

DECEMBER 1985 / \$2.50

Season's Greetings from . . .

ham radio magazine

DIGITAL
COMMUNICATIONS



hr
focus
on
communications
technology

spread spectrum • a packet radio primer • AMTOR, AX.25,
and HERMES • a packet radio frequency and deviation
tester • W1JR, K4IPV, W6SAI, K0RYW • plus ham radio's
five-year cumulative index

ICOM HF Transceiver

IC-745



High Performance Maximum Flexibility

The IC-745 is a full featured, high performance HF base station transceiver with a 100dB dynamic range receiver. PLUS features usually found only in more expensive units.

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- Adjustable AGC
- Receiver Preamp
- 16 tunable Memories with lithium battery backup



- Wide selection of filters and filter combinations (opt.)
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Other Standard Features. Included as standard are many of the features most asked for by experienced ham radio operators: dual VFO's, RF speech compressor, tunable notch filter, program band scan, memory scan, all-mode squelch and VOX.

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Filter	-6dB Width	Center Freq. MHz
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FL54	270 Hz	9.000
FL44A	2.1 KHz	0.455
FL52A	500 Hz	0.455
FL53A	250 Hz	0.455

The IC-745 is the only transceiver today that has so much flexibility at a surprisingly low price...see it at your local ICOM dealer.

ICOM
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What To Look For In A Phone Patch

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- Not interfere with the normal operation of your base station. It should not require you to connect and disconnect cables (or flip switches!) every time you wish to use your radio as a normal base station.
- Not depend on volume or squelch settings of your radio. It should work the same regardless of what you do with these controls.
- You should be able to hear your base station speaker with the patch installed. Remember, you have a base station because there are mobiles. **ONE OF THEM MIGHT NEED HELP.**
- The patch should have standard features at no extra cost. These should include programmable toll restrict (dip switches), tone or rotary dialing, programmable patch and activity timers, and front panel indicators of channel and patch status.

ONLY SMART PATCH HAS ALL OF THE ABOVE.


Now Mobile Operators Can Enjoy An Affordable Personal Phone Patch...

- Without an expensive repeater.
- Using any FM transceiver as a base station.
- The secret is a **SIMPLEX** autopatch, The **SMART PATCH**.

SMART PATCH is Easy To Install

To install **SMART PATCH**, connect the multicolored computer style ribbon cable to mic audio, receiver discriminator, PTT, and power. A modular phone cord is provided for connection to your phone system. Sound simple? ... IT IS!

With SMART PATCH You are in CONTROL



With CES 510SA Simplex Autopatch, there's no waiting for VOX circuits to drop. Simply key your transmitter to take control.

SMART PATCH is all you need to turn your base station into a personal autopatch. **SMART PATCH** uses the only operating system that gives the mobile complete control. Full break-in capability allows the mobile user to actually interrupt the telephone party. **SMART PATCH** does not interfere with the normal use of your base station. **SMART PATCH** works well with any FM transceiver and provides switch selectable tone or rotary dialing, toll restrict, programmable control codes, CW ID and much more.

To Take CONTROL with Smart Patch - Call 800-327-9956 Ext. 101 today.

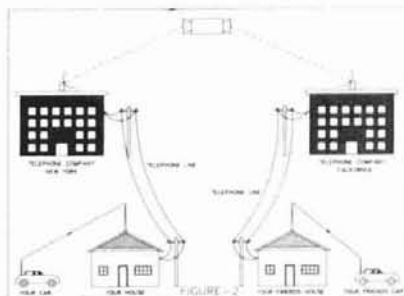
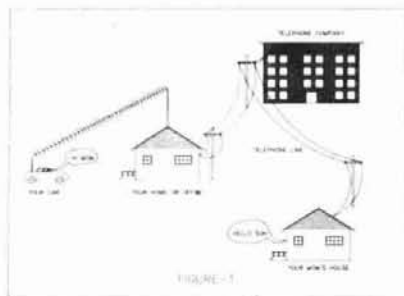
How To Use SMART PATCH

Placing a call is simple. Send your access code from your mobile (example: *73). This brings up the Patch and you will hear dial tone transmitted from your base station. Since **SMART PATCH** is checking about once per second to see if you want to dial, all you have to do is key your transmitter, then dial the phone number. You will now hear the phone ring and someone answer. Since the enhanced control system of **SMART PATCH** is constantly checking to see if you wish to talk, you need to simply key your transmitter and then talk. That's right, you simply key your transmitter to interrupt the phone line. The base station automatically stops transmitting after you key your mic. **SMART PATCH** does not require any special tone equipment to control your base station. It samples very high frequency noise present at your receivers discriminator to determine if a mobile is present. No words or syllables are ever lost.

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Use **SMART PATCH** for:

- Mobile (or remote base) to phone line via Simplex base. (see fig 1.)
- Mobile to Mobile via interconnected base stations for extended range. (see fig. 2.)
- Telephone line to mobile (or remote base).
- **SMART PATCH** uses **SIMPLEX BASE STATION EQUIPMENT**. Use your ordinary base station. **SMART PATCH** does this without interfering with the normal use of your radio.



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WARRANTY?

YES. 180 days of warranty protection. You simply can't go wrong. An FCC type accepted coupler is available for **SMART PATCH**.

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- Easy-to-operate, functional design. Three digit thumbwheel frequency selection and handy top-mounted controls increase operating ease.

- Repeater offset switch.
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TH-31AT/A: -1.6 MHz, reverse, simplex.
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- PB-21H NiCd 500 mAH battery
- DC-21 DC-DC converter for mobile use
- BT-2 manganese/alkaline battery case
- EB-2 external C manganese/alkaline battery case
- SC-8/8T soft cases
- TU-6 programmable sub-tone unit
- AJ-3 thread-loc to BNC female adapter
- BC-6 2-pack quick charger
- BC-2 wall charger for PB-21H
- RA-8A/9A/10A StubbyDuk antenna
- BH-3 belt hook

KENWOOD

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1111 West Walnut Street
Compton, California 90220

TH-series transceivers shown with optional StubbyDuk antenna. TH-31AT shown with PB-21H. Specifications and prices are subject to change without notice or obligation. Complete service manuals are available for all Trio-Kenwood transceivers and most accessories.

ham radio

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DECEMBER 1985

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T. H. Tenney, Jr., W1NLB
publisher

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

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assistant editor

Joseph J. Schroeder, W9JUV
Alfred Wilson, W6NIF
associate editors
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editorial production

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Peter Bertini, K1ZJH
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publishing staff

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assistant publisher

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director of advertising sales

Dorothy Sargent, KA1ZK
advertising production manager

Susan Shorrock
circulation manager
Therese Bourgault
circulation

cover art:
Hans Evers, PA0CX

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(1981-1985)**

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next month.*

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KENWOOD

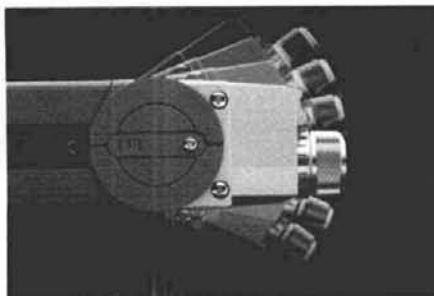
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A high-quality external communications speaker is provided for the best sound quality.
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The unique control panel is designed to increase operating and installation ease. The panel may be moved to provide the best viewing angle and handiest access to controls.
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Optional accessories:

- CD-10 call sign display • PS-430 DC power supply • KPS-7A power supply
- MC-42S regular UP/DOWN hand microphone • MC-55 (8-pin) mobile microphone with time-out timer
- MA-4000 dual band mobile antenna with duplexer • SWT-1/2 2 m/70 cm 100 W antenna tuners • SW-100A/B SWR/power meters • PG-3A noise filter • MB-201 extra mobile mount
- SP-403 compact mobile speaker



CD-10 DCS call sign display

CD-10 maximizes your use of Kenwood's new signalling concept, Digital Code Squelch. DCS uses a data string to open squelch on a receiver that has been programmed to accept the transmitted code. The transmitting station's call is programmed in ASCII. The CD-10 displays the station's call sign, and stores it in memory. Twenty calls may be stored. The CD-10 may be used with **any** receiver to display calls heard.



More product information is available from authorized Kenwood dealers.

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

REFLECTIONS REFLECTIONS

another revolution

We are in the midst of another revolution, albeit a peaceful one. Packet Radio and other forms of digital communications have arrived. Previously staunch users of the various forms of AM and FM have found themselves drawn into the world of zeros and ones and are talking to each other with ever-increasing speeds, efficiencies, and applications. For example, on 220 MHz and higher, up to 5600 characters per second transmission link speeds are both theoretically and legally possible. Passing the same amount of data on CW would require a sending speed of approximately 60,000 wpm — almost a thousand times faster than Ted McElroy's long-standing Morse code record.

Of course the proliferation of personal computers has had an important influence on this process, but I still attribute the rapid growth of this field to the inquisitive, intelligent, and practical mind of the Radio Amateur. For as soon as the first generation of Terminal Node Controllers (the interface between the terminal and the radio) became available, user groups formed and began developing applications ranging from direct message-passing to Packet Bulletin Board Systems (PBBSs).

Though most Packet activity occurs on VHF (in large measure on 145.010 MHz), this does not restrict transmissions to short distances. In fact, as of this date, a large section of each coast is inter-linked by a series of digital repeaters, or as they're better known, "digipeaters."

The startling growth rate of this mode became quite obvious as we prepared David McLanahan's article, "A Packet Radio Primer," for publication. Space was allocated for the April 10 version of the East Coast packet map shown on page 33. By September 10, activity increased dramatically and the size of the map *doubled*. This represents an increase of approximately 100 percent in the number of digipeaters, PBBSs, and home stations used predominantly for digipeating.

It seems particularly appropriate to consider this subject this month. December is, after all, a time of hope and renewal. In the past we've seen exciting developments — such as SSB, FM, and computers — make their mark on Amateur Radio. Will digital communications be the next logical step in this evolutionary process?

Turn the pages of this month's *ham radio* and see when and why the different forms of Packet Radio are appropriately used. And while you're on the subject, see how and why some hams have been experimenting with spread spectrum transmissions, once the exclusive domain of the military.

To paraphrase a well known soft drink manufacturer's slogan, "We're the Packet generation." Read on and see where you might fit in.

Rich Rosen, K2RR
Editor-in-Chief

THE AVERAGE U.S. AMATEUR IS JUST OVER 46 YEARS OLD, FCC's analysis of last April's Form 610s indicates. A detailed study of all that month's 9632 applications (all new licenses, renewals, and modifications) shows Novices to be the youngest, with an average age of 38.5. Techs average 45.1; Extras, 47.3; Generals, 50; Advanced, 51.8. By call areas, 9th district Novices were the youngest, at 35.6, and 0 district Advanced the oldest, at 55.

The U.S. Amateur Population Increased 0.65% During FCC's Fiscal 1985 (ending October 1), though the number of new Amateurs actually decreased by 7.6%. 17,373 newcomers joined Amateur ranks last year, while 14,709 dropouts left the year's end total 412,587. Largest percentage increase by license class was in Extras, up 2,344 to almost 38,000.

SOME MEANS SHOULD BE ESTABLISHED FOR "CERTIFYING" FREQUENCY COORDINATORS on a state or regional basis, as there's apparently no interest in establishing a "National Coordinator," FCC Safety and Special Services Chief Ray Kowalski suggested in his comments during the FM forum at the ARRL National Convention in Louisville. "Certified" coordinators would be those established and generally recognized for a given area; an eight-point plan is to be developed for determining appropriate qualifications and the method of formalizing such certification. Though the plan is to be published in the ARRL's Repeater Coordinators' Newsletter when completed, the League is specifically NOT participating in developing the plan.

Texas's Recoordination To 20 kHz Spacing On 2 Meters Has Been Completed, with the actual shift throughout the state expected to be complete by the end of November.

ARRL'S PROPOSAL TO PERMIT NOVICES PHONE PRIVILEGES probably won't be worked on at the FCC until early 1986, meaning that an NPRM won't be out until late spring at the earliest. So far there seems to be considerable division in the Amateur ranks on the issue, but the age figures in our lead item certainly indicate some change is needed.

Japanese CBers Have Invaded The Lower End Of 10 Meters, P29JS reports in a letter to the Southern California DX Bulletin. He's been hearing Japanese chatter all the way up to 28585 kHz, but without any indication of any "JA" call signs.

METROPLEX HAS BEEN NAMED THE FOURTH NATIONAL VEC effective September 19, the FCC has announced. Metroplex, one of the very first regional VECs, is now actively seeking VEs in other call areas. Call Alex Magocsi, WB2MGB, at (201) 592-6243 for information.

18 Regional And Three National VECs Have Expressed Interest In Joining CARE (Council of Amateur Radio Examining), which is now well along the road toward becoming a viable organization and expects to be incorporated as a not-for-profit corporation under Illinois law before the end of the year. Jim Georgias, W9JUG, can provide further information.

AFTERSHOCKS FROM NEWS MEDIA EXPLOITATION OF AMATEUR FREQUENCIES during the Mexico City earthquake disaster are still going on, with both the FCC and some of the offending news organizations on the receiving end of complaints by concerned Amateurs. Even some media people have themselves admitted feeling that the situation went far beyond reason, though most did not want to be quoted on the issue. Preliminary discussions between the FCC and both the Radio and TV News Directors Association and the National Association of Broadcasters have reportedly taken place, with hope that acceptable guidelines for Amateur Radio/media cooperation can be set up before the next crisis occurs. The FCC had thought it had defined the limitations in its Report and Order on BC Docket 79-47, but a widely distributed industry interpretation of the FCC's action left many in the industry with the impression that Amateur Radio was for their use pretty much as desired!

The FCC Is Interested In Reports Of Specific Media Incursions during the Mexico City crisis; they must be first-person and specific enough to be related to a specific news organization. Send them to Raymond Kowalski, Chief, Safety and Special Services, FCC, 1919 M St., NE, Washington D.C. 20554; tapes of abuses would be particularly welcome.

The Issue Of "Non-Amateur" Use Of Amateur Frequencies is an on-going issue that can't be ignored; the recent petition by a low-power TV broadcaster to use frequencies on the 70-cm Amateur band for TV remotes, and the establishment of a "protection zone" along the Canadian border for Canadian 420-430 MHz commercial users, are cases in point.

STILL MORE "HAM IN SPACE" OPERATIONS FROM SPACE SHUTTLES are shaping up for next year. AMSAT member Dr. Ron Parise, WA4SIR, has been selected to fly on Mission 61E in March, while Dr. Owen Garriott, W5LFL, is scheduled for mission 61K, now set for next September.

GEOSYNCHRONOUS AMATEUR SATELLITES ARE STARTING TO LOOK like real possibilities, according to AMSAT. Earlier, NASA had said it might provide Amateur Radio capability on one of its Advanced Communications Technology Satellites (ACTS), and now it appears an AMSAT transponder ("Phase 4") may find a spot on the same bird. In addition, Arianespace may also be able to provide a piggy-back launch opportunity for an Amateur transponder into geosynchronous orbit. AMSAT officials are now reviewing the possibilities, with particular interest in incorporating new approaches and capabilities in an Amateur proposal.

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The Panasonic Command Series offers something for everyone. With equipment sophisticated enough to impress the most avid enthusiast, and automatic features that get you where you want to be. Fast.

There's a whole world out there that's waiting to be heard. Tune in to it with the Panasonic Command Series.



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A Realistic Simulation of On-the-Air, Two-Way Morse Code 'Ragchew' Contacts (QSOs).

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comments

Dear HR:

In response to KA0DOE's letter in the September, 1985, issue of *ham radio* (Comments, page 15) I have only one comment. The total function of the Novice Amateur Radio license is to introduce the public to Amateur Radio Service by giving them simple privileges on a few selected portions of the Amateur Radio bands and a very simple but effective mode of transmission called CW or Radiotelegraphy. Then it's up to the individual to make that commitment to upgrade to the higher grade license and more privileges.

Bill Eaton, WB1CXI
 Channelview, Texas

something for nothing

Dear HR:

Unlike KA0DOE, I read July's "Presstop" (page 6) with horror and disgust. The present-day attitude of rewarding hams for doing absolutely nothing will be the biggest reason for the ultimate death of the hobby.

Why are unearned extensions of band privileges the only thing that can help encourage these operators? Aren't there myriad challenges available to try the patience and ingenuity of any class of Amateur today? Will more "entertaining" modes give us any "more to encourage us to seek out our full potential as operators?"

At the beginning of World War II, Amateur Radio operators provided a highly proficient cadre of electronics technicians and skilled instructors to the United States. Let me propose a calamity today. What functions could a group of Amateurs provide whose

only claim to technical skill is the ability to box up their equipment and get it to the United Parcel Service?

I was granted a Class B license in 1947 and, one year later, passed the Class A examination. Can I now cry out that I have been a good and faithful ham for 38 years, so I deserve an Extra Class license? Hell, no! I must get my old brain in gear and hit the books and suffer my way back to 20 words per minute. That is one of the basic challenges of Amateur Radio. The frightening thing about "glorified CB operators" is not only the terrible operating practices that a lot of them demonstrate, but the "something for nothing" syndrome that fosters these practices.

If a soldier received the Purple Heart for falling off the back of a 6x6 when he was drunk, it would degrade the sacrifice of all the others who proudly wear that decoration. The time and effort spent to upgrade a license is vital to the spirit of Amateur Radio. With it comes the understanding of the privilege granted us to use certain parts of the radio spectrum. And with that understanding comes the resolve to operate legally and properly.

I raised my children to realize that they were due only what they were willing to expend their time and effort to gain. There is, and certainly should be, no free lunch. In like manner, I do not condone any unearned privileges for any Amateur Radio operator.

Joe Weite, KH6GDR
 Makakilo, Hawaii

short circuit
75-meter transceiver

The PC board art shown in K1BQT's article, "A Compact 75-meter Monoband Transceiver" (November, 1985, page 13) is incorrectly sized. For a complete, corrected set of board art suitable for reproduction, send a stamped, self-addressed No. 10 (business-sized) envelope to *ham radio*, Greenville, New Hampshire 03048.

NEW FROM MFJ

MFJ'S BEST 300 WATT TUNER NOW GIVES YOU A CROSS-NEEDLE METER THAT READS SWR, FORWARD AND REFLECTED POWER — ALL AT A GLANCE.



MFJ-949C
\$149.95

MFJ's best 300 watt tuner is now even better! The MFJ-949C all-in-one Deluxe Versa Tuner II gives you a tuner, cross-needle SWR/Wattmeter, dummy load, antenna switch and balun in a new compact cabinet.

You get quality conveniences and a clutter-free shack at a super price.

A new cross-needle SWR/Wattmeter gives you SWR, forward and reflected power—all at a single glance. SWR is automatically computed with no controls to set. Has 30 and 300 watt scale on easy-to-read 2 color lighted meter (needs 12 V).

A handsome new black brushed aluminum cabinet matches all the new rigs. Its compact size (10 x 3 x 7 inches) takes only a little room.

You can run full transceiver power output—up to 300 watts RF output—and match coax, balanced lines or random wires from 1.8 thru 30 MHz. Use it to tune out SWR on dipoles, vees, long wires, verticals, whips, beams and quads.

A 300 watt 50 ohm dummy load gives you quick tune ups and a versatile six position antenna switch lets you select 2 coax lines (direct or thru tuner), random wire or balanced line and dummy load.

A large efficient airwound inductor—3 inches in diameter—gives you plenty of matching range and less losses for more watts out. 1000 volt tuning capacitors and heavy duty switches gives you safe arc-free operation. A 4:1 balun is built-in to match balanced lines.

Order your convenience package now and enjoy.

SUPER KEYBOARD

MFJ-496
\$169.95



Price slashed 50% to \$169.95! Get a full feature Super Keyboard that sends CW/RTTY/ASCII for the price of a good memory keyer.

You get the convenience of a dedicated keyboard—no program to load—no interface to connect—just turn it on and it's ready to use.

This 5 mode Super Keyboard lets you send CW, Baudot, ASCII, use it as a memory keyer and for Morse Code practice. You get text buffer, programmable and automatic message memories, error deletion, buffer preload, buffer hold.

A 256 character keyboard buffer gives you perfect CW even if you "hunt and peck". A meter reads CW speed and buffer remaining. 4 message memories lets you store up to 256 characters. 4 preprogrammed messages lets you send CQ CQ DE, CQ TEST DE, DE, QRZ. Has speed weight, tone and volume pots that remembers their settings even after power is turned off. Send 60 WPM Baudot and 100 baud ASCII.

You can use it as a deluxe full feature memory keyer that has automatic and programmable memories, iambic operation, dot-dash memories. Has random and pseudo random code generator.

Automatic serial numbering, message repeating, tune switch, shielded for RFI. 12 VDC or 110 VAC with MFJ-1312, \$9.95. 12 x 7 x 3 1/2 inches.

CROSS-NEEDLE SWR/WATT METER

MFJ-815 \$59.95

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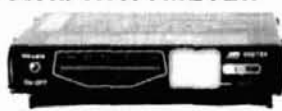
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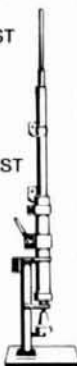
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spread spectrum and digital communication techniques: a primer

Not quite sure
how speech can be
transformed into a
digital signal?
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Ever since the inception of Amateur Radio, hams have kept abreast of the latest and most innovative methods of communication. From the advent of spark-gap radiotelegraphy, to the early FM transmitters, through the 2nd World War — when hams played an important part in concocting the first reliable pulse radar systems — to RTTY, SSTV, SSB, satellite communications, and packet radio, Amateurs have been ardent users of new and fascinating modulation methods.

In recent years there has been interest in a relatively new type of communication technique. While the foundation for this communication method was laid with the advent of ranging radar, it has only been in the past 10 to 15 years that it has received so much attention from both the military and the private sector. This technique, known as *spread spectrum* (SS) is unlike any communication method previously tried by Amateurs. However, judging by our track record, it would seem that it's only a matter of time before we familiarize ourselves with it.

The purpose of this article is to provide an overview of spread spectrum communications for those not familiar with it. While the topic is much too broad to be fully discussed here, the major concepts will be highlighted in a manner that can, I hope, be understood by those with little math background. As well

as the concepts governing spread spectrum and digital communications, typical station hardware requirements will also be addressed.

why spread spectrum?

One might wonder how and why spread spectrum evolved, and how it could be applicable to the Amateur Radio bands. To address the first query, it is necessary to consider the problems associated with military communications during World War II. At the time, jamming and antijamming techniques were the order of the day. By 1945 every Allied Bomber plane was equipped with two jamming transmitters, while it is estimated that as many as 90 percent of all electrical engineers in Germany were involved in an antijamming program of gargantuan proportion.¹

To combat the effects of jamming, spread spectrum was used to spread the signal out, thereby rendering narrow band jammers virtually ineffective. In addition, the fact that spread spectrum could be used with a *low probability of intercept* (LPI) made this an ideal method of communicating while appearing "radio silent" to conventional receivers.

Today the quest for a signal that cannot be jammed continues in military circles; commercial applications, such as banking and private mail systems, require security. As jamming and intercept capabilities become more sophisticated, methods of communicating become increasingly complex. Spread spectrum continues to evolve into a highly complicated mode of communication. Those fascinated with the history of radio would find the accounts of the development of spread spectrum to be very exciting reading. Several excellent accounts are listed in the references.^{1,2,3}

The above-mentioned attributes hardly seem appropriate for Amateur Radio! The FCC rules prohibit any kind of coded or secure communications, and intentional jamming is a problem we would ideally never

By Ted S. Rappaport, N9NB, Box 283, Electrical Engineering, Purdue University, West Lafayette, Indiana 47907

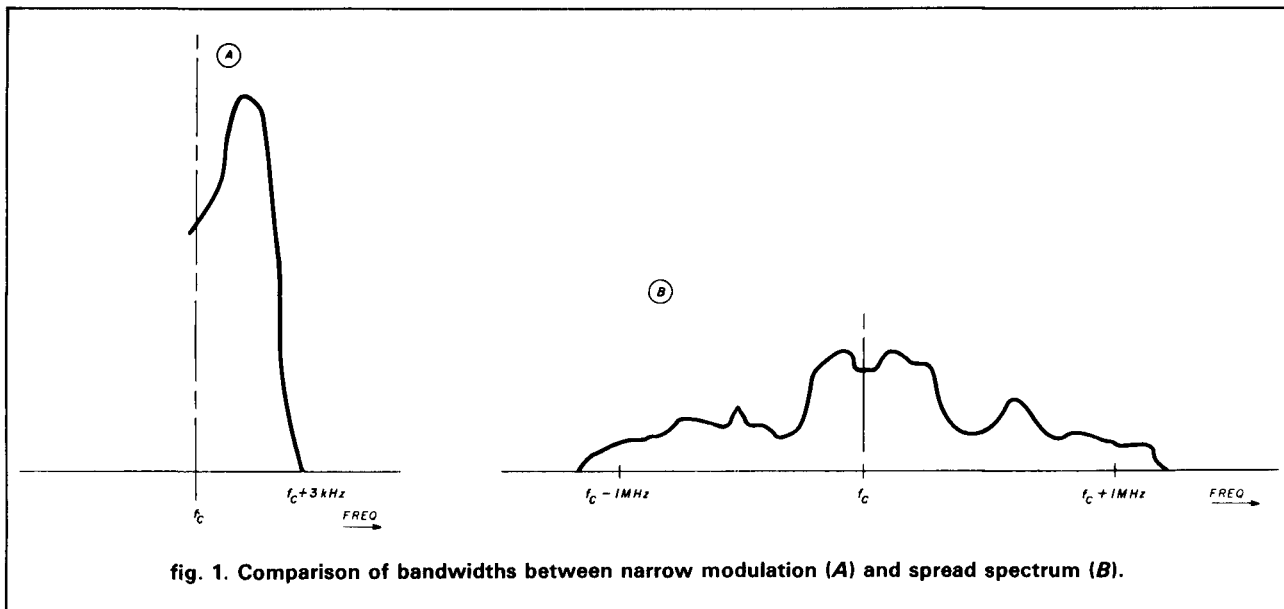


fig. 1. Comparison of bandwidths between narrow modulation (A) and spread spectrum (B).

have to deal with. There are several other benefits, however, that might be of use to us in the future as the Amateur Radio spectrum becomes saturated with users. In fact, a look at why mobile telephone companies are considering SS sheds some light on some of the possible rewards.

In metropolitan areas, where there are many mobile telephone users in a small area, cellular radio has been introduced to alleviate the congestion in the mobile telephone spectrum. In a cellular radio system, as the term suggests, the city is broken into "cells," with each cell having its own multichannel repeater capable of handling a limited number of users within the cell.⁴ As the user travels into an adjacent cell, the adjacent repeater takes over the communication. The cellular technique has been used to increase the maximum number of mobile telephone and commercial radio users from several hundred to several thousand in many cities across the country. Of special interest to the industry is the fact that compared to conventional narrow band modulation techniques, SS has the capability of supporting a larger number of users for a given cell size!⁵

Other advantages that SS offers to both the military and the mobile communication industry include selective addressing capability, code division multiplexing, and interference and multi-path rejection. With SS, it is possible for a transmitter to selectively communicate to one or several receivers while remaining oblivious to other users. Also, several stations may use the same band of frequencies simultaneously without interfering with one another. Since SS signals have very wide bandwidths, conventional narrow band users may also use the same spectrum without adversely

affecting the SS communication. Conversely, the average power of a SS signal in any narrow band region is small, so the narrow band modulation is not severely QRM'ed, either.

As will be demonstrated shortly, SS requires more complex hardware than does conventional narrow band equipment; as the spectrum stands today, its use in Amateur Radio is probably not currently warranted. However, with increased HF and VHF/UHF activity, it is conceivable that we may eventually need a drastically different approach to communications. Progress has recently been made by hams in such areas as coherent CW and packet communications.^{6,7,8,9} The inevitable thrust toward digital communications makes SS appear to be a likely modulation method in the future.

overview of spread spectrum

Figure 1 illustrates the bandwidth of an SSB speech signal compared to a typical spread spectrum signal. As its name implies, spread spectrum is a modulation method whereby the energy of the transmitted signal is spread out over a very wide bandwidth. This is quite unlike SSB or narrow band FM (NBFM), where the transmitter output has a bandwidth on the order of that of the modulating signal (the usable audio bandwidth for speech is about 3 kHz). However, wide band FM (WBFM) transmitters have bandwidths that are many times greater than that of the modulation. Clearly, though, WBFM is not spread spectrum! This is where the second important distinction between spread spectrum and conventional modulation methods must be made.

A spread spectrum communication system uses a

special generated wide band signal that is independent of the message modulation. At the transmitter end, the message modulation (a voice signal) may be multiplied by this independently generated signal, and the resulting mix then transmitted on a carrier. This is known as *Direct Sequence Spread Spectrum (DS)*. Another type of SS, known as *Frequency Hopping Spread Spectrum (FH)*, can be generated by using the independently generated signal to cause the carrier signal to frequency hop in a prescribed manner.

It is the independent signal that determines the amount of bandwidth spreading at the transmitter output. It also determines the immunity the SS signal has to narrow band interference. This independent signal is always digital, and is generated by digital logic devices (such as TTL). The term *pseudo noise code (PN)* is used to describe this independent signal since to an uninformed observer the PN code looks like a random jumble of 1s and 0s. Actually, though, the PN code is a periodic sequence that can be easily gener-

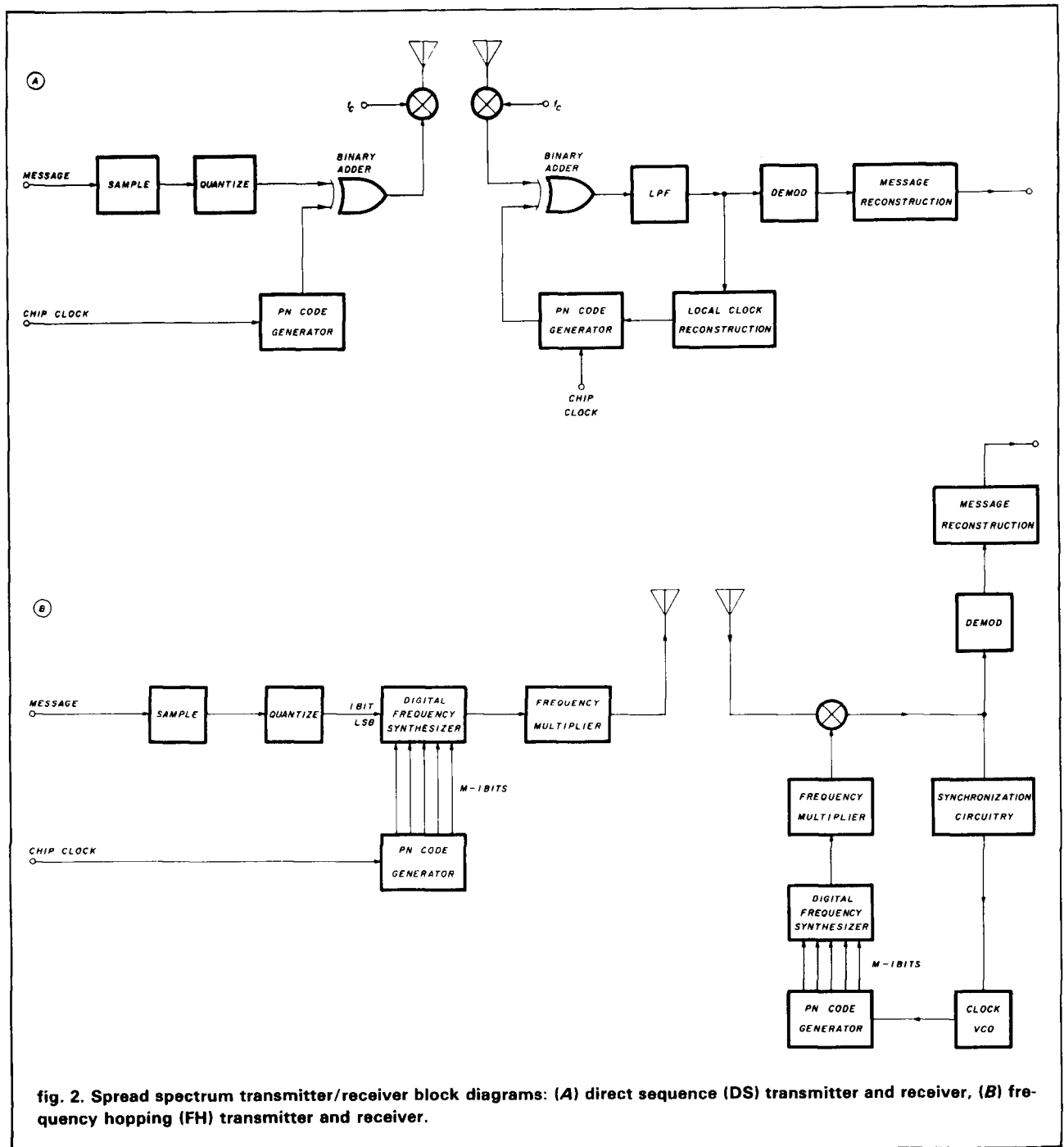
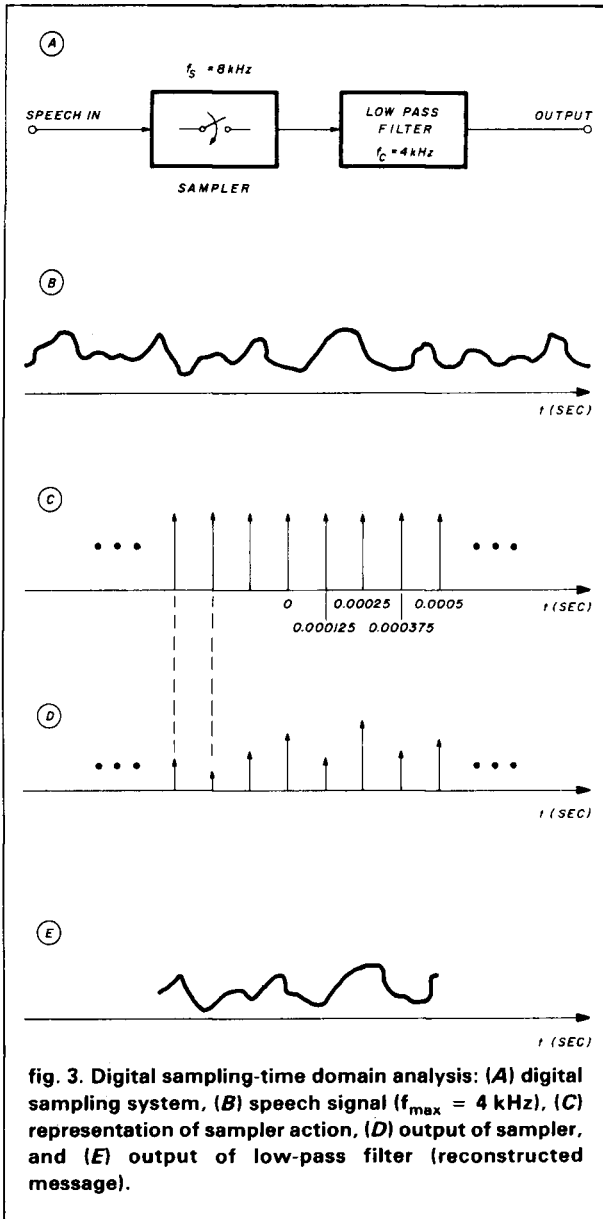


fig. 2. Spread spectrum transmitter/receiver block diagrams: (A) direct sequence (DS) transmitter and receiver, (B) frequency hopping (FH) transmitter and receiver.



ated by a sequence of shift registers. In order to recover the original message, the receiver must be able to reconstruct the same PN code used by the transmitter. When the transmitter and receiving encoding signals are identical, and when they are synchronized in time, then the message is detected. **Figure 2** illustrates block diagrams of spread spectrum transmitter and receiver pairs for both the DS and FH case. A more detailed look at the generation of the PN code is considered subsequently. However, before delving into the details of SS, it is first necessary to become familiar with some basic concepts of digital communications.

digital communication concepts

Because the encoding signal is digital, spread spec-

trum can be considered to be a special form of digital communications. Unlike SSB, AM and FM, which are analog, continuous time communication methods, digital communication systems work on the principle of the sampling theorem.

