is particularly helpful in system checkout and troubleshooting.

The final item I want to mention is the switch, S1. It is used to disable the on/off relay during calibration, initialization, and troubleshooting. Remember that this switch and relay are switching 120 V ac, so *extreme caution should be exercised*. The entire on/off power switch relay can be eliminated from the system if you so wish, but you will have to leave the power turned on to the rotator control all the time. Another switch should be provided in the V+ which goes to the relay transistors so that all relays can be disabled for calibration. This switch should be left open until calibration is complete.

The Software

With the hardware under way, we began work on the computer program. The first step was to determine how to tell the computer how far the antenna could be turned in either direction. To do this, we came up with the following method. We first turned the antenna as far as possible in a counterclockwise direction, entered the number 1000 into the computer, and pressed the ST key. (The 1000 should appear on the address LEDs of the KIM.) The computer interpreted this action and read the bearing on the rotator. This number became the extreme for counterclockwise rotation.

The extreme for clockwise rotation was indicated to the computer by swinging the beam as far as possible in the clockwise direction, entering the number 2000, and pressing the ST key. (These two actions can be done in either order.) Once the extremes of rotation are determined, the operator enters the number 3000 and presses the ST key, thus telling the computer to set all its internal math calculations based on the two extremes of rotation. If you get clockwise and counterclockwise mixed up, the computer will tell you by displaying Es when the 3000 command is entered. We call these steps calibration, and they must be done before the computer can recognize properly any commands to turn to a certain bearing.

After the calibration stage, the operator may enter any bearing, followed by ST, and the computer will do its job. It will—

1) Turn on ac power to the rotator

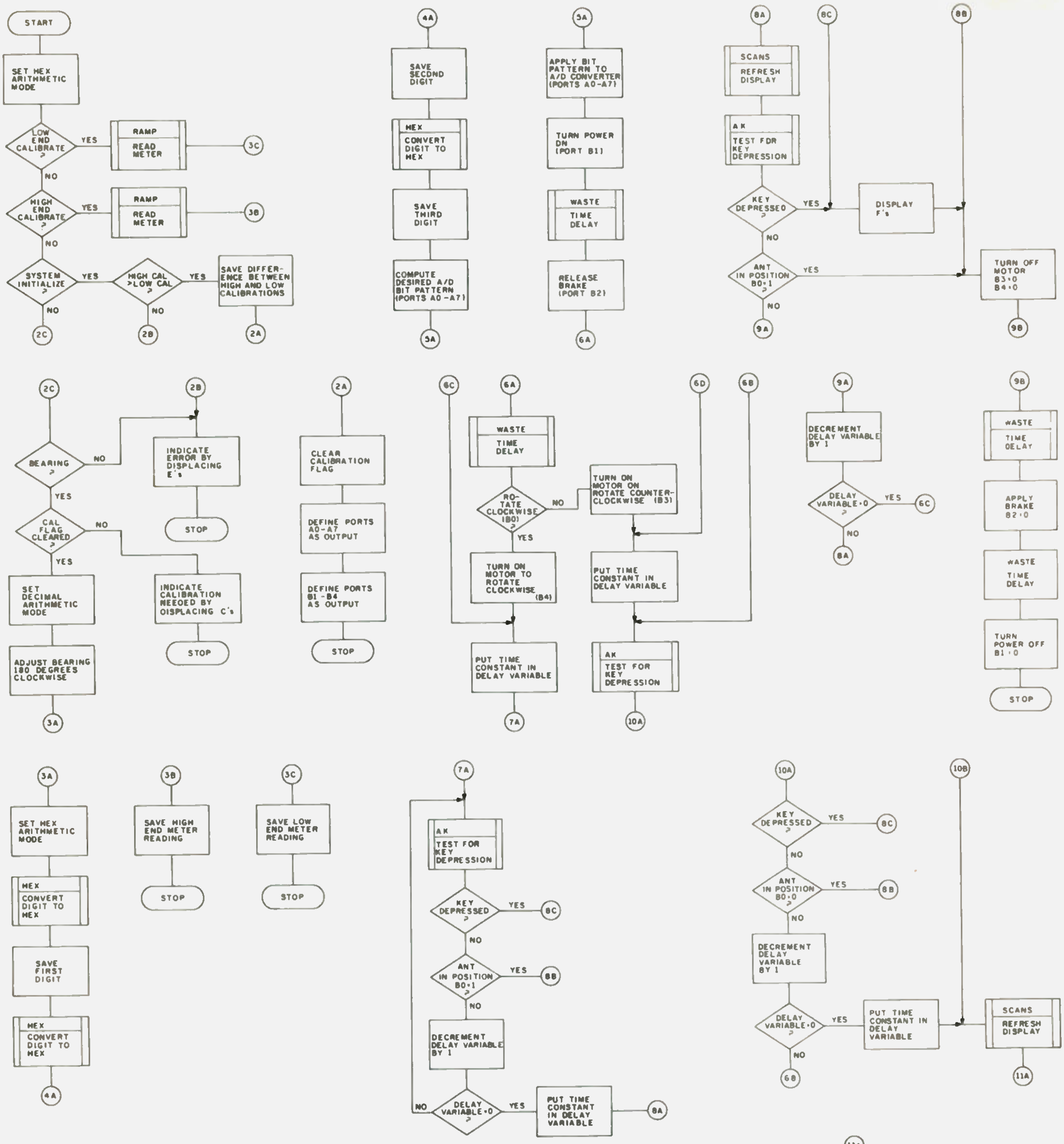
2) Release the brake

3) Turn the antenna to the desired bearing

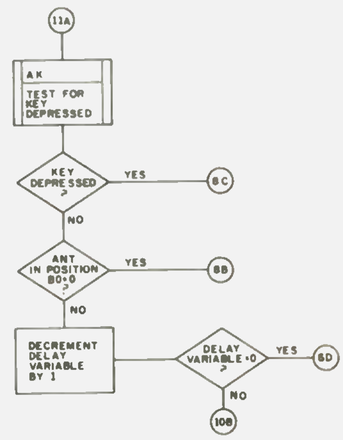
4) Reapply the brake

5) Turn off ac power to the control box

During the time that the antenna is in motion, the



Flowchart.



bearing which was entered by the operator will flash. When the flashing stops, the antenna is in position. A side benefit of this system is that a digital readout of the current antenna position will be shown whenever the antenna is not in motion.

Although the computer is always right, there are some errors which we humans may make. One is attempting to enter a bearing before performing the calibration steps. If we do this, the computer displays Cs, telling us that it will not respond because no calibration has been done. Another is entering a bearing which is not really the one we want and noticing it after the computer begins moving the antenna. We can either wait for the antenna to reach the wrong position and then enter the one we really wanted, or we can touch any key on the keyboard. When any key is touched during rotation, the computer assumes that we entered the wrong bearing and stops the antenna where it is so that we can

Program listing.

```
0020 A9   RAMP     LDA FF
0021 FF
0022 8D            STA 1701     define A0 thru A7 as output
0023 01
0024 17
0025 A9            LDA 00
0026 00
0027 8D            STA 1700     clear output
0028 00
0029 17
002A A0   LTRYAGN  LDY 10
002B 10
002C 88   LOOP10   DEY
002D D0            BNE LOOP10
002E FD
002F A9            LDA 01       test bit
0030 01
0031 2C            BIT 1702
0032 02
0033 17
0034 D0            BNE LGOTIT
0035 06
0036 EE            INC 1700
0037 00
0038 17
0039 4C            JMP LTRYAGN
003A 2A
003B 00
003C AD   LGOTIT   LDA 1700
003D 00
003E 17
003F 85            STA VRAMP
0040 09
0041 60            RTS
0050 A5            LDA VBSVH
0051 08
0052 E9            SBC 00
0053 00
0054 85            STA VBSVH
0055 08
0056 4C            JMP 3A1
0057 A1
0058 03
0059 85            STA VWORK1
005A 0C
005B A5            LDA VWORK2
005C 0D
005D E9            SBC 00
005E 00
005F 85            STA VWORK2
0060 0D
0061 4C            JMP 233
0062 33
0063 02
0064 A2            LDX FF
0065 FF
0066 CA   AGN      DEX
0067 D0            BNE AGN
0068 FD
0069 A9            LDA 01
006A 01
006B 2D            AND 1702
006C 02
006D 17
006E 4C            JMP 2FB
006F FB
0070 02
0071 A2            LDX FF
0072 FF
0073 CA            DEX
0074 D0            BNE AGN1
0075 FD
0076 A9            LDA 01
0077 01
0078 D2            AND 1702
0079 02
007A 17
007B 4C            JMP 363
007C 63
007D 03
0200 D8            CLD          set hex mode
0201 A5            LDA POINTH   high order characters
0202 FB
0203 C9            CMP 10       test for low end calibration
0204 10
0205 F0            BEQ LCALLOW  branch if so
0206 17
0207 CA            CMP 20       test for high end calibration
0208 20
0209 F0            BEQ LCALHI   branch if so
020A 1D
020B C9            CMP 30       test for set calibration
020C 30
020D F0            BEQ LSETCAL  branch if so
020E 23
020F C9            CMP 04       test for bearing
0210 04
0211 90            BCC LBEAR    branch if so
0212 39
0213 A9   LERROR   LDA EE       error code
0214 EE
0215 85   DISP     STA POINT
0216 F9
0217 85            STA POINTL
0218 FA
0219 85            STA POINTH
021A FB
021B 4C            JMP START    display error
021C 4F
021D 1C
021E 20   LCALLOW  JSR RAMP     get I/O value
021F 20
0220 00
0221 A5            LDA VRAMP    low end I/O value
```

enter the correct one. To show that it has stopped without reaching its goal, it displays Fs (failure to reach goal). Another possible error of major concern is that of entering a bearing which is greater than 360 degrees. If this happens, the computer displays Es and waits for a proper entry. The Es also will be displayed if we try to enter a command which it does not recognize (e.g., 5000 instead of 3000).

After the program is read into the computer, the following steps must be taken before the ST key will function. Place the values 00 and 02 in core locations 17FA and 17FB respectively. *This should be done immediately after the program is loaded into the computer.*

Most of the program is straightforward. However, some complexity was involved in determining when the antenna had reached the desired bearing. The approach taken to this problem was to have the microprocessor calculate and generate through the A/D converter a voltage corresponding to the desired bearing. The antenna is then rotated until the voltage from the rotator equals

```
0222 09
0223 85                STA VLOWEND     save it
0224 00
0225 4C                JMP START       exit
0226 4F
0227 1C
0228 20     LCALHI     JSR RAMP        get I/O value for high end
0229 20
022A 00
022B A5                LDA VRAMP
022C 09
022D 85                STA VHIEND      save it
022E 01
022F 4C                JMP START       exit
0230 4F
0231 1C
0232 A5     LSETCAL    LDA VHIEND      high calibration value
0233 01
0234 38                SEC             set for subtract
0235 E5                SBC VLOWEND     subtract low calibration value
0236 00
0237 90                BCC LERROR      error if values reversed
0238 DA
0239 85                STA VCALCONST   save difference
023A 02
023B A9                LDA 00          clear A
023C 00
023D 85                STA VCALFLAG    indicate calibration completed
023E 03
023F A9                LDA FF
0240 FF
0241 8D                STA 1701        set A0 thru A7 as output
0242 01
0243 17
0244 A9                LDA 1E
0245 1E
0246 8D                STA 1703        set B1 thru B4 as output
0247 03
0248 17
0249 4C                JMP START       exit
024A 4F
024B 1C
024C A5     LBEAR      LDA POINTL      low order bearing
024D FA
024E 38                SEC             prepare for subtract
024F F8                SED             set decimal mode
0250 E9                SBC 61          check for illegal bearing
0251 61
0252 A5                LDA POINTH
0253 FB
0254 E9                SBC 03
0255 03
0256 B0                BCS LERROR      report if bearing bad
0257 BB
0258 A5                LDA VCALFLAG    check for calibration performed
0259 03
025A F0                BEQ LCALDNE
025B 05
025C A9     LCAL       LDA CC
025D CC
025E 4C                JMP DISP
025F 15
0260 02
0261 4C                JMP 3C3
0262 C3
0263 03
0267 85                STA VBSVL
0268 07
0269 20                JSR HEX         convert to hex
026A 93
026B 03
026C A5                LDA VREM
026D 0A
026E 85                STA VHEXBRL     first digit
026F 0B
0270 20                JSR HEX
0271 93
0272 03
0273 06                ASL VREM        position second digit
0274 0A
0275 06                ASL VREM
0276 0A
0277 06                ASL VREM
0278 0A
0279 06                ASL VREM
027A 0A
027B 18                CLC
027C A5                LDA VHEXBRL
027D 0B
027E 65                ADC VREM
027F 0A
0280 85                STA VHEXBRL     place second digit
0281 0B
0282 20                JSR HEX         third digit
0283 93
0284 03
0285 66                ROR VREM
0286 0A
0287 66                ROR VHEXBRL     this is input in hex
0288 0B                                divided by 2
0289 A5                LDA VHEXBRL     compute A/D bit pattern
028A 0B
028B 85                STA VWORK1
028C 0C
028D A9                LDA 00
028E 00
028F 85                STA VWORK2
0290 0D
0291 A6                LDX VCALCONST
0292 02
0293 F0                BEQ LCAL        calibrate if constant equals zero
0294 C7
0295 CA     LOOP3      DEX
0296 F0                BEQ LDIV        branch if multiply complete
0297 10
0298 18                CLC             set for add
```

the voltage generated by the A/D converter. At this point, the antenna is pointing in the desired direction.

The first step in this process was to find an algorithm for computing the correct voltage for a given bearing. My rotator is set so that zero degrees is exactly mid-scale, with 180 degrees found at either extreme. To develop a linear correspondence between the bearing and the rotator voltage, it was first necessary to add 180 degrees to the input bearing. This calculation causes the lowest voltage to correspond to the smallest bearing figure after the addition. Since the A/D converter works in 256 steps across its range, we theoretically could find the proper bit pattern for generation of the bearing's voltage by using this formula: 255/360 × input bearing = bit pattern.

The only problem with this approach is that the lowest voltage generated by the A/D converter might not equal the lowest voltage from the rotator. Likewise, the highest voltages might not be equal. Compensation for this factor is included in the calculation. When the value 1000 is en-

```
0299 A5             LDA VWORK1
029A 0C
029B 65             ADC VHEXBRL
029C 0B
029D 85             STA VWORK1
029E 0C
029F A5             LDA VWORK2
02A0 0D
02A1 69             ADC 00
02A2 00
02A3 85             STA VWORK2
02A4 0D
02A5 4C             JMP LOOP3
02A6 95
02A7 02
02A8 A2    LDIV     LDX 00        clear for divide
02A9 00
02AA 38    LOOP4    SEC
02AB A5             LDA VWORK1
02AC 0C
02AD E9             SBC B4
02AE B4
02AF 4C             JMP 59
02B0 59
02B1 00
02B3 90             BCC LBDONE
02B4 04
02B5 E8             INX
02B6 4C             JMP LOOP4
02B7 AA
02B8 02
02B9 8A    LBDONE   TXA
02BA 18             CLC
02BB 65             ADC VLOWEND
02BC 00
02BD 8D             STA 1700      desired voltage
02BE 00
02BF 17
02C0 A9             LDA 02        power on
02C1 02
02C2 8D             STA 1702      turn on box
02C3 02
02C4 17
02C5 A9             LDA 08
02C6 08
02C7 85             STA VTIME     waste time
02C8 0E
02C9 20    LWASTE1  JSR WASTE
02CA 84
02CB 03
02CC C6             DEC VTIMER
02CD 0E
02CE D0             BNE LWASTE1
02CF F9
02D0 A9             LDA 06
02D1 06
02D2 8D             STA 1702      release brake
```

```
02D3 02
02D4 17
02D5 A9             LDA 04
02D6 04
02D7 85             STA VTIMER    waste time
02D8 0E
02D9 20    LWASTE2  JSR WASTE
02DA 84
02DB 03
02DC C6             DEC VTIMER
02DD 0E
02DE D0             BNE LWASTE2
02DF F9
02E0 A9             LDA 01        test bit
02E1 01
02E2 2D             AND 1702      check for left or right
02E3 02
02E4 17
02E5 F0             BEQ LRIGHT    rotate right
02E6 68
02E7 A9             LDA 0E        left motor
02E8 0E
02E9 8D             STA 1702      turn on motor
02EA 02
02EB 17
02EC A9    LMOTOR1  LDA FF
02ED FF
02EE 85             STA VWASTE1
02EF 0F
02F0 20    LOOP5    JSR AK
02F1 FE
02F2 1E
02F3 AA             TAX
02F4 D0             BNE LFAIL
02F5 4E
02F6 4C             JMP 64        test bit
02F7 64
02F8 00
02FB F0             BEQ LOFF
02FC 1F
02FD C6             DEC VWASTE1
02FE 0F
02FF D0             BNE LOOP5
0300 EF    you have now punched in about half of the program!!!
0301 A9             LDA 50
0302 50
0303 85             STA VWASTE1
0304 0F
0305 20    LOOP6    JSR SCANS     refresh display
0306 1F
0307 1F
0308 20             JSR AK
0309 FE
030A 1E
030B AA             TAX
030C D0             BNE LFAIL
030D 36
```

tered into the computer, it generates a series of voltages, beginning with the least possible voltage and stopping when the generated voltage is equal to the rotator voltage. Since at this time the meter should be at its lowest point, as set by the operator, we have the bit pattern representing this position. The same is true for the high end of the meter operation. When the value 2000 is entered, the same series of voltages is generated by the computer, stopping when the generated value is equal to the sample from the rotator. We then have a bit pattern representing the highest point of meter movement. By subtracting these two values, we find a value, K, which we can use in the following formula: K/360 × input bearing = X.

When the value X from this formula is added to the bit pattern representing the lowest point of meter movement, a bit pattern representing the desired bearing results. This pattern can then be applied to the A/D converter and the rotator stopped when the sample voltage from the meter becomes equal to the voltage generated by the converter. Since I/O port B0 is connected to the output of a comparator which com-

```
030E A9            LDA 01        test bit
030F 01
0310 2D            AND 1702
0311 02
0312 17
0313 F0            BEQ LOFF      shut off if voltage OK
0314 07
0315 C6            DEC VWASTE1
0316 0F
0317 D0            BNE LOOP6
0318 EC
0319 4C            JMP LMOTOR1
031A EC
031B 02
031C A9   LOFF     LDA 06
031D 06
031E 8D            STA 1702      shut off motor
031F 02
0320 17
0321 A9            LDA 10
0322 10
0323 85            STA VTIMER
0324 0E
0325 20   LWASTE3  JSR WASTE     waste time
0326 84
0327 03
0328 C6            DEC VTIMER
0329 0E
032A D0            BNE LWASTE3
032B F9
032C A9            LDA 02
032D 02
032E 8D            STA 1702      apply brake
032F 02
0330 17
0331 A9            LDA 04
0332 04
0333 85            STA VTIMER
0334 0E
0335 20   LWASTE4  JSR WASTE     waste time
0336 84
0337 03
0338 C6            DEC VTIMER
0339 0E
033A D0            BNE LWASTE4
033B F9
033C A9            LDA 00
033D 00
033E 8D            STA 1702      power down box
033F 02
0340 17
0341 4C            JMP START     exit
0342 4F
0343 1C
0344 A9   LFAIL    LDA FF        fail code
0345 FF
0346 85            STA F9
```

```
0347 F9
0348 85            STA FA
0349 FA
034A 85            STA FB
034B FB
034C 4C            JMP DISP      display fail code
034D 1C
034E 03
034F A9   LRIGHT   LDA 16        right motor
0350 16
0351 8D            STA 1702
0352 02
0353 17
0354 A9   LMOTOR2  LDA FF
0355 FF
0356 85            STA VWASTE1
0357 0F
0358 20   LOOP7    JSR AK
0359 FE
035A 1E
035B AA            TAX
035C D0            BNE LFAIL
035D E6
035E 4C            JMP 71        test bit
035F 71
0360 00
0363 D0            BNE LOFF
0364 B7
0365 C6            DEC VWASTE1
0366 .0F
0367 D0            BNE LOOP7
0368 EF
0369 A9            LDA 50
036A 50
036B 85            STA VWASTE1
036C 0F
036D 20   LOOP8    JSR SCANS     refresh display
036E 1F
036F 1F
0370 20            JSR AK
0371 FE
0372 1E
0373 AA            TAX
0374 D0            BNE LFAIL
0375 CE
0376 A9            LDA 01        test bit
0377 01
0378 2D            AND 1702
0379 02
037A 17
037B D0            BNE LOFF      shut off if voltage OK
037C 9F
037D C6            DEC VWASTE1
037E 0F
037F D0            BNE LOOP8
0380 EC
0381 4C            JMP LMOTOR2
```

pares the sample voltage from the rotator with the voltage generated by the A/D converter, examination of the port determines the direction of rotation. In this case, a value of 0 indicates that counterclockwise rotation is needed until that port becomes a 1. If 1 is the original value, then clockwise rotation is needed until that port changes to a value of 0.

Another problem to be considered is that the KIM is much faster at issuing requests to the electronic devices than those devices are at accepting the commands. For example, the computer could issue I/O to release the brake and then issue I/O to turn on the motor long before the mechanical action of removing the brake was completed. To adjust for this type of situation, we placed various delay loops in the program. Some of these may be of interest because the length of each delay was arbitrarily selected. Table 1 lists the addresses which can be modified to change the various time delays which apply to the rotator controls. Placing a higher value in any of these locations will increase the time delay, while a smaller value will decrease the delay.

```
0382 54
0383 03
0384 A9        WASTE      LDA FF         waste time
0385 FF
0386 85                   STA VWASTE 3
0387 11
0388 85        LOOP10     STA VWASTE2
0389 10
038A 20        LOOP9      JSR SCANS
038B 1F
038C 1F
038D C6                   DEC VWASTE3
038E 11
038F D0                   BNE LOOP9
0390 F9
0391 60                   RTS
0393 F8        HEX        SED            compute one hex digit
0394 A2                   LDX 00
0395 00
0396 38        LSUB       SEC
0397 A5                   LDA VBSVL
0398 07
0399 E9                   SBC 16
039A 16
039B 85                   STA VBSVL
039C 07
039D 4C                   JMP 50
039E 50
039F 00
03A1 90                   BCC LADD
03A2 08
03A3 8A                   TXA
03A4 18                   CLC
03A5 69                   ADC 01
03A6 01
03A7 AA                   TAX
03A8 4C                   JMP LSUB
03A9 96
03AA 03
03AB 4C        LADD       JMP 3EE
03AC EE
03AD 03
03AE 86                   STX VBSVL
03AF 07
03B0 85                   STA VREM
03B1 0A
03B2 38                   SEC
03B3 E9                   SBC 10
03B4 10
03B5 30                   BMI LRET
03B6 06
03B7 D8                   CLD
03B8 18                   CLC
03B9 69                   ADC 0A
03BA 0A
03BB 85                   STA VREM
03BC 0A
```

```
03BD D8        LRET       CLD
03BE A9                   LDA 00
03BF 00
03C0 85                   STA VBSVH
03C1 08
03C2 60                   RTS
03C3 A5                   LDA POINTL
03C4 FA
03C5 18                   CLC
03C6 F8                   SED
03C7 69                   ADC 80
03C8 80
03C9 85                   STA VPTL
03CA 12
03CB A5                   LDA POINTH
03CC F8
03CD 69                   ADC 01
03CE 01
03CF 85                   STA VPTH
03D0 13
03D1 38                   SEC
03D2 A5                   LDA VPTL
03D3 12
03D4 E9                   SBC 60
03D5 60
03D6 85                   STA VWORK1
03D7 0C
03D8 A5                   LDA VPTH
03D9 13
03DA E9                   SBC 03
03DB 03
03DC 90                   BCC LRDY
03DD 06
03DE 85                   STA VPTH
03DF 13
03E0 A5                   LDA VWORK1
03E1 0C
03E2 85                   STA VPTL
03E3 12
03E4 D8        LRDY       CLD
03E5 A5                   LDA VPTH
03E6 13
03E7 85                   STA VBSVH
03E8 08
03E9 A5                   LDA VPTL
03EA 12
03EB 4C                   JMP 267
03EC 67
03ED 02
03EE A5                   LDA VBSVL
03EF 07
03F0 18                   CLC
03F1 69                   ADC 16
03F2 16
03F3 4C                   JMP 3AE
03F4 AE
03F5 03
```

Power Supply

The power supply we used for the KIM was the same one that was supplied with the unit when we purchased it. For the I/O devices, we used a dual-polarity adjustable bench supply that I normally use to operate the various projects in the ham shack. We set the supply to plus and minus 9 volts. A more permanent supply can be constructed but it must be regulated and must be dual polarity. This can be done easily with two 9-volt regulator chips. The minus regulator needs to supply about 50 milliamps, but the positive regulator must be able to operate the relays, and about 250 milliamps was satisfactory in our unit.

Although this unit was sufficient for our purposes, an ASCII keyboard and 4K of memory could be added to the system. A bearing table for DX calls could be placed in the additional memory. By entering the call prefix, the computer could be directed to look up the proper bearing and automatically rotate the antenna. By including more data in the bearing table, the computer could even display the approximate distance to the DX station. ■

DEALER DIRECTORY

Fontana CA

We carry the following: ICOM, Midland, Amcom, DenTron, KLM, Swan, Drake, Ten-Tec, Wilson, SST, MFJ, Hy-Gain, Lunar, Nye-Viking, B&W, Redi-kilowatt, CushCraft, Mosley, Big Signal, Pipo, etc. Full Service Store **Fontana Electronics, 8628 Sierra Ave., Fontana CA 92335, 822-7710.**

San Jose CA

Bay area's newest Amateur Radio store. New & used Amateur Radio sales & service. We feature Kenwood, ICOM, KDK, Yaesu, Ten-Tec, VHF Engineering & many more. **Shaver Radio, Inc., 1378 So. Bascom Ave., San Jose CA 95128, 998-1103.**

San Leandro CA

Specializing in Amateur Radio Test Guides. F.C.C. Advanced Class test is a snap with our manual. **Bash Educational Services, 15373 Edgemoor St., P.O. Box 382, San Leandro CA 94577.**

Denver CO

Experimenter's paradise! Electronic and mechanical components for computer people, audio people, hams, robot builders, experimenters. Open six days a week. **Gateway Electronics Corp., 2839 W. 44th Ave., Denver CO 80211, 458-5444.**

New Castle DE

ICOM, Ten-Tek, Swan, KDK, NDI, Tempo, Wilson; Authorized dealer: 1 mile off I-95. No sales tax. **Delaware Amateur Supply, 71 Meadow Road, New Castle DE 19720, 328-7728.**

Columbus GA

KENWOOD—YAESU—DRAKE

The world's most fantastic amateur showroom! You gotta see it to believe it! **Radio Wholesale, 2012 Auburn Avenue, Columbus GA 31906, 561-7000.**

Boise ID

Adzen, Amidon, Ameco, ARRL, B&W, Callbook, Collins, CushCraft, Dentron, Hustler, ICOM, Jim-Pak, KDK, MFJ, NPC, Nye, Sams, SST, Swan, Ten-Tec, Wanzer, Wilson. **Custom Electronics, 1209 Broadway, Boise ID 83706, Bob W7SC 344-5084.**

Preston ID

Ross WB7BYZ, has the Largest Stock of Amateur Gear in the Intermountain West and the Best Prices. Call me for all your ham needs. **Ross Distributing, 78 So. State, Preston ID 83263, 852-0830.**

Terre Haute IN

Your ham headquarters located in the heart of the midwest. **Hoosier Electronics, Inc.Q 43B Meadows Shopping Center, P.O. Box 2001, Terre Haute IN 47802, 238-1456.**

Littleton MA

The ham store of N.E. you can rely on. Kenwood, ICOM, Wilson, Yaesu, DenTron, KLM amps, B&W switches & wattmeters, Whistler radar detectors, Bearcat, Regency, antennas by Larsen, Wislon, Hustler, GAM. TEL-COM Inc. **Communications & Electronics, 675 Great Rd., Rt. 119, Littleton MA 01460, 486-3040.**

Laurel MD

Kenwood, Drake, ICOM, Ten-Tec, Swan, Dentron, Tempo and many ham accessories. Also computers by Apple and Exidy. Call toll free 1-800-638-4486. **The Comm Center, Inc., Laurel Plaza—Rt. 198, Laurel MD 20810.**

St. Louis MO

Experimenter's paradise! Electronic and mechanical components for computer people, audio people, hams, robot builders, experimenters. Open six days a week. **Gateway Electronics Corp., 8123-25 Page Blvd., St. Louis MO 63130, 427-6116.**

Camden NJ

X-band (& other frequencies) Microwave Components & Equipment. Laboratory Grade Test Instruments, Power Supplies, 1000's in stock at all times, BUY & SELL all popular makes—HP, GR, FXR, ESI, Sorensen, Singer, etc. **Lectronic Research Labs, 1423 Ferry Ave., Camden NJ 08104, 541-4200.**

Syracuse—Central NY

We deal, we trade, we discount, we please! Yaesu, Ten-Tec, Cushcraft, Drake, Dentron, KLM, Midland, B&W, ICOM, Hygain, Swan, Amcom, Telco, Mirage, DSI etc. Complete 2-way service shop! **Ham-Bone Radio (Div. Stereo Repair Shop) 3206 Erie Blvd. East, Syracuse NY 13214, 446-2266.**

Syracuse-Rome-Utica NY

Featuring: Yaesu, ICOM, Drake, Atlas, DenTronn, Ten-Tec, Swan, Tempo, KLM, Hy-Gain, Mosley, Wilson, Larsen, Midland Southwest Technical Products. You won't be disappointed with equipment/service. **Radio World, Oneida County Airport-Terminal Building, Oriskany NY 13424, 337-2622.**

Phila. PA/Camden NJ

Waveguide & coaxial microwave components & equipment. Laboratory grade test instruments, power supplies. Buy, sell & trade all popular makes, HP, GR, FXR, ESI, Sorensen, Singer, etc. **Lectronic Research Labs., 1423 Ferry Ave., Camden NJ 08104, 541-4200.**

Columbus OH

All major brands featured in the biggest and best ham store for miles around. Come in and twist the knobs before you buy. We ship U.P.S. too. **Universal Amateur Radio, Inc., 1280 Aida Dr., Reynoldsburg (Columbus) OH 43068, 866-4267.**

Houston TX

Experimenter's paradise! Electronic and mechanical components for computer people, audio people, hams, robot builders, experimenters. Open six days a week. **Gateway Electronics INc., 8932 Clarkcrest, Houston TX 77063, 978-6575.**

San Antonio TX

Complete 2 way service shop. Call Dee, W5FSP. Selling Antenna Specialists, Avanti, Azden, Bird, Hy-gain, Standard communications, Genave, Henry, CushCraft, Hustler, ICOM, KDK, MFJ, Nye, Shure, Swan, Tempo, Ten-Tec and others. **Appliance & Equipment Co., Inc., 2317 Vance Jackson Road, San Antonio TX 78213, 734-7793.**

Davenport WA

Preassembled all band antennas 160m/10m. Trap models start at $36.50, no trap models start at $54.50. Complete ham radio repair and parts. **Electronic Communications Service Co., Rt. 1-78K, Davenport WA 99122, 725-6822.**

Port Angeles WA

Mobile RFI shielding for elimination of ignition and alternator noises. Bonding straps. Components for "do-it-yourself" projects. Plenty of free advice. **Estes Engineering, 930 Marine Drive, Port Angeles WA 98362, 457-0904.**

DEALERS

Your company name and message can contain up to 25 words for as little as $150 yearly (prepaid), or $15 per month (prepaid quarterly). No mention of mail-order business or area code permitted. Directory text and payment must reach us 60 days in advance of publication. For example, advertising for the July issue must be in our hands by May 1st. Mail to 73 Magazine, Peterborough NH 03458. ATTN: Aline Coutu.

✓Reader Service—see page 226

Dennis Mitchell K8UR
520 N. Hamilton Street
Ypsilanti MI 48197

Antenna Engineer

—predict performance of phased arrays with a TRS-80

This article is intended for use with a TRS-80 Level II 16K. The program listing is for the amateur who is interested in designing his own array of antennas and predicting the polar plot ahead of time. This ability to predict and create graphic displays on the TRS-80 saves me many hours which previously were spent in building antenna arrays—many of which never quite worked as I had hoped.

The program is set up for an array of up to 10 elements to be plotted, but with only a few program changes, it can calculate and plot any number of elements. All inputs to the program are prompted.

The program needs only five pieces of input information as described below.

1) The number of elements in the array.

2) The relative phase of each element. This is the phasing that each element in the array receives compared to the reference element. The reference element can be any element in the array, and is chosen by the user; all measurements of phase are referenced against it. The phase of the reference element is automatically made zero (0) degrees. The phase of each element in the rest of the array is then the difference in phasing in degrees from the chosen reference element. The examples will make this clear.

3) The angles of elements. The angle of the element is the angle which is made from the user's view of the antenna placement (See Fig. 1).

4) The relative amplitudes of elements. This is how much power each of the elements is getting compared to the reference element. If element #2 is getting the same amount of power as the reference, then the response to the program would be (1). If the element in question were getting twice as much power as the reference, then the reply to the program when asked this question would be (2), and so on.

5) Spacing to an element. This is the spacing, in degrees, from the reference element located at the center of the X-Y coordinate system to the element in question. If you are used to thinking in terms of spacing as parts of a wavelength then remember this: Spacing in degrees = 360° times spacing in parts of wavelength: 360 x .2λ = 72°.

To help clarify any of the above programming steps, refer to Fig. 2 and also to photo A which is the polar plot of the well-known two-element beam, with (1) 90-degree lagging phase, (2) equal power division, and (3) placed at 45 degrees in direction and .25λ, or 90°, from the reference element. The photo shows the cardioid pattern that accompanies the two-element beam. Fig. 2. shows also that the beaming action is at 45 degrees on our coordinate system, with the second element being placed in that direction and having a phase difference of 90

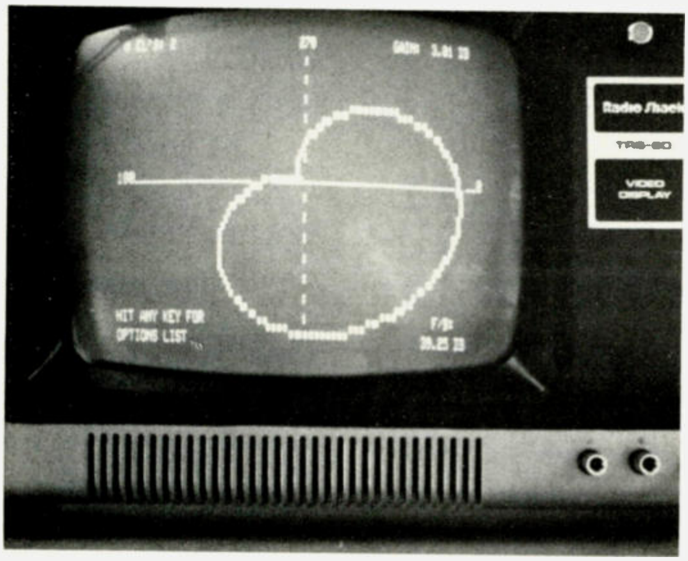


Photo A. Polar plot of two-element array.

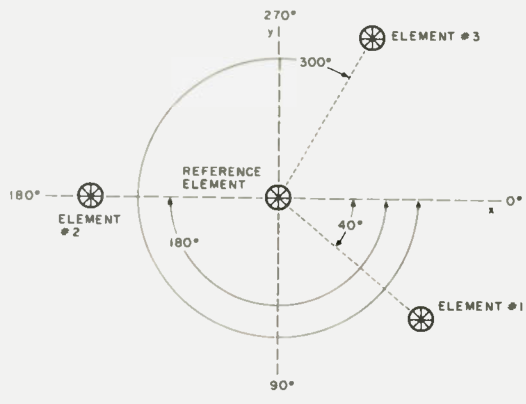


Fig. 1. The reference element is always centered on the X-Y coordinate system. All other element placements are measured as shown here.

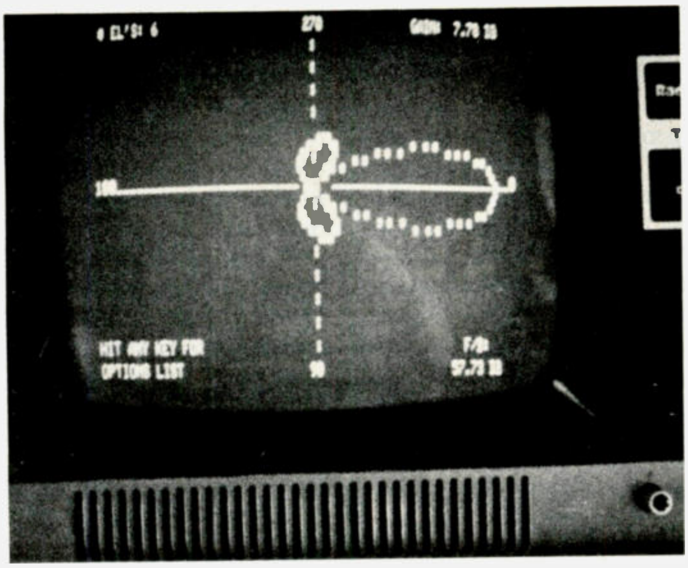


Photo B. Bobtail curtain with equal power division.

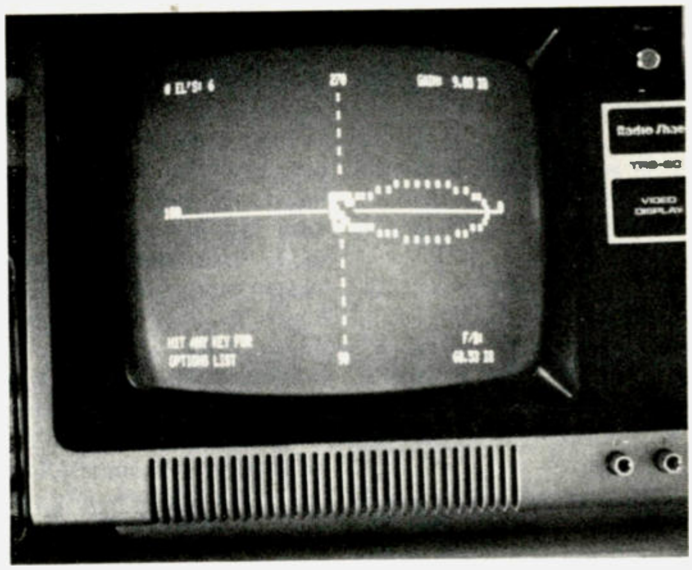


Photo C. Bobtail curtain with unequal power division.

degrees (−90 from reference).

The correct response to the program for a design of this two-element beam would be as follows:

- Relative phase of element #2? −90
- Angle to element #2? 45
- Relative amplitude to element #2? 1
- Spacing to element #2? 90
- Number of elements? 2

The program is very easy to use once the input parameter definitions as just outlined are known.

Lines 20 to 540 are simply inputs and their various formatting. Lines 560 to 780 compute the partials from each element to the total pattern of the array. Lines 820 to 920 are format to start the graphics plot routine. Lines 920 to 1060 scale the pattern to be plotted to fit into the TRS-80 picture format and then start the plot to the screen. The rest of the program consists of various formatting to display the different output routines from the program.

The program will give the

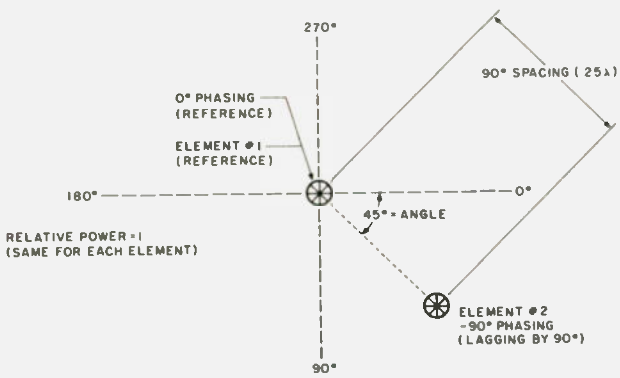


Fig. 2.

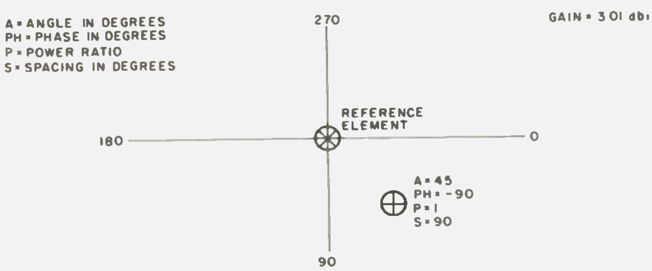


Fig. 3. Bird's-eye view of two-element antenna array placement.

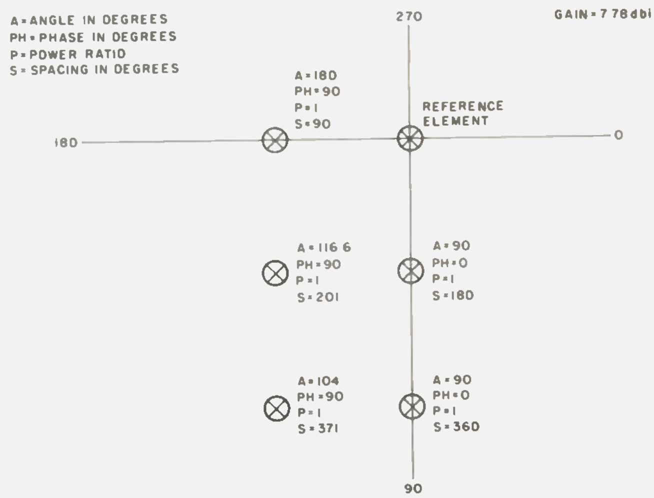


Fig. 4. Bird's-eye view of vertical element placement of Bobtail curtain, equal power division.

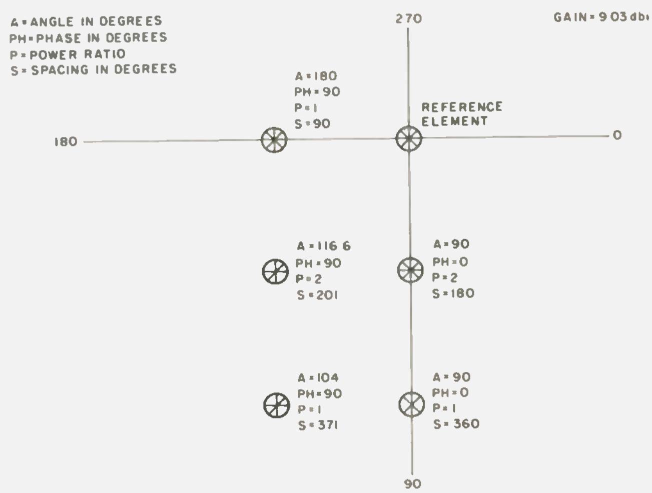


Fig. 5. Same as Fig. 4, with unequal power division.

following outputs at any time during the program once the initial plotting has been done:

- Plot pattern.
- Give gain data every 30 degrees.
- Give gain data every 2 degrees.
- Restart another array design.
- Give graphic element placement of the designed array.
- Give element parameter recap.

Fig. 4 and Fig. 5 and Photos B and C show the variations obtained with the Bobtail curtain antenna, changing only the power division (holding every other parameter constant). It can be seen readily that the correct division for best pattern and gain is in Fig. 5 and Photo C.

The Antenna Designer program can save many hours of field work by computer-designing an antenna idea. With this and imagination, some helpful inputs to one's antenna intuition should come.

There are some assumptions made when using this program that should be mentioned, however. The first is that all elements are assumed to be point sources (isotropic) and the actual pattern developed by most real-life elements is not isotropic. A vertical antenna at ground level can closely compare to an isotropic source better than most and has been my major line of study with this program. Second, the added beaming effect introduced by radiation outside of the plane in which the array lies, is not considered. And third, the problems of mutual coupling among the elements in the array are not considered.

Even with these assumptions, the program closely describes the field-strength patterns from every comparison made to date, and their being neglected should not alter much the pattern or gain of any amateur antenna attempted.

I have cataloged over 200 polar plots using a similar program written in Fortran, for variations of 2 to 10 elements. In all cases, they are essentially identical to other published patterns.

If the reader does not cherish the thought of retyping the listed program, a cassette on quality tape is available from me for $8.00. ■

Bibliography

1. "HP-67/97 Plots Antenna's Polar Pattern," *Electronics Magazine*, September 13, 1979.
2. W. L. Weeks, *Antenna Engineering*, McGraw-Hill, 1968.
3. J. Kraus, *Antennas*, McGraw-Hill, 1950.
4. *ARRL Antenna Handbook*.


```
20 CLS
30 GOSUB1780
180 CLEAR 300
200 DIM GN(360),GM(360):AR=1:BB=2:RD=.0174533:CV=58:CH=95
220 VI=15360:ZL=10:F$="###.##":FI=0
240 G$="##.#####":HY$=STRING$(64,"-"):BL$=STRING$(64," "):B$=LEF
T$(BL$,15)
260 PRINT"INPUT NUMBER OF ELEMENTS  (MAX. 10)";:INPUT NI
280 IF NI=0 OR NI>10 THEN 260
300 CU=(NI+3)*64:GOSUB1440
320 FOR N=2 TO NI
340   PRINT@CU,"INPUT RELATIVE PHASE OF ELEMENT#";N;
360   INPUT A(N):GOSUB 1500:PRINT@(N+1)*64+14,A(N);
380   PRINT@CU,"INPUT ANGLE OF ELEMENT #";N;
400  INPUT O(N):GOSUB 1500:PRINT@(N+1)*64+28,O(N);
420  PRINT@CU,"INPUT RELATIVE AMPLITUDE OF ELEMENT #";N;
440  INPUT R(N):GOSUB 1500:PRINT@(N+1)*64+42,R(N);
460  PRINT@CU,"INPUT SPACING OF ELEMENT #";N;
480  INPUT B(N):GOSUB 1500:PRINT@(N+1)*64+56,B(N);
500  AN$="":PRINT@CU,"";:INPUT"IS THIS DATA CORRECT";AN$
520 IF AN$=""OR LEFT$(AN$,1)="Y",NEXT ELSE 340
540 GOSUB 1500:GOSUB1680
560 ZM=0:PRINT@896,"NOW CALCULATING FOR";
580 PRINT@965,"DEGREE BEARING";
600 FOR J=0 TO 360STEP2
620  PRINT@960,J;
640  FOR N=2 TO NI
660    C=(B(N)*COS((O(N)-J)*RD)+A(N))*RD
680    HO=COS(C)*R(N)+HO:VT=SIN(C)+VT
700    GN(J)=SQR((AR+HO)[BB+(VT[BB))
720    IFGN(J)>ZM,ZM=GN(J):P1=J
740    IFGN(J)<ZL,ZL=GN(J):P2=J
760  NEXT
780  VT=0:HO=0
800 NEXT
820 IFP1>=180THENP3=P1-180ELSEP3=P1+180
840 CLS:FORI=0TO15:POKE15392+(I*64),CV:NEXT
860 FORI=15808TO15871:POKEI,CH:NEXT
880 PRINT@511,"0";:PRINT@991,"90";:PRINT@448,"180";:
    PRINT@31,"270";
900 PRINT@960,"PLOTTING:";
920 FOR M=0 TO 360 STEP2
940 IF FI=0 THEN GM(M)=GN(M)
960   GN(M)=(23/ZM)*GN(M)
980   PRINT@968,M;
1000    X=COS(M*RD)*GN(M)*2.5:IFX<-64,X=-64:IFX>64,X=64
1020    Y=SIN(M*RD)*GN(M):IFY<-23,Y=-23:IFY>23,Y=23
1040    SET(64+X,23+Y)
1060  NEXT
1080 DB=10*(LOG(ZM)/LOG(10)):FB=10*(LOG(GM(P1)/GM(P3))/LOG(10))
1100 IF FI=0 THEN DC=DB
1120 PRINT@0,"# EL'S:";NI;:PRINT@48,"GAIN:";:PRINTUSINGF$;DC;:PR
INT" DB";:PRINT@951,"F/B:";:PRINT@1012,USINGF$;FB;:PRINT" DB";
1140 FI=1
1160 PRINT@896,"HIT ANY KEY FOR";:PRINT@960,"OPTIONS LIST";
1180 IF INKEY$=""THEN GOTO 1180
1200 CLS:PRINT@4,"ENTER";:PRINT@64,"1) PLOT PATTERN";:PRINT@128,
"2) GAIN EVERY 30 DEG.";:PRINT@192,"3) GAIN EVERY 2 DEG.";:PRINT@
256,"4) NEW START";:PRINT@320,"5) ELEMENT PLACEMENT";:PRINT@384,"
6) ELEMENT DATA"
1220 X=0:Y=0:INPUTLL:IFLL=1,ZM=23ELSE IFLL=3,J=2
1240 ON LL GOTO 840,1280,1340,1540,1560
1260 GOSUB 1440:GOTO1160
1280 CLS:PRINTTAB(20)"SYNOPSIS OF GAIN DATA":PRINTHY$;
1300 J=30:REM DEGREE STEP
1320 PRINT,"DEGREE","PWR. GAIN.","DB(I) GAIN"
1340 FORI=0TO360 STEP J
1360   PRINTTAB(16);I,:PRINTUSINGG$;GM(I),:IFGM(I)>=0PRINT,10*(L
OG(GM(I)) /LOG(10))
1380 NEXT
1400 GOTO 1160
1420 END
1440 CLS:PRINTHY$;:PRINT"EL.#";TAB(14);"PHASE";TAB(28);"ANGLE";
     TAB(42);"AMPL.";TAB(56);"SPACING":PRINTHY$;
1460 FOR I=2TONI:PRINTI;TAB(14);A(I);TAB(28);O(I);TAB(42);R(I);
     TAB(56);B(I):NEXT:PRINTHY$;
1480 RETURN
1500 PRINT@CU,BL$;:RETURN
1520 FOR I=CU TO 869 STEP64:PRINT@I,BL$;:NEXT:RETURN
1540 CLS:CLEAR: RUN180
1560 FOR PL=2 TO NI+1:IF B(PL)>BG,BG=B(PL):NEXT
1580 CLS:PRINT@511,"0";:PRINT@991,"90";:PRINT@448,"180";:PRINT@3
1,"270";:FOR RL=2 TO NI:XX=COS(O(RL)*RD)
1600 XX=XX*B(RL)/BG*56+64
1620 YY=SIN(O(RL)*RD)*B(RL)/BG*18+22:SET(XX,YY):SET(XX+1,YY+1):S
ET(XX-1,YY-1):SET(XX+1,YY-1):SET(XX-1,YY+1)
1640 NEXT RL
1660 FOR V=1TO20: SET(64,22):SET(65,23):SET(63,21):SET(65,21):SE
T(63,23):NEXT:FOR VV=1TO20:RESET(65,23):RESET(63,21):RESET(65,21)
:RESET(63,23):NEXT:IF INKEY$="",PRINT@896,"HIT ANY KEY TO";:PRINT
@960,"CONTINUE";:GOTO1660ELSE1160
1680 FOR PL=2TONI+1:IF B(PL)>BG,BG=B(PL):NEXT
1700 PRINT@896,"HIT ANY KEY TO";:PRINT@960,"CONTINUE";:IF INKEY$
=""THEN GOTO1700
1720 CLS:PRINT@511,"0";:PRINT@991,"90";:PRINT@448,"180";:PRINT@3
1,"270";
1740 FOR RL=2TONI:XX=COS(O(RL)*RD):XX=XX*B(RL)/BG*56+64:YY=SIN(O
(RL)*RD)*B(RL)/BG*18+22:SET(XX,YY):SET(XX+1,YY+1):SET(XX-1,YY-1):
SET(XX+1,YY-1):SET(XX-1,YY+1):SET(64,22):NEXT
1760 RETURN
1780 CLS:PRINTCHR$(23):PRINT@532,"RAM-";:FORI=1TO600:NEXT:PRINT@
532,B$:PRINT@538,"-TENNA":FORI=1TO600:NEXT:PRINT@538,B$:PRINT@532
,"RAM-";:FORI=1TO300:NEXT:PRINT@540,"TENNA";:PRINT@960,"";:FORJ=1
TO8:PRINT:FORI=1TO300:NEXT:NEXT:GOTO1800
1800 PRINT@518,"POLAR PLOTTING PROGRAM":PRINT@586,"FOR DRIVEN AR
RAYS":GOTO1820
1820 PRINT@960," 1979 - D.C.MITCHELL - K8UR";:FORI=1TO1500:NEXT:
CLS:PRINTCHR$(28)
1830 PRINT"     THIS PROGRAM LETS THE USER DESIGN HIS OWN PHASED
 ANTENNA   ARRAYS UP TO 10 ELEMENTS.  MORE ELEMENTS MAY BE USED B
Y CHANGING THE '10' IN LINE 280 TO THE DESIRED NUMBER OF ELEMENTS
."
1840 PRINT"     TO DESIGN AN ARRAY, PLACE THE ELEMENTS OUT AS DE
SIRED USING A 'BIRDS EYE' VIEW OF THE ARRAY AND AN X-Y  COORDINAT
E  SYSTEM WITH 0-DEGREES AT THE RIGHT,270 AT TOP,180 AT LEFT AND
90 DEGREEAT BOTTOM."
1850 PRINT"     THE PROGRAM WILL ASK YOU PHASE,ANGLE,AMPLITUDE A
ND SPACING.PHASE IS (-) FOR LAGGING PHASE AND (+) FOR LEADING  PH
ASE.PHASE IS IN DEGREES FROM THE REFERENCE ELEMENT. CHOOSE ONE  E
LEMENT OF THE ARRAY AS A REFERENCE."
1855 PRINT@960,"HIT ENTER TO CONTINUE";:INPUTUU$:CLS
1860 PRINT"     (ALL MEASUREMENTS FOR THE OTHER ELEMENTS WILL BE
 TAKEN FROM THE REFERENCE ELEMENT CHOSEN).ANY ELEMENT WILL DO. TH
E ANGLE IS THE ANGLE BETWEEN THE (0)DEGREE HEADING OF YOUR X-Y CO
ORDINATE, ";
1861 PRINT" THE REFERENCE ELEMENT WHICH IS ALWAYS AT THE CENTER
OF THE X-Y COORDINATE, AND THE ELEMENT IN QUESTION."
1870 PRINT"     THE AMPLITUDE IS THE AMOUNT OF POWER WHICH THE
ELEMENT IN QUESTION RECEIVES COMPARED TO YOUR REFERENCE.  IT IS E
XPRESSED  AS A RATIO.  THE REFERENCE ELEMENT ALWAYS GETS 1:1 POWE
R SO IF"
1875 PRINT" ELEMENT 2 WERE TO GET TWICE AS MUCH POWER, YOUR INPU
T WOULD BE (2) FOR AMPLITUDE.THE SPACING IS HOW FAR THE ELEMENT I
N QUESTION IS FROM THE REFERENCE IN DEGREES."
1880 PRINT"     SEE POOP-SHEET FOR ANY LAYOUT PROBLEMS.

1890 PRINT@960,"HIT ENTER TO CONTINUE";:INPUTUU$:CLS
1900 RETURN
```

Program listing.

baud without missing one character. If you have to take the printer off line (out of paper, etc.), the computer will loop in the program and never lose one character.

Relocating the program to another location should be easy, as the program is completely relocatable. This program is a subroutine, so all you have to do is load the A accumulator with the ASCII character to be printed and execute this program using the BSR instruction (BSR #$C4A8).

Program Description

The program's main line starts at LOC. 'C4A8'; it ends at LOC. 'C4BC'. After the ACIA device has been tested to see if it is free to receive more data, accumulator A is stored in the device's data register '801D'. The program then performs a subroutine that tests the interrupt (handshake) codes (LOC. C4BD through C4DE).

This interrupt subroutine not only takes care of the interrupt codes, but also deals with an inherent timing problem automatically created by the moving printhead and data transmission. TAG "TIME1" and "NEXT1" will adjust this delay I mentioned. Did I say delay? I mean timing. TAG "BITDLY" adjusts the timing problem. Decreasing or increasing the 04 count may cause the interrupt subroutine to miss the handshake signals (hex 11 or hex 13) and, therefore, cause garbage to be printed.

TAG "CLRDEV" really does not need any explanation, as it initially clears and programs the ACIA device.

Now I'm looking for a way to use the SWTP CT-64 at a higher baud rate, say 4800.■

✓Reader Service—see page 226

MOM'S Inventory Clearance SALE

MAIL ORDER MICROS ✓53
Dept. 573 • PO Box 427 • Marlboro NH 03455
Phone: (603) 924-3041

IMSAI HARDWARE

1 **IMSAI 8800 Mainframe** S-100—Excellent condition. #D0087-$839.

1 **IMSAI 80/15 S-100 Development System**—Partially assembled, needs a CPU card, excellent condition. #S0088-$525 as is. **SPECIAL PRICE**.

1 **IMSAI 80/15 S-100 Development System**—Kit, mainframe cover missing, needs a CPU card, excellent condition. #S0089-$500 as is. **SPECIAL PRICE**.

2 **IMSAI 4K RAM card**—S-100, good condition. #D0055-$89.60

ASK MOM

For details of October 1980 Asian and European Electronics Tours. Info #002 No charge

VERBATIM MINI DISKS

For TRS-80, Pet, Apple (Please specify which)
10 PACK—ONLY $26.00
#P007 MOM's offers the Best for Less . . . Again!

IMSAI PARALLEL I/O CARDS

1 ★ **IMSAI Parallel I/O card 4-4**—Four parallel ports, S-100, excellent condition. #D0093S-$176

IMSAI SERIAL I/O CARDS

2 ★ **IMSAI Serial I/O card 2-1 (kit)**—One serial port, full control RS-232 control, S-100, new. #D0092S-$90.

IMSAI SOFTWARE

2 ★ **IMSAI IMDOS V2.02** on 8" Disk for S-100—No documentation, but this is apparently IMSAI's version of CP/M for S-100 systems with an IMSAI Disk Controller. #D0056SS $75 each

1 ★ **TARBELL Cassette Interface (kit)**—Kansas City Interface, Tarbell Phase encoding, S-100, new. #D0064S-$80

HEAD ALIGNMENT KIT

Best cassette recorder tape head alignment kit available. Solves loading problems. #K001-only $9.95.

PHONE INTERFACE

5 **Novation Modem #3102A**—Connects to any phone, originate only, good condition. #S021-$165 each. **SPECIAL PRICE**.

1 ★ **Novation Modem #43**—Connects to any phone, originate only, good condition. #S023S-$155. **SPECIAL PRICE**.

VECTOR GRAPHIC S-100

3 ★ **Vector Graphic ROM/RAM card**—12K empty ROM sockets, 1K RAM, excellent condition. #D0078S-$100

4 **Vector Graphic Analog Interface**—Allows hobbyist to interface analog experiments, S-100, new. #D0079-$79.20

TDL ZAPPLE

3 ★ **TDL ZAP 1K Monitor**—Simple monitor. #D0073S-$10.

INSTANT SOFTWARE HALF PRICE SPECIAL CLOSEOUT—ONLY $4

TRS-80, Level I, Games
Knights Quest/Robot Chase 4K-#ISI0003.
Cave Exploring 16K-#ISI0010.
Doodles & Display 16K-#ISI0030.
Fun Package I 16K-#ISI0041.

TRS-80, Level I, Finance
Status of Homes 4K-#ISI0012.

TRS-80, Level II, Hobby
Model Rocketry Analyzer-#ISI0024.

BOOK CLEARANCE UP TO 50% OFF

Take a Chance with Your Calculator (Lithium-publisher) #BK1002—was $8.95, now $4.50

Chemistry with a Computer (Educomp-publisher) #BK1010—was $9.95, now $5.00

Computer Dictionary (Camelot-publisher) #BK1018—was $5.95, now $3.00

FORTRAN Programming (Camelot-publisher) #BK1019—was $7.95, now $4.00

FORTRAN Workbook (Camelot-publisher) #BK1020—was $4.95, now $2.50.

A Quick Look at BASIC (Camelot-publisher) #BK1043—was $4.95, now $2.50.

How to Buy and Use Minis and Micros (Sams-publisher) #BK1025—was $9.95, now $5.00

How to Program Microcomputers (Sams-publisher) #BK1027—was $8.95, now $4.50.

TDL SOFTWARE-DISK

1 ★ **TDL FDOS & SuperBASIC on 8" Disk**—This requires an ICOM Disk Controller and at least 20K of memory, plus a ZAPPLE Monitor in an S-100 Cabinet (Altair, IMSAI, etc.). #D0065S-$125.

1 ★ **TDL System Software on 5¼" disk**—This set of system software requires a North Star Disk Controller, and a TDL Systems Monitor Board I, and consists of 12K BASIC, Relocator/Linking Loader, Z-80 Editor, and Text Processor. #D0066S-$170.

1 ★ **TDL System Software on 5¼" disk**—This is the same as above, but does not require the Systems Monitor Board I. #D0067S-$190

1 ★ **TDL System Software on 5¼" disk**—Again, as above, but requires a HELIOS Disk Controller and the TDL Systems Monitor Board II (not I). #D0068S-$170.

HONEYWELL

15 ★ **Honeywell ASR-33 Communications Consoles** with TTY paper tape reader and punch. Used, working when removed from service. Shipped freight collect or you pick up. Weight 300 lbs. $375. Order #P006S

MOUNTAIN HARDWARE

7 ★ **Mountain Hardware AC Controller**—Remote AC outlet control, S-100, new. #D040S-$90 each.

MAGIC LIGHT BULB SAVER

If you've got a light bulb you need our MAGIC L.B.S. which increases the life expectancy of a new bulb 93 times! . . . and saves you 44 on energy costs. Regularly $2.50 . . . MOM's price is $1.99 each. #LS001

HEURISTICS SPEECH LAB

1 ★ **Heuristics Speech Lab**—S-100, used, fair condition. #S042S-$90 as is. **SPECIAL PRICE**.

1 **Heuristics Speech Labs**—S-100, new. #D043-$151 each.

CALLBOOKS 10% OFF

US-#CX01-was $16.95, now $15.25
DX-#CX02-was $15.95, now $14.35

SHUGART MINIDISK DRIVES

2 **Shugart MiniDisk Drives**—No cabinet, good condition. #S037-$300 each. **SPECIAL PRICE**.

Prices include 20% discount. **SPECIAL PRICE** includes more than 20% discount.

Quantities are limited, immediate refund if ordered item is no longer available. Please read terms below.

TERMS: FOB Marlboro, NH USA. Limited stock; everything guaranteed as described; you pay postage on returns. PRINT orders clearly. Minimum order $10 plus $2.50 shipping and handling charge in USA only. DOUBLE THAT ELSEWHERE. Orders over $50 add 5% for shipping in Continental USA, 10% elsewhere (we will refund excess). Orders shipped UPS or insured mail only. No CODs please. Send US funds by check or money order. For credit card purchases, add 4%, list AE, MC or VISA, number, and expiration date. Mail to MOM's, Department 573, PO Box 427, Marlboro NH 03455.

Condition of Inventory:
New = original container
Excellent = new, but not in original container
Good = tested or used in store

BRAND NEW* TRS-80's and accessories at FANTASTIC SAVINGS

LEVEL II 16K COMPLETE	$730	#TRS-001
16K EXPANSION UNIT	$425	#TRS-002
32K EXPANSION UNIT	$525	#TRS-003
DISK DRIVES	$425 each (Specify which drive you want)	#TRS-004
FRICTION MODEL PRINTER	$889	#TRS-005
TRACK MODEL PRINTER	$1350	#TRS-006
LINE PRINTER III (AND CABLE)	$1550	#TRS-007
MOD II 64K	$3400	#TRS-008

TERMS: Shipment normally within one week of receipt of your order (with cashier's check, money order, or credit card) for microcomputer and three weeks for accessories (checks take two weeks extra to clear bank). ADD $2.50 PER ITEM for HANDLING. Everything will be sent to you with UPS freight charges COLLECT.

**NOT UPGRADED USED OR RECONDITIONED LEVEL I's WITH OLD KEYBOARDS BUT BRAND SPANKING NEW TRS-80's IN FACTORY CARTONS WITH FULL FACTORY WARRANTY! COMPARE PRICES AND QUALITY AND ORDER FROM MOM'S.*

SIMULATED SURVEILLANCE VIDEO SYSTEMS

Since the video camera systems are totally psychological, that is, the visibility and suggestion of video cameras is what deters the thief's desire to steal, all that is really needed is a device that appears to be a functioning video camera. The SSV System provides the businessman with the same deterrent to crime as real systems at a fraction of the cost, because the cameras and alarm boxes are empty of electronics, but would-be crooks don't know this, and SSV Systems are extremely realistic in detail. Some scan back and forth and all have red neon lights. They feature easy installation, mount on any wall, have metal construction throughout, with wrinkle finish paint, all aluminum lens barrel with f-stops, footage markings, and convex optics, simulated coaxial cable and wall plate, manufacturer's unconditional guarantee, plus warning stickers included with all orders.

SVS 900 Scanning camera features 155 degree scanning action, long-life quiet, 1 rpm motor, only $100 (regularly $119.95) catalog #P0010. SVS-880 stationary camera is adjustable to any angle for fixed view coverage with mounting brackets and hardware, only $50 (regularly $58.95) catalog #P0011; or go first class with the SVS-2000, which has a soft blue finish with satin mylar trim only $105 (regularly $124.95) catalog #P0012, the stationary version is only $55 (regularly $62.95) catalog #P0013. Alarm boxes are only $20 (regularly $24.95) catalog #P0014 and complete your look of having real surveillance equipment installed at your business, home or office.

✓Reader Service—see page 226

Dave Ingram K4TWJ
Eastwood Village 1201 South
Rte. 11, Box 499
Birmingham AL 35210

Hustler Minibeam: the Mobileer's Secret Weapon

—two-el beam fits in your trunk

One of the most useful and convenient accessories of interest to many amateurs is a fold-down minibeam antenna. A portable and efficient gain antenna solves numerous signal radiation problems for traveling amateurs, weekend vacation enthusiasts, or amateurs with limited space. Most minibeam antennas suffer two distinct problems which limit their use by today's "on-the-go" radio amateurs. Either they are too large to be easily transported and quickly erected by one man or they require a large number of parts to be assembled before each period of use. Consequently, many amateurs merely use simple dipoles or mobile whips for their portable activities. The Hustler Minibeam was devised to provide a solution to this dilemma.

This antenna described in this article provides up to 5 dB forward gain, may be operated on the 20-, 15-, or 10-meter bands, and will fit comfortably in one corner of an auto trunk. The vacationing amateur can unpack, assemble, and erect the antenna in less than fifteen minutes, and the approximate cost of this array can be under forty dollars. This two-element beam also may be operated as a rotary dipole for the 40- or 80-meter amateur bands, if desired.

Theory of Operation

Basically, this antenna is a two-element yagi of reduced proportions. Center loading of each element is provided through the use of Hustler mobile resonators, and most of the beam's aluminum tubing is salvaged from an old CB beam antenna. While this small array may be fed directly with 50-Ohm coaxial cable, a 50-Ohm unbalanced-to-balanced balun transformer will substantially improve overall performance.

The requirements for a two-element yagi are relatively simple: The driven element must be ½ wavelength long, and the parasitic element must be either 5% longer if it is used as a reflector or 4% shorter if it is used as a director. The close-spacing distance between driven and parasitic elements should be approximately .15 wavelengths for a reflector and .1 wavelengths for a director. As we have learned through the use of triband minibeams, however, less-than-optimum element spacing is often quite acceptable.

New-Tronics mobile antennas have proven their outstanding ability through numerous years of service, and this minibeam antenna performs with almost the class of its full-sized counterparts. Band changing is accomplished by exchanging resonators as necessary. Additionally, 40-meter or 80-meter resonators may be used with the driven element proper to afford the rotary dipole option. Resonators used with this antenna are not subjected to the stress of mobile activities, so damaged and electrically restored resonators should work very well in this array.

Rather than adjusting element length for resonance at the desired frequency, the beam's resonators are tuned by moving their tip rods and monitoring resonant frequency with an antenna noise bridge or indicator. Once these positions are located, a notch is filed in the resonator's tip rod for future reference. The antenna's driven element may be adjusted for operation by merely tuning for a 1-to-1 swr at the desired frequency. Assuming 20-meter resonators are employed, the driven element should be tuned to approximately 14,250 kHz. As shown in Fig. 1(a), this equals an approximate length of 32.84 feet. A comparable reflector element will be approximately 5% longer, or 34.48 feet in length. In Fig. 1(b), we find that this length equals a resonant frequency of 468/34.48, or 13,570 kHz. Since this frequency is below the resonator's range, each side of the reflector's elements must be extended slightly. This is accomplished by varying the screw-stock length for

Photo A. The knock-down Hustler minibeam can be removed from the trunk of a compact auto and be in use on a moment's notice.

$$\text{1/2 wavelength (ft.)} = \frac{468}{F_Q \text{ (MHz)}}$$

Fig. 1(a). Determining element length.

$$F_Q \text{ (MHz)} = \frac{468}{\text{1/2 wavelength (ft.)}}$$

Fig. 1(b). Determining resonant frequency.

coarse adjustments and adjusting resonator tip rods for fine tuning. While the parasitic element may be adjusted to act as a reflector (lower resonant frequency) or as a director (higher resonant frequency), a slightly higher forward gain will be produced when using a reflector element.

Concept of Construction

Rather than presenting a step-by-step-duplication procedure here, I will describe this antenna in a manner which will allow personal ingenuity and available parts to be used to maximum benefit. You can "mix and match" ideas as you like.

The dipole (driven) element should be constructed first, since it may be used independently or as a reference to ensure that the other element is properly adjusted to its respective frequency.

As shown in Fig. 2, the driven element should be insulated from the boom by whatever means you find convenient. If you can't salvage these parts from a damaged CB beam, a short length of PCV plastic pipe may be used. An old boom-to-mast plate may be incorporated for element mounting, and it will serve double duty should you also desire a rotary dipole arrangement for 80 or 40 meters. A section, or sections, of aluminum tubing totaling 53.75 inches (the length of the New-Tronics Mobile Mast, M01 or M02) can then be inserted and secured to the PCV plastic pipe.

Each end of these aluminum sections is fitted with screw stock (from any hardware store) which mates with Hustler resonators for the desired band of operation. Holes may be drilled through the PCV pipe and aluminum tubing, and sheet metal screws with balun or feedline connection lugs inserted. In order to ensure portability, my driven element is broken into three sections, each slightly less than 3 feet in length. Each section is marked at its insertion length, and screw-type compression clamps are used to secure the element when assembled.

The parasitic element, complete with boom mounting assembly, may be secured from an old CB beam. Many of these arrays employ swaged elements which mate perfectly with the screw stock which is inserted in their outer ends. Since these element sections are not insulated from the boom, they may be removed at that point for transportation and rapid reassembly. Each end of the screw stock-fitted sections should be slotted with a hacksaw and fitted with screw-type compression clamps. Approximately 12- to 16-inch lengths of screw stock should then be inserted and the clamps tightened only enough to hold them securely. A final tightening will be accomplished after the element is tuned to frequency and its position marked with a laundry marker pen. A construction procedure similiar to the above is satisfactory for conventional aluminum tubing assemblies, also.

The boom may be salvaged from a CB beam, or a piece of aluminum shower curtain rod may be utilized. As I have learned from a variety of minibeams marketed in recent years, several variations of boom lengths may be acceptable. I, however, have realized good results using a 6.5-foot

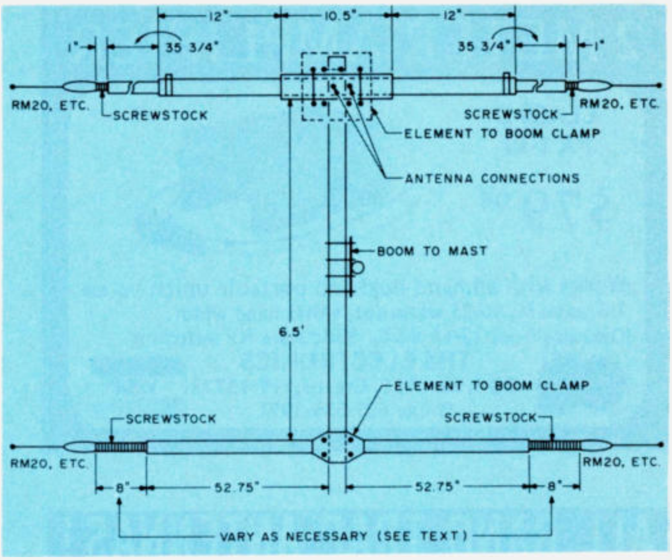


Fig. 2. Electrical/mechanical details of the Hustler minibeam.

boom. This length is approximately .15 wavelengths at 21,300 kHz: a reasonable compromise for 20-, 15-, or 10-meter operations. The boom may be cut in the middle and fitted with a connecting sleeve and mast-mount assembly for portability. (Due to lack of time, I haven't yet added this feature to my minibeam.)

Tuning and Adjustment

Once the antenna is constructed, it may be tuned and marked for later reassembly and use as needed. Each end of the driven element should be adjusted to measure 53.75 inches from center to tips of screw stock. Resonators for the desired band should be fitted and tuned for minimum swr. Next, resonators and screw stocks for the parasitic element should replace those on the driven element, and they, too, should be tuned to their respective frequencies—about 5% lower than the chosen operating frequency. Since the Hustler resonators may not quite reach the parasitic frequency, screw-stock length should be varied in 2-inch increments until tip-rod adjustment range is acquired.

After parasitic resonators are tuned to the calculated frequency, they are marked and inserted into their respective parasitic element sections. The driven element is then reassembled with its pretuned resonators, and the basic tuning is complete. A final tweaking may be accomplished with the aid of a field-strength meter. The parasitic resonators are then carefully adjusted while monitoring forward gain. This procedure is identical to any beam antenna adjustments, so it need not be repeated here.

Additional Notes

The easiest and quickest way to tune all elements of

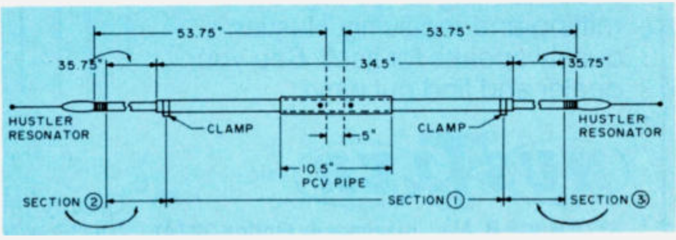


Fig. 3. The three-section breakdown of the driven element (see text).

this antenna involves using an antenna noise bridge and general-coverage receiver. The noise bridges manufactured by MFJ Enterprises and Palomar Engineering are ideal for this operation. Complete antenna tuning procedures are included in the MFJ and Palomar instruction manuals.

Assuming band-to-band color coding is used to mark element positions and resonator tip rods, the collapsed beam can be reconstructed within a matter of minutes. Mobiling amateurs carrying an antenna similiar to this array in their autos are thus ready for hilltop DXing.

While I haven't (yet!) investigated the possibility of using an extended boom and trying a 40-meter beam, the concept looks very promising.

Sections of aluminum tubing salvaged from a 6-meter or CB antenna may replace parasitic element resonators when this array is used on the upper part of 10 meters. Merely calculate their approximate lengths and install tubing in the place of the resonators.

Conclusion

The pint-size beam antenna described in this article is an outstanding performer for any amateur setup. This little gem can be stored and used as required, with minimum assembly and tuning time required. The beam will substantially outperform a dipole or vertical, and its cost is quite reasonable.

I would like to thank Erskine Jackson W4CEC for his clever ideas in the construction of the beam's driven element. Jack operates mobile and portable quite often, and this fold-up concept was his ideal solution. ■

Mike Colvin WDØAKB
1520 43rd Street
Des Moines IA 50311

Keith Greiner AKØQ
421 N. Pleasant Hill Blvd.
Des Moines IA 50317

The Pope Comes to the Cornfields

—and Iowa amateurs provide the communications

Photo A. Charles Corcoran WBØURB consults with one of the 3,000 emergency health teams while Pope John Paul II (background) celebrates mass at Living History Farms. Red hearts and flags were used to help the public identify health teams. (Photo by the official papal visit photographer, Ed Mulvin WBØIFF)

Photo B. A portion of the crowd which came to Living History Farms to see Pope John Paul II. Preliminary estimates indicated that in this group there could be as many as 50 coronary heart attacks, six births, 10 deaths, and 10,000 faintings, depending upon the weather. (Photo by WBØIFF)

Usually, when hams hear the word "disaster," they think immediately of tornadoes, hurricanes, earthquakes, and other displays of the power of Mother Nature. The Amateur Radio Emergency Service is well known to the public for its activities during dire emergencies of that kind.

But large crowds of people also can pose a life-threatening emergency under certain circumstances. The prospect of such an emergency seemed very real to the planners of Pope John Paul II's visit to Des Moines, Iowa, on October 4, 1979. To amateur radio operators in Iowa, the Pope's visit provided an unusual opportunity to help avert a potential disaster.

For two weeks prior to the Pope's official announcement that his tour of Ireland and the United States would include a stop at Living History Farms in Des Moines, city and church officials considered the visit to be a strong possibility. Their initial elation was tempered by the first official estimates of the expected crowd—between 200,000 and 400,000 persons.

A crowd of such magnitude in a large city such as Boston or Chicago, other stops on the Pope's tour, would be no greater cause for concern than the turnout for a tickertape parade or other public spectacle. But in Des Moines, with a total population of only some 236,000, the prospect of doubling or tripling its size for even a few hours caused city and state officials to become very concerned that facilities in the area would not be able to handle the huge crowds expected.

It was immediately clear that the cooperation of many volunteer groups would be necessary to avert potential disaster. Amateur radio services were offered to the Papal Visit Coordi-

Operators Participating in the Papal Visit Operation
Ralph Wallio WØRPK, Chairman
Bob McCaffrey KØCY, Manpower
Keith Greiner AKØQ, Manpower
Mike Colvin WDØAKB, Public Relations
Gary Liljegren WØSH, Control Manager
Charles Stover WØZZM, Control Manager
Tom Hildreth KØHTC, Control Manager

Operators in the field during the visit included the following, plus others from the Des Moines RAA, the Southwest Iowa ARC, the Midlands ARES, the Northeast Iowa RAA, and groups in Story, Boone, and Jasper counties.

NØAJI	WBØDQN	AIØK	WAØTBG
N8AKD	WDØEBS	WBØKXJ	WBØTEY
KØAL	WØEDQ	WAØKZB	WBØTIY
KØALD	WDØEGR	KØLHW	WBØTOT
NØALX	WDØENV	KØLKH	WBØTWW
WDØAMA	WAØEYG	WØLMP	KØUAB
NØANP	WAØFFZ	WAØLTX	WBØUCK
WAØAOR	WAØFOG	WBØMBZ	WBØUIU
WAØAUX	WDØFRE	WØMHC	WBØUOZ
WAØAWA	KAØFRW	WAØMIT	WBØURB
NØAZ	WAØGAZ	WBØMMS	WBØUUL
WB7BCI	WDØGDO	WBØMTZ	KØVEB
KØBGJ	KØGID	WBØMUB	WBØVLL
WDØBKO	WBØGIL	WAØMUG	WBØVUI
WBØBLR	WBØGHK	WAØNAA	WB4VWV
WBØBOR	WBØGXD	WØNKV	WBØWOE
WBØBQV	KØHFU	NØNL	WAØWYW
WAØBRU	KØHHF	WBØNSH	WØWL
WDØBVC	WDØHII	WBØNVL	KØXD
WDØBVG	WAØHKT	WØOIC	WBØYOD
KAØCHK	WDØHRC	WØOMV	WBØYTI
WBØCMC	KØICM	WBØOUL	WAØYXM
WDØCPD	WBØIFF	KØPCG	KØZAL
WBØCPR	WØIYW	WBØPDX	WBØZKU
WDØCSH	WØIZK	WØPKW	WB9ZMV
WBØDEB	WD9JCX	WØPZN	WBØZQC
WAØDEI	WBØJFF	WBØQAM	KØZQ
WØDLN	WBØJGJ	WBØRMN	WAØZUR
WDØDOK	KØJRQ	WAØRVD	WBØZWE
WØDQ	WBØJTQ	WBØUFL	

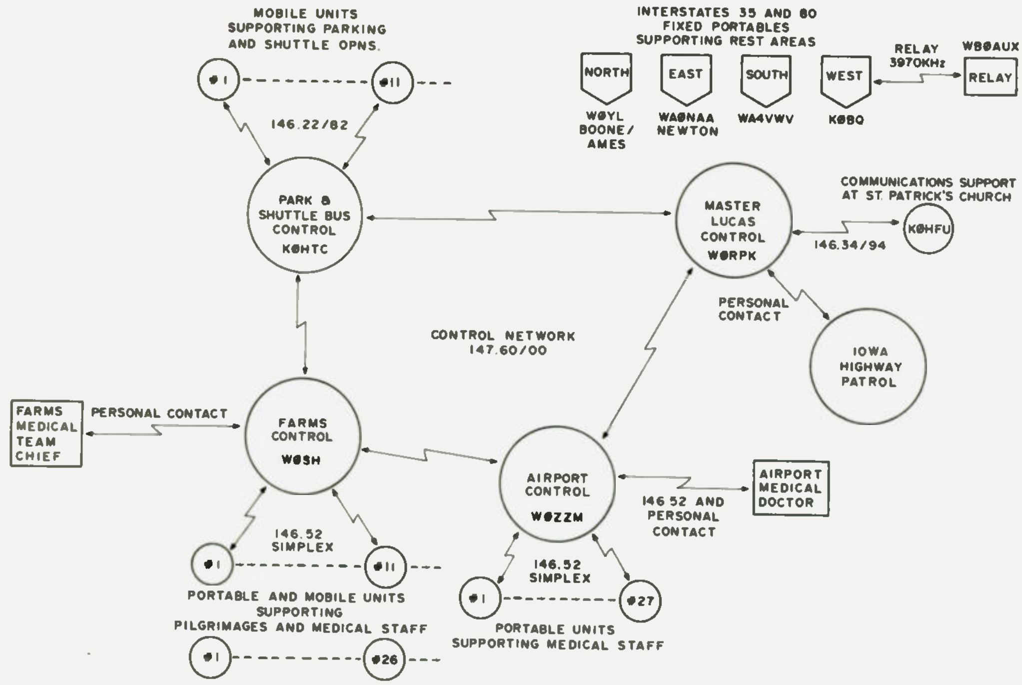


Fig. 1. The Amateur Radio Communications Network shows the control network with three sub-control stations and five distant stations (top right) reporting into it. While both the Farms Control and Airport Control stations communicated with their teams on 146.52, no interference was experienced because the two teams were across town and used less than one Watt of power.

Photo C. Committee chairman, Ralph Wallio WØRPK, coordinates with state officials from the communications center in the basement of the Lucas State Office Building, five miles east of Living History Farms.

nating Team, a group of city, state, and church officials, by the Des Moines Radio Amateur Association soon after news of the papal visit was made public. Shortly thereafter, but only four weeks before the day of the Pope's arrival, Ralph Wallio WØRPK was contacted by the Iowa State Government requesting a preliminary meeting to discuss potential services.

The first meeting held with state and city officials included WØRPK, WØSH, WØZZM, and KØCY. It was obvious from the start, when the state requested 1,500 radio-equipped operators, that local amateur organizational and communicating capacity would be tested beyond the usual! Fortunately, the DMRAA was not starting from scratch. Local hams provide communications for many annual events and maintain two wide-area coverage 2-meter FM repeaters. However, by the time this first meeting was over, it was apparent that hams from all over the state and beyond would be needed to meet the manpower requirements of the visit.

Organization was the first order of business. A special committee was formed with WØRPK as chairman, and duties were delegated. Manpower recruiting was the biggest initial job, and the task of calling hundreds of amateurs locally and in nearby states was begun immediately by KØCY and AKØQ. Emergency coordinators and club presidents from all over Iowa were contacted. A detailed request for volunteers was released through the wire services. W1AW was asked to broadcast bulletins requesting assistance. In addition to contacting Des Moines club members individually, announcements were made on the weekly nets and in the DMRAA newsletter, *Static Sheet*.

Simultaneously, details of the communications system were worked out. Amateur communications were assigned to meet several critical needs. Roving emergency medical teams from the local Heart Association and Red Cross would need communications from their positions in the crowds at the Farms and the Des Moines airport, back to five fully-equipped field hospitals at those locations. Further, a number of walking pilgrimages from parking areas three to four miles away from the Farms were planned, and communications checkpoints along each route were needed to deal with crowd control and medical problems. Communications also were needed at each parking area so that shuttle buses could be dispatched efficiently to pick up new arrivals. Finally, the Iowa Development Commission, which is responsible for providing tourist information, requested on-site communications facilities at interstate rest areas to give the inbound driving public the latest information on traffic conditions and available parking.

Through subsequent weekly meetings of the committee, myriads of operational details were coordinated. Command station locations, equipment and antennas, operating frequencies, portable and mobile location assignments, base-station managers and crews, and security clearances were all confirmed. Throughout the remaining weeks, cooperation from state and local officials was exemplary. There was no doubt that amateur communications were to be an integral part of the public safety plans for the Pope's visit.

On Monday, October 1, just three days before the Pope's arrival, a final public services briefing was held which included top officials of the Iowa State Highway Patrol, the National Guard, several county and local law enforcement agencies, the FBI, the Secret Service, the Red Cross, the Heart Association, and other organizations charged with crowd responsibilities. It was with some pride that WØRPK provided details of the communications plan that amateurs had put into operation.

Final plans for the visit called for the Pope to arrive at the Des Moines airport at 1300 hours. He was to be shuttled by helicopter to a tiny rural church nine miles south of Des Moines where he would meet with the church's parishioners. From there he would be flown to Living History Farms on the western outskirts of Des Moines to say mass for some 350,000 people. His departure was scheduled for approximately 1630 hours.

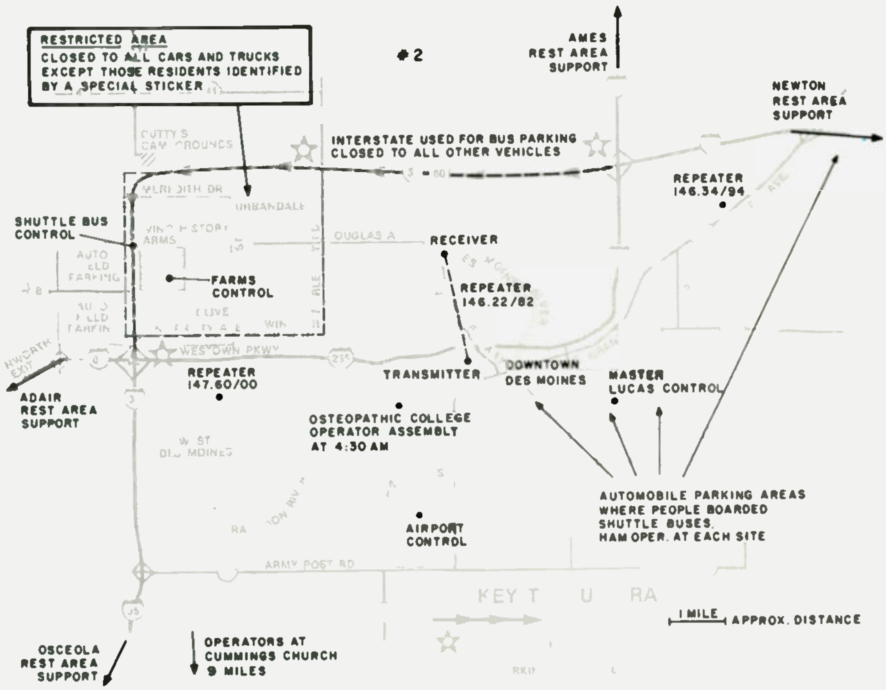


Fig. 2. This official map of the city of Des Moines shows the various elements of the amateur radio operation in perspective with some of the other activities of the day.

The communications plan worked out by the Amateur Radio Planning Committee established five communications networks including a command network with control at a downtown state office building where the Iowa Highway Patrol and other law enforcement agencies were headquartered. Two satellite control stations operating on 2-meter sim-

Photo D. An estimated 350,000 people gathered at Living History Farms. The altar for the papal mass is located in the center of the photograph. The buildings at the upper right contained the amateur radio "Farms Control" and the main hospital facility. Three other hospital facilities were located in tents along the perimeter, just outside the border of this photograph by Bill Dennis KØUKN. Bill took the picture from 7,000 feet as he piloted one of the very few aircraft allowed over the site.

Photo E. After the papal visit, the public walked a quarter of a mile to Interstate 80 where some 2,000 charter buses and hundreds of shuttle buses were parked. (Photo by KØUKN)

Photo F. Members of the public are shown leaving the Living History Farms site after the Pope departed. (Photo by KØUKN)

plex were set up at Living History Farms and the airport to assist the field hospitals in those locations. Another satellite control station was to be put into operation on 22/82 to assist the shuttle busing plan. Fixed portable stations at strategically located rest areas on the interstate highways were to communicate with the command post via 34/94 or 75 meters. Command post communications with the airport, the Farms, and shuttle bus stations were to use 60/00.

Two operators were assigned to assist in emergency communications at the country church about nine miles south of Des Moines.

To complicate matters, both of the local repeaters were struck by lightning about three weeks before the expected visit. This is a most unusual occurrence, since the repeaters are located about five miles apart. The result was a flurry of activity in which the 34/94 repeater was rebuilt from the circuit boards on up. In addition, WBØMBZ assembled a backup repeater, and the Iowa Department of Public Safety provided a modified commercial repeater as a second backup.

On the day of the papal visit, everything was ready. The command post and satellite control stations had been set up two days earlier. Commitments from approximately 150 operators had been received, including 30 operators from the Omaha/Council Bluffs area. This large block of people was assigned as a group to assist with the airport operation.

At 0430 hours on Thursday, October 4, the communications system commenced operations. The early work of the Planning Committee was now over, and everyone anxiously waited to see how well the advance preparations would pay off.

Some pilgrims had arrived at Living History Farms on Wednesday evening to beat the expected throngs. They spent the night huddled together in small groups as temperatures dipped into the mid-thirties. By the time the communication system went on the air at 0430, 1,000 to 2,000 people per hour already were walking past some of the checkpoints. The field operators assisting the medical teams at Living History Farms and the airport reported in the chilly early morning hours to the Des Moines College of Osteopathic Medicine and were greeted with hot coffee supplied by KØCY. They were loaded aboard buses and taken to the airport and various pilgrimage staging areas. From there they walked with the marchers to the Farms, alerting medical teams of any medical emergencies en route.

Crowds at both the Farms and airport were greeted by a very chilly dawn. Shortly after sun-up, a cold breeze began to blow, chilling the gathering spectators who were clad for temperatures in the mid-sixties. The winds continued throughout the day. While thermometers rose to 48 degrees, the wind chill dropped the temperature to an apparent, frigid 25 degrees.

As the crowds gathered, the cold wind took its toll. Field hospitals began treating people suffering from various degrees of exposure. Spectators at the airport faced directly into the wind while gathering on an embankment at the edge of the runway apron where the Pope was to arrive. Among the 15,000 people who eventually gathered at the airport were over 100 severely handicapped in wheelchairs who were placed at the very front of the crowd so that they could be sure to be greeted by the Pope.

By mid-morning, operators at field locations at the Farms and airport passed the message back to medical staff that many blankets were desperately needed. A call went out to nearby motels, city hospitals, the Iowa Highway Patrol, and the Air Force Reserve. In response, several thousand paper blankets, blankets, and plastic bags were sent to help cut the wind and keep people warm.

At about 1030 hours, during the peak of the foot traffic at the Farms area, crowds passing some checkpoints were estimated at 4,000 to 6,000 per hour. Official estimates of the total crowd that eventually gathered at the 40-acre field were 340,000.

Ham radio activities during the day included much more than crowd control and calling for blankets. Operators provided valuable assistance to medical teams. Two doctors from the Omaha/Council Bluffs area, NØAZ and WBØZWE, came to help out for the day. Hams handled a wide variety of problems, including 250 reports of missing children and adults which were fed into a specially-designed computer system operated by the Iowa Department of Public Safety. Other emergencies included 14 suspected cardiac cases, 2 concussions, 3 sprained ankles, a laceration, a broken arm, and an impacted wisdom tooth which was dealt with by the staff dentist at the main field hospital. As it turned out, there were no deaths or births despite expectations. Medical emergencies were minimized by the effective presence of ham radio communications.

All systems functioned as planned, and aside from the failure of a few hand-helds due to weak batteries and long hours of operation (most hams brought extra batteries), there were no major equipment problems. It was gratifying to everyone involved that the many hours of intensive planning paid off.

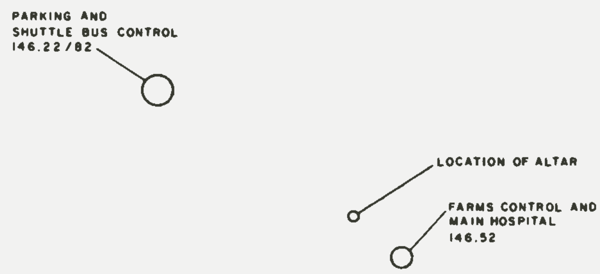


Fig. 3. This official map of the Living History Farms area shows the two control stations in the area plus details of the walking pilgrimages. Ham radio operators assisted with emergency medical communications along the pilgrimage routes.

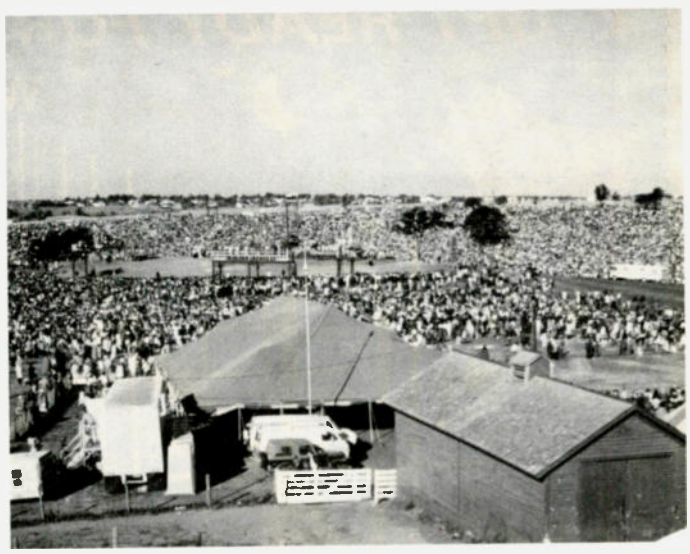


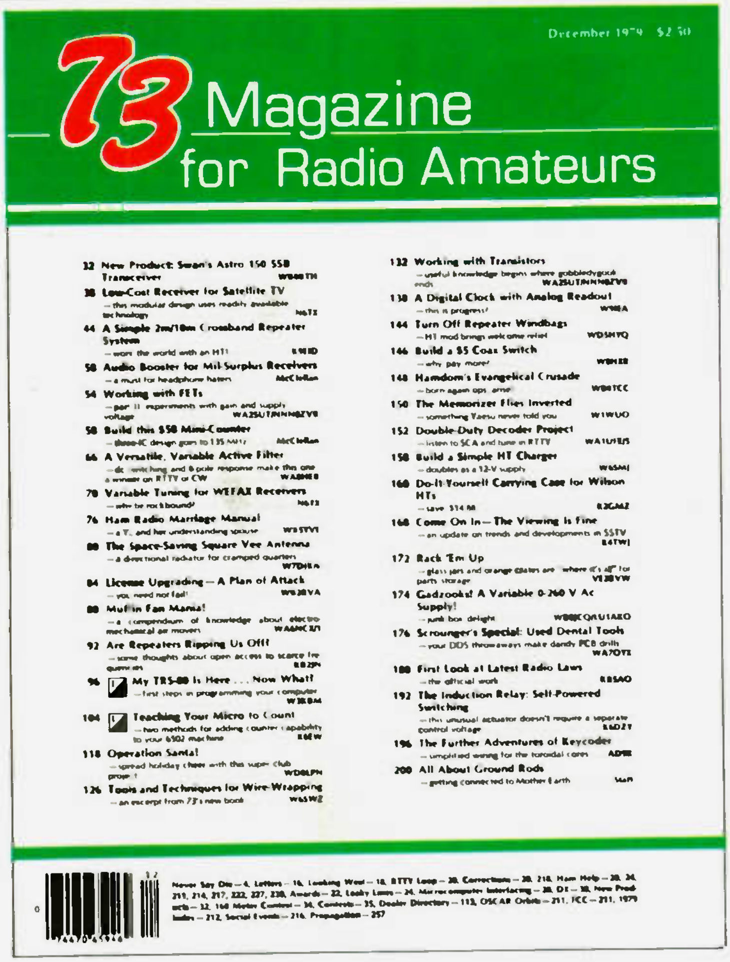
Photo G. This is the view overlooking the press and broadcast communications tent. Members of the press may be seen just beyond the tent. The vertical antenna in the foreground is for military communications. (Photo by WBØIFF)

Photo H. A few of the airport medical teams take a break just outside the Airport Control van. Each control station had two transceivers. One was used to communicate with medical teams on 146.52 MHz and the other was used to communicate with the Lucas Control station on 147.60/00. (Photo by Charles Stover WØZZM)

Photo I. Some of the airport operators took time out for this group picture at the end of the day. (Photo by WØZZM)

The Des Moines Radio Amateur Association's involvement with the Pope's visit has helped cement much closer ties with Iowa State Government and law enforcement agencies and will ensure more effective use of amateur communications in unplanned emergencies. It also has given amateurs involved an opportunity to establish in the future an effective communications system that can be utilized in many kinds of public service situations. In short, the Pope's visit was much more than a religious experience for Des Moines residents. It was an opportunity to establish and field-test a lifesaving communications system that will benefit the public for many years.

Ham radio operators involved in the Des Moines operation can certainly take part of the credit for a comment which came from the coordinator of the Pope's US trip. The coordinator commented that the stop in Des Moines was more organized than stops in all other cities combined. ■



December 1979 $2.50

73 Magazine for Radio Amateurs

32 New Product: Swan's Astro 150 SSB Transceiver
38 Low-Cost Receiver for Satellite TV — this modular design uses readily available technology
44 A Simple 2m/10m Crossband Repeater System — work the world with an HT!
50 Audio Booster for Mil-Surplus Receivers — a must for headphone haters — McClellan
54 Working with FETs — part II: experiments with gain and supply voltage
58 Build this $58 Mini-Counter — McClellan
66 A Versatile, Variable Active Filter — dc switching and 8-pole response make this one a winner on RTTY or CW
70 Variable Tuning for WEFAX Receivers — why be rockbound?
76 Ham Radio Marriage Manual
80 The Space-Saving Square Vee Antenna — a directional radiator for cramped quarters
84 License Upgrading — A Plan of Attack — you need not fail!
88 Muffin Fan Mania! — a compendium of knowledge about electro-mechanical air movers
92 Are Repeaters Ripping Us Off? — some thoughts about open access to scarce frequencies
96 My TRS-80 Is Here ... Now What? — first steps in programming your computer
104 Teaching Your Micro to Count — two methods for adding counter capability to your 6502 machine
118 Operation Santa! — spread holiday cheer with this super club project
126 Tools and Techniques for Wire-Wrapping — an excerpt from 73's new book
132 Working with Transistors — useful knowledge begins where gobbledygook ends
138 A Digital Clock with Analog Readout — this is progress?
144 Turn Off Repeater Windbags — HT mod brings welcome relief
146 Build a $5 Coax Switch — why pay more?
148 Hamdom's Evangelical Crusade — born again ops arise
150 The Memorizer Flies Inverted — something Yaesu never told you — W1WUO
152 Double-Duty Decoder Project — listen to SCA and tune in RTTY
158 Build a Simple HT Charger — doubles as a 12-V supply
160 Do-It-Yourself Carrying Case for Wilson HTs — save $14.88
168 Come On In — The Viewing Is Fine — an update on trends and developments in SSTV
172 Rack 'Em Up — glass jars and orange crates are "where it's at" for parts storage
174 Gadzooks! A Variable 0-260 V Ac Supply! — junk box delight
176 Scrounger's Special: Used Dental Tools — your DDS throwaways make dandy PCB drills
180 First Look at Latest Radio Laws — the official word
192 The Induction Relay: Self-Powered Switching — this unusual actuator doesn't require a separate control voltage
196 The Further Adventures of Keycoder — simplified wiring for the toroidal cores
200 All About Ground Rods — getting connected to Mother Earth — Staff

RIGHT FROM THE START, YOU CAN TELL WHY 73 IS THE #1 BARGAIN!

73 Magazine doesn't hide what's inside with a fancy cover. ***The table of contents is the cover.*** Right from the start, you know that inside 73 are the quality and quantity of articles you've been looking for in an amateur radio magazine.

73 Magazine has ***articles on everything***, from the new ham bands to moonbouncing to mountaintopping. Plus, 73 has the ***most thought-provoking editorials*** of any amateur radio magazine—you may not agree with them, but you'll never be bored. And, 73 has (because of its active ham readership) ***the best mail-order advertising***—to give you more places to shop for lower prices.

SUBSCRIBE TO 73 MAGAZINE TODAY!

AND FIND OUT WHY

WHEN YOU'RE THE #1 BARGAIN, YOU DON'T HAVE TO HIDE IT!

OK, I'll take the #1 Bargain

☐ 1 year—$15 ☐ 2 years—$30 ☐ 3 years—$45
☐ Payment enclosed ☐ Bill me
Bill my: ☐ Master Charge ☐ VISA ☐ Amex

Card # ____________________ Expire Date __________

Signature ____________________ Bank # __________

Name ________________________________

Address ________________________________

City ______________ State __________ Zip __________

73 MAGAZINE—POB 931—FARMINGDALE NY 11737
Canada—1 year—$15 in US funds Foreign—1 year—$26 in US funds
Please allow 6 to 8 weeks for delivery 305B6

THE GIANT AZDEN® COMPANY

REVOLUTIONIZES THE STATE OF THE ART

AWE AND AZDEN. INTRODUCE THE BRILLIANT NEW PCS-2000

NOT $550.00
SPRING SALE
$299.00
REG. $369.00

MICROCOMPUTER CONTROLLED

SUPERIOR COMMERCIAL GRADE 2 METER FM TRANSCEIVER

NOT $550.00
SPRING SALE
$299.00
REG. $369.00

COMPARE THESE FEATURES WITH ANY UNIT AT ANY PRICE

- **FREQUENCY RANGE:** Receive and transmit: 144.00 to 147.995 MHz, 5Khz steps + MARS-CAP and MULTIPLE OFFSET BUILT IN.
- **ALL SOLID STATE-CMOS PL DIGITAL SYNTHESIZED.**
- **SIZE:** UNBELIEVABLE! ONLY 6 3/4" x 2 3/8" x 9 3/4". COMPARE!
- **MICROCOMPUTER CONTROLLED:** All scanning and frequency-control functions are performed by microcomputer.
- **DETACHABLE HEAD:** The control head may be separated from the radio for use in limited spaces and for security purposes.
- **SIX-CHANNEL MEMORY:** Each memory is re-programmable. Memory is retained even when the unit is turned off.
- **MEMORY SCAN:** The six channels may be scanned in either the "busy" or "vacant" modes for quick, easy location of an occupied or unoccupied frequency. AUTO RESUME. COMPARE!
- **FULL-BAND SCAN:** All channels may be scanned in either "busy" or "vacant" mode. This is especially useful for locating repeater frequencies in an unfamiliar area. AUTO RESUME. COMPARE!
- **INSTANT MEMORY-1 RECALL:** By pressing a button on the microphone or front panel, memory channel 1 may be recalled for immediate use.
- **MIC-CONTROLLED VOLUME AND SQUELCH:** Volume and squelch can be adjusted from the microphone for convenience in mobile operation.
- **ACCESSORY OFFSET:** Provides three additional offset values: +0.4 MHz, +1 MHz and +1.6 MHz. Other offsets may also be obtained.
- **25 WATTS OUTPUT:** Also 5 watts low power for short-distance communication.
- **DIGITAL S/RF METER:** LEDS indicate signal strength and power output. No more mechanical meter movements to fall apart!
- **LARGE ½-INCH LED DISPLAY:** Easy-to-read frequency display minimizes "eyes-off-the-road" time.
- **PUSHBUTTON FREQUENCY CONTROL FROM MIC OR FRONT PANEL:** Any frequency may be selected by pressing a microphone or front-panel switch.
- **SUPERIOR RECEIVER SENSITIVITY:** 0.28 uV for 20-dB quieting. The squelch sensitivity is superb requiring less than 0.1 uV to open. The receiver radio circuits are designed and built to exacting specifications, resulting in unsurpassed received-signal intelligibility.
- **TRUE FM, NOT PHASE MODULATION:** Transmitted audio quality is optimized by the same high standard of design and construction as is found in the receiver. The microphone amplifier and compression circuits offer intelligibility second to none.
- **OTHER FEATURES:** Dynamic Microphone, built in speaker, mobile mounting bracket, external remote speaker jack (head and radio) and much, much more. All cords, plugs, fuses, microphone hanger, etc. included. Weight: 6 lbs.
- **ACCESSORIES:** 15' REMOTE CABLE.....$29.95. CS-6R A/C POWER SUPPLY.....$49.95. TOUCHTONE MIC. KIT.....$39.95. EXTERNAL SPEAKER.....$18.00.

AMATEUR-WHOLESALE ELECTRONICS ORDER NOW TOLL FREE

8817 S.W. 129th Terrace, Miami, Florida 33176
Telephone (305) 233-3631 • Telex: 80-3356
U.S. DISTRIBUTOR
DEALER INQUIRIES INVITED ✓5

1-800-327-3102

CREDIT CARD HOLDERS MAY USE OUR TOLL FREE ORDERING NUMBER.

Carl C. Drumeller W5JJ
5824 NW 58 Street
Warr Acres OK 73122

Confused About Phased Arrays?

—educate yourself with this simple model

Confused about how phased antenna elements cause a certain radiation pattern? If you're thinking about two vertical elements, each fed with an equal amount of rf power, you can construct a simple model that'll tell you quickly and accurately just how the actual radiation pattern will look.

Here's what you'll need: a large square of cardboard or similar material, two pins, two pieces of string, and two different-colored marking pens—say, red and green. Establish some measure (inch, cm, etc.) to represent a half wavelength in space (not coaxial cable). Retain that unit of measure for all segments of your pattern checks.

Now here's what you do, taking for the first check the exploration of the radiation pattern of two vertical radiators spaced a half wave (180°) apart and fed in phase. See Fig. 1(a) for a suggested configuration. Take two equal-length strings. These should be several wavelengths long and preferably some multiple of a half wave in total length. Fasten a pin at an end of each string. Then color a half-wave portion of the free end of each string one color (say, red), and going back toward the pins, color the adjacent half-wave section the contrasting color (say, green). Continue this sequence for another half wave or two. Now each of the strings will have the same color combinations at their free ends.

Next, select a spot near the center of that large sheet of cardboard and mark two points, one being directly above the other, a half wavelength away. Stick the two pins into these points. These pins simulate the two radiating elements and establish their relative positions. Then stretch out the two strings horizontally, parallel to each other. Arbitrarily designate this direction as 0°.

Now read your results. Note that like colors are together at the ends of the strings. This shows that the

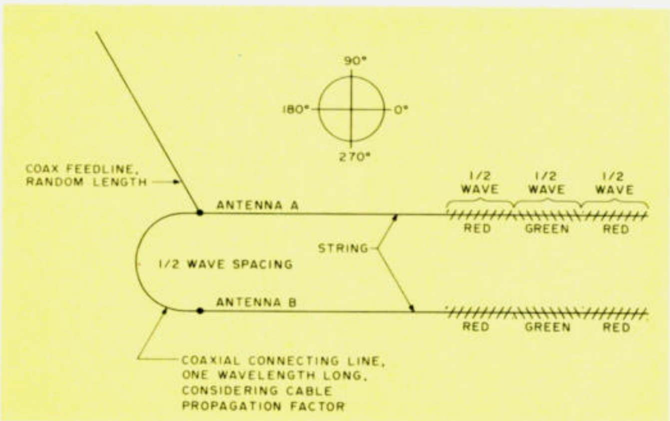


Fig. 1(a). This shows two different situations: the spacing and feed method for actual antennas and the method of simulating the generation of a radiation pattern. This simulation will show the radiation pattern of two antennas spaced a half wave apart and fed in phase with equal power to each antenna. A similar situation will exist at 180°.

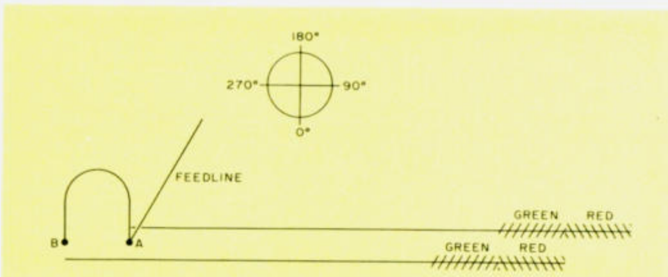


Fig. 1(b). Simulation of the phase relationship of radiation from two antennas spaced one-half wavelength apart and fed in phase with equal power to each antenna. Note the cancellation at 90°. A similar situation will exist at 270°.

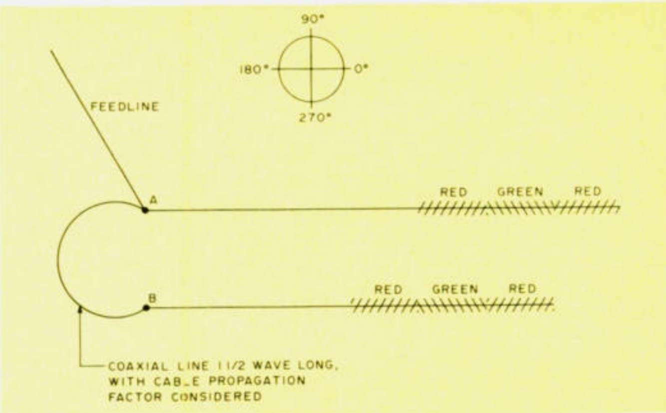


Fig. 2. Simulation of phase relationship at 0° for radiation from two antennas spaced one-half wavelength apart and fed equal power but out of phase. That is, the power fed to antenna B has been delayed 180° by an extra half wavelength of cable. Note the phase cancellation at 0°. A similar situation will exist at 180°. Mentally rotate the lines to 270° and you'll readily see the in-phase relationship. A similar situation exists at 90°.

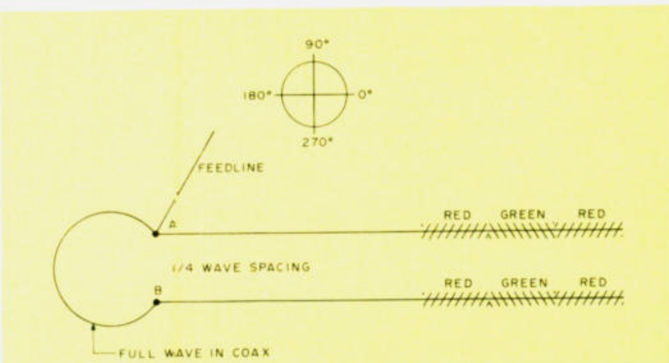


Fig. 3. Simulation for observing the radiation pattern of two antennas spaced a quarter wave apart and fed equal power in phase. Note that the pattern is similar to that of two antennas spaced a half wave apart and fed power in phase, except that the "nulls" are much less deep.

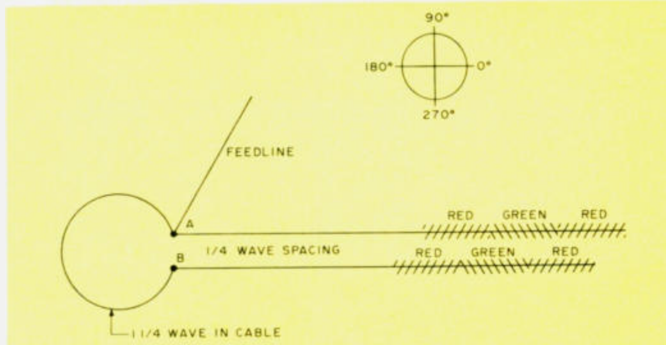


Fig. 4(a). Simulation for observing radiation pattern of two antennas spaced a quarter wave apart and fed equal power but with power fed to antenna B delayed by an extra quarter wavelength of cable. Note partial cancellation, partial enhancement of the pattern at 0°. A similar situation exists at 180°.

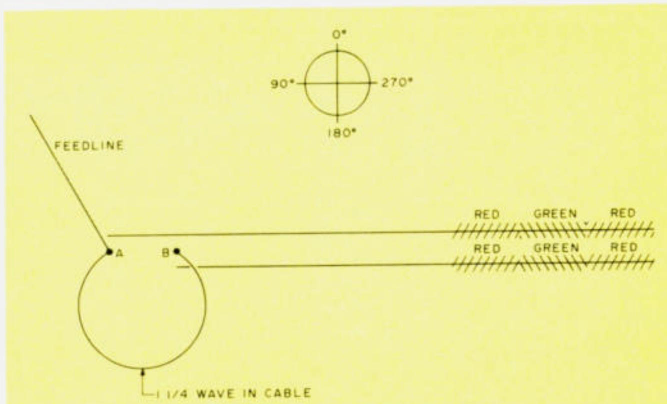


Fig. 4(b). Radiation pattern as observed at 270°. Note full enhancement. A similar situation will not exist at 90°.

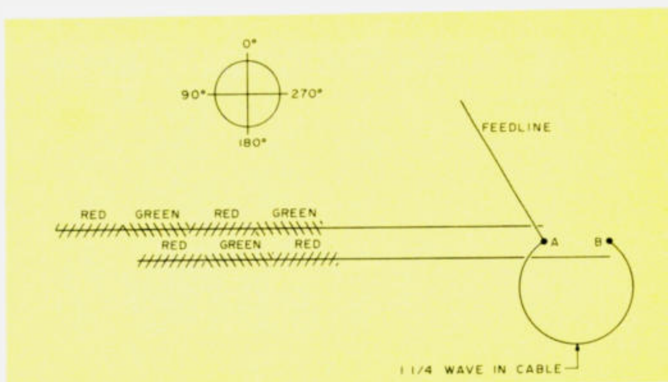


Fig. 4(c). Radiation pattern as observed at 90°. Note cancellation. Contrast this with the pattern observed at 270°, and you'll see the unidirectional effect of this antenna-and-feed configuration.

radiation from each antenna element is in phase with that of the other element, and that the total field strength in that direction (0°) is twice that which would be radiated from a single element. Now rotate the two strings (keeping them parallel to each other) a quarter turn (90°) counterclockwise. Observe the colors. Now you'll see that unlike colors are adjacent, showing that the phase of radiation from one element is unlike that from the other, so that the total field strength in that area is being reduced to nearly zero. Continue counterclockwise around 360° and you will have discovered the azimuthal radiation pattern of two vertical antennas spaced a half wave apart and fed in phase with equal rf power to each element.

For the next portion of your tour of discovery, look at Fig. 2, which tells you how to simulate the radiation from two antenna elements spaced a half wave apart but fed equal rf power with that of one element delayed 180° (½ wave) relative to the other. This is another way of saying they're fed out of phase. For this, you'll need to shorten one string (the one fastened to the pin representing the antenna element fed with the delayed rf power) by one half wave so as to duplicate the effect of delaying the phase of the radiation from that element by 180°.

If you start with the strings pulled out in the same direction, 0°, as in the first portion of the prior check, you'll notice the adjacent colors are unlike. This indicates a minimum (a near null) in field strength at 0°, quite unlike what you found before. As you then swing the "elements" counterclockwise around 360°, you'll note a radiation pattern quite similar to that of the first check but having the points of minimum and maximum field strength displaced by 90°.

But what about other spacing of the radiating elements? Let's try 90° (¼-wave) spacing. This calls for reducing the spacing between pins to one-half what you've been using. Also, you'll need to use equal-length strings for observing the pattern for in-phase feed. After you've looked at that, as in Fig. 3, you might want to shorten one string by one-half wavelength (180°) and check the pattern for out-of-phase feed.

When you've explored those patterns, look at Fig. 4. In this setup, you retain the quarter-wave spacing between elements but delay the rf power fed to one element by 90° (¼ wave). To compensate for this delay, you'll need to shorten the string for the pin representing that element by a quarter wave. Run through the same procedure you've used before. Note now that the pattern is unidirectional instead of bi-directional as on previous checks.

By using proper pin spacing to simulate actual radiating element spacing and proper string length to simulate the initial phase relationship, you can explore any combination your fancy may dictate! Just remember, these simulations are valid only for situations in which the radiating elements are fed equal rf power.

The methods of feeding antenna elements, as shown in the several figures, are displayed in a manner intended to show clearly the delay (or lack of delay) in the phase of rf power fed to one element as related to the phase of rf power delivered to its paired element. There's nothing wrong with these systems other than their requiring an inordinate length of feedline cable. There are other, preferable, ways of doing this in actual antenna installations, so you should consider alternative methods. ■

Matt Wald KA8CGE
497 Staunton Jasper Rd.
Washington Court House OH
43160

A Beam for Less than a Buck

—have a ball for eighty cents

Title catch your eye? I thought it would. No, your contacts didn't fall out, you read it right—80 cents!

Looking for something fast, easy, inexpensive, and effective on 10 meters? Well, this could be right down your alley.

A good majority of amateurs in the ham world started out as CBers. What these ex-CBers don't realize is that they probably have the materials for a good two-element 10-meter beam around the house just sitting there and collecting dust. How about that old CB ground plane you used to use? If this is one of your household treasures, half the battle is won. Here's what I did.

I took my half-wave ground plane, (the particular one I used was a Super Mag), and disassembled the four radials and hardware that fastened the radials to the base. I then went to the local lumber store and got a five-foot piece of 2 x 2. Jerry Swank W8HXR was the supplier of the technical information, such as length of the driven and director elements, the spacing, etc.

What I was going to attempt to build was a 10-meter beam incorporating 2 elements. In this beam, one element is fed directly from the feedline and is a half wavelength of the operating frequency (Fig. 1). This is called the driven element. The other element receives power by either induction or radiation from the driven element and is known as the director element.

The elements were fastened to the wooden boom by using the hardware from my ground plane. Since the four radials were approximately 8½′ long each, I had to cut two of them to a length of 7′ 7″ for a combined length of 15′ 2″ for the director. The other two radials were cut to 8′ 2″ each, for a combined length of 16′ 4″ for the driven element.

If you cut one or both of the elements too short, don't fret, because all is not lost. The length of the driven element will vary a little according to the design frequency. I cut my driven element too short and coiled a piece of bare wire on both sides of the driven element. I then let the wire drape down until I got a good swr reading (Fig. 2). Coaxial cable was then connected between the two radials of the driven element, being sure the shield was insulated from the center conductor. Spacing between driven element and director was around 4′ 3″.

The gain of this antenna was figured to be somewhere around 5 dB, but don't let this small figure scare you. Using the Kenwood TS-520S, this 80-cent cheapie (the cost of the 2 x 2) was found to make a difference in receiving of 2 to 4 S-units higher than my 4-BTV vertical, and 2 S-units when transmitting. (Polarization of the other station will, of course, play an important role.)

So, as you can see, for a very small amount of space you can have a pretty darn effective DX antenna for a fraction-fraction-fraction of the cost of a commercially-made beam. However, if you really feel ambitious and have the extra aluminum around the house or can obtain it for a reasonable price, another element can be added for an additional 3 dB of gain. A balun is not essential, but it could prove to be quite helpful in preventing your coax from radiating.

If you're thinking that it takes an expert craftsman and years of experience to build your own beam, you're wrong. When I built this antenna (about two years ago), I was 15 years old and had just a Novice class license; I know that if I can build my own antenna, *anybody* can!

I truly hope that you will be as satisfied and pleased with your antenna as I am with mine! ■

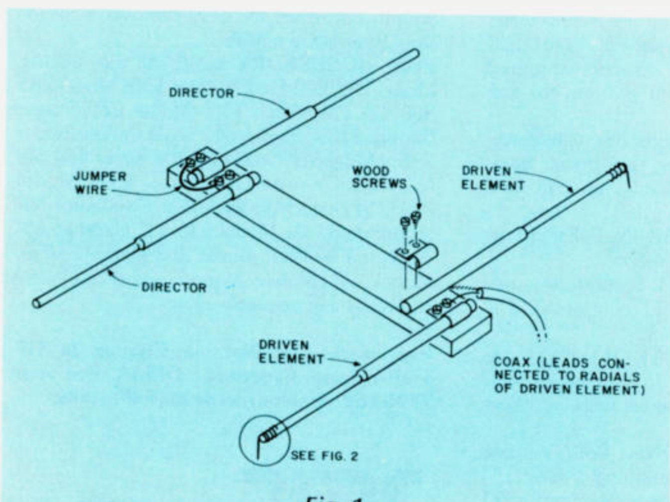


Fig. 1.

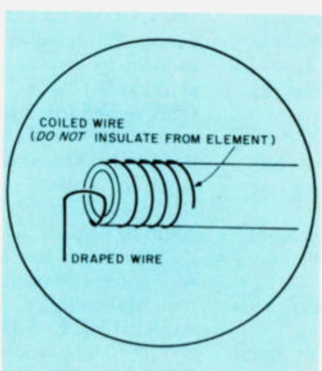
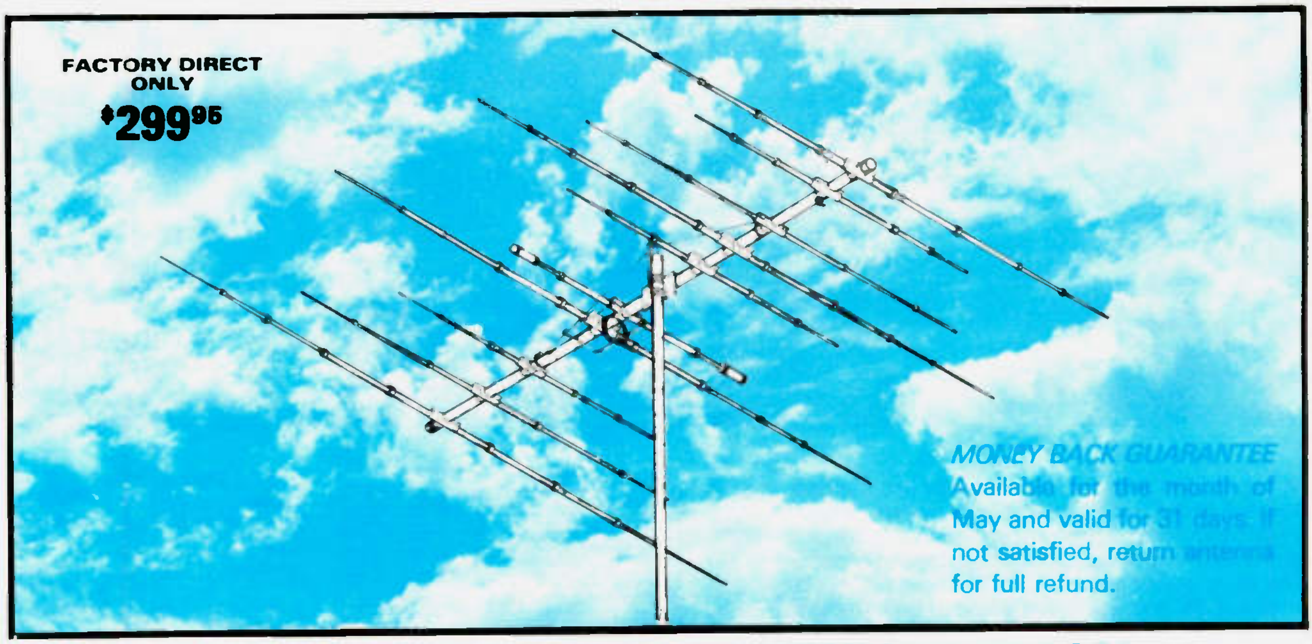


Fig. 2.

WILSON SYSTEMS, INC. PRESENTS . . .

THE NEW SYSTEM 40 TRIBANDER

3 MONOBAND ANTENNAS IN ONE-EACH WITH FULL MONOBAND PERFORMANCE

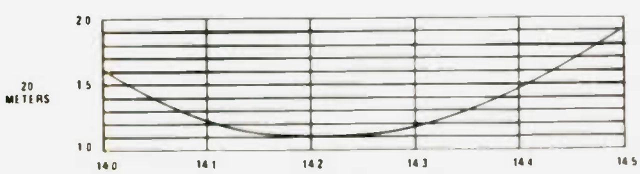


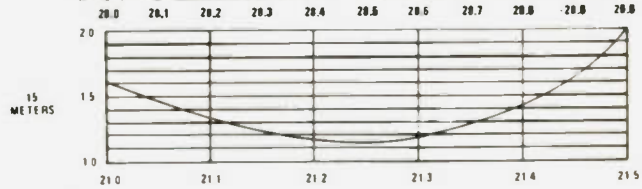
A NEW CONCEPT IN ANTENNA DESIGN
USING A 26 FT. BOOM

- FOR THE SERIOUS DXer WHO WANTS MONOBANDERS ON 10-15-20
- FOUR FULL SIZE 20 MTR ELEMENTS WITH 10 dbd GAIN
- THREE WIDE SPACED 15 MTR ELEMENTS WITH 8.2 dbd GAIN
- FOUR WIDE SPACED 10 MTR ELEMENTS WITH 10.2 dbd GAIN
- ONLY ONE FEED LINE REQUIRED
- DESIGNED WITH NO INTERACTIONS BETWEEN ELEMENTS
- ALL PARASITIC ELEMENTS ARE FULL SIZE
- BROADBANDED — NO SEPARATE SETTINGS REQUIRED FOR PHONE OR CW
- SAME QUALITY HARDWARE AS USED IN ALL WILSON ANTENNAS

— SPECIFICATIONS —

Max. Pwr. Input	Legal Limit	Longest Element	36'
VSWR @ Res	1.2:1	Turning Radius	22' 6"
Impedance	50 ohm	Surface Area	12.1 sq. ft.
Feed Method	Coax Balun Supplied	Wind Loading @ 80 mph	309 lbs.
Matching Method	Modified Beta	Assem. Weight	75 lbs.
F/B Ratio	25 db	Shipping Weight	84 lbs.





AVAILABLE ONLY
FACTORY DIRECT
CALL
1-800-634-6898 TOLL FREE

WSI WILSON SYSTEMS, INC.
4286 S. Polaris, Las Vegas, Nevada 89103
PRICES AND SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

WSI WILSON SYSTEMS, INC.
4286 So. Polaris Ave. • Las Vegas, Nevada 89103

TO: ALL AMATEURS
FROM: WILSON SYSTEMS, INC.

Two months ago we had the pleasure of introducing two new products— the 40 mtr add on kit and the ST-77 tower. This month we would like to introduce an exciting new antenna.

This is the antenna for the serious DX enthusiast . . . for the Ham who has decided to leave the average antenna alone and go for the best. If this describes you, or if you have been wanting monobanders for each of the 10, 15, and 20 mtr bands, but have held back due to the space or tower requirements to stack them — then wait no longer. Wilson Systems has the answer to the problem.

The "System 40" — a full monoband antenna for each band — on one boom and using only one feed line. It is broadbanded enough that a separate setting is not required for phone or cw operation. The parasitic elements are full size and with wide spacing so that there is no interaction between elements.

Extensive engineering and design has produced an antenna that offers all the advantages of separate stacked monobanders but with an added advantage of low cost. The price of the SY-40 is only **$299.95**. *This price is possible only because we are factory direct to you, the amateur.*

To introduce the SY-40, during the month of May we are offering a money-back guarantee. It is as simple as this: If you purchase the antenna during the month of May, 1980, you may try it out for thirty (30) days. At the end of that time, if you are not satisfied with its performance, return it for a full refund. That's how confident we are that you will like this antenna.

See the full page advertisement on the SY-40 elsewhere in this magazine. If you have any questions, please feel free to call on the toll free line (1-800-634-6898).

Yours truly,
JIM WILSON
Wilson Systems, Inc.

WILSON SYSTEMS, INC. — 4286 S. Polaris
Las Vegas, NV 89103 — (702) 739-7401

FACTORY DIRECT ORDER BLANK

Toll-Free Order Number
1-800-634-6898

WILSON SYSTEMS ANTENNAS

Qty	Model	Description	Shipping	Price
	SY40	10 Ele. Tribander for 10, 15, 20 Mtrs.	UPS	299.95
	SY36	6 Ele. Tribander for 10, 15, 20 Mtrs.	UPS	199.95
	SY33	3 Ele. Tribander for 10, 15, 20 Mtrs.	UPS	149.95
	33-6 MK	40 Mtr. Mod Kit for SY33 & SY36	UPS	49.95
	WV-1A	Trap Vertical for 10, 15, 20, 40 Mtrs.	UPS	49.95
	GR-1	Ground Radials for WV-1A	UPS	12.95
	M-520A	5 Elements on 20 Mtrs.	TRUCK	229.95
	M-420A	4 Elements on 20 Mtrs.	UPS	159.95
	M-515A	5 Elements on 15 Mtrs.	UPS	129.95
	M-415A	4 Elements on 15 Mtrs.	UPS	84.95
	M-510A	5 Elements on 10 Mtrs.	UPS	84.95
	M-410A	4 Elements on 10 Mtrs.	UPS	69.95
		ACCESSORIES		
	T²X	Tail Twister Rotor	UPS	296.95
	HD-73	Alliance Heavy Duty Rotor	UPS	109.95
	RC-8C	8/C Rotor Cable	UPS	.12/ft.
	RG-8U	RG-8U Foam-Ultra Flexible Coaxial Cable. 38 strand center conductor, 11 guage	UPS	.21/ft.

NOTE:
On Coaxial and Rotor Cable, minimum order is 100' and 50' multiples.
Prices and specifications subject to change without notice.
Ninety (90) Day Limited Warranty — All Products FOB Las Vegas, Nevada

WILSON SYSTEMS TOWERS

Qty.	Model	Description	Shipping	Price
	TT-45B	Freestanding 45' Tubular Tower	TRUCK	319.95
	RB-45B	Rotating Base for TT-45B w/tilt over feature	TRUCK	224.95
	FB-45B	Fixed Base for TT-45B w/tilt over feature	TRUCK	159.95
	MT-61B	Freestanding 61' Tubular Tower	TRUCK	554.95
	RB-61B	Rotating Base for MT-61B w/tilt over feature	TRUCK	304.95
	FB-61B	Fixed Base for MT-61B w/tilt over feature	TRUCK	219.95
	ST-77B	Freestanding 77' Tubular Tower	TRUCK	959.95
	RB-77B	Rotating Base for ST-77B w/tilt over feature	TRUCK	454.95
	FB-77B	Fixed Base for ST-77B w/tilt over feature	TRUCK	304.95
	GK-45B	Guying Kit for TT-45B	UPS	59.95
	GK-61B	Guying Kit for MT-61B	UPS	79.95
	GK-77B	Guying Kit for ST-77B	UPS	99.95
	WTB-1	Thrust Bearing for Top of Tower	UPS	49.95

Prices Effective May 1-31, 1980 — Nevada Residents add Sales Tax

Ship C.O.D. ☐ Check enclosed ☐ Charge to VISA ☐ MasterCharge ☐

Card No.________________ Expires________

Bank No.________________ Signature________

Name________________ Phone________

Street________________

City________________ State________ Zip________

Prices and specifications subject to change without notice.

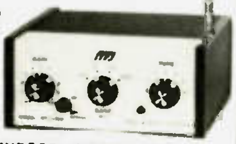
MFJ SHORTWAVE ACCESSORIES

✓47

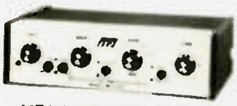
NEW Indoor Tuned Active Antenna. Rivals, can even exceed reception of outside long wire.

Rivals long wires

$79.95



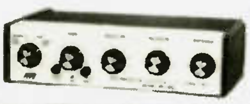
MFJ-1020 NEW INDOOR ACTIVE ANTENNA sits on your desk ready to listen to the world. Rivals, can even exceed reception of outside long wire. Unique Tuned Active Antenna minimizes intermod, provides RF selectivity, reduces noise outside tuned band. Also use as preselector for external antenna. Covers 300 KHz to 30 MHz in five bands. Adjustable telescoping antenna. Controls: Tune, Band Selector, Gain, On-Off/Bypass. LED. FET, bipolar circuitry. 110 VAC, 9-12 VDC or 9 V battery for portable use. Phono jack for external ant. 5x2x6 in.



$99.95

MFJ-1040 RECEIVER PRESELECTOR. Improves weak signal reception, rejects out-of-band signals, reduces image response, 1.8 to 54 MHz. Up to 20 db gain. Low noise MOSFET. Gain control. Bandswitch. Can use 2 ant., 2 rcvrs. ON-OFF/Bypass. 20 db attenuator. LED. Coax, phono jacks. 110 VAC or 9-18 VDC, 8x2x6 in. Also for XCVRS to 350 watts input. Auto bypass. Delay control. PTT jack. **MFJ-1045, $69.95.** Same as MFJ-1040, less attenuator, xcvr auto bypass, delay control, PTT. Use 1 ant., 1 rcvr. 5x2x6 in. 9 V bat., 9-18 VDC or 110 VAC with optional AC adapter, $7.95.

$89.95



MFJ-959 RECEIVER ANTENNA TUNER has low noise 20 db preamp for weak stations. Match antenna to receiver for maximum signal. 1.6 to 30 MHz. Can use 2 ant., and 2 rcvrs. Select tuner, tuner with preamp, tuner with 20 db attenuator, bypass. Gain control. Coax, phono jacks. 110 VAC or 9-18 VDC. 9x2x6 in. **MFJ-950, $59.95.** Same as MFJ-959, less preamp, attenuator, bypass. 6x2x6 in.

MFJ-751 Tunable AM/SSB/CW Filter, $59.95. MFJ-200 Freq. Std., $29.95, more. Free catalog.

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

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

CALL TOLL FREE ... 800-647-1800

Call 601-323-5869 for technical information, order/repair status. Also call 601-323-5869 outside continential USA and in Mississippi.

MFJ ENTERPRISES, INC.

BOX 494, MISSISSIPPI STATE, MS 39762

Tired of High Prices?

Tired of playing roulette with "800" number specials? Forget the toll-free frustration. Take a shortcut and call Long Path Radio. We deliver low prices from the ground up—on towers, rotators, antennas, and accessories. Our goal is to have what you want in stock.

Take a look at the complete line:

HyGain Antennas

- TH6DXX $219.00
- TH5DX $179.00
- TH3MK3 .... $153.00
- TH2MK3 .... $ 99.00
- TH3JR $113.00
- 105BA .... $ 86.00
- 155BA $133.00
- 205BA $219.00
- 204BA $166.00
- 402B $159.00
- DB1015A $103.00
- 18AVT .... $ 70.00
- 14AVQ .... $ 46.00
- BN86 .... $ 12.00

Rohn Towers and Accessories

- 25G section ..... $ 37.99
- 45G section ..... $ 65.99
- HDBX48 self supp. tower .. $316.99
- HDBX56 self supp. tower .. $333.99
- 3/16 EHS guy wire, 500 ft. .... $ 49.00
- 3/16 CCM cable clamp .... $ .44
- ⅜ turnbuckle, eye & eye ..... $ 5.99
- M200H 10 ft. H.D. galvanized mast .... $ 36.99

Tonna F9FT

- 4 element-2 meter .... $ 21.95
- 9 element-2 meter .... $ 29.95
- 16 element-2 meter .... $ 55.00

CDE Rotators

Call or write for your low price.

Cushcraft Antennas

- ATB34 Tribander . $199.00
- 20-3CD $133.00
- 20-4CD $222.00
- 15-3CD .... $ 76.00
- 15-4CD .... $ 87.00
- 10-3CD .... $ 54.00
- 10-4CD .... $ 66.00
- ATV-4 .... $ 74.00
- ATV-5 .... $ 82.00
- ARX-2 .... $ 30.00
- ARX-450 .... $ 30.00
- A-147-11 .... $ 30.00
- 32-19 Boomer ... $ 65.00

Except for Rohn towers, all items shown are complete stock. Sorry, no other products available.

We're here to serve you from 8:30 to 5:00, Monday through Friday, at 1-214-369-3401. Ask for Long Path Radio.

LONG PATH RADIO, INC. ✓84

P.O. Box 29682 Dallas, Texas 75229 1-214-369-3401

TERMS:

All prices F.O.B. Dallas. C.O.D. requires 25% deposit. Money order, cashier's check, O.K. No personal checks. We ship freight collect. If you desire prepaid freight, a small ***Per Item*** *charge will be made for shipping and handling.*

FEATURES

- Auto Send & Receive RTTY & CW
- Connects to TRS-80 User Port & Key/head phone jacks
- 10 message memories 255 char. ea.
- Uses builtin PLL or external TU
- Includes hardware, cassette & manual
- Morse tutorial-10 lessons-corrects mistakes Simplest, fastest way to learn the code
- Morse practice-random 5 letter words
- Auto numbering contest keyer
- Interactive graphics custom PIX
- Autotransmitter control PTT
- Requires Level II Basic & 16K RAM
- CM80 In cabinet as illustrated $279
- M80 As above minus cabinet $149
- M800 Adds advanced RTTY features to M80 $99

PET, APPLE, SORCERER versions available

Write or call for complete catalog

MACROTRONICS, inc.® ✓44

1125 N. Golden State Blvd. / Suite G
Turlock, CA 95380 (S)
(209) 667-2888 / 634-8888

We are experiencing telephone difficulties, please keep trying.

master charge · VISA

California residents add 6% tax

✓Reader Service—see page 226

The California Crank-Up

—most convenient mast around

Rene M. White W6WDF
1640 Hull Drive
San Carlos CA 94070

Recently, while looking for some sort of tower for my two-meter, ten-element yagi, I found myself looking at those sliding push-up tubular masts which are used for hanging up television antennas.

I reasoned that if they could support some of those heavy, long-range DX television monstrosities, they certainly would not suffer under the weight of my two-meter antenna.

At the local ham outlet, I found a sale on these. The twenty-foot masts were going for $16.95. Upon arriving home with my purchase and extending it out on the patio, it was apparent that once installed on the roof, I would have to climb a six-foot ladder in order to push up the top section. As my house consists of three stories, this meant that once I was on the ladder, I would be looking down thirty-six feet to street level with nothing to hold on to. No thanks!

As a result, the mast rested in the yard for many weeks while several ideas for raising the top section were thought of and discarded. Only one method seemed to be reasonable, and that was converting to a crank-up.

If only I could insert a strong aircraft-type cable between the inner and outer tubular sections and attach the cable to the bottom of the inner section employing the same method used on commercial crank-up towers, I would have a cheap, functional, and lightweight mast. The fit between the two sections was quite sloppy and on my first try I was able to insert a 1/16″ cable between the outer 1½″ and the inner 1¼″ tubular sections, but the fit was so tight it was obvious that a smaller cable would be necessary.

The next try was with a 3/32″ aircraft cable which allowed the inner mast to move up and down freely. The cable then was attached to the bottom of the inner section and brought out over the top of the outer mast. Now, by pulling on the cable, the top section could be raised and lowered with ease. It became evident, however, that the cable traveling over the lip of the outer mast would become badly abraded, so an extension was fabricated with a wheel guide on one end. This was attached near the top of the outer mast in order to change the angle of cable entry. The lip of the mast was filed and sanded to a smooth contour and a heavy deposit of waterproof grease was applied. The extension containing the wheel guide is made of 1/8″ x 1″ x 10″ fairly malleable steel scrap with the guide mounted on the end. Shims were used to maintain the extension at the desired angle. I'm sure that anyone with access to machine tools can improve on this, but this simple assembly works very smoothly. As an afterthought, I realized that a larger wheel would improve this operation.

Near the bottom of the mast is mounted a small winch rated at 1000 pounds. Although overrated for this application, it was on sale at K-Mart at $14.95. This is secured with two 1¾″ muffler clamps and is easily moved up or down vertically as required.

In choosing a mast for this application, it would be advisable to pick one with as much space as possible between the inner and outer sections for ease of cable access.

The mast has been on the roof for the past seven months. The antenna has been raised and lowered six or seven times for swr or element adjustment. All these were made at eyeball level with both feet flat on the elevated bedroom roof while the base of the mast was mounted at second-story level. The convenience, safety, and low cost of this easily constructed crank-up mast should not be overlooked. For light duty, it has all the attributes of a commercial one. ■

Walt Becker K1QPS
General Delivery
St. Augustine FL 32084

The Beachside 2-Meter Beam

—stands up to salt spray

For several months each year, I live on the beach on Anastasia Island just south of St. Augustine, Florida. The chief enemy of all antennas used in a coastal region is salt spray aided by heavy dews and tropical rains. These will reduce steel bolts to rust and render insulators useless in just a few short weeks.

There are no hills here, and the prevailing northeast winds plus the fact that I live in a trailer dictate the use of a simple design with low surface area and the use of only moderate height—about 20 feet.

I wanted to operate repeaters in Jacksonville (about 55 miles north), Daytona Beach (45 miles south), and Gainesville (about 75 miles west). The 3-element, balun-fed, Y-matched, all dc-grounded beam that I designed and built will do this when fed with the 1½-Watt output from a Tempo S1. When fed 25 Watts from my Kenwood 7625, it will deliver ample signal to operate repeaters in Titusville, Orlando, and St. Petersburg, all of which are more than twice as far away.

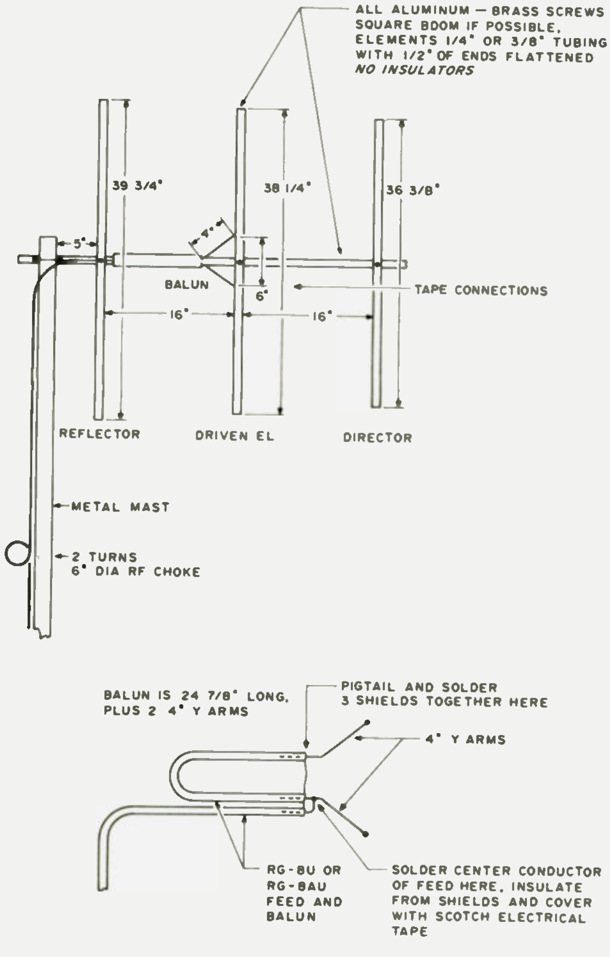
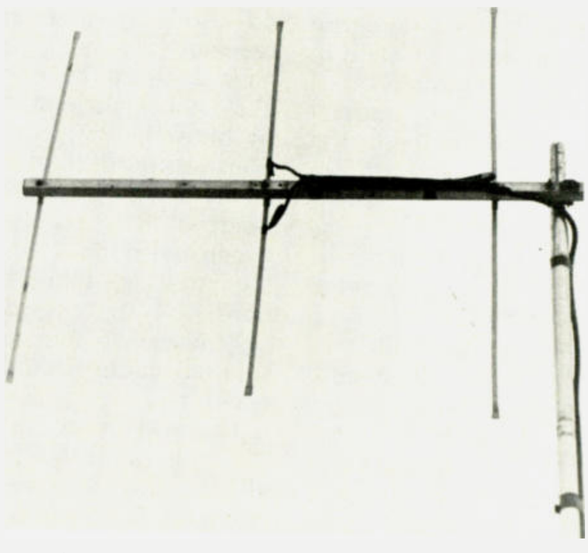


Fig. 1.



Beachside 2-meter beam with Y-match and balun.

The beam is made from a junked TV antenna. It is mounted on a piece of TV mast, vertically, with a single U-clamp about 5" behind the reflector. The metal mast has no appreciable effect on the gain and provides a perfect dc ground, which is very useful here in Florida where 12-hour thunderstorms are not uncommon.

The element dimensions given will enable use anywhere in the 2-meter band; the Y-arms are exactly 4" and are attached to the driven element exactly 3" either side of the center, or 6" apart, with either clips or screws. These connections should be covered with a double layer of Scotch electrical tape. If this is done carefully, the joints will remain clean for several years even in this tropical climate.

The balun is made from RG-8/U or other good quality, 52-Ohm coax, and is 24 7/8" long plus the 4" Y-arms on either end. The arms and the joint where the three shields are soldered together also are covered with Scotch electrical tape. The balun is attached to the driven element, folded lengthwise alongside the feedline, taped to the boom, and then led down the mast.

Although circulating rf currents on the coax shield do not seem to be a problem if the line is arranged as shown, it is always good practice to make a 2-turn, 6"-7"-diameter coil in the coax down away from the field of the beam and before the coax enters the shack.

The Beachside 2-meter beam can be dismounted, folded, and transported easily, as it occupies a space only 39" long and about 2" in diameter. ■

Richard C. Jaeger K4IQJ
727 McKinley Avenue
Auburn AL 36830

Double Duty Mag-Mount Antenna

—it's a portable GP, too

When on the road, I have always enjoyed operating two meters with a modified IC-22S and a Hy-Gain ¼-wave magnetic-mount antenna. The rig operates well from the car, but has had swr problems when operated with the antenna in hotel rooms. Without the car acting as a ground plane, the swr of the antenna was above 3:1, which caused the swr protection circuitry of the IC-22S to substantially reduce the power output of the rig. I decided to try to modify the antenna so that it also could be used as a ground plane for portable operation. I wanted the conversion to ground-plane operation to be simple and not interfere with the antenna operation when mounted on the car top.

The resulting conversion is shown in Photo A. The ground plane is constructed from the small brass tubing found in most hobby shops. Each arm is built from one 12-inch length of 1/8-inch diameter tubing and one 11-inch piece of 5/32-inch diameter tubing. The two pieces are slipped together and adjusted to a total length of 20 inches. The joint and ends of the tubing are then soldered. One-inch pieces of 5/32-inch tubing are soldered to the base of the magnetic mount antenna and serve as mounting sleeves to hold the ground-plane legs. It was necessary to sand the base of the ¼-wave antenna in order to make a good solder connection.