The sampling theorem, developed by Nyquist in 1924,¹⁰ states that a continuous time signal may be represented by a sequence of discrete time snapshots, or samples, without any loss of information in the signal, provided that the samples are taken at a rate which is at least twice as great as the highest frequency component of the original continuous time signal. A basic relationship which relates the sampling frequency (f_s) to the time duration between successive samples (T_s) is

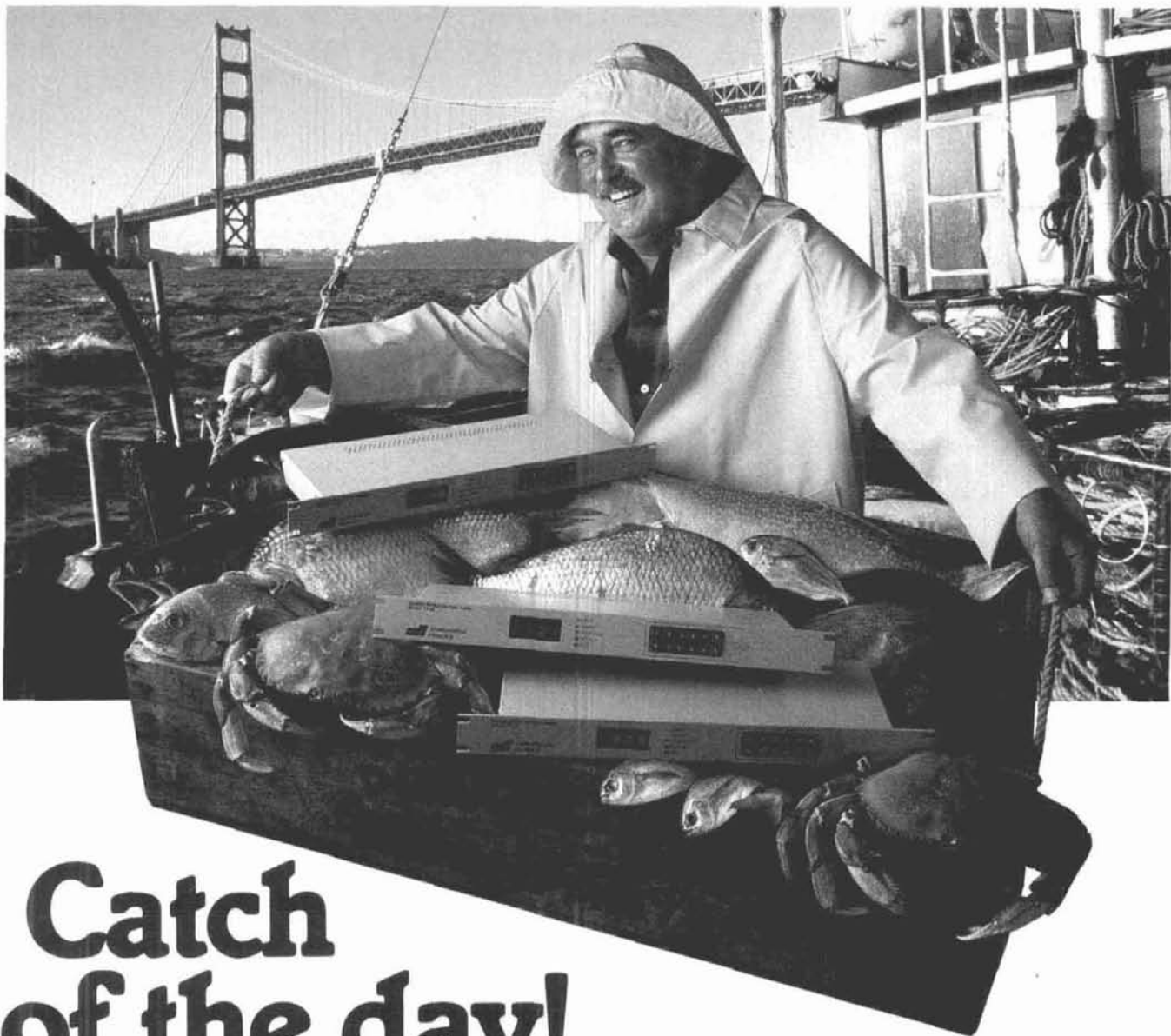
$$f_s = \frac{1}{T_s} \quad (1)$$

Figure 3A shows the components of a typical sampling system. **Figure 3B** illustrates a typical speech signal that has been band limited to have a peak frequency component of 4 kHz. The action of the sampler is shown in **fig. 3C**. **Figure 3D** illustrates the output of a sampler that is taking samples at a rate of 8000 samples per second (twice the rate of the highest message component). **Figure 3E** shows the recreated message waveform after the samples are placed through a low-pass filter having a cutoff of 4 kHz.

In order to lay a foundation for the analysis and understanding of SS, it is instructive to look at the sampling theorem from a different point of view. In the early 1800's, Fourier, a famous mathematician, observed that most functions could be represented by a summation of sinusoids having different amplitudes and periods. In short, he laid the groundwork for the development of the celebrated Fourier transform. This transformation allows one to analyze a signal in the frequency domain rather than in the time domain.

Frequency domain analysis can directly give information pertaining to the bandwidth of a signal. Tables such as **table 1** have been compiled which lists the Fourier transforms of many common signal shapes.^{11,12,13} By analyzing the sampling circuit of **fig. 3A** in the frequency domain, we can better explain how and why the sampling theorem holds.

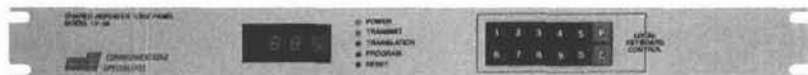
From **table 1**, the Fourier transform of an impulse sampler is an impulse train in the frequency domain. Note that in the time domain (**fig. 3C**), the sampling action is effectively multiplying the input signal by a "1" at each sampling instant, and multiplying by "0" in the interval between samples. Just as time signals have Fourier transforms, so do time operations such as addition and multiplication. The Fourier transform of a time multiplication is known as *frequency convolution*. Convolution is a fundamental concept in control



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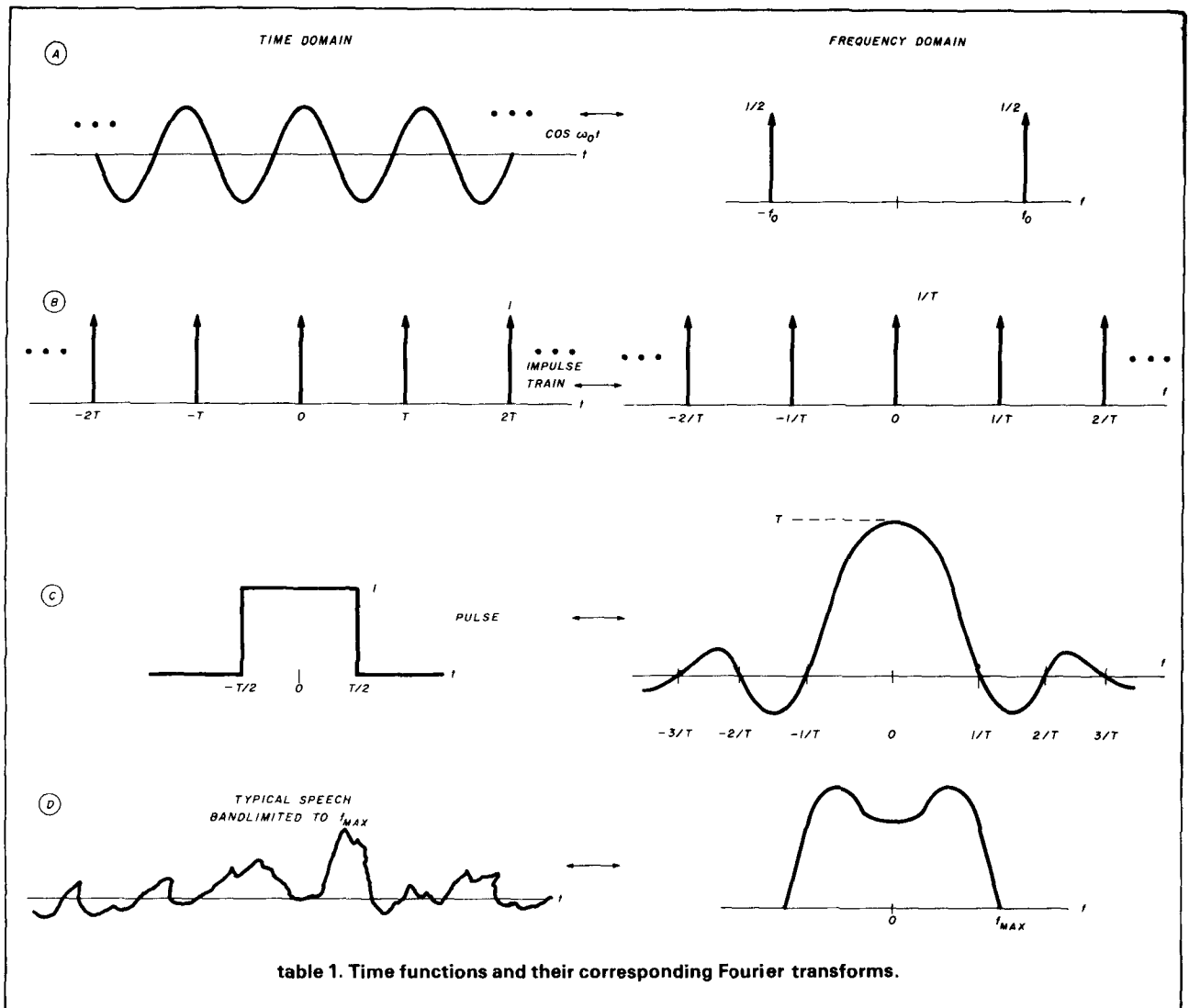
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and communication theory, and is used to express the output of a system or filter in terms of the input signal and the system impulse response, (i.e., the response of the system to a sudden input signal). For this discussion, it is necessary to know only that the convolution of a band-limited spectrum (fig. 4A) with a frequency pulse train (fig. 4B) yields the original message spectrum replicated at each of the pulse train harmonics. Hence, by frequency domain techniques, we find that the output of an ideal sampler is the original message spectrum replicated throughout the entire frequency domain and separated by integer multiples of the sampling frequency (fig. 4C). By low-pass filtering the sampler output, we can recreate the original message exactly (fig. 4D). By the same token, we could bandpass filter the output of the sampler and also recreate the message, although this is not usually done.

If the highest frequency of the input message exceeds one half of the the sampling rate, then an

undesirable effect known as *aliasing* occurs. As can be seen in fig. 4E, each adjacent message spectrum overlaps so that the LPF output is not the original message, but rather a distorted signal. With frequency domain analysis, it becomes clear why the sampling frequency must be at least twice that of the peak frequency component of the input.

Before moving on, it should be noted that this quick look at the sampling theorem assumes an "ideal" sampler — one for which the sample durations are infinitely small. In reality, the sample durations are small, but finite. Taking this into account yields similar, but slightly more complicated, results. Figure 5 illustrates the spectrum of the output of a typical "real world" sampler. As the sample widths become wider, there is less energy at the higher frequencies. This is why the sampler is followed by a low-pass filter rather than a band pass filter. Also neglected here are some amplitude scaling factors that are involved in transforming between the time domain and frequency domain.

These subtleties are required in exact problem solving, but are not important in gaining a good understanding of the sampling theorem. Those interested in the finer details of the sampling theorem and Fourier transform techniques might find the references helpful.^{11,12,13,14,15}

data communication

Certain digital communication systems such as RTTY and packet radio, where the message text is originated by a keyboard rather than continuous-time speech, are known as data communication. In this case the sampling theorem does not apply, since there is no continuous time signal to sample. However, the data rate (the rate at which information can be sent) is a function of the number of bits used to represent each character, and is also a function of the time duration of each bit.

For example, the American Standard Code for Information Interchange (ASCII) prescribes that each keyboard character be represented by a unique 7-bit data word. The letter i, for example, is represented by the binary word 1101001. If each bit has a time duration of 1 millisecond, then any character may be sent down a channel in a time of 7ms. If a start bit, a stop bit, and a parity bit are sent along with the data, then one character can be sent every 10 ms. The data rate for this set-up would be 1000 bits per second (bps), or 100 characters per second.* Data communications of this type are termed "asynchronous" since the receiver never knows when the sender will depress the keyboard. The start bit and stop bit are the necessary overhead to identify each of the keyboard entries. The parity bit is used to validate the received data. **Figure 6** illustrates a complete asynchronous character word for the letter i.

There is a trade-off between bit rate and occupied bandwidth of a digital signal. A good rough estimate is that the required bandwidth of a digital signal is equal to the reciprocal of the bit duration. For the previous example, the required bandwidth would be on the order of

$$BW = \frac{1}{t_{bit}} = \frac{1}{0.001 \text{ s}} = 1000 \text{ Hz}$$

For a faster data rate, more bandwidth is required. In a band-limited channel, such as a commercial telephone line, there is an upper limit on the bit rate. This is why home computer modems seldom exceed a data rate of 1200 bps.¹⁶ While spread spectrum is well suited for either voice or data messages, the remainder of this article will consider only a voice message. Once the voice is "digitized," it is sent through the channel in the same manner as data.

*In digital communications the bit rate is the same as the baud rate, so for this example the data rate is equivalently 1000 baud.

quantization

From the sampling theorem, we know that it is necessary to send only the voltage values of the samples rather than the continuous time signal. If the sample values could be represented in a digital fashion, then we could take advantage of schemes that have been developed expressly for digital communication. In short, digital communications systems are able to outperform analog methods because signal reception is based on distinguishing whether a "0" or a "1" was sent, rather than trying to recreate a random continuous time waveform directly. Schemes such as *error correction coding* and *minimum probability of error receivers* can be used to provide far superior performance when compared to analog communication techniques.

To represent the height of a sample value digitally, it is necessary to quantize the sample. For binary data (standard digital logic), the quantizing action truncates the actual sample value so that each sample is represented by a fixed number of bits (i.e., every sample is expressed by N bits) in the time between successive samples. Since it is conceivable that the samples can take on a continuum of values, there is some error introduced by the quantizer. However, if a limiter is used (to contain the voice signal voltage within the limits of the quantizer) and if there is a sufficient number of levels in the quantizer, then this error, known as *quantization noise*, is quite small.

The quantizer is an important concept in digital communications. The resolution, or the accuracy in which a sample can be represented, is directly related to the N, the number of bits used to represent each sample. For N bits, there are 2^N quantizer levels (sometimes called *bins*).

An example is useful to clarify how speech can be quantized and sent down a channel as a digital bit stream. **Figure 7** demonstrates how the sample values are assigned data words in a three-bit quantizer (N=3). As indicated in **fig. 7**, there is some error introduced because of the fact that each sample is represented by only a three-bit word. By using more bits, each sample can be more accurately represented. Surprisingly, though, even with only three bits of quantization, intelligible speech can be transmitted.¹⁷ Once assigned a quantization data word, the truncated sample is converted into 1s and 0s and sent down the channel. The output of the quantizer is known as *pulse code modulation*, since the message has been coded into a train of digital pulses. Since N bits must be sent in the time between adjacent samples, the bit duration of the quantized data is

$$T_{bit} = \frac{T_s}{N} \quad (2A)$$

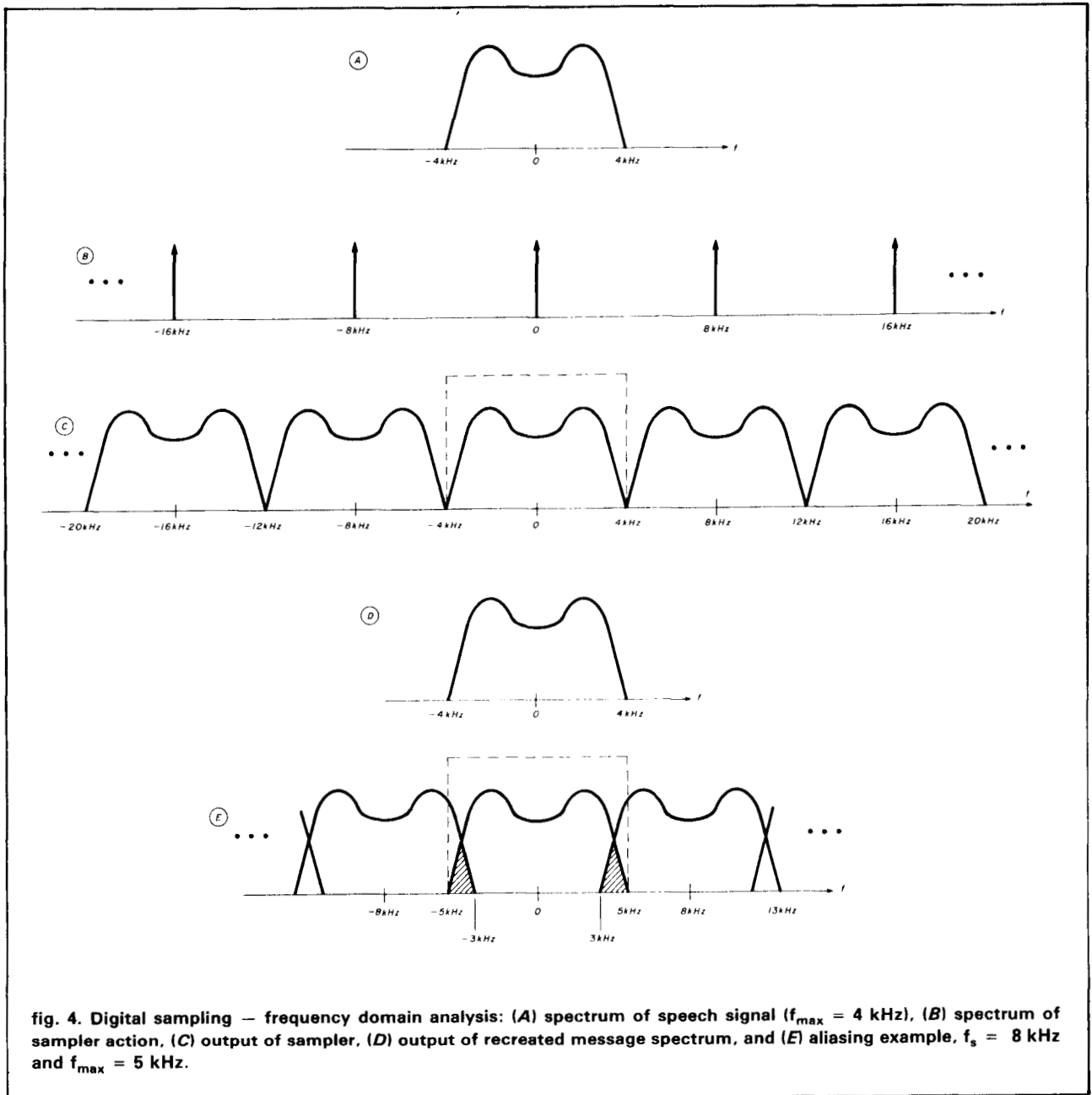


fig. 4. Digital sampling — frequency domain analysis: (A) spectrum of speech signal ($f_{\max} = 4$ kHz), (B) spectrum of sampler action, (C) output of sampler, (D) output of recreated message spectrum, and (E) aliasing example, $f_s = 8$ kHz and $f_{\max} = 5$ kHz.

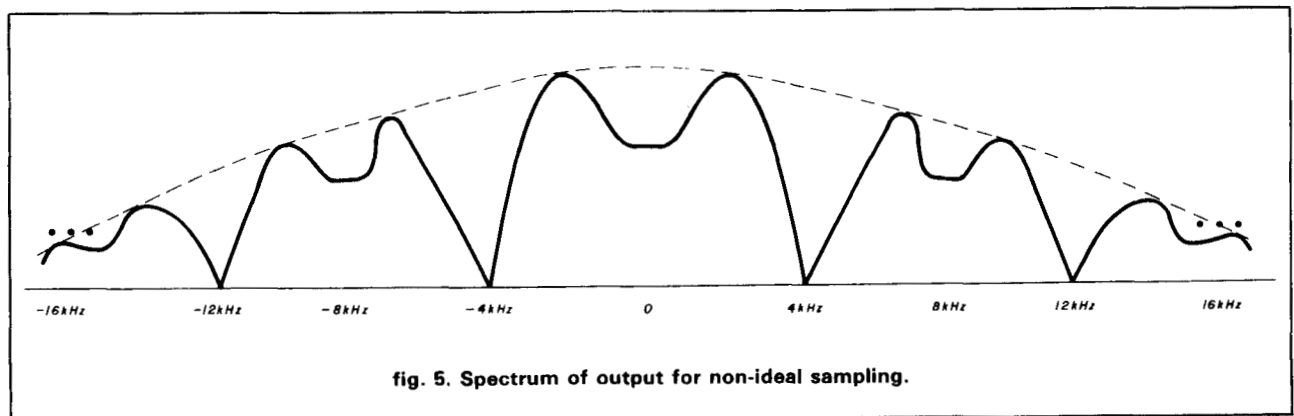


fig. 5. Spectrum of output for non-ideal sampling.

where T_s is the time between adjacent samples. Since

$$T_s = \frac{1}{f_s} \quad (2B)$$

each quantizer bit duration is given by

$$T_{bit} = \frac{1}{Nf_s} \quad (2C)$$

Hence, the bandwidth is given by

$$BW = Nf_s \quad (2D)$$

A practical method of sampling and quantizing is to use a *sample and hold* circuit followed by an *analog-to-digital* (A/D) converter. The sample and hold is similar to the ideal sampler, except the sample height is held for the entire time duration between samples, and is updated at each new sampling instant. While the sample value is held at a constant level, it is converted into a digital signal by the A/D converter. The end result is identical to that of **fig. 7**.

To recreate the message, the digital bit stream is clocked into a *digital-to-analog* (D/A) converter. This undoes the effect of quantizing which the A/D had

upon the original message samples. The D/A output is then low-pass filtered to transform the reconstructed samples into the original message.

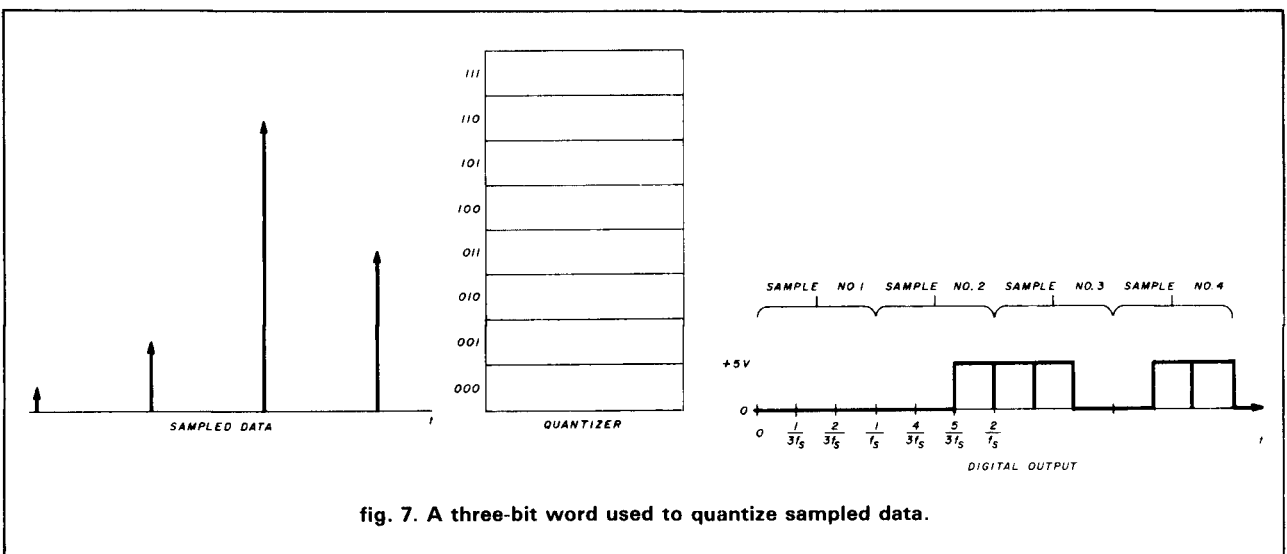
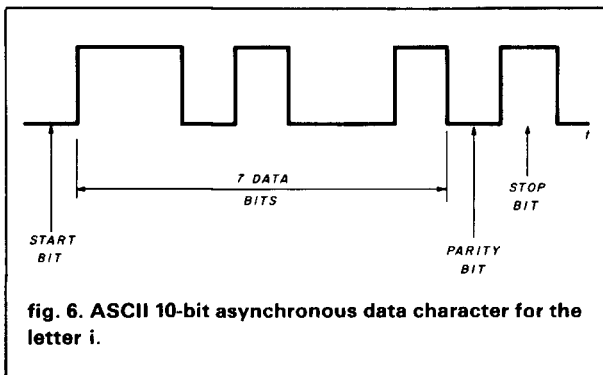
spread spectrum systems

There are many types of spread spectrum systems. These include direct sequence (DS), frequency hopping (FH), time hopping (TH), chirp, and hybrid systems which combine several techniques at once. Only DS and FH are considered here, since these seem to be most easily implemented. Common to both of these types of SS systems is the need to generate and reconstruct a PN (pseudonoise) code.

To produce the DS spread spectrum signal, a PN code signal must be produced that has a bit rate (bandwidth) much greater than that of the quantized message. For FH spread spectrum, it is not so much the bit rate that matters as does the number of bits used in a complete cycle of the PN code.

The PN code can be generated by a feedback arrangement of flip-flop stages. A flip-flop is a digital device which can store a binary value (either a 0 or a 1). Flip-flops can be connected in series to form shift registers. As the term implies, shift registers store several binary digits and shift them to the left or right each time an external clock pulse is received.

The simplest PN codes (there are several types) are known as *maximal linear codes*, or *m-sequences*. These are produced by m-stage shift registers which use feedback to produce periodic codes that have N bits before recycling. For an m-stage shift register, there are $N = 2^m - 1$ bits in each period. **Figure 8** illustrates a three-stage shift register. All three flip-flops of the shift register are clocked to the right simultaneously, and each time a clock pulse appears, a new binary digit appears at the output. **Table 2** indicates the value held by each flip-flop for a given time inter-



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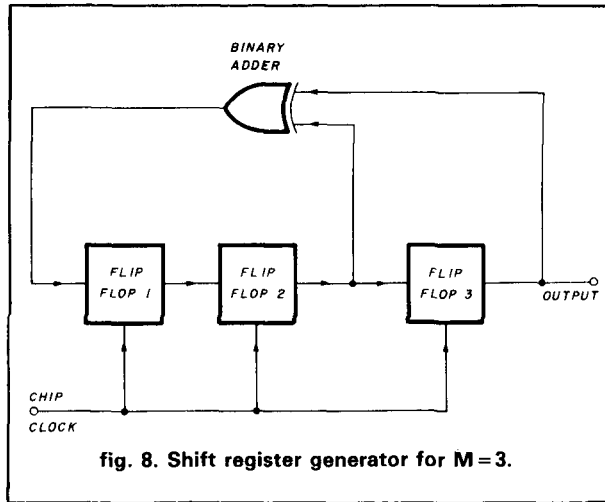


fig. 8. Shift register generator for $M=3$.

val. **Figure 9** shows the digital signal that would be produced by a standard TTL circuit.

To avoid confusion between the PN code and the actual message bit stream, the term chip is used to describe each bit of a PN code. For a chip duration of t_1 seconds, the periodic PN sequence repeats itself every Nt_1 seconds. For the example shown in **fig. 9**, the same chip value would be seen every $7t_1$ seconds apart.

By changing shift register feedback paths, it is possible to generate many unique m -sequence codes, each having a period of N chips. The number of possible codes is important since it defines the maximum number of users that can be uniquely addressed, assuming that each user has the same length shift register. The exact number of unique codes is dependent upon the number of shift register stages and the possible feedback paths. In general, the longer the shift register, the more unique codes exist. However, as can be noted in **table 3**, when the shift registers consist of a prime number of stages, there is a maximum of codes for a minimum of hardware.

Modular Shift Register Generators (MSRGs) such as the MC8504 are available for easy PN code generation. The MC8504 is a 16-pin chip that features four stages of an expandable shift register. They may be cascaded, and additional flip-flops (such as a 7474) may be added to implement an arbitrarily long m -sequence. A nine-stage MSRG capable of producing 48 selectable 511 chip codes is shown in **fig. 10**.