The ground-plane antenna in its broken-down form is shown in Photo B. The antenna with its ground-plane arms still fits very nicely in my suitcase when traveling. The antenna attaches in its normal fashion to the top of the car for mobile operation and the ground-plane arms slip into the mounting sleeves for quick conversion to portable operation. The swr of the antenna has been measured to be slightly more than 1.4:1. This represents the minimum swr to be expected from the 36-Ohm radiation resistance of a ground-plane antenna with horizontal arms. The IC-22S now operates into the converted antenna without any noticeable power reduction and the antenna has added to my operating enjoyment on numerous trips and on vacation. ■

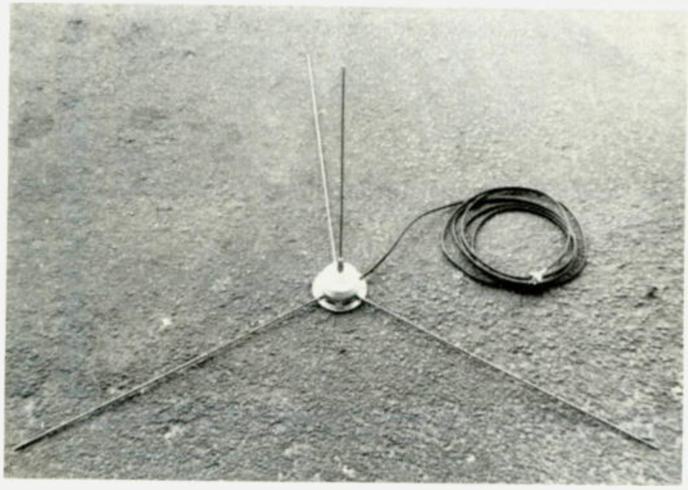


Photo A.

Photo B.

Check these state-of-the-art specifications

- Power Capability: 2500 W PEP
- Frequency Range: Continuous 3.0 to 30 MHz
- Impedance Matching: 20 ohms to 300 ohms to 50 ohms resistive
- Direct Reading SWR Meter: 1 to infinity
- Direct Reading Power Meter: Two meter scales from 0 W to 250 W and 0 W to 2500 W; front panel switch selects FWD or Reflected Power. *(Illuminated panel meters)*
- Power meter displays RMS with continuous carrier and automatically displays PEAK when driven with SSB signal.
- Average "Automatic" tune-up time: 10 seconds or less
- Tune-up time not affected by power level; can be as low as 1 W.
- A unique "Linear Disable" circuit automatically switches companion linear amplifier to standby within milliseconds whenever SWR exceeds a threshold preset on front panel, thus protecting the linear and antenna tuner from excessive SWR.
- Toroidal bridge coupler provided in separate enclosure, permitting it to be installed directly at the output of the transmitter for meaningful SWR measurements.
- Power requirements are 115/230 VAC 50-60 Hz, 10 W operating/5 W standby; or 13.5 VDC, 1 A operating/.5 A standby.
- Antenna tuner packaged in cabinet 17" W x 5-1/4" H x 14" D (Rack mounting optional).

J.W. Miller Division
BELL INDUSTRIES ✓308

19070 REYES AVE. ■ P.O. BOX 5825
COMPTON, CALIFORNIA 90224

✓Reader Service—see page 226

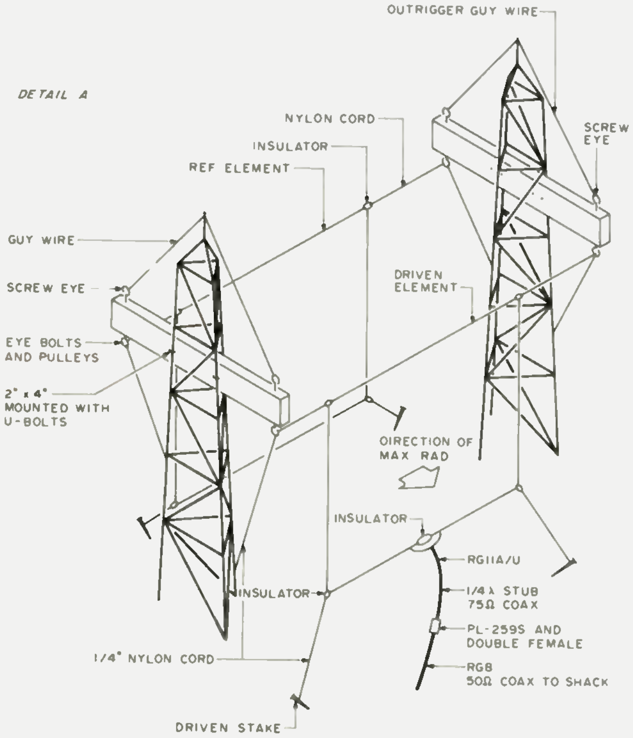
Anthony W. DePrato WA4JQS
205 Cherokee Trail
Somerset KY 42501

A 40-Meter Quad for $20

—assuming you own two towers

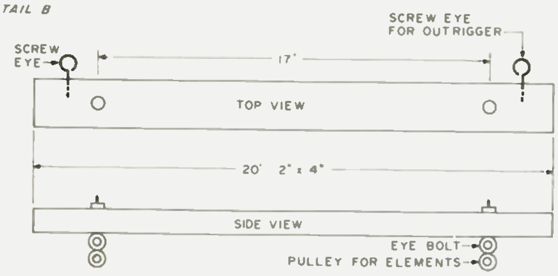
With the increased DX activities on 80 and 40 meters, I decided to try my hand at 40-meter DXing. I soon found out that the old inverted vee antenna just did not make the grade. I could do a fair job running a kW, but in the pileups with all the big guns, it was an entirely different story.

DETAIL A



REF ELEMENT 5% LONGER THAN DRIVEN ELEMENT
2 x 4s MOUNTED TO TOWERS WITH U-BOLTS

DETAIL B



What I needed was an antenna with gain and directivity but with low cost and low wind loading. So a beam was out of the question. I decided, therefore, upon a fixed-direction quad. Since I have towers on the east and west ends of my lot located approximately 200′ apart, I decided to string the quad between these two towers.

My first try was a driven element only. This was an improvement in signal gain but was bi-directional north and south. One added advantage was a decrease of broadcast QRM from Europe, but, like everyone else, I wanted something better, so I decided to add a reflector element.

How to do it, was the problem. It then dawned on me that since the spacing between elements was around 17 feet, why not use 20′ two-by-fours in the top of the towers to get the element spacing? So, after a look in my junk box and a visit to the local hardware store, I was ready to start work.

After cutting the wire for the driven element and reflector to their respective lengths, I installed four insulators on the reflector so that each side was 35′ 8″ in length. Five insulators were used on the driven element to give each side a length of 34′ 8″, with the fifth insulator used where the coax is attached.

I drilled holes 17′ apart in each of the two-by-fours and installed eye bolts with pulleys in each hole. Screw eyes were installed in the end of each to attach the outrigger support wires to keep the two-by-fours from bending from element strain. I used spar varnish to weatherproof them. They were mounted in the top of the towers with 1½″ U-bolts. Guy wire was used as an outrigger.

Be sure to get some help installing the two-by-fours as they are hard to handle by yourself. Quarter-inch nylon cord was used to pull each element into the air; the bottom halves were tied off to ground stakes.

After the antenna was installed, swr and bandwidth checks proved to be better than I had hoped for. The swr meter showed that reflected power was lowest at 7.200 MHz. On-the-air tests have proven to be excellent. The quad is fixed to the south south-west, and reports from VK and ZL have been S9 plus constantly. I've received S9 into Japan, long path So, if you can't put up a 40-meter beam, then try this antenna. You might be surprised. Total cost of this antenna was $20.00. ■

Construction Details

Specifications:
Two-element quad; 8.0 dB gain; 20 dB front-to-back ratio; spacing is 1/8 λ, which is 17.0 feet; No. 14 wire, enameled copper; 5% difference factor between elements; design frequency is 7.200 MHz.

Driven Element
For the driven element, I used $L = 1005/F_{MHz}$ to obtain the element length. For 7.200 MHz, this is 139' 5" or 34' 8" per side.

Reflector
Here, I used $L = 1030/F_{MHz}$ to obtain a wire length for 7.200 MHz of 143' 0" or 35' 9" per side.

Feeding the Quad
I decided to use a quarter-wave stub to feed the driven element. I used 72-Ohm coax since I had a large amount on hand. However, kW-rated twinlead also can be used. Below are the lengths for both coax and twinlead.

Stubs
The formula $L = 246(VF)/F_{MHz}$ is used for stub length.
For RG-11A/U coax, Z = 72 Ohms and VF = 0.66. Driven element stub length for 7.200 MHz is 22' 6½".
For 1 kW-rated twinlead, Z = 72 Ohms and VF = 0.71. Stub length for 7.200 MHz is 24' 3".

The stubs should be cut as close to calculated lengths as possible. Using a PL-259 with a barrel connector, I attached the stub to the 52-Ohm coax feedline to the shack. Using my noise bridge and R-4C, I tuned the 52-Ohm coax stub for lowest swr.

References
1. *Radio Handbook*, 20th edition, Orr.
2. *Cubical Quad Antennas*, Orr.
3. *Antenna Handbook*, 78 edition, Orr.
4. ARRL *Antenna Book*, 78 edition, ARRL.

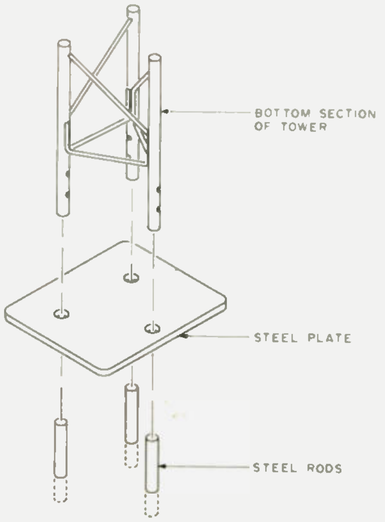
Stephen J. Dowlen WA5TDT
Box 16552
Lubbock TX 79490

A Dirt-Cheap Tower Base

—you can take it with you

When I finally bought the antenna tower I had wanted for years, I found I had given little thought to how it would be anchored to the ground. Obviously, the base should be anchored so that lateral movement parallel to the ground is not possible and also so that the base will not settle into the ground and thus slacken the guy wires. The salesman at the electronics store suggested I buy the short section that Rohn sells with its 24-series towers. I was told that most people set the short section in a hole and pour concrete around it, filling up the hole and leaving a few inches of the section protruding above the top—just enough to attach a section of the tower.

The salesman and I discussed what would happen to this excellent mounting base when it came time to move to another home. He told me that most hams remove the tower from the base and simply saw off the three protruding legs of the short section (flush with the surface of the concrete) and cover the remains with a thin layer of dirt. Somehow I could not reconcile myself to the thought of leaving a part of my precious tower buried in someone's backyard, so I decided to buy five sections of Rohn 24 tower and a top section as planned—and went home to study the problem.



During the years I spent growing up on a farm and later working as a welder and electrician, I was exposed to a variety of problems that required improvisational techniques (jury-rigging). I was determined to utilize my experience in finding another method by which I could anchor my tower. The answer lay on the scrap pile of steel which I have collected over the years. I dug out a 2′ x 2′ piece of ¼″-thick steel plate and three 4′-long steel rods having a diameter slightly less than the inside diameter of the legs of a tower section. I set the bottom of a tower section on the approximate center of the plate and marked the location of each of the three legs. Then I drilled a hole just large enough to allow a rod to pass through at each of the three marks. The plate was placed flat on the ground at the location where the tower would stand. Each rod was run through a drilled hole in the plate and pounded into the ground with a sledgehammer until about eight inches of each rod was left protruding above the plate. The legs of the first section of the tower were placed over the ends of the rods, and a level was used to ensure that this section was perfectly vertical before proceeding.

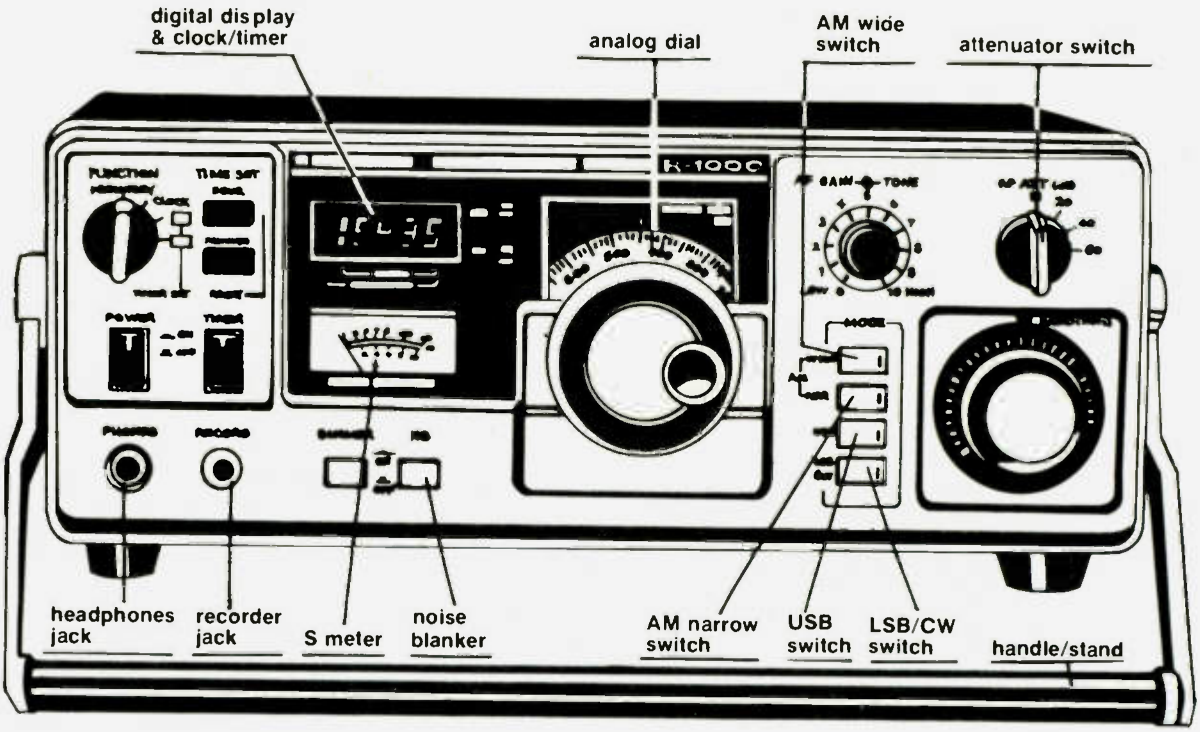
I then drilled holes through the rods using the bolt holes in the tower legs as guides. Then I installed bolts and nuts to secure each rod and leg together. My tower was now anchored against any lateral movement by the steel rods, and further settling was prevented by the steel plate which the bottom of each leg rested upon. *Caution: This type of mounting is not secure enough to keep the tower section upright while supporting the weight of a climber. The first section of tower must be firmly guyed or supported until the first set of permanent guy wires is installed further up the tower.*

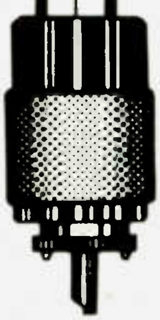
My tower has now been up for three years and has withstood countless assaults by the notorious west Texas wind, along with ice storms, without settling or shifting. The tower is guyed at the 20-, 40-, and 58-foot levels in all four directions, and there are no less than eight HF, VHF, and UHF antennas mounted on the top 20 feet. Naturally, if your soil is softer than my hardpacked dirt, the square footage of the steel plate should be increased. As the area of the plate is increased, the thickness should also be increased proportionately.

Now, you say, how does this anchor method benefit you when you pack up to leave town? Read on! Disassemble your tower and remove the bottom section from the rods. Enlist the aid of your auto bumper jack and a few feet of sturdy chain. The chain is looped around the top of the rod and prevented from sliding by a bolt or pin inserted through the bolt hole in the rod. The remainder of the chain is looped over the hook of the jack and the rod can then be jacked out of the ground. If it cannot be pulled out of the ground by hand (after the jack has reached the upper limit of travel), simply allow the chain to slide downward on the rod as the jack is lowered, clamp a large vise-grip plier on the rod above the chain, and crank it out of the ground with the jack. Now you can load up everything and start over again somewhere else!

A word of caution—*never* climb a tower without a sturdy pair of boots (preferably lineman-type with steel arch supports), a sturdy climbing belt or safety belt of the industrial type, and an approved hard hat or hard cap. You may think a hard hat is unnecessary and silly if you are the strong and virile type, but I assure you that you will be glad you have one should a gust of wind catch an antenna on the way up and clobber the old cranium! Head protection is also a must for anyone working *under* a climber. A 3-inch screwdriver dropped from 50 feet can penetrate even a hard head like mine. *Be careful* and have fun! ■

New from Longs . . . Kenwood R-1000 compact communications receiver KENWOOD





The new, compact (12¾W x 4½H x 8-9/16"D) R-1000 is a high class general coverage receiver covering 30 bands from 200 KHz to 30 MHz. It features: PLL synthesizer, digital display readout (1 KHz step) and analog dial calibrated at 10 KHz intervals from 0 to 1,000 KHz. The 12 hr. quartz digital clock with timer can be set to go on or off at any time. A stepped RF attenuator provides 20, 40, and 60 dB attenuation to protect the unit from damage by high input power signals. Also features: 3 stage IF filter, tone control, built-in noise blanker, dimmer switch, recording terminal, selectable AC power voltage (100, 120, 220 or 240 VAC), wire antenna terminals and UHF connector (SO-239 for coax cable), large 10 cm built-in speaker, external speaker jack, 2 position antenna selector switch, accessory terminals for timer and muting circuit. Has calibrated S meter, AF gain control, 4 mode switches. Selects LSB/CW, USB, narrow AM or wide AM.

Sensitivity (S + N/N 10 dB or more): SSB 200 KHz - 2 MHz: 5 micro V, AM 50 micro V. SSB 2 MHz - 30 MHz 0.5 micro V, AM 5 micro V. Frequency stability: ± 2 KHz Max. from 1-60 min. after power on, + 300 Hz max. in every subsequent 30 min. Selectivity: AM (wide) 12 KHz at -6dB, 25 KHz at -50dB. AM (narrow) 6 KHz at -6dB, 18 KHz at -50dB. SSB/CW 2.7 KHz at -6dB, 5 KHz at -60dB.

499.00

List Price. Call for quote.

42

Long's

master charge THE INTERBANK CARD

VISA

Use your Master Charge or BankAmericard/VISA when you order.

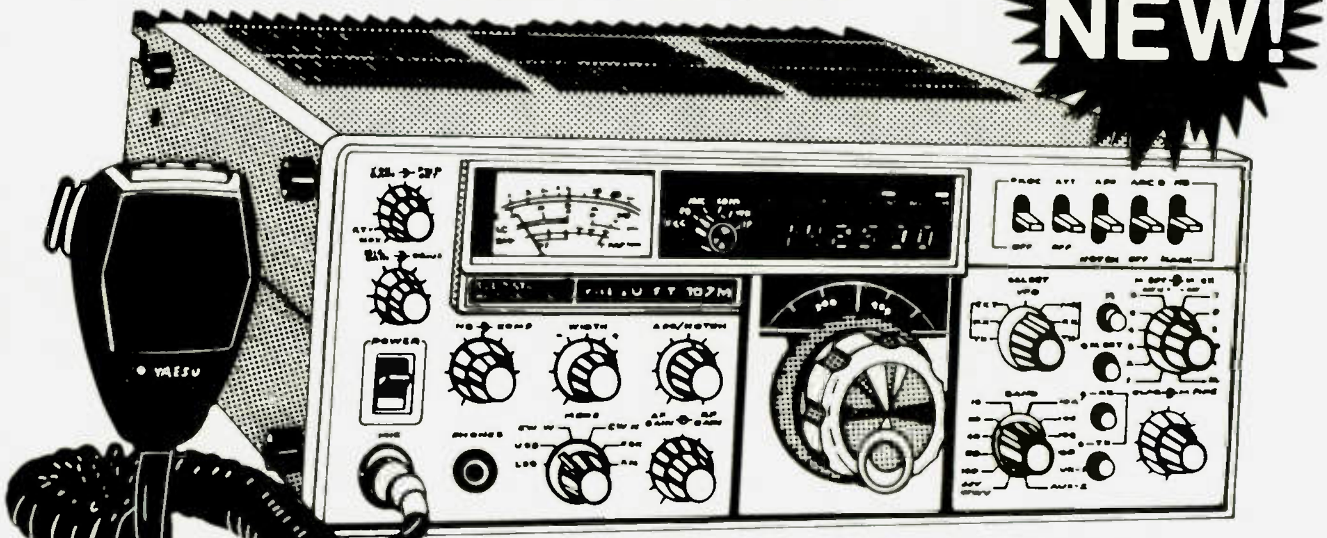
Ham Radio Department Store

MAIL ORDERS: P.O. BOX 11347 BIRMINGHAM, AL 35202 • STREET ADDRESS: 2808 7TH AVENUE SOUTH BIRMINGHAM, ALABAMA 35233

Reader Service—see page 226

New from Long's . . . YAESU FT-107M all solid state HF SSB transceiver

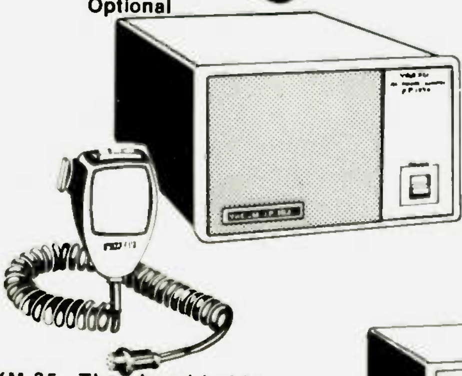
NEW!



Shown with YM-35 mic Optional

A high performance HF transceiver covering all bands 160-10 meters with 2 auxillary band positions available for future expansion. Operating at an input power of 240W on SSB/CW and 80W on AM/FSK. Features digital plus analog frequency display, advanced LSI frequency counter, VOX, RF speech processor, built-in SWR meter, peak/notch audio filter, and variable bandwidth. Optional Digital Memory Shift (DMS) has 12 discrete memories. Stores individual frequencies or use as 12 full coverage VFOs. (500 kHz each) Remote scanning possible with YM35 mic if radio is equipped with optional DMS. Sensitivity: 0.25 uV for 10dB S/N, CW/SSB, FSK, 1.0uV for 10dB S/N AM. Power required: 13.5 V DC at 20 amps.

1045.00 List Price. Call for quote.

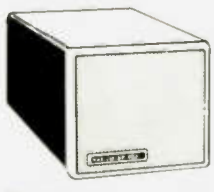


FP-107E- External AC power supply/speaker console. Supplies 13.5V DC at 20 amps for proper operation of the FT 107M. 4 ohm 3W speaker built-in.

145.00 List Price. Call for quote.

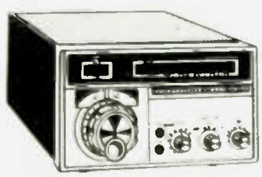
YM-35 The hand-held scanning mic provides up/down scanning as well as scanning speed control for convenient operation. Used for scanning with a DMS memory equipped FT107M. 600 ohm impedance.

19.00 Call Today.



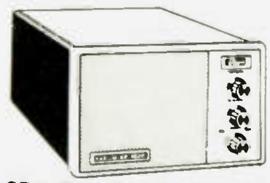
SP-107 matching speaker for use with the FT107M. 4 ohms 5 watts.

29.00 Call Today.



FV-107 Solid state external remote VFO. Operates full transceive, receive, or transmit only. Features a ±2.5 kHz clarifier and a precision analog dial.

125.00 List Price. Call for quote.



SP-107P Speaker/phone patch for FT107M has RX and TX gain control and VU meter. Use with high or low mic input impedance and PTT or VOX operation. 4 ohm 5W speaker built-in.

67.00 Call Today.

Long's

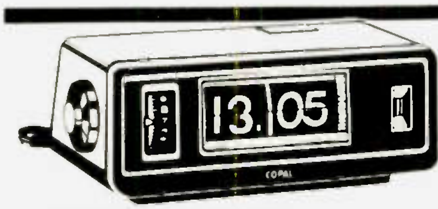
master charge THE INTERBANK CARD

VISA

Use your Master Charge or BankAmericard/VISA when you order.

Ham Radio Department Store

MAIL ORDERS: P.O. BOX 11347 BIRMINGHAM, AL 35202 • STREET ADDRESS: 2808 7TH AVENUE SOUTH BIRMINGHAM, ALABAMA 35233



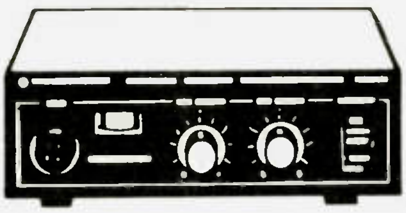
COPAL RP-205 24-hour clock with 24-hour alarm
Highly accurate with a 24-hr. alarm that can be set for either AM or PM and in 10-minute intervals. Features illuminated leaf-type numerals and precision synchronous motor.
19.95

DYNAMIC INSTRUMENTS nickle cadmium rechargeable batteries
Never run out of batteries again. Guaranteed for 5 years

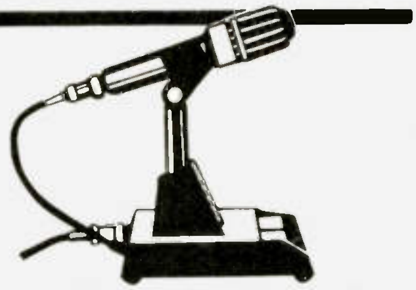
Size AA	List 7.35	**2 for 4.33**
Size C	List 7.95	**2 for 5.15**
Size D	List 8.25	**2 for 5.30**
9 volt	List12.95	**9.50 each**

BENCHER BY-1 Iambic paddle
With solid silver contact points, full range adjustment, non-skid feet and heavy steel black-textured base.
39.95 Call today.

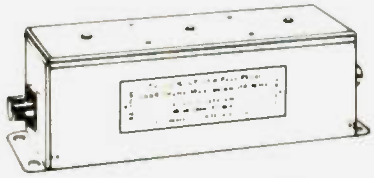
HY-GAIN 287 magnetic mount foldover antenna
The 287 with unique foldover design has 5/8 wave for low angle radiation. Adjustable thru a 180 degree arc and withstands speeds up to 120 mph. Less than 1.4:1 VSWR, 144-148 MHz, power rated to 150 W, 3 dB gain, DC grounded.
19.95 Call today.



KENWOOD PC-1 phone patch
The PC-1 features NULL control, RX and TX gain controls and VU meter. Connects between a transceiver and a phoneline.
59.95 Call today.



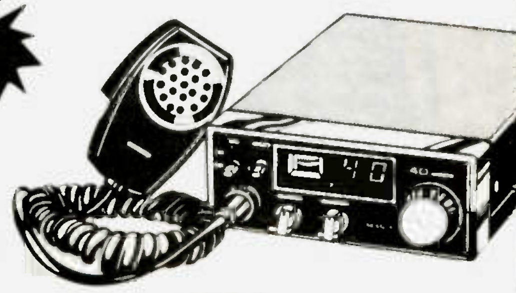
KENWOOD MC-50 dynamic desk mic
The MC-50 features dual impedance, 500 ohms or 50K ohms. Compatible with Kenwood equipment.
45.00 Call today.



DRAKE TV-3300-LP low pass filter
Low pass filters, properly attached to transmitters attenuate all harmonics falling in any TV channel or the FM band. 1000W max. below 30 MHz. Attenuation better than 80dB above 41 MHz.
26.60 Call today.

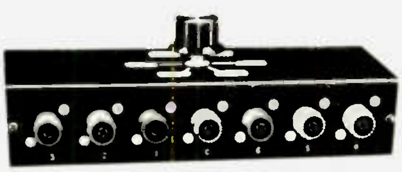
SAVE $90!

SHARP CB-2460 40-channel CB transceiver



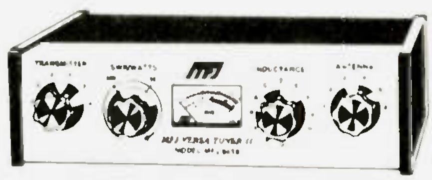
A full featured 40-channel CB with RF/signal meter, channel 9 priority monitor with LED readout, detachable mic with PTT switch, PA operation optional. Also delta tuning, squelch control and automatic noise limiter.

49.95 List Price 139.95



B & W 595 coax switch
Features 6 outputs, a power rating of 2 KW PEP and VSWR of less than 1.2:1 up to 150 MHz. Grounds all unused antennas.
21.50 Call today.

TELEX Audio Fax 610 headphones
Shock and moisture resistant with easy adjustment for fit and comfort. Snap-fit plug-in cord. Impedance - 600 ohms.
6.32

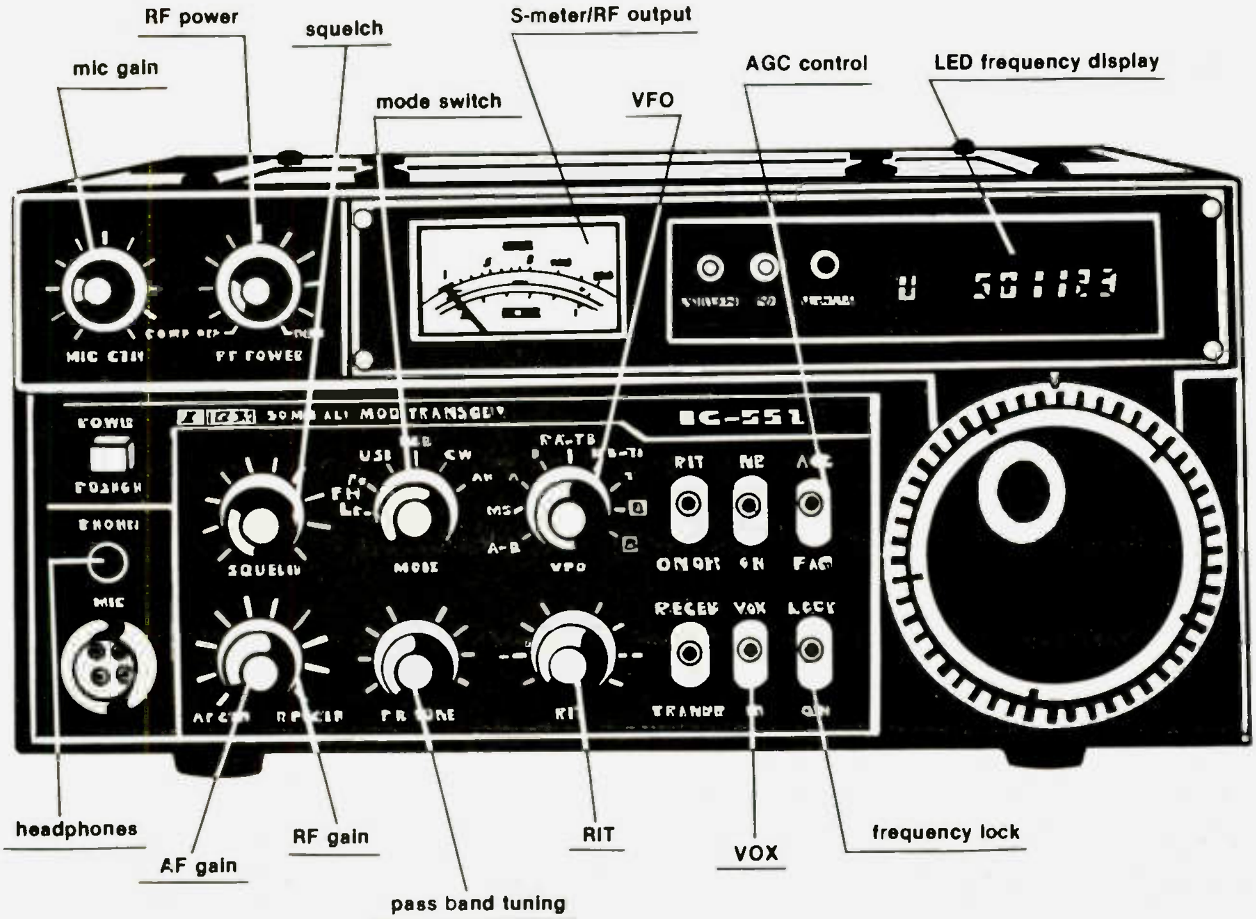


MFJ-941B Versa tuner II
Has SWR and dual range wattmeter, antenna switch, built-in balun and 300W RF output. Has SO-239 connectors and mobile mounting bracket.
79.95 Call today.

Call Toll Free 1-800-633-3410

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

ICOM IC-551 compact 50 MHz all mode transceiver



Icom's IC-551 is an all mode 6 meter unit in a compact, easy to use instrument which uses a built-in microprocessor for frequency control and scanning. The no backlash, no delay dual VFO light chopper system is included as a standard feature and provides split frequency operation as well as completely variable offsets. It covers 50.000 MHz to 53.999.9 MHz and features a 6 digit frequency readout, 2 digital VFO's, built-in AC/DC power supply, variable output from 1 to 10 watts, dial lock switch for mobile use, noise blanker, variable scan speed, and 3 memories. It can scan memories and scan the entire 6 meter band or any selected segment of the band. Modes:SSB, CW, AM, FM (optional). FF speech processor and variable bandpass module optional. VOX unit available. Power output: SSB 10W PEP (1-10W adjustable), CW 10W (1-10W adjustable), AM 4W (1-4 adjustable),FM 10W (1-10W adjustable).

ICOM

Sensitivity: SSB, CW, AM less than 0.5 microvolts for 10 dB S+N/N FM. More than 30 dB S+N+D/N+D at 1 microvolt. Less than 0.6 microvolts for 20 dB noise quieting.

449.00

Call for quote.

Call Toll Free 1·800·633·3410

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

Dr. Ken Jenkins WB6MMV/7
1801 Cedar Street
Newberg OR 97132

Triband Dual Delta

—here's an attic antenna that works

One of the nicest things about amateur radio is that one often can obtain excellent performance from simple antennas. I recently moved into a new house which depleted my bank account beyond my wildest nightmares. I had hoped to be able to find a triband beam antenna that would fit my financial situation, but it did not take long for reality to ruin my dreams of a cheap, effective beam antenna. Consequently, I decided to homebrew the most effective triband antenna that I could for the least amount of money.

After much searching and experimenting, the type of antenna I finally settled on covered 20, 15, and 10 meters, and was cheap, reasonably effective, and, as a bonus, was completely hidden from view. The antenna I chose was a delta-loop antenna, using the driven element of a delta-loop beam mounted horizontally *inside* the attic of my new house.

Construction

The formula for the length of the driven element of a delta loop is $1005/f_{MHz}$. Since I was bound to need some extra wire at the ends, I cut the antenna to 71 feet overall in length for a 20-meter loop. I mounted the antenna to the rafters inside the attic, using screw hooks and ceramic insulators to hold the wire at three corners.

I used #14 solid, Formvar-insulated wire simply because it was cheap and available; you could use smaller wire if cost considerations were important, however. Try to select a section of the attic that doesn't have a lot of metal ductwork or plumbing lines that could detract from the performance of the delta loop. Also, make sure that the wire isn't touching any wood or metal inside the attic.

I initially fed the antenna with a random length of 50-Ohm coaxial cable and a 1:1 balun. However, I found out that the swr was substantially higher than I wished. I measured the antenna with a noise bridge and found out that an impedance-matching device would be necessary to use the antenna on 20 meters. Rather than changing the length of the antenna, using a length of 72-Ohm coaxial cable to match the impedance, or using a gamma match, I chose to substitute a 4:1 balun for the 1:1 balun already on the antenna. I was rewarded with an swr of 1.3 to 1 across almost all of the 20-meter band. The broadband characteristics of the antenna were helpful with respect to swr, although overall efficiency suffered due to the relatively low Q. As a bonus, the antenna worked very well on the entire 10-meter band also, with an swr of 1.8 to 1 on the entire band.

For a total investment of $25, I had a 20- and 10-meter antenna that had a theoretical gain of 2 dB over a dipole and, best of all, it was completely invisible to the neighbors.

Not happy with missing out on the action on 15 meters, however, I added a second delta loop inside

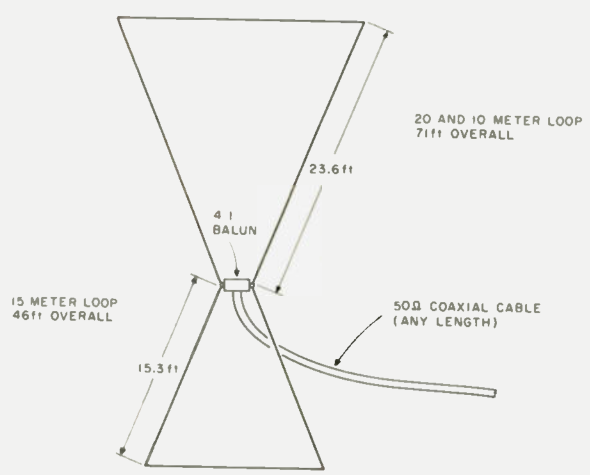


Fig. 1. Top view of the dual delta loop.

the first loop. The second loop was cut to 46 feet and also was laid out in the form of an equilateral triangle. The 15-meter loop was soldered to the 4:1 balun at the same point that the 20- and 10-meter loop was soldered.

Needless to say, adding the 15-meter loop increased the swr of the 20- and 10-meter loop to over 2.5 to 1 on both bands. Since I wasn't ready to give up yet, I took the 15-meter loop and rotated it 180 degrees so that the balun was now at the apex of two delta loops (see Fig. 1). This variation was a winner, with the swr on 20 and 10 returning to its original values and the 15-meter loop giving a 2.1 to 1 swr across the entire band.

Performance

While I would like to say that I worked some exotic DX while running barefoot with 3 Watts on sideband, I can't say that the performance of my dual delta loop is equal to that of a beam, but it will provide a bit better performance than a longwire or a dipole, and with an acceptable swr on 20, 15, and 10 meters.

The antenna appears to be omnidirectional, although ductwork inside the attic might affect the radiation pattern somewhat. Needless to say, mounting the dual delta loop outside and much higher than the 10-foot height of mine will provide some increase in performance.

The low price ($30) and unobtrusive nature of the dual delta loop make it attractive to hams who are faced with restrictive covenants regarding towers and antennas. Try the dual delta loop; you can't beat it for performance, price, and simplicity. It really beats a dipole! ■

Rich Dease SV0WX
Det. 183, Box 1072
APO New York NY 09254

Try a Fox and Hare Special

—antenna for DF operations

I always have sought unusual objects to use as antennas ever since I first saw my brother load into a curtain rod in his shack and work Japan on 10 meters.

One old idea I never tried was to check the radiation characteristics of a globe as a driven element. The idea is that half the circumference of a globe is really the same as many quarter wavelength verticals bent in an arc.

I didn't have a globe of 12½" diameter, so I thought I would try a circle of wire, total length 38", and see if it would load. Not knowing how to approach counterpoise construction for such a configuration, I added one radial, horizontal and in line with the loop. The field strength meter I had nearby for comparison of the globe vs vertical antenna indicated an extremely sharp single directivity.

I also tried bending the radial down 45° from horizontal; however, this only increased the beamwidth to about 40°. I tried several other settings but returned to the original, which proved to be the optimum position for narrow beamwidth.

Construction

The antenna loop and radial are made of #14 copperweld wire. After soldering the loop together, it is securely fastened to a 10" long wooden handle by wire staples. The radial is connected in a like manner. A small bead (from XYL?) should be epoxied on the end for safety.

Conclusion

This highly directional antenna, combined with a portable 2 meter rig with S-meter, makes an excellent "fox and hare" transmitter hunt combination. Its relatively small physical size and excellent front to back/front to side ratio make this antenna also practical for HF experimentation. ■

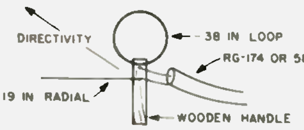


Fig. 1.

John M. Franke WA4WDL
Apartment 225
1006 Westmoreland Avenue
Norfolk VA 23508

Norman V. Cohen WB4LJM
7719 Sheryl Drive
Norfolk VA 23508

The IC Outener

—remove soldered-in chips

We thought that we would never try to salvage integrated circuits from surplus boards until the construction of a microprocessor was started. After pricing the needed integrated circuits, it became obvious that salvaging would have to be done or we would simply have to forget the idea of a personal computer.

The first method tried was using a vacuum-powered solder remover. It was too slow, and a fair number of the circuits were destroyed or their operation became marginal because they were overheated. There were similar results using wire braid to absorb the solder.

Using a propane torch to heat all of the pins simultaneously was faster and less damaging, but was dangerous. We almost set the workbench on fire twice, and we did not like the fumes coming from the overheated printed circuit board.

Putting our heads and resources together, a more practical solution was found. A sixteen-pin integrated circuit socket-hole pattern was laid out on a piece of 3/16″ brass measuring .5″ × .9″. The holes were drilled through with a #43 drill as shown in Fig. 1. The oversized holes permit even heating around each pin of the integrated circuit simultaneously.

Fig. 2 illustrates how the tool was mounted to a small 50-Watt soldering pencil. For our pencil, a cutoff 6-32 brass screw was used, but you might have to devise a slightly different arrangement, depending on the pencil you have.

With the tool pressed against the bottom of the printed circuit board, the typical time to desolder an integrated circuit is only three seconds. ■

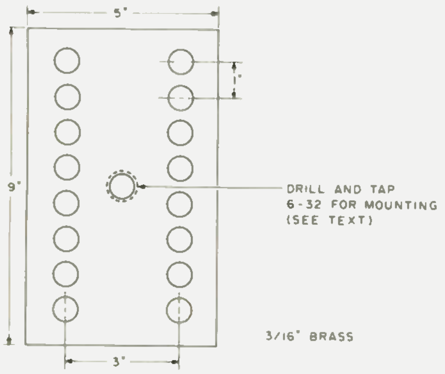


Fig. 1. Desoldering tool.

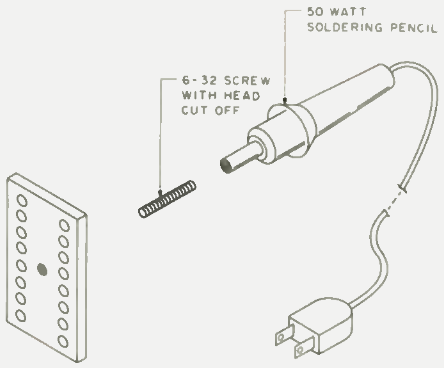


Fig. 2. Mounting arrangement.

THE REPEATER

FOR FAST SCAN AMATEUR TELEVISION
[420–450 MHz]

the APTRON model 1570B–

A COMPLETE UNIT INCLUDING FILTERS–

ONLY $1465.

FOR COMPLETE INFORMATION CALL 812-336-4775, or write–

APTRON LABS ✓8

PO BOX 323, BLOOMINGTON, INDIANA, 47402

✓Reader Service—see page 226

OSCAR Orbits

Courtesy of AMSAT

Any satellite placed into a near-Earth orbit suffers from the cumulative effects of atmospheric drag. The much publicized descent of the Skylab space station was a graphic demonstration of these effects.

The OSCAR satellites are subject to atmospheric drag, of course, and the present period of intense solar activity has accentuated the problem. During this period, our sun has been expelling huge numbers of charged particles, some of which find their way into the Earth's upper atmosphere, increasing the density (and thus the drag) there. It is through this region that the OSCARs must pass. OSCAR 8, in a lower orbit than OSCAR 7, is the more seriously affected of the two.

If the drag factor is not considered when OSCAR calculations are performed, long-range orbital projections will be in error. For example, by the end of 1979, OSCAR 8 was more than 20 minutes ahead of some published schedules. The nature of orbital mechanics is such that extra drag on a satellite causes it to move into a lower orbit, resulting in a shorter orbital period. Thus, the satellite arrives above a given Earthbound location earlier than predicted.

Using data supplied to us by Dr. Thomas A. Clark W3IWI of AMSAT, the equatorial crossing tables shown here were generated with the aid of a TRS-80™ microcomputer. The tables take into account the effects of atmospheric drag and should be in error by a few seconds at most.

The listed data tells you the time and place that OSCAR 7 and OSCAR 8 cross the equator in an ascending orbit for the first time each day. To calculate successive OSCAR 7 orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the day's first ascending (northbound) equatorial crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world from you, it will descend over you. To find the equatorial descending longitude, subtract 166° from the ascending longitude. To find the time OSCAR 7 passes the North Pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR 7 when it is within 45 degrees of you. The easiest way to determine if OSCAR is above the horizon (and thus within range) at your location is to take a globe and draw a circle with a radius of 2450 miles (4000 kilometers) from your QTH. If OSCAR passes above that circle, you should be able to hear it. If it passes right overhead, you should hear it for about 24 minutes total. OSCAR 7 will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15° east or west of you, add another minute; at 30°, three minutes; at 45°, ten minutes. Mode A: 145.85-.95 MHz uplink, 29.4-29.5 MHz downlink, beacon at 29.502 MHz. Mode B: 432.125-.175 MHz uplink, 145.975-.925 MHz downlink, beacon at 145.972 MHz.

At press time, OSCAR 7 was scheduled to be in Mode A on odd numbered days of the year and in Mode B on even numbered days. Monday is QRP day on OSCAR 7, while Wednesdays are set aside for experiments and are not available for use.

OSCAR 8 calculations are similar to those for OSCAR 7, with some important exceptions. Instead of making 13 orbits each day, OSCAR 8 makes 14 orbits during each 24-hour period. The orbital period of OSCAR 8 is therefore somewhat shorter: 103 minutes.

To calculate successive OSCAR 8 orbits, make a list of the first orbit number (from the OSCAR 8 chart) and the next thirteen orbits for that day. List the time of the first orbit. Each successive orbit is then 103 minutes later. The chart gives the longitude of the day's first ascending equatorial crossing. Add 26° for each succeeding orbit. To find the time OSCAR 8 passes the North Pole, add 26 minutes to the time it crosses the equator. OSCAR 8 will cross the imaginary San Francisco-to-Norfolk line about 11 minutes after crossing the equator. Mode A: 145.85-.95 MHz uplink, 29.4-29.50 MHz downlink, beacon at 29.40 MHz. Mode J: 145.90-146.00 MHz uplink, 435.20-435.10 MHz downlink, beacon on 435.090 MHz.

OSCAR 8 is in Mode A on Mondays and Thursdays, Mode J on Saturdays and Sundays, and both modes simultaneously on Tuesdays and Fridays. As with OSCAR 7, Wednesdays are reserved for experiments.

OSCAR 7 ORBITAL INFORMATION FOR MAY

ORBIT #	DATE	TIME (GMT)	EQ. CROSSING (DEGREES WEST)
24972	1	0019:11	74.0
24985	2	0113:27	88.4
24997	3	0012:46	73.3
25010	4	0107:01	86.9
25022	5	0006:20	71.7
25035	6	0100:36	85.3
25048	7	0154:51	98.9
25060	8	0054:10	83.7
25073	9	0148:26	97.3
25085	10	0047:45	82.2
25098	11	0142:00	95.8
25110	12	0041:19	80.6
25123	13	0135:35	94.2
25135	14	0034:53	79.1
25148	15	0129:09	92.6
25160	16	0028:28	77.5
25173	17	0122:43	91.1
25185	18	0022:02	75.9
25198	19	0116:18	89.5
25210	20	0015:36	74.4
25223	21	0109:52	88.0
25235	22	0009:11	72.8
25248	23	0103:26	86.4
25260	24	0002:45	71.2
25273	25	0057:01	84.8
25286	26	0151:16	98.4
25298	27	0050:35	83.3
25311	28	0144:50	96.8
25323	29	0044:09	81.7
25336	30	0138:25	95.3
25348	31	0037:43	80.1

OSCAR 8 ORBITAL INFORMATION FOR MAY

ORBIT #	DATE	TIME (GMT)	EQ. CROSSING (DEGREES WEST)
10983	1	0010:51	53.8
10997	2	0015:43	55.1
11011	3	0020:35	56.3
11025	4	0025:27	57.6
11039	5	0030:19	58.8
11053	6	0035:11	60.0
11067	7	0040:03	61.3
11081	8	0044:55	62.5
11095	9	0049:47	63.7
11109	10	0054:38	65.0
11123	11	0059:30	66.2
11137	12	0104:22	67.5
11151	13	0109:13	68.7
11165	14	0114:05	69.9
11179	15	0118:56	71.2
11193	16	0123:48	72.4
11207	17	0128:39	73.6
11221	18	0133:31	74.9
11235	19	0138:22	76.1
11248	20	0000:01	51.6
11262	21	0004:52	52.8
11276	22	0009:43	54.0
11290	23	0014:34	55.3
11304	24	0019:25	56.5
11318	25	0024:16	57.7
11332	26	0029:07	59.0
11346	27	0033:58	60.2
11360	28	0038:49	61.4
11374	29	0043:40	62.7
11388	30	0048:30	63.9
11402	31	0053:21	65.1

OSCAR 7 ORBITAL INFORMATION FOR JUNE

ORBIT #	DATE	TIME (GMT)	EQ. CROSSING (DEGREES WEST)
25361	1	0131:59	93.7
25373	2	0031:18	78.6
25386	3	0125:33	92.2
25398	4	0024:52	77.0
25411	5	0119:07	90.6
25423	6	0018:26	75.4
25436	7	0112:42	89.0
25448	8	0012:01	73.9
25461	9	0106:16	87.5
25473	10	0005:35	72.3
25486	11	0059:50	85.9
25499	12	0154:06	99.5
25511	13	0053:25	84.3
25524	14	0147:40	97.9
25536	15	0046:59	82.8
25549	16	0141:14	96.4
25561	17	0040:33	81.2
25574	18	0134:48	94.8
25586	19	0034:07	79.6
25599	20	0128:22	93.2
25611	21	0027:41	78.1
25624	22	0121:57	91.7
25636	23	0021:15	76.5
25649	24	0115:31	90.1
25661	25	0014:50	75.0
25674	26	0109:05	88.5
25686	27	0008:24	73.4
25699	28	0102:39	87.0
25711	29	0001:58	71.8
25724	30	0056:13	85.4

OSCAR 8 ORBITAL INFORMATION FOR JUNE

ORBIT #	DATE	TIME (GMT)	EQ. CROSSING (DEGREES WEST)
11416	1	0058:12	66.4
11430	2	0103:02	67.6
11444	3	0107:53	68.8
11458	4	0112:43	70.1
11472	5	0117:34	71.3
11486	6	0122:24	72.5
11500	7	0127:15	73.8
11514	8	0132:05	75.0
11528	9	0136:55	76.2
11542	10	0141:45	77.5
11555	11	0003:23	52.9
11569	12	0008:13	54.1
11583	13	0013:03	55.4
11597	14	0017:53	56.6
11611	15	0022:43	57.8
11625	16	0027:33	59.0
11639	17	0032:23	60.3
11653	18	0037:13	61.5
11667	19	0042:03	62.7
11681	20	0046:52	64.0
11695	21	0051:42	65.2
11709	22	0056:31	66.4
11723	23	0101:21	67.7
11737	24	0106:10	68.9
11751	25	0111:00	70.1
11765	26	0115:49	71.3
11779	27	0120:39	72.6
11793	28	0125:28	73.8
11807	29	0130:17	75.0
11821	30	0135:06	76.3

Social Events

Listings in this column are provided free of charge on a space-available basis. The following information should be included in every announcement: sponsor, event, date, time, place, city, state, admission charge (if any), features, talk-in frequencies, and the name of whom to contact for further information. Announcements must be received two months prior to the month in which the event takes place.

NEENAH WI
MAY 3

The 3-F Amateur Radio Club will hold its swapfest on Saturday, May 3, 1980, at the Neenah Labor Temple, 157 South Green Bay Road, Neenah WI. Admission is $1.50 in advance for tickets and $1.50 for tables. Admission at the door will be $2.00 for tickets and $2.00 for tables. Facilities include a large parking area, and large indoor and outdoor swap area, with a free auction provided at the conclusion of the day. Food and beverages will be available. For further information, write Mark Michel W9OP, 339 Naymut Street, Menasha WI 54952, or phone (414)-722-4034.

MEADVILLE PA
MAY 3

The sixth annual Northwestern Pennsylvania Hamfest will be held on May 3, 1980, at the Crawford County Fairgrounds, Meadville PA. The gates will open at 8:00 am. Admission is $3.00; children under 12 are free. Indoor table spaces are $5.00 and outside car spaces are $2.00. Bring your own tables. Refreshments will be available. Talk-in on .04/.64, .81/.21, and .63/.03. For information, write CARS, PO Box 653, Meadville PA 16335, Attention: Hamfest Committee.

DULUTH MN
MAY 3

The Arrowhead Radio Amateurs will hold their annual spring swapfest at the First United Methodist Church, 230 E. Skyline, Duluth, Minnesota, from 10:00 am to 3:00 pm on Saturday, May 3, 1980. Activities include a flea market, silent and live auctions, special-interest

✓Reader Service—see page 226

Radio Amateurs!

AZDEN PGS-2000
••• $339.00 List. Ask For Quote

SWAN ASTRO 102BX
••• $1195.00 List. Ask For Quote

TEN-TEC OMNI D
••• $1119.00 List. Ask For Quote

Amateur equipment accessories & antennas.
Amateur & commercial repair service.

Appliance & Equipment Company inc. ✓301

2317 Vance Jackson Rd. San Antonio, TX 78213
(512) 734-7793

NOW! NOW! NOW! NOW! NOW!

The ultimate answer for eliminating the damaging effects of antenna weight on your rotor . . . . it's the

"UDM THRUSTOR"

- Fits any taper tower or can be used with flat top.
- Accepts 1¼" mast pipe
- All steel construction.
- Utilizing precision ground & hardened ball-type thrust bearing.
- Comes ready to install.
- Eliminates the damaging effect on your rotor.
- Shipped prepaid UPS (U.S.A.)
- Check, cash, money order, Visa, MasterCharge. $49.95 complete.
- Also available for 2" mast pipe for $59.95

UDM ENTERPRISES ✓319
P.O. Box 2037, Sandusky, Ohio 44870

CB TO 10 METER

10 METER CONVERSION KITS FOR CB RADIOS AM-FM & SSB

- Kits for over 300 Models of CB Radios
- Low Cost from $10.00
  Easy to Install with All Instructions
  Tune-Up Procedure Alignment
- KITS FOR MOST POPULAR UNITS
  Over 5,000 Satisfied Customers
- Write or Call Today for Our Free 1980 Catalogue

AMERICAN CRYSTAL SUPPLY COMPANY
PO Box 638
W Yarmouth, MA 02673
(617) 771-4634 ✓7

New SATELLITE For the TV home.

Supersharp Reception—Color Like Never Before

Get over 50 channels of television directly from the satellite! HBO, Showtime, the Superstations, and sports from around the world!

Works Anywhere!

Buy complete or build and save. Our book *tells everything!* Send $7.95 today or call our 24 hr. C.O.D. Hotline! (305) 869-4283

SPACECOAST RESEARCH ✓309
P.O. Box 442, Dept. G, Altamonte Springs, FL 32701

SYNTHESIZED SIGNAL GENERATOR

• Covers 100 to 179.999 MHz in 1 kHz steps with thumb-wheel dial • Accuracy .00001% at all frequencies • Internal frequency modulation from 0 to over 100 kHz at a 1 kHz rate • Spurs and noise at least 60dB below carrier • RF output adjustable from 50 to 500mv across 50 ohms • Operates on 12vdc @ ½ amp • Price $299.95 plus shipping.

In stock for immediate shipping. Overnight delivery available at extra cost. Phone: (212) 468-2720. ✓311

VANGUARD LABS
196-23 Jamacia Ave. Hollis, NY 11423

NEW CATALOG

WORLD'S FINEST ELECTRONIC Govt. SURPLUS EQUIPMENT

New ITEMS . . . New BARGAINS!

FREE UPON REQUEST!

If you haven't received our new Catalog, write for free copy today.

We accept VISA or Mastercharge

Address Dept 73 • Phone 419/227-6573

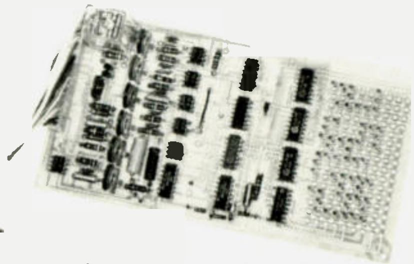
FAIR RADIO SALES ✓22
1016 E. EUREKA • Box 1105 • LIMA, OHIO • 45802

---

50 144 REPEATERS 220 450 Mhz

Hi Pro Mk I

New and Improved Receiver and Transmitter



Available Separately:

COR Identifier: All on one board, programmable, Fully adjustable, time out (.5-7 min.), hang time (0-1 min.), identifier (1-10 min.), tone, speed, volume, L.E.D. outputs, low current drain CMOS logic, plugs for easy installation and removal plus much more. $89.95

OPTIONS
- Duplexers
- Basic auto patch
- Matching cabinet
- .0005% High stability crystals

Basic Repeater $599.95
2M 130-175 MHz Basic Repeater for 2 meters with all the features of the HI Pro MkI less the power suply and front panel controls and accessories.

50 MHz $889.95 450 MHz 899.95
144 or 220 MHz 799.95

PA Res. add 6% tax
PLUS SHIPPING

Maggiore Electronic Laboratory
845 Westtown Rd.
West Chester, PA. 19380 Phone 215 436-6051 ✓46

This NEW MFJ Versa Tuner II . . .

has SWR and dual range wattmeter, antenna switch, efficient airwound inductor, built in balun. Up to 300 watts RF output. Matches everything from 1.8 thru 30 MHz: dipoles, inverted vees, random wires, verticals, mobile whips, beams, balanced lines, coax lines.

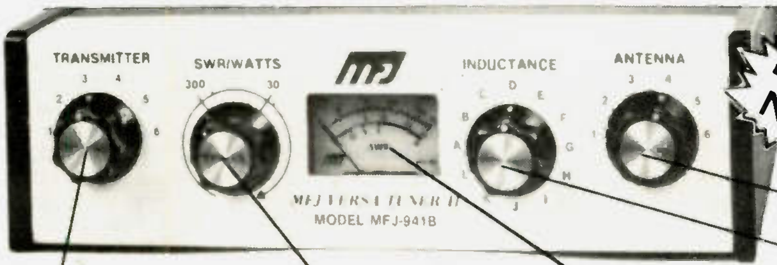
MFJ LOWER PRICES!

NEW, IMPROVED MFJ-941B HAS . . .
- More inductance for wider matching range
- More flexible antenna switch
- More sensitive meter for SWR measurements down to 5 watts output

BRAND NEW

NEW LOWER PRICE

$79.95



Transmitter matching capacitor. 208 pf. 1000 volt spacing.

Sets power range, 300 and 30 watts. Pull for SWR.

Meter reads SWR and RF watts in 2 ranges.

Efficient airwound inductor gives more watts out and less losses.

Antenna matching capacitor. 208 pf. 1000 volt spacing.

Only MFJ gives you this MFJ-941B Versa Tuner II with all these features at this price:

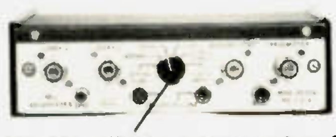
A SWR and dual range wattmeter (300 and 30 watts full scale) lets you measure RF power output for simplified tuning.

An antenna switch lets you select 2 coax lines direct or thru tuner, random wire/balanced line, and tuner bypass for dummy load.

A new efficient airwound inductor (12 positions) gives you less losses than a tapped toroid for more watts out.

A 1:4 balun for balanced lines. 1000 volt capacitor spacing. Mounting brackets for mobile installations (not shown).

With the NEW MFJ Versa Tuner II you can run your full transceiver power output — up to 300 watts RF power output — and match your transmitter to any feedline from 160 thru 10 Meters whether you have coax cable, balanced line, or random wire.



ANTENNA SWITCH lets you select 2 coax lines direct or thru tuner, wire/balanced line, dummy load.

You can tune out the SWR on your dipole, inverted vee, random wire, vertical, mobile whip, beam, quad, or whatever you have.

You can even operate all bands with just one existing antenna. No need to put up separate antennas for each band.

Increase the usable bandwidth of your mobile whip by tuning out the SWR **from inside your car.** Works great with all solid state rigs (like the Atlas) and with all tube type rigs.

It travels well, too. Its ultra compact size 8x2x6 inches fits easily in a small corner of your suitcase.

This beautiful little tuner is housed in a deluxe eggshell white Ten-Tec enclosure with walnut grain sides.

SO-239 coax connectors are provided for transmitter input and coax fed antennas. Quality five way binding posts are used for the balanced line inputs (2), random wire input (1), and ground (1).

NEW 300 WATT MFJ VERSA TUNER II'S: SELECT FEATURES YOU NEED.

NEW MFJ-945 HAS SWR AND DUAL RANGE WATTMETER. NEW LOWER PRICE

$69.95 BRAND NEW

Same as MFJ-941B but less 6 position antenna switch.

NEW MFJ-944 HAS 6 POSITION ANTENNA SWITCH ON FRONT PANEL. NEW LOWER PRICE

$69.95 BRAND NEW

Same as MFJ-941B but less SWR/Wattmeter.

NEW MFJ-943 MATCHES ALMOST ANYTHING FROM 1.8 THRU 30 MHz. NEW LOWER PRICE

$59.95 BRAND NEW

Same as MFJ-941B, less SWR/Wattmeter, antenna switch, mounting bracket. 7x2x6 in.

ULTRA COMPACT 200 WATT VERSA TUNERS FOR ALL YOUR NEEDS.

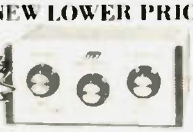
MFJ-901 VERSA TUNER MATCHES ANYTHING, 1.8 THRU 30 MHz. NEW LOWER PRICE

$49.95 BRAND NEW

Efficient 12 position air inductor for more watts out. Matches dipoles, vees, random wires, verticals, mobile whips, beams, balanced lines, coax. 200 watts RF, 1:4 balun, 5x2x6 in.

MFJ-900 ECONO TUNER MATCHES COAX LINES/RANDOM WIRES. NEW LOWER PRICE

$39.95 BRAND NEW



Same as MFJ-901 but less balun for balanced lines. Tunes coax lines and random lines.

MFJ-16010 RANDOM WIRE TUNER FOR LONG WIRES. NEW LOWER PRICE

$29.95

1.8 thru 30 MHz. Up to 200 watts RF output. Matches high and low impedances. 12 position inductor. SO-239 connectors. 2x3x4 inches. Matches 25 to 200 ohms at 1.8 MHz. Does not tune coax lines.

For Orders Call toll-free 800-647-1800

✓47 **Order any product from MFJ and try it. If not delighted, return within 30 days for a prompt refund (less shipping).**

Order today. Money back if not delighted. One year unconditional guarantee. Add $3.00 shipping/handling.

For technical information, order/repair status, in Mississippi, outside continental USA, call 601-323-5869.

Order By Mail or Call TOLL FREE 800-647-1800 and Charge It On

VISA

master charge

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

programs (ARRL, VHF, and DXing), and prizes. There will be food available and plenty of free parking. Talk-in on .34/.94, WØGKP. For more details, send an SASE to ARAC Swapfest, 123 E. 1st Street, Duluth MN 55802.

LYNCHBURG VA
MAY 3

The Lynchburg Amateur Radio Club will hold its annual swapfest on May 3, 1980, at Brookville High School in Lynchburg. Doors will open at 10:00 am. Tables will be available, along with plenty of free parking, space for tailgaters, and food service. For further information, contact John McClenon, 712 Riverside Drive, Lynchburg VA 24503.

WARMINSTER PA
MAY 4

The Warminster Amateur Radio Club will hold the sixth annual Ham-Mart on Sunday, May 4, 1980, from 9:00 am to 4:00 pm at the William Tennent Intermediate High School, Route 132 (Street) and Newtown Roads, Warminster PA. There will be door prizes, a flea market, an auction, and a free FM clinic. There will be food, drink, and tables available. Registration is $2.00 per person (children under 14 free), $3.00 per space for sellers, and $5.00 per space for one indoor table. Tickets for the Wilson HT drawing are additional. Talk-in on 146.52 simplex or 146.16/.76 on the PARA repeater. For more information, write WARC, PO Box 113, Warminster PA 18974, or call Pat Cawthorne W3DNI, (215)-672-5289.

FALL RIVER MA
MAY 4

The fourth annual Bristol County Amateur Radio Association flea market and radio auction will be held on Sunday, May 4, 1980, from 9:00 am until 5:00 pm at the Knights of Columbus Hall, Meridian Street, Fall River MA. Talk-in on 146.31/.91. For more information, write to Gerald P. DiChiara AA1Q, 35 Central Avenue, Assonet MA 02702.

STIRLING NJ
MAY 4

The Tri-County Radio Association will hold its annual indoor hamfest/flea market on May 4, 1980, at the Passaic Township Youth Center, Valley Road, Stirling NJ, from 9:00 am to 4:00 pm. Admission is $2.00 and tables are $5.00. Food will be served. There will be many door prizes. Talk-in on 147.855/.255 or 146.52. For information, write TCRA, Box 412, Scotch Plains NJ 07076, or phone Herb Klawunn at (201)-647-3461.

DE KALB IL
MAY 4

The Kishwaukee Radio Club and the De Kalb County Amateur Repeater Club will hold their annual indoor/outdoor hamfest on Sunday, May 4, 1980, from 8:00 am to 3:00 pm at the Notre Dame School (3 miles south of De Kalb, between Highway 23 and South 1st Street on Gurler Road). Tickets are $1.50 in advance and $2.00 at the door. Indoor tables are available, but if you bring your own, the setup is free. Talk-in on 146.13/.73 and .94 simplex. For further information, send an SASE to Howard WA9TXW, PO Box 349, Sycamore IL 60178.

AURINGEN GERMANY
MAY 4

The Wiesbaden Amateur Radio Club and DOK F20 Club of Wiesbaden will sponsor a hamfest on Sunday, May 4, 1980, starting at 10:00 am at Auringen (5 km North of Wiesbaden on Highway 455). The activities will include a flea market, vendors, displays, computer demonstrations, technical assistance, left-foot CW contest with 5 wpm certificate, prizes, and plenty of refreshments. Talk-in on 145.55 MHz. Signs will be posted giving directions to the hamfest from the major Autobahns passing Wiesbaden.

NEWPORT RI
MAY 5

The Newport County Radio Club will hold an auction on May 5, 1980, at 7:00 pm at the Seamen's Institute, 18 Market Square, Newport RI 02840.

FRESNO CA
MAY 9-11

The Fresno Amateur Radio Club, Inc., will hold the 38th annual Fresno Hamfest on May 9-11, 1980, at the Hacienda Inn, Clinton and 99, Fresno CA. Full registration is $20.00 in advance; $23.00 at the door. Partial registration is $5.00. The ladies' program is $7.00. Advance registration closes May 2, 1980. There are many activities planned, including a prime rib banquet. Talk-in on 146.34/.94. For more information, write to Fresno Hamfest, PO Box 783, Fresno CA 93712.

SANTA BARBARA CA
MAY 9-11

The 25th annual West Coast VHF Conference will be held on May 9-11, 1980, at the Miramar Hotel, Santa Barbara CA. Highlights will include a hospitality room on Friday evening (May 9), technical sessions on Saturday (May 10), a program featuring key participants in the VHF-UHF propagation breakthroughs of 1979-80, noise-figure measurements on Saturday evening, antenna gain measurements on Sunday morning, plus technical exhibits, door prizes, and a drawing. Pre-registration is $4.00 per person until May 1, 1980, and registration at the door is $6.00. Registration forms, hotel information, and further details may be obtained by writing to Wayne Overbeck N6NB, Conference Coordinator, 5818 Woodlake Avenue, Woodland Hills CA 91367; (213)-347-3456 (home) or (213)-446-4311 (office).

GREEN BAY WI
MAY 10

The Green Bay Mike and Key Club will hold its swapfest from 8:30 am to 3:30 pm on May 10, 1980, at the Ashwaubenon Recreation Center. Admission will be $1.50 advanced and $2.00 at the door. Food and beverages will be served. There will be drawings for door prizes. For more information, contact Bob Duescher KA9BXG, 1011 13th Ave., Green Bay WI 54304. Talk-in on .72/.12.

DEERFIELD NH
MAY 10

The Hosstraders Net will hold its 7th annual tailgate swapfest on Saturday, May 10, 1980, at the Deerfield Fairgrounds, Deerfield NH. There will be covered buildings, in case of rain. Admission is $1.00, with no commission or percentage. Commercial dealers are welcome at the same rate. Excess revenues will benefit the Boston Burns Unit of the Shriner's Hospital for Crippled Children. Last year we donated $1,355. Talk-in on .52 and 146.40/147.00. For information or map, send an SASE to Joe Demaso K1RQG, Star Route, Box 56, Bucksport ME 04416, or Norm Blake WA1IVB, PO Box 32, Cornish ME 04020.

ROCHESTER NY
MAY 16-17

The Rochester Hamfest and New York State ARRL Convention will be held on Friday and Saturday, May 16-17, at the Monroe County Fairgrounds Dome Center, Route 15A, Rochester, New York. Indoor and outdoor flea-market space will be available. Forums, technical programs, and other meetings will be held on Saturday. Equipment displays and flea market will open on Friday afternoon. Hamfest headquarters is the Rochester Marriott Inn at the NY State Thruway. Send a QSL to Rochester Hamfest, Box 1388, Rochester NY 14603, to have your name added to the mailing list, or call us at (716)-424-1100 for specific information.

BOXBOROUGH MA
MAY 16-18

The sixth annual Eastern VHF/UHF Conference will be held on May 16-18, 1980, at The Sheraton Inn and Conference Center, I-495 at Route 111, Boxborough MA. Registration is $10.00 in advance of May 1, 1980, and $15.00 at the door. Reservations for the Saturday evening banquet are $16.50 and must be made by May 1, 1980. Room accommodations and meals will be available. Features will include a hospitality room Friday evening; technical talks on antennas, propagation, receiver design, OSCAR Phase III, transmitter design, and microwave circuitry; noise figure measurements through 2300 MHz; EME panel discussion; 70-cm antenna gain measurement; technical exhibits; door prize drawings for early registration. For reservations, make checks out to Eastern VHF/UHF Conference. For more information, contact Rick Commo K1LOG, 3 Pryor Road, Natick MA 01760.

DALLAS TX
MAY 16-18

The Region 4 Conference of Air Force MARS will be held on May 16-18, 1980, in Dallas TX. Prospective members are welcome. For further details, contact Jerry Barnes K5AKB/AFF4C, 637 Pinehurst Drive, Richardson TX 75080.

COEUR D'ALENE ID
MAY 17

The Kootenai Amateur Radio

Society will hold its annual Ham Meet on May 17 1980, at the Northern Idaho Fairgrounds, Government Way, Coeur d'Alene ID. There will be commercial displays, auctions, a swap and shop, contests, and a snack bar. On Friday evening there will be entertainment. Doors will open at 7:00 am and the show will start at 9:00 am. Parking will be available at the fairgrounds. Talk-in on 146.52 simplex and 146.37/.97, club repeater W7LQT/R. For information on free table reservations or tickets, write KARS, Route 1, Box 87, Rathdrum ID 83858.

CADILLAC MI
MAY 17

The Wexaukee Amateur Radio Association will hold its 20th annual swap shop on Saturday, May 17, 1980, from 9:00 am until 4:00 pm at the National Guard Armory, 415 Haynes Street, Cadillac MI. Tickets are $2.00. Door prizes, free parking, and lunches will be available. Talk-in on 146.37/.97. For further information, write Robert Bednarick WD8RZL, PO Box 163, Cadillac MI 49601.

LOS ALTOS HILLS CA
MAY 17

The Electronics Museum Amateur Radio Club will hold its annual swap meet on Saturday, May 17, 1980, starting at 9:00 am at Foothill College, Los Altos Hills CA 94022. The flea market will be restricted to radio and electronic items only. Sellers' spaces will be $5.00. There will be plenty of free parking available. Talk-in on .52.

WOODBRIDGE NJ
MAY 17

The DeVry Tech Amateur Radio Club will hold its fourth annual flea market on Saturday, May 17, 1980, in the rear parking lot at the DeVry Technical Institute. 479 Green Street (between Route 1 and Route 9). Woodbridge NJ. Admission is free and space is $3.00. Talk-in on 146.52.

BIRMINGHAM AL
MAY 17-18

The Birmingham Amateur Radio Club, Inc., will hold its Birminghamfest '80 on May 17-18, 1980, in the Birmingham-Jefferson Civic Center. Highlights will include hourly prize drawings and a buffet banquet on Saturday night with a nationally prominent speaker. There is a possibility of FCC exams being given. There will be exhibitors' booths, and lodging and food will be available within a short distance. For more details, contact Bill Hocutt KC4P, Exhibits Chairman, Birminghamfest '80, PO Box 603, Birmingham AL 35201.

DURHAM NC
MAY 17-18

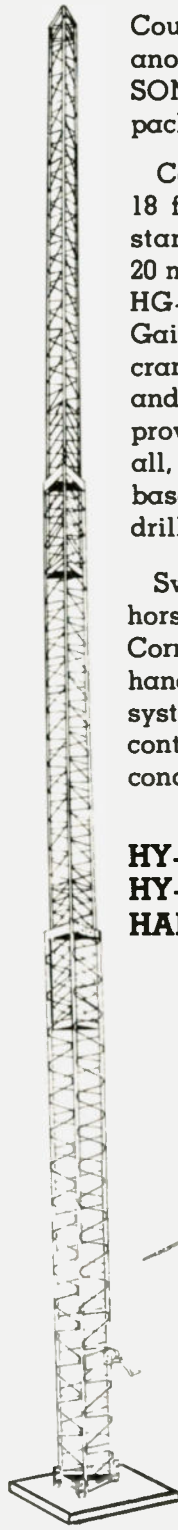
The Durham FM Association will hold its annual Durhamfest on May 17-18, 1980, at the South Square Mall, Durham, US 15-501 South. Activities will include prizes, a totally covered flea market, free tailgating spaces, overnight parking, and possible FCC exams. There will be lodging, food, and facilities available, as well as tables with electrical power. Admission is free with a $3.00 admission charge for dealers and vendors. A shopping mall will be available and there will be Sunday bingo for the family. Talk-in on 147.825/.225, 146.34/.94, 222.34/.94. For more information, write Durhamfest, Box 8651, Durham NC 27707.

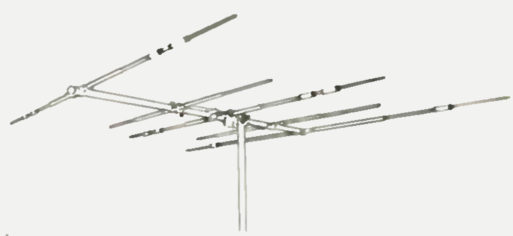
WABASH IN
MAY 18

The Wabash County Amateur Radio Club will hold its 12th annual hamfest on Sunday, May 18, 1980, from 6:00 am until 3:00 pm at the Wabash County 4-H Fairgrounds, Wabash IN. Admission will be $3.00 at the gate or $2.50 in advance and will include a chance in the major prize drawing. There will be plenty of food, door prizes, and parking. Camping space is available for Saturday night. Talk-in on 147.63/.03 and 146.52 simplex. For tickets or more info, send an SASE to Dave Spangler N9ADO, 45 Grant St., Wabash IN 46992.

EASTON MD
MAY 18

The sixth annual Easton Amateur Radio Society hamfest will be held on May 18, 1980, rain or shine, at the Easton Senior High School cafetorium on Route 50, just south of Easton at mile marker 66, from 10:00 am until 4:00 pm. Donation is $2.00, with an additional $2.00 for tables or tailgaters. Talk-in on .52 simplex and 146.445/147.045 on the repeater in Easton. For more details, write R. C. Thompson KA3BKW, PO Box 1473, Easton MD 21601, or Easton Amateur





Radio Society, Inc., Box 781, Easton MD 21601.

YAKIMA WA
MAY 18

The Yakima Amateur Radio Club, W7AQ, will hold its annual hamfest on Sunday, May 18, 1980, in Yakima WA. Breakfast and lunch will be served, starting at 7:00 am. There will be door prizes, a swap shop, and new product dealers will be present. A free parking area for self-contained vehicles at the hamfest site will be available. Talk-in on .34/.94, .25/.85, and .01/.61. For further information, call Walt Hart at 575-4488 or Kenneth Zahn at 452-7982.

ISLIP LI NY
MAY 18

The Long Island Mobile Amateur Radio Club, Inc., will hold the ARRL Hamfair '80 on May 18, 1980, from 9:00 am to 4:00 pm at the Islip Speedway, on Islip Avenue (Rte. 111), one block south of the Southern State Parkway, Exit 43. There will be over 300 exhibitors and no reservations are needed. General admission is $2.00 and exhibitors' admission is $3.00 per space. There will be many door prizes awarded and plenty of parking space. Food and refreshments will be available at the track. The rain date will be June 1, 1980. For additional information, phone Sid Wolin K2LJH (516)-379-2861 nights, or Hank Wener WB2ALW (516)-484-4322 days.

EVANSVILLE IN
MAY 18

The Tri-State Amateur Radio Society will hold its annual hamfest on May 18, 1980, at the Vanderburg County 4-H Center, Evansville IN. Grounds for the hamfest will be open at 8:00 am CST Sunday morning. There will be no admission charge. Tickets will be on sale for door prizes. In addition, there will be many other lesser prizes awarded for hamfest attendance. Exhibit tables inside the hall will be $2.50 each, and a 4-by-8-foot space in a covered area adjacent to the hamfest will be available for $1.00 per space. Food and beverage will be available. Saturday overnight camping space is available for those so equipped. Talk-in will be on the Evansville 147.75/.15 repeater. For further details, contact Dave Bradford N6ACP/9, 313 E. Franklin Street, Evansville IN 47711.

WASHINGTON DC
MAY 24

The Maryland FM Association will hold its third hamfest on Saturday, May 24, 1980, 8:00 am to 4:00 pm at the Greenbelt Armory at the intersection of Greenbelt Road (MD Route 193) and the Baltimore-Washington Parkway, NE of Washington DC, just off I-95/495. Activities include cash prizes, catered food, indoor displays and flea market, and a separate outdoor tailgating area. Donations are $3.00, tailgating is $2.00, and tables are $5.00. Talk-in on 52.525 simplex, 146.16/.76, 146.28/.88, 146.52 simplex, and 449.1/444.1. Tables may be reserved by paying in advance to Fred Siebert K3PNL, 8357 Reservoir Road, Fulton MD 20759. If acknowledgement is desired, please include an SASE.

GORHAM ME
MAY 24

The Portland Amateur Wireless Association and the University of Southern Maine Radio Club will hold a flea market on May 24, 1980, from 9:00 am to 5:00 pm on the campus of the University of Maine, Gorham ME. Admission is $1.00 per person. Indoor and outdoor sites will be available. Talk-in on .52, .73, and .06. For further information, contact Jon Taylor N1SD, 44 Mitton Street, Portland ME 04102, or phone (207)-773-2651.

ST. LOUIS MO
MAY 24-25

The ARRL Midwest and Central Divisions will hold their amateur radio and computer hobbyist convention on May 24-25, 1980, at the Cervantes Convention Center, St. Louis, Missouri. Featured will be prominent speakers, information forums, equipment displays and demonstrations, and an indoor flea-market sale. Friday night, May 23rd, will be "Amateur Radio Night" at Busch Memorial Stadium, where the St. Louis Cardinals will play the San Diego Padres. On Saturday night, May 24th, the convention banquet and dance will be held on the riverboat *Admiral*. On Memorial Day, May 26th, there will be an all-day visit to Six Flags Over Mid-America. For more information, write to the Gateway Amateur Radio Association, Inc., Box 68, Marissa IL 62257.

FREMONT OH
MAY 25

The Sandusky Valley Amateur Radio Club will hold its third annual hamfest on Sunday, May 25, 1980, at the Sandusky County Fairgrounds, Fremont OH. Doors open at 7:00 am. Admission is $1.00 and all tables are free. Talk-in on .52/.52 and 146.31/.91. For tickets or additional information, send an SASE to Ron Winke WB8NMK, 1200 Stilwell Avenue, Fremont OH 43420.

HAMBURG PA
MAY 25

The Reading Radio Club will hold its second annual hamfest on Sunday, May 25, 1980, in the Hamburg PA Fieldhouse (take Rte. 22 from east or west, Rte. 61 from north or south). There are indoor as well as outdoor sites. Cash and equipment prizes will be awarded. Talk-in on 146.31/.91 and 146.52. For information, write W3BN, PO Box 124, Reading PA 19603.

ST. PAUL MN
MAY 31

The North Area Repeater Association, Inc., will hold its Amateur Fair on Saturday, May 31, 1980, at the Minnesota State Fairgrounds, St. Paul MN. This is a swapfest and exposition for amateur radio operators and computer enthusiasts. There will be free overnight parking for self-contained campers on May 30th. Exhibits, booths, and prizes will be featured. Admission is $3.00. For information or reservations, write Amateur Fair, PO Box 30054, St. Paul MN 55175.

MANASSAS VA
JUN 1

The Ole Virginia Hams Amateur Radio Club, Inc., will hold its seventh annual Manassas Hamfest on Sunday, June 1, 1980, at the Prince William County Fairgrounds, Route 234, Manassas VA. Booths are available. Admission is $3.00, children under 12 are free, and tailgaters are $2.00. Talk-in on 146.37/146.97 repeater (WB4HHN) and 146.52 simplex. For further information, contact Joseph A. Schlatter K4FPT, Ole Virginia Hams ARC, Inc., PO Box 1255, Manassas VA 22110.

WILMINGTON OH
JUN 1

Clinton County area amateurs will sponsor the first annual Clinton County area Hamfest 1980 on June 1, 1980, 8:00 am to 5:00 pm, at the Clinton County Fairgrounds, Wilmington OH. Admission will be $3.00; 12 and under are free. Flea-market space is free. There will be door prizes and free parking. Food and drinks will be available. Talk-in on .72/.12. For more info, send an SASE to CCARA c/o Russ Eidemiller WD8NPZ, 310 Bethel Lane, Wilmington OH 45177.

BRAINTREE MA
JUN 1

The South Shore Amateur Radio Club will hold its annual auction on Sunday, June 1, 1980, at the Viking Club, 410 Quincy Avenue (Route 53), Braintree MA. A flea market will precede the auction from 10:00 am to 2:00 pm in the Viking Club parking lot, weather permitting. Space is $3.00; bring your own table. No reservations are necessary. The auction will start at 2:00 pm and admission is free. There will be a 15 percent club commission on auction items only. For further information, contact The South Shore Amateur Radio Club, c/o Kristen Johnson K1WQ, 86 Alton Road, Quincy MA 02169.

CHELSEA MI
JUN 1

The Chelsea Swap and Shop will be held on Sunday, June 1, 1980, at the Chelsea Fairgrounds, Chelsea MI. Gates will open for sellers at 5:00 am and for the public from 8:00 am until 2:00 pm. Admission is $1.50 in advance or $2.00 at the gate. Children under 12 and non-ham spouses are admitted free. Talk-in on .52 and .37/.97. For more information, write William Altenberndt, 3132 Timberline, Jackson MI 49201.

GREELEY CO
JUN 7

The Northern Colorado Amateur Radio Club will hold its Superfest II hamfest on Saturday, June 7, 1980, from 7:00 am to 4:30 pm in the Weld County Exhibition Building, Greeley CO. Features will include an operating satellite television receiving station, the Colorado Code Contest, and an auction. Additional special events are planned for families. Registration will be $3.00, with exhibition space and swap tables included at no extra cost. For further information, including details about commercial exhibit space, contact Gus Fox, PO Box 895, Greeley CO 80632.

GUELPH ONT CAN
JUN 7

The Guelph Amateur Radio Club will hold the Central Ontario Amateur Radio Fleamarket and Computer Fest on Saturday, June 7, 1980, from 8:00 am until 4:00 pm at the Centennial Arena, College Avenue West, Guelph, Ontario, Canada. Admission is $1.00, with children 12 years and under admitted free. Admission for vendors is an additional $2.00. There will be commercial displays, home-computer displays, and the Sidebanders dinner at 5:00 pm (contact Jack Kirby VE3AFN). Refreshments will be available during the day. Talk-in on .52/.52, .37/.97 KSR, and .96/.36 ZMG. For further information, contact Rocco Furfaro VE3HGZ, Guelph Amateur Radio Club, PO Box 1305, Guelph, Ontario, Canada N1H 6N9 or call (519)-824-1157.

HUNTINGTON WV
JUN 7-8

The Tri-State Amateur Radio Association will hold its 18th annual hamfest on June 7-8, 1980, at the Huntington Civic Center, Huntington WV. Admission is $3.00 for both days, with additional prize tickets $1.00 each. Prizes will be awarded both days. Commercial and flea market spaces are available at reasonable prices. Activities will include forums, hidden-transmitter hunts, a left-footed CW contest, a Saturday-night banquet, and lots of demonstrations and activities for the non-amateurs, XYLs and harmonics. Hotels, restaurants, shopping areas, and a limited number of RV hookups are within walking distance. Talk-in on 146.04/146.64. For more information, contact the Tri-State Amateur Radio Association, c/o Phil Jones WD8OTJ, 309 22nd Street West, Huntington WV 25704.

GRANITE CITY IL
JUN 8

The Egyptian Radio Club will hold a hamfest and flea market on June 8, 1980, beginning at 8:00 am at the ERC Clubhouse, Slough Road, Granite City IL. Tickets are $1.50. Refreshments, activities for women and children, and overnight camping are available. Prizes will be awarded. Talk-in on 146.16/.76 and 146.52.

JEFFERSON CITY MO
JUN 8

The Missouri Single Side Band Net Picnic will be held on Sunday, June 8, 1980, at Binder Lake, Jefferson City MO. There will be a covered dish dinner served at noon and drinks will be furnished by the Net. For information, contact Benton C. Smith K0PCK, net manager, Prairie Home MO 65068.

MAYVILLE ND
JUN 8

The Goose River Amateur Radio Club will hold its annual hamfest on June 8, 1980, at Island Park, Mayville ND. Features will include a flea market, an auction, door prizes, free coffee, and camping facilities. For more information, call or write Mary Carlson, Route 2, Hatton ND, (701)-543-3287.

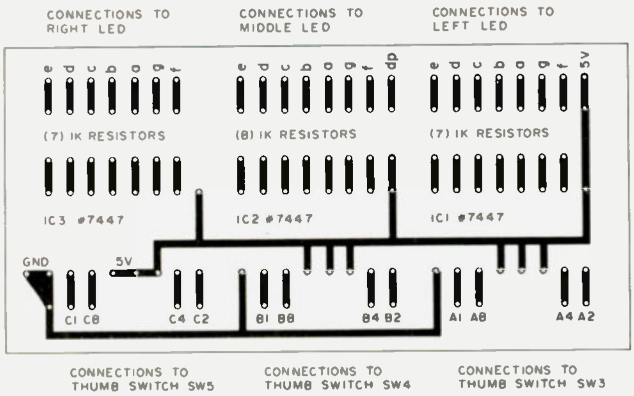
ALLENWOOD PA
JUN 8

The 9th annual Milton Amateur Radio Club Hamfest will be held on June 8, 1980, rain or shine, at the Allenwood Firemen's Fairgrounds, located on US Route 15, 4 miles north of I-80, Allenwood PA. Hours are from 8:00 am to 5:00 pm. Registration for sellers is $2.50 in advance or $3.00 at the gate. XYLs and children are free. Featured will be a flea market, an auction, contests, cash door prizes, a free portable and mobile FM clinic, and supervised children's activities. There will be an indoor area available, plus food and beverages. Camping and motels are located nearby. Talk-in on .37/.97 and .52 simplex. For further details, write Kenneth E. Hering WA3IJU, RD #1, Box 381, Allenwood PA 17810, or phone (717)-538-9168.

JACKSONVILLE IL
JUN 15

The Jacksonville Area Amateur Radio Club will hold its 15th annual hamfest and flea market on June 15, 1980, at the Morgan County Fairgrounds, Jacksonville IL. Tickets are $1.50 each or four for $5.00.

Corrections



Revised Fig. 2, "Neat Readout for the 2036."

In my article, "Neat Readout for the 2036" (March, 1980, p. 62), the switch connection designations on the foil pattern, Fig. 2, are wrong. The schematic, Fig. 1, is correct. All three switch connections' sequences in Fig. 2 *should read* 1-8-4-2, instead of 8-4-2-1.

I recently learned of a kit with the same type of readout and a slightly different circuit. For those who don't like to make circuit boards, a note to Jim Forkin, 3210 Shadyway Drive, Pittsburgh PA 15227, will bring details.

Richard W. List K3GRX
Pittsburgh PA

✓Reader Service—see page 226

TUFTS ELECTRONIC

TUFTS Electronic Department Store TUFTS

OMNI

Designed to give you every advantage, every capability, whatever your operating specialty. Totally solid-state, 8 bands, broad-band design, analog and digital readouts, built-in VOX and PTT, built-in adjustable squelch, built-in 4-position CW/SSB filter, 8-pole crystal SSB filter, 2-speed break-in, WWV reception, front panel control of linear or antenna bandswitching, built-in phone patch jacks, built-in "timed" crystal calibrator, built-in zero beat switch, separate receiving antenna capability, built-in SWR bridge, front panel microphone and phone jacks, adjustable automatic level control, built-in adjustable sidetone, dual compression-loaded speakers, automatic sideband selection, plug-in circuit boards, 12VDC, 117VAC (external supply is required for fixed station use), accessories available, much more.

OMNI SPECIFICATIONS:

Frequency Bands: 1.8-2.3, 3.5-4.0, 7.0-7.5, 14.0-14.5, 21.0-21.5, 28.0-28.5, 28.5-29.0, 29.0-29.5, 29.5-30.0 MHz transceive; 10.0-10.5 MHz receive only. Permeability tuned VFO and receiver rf amplifier.

Vernier Tuning: 18 kHz per revolution, typical.

OMNI-A Accuracy: ±1kHz from nearest 25 kHz calibration point.

Pulsed 25 kHz crystal calibrator in OMNI-A.

OMNI-D Accuracy: ±100 Hz.

OMNI-A Readout: Slide rule dial indicates 100 kHz segment, dial skirt increment to 1 kHz. Three dial scales.

OMNI-D Readout: Six digit, 0.43" LED numerals. Least significant digit indicating 100 Hz green, all others red.

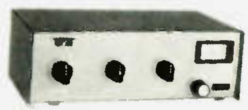
VFO Stability: Less than 15 Hz change per F°, averaged over a 40° change from 70° to 110°, after 30 minute warmup. Less than 10 Hz change from 105 to 125 VAC line voltage when using TEN-TEC power supply.

Automatic sideband selection, reversible. Provisions for remote VFO, Model 243. Power switch remotely controls power supply.

TEN-TEC

MODEL 247 — Antenna Tuner

Matches 50 ohm unbalanced output from transmitter to a variety of balanced of unbalanced antenna impedances. Popular universal Transmatch circuit with one kV capacitor spacing and 46-tap silver plated inductor (pat. pending) allows vernier adjustment up to 200W rf rating. Handsome enclosure matches 540/544 transceivers.



MODEL 277 ANTENNA TUNER/SWR BRIDGE $85.00

This versatile antenna tuner offers the same unique features of the model 247 plus the handy addition of a built-in SWR bridge and meter. The SWR meter shows ratios of 1:1 up to 5:1 and values in-between, has panel mounted Sensitivity Control and Forward-Reverse Switch. Makes an ideal accessory to the TEN-TEC Century/21. Size 3 1/2"H x 10 1/4"W x 6 1/2"D.

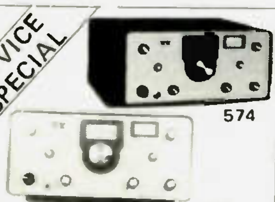
MODEL 645 — Electronic Keyer

The 645 keyer uses transistor switching and is powered by the transceiver (so it is compatible with any TEN-TEC transceiver). Adjustable magnetic paddle return. Self completing characters. Dit and dah memories with defeat switches.

MODEL 241 — Crystal Oscillator

Six crystal positions allow operating spot frequencies in or out of bands. Will extend range 100 kHz from 80 and 40 meter band edges and 200 kHz on remaining bands. Cannot be used with Models 242 or 244. Plugs into accessories socket. Matching enclosure.

NOVICE SPECIAL



574

570

Century 21 (570 or 574)

Novice Exclusive

Purchase your Century 21 (570 or 574) from us and have up o one year to apply the full purchase price towards a model 540, 544, 545, or 546 when you upgrade your station.

ADDITIONAL CRYSTALS

Extend 10m coverage to 30MHz. Model 212 29.0 to 29.5 MHz. Model 213 29.5 to 30.0 MHz.

MODEL 249 — Noise Blanker

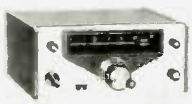
Plug-in PC assembly for either model. Effectively blanks most impulse noise. Blanker is inserted into receiving i-f channel. Disabling switch on front panel.

MODEL 245 — CW Filter

Plug-in PC assembly consists of four active, low Q op-amps. Center frequency of 750 Hz, bandwidth of 150 Hz. Two selectivity responses available with front panel control. Shape factor of 7.2 @ 6/60 dB.

MODEL 240 — 160m Converter

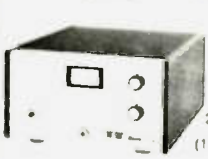
Provides 160m operation at 75% power level. In addition to using 540/544 VFO for variable transceive operation, one of two owner-selected crystal positions can be used for transmitting while the VFO is used for receiving. This is useful for listening in the DX window and transmitting outside of it. Housed in matching enclosure.



MODEL 242 — Remote VFO

Duplicate of 540/544 VFO for operation on two frequencies. Switch, with LED indicators, allows selection of six possible modes. TRANSCEIVER transmit and receive; REMOTE transmit and receive; TRANSCEIVER transmit-REMOTE receive; REMOTE transmit-TRANSCEIVER receive; TRANSCEIVER transmit- both receive; REMOTE transmit-both receive. Full break-in is preserved for all modes. Two crystal positions, selected from front panel, for spot frequency or out of band use. Matching enclosure. Plugs into accessory socket on either Model 540 or 544.

262M 262M E



252M 252M E (115-230 VAC)

MODEL 262M/262M/E
MODEL 252M/252M/E (115-230 VAC)
AC Power Supplies

Fully voltage regulated to provide highly stable, pure DC (225W) from 117 VAC. Panel DC ammeter. Instantaneous overload protection circuit prevents damage caused by excessive current drain; reset by momentary turn-off. Model 262M has, in addition, a complete VOX system. VOX controls are located on front panel. Low frequency components in voice, below cut-off frequency of speaker, actuate T/R function.

MODEL	DESCRIPTION	PRICE
	ACCESSORIES	
206A	Crystal Calibrator	$34.50
208	CW Filter, for Model 509	34.50
212	Crystal, for Models 540/544, 29.0-29.5 MHz	5.00
213	Crystal, for Models 540/544, 29.5-30.0 MHz	5.00
214	Electret Microphone, for Model 234	39.00
215P	Microphone, Ceramic with plug	29.50
215PC	Microphone, Ceramic with plug and coil-cord	34.50
217	500 Hz 8 Pole Ladder Filter	55.00
218	1.8 kHz 8 Pole Ladder Filter	55.00
234	Speech Processor	124.00
240	One-Sixty Converter, for Models 540/544	110.00
241	Crystal Oscillator, for Models 540/544	35.00
242	Remote VFO, for Models 540/544	179.00
243	Remote VFO, for Models 545/546	139.00
244	Digital Readout/Counter for Models 540/544	197.00
245	CW Filter, for Modesl 540/544	25.00
247	Antenna Tuner	69.00
248	Noise Blanker, for Models 545/546	49.00
249	Noise Blanker, for Models 540/544	29.00
273	Crystal, for Models 570/574, 28.5-29.0	5.00
276	Crystal Calibrator, for Model 570	29.00
277	Antenna Tuner/SWR Bridge, for Model 570	85.00
1102	Snap-up Legs (pair)	1.00
1140	DC Circuit Breaker, for Models 540/544 and 545/546	8.75
1145	Knob Set for Models 540, 509	5.00
1150	Overvoltage Protector, for Models 252/262 Series	15.00
1170	DC Circuit Breaker, for Model 570	8.75
	POWER SUPPLIES	
210	117 VAC, 13 VDC, 1 A	34.00
210/E	Same as Model 210, but 115/230 VAC	39.00
252M	117 VAC, 13 VDC, 18 A	139.00
252M/E	Same as Model 252M, but 115/230 VAC	146.00
252MO	Same as Model 252M, but matches OMNI	139.00
252MO/E	Same as Model 252MO, but 115/230 VAC	146.00
262M	117 VAC, 13 VDC, 18 A. Deluxe, with VOX	159.00
262M/E	Same as Model 262M, but 115/230 VAC	166.00
	TRANSCEIVERS	
509	Argonaut, 5 W. SSB/CW, 3.5-30 MHz	389.00
540	Transceiver, 200 W. SSB/CW, 3.5-30 MHz	699.00
544	Transceiver, Digital, 200 W. SSB/CW, 3.5-30 MHz	869.00
545	OMNI-A, Analog, Series B, SSB/CW, 1.8-30 MHz	1119.00
570	Century/21, 70 W. CW, 3.5-29 MHz	349.00
574	Century/21, Digital, 70 W. CW, 3.5-29 MHz	449.00
	KEYERS	
645	Ultramatic, Dual Paddle for 545/546	85.00
670	Single Paddle Keyer, for Model 570/574	34.50
KR-5A	Single Paddle Keyer, 6-14 VDC	39.50
KR-20A	Single Paddle Keyer, 117 VAC/6-14 VDC	69.50
KR-50	Ultramatic Keyer, Dual Paddle, 117 VAC/6-14 VDC	110.00

P.O. Box 75, Somerville, Mass., 02145

B&W from Barker & Williamson

On this page Tufts brings you . . .
B&W

5 –BAND TRAP DIPOLE
(80 thru 10 Meters)

Power rated 2k WPEP, approx. 110 ft. span

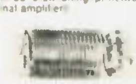
Complete with: wire, traps, end insulators, 50 ft. RG-8/U, PL-259 connector, heavy-duty cast aluminum and steatite center connector.

Pre-assembled: Model 370-11 – $64.95
Kit (illustrated): Model 370-12 – $54.95

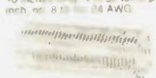
Model Number	Dia.	TPI	Wire Size (AWG)	Length of Coils (Inches)	PRICE
404T	1/2	4	18	2	$2.20
406T	1/2	6	18	2	2.33
408T	1/2	8	18	2	2.33
410T	1/2	10	18	2	2.42
416T	1/2	16	20	2	2.53
432T	1/2	32	24	2	2.75
504T	5/8	4	16	2	2.20
506T	5/8	6	18	2	2.27
508T	5/8	8	18	2	2.33
510T	5/8	10	18	2	2.46
516T	5/8	16	20	2	2.53
532T	5/8	32	24	2	2.66
604T	3/4	4	16	2	2.10
606T	3/4	6	18	2	2.17
608T	3/4	8	18	2	2.30
610T	3/4	10	18	2	2.37
616T	3/4	16	20	2	2.42
632T	3/4	32	24	2	2.61
804T	1	4	16	3	2.31
806T	1	6	18	3	2.45
808T	1	8	18	3	2.52
810T	1	10	18	3	2.56
816T	1	16	20	3	2.73
832T	1	32	24	3	2.78
1004T	11/4	4	14	10	6.17
1006T	11/4	6	14	10	6.33
1008T	11/4	8	16	10	7.17
1010T	11/4	10	18	10	7.33
1016T	11/4	16	20	10	7.48
1032T	11/4	32	24	10	7.89
1204T	11/2	4	14	10	6.36
1206T	11/2	6	14	10	6.79
1208T	11/2	8	16	10	7.17
1210T	11/2	20	18	10	7.24
1216T	11/2	16	20	10	7.50
1232T	11/2	32	24	10	7.82

Model Number	Dia.	TPI	Wire Size (AWG)	Length of Coils (Inches)	PRICE
1404T	13/4	4	14	10	$7.10
1406T	13/4	6	14	10	5.01
1408T	13/4	8	14	10	5.12
1410T	13/4	10	16	10	5.23
1416T	13/4	16	18	10	5.36
1432T	13/4	32	24	10	5.65
1604T	2	4	12	10	9.60
1606T	2	6	14	10	9.71
1608T	2	8	14	10	9.82
1610T	2	10	16	10	9.94
1616T	2	16	18	10	10.14
2004T	21/2	4	12	10	10.90
2006T	21/2	6	12	10	11.01
2008T	21/2	8	12	10	11.12
2010T	21/2	10	16	10	11.23
2404T	3	4	10	10	13.17
2406T	3	6	12	10	13.28
2408T	3	8	14	10	13.40
2410T	3	10	14	10	13.50
195-1	3	––	––	––	52.38
195-2	3	––	––	––	61.02
3204T	4	4	8	10	69.39
3206T	4	6	10	10	70.74
3208T	4	8	12	10	67.23
3210T	4	10	12	10	68.58
4004T	5	4	8	10	83.16
4006T	5	6	10	10	84.78
4008T	5	8	12	10	86.94
4010T	5	10	12	10	90.45
4804T	6	4	8	10	92.34
4806T	6	6	10	10	99.36
4808T	6	8	12	10	100.98
4810T	6	10	12	10	108.00

PI-DUX® Coils
High precision air wound coils for band switching pi network final amplifiers

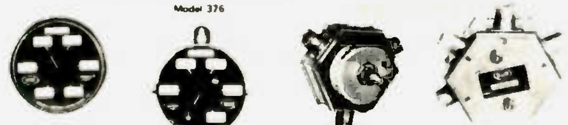


AIR-DUX® Air Wound Coils
10 inches long, 4 to 32 turns per inch, 8 to 24 AWG



Model 195 1 rated [illegible] KW PEP
Model 195 2 rated [illegible] 2 KW PEP

COAXIAL SWITCHES AND ACCESSORIES
for antenna selection and RF switching

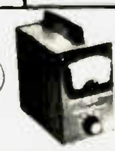


Model 375 Model 376 Model 550A 2 Model 551A

Model 592 Model 595 Model 550A Model 377

Model 593 Model 594 Model 590 Model 590G

MODEL	DESCRIPTION	PRICE
	SWITCHES	
375	PROTAX switch. Grounds all except selected output circuit. 6 Outputs.	$19.75
376	PROTAX switch. Grounds all except selected output circuit. Sixth switch position grounds all outputs. 5 Outputs.	19.75
377	Coaxial Antenna Relay	22.50
550A	Antenna/RF Coax Switch. 5 Outputs.	17.50
550A-2	Antenna/RF Coax Switch. 2 Outputs.	14.95
551A	Special 2-pole, 2-position switch used to switch any RF device in or out of series connection in a coaxial line. 2 Outputs.	17.95
556	Bracket only, for wall mounting of radial connector switches.	.95
590	Antenna/RF Coax Switch. 5 Outputs.	18.50
590G	Grounds all except selected output circuit. 5 Outputs.	18.50
592	Antenna/RF Coax Switch. 2 Outputs.	17.75
593	Single pole, 3 position Antenna RF/Coax Switch.	17.50
594	D.P.D.T. Antenna /RF Coax Switch. Interchanges two outputs between two inputs.	18.25
595	Grounds all except selected output circuit. 6 Outputs.	21.50



Model 333 dummy load wattmeter – Favorite Lightweight Portable–250 WATT RATING – Air Cooled. Ideal field service unit for mobile 2-way radio – CB, marine, business band. Best for QRP amateur use, CB, with zero to 5 watts full scale low power range.

Frequency Range	DC to 300 MHz
VSWR	Less than 1.3:1 to 230 MHz
Power Range	250 watts intermittent
Wattmeter Ranges	0-5, 0-50, 0-125, 0-250
Connector	SO 239
Size	4" × 7" × 8"
Shipping Weight	[illegible]
Price	[illegible]

Model 374 dummy load wattmeter – Top of the Line – 1500 WATT RATING – Oil Cooled. Our highest power combination unit. Rated to 1500 watts input (intermittent). Meter ranges are individually calibrated for highest accuracy.

Frequency Range	DC to 300 MHz
VSWR	Less than 1.3:1 to 230 MHz
Power Range	1500 watts [illegible] intermittent. Warning light signals maximum heat limit
Wattmeter Ranges	0-15, 0-50, 0-300, 0-1500
Input Connector	SO 239 hermetically sealed
Size	4 [illegible] × 10
Shipping Weight	[illegible]
Price	[illegible]

High Power – 1000 WATT RATING – Oil Cooled – model 334A dummy load wattmeter. Our most popular combination unit. Handles full amateur power. Meter ranges individually calibrated. Can be panel mounted.

Frequency Range	DC to 300 MHz
VSWR	Less than 1.3:1 to 230 MHz
Power Range	1000 watts CW intermittent. Warning light signals maximum heat limit
Wattmeter Ranges	0-10, 0-100, 0-300, 0-1000
Input Connector	SO 239 (hermetically sealed)
Size	4 [illegible] × 9 × 10
Shipping Weight	12 lbs
Price	$195.00

Wide range attenuator – Model 371 1. Seven rocker switches provide attenuation from 1 dB to 61 dB in 1-dB steps. Switches are marked in dB, 1-2-3 5 10 20 20. Sum of actuated switches (IN position) gives attenuation. With all switches in OUT position, there is NO insertion loss. Attenuator installs in coaxial line using UHF connectors.

Power Capacity	[illegible] watt
VSWR	1.3:1 maximum DC to 225 MHz
Impedance	50 ohms
Accuracy	[illegible] DC to 60 MHz; [illegible] DC to 160 MHz; [illegible] DC to 225 MHz
Size	[illegible]
Shipping Weight	[illegible]
Price	[illegible]

TUFTS Electronic Department Store TUFTS

TUFTS ELECTRONIC

TUFTS Electronic Department Store TUFTS

On this page Tufts brings you . . .
YAESU

YAESU

FT-101ZD
High-Performance HF Transceiver
Today's technology, backed by a proud tradition, is yours to enjoy with the all new FT-101ZD HF SSB/CW transceiver. This no-compromise rig includes vairable IF bandwidth, digital plus analog frequency display, a built-in RF speech processor, and a wide receiver dynamic range. The FT-101ZD may be used with all of the FT-901 series accessories, providng such exciting features as a scanning external VFO, memory, VHF and UHF coverage, and extensive monitoring capability.

FT-101Z
Top Performance for the Budget-Minded Amateur
If economy is an important consideration, and you don't need the frequency counter and digital display, then choose the FT-101Z. The precision VFO gear mechanism is coupled to an easy-to-read analog display, providing resolution to greater than 1 kHz. All other features – the variable IF bandwidth, rf speech processor, superb noise blanker, VOX – are identical to the FT-101ZD.

YC-500
500 MHz Frequency Counter
The YC-500 utilizes advanced IC techniques and a dual range system to provide accurate 8 digit readout to cover 500 MHz. Both MHz and kHz indications can be selected with ease over this range with a flip of a switch on the front panel. A built-in ac and dc supply enables complete portability, and a double-sided epoxy circuit board ensures stable and accurate operation with reliability for many years.

FT-127RA – 220 MHz FM
FT-227RB – 144 MHz FM
FT-627RA – 50 MHz FM
Scanning Memorizers
The FT-127RA, FT-627RA, and FT-227RB FM transceivers allow scanning and expanded memory coverage for the demanding VHF FM operator. Both feature up/down scanning capability, with control from the microphone; the scanner will also search for a busy or clear channel, if you wish. Four memory channels are also available – two for simplex channels, three for repeater channels, and one for a split of up to 4 MHz.

FT-7B
HF Mobile Transceiver
The all-solid-state FT-78 provides power and performance for the amateur on the move. The rugged transistor final amplifier stage operates at an input power of 100W for SSB and CW, 25W for AM. The YC-78 optional frequency display provides safe indication of your operating frequency from your dash board, steering column, or other convenient location.

NEW FROM YAESU
FT-707 – "WAYFARER"

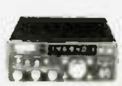
The FT-707 offers you a full 100W output on 80-10m and operates SSB, CW, and AM modes. This full-featured transceiver is ideally suited for your home station or as a traveling companion for mobile or portable operation.

FEATURES:

- Fast/slow AGC selection
- Advanced noise blanker
- Built-in calibrator
- WWV/JJY Band
- Bright Digital Readout
- Fixed crystal position
- 2 auxiliary bands for future expansion
- Unique multi-color bar metering – monitors signal strength, power output, and ALC voltage.

FT-901 DM
Our Top-of-the-line Transceiver
Unparalleled receiver performance, combined with state-of-the-art transmitter features, makes our top-of-the-line FT-901DM the ham's dream, at home or away. The receiver features continuously variable IF bandwidth, rejection tuning, a CW audio peak filter, and industry-leading dynamic range. The transmit side includes a built-in Curtis 8044 IC keyer, RF speech processor, and a 10-second "TUNE" mode timer, which prevents damage to your finals caused by excessive key-down time while tuning.

FT-625RD
All-Mode 6m Transceiver
The FT-625RD is designed for today's demanding 6m operator. Built into every FT-625RD are an rf speech processor, a high-performance noise blanker, and ±1 MHz repeater split for FM buffs. Available as an option is Yaesu's exciting memory unit, allowing storage and recall of any frequency.



CPU-2500R
2m FM Transceiver with CPU
The age of computers has exploded onto the amateur scene with the announcement of the new CPU-2500R 2m FM transceiver. Controlled by a 4-bit central processing unit (CPU), the CPU-2500R contains a scanner, 4 memory channels, manual or automatic tone burst generation, an optional sub-audible tone squelch, and 25W output across the band.

MODEL	DESCRIPTION	PRICE
	HF TRANSCEIVERS	
FT-901DM	160-10m xcvr	$1459.00
FT-101ZD	160-10m xcvr	895.00
FT-101Z	Analog Version	749.00
	UHF TRANSCEIVER	
FT-720RU	440-450 FM xcvr	499.00
	SOLID STATE HF XCVRS	
FT-78	80-10m 100W	675.00
FT-107M	160-10m SSB/CW/AM w/o DMS & memory	1045.00
FT-707	80-10m 200W	TBA
	VHF TRANSCEIVERS	
CPU2500RK	FM mobile keyboard	585.00
FT-127RA	200 MHz AutoScan	479.00
FT-207R	2m Syn. 3W Handie	399.00
FT-225RD	2m with Digital	895.00
FT-227R8	2m/4 Mem. w/YM-22	425.00
FT-625RD	6m All Mode xcvr	895.00
FT-627RA	6m 4 Memory xcvr	399.00
	SOLID STATE RECEIVERS	
FRG-7	Communications	370.00
FRG-7000	All Band HF	655.00
	LINEAR AMPLIFIER	
FL-2100ZA	160-15m	599.00
	ACCESSORIES ALL MODELS	
YH-55	Headset	15.00
FF501dx	Lo pass filter	34.00
QTR-24D	Quartz Clock	49.00
	TEST EOUIPMENT	
YC-500J	500 MHz 10 PPM	239.00
YC-500S	500 MHz 1 PPM	399.00
YC-500E	500 MHz 0.02 PPM	537.00
YS-2000	2000W Peak Reading SWR Bridge	95.00
	ACCESSORIES FOR 901/101ZD Series (All items can be used with the 101ZD Series except * Items.)	
FA-9	Fan	$ 20.00
FM-901*	FM Adapter	45.00
KY-901*	Keyer Unit	45.00
MU-901*	Memory Unit	124.00
DC-901*	DC-DC Converter	60.00
SP-901	Speaker	35.00
SP-901P	Speaker/Patch	74.00
FTV-901R	Transverter w/2m	455.00
"	2m adapter only	154.00
"	6m adapter only	110.00
"	70 cm adapter only	255.00
YO-901	Monitor w/scope	515.00
YR-901	Code/RTTY Decoder	730.00
FV-901DM	Synthesized VFO	415.00
FC-901	Antenna Tuner	199.00
XF8.9HC	CW Filter	45.00
XF8.9B*	AM Filter	45.00
DC-101ZD	DC-DC Converter	60.00
ZD-1	Analog Readout	150.00
FV-101Z	Remote VFO	175.00
	ACCESSORIES FOR VHF EOUIPMENT	
P8-1424	Marker Unit	50.00
P8-1555	Tone Squelch Unit	30.00
MM8-4	Mobile Unit for (6208 & FT-221)	23.00
MM8-5	Mobile Mount (227R)	8.00
FP-4	4 Amp Pwr. Supply	50.00
FP-12	12 Amp Pwr. Supply/Spkr (2500RK)	132.00
MU225/625	Memory Unit for (225RD & 625RD)	165.00
XF10.8HC	CW Filter (625RD)	45.00
XF10.8HS	SS8 Filter (625RD)	45.00
FSP-1	Remote Speaker	21.00
FTS-64	64 Tone Switchable CTCSS/Burst Encoder	80.00
FTS-32ED	32 Tone CTCSS Programmable Encoder/Decoder	TBA
	ACCESSORIES FOR 101 SERIES	
FTV-250	2m Transverter	275.00
FA-9	Fan	20.00
XF-30B	AM Filter	40.00
XF-30C	CW Filter	40.00
DC-1	DC-DC Converter	50.00
YO-101	Monitor Scope	320.00
YC-6018	Digital Readout	235.00
SP-1018	Speaker	25.00
	ACCESSORIES FOR HAND-HELD XCVRS	
NC-1A	15 hr. Drop-in Charger	$ 46.00
NC-2	3 hr. Drop-in with Power Supply	90.00
PA-1	Mobile Battery Eliminator	39.00
LCC202	Leather Carry Case	35.00
TC-202	Top Cover	3.95
N8P-9	Battery Pack	23.00
NC-98	15 hr. Wall Mount Charger	10.00
YM-24	Speaker Mic	32.00
F8A-1	Battery Sleeve	8.00
LCC-7	Leather Carry Case	35.00
TA-2	Telescope Antenna	8.50
FTS-32E	Syn. 32 Tone CTCSS/Burst Encoder	40.00
	ACCESSORIES FOR SOLID STATE XCVRS	
FP-12	12 Amp Speaker with Power Supply	132.00
YC-78	Digital Readout Counter	110.00
FP-107	Internal Power Supply	139.00
FP-107E	External Power Supply	145.00
DMS-107	Digital Memory Shift	125.00
FC-107	Antenna Tuner	139.00
FV-107	Remote VFO	125.00
SP-107	Speaker	29.00
SP-107P	Speaker/Patch	67.00
FTV-107R	Transverter w/2m	284.00
"	6m Adapter only	110.00
"	70 cm Adapter Only	255.00

P.O. Box 75, Somerville, Mass., 02145

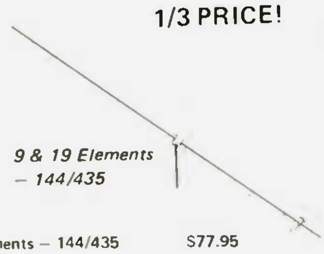
DEPARTMENT STORE TUFTS

F9FT SALE!

1/3 PRICE!

ON REMAINING

F9FT ANTENNAS



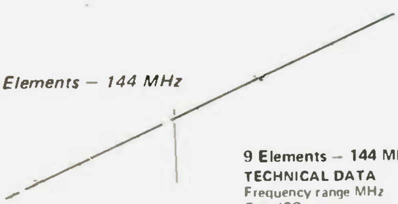
9 & 19 Elements – 144/435

Special OSCAR – 9 & 19 Elements – 144/435 — **$77.95**

TECHNICAL DATA

Frequency range MHz	144/146	430/440
Gain ISO	14 dB	17 dB
Horizontal aperture angle*	2 x 19°	2 x 14°
Vertical aperture angle*	2 x 23°	2 x 16°
Front-to-back ratio	15 dB	23 dB
Side lobe attenuation	> 50 dB	> 38 dB
SWR	≤ 1.3	≤ 1.2
Impedance	50	50
Weight	1.9 kg	1.1 kg
Physical length	3.3m	3.2 m
Windload*	6.4 kgp	5.4 kgp

*The indicated value is given at -3 dB



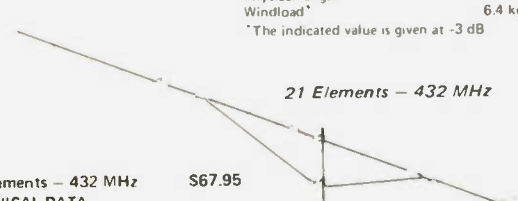
9 Elements – 144 MHz

9 Elements – 144 MHz — **$39.95**

TECHNICAL DATA

Frequency range MHz	144/146
Gain ISO	14 dB
Horizontal aperture angle*	2 x 19°
Vertical aperture angle*	2 x 23°
Front-to-back ratio	15 dB
Side lobe attenuation	> 50dB
SWR	≤ 1.3
Impedance	50
Weight	1.9 kg
Physical length	3.3m
Windload*	6.4 kgp

*The indicated value is given at -3 dB



21 Elements – 432 MHz

21 Elements – 432 MHz — **$67.95**

TECHNICAL DATA

Frequency range MHz	432/435
Gain ISO	19 dB
Horizontal aperture angle*	2 x 12°
Vertical aperture angle*	2 x 13°
Front-to-back ratio	23 dB
Side lobe attenuation	> 40 dB
SWR	≤ 1.1
Impedance	50
Weight	2.6 kg
Physical lenth	4.6m
Windload*	6.4 kgp

*The indicated value is given at -3 dB

16 Elements – 144MHz

16 Elements – 144 MHz — **$79.95**

TECHNICAL DATA

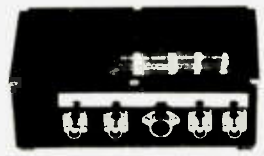
Frequency range MHz	144/146
Gain ISO	17.8 dB
Horizontal aperture angle*	2 x 16°
Vertical aperture angle*	2 x 17°
Front to back ratio	22 dB
Side lobe attenuation	> 60 dB
SWR	≤ 1.2
Impedance	50
Weight	4.4 kg
Physical length	6.4m
Windload*	16 kpg

*The indicated value is given at -3 dB

Antennas for the Active Amateur

MICROWAVE MODULES TEXAS RF

SALE! 1/2 PRICE! ON REMAINING MODULES



MICROWAVE MODULES HIGH PERFORMANCE UNITS FOR 144, 432 and 1296 MHz

144 MHZ MOSFET CONVERTER MMC144/28
With dual protected gate Mosfet RF Amplifier and Mixer stages
Input frequency 144 146 MHz
I.F. output frequency 28 30 MHz
Typical gain 30 dB
Guaranteed maximum noise figure 2.5 dB
Typical image rejection 65 dB
Crystal oscillator frequency 116 MHz (zener controlled)
Maximum frequency error at 144 MHz 3 KHz
Power requirements 12 volts DC *25% at 50 mA
Other I.F. output frequencies available
12 14, 14 16, 18 20, 24 26 MHz

144 MHZ MOSFET CONVERTER MMC 144/28 LO
Similar to the MMC144/28 this unit features an additional 116 MHz buffer amplifier to provide a local oscillator signal suitable for transverter use

144 MHZ DOUBLE CONVERSION MOSFET CONVERTER MMC144/2 MMC144/4
This unit has been developed to meet the requirement for a converter suitable for use with receivers having better performance at lower frequencies
Input frequency 144 146 MHz
I.F. output frequencies available 2 4, 4 6 MHz
Oscillator frequency 71 MHz (2 4 MHz IF), 70 MHz (4 6 MHz IF)
Maximum frequency error at 144 MHz 3 KHz
Typical gain 30 dB
Guaranteed maximum noise figure 2.5 dB
Power requirements 12 volts DC *25% at 30 mA

144 MHZ DUAL OUTPUT MOSFET PREAMPLIFIER MMA144
This two stage mosfet preamplifier has two separate isolated outputs for feeding two receivers for example
Input frequency 144 146 MHz
Typical gain 18 dB
Guaranteed maximum noise figure 2.5 dB
Bandwidth 5 MHz at 3 dB 8 MHz at 10 dB
Power requirements 12 volts DC *25% at 25 mA

432 MHZ MOSFET CONVERTER MMC432/144
Two RF Amplifiers and a Mosfet Mixer combine high sensitivity and low cross modulation characteristics
Input frequency 432 434 MHz
I.F. output frequencies available 14 16, 18 20, 28 30, 144 146 MHz
Typical gain 30 dB
Guaranteed maximum noise figure 3.8 dB
Crystal oscillator frequency 101 MHz (28 30 MHz IF) (zener controlled) 96 MHz (144 146 MHz IF)
Maximum frequency error at 432 MHz 5 KHz
Power requirements 12 volts DC *25% at 45 mA

1296 MHZ CONVERTER MMC 1296/28 MMC1296/144
A hybrid ring mixer with a matched pair of hot carrier diodes driving a dual gate mosfet I.F. amplifier
Input frequency 1296 1298 MHz
I.F. output frequencies available 28 30 144 146 MHz
Typical gain 25 dB
Guaranteed maximum noise figure 8.5 dB
Crystal oscillator frequency 105 666 MHz (28 30 MHz IF) (zener controlled) 96 MHz (144 146 MHz IF)
Maximum frequency error at 1296 MHz 20 kHz
Power requirements 12 volts DC *25% at 50 mA
Connectors 50 ohm BNC

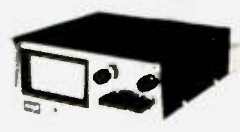
TRANSVERTERS:

MMT 144/28	259.95
MMT 144/50	259.95
MMT 432/28S	329.95
MMT 432/50S	329.95
MMT 432/144S	389.95
RECEIVING CONVERTERS:	
MMC 144/28	65.95
MMC 144/28LO	70.95
MMC 432/28S	95.95
MMC 432/144	95.95
MMC 1296/28	85.95
MMC 1296/144	85.95
VARACTOR TIPLER:	
MMV 1296	110.95
ATTENUATORS:	
MAA 16	27.95

CDE Two NEW Rotors from Cornell-Dubilier

TAIL TWISTER™

HAM IV



- For the New Super Communications Antennas
- New Thickwall Casting
- New Steel Ring Gear
- New Metal Pinion Gear
- New Motor Prebrake
- New Super Wedge Brake
- New L.E.D. Control Box
- Safe 26 Volt Operation

Designed for the newest of the king-size communications antennas, the TAIL TWISTER™ is the ultimate in antenna rotational devices. The TAIL TWISTER™ starts with a deluxe control box featuring snap action controls for brake and directional controls; L.E.D. indicators signal rotation and brake operation, while the illuminated meter provides direction readout. This new control box couples to the newest bell rotor. Using the time tested bell rotor principle, the TAIL TWISTER™ is a brand new design with thickwall castings and six bolt assembly. A brand new motor with prebrake action brings the antenna system to an easy stop, while the massive square front brake wedge locks the assembly in place. A new stainless steel spur gear system provides final drive into a new steel ring gear for total reliability. Triple race, 138 ball bearing assembly carries dead weight and maintains horizontal stability.

An optional heavy duty lower mast adaptor is available for lighter loads with mast mounting.

Price: $279.00

The HAM IV sets new levels of performance. Snap action switched wedge brake and rotational controls brings pinpoint accuracy to large directional arrays popular in communications. A new motor provides pre-brake action to assist in slowing down rotational mass, and the new thicker wedge brake offers far stronger lock-in phase action. To take full advantage of this new design, the HAM III is designed for in-tower mounting. A new optional heavy duty lower mast adaptor is available when the HAM III is to be mast mounted with smaller arrays. A stainless steel spur gear system multiplies the torque into the dual race 98 ball bearing support assembly assuring years of trouble free performance. **Price: $189.00**

TUFTS Electronic Department Store TUFTS

TEL. 1-617-391-3200

TUFTS ELECTRONIC

TUFTS Electronic Department Store TUFTS

ATARI®

A Warner Communications Company

ANNOUNCING A NEW GENERATION OF PERSONAL COMPUTERS BY ATARI®

ATARI® 800™ PERSONAL COMPUTER SYSTEM

$1080.00

ATARI 800

The ATARI 800 is a top-of-the-line personal computer system. Its expandable memory, advanced peripheral components, comprehensive software library, and modular design assure that it will never become obsolete.

Whether it's for business and household management, education, or entertainment, the ATARI 800 can be tailored to specific needs and has been designed to change as those needs change. This "timeless" computer system can be used by people with no previous computer experience, although it doesn't compromise capability for the sophisticated user.

SOFTWARE LIBRARY

The hardware which makes up the ATARI 800 Personal Computer System is only half the story.

The other half is ATARI's complete software library. You get a full choice of ROM cartridge, tape cassette, and diskettes that give you complete control in shaping your computer's character and applications. For data management. For problem solving. For education. For fun and games.

You can even create and apply your own programs. ATARI's BASIC Language cartridge gives you direct access to your computer's central processing unit, memory and color, sound and file transfer capabilities. So you can design, write and implement your own programs. Or modify existing ones to suit your needs. Easily. Even if you've never talked to a computer before.

ATARI 410 Program Recorder

Comes supplied with your ATARI 800 Personal Computer. The program recorder gives you the ability to utilize any ATARI pre-recorded tape cassette program. It also lets you store your own programs on audio cassette tapes. It can store up to 100K bytes per 60 minute tape. **$89.95**

ATARI 820 Printer

(Optional)

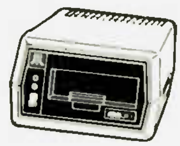
High resolution, dot-matrix impact printer uses inexpensive, standard roll paper. Prints more than 2,000 characters per minute to provide permanent printed records of program listings and program results. **$599.95**

ATARI Memory Modules

(Optional)

Unique 8K and 16K plug-in RAM modules let you instantly expand your computer's internal memory up to 48K.

8K $124.95
16K $199.95



ATARI 810 DISC DRIVE

(Optional)

Uses standard 5¼" diskettes to add up to 88K bytes of rapid access information storage for each diskette. As many as four 810 Disk Drive units can be operated simultaneously and accessed individually.

$699.95

ATARI® 400™ PERSONAL COMPUTER SYSTEM

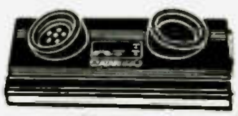
$630.00

ATARI 400

The ATARI 400 Personal Computer is just that: a computer that you can use. It's easy to own. And easy to operate. Even if you've never used a computer before.

But don't let its simple operation fool you. The ATARI 400 is a full-fledged general purpose computer that can go a long way towards simplifying your complex life.

All you have to do is pick a program from ATARI's comprehensive library of plug-in cartridge and cassette tape software. Everything from small business management to home finance and computerized education. Plus some of the most challenging, most exciting computer games ever.



ATARI® 830™ MODEM

ATARI® 850™ INTERFACE MODULE

JOYSTICK CONTROLLERS

PADDLE CONTROLLERS

ROM PROGRAMS

CASSETTE PROGRAMS

The system

The **ATARI 800™** system provides easy access to a wide variety of household information. Uses such as music composition, electronic art, and household security control are all planned applications for the **ATARI 800** system. The educational and entertainment value built into the system is endless.

For professional use, the **ATARI 800** is expandable to keep up with the needs of most small businesses, and with the needs of large businesses where the central computer is overloaded.

Business & household management

- **Personal Financial Management** Income and expense record keeping keyed to rapid retrieval for income tax purposes
- **Record Keeping** Books, records, serial numbers, insurance policies
- **Charge Account Management** (With check printing)
- **Personal Capital Investment Management** Stocks, bonds, real estate, with stock quotation service
- **Mailing List/Address Book** (With printing)
- **Computerized Appointment Calendar**
- **Inventory Management**
- **Accounts Payable**
- **Touch-typing Trainer**
- **Payroll**

Educational applications

The exclusive **ATARI 800 Educational Library** on audio digital cassettes, contains over 20 subjects, including

- Algebra
- Economics
- Auto Mechanics
- Sociology
- U.S. History
- Zoology
- Counseling Procedures
- Vocabulary Builder
- Basic Psychology
- Spelling
- Spanish
- Accounting
- Carpentry
- Great Classics
- Statistics
- Basic Electricity
- World History

Direct interaction with the computer takes place through the keyboard, television screen, and speaker. This running dialogue between the user and the computer is highlighted by immediate feedback on accuracy and understanding.

Entertainment applications

The **ATARI 800** is capable of playing sophisticated thinking and action games. The **Entertainment Program Library** consists of

Thinking games
Chess
Backgammon
Business Simulations
Stock Market Simulation
Space Adventure
Strategy Games

Action games
Four-Player Basketball
Superbug™ Driving Game
Game of Life
Super Breakout™

P.O. Box 75, Somerville, Mass., 02145

DEPARTMENT STORE TUFTS

On this page Tufts brings you . . .
Datong — Fox
Bencher — Bird

DATONG ELECTRONICS LIMITED

FL1 . . . Frequency-Agile Audio Filter

MODEL FL1

Frequency – Agile Audio Filter

The Datong Frequency-Agile Audio Filter is intended primarily for post-detector signal filtering in RF and LF communications receivers for SSB and CW. It offers an unusually versatile combination of benefits to the user including

For the SSB operator

- Fast automatic suppression of interfering heterodyne whistles in the range 280-3000 Hz by a unique search-lock-and-track notch filter. The tracking notch can be left in circuit with no audible effect until a whistle appears in which case the whistle will 'disappear' within typically one second.
- A continuously adjustable audio 'window' or a variable-width notch to improve reception in the presense of other off-tune SSB, RTTY or SSTV signals.

For the CW operator:

- Continuously variable center-frequency (280-3000 Hz) and bandwidth (25-1000 Hz) for perfect matching of receiver passband to changing band conditions, sending speeds, and personal preference.
- Flat-topped, steep-skirted response shape for optimum ease of tuning combined with excellent noise rejection.
- Linear tuning law with bandwidth independent of frequency and gain independent of bandwidth for natural 'feel'.

ASP . . . Automatic Speech Processor

ASP

Automatic Speech Processor

The ASP internally generates its own SSB signal and processes it up to 30 lb.! This processed signal is demodulated and delivered to your rig's mic input with fully automatic AGC control of both input and output level.

ASP Features:

- Installs between mic and transmitter!
- No need to open the rig!
- Push button selection of processing
- Harmonic distortion – less than 0.5% at 1 kHz.
- Internal tone generator allows easy and accurate initial adjustment – no scope needed.
- Selectable HiZ or LoZ mic input.
- Operates from 12 Vdc internal or external.
- Size 7¼" x 1¾".
- For use in PTT (non-VOX) operation.

MODEL D-70

Morse Tutor

The Morse Tutor provides a highly effective new way to practice Morse code reception at all levels of skill. It provides an unlimited supply of precision Morse at the turn of a switch, plus a built-in oscillator for sending practice.

D70 Features:

- Produces random five character groups. You can choose all letters, all figures, or mixed.
- Calibrated variable speed (6½-37 wpm) and variable delay (up to 3 seconds) between letters for optimum learning efficiency. This delay facility means that right from the start you can learn each letter and number as it ought to be learnt, that is with the dots and dashes within a letter fast enough to form a complete sound pattern, but with a long delay between each letter. As you improve you simply reduce the delay between letters.
- Internal loudspeaker, plus personal earpiece for private listening.

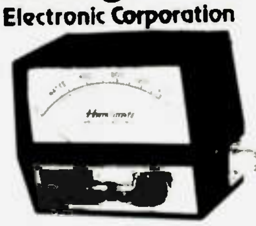
PRICE

ASP Automatic Speech Processor	$259.95
FL-1 Frequency Agile Audio Filter	219.95
UC-1 UP Converter	379.95
D-70 Code Tutor	159.95
DATEST I	189.95
DATEST II	169.95
D-75	179.95
RFC M RF Clipper Board Assembly	59.95
M100	20.00

BIRD Electronic Corporation

$99 VHF model 4362 (140-180 MHz)

$99 HF model 4360 (18- 30 MHz)



The 4360, 4362 HAM-MATE Directional Wattmeters are insertion type instruments for measuring forward or reflected power in 50-ohm coaxial transmission lines. They are direct descendants of the model 43 THRULINE® Wattmeter — the professional standard of the industry — and will accurately measure RF power flow under any load condition. Each wattmeter is made up of a precisely machined section of 50-ohm line, a rotatable sensing element and meter calibrated in watts, all mounted in a high impact plastic housing. It is this type of solid construction and the directional THRULINE coupling circuit, without toroids, that account for the superiority of the HAM-MATE Wattmeters.

the indispensable BIRD 43 THRULINE WATTMETER

Power Range	Frequency Bands (MHz) 2-30	25-60	100-250	200-500	400-1000
5 watts		5A	5C	5D	5E
10 watts		10A	10C	10D	10E
25 watts		25A	25C	25D	25E
50 watts	50H	50A	50C	50D	50E
100 watts	100H	100A	100C	100D	100E
250 watts	250H	250A	250C	250D	250E
500 watts	500H	500A	500C	500D	500E
1000 watts	1000H	1000A	1000C	1000D	1000E
2500 watts	2500H				
5000 watts	5000H				

MODEL 43	$135.00
Elements (Table 1) 2-30 MHz	50.00
Elements (Table 1) 25-1000 MHz	42.00
Carrying case for Model 43 & 6 elements	28.00
Carrying case for 12 elements	17.00

READ RF WATTS DIRECTLY! (Specify Type N or SO239 connectors) 0.45 – 2300 MHz, 1-10,000 Watts ±5%, low insertion VSWR – 1.05. Unequalled economy and flexibility. Buy only the element(s) covering your present frequency and power needs, add extra ranges later if your requirements expand.

The Bencher Ultimate Paddle . . . a dual lever, iambic keyer paddle that will increase your speed, accuracy & operating comfort.

- ADJUSTABLE CONTACT POINT SPACING – Precision screw adjustments on each set of contacts make exact settings easy. Contact posts are split and locked by set screws, eliminating the need for locknuts.
- WIDE RANGE OF TENSION ADJUSTMENT – Tension on finger knobs is maintained by a long expansion spring. Dual screw adjustments adjust spring tension to match your "fist."
- SELF ADJUSTING NEEDLE BEARINGS – Keying shafts pivot in nylon bearings that "float" on machined brass fittings. Spring tension prevents free play and slop; eliminates contact bounce and backlash.
- SOLID SILVER CONTACT POINTS – The contact points are solid silver for a lifetime of flawless keying.
- PRECISION MACHINED COMPONENTS – Main frame, contact posts, spring post and bearing ring are all machined from solid brass . . . polished and chrome plated for durability and rich appearance. The Bencher Paddle looks as good as it works!
- HEAVY STEEL BASE; NON SKID FEET – Finished in an attractive black wrinkle finish (chrome plating optional), the base measures 9.5cm x 10.2cm x 1.3cm thick. It weighs 1 kilogram, and with its non-skid rubber feet is as solid as a rock.

Model BY-1 Standard Black Base . . $42.95. Model BY-2 Polished Chrome Base . . . $52.95.

BENCHER, INC.

FOX™

First is the Fox XK. It reads all bands and tucks away on the visor.

Our remote (RW) unit is "out of sight" when installed. Out of sight in performance, too.

And now there's Superfox!

The first remote superheterodyne radar warning system. Superfox has 10 times the sensitivity capability of any conventional radar detector. It is ideal for custom installations.

PRICE LIST

Order No.	Description	Price
60	Fox XK All band detector w/self contained aural/visual alarm	$109.00
60-2	Fox XK (RW) All band detector w/remote control, waterproof	$139.00
60-3	Super Fox Super-Heterodyne remote radar warning system	$299.95

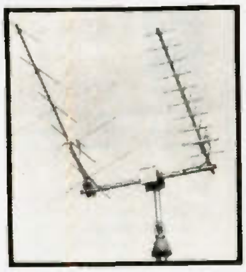
TUFTS Electronic Department Store TUFTS

TEL. 1-617-391-3200

DEPARTMENT STORE TUFTS

cushcraft

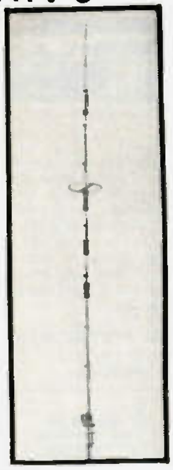
OSCAR



OSCAR Satellite Communications

Cushcraft offers complete antenna systems for OSCAR satellite communications on 2m and 70 cm. On 145 MHz the 10 element twist antenna (5 vertical elements, 5 horizontal) yields up to 10.8 dBd gain; the 20 element 435 MHz twist (10 vertical elements plus 10 horizontal) provides up to 13.6 dBd gain. For greater performance on 2m choose the 20 element 145 MHz twist which offers 13.6 dBd gain. The half power beamwidth of these antennas has been optimized for reliable satellite communications with minimum tracking requirements. All twist antennas come complete with coaxial matching harness for selectable horizontal, vertical or circular polarization. Match 50 ohm feedline.

ATV-5



ATV-5

This trapped vertical antenna system has been engineered for five band operation on 80m-10m. The high Q traps are carefully optimized for wide operating bandwidth. 2:1 SWR bandwidth with 50 ohm feedline is approximately 1 MHz on 10m, more than 500 kHz on 15m and 20m, 160 kHz on 40m and 75 kHz on 80m. Instructions are provided for adjusting resonance to your preferred part of the band, CW or SSB. Built in coaxial connector takes PL 259. Nominal height 293 inches. Rated at 2000 watts PEP on all bands.

Two Meter Boomers

Whether you have the space for the 3.2λ 32-19 or the compact 2.2λ models, 2m Boomers are your best choice. They offer the maximum gain available for their boom length (See NBS no. [illegible]). They feature trigon reflectors for additional front to back ratio and cleaner patterns. All stainless steel hardware and heavy gauge heat treated aluminum are used throughout. Whatever your choice of 2m activity, the Boomer will fill your needs. For FM use the 228FB or 214FB. For CW/SSB on the low end use 32-19 or 214B. In EME, DX or just reliable QSOs, Boomer will perform for you.

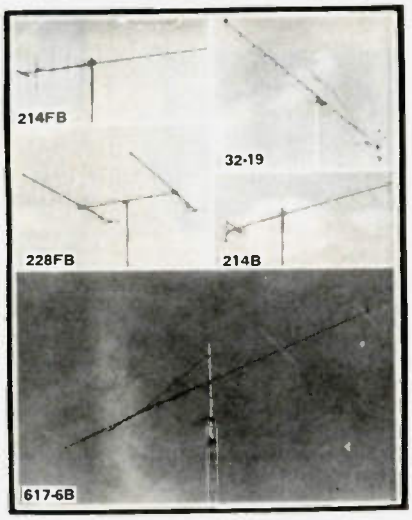
Six Meter Boomers

The new 6m Yagi offers more boom, more gain and fewer elements. Designed for the low end of the band, the 6m Boomer has Cushcraft's typical attention to detail: the Boomer's balanced feed with balun and extra heavy duty mechanical construction. The secret behind its super performance and light weight is special element spacing and boom lengths.

Specifications

Model number	32-19	214B	214FB	228FB	617-6B
Frequency range (MHz)	144-146	144-146	144.5-148	144.5-148	50.0-51
Forward gain (dBd)	16.2	15.2	15.2	18.2	14
Front to back ratio (dB)	24	24	24	24	30
E-plane Bwdth (deg)	2x14	2x17	2x17	2x17	2x19
H-plane Bwdth (deg)	2x17	2x18	2x18	2x9	NA
Side lobe attenuation (dB)	-60	-60	-60	-60	-60
SWR less than (typ)	1.2:1	1.2:1	1.2:1	1.2:1	1.2:1
Impedance (ohm)	50	50	50	50	50
Recommended stacking distance E-plane (ft) H-plane (ft)	14 12	10 10	10 10	10 10	NA 22.5
Weight (lbs)	[illegible]	[illegible]	8	[illegible]	26
Length (ft)	22	15	15	[illegible]	34
Longest element (in)	40½	40½	39½	39½	113½
Turning radius (ft)	[illegible]	[illegible]	7.5	9.5	17.7
Windload (sq ft)	3.1	1.2	[illegible]	[illegible]	4.8

On this page Tufts brings you . . .
Cushcraft
Save Your Radio



Skywalker

Specifications

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

ALL PRICES SHOWN ARE LIST PRICES!
CALL FOR SPECIAL PACKAGE PRICING!

Skywalker

3 and 4 Element Single Band Yagis

Skywalker

More contacts, less waiting, less interference, and a better signal at the other end are yours with the Skywalker series of single band Yagis. The 10dBd forward gain of the 4 element models will put you first in line. See the chart for all the details.

Heavy wall heat treated 6063-T832 aluminum tubing, ruggedly plated steel fasteners, and carefully formed aluminum brackets. Assembly is simple with the new Cushcraft Boom Assembly Marking System.

ATB-34

ATB-34

ATB-34 — 10-15-20 Meters

The Cushcraft ATB-34 3 band antenna offers the no compromise performance of a single band Yagi on 10m, 15m, and 20m and represents the best in state of the art antenna design. The antenna's rugged construction, broad bandwidth, and four active elements give superb performance. Quality workmanship and the use of the best available materials give an estimated wind survival rating of 90 mph. Forward gain is 7.5 dBd on all bands. Front to back ratio is nominally 30 dB on 20m, 22 dB on 15m, and 18 dB on 10m. Nominal input impedance is 50 ohms. VSWR is 1.5:1 or less at resonance.

PRICE LIST

MODEL	DESCRIPTION	LIST PRICE
BOOMER ANTENNAS		
32 19	144-146 MHz, 19 element, 3.2λ	89.95
214B	144-146 MHz, 14 element, 2.2λ	69.95
214FB	144.5-148 MHz, 14 element, 2.2λ	69.95
228FB	144.5-148 MHz, 28 element, 2.2λ	219.95
617 6B	50-51 MHz, 6 element, 1.2λ	199.95
BOOMER STACKING KITS		
32 SK	Stacking Harness & P.D., 2 Boomers	39.95
324 QK	Quad Stacking Kit, 4 Boomers	389.95
22 SK	Stacking Harness & P.D., 2 Jr. Boomers	36.95
224 QK	Quad Stacking Kit, 4 Jr. Boomers	249.95
228 VPK	Vert. Pol. Kit, 2 FM Boomers	89.95
PD 2	Power Divider, 2 Boomers	18.95
PD 4	Power Divider, 4 Boomers	29.95
MULTIBAND HF ANTENNAS		
ATB 34	Three Band 4 element Beam	289.95
ATV 3	Three Band Trapped Vertical	49.95
ATV 4	Four Band Trapped Vertical	99.95
ATV 5	Five Band Trapped Vertical	109.95
SKYWALKER BEAMS		
20 4 CD	14 MHz, 4 element (2 cartons) Replaces	299.95
20 3 CD	14 MHz, 3 element, A14 3	199.95
15 4 CD	21 MHz, 4 element, A21 4	119.95
15 3 CD	21 MHz, 3 element, A21 3	99.95
10 4 CD	28 MHz, 4 element, A28 4	[illegible]
10 3 CD	28 MHz, 3 element, A28 3	89.95
MOBILE ANTENNAS		
AMS 147	146-148 MHz, Stainless Magnet Mt	29.95
ATS 147	146-148 MHz, Stainless Trunk Mt	29.95
AMS 220	220-225 MHz, Stainless Magnet Mt	29.95
ATS 220	220-225 MHz, Stainless Trunk Mt	29.95
FM ANTENNAS		
A147 4	146-148 MHz, 4 element	26.95
A147 11	146-148 MHz, 11 element	39.95
A147 20T	144 & 147 MHz, 20 element	87.95
A147 22	146-148 MHz, 22 element	119.95
A220 7	220-225 MHz, 7 element	29.95
A220 11	220-225 MHz, 11 element	37.95
A449 6	449 MHz, 6 element	28.95
A449 11	449 MHz, 11 element	37.95
AFM 4D	144-148 MHz, Four Pole	69.95
AFM 24D	220-225 MHz, Four Pole	64.95
AFM 44D	440-450 MHz, Four Pole	59.95
AR 2	135-170 MHz, Ringo	24.95
AR 6	50-54 MHz, Ringo	39.95
AR 220	220-225 MHz, Ringo	24.95
AR 450	440-460 MHz, Ringo	24.95
ARX 2	135-170 MHz, Ringo Ranger	39.95
ARX 2K	135-170 MHz, Ranger Kit	18.95
ARX 220	220-225 MHz, Ringo Ranger	39.95
ARX 450	435-450 MHz, Ringo Ranger	39.95
FM STACKING KITS		
A14 SK	Stacking Kit for two A147 4	19.95
A14 VPK	Vert. Pol. for two A147 4	29.95
A21 SK	Stacking Kit for two A220 11	19.95
A220 VPK	Vert. Pol. for two A220 11	29.95
A147 SK	Stacking Kit for two A147 11	19.95
A147 VPK	Vert. Pol. for two A147 11	12.95
A449 SK	Stacking Kit for two A449 6 or 11	19.95
A449 VPK	Vert. Pol. for two A449 6 or 11	29.95
BLITZ BUGS		
LAC 1	Coax Lightning Arrester	4.95
LAC 2	Coax Lightning Arrester	4.95
TWIST ANTENNAS		
A14T MB	Twist Mounting Boom & Bracket	21.95
A144 10T	145 MHz, 10 element	49.95
A144 20T	145 MHz, 20 element	89.95
A432 20T	430-436 MHz, 20 element	59.95
VHF UHF BEAMS		
A50 3	50 MHz, 3 element beam	49.95
A50 5	50 MHz, 5 element beam	69.95
A50 6	50 MHz, 6 element beam	89.95
A50 10	50 MHz, 10 element beam	119.95
A144 7	144 MHz, 7 element beam	29.95
A144 11	144 MHz, 11 element beam	39.95
A430 11	432 MHz, 11 element beam	37.95
VHF UHF STACKING KITS		
A11 SK	Stacking Kit for two A144 11	19.95
A17 SK	Stacking Kit for two A144 7	19.95
A41 SK	Stacking Kit for two A430 11	18.95
A535 SK	Stacking Kit for two A50 3, A50 5	19.95
A561 SK	Stacking Kit for two A50 6, A50 5	29.95
AQK 144	Stacking Kit for four A144 11 Hor. Pol.	119.95
AQK 444	Stacking Kit for four A430 11	109.95
DX ARRAYS 20 ELEMENT		
DX 120	144 MHz	59.95
DX 220	220 MHz	49.95
DX 420	432 MHz	39.95
DX ARRAY BALUNS		
DX 1BN	1:1 Balun for DX 120	18.95
DX 2BN	1:1 Balun for DX 220	16.95
DX 4BN	1:1 Balun for DX 420	16.95
DX ARRAY 40 ELEMENT STACKING KITS		
DXK 140	Stacking Kit for two DX 120	159.95
DXK 440	Stacking Kit for two DX 420	69.95
DX ARRAY 80 ELEMENT STACKING KITS		
DXK 180	Stacking Kit for four DX 120	299.95
DXK 480	Stacking Kit for four DX 420	119.95

STOP THIEF!

SAVE YOUR RADIO!

DESIGNED FOR COMMERCIAL USE UP TO 1000 MHZ

The TUFTS SAVE YOUR RADIO bracket can save you a bundle [illegible]. Why worry about rig ripoff? The TUFTS SVR bracket mounts quickly and easily in your car and makes it possible to snap your rig out of its bracket when you park and put it out of sight.

The connector system has a special coaxial cable connector which will provide you with a lossless connection right up to 1000 MHz. In addition to the quick coax connector there are also four power and accessory connections which are made automatically when the rig is slid into its bracket — just what you need for [illegible] and loudspeaker connections of the set.

[illegible] bracket and connector system [illegible] take a beating. [illegible] 16 gauge steel plate for a [illegible] leave the rig [illegible] in its bracket. [illegible] the dash to get [illegible] the first time [illegible].

With [illegible] these brackets you can bring the mobile rig into the house and use it in seconds. Or [illegible] you can take an AC supply for the rig and use it in your home room. Price **$34.95**

6 METER BEAMS

3-5-6-10 ELEMENTS

Description	3 element	5 element	6 element	10 element
Model No.	A50 3	A50 5	A50 6	A50 10
Boom Length	6	12	20	24
Longest El.	117	117	117	117
Turn Radius	6	7.6	11	13
Fwd. Gain	7.5 dB	9.5 dB	11.5 dB	13 dB
F B Ratio	20 dB	24 dB	26 dB	28 dB
Weight	7 lbs	11 lbs	18 lbs	25 lbs

3/4, 1-1/4, 2 METER BEAMS

Model No.	A144 7	A144 11	A2[illegible] 11	A430 11
Description	2m	2m	1¼m	¾m
Elements	7	11	11	11
Boom Lngth	98	144	102	57
Weight	4	6	4	3
Fwd. Gain	11 dB	13 dB	13 dB	13 dB
F B Ratio	26 dB	28 dB	28 dB	28 dB
Fwd. Lobe @ half pwr pt	46	42	42	42
SWR @ Freq	1 to 1	1 to 1	1 to 1	1 to 1

TUFTS Electronic Department Store TUFTS

TEL. 1-617-391-3200

DEPARTMENT STORE TUFTS

TUFTS

Electronic Department Store

OPEN DAILY 9-9
SATURDAY 9-6

master charge ORDER BLANK VISA

P.O. Box 27, Somerville, Mass., 02155, 1-617-391-3200

Prices FOB Medford, Mass. Mass. residents add 5% sales tax. Minimum $3.00 for shipping and handling on all orders.