Direct sequence (DS) spread spectrum. As shown in **fig. 2A**, the PN code is added with the digitized message (usually PCM) to produce a digital signal that can be readily modulated. If one of the adding signals is wide band, then the resulting adder output signal is also wide band. Since the PCM has a bandwidth on the order of the original message, it is necessary to use a PN code which has a bandwidth several orders of magnitude larger than the message band-

table 2. Contents of Shift Register Stages for $m = 3$.

	stage 1	stage 2	stage 3
initial contents	1	1	1
clock pulse 1	0	1	1
clock pulse 2	0	0	1
clock pulse 3	1	0	0
clock pulse 4	0	1	0
clock pulse 5	1	0	1
clock pulse 6	1	1	0
clock pulse 7	1	1	1

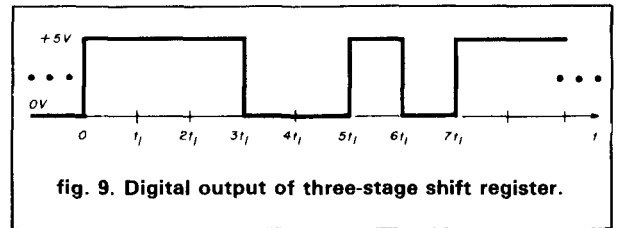


fig. 9. Digital output of three-stage shift register.

width in order to obtain large bandwidth spreading. For this reason, the chip rate is typically run at speeds of several Megachips per second (Mcps).

The output of the binary adder is fed into a balanced modulator. This modulator produces a particular carrier phase for a logic "1" and a 180-degree shifted carrier for a logic "0." Hot-carrier diodes are used in conjunction with wide band transformers to produce the final RF signal. **Figure 11** illustrates a double-balanced mixer, which is the most commonly used type of balanced modulator. The balanced modulator input and output signals are shown in **fig. 12**. While the output waveform appears simple in the time domain, frequency domain analysis reveals that there is a wide band of frequency components centered around the nominal carrier frequency.

In a DS-SS receiver, just as with any RF receiver, it is first necessary to bring the modulation down to baseband. This is accomplished by mixing the received signal with a local oscillator that is adjusted to the transmitter's frequency. Then, the coded signal must be matched with an internally generated PN code. This is accomplished by binary addition. If the internal PN code generator is not correlated with the incoming signal, the resulting adder output is called *code noise*. However, when the internal code is synchronized with the incoming signal, the output of the binary adder collapses to the original digital message bit stream. A manual tuning dial can be used to adjust the phase of the code generator until synchronization is obtained. Better yet, a microprocessor can be used to automatically adjust the receiver PN code phase. Once synchronized, the demodulation may be accomplished by using a D/A converter followed by a low pass filter.

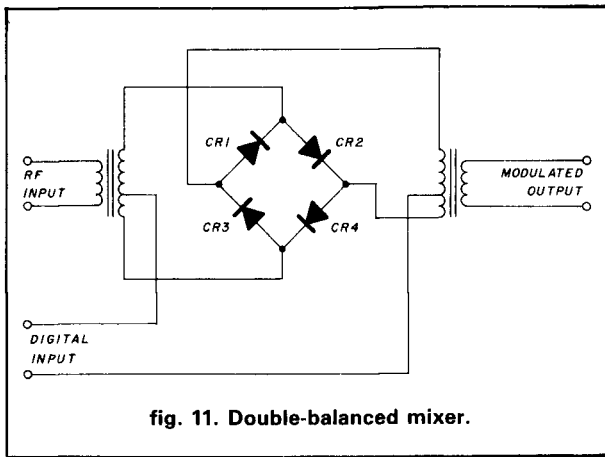
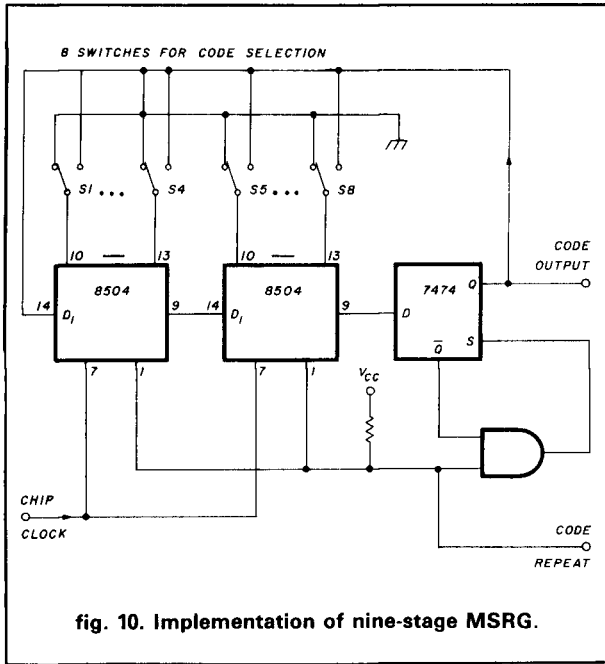


table 3. Characteristics of M-sequences of various length.

M stages	maximum number of unique codes	number of chips per period
3	2	7
4	4	15
5	6	31
6	4	63
7	18	127
8	16	255
9	48	511
10	60	1023
11	176	2047
13	630	8191
20	19,200	1,048,575
30	11,880,000	1,073,741,823
61	3.1×10^{16}	2.3×10^{18}

Since the receiver uses an internal clock signal for code reconstruction, the low pass filter could be of the switched capacitor variety.

It is important to note several points of practical interest. Obviously, the receiver must tune to the sender's transmitting frequency in order to establish the possibility of communication. This suggests that calling frequencies would be advisable for the first Amateur attempts at DS-SS communication. Furthermore, a standard shift register length (or a few agreed upon lengths) seems mandatory, since the senders and receivers must be able to match each other's PN code. A fixed chip duration is necessary, too, so that all stations would be ensured that they could synchronize with the other users.

Before leaving DS-SS, a word should be said about PN code length. In military applications, where security is an important consideration, it is not uncommon to find PN coding schemes which use shift register stages of length 40 or greater. If each chip duration is 1 microsecond, then one cycle of an $m = 40$ PN code is completed in a time of

$$(2^{40} - 1) \text{ chips} \times \frac{10^{-6} \text{ sec}}{\text{chip}}$$

$$= 1.1 \times 10^6 \text{ sec} = 12.7 \text{ days}$$

Even if an interceptor listened in on this signal for several hours, it would appear to be a random jumble of binary digits. For long codes such as this, it takes a very long time to synchronize the receiver. On the other hand, if a shorter PN code is used (say, $m = 13$), then the entire code sequence is repeated every 8.3 milliseconds! A code having such a short period can be synchronized quite quickly at the receiver end.

Frequency hopping (FH) spread spectrum. In a FH-SS system (fig. 2B) there is a narrow band transmission occurring at any given time instant. However, there is a wide range of frequencies from which the transmitter may select. The particular frequency selected for use at any given moment is determined jointly by the digitized message bit stream and the PN code generator.

The message bit stream is used as the least significant bit (LSB) of an M bit data word. The PN code generator supplies the other M-1 bits. The data word is then used to determine the additive offset required to generate the proper frequency. Frequency hopping takes place over $N = 2^M$ frequencies separated by integer multiples of f_1 , where f_1 is the gap between adjacent hop frequencies. The repetition rate of the frequency hopping sequence is determined by the number of stages in the PN code generator and by the speed of the chip clock. Since the generator supplies M-1 chips for each hop, the frequency hop sequence repeats every

$$\frac{(2^m \text{ stages} - 1)}{(M-1)} \text{ hops}$$

table 4. Indirect frequency synthesizer ICs and their characteristics.

part number	number of frequencies	reference frequency	maximum divider input frequency	control
Hughes HCTR0347	45	50 Hz-500 kHz	10 MHz	8 bits parallel
Nitron 6410	100	4.00 MHz	1.6 MHz	8 bits parallel
Motorola 145104	256	10.24 MHz	4.0 MHz	8 bits parallel
National DS8906	16384	10.24 MHz	120 MHz	20 bits parallel
National MM55110	1024	10.24 MHz	3.0 MHz	10 bits parallel
Fairchild 11C84	128	10.24 MHz	20 MHz	7 bits parallel
AD-TECH FS-2574	1000	10.00 MHz	258 MHz	10 bits parallel

Figure 13 illustrates a typical FH transmission for the case of $M = 3$ and a nine-stage m-code generator using a 1-kHz chip clock.

Typical values for a suitable FH system might be $f_1 = 500$ kHz and $M = 3$ bits. For this example, the total RF bandwidth of the system would be

$$2^3 \text{ frequencies} \times \frac{500 \text{ kHz separation}}{\text{frequency}} = 4.0 \text{ MHz}$$

If the lowest frequency of the transmitter were 420 MHz, the highest frequency used by this system would be 424.0 MHz.

The frequency synthesizer is the key to an FH-SS system. Its operating characteristics (such as frequency range, switching speed, and hop duration) determine a system's capability. There are two major classes of synthesizers, the direct type and the indirect type. The direct frequency synthesizer uses filters and mixers and is seldom found in current Amateur gear. The indirect type uses phase-lock-loops (PLLs) to generate the desired frequency set. As a rule, indirect synthesizers are not as quick to switch frequencies, but are easier to implement.

Figure 14 shows a block diagram of an indirect frequency synthesizer. Those familiar with PLLs will immediately recognize the structure. The reference frequency, f_1 , is related to the output frequency, f_j , by

$$f_j = n_j \times f_1$$

since the VCO and the feedback loop forces f_j/n_j to equal f_1 . As can be seen in table 4, indirect frequency synthesizers, manufactured by several IC companies, can produce output frequencies above 100 MHz. To achieve greater frequencies, multiplier stages must be added.

The duration of a single frequency hop (t_h) may be longer or shorter than the duration of a message bit. If the message bit duration is longer than t_h , then the system is called a *fast hop FH* system since the hop rate is greater than the message bit rate. Otherwise, the system is termed *slow hop FH*. The advantage of a fast hop system is that if there is interference on one of the hop frequencies, the garbled message bit may

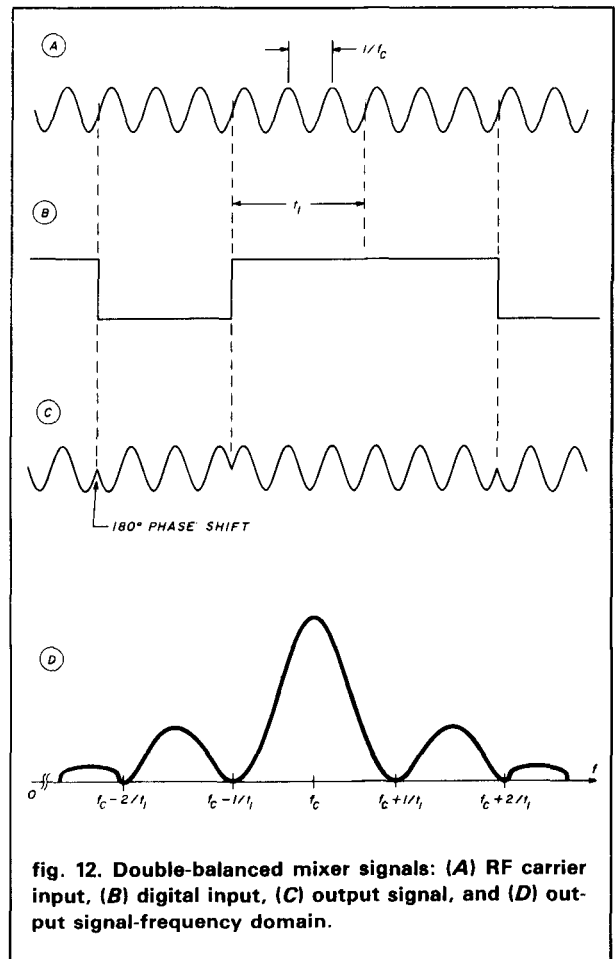


fig. 12. Double-balanced mixer signals: (A) RF carrier input, (B) digital input, (C) output signal, and (D) output signal-frequency domain.

still be present at the next hop frequency. For slow hop systems, error correction coding is needed since QRM on a given hop frequency could obliterate several message bits.

Reception of an FH-SS signal is achieved by synchronizing the receiver frequency with that of the transmitter's. Once synchronization occurs, the receiver output is identical to FSK, with the mark and space separated by f_1 Hz. The demodulator can consist of band pass filters which are compared to determine the value of the message bit. The actual message

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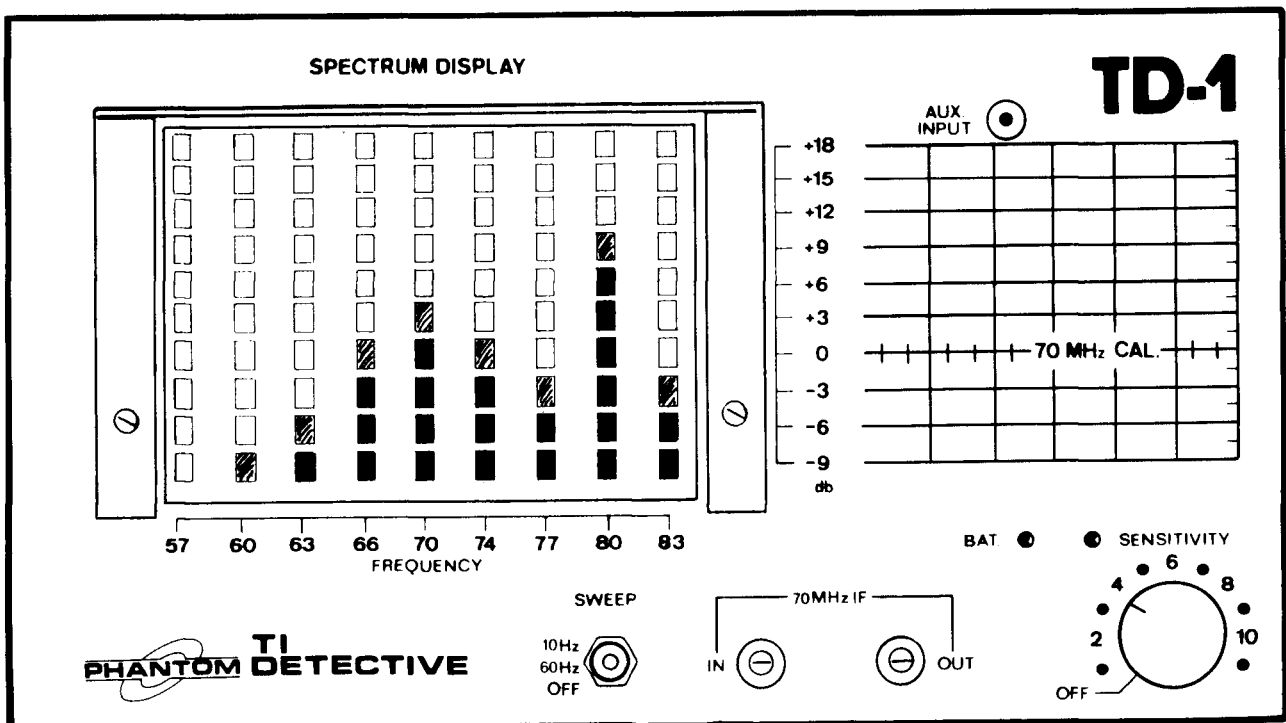
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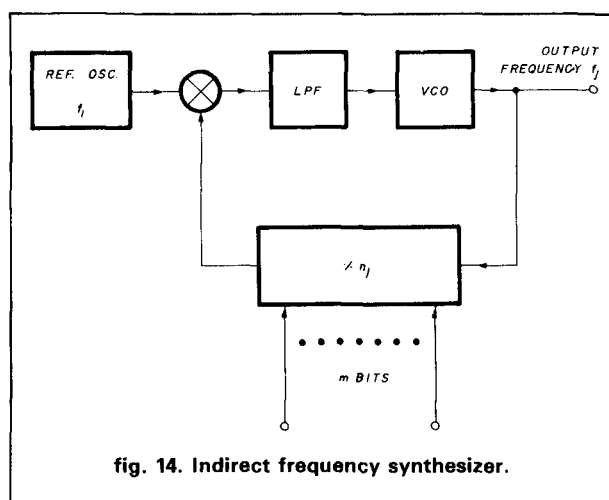
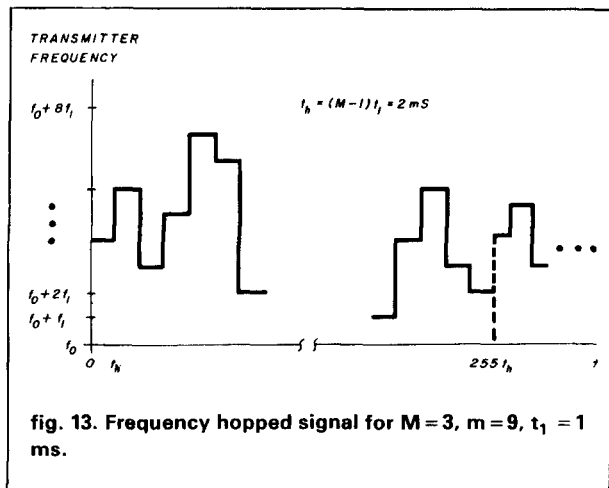
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is then reconstructed by using a D/A and a low-pass filter.

Synchronization must be acquired in roughly the same manner as in the DS case. A computer shifts the $M-1$ bit PN code until the receiver tracks the transmitter through each hop. As cited in the DS case, a shorter PN code period ensures quicker acquisition of the transmitted signal.

With indirect synthesizer chips and MSRG chips readily available, it appears that FH systems could be constructed with slight modification to existing VHF/UHF gear. Certain standards such as hop duration, frequency band allocation, and the number of hop frequencies need to be developed, however.

future of spread spectrum

In late May, 1985, the FCC approved docket 81414, which allows the use of spread spectrum on all ham frequencies above 420 MHz as of May, 1986. Temporary authorizations are now being given to those Amateurs interested in experimentation.

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mode of communication unlike any other we've ever tried. With this new mode, our hobby may take a big step toward reaching state-of-the-art digital communication techniques. There's a lot of work to be done, though; defining protocols for Amateur SS will not be simple.

conclusion

The world of digital communications is a new, exciting technological field, and the future is being shaped daily by advances in this area. As Amateur operators, part of our charter is to increase the reservoir of electronics experts. While we don't have to be experts on digital communications, it's probably good for us to know the how's and why's of what is going on around us. Perhaps this article has shed some light on a subject that, as timely as it is, has not been widely discussed in the Amateur Radio literature.

For those interested in learning more about spread spectrum systems, the definitive reference is *Spread Spectrum Systems*, by Robert C. Dixon.¹⁷ Dixon's book was the first on the topic, and has recently been revised to include discussions about practical hardware considerations. Also good is a book just released: *Modern Communications and Spread Spectrum* by C.D. McGillem and G.R. Cooper.¹³ This book treats practically every type of modulation method and highlights some of the more important concepts of SS communication.

references

1. Robert A. Scholtz, "The Origins of Spread-Spectrum Communications," *IEEE Transactions on Communications*, May, 1982, pages 822-854.
2. David Kahn, "Cryptology and the Origins of Spread Spectrum," *IEEE Spectrum*, September, 1984, pages 72-80.
3. F.E. Terman, "Administrative History of the Radio Research Laboratory," *Radio Research Lab., Harvard University*, Cambridge, Massachusetts Rep. 411-299, March 21, 1946.
4. G.R. Cooper and R.W. Nettleton, "Cellular Mobile Technology: The Great Multiplier," *IEEE Spectrum*, June 1983, pages 30-37.
5. W.F. Utlaug, "Spread-Spectrum: Principles and Possible Application to Spectrum Utilization and Allocation," *IEEE Communications Magazine*, September, 1978, pages 21-30.
6. Bill de Carle, VE3OBE, "Technical Correspondence," *QST*, June, 1985, page 41.
7. C. Woodson, W6NEY, "Coherent CW," *QST*, May-June, 1981.
8. *AMSAT Packet Conference*, October 8-10, 1982.
9. *Packet Radio Terminal Node Controller (TNC) System Manual*, Tucson Amateur Packet Radio Corporation.
10. H. Nyquist, "Certain Factors Affecting Telegraph Speed," *Bell System Technical Journal*, Volume 3, No. 2, 1924, pages 324-346.
11. G.R. Cooper and C.D. McGillem, *Continuous and Discrete Signal and System Analysis*, Holt, Rinehart and Winston, Inc., 1974, page 365.
12. F.G. Stremmler, *Introduction to Communication Systems*, 2nd edition, Addison-Wesley Publishing Co., 1974, page 88.
13. C.D. McGillem and G.R. Cooper, *Modern Communications and Spread Spectrum*, McGraw-Hill Publishing Co., 1986.
14. K. Shanmugam, *Digital and Analog Communication Systems*, John Wiley and Sons, 1979.
15. L.W. Couch II, *Digital and Analog Communication Systems*, MacMillan Publishing Co., Inc., 1983.
16. Herb Friedman, "Modems," *Radio Electronics*, April, 1983, pages 85-89.
17. R.C. Dixon, *Spread Spectrum Systems*, John Wiley and Sons, 1984, page 143.

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a packet radio primer

General information to get you started

Packet is the most exciting thing to hit ham radio since voice communication. It far overshadows SSB in importance, and it will, I believe, have even more impact on Amateur Radio than the proliferation of repeaters in the early 1970s.

At its simplest, packet radio resembles radio teletype. But there are differences between the two. First, a packet message is not transmitted as it is being typed. Instead, the characters are stored in a buffer and then sent in a block at the transmission speed of the link — up to 5,600 characters per second (cps) at 220 MHz and higher frequencies, 1960 cps for 6 and 2 meters, 120 cps on 10 meters, and 30 cps for the low bands. Thus, even in a hot-and-heavy QSO, transmit duty cycle and channel utilization are low.

Second, each packet station "knows" its own call and recognizes the messages addressed to it. A number of QSOs can occur on one channel simultaneously, yet each station in the connected mode* will have a screen clear of all messages other than its own contact.

Third, because of computerized error checking, you'll see only perfect, noise-and-garble-free transmissions (note that I didn't say "error-free"; I have a problem with my typing) unless you disable the error-checking function. And that's just for starters!

digital repeaters

Packets can be repeated. If you don't value the friendship of your fellow repeater users, packets can be put through your local 34-94 machine, but the raucous buzz will drive the control operator, and anyone else monitoring, mad. The better method is to use a digital repeater or "digipeater." This is a very simple device — just a regular packet station. The scheme is quite different from a voice repeater. The digipeater receives the packet signal, stores it in digital form and checks it for errors. If there are no errors, the digipeater retransmits it.

All operation is on one frequency — no duplexers are required, receiver desensitization by the accom-

panying transmitter cannot occur, and each packet is checked for errors at each digipeater. Unlike voice transmissions via repeaters, packet messages can be sent long distances on the VHF/UHF bands by naming a number of sequential digipeaters to form a path to the destination.

Although, at this moment, most packet activity takes place on 2 meters, there are a number of stations on both coasts operating "gateways," low band packet stations designed for long haul message passing with collection and distribution at either end via VHF or UHF.

packet applications

The four main uses for packet radio at the moment appear to be the following:

- **normal, rag-chew type QSOs.** This of course, includes the exchange of any type of traffic between two stations;
- **direct message passing** (if the destination station is running, I can leave a message on it, without the help or intervention of the operator);
- **Packet Bulletin Board Systems (PBBSs)** similar to the telephone-accessed bulletin board/program exchanges used by computer hobbyists, and **packet mail boxes**, which are usually operated in conjunction with a PBBS. In these, a message can be left for a specific ham by call, for a group such as GLBers, or for everybody (in this case, the call entered as "ALL"). Stations operating mail boxes usually transmit the calls for which they hold traffic. Thus it is not necessary to "check into" the PBBS to know if you have mail.

computer bulletin boards

It's not necessary for your QSO to be with a real, live human. Back in the middle 1970s, several computer operators in the Chicago area set up Remote CP/M (RCP/M) computers with personal message services, bulletin boards, and facilities to exchange computer programs, accessible to anyone with a telephone modem and a teletype or other computer terminal.

These "tele-computing" facilities have proliferated, and it's a poor town, indeed, that doesn't have at least two or three telephone-accessed, computerized bulletin board program exchanges devoted to some com-

By **David McLanahan, WA1FHB**, Box 17, Marlow, New Hampshire 03456

*"Packetese" for being in QSO —Ed.

puter-related or other special interest. (The problem with these marvelous facilities is that if you really get into them, your telephone bill approaches infinity asymptotically.)

This type of activity is a natural for packet radio, and packet bulletin board systems (PBBSs), usually running CP/M, are now springing up nearly everywhere. Many of these stations, based on surplus Xerox 820 computer boards, use software donated to the public domain by Hank Oredson, WØRLI, and distributed by ARRL and through the Newington, Connecticut, FIDO-Net bulletin board (203 665-1114). These bulletin boards offer the advantages of their telephone counterparts without running up your phone bill, and offer an additional convenience: most have a "beacon," a short automated transmission announcing their presence at regular intervals.

These PBBS beacons often include all ham calls for whom the board presently holds messages. Thus, unlike the telephone-accessed boards, you need not "log on" to know if you have mail; just monitor the channel and watch the beacon. In this application, the old ham expression of "reading the mail" takes on a new significance.

for the future

There are two precursors of things to come. The first is the concept of a "local user." This means that a ham tells area PBBS operators which PBBS he considers "home." Messages left for him on other boards are then forwarded to his "home" board. This is now handled manually, but automatic forwarding is only a computer program away.

Second, it's now necessary for a packeteer to determine the digipeater string and enter the calls manually. To assist with this, many PBBSs carry area system maps showing digipeater calls and station locations (an abbreviated map is shown in **fig. 1**). However, as I write, a number of hams are working on computer programs that monitor digipeater traffic, picking up routes and maintaining a dynamic area map in real time.

It doesn't take a great leap of imagination to see where all this is leading: automatic path selection and dynamic call forwarding, both "transparent to the user"; all you do is type the call and the computer and packet board does the rest (with a name/call file for your friends, all you'd need to type would be the name). We're rapidly approaching the point reached years ago by television's Napoleon Solo, who, when stranded on a remote Pacific isle, simply whispered "Open channel D," into his fountain pen. Our main unresolved technical challenge will be to place a workable (and comfortable) keyboard on the side of the pen!

There is one thorn in this rosy future: channel space. I've said that packet transmission is error-free, but I carefully avoided any reference to transmission times. At the moment, channels are relatively quiet, and over short paths things can happen quickly. For example, working through two 2-meter digipeaters handling little or no other traffic, packet delivery times run on the order of 4 to 5 seconds each. This is quite reasonable. But, add a few more QSOs, a longer path (several digipeaters), or someone using a PBBS (which shovels out long program or message packets as fast as it can), and things bog down quickly.

While we're on the subject of transmission speeds, two additional notes are necessary. First, the speeds given at the beginning of the article are FCC-permitted *maxima*. While 300 Baud (30 cps), the legal maximum, is used on the low bands, on 2 meters the universally used speed is presently 1200 Baud (120 cps) rather than the allowed 19.6 kilo-Baud, purely because the 1200 will go through a normal voice channel while the higher data rates (which require greater bandwidths) will quickly run aground in the intermediate frequency amplifier and audio circuitry of a normal voice rig.

Second, 1200 Baud sounds like a nice, snappy exchange rate, particularly if you're accustomed to a 300 Baud terminal. Sorry about that; the 1200 Baud is the character transmission rate. When it comes to actual message or data exchanges, the through-put (useful traffic passed) will be at a much lower effective speed, especially if noise or a busy channel forces repeats of transmissions. This is due to overhead within the packet (message header and such) and the necessity of getting acknowledgement for each packet.

Of course, packet activity has no way to go but up as more people get involved. Again, we have technical solutions that will (we hope) be here before the problems are — inexpensive "ham type" digipeaters up at UHF and microwave where transmission speeds can be increased dramatically. This doesn't mean you'll have to put a 1296 MHz rig in your car; local traffic can still be handled on 2 meters, but the heavy and long-distance communications can go on the microwave links.

equipment

You need only three pieces of equipment to operate on packet radio: a 2-meter transceiver (nothing special, that old rock-bound clunker in the basement will probably do, with some tuning); a Terminal Node Controller (TNC — the actual "packet board"); and a computer or computer terminal with which to communicate with the TNC.

Of course, there are always other ways. If you want to save time and reduce aggravation, there's the Pack-

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fig. 1. At right is a graphic representation of Packet Radio links believed to exist on 145.010 MHz on the East coast of North America. The area covers part of Canada and extends to North Carolina. Another file, called SOUTMAP.NNN, covers the area from Virginia south to Florida.

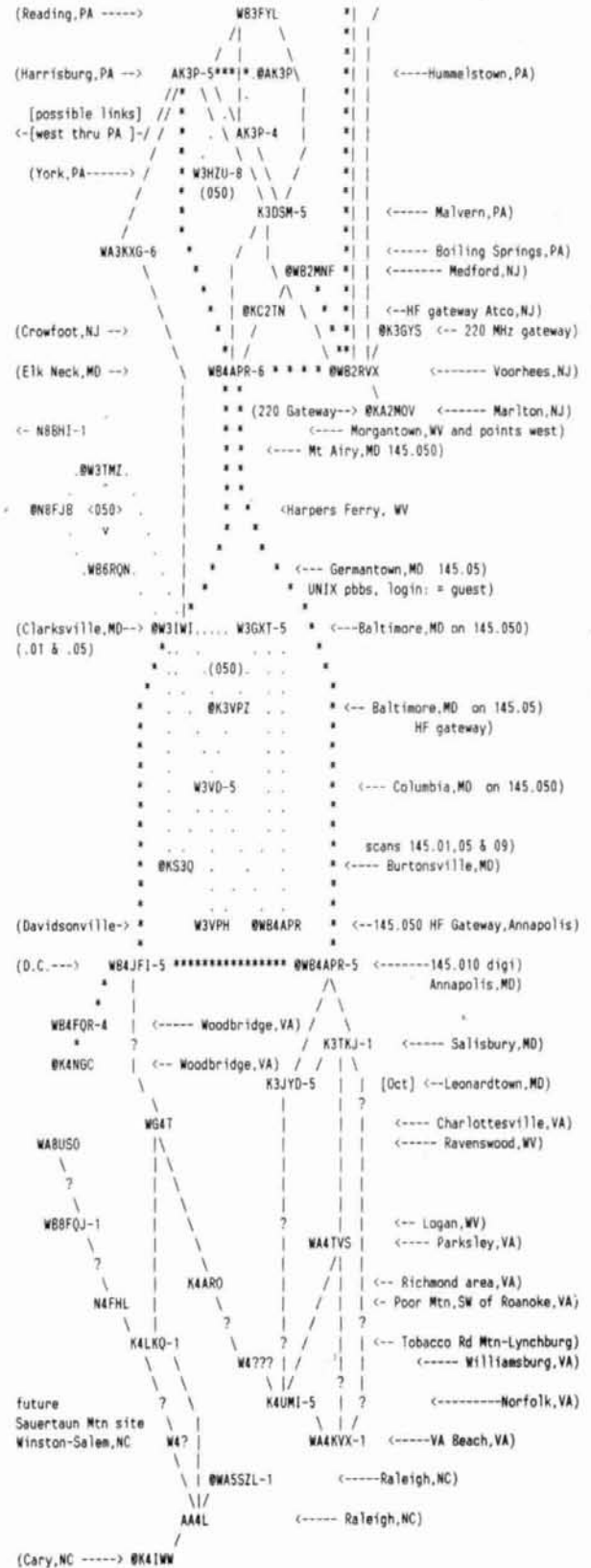
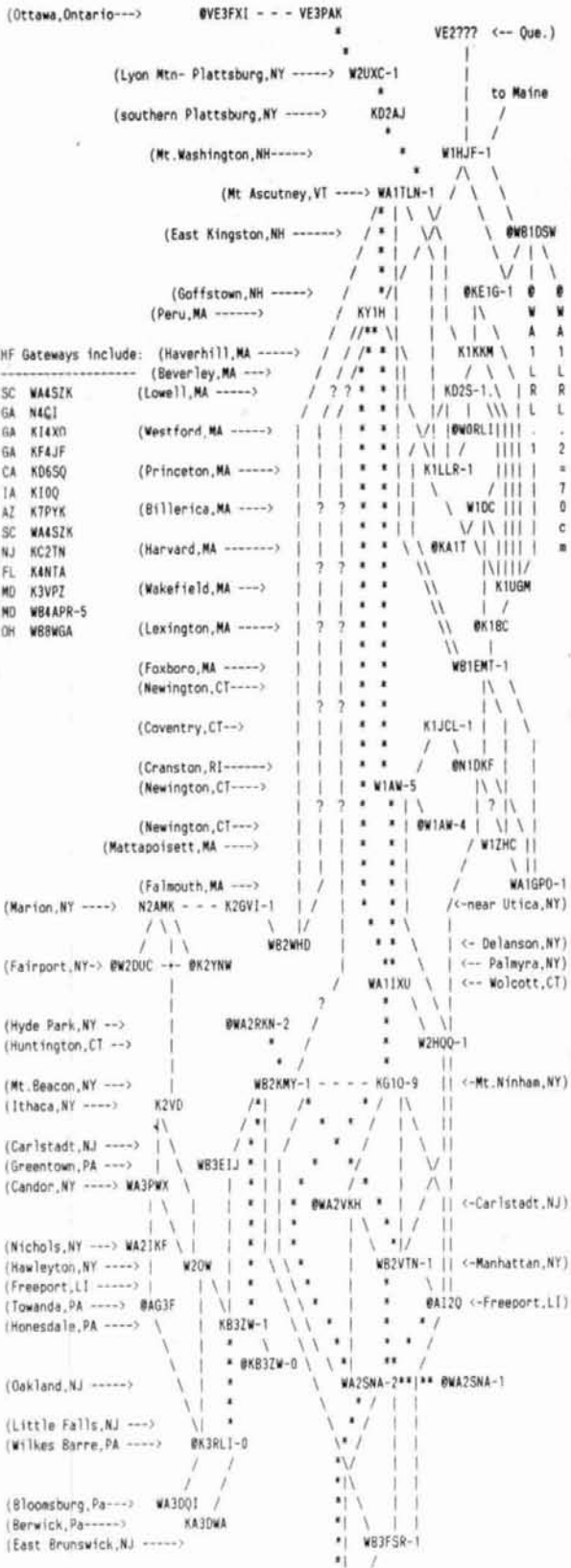
Included in these maps are digipeaters, Packet Bulletin Board Stations (PBBS), and home stations usually left on for digipeating. Updated maps covering this and other areas are available from stations running WØRLI-compatible software for PBBSs, mailboxes and/or gateways; these stations are indicated by the use of the "@" character preceding the call sign.