CAT. NO.	PAGE NO.	DESCRIPTION	QUANTITY ORDERED	UNIT PRICE	TOTAL PRICE

5% Sales Tax (Mass. Residents)	
Shipping and Handling	$3.00 Min.
Amount Enclosed	

Name ____________________ Call __________
Address ____________________
City ____________________ State ______ Zip ______

☐ Check Enclosed ☐ Visa ☐ Master Charge ☐ Send Free Catalog

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

Card no. ____________________ Card exp. date __________
Signature ____________________

SPECIAL PRICING NOTICE

Many of the major items, such as transceivers, are available at special discount prices. A complete list of these special discount prices may be obtained by writing or calling our mail order department. If your order contains one of the items on the current discount list our sales staff will make sure that your receive the lower prices.

You may call us at (617) 391-3200 for quotes off our discount list.

SST T-8 MOBILE IMPEDANCE TRANSFORMER

All bands (160m-10m) with any wire • 200W output • Any transceiver • Home or portable • Neon tune-up indicator.

$29.95

SST T-2 ULTRA TUNER

Tunes out SWR on any antenna – coax fed or random wire (160m-10m). Any rig – up to 200W RF output. Rugged, yet compact: 5¼" x 2¼" x 2½".

$37.95

SST T-4
ULTRA TUNER DELUXE

ULTRA TUNER DELUXE Matches any antenna – coax fed or random wire on all bands (160m-10m). Tune out the SWR on your antenna for more efficient operation of any rig. Home, mobile, portable – only 9" x 2½" x 4¼". • 300W rf output capability • SWR meter with 2-color scale • Antenna Switch selects between two coax fed antennas, random wire, or tuner bypass • Pi-network design. Attractive black.

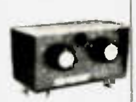
$64.95

SST T-6 ULTRA TUNER

Matches 52 Ohm coax to the lower impedance of a mobile whip. Taps between 3 and 50 Ohms. 3-30 MHz. 300W output. 2¾" x 2" x 2¼".

$19.95

SST T-1 RANDOM WIRE ANTENNA TUNER



Most versatile antenna tuner available. Any antenna – coax fed or random wire (160m-10m). Front panel function switch selects between two circuits – a Pi or L network – or tuner bypass. Front panel antenna switch. Relative output meter. 200W output –will work with virtually any transceiver. 6½" x 3" x 3". Attractive bronze finished enclosure.

$59.95

SST A-1 Amplifier Kit. 1W in 15 out. All parts, circuit board, instructions. Easy to build. $22.95

SST DL-1 K4RLJ DUMMY LOAD. 1000W PEP. 1.5:1 1-225 MHz. Scaled. 3-1/8" x 4-3/8". $19.95

SST B-1 Balun for using T-2, T-4, T-6, or similar tuner with balanced open wire lines. 300W. $5

SST ELECTRONICS

TUFTS Electronic Department Store TUFTS

TEL. 1-617-391-3200

✓Reader Service—see page 226

RTTY Loop

from page 12

will prevail. Thus, the "standard" 170-Hz shift, low-space on FSK, should be the way to go on HF. On VHF, the choice would be between using the old 2975-Hz/2125-Hz AFSK tones or trying something new. I look forward to the day when modem tone pairs are tried, for full-duplex communication! Baud rates will be another stumbling block. Hams without computers, just eight-level terminals, may be using mechanical printers, such as KSR/ASR Teletype® machines, that are limited to 110 baud. Much in the way of "standard" interchange over modem circuits is conducted at 300 baud. Certainly most of us with computers and/or video displays will be able to handle 1200 baud or faster, and it will be interesting to see what turns up on 450 MHz, where baud rates are nearly unbounded!

So there we have it—an exciting new frontier for RTTY. ASCII shall join with the introduction of personal computers to revolutionize the way we look at non-voice amateur communication. And RTTY Loop will be there!

Review

THE ILLUSTRATED DICTIONARY OF ELECTRONICS

If you have been looking for a *comprehensive* electronics dictionary, then TAB BOOKS' *The Illustrated Dictionary of Electronics* (No. 1066) by Rufus P. Turner just may be the ticket. As the cover states, this work (868 pages!) contains "Complete, modern definitions for well over 24,000 electronics/computer terms!" The "illustrated" part comes from the nice sprinkling of explanatory drawings found throughout.

Many so-called electronics dictionaries have, in the past, been very skimpy in numbers of terms and lengths of definitions. This is not the case with this one. On top of having a listing for just about everything that you can think of, many definitions refer to related subjects which may further enhance your understanding of a word or phrase. For instance, if you look up "transverse electric mode," the explanation also asks you to "Compare *transverse magnetic mode*" and to "Also see *waveguide mode*."

Definitions of "monkey chatter," "water capacitor," "von Hippel breakdown theory," "episcotister," and "Bunet's Formula" are included in this very comprehensive listing of common and not-so-common electronics and computer terms and phrases. Lest you think that this book is too deep for a non-engineer, it also has definitions for ham-type terms such as "sideswiper," "double-extended Zepp antenna," "bazooka," and "slow-blow fuse."

Also included is a "Tables and Data" section, which contains, among other things, a wire gauge table, C°-to-F° conversions, many general-purpose conversion factors, electronic abbreviations, and many math and electronics constants.

The real way to appreciate this dictionary is to get ahold of one. Even at $14.95, it won't take long to pay for itself in the confidence that you gain by increasing your vocabulary and your understanding of the electronics revolution. Once you start thumbing through this one, it will be tough to put it back on the shelf. *TAB BOOKS, Blue Ridge Summit PA 17214.*

Gene Smarte WB6TOV
News Editor

Ham Help

I am presently here at ISP in Ft. Madison, Iowa, and am interested in trying to take my Novice license test here. This would be under unusual conditions, among which are not being able to use a code oscillator or have any radios besides the regular AM-FM broadcast receivers. This is because the feeling is that we may be able to hear police broadcasts on a ham or amateur radio. I know that this isn't possible, having studied electronics and radio schematics for several years and also having been in business.

I would like to get a small amateur club started inside these walls, but help is needed to explain to the staff just what amateur radio is, what it does in times of emergencies, and what a person could even learn if just given the chance to prove it.

I've been trying to learn the Novice theory and also the code here by my own means, and have learned much of it already. I'm also studying the *Novice Class License Study Guide* and working on all 49 test questions, in hopes I'd be able to get the Novice license exam while here. Possibly, that may prove to some in here that a man can do something on his own even when locked up.

I'm presently a subscriber to *73 Magazine* and enjoy very much the articles that everyone has written. I would like to hear from anyone who may have an answer for me while I'm here.

I'm also trying to get into the electronics shop here in hopes of being able to learn more in the field of electronics and, hopefully, also being able to take a correspondence course in electronics/communications and work towards a 2nd class license, too.

I'm presently doing a 10-year sentence and may possibly go up for a parole in October of this year. I hope I'll have my Novice license and, possibly, the communications course completed and my diploma received to show the board here by that time.

I sincerely hope that any readers who may be able to help will write me here.

Richard Hollingshead
Box 316-201957
Ft. Madison IA 52627

I would appreciate any information on converting a CPI 400 CB rig to 10 meters.

Ron Feldstein KA6IPY
PO Box 681
Simi Valley CA 93065

I would like to contact anyone who is interested in or operating with 10-GHz equipment. I live in the Toledo, Ohio, area in southern Michigan.

Paul Bachman WB8ATA
11705 Munson Hwy.
Morenci MI 49256

I need a manual or parts list and schematic for a National NC-183 receiver.

I would also like to contact members of the WWII San Pedro/Espirito Santo Sonar Team: Bates, E.T. and C.R., Jackson, Harrison, and others.

R. L. Story K5ANG
705 W. Gravwyler
Irving TX 75061

I have a Hammarlund HQ-160 in good condition, but I need i-f transformer T1 and 2 (455/3035 kHz) to restore it to its original condition. I will buy a salvaged transformer or a junked 160 for parts. I also have an original owner's manual which I would duplicate for cost and postage if anyone needs it.

Stan Horne WD4HKG
5939 Redberry Lane
Jacksonville FL 32211

I would like to acquire the location, time, and any other important information about a CW County Hunters Net currently in operation. Thank you.

Michael Cent WD9GFL
840 E. 166th Place
S. Holland IL 60473

I need a DC7302N or a Mostek MK50362 40-pin clock chip to complete K6SK's "A Single IC Time Machine" in the February, 1979, *73*. If you have one surplus to your requirements or have information on possible sources, please write to me. No reasonable price refused.

Bill Maxwell VK1MX
33 Dunbar Street
Fraser, A.C.T.
Australia 2615

The UDT 170

The SMART TU for RTTY & MORSE

The UDT 170 Universal Data Transceiver will instantly convert any ASCII or Baudot teletype or video terminal into a multiple baud rate data transceiver for ASCII, Baudot or Morse operation. It features ...

- 170/850 HZ Shift
- Dual 6 pole active filters for weak signal operation
- ASCII/Baudot Regeneration with multiple baud rates
- CW Auto Ident (optional)
- 1-150 WPM Morse with Auto-track
- Computes & Displays WPM copy rate & Buffer Status
- Selectable line length from 40 to 80 characters
- Metal Enclosure 12"x7 1/4"x3 1/2"

For more information write or phone

Cost Complete and Assembled $479

Price subject to change without notice

XITEX CORP. ✓82
9861 Chartwell Drive
Dallas, Texas 75243
(214) 349-2490

NEW MFJ SOLID STATE
24 HOUR DIGITAL CLOCK

Eliminate converting to GMT. Pleasant BLUE easy-on-eyes display. Bright .6 inch digits. ID timer. Alarm, snooze, lock functions. Power out, alarm on indicators. Assembled.

Pleasant Blue Display is easy-on-eyes.
Bright .6 inch digits.
Built-in ID timer.

$29.95

The MFJ-101 is a new all solid state 24 hour digital clock. Just set it to GMT and forget about converting to GMT.

Pleasant blue .6 inch digits (like TS-820S) are easy-on-eyes and bright enough to see clear across your room.

ID timer alerts you every 9 minutes after you tap ID/doze button.

Set alarm to remind you of SKED or simply to wake you up in morning. Has alarm on indicator.

Fast/slow set buttons make setting time and alarm simple.

Lock function prevents missetting time/alarm. Digits flash if power is interrupted. Rugged black plastic case. Brush aluminum front/top panel.

UL approved. 110 VAC. 50/60 HZ switch for USA, Europe, Japan and other countries. Use 220/240 VAC with optional AC adapter. 6x2x3 in.

Order from MFJ and try it — no obligation. If not delighted, return it within 30 days for refund (less shipping). One year limited warranty by MFJ.

Order today. Call toll free 800-647-1800. Charge VISA, MC or mail check, money order for $29.95 plus $3.00 shipping/handling for MFJ-101.

Don't wait any longer to enjoy the convenience of reading GMT time directly.

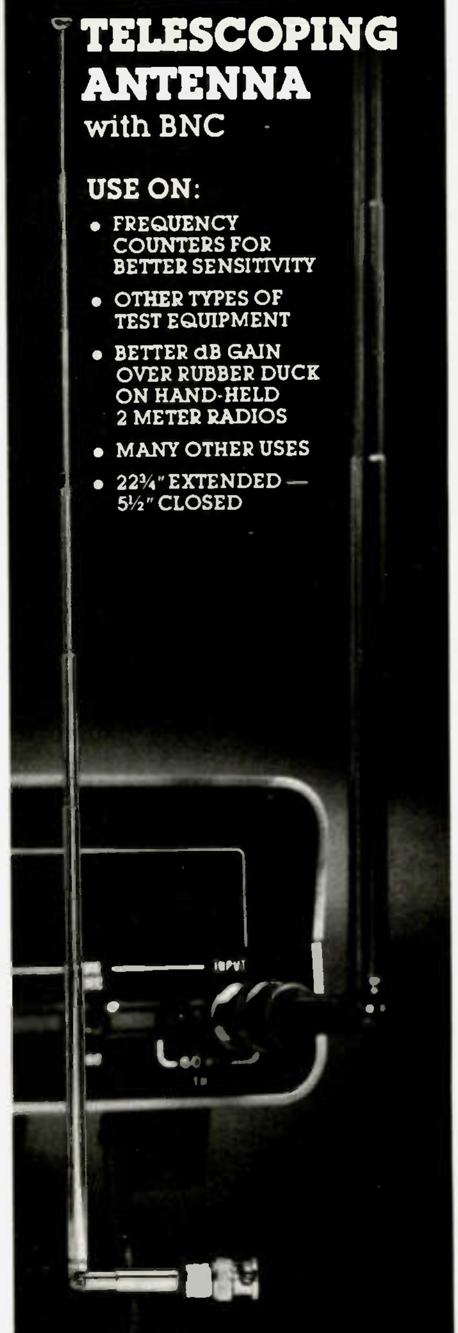
CALL TOLL FREE ... 800-647-1800

Call 601-323-5869 for technical information, order/repair status. Also call 601-323-5869 outside continental USA and in Mississippi. ✓47

MFJ ENTERPRISES, INC.
BOX 494, MISSISSIPPI STATE, MS 39762

TRIONYX IND

TELESCOPING ANTENNA
with BNC



USE ON:

- FREQUENCY COUNTERS FOR BETTER SENSITIVITY
- OTHER TYPES OF TEST EQUIPMENT
- BETTER dB GAIN OVER RUBBER DUCK ON HAND-HELD 2 METER RADIOS
- MANY OTHER USES
- 22¾" EXTENDED — 5½" CLOSED

$8.95 PLUS $1.50 POSTAGE
Indiana residents add 4% sales tax

TRIONYX INDUSTRIES
6219 COFFMAN ROAD
INDIANAPOLIS, IND. 46268
317-291-7280 ✓327

MASTER CHARGE/VISA — ACCEPTED

DEALER PRICING UPON REQUEST
WE CAN PUT ANY TYPE OF CONNECTOR ON THE ANTENNA
WRITE FOR PRICE AND AVAILABILITY.

✓Reader Service—see page 226

W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

from page 6

with a similar interest. In order to talk about loudspeaker enclosures, I need both RTTY and SSTV techniques . . . so I can show drawings and calculations. Oh, it can be done via voice, but it would be faster and better via other modes.

The coming new bands? The only one with an estimated date for our use is only 50 kHz wide, so let's not worry about it. That will fill up solid the first day with certificate hunters and be of little use from then on. Allowing 3 kHz per channel, we will be able to accommodate about 15 QSOs at once. What we will actually have is fifty almost-impossible-to-understand contacts going on simultaneously.

The prospects for further satellite communications are not a lot brighter. Once we get a satellite which is usable over much of the day instead of for a few minutes every few hours during a small part of the day, as we have at present, the small passband of the satellite will, I suspect, fill right up. It will only take one kilowatt KP4 to screw up everything . . . as we have already discovered. Like the 10-MHz band, the satellite passband will probably develop into a solid mass of hard-to-read signals. Digital techniques may permit more dependable communications if we change to admitting that it is time to stop wasting spectrum with unnecessary communications.

What is unnecessary? Well, we could argue that a lot, but assuming that idle chitchat is considered necessary, we might cut down on the frequency and time required for station identification. I've heard emergency nets spending almost half their time reciting calls instead of keeping at message handling. If we cut callsigns out of repeater contacts, we would be able to accommodate double the number of stations without building any more repeaters.

In all fairness to those operating mobile, if we start restricting the communications by eliminating most of the call identification, the recitation of the equipment, the detailed news of where the car is at that moment, and a few other such items of equal significance, the air would get very quiet. When we are driving, much of our attention is on the road and it is difficult to think of anything of interest to talk about . . . so we fill the air with the insignificant, happy in the thought that we are communicating. We really aren't.

What about the microwaves? Well, after a good deal of work with 10.5 GHz, I can report that I will be surprised if anything much develops in these frequencies. We lost them in 1971 for ham satellite use . . . and the limited range we can get with them without a satellite repeater makes them of little value to us in the foreseeable future. The equipment is difficult to build, breaks down constantly, and is expensive.

If we could get some microwave bands for ham satellite use, we could see some fantastic developments in these frequencies. This is one of the reasons why I think is it important for us to start working seriously on getting amateur radio developed in as many of the Third World countries as possible. We need all the enthusiastic support we can get if we are ever going to make any headway towards regaining some satellite channels.

There is a lot of worry about 220 MHz . . . and rightfully so. First, it was the EIA, backed by some of the bigger CB manufacturers, trying to get it turned into a new CB band. When this was thwarted, we found the FCC, backed by the ARRL, thinking in terms of using it as a pseudo-CB band for entry level (no-code) hams. Then the marine interests started getting into the act. It takes an act of courage to spend the time and money to develop a repeater system on 220 MHz these days.

The time was when amateurs did not have to immediately fill up bands with signals in order to preserve them. Indeed, there is strong historical reason for adhering to this policy. Unfortunately, much of government and the emotions of hams run on a here-and-now basis, with little consideration for the future, and this lack of perspective has to be taken into mind when dealing with our ham bands.

For instance, the top half of two meters was virtually unused from the time it opened in 1946 until over twenty years later. This brought on pressures for giving these frequencies away for CB use, a suggestion put forth by one of the ham magazines, no less. If those frequencies had not been lying fallow, it might have been impossible for us to develop the network of repeaters and channelized communications we have today. We started to see FM coming in the early 1960s, but the time wasn't right until the frustration over incentive licensing had quieted down.

Today, we have a great many ham bands which are virtually unused. We may come up with modes of communications which will populate these bands. If we could solve the problem of developing program material, we could use the 1200-MHz band for a network of television repeaters. So far, the pioneers of ham television have come up with no solution to this problem, and this, more than any other obstacle, has kept interest in this mode at a minimum. A few test repeaters have been set up on 420 MHz, but these have not caught interest generally and growth has been unimpressive.

The communications we need for our home computers is not along ham lines, so I think this will take the route of telephone lines and TV cables, so that anyone can be accessed, not just hams. Some hams may set up test repeaters for digital communications, but the limitations against commercial use will not permit extensive investment of time or money in this direction.

If we were to take away the utterly mundane content of ham communications, would amateur radio continue to even exist? Experiments with trying to carry on contacts without mentioning the ham gear used, the weather, or extensive drivel about one's hometown have been dismal failures, leading us to surmise that an intelligent conversation between two newly-met people, trying to hear each other through interference from others, is too elusive a goal. When one enters into this, one quickly discovers that the mouth is as dry as the wits and that outside of a stuttering about the signal strength, little conversation comes to mind. It's as vacuous as cocktail-party talk. Perhaps some amateurs will tackle this situation and pioneer the use of intelligence and wit over the air, being kind enough to take notes and let the rest of us know how in the hell they did it. This is unlikely.

There may be some renewed pressure for the development of the completely unattended station . . . where DXCC can be achieved automatically within a few minutes by means of two-way digital communications. This might clear up a lot of the clutter. Will the complete ham rig of 1990 have counters on it to indicate the countries worked that day, that week, that month, and so far that year? With perhaps a switch to indicate the number of prefixes worked, states, continents, zones, ITU zones, etc.? Perhaps we'll have certificates for nine-band DXCC in one day which are popular by 1990.

With a growth in crossband repeating, we may need to open up more control channels on the 420-MHz band, squeezing those television pioneers up to the 1200-MHz band . . . where some think they should have gone in the first place. We may see more hams with HTs on their belts, grabbing them to say hello to a friend in Zanzibar as DXing via repeaters gets more popular . . . and more automated. I remember hearing the hams in Vail working a DXpedition while I was skiing and my hoping I could at least be patched through from the slopes to make the contact. It didn't work. On Navassa, I did make several contacts via a two-meter link to the low-band station and at one time I had a two-meter repeater set up at the *73* offices in Peterborough through which I worked a lot of 20-meter DX. It's great fun and I think it will be popular.

What about narrowband voice modulation? That was covered in an article recently in *73* and none of the letters resulting gives any serious hope that

JAN CRYSTALS HOLD THE FREQUENCY

- CB
- CB standard
- 2 meter
- Scanners
- Amateur Bands
- General Communication
- Industry
- Marine VHF
- Micro processor crystals

Send 10¢ for our latest catalog. Write or phone for more details.

JAN CRYSTALS

master charge · VISA · easy to charge

2400 Crystal Drive
Ft. Myers, Florida 33907
all phones (813) 936-2397

39

TWO REALLY GREAT ANTENNAS

THE JOYSTICK VFA (Variable Freq. Antenna) claims unbeaten scoring over commercial and/or conventional antennae.

● Simple, rapid erection ● Not only 6-band but CONTINUOUS 0.5 – 30Mhz., incl. BC & MARS ● Omni-directional ● Substantially Harmonic FREE ● 1,000,000 miles per watt, world record! ● Poor QTH's enhanced! CLIFF DWELLERS DREAM ANTENNA! ● QUOTE from RADIO ZS (South Africa) "A remarkable antenna with great possibilities. Its physical size makes confined space operation a practical proposition".

SYSTEM 'A' $110.00
150 W.P.E.P. &/or Receiving only

SYSTEM 'J' $130.00
500 W.P.E.P. &/or Improved
Q Factor Receive

UP-DATE FOR THE EIGHTIES
NEW JOYMASTER

You get all the **JOYSTICK VFA** top-notch capability plus the JOYMASTER BONUS of EARTH INDEPENDENCE. This new system gives you TUNED ARTIFICIAL EARTH radials on ham bands 80 thru' 10. Now snap your fingers at 99% of QTH problems!

SYSTEM 'JM1' $147.00
150 W.P.E.P. &/or Receiving only

SYSTEM 'JM2' $162.00
500 W.P.E.P. &/or improved
Q Factor Receive

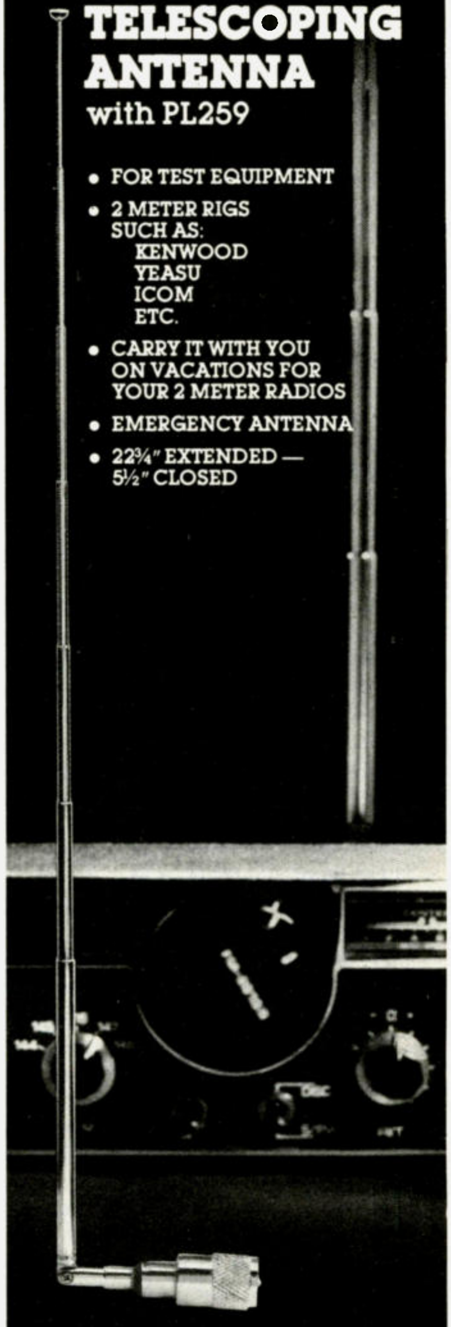
JOYSTICK VFA OWNERS, update your system to **JM1/JM2** for **$86.00 and $101.00,** respectively. Rush Mastercharge/Visa no. or check or request FREE literature. All goods assemble easily from the pack – then you have your REALLY COMPACT ANTENNA SYSTEM. Matching ATU's. Air mail cost incl.

PARTRIDGE ELECTRONICS LTD
8, Partridge House,
G3CED Broadstairs, Kent, England. G3VFA
Tel: 011 44 0843 62535

Please send all reader enquiries directly

TRIONYX IND

TELESCOPING ANTENNA
with PL259



- FOR TEST EQUIPMENT
- 2 METER RIGS SUCH AS:
  KENWOOD
  YEASU
  ICOM
  ETC.
- CARRY IT WITH YOU ON VACATIONS FOR YOUR 2 METER RADIOS
- EMERGENCY ANTENNA
- 22¾" EXTENDED — 5½" CLOSED

$8.95
PLUS $1.50 POSTAGE
Indiana residents add 4% sales tax

TRIONYX INDUSTRIES
6219 COFFMAN ROAD
INDIANAPOLIS, IND. 46268
317-291-7280

MASTER CHARGE/VISA — ACCEPTED

DEALER PRICING UPON REQUEST
WE CAN PUT ANY TYPE OF CONNECTOR ON THE ANTENNA
WRITE FOR PRICE AND AVAILABILITY.

327

NOW - THE NEW

AMCODER

IT'S EVEN BETTER!!!

4" x 2⅜" x 6"

- Still only 40hz wide. Single signal - no QRM/QRN reception. Immune to impulse (ignition) noise.
- Still tape quality audio with TTL compatable signal for computer interface applications. No noise appears in the AMCODER output.
- NOT A FILTER!! Its CW regeneration.
- NOW - dig into the noise for the weak ones without front end overload with our new AGC module. No locking on noise.
- No mods to your gear. Just plug into phone jack. Speaker or phone outputs with bypass swtiching when not in use. No external power required.
- 26DB dynamic range (5 to 6 S unit fade margin) with AGC module when properly adjusted.
- Constant level input to the AMCODER regardless of receiver audio level with either S-1 or 30 over 9 signals. (Works on phone signal levels too) with the AGC module.
- Still reduced operator fatigue, variable frequency acquisition, 400-1400hz and variable frequency output tone (and smoother)
- Still variable output level for station speaker or head phones.

Complete kit (Less AGC option) (Cabinet included)	**$79.95**
AGC Module (only FWT) for older AMCODERS	**29.95**
AGC Module (Only FWT) for new AMCODERS	**29.95**
New AMCODER Factory wired & tested	**94.95**
With AGC Module installed	**119.95**

Foreign - Add $20.00 - all in U.S. Funds.

Ship your old AMCODER to AMC for updating and installation of AGC module - we pay for return shipping **32.50**

VISA & Mastercharge Accepted
Maryland residents - add 5% Sales Tax.
Write for brochure or check reader info card

AMC ENGINEERING
P.C. Box 427
Jessup, Md. 20794
Phone: 301-799-7741

6

ALDELCO ELECTRONICS COMPANY

RF DEVICES

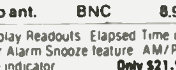
2N5913 1.7W 175 MHz	$1.70	2N6080 4W 175 MHz	5 40
2N3866 1W 400 MHz	1.25	2N6081 15W 175 MHz	8 45
2N5589 3W 175 MHz	4 75	2N6082 25W 175 MHz	10 95
2N5590 10W 175 MHz	7 80	2N6083 30W 175 MHz	11.75
2N5591 25W 175 MHz	10 95	2N6084 40W 175 MHz	13.30

OVERVOLTAGE PROTECTION OV-12 Provides protection from runaway Power Supply Voltage. Triggers @16V 25 Amp rated, 1 piece moulded unit for 12 Volt DC fused Power Supply $8.95 OV-5 for 5 Volt PS triggers at 7V $9.95

ACCUKEYER KIT. Similar to Handbook version. Includes PC Board, IC's, Sockets & all parts. Includes sidetone on board, lambic operation dot dash mamory. **Only $21.95**

NEW MEMORY KIT. 1056 bit memory expandable to 4224 bits. 1 2102 supplied. Additional chips $1.25 each. Led indicator. Adaptable to other keyers. Uses 5VDC. **Only $21.95**

Dual digital 12 or 24 HOUR CLOCK KIT. NOW WITH A NEW WALNUT WOOD GRAIN CABINET Model ALD 5-W Six Big 0 5 Displays **Only $52.95** 12 or 24 Hour Operation — Each Clock controlled separately Freeze Feature for Time Set — Easy assembly for clock and Cabinet



5 x 7 3 dot matrix display		3.95
Handie Talkie collapsible whip ant.	BNC	8.95

ALARM CLOCK KIT Six 0 5 LED Display Readouts Elapsed Time indicator 12 Hour Format with 24 Hour Alarm Snooze feature AM/PM indicator Power Supply power failure indicator **Only $21.95**
12 or 24 Hour Clock Kit 0 5 Display LED s **$19.95**
Wood Grain Cabinet **$4.95**

TUNABLE AMATEUR TV CONVERTER Receive Fast Scan ATV in the 420 MHz Band with any TV Set Low noise high gain Amplifier stage with Varactor Tuned input and output Built-in 110 VAC Supply Two Tone Walnut & Beige Cabinet measuring 1-7/8" x 4-1/4" x 4-1/8" Factory Wired & Tested 2 Year Guaranty **Only $59.95**

Lunch Counter Kit (boards & front panel only) $14.50

11C90 Prescaler	$19.95	1 MHz crystal	$ 7.95
74C925 Multiplex	$15.95	10-60 PF trimmer	$ .60
F9368 Drivers (2)	$15.95	704 displays, each	$ 1.25
Resistor Kit	$ 1.75	Capacitor Kit	$ 6.00

Add 6% for Shipping. Min. Order $10.00. Out of USA send Certified Check or Money Order. Include Postage.

ALDELCO

2789 A Milburn Avenue, Baldwin, NY 11510
(518) 378-4555

300 *Send 1st class stamp for our catalog*

this mode is going to be popular. Our reports that the League has dropped it seem factual, despite their early enthusiasm for it, complete with articles in *QST*, chapter in the *Handbook*, etc.

The recent move by the FCC to disenfranchise us from giving Novice exams is one which should be countered. I'd like to see ham clubs given the power to give all of the ham tests.

In 1960, we could clearly see sideband coming on strong. In 1970, we could see FM beginning to develop. Now, in 1980, I don't see any changes of those magnitudes starting up. Maybe in another year we'll have some changes which cast their shadow ahead and enlighten us as to what amateur radio may be like in 1990. Right now, it looks a lot like it will be much as it is today.

My unasked-for advice is to jealously preserve our amateur frequencies, whether we are using them or not. We will have a healthy amateur radio service in 1990 if our industry is able to stop knifing itself and work toward setting up a lobby in Washington to deal with the FCC and Congress . . . a national lobby to encourage the growth of the hobby nationwide . . . and an international lobby to get amateur radio into as many small countries as possible.

With your help, I'll do all I can toward these goals.

My own goal is to have *73* at least 500 pages thick by 1990, serving over a million U.S. hams and encouraging even more pioneering of new communications techniques.

CLARIFICATION REQUESTED

One of the hams in California who has done much to make things happen wrote recently to say that in those areas where he is familiar with the ARRL, he has found my editorials accurate. His suggestion for those who feel like beefing about my "anti-ARRL" stance is for them to write to the League and demand an explanation of the facts I have presented. Find out whether I am right or wrong. If I'm wrong, then let me know in what way, because I want to know that more than they do. If I am right, then get after the League to clean up their act. When it comes to my editorials about the ARRL, I don't think you are going to find any areas of error of fact . . . I make darned sure I know what's what before I write.

If all readers would get indignant about the things going on and make it their business to really find out for themselves, the ARRL would have to make some big changes in short order. It is the sheep-like acceptance of bad management, dishonesty, pompous arrogance, and coverups which greatly weaken amateur radio. It's your money, fellows. Don't you object to being ripped off? I sure wish you could hear the disdain some of the HQ gang express for the average amateur while they are boozing it up at the members' expense at League cocktail parties. They seem to think you are a bunch of suckers . . . and if you continue to apologize for them and let them get away with highway robbery, they may be right.

EIA ATTACKING 220 MHz AGAIN

The Electronic Industries Association (EIA), which gets money from the CB industry rather than the ham industry, is again putting pressure on the FCC for the opening of two megahertz of the amateur 220-225-MHz band. They point out that this would provide 80 channels for CB FM use to meet personal radio needs, leaving three MHz for existing government and amateur use.

When there is a constant pressure in Washington, backed by a good deal of money and expertise, with no opposing ham lobby pressure, eventually it is going to prevail. Persistence is a powerful tool, particularly when it is virtually unopposed. Sure, the reasonable thing is to keep the band for ham use, but when did you last see reason prevail with our government? Money and power talk in Washington.

The argument goes that a few hundred amateurs should not keep 15 million CBers from getting a service that they badly need. The FCC Commissioners are thus under pressure to accede to the EIA and the huge CB market, while the ham industry can't even keep an industry organization going to speak up for the hams.

THE WOODPECKER AGAIN

A couple of readers sent along a clipping from *The Spotlight*, one of those sensational weekly papers like the *Enquirer*. This had to do with Russian experiments to change our weather by means of high frequency radio transmissions. The article pointed out that the experiments had backfired, giving the US a mild winter and ravaging the USSR.

The article attributes the concept of changing the weather to Nikola Tesla and his experiments with transmitting power. It says that Tesla said that his findings could be used to modify the weather. Well, I've read everything by Tesla that I could find and I don't recall any such thing in his articles, lectures, or other writings. I'd like to see a reference on that one.

I really can't imagine what the results would be to the world if the Tesla system of transmitting power were put into effect. He generated enormous amounts of power, stepped up the voltage with a gigantic induction coil (Tesla coil), and arced the voltage into the Earth at a frequency which set the entire Earth into oscillation. He calculated the time it would take for the wave from the lightning charge to travel all the way through the Earth and reflect back and set his arcing frequency equal to that. It seemed to work, for he was able to go many miles from the transmitting station and light up banks of lamps with an antenna and ground connection.

Unfortunately, Tesla was not one for keeping much around in plans for his ideas and inventions, so the details of his power transmitting system are either lost or possibly under lock by our government. Many of his papers were locked up by the US government when he died.

Tesla was probably one of the greatest inventors the world has ever seen, in case you have missed articles or books about him. He, single-handedly, invented alternating current and got all of the basic patents for the system. He invented the ac generator, the ac motor, the transformer, the transmission line, the tuned circuit, the loudspeaker, the electric clock, and a raft of other devices. Unfortunately, he was not a businessman and was screwed out of millions of dollars; eventually, he went into bankruptcy when he had the audacity to start building a world power transmitting station on Long Island. His station was also going to transmit radio . . . news and music. This is strange only when you realize that at this time most radio experts were convinced that it would never be possible to send the human voice over the radio. I have several old books which are quite positive about this. Tesla was years ahead of everyone in both power and radio.

Well, the *Spotlight* story was that the woodpecker signals we've been hearing are a Russian effort to change the weather patterns, an effort which screwed up this winter, and that the Russians have been getting the bum weather instead of us. Baloney.

Those powerful radio transmissions from Russia are thought to be over-the-horizon radar and this seems most likely. The ability of amateurs to force the woodpecker to move frequency indicates that the Russians are listening to signals bouncing back. All we have to do is get on a channel where the woodpecker is very strong and match the pulses with dits from our rigs and they soon change frequency. We can move up or down with them and keep them moving in this way. If they were trying to zap us with strong radio signals to drive us nuts or to push around the jet stream, there is no good reason for them to be listening to the return echoes. My bid is for long-range radar and *The Spotlight* can look for some other fishing expedition.

FED UP YET?

Say, when are we Americans going to get fed up with the inroads Russia is making all over the world? They announced years ago that they intended to take over the world and they have been hard at it ever since. We blind ourselves with wishful thinking . . . getting suckered into SALT agreements which hold us back and appear to be ignored by Russia.

The sooner we start making a fuss about this with Congress and get them to do something to counter this steady pressure, which has been working wonderfully, the sooner we will see things start to turn around.

What good does it do us to abhor our CIA people doing sneaky things when we are doing nothing to stop or counter the same or worse type of things being done by Russia? It is al-

most time to stop being silly about this and recognize that Russia means exactly what it has been saying all these years.

In the meanwhile, we have lost our clout just about everywhere in the world. It was just a few years ago that we spent several billion dollars and a good bunch of our men conquering all of the countries of North Africa and most of Europe. Then, instead of setting up some means of long-range control, we quickly got out and left vacuums which have been filled by some pretty rotten people. And we further pressured the European countries to get out of their colonies, with disastrous results all over Africa. We have little to be proud of in the countries I've visited there: Uganda, Tanzania, Ethiopia, Sudan. All of them are in terrible shape.

The stupid action in Viet Nam might have been avoided if we had some brains behind our foreign policies. We turned that situation over to the military and they did the only thing in their book—fight. There was no attempt at any time to try to outsmart the enemy. I visited the area in 1966 and talked with people in the neighboring countries and came up with an alternate to the fighting which I still think would have worked. I couldn't get anyone to pay any attention to it.

Russia is pouring fuel on the Iranian situation with emotional broadcasts. They are supplying arms and technical help in every known trouble spot, trying to undermine the governments so Russian agents can take over. They have an impressive record of winning at this, and we have an incredible record of screwing up and losing.

So what do I suggest? Call me reactionary, if you will, but isn't it time to beef up the CIA and get them back into their old business? We need to know what the hell is going on in all of the countries of the world. Call it spying, if you want . . . though I tend to think in terms of spy stories and secret plans, new weapons, etc., as being the main purpose of spying, not the keeping track of the political and economic progress of a country.

We would do well to know where Russia is setting up shop to upset things. We want to know where they are supporting insurgents and coups. We also want to know ahead of time of popular resistances to governments such as those recent ones in Central America and Iran. With better intelligence, we might not continually find our country backing bad dictators; we might find ourselves on the side of the people of these countries. I'm not sure how I feel about getting in there and helping overthrow bum governments, but I'm thinking about it.

Other than Central America, South America, Africa, and Asia, we are in pretty good shape. Or are we that sure of Mexico and Canada? I think Germany is on our side, but I'm not at all sure about France. It's getting lonely.

DRATTED DRAFT

Carter got all involved with the brouhaha over the draft, when all he apparently had in mind was trying to send a message to the Russians that he was serious about being irritated over the invasion of Afghanistan. All this ado got me to thinking about the whole matter of recruiting military people via the draft system.

A few hundred years ago, when kings needed to get an army together to either take over some other country or protect their own, they sent out a bunch of recruiters who grabbed every young man in sight and put them into uniform. They used a similar system to get navy personnel, and this caused some irritation when Britain began "impressing" American sailors. Whatever name you put on it, it comes down to slavery as a way to keep costs down.

The slavery concept is still popular for filling the ranks of the armed forces, where the pay is low and personal freedom quite restricted. Other than trying to pay less than the going price for help, what justification is there for the draft?

Some parallels are drawn with Sweden and Switzerland, where all men are required to put in some time for their country. Those are small countries and they have to have every man trained and ready to protect their country from invasion. We don't. What we need are a few people to fight in the limited wars which spring up around the world (since the drastic use of nuclear weapons is unlikely) and the technicians and office personnel to back them up. We do have to continue to have the nuclear backup, but that will take mostly technicians.

The technicians and office personnel don't have to be trained for field combat, and their pay should be on a par with industry so they will stay at their jobs for twenty to forty years as they would in private industry. When you consider the cost of training and retraining, higher salaries are not that much more costly.

We do need a continuing source of youngsters to be ready for combat, and here again, if we provide incentive, I think we can get good ones. In return for their work, we might provide them with extensive vocational training which would fit them for the job market. This might be a good way to provide help for the underschooled and underprivileged. If the benefits are right, we'll see people going for it . . . men, women, black, and white.

Of course, I have perhaps an unusual viewpoint when it comes to fighting. I figure that using force indicates that you have been outsmarted. I much prefer to try to set things up so we are continually outsmarting the other side. Notice that I did not refer to them as the "enemy." They are people, too, though we may be at odds due to some psychological difference in programming since birth. I don't think that hate is going to solve much; I think that we would get a more amicable solution to problems if we would try hard to understand those with whom we disagree and try to bring them around.

Just as an example . . . what would happen in a war where prisoners were treated well instead of being made miserable? Suppose we fed them well, entertained them, gave them interesting work to do, educated them, provided them with companionship, and, in general, made it far better than they had it at home? Sure, it would be expensive, but far less costly than a long war. We were spending over $500,000 each to kill off the North Vietnamese and that was no bargain.

Before you start arguing with me over my example, see if you can get hold of the concept behind it first. Otherwise we'll be going through the same silly routine Carter got started with his draft bunk.

There is a basic problem with politicians . . . they try hard to to tell us what they think we want to hear. Where Churchill waved the symbol of victory at us with two fingers, our politicians are waving one finger at us, wet, trying to see which way the wind is blowing. We need a leader, not someone standing there asking us which way we want to go.

Most Americans don't want to have to worry continuously about Russia aiming at taking over the world, so we don't think about it and our politicians pretend it isn't happening. We go through brief times of anxiety when they march into a country such as Hungary, Czechoslovakia, or Afghanistan, but we soon listen to politicians who tell us not to worry and we stop worrying.

A visit to any store will tell you that the world is a global community. Much of our food comes from abroad, as do our cars, our electronic equipment, our clothes, our furniture, etc. We can't fool ourselves that we can let up the pressure to make the world the way we think best, because if we do, we will find the Russians have not let up their pressure for a minute. They are supplying arms for fighting in several parts of Africa. They are supplying arms for the Middle East combatants, for Asia fighting, and for any other group which might upset a country enough for communism to take over. It's hard on the world, but can we do any less than our best to oppose this relentless force in every part of the world?

We got outsmarted in Viet Nam and we lost that battle. This was so traumatic that we curled up and tried to avoid confrontation from then on . . . and we see what that has done. The mess is not improving because we try to hide from it . . . it's getting much worse.

On the one hand, we gripe about the cost of gas, yet we seem to be taking no long-range measures to improve that situation. We have countries who would be our friends if we supported them as well as Russia supports their surrogates. The world leaders know the difference between the U.S. and the USSR. Perhaps we need some sort of marketing organization for America . . . something a bit more up front than the CIA spooks and far less inhibited than our State Department, known in Washington as Foggy Bottom.

When you get into a war, you

are trying to push directly against your adversary. Perhaps we can do better if we use the techniques of judo and go along with those we want to change, applying a steady pressure to gradually change their direction in the way we want them to go. This is what Russia has been doing, with great success. It gets them into no wars directly and lets others do the fighting.

Sure, world hunger is a big problem and it is forcing most of the small countries into changes. I hope there is no disagreement that the direction to take to work out of this bind is toward education and civilization. I think that microcomputers will be having a profound effect on world education by the end of this century by substantially reducing the cost of education. I think that amateur radio can have a tremendous effect, too, by helping to bring technical education to emerging nations and thus speeding their paths toward civilization via less expensive education and the supply of technicians and engineers needed for telephone, radio, television, and computerized communications.

In this spirit, I have established a fee arrangement for my talks to hamfests and conventions which includes $1,000 to be put into an account for use in developing amateur radio in Third World countries. There is no advantage to this being a one-man drive, so I call on all ARRL members to get their directors to have the League set up a system for sending top hams to visit the heads of Third World nations and get them interested in setting up a network of amateur radio clubs throughout their countries as a way to speed progress. If League officials also asked for $1,000 for such a fund for speaking at hamfests, this movement would be funded in essence by every amateur attending a hamfest or convention.

Without inexpensive and effective communications, both government and business are hobbled . . . and there would be no good way to take the next step of providing inexpensive education via this communications network. Hamming has to come first before anything else will be economically feasible. Yes, I've only helped open amateur radio in one country . . . but that is one more than anyone else has so far. There is much to be done.

GETTING MOVING AGAIN

The drop in new licensees has resulted in some serious chain reactions, such as a loss of prestige with the FCC, loss in sales of ham gear by dealers (which makes ham gear cost more), increasing failures of small ham manufacturing firms and the possible loss of at least one of the ham magazines . . . and maybe even two or three.

Most of the two-hundred-plus small firms making ham gear are made up of one or two avid hams who got started on the kitchen table with some unit or service they thought might be of interest to fellow hams. These entrepreneurs were, almost without exception, underfinanced and with little commercial experience before they went into the ham business. They are in it as much for the fun of it as making a living. I really hate to see the downturns in ham buying come along and sink these small firms by the dozens, dashing hopes of enthusiastic hams who hope to make it big one of these days.

Many of the large firms got started in just this way . . . in fact, most of them did. Now they are making a living for hundreds of employees and dealers, furnishing us with the latest in state-of-the-art ham gear at prices that astound commercial communications people.

So what can be done to get amateur radio back into a growth mode? While part of the responsibility for this lies with every amateur, I think that our best way to tackle the situation is via our ham clubs. I've written before that studies of new hams in the past have indicated that half of the newcomers are either 14 or 15 years old. So why go hunting for new blood where the results are going to be more difficult to achieve? The obvious place to go is to the high schools, where the 14/15-year-olds are in quantity, all separated for you.

If your club starts contacting high schools in your area, I think you will find them quite cooperative in putting you in touch with the students. This can be done via posters announcing a special talk by someone from your club on the prospects for jobs in the electronics and communications industry during the next twenty years . . . pointing out that the best way to really get into this is via amateur radio . . . and that your club, oddly enough, has some low-cost classes to get them started with their Novice tickets.

You might also have some of your teenage club members set up a special events station at the school for a few days so the students can get an idea of what ham contacts are like, see that their classmates are involved, and see that it is not all that difficult to get into.

Your club classes can be a success if you get good teachers and remember that one of the basic secrets is to keep it fun. You don't get any cooperation by using shame to force people to attend classes or to teach them. You get students to sign up by emphasizing the benefits to them . . . the fun, the peer prestige of understanding radio and electronics, the fun of being able to carry around an HT, etc. It seems best to charge for the classes as this tends to keep students coming in spite of other interests. It doesn't hurt to set up a certificate for completion of the class and passing of the Novice test.

Beyond that, as I've said before, if your club has worked out any stratagems which help attract people to classes or help them to graduate, please write them up and send them in so we can pass the word.

PICTURES WANTED

Further, to encourage clubs and classes, please make sure that someone in your club snaps a good picture of the club with the class and gets it to *73* for possible publication. The more of these I can publish, the more clubs may be encouraged to get into action.

If we can get just 2,000 ham clubs to get ham classes going, we will be able to get back into a growth situation with our hobby. We need about 5,000 new licensees per month if we are going to grow, so this averages out to just 2½ per club per month. There are 3,855 clubs listed in the *Callbook*, so 5,000 new hams per month should not be all that difficult to accomplish. But it's entirely up to *you*.

I'd like to see an honor roll of ham clubs which promise to meet that minimum of 2½ new licensees per month. If your club will send a statement making such a promise to me, I'll start such an honor roll in *73*.

THAT CODE

Rather than spending a lot of time in class teaching the code, you'll get it done easier and faster if you encourage the students to get a good set of code tapes. I happen to think that the *73 Magazine* tapes are by far the best and I don't know of a single scientific study which has shown otherwise. Some of the other code tapes are so bad that it is a disgrace. I don't see how anyone can honestly sell a tape with variable speed code on it. We have lost more ham prospects due to this than any other single factor . . . hundreds of thousands of good ham prospects have been frustrated by the code . . . needlessly.

Clubs would do well to contact *73* and buy code cassettes wholesale, passing along the savings to the students or to the club. If each student had a cassette and spent a half hour a day with it, your code problems would be over. *Never* give code speed tests. Students should copy code at the FCC test speed until they are able to copy easily and know that they are 100% in their copy. Anything less may cause panic under test conditions.

With my code system, there is no plateau. You learn each character at 13 wpm and you know it from then on, reading it on a subconscious basis. It is fast and easy.

The *73* code tapes start with an introductory cassette which teaches the sound patterns of all of the letters, numbers, and punctuation you will need. It starts right out with complete words in the first few minutes, giving the first-time student confidence that the code is not really difficult to master. Clubs should use this tape for the first session with Morse code, and there is no reason a student should ever have to use it a second time.

The next step is a 6-wpm tape. This is aimed at students who are going to try for the Novice or Technician test. Each character is sent at 13 wpm, just as on the official FCC tests, but the spacing is at the six-wpm rate. This is not only preparing the student for the Novice test, but also enforcing the code sound patterns subconsciously for the 13-wpm test later on. Oddly enough, it does not take much more time to get proficient at copying code at 13 wpm than it does at 5 wpm. Some students get started right off at 20 wpm and find that within a few days, they have that mastered.

The code groups on my 6-wpm tape are designed to be as difficult as possible, making it duck soup when you come to the FCC tests which are in plain language. It is far better to be overtrained than under. The tenseness during a test is far less when you hear the code coming at you at well below your ability to copy. You immediately relax and copy to perfection, rather than working up a sweat and struggling. It makes a world of difference.

Next, I have a 13-wpm tape . . . which is really at 14-wpm, even if it sounds like 20 wpm when you first start trying to copy. Again, I send the most difficult patterns of characters, purposely trying to make life difficult for you. And, again, you'll almost fall asleep when you sit down to the FCC plain-text exam.

My 20-wpm tape is at 21 wpm, of course, and when you can copy it with comfort, you will also be able to hack plain text at 25 wpm or even 30. Some users of these tapes accuse me of being positively vicious in my character groups. I do admit to a fiendish delight and I love to see eyes pop open with disbelief when students first try to copy this. Heh, heh!

The *73* tapes sell through most ham stores for $4.95 each. Clubs may buy them in bulk (ten or more per order) for a 25% discount: $37 for ten tapes or $73 for twenty tapes.

Looking *West*

from page 10

they are on two. Jamming of any sort is a rare occurrence and, by and large, 220 MHz is a happy family of currently about 5,000.

You need not take my word for this. Next time you venture west, bring along your 220 radio. There are plenty of wide-coverage open systems on many mountaintops, like WA6VNV/RPT and WA6LHK/RPT on Oat Mountain, W6NUI/RPT in Palos Verdes, and many, many more. If you need an up-to-date list of repeaters in this area, an SASE sent to the 220-SMA of Southern California, PO Box 8306, Van Nuys CA 91409, will bring one. If you have any questions about repeater operation, coordination, or anything else, write them and they will respond. By and large, the southern California 220-MHz sub-community is an excellent example of how good a band can be.

THAT GENIUS IN MARISSA DEPARTMENT

I want to relate a story to you that happened recently. In January, when Bill Orenstein and I took off to cover the Consumer Electronics Show in Las Vegas, we were unaware that about 24 hours after our departure the Collins RP-150 cartridge tape player that feeds the weekly Westlink News took an unexpected nose dive. Needless to say, Murphy's Law had taken its course in our absence, and we returned to find a blown fuse and burned-out motor. Also, the phone was ringing off the hook. Bill spent the next few days "hand feeding" callers from the master tape on the Teac, while I did what I could for the RP-150. I needed a new motor and such was not available at a moment's notice. This is not your standard home-entertainment recorder. It uses special continuous-loop broadcast tape cartridges and cues off on an audio pulse. In general, such machines are very reliable, but when you realize that this one was dated 1960, it's obvious to see how a failure such as this can occur. We had another P-130 play-only unit, but that, too, had some problems. We needed a replacement fast, something to hold us for a few weeks until we could get the Collins repaired.

The answer did not come in a blinding flash; rather, it came subtly, when my copy of *73* arrived. I was sitting in the shack, listening to a Neil Diamond tape, when I happened across an article by Bob Heil K9EID (January, 1980, page 92) on the voice ID system used on the M.A.R.C. repeater. It used an 8-track-type tape deck and some very simple circuitry. Hmmm . . . could it be adapted to get Westlink back in operation? I had a drawerful of 7402 integrated circuits, quite a few NPN transistors, and even though it was Sunday, the local Radio Shack could provide the rest of the needed parts. It took about 2 hours, including a trip to RS to finish the controller and another half hour to interface it to the Juliette 8-track player that I had been listening to earlier in the day. I won't go into all the technical details here. If enough of you are interested, I will write a technical article on how to convert an 8-track player to an automatic telephone tape feed unit which responds to an unattended ringing telephone and has yet to fail. The main thing is that it worked, and, while for our purposes the overall quality of audio was not equal to the Collins machine, it kept Westlink in operation for the necessary time period so that repairs could be made to the normal news-feed equipment.

Bob and I have never met, though we have spoken on the phone and exchanged many letters. In fact, for those of you who are unaware, Bob is the guy spearheading the A.R.C.H. Convention in St. Louis the 24th and 25th of this month. Even though air travel has become very expensive of late, after the reports I heard about last year's outing, this is one I don't intend to miss. For example, the banquet will be held aboard the riverboat *Admiral*, while cruising the Mississippi river. There will be dining and dancing, and the guest speaker will be a friend of mine named Roy Neal K6DUE. Bob and his group have gone all out to make this the best convention of 1980, and knowing the drive of Bob Heil, I suspect it's going to exceed even his expectations. Oh . . . I hear rumors that a certain Wayne Green W2NSD/1 will also be speaking. As a newsman, that alone is worth the trip. So, if you see a guy toting a JVC video camera and Sony field recorder, looking as if he is about to keel over from the weight at any moment, stop and say hello. It might just be yours truly putting together yet another video production of the Westlink video lending library.

Meanwhile, to those who say experimentation is a thing of the past, phooey. As long as there are hams around like Bob Heil K9EID, this hobby service will never be lacking in new ideas. Bob is one of those "one in a million" people whom this hobby is blessed with, and I can't wait to meet him and thank him personally for bailing us out of a tough position. To the genius of Marissa, Illinois, I say thanks.

SPEAKING ABOUT WESTLINK DEPARTMENT

When I took over this shoestring operation last summer, I never envisioned that it would grow as big as it has. They say that every ham finds a particular niche in amateur radio. If this is true, then I guess I have finally found mine. Producing a weekly 10-minute QST takes about 10 hours of time each week and I love every minute. What makes it all the better are the people who work with me. I have mentioned Bill Orenstein KH6IAF many times in this column. Bill is a radio engineer with NBC network news out of Burbank's famed "peacock factory." It was Bill who donated office and studio space in Hollywood and it's Bill who spends many hours hand-cutting each newscast, doing the same thing as a hobby as he does for a living. That's dedication.

We are also very lucky to have four regular announcers who do a great job. Burt Hicks WB6MQV is broadcast engineer as well, with on-the-air experience in Armed Forces radio and television. Alan Kaul W6RCL, who also produces some of our newscasts, is a network television field producer for NBC News. Jim Davis KA6IUH (ex-KA8BWZ) is currently Program Director for radio station KMPC and has many, many years of on-the-air experience in radio. Our last "regular" needs no introduction other than to say the magic words, "Lenore Jensen W6NAZ." In my 38 years, I have not met a more devoted and lovely person than Lenore. She is the epitome of what this service is all about and deserves all the kudos that the amateur community can give her. She is a true professional in every sense of the word.

As time has passed, others have become members of the Westlink News Team. Legal items are covered by Joe Merdler N6AHU, President of the Personal Communications Foundation, professor Norman Chalfin K6PGX of JPL is our AMSAT/OSCAR correspondent, and Mike Michaels WA8ARZ/

KH6 and Pat Corrigan KH6DD cover the Pacific islands for us. Pat is a well-known DXer and Mike is a radio personality on KIOE in Honolulu. Finally, there is Mitch Wolfson DJ0QN in Munich, who files his reports from the Continent. An "unofficial" but very important part of the operation is Joe Schroeder W9JUV in Chicago. Joe singlehandedly produces *HR Report*. We have been very lucky to be able to develop a good dialogue with Joe and all of the amateur publications, and, frankly, I feel that this has been of benefit to everyone.

There are many other people who volunteer their time and talent to make the weekly QST come about. None of us is paid. In fact, Westlink has no paid employees whatsoever. From time to time, people ask us why we do it, why we devote that much time each week to the project. I cannot speak for the others, but I love it. So we continue, and will keep going till the time comes when someone comes along who can do it better. Maybe some day someone will, but for the moment, we are doing the best we can with the limited resources at our disposal. We hope you like what we do. Those of you who might like more information about the weekly news service, which in this over-inflated world is still free, can drop us a note at the Westlink Radio Network, 7046 Hollywood Boulevard, Suite 718, Hollywood CA 90028. Please include an SASE.

By the way, if you need a program for your next radio club meeting, we have several videotaped presentations available on a free-loan basis. Included are several talks by Wayne Green, several technical films, and a spectacular talk by Alan Kaul W6RCL on producing news in foreign (and often hostile) places like Iran and Thailand. A request sent to the same address, with an SASE, will bring you a complete list and, like the newscasts, loan of the tapes is free except for postage. Wayne's presentation on microwave communications is a dandy. Oh, yes, these tapes are available on VHS, SP speed only.

FAREWELL WA6TDD, ET AL

I should have written about this some time ago, but the demise of the WA6TDD repeater was something very personal to me, and it took a while to get my perspective back on the matter. Over the years, WA6TDD had several callsigns, including WR6ABE and WR6AMD. When the Mt. Wilson-based system went to its final reward, it bore the callsign WA6KOS/RPT, a callsign that is still with us from a new location. More about this later on.

WA6TDD was born of a childhood dream of Burt Weiner K6OQK. In the 16 or so years of its existence, WA6TDD showed the "others" how to do it. Innovations such as the reset beep tone, microwave control, and state-of-the-art audio processing all came to the world of amateur FM repeater communication because of Burt and WA6TDD. Sitting atop Mt. Wilson, the system could be heard for over 175 miles in most directions and, to my knowledge, it was one of the first systems to pioneer the use of circular polarization for FM communications. WA6TDD was truly a repeater ahead of its time.

Its demise cannot be blamed on the aloof repeater owner syndrome. Unlike most two-meter system licensees, Burt and those who took over the license of the system after his decision to only involve himself in the technical aspects of its operation were always on the air. Maybe it's that they cared too much. I don't really know. I do know that for all its technical achievements over the years, the user problems it incurred the last few years of its life were the reason for its being taken out of service. In my opinion, Burt did the only thing he could. How would you feel if you saw the utilization of something you had nurtured for years being destroyed by a small but arrogant group of people who returned your kindness with hate and ridicule? In the end, virtually all of the regular users had gone elsewhere and, where there had once been joy and sunlight, there was only ongoing bickering and character assassination. Much of the latter was directed toward the person providing the service. This group claimed to be "liberating" the channel from its tyranny, but there had been no "tyranny" until they showed up and made the claim. Why? I cannot read the minds of others. What's really ironic is that in "killing" WA6TDD, they only proved to other system owners that the concept of aloofness was the only way to go.

PICKING UP THE PIECES DEPARTMENT

Though WA6TDD is now only a memory, the channel pair is still quite active. Dave Faraone WA6KOS, who was the last licensee of the Mt. Wilson operation, had made a promise that another repeater would come into being to replace Wilson. Dave has kept that promise. Currently operating from atop Santiago Peak in Orange County is the new WA6KOS/RPT. There are a few differences, but not many. In order to appease the many remote-base owners using the same mountaintop, Dave was forced to invert the channel pair. Currently, the system operates 146.40 MHz in, 147.435 MHz out. In getting an open repeater on that mountaintop on that channel pair, Dave performed a minor miracle. For years, Santiago had been strictly the domain of the remote owner. An open two-meter box, especially one that operated anywhere near the 146.46 remote-base intercom channel, had been taboo. But Dave didn't just plunk down a repeater and say, "Here I am." He spent many months laying the groundwork. He met many times with the remote owners and enlisted their aid in the project. He took a positive cooperative attitude, and by doing so, he was well received on the hill when it came time to fire up the box. He has since worked hand in hand with the remote owners to clean up any small amount of interference the new repeater might have been giving the remotes, and has never once complained about interference his system has suffered due to the others. This statesman-like approach has made his system a welcome addition to Santiago, rather than a liability.

Dave has been very successful on Santiago, although he was not when he was on Wilson. Remember, he was the licensee of Wilson at the time of its demise. The people who hounded TDD off the air rarely show up there any more, and when they do, it's the same old rhetoric, but nobody seems to pay attention. The word is that they're out "liberating" other repeaters, but are having a bit of trouble, in that repeaters keep getting shut down on them abruptly. It's kind of hard to hassle a licensee you cannot reach either on the phone, on the air, or via the mail. Moreover, there are rumblings that many of the repeater owners who abandoned SCRA/TASMA when it restructured along the lines of permitting voting membership to non-system owners have now formed a new "repeater-owners-only organization" along the lines of the old SCRA. I have heard this story from far too many sources to discount it, but at press time, the details, even the organization's name (if it has one), are unknown. I can tell you that it's almost impossible to find a two-meter open repeater owner on his system these days anywhere in the Los Angeles-San Diego rf corridor, and the same seems to hold true for control operators. Oh, they're definitely listening. Obviously, someone is turning the machines off on the problems, but there is never a comment or a voice of ridicule. Just someone inconspicuously pulling the big switch.

There is one exception to this rule. His name is Dave Faraone and, somehow, for some unexplainable reason, he seems to be succeeding while remaining totally visible and accessible to the system's usership. From the new location, he has picked up a crop of new users who could not access the system when it was on Wilson. Additionally, some of those who had abandoned TDD during its "dark days" drift by now and again to say hello. Why Dave is succeeding from this location when he could not from the Wilson site, I cannot say. I never saw the claimed tyranny, so I see no difference between Wilson and Santiago, other than the lack of certain technical details like the amazing audio processing and the little reset beep that was company to me on many nights.

ANOTHER OWNER FIGHTS BACK DEPARTMENT

Our final item this month concerns the WR6ABN/K6MYK/W6MEP/RPT 147.84/.24 repeater. The story goes something like this. After liberating the TDD system, the next system to fall prey to problems was the old K6MYK/WR6ABN repeater. Though not the nation's first repeater, it is the longest continually operating system, dating back to an era when most repeaters were AM rather than FM. In November of '79, Art Gentry, its owner, announced that as of the expiration of the WR6ABN license, the system would cease open operation. Everyone, including me, thought that this meant that under the W6MEP/RPT callsign, the system would become a closed- or private-category repeater with select usership. Only one small detail—Art never elaborated on the details of the change and just about everyone was caught off guard when the system reappeared under its new format. You see, it really remained an open repeater technically, but for the past three months, W6MEP/RPT has spent 24 hours a day, 7 days a week, in what might best be termed a random code practice mode. It still repeats from its input channel, but the single signal it's repeating is the practice CW.

Is it legal? According to FCC sources, it's very legal. In fact, since the CW is the primary signal, anyone talking over it might be held in violation of the rules! How about being fair to the users?

By the time the repeater reverted to this operation, the system provided little in the way of utility. It was jammed constantly and might well be serving a far better purpose operating the way it is now. With well over 300 repeaters in southern California on 2 meters, 90% of which are open, it's really hard to say that there is no other repeater to operate on, though that's the claim many have already made. There's only one question yet unanswered and that's how long this status quo will remain—how long W6MEP/RPT will remain a "CW practice" channel. Like other things, this is one that cannot easily be answered, since the system owner is unavailable for comment. Meanwhile, at least in this case, our phony liberationists have failed, and, boy, do they have egg on their faces this time. They need an enemy to fight, and the so-called "enemy" just isn't around any more.

LETTERS

from page 21

the world. Or, perhaps, a ten-cent stamp to be used on QSL cards mailed in the U.S., Canada, and our territories.

Placing the American flag into homes all over the world would do much to impress the world with the importance of international peace through free and unrestricted communications by amateur radio operators. We are hoping you all will flood Congress with your letters.

Loren Carlberg WB5WDG
Muskogee OK

TECH VS. CRAFT

After reading your editorial in the January issue of *73*, I felt compelled to make a few comments!

First of all, I would *never* recommend the occupation of electronics tech to anyone. It is the most underpaid occupation that I can think of. Suggest to young hams that, if they cannot get a degree, train to be an electrician—it pays *much* more!

In 19 years of experience as a tech, fairly well qualified in most disciplines, very well in several, and with employment in large companies (Texas Instruments), many small companies, ham radio companies, state agencies, city agencies, and field-service organizations (IBM and Industrial Nucleonics), plus a federal job or two, I have come to these conclusions: not only is the pay scale consistently lower than that of "craft skills" (electrician, plumber, carpenter, etc.), but the "bennies" are usually inferior and the advancement chances are *usually* limited by the custom of considering a technician as a "junior engineer," rather than as being in a totally separate profession.

Adding this to your argument as to the reason for the defection of the majority of the electronics industry to the far east, I think, perhaps, the conclusions may be somewhat different. I personally believe the fault lies with the greed of many companies, going around possible labor problems to have their products produced elsewhere for a larger profit. I find no fault with a profit motive, but I think that there are several kinds of profit, and that the quickest is not necessarily the best.

These companies which go bankrupt generally have themselves and their own attitude to blame; we are well rid of them.

R. R. De Jongh WB7CPT
Bellevue WA

SCHOLARSHIPS

The Foundation for Amateur Radio, Inc., a nonprofit organization with its headquarters in Washington DC, plans to award seven scholarships for the academic year 1980-81.

All amateurs holding a license of at least the FCC General class or equivalent can compete for one or more of the awards if they plan to pursue a full-time course of study beyond high school and are enrolled or have been accepted for enrollment in an accredited university, college, or technical school. The scholarship awards range from $300 to $900, with preference given in some of them to residents of various areas.

Additional information and an application form can be requested by a letter or postcard, postmarked prior to May 31, 1980.

The Foundation is devoted exclusively to promoting the interests of amateur radio and to scientific, literary, and educational pursuits which advance the purpose of amateur radio.

FAR Scholarships
8101 Hampden Lane
Bethesda MD 20014

MORE RFI DOPE

Thank you for the informative articles in the February, 1980, issue. I especially enjoy your editorials and letters and also enjoy the historical articles.

In regard to the WARC conference, I see no reason why the USA doesn't have 50 votes. The USSR counts all their satellites and republics within their borders.

Also, in regard to W4PZV's excellent article, "In Search of Power Line Interference," I was quite surprised that some power companies take such a dim view of TVI and RI complaints. In this area, just a phone call to the local office will suffice and they will send a technician to investigate.

Prior to retirement, I did considerable TVI and RI for the local power company and can attest to the use of a Sprague 610 Locater, tunable from 550 kHz to 220 MHz, and the sledge (hi!). In fact, some customers have called the office to report that an employee was knocking down poles!

Wet weather clears up noise because it not only shorts out gaps but swells the poles and cross-arms and tightens the hardware.

In regard to noisy transformers, this noise will never stop until the culprit is replaced. The noise will usually peak at about 2.5 to 3.5 MHz, depending on the kW capacity of the transformer, to 50 MHz on extremely noisy ones.

The worst case, a radiated carrier traveling thirty miles and varying in frequency up to 160 MHz, was traced by directional bearings to a solid-state intercom using building wiring as an intercom path *and* as a high-quality antenna! This carrier varied with signal strength and frequency and had 60-Hz modulation. It took two weeks to locate.

Other items to check out are photoelectric cells on street lights, heating pads, water beds, fluorescent lamps, TV sets, electric blankets, etc.

Robert K. Brenstein KA6EUP
Santa Rosa CA

THANKS TO ALL

Letters of praise are always fun to write, but I'll add one more.

I have read your magazine's regular articles on CB-to-10 conversions, and the itch finally had to be scratched. First, I laid my hands on a 23-channel CB. When I popped the top off, all the things I memorized for the various exams that regularly confront us disappeared from my gray matter. Not being the shy type, I called your editorial staff and pleaded for some direction on finding a conversion scheme. The understanding given the caller was both appreciated and friendly. Being in the hotel business, I am sensitive to attitudes and genuine concern. Both these qualities were apparent.

My particular rig had not been covered by your articles, but I was directed to one of your advertisers—American Crystal Supply Co. Well, I called up to West Yarmouth and hooked up with Arthur Mott at ACS. Being totally inexperienced, I was looking for guidance. What I received was overwhelming support and technical advice. I ordered the crystal kit from Arthur and received it via parcel post in two days. So far, so good.

Then I tried to read the instructions—nothing! I couldn't get past step one, so I called Arthur again. He lent a sympathetic ear to me and had saintly patience. On this advice, I armed myself with a Sams Photofact® and set to work.

After several conversations with Arthur, covering everything from weather to schematics and varactors, I fired up the flame thrower I use as a soldering gun (is 75 Watts too much heat?) and in 90 minutes I was on the air . . . Swan Island QRP!

Wayne, Arthur Mott, American Crystal Supply, and your staff deserve high praise. We always claim to be a fraternity, but often it's a quick hello and a kiss good-by . . . you're on your own, chum. However, this wasn't the case with the fine people above, and I hope to someday meet them and treat them to some adult beverages. They are what hamming is all about.

Greg Smith KB5PE
Cypress TX

Awards

from page 23

ed for the 200, 300, and 400 bar awards. Where it will end, nobody knows, for the most numbers collected to date is by Grace K5MRU, who now has 8200 confirmed.

When you reach the 500 bar, serial numbers are then assigned to each bar issued thereafter. Once the applicant reaches 1000, he or she reaches the first step in which award plaques are issued. Plaques are issued also for 2500, 5000, and 7500 contacts.

Of course, the awards program does not stop here. Following are some others.

10-10 WAS AWARD

This award requires an applicant to make at least one contact in each state with another member of Ten-Ten International. QSL cards and sufficient postage for their safe return are to be sent with your application to WB6OMH. This award is issued for contacts made only after January 1, 1973, on any authorized mode on the ten-meter band.

THE VP CERTIFICATE

To qualify for this award, a Net member must have earned his or her "500 bar," at which time a VP Number and certificate were assigned. The idea for the VP Certificate issued here is to work at least 100 other Net members who have achieved their 500 bar and who have been issued a VP serial number. To be valid, all contacts must be made between 28.500 and 28.550 MHz or above 29 MHz, with the contact lasting at least 5 minutes. As with all 10-10 awards, application must indicate the 10-10 number, callsign, name, frequency, and exact QTH. Also, a definite requirement is to list the station's VP serial number.

All contacts must be made on or after October 15, 1979, to qualify. Send your application to: Grace Dunlap K5MRU, Box 445, La Feria TX 78559.

To the best of our knowledge, there is no award fee.

LUCKY 13 AWARD

The Lucky 13 Award is to prove that your station is capable of working the entire 10-meter band. This is not a frequency-measuring test and it is not necessary to stay exactly on the prescribed frequencies. The idea here is to make contact with 13 different VP members on each 100-kHz segment of the band: 28.500, 28.600, 28.700, 28.800, 28.900, 29.000, 29.100, 29.200, 29.300, 29.400, 29.500, 29.600, and 29.690 (29.700 is the band edge, so be careful). Any mode or mixed mode is permissible. As with all awards, you must log the callsign, the VP number, the first name, the QTH, and, in this case, the date and time of each contact claimed. It is not necessary to send QSLs, but you should have your list verified and mailed to: Rich Richardson WBØFQD, 960 E. Cottonwood Avenue, Littleton CO 80121.

FEARL AWARDS

I just received award information from a personal friend of mine who used to reside here on Whidbey Island, Glenn KA8GW (WB7SPD), who is stationed with the US Navy in Masawa, Japan. Glenn urges those seeking the awards being offered by the Far East Auxiliary Radio League (FEARL) to be careful to only count those contacts with KA stations in Japan and not to include those in the continental United States.

Glenn mentioned a couple of nets which may assist those wishing to meet the award requirements in a minimum of time. 14.285 MHz is the golden frequency on Sundays at 0200Z and Wednesdays at 1200Z.

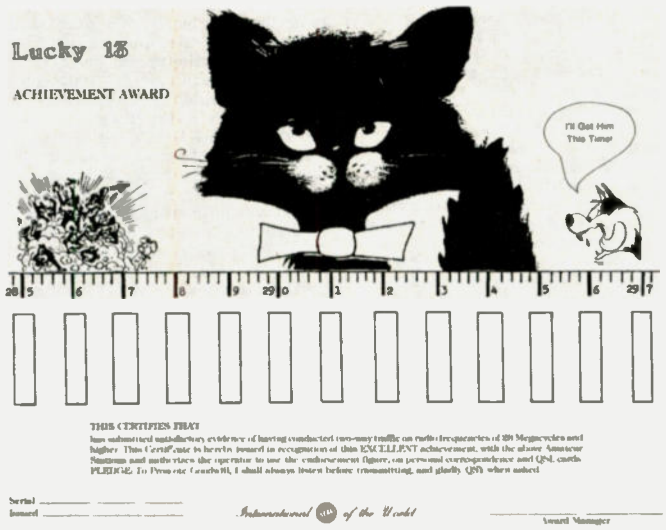
All FEARL awards are available for $1.00 or 7 IRCs, which must be sent with your application to: Far East Auxiliary Radio League, Attention: Awards Manager, c/o Sam Fleming KA2SF, GARH-ID-GS-M NCS Japan, APO San Francisco CA 96343.

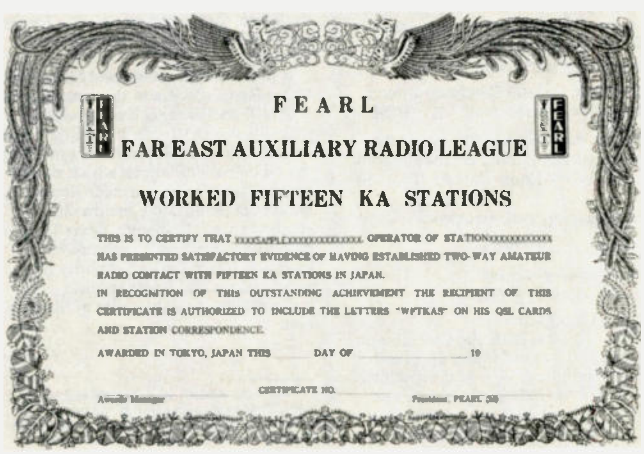
WORKED FIFTEEN KA STATIONS

To qualify for the WFTKAS Award, applicants must work a minimum of at least 15 KA stations located in Japan or Okinawa. Stateside KA stations do not count. There are no mode or band restrictions nor are there any date limitations. General certification rules apply, with proper logbook data.

KA RAG CHEWERS CLUB

This award certifies the applicant has presented evidence of having had a rag chew with a KA station in the Orient for a period




FEARL

FAR EAST AUXILIARY RADIO LEAGUE

WORKED FIFTEEN KA STATIONS

THIS IS TO CERTIFY THAT xxxSAMPLExxxxxxxxxxxx OPERATOR OF STATIONxxxxxxxxxx HAS PRESENTED SATISFACTORY EVIDENCE OF HAVING ESTABLISHED TWO-WAY AMATEUR RADIO CONTACT WITH FIFTEEN KA STATIONS IN JAPAN.

IN RECOGNITION OF THIS OUTSTANDING ACHIEVEMENT THE RECIPIENT OF THIS CERTIFICATE IS AUTHORIZED TO INCLUDE THE LETTERS "WFTKAS" ON HIS QSL CARDS AND STATION CORRESPONDENCE.

AWARDED IN TOKYO, JAPAN THIS ______ DAY OF ______ 19

CERTIFICATE NO. ______

Awards Manager

President, FEARL

FAR EAST AUXILIARY RADIO LEAGUE

FEARL

THIS IS TO CERTIFY THAT -----SAMPLE------------, OPERATOR OF STATION ---------, BY HIS PERFORMANCE AND BY PRESENTING SUCH SATISFACTORY EVIDENCE WHICH MAY HAVE BEEN REQUIRED, HAS PROVEN WORTHY OF THE TITLE OF

RAG CHEWER SUPREME

THIS INDIVIDUAL HAS QUALIFIED FOR THIS TITLE BY ENGAGING IN CONVERSATION WITH A KA STATION THROUGH THE MEDIUM OF AMATEUR RADIO ON ONE OR MORE SUBJECTS OF PERSONAL CHOICE FOR A PERIOD OF TIME IN EXCESS OF ONE HOUR. THIS PERSON IS AUTHORIZED TO REFER TO HIMSELF AS A RAG CHEWER SUPREME AND IS EXTENDED AN OPEN INVITATION TO REPEAT THIS ACT OF ENDURANCE WITH ANY AND ALL KA STATIONS.

AWARDED IN TOKYO, JAPAN THIS ______ DAY OF ______________ 19

CERTIFICATE NO. ________

Awards Manager

President, FEARL

of not less than thirty minutes. There are no band, mode, or date limitations. To apply, merely give general logbook data, including the time your QSO began and ended. GCR apply.

RAG CHEWER SUPREME

Should you be longwinded and were fortunate to enjoy an hour-long QSO with any KA station in the Orient, then the Rag Chewer Supreme Award is designed especially for you. To apply, merely provide logbook data and the appropriate award fee of $1.00 or 7 IRCs. GCR apply.

KA ROUNDTABLE AWARD

To qualify for this award, the applicant must establish and maintain two-way amateur radio communications with at least two KA stations in the Orient on the same frequency at the same time for a minimum of thirty minutes. There are no special band or mode endorsements. Date is not a factor. GCR apply.

SHORTWAVE LISTENER AWARD

For the shortwave listeners, FEARL presents this award for having heard and rendered a signal report to the operators of at least two KA stations in the Orient. Applicants merely send general logbook data and the appropriate award fee when applying.

CHARLES DENNIS WBØZKG

Probably one of the toughest bands on which to obtain contacts in all 50 states is 6 meters. Nevertheless, the challenge didn't stop Charlie WBØZKG from Toledo, Iowa.

Charlie, equipped with a Swan 250 six-meter rig and a Wilson six-element wide-spaced yagi, began his pursuit in June, 1979. Within 5 months, he had worked all 50 US states and was awarded *73 Magazine*'s Worked All USA Award #1 for his 6-meter feat. Since that time, Charlie has gone on to add over a dozen DX countries to his list of QSOs, plus a host of contacts via 6/10 meter crossband from Europe.

First licensed in January, 1977, Charlie was issued his present call, WBØZKG, as a Novice. Fourteen months later, he upgraded to his present status of Technician.

Not being able to utilize HF phone privileges, he purchased a Yaesu FT-221R all-mode two-meter transceiver and a 22-element Cushcraft 2-meter array and settled for FM communications. Wishing to find a new frontier, Charlie then purchased a 50-foot crank-up tower, two F9FT (32-element total) arrays, and set out to conquer 2-meter sideband. For his efforts, over 20 US states and several Canadian provinces were added to his list of credits.

It was shortly after this that Charlie began getting frustrated again and wanted to move on. This is when he got his first taste of six-meter operation, a band which he now calls home.

Charlie is president of the Central Iowa Amateur Radio Club, and his wife, Mary KAØCWR, assists him in editing the monthly club newsletter.

Charlie met his wife in 1977 and they were married the following year in June at the Field-Day site, right smack dab in the middle of all the contesting that was going on!

In the future, Charlie hopes to expand his station to include multiple antenna arrays for 50, 144, 432, and 1296 MHz. His present HF station, although not too productive lately, consists of a TS-520 with a TA-33-40KR and SB-220. As Charlie puts it, "About the only way I'll ever get to use it is to upgrade, but I'm having too much fun on 6 meters!"

FCC

Reprinted from the Federal Register.

[Docket No. 20777; RM-2429; RM-2550; and RM-2771; FCC 80-35]

Deregulation of Part 97 of the Rules Regarding Emissions Authorized in the Amateur Radio Service

AGENCY: Federal Communications Commission.

ACTION: Third report and order.

SUMMARY: The Commission adopts rules allowing amateur radio operators to use the American Standard Code for Information Interchange (ASCII) for radioteleprinter communications, remote control operations, the operation of data networks, and other uses consistent with the amateur rules.

EFFECTIVE DATE: March 17, 1980.

ADDRESSES: Federal Communications Commission, Washington, D.C. 20554.

FOR FURTHER INFORMATION CONTACT: John B. Johnston, Chief, Personal Radio Branch, Private Radio Bureau, (202) 254-6884.

SUPPLEMENTARY INFORMATION:

Third Report and Order

Adopted: January 30, 1980.
(Released: February 7, 1980.

By the Commission:

1. On August 8, 1978, the Commission adopted a Notice of Inquiry and Further Notice of Proposed Rule Making which was published in the Federal Register (43 FR 36984) on August 11, 1978. This Notice proposed deregulating the emissions authorized in the Amateur Radio Service by providing for the use of the American Standard Code for Information Interchange (ASCII)[1] by amateur radioteleprinter operators. Section 97.69 of the Commission's Rules, which regulates radioteleprinter transmissions in the Amateur Radio Service, presently allows only the use of the International Telegraphic Alphabet No. 2 (often referred to as the "Baudot Code") under carefully specified technical parameters. Since 1968, ASCII has largely replaced the Baudot Code as the teleprinter code in common commercial usage in the United States. The Commission felt it appropriate, therefore, that it make provision for the use of ASCII in the Amateur Radio Service.

2. In the above-mentioned Notice, the Commission discussed the composition of ASCII and various factors which make its use desirable. In addition, we raised a number of questions concerning the technical limitations which should be applicable to its use, such as the maximum permissible bandwidth, sending speed, frequency deviation and modulating frequency, permissible emission types, the use of parity bits, synchronous and asynchronous transmission, and the order of the data bits.

[1] The term "ASCII", used throughout this proceeding, refers to the USA Standard Code for Information Interchange as defined in the United States of America Standards Institute Standard X3.4-1968.

Summary of Comments

3. Approximately 55 comments were filed, including 2 reply comments. Almost 80 percent of those filing comments expressed the belief that if the Commission was to be true to the spirit of § 97.1 of the amateur rules (which explains the basis and purpose of the Amateur Radio Service), particularly in reference to the provisions concerning "continuation and extension of the amateur's proven ability to contribute to the advancement of the radio art,"[2] and "advancing skills in both the communications and technical phases of the art,"[3] then it should adopt few, if any, restrictions or standards relating to radioteleprinter operation. The comments generally reflect the view that any standards adopted should be as broad as possible (such as the specification of maximum permissible bandwidth) and should not be concerned with specific radioteleprinter code types or the transmission parameters normally associated with the use of such codes. A number of those filing comments expressed the belief that in raising such detailed questions about the specifics of radioteleprinter operation, the Commission was in fact proposing a "reregulation" of the Amateur Radio Service, not the "deregulation" which was represented. Thus, in the face of what was perceived as conflicting and contradictory intentions on the Commission's part, many of those filing comments, after initially arguing for only the most minimal or necessary technical standards, went on to make specific recommendations in response to the questions raised by the Commission in the Notice.

[2] See Section 97.1, Paragraph (b) of the Commission's Rules.

[3] Ibid, Paragraph (c).

4. There was virtually unanimous agreement that the Commission should not concern itself with (or adopt rules relating to) the use of a parity bit, the order of the bits (in terms of most or least significant), or the use of synchronous or asynchronous transmission. There was also general agreement that the permissible bandwidths of ASCII or other radioteleprinter signals should be similar to the traditional bandwidths associated with the use of the Baudot Code in the various frequency bands. In most cases, these traditional radioteleprinter bandwidths were taken as the basis for calculating maximum permissible sending speeds (but not "standard" sending speeds), inasmuch as operation within such maximum specified limits is very easily ascertained (thus facilitating compliance); and provides amateur radioteleprinter operators with some latitude in sending speed which would be lost with little, if any, advantage, if we were to specify or require the use of "standard" speeds within certain tolerances. Thus, there appeared to be a general consensus of opinion that the speed between 3.5 and 29.7 MHz should be limited to 300 bauds where the use of F1 emission is authorized, 1200 bauds between 50.1 and 225 MHz where the use of F1, F2 and A2 emissions are authorized, and no limit above 420 MHz. Several of those filing comments, however, pointed out the dual "wideband" and "narrowband" nature of the 10 meter band (28.0-29.7 MHz), and argued that the use of up to 1200 bauds would appear to be appropriate. There were also some comments

suggesting that 19.6 kilobauds would be an appropriate limit in the higher (i.e., above 420 MHz) amateur frequency bands. There were many indications, in the comments, that while amateur operators, in general, favored flexible rules which fostered experimentation; many would none the less use conventional codes and sending speeds in conjunction with traditional or generally accepted frequency shifts or modulating frequencies, or with technical parameters chosen with more of a view toward more efficient, spectrum conserving operation.

5. In other comments, amateur operators expressed interest in using radioteleprinter codes other than Baudot or ASCII. Frequently cited examples were the Binary Coded Decimal (BCD), Extended Binary Coded Decimal Interchange Code (EBCDIC), Moore and Correspondence (IBM Selectric) codes. It was also felt that the Commission should allow the use of various "computer" or "machine" languages for computer-to-computer communication; and that the rules should provide for experimentation in the use of "packet switching" techniques. Recognizing that under such an approach, it would be impossible for the Commission's enforcement personnel to intercept all radioteleprinter transmissions, several of those filing comments pointed out that amateurs have repeatedly demonstrated their ability to enforce self-imposed standards, and recommended that the Commission take an approach of adopting generalized and non-specific rules which deal only with the general form, and not the content of transmissions. Reference is made to the generally high degree of amateur operator compliance with the rules relating to permissible communications as the foundation for this deregulatory approach.

6. About the only comments at variance with the general amateur operator consensus on this matter were filed by the National Communications System (NCS).[4] NCS argued that the Commission should adopt relatively detailed technical standards (based on ANSI, CCITT and CCIR standards[5] in order to foster what it terms "interoperability." NCS views the Amateir Radio Service as a valuable national resource of potentially great significance in augmenting commercial and Federal Government communications networks. It feels that "interoperability" or communications system compatibility would be best ensured by the Commission's adoption of technical limitations on radioteleprinter operation. While these limitations would be specified in rather considerable detail, NCS nevertheless feels that they would still allow ample room for technological innovation and advancement in performance.

Conclusions

7. Our intent in this proceeding was simply to expand the operating capabilities available to amateur radioteleprinter operators by providing for the use of ASCII. We find, however, that the comments generally go beyond our proposal and seek more or less total deregulation in the area of radioteleprinter operation. We are not necessarily opposed to such extensive deregulation; and we agree that it would be in perfect harmony with the basis and purpose of the Amateur Radio Service as articulated in § 97.1 of the rules. However, it is not clear that such an action would be consistent with Article 41 of the International Telecommunications Union (ITU) Regulations.[6] Additional exploration is needed to verify the literal and implied intent of Article 41 in relation to international radioteleprinter communications.

8. Past experience with the use of the Baudot code in the Amateur Radio Service indicates that the vast majority of operatore use common radioteleprinter standards, thus simplifying enforcement monitoring both by amateurs and our monitoring personnel. Accordingly, we are not adopting further standards at this time with regard to the use of the ASCII radioteleprinter code.

9. On the matter of "interoperability" raised by the National Communications System, the Commission feels that even if no standards were being adopted, most amateur radioteleprinter operators would communicate with conventional equipment and operate in accordance with generally accepted technical standards. Even those operators who may be heavily involved in experimentation would certainly provide themselves with the capability of conventional operation within a very short time frame. We feel, then, that NCS's concern about "interoperability" is needless, particularly in view of the record of amateur operator preparedness in past emergencies.

10. In view of the foregoing discussion, we have decided to amend § 97.69 of the amateur rules to provide for the use of ASCII in the Amateur Radio Service. The only limitation we are placing on the use of ASCII is a sending speed limit applicable to each band.[7] The Commission recognizes that ASCII, as a means of digital communication, may have uses other than as a means of radioteleprinter communication (such as, but not restricted to, control of a station or object, transfer of computer programs or direct computer-to-computer communications and communication in data networks). To the extent that such uses do not conflict with other provisions set forth in rules, they are permissible.

11. Accordingly, it is ordered, that effective, March 17, 1980, Part 97 of the Commission's rules is amended as shown in the Appendix, pursuant to the authority contained in Sections 4(i) and 303 of the Communications Act of 1934, as amended. Further information on this matter may be obtained by contacting John B. Johnston, Private Radio Bureau, Rules Division, Personal Radio Branch, at (202) 254-6884.

(Secs. 4, 303, 48 stat., as amended, 1066, 1082; 47 U.S.C. 154, 303)

Federal Communications Commission.

William J. Tricarico,

Secretary.

Appendix

I. Part 97 of the Commission's Rules and Regulations is amended as follows:

1. in § 97.69, is re-entitled "Digital transmissions" and is amended to read as follows:

§ 97.69 Digital transmissions.

Subject to the special conditions contained in paragraphs (a) and (b) below, the use of the International Telegraphic Alphabet No. 2 (also known as the Baudot Code) and the American Standard Code for Information Interchange (ASCII) may be used for such purposes as (but not restricted to) radio teleprinter communications, control of amateur radio stations, models and other objects, transfer of computer programs or direct computer-to-computer communications, and communications in various types of data networks (including so-called "packet switching" systems); provided that such operation is carried out in accordance with the other regulations set forth in this Part.

(a) Use of the International Telegraphic Alphabet No. 2 (Baudot Code) is subject to the following requirements:

(1) Transmission shall consist of a single channel, five-unit (start-stop) teleprinter code conforming to International Telegraphic Alphabet No. 2 with respect to all letters and numerals (including the slant sign or fraction bar); however, in "figures" positions not utilized for numerals, special signals may be employed for the remote control of receiving printers, or for other purposes indicated in this section.

(2) The transmitting speed shall be maintained within 5 words per minute of one of the following standard speeds: 60 (45 bauds), 67 (50 bauds), 75 (56.25 bauds) or 100 (75 bauds) words per minute.

(3) When frequency shift keying (type F1 emission) is utilized, the deviation in frequency from the mark signal to the space signal, or from the space signal to the mark signal, shall be less than 900 Hertz.

(4) When audio frequency shift keying (type A2 or F2 emission) is utilized, the highest fundamental modulating frequency shall not exceed 3000 Hertz, and the difference between the modulating audio frequency for the mark signal and that for the space signal shall be less than 900 Hertz.

(b) Use of the American Standard Code for Information Interchange (ASCII) is subject to the following requirements:

(1) The code shall conform to the American Standard Code for Information Interchange (ASCII) as defined in American National Standard Institute (ANSI) Standard X3.4–1968.

(2) F1 emission shall be utilized on those frequencies between 3.5 and 21.25 MHz where its use is permissible; and the sending speed shall not exceed 300 bauds.

(3) F1, F2 and A2 emissions may be utilized on those frequencies between 28 and 225 MHz where their use is permissible; and the sending speed shall not exceed 1200 bauds.

(4) F1, F2 and A2 emissions may be utilized on those frequencies above 420 MHz where their use is permissible; and the sending speed shall not exceed 19.6 kilobauds.

PR Bulletin 1035
January 1980

Federal Communications Commission
Private Radio Bureau
Washington, D.C. 20554

STUDY GUIDE FOR THE AMATEUR RADIO OPERATOR LICENSE EXAMINATIONS

This Bulletin contains syllabi for the FCC amateur radio examinations.

WHY ARE AMATEUR RADIO OPERATOR EXAMINATIONS REQUIRED?

The examinations determine if you are qualified for the privileges conveyed by an amateur radio license. Those privileges are many and diverse. As an amateur radio operator, you will be allowed to build, repair, and modify your radio transmitters. You will be responsible for the technical quality of your station's transmissions. You will be allowed to communicate with amateur radio operators in other countries around the world and, in some cases, send messages for friends. As you upgrade to the higher operator license classes, you will be allowed to communicate using not only telegraphy and voice, but also teleprinting, facsimile, and several forms of television. For such a flexible radio service to be practical, you and every other amateur radio operator must thoroughly understand your responsibilities and develop the skills needed to operate your amateur radio station properly.

WHAT SUBJECTS DO THE AMATEUR RADIO EXAMINATIONS COVER?

The examinations cover the rules, practices, procedures, and technical material that you will need to know in order to operate your amateur radio station properly. Each examination element is composed of questions which will determine whether you have an adequate understanding of the topics listed in the corresponding syllabus. For example, all Element 3 examination questions are derived from the Element 3 syllabus, which appears on pages 5, 6, and 7 of this Bulletin. To properly prepare for an examination, you should become knowledgeable about all of the topics in the syllabus for the element you will be taking. Every examination covers nine general subjects:

·Rules and Regulations	·Circuit Components	·Antennas and Feedlines
·Electrical Principles	·Practical Circuits	·Radio Wave Propagation
·Signals and Emissions	·Operating Procedures	·Amateur Radio Practice

Periodically, the syllabi are updated to reflect changing technology and amateur radio practices. Comments on the study guide contents are welcome. Mail them to:

Personal Radio Branch
Federal Communications Commission
Washington, D.C. 20554

WHERE CAN STUDY MANUALS BE OBTAINED?

A study manual can be helpful in preparing for an examination. Several publishers offer manuals or courses based upon the material in this Bulletin. These may be found in many public libraries and radio stores. The FCC does not offer such manuals, nor recommend any specific publisher. However, you will find two FCC publications, Part 97 - Rules and Regulations for the Amateur Radio Service and How to Identify and Resolve Radio-TV Interference Problems, useful when preparing for the amateur radio examinations. Copies are sold by the Superintendent of Documents, U. S. Government Printing Office, Washington, D.C. 20402. Specify stock number 004-000-00357-8 for Part 97 and stock number 004-000-00345-4 for the Radio-TV interference booklet.

STUDY TOPICS FOR THE NOVICE CLASS AMATEUR RADIO OPERATOR LICENSE EXAMINATION
(Element 2 Syllabus)

A. RULES AND REGULATIONS

DEFINE:

(1) AMATEUR RADIO SERVICE 97.3(a)	(2) AMATEUR RADIO OPERATOR 97.3(c)
(3) AMATEUR RADIO STATION 97.3(e)	(4) AMATEUR RADIO COMMUNICATIONS 97.3(b)
(5) OPERATOR LICENSE 97.3(d)	(6) STATION LICENSE 97.3(d)
(7) CONTROL OPERATOR 97.3(o)	(8) THIRD PARTY TRAFFIC 97.3(v)

[4] The National Communications System is a confederation in which certain Federal Agencies participate with their assets to provide necessary communications for the Federal Government under all conditions raging from a normal situation to national emergencies and international crises, including nuclear attacks. The primary assets of the NCS include the telecommunications networks of the Departments of State, Defense, Interior, Commerce, Energy and the Federal Aviation Administration, the General Services Administration, the Central Intelligence Agency, the National Aeronautics and Space Administration, and the International Communications Agency.

[5] ANSI—American National Standards Institute. CCIR—International telegraph and telephone consultative committee. CCIR—International Radio Consultative Committee.

[6] A preliminary opinion on this matter is that Article 41, section 2(1) (which states, in part, that "transmissions between amateur stations of different countries . . . shall be made in plain language") could be construed to allow the use of "standard" radioteleprinter codes for international communications, but no other type of radioteleprinter code, whether it be used for experimental purposes or otherwise. However, Article 41 does not appear to prohibit the use of an unlimited number of radioteleprinter codes domestically.

[7] Recognizing that the use of slower speeds is likely to be the norm, we have, in order to provide maximum flexibility, decided to permit speeds up to 300 bauds between 3.5 and 28 MHz, 1200 bauds between 28 and 225 MHz, and 19.6 kilobauds above 420 MHz. (See the Appendix, revised 97.69 for additional details.)

NOVICE CLASS OPERATOR PRIVILEGES:

(9) AUTHORIZED FREQUENCY BANDS 97.7(e)
(10) AUTHORIZED EMISSION (A1) 97.7(e)

PROHIBITED PRACTICES:

(11) UNIDENTIFIED COMMUNICATIONS 97.123
(12) INTENTIONAL INTERFERENCE 97.125
(13) FALSE SIGNALS 97.121
(14) COMMUNICATION FOR HIRE 97.112(a)

BASIS AND PURPOSE OF THE AMATEUR RADIO SERVICE RULES AND REGULATIONS:

(15) TO RECOGNIZE AND ENHANCE THE VALUE OF THE AMATEUR RADIO SERVICE TO THE PUBLIC AS A VOLUNTARY, NON-COMMERCIAL COMMUNICATION SERVICE, PARTICULARLY WITH RESPECT TO PROVIDING EMERGENCY COMMUNICATIONS. 97.1(a)
(16) TO CONTINUE AND EXTEND THE AMATEUR RADIO OPERATORS' PROVEN ABILITY TO CONTRIBUTE TO THE ADVANCEMENT OF THE RADIO ART. 97.1(b)
(17) TO ENCOURAGE AND IMPROVE THE AMATEUR RADIO SERVICE BY PROVIDING FOR ADVANCING SKILLS IN BOTH THE COMMUNICATION AND TECHNICAL PHASES. 97.1(c)
(18) TO EXPAND THE EXISTING RESERVOIR WITHIN THE AMATEUR RADIO SERVICE OF TRAINED OPERATORS, TECHNICIANS, AND ELECTRONICS EXPERTS. 97.1(d)
(19) TO CONTINUE AND EXTEND THE RADIO AMATEURS' UNIQUE ABILITY TO ENHANCE INTERNATIONAL GOOD WILL. 97.1(e)

OPERATING RULES:

(20) U. S. AMATEUR RADIO STATION CALL SIGNS 2.302 and FCC Public Notice
(21) PERMISSIBLE POINTS OF COMMUNICATIONS 97.89(a)(1)
(22) STATION LOGBOOK, LOGGING REQUIREMENTS 97.103(a), (b); 97.105
(23) STATION IDENTIFICATION 97.84(a)
(24) NOVICE BAND TRANSMITTER POWER LIMITATION 97.67(b), (d)
(25) NECESSARY PROCEDURE IN RESPONSE TO AN OFFICIAL NOTICE OF VIOLATION 97.137
(26) CONTROL OPERATOR REQUIREMENTS 97.79(a), (b)

B. OPERATING PROCEDURES

(1) R-S-T SIGNAL REPORTING SYSTEM
(2) CHOICE OF TELEGRAPHY SPEED
(3) ZERO-BEATING RECEIVED SIGNAL
(4) TRANSMITTER TUNE-UP PROCEDURE

(5) USE OF COMMON AND INTERNATIONALLY RECOGNIZED TELEGRAPHY ABBREVIATIONS, INCLUDING: CQ, DE, K, SK, R, $\overline{AR}$, 73, QRS, QRZ, QTH, QSL, QRM, QRN

C. RADIO WAVE PROPAGATION

(1) SKY WAVE; "SKIP"
(2) GROUND WAVE

D. AMATEUR RADIO PRACTICE

(1) MEASURES TO PREVENT USE OF AMATEUR RADIO STATION EQUIPMENT BY UNAUTHORIZED PERSONS

SAFETY PRECAUTIONS:

(2) LIGHTNING PROTECTION FOR ANTENNA SYSTEM
(3) GROUND SYSTEM
(4) ANTENNA INSTALLATION SAFETY PROCEDURES

ELECTROMAGNETIC COMPATABILITY - IDENTIFY AND SUGGEST CURE:

(5) OVERLOAD OF CONSUMER ELECTRONIC PRODUCTS BY STRONG RADIO FREQUENCY FIELDS
(6) INTERFERENCE TO CONSUMER ELECTRONIC PRODUCTS CAUSED BY RADIATED HARMONICS

INTERPRETATION OF S.W.R. READINGS AS RELATED TO FAULTS IN ANTENNA SYSTEM:

(7) ACCEPTABLE READINGS
(8) POSSIBLE CAUSES OF UNACCEPTABLE READINGS

E. ELECTRICAL PRINCIPLES

CONCEPTS:

(1) VOLTAGE
(2) ALTERNATING CURRENT, DIRECT CURRENT
(3) CONDUCTOR, INSULATOR
(4) OPEN CIRCUIT, SHORT CIRCUIT
(5) ENERGY, POWER
(6) FREQUENCY, WAVELENGTH
(7) RADIO FREQUENCY
(8) AUDIO FREQUENCY

ELECTRICAL UNITS:

(9) VOLT
(10) AMPERE
(11) WATT
(12) HERTZ

(13) METRIC PREFIXES: MEGA, KILO, CENTI, MILLI, MICRO, PICO

F. CIRCUIT COMPONENTS

PHYSICAL APPEARANCE, APPLICATIONS, AND SCHEMATIC SYMBOLS OF:

(1) QUARTZ CRYSTALS
(2) METERS (D'ARSONVAL MOVEMENT)
(3) VACUUM TUBES
(4) FUSES

G. PRACTICAL CIRCUITS

BLOCK DIAGRAMS:

(1) THE STAGES IN A SIMPLE TELEGRAPHY (A1) TRANSMITTER
(2) THE STAGES IN A SIMPLE RECEIVER CAPABLE OF TELEGRAPHY (A1) RECEPTION
(3) THE FUNCTIONAL LAYOUT OF NOVICE STATION EQUIPMENT, INCLUDING TRANSMITTER, RECEIVER, ANTENNA SWITCHING, ANTENNA FEEDLINE, ANTENNA, AND TELEGRAPH KEY

H. SIGNALS AND EMISSIONS

(1) EMISSION TYPE A1

CAUSE AND CURE:

(2) BACKWAVE
(3) KEY CLICKS
(4) CHIRP
(5) SUPERIMPOSED HUM
(6) UNDESIRABLE HARMONIC EMISSIONS
(7) SPURIOUS EMISSIONS

I. ANTENNAS AND FEEDLINES

NECESSARY PHYSICAL DIMENSIONS OF THESE POPULAR HIGH FREQUENCY ANTENNAS FOR RESONANCE ON AMATEUR RADIO FREQUENCIES:

(1) A HALF-WAVE DIPOLE
(2) A QUARTER-WAVE VERTICAL

COMMON TYPES OF FEEDLINES USED AT AMATEUR RADIO STATIONS

(3) COAXIAL CABLE
(4) PARALLEL CONDUCTOR LINE

STUDY TOPICS FOR THE TECHNICIAN/GENERAL CLASS AMATEUR RADIO OPERATOR LICENSE EXAMINATION
(Element 3 Syllabus)

A. RULES AND REGULATIONS

(1) CONTROL POINT 97.3(p)
(2) EMERGENCY COMMUNICATIONS 97.3(w); 97.107
(3) AMATEUR RADIO TRANSMITTER POWER LIMITATIONS 97.67
(4) STATION IDENTIFICATION REQUIREMENTS 97.84(b), (f), (g); 97.79(c)
(5) THIRD PARTY PARTICIPATION IN AMATEUR RADIO COMMUNICATIONS 97.79(d)
(6) DOMESTIC AND INTERNATIONAL THIRD PARTY TRAFFIC 97.114; Appendix 2, Art. 41, Sec. 2
(7) PERMISSIBLE ONE-WAY TRANSMISSIONS 97.91
(8) FREQUENCY BANDS AVAILABLE TO THE TECHNICIAN CLASS 97.7(d)
(9) FREQUENCY BANDS AVAILABLE TO THE GENERAL CLASS 97.7(b)
(10) LIMITATIONS ON USE OF AMATEUR RADIO FREQUENCIES 97.61
(11) SELECTION AND USE OF FREQUENCIES 97.63
(12) RADIO CONTROLLED MODEL CRAFTS AND VEHICLES 97.65(a); 97.99
(13) RADIOTELEPRINTER EMISSIONS 97.69

PROHIBITED PRACTICES:

(14) BROADCASTING 97.113
(15) MUSIC 97.115
(16) CODES AND CIPHERS 97.117
(17) OBSCENITY, INDECENCY, PROFANITY 97.119

B. OPERATING PROCEDURES

(1) RADIOTELEPHONY
(2) RADIO TELEPRINTING
(3) USE OF REPEATERS
(4) VOX TRANSMITTER CONTROL
(5) FULL BREAK-IN TELEGRAPHY
(6) OPERATING COURTESY
(7) ANTENNA ORIENTATION
(8) INTERNATIONAL COMMUNICATION
(9) EMERGENCY PREPAREDNESS DRILLS

C. RADIO WAVE PROPAGATION

(1) IONOSPHERIC LAYERS; D, E, F1, F2
(2) ABSORPTION
(3) MAXIMUM USABLE FREQUENCY
(4) REGULAR DAILY VARIATIONS
(5) SUDDEN IONOSPHERIC DISTURBANCE
(6) SCATTER
(7) SUNSPOT CYCLE
(8) LINE-OF-SIGHT
(9) DUCTING, TROPOSPHERIC BENDING

D. AMATEUR RADIO PRACTICE

SAFETY PRECAUTIONS:

(1) HOUSEHOLD AC SUPPLY AND ELECTRICAL WIRING SAFETY
(2) DANGEROUS VOLTAGES IN EQUIPMENT MADE INACCESSIBLE TO ACCIDENTAL CONTACT

TRANSMITTER PERFORMANCE:

(3) TWO TONE TEST
(4) NEUTRALIZING FINAL AMPLIFIER
(5) POWER MEASUREMENT

USE OF TEST EQUIPMENT:

(6) OSCILLOSCOPE
(7) MULTIMETER
(8) SIGNAL GENERATORS
(9) SIGNAL TRACER

ELECTROMAGNETIC COMPATIBILITY; IDENTIFY AND SUGGEST CURE:

(10) DISTURBANCE IN CONSUMER ELECTRONIC PRODUCTS CAUSED BY AUDIO RECTIFICATION

PROPER USE OF THE FOLLOWING STATION COMPONENTS AND ACCESSORIES:

(11) REFLECTOMETER (VSWR METER)
(12) SPEECH PROCESSOR - RF AND AF
(13) ELECTRONIC T-R SWITCH
(14) ANTENNA TUNING UNIT; MATCHING NETWORK
(15) MONITORING OSCILLOSCOPE
(16) NON-RADIATING LOAD; "DUMMY ANTENNA"
(17) FIELD STRENGTH METER; S-METER
(18) WATTMETER

E. ELECTRICAL PRINCIPLES

CONCEPTS:

(1) IMPEDANCE
(2) RESISTANCE
(3) REACTANCE
(4) INDUCTANCE
(5) CAPACITANCE
(6) IMPEDANCE MATCHING

ELECTRICAL UNITS:

(7) OHM
(8) MICROFARAD, PICOFARAD
(9) HENRY, MILLIHENRY, MICROHENRY
(10) DECIBEL

MATHEMATICAL RELATIONSHIPS:

(11) OHM'S LAW
(12) CURRENT AND VOLTAGE DIVIDERS
(13) ELECTRICAL POWER CALCULATIONS
(14) SERIES AND PARALLEL COMBINATIONS; OF RESISTORS, OF CAPACITORS, OF INDUCTORS
(15) TURNS RATIO; VOLTAGE, CURRENT, AND IMPEDANCE TRANSFORMATION
(16) ROOT MEAN SQUARE VALUE OF A SINE WAVE ALTERNATING CURRENT

F. CIRCUIT COMPONENTS

PHYSICAL APPEARANCE, TYPES, CHARACTERISTICS, APPLICATIONS, AND SCHEMATIC SYMBOLS FOR:

(1) RESISTORS
(2) CAPACITORS
(3) INDUCTORS
(4) TRANSFORMERS

(5) POWER SUPPLY TYPE DIODE RECTIFIERS

G. PRACTICAL CIRCUITS

(1) POWER SUPPLIES
(2) HIGH-PASS, LOW-PASS, AND BAND-PASS FILTERS
(3) BLOCK DIAGRAMS SHOWING THE STAGES IN COMPLETE AM, SSB, AND FM TRANSMITTERS AND RECEIVERS

H. SIGNALS AND EMISSIONS

(1) EMISSION TYPES AØ, A3, F1, F2, F3
(2) SIGNAL; INFORMATION
(3) AMPLITUDE MODULATION
(4) DOUBLE SIDEBAND
(5) SINGLE SIDEBAND
(6) FREQUENCY MODULATION
(7) PHASE MODULATION
(8) CARRIER
(9) SIDEBANDS
(10) BANDWIDTH
(11) ENVELOPE
(12) DEVIATION
(13) OVERMODULATION
(14) SPLATTER

(15) FREQUENCY TRANSLATION; MIXING, MULTIPLICATION
(16) RADIOTELEPRINTING; AUDIO FREQUENCY SHIFT KEYING, MARK, SPACE, SHIFT

I. ANTENNAS AND FEEDLINES

POPULAR AMATEUR RADIO ANTENNAS AND THEIR CHARACTERISTICS:

(1) YAGI ANTENNA
(2) QUAD ANTENNA
(3) PHYSICAL DIMENSIONS
(4) VERTICAL AND HORIZONTAL POLARIZATION

(5) FEEDPOINT IMPEDANCE OF HALF-WAVE DIPOLE, QUARTER WAVE VERTICAL
(6) RADIATION PATTERNS; DIRECTIVITY, MAJOR LOBES

CHARACTERISTICS OF POPULAR AMATEUR RADIO ANTENNA FEEDLINES; RELATED CONCEPTS:

(7) CHARACTERISTIC IMPEDANCE
(8) STANDING WAVES
(9) STANDING WAVE RATIO; SIGNIFICANCE OF
(10) BALANCED, UNBALANCED
(11) ATTENUATION
(12) ANTENNA-FEEDLINE MISMATCH

STUDY TOPICS FOR THE ADVANCED CLASS AMATEUR RADIO OPERATOR LICENSE EXAMINATION (Element 4A Syllabus)

A. RULES AND REGULATIONS

(1) FREQUENCY BANDS AVAILABLE TO THE ADVANCED CLASS AMATEUR RADIO OPERATOR AND LIMITATIONS ON USE 97.7(a); 97.61
(2) AUTOMATIC RETRANSMISSION OF AMATEUR RADIO SIGNALS AND SIGNALS FROM OTHER RADIO SERVICES 97.3(x); 97.113; 97.126
(3) AMATEUR RADIO STATIONS IN REPEATER OPERATION 97.3(1); 97.85; 97.61(c)
(4) AMATEUR RADIO STATIONS IN AUXILIARY OPERATION 97.3(1); 97.86; 97.61(d)
(5) REMOTE CONTROL OF AMATEUR RADIO STATIONS 97.3(m)(2); 97.88
(6) AUTOMATIC CONTROL OF AMATEUR RADIO STATIONS 97.3(m)(3)
(7) CONTROL LINK 97.3(r)
(8) SYSTEM NETWORK DIAGRAM 97.3(u)
(9) STATION IDENTIFICATION 97.84(c), (d), (e)
(10) STATION LOG REQUIREMENTS 97.103(c), (d), (e), (f), (g)
(11) HEIGHT LIMITATIONS FOR AMATEUR RADIO STATION ANTENNA STRUCTURES, INCLUDING FAA NOTIFICATION CRITERIA, AND CALCULATION OF HEIGHT ABOVE AVERAGE TERRAIN 97.45; 97.67(c); Appendix 5

B. OPERATING PROCEDURES

(1) FACSIMILE TRANSMISSION
(2) SLOW-SCAN TELEVISION TRANSMISSION

C. RADIO WAVE PROPAGATION

(1) SPORADIC-E
(2) SELECTIVE FADING
(3) AURORAL PROPAGATION
(4) RADIO-PATH HORIZON

D. AMATEUR RADIO PRACTICE

USE OF TEST EQUIPMENT:

(1) FREQUENCY MEASUREMENT DEVICES
(2) GRID-DIP METER; SOLID STATE DIP METER

(3) PERFORMANCE LIMITATIONS OF OSCILLOSCOPES, METERS, FREQUENCY COUNTERS; ACCURACY, FREQUENCY RESPONSE, STABILITY

ELECTROMAGNETIC COMPATIBILITY:

(4) INTERMODULATION INTERFERENCE
(5) RECEIVER DESENSITIZING
(6) CROSS MODULATION INTERFERENCE
(7) CAPTURE EFFECT

E. ELECTRICAL PRINCIPLES

CONCEPTS:

(1) REACTIVE POWER
(2) SERIES AND PARALLEL RESONANCE
(3) SKIN EFFECT
(4) FIELDS, ENERGY STORAGE, ELECTROSTATIC, ELECTROMAGNETIC

MATHEMATICAL RELATIONSHIPS:

(5) RESONANT FREQUENCY, BANDWIDTH, AND "Q" OF R-L-C CIRCUITS, GIVEN COMPONENT VALUES
(6) PHASE ANGLE BETWEEN VOLTAGE AND CURRENT, GIVEN RESISTANCE AND REACTANCE
(7) POWER FACTOR, GIVEN PHASE ANGLE
(8) EFFECTIVE RADIATED POWER, GIVEN SYSTEM GAINS AND LOSSES
(9) REPLACEMENT OF VOLTAGE SOURCE AND RESISTIVE VOLTAGE DIVIDER WITH EQUIVALENT CIRCUIT CONSISTING OF A VOLTAGE SOURCE AND ONE RESISTOR (AN APPLICATION OF THEVENIN'S THEOREM, USED TO PREDICT THE CURRENT SUPPLIED BY A VOLTAGE DIVIDER TO A KNOWN LOAD)

F. CIRCUIT COMPONENTS

PHYSICAL APPEARANCE, TYPES, CHARACTERISTICS, APPLICATIONS, AND SCHEMATIC SYMBOLS FOR THE FOLLOWING:

(1) DIODES; ZENER, TUNNEL, VARACTOR, HOT-CARRIER, JUNCTION, POINT CONTACT, PIN
(2) TRANSISTORS; NPN, PNP, JUNCTION, UNIJUNCTION, POWER, GERMANIUM, SILICON
(3) SILICON CONTROLLED RECTIFIER, TRIAC
(4) LIGHT EMITTING DIODE, NEON LAMP
(5) CRYSTAL LATTICE SSB FILTERS

G. PRACTICAL CIRCUITS

(1) VOLTAGE REGULATOR CIRCUITS; DISCRETE AND INTEGRATED
(2) AMPLIFIERS; CLASS A, AB, B, C; CHARACTERISTICS OF EACH TYPE
(3) IMPEDANCE MATCHING NETWORKS; PI, L, PI-L
(4) FILTERS; CONSTANT K, M-DERIVED, BAND-STOP, NOTCH, MODERN-NETWORK-THEORY, PI-SECTION, T-SECTION, L-SECTION (NOT NECESSARY TO MEMORIZE DESIGN EQUATIONS; KNOW GENERAL DESCRIPTION, CHARACTERISTICS, RESPONSES, AND APPLICATIONS OF THESE FILTERS)
(5) OSCILLATORS; VARIOUS TYPES AND THEIR APPLICATIONS; STABILITY

TRANSMITTER AND RECEIVER CIRCUITS - KNOW PURPOSE OF EACH, AND HOW, BASICALLY, EACH FUNCTIONS:

(6) MODULATORS; AM, FM, BALANCED
(7) TRANSMITTER FINAL AMPLIFIERS
(8) DETECTORS, MIXER STAGES
(9) RF AND IF AMPLIFIER STAGES

CALCULATION OF VOLTAGES, CURRENTS, AND POWER IN COMMON AMATEUR RADIO ORIENTED CIRCUITS:

(10) COMMON EMITTER CLASS A TRANSISTOR AMPLIFIER; BIAS NETWORK, SIGNAL GAIN, INPUT AND OUTPUT IMPEDANCES

(11) COMMON COLLECTOR CLASS A TRANSISTOR AMPLIFIER; BIAS NETWORK, SIGNAL GAIN, INPUT AND OUTPUT IMPEDANCES

CIRCUIT DESIGN; SELECTION OF CIRCUIT COMPONENT VALUES:

(12) VOLTAGE REGULATOR WITH PASS TRANSISTOR AND ZENER DIODE TO PRODUCE GIVEN OUTPUT VOLTAGE
(13) SELECT COIL AND CAPACITOR TO RESONATE AT GIVEN FREQUENCY

H. SIGNALS AND EMISSIONS

(1) EMISSION TYPES A4, A5, F4, F5
(2) MODULATION METHODS
(3) DEVIATION RATIO
(4) MODULATION INDEX
(5) ELECTROMAGNETIC RADIATION
(6) WAVE POLARIZATION
(7) SINE, SQUARE, SAWTOOTH WAVEFORMS
(8) ROOT MEAN SQUARE VALUE
(9) PEAK ENVELOPE POWER RELATIVE TO AVERAGE
(10) SIGNAL TO NOISE RATIO

I. ANTENNAS AND FEEDLINES

(1) ANTENNA GAIN, BEAMWIDTH
(2) TRAP ANTENNAS
(3) PARASITIC ELEMENTS
(4) RADIATION RESISTANCE
(5) DRIVEN ELEMENTS
(6) EFFICIENCY OF ANTENNA
(7) FOLDED, MULTIPLE WIRE DIPOLES
(8) VELOCITY FACTOR
(9) ELECTRICAL LENGTH OF A FEEDLINE
(10) VOLTAGE AND CURRENT NODES
(11) MOBILE ANTENNAS
(12) LOADING COIL; BASE, CENTER, TOP

STUDY TOPICS FOR THE AMATEUR EXTRA CLASS AMATEUR RADIO OPERATOR LICENSE EXAMINATION (Element 4B Syllabus)

A. RULES AND REGULATIONS

(1) FREQUENCY BANDS AVAILABLE TO THE U. S. AMATEUR RADIO OPERATOR AND LIMITATIONS ON THEIR USE INCLUDING VARIATIONS FOR REGIONS 1 & 3 97.61; 97.95
(2) SPACE AMATEUR RADIO STATIONS 97.3(1)
(3) PURITY OF EMISSIONS 97.73
(4) MOBILE OPERATION ABOARD SHIPS OR AIRCRAFT 97.101
(5) RACES OPERATION Part 97, Subpart F
(6) POINTS OF COMMUNICATIONS 97.89

B. OPERATING PROCEDURES

(1) USE OF AMATEUR RADIO SATELLITE
(2) AMATEUR FAST-SCAN TELEVISION

C. RADIO WAVE PROPAGATION

(1) EME; "MOONBOUNCE"
(2) METEOR BURST
(3) TRANS-EQUATORIAL

D. AMATEUR RADIO PRACTICE

USE OF TEST EQUIPMENT:

(1) SPECTRUM ANALYZER; INTERPRET DISPLAY; DISPLAY OF TRANSMITTER OUTPUT SPECTRUM, SUCH AS COMMONLY FOUND IN NEW PRODUCT REVIEW ARTICLES IN AMATEUR RADIO MAGAZINES

(2) LOGIC PROBE; INDICATION OF HIGH OR LOW STATE, PULSING STATE

ELECTROMAGNETIC COMPATABILITY:

(3) VEHICLE NOISE SUPPRESSION; IGNITION NOISE, ALTERNATOR WHINE, STATIC

(4) DIRECTION FINDING TECHNIQUES; METHODS FOR LOCATION OF SOURCE OF RADIO SIGNALS

E. ELECTRICAL PRINCIPLES

CONCEPTS:

(1) PHOTOCONDUCTIVE EFFECT
(2) EXPONENTIAL CHARGE/DISCHARGE

MATHEMATICAL RELATIONSHIPS; CALCULATIONS:

(3) TIME CONSTANT FOR R-C AND R-L CIRCUITS (INCLUDING CIRCUITS WITH MORE THAN ONE RESISTOR, CAPACITOR OR INDUCTOR)
(4) IMPEDANCE DIAGRAMS; BASIC PRINCIPLES OF SMITH CHART
(5) IMPEDANCE OF R-L-C NETWORKS AT A SPECIFIED FREQUENCY
(6) ALGEBRAIC OPERATIONS USING COMPLEX NUMBERS; REAL, IMAGINARY, MAGNITUDE, ANGLE

F. CIRCUIT COMPONENTS

PHYSICAL APPEARANCE, TYPES, CHARACTERISTICS, APPLICATIONS, AND SCHEMATIC SYMBOLS FOR:

(1) FIELD EFFECT TRANSISTORS; ENHANCEMENT, DEPLETION, MOS, CMOS, N-CHANNEL, P-CHANNEL
(2) OPERATIONAL AMPLIFIER AND PHASE-LOCKED LOOP INTEGRATED CIRCUITS
(3) 7400 SERIES TTL DIGITAL INTEGRATED CIRCUITS
(4) 4000 SERIES CMOS DIGITAL INTEGRATED CIRCUITS
(5) VIDICON; CATHODE RAY TUBE

G. PRACTICAL CIRCUITS

(1) DIGITAL LOGIC CIRCUITS; FLIP-FLOP, MULTIVIBRATOR, AND/OR/NAND/NOR/GATES
(2) DIGITAL FREQUENCY DIVIDER CIRCUITS; CRYSTAL MARKER, COUNTERS
(3) ACTIVE AUDIO FILTERS USING INTEGRATED OPERATIONAL AMPLIFIERS

HIGH PERFORMANCE RECEIVER CHARACTERISTICS

(4) NOISE FIGURE, SENSITIVITY
(5) SELECTIVITY
(6) DYNAMIC RANGE

CALCULATION OF VOLTAGES, CURRENTS, AND POWER IN COMMON AMATEUR RADIO ORIENTED CIRCUITS:

(7) INTEGRATED OPERATIONAL AMPLIFIER; VOLTAGE GAIN, FREQUENCY RESPONSE
(8) F.E.T. COMMON SOURCE AMPLIFIER; INPUT IMPEDANCE

CIRCUIT DESIGN; SELECTION OF CIRCUIT COMPONENT VALUES:

(9) L-C PRESELECTOR WITH FIXED AND VARIABLE CAPACITORS TO TUNE A GIVEN FREQUENCY RANGE
(10) SINGLE STAGE AMPLIFIER TO HAVE DESIRED FREQUENCY RESPONSE BY PROPER SELECTION OF BYPASS AND COUPLING CAPACITORS

H. SIGNALS AND EMISSIONS

(1) PULSE MODULATION; POSITION, WIDTH
(2) DIGITAL SIGNALS
(3) NARROW BAND VOICE MODULATION
(4) INFORMATION RATE VS. BANDWIDTH
(5) PEAK AMPLITUDE OF A SIGNAL
(6) PEAK-TO-PEAK VALUES OF A SIGNAL

I. ANTENNAS AND FEEDLINES

(1) ANTENNAS FOR SPACE RADIO COMMUNICATIONS; GAIN, BEAMWIDTH, TRACKING
(2) ISOTROPIC RADIATOR; USE AS A STANDARD OF COMPARISON
(3) PHASED VERTICAL ANTENNAS; RESULTANT PATTERNS, SPACING IN WAVELENGTHS
(4) RHOMBIC ANTENNAS; ADVANTAGES, DISADVANTAGES
(5) MATCHING ANTENNA TO FEEDLINE; DELTA, GAMMA, STUB
(6) PROPERTIES OF 1/8, 1/4, 3/8, AND 1/2 WAVELENGTH SECTIONS OF FEEDLINES; SHORTED, OPEN

New Products

from page 28

channel 1 and 147.330 MHz from the microphone only, since M1 CALL and 10k UP and 10k DOWN keys are built into it. The offset can be chosen at will by means of the ±600 SHIFT key, since offset information and memory are stored independently.

Other Controls

Let's discuss more fully the function of that strange rotary switch in the upper right labeled OFFSET/SCAN. The radio operates normally when this switch is to the right of center. The letters represent the scan modes "free," "busy," and "vacant." This switch is responsible for choosing the scan mode. In this respect, the left and right portion of the switch range are identical. But when the switch is to the left of center, an offset is thrown in that does not show up on the display. This offset is +1 MHz with respect to whatever is indicated on the display while transmitting. You can have three nonstandard offsets by using the ±600 SHIFT key in addition to the +1-MHz split. The offsets so obtained are +400 kHz, +1 MHz, and +1.6 MHz. The value of the offset provided by the OFFSET/SCAN switch is controlled by a crystal and can be changed to suit individual needs. This is particularly useful if MARS/CAP operation is contemplated.

The PCS-2000 has two front-panel selectable levels of output power: 25 Watts and 5 Watts. The low-power level can be adjusted from roughly 3 to 7 Watts. To operate in low power, you simply pull on the front-panel squelch knob.

There are two push-in lock switches on the front panel; one is for adding 5 kHz and the other is for selecting front-panel or microphone control of volume and squelch. (It's easy to leave the latter button depressed and then forget about it. This happened to me two or three times. I frantically twisted the front-panel volume knob, wondering why the radio was silent with the squelch wide open!)

Relative power and received signal strength are indicated by the digital LED S-/rf meter. This kind of meter gives surprising detail and is easy to read from a distance. Since each LED can vary in brightness, many different levels are discernible.

Operation and Servicing

In operation, this transceiver is smooth and quiet. There are no relays. Clicking, popping, and squelch tails are hardly noticeable. The microphone PTT button must be depressed firmly to get modulation; pushing it part way in will throw out a carrier but there won't be any audio. It won't hurt to mention again that the OFFSET/SCAN switch should be to the right of center unless you're using a nonstandard split.

The interior of the rear portion houses the transmitter and receiver circuitry which consists of four circuit boards. Each can be removed completely for servicing since all interconnecting wires can be unplugged. The construction of the control head is quite miniaturized, but it comes apart in a logical and orderly fashion. This is in contrast to some units I have seen which appear to be thrown together with no forethought at all. The physical ruggedness is as good as any I've seen. The radio carries a 90-day warranty. All warranty inquiries should be directed to the distributor.

For More Information

The Azden PCS-2000 is distributed by Amateur-Wholesale Electronics, 8817 S.W. 129 Terrace, Miami FL 33176. Detailed specification sheets are available from them, as well as MARS/CAP modification information. Several accessories are available, including a desktop microphone, a gooseneck-type mobile microphone (both with all the remote functions of the standard microphone), touchtone modification kit, 6-Amp power supply, and 15-foot remote cable with control-head mounting hardware. Standard accessories are: microphone, mobile mounting bracket with all hardware, power cable with fuse and spare fuse, and memory backup cells. The PCS-2000 sells for $299. Reader Service number 5.

Stan Gibilisco WA0OKV
Miami FL

New telescopic tower from Aluma Tower Co.

MOBILE TELESCOPIC TOWERS FROM ALUMA TOWER CO.

Aluma Tower Company is now manufacturing five styles of mobile van roof-mounted telescopic towers.

These towers will crank up on the heavier duty model to 60 feet if required. They are manufactured for easy mounting on your van ladder rack so they can be cranked up easily when needed for use and cranked down easily for storage.

These quality-made aluminum towers are tungsten inert gas welded (heli-arc) for strength. These aluminum crank-up van towers are also manufactured with a safety stop for safe, trouble-free usage.

Aluma Tower Company, 1639 Old Dixie Highway, Vero Beach FL 32960; (305)-567-3423. Reader Service number 476.

THE PACE COMMUNICATOR MX

In April of 1979, I decided to buy a hand-held 2-meter rig. I had seen an advertisement on the new Pace Communicator MX and, since I was very satisfied with my Communicator II, I decided to buy one. I bought the Communicator II because of the excellent reputation Pace has in the commercial two-way radio field. When I decided to buy a 2-meter hand-held, the Pace ads for the new Communicator MX intrigued me. Then, at the Two-Way Radio Dealers' Show at Denver, I saw one in the flesh. I was hooked and had to have one.

The controls and layout are not only simple, but also functional. On top is the on/volume control, the squelch control, and the channel selector knob. On one side is the PTT and the offset selector switch, which provides +600 kHz, −600 kHz, and simplex. On the front is the Hi-Lo power switch and the meter-type battery level indicator. The antenna connector, a BNC (my favorite: no fumbling when switching to an external antenna for mobile), and a factory-wired, external microphone jack are also located on the top. Using 13 diodes, 12 transistors, 1 FET, and 3 ICs, the Communicator MX operates in a 16F3 mode. Pace uses offset modulator crystals of 17.5 MHz for the +600, 16.9 MHz for the simplex, and 16.3 MHz for the −600 switching. Power output is rated only as 1 Watt on high (mine measured 1.6 Watts on high and .75 Watts on low) into a nominal 50 Ohms. Deviation is ±5 kHz (adjustable). Spurious harmonics are more than 50 dB below carrier level and frequency stability is better than 15 ppm from −30° to +60° C.

The receiver is a double superheterodyne using 16.9-MHz and 455-kHz i-fs. Sensitivity is rated at less than .5 microvolts for 20-dB quieting or .35 microvolts for 12-dB SINAD (mine checked out at .30 microvolts for 20 dB and .20 microvolts for 12-dB SINAD). Image and receiving spurious rejection is 60 dB down; selectivity is 60 dB down at ±12 kHz. Audio output is at least 400 mW at 10% THD.

The Communicator MX requires only one crystal per channel, weighs 1.03 pounds (with batteries), and measures 6.06" H x 2.67" W x 1.64" T. The MX draws only 300 mA transmit (1 W) and 100 mA receive unsquelched (25 mA squelched).

By removing one screw, the front snaps off, allowing *easy* access to all controls, adjustments, and crystals. This unit is a jewel to work on, compared to many others I have seen.

The Communicator MX comes with a .52 crystal, rubber duck, vehicular charge adaptor, and nicad pack. Pace is maintaining a stock of the standard repeater frequency crystals, or these may be ordered from your regular crystal supplier. I have found the delivery from Pace excellent: less than two weeks!

The Communicator MX, priced at $265.00, carries a dealer-backed factory warrant for one year. For further information, contact a Pace dealer.

Pathcom, Inc., Amateur Radio Products Group, 24105 South Frampton Ave., Harbor City CA 90710; (800)-421-1196; in CA, (800)-261-1208. Reader Service number 478.

Larry L. Vaughan KA5ECP
Los Alamos NM

A REVIEW OF THE KENWOOD TR-2400 HAND-HELD

I can't remember when I have been as favorably impressed with a new piece of ham radio equipment as I have been with my new Kenwood TR-2400. This new microprocessor-controlled, hand-held, 2-meter FM rig has many advanced operating features that make it compare favorably with many larger mobile and base station rigs that I have used.

The TR-2400 covers the entire 2-meter band, with some additional coverage at each end of the band for MARS operation. Synthesized 5-kHz channels are selected by pushing the calculator-style keypad switches on the front of the rig, and both receive and transmit frequencies are displayed on a large liquid-crystal digital readout display above the keypad on the front panel. The liquid-crystal display is on whenever the rig is on. It is very easy to read and is not washed out by bright sunlight. A front-panel switch turns on a lamp to illuminate the display for night viewing.

For repeater operation, a top-mounted rotary switch selects the transmitter offset: +600 kHz, −600 kHz simplex or a fourth position that allows for operation with any non-standard repeater split by offsetting the transmitter to a frequency stored in memory.

Speaking of memory, this little rig has ten programmable memories! This may seem like a bit of overkill at first, but if you are like me, you will soon find that you are using them all! It is very handy to be able to return to a frequency instantly by simply punching up the appropriate memory channel.

Memory programming is easy: Simply push the "M" key followed by a number key (0 to 9) and the displayed frequency is entered into the memory channel corresponding with the number key that was pushed.

Frequencies are recalled from memory in a similar manner, by pushing the "MR" (memory recall) key followed by the desired memory number key. All frequencies stored in memory are held in storage even if the TR-2400 power switch is turned off. The memory circuitry used draws only 700 microamps from the rig's battery, so a freshly-charged battery will hold the memories' contents for over four weeks without a battery recharge.

The TR-2400 also offers very convenient scanning features. You can scan the memory channels by simply pushing the "MS" key, and the rig will scan through the ten memories, always starting with memory number one. The memories are scanned at a rate of approximately one channel per second, which allows enough time to read the frequencies displayed as channels are sampled. A top-panel-mounted "busy/open" switch selects one of two memory scanning modes. In the "busy" position, the rig will stop scanning on the first occupied memory channel. Scanning will resume when that signal goes off the air. In the "open" switch position, the scanning will stop on the first memory channel that is not occupied. Scanning can be instantly stopped at any time by simply pushing the "stop" key.

The TR-2400 also provides a manual or "band scan" function. Two of the keys on the keypad control this feature. If the "up" key is pressed once, the frequency will increase by 5 kHz, and if this key is held down, the rig will scan rapidly up the band. Similarly, pushing the "down" key once will cause the frequency to decrease by 5 kHz, and holding this key down will cause the rig to scan rapidly down the band. Using these two keys allows you to "tune" up and down the band to search for the presence of signals. The scan rate for this function is very fast . . . about 80 kHz per second. You can scan through the entire 4 MHz of the 2-meter band in less than a minute.

The TR-2400 has two "lock" switches on the front panel: One is used to disable the push-to-talk switch, the other is used to disable the keypad switches. These two functions come in very handy if you are carrying the rig in your pocket and don't want to be surprised by an unwanted transmission or frequency change! The squelch and on-off/volume controls are top mounted, a convenience that allows adjustment of these controls without removing the transceiver from your pocket.

The liquid-crystal readout, in addition to displaying the receive and transmit frequencies, also shows the memory channel number in use and has four small triangle shaped indicators that are activated to indicate: (1) The rig is in the transmit mode, (2) the frequency displayed has been recalled from memory, (3) the lamp switch is on, and (4) the batteries need charging.

In addition to the frequency and memory control functions, the keypad also functions as a full 16-key touchtone pad when in the transmit mode. There is also a switch provided to enable an internal subaudible tone encoder or PL. Kenwood does not provide or make available a tone encoder module, but they are available from a number of sources or can be home-brewed.

A momentary action push-to-reverse switch can be used to reverse the transmit and receive frequencies instantly to listen on the input of a repeater. This feature is very handy to use for checking to determine if you are within simplex range of a station being heard or worked via a repeater.

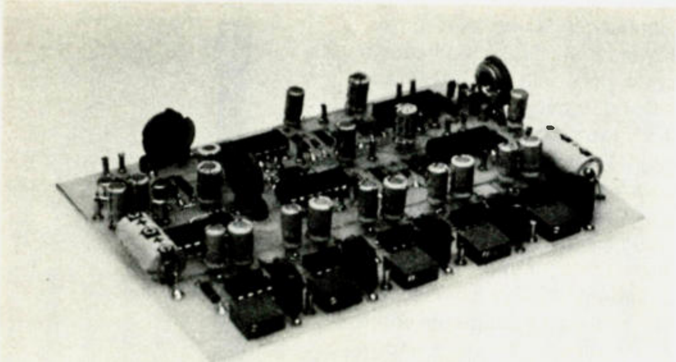
Input/output jacks include an external speaker/earphone output jack, external microphone and push-to-talk inputs, charger input, and a standard BNC connector for the antenna connection, which makes the antenna changing easy for mobile/portable change-over. This transceiver has separate speaker and microphone elements, and, like the built-in microphone, the remote microphone input is designed to accept a condenser microphone. A low-impedance dynamic microphone can also be used if a 1 microfarad non-polarized capacitor is added in series with the microphone "hot" lead to block dc.

TR-2400 hand-held from Kenwood.

The battery pack in the TR-2400 is a 9.6-volt, 500-mAh nicad unit constructed from eight size AA nicad batteries.

The ac charger that is supplied with the TR-2400 is a constant-current charger. The TR-2400 must be turned off to accept a charge from this charger, and a full charge takes 15 hours. Optional quick-chargers are available as accessory items.

Like most hand-held rigs, battery life is on the short side, but if you listen much more than you transmit, you will get surprisingly long operation from a charge. Using a laboratory-grade digital multimeter, I measured battery current drain as follows:



Spectrum's TTC100.

squelched (or scanning)—27.2 mA; squelch open, audio at minimum—37.6 mA; receiver at "normal" audio level—40.0 mA; very loud audio volume level—50 to 100 mA; transmitting—525 mA; display lamp on—25.0 mA additional.

The above current drain conditions would correspond to battery charge life conditions as follows: continuous squelched—18.4 hours; continuous receiving—12.5 hours; continuous transmitting—0.95 hours.

A realistic example of combined operating time would be: ½ hour transmitting, 8 hours receiving and scanning.

I've found the TR-2400 to be a very smooth working little machine! Not only is it a great little portable rig, but I've found its many convenient features make it a very good performer for mobile operation as well! Using a magnetic-mount 5/8-wave whip antenna on the roof of my car, I have no trouble at all hitting my favorite repeaters with the TR-2400's 1½ Watts output . . . and the TR-2400 is small enough that I even have room for it in my compact car.

Audio quality is excellent, both on transmit and on receive, and when used with a larger external speaker, the receiver sounds as good in my base station as any 2-meter rig I've used. Receiver sensitivity is excellent . . . much better than I would have expected from such a small package.

A radio this small with all its sophisticated features could have been described by a science fiction writer twenty years ago. Today, it's merely taken for granted as a product of our expanding technology. My overall impression of the TR-2400 is that it is a terrific rig . . . almost the ultimate in a hand-held. But I'm an old "nitpicker" who can find faults with anything, and I have three minor nits to pick with the TR-2400:

1. The low battery indicator, in my opinion, does not give sufficient "early warning" of a low battery condition. When the low battery indicator comes on, you have to say your 73's fast . . . because there is only about one minute of transmit time remaining!

2. There is a slight delay of about a half second after the push-to-talk switch is pressed before the rig actually starts transmitting. This fact must be constantly kept in mind or the first part of a transmission can be clipped out!

3. When using the earphone supplied with the TR-2400, there is a very loud and annoying click that occurs on squelch break. I've found that adding a 200- to 600-Ohm resistor in series with the earphone reduces the earphone's sensitivity sufficiently to allow a higher volume control setting to be used. This effectively reduces the click sound to a tolerable level. I would suggest using a 1/8-Watt resistor and installing it in the earphone itself, rather than at the earphone jack inside the rig, as this method will still allow for driving an external speaker from the earphone jack when desired.

The TR-2400 price class is under $400 and it comes complete with nicad battery pack, charger, earphone, wrist strap, and rubber flex antenna. Optional accessories include a leather holster carrying case, a spare battery pack, a service manual, and quick chargers for both ac and 12-volt dc that will fully charge a dead battery in an hour and a half.

In conclusion, the TR-2400 is a superb portable transceiver. I can only think of one thing that it is lacking: a signal strength indicator. (I think a "bar graph" type indicator incorporated in the liquid crystal display would be great for the S-meter function!) Not only is this new rig a top performer, but it is also one of the best looking rigs I've seen. I've found that carrying a portable hand-held of this type will attract a lot of attention from non-hams. It's a great way to start up a conversation and introduce someone to amateur radio. *Trio-Kenwood Communications, Inc., 1111 West Walnut, Compton CA 90220.*

John Rehak N6HI
Garden Grove CA

SPECTRUM'S TTC100 TOUCHTONE™ DECODER/CONTROL BOARD

The TTC Touch-Tone™ Decoder/Control Board is designed to remotely switch a control function in a repeater or other radio system by means of a 3-digit touchtone control code. The board can be used for various on/off applications, including transmitter on/off, autopatch on/off, PL on/off, high/low power, and audio on/off, for selective calling using individual codes, etc. The audio tone input to this board can be from the repeater's receiver, an auxiliary receiver, a land-line link or any other audio source.

The TTC100 employs a digital anti-falsing design which prevents false triggering of the control function by stray noise, voice, or other tones. Also, the correct tones must be entered in the correct sequence or the circuit will not trigger.

The output switching circuitry can be jumper-wired to produce a 5-V TTL level trigger pulse, or latch on or off. Two transistor switches are provided to trigger external circuitry, e.g., relays, external logic, etc. These transistor switches can sink as much as 100 mA each. The 3-digit code can be changed in the field with a minimum of effort by changing jumper wires and retuning the decoders. Five phase-locked-loop tone decoders are provided on the board for good flexibility in tone selection. Multi-turn cermet trimpots are used for ease of "setability" and maximum stability. Low-current-draw CMOS logic is used (TTL compatible).

Spectrum Communications, 1055 W. Germantown Pk., Norristown PA 19401; (215)-631-1710. Reader Service number 68.

HDR300 ROTATOR

Telex's model HDR300 matches a rugged heavy-duty rotator with a digital-readout control console. This is a military/industrial grade rotator which is priced to be practical for amateur use. The model HDR300 easily handles up to 25 square feet of antenna area with an additional 15% safety margin—even in high winds! This new rotator has muscle to spare, with a stall torque of 5000 in/lbs (567 N/m)—higher than any amateur antenna rotator currently on the market. It also features a brake holding torque of 7500 in/lbs. (850 N/m) and a mechanical travel of 390°. The HDR300 will support 500 lbs (227 kg), will accept masts of 1¾" (44.4 mm) to 3" (76.2 mm) o.d. and uses a 24-volt ac motor for safe, reliable operation.

The state-of-the-art control console features a digital azimuth readout which is accurate to ±1°. The brake is automatically engaged when you turn the rotator off. Furthermore, the brake release and rotation functions are separate, ensuring complete brake control and extended rotator life. A single eight-conductor control cable connects the rotator with the control console. *Telex Communications, Inc., 9600 Aldrich Avenue South, Minneapolis MN 55420; (612)-884-4061.* Reader Service number 316.

HUSTLER ENTERS 220-MHZ AMATEUR BAND WITH INTRODUCTION OF ALL-NEW 1¼-METER 7-DB GAIN VERTICAL FIXED STATION ANTENNA

The all-new Hustler 220-MHz vertical fixed station amateur antenna, designated the Model G7-220, was recently introduced by Hustler, Inc. The G7-220 marks Hustler's entry into the now-popular 220-MHz band and complements their existing base and mobile amateur antenna line. The superior 7 dB gain of the antenna, for both transmitting and receiving, makes it the most powerful omnidirectional 1¼-meter antenna available. The all-new rugged design of the

Hustler G7-220 antenna keeps the signal radiation pattern at the lowest possible angle to the horizon for maximum efficiency and longest range

The Model G7-220 has an swr of 1.5:1 across its entire 5-MHz bandwidth, with swr at resonance of 1.2:1 at the antenna. The radiating element of the Hustler G7-220 is dc grounded for static discharge and the antenna has a 50-Ohm feedpoint impedance.

This new Hustler 220-MHz vertical combines the latest antenna technology and the best available corrosion-resistant materials for extra-long life. Only Hustler uses all stainless steel hardware in amateur and professional products. Each component is precisely built for quick and easy assembly.

The 122"-long vertical element and four 14¾"-long radials of the G7-220 are made from high-strength heat-treated aluminum. Each radial is 3/16" o.d. The G7-220's N-type connector, used on all new Hustler amateur verticals, provides a tight all-weather seal and virtually perfect rf characteristics under all conditions.

The G7-220 weighs only seven pounds and is easily mounted on any vertical support up to 1¾" o.d. Wind loading of the antenna is only 26 pounds at 100 mph velocities.

For further information on this or other Hustler products, write *Hustler, Incorporated, 3275 North B Avenue, Kissimmee FL 32741.* Reader Service number 305.

HEATH INTRODUCES A NEW AMATEUR RADIO TRI-BAND BEAM WITH HEATHKIT ASSEMBLY MANUAL

Heath Company, the world's largest electronic kit manufacturer, appears to have good news for any amateur who ever tried assembling a beam antenna. The Heathkit SA-7010 triband yagi comes with a step-by-step manual, something the ham community has been asking for.

This 4-element 20-, 15-, and 10-meter beam features three active elements on each band and is said to give 8.3 dB actual gain over a dipole. Front-to-back ratio is listed at 25 dB. A separate reflector is provided for correct monoband spacing on 10 meters. Vswr, according to Heath, is less than 1.5:1 at resonance on each band. The SA-7010 is rated for full legal power.

The boom length of this tribander is 16 feet, with a longest element of 31 feet. Turning radius is 17 feet, 5 inches, and wind surface area is 5.8 square feet.

Because of the detailed instruction manual, Heath expects this new beam to be popular not only with individual hams, but also with amateur radio clubs who seek easy assembly for Field Day use.

Heath Company is a subsidiary of Zenith Radio Corporation. *Heath Company, Benton Harbor MI 49022.* Reader Service number 303.

TE-12P PROGRAMMABLE TWELVE-TONE ENCODER

A new product recently released by Communications Specialists is a programmable twelve-tone encoder, available in either subaudible or burst-tone configuration.

In the subaudible range, this encoder will allow the programming of twelve standard frequencies from 67.0 Hz to 203.5 Hz, and in the audible range, burst tones may be selected in the range of 1600.0 Hz to 2550.0 Hz in 50-Hz increments. Additionally, there are thirteen other frequencies available which may be used for either burst or test purposes.

This encoder is housed in a durable plastic case measuring 5.25" x 3.3" x 1.7" and is complete with mounting bracket and hardware. It may be powered by voltages from 6 to 30 V dc unregulated at 8 mA and provides a low-impedance, low-distortion, adjustable sine-wave output of 5 volts peak-to-peak. Reverse polarity protection is built in.

Programming each channel of this encoder is a simple matter and can be done in seconds. A 5-position DIP switch is furnished for each of the twelve channels. It is merely a matter of setting each switch to the proper ON and OFF positions to achieve a binary-coded frequency.

The output level is flat to within 1.5 dB over the entire range of frequencies selected. In the low frequency range, the frequency accuracy is ±.1 Hz; in the high frequency range, the accuracy is within ±1.0 Hz. Subaudible tones are designated as Group A tones and audible frequencies are Group B tones. No counter or other frequency measuring device is needed to set frequencies.

A full one-year warranty is provided if the unit is returned to the factory for repair. *Communications Specialists, 426 West Taft Avenue, Orange CA 92667; (714)-998-3021 (California); (800)-854-0547.* Reader Service number 15.

REGENCY K500 PROGRAMMABLE SCANNER

Regency has come a long way since the introduction of its "Touch," a programmable VHF/UHF scanner. The K100 was a distinct improvement, and the new K500 has even greater flexibility.

The K500 follows the styling of its predecessors. Two touch-pad clusters provide frequency entry, frequency banks, and commands. Frequency range of the K500 is identical to that of previous models: 30-50, 144-174, and 440-512 MHz FM.

The "500" nomenclature refers to the 545 preprogrammed ROM channels. By pressing one of three service-search keys, the listener may scan specific frequencies assigned to police, fire, mobile telephone, and weather.

Additionally, 40 touch-entry RAM channels may be programmed to any frequencies within the tuning range of the scanner. Because they are in five banks of eight channels each, it is possible to switch in and out sets of frequencies at will. This is handy for programming ham repeaters in one bank, ambulance/emergency channels in another, i-f frequencies when using the receiver with an external converter, and so on.

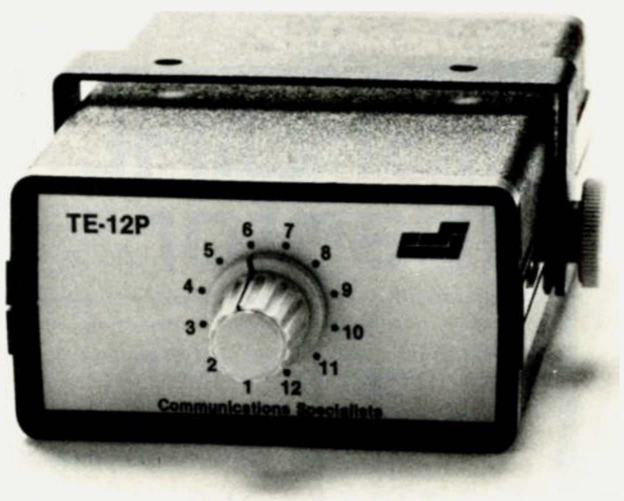
I was pleased to see that the scan and search rate of the K500 was 15 channels per second. One difficult design challenge in scanning receivers is providing good tracking of the rf stages while the frequency is changing rapidly. Coupled with the large burden of commands on the microprocessor in such a sophisticated piece of equipment, rapid scan/search rate is a real bonus.

Channel spacing is automatically 5 kHz on VHF, 12.5 kHz on UHF. Fourteen other increasing channel spacing increments up to 75 kHz on VHF and 187.5 kHz on UHF may be commanded at will. Selectivity is a sharp ±7.5 kHz at 6 dB, ±18 kHz at 18 dB.

Scan delay is selectable as either .6 or 2 seconds, while search delay is 4 seconds (nominal delay times).

While the LED display is still small when compared to those on competitive models, it is still clearly visible from the operating position. Including the three different frequency range displays, nearly two dozen types of readout signals alert the user to various programming options and warnings. Power failure, out-of-band entry, low battery voltage for memory, weather channel selected, and many other status signals will appear automatically as appropriate.