The primary routes used for mail forwarding in EASTNET are marked with asterisks (****), while other links are shown by either | \ or / as connecting characters. All "*****" routes are presently on 145.010. In the Baltimore/Washington area .050 is heavily used for local traffic. Links on 145.050 MHz in Maryland, West Virginia, and Pennsylvania are connected on this map by dots. 220 MHz trunk links will parallel 145.010 in the future.

To improve readability of this linking you might want to use felt tipped pens to outline the various linking paths. Links marked with a question mark indicate a link of unknown reliability. If any links shown on this map prove to be unreliable or nonexistent, please drop me a note. Send the info to me, K1HTV @ W3IWI, via one of the many auto-forwarding PBBSs or via the U.S. mail (see Callbook for address).

Thanks to Rick Zwerko, K1HTV, one of 10 acting directors of the Mid-Atlantic Packet Radio Council (MAPRC). Formerly Vice-President for Operations, AMSAT, Rick also served as a member of the AMSAT Board of Directors and was past president of the Northeast VHF Association.

— WA1FHB



eterm, a portable unit (\$995) that combines a TNC and a computer terminal in one sleek-looking designer case (see photo). If you go that route, you can disregard the rest of this article and be on the air half an hour after unpacking the box . . .

I claim no special expertise in the area of 2-meter transceivers. I'm using an Azden PCS4000 because I happen to have it, and it's working fine. The only caveat is that most 2-meter packet activity is below 146 MHz and some of the older narrow-band equipment needs a tweak to get down there.

I'm using a GLB PK-1 Terminal Node Controller. I chose it because it appears to be the least expensive one available (\$165). At 4-1/2 x 9-1/2 inches (11.4 x 24 cm) it's also the smallest one I've seen. It also requires only a single-voltage power supply (+12 VDC at 170 mA) and it doesn't mind "mobile-type" voltage excursions; I've used it from 14-1/2 to 9 volts without a hiccup. And, like other TNCs on the market, the Z-80-based GLB features "dynamic programming"; the manufacturer frequently releases a new ROM offering enhanced and improved features.

Other TNCs are available from Vancouver Amateur Digital Communications Group, Tucson Amateur Packet Radio, Heath, AEA, Kantronics, Ashby, and Packeterm, to name a few (fig. 2). Richardson software converts a TRS-80 Model 1, 3, 4, or 4P into a computer/TNC*.

The last necessity, the terminal, offers the most opportunity for self-expression. It can be anything from a Model 15 Teletype to a microcomputer such as a Sinclair ZX-81 or a Commodore 64. The microcomputer route is the most popular. Of course the micro must have a serial port (or an adapter to provide one) as well as a modem program. (The Model 15 Teletype was preprogrammed at the factory.)

getting started

As with everything else, the most difficult part is getting started, especially if you don't have a packet Elmer around. You'll need either a reasonably local packet station that will give you a strong signal or two set-ups that you can work back-to-back. An independent monitor receiver is a big help.

There's nothing special about the monitor receiver. It can be any kind of tunable or fixed-frequency rig capable of receiving your area's packet channel(s). Be aware that some of the programmable (no-crystal) scanners won't tune lower than 146 MHz without special measures. For example, on my 16-channel Regency "Touch," Model ACT-T-16K, I must press, in order, MA, 9, CL, PR, then key in the frequency I want, and hit PR again.

*Synchronous Packet Radio Using the Software Approach — AX.25, by R.M. Richardson, W4UCH, available from Ham Radio's Bookstore, Greenville, NH 03048 (\$21.95 plus \$3.50 postage & handling)

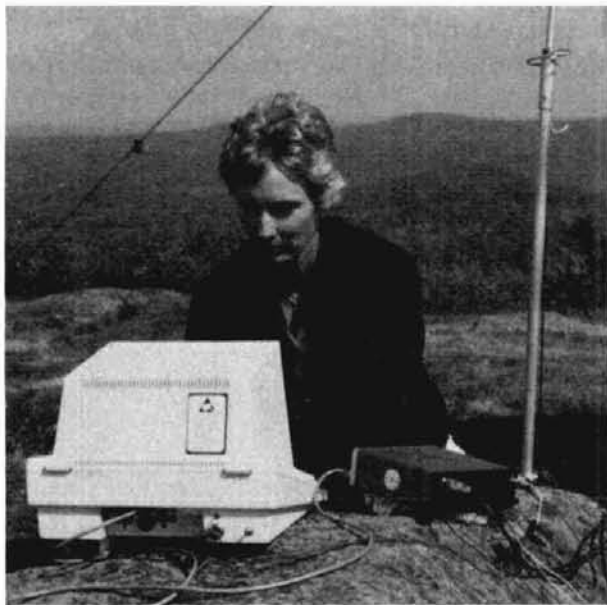


fig. 2A. Cynthia "Sam" Hensley, KY1D, operates Packeterm™ IPT, a portable terminal and TNC combined in one unit, from summit of Pitcher Mountain in Stoddard, New Hampshire.

This receiver is then set up on its own 1/4-wave whip near your packet station. Because a TNC requires a better signal to noise ratio than voice, if another station sounds reasonable on the quarter-wave whip, it will probably be fine for packet, assuming that you are using an outdoor gain antenna for the packet transceiver.

The monitor is used, first, to compare your station's deviation with others in the neighborhood, and, second, to keep track of when (and how) your station is transmitting. After your packet set-up is thoroughly established and proven, you may wish to return this radio to its prior service monitoring the local police, but till then it'll be invaluable in getting you started.

To begin with, you have to get your computer or terminal working with your TNC. This requires, first, an RS-232 interface from the computer or terminal to be connected with the RS-232 interface on the TNC, and, second, if you're using a computer, driver software (usually a "Modem" or "Terminal Emulator" program) to access the RS-232 port. Because the programming depends on the brand and type of computer used, I'll leave that part to you and your software dealer or local computer guru.

I can, however, provide some advice on using the RS-232.

the RS-232

First, the actual RS-232 specification doesn't define a physical connector, although a DB-25 is usually used. Second, RS-232 defines interfaces for modems and for terminals, but not for computers. Third, two

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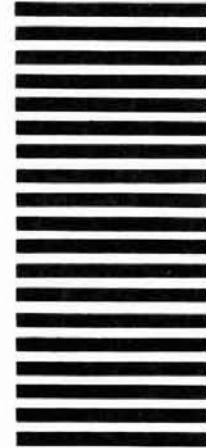
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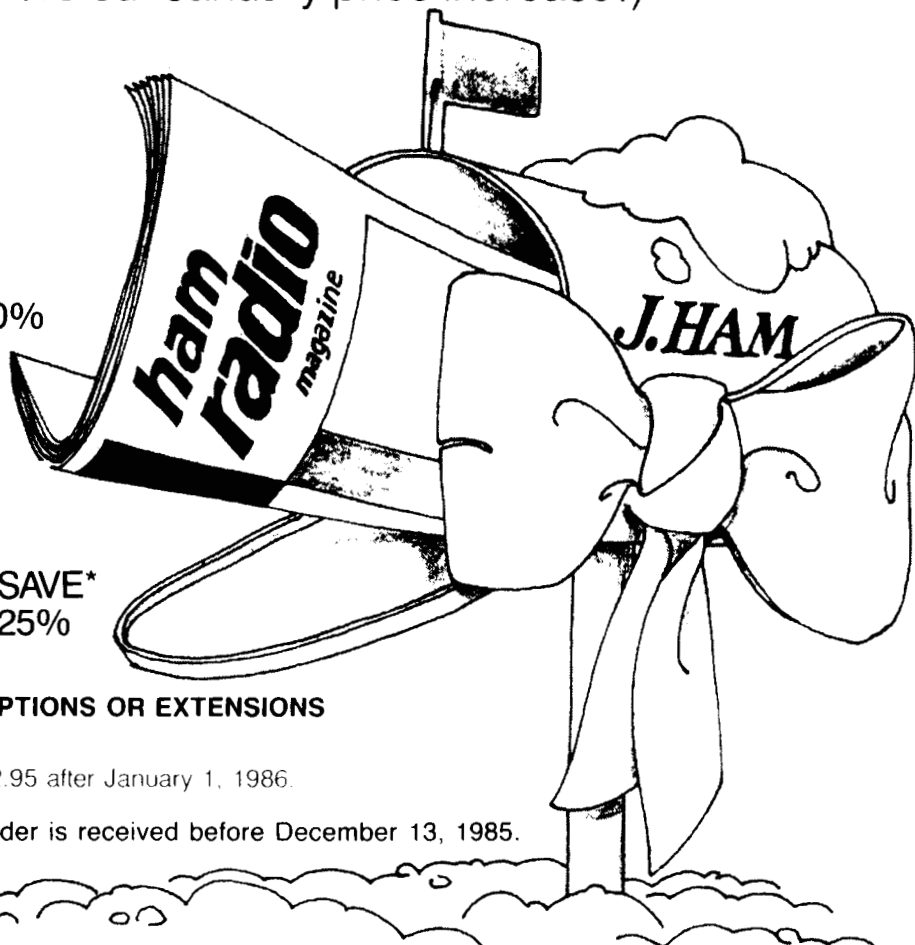
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identical RS-232 interfaces (two modem interfaced or two terminal interfaces) won't work together because both will be transmitting data on one line and both will be "listening" on another line. Therefore, before you actually hook things together, compare the instructions for your computer and your TNC.

Normally, the computer will talk (transmit data, data out, or TxD) on pin 2 of the DB-25 and the TNC will listen (receive data, data in, or RxD) on the same pin number. If your literature shows that your two devices work this way, use a pin-for-pin cable. If, on the other hand, both units are talking on the same line, you'll have to swap pins 2 and 3 at just one end of the cable. (If you make the swap at both ends, you're back where you started!) Along with that swap, go swaps on several of the control lines, although ground *always* remains on pins 1 and/or 7. Check your literature.

If you find that you do require some line swaps, but

all you have is a pin-for-pin cable, check its connector type. There are three types of DB-25 connectors in common use commercially: insulation displacement connector (IDC), crimped onto ribbon cable; solder cup connector with wire leads soldered in as required; and crimp-type, where the pins are crimped onto the wires and then popped into the connector shell.

If you have only a ribbon cable, you're stuck. With the solder cup connector, changing conductors around is relatively simple, assuming that you have both patience and a small soldering pencil. Changing the pins around on the crimp-type connector is even easier than resoldering if you can get the little plastic insertion and extraction tools. Both tools (which slip together for storage) are slotted lengthwise for slipping over the wire. The tool is then slid down the wire so that its point enters the back of the connector block around the connector pin. Gently pulling the wire slides the pin out of the block. Reinsertion is just the reverse. Place the tool on the wire up against the pin and use the tool to seat the pin in the block.

Although these tools are inexpensive, they may be difficult to find. Made of plastic, they will break in time. You might try purchasing several from an industrial distributor who stocks the connectors.

listening to the data

If you're sure the wiring is under control but the interface still doesn't work, check to make certain that both units are really transmitting data when they should. Look at the TxD line from the computer. (An oscilloscope is ideal for this but you can use the audio channel of your video monitor, if it has one, or another audio amplifier and speaker.

Remove the plug cover from the cable connector at either end. Make sure that the audio channel ground is connected to the computer system ground. With the volume of the audio channel set low (to avoid ear-shattering surprises) check the audio by touching the exposed audio connection with your finger while the rest of your body is ungrounded. You should get a loud AC hum. Then, using a small-gauge conductor wedged into the back of the DB-25, make contact between either pin 2 or pin 3 and the audio input.

Now try a command to the TNC. With the GLB PK-1, the first thing it wants to see is a carriage return <cr> to establish the baud rate, which should be 9600 Baud or slower. (The baud rate between TNC and "terminal" has nothing to do with the "on the air" data rate of 1200 Baud.) When the GLB receives its carriage return, it responds with a dozen-character sign-on. If serial data is present on the line you've chosen, you'll get a raucous buzz (or a short burp) for a single character like the <cr>. Try this a couple of times. If the power doesn't come on cleanly (i.e., bounce in the power switch) it can discombobulate



fig. 2B. Packet terminal units from (A) AEA, (B) Heathkit, and (C) Kantronics.

the GLB's initialization routine. Hit GLB reset and try <cr> again.

If you still don't get the buzz, the most likely cause is that a required RS-232 control signal is not being handled properly. Of course, this requires a check of the RS-232 specifications as interpreted by the two particular devices that are giving you grief. For example, with the GLB PK-1, check to see that the computer or terminal is putting a high (>3VDC) on RTS (Ready To Send) (DB-25 pin 4 on the GLB), and that the computer doesn't need more control signals than the high that the GLB puts on its CTS (Clear To Send) (DB-25 pin 5) line.

If either the computer or the TNC is not getting the control signal(s) it requires, you won't hear data on either line from the end(s) with the problem. Check your control lines with a VOM.

Once the terminal-TNC interface is working, you are ready to hook the TNC to your transceiver, following the TNC manufacturer's guidelines.

Now see if you can receive. Connect all the equipment up and turn it on, instructing your packet board to display everything without checking the packets for transmission errors ("Garbage mode" on the GLB, **SG-E**). Wait for activity on the channel (as indicated by your transceiver's S-meter or the monitor radio) and see if it prints. (Very short transmissions may be connect requests or acknowledgements that will not yield a printable message.) If that works, try transmitting. Send anything and compare the sound of your transmitter through the monitor radio with the sound of another packet station. *If your signal doesn't sound raspy and disagreeable, your audio is set too low.*

talking to yourself — by radio

If the audio sounds okay, try talking to yourself through the other station. Program your call as the destination as well as the originator, making sure that the SSID numbers (usually zero) are the same. Then type in the call of the other packet station or digipeater, again watching the SSID. Many digipeaters use an SSID of one, with zero used by the trustee's home station. W1AW has several packet stations with SSIDs running up to 5! With the GLB your destination is set with **SD** and your digipeater(s) with **SV** (send via).

Now issue the command to connect (**AC** on the GLB). Your transmitter should come on for a short period (less than a second) followed almost instantly by a similar-length transmission by the other station. Your terminal should then "ring its bell" and display **-Connected to <your call>**. Now type a short message and hit your "dispatch" character (on the GLB this defaults to a line feed). The message should be duplicated almost immediately on your screen, then be followed in a second or two by another bell and an **-Ack**.

The **-Ack** means that the "receiving-you" has acknowledged the message back to the "sending-you." If the **-Ack** is not received by the TNC, the message will be held in the TNC's buffer and the transmission repeated. With the GLB, to disconnect, type **Control-C**. When disconnect is complete, the screen will show **#1**.

If all that worked, you're ready for a real, live QSO or a longer path test. On multi-hop self-connects, you must provide the *entire* round trip in the digipeater string. (Like any other computer, the TNC is wonderfully fast but very stupid.) Thus to self-connect through W1AA-1, W2BB-0, and W3CC-1, for example, your string must read W1AA 1, W2BB 0, W3CC 1, W2BB 0, W1AA 1.

If all this works, you're home free. If questions or problems arise, you can connect with another packeteer in your area and ask for help. You can also access your local PBBSs. Start with the one that's on the shortest, quietest, most reliable path until you get the hang of it. (The wee, small hours of the morning are the best time for this experimenting.) All you have to do is connect with the PBBS station, then be patient while it announces itself and gives you its prompt line ending with CP/M's >. It will then be looking for a letter command followed by a carriage return (and on the GLB, a line feed to send the packet). For starters, try an "H" (for Help). It should reward you with a list of its commands and explanations. If you have a printer, turn it on so you'll have a hard copy for future reference.

Of course, there's a great deal more to packet radio than I've mentioned here, and the field is changing rapidly, but, as the Chinese say, "The longest journey begins with but a single step." As with any Amateur Radio activity, the biggest and most important step is just getting on the air so you can contact fellow hams. I trust that you'll enjoy the rest of this unending journey.

ham radio

for further reading...

A special package of four back issues of *ham radio*, featuring the following Packet Radio articles, is available from Ham Radio's Bookstore:

"*Amateur Packet Radio, Part 1*," by Margaret Morrison, KV7D and Dan Morrison, KV7B, July, 1983; part 2, August, 1983.

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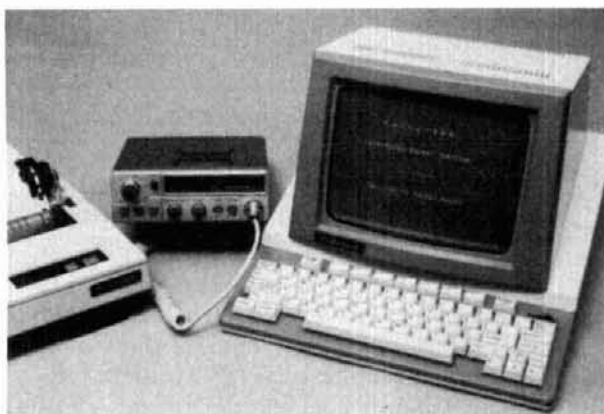
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Recent observations of packet radio signals revealed some startling facts. Several stations intending to be on 145.01 MHz were found as much as 3 or 4 kHz off frequency. Deviation levels also varied quite a bit.

Off-frequency operation and overdeviation cause distortion of the audio signal. Too little deviation results in a poor signal to noise ratio. In all these cases, the result is the same: a modem is less likely to demodulate the signal properly. Packets are retransmitted an excessive number of times and the channel gets clogged up.

The New England Packet Radio Association tried to improve the situation by having a calibration session at one of the regular meetings. A frequency counter, deviation meter, and qualified engineers were present to make sure everybody's equipment was properly adjusted. There was plenty of advance publicity, but no more than a few people bothered to bring their equipment.

Several months later a new beacon appeared on the air, transmitting "WB2OSZ>BEACON: frequency/deviation tester available." During the first few days of operation, many stations connected and received the following message:

"Welcome to the WB2OSZ automatic frequency/deviation tester. Instructions:

- 1. Send several non-blank lines.*
- 2. Wait for reply after each.*
- 3. Ignore any occasional erratic values.*
- 4. Disconnect when done.*

Recommended deviation is no more than 3 kHz. Anyone who disagrees with the results is invited to supply a reference more accurate than my 2AT. John"

Each time a packet was sent to the automated station, a reply was sent back in the form, "Your frequency is about 1.8 kHz too high. Deviation is about 2.6 kHz."

circuit description

The voltage from the detector of an FM receiver is proportional to the frequency of the incoming radio signal. Extracting the DC component of this will provide a measure of the carrier frequency. The peak amplitude of the AC component is proportional to the deviation. **Figure 1** shows a block diagram of a system designed to extract these parameters.

The first step is to obtain a DC-coupled signal from the demodulator of your FM receiver. The entire signal flow from receiver to computer is shown in **fig. 2A** and the individual circuits detailed in the **figs. 2B** through **2E**. **Figure 2B** contains a circuit used with an old VHF Engineering transceiver; it should work with anything else using an LM 3065, an MC 1358, or a CA 3065 quadrature detector. (This part will have to be customized for your particular rig.) It produces a zero volt output for a carrier on the desired frequency and changes by a half volt for each kHz change.

The next step is to extract DC and AC components of the signal with low- and high-pass filters (**fig. 2C**). U2 and associated components form a low-pass filter. Their output is proportional to the amount the incoming signal is off frequency. For example, -1.5 volts means the signal is 3 kHz too low.

The AC component, of course, is the audio. It is extracted by a high-pass filter composed of C3 and R12. This is fed through a full wave rectifier, peak detector, and another low-pass filter. R14 limits the peak current out of U4. (Without it, nasty spikes appeared on the power supply output). R18 boosts the gain slightly above unity to compensate for a small loss in the high-pass filter and peak detector. The result

By John W. Langner, WB2OSZ, 115 Stedman Street, Chelmsford, Massachusetts 01824

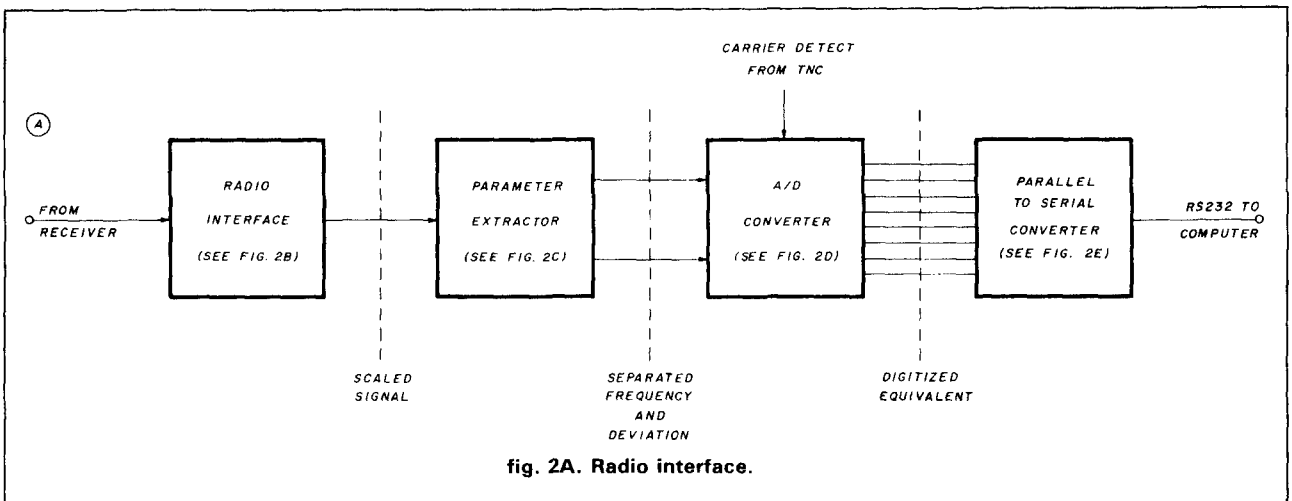
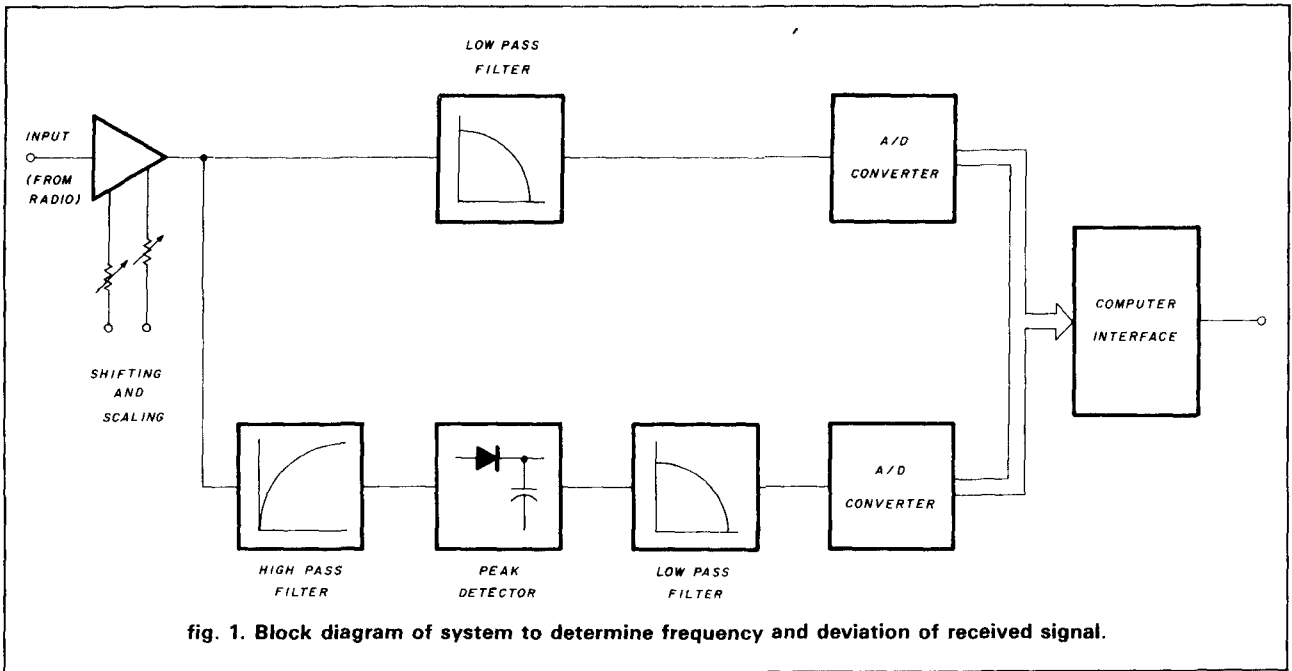


table 1. Integrated circuit pin designations for the supply lines.

	ground	+5 volts	-12 volts	+12 volts
555	1	8		
741			4	7
ADC 0804	10	20		
1458			4	8
74121	7	14		
AY-5-1013	3	1	2	

is a voltage proportional to the peak deviation, again 0.5 volt/kHz.

To build a useful piece of test equipment, connect these voltages to a pair of meters. You can also inte-

grate your system with a computer to open up many possibilities for automated operation. If you have a computer with joy stick input, you already have a pair of analog-to-digital converters and don't have to build the rest of the circuit. For those with computers not intended for playing games, additional external circuitry is required.

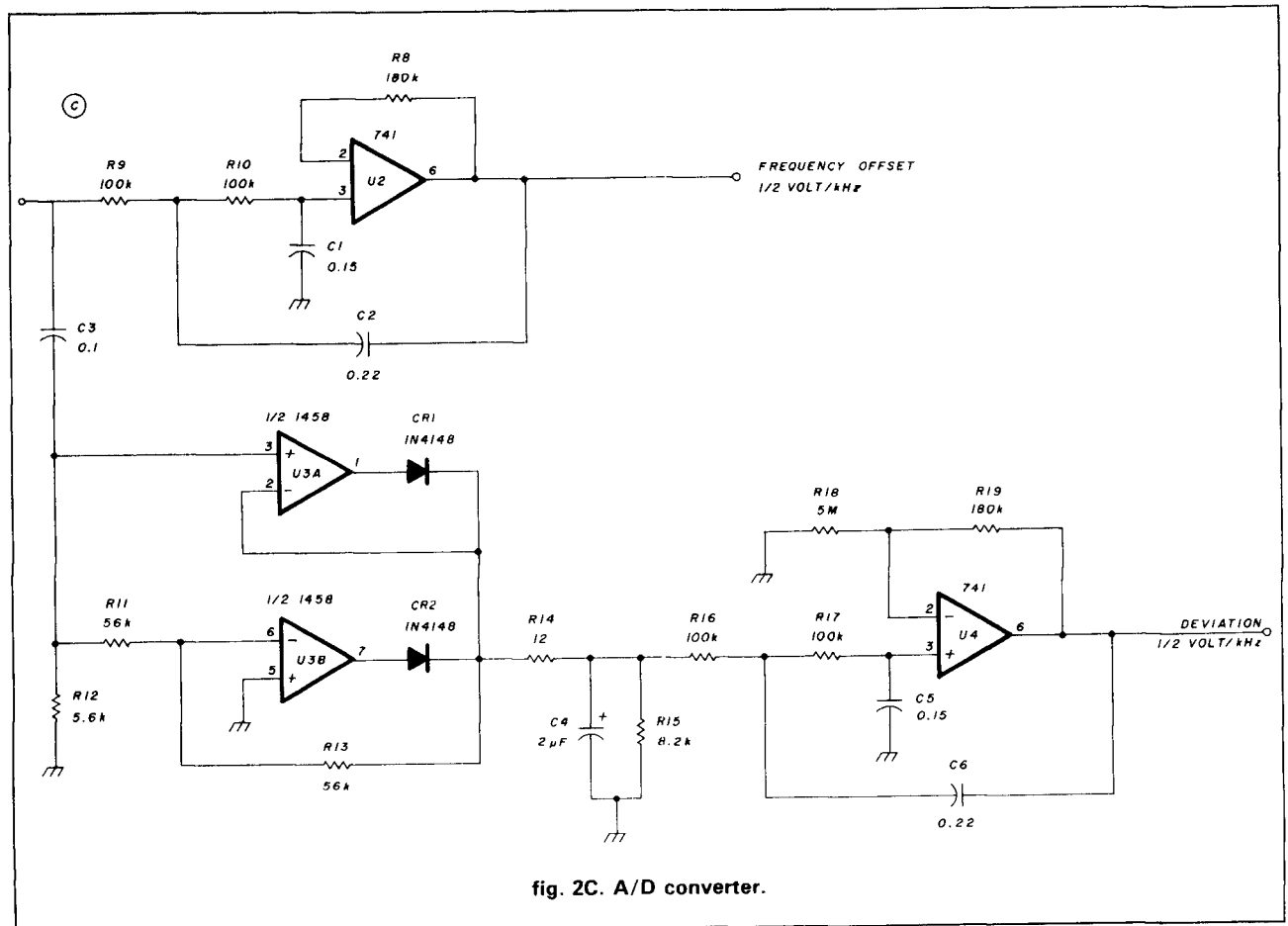
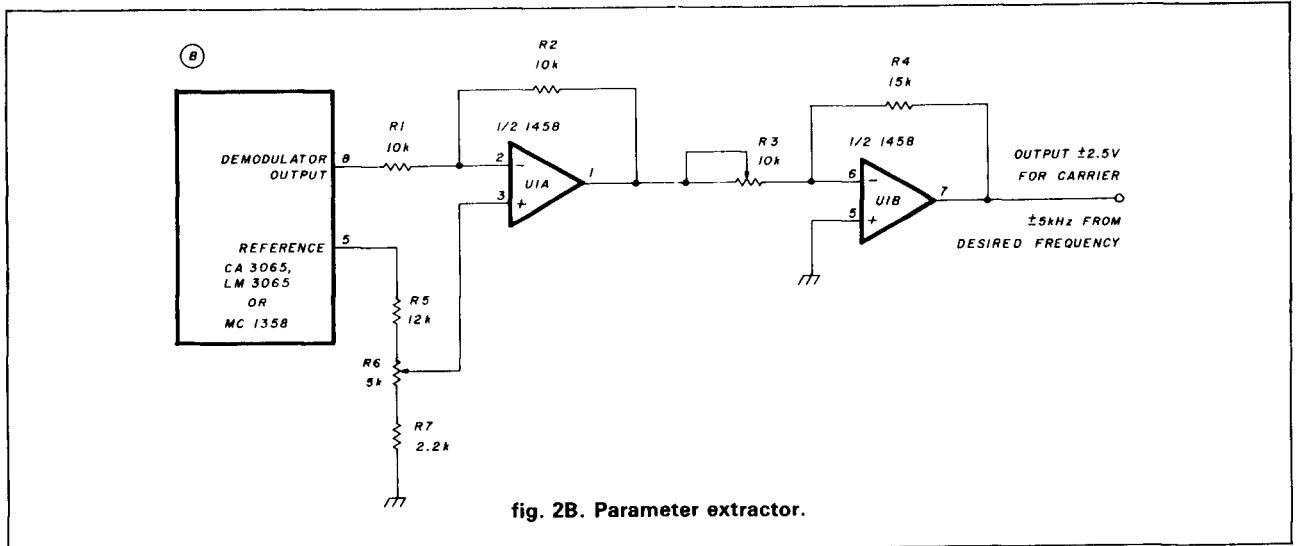
The analog voltages must be converted to digital signals the computer can understand. This is accomplished by the ADC0804 A/D converters in fig. 2D, which convert a voltage in the range of 0 to 5 volts into a corresponding number in the range of 0 to 255 in less than 20 microseconds. U7 and U8 determine when to start the conversion. CR3 through CR6 protect the inputs of U5 and U6 from voltages that could

damage them. CR3 through CR6 should not conduct during normal operation.