The K500 has a built-in clock which can display hours, minutes, and seconds. In addition, an alarm can be activated



Communications Specialists' TE-12P.

New code reader from Microcraft.

by the operator.

A weather alert function is selectable in the scanner; when the National Weather Service broadcasts a warning tone, the scanner will automatically lock on the weather channel to provide the message regardless of the present functional status of the scanner (other than search or time). It is defeatable if not desired.

A priority channel is also available for any local frequency of importance. When the priority function is engaged, the receiver will sample the prioritized channel every two seconds, causing a brief interruption in any transmission to which you are listening. While this may take some getting used to, it is unlikely that any information will be missed during the brief split-second intermission.

During search, active channels will automatically stop the search function and display their frequencies. By pressing the "STORE" key, up to eight of these frequencies may be stored automatically in memory for later recall. This permits the user to leave the receiver unattended, returning later to see what frequencies came up during search. He may further identify the sources of any transmissions by the use of the auxiliary function, an automatic switch for activating a tape recorder any time the squelch breaks.

Search-stored frequencies are automatically written into bank 500. The entire bank may be moved to another bank (100 through 400), freeing up bank 500 for another eight intercepted channels, or the former eight may be written over after reviewing the frequencies merely by reactivating the search/store function.

Another feature of the K500 is its ability to count the number of transmissions intercepted on a channel up to 32,767. For example, if you would like to know whether a local repeater gets much use but don't particularly feel like listening to it all day, let the K500 do it for you.

The count feature is also a handy research tool for determining the activity of assignable channels to determine the one which is least likely to have interference from other users.

One unadvertised advantage of the K500 (and the K100 as well) is its unique ability to be programmed beyond its advertised frequency range. Simply by pressing the decimal key immediately before entering the desired frequency, the lower limit of the tuning range may be extended several megahertz. The upper limit is extended slightly.

For further information, write *Regency Electronics, Inc., 7707 Records St., Indianapolis IN 46226*. Reader Service number 477.

Robert B. Grove
Brasstown NC

MICROCRAFT MORSE-A-WORD CODE READER

An eight-character Morse code reader has been introduced by Microcraft Corporation for SWLs, beginners, and veteran amateur radio operators. It accepts audio signals from a communication receiver's headphone jack or loudspeaker and displays the decoded characters. All text characters—letters, numerals, punctuation marks, special Morse symbols and word spaces—are shown sequentially on the display in moving character fashion. Code speeds of 5 to 35 wpm can be copied depending on the setting of the front panel control. The MORSE-A-WORD also includes a built-in code practice oscillator and monitor speaker for Morse code practice sessions. Complete kits and wired and tested versions are available. It measures 7.37" W x 5.75" D x 3.37" H. Net weight is 4 lbs. For more information, phone or write *Microcraft Corporation, PO Box 513, Thiensville WI 53092; (414)-241-8144.* Reader Service number 50.

Ham Help

I would like to build the 140-Watt solid-state linear amplifier (1.6-30 MHz) described in the 1979 and 1980 *Radio Amateur's Handbook*. If anyone has located the parts to build this unit as described in the book, please contact me.

Most important to find are the Ferroxcube VK200 19/4B, Stackpole and Fair-Rite Products ferrite beads and cores, and the heat sinks: Thermalloy 6153 or Aavid Engineering 60140 extrusion.

If anyone has schematics of this type of amp (broadband, 100-Watt or more), I will pay for copies.

John Pisarski
114 Evans Road
Norristown PA 19403

I'm looking for a Sams' book, *101 Ways to use your Sweep Generator*, TEM-1. I would like to buy or borrow and return.

B. J. Wenner VE6WN
Box 66
Ralston, Alberta
Canada T0J 2N0

I am trying to contact Edward H. Dollar, who operated as KZ5SD (silver dollar). Any information regarding his present address will be greatly appreciated.

Jack C. Petree WB4OVX
3232 West Ridge Road, SW
Roanoke VA 24014

Corrections

In the article, "Lab-Quality Hi I Supply" (March, 1980), the following changes should be made:

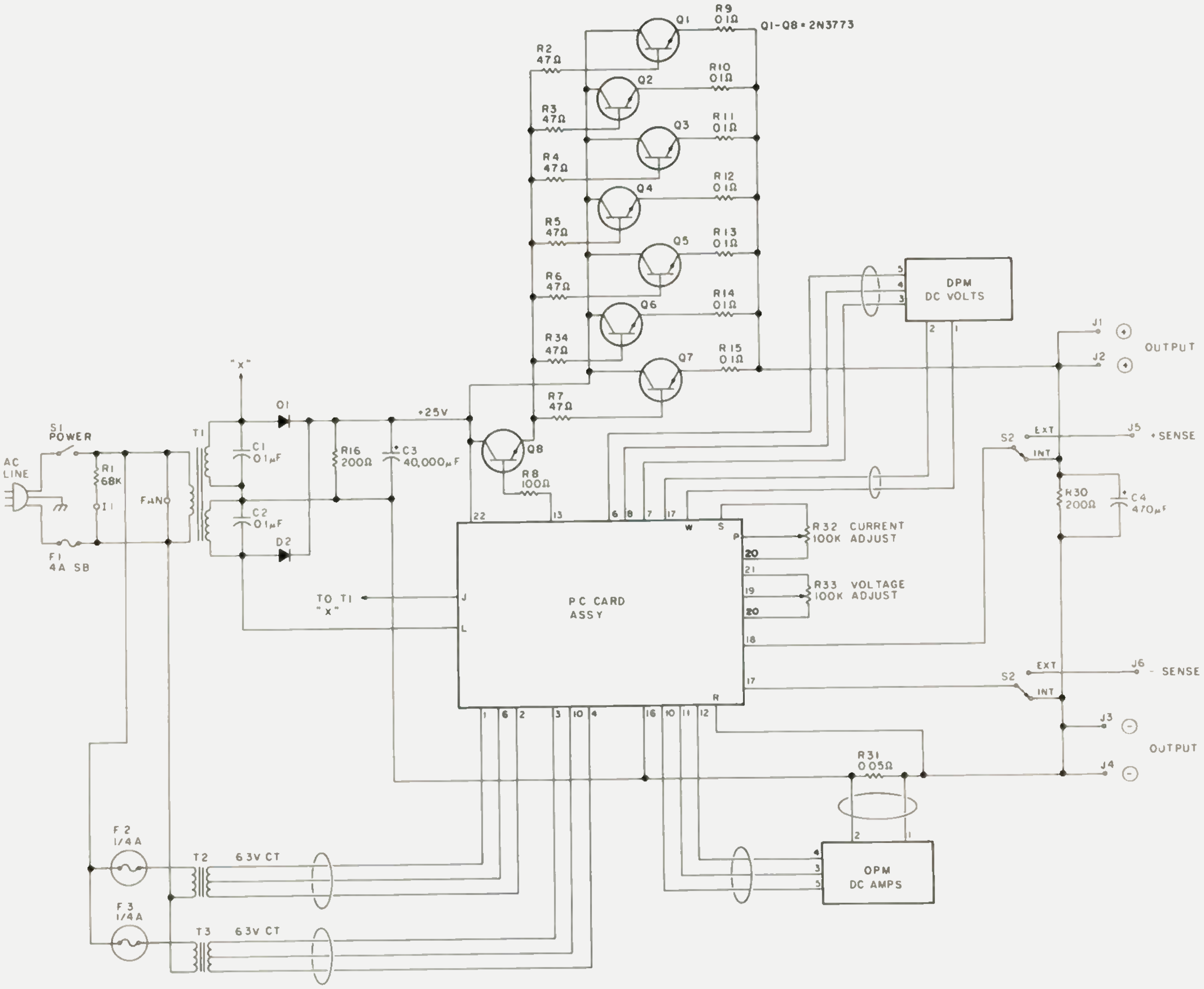
1) In Fig. 3, page 89, the arrow from the anode of D3 should go to R24 only, *not* to R22–R23 as indicated.

2) On page 90, column 1, lines 11 and 12 should read, "those resistors, R2–R6, R34, and R9–R15, are necessary to pre-."

A corrected Fig. 4 also appears here. There is a wiring change at Q8 and the addition of missing pin numbers on the PC card block.

We apologize for the errors and any inconvenience which they have caused.

Susan Philbrick
Asst. Managing Editor



Revised Fig. 4. "Lab-Quality Hi I Supply."

Ham Help

I would appreciate any information I could get on mods for the Kenwood TS-820S, mods to expand the frequency range of the Clegg FM-28, and information to convert the Fanon model IC-5000 or Courier CWT-50 6-channel CB handie-talkies to ten meters. Thank you.

David K. Gordon
WB2YUJ/NNN0WNI
155 Nimbus Road
Holbrook NY 11741

I would like to get in touch with anyone who is interested in improving the Macrotronics M650 RTTY program.

David L. Shiplett WL7ACY
5062F Polaris Street
Eielson AFB AK 99702

I need information on firing up a Globe Electronics transmitter, model HG-303, operating manual or plain-English instructions. I will gladly pay for any reproducing or shipping charges. Many thanks.

Frank E. Jankowski N3AWO
3225 Gaul Street
Philadelphia PA 19134

I desperately need a manual and schematic for an RT-841/PRC-77 field radio. I've tried everywhere, including Fair Radio. I will pay for any shipping or copying charges. Any help would be greatly appreciated.

Tommy Norris
Rt. 1, Box 412
Auburn KY 42206

I would like a mint-condition Wilson 220-MHz transceiver preferably with touchtone™ pad—cash or trade.

Charles M. White, Jr., M.D.
PO Box 8577-A
Greenville SC 29604
(803)-242-5642

I'm looking for a Collins KWS-1 transmitter, a PTO assembly #70E23, or component parts. Please include description and prepaid prices. Thanks.

Graham G. Kent W7CZL
13387 Lester Road NW
Silverdale WA 98383

Leaky Lines

from page 14

coffin, with a bug under his right hand. A power supply was also interred. Both an ac line and a coaxial cable were to be run from the casket, to be attached to a power outlet and an antenna rigged in a nearby tree.

That is all I know of this matter, but I would dearly love to know whether these arrangements were carried out when they planted this fellow. I don't know how long they maintained a vigil on the appointed frequency, or indeed, whether anyone ever took the thing seriously enough to monitor for the signal of the decedent, whose call letters I can no longer recollect.

But, please, if anyone knows anything about this, I'd be obliged greatly if you would drop me a line about it. Talk about hidden transmitter hunts!

Contests

from page 25

ceived, band used, type of emission, and multipliers claimed. Summary of score and checklist will be appreciated. Mail entry, with a large letter-sized SASE for return of awards and summary, postmarked by June 1st to: Atlanta Radio Club, Inc., c/o Johnny Jones WD4OPT, 1671 Bristol Drive, Atlanta GA 30329. Standard disqualification rules will apply.

WORKED ALL BRITAIN CONTEST—HF CW

Starts: 0900 GMT May 11
Ends: 2100 GMT May 11

There are 5 Worked All Britain Contests during the year. The first was on March 30th, but the information was received too late for publication. The remaining dates are shown in the calendar.

All contacts must be made using CW on the 20- to 10-meter amateur bands. Operating classes include: single- or multi-operator, single- or multi-band, and SWLs. In the case of multi-operator, only one transmitter may be used at any time. There is a special section for mobile operators.

EXCHANGE:

RST, QSO number from 001, WAB area and county. Book numbers and districts may be requested, but are not mandatory as part of the exchange.

SCORING:

Score 5 points for each completed QSO. Stations may be worked on other bands for extra points.

Multipliers for UK contestants are each WAB area and each overseas country (DXCC list). In addition, Alderney, Guernsey, Jersey, and Sark count as separate countries. The remainder of G, GD, GI, GM, and GW count as one multiplier only.

Multipliers for overseas contestants are each WAB area, county, and each G prefix (G, GD, GM, and GW). Multipliers count on each band, i.e., a station worked on three bands = 3 multipliers.

For mobile entries, every contact made from a different area will count five points, but the multiplier counts once only (for example, mobile station from ten different areas—score is 10 times 5 points, but only one multiplier for the mobile station).

AWARDS:

Certificates for the leading contestant in each class or entry. For awards, each G prefix is separate. There will also be certificates issued to the leading contestants from each DXCC country and also to SWLs. Certificates for 2nd and 3rd will be issued if there are 10 or 25 entries from a particular country or call area.

ENTRIES:

Logs must show the title of the contest, name and full postal address of the contestant, QSO details, total points claimed, multipliers claimed, and the full details of all operators when multi-operator entry is submitted. Logs must be sent to the Contest Manager: R. L. Senter G4BFY, 27 Station Road, Thurnby, Leicester LE7 9PW, England.

Entries must be postmarked not later than one calendar month following the date of the contest and must be received by the contest manager not later than 40 days following the said contest. A signed declaration that the station was operated in accordance with the current licensing conditions must accompany all entries. It is a condition of entry that the decision of the WAB Contest Manager and the WAB Committee shall be absolute in the case of dispute. For SWLs, all stations logged must be participating in the contest and giving serial numbers which must be logged. The results will be reported to the RSGB and the Contest Manager will supply a detailed result sheet on receipt of an SAE on or after November 1st.

DOGWOOD FESTIVAL QSO PARTY

Saturday, May 17
1300 to 2200 GMT

Operating on six amateur bands with the club call WB1CQO, members of the Greater Fairfield Amateur Radio Association will explain the significance of the community-wide Dogwood Festival during QSOs. Contacts will be confirmed with a special commemorative QSL card. Stations wishing to work the Dogwood Festival station, WB1CQO, should check these SSB frequencies: 3975, 7235, 14330, 21420, and 28710. FM operation will be on 146.55 simplex. Special QSLs will be sent upon receipt of an SASE or IRCs to: QSL Manager Grace von Stein WB1GVZ, 248 Euclid Avenue, Fairfield CT 06432.

The Dogwood Festival celebrates the blossoming of 30,000 dogwood trees. Fairfield's original white dogwood trees were planted in 1795, with pink varieties imported from Japan 100 years later. The Dogwood Festival began in 1936 and today thousands of visitors flock to the historic area when the dogwoods are at the height of their bloom.

TRI-STATE QSO PARTY

Starts: 0001 GMT May 17
Ends: 2400 GMT May 18

The Tri-State Amateur Radio Association is instituting a new award to establish an awareness of amateur radio in the Tri-State area. This QSO party is intended to help kick off the new award program. Look for Tri-State activity on the following frequencies: Phone—3935, 7235, 14280, 21380, 28575; CW—3550, 7050, 14050, 21050, 28050.

For the purpose of this award, the Tri-State area will consist of those parts of West Virginia, Kentucky, and Ohio that lie within a 20-mile radius of Huntington, West Virginia.

To qualify for the award, an amateur radio station within the continental limits of the United States must submit proof of 2-way contacts with 10 amateur stations within the Tri-State area, 4 of which must be members of the Tri-State Amateur Radio Association. Stations outside the continental limits of the United States need only 5 contacts within the Tri-State area, 2 of which must be members of the Tri-State Amateur Radio Association. A contact with a Novice station within the Tri-State area will count as two contacts toward the award. Contacts may be made on any amateur band; however, not more than 1 contact can be made through a repeater.

Only contacts made after May 16th may be counted toward this award. As proof of contact, do not send QSL cards. Send a copy of the log listing call letters, date, time, and band. Do not send an SASE. This log must be verified by two other amateurs or an officer of an amateur radio club and mailed to: TARA, Attn: Jim Baker K8KVX, PO Box 1295, Huntington WV 25715.

FLORIDA QSO PARTY

Starts: 1500 GMT May 17
Ends: 2359 GMT May 18

This is the 15th annual Florida QSO Party sponsored by *Florida Skip*. All amateurs worldwide are eligible and invited to participate. All amateur bands may be used. All stations will separate phone and CW logs. A station may be worked once on each band on each mode. Neither crossband nor crossmode contacts will count for contest credit. Florida stations may work other Florida stations, but for contest points only. Out-of-state stations may not work each other for contest credit. Contacts made on repeaters do not count for credit.

Florida stations will be divided into two classes. Class A stations are those operating portable or mobile on emergency power and running 200 Watts or less inside Florida but outside of their home counties. Class B stations are all other stations operating in Florida.

Each entrant agrees to be bound by the provisions of the contest announcement, the regulations of the applicable licensing authority, and decisions of the *Florida Skip* Contest Committee, which are final.

EXCHANGE:

Florida stations send RS(T) and county of operation. Others send RS(T) and US state, Canadian province, or country.

FREQUENCIES:

Phone — 3945, 7279, 14319, 21379, 28579, 50.2, 146.52.

CW — 3555, 7055, 14055, 21055, 28055.

SCORING:

Florida stations count one point per QSO with out-of-state or other Florida stations. Multiplier is the sum of states (49 max.), provinces (12 max.), DX countries (25 max.), and ITU regions (5 max.) actually worked; maximum multiplier is 91. Others count 2 points per QSO with each Florida station. Multiplier is the number of different Florida counties worked (67 max.). Final score is the product of QSO points and the multiplier. Class A stations only multiply score by 1.5 to obtain final total.

AWARDS:

Certificates for phone and CW to the top single-operator score in each state, province, DX country, and each Florida county. There are also 5 plaques to be awarded as follows: high single operator in Florida and out-of-state, CW and phone, and the Florida club with the highest

Results

RESULTS OF THE 1979 MICHIGAN QSO PARTY
Sponsored by the Oak Park Amateur Radio Club

MICHIGAN RESULTS

Call	*Score*	*County*
K8RO**	62,560	Oakland
W8PBO*	60,350	Macomb
K8WS	48,000	Saginaw
WA8MAM**	42,768	Houghton
K8OT	40,920	Saginaw
WD8ITS	39,680	Alpena /8†
WD8QOY*	20,856	Bay
W8JKU	18,069	Oakland
K8DD*	17,700	St. Clair
WB8ZJL	12,896	Macomb
WD8QBB*	12,626	Midland
N8AOE	10,176	St. Clair /8
N8AWD	9,840	Macomb
WD8JRU	9,800	Bay
K8AQM*	9,180	Lenawee
WD8NNM	7,568	Macomb
WB8SLQ	6,560	Macomb
WD8JNP	5,680	Saginaw
N8ADW*	5,434	Arenac /8
WD8QXM*	5,280	Otsego /8
N8MK	5,148	Saginaw
W8YL	4,968	Lenawee
W8LDB	4,560	Oakland
K8SJQ*	4,454	Iosco
WD8QVD	4,444	Oakland
WB8ZJI	4,059	Macomb
WB8LWS	3,731	Macomb
K8KIC	3,675	Lenawee
WA8AFS	3,610	Lenawee
AC8A*	3,500	Roscommon
W8ETH	3,404	Oakland
W8WVU*	3,008	Hillsdale /8
AE8D	2,970	Macomb
KB8GC*	2,871	Missaukee
WD8QNM	2,720	Macomb
W8WVU	2,256	Lenawee
W8YY	2,130	Houghton
N8AJA	1,950	Macomb
WA8QAF	1,925	Macomb
WD8KAM*	1,736	Wayne
KB8EU	1,674	Lenawee
K8MAJ	1,540	Macomb
WB8SYA*	1,428	Dickenson
WB8ZME	1,352	Macomb
W8RNY	800	Macomb
KB8AX	798	Macomb
WA8ZTQ*	768	Ingham
N8ABW	480	Lenawee
WD8LBH	435	Oakland
WD8JRU*	420	Tuscola
K8QLM	360	Macomb
W8TWJ	348	Oakland
WA8VEB	260	Oakland
W8WOJ	195	Midland
KB8HS	192	Macomb
WD8AUX	126	Lenawee
WD8LCE	120	Lenawee
W8TVY	77	Macomb
N8APX	66	Macomb
KA8ENF	40	Midland
K8EGG	20	Macomb
WD8QEA	9	Midland

OUT-OF-STATE RESULTS

State	*Call*	*Score*
Arkansas	WD5GZL*	675
	WA5DTK	615
California	N6MU*	1,680
Delaware	N3AHA*	864
Florida	W2HAE/4*	264
Illinois	K9BG**	8,400
	WA9FET	546
	K9CW	240
Maryland	W3PYZ*	2,808
Massachusetts	WB1ANT*	207
Minnesota	WA0RMG*	198
New Mexico	KB5DQ*	35
New Jersey	AJ2X*	918
	WB2YOF	96
New York	N2RT*	2,139
	K2POA	286
North Carolina	WD4JBL*	220
Ohio	WB8YDN*	4,508
Pennsylvania	K3NB*	7,072
South Carolina	WA4YUU*	24
South Dakota	WD0BMS*	250
Tennessee	WD8CKP/4*	455
Texas	WA5OOB*	944
	WD8DKJ/5	96
	W5VD	40
Wisconsin	K9GTQ*	220
Canada	VE3KK*	2,016

CLUB SCORES

1. L'Anse Creuse ARC	255,069***
2. Saginaw Valley ARA	103,668
3. Midland ARC	43,426
4. Adrian ARC	18,865
5. Bay Area ARC	5,280
6. Mich-a-Con	1,428

*Certificate
**Trophy
***Trophy (5th year)
†Multi-op

aggregate score.

ENTRIES:

Phone and CW entries are to be *separated*! Along with legible logs in chronological order, a summary sheet is required with each entry. The summary sheet must contain score, number of QSOs, multiplier, station's callsign, entry class and number of Florida counties, power source for Class A entries; state, province, country, or region of operation; callsigns of all operators/loggers if multi-op; name of club if part of a club aggregate score; name and address typed or printed in block letters; and a signed declaration that all rules and regulations have been observed. Include a 15-cent stamp for contest results from a future issue of *Florida Skip*. At the discretion of the contest committee, stations and/or operators may be disqualified for improper reporting, excessive dupes, errors in multiplier lists, unreadable logs, obvious cheating, etc. Anyone disqualified in this year's Florida QSO Party will be barred from the contest next year. All entries must be received on or before June 15th. Late DX entries will be accepted within reason. Mail all entries to: *Florida Skip* Contest Committee, PO Box 660501, Miami Springs FL 33166.

MASSACHUSETTS QSO PARTY
Starts: 1600 GMT May 17
Ends: 0200 GMT May 19

Sponsored by the Greater New Bedford Contesters. A station may be worked once per band. Phone and CW are considered separate bands. No crossband or repeater contacts are permitted. Mobiles and portables may be contacted each time a county change takes place.

EXCHANGE:

RS(T) and state, VE province, or MA county.

SCORING:

All stations count 2 points for each completed SSB exchange and 4 points for each completed CW exchange. MA stations then take the total QSO points and multiply by the total number of MA counties, states, and provinces worked to compute the final score. Others multiply the total QSO points by the total number of MA counties worked. Add a 50-point bonus to the total score for each sponsor worked; each can be worked only once for bonus points. The sponsors are W1FJI, N1AS, and K1KJT. DX stations count for QSO points only.

FREQUENCIES:

Phone—1820, 3960, 7260, 14290, 21390, 28590, and 50.110.

CW—1810, 3560, 7060, 7120, 14060, 21060, 21120, 28060, and 28120.

Use of FM simplex is encouraged. Please use CW in CW bands only!

AWARDS:

Certificates will be awarded to 1st, 2nd, and 3rd place winners in each MA county as well as each state. Two special awards will be given out: one to the amateur radio club with the highest aggregate score in MA with a minimum of three logs, and one to the station in MA who submits the all-time highest number of QSOs. The current record is held by K1GSK with 1483 QSOs in the 1979 Massachusetts QSO Party. In addition, a certificate will be given to stations working all 3 sponsors.

ENTRIES:

Logs must show date, time, band, mode, callsign, state and province worked, and exchange RS(T). Submit a separate summary sheet along with the logs. Summary sheet should include: name, call, mailing address, club affiliation for aggregate score, total QSO points, multipliers claimed, and total score. Deadline for mailing is June 30th. For awards and results, include 30 cents postage (no envelope). Address entries to: Ed Peters K1KJT, 29 Greenbrier Drive, New Bedford MA 02745.

MICHIGAN QSO PARTY
Contest Periods:
1800 GMT Saturday, May 17 to 0300 GMT Sunday, May 18
1100 GMT Sunday, May 18 to 0200 GMT Monday, May 19

This year's QSO party will be sponsored by the Oak Park ARC. Phone and CW are combined into one contest. Michigan stations can work Michigan counties for multipliers. A station may be contacted once on each band/mode. Portable/mobiles may be counted as new contacts each time they change counties.

EXCHANGE:

RS(T), QSO number, QTH as state, country, or Michigan county.

FREQUENCIES:

Phone—1815, 3905, 7280, 14280, 21380, 28580.

CW—1810, 3540, 3725, 7035, 7125, 14035, 21035, 21125, 28035, 28125.

VHF—50.125, 145.025.

SCORING:

Multipliers are counted only once. Michigan stations score 1 point per phone QSO and multiply by the total number of states, countries, and Michigan counties. Each CW contact counts 2 points; KL7 and KH6 count as states; VE counts as a country. Maximum multiplier is 85.

Others take QSO points times the total number of Michigan counties. QSO points are 1 point per phone QSO and 2 points per CW QSO. Score 5 points for each club station contact with W8MB. Maximum multiplier is 83.

VHF-only entries—same as above except multipliers per VHF band are added together for total multiplier. Score 5 points for each OSCAR QSO. No repeater contacts are allowed.

AWARDS:

Only single-operator stations qualify. Michigan trophies to high Michigan score, high Michigan (Upper Peninsula) score, high aggregate club score. Plaque to high VHF-only entry and high mobile. Certificates to high score in each county with a minimum of 30 QSOs. Out-of-state high trophy and certificates for high score in each state and country.

ENTRIES:

A summary sheet is requested showing the scoring and other pertinent information, name and address in block letters, and a signed declaration that all rules and regulations have been observed. Michigan stations include club name for combined club score. Party contacts do not count toward the Michigan Achievement Award unless one fact about Michigan is communicated. Members of the Michigan Week QSO Party Committee are not eligible for individual awards. Decisions of the Contest Committee are final. Results will be final on July 31st and will be mailed to all entries. Mailing deadline is June 30th. Send to: Mark Shaw K8ED, 3810 Woodman, Troy MI 48084.

MICHIGAN ACHIEVEMENT AWARD

This will be the 22nd year that hams have had their own program to publicize Michigan and its products. Just as for the past 22 years, the Governor will award Achievement Certificates to hams who take part in telling the world of Michigan's unlimited resources, opportunities, and advantages. Certificates are awarded on the following basis:

1. A Michigan ham submits log information and names and addresses (if possible) of 15 or more contacts made to out-of-state or DX hams with information regarding Michigan.

2. An out-of-state ham, including Canada, submits log information and names and addresses (if possible) of at least 5 Michigan hams who relate facts to him about Michigan.

3. A foreign ham, excluding any resident of Canada, submits the call letters and name/address plus log information for at least one Michigan ham who has told him about Michigan.

Only QSOs made during Michigan Week, May 17-24, will be considered valid. All applications for certificates must be postmarked by July 1st and mailed to: Governor William Milliken, Lansing MI 48902.

HOLLYWOOD ARC ANNIVERSARY QSO PARTY
Contest Periods:
1100 to 1900 GMT May 24
2300 GMT May 24 to 0700 GMT May 25
1500 to 2359 GMT May 25

The purpose of this contest is for HARC members to work as many stations as possible in as many different states, provinces, and countries as possible, and for non-members to work as many HARC members as possible.

EXCHANGE:

HARC members send RS(T) and consecutive serial number; others send RS(T) and state, province, or country.

FREQUENCIES:

Phone—3980, 7280, 14280, 21380, 28580.

CW—70 kHz up from each band edge and Novice bands.

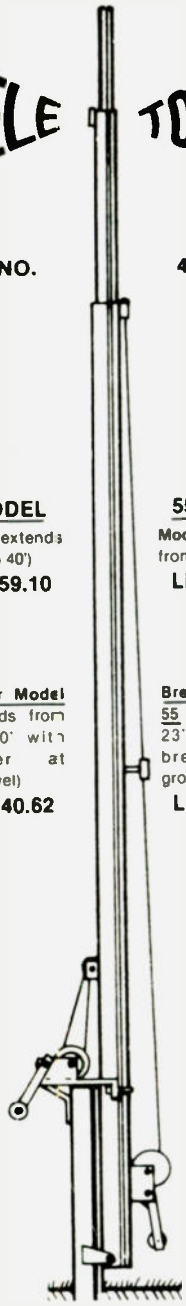
SCORING:

Count one point per QSO. Members multiply QSOs by sum of states, provinces, and countries. Non-members multiply QSOs by sum of different prefixes worked on each band.

ENTRIES:

HARC members should include dupe sheets for entries of over 500 QSOs. Copies of logs should be mailed by June 20th to: Bob Patten N4BP, 2311 Nassau Drive, Miramar FL 33023.

Completely Free Standing Towers



TELE TOW'R

PAT. NO. 4,151,534

40' MODEL
Model 40 (extends from 21' to 40')
List $259.10

55' MODEL
Model 55 (extends from 21' to 55')
List $473.97

Breakover Model 40 (extends from 23' to 40' with breakover at ground level)
List $440.62

Breakover Model 55 (extends from 23' to 55' with breakover at ground level)
List $661.75

All steel constructed.

Concrete sleeve available for all models.

72

TELE-TOW'R MFG. CO., INC.
P.O. Box 3412 • Enid, OK 73701
405-233-4412

Lynda says:

Step up To Tempo

AND SAVE, SAVE ...

That's right . . . buy now the new Tempo S5 handheld and save, save, save! The S5 offers switchable 1 & 5 watts output, 800 channels, external microphone capability, and time proven dependability with so much more.

The world's first synthesized handheld sells for $399.00 with touch-tone pad, $349.00 without. Matching accessories include leather case, rubber antenna, 16 button touch-tone pad, cigarette lighter plug, power amplifiers, etc. Call now for your price, brochures. Export inquiries are invited.

Communications for Worldwide Use

CTG Communications Technology Group Incorporated

448 Merrick Road, Oceanside, N. Y. 11572 U.S.A. (516) 536-5724
Telex 640-596/TWX 510-225-7536

APPLE Owners send & receive CW/RTTY

FEATURES

- Send & Receive MORSE, BAUDOT, ASCII
- Connects to APPLE game I/O port
- Split Screen - edit while receiving
- Uses builtin PLL or external TU
- Includes hardware, cassettes & manual
- Word Oriented Editor
- Instant Break operation—preserve type-ahead buffer
- Eight message memories—255 char. ea.
- Auto transmitter control—PTT
- Diddle, Replay, Cassette Save, CW ID (RTTY only)
- Random Practice, Beacon, change spacing (Morse only)
- **CA650** in cabinet as illustrated **$259**
- **TA650** FFD-1 active filter RTTY demodulator, XTL-1 xtal controlled AFSK and AC power supply installed in CA650 (assembled/tested) **$499**

Write or call for complete catalog

44

MACROTRONICS, inc.®
1125 N. Golden State Blvd. / Suite G
Turlock, CA 95380 (S)
(209) 667-2888 / 634-8888

We are experiencing telephone difficulties, please keep trying.

master charge VISA

California residents add 6% tax

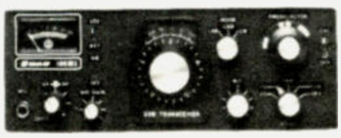
Lynda Says . . . We can't thank you enough.

All of you out there. For the year of '79 was great for all of us. I would like to pass along the savings to you. Select one of these fine transceivers with either your credit card, trade-in or cash deal. We want your business and thank you for it. Why not find out why Hams from all over the world come to CTG. We are on the South Shore on Long Island with a real Ham Radio Showroom that can't be beat. Come in, call at any hour or write for free brochures. Export inquiries invited.

Ten-Tec Omni Series B

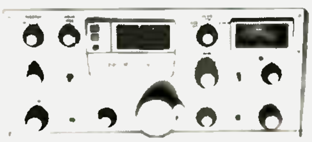
Ten-Tec O Transceiver. 160-10 Mtrs. Digital Readout. Four position CW/SSB Filter. 200 Watts SSB. Regularly sells for **$1,119.00/Now $995.00.**

Kenwood TS120S. 80-10 Mtrs. Digital Readout, Analog Dial, 200 Watts SSB power. Reg. **$699.00/Now $665.00.**



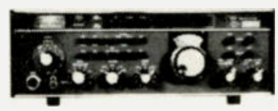
Swan 100MX Solid-State. 10-80 Mtrs. 235 Watts SSB power with noise blanker. Regularly sells for **$699.95/Now $549.00.**

Swan Astro 150 VRS Tuning 10-80 Mtrs. 235 Watts SSB. Fully Microprocessor Controlled frequencies. Regularly sells for **$925.00/Now $765.00.**

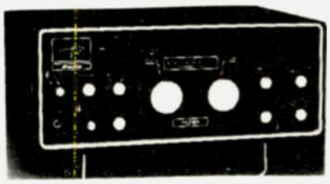


NCX 1000 Transceiver. 10-80 Mtrs. 1 kW SSB, AM, CW, RIT Control. Speech Clipper. Built-in P.S. Much more. Regularly sells for **$1,695.00/Now $1,495.00.**

Kenwood TS180S with DFC. 160-10 Mtrs. 200 Watts, Digitally Tuned Memory, Regularly **$1,149.95/Now $1,092.46.**



Drake TR7/DR7. Reg. **$1,395.00/Call** for your price.



Swan 102BX Transceiver. Dual PTO's 235 Watts SSB & CW. 1.8-30 MHz I.F. Passband Tuning. Tunable Notch Filter, much, much more. Regularly sells for **$1,195.00/Now $995.00.**

Kantronics Field Day TTY Code Reader. Reg. **$449.00/Now $350.00.**

CDE Tailtwister Rotor TX2
Reg. **$349.00/Now $189.00**

CTG

Communications Technology Group, Incorporated®

85 *Communications for Worldwide Use*

448 Merrick Road
Oceanside, N. Y. 11572
1708 Rockaway Avenue
Lynbrook, N. Y. 11563
(516) 536-5724
Telex 640-596/TWX 510-225-7536

Reader Service—see page 226

SURPLUS ELECTRONICS CORP. 69

7294 N.W. 54 STREET
MIAMI, FLORIDA 33166

PHONE: (305) 887-8228
TWX: 810-848-6085

WHOLESALE · RETAIL

SO239

10/$5.00 — 100/$35.00
50/$20.00 — 1000/$300.00

E. F. Johnson NICAD

12.0 V. 1.2 AH @ 10 hr rate
4 1/2" x 1 7/8" x 1 3/4" $1495ea.

E. F. Johnson S Meter

Edge Meter 250 UA. Fits in 5/8" x 1-3/8" hole. MTG holes on each end 1-1/4" behind panel. Black scale 0-5 bottom 1-20 top
$1.25 ea. — 5/$5.00

E. F. Johnson Signal Strength Meter

200 UA $2\frac{1}{2}$ x $2\frac{1}{2}$ Sq mounts in $1\frac{3}{4}$ hole 1" behind panel Scale 1-30 db top 0-5 bottom
$4.95ea — 5/$20.00

PANEL METERS

$4.00 ea — 2 for $7.00

25-0-25 dc volts } $2\frac{1}{4}$" x 3"

0-25 dc Volts
0-50 ac Volts } $2\frac{1}{4}$" x $2\frac{1}{4}$"

-Shunt Required-

Double Row/Wire Wrap .100

25 pins	$3.49 ea	10/$30.00
30 pins	$3.96 ea	10/$32.00
50 pins	$5.43 ea	10/$45.00

Double Row/Solder Eyelet .156

6 pins	$1.10 ea	10/$ 9.00
15 pins	$1.55 ea	10/$12.50
22 pins	$2.08 ea	10/$17.00
43 pins	$3.66 ea	10/$30.00

C & K SWITCHES

PART #	MOVEMENT	
7101	ON/NONE/ON	SPST
7103	ON/OFF/ON	SPST
7108	ON/NONE/(ON)	SPST
7201	ON/NONE/ON	DPDT

$1.00 EA — 6 FOR $5.00

6 TV GAMES ON (1) CHIP

Gen Instr AY-3-8500-1
28 Pin Plastic Case
EVERYDAY LOW PRICE $7.50 ea

CB SPECIAL

Brand new printed circuit board assembly. Used in all HyGain 40 Channel CB transceivers. Fits many other manufacturers' units also. Squelch pot/volume control/channel selector switch not included.

1-9 – 7.50 ea. — 50-99 – 6.00 ea.
10-49 – 6.50 ea. — 100-up – 5.50 ea.

Board Dimensions 6" x $6\frac{1}{2}$"

CB SPECIAL W/40 ch SW same as above

1-9 $10.50 ea. — 50-99 $9.00 ea.
10-49 $9.50 ea. — 100-up $8.50 ea.

Serviceman Special

New Hy-Gain 40ch CB Less Case, Speaker & Knobs (as is) $14.95 ea

NEW Hy-Gain Remote 40ch CB

Less Case, Speaker & Control Mic (as is) $14.95 ea

ASTATIC T-UG8-D104

PREAMP Desktop microphone w/crystal element 3 Pin Plug $35 ea.

NEW E.F. Johnson Power Mic/Less Cord. Desktop Style

$19.95 ea

ILEX COPY LENS F:5.6,6.1

Focal Length (155MM) $1\frac{3}{4}$" D. 2 1/16" L. 1 1/16" Fixed iris. $7.50 ea.

CERAMIC IF FILTERS

EFC L455K
$3.50 ea.

8 Position Dip Switches

16 pin (AMP) $1.50 ea. 10/$13.50

15' MODEM CABLES

10#22ga wire w/shield, DB25P conn & DB51226-1 cover on one end
$5.50 ea. 10/$50.00

25' MODEM CABLES

13#22ga wire w/shield, DB25P conn & DB51226-1 cover on one end
$6.50 ea. 10/$60.00

12 Vdc RELAY

SPST 35 Amp Contacts
Open Frame
Rugged, great for mobile use
$4.50 ea — 5/$20.00

12 Vdc RELAY

SPST Open Frame
5 Amp Contacts
Mfg-Magnecraft
$1.50 ea — 4/$5.00

22 pins/Double Row/Dipped Solder

.156 — $2.08 ea — 10/$17.00

22 pins/Double Row/Wire Wrap

.156 — $2.44 ea — 10/$19.00

12 V DC Horn

2" diameter x $1\frac{1}{4}$" deep
.75 each
3/$2.00

100 ASSORTED DISC CAPS

(FULL LEADS) 20 EA OF 5 DIFFERENT VALUES $2.00 PER PACK

Autronic Elect Auto Alarm

Easy installation independent circuits solid state 12V neg ground $5.00 ea.

White Porcelain Egg Insulator

$1\frac{1}{2}$" x 1" 50¢ ea. — 3 for $1.25

Extralytic

4800 µF at 7.5 VDC
$1\frac{3}{4}$" length x 1" diameter
$3.00 each
50 µF at 200 VDC
$1\frac{3}{4}$" length x $\frac{3}{4}$" diameter
$2.00 each

CAPS RADIAL LEADS

2200 uF @ 16V
.25 ea. 10/$2.00

SOLDER LUG-TYPE CAPS

50 UF @ 350V 1" D x 3" L
50 UF @ 450V 1" D x $2\frac{1}{2}$" L
50 UF @ 450V 1" D x 3" L
60¢ EA. — 5 FOR $2.50

15' MODEM CABLES

14#22ga wire w/shield, DB25P conn & DB51226-1 cover on one end $6.00 ea. 10/$55.00

15' MODEM CABLES

10#22ga wire w/shield, DB25S conn & DB51226-1 cover on one end $6.50 ea. 10/$60.00

EFJ CRYSTAL OVENS

6V/12V 75°
$5.00 ea.

ASSORTED ELECTROLYTICS

VALUE/MFD		VOLTS	DIA		LENGTH	PRICE
63,000	@	15V	3"	x	$5\frac{1}{2}$"	4.00 ea
10,000	@	20V	$1\frac{1}{2}$"	x	53/4"	3.00 ea
2,700	@	25V	$1\frac{1}{4}$"	x	$2\frac{1}{4}$"	2.00 ea
2,900	@	25V	$1\frac{1}{4}$"	x	2"	2.00 ea
3,000	@	25V	$1\frac{1}{2}$"	x	$4\frac{1}{2}$"	2.00 ea
18,000	@	25V	2"	x	4"	3.00 ea
21,000	@	25V	$2\frac{1}{2}$"	x	3"	3.00 ea
1,000	@	50V	$1\frac{1}{4}$"	x	$3\frac{1}{4}$"	2.50 ea
34,800	@	50V	3"	x	$5\frac{1}{2}$"	3.00 ea
450	@	75V	$1\frac{1}{4}$"	x	$2\frac{1}{4}$"	2.00 ea
500	@	100V	$1\frac{1}{2}$"	x	$3\frac{1}{2}$"	2.00 ea
240	@	300V	$1\frac{1}{4}$"	x	$3\frac{1}{4}$"	2.00 ea
50	@	450V	$1\frac{1}{4}$"	x	2"	2.00 ea

IC SOCKETS

Cambion
Gold Plated Wire Wrap

14 pin	.35 ea	10/$3.00
16 pin	.38 ea	10/$3.30

COMCO XTAL FILTER

23/8" x 1" x $\frac{3}{4}$"
13KC BW $10.00 ea.

Coax Connectors

UG-273/U BNC-F/UHF-M 2.50
UG-255/U BNC-M/UHF-F 3.00
UG-146A/U N-M/UHF-F 4.50
UG-83B/U N-F/UHF-M 4.50
UG-175 RG-58 Adapt. .20
UG-176 RG-59 Adapt. .20

TRIMMER CAPS

Can fit in your watch
3.5-20 pF & 5-30 pF
$.75 ea., 2/$1.25
5/$3.00

POLY FOAM COAX 50 Ohm

Low Loss = to RG174
$4.95/100' $3.00/50'

ULTRASONIC TRANSDUCER

Detects sound above the range of human hearing! Transmits & receives
$2.50 ea. 5/$10.00

MAGNETIC PICK UP TRANSDUCER

Converts motion to ac voltage without mechanical linkage
$\frac{3}{8}$" x 2" w/6' shielded cable
$4.95 ea.

SOLDERLESS TEST PROD (BLACK)

Threaded type, molded handle
$.40 ea. 10/$3.50

USED MUFFIN FANS

3 blades, 110VAC, $4\frac{3}{4}$" sq.
$5.95

CW MINI SLIDE SW

DPDT .15 ea. 10/$1.25

ALL STAR AIR VARIABLE

24-275 pF .75 ea.

RED SEVEN SEGMENT DISPLAY

TIL 322P $1.00 ea.

BOURNS' EDGE MOUNTING

5K pot single turn
3345W series $1.50 ea.

12 VOLTS @ ½ AMP

Filament transformer
$1\frac{5}{8}$" x 2" x 1" $1.50 ea.

CTS DP6P ROT SWITCH

.50 ea. 5/$2.00

AXIAL LEAD ELECTROLYTIC CAPACITORS

2 uF @ 15V
10 uF @ 15V
20 uF @ 15V
50 uF @ 15V
2.2 uF @ 25V
3.3 uF @ 25V
1 uF @ 35V
2 uF @ 150V
} 12 ea. for $1.00

25 uF @ 25V
3 uF @ 50V
5 uF @ 50V
10 uF @ 50V
} 15 ea. for $2.00

250 uF @ 25V
100 uF @ 50V
50 uF @ 75V
} 10 ea. for $2.00

TERMS: *All material guaranteed • If for any reason you are not satisfied, our products may be returned within 10 days for a full refund (less shipping). Please add $3 for shipping and handling on all orders. Additional 5% charge for shipping any item over 5 lbs. COD's accepted for orders totaling $50.00 or more. All orders shipped UPS unless otherwise specified. Florida residents please add 4% sales tax. Minimum order $15.00*

EQUIPMENT / COMPONENTS / WIRE & CABLE / ACCESSORIES

P.O. Box 4430M, Santa Clara, CA 95054
Will calls: 2322 Walsh Ave.
(408) 988-1640

Low Cost...High Performance

DIGITAL MULTIMETER

$99.95 WIRED

Low cost, high performance, that's the DM-700. Unlike some of the hobby grade DMMs available, the DM-700 offers professional quality performance and appearance at a hobbyist price. It features 26 different ranges and 5 functions, all arranged in a convenient, easy to use format. Measurements are displayed on a large 3½ digit, ½ inch high LED display, with automatic decimal placement, automatic polarity, and overrange indication. You can depend upon the DM-700, state-of-the-art components such as a precision laser trimmed resistor array, semiconductor band gap reference, and reliable LSI circuitry insure lab quality performance for years to come. Basic DC volts and ohms accuracy is 0.1%, and you can measure voltage all the way from 100 μv to 1000 volts, current from 0.1 μa to 2.0 amps and resistance from 0.1 ohms to 20 megohms. Overload protection is inherent in the design of the DM-700, 1250 volts, AC or DC on all ranges, making it virtually goof proof. Power is supplied by four 'C' size cells, making the DM-700 portable, and, as options, a nicad battery pack and AC adapter are available. The DM-700 features a handsome, jet black, rugged ABS case with convenient retractable tilt bail. All factory wired units are covered by a one year limited warranty and kits have a 90 day parts warranty.

Order a DM-700, examine it for 10 days, and if you're not satisifed in every way, return it in original form for a prompt refund.

Specifications

DC and AC volts:	100 μV to 1000 Volts, 5 ranges
DC and AC current:	0.1 μA to 2.0 Amps, 5 ranges
Resistance:	0.1Ω to 20 megohms, 6 ranges
Input protection:	1250 volts AC/DC all ranges fuse protected for overcurrent
Input impedance:	10 megohms, DC/AC volts
Display:	3½ digits, 0.5 inch LED
Accuracy:	0.1% basic DC volts
Power:	4 'C' cells, optional nicad pack, or AC adapter
Size:	6"W x 3"H x 6"D
Weight:	2 lbs with batteries

Prices

DM-700 wired + tested	$99.95
DM-700 kit form	79.95
AC adapter/charger	4.95
Nicad pack with AC adapter/charger	9.95
Probe kit	3.95

TERMS: Satisfaction guaranteed or money refunded, COD, add $1.50. Minimum order $6.00. Orders under $10.00, add $.75. Add 5% for postage, insurance, handling. Overseas, add 15%. NY residents, add 7% tax.

master charge

VISA

600 mHz COUNTER

$99.95 WIRED

The CT-70 breaks the price barrier on lab quality frequency counters. No longer do you have to settle for a kit, half-kit or poor performance, the CT-70 is completely wired and tested, features professional quality construction and specifications, plus is covered by a one year warranty. Power for the CT-70 is provided by four 'AA' size batteries or 12 volts, AC or DC, available as options are a nicad battery pack, and AC adapter. Three selectable frequency ranges, each with its own pre-amp, enable you to make accurate measurements from less than 10 Hz to greater than 600 mHz. All switches are conveniently located on the front panel for ease of operation, and a single input jack eliminates the need to change cables as different ranges are selected. Accurate readings are insured by the use of a large 0.4 inch seven digit LED display, a 1.0 ppm TCXO time base and a handy LED gate light indicator.

The CT-70 is the answer to all your measurement needs, in the field, in the lab, or in the ham shack. Order yours today, examine it for 10 days, if you're not completely satisfied, return the unit for a prompt and courteous refund.

Specifications

Frequency range:	10 Hz to over 600 mHz
Sensitivity:	less than 25 mv to 150 mHz less than 150 mv to 600 mHz
Stability:	1.0 ppm, 20-40°C, 0.05 ppm/°C TCXO crystal time base
Display:	7 digits, LED, 0.4 inch height
Input protection:	50 VAC to 60 mHz, 10 VAC to 600 mHz
Input impedance:	1 megohm, 6 and 60 mHz ranges 50 ohms, 600 mHz range
Power:	4 'AA' cells, 12 V AC/DC
Gate:	0.1 sec and 1.0 sec LED gate light
Decimal point:	Automatic, all ranges
Size:	5"W x 1½"H x 5½"D
Weight:	1 lb with batteries

Prices

CT-70 wired + tested	$99.95
CT-70 kit form	75.95
AC adapter	4.95
Nicad pack with AC adapter/charger	14.95
Telescopic whip antenna BNC plug	7.95
Tilt bail assembly	3.95

ramsey electronics

62 **BOX 4072, ROCHESTER, N.Y. 14610**
PHONE ORDERS CALL
(716) 271-6487

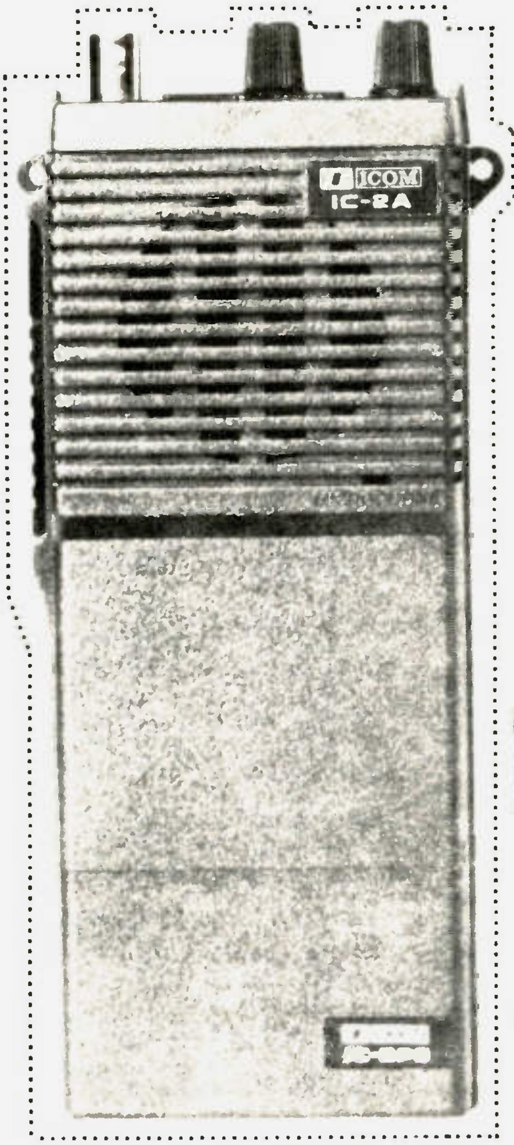
The Question we seem to get most often from our customers:

"WHEN IS ICOM COMING OUT WITH A HANDIE-TALKIE!"

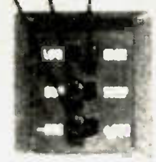
ICOM IC-2A SYNTHESIZED 2 METER HANDIE TALKIE

FEATURES YOU'VE WANTED

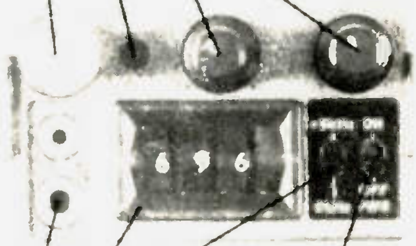
- □ 800 T/R Channels. Synthesized.
- □ 1.5 Watt Output High/Low Power Battery Saving Switch to .15 Watt.
- □ Separate built in Speaker & Mic. Excellent audio quality
- □ Compact. About the size of a dollar bill.
- □ Variable size Nicad Power Pack, 3 sizes available to suit your needs. (250 MA standard). Makes the IC-2A the most compact synthesized HT on the market.
- □ ICOM level Receiver Performance-ICOM Quality Receiver in a compact package (.2uv/20db typical)
- □ Optional Tone Pad, Desk Charger, Speaker/Mic available.
- □ With slip on/slip off Bottom Nicad Pack, you can vary the size of the HT from about 116 mm high to 175 mm high. Easy to carry extra Snap-on packs with you for extended trips.



BACK VIEW
±600 khz offset
simplex/duplex
Hi/lo power



TOP VIEW
BNC antenna connector
"Rubber Duckie" standard
transmit indicator
squelch
volume control



on/off
5 khz channel selection
10 khz channel selection
speaker/mic jack

ICOM

THE ANSWER IS: NOW!

All 800 channels of it!

PHONE: (312) 848-6777

✓67

SPECTRONICS, INC. — 1009 GARFIELD ST., OAK PARK, ILL.-60304

SEMICONDUCTORS SURPLUS

2822 North 32nd Street/Unit -1 Phoenix, Arizona 85008 (602) 956-9423

We accept checks, MasterCharge, and Visa

Prices subject to change without notice

WE ACCEPT MASTERCHARGE, VISA, CHECKS, AND C.O.D.'s PHONE IN YOUR ORDER
NO ORDERS WILL BE ACCEPTED UNDER $10.00, NOT INCLUDING SHIPPING!

GE H13A1 PHOTO
COUPLER-INTERRUPTER
MODULE $1.99 each

6X4 SOLID STATE
TUBE $1.99 each

MALLORY HIGH VOLTAGE
CAPACITOR
100 mfd @ 350 VDC
1" x 2 7/8" long
$1.99 each

NEW $\frac{1}{4}$" INSULATED
SHAFT COUPLERS
$1.99 each

12 VDC WATER PUMPS
1$\frac{1}{4}$" round x 2" long
$1.99 each

SLIDE POTS
10 K and 50 K
99¢ each

DUAL SLIDE POTS
50 K $1.99 each

G10 COPPER CLAD .062
7" x 14" $2.99 ea.
4$\frac{1}{2}$" x 24$\frac{1}{4}$" 2.99 ea.
4" x 36$\frac{1}{2}$" 2.99 ea.

TO-3 HEAT SINK
AAVID #12-13426-03
2/$1.50

NEW ATLAS DL-300
52 Ohm DUMMY LOAD
300 W intermittent
100 W continuous
$13.99 each

NEW 2 WATT STEREO AMP.
with only one IC
High imp. input
8 Ohm output
12 VAC, 5" long x 2"
$4.99 each

100 ASSORTED DISC
CAPS new full leads
Different values
10 each of 10
$3.00

100 ASSORTED
ELECTROLYTICS
New full leads
Different values
10 each of 10
$3.99

USED MUFFIN FANS
3 and 4 blades
110 VAC 4 3/4" sq.
$4.99 each

2N6071 POWER TRIAC
4 Amps 200 V
69¢ each or 2/$1.00

2N6027 or 2N6028
PROGRAMMABLE
UNIJUNCTIONS
2/$1.00

NEW CORCOM EMI
FILTERS Model 3B1
3A @ 115/230 VAC
$3.99 each OR
Model 10K3
10A @ 115/250 VAC
$4.99 each

NEW AUTOMATIC RADIO
Model PPS1480
POWER SUPPLY
Input voltage 115 VAC
Output 12VDC @ 1.75A
5$\frac{1}{2}$" deep x 4" long
3" high $19.95

NEW MAGNAVOX T.V.
SPLITTERS
Model 600D 6dB
Used for two TV
sets, $1.99 each

NEW MATCHING
TRANSFORMERS
75 Ohm to 300 Ohm
Model MT75
$1.99 each

BENDIX RF
CONNECTOR
Model 1106-1
1 male BNC with
3 female BNC
$4.99 each

MEKO REED RELAY
5 VDC coil
SPST 69¢ each
SPDT 99¢ each

NEW BARBER-COLMAN
6 VDC MOTOR
Model BYQM43600-2
$1.99 each

NEW KINGS RF CONN.
Type N male for
1" coax
Model 91836/
MS39012/01-0004
$9.99 each

NEW ITT/GREMAR
Type N male for
$\frac{1}{2}$" coax
Model 16408/7407
$2.50 each

NEW 12 VDC PILOT
LIGHTS
Industrial Devices
Model 2190F50
Red OR Green
69¢ each

NEW CM/DRAKE
PILOT LIGHTS
125 VAC @ $\frac{1}{4}$ W
Model 6403-403-
603 69¢ each

NEW MALLORY HIGH VOLTAGE
CAPACITOR
100 mfd @ 350 VDC
1" x 3" $1.99 each

1 MHz CRYSTALS
USED but good
$2.99 each

SOLDER WICK
Size 4
5 feet for $1.99

HIGH VOLTAGE RECTIFIERS
Part #DG-1005
1000 PIV @ 1.5 Amp
10/$1.75

NEW MOTOROLA UHF POWER
AMPLIFIERS
Model MHW710
Output 13 W @ 400-512 MHz
12 VDC 19.4dB gain min.
$49.95 each
Model MHW709
7.5 W output @ 400-512 MHz
12 VDC 18.8dB gain min.
$40.95 each

NEW RCA SCR's
TAS8613B
75A 250V
$3.99 each

NEW LAMBDA OVER VOLTAGE
PROTECTORS
Model L-12-OV-5
5 VDC @ 12 Amps
$3.99 each
DATA 50¢ each

CERAMIC STAND OFFS
$\frac{1}{2}$" round X 1" long OR
3/8" round x 1$\frac{1}{4}$" long
36¢ each

NEW 100 KC CRYSTALS
$6.99 each

Reader Service—see page 226

RAMSEY ELECTRONIC'S ✓62

PARTS WAREHOUSE

We now have available a bunch of goodies too good to bypass. Items are limited so order today.

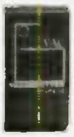
PO BOX 10101
Rochester, NY 14610
716-271-6487
716-454-5598

Call Your Phone Order In Today

TERMS: Satisfaction guaranteed or money refunded. COD add $1.50. Minimum order $6.00. Orders under $10.00 add $.75. Add 5% for postage, insurance, handling. Overseas add 15%. NY residents add 7% tax

MINI KITS - YOU HAVE SEEN THESE BEFORE NOW HERE ARE OLD FAVORITE AND NEW ONES TOO. GREAT FOR THAT AFTERNOON HOBBY.

FM MINI MIKE



A super high performance FM wireless mike kit! Transmits a stable signal up to 300 yards with exceptional audio quality by means of its built in electret mike. Kit includes case, mike, on-off switch, antenna, battery and super instructions. This is the finest unit available.

FM-3 Kit	$14.95
FM-3 Wired and Tested	19.95

Color Organ

See music come alive! 3 different lights flicker with music. One light each for high, mid-range and lows. Each individually adjustable and drives up to 300 W, runs on 110 VAC

Complete kit, ML-1
$8.95

Video Modulator Kit

Converts any TV to video monitor. Super stable, tunable over ch 4-6. Runs on 5-15V, accepts std video signal. Best unit on the market! Complete kit VD-1 $7.95

Led Blinky Kit

A great attention getter which alternately flashes 2 jumbo LEDs. Use for name badges, buttons, warning panel lights, anything! Runs on 3 to 15 volts.
Complete kit, BL-1
$2.95

Super Sleuth

A super sensitive amplifier which will pick up a pin drop at 15 feet! Great for monitoring baby's room or as general purpose amplifier. Full 2 W rms output, runs on 6 to 15 volts, uses 8-45 ohm speaker
Complete kit BN-9 $5.95

CPO-1

Runs on 3-12 Vdc 1 watt out, 1 KHZ good for CPO, Alarm, Audio Oscillator. Complete kit $2.95

FM Wireless Mike Kit

Transmits up to 300' to any FM broadcast radio, uses any type of mike. Runs on 3 to 9V. Type FM-2 has added sensitive mike preamp stage

FM-1 kit $3.95 FM-2 kit $4.95

Whisper Light Kit

An interesting kit, small mike picks up sounds and converts them to light. The louder the sound, the brighter the light. Includes mike, controls up to 300 W, runs on 110 VAC
Complete kit, WL-1
$6.95

Tone Decoder

A complete tone decoder on a single PC board. Features 400-5000 Hz adjustable range via 20 turn pot voltage regulation, 567 IC. Useful for touch-tone burst detection, FSK, etc. Can also be used as a stable tone encoder. Runs on 5 to 12 volts.
Complete kit TD-1 $5.95

Universal Timer Kit

Provides the basic parts and PC board required to provide a source of precision timing and pulse generation. Uses 555 timer IC and includes a range of parts for most timing needs

UT-5 Kit $5.95

Mad Blaster Kit

Produces LOUD ear shattering and attention getting siren like sound. Can supply up to 15 watts of obnoxious audio. Runs on 6-15 VDC

MB-1 Kit $4.95

Siren Kit

Produces upward and downward wail characteristic of a police siren. 5 W peak audio output, runs on 3-15 volts, uses 3-45 ohm speaker
Complete kit, SM-3 $2.95

60 Hz Time Base

Runs on 5-15 VDC. Low current (2.5ma) 1 min month accuracy TB-7 Kit $5.50
TB-7 Assy $9.95

CLOCK KITS

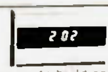
Your old favorites are here again. Over 7,000 Sold to Date. Be one of the gang and order yours today!

Try your hand at building the finest looking clock on the market. Its satin finish anodized aluminum case looks great anywhere, while six .4" LED digits provide a highly readable display. This is a complete kit, no extras needed, and it only takes 1-2 hours to assemble. Your choice of case colors: silver, gold, black (specify).

Clock kit, 12/24 hour, DC-5	$24.95
Clock with 10 min. ID timer, 12/24 hour, DC-10	$29.95
Alarm clock, 12 hour only, DC-8	$29.95
12V DC car clock, DC-7	$29.95

For wired and tested clocks add $10.00 to kit price.

Car Clock



The UN-KIT, only 5 solder connections

Here's a super looking rugged and accurate auto clock which is a snap to build and install. Clock movement is completely assembled — you only solder 3 wires and 2 switches, takes about 15 minutes! Display is bright green with automatic brightness control photocell — assures you of a highly readable display day or night. Comes in a satin finish anodized aluminum case which can be attached 5 different ways using 2 sided tape. Choice of silver, black or gold case (specify).

DC-3 kit 12 hour format	$22.95
DC-3 wired and tested	$29.95

Calendar Alarm Clock

The clock that's got it all. 6-.5" LEDs, 12/24 hour, snooze, 24 hour alarm, 4 year calendar, battery backup and lots more. The super 7001 chip is used. Size 5x4x2 inches. Complete kit, less case (not available)
DC-9 $34.95

Under Dash Car Clock

12/24 hour clock in a beautiful plastic case features 6 jumbo RED LEDS, high accuracy (.001%), easy 3 wire hookup, display blanks with ignition, and super instructions. Optional dimmer automatically adjusts display to ambient light level.

DC-11 clock with mtg. bracket	$27.95 kit
DM-1 dimmer adapter	$2.50
Add $10.00 Assy. and Test	

Video Terminal

A completely self-contained, stand alone video terminal card. Requires only an ASCII keyboard and TV set to become a complete terminal unit. Features are single 5V supply, XTAL controlled sync and baud rates (to 9600), complete computer and keyboard control of cursor. Parity error control and display. Accepts and generates serial ASCII plus parallel keyboard input. The 6416 is 64 char. by 16 lines with scrolling, upper and lower case (optional) and has RS-232 and 20ma loop interfaces on board. Kits include sockets and complete documentation.

RE 6416 terminal card kit (add $60.00 for wired unit)	$189.95
Lower Case option	$13.95
Power Supply	$14.95
RF Modulator kit	$7.95

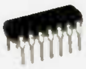
PARTS PARADE

IC SPECIALS

LINEAR

301	$.35
324	$1.50
380	$1.50
555	$.45
556	$1.00
565	$1.00
566	$1.00
567	$1.25
741	10/$2.00
1458	$.50
3900	$.50
3914	$2.95
8038	$2.95

CMOS



4011	.20
4013	.25
4046	$1.85
4049	.40
4059	$9.00
4511	$2.00
4518	$1.35
5639	$1.75

READOUTS

FND 359 .4" C C	$1.00
FND 507/510 .5" C A	1.00
MAN 72/HP7730 .33" C A	1.00
HP 7651 .43" C A	2.00

TRANSISTORS

2N3904 NPN C-F	15/$1.00
2N3906 PNP C-F	15/$1.00
2N4403 PNP C-F	15/$1.00
2N4410 NPN C-F	15/$1.00
2N4916 FET C-F	4/$1.00
2N5401 PNP C-F	5/$1.00
2N6028 C-F	4/$1.00
2N3771 NPN Silicon	$1.50
2N5179 UHF NPN	3/$2.00
Power Tab NPN 40W	3/$1.00
Power Tab PNP 40W	3/1.00
MPF 102/2N5484	$.50
NPN 3904 Type T-R	50/$2.50
PNP 3906 Type T-R	50/$2.50
2N3055	$.60
2N2646 UJT	3/$2.00

TTL

74S00	$.40
7447	$.65
7475	$.50
7490	$.50
74196	$1.35

SPECIAL

11C90	$13.50
10116	$1.25
7208	$17.50
7207A	$5.50
7216D	$21.00
7107C	$12.50
5314	$2.95
5375AB/G	$2.95
7001	$6.50

FERRITE BEADS

With info and specs 15/$1.00
6 Hole Balun Beads 5/$1.00

Sockets

8 Pin	10/$2.00
14 Pin	10/$2.00
16 Pin	10/$2.00
24 Pin	4/$2.00
28 Pin	4/$2.00
40 Pin	3/$2.00

Diodes

5.1 V Zener	20/$1.00
1N914 Type	50/$1.00
1KV 2Amp	8/$1.00
100V 1Amp	15/$1.00

25 AMP
100V Bridge
$1.50 each

Mini-Bridge 50V
1 AMP
4 for $1.00

Resistor Ass't

Assortment of Popular values - ¼ watt. Cut lead for PC mounting. ½" center, ¼" leads, bag of 300 or more $1.50

Crystals

3.579545 MHZ	$1.50
10.00000 MHZ	$5.00
5.248800 MHZ	$5.00

Switches

Mini toggle SPDT $1.00
Red Pushbuttons N.O. 3/$1.00

Earphones

3" leads, 8 ohm, good for small tone speakers, alarm clocks, etc. 10 for $1.00

AC Adapters

Good for clocks, nicad chargers, all 110 VAC plug one end

8.5 vdc @ 20 mA	$1.00
16 vac @ 160mA	$2.50
12 vac @ 250mA	$3.00

Mini 8 ohm Speaker

Approx 2¼" diam. Round type for radios, mike etc. 3 for $2.00

Solid State Buzzers

Small buzzer 450 Hz 86 dB sound output on 5-12 vdc at 10-30 mA. TTL compatible $1.50

Slug Tuned Coils

Small 3/16" Hex Slugs turned coil 3 turns 15/$1.00

AC Outlet

Panel Mount with Leads 4/$1.00

CAPACITORS

TANTALUM	ALUMINUM	DISK CERAMIC
Dipped Epoxy	Electrolytic	.01 16V disk 20/$1.00
1.5 uF 25V 6/$1.00	1000 uF 16V Radial $.50	.1 16V 15/$1.00
1.8 uF 25V 6/$1.00	500 uF 20V Axial $.50	.001 16V 20/$1.00
.25 uF 25V 6/$1.00	150 uF 16V Axial 5/$1.00	100 pF 20/$1.00
	10 uF 15V Radial 10/$1.00	.047 16V 20/$1.00

DC-DC Converter

+5 vdc input prod. -9 vdc @ 30ma
+9 vdc produces -15 vdc @ 35ma $1.25

Ceramic IF Filters

Mini ceramic filters 7 KHz B.W. very sharp $1.50 ea.

Trimmer Caps

25K 20 Turn Trim Pot	$1.00
1K 20 Turn Trim Pot	$.50

Sprague - 3-40 pf Stable Polypropylene .50 ea.

Crystal Microphone

Small 1" diameter ¼" thick crystal mike cartridge $.75

Mini RG-174 Coax

10 ft. for $1.00

Coax Connector

Chassis mount
BNC type $1.00

9 Volt Battery Clips

Nice quality clips 5 for $1.00
⅜" Rubber Grommets 10 for $1.00

Parts Bag

Asst. of chokes, disc caps, tant., resistors, transistors, diodes, MICA caps etc. sm. bag (100 pc) $1.00 lg. bag (300 pc) $2.50

Connectors

6 pin type gold contacts for mA 1003 car clock module price .75 ea.

Leds - your choice, please specify

Mini Red, Jumbo Red, High Intensity Red, Illuminator Red 8/$1
Mini Yellow, Jumbo Yellow, Jumbo Green 6/$1

Varactors

Motorola MV 2209 30 PF Nominal cap 20-80 PF - Tunable range - .50 each or 3/$1.00

Audio Prescaler

Make high resolution audio measurments, great for musical instrument tuning, PL tones, etc. Multiplies audio UP in frequency, selectable x10 or x100, gives .01 HZ resolution with 1 sec gate time! High sensitivity of 25 mv, 1 meg input z and built-in filtering gives great performance. Runs on 9V battery, all CMOS.

PS-2 kit	$29.95
PS-2 wired	$39.95

600 MHz PRESCALER

Extend the range of your counter to 600 MHz. Works with all counters. Less than 150 mv sensitivity, specify - 10 or -100

Wired, tested, PS-1B	$59.95
Kit, PS-1B	$44.95

30 Watt 2 mtr PWR AMP

Simple Class C power amp features 8 times power gain. 1 W in for 8 out, 2 W in for 15 out, 4W in for 30 out. Max output of 35 W, incredible value, complete with all parts, less case and T-R relay.

PA-1, 30 W pwr amp kit	$22.95
TR-1, RF sensed T-R relay kit	6.95

MRF-238 transistor as used in PA-1 8-10db gain 150 mhz $11.95

RF actuated relay senses RF (1W) and closes DPDT relay. For RF sensed T-R relay
TR-1 Kit $6.95

Power Supply Kit

Complete triple regulated power supply provides variable 6 to 18 volts at 200 ma and +5 at 1 Amp. Excellent load regulation, good filtering and small size. Less transformers, requires 6.3 V @ 1 A and 24 VCT
Complete kit, PS-3LT $6.95

OP-AMP Special

BI-FET LF 13741 - Direct pin for pin 741 compatible, but 500,000 MEG input z, super low 50 pa input current, low power drain

50 for only $9.00 10 for $2.00

Regulators

78MG	$1.25	7812	$1.00
79MG	$1.25	7815	$1.00
723	$.50	7905	$1.25
309K	$1.15	7912	$1.25
7805	$1.00	7915	$1.25

Shrink Tubing Nubs

Nice precut pces of shrink size 1" x ⅛" shrink to ⅛". Great for splices 50/$1.00

Mini TO-92 Heat Sinks

Thermalloy Brand 5 for $1.00
To-220 Heat Sinks 3 for $1.00

Opto Isolators - 4N28 type $.50 ea.
Opto Reflectors - Photo diode + LED $1.00 ea.