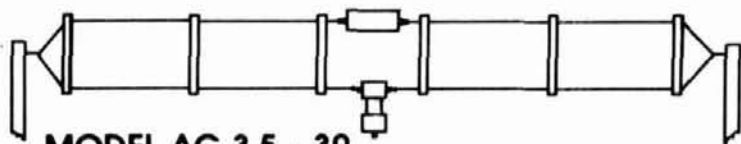
A purist may wish to connect a precision 2.5 volt reference to the V_{REF} pins. In its absence, internal voltage dividers use one half of the 5-volt supply.

When should the A/D converters be commanded

to start the conversion? You wouldn't want to do it when an audio carrier is first detected because the low-pass filters wouldn't have had time to settle down. And you can't do it after the computer has received the packet contents from the TNC (terminal node controller) because the audio signal is long gone. I decided



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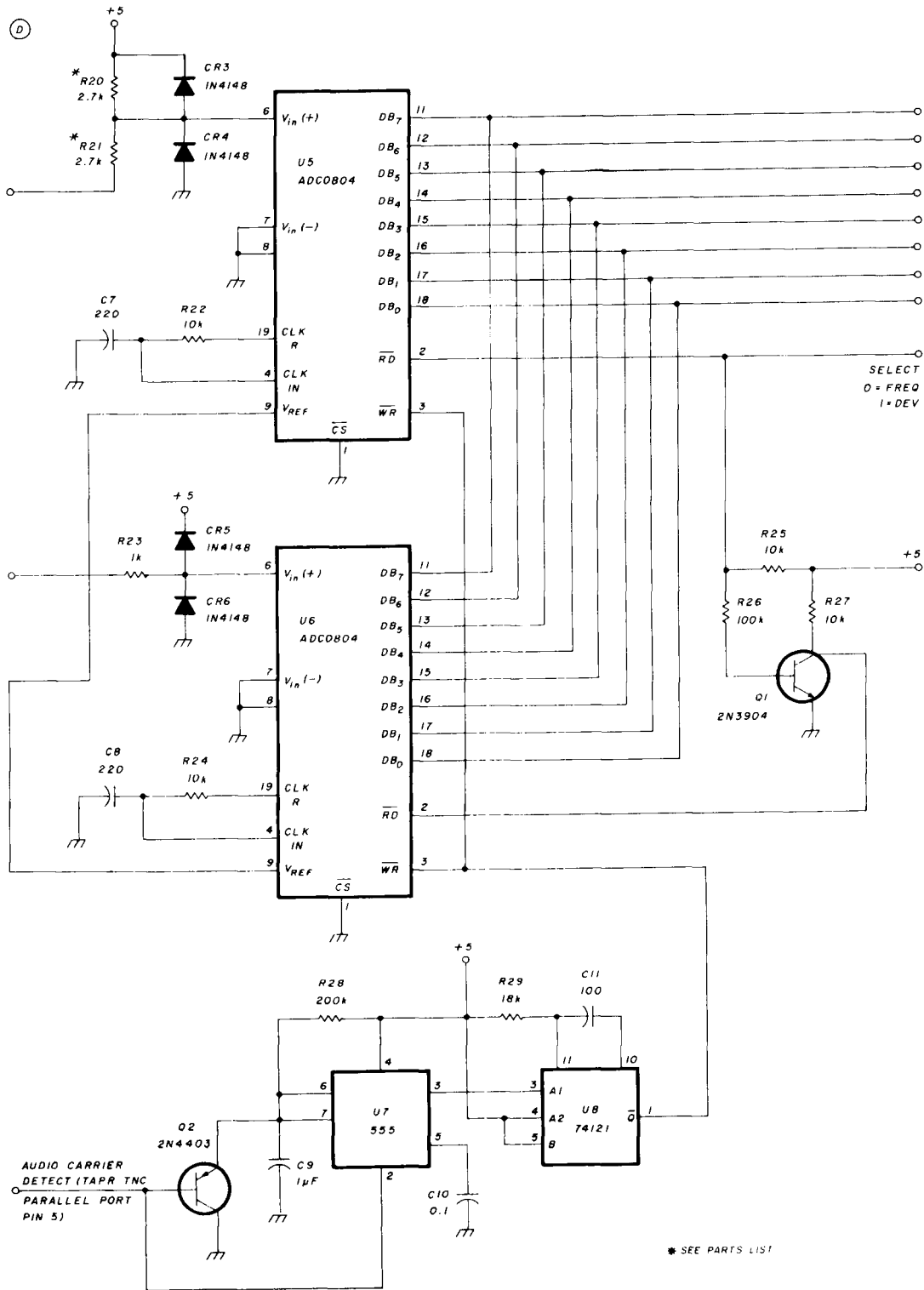
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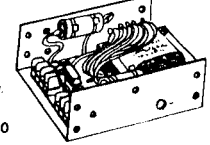
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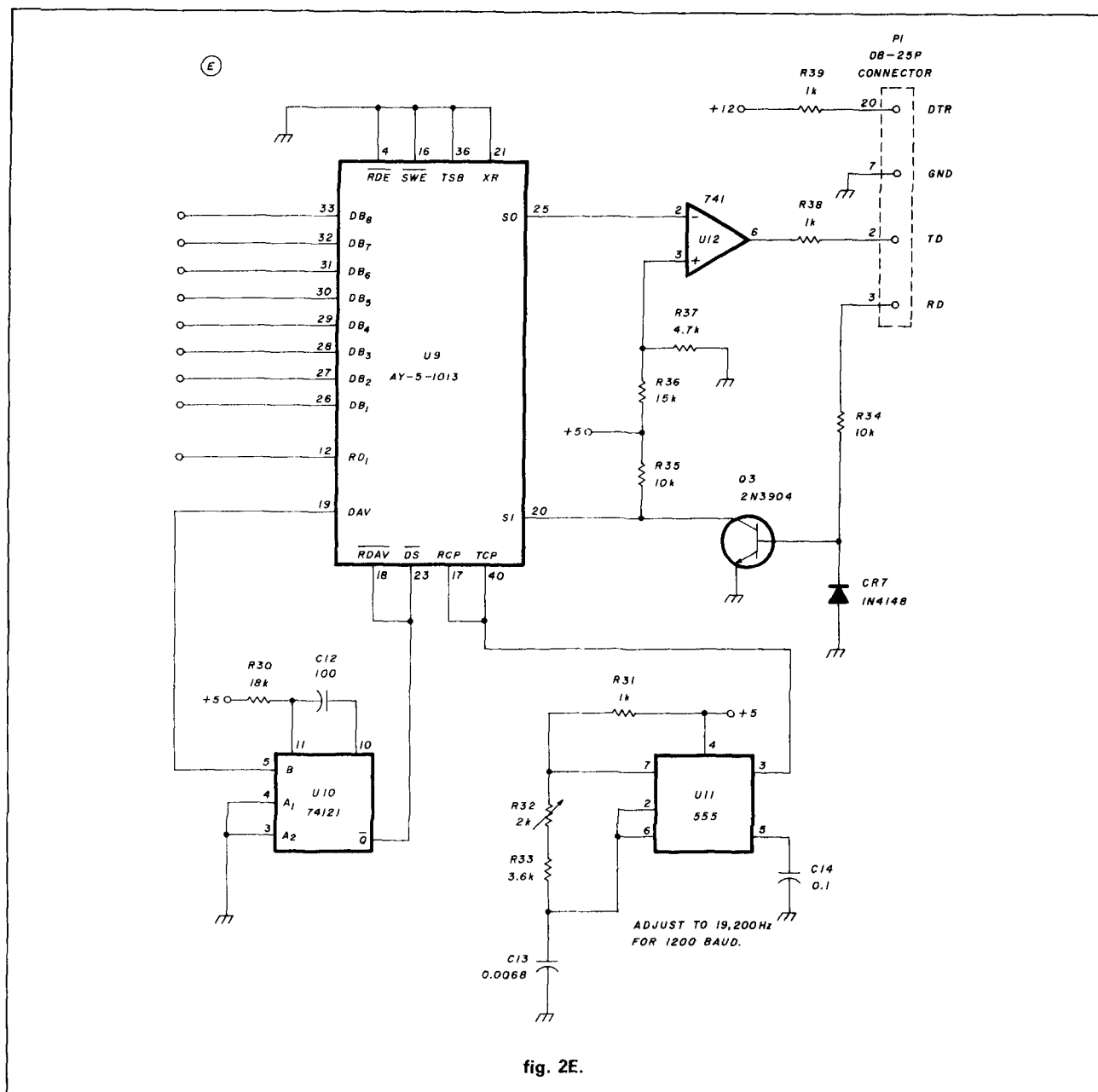


fig. 2E.

to sample the analog signals after the audio carrier had been present for approximately 200 milliseconds. This provides sufficient time for the analog components to settle down but is before the end of the shortest packet. A carrier detect signal is available at pin 5 of the parallel connector on the back of a TAPR TNC.* AEA and Heathkit units, similar to TAPR's, are probably the same.

The computer I'm using doesn't have any parallel input, but does have a spare serial (RS-232) port. The remainder of the circuit converts the parallel data into serial form for communication with the computer as shown in fig. 2E.

When the computer wants to obtain the most recent measurements, it sends a character to the circuit. The UART (U9) converts the serial character to parallel form and causes U10 to generate a pulse. The least significant bit of the character comes out of pin 12 and selects one of the A/D converters. The pulse from U10 causes the UART to begin conversion of the data from parallel to serial form.

The connections shown for P1 assume a computer port expecting a terminal. If using a modem port, use a DB-25S connector instead and swap the connections to pin 2 and 3.

U11 determines the speed for communications. R32 is adjusted for a frequency 16 times the desired baud rate, for instance 19200 Hz for 1200 baud. The com-

*Tucson Amateur Packet Radio.

item	description	quantity	approximate cost
C1,C5	0.15 μ F mylar (could use 0.1 + 0.047)	2	0.48
C2,C6	0.22 μ F mylar	2	0.33
C3,C10,C14	0.1 μ F disc ceramic	3	0.15
C4	2 μ F electrolytic (could use two 1 μ F)		0.34
C7,C8	220 pF mica	2	0.42
C9	1 μ F electrolytic		0.17
C11,C12	100 pF mica	2	0.35
C13	0.0068 mylar (could use 0.0047 + 0.0022)		0.24
CR1-CR7	1N4148 or similar	7	0.10
P1	DB-25P connector		2.39
Q1,Q3	2N3904 or similar NPN	2	0.25
Q2	2N4403 or similar PNP		0.25
R1,R2,R22,R24, R25,R27,R34,R35	10 kilohm		0.29
R3	10 kilohm, trim pot		
R4,R36	15 kilohm		
R5	12 kilohm		
R6	5 kilohm, 15 turn trim pot		1.19
R7	2.2 kilohm		
R8,R9	180 kilohm		
R9,R10,R16, R17,R26	100 kilohm		
R11,R13	57 kilohm		
R12	5.6 kilohm		
R14	12 ohms		
R15	8.2 kilohms		
R18	6 Megohms		
R20,R21	2.7 kilohms, *closely matched		
R23,R31,R38,R39	1 kilohm		
R28	200 kilohms		
R29,R30	18 kilohms		
R32	2 kilohms, 15 turn trim pot		1.19
R33	3.6 kilohms		
R37	4.7 kilohms		
	fixed 1/4 watt resistors	34	0.06
U1,U3	1458, dual op amp	2	0.59
U2,U4,U12	741, op amp	3	0.35
U5,U6	ADC 0804, analog to digital converter	2	3.49
U7,U11	555, timer	2	0.39
U8,U10	74121, monostable multivibrator	2	0.39
U9	AY-5-1013A, UART		3.95
Approximate total			\$28.00

*not in the catalog; possible substitutions are indicated.

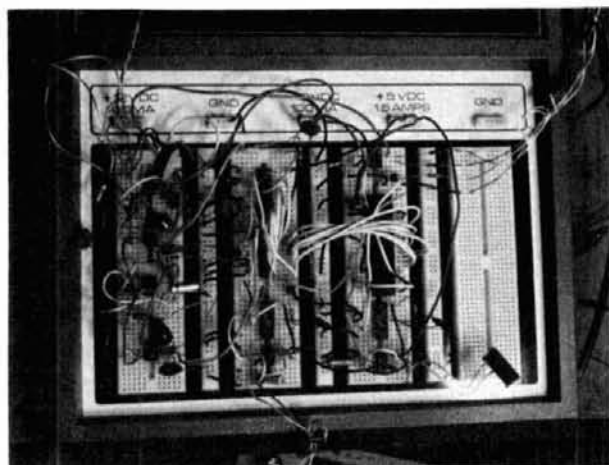


fig. 3. Point-to-point wired circuits.

pleted point-to-point wired circuits are shown in fig. 3. Pin designations for the six integrated circuit supply lines are provided in table 1.

software description

In the automatic answer mode, the station "advertises" the service available by beaconing and waiting

```

/* Snatch values from A/D */
/* converters before they */
/* have more of a chance to */
/* change. */

n_freq = adc_sample(0);
n_dev = adc_sample(1);

/* Any processing of */
/* received record is now */
/* done. */
/* This could include placing */
/* on screen, printing, */
/* saving in a disk file, */
/* etc. */

:
:

/* Process calibration data. */
/* First scale and convert */
/* to decimal digits. */

/* Ignore blank lines. */

if (Rrec_len > 0)
{
/* Approximate conversions: */
/* (Extreme values won't get */
/* thru most receivers.) */
/*
/* freq      raw      final      text */
/* offset    data    number    result */
/* (kHz)
/* -----
/* -10       0       -100     "-10.0"
/* -5        64      -50      "-5.0"
/* 0         128     0        ".0"
/* +5        192     50       "5.0"
/* +10       255     100      "10.0"
/*
/* deviation
/* -----
/* 0         0       0        ".0"
/* 5         128     50       "5.0"
/* 10        255     100      "10.0"

n_freq=((n_freq-128)*100)/128;
n_dev = (n_dev * 100) / 256;

for_mat(n_freq, s_freq);
for_mat(n_dev, s_dev);

/* Package compactly for */
/* screen or log file. */

if (n_freq > 0)
strcpy(s_compact, "[ +");
else
strcpy(s_compact, "[ ");

```

fig. 4. Segment of a routine executed when connection is first established.

```

norm_str("Welcome to the WB2OSZ
        automatic frequency/
        deviation tester.");
norm_str(" ");
norm_str("Instructions:");
norm_str(" 1. Send several
        non-blank lines.");
norm_str(" 2. Wait for reply
        after each.");
norm_str(" 3. Ignore any
        occasional erratic
        values.");
norm_str(" 4. Disconnect when
        done.");
norm_str(" ");
norm_str("Recommended deviation
        is no more than 3 kHz.");
norm_str("Anyone who disagrees
        with the results is
        invited");
norm_str("to supply a reference
        more accurate than my
        2AT.");
norm_str(" ");
norm_str("                                John");

/* Open the log file. */
/* Use the radio call with */
/* ".CAL" for file type. */

strcpy(temp,call);
strcat(temp, ".CAL");

Fp_cal_log = fopen(temp,"a");

now = time(0);
my_time(&now,date_and_time);

fprintf(Fp_cal_log,
        "%s %s, %s\n", f_name,
        l_name, date_and_time);

/* Find out if direct */
/* connection or via */
/* digipeater(s). */

function_key (F_TNC_COMMAND);
hang_around (1);
function_key (F_CONNECT);
normal_key (CR);
hang_around (1);
function_key (F_CONVERS);

/* Another routine, that */
/* determines types of */
/* messages from TNC, stashes */
/* away the connection path. */
/* The closest digipeater, if */
/* any, is put in */
/* Digi_nearest and used in */

```

```

strcat(s_compact, s_freq);
strcat(s_compact, ", ");
strcat(s_compact, s_dev);
strcat(s_compact, "]\n");

fprintf (Fp_cal_log,"%s\n",
        s_compact);

/* Construct more self- */
/* explanatory form for */
/* report to user. */
/* Instead of signed number */
/* for offset, give absolute */
/* value and "too low" or */
/* "too high." */

if (n_freq < 0)
{
    strcpy(too, "low");
    for_mat(-n_freq, s_freq);
}
else
    strcpy(too, "high");

/* See if direct connection. */
/* If one or more digipeaters */
/* used, put call of closest */
/* one in the message. */

if (Digi_nearest[0] == NUL)
    strcpy(who, "Your");
else
{
    strcpy (who, Digi_nearest);
    strcat (who, "'s");
}

sprintf(message, "%s frequency
        is about %s kHz too %s.
        Deviation is about %s
        kHz.", who, s_freq, too,
        s_dev);

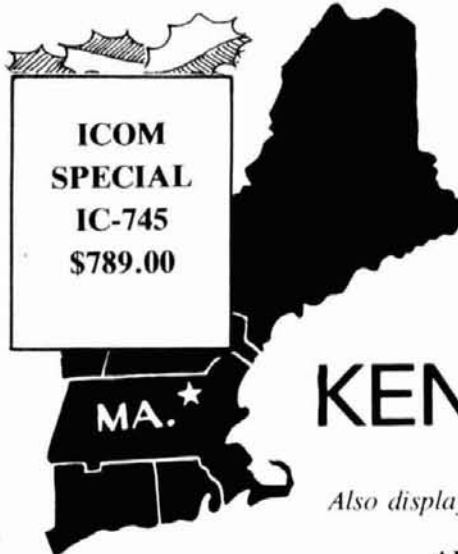
norm_str(message);
}

```

fig. 5. Segment of a routine executed when a record is received from the station being tested.

for someone to connect. The user of the system is greeted with an explanation and a log file is opened (a program fragment is shown in fig. 4). For each record received, the A/D converters are sampled. The numbers are scaled to appropriate units, formatted into a message and sent back (a program fragment is shown in fig. 5). The user, date, time, and measurements are saved in a file for later analysis.

The method is certainly not foolproof. There is a chance that another packet's characteristics were sampled in the time that it took for the line of text to be



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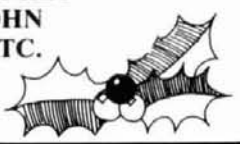
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Newington, Connecticut 06111
*Gateway: The ARRL Packet
Radio Newsletter*

British Amateur Radio
Teleprinter Group
7 Daubeny Close
Harlington,
Dunstable, Beds, LU5 6NF
DATACOM

Chicago Area Packet
Radio Association
21W464 Army Trail Rd.
Addison, Illinois 60101
CAPRA Beacon

Florida Amateur Digital
Communications Association
812 Childers Loop
Brandon, Florida 33511
FADCA > Beacon

Georgia Radio Amateur
Packet Enthusiast Society
P.O. Box 1354
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Grapevine

New England Packet
Radio Association
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Bedford, Massachusetts 01730
NEPRA PacketEar

Northwest Amateur Packet
Radio Association
13304 131st street KPN
Gig Harbor, Washington 98335
Zero Retries

Softnet User Group
Department of EE
Linköping University
S-581 83 Linköping, Sweden
Softnet News

Sydney Amateur Digital
Communications Group
P.O. Box 231
French's Forest, NSW
Australia 2086
The Australian Packeteer

Tucson Amateur Packet
Radio Corporation
P.O. Box 22888
Tucson, Arizona 85734
Packet Status Resister

Utah Packet Radio Association
4382 Cherryview Drive
West Valley City, Utah 84120
UPRA Connect

Vancouver Amateur Digital
Communications Group
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transferred from the TNC to the computer. This is why instructions say to ignore any occasional erratic values.

One puzzled ham connected and got all kinds of random frequency reports, even though he hadn't sent anything. It turns out that a playful Amateur continually attempted to connect to my station while tuning his frequency back and forth. The solution was to recognize and ignore the "**** Connect request ..." message from the TNC.

There's also a manual mode that allows the system operator to perform measurements on another station by digipeating back to himself via the other station or just watching everything go by. The reporting and logging of measurements are naturally different, but the calculations are the same.

You don't need a high-powered computer for this application — something like a VIC-20 and a little BASIC program will be fine. It is important to get the line of text from the TNC quickly (at least 1200 baud) and sample the A/D converters before another packet comes along. After the data has been collected, there's plenty of time to do the calculations and prepare a response.

calibration

Proper adjustment is important to avoid giving incorrect reports. The procedure is simple. All you need is an accurate RF signal generator and voltmeter. I used the popular ICOM model 2AT synthesized RF signal generator as my source.

First set the signal generator (and receiver of course) to your local packet radio frequency. 145.01 MHz seems to be the most popular frequency in most parts of the country. Adjust R6 for zero volts at pin 7 of U1. Set the signal generator frequency 5 kHz higher and adjust R3 for 2.5 volts at the same place. Finally, set the frequency 10 kHz lower (i.e., 5 lower than original) and observe the voltage. It should be close to -2.5 volts.

If the negative voltage is much different than -2.5, you have a linearity problem as I did. In this case, alter the setting of R3 until you set a DIFFERENCE of 5 volts between + and - 5 kHz input. At least this will give a fairly accurate deviation for signals on frequency.

improvements

The output from my receiver is not very linear. For instance, a station 2 kHz too high might be given a report that it's 2.5 kHz too high, while a station 2 kHz too low might be told he's 1.5 kHz off frequency. (Note: a person on frequency is told he is on frequency. The problem is non-linearity, not an offset of 0.5 kHz.) Possible solutions are compensation in software, repair of the radio — or purchase of a new radio.

The modems commonly used for packet require the two tones to be fairly close in amplitude. Hank, WØRLI, suggested measuring the amplitudes of the

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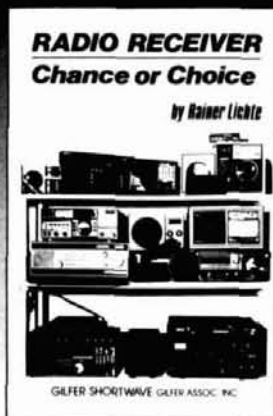
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tones separately. This would require two band-pass filters (for 1200 and 2200 Hz) instead of the high-pass filter made up of C3 and R12. An additional peak detector, low-pass filter, and A/D converter would also be required. The deviation measurement would be based on the larger value. The difference in amplitude could be reported something like, "Amplitude of 2200 Hz tone is 89 percent of other tone."

conclusion

Asking people to drag their equipment to a meeting for adjustment was not successful; the automated approach has produced much better results. During the first few days of operation about 20 stations tried out the system. (This might not sound like many but I'm running only 1-1/4 watts in a valley.) During later measurements, most stations that were substantially off had made correcting adjustments.

For readers who wish to become better informed about packet radio, a list of organizations with newsletters oriented toward digital communications via Amateur Radio is shown in table 2.

acknowledgements

Thanks to Gary, WA1GRC, for the idea and for nagging us at every NEPRA meeting until someone actually designed and built the unit.

bibliography

- Borden, David W., K8MMO, "Applications of Packet Radio - Part I: Direction Finding Network," *QEX*, January, 1984, page 6.
- Borden, David W., and Rinaldo, Paul L., "The Making of an Amateur Packet-Radio Network," *QST*, October, 1981, page 28.
- Drentea, Cornell, WB3JZO, "The New Industrial Revolution: Packet Radio and Local Area Networking," *ham radio*, December, 1984, page 34.
- Goode, Steve, "BER Performance of TAPR TNC Modem," *QEX*, August, 1983, page 3.
- Johnson, Lyle, WA7GXD, "Join the Packet-Radio Revolution," *73*, September, 1983, page 19.
- Johnson, Lyle, WA7GXD, "Join the Packet-Radio Revolution, Part II," *73*, October, 1983, page 20.
- Johnson, Lyle, WA7GXD, "Join the Packet-Radio Revolution, Part III," *73*, January, 1984, page 36.
- Markoff, John, "Bulletin Boards in Space," *BYTE*, May, 1984, page 88.
- Moore, Jeffrey, KQ1E, "'Packet' Meteor Scatter Communications," *QEX*, December, 1983, page 3.
- Morrison, Margaret and Dan, "Amateur Packet Radio: Part 1," *ham radio*, July, 1983, page 14.
- Morrison, Margaret and Dan, "Amateur Packet Radio: Part 2," *ham radio*, August, 1983, page 18.
- Richardson, Robert M., W4UCH, "Packet Radio: The Software Approach," *ham radio*, September, 1984, page 63.
- ARRL, *The ARRL 1985 Handbook for the Radio Amateur*, American Radio Relay League, Newington, Connecticut, 1985.
- ARRL, *First ARRL Amateur Radio Computer Networking Conference, October, 1981*, American Radio Relay League, Newington, Connecticut, 1981, (\$8.00).
- ARRL, *Second ARRL Amateur Radio Computer Networking Conference, March, 1983*, American Radio Relay League, Newington, Connecticut, 1983, (\$9.00).
- ARRL, *Third ARRL Amateur Radio Computer Networking Conference, April, 1984*, American Radio Relay League, Newington, Connecticut, 1984 (\$10.00).
- ARRL, *Fourth ARRL Amateur Radio Computer Networking Conference, March, 1985*, American Radio Relay League, Newington, Connecticut, 1985, (\$10.00).

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Excepting Thee and Me, Old Friend,
Who Never Worked Ye Stuffe.*

This touching ode to DX, written by By Goodman, W1DX, in the late 1940s, certainly applies to DX today, as far as I'm concerned.

But while HF DXers may be moaning and groaning over the mediocre conditions, low frequency DXers are having a fine time. Eighty and 160 meters are *jumping* these days!

A note from Bob Eldridge, VE7BS, tells of some of the DX worked in the Pacific Northwest:

The Australian CW signals can be anywhere, usually below 1825 kHz. The VK SSB rag-chewing groups on daily are most often about 1832 kHz and 1825 kHz, with a few around 1815 kHz. They are most consistent this time of year (early summer) when they can be worked virtually every morning (their evening). I hear them from about half an hour before sunrise to about half an hour after. At about the time they come up in strength here they are dropping out at W0ZV (Colorado), and

he drops out to me at about the same time. He also hears them before and after his sunrise, so the VK opening to North America on 160 meters is quite long.

But although the Spring equinox is the most reliable time for Pacific contacts, I notice looking back through the log that I had good DX contacts in January and February and some DX in every month of the year. This week (week of July 24th) everyone is on the lookout for T31AT (Kiribati) and A35PP (Tonga).

VE7BS uses an inverted-V antenna with the apex at 105 feet and the ends about 60 feet (fig. 1). This is his "comparison antenna" for the others that he has experimented with from time to time. Bob says it is broadside to Australia and Europe, but works reasonably well in all directions. Three parallel wires are used in each leg and the coax feedline is wound into an RF choke just below the feedpoint of the antenna.

Another 160-meter antenna that VE7BS has used with success is the so-called "Lazy-U," shown in fig. 2. The vertical portion can be from 50 to 100 feet long, with the horizontal portions bringing the system to resonance without contributing much horizontally polarized radiation. The VE7BS "Lazy-U" worked better than the inverted-V in some directions and this was the antenna he used to land 5N8ARY (Nigeria).

An interesting adaptation of this ver-

tical antenna that some 160-meter DXers use is the so-called "G8ON" antenna, named after the Amateur who popularized it on the band (fig. 3). The antenna is a half-wavelength long, with the high current portion in the vertical plane. The wire is end-fed from the top end.

In closing, Bob has some interesting remarks about radial systems, as applied to 160-meter antennas. He advised the 160-meter operator not to worry too much about extensive radial systems. He says:

I managed WAC on 160 meters with a vertical without any radials and K7VIC has one of the most potent signals on the band using a vertical top-loaded monopole without radials, so I wouldn't get depressed if I had no room for radials. For transmitting, I see nothing wrong with a 45-foot tower, top-loaded with a Yagi, working against a few properly disposed 8-foot ground rods near the base and a cluster of short radials or chicken wire mesh under the tower. As far as I can see, the main disadvantage of a relatively short, loaded vertical is the narrow bandwidth achieved without retuning.

For those west coast DXers interested in 160 meters, Bob recommends (and I concur) the *160 meter West Coast Bulletin*, published by Dennis Peterson, N7CKD, 4248 A Street SE, Space 609, Auburn, Washington 98002. An SASE might bring you details from N7CKD.

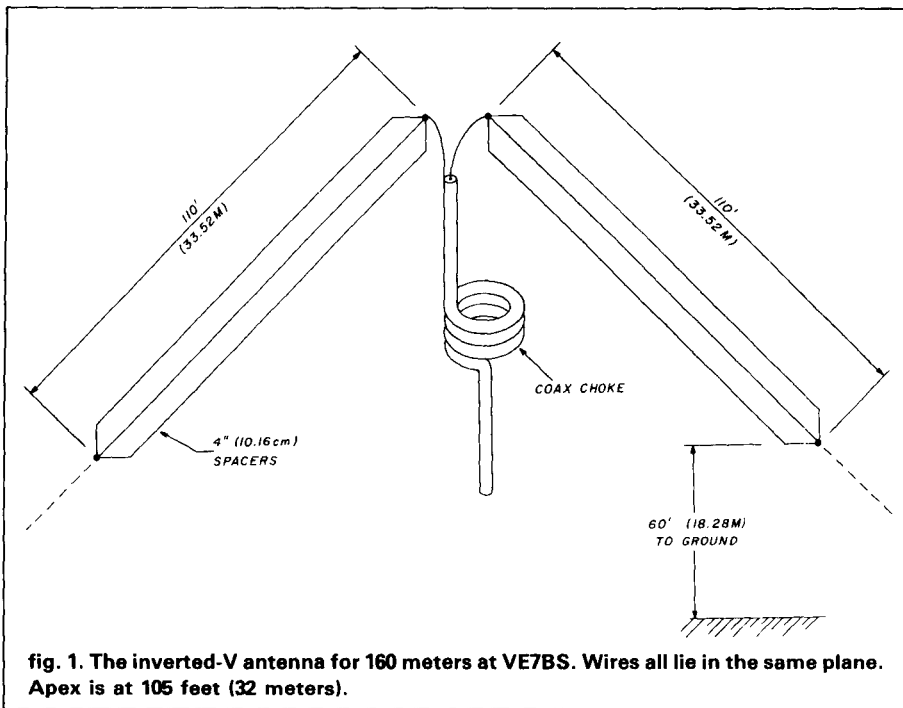


fig. 1. The inverted-V antenna for 160 meters at VE7BS. Wires all lie in the same plane. Apex is at 105 feet (32 meters).

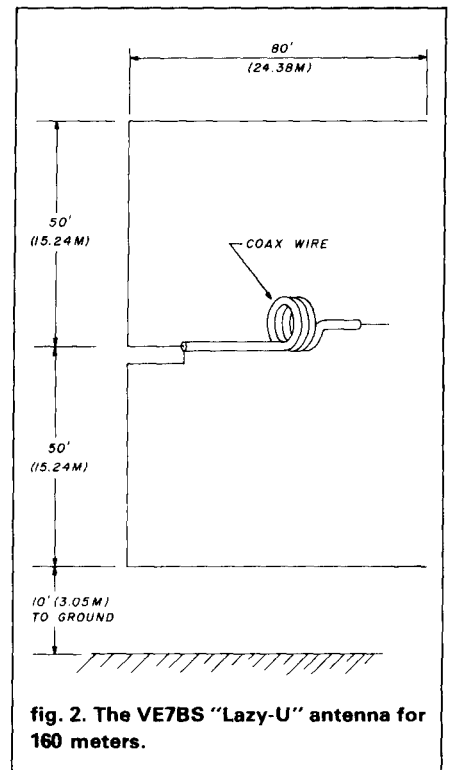


fig. 2. The VE7BS "Lazy-U" antenna for 160 meters.

the effects of trees and vegetation on your signal

From time to time I've received inquiries from Amateurs asking what effect upon their signals a nearby tree, or group of trees, might have. Since I didn't know, I could only reply with an evasive, ambiguous answer. My good friend Marv, W6FR, who was "bugged" by a tall tree into which his 20-meter beam fired on the European path, was convinced that during the months the tree was in bloom with heavy foliage, his signal suffered. When pressed for specifics, however, he admitted under pressure that his often-stated conclusion was a hunch. The upshot of this was that his local DX competitors felt they had a psychological edge on Marv during the spring months when the tree was in its full glory!