Molex Pins

Molex already precut in length of 7. Perfect for 14 pin sockets 20 strips for $1.00

CDS Photocells

Resistance varies with light. 250 ohms to over 3 meg 3 for $1.00

✓Reader Service—see page 226

7400 TTL

SN7400N	.20	SN7470N	.29	SN74160N	.89
SN7401N	.20	SN7472N	.29	SN74161N	.89
SN7402N	.20	SN7473N	.35	SN74162N	1.95
SN7403N	.20	SN7474N	.35	SN74163N	.89
SN7404N	.25	SN7475N	.49	SN74164N	.89
SN7405N	.20	SN7476N	.35	SN74165N	.89
SN7406N	.29	SN7479N	5.00	SN74166N	1.25
SN7407N	.29	SN7480N	.50	SN74167N	1.95
SN7408N	.20	SN7482N	.99	SN74170N	1.59
SN7409N	.20	SN7483N	.69	SN74172N	6.00
SN7410N	.18	SN7485N	.89	SN74173N	1.25
SN7411N	.25	SN7486N	.35	SN74174N	1.00
SN7412N	.25	SN7489N	1.75	SN74175N	1.00
SN7413N	.40	SN7490N	.45	SN74176N	.79
SN7414N	.70	SN7491N	.59	SN74177N	.79
SN7416N	.25	SN7492N	.43	SN74179N	1.95
SN7417N	.25	SN7493N	.43	SN74180N	.79
SN7420N	.20	SN7494N	.65	SN74181N	1.95
SN7421N	.29	SN7495N	.65	SN74182N	.79
SN7422N	.39	SN7496N	.65	SN74184N	1.95
SN7423N	.25	SN7497N	3.00	SN74185N	1.95
SN7425N	.29	SN74100N	1.25	SN74186N	9.95
SN7426N	.29	SN74107N	.35	SN74188N	3.95
SN7427N	.25	SN74109N	.59	SN74190N	1.25
SN7429N	.39	SN74116N	1.95	SN74191N	1.25
SN7430N	.20	SN74121N	.35	SN74192N	.79
SN7432N	.25	SN74122N	.39	SN74193N	.79
SN7437N	.25	SN74123N	.59	SN74194N	.89
SN7438N	.40	SN74125N	.49	SN74195N	.69
SN7439N	.25	SN74126N	.49	SN74196N	.89
SN7440N	.20	SN74132N	.75	SN74197N	.89
SN7441N	.89	SN74136N	.75	SN74198N	1.49
SN7442N	.59	SN74141N	.79	SN74199N	1.49
SN7443N	.75	SN74142N	2.95	SN74S200	4.95
SN7444N	.75	SN74143N	2.95	SN74251N	.99
SN7445N	.75	SN74144N	2.95	SN74279N	.79
SN7446N	.69	SN74145N	.79	SN74283N	2.25
SN7447N	.59	SN74147N	1.95	SN74284N	3.95
SN7448N	.79	SN74148N	1.29	SN74285N	3.95
SN7450N	.20	SN74150N	1.25	SN74365N	.69
SN7451N	.20	SN74151N	.59	SN74366N	.69
SN7453N	.20	SN74152N	.59	SN74367N	.69
SN7454N	.20	SN74153N	.59	SN74368N	.69
SN7459A	.25	SN74154N	1.50	SN74390N	1.95
SN7460N	.20	SN74155N	.79	SN74393N	1.95
		SN74156N	.79		
		SN74157N	.65		

CMOS

CD4000	.39	CD4028	.89	CD4070	.55
CD4001	.39	CD4029	1.49	CD4071	.49
CD4002	.39	CD4030	.49	CD4072	.49
CD4006	1.19	CD4035	.99	CD4076	1.39
CD4007	.25	CD4040	1.49	CD4081	.39
CD4009	.49	CD4041	1.49	CD4082	.39
CD4010	.49	CD4042	.99	CD4093	.99
CD4011	.39	CD4043	.89	CD4098	1.19
CD4012	.25	CD4044	.89	MC14409	14.95
CD4013	.49	CD4046	1.79	MC14410	14.95
CD4014	1.39	CD4047	2.50	MC14411	14.95
CD4015	1.19	CD4048	1.35	MC14419	4.95
CD4016	.59	CD4049	.49	MC14433	13.95
CD4017	1.19	CD4050	.69	MC14506	.75
CD4018	.99	CD4051	1.19	MC14507	.99
CD4019	.49	CD4053	1.19	MC14562	11.95
CD4020	1.19	CD4056	2.95	MC14583	2.49
CD4021	1.39	CD4059	9.95	CD4508	3.95
CD4022	1.19	CD4060	1.49	CD4510	1.39
CD4023	.29	CD4066	.79	CD4511	1.29
CD4024	.79	CD4068	.39	CD4515	2.95
CD4025	.23	CD4069	.45	CD4518	1.29
CD4026	2.95			CD4520	1.29
CD4027	.69			CD4566	2.25

74C00

74C00	.39	74C85	2.49	74C163	2.49
74C02	.39	74C90	1.95	74C164	2.49
74C04	.45	74C93	1.95	74C173	2.60
74C08	.49	74C95	1.95	74C192	2.49
74C10	.49	74C107	1.25	74C193	2.49
74C14	1.95	74C151	2.90	74C195	2.49
74C20	.39	74C154	3.00	74C922	7.95
74C30	.39	74C157	2.15	74C923	6.25
74C42	1.95	74C160	2.49	74C925	8.95
74C48	2.49	74C161	2.49	74C926	8.95
74C73	.89			80C95	1.50
74C74	.89			80C97	1.50

LINEAR

78MG	1.75	LM340K-18	1.35	LM710N	.79
LM106H	.99	LM340K-24	1.35	LM711N	.39
LM300H	.80	LM340T-5	1.25	LM723N/H	.55
LM301CN/H	.35	LM340T-6	1.25	LM733N	1.00
LM302H	.75	LM340T-8	1.25	LM739N	1.19
LM304H	1.00	LM340T-12	1.25	LM741CN/H	.35
LM305H	.60	LM340T-15	1.25	LM741-14N	.39
LM307CN/H	.35	LM340T-18	1.25	LM747N/H	.79
LM308CN/H	1.00	LM340T-24	1.25	LM748N/H	.39
LM309H	1.10	LM358N	1.00	LM1310N	1.95
LM309K	1.25	LM370N	1.95	LM1458CN/H	.59
LM310CN	1.95	LM373N	3.25	MC1488N	1.95
LM311N/H	.90	LM377N	4.00	MC1489N	1.95
LM312H	1.95	LM380N	1.25	LM1496N	.95
LM317K	6.50	LM380CN	.99	LM1556V	1.75
LM318CN/H	1.50	LM381N	1.79	MC1741SCP	3.00
LM319N	1.30	LM382N	1.79	LM2111N	1.95
LM320K-5	1.35	NE501N	8.00	LM2901N	2.95
LM320K-5.2	1.35	NE510A	6.00	LM3053N	1.50
LM320K-12	1.35	NE529A	4.95	LM3065N	1.49
LM320K-15	1.35	NE531H/V	3.95	LM3900N(3401)	.59
LM320K-18	1.35	NE536T	6.00	LM3905N	1.49
LM320K-24	1.35	NE540	6.00	LM3909N	1.25
LM320T-5	1.25	NE544N	4.95	MC5558V	.59
LM320T-5.2	1.25	NE550N	1.30	8038B	4.95
LM320T-8	1.25	NE555V	.39	LM75450N	.49
LM320T-12	1.25	NE556N	.99	75451CN	.39
LM320T-15	1.25	NE560B	5.00	75452CN	.39
LM320T-18	1.25	NE562B	5.00	75453CN	.39
LM320T-24	1.25	NE565N/H	1.25	75454CN	.39
LM323K-5	5.95	NE566CN	1.75	75491CN	.79
LM324N	1.49	NE567V/H	.99	75492CN	.79
LM339N	.99	NE570N	4.95	75493N	.89
LM340K-5	1.35	LM703CN/H	.69	75494CN	.89
LM340K-6	1.35	LM709N/H	.29	RC4136	1.25
LM340K-8	1.35			RC4151	3.95
LM340K-12	1.35			RC4194	4.95
LM340K-15	1.35			RC4195	4.49

74LS00TTL

74LS00	.35	74LS51	.29	74LS139	1.05
74LS01	.35	74LS54	.29	74LS151	1.05
74LS02	.35	74LS55	.29	74LS155	1.05
74LS03	.35	74LS73	.54	74LS157	1.05
74LS04	.42	74LS74	.54	74LS160	1.15
74LS05	.42	74LS75	.71	74LS161	1.39
74LS08	.35	74LS76	.54	74LS162	1.25
74LS09	.42	74LS78	.49	74LS163	1.39
74LS10	.35	74LS83	1.05	74LS164	1.50
74LS11	.75	74LS85	1.50	74LS175	1.25
74LS13	.59	74LS86	.54	74LS181	2.49
74LS14	1.25	74LS90	.71	74LS190	1.39
74LS15	.35	74LS92	.90	74LS191	1.39
74LS20	.35	74LS93	.90	74LS192	1.39
74LS21	.35	74LS95	.99	74LS193	1.39
74LS22	.35	74LS96	1.15	74LS194	1.39
74LS26	.35	74LS107	.54	74LS195	1.39
74LS27	.35	74LS109	.54	74LS253	1.25
74LS28	.35	74LS112	.54	74LS257	1.05
74LS30	.35	74LS123	1.50	74LS258	1.75
74LS32	.42	74LS125	1.05	74LS260	.83
74LS37	.45	74LS132	.99	74LS279	.90
74LS40	.35	74LS136	.59	74LS367	.75
74LS42	1.05	74LS138	1.05	74LS368	.75
74LS47	1.05			74LS670	2.49

Cromemco
incorporated

Z80-4MHz Single Card Computer

Cromemco's Single Card Computer is a complete computer which brings the power of the Z-80 and the flexibility of the S-100 bus to the dedicated control environment.

The card offers 4 MHz operation, 8K bytes of on-board 2716 PROM, and 1K byte of static RAM memory. This stand-alone card also provides an RS 232 (or 20mA current loop) serial interface with programmable baud rates to 76,800, vectored interrupts, 24 bits of bidirectional parallel I/O and 5 programmable timers. Only a power supply and PROM software are required for operation. The Single Card Computer is assembled and tested (Model SCC-W) for $450. The Monitor and Control BASIC are available in two ROM's (Model MCB-216) for $98.

SCC-W (Assembled) **$450.00**

DISCRETE LEDS

XC556R	.200"	red	5/$1	MV50	.085"	red	6/$1	XC111R	.190"	red	5/$1
XC556G	.200"	green	4/$1	XC209R	.125"	red	5/$1	XC111G	.190"	green	4/$1
XC556Y	.200"	yellow	4/$1	XC209G	.125"	green	4/$1	XC111Y	.190"	yellow	4/$1
XC556C	.200"	clear	4/$1	XC209Y	.125"	yellow	4/$1	XC111C	.190"	clear	4/$1
XC22R	.200"	red	5/$1	XC526R	.185"	red	5/$1				
XC22G	.200"	green	4/$1	XC526G	.185"	green	4/$1	INFRA-RED LED			
XC22Y	.200"	yellow	4/$1	XC526Y	.185"	yellow	4/$1	¼"x¼"x1/16" flat			5/$1
MV10B	.170"	red	4/$1	XC526C	.185"	clear	4/$1				

DISPLAY LEDS

TYPE	POLARITY	HT	PRICE	TYPE	POLARITY	HT	PRICE
MAN 1	Common Anode red	270	2.95	MAN 6730	Common Anode-red ± 1	560	.99
MAN 2	5 x 7 Dot Matrix red	300	4.95	MAN 6740	Common Cathode-red-D D	560	.99
MAN 3	Common Cathode red	125	.25	MAN 6750	Common Cathode red ± 1	560	.99
MAN 4	Common Cathode-red	187	1.95	MAN 6760	Common Anode-red	560	.99
MAN 7G	Common Anode-green	300	1.25	MAN 6780	Common Cathode-red	560	.99
MAN 7Y	Common Anode-yellow	300	.99	DL701	Common Anode-red ± 1	300	.99
MAN 72	Common Anode-red	300	.75	DL704	Common Cathode-red	300	.99
MAN 74	Common Cathode-red	300	1.25	DL707	Common Anode-red	300	.99
MAN 82	Common Anode-yellow	300	.49	DL728	Common Cathode-red	500	1.49
MAN 84	Common Cathode-yellow	300	.99	DL741	Common Anode-red	600	1.25
MAN 3620	Common Anode-orange	300	.49	DL746	Common Anode-red ± 1	630	1.49
MAN 3630	Common Anode-orange ± 1	300	.99	DL747	Common Anode-red	600	1.49
MAN 3640	Common Cathode-orange	300	.99	DL749	Common Cathode-red ± 1	630	1.49
MAN 4610	Common Anode-orange	300	.99	DL750	Common Cathode-red	600	1.49
MAN 4640	Common Cathode-orange	400	.99	DL338	Common Cathode-red	110	.35
MAN 4710	Common Anode red	400	.99	FND70	Common Cathode	250	.69
MAN 4730	Common Anode-red ± 1	400	.99	FND358	Common Cathode ± 1	357	.99
MAN 4740	Common Cathode-red	400	.99	FND359	Common Cathode	357	.75
MAN 4810	Common Anode-yellow	400	.99	FND503	Common Cathode(FND500)	500	.99
MAN 4840	Common Cathode-yellow	400	.99	FND507	Common Anode (FND510)	500	.99
MAN 6610	Common Anode-orange-D D	560	.99	5082-7730	Common Anode-red	300	.99
MAN 6630	Common Anode-orange ± 1	560	.99	HDSP-3400	Common Anode-red	800	1.50
MAN 6640	Common Cathode-orange-D D	560	.99	HDSP-3403	Common Cathode red	800	1.50
MAN 6650	Common Cathode-orange ± 1	560	.99	5082-7300	4 x 7 sgl Digit-RHDP	600	19.95
MAN 6660	Common Anode-orange	560	.99	5082-7302	4 x 7 Sgl Digit-LHDP	600	19.95
MAN 6680	Common Cathode-orange	560	.99	5082-7304	Overrange character (± 1)	600	15.00
MAN 6710	Common Anode-red-D D	560	.99	5082-7340	4 x 7 Sgl Digit-Hexadecimal	600	22.50

RCA LINEAR

CA3013T	2.15	CA3082N	2.00
CA2023T	3.25	CA3083N	1.60
CA3035T	2.48	CA3086N	.85
CA3039T	1.35	CA3089N	3.75
CA3046N	1.30	CA3130T	1.39
CA3059N	3.25	CA3140T	1.25
CA3060N	3.25	CA3160T	1.25
CA3080T	1.25	CA3401N	.59
CA3081N	2.00	CA3600N	3.50

CALCULATOR CHIPS/DRIVERS

MM5725	$2.95
MM5738	2.95
DM8864	2.00
DM8865	1.00
DM8887	.75
DM8889	.75
9374 7-seg. LED driver	1.50
MM5309	4.95

CLOCK CHIPS

MM5309	4.95
MM5311	4.95
MM5312	4.95
MM5314	4.95
MM5316	6.95
MM5318	9.95
MM5369	2.95
MM5387/1998	4.95
CT 7001	6.95

MOTOROLA

MC1408L7	4.95
MC1408L8	5.75
MC1439L	2.95
MC3022P	2.95
MC3061P	3.50
MC4016(74416)	7.50
MC4024P	3.95
MC4040P	6.95
MC4044P	4.50

LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100
8 pin LP	.17	.16	.15
14 pin LP	.20	.19	.18
16 pin LP	.22	.21	.20
18 pin LP	.29	.28	.27
20 pin LP	.34	.32	.30
22 pin LP	.37	.36	.35
24 pin LP	.38	.37	.36
28 pin LP	.45	.44	.43
36 pin LP	.60	.59	.58
40 pin LP	.63	.62	.61

SOLDERTAIL STANDARD (TIN)

	1-24	25-49	50-100
14 pin ST	.27	.25	.24
16 pin ST	.30	.27	.25
18 pin ST	.35	.32	.30
24 pin ST	.49	.45	.42
28 pin ST	.99	.90	.81
36 pin ST	1.39	1.26	1.15
40 pin ST	1.59	1.45	1.30

SOLDERTAIL (GOLD) STANDARD

	1-24	25-49	50-100
8 pin SG	.39	.35	.31
14 pin SG	.49	.45	.41
16 pin SG	.54	.49	.44
18 pin SG	.59	.53	.48
24 pin SG	.79	.75	.69
28 pin SG	1.10	1.00	.90
36 pin SG	1.65	1.40	1.26
40 pin SG	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-24	25-49	50-100
8 pin WW	.59	.54	.49
10 pin WW	.69	.63	.58
14 pin WW	.79	.73	.67
16 pin WW	.85	.77	.70
18 pin WW	.99	.90	.81
20 pin WW	1.19	1.08	.99
22 pin WW	1.49	1.35	1.23
24 pin WW	1.39	1.26	1.14
28 pin WW	1.69	1.53	1.38
36 pin WW	2.19	1.99	1.79
40 pin WW	2.29	2.09	1.89

1/4 WATT RESISTOR ASSORTMENTS – 5%

ASST. 1	5 ea	10 OHM / 27 OHM	12 OHM / 33 OHM	15 OHM / 39 OHM	18 OHM / 47 OHM	22 OHM / 56 OHM	50 PCS	$1.75
ASST. 2	5 ea	68 OHM / 180 OHM	82 OHM / 220 OHM	100 OHM / 270 OHM	120 OHM / 330 OHM	150 OHM / 390 OHM	50 PCS	1.75
ASST. 3	5 ea	470 OHM / 1.2K	560 OHM / 1.5K	680 OHM / 1.8K	820 OHM / 2.2K	1K / 2.7K	50 PCS	1.75
ASST. 4	5 ea	3.3K / 8.2K	3.9K / 10K	4.7K / 12K	5.6K / 15K	6.8K / 18K	50 PCS	1.75
ASST. 5	5 ea	22K / 56K	27K / 68K	33K / 82K	39K / 100K	47K / 120K	50 PCS	1.75
ASST. 6	5 ea	150K / 390K	180K / 470K	220K / 560K	270K / 680K	330K / 820K	50 PCS	1.75
ASST. 7	5 ea	1M / 2.7M	1.2M / 3.3M	1.5M / 3.9M	1.8M / 4.7M	2.2M / 5.6M	50 PCS	1.75

ASST. 8R Includes Resistor Assortments 1-7 (350 PCS) **$9.95 ea.**

TELEPHONE/KEYBOARD CHIPS

AY-5-9100	Push Button Telephone Dialler	$14.95
AY-5-9200	Repertory Dialler	14.95
AY-5-9500	CMOS Clock Generator	4.95
AY-5-2376	Keyboard Encoder (88 keys)	14.95
HD0165	Keyboard Encoder (16 keys)	7.95
74C922	Keyboard Encoder (16 keys)	7.95
74C923	Keyboard Encoder (20 keys)	6.25

ICM CHIPS

ICM7045	CMOS Precision Timer	24.95
ICM7205	CMOS LED Stopwatch/Timer	19.95
ICM7207	Oscillator Controller	7.50
ICM7208	Seven Decade Counter	19.95
ICM7209	Clock Generator	6.95

NMOS READ ONLY MEMORIES

MCM6571	128 X 9 X 7 ASCII Shifted with Greek	13.50
MCM6574	128 X 9 X 7 Math Symbol & Pictures	13.50
MCM6575	128 X 9 X 7 Alpha Control Char Gen	13.50

MISCELLANEOUS

TL074CN	Quad Low Noise bi-fet Op Amp	2.49
TL494CN	Switching Regulator	4.49
TL496CP	Single Switching Regulator	1.75
11C90	Divide 10/11 Prescaler	19.95
95H90	Hi-Speed Divide 10/11 Prescaler	11.95
4N33	Photo-Darlington Opto-Isolator	3.95
MK50240	Top Octave Freq. Generator	17.50
DS0026CH	5Mhz 2-phase MOS clock driver	3.75
TIL308	27" red num. display w/integ. logic chip	10.95
MM5320	TV Camera Sync. Generator	14.95
MM5330	4½ Digit DPM Logic Block (Special)	3.95
LD110/111	3½ Digit A/D Converter Set	25.00/set
MC14433P	3½ Digit A/D Converter	13.95

LITRONIX ISO-LIT 1
Photo Transistor Opto-Isolator (Same as MCT 2 or 4N25)
49¢ each

SN 76477
SOUND GENERATOR
Generates Complex Sounds
Low Power · Programmable
$3.95 each

TV GAME CHIP AND CRYSTAL
AY-3-8500-1 and 2.01 MHZ Crystal (Chip & Crystal includes score display, 6 games and select angles, etc. **7.95/set**

EXAR

XR205	$8.40			XR2242CP	1.50
XR210	4.40			XR2264	4.25
XR215	4.40			XR2556	3.20
XR320	1.55			XR2567	2.99
XR-L555	1.50	JE2206KB	19.95	XR3403	1.25
XR555	.39	XR1800	3.20	XR4136	1.25
XR556	.99	XR2206	4.40	XR4151	3.95
XR567CP	.99	XR2207	3.85	XR4194	4.95
XR567CT	1.25	XR2208	5.20	XR4202	3.60
XR1310P	1.95	XR2209	1.75	XR4212	2.05
XR1468CN	3.85	XR2211	5.25	XR4558	.75
XR1488	1.95	XR2212	4.35	XR4739	1.15
XR1489	1.95	XR2240	3.45	XR4741	1.47

DIODES

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
1N746	3.3	400m	4/1.00	1N4002	100 PIV	1 AMP	12/1.00
1N751	5.1	400m	4/1.00	1N4003	200 PIV	1 AMP	12/1.00
1N752	5.6	400m	4/1.00	1N4004	400 PIV	1 AMP	12/1.00
1N753	6.2	400m	4/1.00	1N4005	600 PIV	1 AMP	10/1.00
1N754	6.8	400m	4/1.00	1N4006	800 PIV	1 AMP	10/1.00
1N757	9.0	400m	4/1.00	1N4007	1000 PIV	1 AMP	10/1.00
1N759	12.0	400m	4/1.00	1N3600	50	200m	6/1.00
1N959	8.2	400m	4/1.00	1N4148	75	10m	15/1.00
1N965	15	400m	4/1.00	1N4154	35	10m	12/1.00
1N5232	5.6	500m	.28	1N4733	5.1	1w	.28
1N5234	6.2	500m	.28	1N4734	5.6	1w	.28
1N5235	6.8	500m	.28	1N4735	6.2	1w	.28
1N5236	7.5	500m	.28	1N4736	6.8	1w	.28
1N5242	12	500m	.28	1N4738	8.2	1w	.28
1N5245	15	500m	.28	1N4742	12	1w	.28
1N456	25	40m	6/1.00	1N4744	15	1w	.28
1N458	150	7m	6/1.00	1N1183	50 PIV	35 AMP	1.60
1N485A	180	10m	5/1.00	1N1184	100 PIV	35 AMP	1.70
1N4001	50 PIV	1 AMP	12/1.00	1N1185	150 PIV	35 AMP	1.70
				1N1186	200 PIV	35 AMP	1.80
				1N1188	400 PIV	35 AMP	3.00

SCR AND FW BRIDGE RECTIFIERS

C36D	15A @ 400V	SCR(2N1849)	$1.95
C36M	35A @ 600V	SCR	1.95
2N2328	1.6A @ 300V	SCR	.50
MDA 980-1	12A @ 50V	FW BRIDGE REC	1.95
MDA 980-3	12A @ 200V	FW BRIDGE REC	1.95

TRANSISTORS

C106B1	.50			2N3904	4/1.00
MPSA05	.30	2N3055	.89	2N3905	4/1.00
MPSA06	5/1.00	MJE3055	1.00	2N3906	4/1.00
TIS97	6/1.00	2N3392	5/1.00	2N4013	3/1.00
TIS98	6/1.00	2N3398	5/1.00	2N4123	6/1.00
40409	1.75	PN3567	3/1.00	PN4249	4/1.00
40410	1.75	PN3568	4/1.00	PN4250	4/1.00
40673	1.75	PN3569	4/1.00	2N4400	4/1.00
2N918	4/1.00	MPS3638A	5/1.00	2N4401	4/1.00
2N2219A	2/1.00	MPS3702	5/1.00	2N4402	4/1.00
2N2221A	4/1.00	2N3704	5/1.00	2N4403	4/1.00
2N2222A	5/1.00	MPS3704	5/1.00	2N4409	5/1.00
PN2222 Plastic	7/1.00	2N3705	5/1.00	2N5086	4/1.00
2N2369A	4/1.00	MPS3705	5/1.00	2N5087	4/1.00
MPS2369	5/1.00	2N3706	5/1.00	2N5088	4/1.00
2N2484	4/1.00	MPS3706	5/1.00	2N5089	4/1.00
2N2906	4/1.00	2N3707	5/1.00	2N5129	5/1.00
2N2907	5/1.00	2N3711	5/1.00	PN5134	5/1.00
		2N3724A	.65	PN5138	5/1.00
2N2925	5/1.00	2N3725A	1.00	2N5139	5/1.00
MJE2955	1.25	2N3772	2.25	2N5210	5/1.00
2N3053	2/1.00	2N3823	1.00	2N5449	3/1.00
		2N3903	5/1.00	2N5951	3/1.00

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-99	100-		1-9	10-99	100+
10 pf	.05	.04	.03	.001µF	.05	.04	.035
22 pf	.05	.04	.03	.0047µF	.05	.04	.035
47 pf	.05	.04	.03	.01µF	.05	.04	.035
100 pf	.05	.04	.03	.022µF	.06	.05	.04
220 pf	.05	.04	.03	.047µF	.06	.05	.04
470 pf	.05	.04	.035	.1µF	.12	.09	.075

100 VOLT MYLAR FILM CAPACITORS

.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22

+20% DIPPED TANTALUMS (SOLID) CAPACITORS

.1/35V	.39	.31	.25	1.5/35V	.41	.33	.26
.15/35V	.39	.31	.25	2.2/35V	.51	.41	.33
.22/35V	.39	.31	.25	3.3/25V	.53	.43	.34
.33/35V	.39	.31	.25	4.7/25V	.63	.51	.41
.47/35V	.39	.31	.25	6.8/25V	.79	.63	.50
.68/35V	.39	.31	.25	15/25V	1.39	1.12	.89
1.0/35V	.39	.31	.25	22/6V	.79	.63	.50

MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS

Axial Lead				Radial Lead			
.47/50V	.15	.13	.10	.47/25V	.15	.13	.10
1.0/50V	.16	.14	.11	.47/50V	.16	.14	.11
3.3/50V	.14	.12	.09	1.0/16V	.15	.13	.10
4.7/25V	.15	.13	.10	1.0/25V	.16	.14	.11
10/25V	.15	.13	.10	1.0/50V	.16	.14	.11
10/50V	.16	.14	.12	4.7/16V	.15	.13	.10
22/25V	.17	.15	.12	4.7/25V	.15	.13	.10
22/50V	.24	.20	.18	4.7/50V	.16	.14	.11
47/25V	.19	.17	.15	10/16V	.14	.12	.09
47/50V	.25	.21	.19	10/25V	.15	.13	.10
100/25V	.24	.20	.18	10/50V	.16	.14	.12
100/50V	.35	.30	.28	47/50V	.24	.21	.19
220/25V	.32	.28	.25	100/16V	.19	.15	.14
220/50V	.45	.41	.38	100/25V	.24	.20	.18
470/25V	.33	.29	.27	100/50V	.35	.30	.28
1000/16V	.55	.50	.45	220/16V	.23	.17	.16
2200/16V	.70	.62	.55	470/25V	.31	.28	.26

$10.00 Min. Order – U.S. Funds Only
Calif. Residents Add 6% Sales Tax
Postage – Add 5% plus $1 Insurance (if desired)

Spec Sheets – 25¢
1980 Catalog Available – Send 41¢ stamp

FREE 1980 CATALOG

Jameco ELECTRONICS

PHONE ORDERS WELCOME (415) 592-8097

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

5-80 ✓38

Reader Service—see page 226

Nicad battery charger . . . $5.95

TUNNEL DIODES

TYPE	PRICE
TD261A	$10.00
TD263A	10.00
1N2930	7.65
1N3716	5.00
1N4396	7.50

Polorad Model 1206
1.95 to 4.20 GHz
signal source
$400.00
Model 1107 3.8 to 8.20
GHz signal generator
$550.00

FETS

3N128	$1.00
40673	1.39
MPF102	.45
MPF121	1.00
MPF131	1.00

E.F. Johnson tube socket #122-0275-001
for 3-400Z, 3-500Z, 4-125A, 4-250A, 4-400A
$29.95/pair

2300 MHz CONVERTER KIT

PC board and assembly instructions	$ 25.00
PC board with 13 chip caps — assembled	44.99
PC board with all parts for assembly	79.99
PC board assembled and tested	120.00
Power supply kit	44.99
Yagi antenna	59.99
Complete unit, assembled and tested	299.99

RF TRANSISTORS

TYPE	PRICE				
2N1561	$15.00	2N5590	6.30	MM1550	10.00
2N1562	15.00	2N5591	10.35	MM1552	50.00
2N1692	15.00	2N5637	20.70	MM1553	56.50
2N1693	15.00	2N5641	4.90	MM1601	5.50
2N2632	45.00	2N5642	8.63	MM1802/2N5842	7.50
2N2857JAN	2.45	2N5643	14.36	MM1607	8.65
2N2876	12.35	2N5645	11.00	MM1661	15.00
2N2880	25.00	2N5764	27.00	MM1669	17.50
2N2927	7.00	2N5842	8.65	MM1943	3.00
2N2947	17.25	2N5849	19.50	MM2605	3.00
2N2948	15.50	2N5862	50.00	MM2608	5.00
2N2949	3.90	2N5913	3.25	MM8006	2.15
2N2950	5.00	2N5922	10.00	MMCM918	1.00
2N3287	4.30	2N5942	46.00	MMT72	.61
2N3294	1.15	2N5944	7.50	MMT74	.94
2N3301	.75	2N5945	10.90	MMT2857	2.88
2N3302	1.05	2N5946	13.20	MRF304	43.45
2N3304	1.48	2N6080	5.45	MRF420	20.00
2N3307	10.50	2N6081	8.60	MRF450	12.35
2N3309	3.90	2N6082	9.90	MRF450A	12.35
2N3375	8.75	2N6083	11.80	MRF454	20.10
2N3553	1.45	2N6084	13.20	MRF458	18.95
2N3755	7.20	2N6094	5.75	MRF475	5.00
2N3818	6.00	2N6095	10.35	MRF476	5.00
2N3866	1.09	2N6096	19.35	MRF502	.49
2N3866JAN	2.70	2N6097	28.00	MRF504	6.95
2N3866JANTX	4.43	2N6138	18.70	MRF509	4.90
2N3924	3.20	2N6166	36.80	MRF511	8.60
2N3925	6.00	2N6265	75.00	MRF901	5.00
2N3927	11.50	2N6266	100.00	MRF5177	20.70
2N3950	26.25	2N6439	43.45	MRF8004	1.44
2N4072	1.70	2N6459/PT9795	18.00	PT4186B	3.00
2N4135	2.00	2N6603	12.00	PT4571A	1.50
2N4261	14.60	2N6604	12.00	PT4612	5.00
2N4427	1.09	A50-12	25.00	PT4628	5.00
2N4429	7.50	BFR90	3.00	PT4640	5.00
2N4430	20.00	BLY568C	25.00	PT8659	10.72
2N4957	3.50	BLY568CF	25.00	PT9784	24.30
2N4958	2.80	CD3495	15.00	PT9790	41.70
2N4959	2.12	HEP76/S3014	4.95	SD1043	5.00
2N4976	13.00	HEPS3002	11.30	SD1116	3.00
2N5090	6.90	HEPS3003	29.88	SD1118	5.00
2N5108	3.90	HEPS3005	9.95	SD1119	3.00
2N5109	1.55	HEPS3006	19.90	TA7993	75.00
2N5160	3.34	HEPS3007	24.95	TA7994	100.00
2N5179	.60	HEPS3010	11.34	TRWMRA2023-1.5	42.50
2N5184	2.00	HEPS5026	2.56	40281	10.90
2N5216	47.50	HP3583IE/		40282	11.90
2N5583	4.43	HXTR5104	50.00	40290	2.48
2N5589	4.60	MM1500	32.20		

MHZ ELECTRONIC KITS:

kit #1
Motorola MC14410CP CMOS Tone Generator
CMOS Tone Generator uses 1MHZ crystal to produce standard dual frequency dialing signal. Directly compatible with 12 key Chomeric Touch Tone Pads. Kit includes the following:

1 Motorola MC14410CP Chip
1 PC Board
And all other parts for assembly, with 1 MHz crystal $20.65

Kit #2
Fairchild 95H90DC Prescaler 350MHZ.
95H90DC Prescaler divides by 10 to 350 MHZ. This kit will take any 35MHZ Counter to 350 MHZ. Kit includes the following:

1 Fairchild 95H90DC Chip
1 2N5179 Transistor
2 UG-88/U BNC Connectors
1 PC Board
And all other parts for assembly. NOW ONLY $24.95
Less 95H90 chip $10.95

FAIRCHILD VHF AND UHF PRESCALER CHIPS

95H90DC	350MHZ Prescaler Divide by 10/11	$ 9.50
95H91DC	350MHZ Prescaler Divide by 5/6	8.95
11C90DC	650MHZ Prescaler Divide by 10/11	16.50
11C91DC	650MHZ Prescaler Divide by 5/6	15.95
11C83DC	1GHZ Divide by 248/256 Prescaler	29.90
11C70DC	600MHZ Flip/Flop with reset	12.30
11C58DC	ECL VCM	4.53
11C44DC	Phase Frequency Detector (MC4044P/L)	3.82
11C24DC	Dual TTL VCM (MC4024P/L)	3.82
11C06DC	UHF Prescaler 750MHZ D Type Flip/Flop	12.30
11C05DC	1GHZ Counter Divide by 4	74.35
11C01FC	High Speed Dual 5-4 Input NO/NOR Gate	15.40

CRYSTAL FILTERS: Tyco 001-19880 same as 2194F
10.7MHZ Narrow Band Crystal Filter
3 db bandwidth 15khz minimum 20 db bandwidth 60khz minimum 40 db bandwidth 150khz minimum. Ultimate 50 db: Insertion loss 1.0db Max. Ripple 1.0db Max. Ct. 0 + − 5pf. Rt. 3600 Ohms.
NOW ONLY $5.95

We bought 6,000 LED digital clocks, made by Spartus. All have alarms. Sold as is. (Some alarms don't work.)
$7.95 each/2 for $13.95
Have National clock module Model MA 1002 and 1023. Can be used for 12- or 24-hours.

TUBES

2E26	$5.00	4X150B	$76.00
3-500Z	102.60	4X150G	111.00
3-1000Z	268.00	100TH	144.00
3B28	5.00	572B	39.00
3X2500A3	150.00	811A	12.95
4-65A	90.00	813	29.00
4-125A	117.00	5894	42.00
4-250A	136.00	6146A	6.00
4-400A	142.00	6146B	7.00
4-1000A	368.00	6159	10.60
5-500A	145.00	6293	18.50
4CX250B	65.00	6360	6.95
4CX250F	85.00	6907	40.00
4CX250G	85.00	6939	14.75
4CX250K	113.00	7360	12.00
4CX250R	92.00	7984	10.40
4CX300A	147.00	8072	49.00
4CX350A	107.00	8156	7.85
4CX350FJ	116.00	8226	127.70
4CX1000A	394.00	8295A/PL172	328.00
4CX1500B	458.00	8458	25.75
4CX1500A	400.00	8560AS	50.00
4X150A	63.00	8950	7.80

TERMS:
All checks and money orders are in U.S. funds!
All orders sent first class or UPS.
Please include $1.50 minimum for postage.
All prices are in U.S. dollars.
All parts prime/guaranteed.
5% service charge on all bank cards.

BANK AMERICARD/VISA/MASTERCHARGE
Your Number
(or equivalent)
Exp. Date
Your Signature:

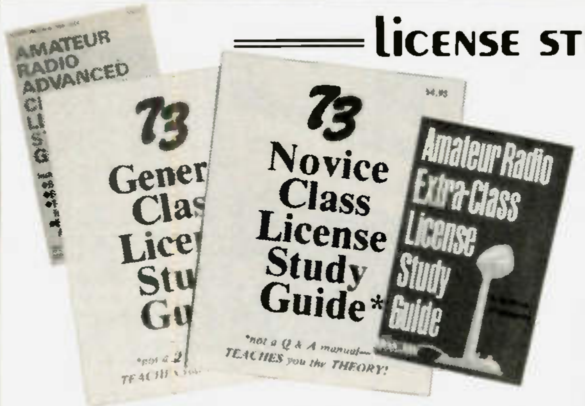
MHz electronics ✓48

(602) 242-3037
2111 W. Camelback
Phoenix, Arizona 85015

✓Reader Service—see page 226

Radio Bookshop

license study guides & tapes



● NOVICE STUDY GUIDE—SG7357—Here is a completely new study guide and reference book for the potential ham. This is not a question/answer memorization course. Electronic and radio fundamentals are presented and explained in an easy-to-understand fashion, preparing the beginner for the Novice exam. Includes the latest FCC amateur regulations, as well as application forms. Easily the best path into the exciting world of ham radio! $4.95.*

● GENERAL CLASS STUDY GUIDE—SG7358—A complete theory course for the prospective General or Technician. This reference explains transistor, amplifier, and general radio theory, while preparing the Novice for the "big" ticket. After getting your ticket, you'll use this guide again and again as an electronics reference source. Not a question/answer guide that becomes dated when the FCC updates the amateur exams. $5.95.*

● ADVANCED CLASS LICENSE STUDY GUIDE—SG1081—Ready to upgrade your license? To prevent retaking the FCC theory exam, you need the *73* Advanced theory guide. SSB, antenna theory, transmitters, and electronics measuring techniques are covered in detail in this easy-to-follow study guide. Special modes and techniques, such as RTTY, are also treated. An engineering degree is *not* necessary to master the Advanced theory—try this book before visiting the examiner's office! $6.95.* (Published by TAB Books previous to recent changes in FCC exam material.)

● EXTRA CLASS LICENSE STUDY GUIDE—SG1080—Before going for your 1 x 2 call, it pays to be a master of the Extra class electronics theory. This study guide is the logical extension of the *73* theory course. All the theory necessary to pass the exam is presented. Antennas, transmission lines, swr are discussed, as well as noise, propagation, and specialized communication techniques. This book is not a classroom lecture or memorization guide, but rather a logical presentation of the material that must be *understood* before attempting the Extra exam. Save yourself a return trip to the FCC and try the *73* method first! $5.95.*

NOVICE THEORY TAPES
Startling Learning Breakthrough

● NOVICE THEORY TAPES—CT7300—Startling Learning Breakthrough. You'll be astounded at how really simple the theory is when you hear it explained on these tapes. Three tapes of theory and one of questions and answers from the latest Novice exams give you the edge you need to breeze through your exam. *73* is interested in helping get more amateurs, so we're giving you the complete set of our tapes for the incredibly low price of **ONLY $15.95.***

Scientists have proven that you learn faster by listening than by reading because you can play a cassette tape over and over in your spare time—even while you're driving! You get more and more info each time you hear it. You can't progress without solid fundamentals. These four hour-long tapes give you all the basics you'll need to pass the Novice exam easily. You'll have an understanding of the basics which will be invaluable to you for the rest of your life! Can you afford to take your Novice exam without first listening to these tapes? Set of 4—$15.95.*

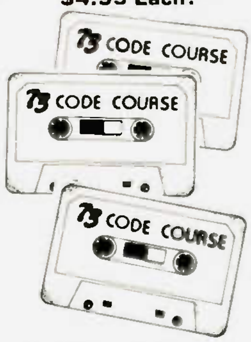
These tapes were made previous to recent changes in FCC rules. These minor changes do not affect the *theory* involved. A new set of tapes reflecting these rule changes is being developed. Expected availability is June 1980.

SSTV

● SLOW SCAN TELEVISION TAPE—CT7350—Prize-winning programs from the 73 SSTV contest. Excellent for Demo! $5.95.*

73 CODE TAPES

Any Four Tapes For $15.95!* $4.95 Each!*



"GENESIS"

5 WPM—CT7305—This is the beginning tape for people who do not know the code at all. It takes them through the 26 letters, 10 numbers and necessary punctuation, complete with practice every step of the way using the newest blitz teaching techniques. It is almost miraculous! In one hour many people—including kids of ten—are able to master the code. The ease of learning gives confidence to beginners who might otherwise drop out.

"THE STICKLER"

6+ WPM—CT7306—This is the practice tape for the Novice and Technician licenses. It is made up of one solid hour of code, sent at the official FCC standard (no other tape we've heard uses these standards, so many people flunk the code when they are suddenly—under pressure—faced with characters sent at 13 wpm and spaced for 5 wpm). This tape is not memorizable, unlike the zany 5 wpm tape, since the code groups are entirely random characters sent in groups of five.

"BACK BREAKER"

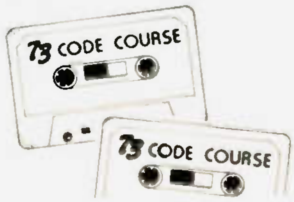
13+ WPM—CT7313—Code groups again, at a brisk 13 per so you will be at ease when you sit down in front of the steely-eyed government inspector and he starts sending you plain language at only 13 per. You need this extra margin to overcome the panic which is universal in the test situations. When you've spent your money and time to take the test, you'll thank heavens you had this back-breaking tape.

"COURAGEOUS"

20+ WPM—CT7320—Code is what gets you when you go for the Extra class license. It is so embarrassing to panic out just because you didn't prepare yourself with this tape. Though this is only one word faster, the code groups are so difficult that you'll almost fall asleep copying the FCC stuff by comparison. Users report that they can't believe how easy 20 per really is with this fantastic one hour tape.

"OUTRAGEOUS"

25+ WPM—CT7325—This is the tape for that small group of overachieving hams who wouldn't be content to simply satisfy the code requirements of the Extra Class license. It's the toughest tape we've got and we keep a permanent file of hams who have mastered it. Let us know when you're up to speed and we'll inscribe your name in 73's CW "Hall of Fame."



*Use the order card in the back of this magazine or itemize your order on a separate piece of paper and mail to: 73 Radio Bookshop ● Peterborough NH 03458. Be sure to include check or detailed credit card information. *Add $1.00 handling charge. Note: Prices subject to change on books not published by 73 Magazine. Questions regarding your order? Please write to Customer Service at the above address. Please allow 4-6 weeks for delivery.

FOR TOLL FREE ORDERING CALL 1-800-258-5473

Radio Bookshop

73 TECHNICAL LIBRARY

● **BEHIND THE DIAL**—BK7307—By Bob Grove. Get more fun out of shortwave listening with this interesting guide to receivers, antennas, frequencies and interference. $4.95.*

● **THE CHALLENGE OF 160**—BK7309—is the newest book in the *73* technical library, dedicated to 160 meter operating. Si Dunn provides all necessary information to get started on this unique band. The all-important antenna and ground systems are described in detail. The introduction contains interesting photos of Stew Perry's (the King of 160) shack. This reference is a must for new and experienced "Top Band" operators. Price: $4.95.*

● **IC OP-AMP COOKBOOK**—BK1028—by Walter G. Jung. Covers not only the basic theory of the IC op amp in great detail, but also includes over 250 practical circuit applications, liberally illustrated. 592 pages, 5½ × 8½, softbound. $12.95.*

● **THE POWER SUPPLY HANDBOOK**— BK7305—Need a power supply for a gadget you're building? In the **POWER SUPPLY HANDBOOK** there are dozens ready-to-build, plus detailed steps for designing your own. There are circuits and parts lists for all kinds of supplies, ranging from simple DC types to highly stable regulated versions. If you need a circuit to convert a DC voltage to a higher or lower voltage, turn DC into AC, or AC to DC—then this is the book you need. With more than 400 pages, you should be able to find just the circuit you need. Without a doubt one of the best power supply source books available, compiled by the editors of 73. $7.95.*

● **INTRODUCTION TO RTTY**—BK7380—A beginner's guide to radioteletype including teletypewriter fundamentals, signals, distortion and RTTY art. You can be a RTTY artist! A *73* publication. $2.00.*

● **THE NEW RTTY HANDBOOK**—BK7347—is a new edition and the only up-to-date RTTY book available. The state of the art has been changing radically and has made all previous RTTY books obsolete. It has the latest circuits, great for the newcomer and expert alike. $5.95.*

● **PROPAGATION WIZARD'S HANDBOOK**—BK7302—by J. H. Nelson. When sunspots riddled the worldwide communications networks of the 1940's, John Henry Nelson looked to the planets for an answer. The result was a theory of propagation forecasting based upon interplanetary alignment that made the author the most reliable forecaster in America today. The book provides an enlightened look at communications past, present, and future, as well as teaching the art of propagation forecasting. $6.95.*

● **SSB . . . THE MISUNDERSTOOD MODE**—BK7351—by James B. Wilson. Single Sideband Transmission . . . thousands of us use it every day, yet it remains one of the least understood facets of amateur radio. J. B. Wilson presents several methods of sideband generation, amply illustrated with charts and schematics, which will enable the ambitious reader to construct his own sideband generator. A must for the technically-serious ham. $5.50.*

● **SSTV HANDBOOK**—BK7354(hardcover), BK7355(softcover)—This excellent book tells all about it, from its history and basics to the present state-of-the-art techniques. Contains chapters on circuits, monitors, cameras, color SSTV, test equipment and much more. Hardbound $7.00, softbound $5.00.*

● **WEATHER SATELLITE HANDBOOK**—BK7370—Simple equipment and methods for getting good pictures from the weather satellite. Antennas, receivers, monitors, facsimile you can build, tracking, automatic control (you don't even have to be home). Dr. Taggart WB8DQT. $4.95.*

● **TOOLS & TECHNIQUES FOR ELECTRONICS**—BK7348—is an easy-to-understand book written for the beginning kit builder as well as the experienced hobbyist. It has numerous pictures and descriptions of the safe and correct ways to use basic and specialized tools for electronic projects as well as specialized metal working tools and the chemical aids which are used in repair shops. $4.95*

● **THE CONTEST COOKBOOK**—BK7308—reveals the secrets of the contest winners (Domestic, DX and specialty contests), complete with photos and diagrams of equipment used by the top scorers. Find out how to make 150 contacts in one hour. $5.95*

* Use the order card in the back of this magazine or itemize your order on a separate piece of paper and mail to: 73 Radio Bookshop ● Peterborough NH 03458. Be sure to include check or detailed credit card information. *Add $1.00 handling charge. Note: Prices subject to change on books not published by 73 Magazine. Questions regarding your order? Please write to Customer Service at the above address. Please allow 4-6 weeks for delivery.

FOR TOLL FREE ORDERING CALL 1-800-258-5473

Radio Bookshop

TEST EQUIPMENT

● **RF AND DIGITAL TEST EQUIPMENT YOU CAN BUILD**—BK1044—Rf burst, function, square wave generators, variable length pulse generators—100 kHz marker, i-f and rf sweep generators, audio osc, af/rf signal injector, 146 MHz synthesizer, digital readouts for counters, several counters, prescaler, microwave meter, etc. 252 pages. $5.95.*

● **VOL. I COMPONENT TESTERS**—LB7359— . . . how to build transistor testers (8), diode testers (3), IC testers (3), voltmeters and VTVMs (9), ohmmeters (8 different kinds), inductance (3), capacity (9), Q measurement, crystal checking (6), temperature (2), aural meters for the blind (3) and all sorts of miscellaneous data on meters . . . using them, making them more versatile, making standards. Invaluable book. $4.95.*

● **VOL. II AUDIO FREQUENCY TESTERS**—LB7360— . . . jam packed with all kinds of audio frequency test equipment. If you're into SSB, RTTY, SSTV, etc., this book is a must for you . . . a good book for hi-fi addicts and experimenters, too! $4.95.*

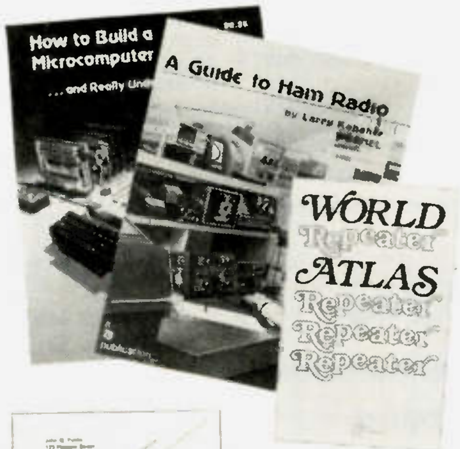
● **VOL. III RADIO FREQUENCY TESTERS**—LB7361—Radio frequency waves, the common denominator of Amateur Radio. Such items as SWR, antenna impedance, line impedance, rf output and field strength; detailed instructions on testing these items includes sections on signal generators, crystal calibrators, grid dip oscillators, noise generators, dummy loads and much more. $4.95.*

● **VOL. IV IC TEST EQUIPMENT**—LB7362—Become a troubleshooting wizard! In this fourth volume of the 73 TEST EQUIPMENT LIBRARY are 42 home construction projects for building test equipment to work with your ham station and in servicing digital equipment. Plus a cumulative index for all four volumes of the 73 TEST EQUIPMENT LIBRARY. $4.95.*

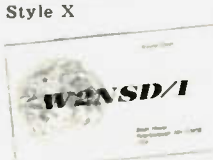
THE WELL-EQUIPPED HAM SHACK

● ***73 MAGAZINE* BINDERS**—Preserve and protect your collection for your lifetime! There's no excuse for lost issues when you have these handsome red binders with gold lettering. Order 1—BN1001—for $6.50*; 2 or more—BN1002—for $6.00 each.* (specify 1978 or 1979 binders)

● **QSL CARDS**—*73* turns out a fantastic series of QSL cards at about half the cost of having them done elsewhere because they are run as a fill-in between printing books and other items in the 73 Print Shop. 250 Style W—QW0250—for $8.95*; 500 Style W—QW0500—for $13.95*; 250 Style X—QX0250—for $8.95*; 500 Style X—QX0500—for $13.95*; 250 Style Y—QY0250—for $8.95*; 500 Style Y—QY0500—for $13.95.* Allow 6-12 wks. for delivery.



Style X



Style W

Style Y

● **HOW TO BUILD A MICROCOMPUTER—AND REALLY UNDERSTAND IT**—BK7325—by Sam Creason. The electronics hobbyist who wants to build his own microcomputer system now has a practical "How-To" guidebook. Sam Creason's book is a combination technical manual and programming guide that takes the hobbyist step-by-step through the design, construction, testing and debugging of a complete microcomputer system. $9.95.*

● **1980 WORLD REPEATER ATLAS**—BK1080—Completely updated for 1980, over 230 pages of repeater listings are indexed by location and frequency. More than 50 maps pinpoint 2000 repeater locations throughout the USA. Foreign listings include Europe, the Middle East, South America and Africa. $4.95.*

● **BACK ISSUES**—Complete your collection; many are prime collectables now, classics in the field! A full collection is an invaluable compendium of radio and electronics knowledge!

Single back issue—ST0000—$3.00*;
25 our choice—ST2500—$12.00*;
25 your choice—ST2501—$25.00*;
5 your choice—ST0500—$8.75*;
10 your choice—ST1000—$14.00.*

● **OWNER REPAIR OF RADIO EQUIPMENT**—BK7310—Frank Glass K6RQ shares over 40 years of operating, servicing, and design experience in this book which ranges from the elementary to the highly technical written for the top engineers in the field. It is written in narrative style on the subjects of electronic servicing, how components work, and how they are combined to provide communication equipment. This book will help you understand the concepts required to service your own station equipment. $7.95.*

● **FREE BACK ISSUE CATALOGS** are yours for the asking . . . specify 73 Magazine and/or Kilobaud Microcomputing back issue catalog when you send your name and address to us on a postcard.

● **A GUIDE TO HAM RADIO**—BK7321—by Larry Kahaner WB2NEL. What's Amateur Radio all about? You can learn the basics of this fascinating hobby with this excellent beginner's guide. It answers the most frequently asked questions in an easy-going manner, and it shows the best way to go about getting an FCC license. A Guide to Ham Radio is an ideal introduction to a hobby enjoyed by people around the world. $4.95.*

● **LIBRARY SHELF BOXES**—These sturdy white, corrugated, dirt-resistant boxes each hold a full year of *73* or *Kilobaud Microcomputing*. With your order, request self-sticking labels for any of the following: *73, Kilobaud Microcomputing, CQ, QST, Ham Radio, Personal Computing, Radio Electronics, Interface Age*, and *Byte*. Order 1—BX1000—for $2.00*; order 2-7—BX2002—for $1.50 each*; order 8 or more—BX1002—for $1.25 each*.

* Use the order card in the back of this magazine or itemize your order on a separate piece of paper and mail to: 73 Radio Bookshop ● Peterborough NH 03458. Be sure to include check or detailed credit card information. *Add $1.00 handling charge. Note: Prices subject to change on books not published by 73 Magazine. Questions regarding your order? Please write to Customer Service at the above address. Please allow 4-6 weeks for delivery.

FOR TOLL FREE ORDERING CALL 1-800-258-5473

Radio Bookshop

● **CMOS COOKBOOK**—BK1011—by Don Lancaster. Details the application of CMOS, the low power logic family suitable for most applications presently dominated by TTL. Required reading for every serious digital experimenter! $10.50.*

● **TVT COOKBOOK**—BK1064—by Don Lancaster. Describes the use of a standard television receiver as a microprocessor CRT terminal. Explains and describes character generation, cursor control and interface information in typical, easy-to-understand Lancaster style. $9.95.*

● **HOBBY COMPUTERS ARE HERE!**—BK7322—If you want to come up to speed on how computers work . . . hardware and software . . . this is an excellent book. It starts with the fundamentals and explains the circuits, the basics of programming, along with a couple of TVT construction projects, ASCII-Baudot, etc. This book has the highest recommendations as a teaching aid for newcomers. $4.95.*

● **THE NEW HOBBY COMPUTERS**—BK7340—This book takes it from where **Hobby Computers Are Here!** leaves off, with chapters on Large Scale Integration, how to choose a microprocessor chip, an introduction to programming, low cost I/O for a computer, computer arithmetic, checking memory boards, a Baudot monitor/editor system, an audible logic probe for finding those tough problems, a ham's computer, a computer QSO machine . . . and much, much more! $4.95*

● **HOW TO MAKE MONEY WITH COMPUTERS**—In 10 information-packed chapters, Jerry Felsen describes more than 30 computer-related, money-making, high profit, low capital investment opportunities. $15.00.* (BK1003)

● **TTL COOKBOOK**—BK1063—by Donald Lancaster. Explains what TTL is, how it works, and how to use it. Discusses practical applications, such as a digital counter and display system, events counter, electronic stopwatch, digital voltmeter and a digital tachometer. $9.50.

* Use the order card in the back of this magazine or itemize your order on a separate piece of paper and mail to: 73 Radio Bookshop ● Peterborough NH 03458. Be sure to include check or detailed credit card information. *Add $1.00 handling charge. Note: Prices subject to change on books not published by 73 Magazine. Questions regarding your order? Please write to Customer Service at the above address. Please allow 4-6 weeks for delivery.

kilobaud

MICROCOMPUTING™

Yes! Please send me Kilobaud MICROCOMPUTING at a saving of 40% to 50% off the newsstand price.

- ☐ 12 issues for $18 (save 40%)
- ☐ 24 issues for $30 (save 50%)
- ☐ 36 issues for $45 (save 50%)
- ☐ New subscription ☐ Renewal
- ☐ Payment enclosed $ ________
- ☐ VISA ☐ MC ☐ AE ☐ Bill me

Card # ________

Interbank # ________ *Exp. date* ________

Signature ________

Name ________

Address ________

City ________ *State* ________ *Zip* ________

—for even faster service call toll-free (800) 258-5473

Canada: same as US, in US funds.
Other foreign: $23 one year only, US funds.

305B6

MICROCOMPUTING ● POB 997 ● Farmingdale NY 11737

MOVING?

Let us know 8 weeks in advance so that you won't miss a single issue of 73 Magazine.
Attach old label where indicated and print new address in space provided. Also include your mailing label whenever you write concerning your subscription. It helps us serve you promptly. Write to:

73 magazine

Subscription Department
P.O. Box 931
Farmingdale NY 11737

- ☐ Address change only
- ☐ Extend subscription
- ☐ Enter new subscription
- ☐ 1 year $18.00
- ☐ Payment enclosed
- ☐ Bill me later

If you have no label handy, print OLD address here.

AFFIX LABEL

Name ________ Call ________

Address ________

City ________ State ________ Zip ________

print NEW address here:

Name ________ Call ________

Address ________

City ________ State ________ Zip ________

301B55

propagation

by
J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7	7	7	7	7	14	14	14	14
ARGENTINA	21A	21	14	14	14	7A	21	21	21A	21A	21A	21A
AUSTRALIA	21	14A	14	7A	7B	7B	14	14	14B	14B	14	21A
CANAL ZONE	21	21	14	14	7A	7A	14	21	21	21A	21A	21A
ENGLAND	14	7A	7	7	7	14	14	14A	21A	21	21	14A
HAWAII	21	14	14	7	7	7	7	14	14	14	14A	21
INDIA	14	14	7B	7B	7B	7B	14	14	14	14	14	14
JAPAN	14A	14	14	7B	7B	7B	7	7	14	14	14	14
MEXICO	21	14	14	7A	7	7	7A	14	14	21	21	21
PHILIPPINES	14	14	14	7B	7B	7B	7B	14	14	14	14	14
PUERTO RICO	21	14	14	7	7	7	14	14	21	21	21	21
SOUTH AFRICA	14	7	7B	14	14	14	21	21A	21A	21A	21	14
U. S. S. R.	14	7	7	7	7	14	14	14	21	21	21	14
WEST COAST	21	14A	14	14	7	7	14	14	14A	21	21	21

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7	7	7	7	7	14	14	14	14
ARGENTINA	21A	21	14	14	14	7A	14	21	21A	21A	21A	21A
AUSTRALIA	21	21	14	14	14	14B	14	14	14B	14B	21	21A
CANAL ZONE	21A	21	14	14	7A	7A	14	14	21	21A	21A	21A
ENGLAND	14	7A	7	7	7	7	14	14	14	14A	21	14A
HAWAII	21	21	14	14	7A	7	7	14	14	14A	21	21A
INDIA	14	14	14	7B	7B	7B	7B	7B	14	14	14	14
JAPAN	14A	14	14	14	7B	7B	7	7	14	14	14	14
MEXICO	21	14	14	7	7	7	7	14	14	14	14	14A
PHILIPPINES	14	14	14	14B	7B	7B	7B	14	14	14	14	14
PUERTO RICO	21	21	14	14	7	7	14	21	21	21A	21A	21A
SOUTH AFRICA	14	7	7B	7B	7B	7B	14	14	14	21	21	14
U. S. S. R.	14	7	7	7	7	7	7A	14	14	14A	14A	14

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7A	7	7	7	7	14	14	14	14
ARGENTINA	21A	21A	14	14	14	7A	14	21	21A	21A	21A	21A
AUSTRALIA	21A	21A	21A	21	14	14	14	14	14B	14B	21	21A
CANAL ZONE	21A	21	14	14	14	7A	14	14	21	21	21A	21A
ENGLAND	14	7B	7	7	7	7	7	14	14	14	14A	14A
HAWAII	21A	21A	21A	21	14	14	7A	14	14	21	21	21A
INDIA	14	14	14	14	7B	7B	7B	7B	14	14	14	14
JAPAN	14A	14	14	14	14	7B	7	7	14	14	14	14
MEXICO	21	21	14	7A	7	7	7	14	14	14A	21	21
PHILIPPINES	14A	14	14	14	14	14B	7B	14	14	14	14	14
PUERTO RICO	21	21	14	14	7	7	7	14	21	21	21A	21A
SOUTH AFRICA	14	7	7B	7B	7B	7B	7B	14	14	14	21	14
U. S. S. R.	14	7B	7	7	7	7	7B	14B	14	14	14	14
EAST COAST	21	14A	14	14	7	7	14	14	14A	21	21	21

A = Next higher frequency may also be useful
B = Difficult circuit this period
F = Fair
G = Good
P = Poor
SF = Chance of solar flares

may

sun	mon	tue	wed	thu	fri	sat
				1 G	2 G	3 G
4 G	5 G	6 F/SF	7 F/SF	8 P/SF	9 F	10 G
11 G	12 G	13 F/SF	14 F/SF	15 G	16 G	17 G
18 G	19 G	20 G	21 F/SF	22 F	23 F	24 G
25 G	26 G	27 G	28 G	29 G	30 G	31 G

Reader Service—see page 226

List of Advertisers

To receive full information from our advertisers please complete the following postage-paid card.

R.S. No.		Page
2	Advanced Elect. Appl.	172
3	AED Electronics	67
300	Aldelco	177
314	Alliance Mfg. Co.	130
476	Aluma Tower Co.	190
5	Amateur-Whsle Elect.	26, 117, 210
6	AMC Engineering	177
7	American Crystal Supply	154
301	Appl. & Equip. Co., Inc.	154, 179, 200
8	Aptron Laboratories	151
*	Associated Radio	214
*	Atlanta HamFestival	77
10	Avanti Research & Develop.	133
11	Barker-Williamson	148
12	Bullet Electronics	220
13	Clegg	129
14	Comm. Center, NE	55, 149
15	Comm. Specialists	8, 9, 193
85	Comm. Tech. Group	199, 201
16	Crown Micro Prod.	179
86	Daring On Ind.	194
330	Debco Electronics	147
17	Dielectric Comm.	139
*	Digital Research Parts	218
19	RL Drake Co.	33
20	DSI Instruments	107
*	80 Microcomputing	101
71	Electronics Book Club	19
22	Fair Radio Sales	154
23	Flesher Corp.	67
323	Fox-Tango Corp.	120
24	Gemini Instrument Co.	200
25	Germantown Amat. Supply	42
27	G.I.S.M.O.	137
28	Godbout Electronics	212
*	Hal Comm. Corp.	13, 153
31	Hal-Tronix	130
30	The Ham-Key Co.	64
32	Ham Radio Center	47
33	Hamtronics, NY	219
303	Heath Co.	29, 193
34	Henry Radio	Cov. II
304	HFT, Inc.	200
305	Hustler, Inc.	106, 192
316	Hy-Gain Div. of Telex Comm., Inc.	23, 25, 27, 192
*	ICOM	7
37	iRL	81
38	Jameco Electronics	213
39	Jan Crystals	177
*	Kantronics	116
*	Kenwood	Cov. IV, 5, 191
*	Kilobaud Microcomputing	224
40	KLM Electronics	114
322	Larsen Antennas	172
41	LaRue Electronics	116
315	Lectronic Research Labs	179
84	Long Path Radio	128
42	Long's Electronics	140-145
44	Macrotronics	128, 199
45	Madison Electronics Supp.	157
46	Maggiore Electronic Lab.	154
47	MFJ Enterprises	128, 155, 175, 200
48	MHz Electronics	216, 217
49	Micro Control Specialties	137
50	Microcraft Corp.	179, 194
51	Microlog Corp.	15
313	Micro Management Sys.	150
52	Mid Com Electronics, Inc.	120
308	JW Miller Div. Bell Ind.	135
26	M & M RF Distributors	116
479	MS Comm Associates	26
53	MOM's	102, 103
318	National Comm. Group Co.	133
54	OK Machine & Tool	95, 99, 101
55	Optoelectronics, Inc.	51
325	Outdoor Outfitters	159
*	Palomar Engineers	66
*	Partridge Elect Ltd	177
478	Pathcom, Inc.	190
57	PC Electronics	64
58	Poly Paks	215
59	Protronics, Inc	53
69	Quest Electronics	203
61	Radio Amateur Callbook	173
*	Radio World	116
62	Ramsey Electronics	204, 211
477	Regency Elect., Inc.	193
63	RF Power Labs, Inc.	179
329	RF Products	139
64	Semiconductors Surplus	206-209
*	73	159, 221-226
65	S-F Amateur Radio Serv.	147
66	Signalcrafters, Inc	85, 173
317	Space Electronics	200
309	Spacecoast Research	154
67	Spectronics, Inc.	205
68	Spectrum Comm.	65, 192
69	Surplus Electronics	202
70	Swan Electronics	20, 67
312	Technical Clinic	200
72	Tele-Tow'r Mfg. Co.	199
316	Telex Comm., Inc.	23, 25, 27, 192
328	Telrex Laboratories	129
*	Ten-Tec, Inc.	11, 121
73	TET, USA	35
75	Thomas Comm.	59
324	THS Electronics	106
76	Trac Electronics	66
327	Trionyx Ind.	173, 175, 177
77	Tufts Radio Electronics	160-171
319	UDM Enterprises	154
310	Ultima Electronics, Ltd.	200
311	Vanguard Labs	154
80	Western Electronics	106
81	Wilson Elect.	3
*	Wilson Sys., Inc.	123-127
82	Xitex Corp.	175
83	Yaesu Electronics Corp.	Cov. III, 43, 79

*Please contact these advertisers directly.

Books, ETC.

To order, complete the following postage-paid card, or itemize your order including detailed credit card information or check and mail to: 73 Magazine/Mail Order Dept./Peterborough NH 03458.

Catalog #	Item	Price
BK1016	73 DIPOLE & LONG WIRE ANTENNAS	$ 5.50
ST0000	73 BACK ISSUE	$ 3.00
ST2500	73 BACK ISSUES—25 OUR CHOICE	$12.00
ST0500	73 BACK ISSUES—5 YOUR CHOICE	$ 8.75
ST1000	73 BACK ISSUES—10 YOUR CHOICE	$14.00
ST2501	73 BACK ISSUES—25 YOUR CHOICE	$25.00
BK1081	BASIC NEW 2ND EDITION	$ 6.95
BK7307	BEHIND THE DIAL	$ 4.95
BN1001	BINDER—73—1	$ 6.50
BN1002	BINDER—73—2 AND UP	$ 6.00
BK7309	CHALLENGE OF 160	$ 4.95
CT7305	CODE TAPE—5 WPM	$ 4.95
CT7306	CODE TAPE—6 + WPM	$ 4.95
CT7313	CODE TAPE—13 + WPM	$ 4.95
CT7320	CODE TAPE—20 + WPM	$ 4.95
CT7325	CODE TAPE—25 + WPM	$ 4.95
CT7394	CODE TAPES (ANY FOUR ABOVE)	$15.95
BK7308	THE CONTEST COOKBOOK	$ 5.95
BK7321	GUIDE TO HAM RADIO	$ 4.95
BK7304	GIANT BOOK OF AMATEUR RADIO ANTENNAS	$12.95
BK7322	HOBBY COMPUTERS ARE HERE	$ 4.95
BK7325	HOW TO BUILD A MICROCOMPUTER & REALLY UNDERSTAND IT	$ 9.95
BK1003	HOW TO MAKE MONEY WITH COMPUTERS	$15.00
BK7306	HOW TO SELL ANYTHING TO ANYBODY	$ 2.25
BK1028	IC OP AMP COOKBOOK	$12.95
BK7380	INTRO TO RTTY	$ 2.00
BK7340	THE NEW HOBBY COMPUTERS	$ 4.95
CT7300	NOVICE THEORY TAPES	$15.95
BK7310	OWNER REPAIR OF RADIO EQUIPMENT	$ 7.95
BK7305	POWER SUPPLY HANDBOOK	$ 7.95
BK1015	PRACTICAL ANTENNAS FOR THE RADIO AMATEUR	$ 9.95
BK7302	PROPAGATION WIZARD'S HANDBOOK	$ 6.95
QW0250	QSL CARDS—STYLE W—250	$ 8.95
QW0500	QSL CARDS—STYLE W—500	$13.95
QX0250	QSL CARDS—STYLE X—250	$ 8.95
QX0500	QSL CARDS—STYLE X—500	$13.95
QY0250	QSL CARDS—STYLE Y—250	$ 8.95
QY0500	QSL CARDS—STYLE Y—500	$13.95
BK1080	1980 WORLD REPEATER ATLAS	$ 4.95
BK1044	RF DIGITAL TEST EQUIPMENT	$ 5.95
BK7347	RTTY HANDBOOK	$ 5.95
BX1000	SHELF BOX—1	$ 2.00
BX1001	SHELF BOXES—2	$1.50 each
BX1002	SHELF BOXES—8 AND UP	$1.25 each
BK7351	SSB THE MISUNDERSTOOD MODE	$ 5.50
BK7354	SSTV HANDBOOK (HARDCOVER)	$ 7.00
BK7355	SSTV HANDBOOK (SOFTCOVER)	$ 5.00
CT7350	SSTV TAPE	$ 5.95
SG1081	STUDY GUIDE—ADVANCED CLASS	$ 6.95
SG1080	STUDY GUIDE—EXTRA CLASS	$ 5.95
SG7358	STUDY GUIDE—GENERAL CLASS	$ 5.95
SG7357	STUDY GUIDE—NOVICE CLASS	$ 4.95
LB7359	TEST EQUIP LIB V1—COMP TESTERS	$ 4.95
LB7360	TEST EQUIP LIB V2—AUDIO TESTERS	$ 4.95
LB7361	TEST EQUIP LIB V3—RADIO EQUIP.	$ 4.95
LB7362	TEST EQUIP LIB V4—IC TEST EQUIP.	$ 4.95
BK7348	TOOLS & TECHNIQUES	$ 4.95
BK1063	TTL COOKBOOK	$ 9.50
BK1064	TVT COOKBOOK	$ 9.95
BK1069	VERTICAL BEAM & TRIANGLE ANTNS	$ 5.50
BK7368	VHF ANTENNA HANDBOOK	$ 5.95
BK7370	WEATHER SATELLITE HANDBOOK	$ 4.95

READER SERVICE

73 Magazine, P.O.B. 2739, Clinton, IA 52735

Reader Service: Return this card to receive full information on the products advertised in this issue. Refer to the ad. You will find numbers near the logo of each advertiser. Each represents the advertiser's individual Reader Service Number. Circle the corresponding numbers on one of the cards on this page, include your name, address & zip, and drop in a mailbox. In 4-6 weeks you'll hear from the advertiser directly.

This card is valid until August 31, 1980.

Please help us to bring you a better magazine—by answering these questions:

I. What is your age?
- ☐ A. under 18
- ☐ B. 18-22
- ☐ C. 23-40
- ☐ D. 41-60
- ☐ E. over 60

II. ARRL
- ☐ 1. Love it
- ☐ 2. Don't care
- ☐ 3. Hate it

III. If you are not a subscriber please circle number 500.

1	6	11	16	21	126	131	136	141	146	251	256	261	266	271	376	381	386	391	396
2	7	12	17	22	127	132	137	142	147	252	257	262	267	272	377	382	387	392	397
3	8	13	18	23	128	133	138	143	148	253	258	263	268	273	378	383	388	393	398
4	9	14	19	24	129	134	139	144	149	254	259	264	269	274	379	384	389	394	399
5	10	15	20	25	130	135	140	145	150	255	260	265	270	275	380	385	390	395	400
26	31	36	41	46	151	156	161	166	171	276	281	286	291	296	401	406	411	416	421
27	32	37	42	47	152	157	162	167	172	277	282	287	292	297	402	407	412	417	422
28	33	38	43	48	153	158	163	168	173	278	283	288	293	298	403	408	413	418	423
29	34	39	44	49	154	159	164	169	174	279	284	289	294	299	404	409	414	419	424
30	35	40	45	50	155	160	165	170	175	280	285	290	295	300	405	410	415	420	425
51	56	61	66	71	176	181	186	191	196	301	306	311	316	321	426	431	436	441	446
52	57	62	67	72	177	182	187	192	197	302	307	312	317	322	427	432	437	442	447
53	58	63	68	73	178	183	188	193	198	303	308	313	318	323	428	433	438	443	448
54	59	64	69	74	179	184	189	194	199	304	309	314	319	324	429	434	439	444	449
55	60	65	70	75	180	185	190	195	200	305	310	315	320	325	430	435	440	445	450
76	81	86	91	96	201	206	211	216	221	326	331	336	341	346	451	456	461	466	471
77	82	87	92	97	202	207	212	217	222	327	332	337	342	347	452	457	462	467	472
78	83	88	93	98	203	208	213	218	223	328	333	338	343	348	453	458	463	468	473
79	84	89	94	99	204	209	214	219	224	329	334	339	344	349	454	459	464	469	474
80	85	90	95	100	205	210	215	220	225	330	335	340	345	350	455	460	465	470	475
101	106	111	116	121	226	231	236	241	246	351	356	361	366	371	476	481	486	491	496
102	107	112	117	122	227	232	237	242	247	352	357	362	367	372	477	482	487	492	497
103	108	113	118	123	228	233	238	243	248	353	358	363	368	373	478	483	488	493	498
104	109	114	119	124	229	234	239	244	249	354	359	364	369	374	479	484	489	494	499
105	110	115	120	125	230	235	240	245	250	355	360	365	370	375	480	485	490	495	500

Name ______________________

Address ______________________

City ______________________ State ________ Zip ________

73 Magazine • May 1980

BOOKS

73 Magazine, Pine Street, Peterborough, N.H. 03458

Please send me the following 73 products:

Qty.	Catalog #	Title	Unit Price	Total

Add $1 shipping/handling ________

Total ________

Please allow 4-6 weeks for delivery.

Enclosed $ ________ ☐ Check ☐ M.O.

Bill: ☐ AE ☐ MC ☐ Visa

Card # ______________________ Exp. date ________

Signature ______________________ Interbank # ________

Name ______________________

Address ______________________

City ______________________

State ______________________ Zip ______________________

5/80

SUBSCRIPTION

73 Magazine P.O. Box 931 Farmingdale, N.Y. 11737

73 subscribers save 50% off the newsstand price.

☐ New subscription ☐ Renewal

☐ 1 year—$15

☐ 2 years—$30

☐ 3 years—$45

Enclosed $ ________ ☐ Check ☐ M.O.

Bill: ☐ MC ☐ Visa ☐ AE ☐ me

Card # ______________________ Exp. date ________

Signature ______________________ Interbank # ________

Name ______________________

Address ______________________

City ______________________ State ________ Zip ________

Canada $15 per year US funds
Other foreign $26 one year only US funds

305B9

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO 73 PETERBOROUGH NH 03458

POSTAGE WILL BE PAID BY ADDRESSEE

73 MAGAZINE
Subscription Dept.
POB 931
Farmingdale NY 11737

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO 73 PETERBOROUGH NH 03458

POSTAGE WILL BE PAID BY ADDRESSEE

73 MAGAZINE
Peterborough
NH 03458

Att. Mail Order

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 217 CLINTON IA 52735

POSTAGE WILL BE PAID BY ADDRESSEE

73 MAGAZINE
POB 2739
Clinton IA 52735

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

FT-707 is shown with optional FV-707DM VFO & Scanning Microphone

THE FT-707 "WAYFARER"

The introduction of the "WAYFARER" by Yaesu is the beginning of a new era in compact solid state transceivers. The FT-707 "WAYFARER" offers you a full 100 watts output on 80-10 meters and operates SSB, CW, and AM modes. Don't let the small size fool you! Though it is not much larger than a book, this is a full-featured transceiver which is ideally suited for your home station or as a traveling companion for mobile or portable operation.

The receiver offers sensitivity of .25 uV/10 dB SN as well as a degree of selectivity previously unavailable in a package this small. The "WAYFARER" comes equipped with 16 poles of IF filtering, variable bandwidth and optional crystal filters for 600 Hz or 350 Hz. Just look at these additional features:

FT-707 with Standard Features

- Fast/slow AGC selection
- Advanced noise blanker
- Built-in calibrator
- WWV/JJY Band
- Bright Digital Readout
- Fixed crystal position
- 2 auxiliary bands for future expansion
- Unique multi-color bar metering—monitors signal strength, power output, and ALC voltage.

FT-707 with Optional FV-707DM & Scanning Microphone

- Choice of 2 rates of scan
- Remote scanning from microphone
- Scans in 10 cycle steps
- Synthesized VFO
- Selection of receiver/transmitter functions from either front panel or external VFO
- "DMS" (Digital Memory Shift)

Impressive as the "WAYFARER" is its versatility can be greatly increased by the addition of the FV-707DM (optional). The FV-707DM, though only one inch high, allows the storage of 13 discrete frequencies and with the use of "DMS" (Digital Memory Shift) each memory can be band-spread 500 KHz. These 500 KHz bands may be remotely scanned from the microphone at the very smooth rate of 10 Hz steps.

The FT-707 "WAYFARER" is a truly unique rig. See it today at your authorized Yaesu Dealer.

YAESU
The radio.

YAESU ELECTRONICS CORP., 6851 Walthall Way, Paramount, CA 90723 ● (213) 633-4007
YAESU ELECTRONICS Eastern Service Ctr., 9812 Princeton-Glendale Rd., Cincinnati, OH 45246


SPRING SPECIAL
STARTS APRIL 1
Ask your Authorized
Kenwood Dealer
TS-180S with DFC*
Digital Frequency Control*
...a Kenwood innovation
for maximum
HF operating enjoyment!
KENWOOD
DC POWER SUPPLY PS-30
KENWOOD
SP-180
KENWOOD VFO-180
PS-30
SP-180
TS-180S
VFO-180
Kenwood's TS-180S with DFC is an all solid-state HF transceiver designed for the DXer, the contest operator, and all other Amateurs who enjoy the 160 through 10-meter bands. The features prove, beyond doubt, that the TS-180S is the classiest rig available! Visit your local Authorized Kenwood Dealer and inquire about the exciting TS-180S with DFC!
KENWOOD
...pacesetter in amateur radio
TRIO-KENWOOD COMMUNICATIONS INC.
1111 WEST WALNUT/COMPTON, CA 90220