The June/July issue of *Broadcasters ID* (published by Information Dissemination, 2501 Hilldale Boulevard, Arlington, Texas 76016) has some interesting information on this subject. In an article by E.J. Pryor, Jr., of Broadcast Technologies, Inc., the subject of foliage and vegetation is

discussed, with respect to AM and FM broadcasting. The article says, in part:

Almost any engineer at an AM directional station could tell you that his array shifts each year due to the many factors which are related to seasons.

In most cases, some of the changes can be traced to ground conductivity which varies due to the moisture, water table variance, and the temperature factor in the area. Foliage growth has a direct effect on the radiation performance of your transmitting antenna....

The vegetation surrounding your transmitter plant absorbs and reradiates some of the energy radiated by your antenna. At AM frequencies, the vertical field can be reduced significantly by high grass and green trees near the antenna farm. At FM frequencies, this signal loss can be approximately 2.5 dB. Above 1000 MHz, the losses due to ground scatter, signal absorption, Fresnel zone losses and terrain can drastically change with the green season. Losses can be as much as 10 dB, or more.

You can control the foliage on your property where your transmitter and tower are located. Regardless of your frequency, the area around your trans-

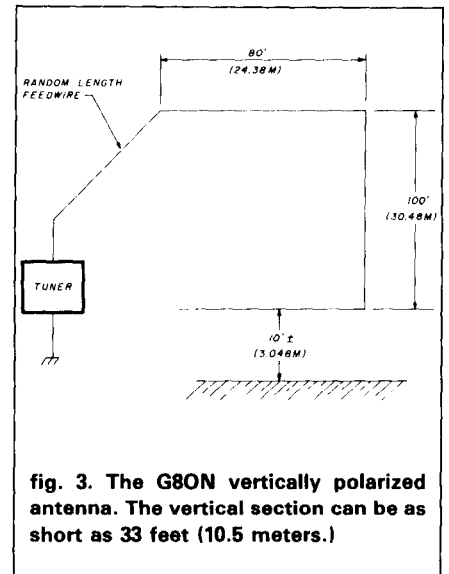


fig. 3. The G80N vertically polarized antenna. The vertical section can be as short as 33 feet (10.5 meters.)

mitter plant should be mowed regularly and kept free of trees. Trees have the greatest effect on your signal.... Tall grass, especially when green or freshly wet, can detune a directional array, upset drive point impedance, mutual coupling factors and significantly degrade the station's performance.

While these remarks are aimed at

vertical AM broadcast antennas and FM arrays, the ideas could apply to Amateur antennas. Most Amateur HF antennas are horizontally polarized, and my personal opinion (apologies to W6FR) is that nearby trees and foliage have relatively little effect on antenna performance in the HF region. In the case of vertical antennas, however, Mr. Pryor's remarks may be interpreted to mean that foliage and tall grass can affect the operation of the vertical antenna in the HF/VHF spectrum as well as in the broadcast band.

I would appreciate hearing from readers who may have experience in this area to find out what effect, if any, nearby trees and bushes have on the operation of both horizontally and vertically polarized Amateur antennas in the HF and VHF regions.

the W0SVM "shorty-forty" dipole

A good idea and a catchy name! Jack, W0SVM, has spent considerable time and effort designing a compact, practical dipole antenna for city dwellers who don't have the space to put up a full-size 40-meter antenna and for various reasons don't want to use a vertical antenna.

Jack wanted to build a simple, rugged antenna that would not have loading coils flopping around out in the elements. He felt that a center loading coil could do the job, if the coil was made properly. After several months of experimentation, he came up with the antenna shown in **fig. 4**. Briefly, it's a center-loaded dipole about half the size of the full dipole. The feedline is tapped on the loading coil in such a manner as to provide a good match to a 50-ohm line. The line is cut to an electrical half or full-wavelength and can be run directly to the transmitter or to a transmatch for maximum frequency flexibility. When used with a simple transmatch, the antenna has a 500-kHz passband between the 1.5:1 SWR points.

The resonant frequency of the antenna is determined by the wire sections. The difference in tip lengths be-

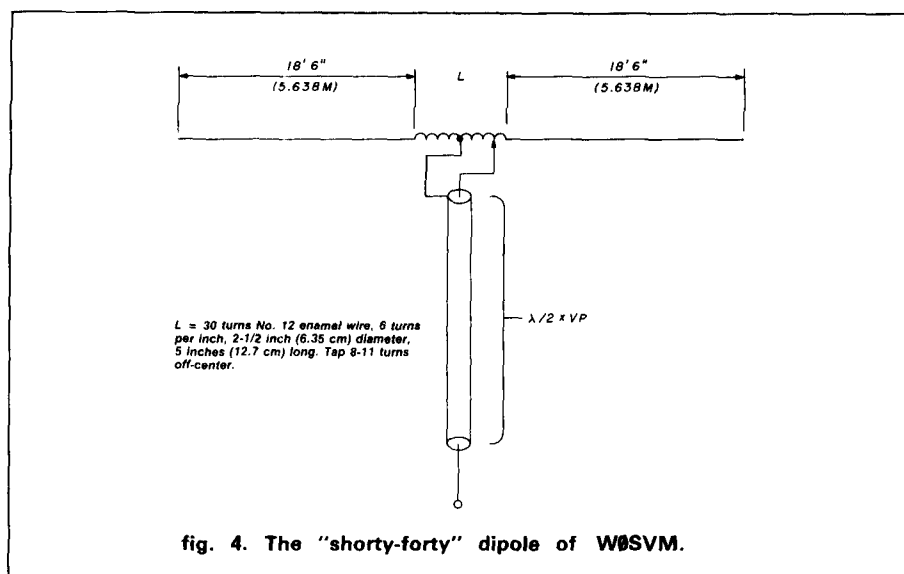


fig. 4. The "shorty-forty" dipole of W0SVM.

tween 7.0 and 7.3 MHz is 10 inches. It's best, therefore, to cut the antenna to that portion of the band in which most of the operating is to be done. Without the transmatch, bandwidth of the antenna is about 150 kHz between the 1.5:1 SWR points.

The shield of the coax line is tapped to the center point of the coil and the center conductor is tapped off-center. Using the 18-foot, 6-inch (5.638 meters) flat-top dimensions, the coil is tapped 11 turns off-center for operation at the low end of the band and at nine turns off-center for operation at the high end of the band.

Exact antenna resonance and the minimum value of SWR can be achieved at any point in the band by changing the tip length of the wires and the feedpoint on the coil. If operation is mainly confined to the high frequency end of the band, the wire sections can be reduced in length to 17 feet 8 inches (5.384 meters). All in all, the design is quite flexible and the resonant frequency and impedance match can be varied at will to suit any spot in the band, and also to match a 75-ohm transmission line, if desired.

The antenna can be erected in the conventional fashion or made into an inverted-V, with the end tips close to ground level. For best results, the center of the antenna should be from

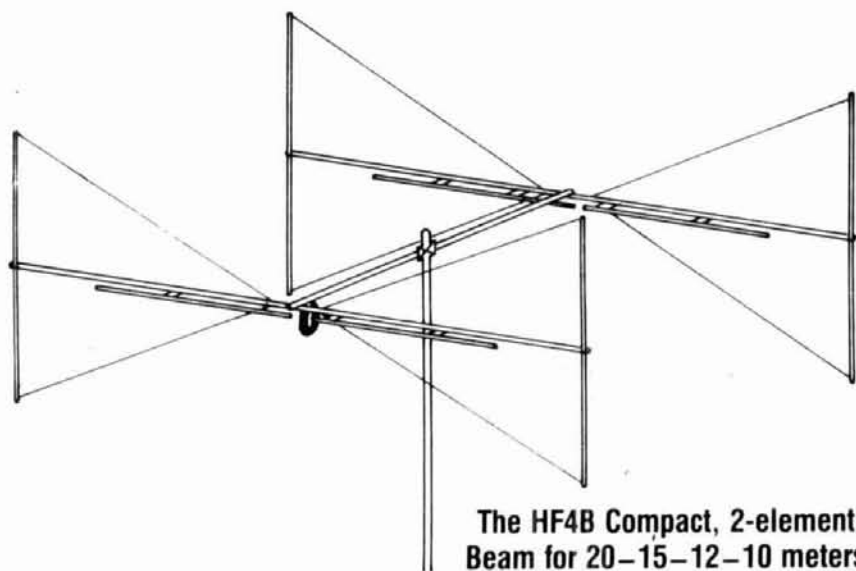
30 to 50 feet (9 to 15 meters) in the air, and relatively clear of nearby objects.

While W0SVM doesn't mention it, I've found it helpful in some cases to wind the feedline into a choke coil directly below the antenna feedpoint. This reduces the RF field on the outside of the coax line and can reduce TVI in some instances. Of course, if the feedline is run parallel to the antenna after the choke is installed, all bets are off because the antenna will be coupled to the feedline by mere proximity. It's best to bring the feedline down vertically below the center of the antenna to ground level, or to the level of the station, if it's located on a higher floor. Running the feedline parallel to the antenna element(s) is bad practice, regardless of the type of antenna used.

do you have an unusual antenna?

Do you have an unusual antenna installation that would be of interest to readers? If so, I'd like to see it. Just send a clear pencil sketch of the antenna, including dimensions and the electrical characteristics, such as the SWR or operating bandwidth. A good black-and-white photograph is always appreciated, if the antenna can be photographed! (It's very difficult to take a decent picture of a wire antenna — although I have a friend who got

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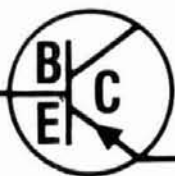


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good pictures of a wire antenna by taking the picture at night, using a camera with a flash attachment.)

Antennas featured in this column will win their owners an autographed copy of my *Beam Antenna Handbook*. * For those who don't have an inspirational antenna to talk about, the handbook is available from Ham Radio's Bookstore.

MXHNY

In closing this December column, I wish my readers a Merry Christmas and a Happy New Year. And may DX be good to you in 1986!

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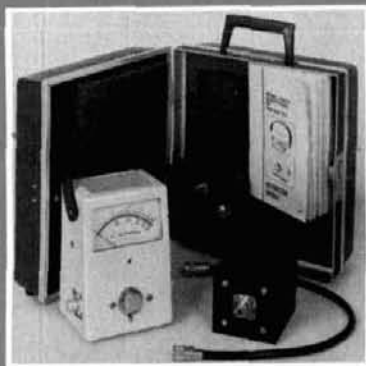


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Determining the next step
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AMTOR, AX.25, and HERMES: a performance analysis of three systems

AMTOR and the AX.25 packet protocol are currently being heralded as the state-of-the-art in Amateur digital communications. This article reports the results of an objective performance analysis of these two systems, and compares each to HERMES, a third, newly proposed system. Four performance measures are described and applied to each system.

applications

In order to choose reasonable conditions under which to evaluate the performance of competing communications systems, it is first necessary to look at the ways Amateurs actually use digital communications.

If you listen to normal RTTY traffic on the HF bands, you'll find that most Amateurs are engaged in casual conversation. These QSOs are almost exclusively conducted at a 45 baud (60 WPM Baudot) channel rate, with throughput usually limited by the speed at which the respective operators can type. While some of us can type fast enough to keep a 45 baud system running fairly continuously, most cannot.

Other users — though fewer in number — are involved in RTTY traffic nets, using computers or RTTY equipment to relay third-party message traffic. Although surprisingly little RTTY traffic handling actually occurs (compared to the amount handled by CW or SSB) at this time, the availability of improved digital communications schemes may help to encourage the growth of this type of activity.

Some users employ computer data transfer for traffic handling. It is primarily this application for which the AX.25 "packet" systems are designed. And on VHF, packet radio activity is growing rapidly. AX.25 has the capability of supporting conversation just like

RTTY, as well as direct computer-to-computer data file transfer.

I believe we should push for a single digital communications scheme that can adequately support all types of users at both HF and VHF, including satellite links. Such a system is not currently in use, nor has one yet been proposed.

Two of the three classes of users described above are dealing exclusively with plain language text, using the Baudot alphabet (or the AMTOR variation of the Baudot alphabet). Computer hobbyists are using ASCII, sending it in an eight-bit format so that arbitrary computer data (as well as text) can be transmitted within that scheme as well. Whatever digital scheme we agree to accept as standard, it should support both types of alphabet.

Those using digital communications for casual conversations are probably not too worried about a few errors now and then in the received text, but would like to see the channel processing their data fast enough (100 bps is probably sufficient). On the other hand, the other two user classes have no tolerance for any hits, and are willing to sacrifice some channel throughput to attain the required reliability. It would be best to have a system that could be conveniently optimized by the operator for each of these different applications.

comparing systems

The following four criteria are useful in comparing the various systems available:

- **Throughput under ideal channel conditions.** An "ideal" channel introduces no errors, thereby allow-

By Jerome T. Dijak, W9JD/4, 2736 Gwynnbrook Road, Montgomery, Alabama 36116

ing the communications system to run at its highest possible rate. (This is expressed in characters per second (cps).)

- **Robustness.** This is the probability, expressed as a percentage, that the system will falsely accept random noise or badly corrupted characters as valid. Any system must reject (or correct) all corrupted data received under these conditions with high reliability — i.e., have a very low probability of falsely accepting corrupted data characters as valid. (The mathematics used to compute this probability for each of these two systems evaluated is presented in the appendix.)

- **Bit Error Rate (BER) required to stop progress (expressed as a percentage).** It is assumed that random bit errors are occurring at a certain rate. How high must this error rate be to prevent the system from occasionally transferring data successfully? Under these circumstances, the throughput of the communications system is sharply reduced since there are many repeats. But we want the system to make *some* progress — occasionally, data should be correctly transferred and acknowledged by the receiving end. Other things being equal, it is desirable for a system to be able to tolerate as high a random BER as possible before forward progress is stopped.

- **Minimum Required Error Free Seconds (MREFS) to maintain progress in forward data transfer.** Here a channel generating "burst" errors is assumed. The channel makes no errors for a certain length of time, and then becomes unusable for a certain length of time (an error burst). An interesting parameter of a communications system is how short the "good" period of the channel may be while still allowing successful and correct data transfer to occur occasionally. Other things being equal, a system should have a low MREFS requirement.

To make reasonable comparisons, we will assume that each of the packet protocol systems is being operated with the same type of channel, arbitrarily a 100 bps synchronous channel such as that specified for AMTOR, with a 20 millisecond allowance for radio turn-around from transmit to receive and vice-versa. For consistency, it is assumed that a 5-bit symbol alphabet (Baudot) is being used when specifying throughput performance, even though any of the systems can transfer Baudot, ASCII (7-bit), or arbitrary computer data (8-bit) by employing appropriate alphabet conversion subroutines.

Figure 1 illustrates AMTOR in operation.^{1,2} In the ARQ mode, AMTOR sends three 7-bit characters and then pauses for an acknowledgement signal (one 7-bit character) from the receiving station before proceeding with the next three-character group. If no acknowledgement character is received, the last three-character group is repeated.

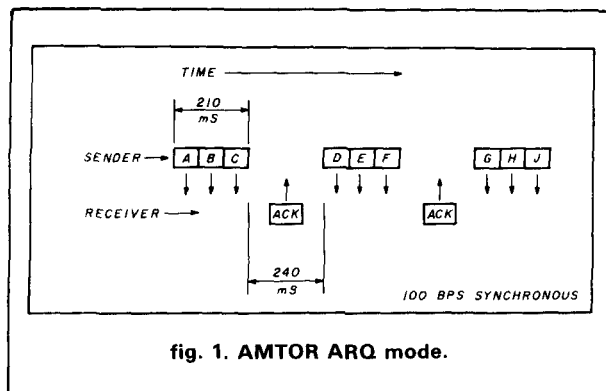


fig. 1. AMTOR ARQ mode.

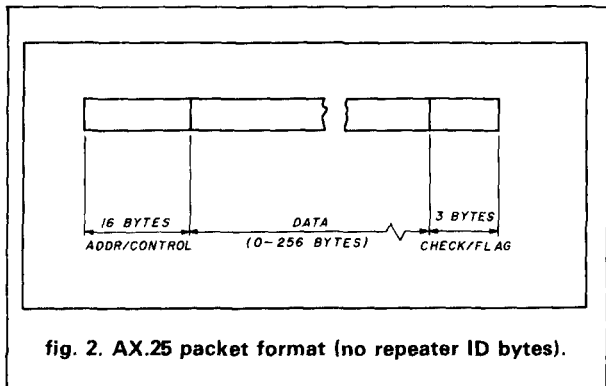


fig. 2. AX.25 packet format (no repeater ID bytes).

Time relationships are quite specific. AMTOR spends 210 milliseconds sending each group, and 240 milliseconds waiting for the acknowledgement before sending the next group.

Like Baudot, AMTOR uses a 32-character alphabet, but uses 7-bit symbols instead of the Baudot's 5-bit symbols. Each AMTOR symbol is composed of three 0 bits and four 1's, allowing it to detect errors in its received data (sometimes). To do this, AMTOR uses a simple parity check. Each received character must have four 1 bits and three 0 bits; if it doesn't, an error is flagged, and the entire group is discarded and must be repeated.

If the channel makes one bit error per character (or any *odd* number of bit errors per character) this simple parity check successfully detects the error. But if the channel reverses two (or any *even* number) of the character's bits, its 4/3 parity ratio will be preserved even though it has now been transformed into a different character of the alphabet. Under these conditions, the AMTOR code will fail to detect the error.

With the channel producing few errors, it is likely that no more than 1 bit error per character will be experienced. When the channel is very poor, however, and is making many bit errors, one has about an equal chance of experiencing an odd or even number of errors. Consequently, there is a 50 percent chance of an incorrect character unintentionally satisfying the parity check.

packet system design

Good references for a detailed description of the AX.25 or "packet protocol" are available.^{2,3} AX.25 is an adaptation of the 15-year-old data communications protocol pioneered by the Defense Advanced Research Projects Agency in the 1960s for error-free communications within telephone computer networks. This protocol assumes a telephone channel, or a channel of similar quality (in terms of signal-to-noise ratio, bandwidth, and lack of interference) in its design.

Figure 2 shows the current AX.25 packet makeup: 16 bytes or more of synchronizing and header information at the beginning of each packet, followed by up to 256 bytes of information, with the packet finished out with three final bytes for error checking and flagging the end of the frame. If the packet has been processed by one or more repeaters, seven additional address bytes are added to the packet to identify each repeater, up to a maximum of 9. For purposes of this discussion, use of a simplex channel only, with its requirement for only 19 overhead bytes in an AX.25 frame, is assumed.

Although AX.25 includes a significant amount of overhead in each packet, it is a very good system in light of the environment for which it was originally designed. It is not, however, ideal for use on a channel that doesn't look much like a telephone channel — a narrowband HF channel with fading, noise, and a high error rate, for instance.

Because this system was designed for transmitting computer data, it contains a robust error detecting scheme that provides a good probability of detecting a garbled block regardless of the source or severity of the errors.

Figure 3 shows the flow of activity on a packet channel. Since just one block at a time is sent, and each block must be acknowledged by the receiving station before the next block is sent, a certain amount of channel time is inevitably spent waiting. For our analysis, delays similar to those used with AMTOR are assumed.

The packet protocol is somewhat adaptive. Depending upon channel conditions, the operators can adjust the length of each packet by controlling the number of data characters sent (up to 256) in each block. Thus, when conditions are good and the channel is rarely making errors, a full-size block may be used, with a correspondingly small proportion of the channel time wasted in packet addressing overhead and waiting for acknowledgements. On the other hand, when the channel is very bad, the character count can be greatly reduced to shorten the packets, thus improving the chance of their being received error-free. Very short packets are quite inefficient, however, because of the addressing bytes that must always be included.

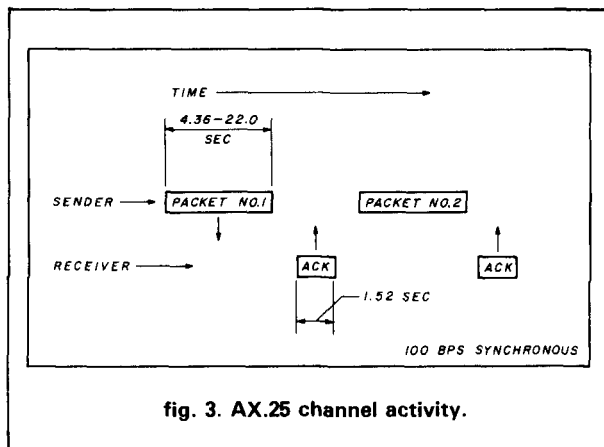


fig. 3. AX.25 channel activity.

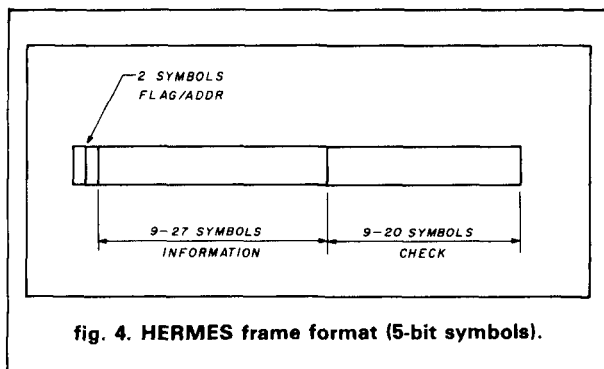


fig. 4. HERMES frame format (5-bit symbols).

For our purposes, then, we will examine the packet systems running with both maximum length packets (even though, in practice, hams rarely use more than about 80 data characters per packet) and extremely short packets (only 16 data characters) as well.

HERMES system design summary

HERMES was designed to be superior to both AMTOR and AX.25 in the Amateur narrowband HF environment. The latest version of a system described in reference 4, HERMES has been used experimentally for the past several years.

The key to HERMES is the use of a Reed-Solomon forward error-correcting code. The chosen code uses a 5-bit symbol alphabet and 31 symbols per block; a typical frame is diagrammed in fig. 4. The coder and decoder are adaptive — i.e. the ratio of data symbols to check symbols in each block is controllable by the operators to allow optimization to channel conditions. The check symbols add redundancy to the data in a special way that allows the system to mathematically correct some symbols in each frame that have been altered or destroyed by the channel. (Reference 4 also provides additional details on how forward error correcting systems work.)

This feature allows HERMES to perform efficiently when channel conditions are favorable, as well as

when the channel conditions are poor (in this case data transfer efficiency is traded off in favor of gaining additional error correcting capability).

HERMES uses a protocol that assumes a single link (i.e., a pair of stations in contact), but is also designed to accommodate net type operations. Unlike AX.25, it is not configured to allow several simultaneous and independent QSOs on a single channel, thus greatly reducing the number of overhead bytes that must be transmitted in each block.

The system is designed to handle Baudot characters, and conversions of 7-bit ASCII characters and arbitrary 8-bit bytes directly, so that all types of data can be handled with the same efficiency.

The operator can choose any of 48 different configurations that have been implemented; these support 16 different modes in each of the Baudot, ASCII, and byte communications modes. Data transfer efficiency of the system ranges from 93.5 down to 32.3 percent, depending on the degree of error correcting capability chosen. The probabilities of falsely accepting corrupted data as valid vary from 2.6 to 0.0000009 percent; error correcting capabilities vary from 0 (error detection only) to 11 symbol errors per block (35 percent correction capability).

The system can function in an **ARQ** mode or in a broadcast mode in which no acknowledgements are sent. In the **ARQ** mode, HERMES sends from nine to 27 data blocks per transmission (depending upon system configuration), after which the link is turned around, and the receiving station sends one "acknowledge" frame to identify all the blocks that were received correctly or were correctable. This pattern is illustrated in **fig. 5**. Since the ratio of data frames to acknowledge frames is quite high, there are relatively few link turn arounds and little wasted link time spent waiting for radios to switch. In the broadcast mode, HERMES sends the data frames using the same code configurations, but does not wait for acknowledgements.

AMTOR (ARQ) analysis

AMTOR sends three characters (requiring 210 milliseconds), then pauses for 240 milliseconds to allow the acknowledge signal to be received. Therefore 3 characters require 450 milliseconds to send under ideal conditions, resulting in a 6.67 cps throughput.

Under conditions of no signal (random noise input only), AMTOR will recognize a "block" only if it sees three valid characters. Since there are 34 legal characters out of the 128 possible 7-bit characters, the probability of any single character looking valid, with random input, is $34/128 = 0.266$. The probability that three such characters in a row are received with only noise input is the third power of this number, or about 1.9 percent.

Under very noisy signal conditions, in which we assume that many bit errors are being experienced, and we assume that a valid signal is being received in addition to the noise, we have a 50 percent chance of experiencing an even number of bit reversals in the received characters. If the odds of receiving an incorrect, but valid-looking, character are 50 percent, then the probability of receiving three of these is the third power of 0.50, or 12.5 percent. This second case is really more relevant to our discussion, and it is this number that we'll use for our robustness figure for AMTOR.

Just one bit error during each 450 millisecond is enough to stop data transfer progress with this system. This bit error would either corrupt the data transmission or the acknowledge signal, and the corruption of either is sufficient to force a repeat. Once we continually force repeats, the forward transfer of data has stopped. One bit in 450 milliseconds at a 100-bps data rate corresponds to a 2.22 percent BER.

To get data through once in a while, AMTOR needs to occasionally obtain a 450 millisecond window of error-free transmission by the channel. Therefore, for this system, $MREFS = 0.45$.

maximal frame packet analysis

A maximal length frame (256 data bytes) is used to configure the packet system for performance under ideal conditions. Without the repeater addressing bytes, the standard AX.25 packet requires 19 bytes of overhead for addressing and error checking, so the complete frame is 275 bytes long.

The AX.25 acknowledge frame would consist of just the 19 overhead bytes. With 22.0 seconds required to send the 275 byte information packet at 100 bps and 1.52 seconds required to send the acknowledge packet (plus two 20 millisecond intervals assumed for radio switching), the system requires 23.56 seconds to transfer one frame under ideal conditions. This corresponds to 10.86 cps for 8-bit characters, or 17.36 cps for equivalent 5-bit characters (409 5-bit characters can be loaded into the 256 byte data frame).

By the nature of the 16-bit CRC (Cyclic Redundancy Check) code used for error detection in the AX.25 format, the probability of a corrupted block being falsely accepted as valid is $1.53E-5$ (0.00153 percent), regardless of whether we are talking about random noise or a noisy signal input to the system. The CRC is a much more sophisticated algorithm than the simple parity check used in AMTOR, and is much more robust in the presence of massive channel errors.

Since AX.25 is only an error detection scheme, one bit error occurring during every 23.56 seconds would destroy the correctness of either the data frame or the ACK frame, and in either case the data frame would need to be repeated. Therefore, a random BER of

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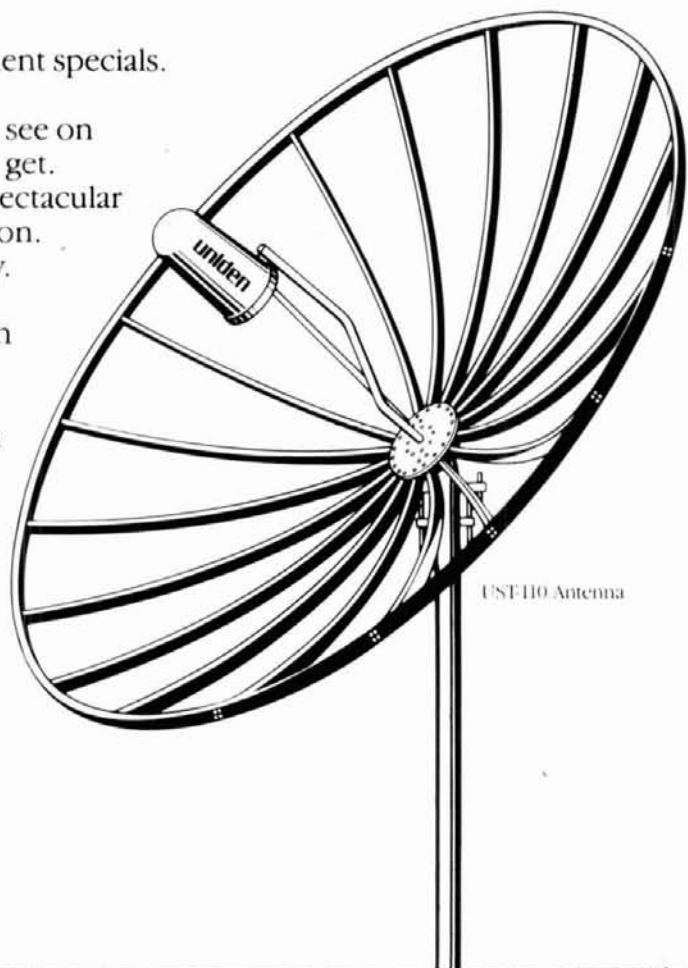
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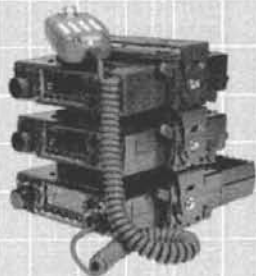
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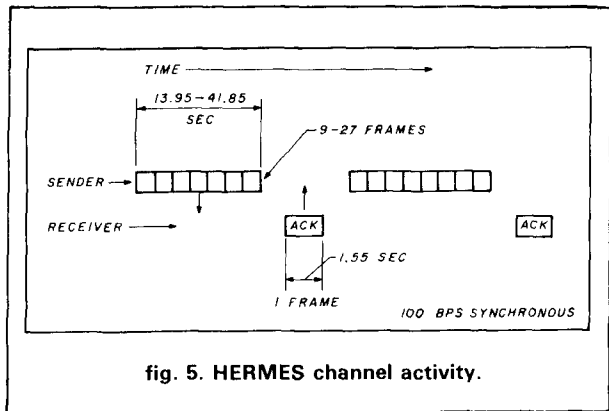


fig. 5. HERMES channel activity.

1/2356 or 0.042 percent would stop all progress for AX.25 in this configuration.

By the same token, to get data through once in a while, the channel must occasionally be good for at least 23.56 seconds at a time. So MREFS = 23.56.

minimal frame packet analysis

When channel conditions are very poor, we would want to operate the packet system with a very short frame — let's say just 16 data bytes, in addition to the 19 overhead bytes always required.

With this frame length, we need only 2.8 seconds to send the data frame, and a total of 4.36 seconds to complete a data transfer, including the ACK frame. This corresponds to 3.67 cps for 8-bit data and 5.87 cps for 5-bit characters.

The probability of a corrupted block being falsely accepted as valid is the same as with the maximal frame configuration, 0.0015 percent since this characteristic depends only upon the number of check bits used and the error detection algorithm.

The BER required to stop the system is now 1 bit in 4.36 seconds, or 0.23 percent. MREFS for this configuration is 4.36.

HERMES analysis

Case 1. For the first HERMES configuration we assume a good quality channel and choose a mode appropriate for maximum data throughput and adequate error probability for conversational use. We use a configuration with 29 data symbols and just 2 check symbols per block and operate the decoder in an error-detecting mode only.

For the throughput calculation, we assume the transmission of 27 data frames containing 27 information characters each, followed by 1 acknowledge frame from the receiving station. After allowing for two 20 millisecond switching intervals for the radios, the total time required for the exchange is 43.44 seconds. Since 729 characters are transferred, throughput is 16.78 cps (5-bit characters).

With two 5-bit check symbols and an error detect-

ing mode only, the probability of falsely accepting a bad block is 0.098 percent, regardless of whether we are talking about random noise or a noisy signal being fed in to the system.

To stop forward data transfer, we must have 1 or more bad bits in each frame sent by the sending station, which corresponds to one bit error out of 155, or a 0.65 percent BER. We can make some progress as long as at least one frame can get through once in a while, which requires 1.55 seconds, so MREFS = 1.55.

Case 2. For our second example we choose a HERMES configuration with 17 data symbols and 14 check symbols in each frame, with the decoder running in a six-error correcting mode (6 symbols out of each 31 symbol frame can be corrected).

In this configuration, the system will send up to 15 data frames before waiting for an acknowledge frame from the receiving station. This works out to 24.84 seconds to transmit the 15 frames and receive the acknowledgement. 225 characters would be transmitted during this time, for a throughput under ideal conditions of 9.06 cps.

In this mode, the decoder's probability of falsely accepting a bad block as valid is 0.000059 percent.

Since six symbol errors can be made in each frame with the decoder still being able to correct the block, this corresponds to one symbol in every five being in error. In order to stop forward progress, then, we must have one character in every 4 be in error. This corresponds to a random bit error rate of 1 in 20, or 5 percent.

On a bursty channel, we must be able to receive at least 25 symbols of a block without error in order to be able to correct it completely. This corresponds to MREFS = 1.25 seconds.

Case 3. For this example we assume a very poor channel, and are willing to sacrifice additional throughput to enhance the forward error-correcting power of the code. Here we use a configuration with 11 data symbols and 20 check symbols per block, and we allow the decoder to correct up to 10 errors per frame.

In this configuration, HERMES will send 9 data frames at a time before waiting for an acknowledgement, and spend 15.54 seconds doing it. In these 15.54 seconds, 81 characters will be transferred, for a throughput of 5.21 cps.

In this configuration, the probability of the decoder falsely accepting an invalid block is 0.0000029 percent.

Since the decoder can correct 10 symbols out of a 31 symbol frame, a channel making random bit errors can destroy every third symbol, and the decoder will still be able to fully correct the frame. Therefore, to stop the system, the channel must corrupt one symbol out of every two, for a random bit-error rate of 10 percent.

table 1. Performance summary.

system/statistic	throughput (cps)	robustness (percent error)	BER required to stop (percent)	MREFS (seconds)
AMTOR ARQ	6.67	12.5	2.220	0.45
AX.25 (Max)	17.36	0.0015	0.042	23.56
AX.25 (Min)	5.87	0.0015	0.230	4.36
HERMES/1	16.78	0.098	0.650	1.55
HERMES/2	9.06	0.000059	5.000	1.25
HERMES/3	5.21	0.0000029	10.000	1.05

On a bursty channel, we need to get 21 symbols out of every frame transmitted without error, so MREFS = 1.05.

performance summary

Table 1 summarizes the performance figures we have developed for each of the competing schemes. Once again, the ideal system would have a high throughput, a very low robustness percentage, a very low BER required to stop, and a very low MREFS.

AMTOR can absorb up to a 2.22 percent random channel BER before being stopped, and needs only 0.45 seconds to make progress, which is good, but the fact that it has a 12.5 percent chance of falsely accepting invalid data as valid is disqualifying. We can, and should, do much better than that.

The two AX.25 packet configurations evaluated, which fully bracket the usual operating configurations, represent the extremes of performance available with the AX.25 protocol. First, we see that packet's probability of falsely accepting invalid data is fairly low, which is good. 0.0015 percent is low enough for most purposes, and might need augmentation only when very large files are transferred at high data rates at UHF and beyond. (This figure equates to the acceptance of one bad frame in about 67,000.)

The maximal packet configuration produces a good throughput figure of 17.36 cps, but at the expense of allowing only a 0.042 percent random BER before being stopped and requiring 23.56 seconds to get a packet through. As we said before, if you have a good enough channel, this will work nicely. Good channels are pretty easy to get at VHF, but HF is another story.

The minimal packet configuration allows the channel BER to increase by a factor of 5, up to 0.23 percent and reduces the minimum required error-free seconds to 4.36, which is more realistic for an HF channel. The throughput, however, has now dropped to 5.87 cps.

HERMES configuration 1 was chosen to obtain the highest possible throughput while maintaining a robustness adequate for conversational communications. It achieves a 16.78 cps throughput, which is very nearly as good as the AX.25 protocol under the best

of conditions, and it does this while allowing a 0.65 percent BER before being stopped (this is 15 times more tolerant than the maximal length packet scheme), and an MREFS figure of just 1.55 seconds (1/15th the minimum required time for maximal length packet). Robustness in this configuration, 0.098 percent, is not as good as the AX.25 figure, but is more than adequate for the intended application, casual conversation.

Comparing the performance of HERMES case 1 to the minimal length packet case, we see that the packet scheme runs at about one-third the throughput and is still about three times less tolerant in both BER and MREFS.

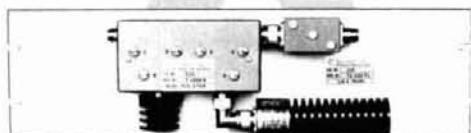
HERMES configuration 2 was chosen for use on a moderately degraded channel, and in an application where high accuracy was required. Its 9.06 cps throughput falls midway between the extremes of the AX.25 configurations and its robustness is several orders of magnitude better than AX.25. Interestingly enough, it does this while being even more tolerant of channel errors, now allowing a 5 percent random BER before being stopped, and requiring 1.25 error-free seconds to transfer data. Comparing these figures to those for the minimal length packet scheme, HERMES is providing 54 percent more throughput while allowing a 27 times greater random BER in the channel, and requiring "good channel" bursts only one-third as long as AX.25. All these factors translate to superior performance by HERMES.

Even though the performance of AMTOR is disqualifying, due to its poor robustness, it is interesting to note that in this case, HERMES provides 36 percent more throughput. And while AMTOR does excel in the MREFS department, requiring only 0.45 seconds compared to 1.25 for HERMES, HERMES will allow more than twice as high a random BER before being stopped (5 percent versus 2.2 percent, overall), therefore, HERMES wins the comparison here, too.

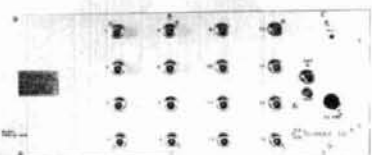
Chosen for use on a very bad channel, HERMES case 3 allows a throughput of 5.21 cps, slightly worse than the minimal length packet case. But it has a phenomenally low probability of falsely accepting invalid data (0.0000029 percent), and can withstand a



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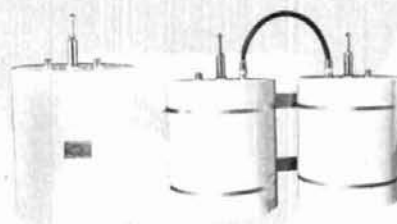


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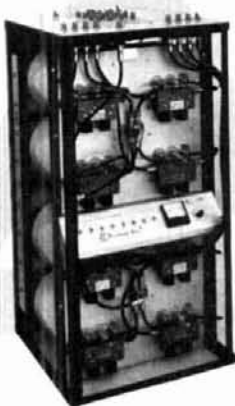
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10 percent random BER, 50 times that tolerated by the AX.25 scheme even with minimal length packets.

conclusions

Although AMTOR has excellent burst error performance, its probability of falsely accepting invalid data under poor conditions (at 12.5 percent) makes it a non-competitor when systems like AX.25 and HERMES are considered.

Under good channel conditions the AX.25 packet scheme does very nicely, with good throughput and adequate robustness, but it bogs down rather rapidly once channel conditions start to degrade, since it has no capability for forward error correction.

HERMES combines, in one adaptive system, the capability to achieve very nearly the same throughput as AX.25 under ideal conditions, as well as very nearly the burst error performance of AMTOR. It allows convenient optimization and is able to tolerate a much higher rate of random channel errors than is either AMTOR or AX.25 due to HERMES's use of powerful Reed-Solomon forward error correcting codes. It represents the next step in flexible and robust digital communications.

Appendix

The probability of falsely accepting a corrupted data block (an "Undetected Bad Block") will be denoted as P_{UBB} . It can be computed as follows for an error-correcting or error-detecting algebraic block code (such as the CRC or Reed-Solomon codes.)

For an error-correcting code:

$$P_{UBB} = \frac{\binom{A-1}{E} \cdot (A-1)^E}{A^C}$$

where: A = 2^m (the code alphabet size)
 m = the number of bits per codeword symbol
($m = 8$ for AX.25 CRC, $m = 5$ for HERMES)
 $A - 1 = 2^m - 1$
 E = the number of errors being corrected by the decoder
 C = the number of check symbols in each codeword

$$\binom{A-1}{E} = \frac{(A-1)!}{E! (A-1-E)!}$$

For an error-detecting code:

$$P_{UBB} = 1/A^C$$

where: A and C are defined as above for error-correcting codes.

references

- J. P. Martinez, "AMTOR, An Improved Error-Free RTTY System," *QST*, June, 1981, page 25.
- The ARRL 1985 Handbook For The Radio Amateur, American Radio Relay League, Newington, Connecticut, 1985, Chapter 19.
- Lyle Johnson, "Join The Packet Radio Revolution," *73*, September, 1983, page 19.
- Jerome T. Dijk, W9JD, "Save Your Signal With Forward Error Correction," *73*, August, 1983, page 44.

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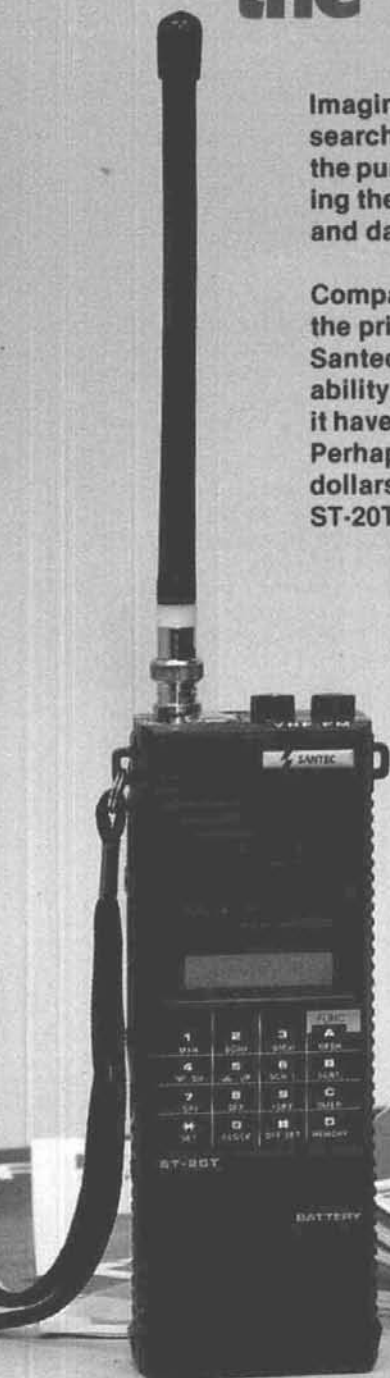
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tracking the hideous intermittent — part 2: thermal intermittents

In Part 1 of this two-part series we dealt with the problem of troubleshooting mechanical intermittents. In Part 2 we'll discuss thermal intermittents and their solution.

Both heat and cold can affect a piece of electronic equipment for the worse; in its most blatant form, the set refuses to operate properly under either hot or cold conditions. During the winter Amateur mobile equipment is subjected to the local overnight temperature, which may be as low as 40 degrees below zero in some areas. During the summer, on the other hand, mobile equipment will be subjected to temperatures considerably above local air temperatures. In 1963, when a major automobile electronics company began experiencing reliability problems with its new solid-state models, it asked employees to leave their cars unlocked so that the engineers could measure the cabin temperatures. After four hours in 90-degree sunlight, the interior temperatures were found to be 140 degrees at the front seat and up to 180 degrees behind the dashboard!

These extremes of temperature can result in some peculiar intermittents.

One familiar form is the set that won't work when you get into the car, but will work ten minutes after the heater or air conditioner has altered the cabin temperature.

Equipment used at the home or base station doesn't suffer the extremes of ambient temperature, but nonetheless may experience temperature-related intermittents. Typically, a set will either fail to work at all until it heats up, or will work nicely until it reaches a certain temperature and then fail. Even when an intermittent isn't specifically related to temperature, it's frequently true that changes in temperature will

aggravate the situation, thereby allowing you to find it more easily.

when the problem is heat

First, let's talk about how to heat up a set. Use a high-wattage lamp, sun lamp or hair dryer for general area heating to determine that the fault is temperature sensitive, rather than mechanical in origin. In a piece of equipment containing general power devices (or vacuum tubes), we can often heat up the circuits just by placing a box, towel, or blanket over the unit. This method is particularly useful for thermal faults that occur only in the cabinet. The thermal fault will continue for a few minutes after the box, towel, or blanket is removed, allowing time for troubleshooting.

Although area heating will give you the time needed to troubleshoot a fault, it won't help you find a specific thermally sensitive component. For this chore we must use local area heating. Several methods are available. A small high-intensity lamp, for example, will allow heating of a small area on a PCB. A soldering iron or gun will concentrate heat on an even smaller area almost to the exact component. (Be careful, — the hot tip of the soldering tool can damage some components, especially polyethylene capacitors.)

Another method used for heating individual components is shown in fig. 1. In this approach, the heat source is a 6 or 12-volt incandescent lamp. A No. 47 or No. 1891, for example. A small cylinder made of some material such as insulated sleeving ("spa-

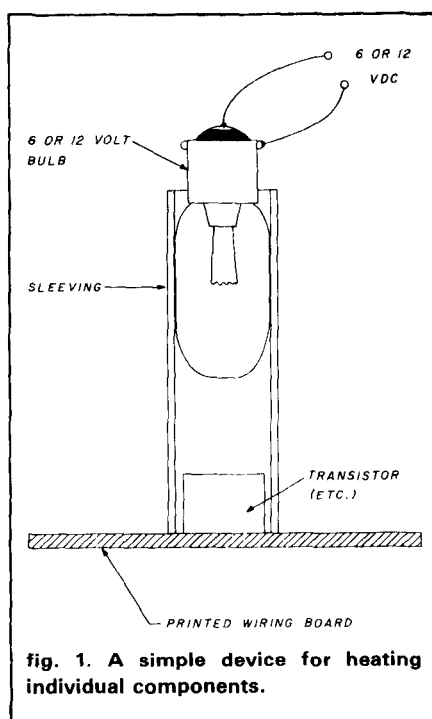


fig. 1. A simple device for heating individual components.

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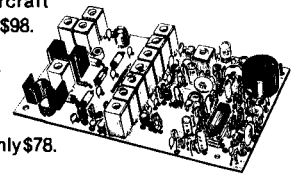
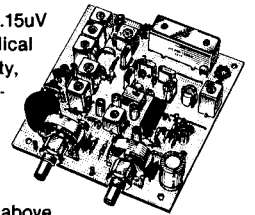


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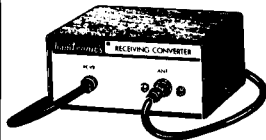
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28-30	220-222*
50-54	220-224
144-146	50-52
50-54	144-148
144-146	28-30

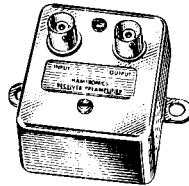
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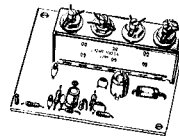
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ghetti") is designed to fit over components such as transistors and some integrated circuits. The heat source is placed in the open end, thereby concentrating the heat only on the component under suspicion. The tale will be told in about 30 seconds.

The indication that the component being tested is bad will be obvious. There will be a sudden change of operation, or a sudden increase in the noise produced by the circuit — the change is only rarely subtle.

2-meter FM ham rigs, by the way). In most cases, 30 to 60 minutes in the refrigerator yields 5 to 10 minutes of troubleshooting time.

Local cooling is necessary for isolating components. Use a can of freon "freeze spray" as shown in **fig. 2**. (Electronic supply stores sell this product under several different brand names. The stores most likely to carry freeze spray are those whose clientele includes radio/TV/audio repair shops.)

Be careful not to spray too wide an

this case, however, we replace components on a "scattergun" basis. (*I can hear the howls from here! I admit it's not very elegant, and provides no balm at all to save the ego of the technical genius. After all, any dumb grunt can unsolder a half dozen components and replace them. . . .* But let's consider some *facts of life*.)

I once worked in a hospital electronics laboratory that repaired clinical equipment. The emphasis was on low-cost, rapid repairs. One famous brand-name patient monitor used vintage circuitry. The ECG preamplifier and the DC power supply regulator used literally dozens of 2N3393, 2N3906, and 2N3904 plastic small-signal transistors. These transistors were typically connected six to eight at a time in circuits with multiple feedback and signal paths, all direct coupled. (Troubleshooting in circuits like this is a *dog*.) At that time, those transistors cost us \$25 per hundred in bulk-packed bags. It takes 15 minutes to replace eight small transistors that cost \$2 *total*. A total of 30 minutes put the equipment back on line.

The situation is only a little different for you. The biggest difference is that *you* buy transistors in overpriced blister packs rather than lots of a hundred; that's the price paid for buying onesie-twosies. Nevertheless, when the troubleshooting problem seems intractable, shotgunning components is a practical alternative!

You can be almost as efficient by removing components one at a time and testing each one as you go. If you find the faulty components, then it's a reasonable bet that the job is done. Unfortunately, the nature of intermittents — and Murphy's law — means that this form of troubleshooting frequently fails.

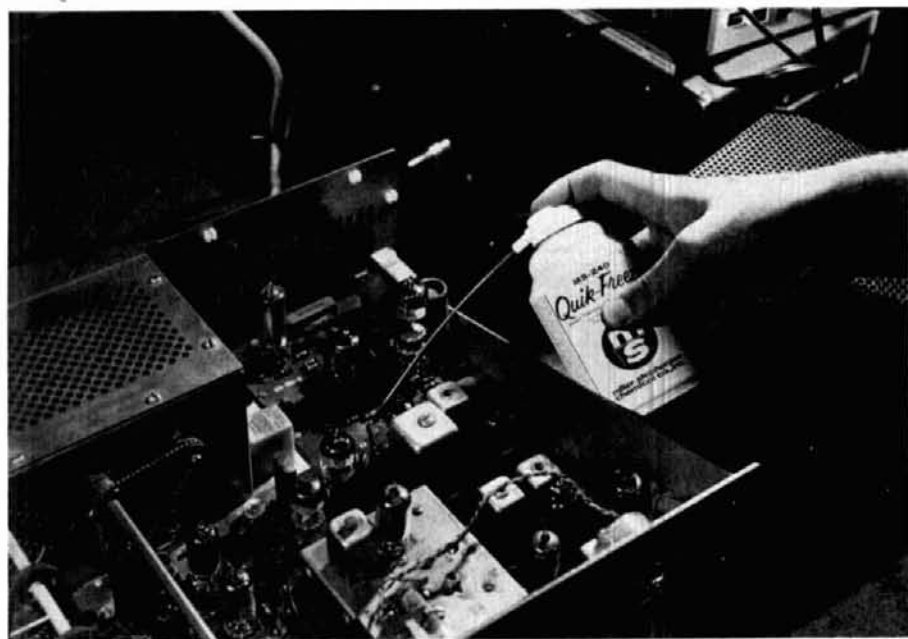


fig. 2. Freeze spray will cool off components.

when the problem is cold

"Cold" can mean anything from room temperature to arctic temperatures. When equipment fails to operate in this range, area cooling is in order.

Area cooling is more difficult, in some cases, than area heating. Try putting small devices (up to, say, the size of a mobile transceiver) in the refrigerator for about an hour. I still fondly recall the looks on the faces of shocked boat radio customers when I placed their "won't work on cold days" VHF-FM transceivers in the shop refrigerator. (Many of those rigs are merely overpriced variants of

area. Freeze spray is expensive and general area cooling won't help you find the bad components anyway. Use the spray only on individual components or small groups of components.

You can verify identification of the bad component by reheating it with soldering iron or the gizmo shown in **fig. 1**.

If the problem repeatedly appears and disappears on heating/cooling cycles, then you've found the source of the problem. Even if the problem isn't consistently repeatable, however, we can "work the odds" and replace the component "on speculation."

Our final method for fixing intermittents is another shotgun approach. In

have a question for Joe Carr?

Send your question to Joe Carr, *ham radio*, Greenville, New Hampshire 03048. While not every letter can be answered personally, he will try to answer as many as possible in this column. — Ed.

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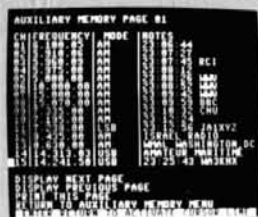
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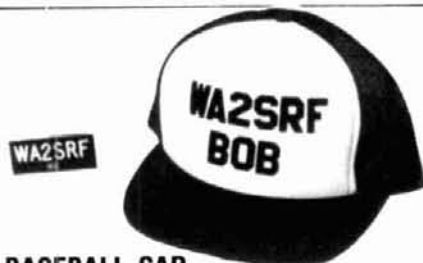
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VHF/UHF WORLD

Joe Reiser
W1JR

Old Wives' tales and trivia

It's hard to believe that two years have passed since my first column appeared in *ham radio*.

Before I accepted K2RR's invitation, I spent much time trying to determine what kind of information would be required and how it should be organized. I knew that the material would have to be interesting, informative, easily understood, technically correct, and presented in proper sequence.

The selection of general topics was easier. After all, I knew that antennas, receivers, transmitters, propagation, and test equipment were invariably favorite subjects of conversation whenever Amateurs got together. So I narrowed these general topics down to a list of specific technical subjects I thought most VHF/UHFers and HFers would find useful and then tried to arrange them — in building block fashion — in such a manner that all the basics would eventually fall into place. This may explain why I didn't jump into highly technical subjects — such as microwaves — right away.

Finally, I drew on my vast file of letters, both those answered and those I hadn't had time to answer. These clearly identified both the subjects of greatest interest and those subjects that Amateurs find most confusing. This immediately flagged specific items within the more general list of topics that needed special attention. Some letter writers, of course, asked for articles about microwaves. They had to wait, since microwaves wouldn't be easy to discuss without a base to draw on.

Finally, the list of actual column

topics and their tentative scheduling was complete. You've seen the result; in future columns, I'll try to cover new subjects, expand on subjects already covered, and explore further up into the microwave spectrum.

In the meantime, if you're following this series and can spare a few minutes, I need a favor: please drop me a note telling me what you liked and disliked about this column so far. Be frank. If I did a botch job on any subject, left you hanging on some item or left out a major point, let me know so I can try to correct the situation in a future column. I'll draw heavily on the letters for future topics.

Of course, as I've stated before, I can't possibly cover everything, nor can I answer all letters received. Just like you, I have only 24 hours in a day and a family that needs at least some of my time. After all, this is supposed to be a hobby!

So let's take a break from the usual format and see how sharp you are. *This will be your final exam on the first 23 installments and associated references listed therein.* With the help of some of my VHF/UHF friends and lots of letters to draw from, I've put together some trivia, some facts, some fallacies, and a few old wives tales. I hope they'll be fun to discuss and at the same time provide informative answers.

antennas

Let's start with everyone's favorite subject — antennas — and see what kind of old wives tales, etc., we hear. *Keep score, and no open books!*

1. "If your antenna stayed up last winter it wasn't big enough." This

is an original quote from one of the greatest VHF/UHFers ever, Sam Harris, ex W1FZJ, W1BU, KP4DJN, etc.

This statement is obviously not true. Maybe you live in Southern California. Or maybe you had a mild winter. Even better yet, maybe you built a big antenna but engineered the mechanics properly. It's nearly impossible to anticipate everything. How can any antenna survive a hurricane with winds exceeding 100 mph (161 kmph)? And how can you prevent your neighbor's tree from falling on and snapping your guy wires?

Tom, K8MMM, put it quite humorously in a recent letter: "If an outlandishly super-huge spectacle of an antenna doesn't stay up through *anything* nature has to afford for a particular area, it was too big, amateurishly conceived, and when down, due to all of the above — its owner is one of the least-heard-from and weakest things on the face of the earth!"

All things being equal, you can design a good antenna system with adequate gain if you follow the rules given in references 1, 2, and 3. Reference 4 discusses mechanical considerations and tubing strengths. *Do* build your antennas large enough, but not too large, and do so only with adequate mechanical strength!

2. "Always put your antenna as high as possible to get the best DX." This statement is basically true. However, there is a law of diminishing returns. First, if you're fortunate enough to be situated on a hilltop and have no obstructions, there's little to be gained by going up over 3 to 5 wavelengths. There's a problem if your

takeoff angle gets too low, especially when using F2, aurora, and sporadic-E propagation. At five wavelengths' height the takeoff angle will be about 3 degrees. Both EI2W and VE1ASJ found that often the optimum F2 signals come in with the antenna tilted upward several degrees! Ten wavelengths high is a real waste of time. If you do put up a large antenna on a high tower, it just may be large enough to meet the requirements spelled out by K8MMM.

Furthermore, especially on the UHF and microwave bands, the feedline loss can be horrendous.⁵ Depending on frequency, going up an additional 50 feet (15 meters) may increase the effective gain by 1 dB while incurring another 2 dB feedline loss, an overall net loss of 2dB in station performance.⁶ For VHF/UHF'ers I offer the following rule: *go high enough to clear local obstructions and STAY THERE. This is probably high enough!*

3. "Collinears are preferred over Yagis because they have broader bandwidth and larger capture area." This is truly a fallacy. While the bandwidth of a collinear antenna may be greater than a Yagi's, the matching method is often the limiting factor.¹ Also, what good is bandwidth when most VHF/UHFers never stray more than 50-100 kHz from the calling frequencies?⁶

As for capture area, this is a frequently misunderstood concept that was discussed in depth in reference 3. Capture area is directly related to gain regardless of the physical configuration of the antenna. Note that the capture area of a Yagi is usually much greater than its width and height, while with a parabolic dish it's the reverse, typically only 55 to 60 percent of the area of the dish.³

As discussed in reference 1, the choice of a collinear is primarily one of cost versus physical area. The collinear is usually a low-cost antenna, but takes up lots of area. The Yagi, while more critical to design, has less physical area and allows multiple antennas even on different bands on the same

mast. The bandwidth doesn't usually enter into the final decision at all.

4. "Always stack Yagis two-thirds of the boomlength apart." Under certain conditions, typically with intermediate (2 to 3 wavelengths) Yagis, this may be true. However, for the vast majority of designs in use, and particularly the long Yagis, this would be a gross error.

This two-thirds boomlength rule was a common misconception when the effects of capture area were poorly understood. Stacking antennas too closely results in low gain, while stacking too far apart (especially with Yagis), gives high sidelobes and a beamwidth so narrow as to make aiming the antenna³ properly very difficult. Check the beamwidth.² Then consult the charts in reference 3 and stack those antennas accordingly.

5. "The best Yagi designs are the ones produced by NBS." The NBS Yagis were a great stride forward. For once we had a cookbook with measured results. However, only six of the original NBS designs were provided in NBS Technical Note 688.⁷ That represents only a small percentage of Yagi designs available to date.

The noteworthy item about the NBS Yagi antennas is that if they are properly duplicated, they will work to specification. However, if one of the six designs doesn't fill your requirements, or if you need a longer boomlength, there are no other NBS designs available.

Today there are literally an infinite number of other designs that will fit any length of boom desired.^{8,9} Furthermore, using computer optimization techniques, up to 0.5 dB gain improvement is possible using existing Yagi designs such as the NBS 4.2 wavelength design.¹⁰ We've just begun to open up a whole new area for improved Yagi antennas.

6. "T matches should be used on high performance Yagi antennas since Gamma matches don't work very well." This fallacy has been around for some time. It was fueled

when all the new high-performance Yagi antennas, using balanced feeds and T matches, started springing up in the late 1970s. The Gamma match is capable of good performance. But it tends to inject a small imbalance into the design, which can cause a slight pattern skewing. The latter effect can be obviated by unbalancing the length of the driven element.¹¹

Establishing a good ground for the Gamma return path is difficult. Hence, at UHF frequencies, the transmission line often gets hot and the VSWR and radiation pattern of the antenna changes as the feedline is moved to different positions. Furthermore, the size of the gamma rod can get out of proportion at the higher frequencies.

Therefore, a good T match with a built-in balun is hard to beat, especially when antennas are to be stacked. It takes more hardware, however, than a Gamma match and can be lossy if the balun design is not properly handled.

7. "Every time the size of an antenna array is doubled, the gain increases by 3 dB." This is true only in theory. Most antennas don't have a perfectly rectangular capture area or a clean pattern free of sidelobes.³ As a result, antennas usually have to be stacked more closely than desired, with a resulting loss of gain.³

Stacking harness loss — which can approach 0.5 dB! — cannot be ignored. This is why the backplane feed system is recommended at the higher frequencies and where long transmission lines are used.⁴

Failure to provide sufficient mechanical strength not only in the individual antenna to be stacked but in the stacking frame can also cause gain to be lower than expected. Therefore, an array of long Yagis with a few feedlines is recommended over an array of smaller Yagis with more feedlines.¹ Plan on a 2.5 dB increase for each doubling of the array size.

8. "Sidelobes rob power and lower antenna gain." This is not necessarily true. The relationship of gain to sidelobe ratios was discussed in reference

2. It was shown in reference 3 that if the sidelobes are down 15 to 18 dB in the antenna to be stacked, the grating lobes in the final array should be down 13 dB for optimum gain. However, if the antennas to be stacked have sidelobes 13 or less dB down before stacking, they can't be optimally stacked. Each case must be studied separately, using references 2 and 3.

9. "A good antenna requires a balun." Not true. As stated above, a Gamma match can be effective. A well designed balun can do a great job of eliminating any radiation from a transmission line.¹² But an improperly designed balun, or one that uses a lossy transmission line, can actually *lower* the gain of the antenna! Proceed with caution and keep all balun losses as low as possible.

10. "Front-to-side and front-to-back ratios are important antenna design parameters." This statement is only partially true. The lobes at 90 degrees off boresight on a properly designed and built Yagi antenna are virtually at infinity in the E plane.²

A good front-to-back ratio may seem desirable for eliminating an interfering signal off the back of an antenna, but ratios exceeding 20 dB are not going to measurably improve gain or noise temperature. Furthermore, the angle subtended by the rear lobe is typically narrow so it is of dubious value. In a contest, it may be to your advantage to have some rear lobe radiation so you don't miss a new station or multiplier off the back of your antenna.

11. "The more elements in a Yagi antenna, the higher the gain." This is definitely false. Note that the NBS 4.2 wavelength Yagi has 15 elements, or two fewer elements than the 3.2 wavelength design. Yet it has more gain.⁷

What's more important in a Yagi antenna design is where the elements are placed with respect to each other (proper inter-element spacing) and the respective lengths of each director. There is a minimum number of ele-

ments to optimize the gain for each boom length. However, while extra elements may not be required, they can frequently be used to improve pattern and bandwidth of the design.^{8,9}

12. "Stacking improves gain and performance." Properly executed, the gain of an array is improved if it's properly stacked.³ Unfortunately, the operational performance may be degraded. For instance, if the beamwidth is too narrow in the horizontal plane, the array may not be optimum for meteor scatter operation, where the signals frequently arrive off the path.¹³ Also, auroral propagation may be degraded by vertical stacking. The proper stacking, be it vertical or horizontal, is a function of the type of propagation desired.⁶

operating

1. "The best place to operate is right on the calling frequencies since that's where the action is." Unfortunately, there's plenty of truth to this statement, especially when good propagation conditions are occurring, such as during meteor shower and sporadic-E openings. This has been a real problem ever since the concept of VHF/UHF "calling frequencies" was instituted in the U.S.A. in 1978.⁶ It's really sad, since it usually deprives all but the largest stations from sharing in the DX.

If the calling frequency concept is properly used, stations will call CQ or an appropriate station and *immediately* QSY to a different frequency so that others can then use the calling frequency. *Always remember to QSY at least 10 kHz away from the calling frequency.* QSYing only 5 kHz away very often causes QRM to other stations listening on the calling frequency, especially if adjacent stations are strong or if there is any splatter.

2. "146.52 MHz is a good frequency for VHF contest operation since there are so many stations that operate there." This frequency has been controversial for some time. In the early days of FM operation, most rigs were crystal-controlled and 146.52

MHz was often the only simplex crystal provided when the rigs were purchased. Hence it became a common meeting frequency for those who use simplex channelized FM. But as time went by, this frequency became very congested. What's more, it became a calling frequency for FM'ers as well as a frequency for passing emergency traffic. So it became a real sore point when contesting invaded 146.52 FM.

For the present, it's rather a moot question since contests — at least those run by ARRL — are no longer permitted on this frequency. Suffice it to say that this frequency should be used only as a calling frequency and for passing emergency traffic. Once contact is established, a quick QSY to one of the adjacent FM channels is suggested.

3. "Scheduling stations during a contest, especially those stations out of your area, helps to improve your score." This is probably not true unless you're a big contest station and desperately need every possible multiplier. Schedules do attempt to bring together people who normally may have difficulty casually running into each other. But schedules frequently take up valuable contest time. If too much time is used on schedules, there's a possibility that you may miss contacts by not working random stations that stay around for only a short time. Scoring must be carefully evaluated to see where your strengths and weaknesses lie.

4. "Everyone should develop his or her own style of operating procedures." This is an individual preference. It's always interesting when someone develops a new procedure that increases or improves communications. Such cases that quickly come to mind are meteor scatter and EME QSO procedures. But Amateurs who try to invent new procedures should be prepared to have lots of failures unless others know what they're up to! Confusion may follow when new routines or procedures are adapted. Signals on VHF/UHF are often weak, and any changes in operating procedures from

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those normally used could cause confusion and incomplete QSOs.

propagation

1. "Operation on EME requires an investment of thousands of dollars." This is no longer true, especially if you're resourceful and are willing to build much, or even all, of your own gear. The most costly items associated with EME operation are usually the antenna system and the power amplifier. There are now more than enough antenna designs available to enable you to "roll your own" EME antenna for any band where EME operation is presently conducted. Their performance can equal or exceed that of any commercially available antenna.

Likewise, there are plenty of designs available for power amplifiers.^{14,15} There's no need to run expensive tubes unless you want to go to the legal limit. Many active EME'ers (including yours truly) have never run over 750 watts of output power and have been quite successful. You can also purchase or trade amplifiers.

Full legal power can definitely increase success ratios. Power helps when conditions are poor or if one of the EME stations is only marginal. (For further information, see references 16 and 17. The bibliographies at the end of these references provide more than enough information to help you keep costs down.) *The best advice I can give on keeping costs low is to try tested and proven designs. Avoid inventing new designs that may be more costly — especially if they're not successful!*

2. "The Perseids meteor shower always peaks on the morning of August 11." This is a myth. There are times every few years when this meteor shower *does* peak on this date and time. But you have to remember that the showers occur at the same time each year unless they're deflected by a planetary encounter. Since our year is 365.25 days long (that's why we have a leap year every four years), the shower, in Earth time, will occur approximately 6 hours later each year!

Even though the shower may peak at a specific time, that may not be the best time for a schedule, since the radiant* of the shower may not be in the proper location for communication in the direction desired. For example, it won't be very productive to operate when the radiant of the shower is on the other side of the earth, even if it *is* during the peak of the shower! (See references 13 and 18 for further information on this and other questions about meteor scatter communications.) At the end of each month's VHF/UHF World column I list the latest updated information on the predicted peak of the major showers; please note that this information does not include the location of the radiant.)

3. "Circular polarization is the only way you can operate on OSCAR." This has been proven false many times by those who regularly operate the satellites. It's true that circular polarization can yield up to 3 dB improvement on transmitting and receiving the satellites.

However, due to the geometry involved, the "sense" of circular polarization may actually reverse. As a result, you'd be significantly weaker on circular polarization during these times than if you used linear polarization if the sense reverses.

The bottom line is that you can use linear polarization on OSCAR with the possibility of a greater fading rate. Circular polarized antenna systems are recommended, *but only if they provide the capability for switching sense from clockwise to counterclockwise as required.*

4. "Good openings always occur with a high barometer." This is particularly true for tropospheric propagation, but is not true for aurora, F2, sporadic E, etc. In North America, the best tropo openings seem to occur during the spring near the Gulf of Mexico, during the summer on the California-to-Hawaii path, and during the summer and fall in the more northern latitudes.^{6,19}

*Radiant — the point in the sky from which meteors appear to emanate.

Furthermore, the best tropo openings usually occur when a slow-moving high pressure (30.3 inches or 1025 millibars) area is present and mixed with warm moisture from the south. (For further information, see references 6 and 19.)

5. "The VHF/UHF bands are always open. It's just a case of no activity." This is a definite fallacy. I frequently hear this statement right after a VHF contest when the propagation conditions were good and there were lots of mountain-top stations. The dates of the ARRL June and September VHF QSO parties were purposely chosen to coincide with periods that have proven, over the years, to offer a high probability of extended openings. The August UHF and the spring Sprint contests are usually popular even though extended openings are few because of poorer propagation conditions at that time of year.

High locations do give some DX extension by virtue of the fact that they see a more distant horizon than a low-altitude station. Most mountain-toppers have shorter feedline and fewer obstructions to limit propagation. Although there are admittedly more mountain-top operations during the contests, there are fortunate persons who own mountain-top QTH's and are on the air year 'round. They can testify to the inaccuracy of the falsehood above.

Many good openings go undetected or are caught by only a few avid or lucky operators. Openings are missed mainly because of low, uncoordinated activity. We all know the frustration of calling a CQ with a highly directive antenna, only to find out later that a DX station was heard in our area, but that he had his antenna pointed in a different direction at the time of our CQ.

The best way to catch openings is to watch weather maps, be vigilant during the most likely seasons for openings^{6,19} monitor the calling frequencies, take advantage of propagation beacons, and adhere to nightly schedules as well as uniform activity nights and hours.⁶

6. "It takes a hurricane to get a good tropo opening." I have long observed that the good openings at higher latitudes often occur when hurricanes occur south of the path (references 6 and 9). But there are exceptions — for example, the Gulf of Mexico opening in the spring, and openings in the fall in the more northern latitudes.

What's required for an opening is explained in item 4 above. Yet the coincidence of longer DX openings occurring when hurricanes are present cannot be denied. Hurricanes cause low pressure areas to develop. These low-pressure areas affect high pressure areas, causing them to build up and move slowly — this slow movement, combined with the warm moisture drawn from the low pressure area, results in extended openings.⁶

receivers

1. "You need a GaAs FET preamp to work DX on the VHF/UHF bands." This is definitely false. How do you explain all the DX before solid-state devices were available in the 1960s? There are plenty of good JFETs, MOSFETs, and bipolars that yield low noise figures (1 to 2 dB), which is more than sufficient for non-EME modes where local noises are frequently the limiting factor in communications.

There's no denying that GaAs FETs are becoming very popular.²⁰ In many cases, they've improved receiver sensitivity. But the fallacy that they're the *only* devices that work well has probably been irrevocably spread since antenna-mounted preamplifiers are now quite popular and most use GaAs FETs.

2. "A low noise figure receiver will always outperform one with a high noise figure." You can't deny that receiver sensitivity is a great factor in communications. After all, "If you can't hear them, you can't work them." But noise figure is only one part of the equation. High dynamic range is also extremely important, especially if other strong stations are present. Low-noise preamplifiers often

have poor dynamic range.²⁰ High gain ahead of a mixer, especially a poor one, can cause blocking and IMD as well as other annoying phenomena.²¹

Many modern receivers, and in particular the synthesized HF transceivers, have very poor phase noise and are easily overloaded.²² Therefore, in order to hear the weak ones, attention must be paid to the dynamic range as well as the noise figure of the receiver.

3. "28 MHz is a good IF for a VHF/UHF converter." Generally speaking, this is true. Attention must be paid to dynamic range, as just discussed. However, when you go up into the UHF frequencies, image rejection becomes a real problem.²³ It's not a trivial problem to filter out an image only 56 MHz away from a 1296 MHz converter without incurring some undesirable filter loss.²⁴ Image rejection or image recovery mixers are recommended.²³ For simplicity, 2-meter (144-144.5 MHz) IFs are an acceptable alternative and are becoming very popular.

4. "A 1 MHz crystal calibrator makes an accurate VHF/UHF frequency calibrator." This is definitely false. Crystals below 3 MHz (because of their "cut") are usually much less stable than those between 3 and 10 MHz.²⁵ Furthermore, 3 and 4 MHz markers are very convenient because they can place loud, easy-to-find calibration points in most receivers on 144 MHz and above.

The calibrator discussed in reference 25 is highly recommended and should be an essential part of every well-equipped VHF/UHF station regardless of the equipment used. Your success rate drops dramatically when you don't know your frequency within at least 1 kHz, especially on EME and meteor scatter communications.^{13,16,17}

5. "You need a Hewlett Packard 8970A noise figure meter to accurately tweak a preamplifier to its lowest possible noise figure." This is definitely false. There were plenty of optimized low-noise preamplifiers long before the HP 8970A arrived on the

scene a few years ago. The older AIL models 74 and 75 as well as the HP 340 series gave good results.

The principal reason for the popularity of the HP 8970A is that it's quick and easy to use, measures both noise figure and gain simultaneously, and has a digital readout with 0.01 dB precision. It's been shown, however, even by the manufacturer, that the results are probably only accurate to ± 0.5 dB. It's also been shown more recently that preamplifiers with poor input VSWR (such as most GaAs FETs) can cause large measurement errors (up to 0.5 dB) if you don't use a noise tube with at least 10 dB of extra internal attenuation (such as the newer HP 346A type).²⁰

Don't be fooled by digital readouts and extravagant claims. What's really important is *whether your preamplifier is optimized to the minimum noise figure it can deliver* (this can be done with either the older or newer instruments) and *how it stacks up with other designs* (comparison at noise figure measurement parties).

6. "A 1N21 or back biased transistor makes a good noise figure generator." This is usually untrue. Many of the older 1N21 type of noise generators had terrible VSWR that caused the preamplifier under alignment to be optimized to the noise generator impedance rather than to 50 ohms. This can also be true with transistors. Always use at least 10 dB of attenuation, preferably an attenuator "pad" with low (1.2:1 maximum) VSWR, between your noise generator and the device-under-test. (See item 5 above.)

7. "A Dow-Key relay won't have sufficient isolation at VHF/UHF frequencies." This can be misleading unless the specific type of relay is stated. Some of the Dow-Key relays have an extra isolation feature. Other manufacturers also have isolation problems.

It has been pointed out that for safety's sake, the power entering a low-noise preamplifier should not exceed 10 milliwatts and 100 milliwatts at worst case.¹⁶ It was also shown in

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EX-243 Electronic keyer unit	50.00	
IC-745 9-band xcvr w/1-30 MHz rcvr	999.00	779 ⁹⁵
PS-35 Internal power supply	160.00	144 ⁹⁵
EX-241 Marker unit	20.00	
EX-242 FM unit	39.00	
EX-243 Electronic keyer unit	50.00	
FL-45 500 Hz CW filter (1st IF)	59.50	
FL-54 270 Hz CW filter (1st IF)	47.50	
FL-52A 500 Hz CW filter (2nd IF)	96.50	89 ⁹⁵
FL-53A 250 Hz CW filter (2nd IF)	96.50	89 ⁹⁵
FL-44A SSB filter (2nd IF)	159.00	144 ⁹⁵
HM-10 Scanning mobile microphone	39.50	
SM-6 Desk microphone	39.00	
HM-12 Extra hand microphone	39.50	
MB-12 Mobile mount	19.50	



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FL-32 500 Hz CW filter (1st IF)	59.50	
FL-63 250 Hz CW filter (1st IF)	48.50	
FL-52A 500 Hz CW filter (2nd IF)	96.50	89 ⁹⁵
FL-53A 250 Hz CW filter (2nd IF)	96.50	89 ⁹⁵
FL-33 AM filter	31.50	
FL-70 2.8 kHz wide SSB filter	46.50	
HM-12 Extra hand microphone	39.50	
SM-6 Desk microphone	39.00	
RC-10 External frequency controller	35.00	
MB-18 Mobile mount	19.50	

IC-720A 9-band xcvr • (CLOSEOUT) •	1349.00	749 ⁹⁵
PS-15 20A external power supply	149.00	134 ⁹⁵
FL-32 500 Hz CW filter	59.50	
FL-34 5.2 kHz AM filter	49.50	
BC-10A Memory back-up	8.50	
SM-5 8-pin electret desk mic	39.00	
MB-5 Mobile mount	19.50	

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BP-10 Internal Nicad battery pack	79.50	
BP-15 AC charger	12.50	
EX-248 FM unit	49.50	
LC-10 Leather case	34.95	

VHF/UHF base multi-modes	Regular	SALE
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BC-10A Memory back-up	8.50	
SM-2 Electret desk microphone	39.00	
IC-271A 25W 2m FM/SSB/CW	699.00	569 ⁹⁵
AG-20 Internal preamplifier*	56.95	
IC-271H 100W 2m FM/SSB/CW	899.00	759 ⁹⁵
AG-25 Mast mounted preamplifier*	84.95	
IC-471A 25W 430-450 SSB/CW/FM xcvr	799.00	699 ⁹⁵
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UT-15S UT-15S w/TS-32 installed	79.95	

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IC-490A 10W 430-440 SSB/FM/CW	649.00	579 ⁹⁵
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IC-27H Compact 45W 2m FM w/TTP mic	409.00	359 ⁹⁵
IC-37A Compact 25W 220 FM, TTP mic	449.00	299 ⁹⁵
IC-47A Compact 25W 440 FM, TTP mic	469.00	399 ⁹⁵
PS-45 Compact 8A power supply	112.95	99 ⁹⁵
UT-16/EX-388 Voice synthesizer	29.95	
SP-10 Slim-line external speaker	29.95	
IC-3200A 25W 2m/440 FM w/TTP	549.00	489 ⁹⁵
UT-23 Voice synthesizer	29.95	
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Larsen PO-TLM Trunk-lip mount	20.18	
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IC-120 1W 1.2 GHz FM Mobile	499.00	449 ⁹⁵
ML-12 1.2 GHz 10W amplifier	339.00	299 ⁹⁵

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RP-1210 1.2 GHz, 10W FM, 99 ch. synth	1199.00	1089
Duplexer 1210 1.2 GHz duplexer	1199.00	1089
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LC-11 Vinyl case	17.95	
LC-14 Vinyl case for Dlx using BP-7/8	17.95	
LC-02AT Leather case for Dlx models w/BP-7/8	39.95	

Accessories for both models	Regular	SALE
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BP-3 Extra Std. 250 mah/8.4V Nicad Pak	29.50	
BP-4 Alkaline battery case	12.50	
BP-5 425mah/10.8V Nicad Pak - use BC35	49.50	
CA-2 Telescoping 2m antenna	10.00	
CA-5 5/8-wave telescoping 2m antenna	18.95	
FA-2 Extra 2m flexible antenna	10.00	
CP-1 Cig. lighter plug/cord for BP3 or Dlx	9.50	
DC-1 DC operation pak for standard models	17.50	
LC-2AT Leather case for standard models	34.95	
RB-1 Vinyl waterproof radio bag	30.00	
HH-SS Handheld shoulder strap	14.95	
HM-9 Speaker microphone	34.50	
HS10 Boom microphone/headset	19.50	
HS-10SA Vox unit for HS-10 & Deluxe only	19.50	
HS-10SB PTT unit for HS-10	19.50	
ML-1 2m 2.3w in/10w out amplifier	SALE 79.95	
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RC-12 Infrared remote controller	TBA	
R-71A 100 kHz-30 MHz, 117V AC	\$799.00	659 ⁹⁵
RC-11 Infrared remote controller	59.95	49 ⁹⁵
FL-32 500 Hz CW filter	59.50	
FL-63 250 Hz CW filter (1st IF)	48.50	
FL-44A SSB filter (2nd IF)	159.00	144 ⁹⁵
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reference 16 that for optimum results and safety, a two-relay system is recommended. The second relay should return the preamplifier to 50 ohms during transmit to prevent amplifier oscillation and possible destruction during transmission periods.

It was further pointed out in references 16 and 26 that the length of transmission line between the two relays is important if the increased isolation is to be obtained. Suffice it to say that much more attention should be paid to the relay types used and at least 50 dB of transmit-to-receive isolation is highly recommended, especially when high power is used.

8. "I built it just like the article and it didn't work." Oh, how often authors hear this statement! For this very reason I've often spent hours carefully writing and then *rewriting* my column to make sure that everything is perfectly clear. Proof copies are carefully scrutinized several times through the various stages of production. However, bugs do occasionally creep in!

Suffice it to say that all circuits should be duplicated *exactly* as shown (providing that an error hasn't crept into the schematic!) unless you have enough test equipment and experience to outwit the author. I must admit that I will sometimes not publish new designs for fear that they may be too complicated or will be likely to cause a rash of angry letters. *If you alter an author's circuit, however slightly, or substitute a different part than specified, don't blame the author or ask him for help if you experience a problem!*

transmission lines

1. "Open-wire transmission line has less loss than coax." This is probably true if the VSWR on the open wire line is low, or if there's no contamination or moisture on the insulators.⁴ However, open wire lines must be relatively straight and be kept away from other lines and antennas. As a result, coaxial cable, even though it may have slightly higher loss, may be more desirable, especially when multi-

ple antennas and feedlines are present on the same mast. (For further information on this subject, see references 4 and 5.)

2. "Always cut phasing lines in multiples of one-half wavelength."

This theory was debunked in reference 4, where it was pointed out that for proper power distribution, odd numbers of quarter-wavelength feedlines are preferred. (Refer to reference 4 and its references for further information on this subject.)

3. "The way to improve EME antennas is to replace all coax with open wire lines." This subject was discussed in detail in references 4 and 5. For many of the reasons mentioned above, coaxial cable, properly chosen and used, may be preferable to open wire line.

4. "You need a Bird wattmeter to accurately measure transmitter output power and VSWR." This is also not true. There are other suppliers of good accurate power/VSWR meters. Most power meters have their own limitations. For instance, the accuracy of the power indicated is usually only ± 5 percent of full scale. This means that a 5-watt error is possible on the 100-watt scale. This can really affect the power measurement at a 25-watt power level on the same scale!

VSWR measurement accuracy is affected by the directivity or ability of the instrument to be able to distinguish between a true and a poor VSWR. Typically 20 to 30 dB is the limit, meaning that VSWR readings below 1.2:1 may be inaccurate.

Accurate readings of VSWR can be accomplished at low levels using the techniques and inexpensive coupler or VSWR bridge described in reference 27. If you build a hybrid coupler similar to the one in reference 27, you can build your own power meter and calibrate it against a borrowed meter. Unless you're measuring power near the legal limit or are trying to measure the efficiency of a high-power amplifier, an expensive power/VSWR meter is not

required. But once you use one, you'll be hard pressed to do without it.

5. "A 1.5:1 VSWR is good enough."

This is true. But where is the VSWR measured, and how accurate is the VSWR meter? Reference 5 pointed out that the length and loss of the transmission line between the antenna under test is extremely important on VHF and higher frequencies. For instance, a line loss of 7 dB (not uncommon on some of the higher bands where long runs are needed) transforms an open or short circuit (infinite VSWR!) at the far end into 1.5:1 VSWR at the near end.²⁷

It can't be stressed enough that for optimum performance on the VHF and the higher bands, the quality of the VSWR meter as well as the feedline loss⁵ must be taken into account when testing for VSWR!

6. "RG-58 can be used on 432 MHz." True — but the results may be disastrous! This type of line normally has a loss of over 10 dB per 100 feet (30.5 meters) and can handle only about 75 watts safely at 432 MHz.⁵ So RG-58 coax cable should be used only sparingly in places where the line loss is not critical.

7. "PL259s are OK at 432 MHz."

True. But this is so only if the PL259 is properly integrated with the coaxial cable. It must be stressed that the PL259 is not watertight, doesn't have a guaranteed VSWR, and probably can't handle much power on the UHF frequencies. Therefore, it should be avoided if at all possible.

8. "Helix™ and hardline transmission lines are too expensive for Amateurs." This is a common misconception.⁵ The cost of generating high power at VHF/UHF frequencies and high transmission line losses are usually the limiting factors in successful communications. Placing preamplifiers at the top of a tower helps the receive path, but transmitters (especially the high power tube type) are not readily mounted at the top of a mast.

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loss, will not only deliver the most "bang for the buck," but will also frequently outlast lower cost transmission lines by a 2 to 5:1 ratio. If remote relays are used, they can do double or even better duty by servicing multiple antennas. As a result, *the high initial cost is quickly amortized over the years and the performance is top notch to boot.* Couple this with the favorable prices often found at flea markets and you have a super bargain!

9. "The G-line is a nickname for the chorus line at a burlesque house."

I ask this question to see if you're still awake. "G-line" was mentioned in my October, 1985, VHF/UHF World Column.⁵ It's basically a single wire transmission line similar to a toy "string telephone." It has many exciting possibilities for low loss and inexpensive installations. See the October article for further information.

transmitters

1. "VHF/UHF amplifiers typically have 20 dB of gain." This theory, which has been around for some time now, invariably causes grief when someone discovers that you can't run 1500 watts of output with a 10-watt driver.¹⁴ Typically speaking, the gain of most VHF amplifiers is 15 to 20 dB and 10 to 16 dB at UHF. This is only if the amplifier is operated in linear service. Class C has lower gain and is not recommended for reasons mentioned in reference 14.

The more modern grounded grid triodes frequently have 3 dB lower gain than this although they are usually more stable than the older neutralized designs. When you buy or build an amplifier, check the specifications beforehand and see what the drive requirements will be. You may need an additional driver to get the output power expected from your amplifier.²⁸

2. "You can run a single 4CX250B at 500 to 600 watts output." True, *but your tube won't last very long!* Amateurs seem to have a thing about running devices past manufacturers' ratings! They frequently provide insufficient cooling to boot. Better read

references 14 and 15 and drop your power, too. Both you and the tube will be friends for a longer time!

3. "You can't operate 2-meter EME without an 8877 amplifier." If there ever was a misconception, this is it. *Hundreds of Amateurs operate EME without running the legal limit or using a high power tube like the 8877.*

Other tubes that will deliver the same power^{14,15} are available. Tubes can also be run in parallel. You can operate EME with as low as 500 watts of output power if you're patient, have sufficient antenna gain, and "have your act together."^{16,17}

4. "Speech processing extends your SSB transmitting range and prevents you from splattering."

This statement is true as long as you use the speech processing properly and don't overdrive your transmitter. All too often, Amateurs not only run their amplifiers in a highly non-linear fashion but also run improperly adjusted speech processors. If you run speech processing, the duty cycle on the power amplifier will increase. If you don't increase cooling to the final stage, you could experience premature failure.

5. "If your maximum output power level is 100 watts you should occasionally see that power level register on SSB peaks on your output power meter."

Boy, here's another big lie. Ever since reasonably priced power meters became available, they've been used to do the wrong things. For starters, most power meters have a highly damped meter movement. As a result, they respond slowly. The truth of the matter is that *under normal circumstances, the power meter should be indicating no more than about 25 to 30 percent of the actual power level of the amplifier in a key-down position.*²⁸ It's for this very reason that solid-state amplifier/drivers have gotten such a bad reputation.

6. "You can run a pair of 4CX250B's at 1 kW output on SSB." This is true. However, you won't have many

friends. The 4CX250B is rated on SSB operation at 500 watts input for 300 watts PEP output per tube with an IMD of only 25 dB.¹⁴ IMD of 30 dB is considered Amateur standard. So don't argue with fellow Amateurs when they say you're splattering and you are only running 600 watts PEP output from a pair of 4CX250Bs!

7. "IMD isn't a real problem on the VHF/UHF bands since there are so few stations and they're all geographically separated."

Amateurs on VHF/UHF used to say that they didn't have to worry about dirty signals on VHF/UHF since there were so few people and so much spectrum available. But that's all changing now, with many stations coming on and often operating in close proximity to the calling frequencies. Line of sight, higher gain antennas, and sensitive receivers that often lack high dynamic range are compounding the problem.^{21,22} Better start watching your signal quality as closely as you do on the DC bands.

summary

This month's column, sort of a mixed bag, was intended to put to rest several of the most popular old wives' tales. Most of the statements made were addressed in the past 23 columns and the other references cited. I hope you'll be sufficiently interested in the subjects discussed to research the referenced material independently. At the same time, I hope you've enjoyed this departure from my usual format and will continue to follow this column as faithfully as you have. Don't forget to drop me a line with any suggestions or advice.

acknowledgements

I'd like to thank all the unnamed Amateurs who brought the statements for this month's column to mind. Unfortunately, I can't name you all, but some of you would rather not be identified anyhow! I do want to extend special thanks to Lewis Collins, W1GXT, and Gary Madison, WA2NKL, for helping me assemble many of the statements used as the basis for this month's column.

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references

1. Joe Reisert, W1JR, "VHF/UHF World: VHF/UHF Antennas and Antenna Systems," *ham radio*, February, 1984, page 46.
2. Joe Reisert, W1JR, "VHF/UHF World: Determining VHF/UHF Antenna Performance," *ham radio*, May, 1984, page 110.
3. Joe Reisert, W1JR, "VHF/UHF World: Stacking Antennas, Part 1," *ham radio*, April, 1985, page 129.
4. Joe Reisert, W1JR, "VHF/UHF World: Stacking Antennas, Part 2," *ham radio*, May, 1985, page 95.
5. Joe Reisert, W1JR, "VHF/UHF World: Transmission Lines," *ham radio*, October, 1985, page 83.
6. Joe Reisert, W1JR, "VHF/UHF World: The VHF/UHF Primer — an Introduction to Propagation," *ham radio*, July, 1984, page 14.
7. Joseph H. Reisert, Jr., W1JR, "How to Design Yagi Antennas," *ham radio*, 1977, page 22.
8. Günter Hoch, DL6WU, "Extremely Long Yagi Antennas," *VHF Communications*, 1982 Summer issue, page 130.
9. James Lawson, W2PV, "Antenna Gain and Directivity Over Ground," *ham radio*, August, 1979, page 12, and "Yagi Antenna Design," *ham radio*, January, 1980, page 22; February, 1980, page 19; May, 1980, page 18; June, 1980, page 32; July, 1980, page 18; September, 1980, page 37 (see page 67 of September issue for short circuit); October, 1980, page 29; November, 1980, page 22; and December, 1980, page 30.
10. Stanley Jaffin, WB3BGU, "Applied Yagi Antenna Design, Part 6: The Model and a Special Tool," *ham radio*, October, 1984, page 89.
11. Katashi Nose, KH6IJ, "Notes on Parasitic Beams," *QST*, March, 1960, page 43.
12. Joe Reisert, W1JR, "VHF/UHF Techniques: Feeding and Matching Techniques for VHF and UHF Antennas," *ham radio*, May, 1976, page 54.
13. Joe Reisert, W1JR, "VHF/UHF World: Improving Meteor Scatter Communications," *ham radio*, June, 1984, page 82.
14. Joe Reisert, W1JR, "VHF/UHF World: VHF/UHF High Power Amplifiers, Part 1," *ham radio*, January, 1985, page 97.
15. Joe Reisert, W1JR, "VHF/UHF World: VHF/UHF High Power Amplifiers, Part 2," *ham radio*, February, 1985, page 38.
16. Joe Reisert, W1JR, "Requirements and Recommendations for 70-cm EME," *ham radio*, June, 1982, page 12.
17. Joe Reisert, W1JR, "VHF/UHF World: 220-MHz EME Requirements," *ham radio*, September, 1984, page 45.

18. Walter Bain, W4LTU, "VHF Propagation by Meteor-Trail Ionization," *QST*, May, 1974, page 41.
19. Joe Reisert, W1JR, "VHF/UHF World-Propagation Update," *ham radio*, July, 1985, page 86.
20. Joe Reisert, W1JR, "VHF/UHF World: Low-Noise GaAs FET Technology," *ham radio*, July, 1985, page 99.
21. Joe Reisert, W1JR, "VHF/UHF World: High Dynamic Range Receivers," *ham radio*, November, 1984, page 97.
22. Joe Reisert, W1JR, "VHF/UHF World: High Dynamic Range on 2 Meters," November, 1985, page 54.
23. Joe Reisert, W1JR, "Getting Started on 13 and 23-cm," *Proceedings of the First Annual 1296/2304 MHz Conference*, Estes Park, Colorado, September, 1985 (copies of Proceedings available from W0PW).
24. Joe Reisert, W1JR, "VHF/UHF World: The VHF/UHF Primer — An Introduction to Filters," *ham radio*, August, 1984, page 112.
25. Joe Reisert, W1JR, "VHF/UHF World: VHF/UHF Frequency Calibration," *ham radio*, October, 1984, page 55.
26. Joe Reisert, W1JR, "VHF/UHF World: Protecting Equipment," *ham radio*, June, 1985, page 83.
27. Joe Reisert, W1JR, "VHF/UHF Techniques: Matching Techniques for VHF/UHF Antennas," *ham radio*, July, 1976, page 50.
28. Joe Reisert, W1JR, "VHF/UHF World: Medium Power Amplifiers," *ham radio*, August, 1985, page 39.

important VHF/UHF events

- December 2: 7 to 11 PM local SWOT
2-meter QSO party (information from K5IS)
- December 11: EME Perigee
- December 13: Peak of the Geminids Meteor Shower predicted at 0650 UTC
- December 21: Peak of the Ursids Meteor Shower predicted at 2200 UTC
- December 21: ± 1 month, winter peak of sporadic-E propagation
- January 3: Peak of the Quadrantids Meteor Shower predicted at 2300 UTC
- January 8: EME perigee
- January 11-12: ARRL VHF Sweepstakes contest

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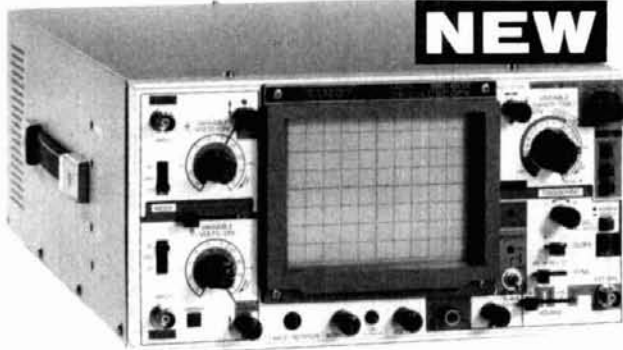
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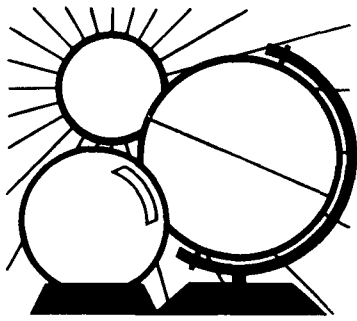


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MUF Forecasting

Recent studies of variations in maximum usable frequency (MUF) and its controlling factor, foF2 (the maximum ion density of the ionosphere), show how to do MUF forecasting (a day or two ahead) during the next year of DXing. In previous columns, methods for obtaining a mid-latitude noontime foF2 or MUF baseline (average) value using the average solar flux value for the same month were provided.¹

The daily percentage change in MUF can be obtained by using a factor related to the daily change in solar flux or geomagnetic A index. The factor given in 1984 was percentage change in MUF equals 30 per cent of the solar flux change (1 per cent for every 3 flux units). This was when the solar flux numbers were in the 150s, with large daily excursions of 10 to 20 units and a 2 to 3-day delay for the ionosphere's foF2 to catch up. This approach to forecasting really works!

Now that we're near minimum sunspot number, does the same factor still apply? No. Since the ionosphere is a geophysical system in equilibrium (i.e., balanced), expect compensating conditions to occur even though MUFs are lower. The large and fast variations no longer occur but are slower-changing — 10 to 20 units in value over a period of several days.

One study shows that the ionosphere is now more sensitive to solar flux changes. The new factor has each flux unit equal to 1.2 the percentage foF2 change. In addition, the 2 to 3-day delay is no longer experienced because solar flux variations occur slowly enough for the ionosphere to "keep in step."

The study also indicated that the

influence of geomagnetic field variations on the ionosphere is greater now than when solar flux levels were higher. For example, at higher fluxes, an A of 16 to 30 decreased the foF2 by approximately 4 to 7 per cent and an A of over 100 resulted in a 15 per cent decrease from the median value of the month. At the current flux level, an A of 11 to 70 causes an 8 to 25 per cent decrease in foF2. There appears to be quite a difference. However, the foF2 median value at the higher value of flux was 9 MHz; currently it is 5.5 MHz. Take 15 per cent of 9 MHz and 25 per cent of 5.5 MHz. Notice that these values are very close to 1.25 MHz — the actual foF2 reduction — in either case.

The ionosphere has a way of equalizing effects between sunspot extremes. These foF2, solar flux, and A index relationships were further confirmed by a study conducted at the Institute of Telecommunication Sciences (ITS) in Boulder, Colorado. The study examined the distribution of MUF values about the median (value) for the month over a 6-hour period during each day during the various seasons and over three sunspot number ranges. They found little difference (only 2 per cent) between mid-latitude MUF variation and sunspot levels. (More on this study next month).

In summary, the current solar flux increases, though small, cause the mid-latitude MUF to increase (1 per cent for each flux unit). During disturbed geomagnetic field conditions, the reduction in mid-latitude MUF (which occurs a few hours after the onset of a storm) can be found from this relationship: percentage change in MUF = $0.375A + 3.75$. Values of solar flux and geomagnetic field indices are

broadcast by WWV at 18 minutes after the hour. These new factors should help you more accurately forecast DX conditions during the next few years of low sunspot numbers.

last minute forecast

The higher HF bands (10 through 30 meters) are expected to be best during the first and second weeks of December as well as part of the last week of the month. A solar flux peak on December 5 and another on January 1 are expected to occur, enhancing DX conditions. Lower solar flux values will mean lower MUFs during the third and fourth weeks of December. However, lower flux means greater daytime signal strengths on the lower HF bands since there'll be less absorption during these times. Lower absorption normally occurs during the winter months as well as during the 27-day solar cycle minimums. The geomagnetic field will probably be disturbed during the third week of the month. These disturbances result in a reduced MUF on east-west and northern paths and an enhanced MUF on transequatorial paths.

The Geminids meteor shower, which will peak on December 13-14, will provide the richest and most reliable display of the year, with rates of 60 to 70 per hour. Because optical observations may be difficult or impossible during periods of poor weather in December, actual numbers must be determined by radio reception. A smaller version of the shower will be observed on December 22.

Lunar perigee and a full moon will occur on December 11 and 27, respectively. Winter solstice occurs on the 21st at 2208 UT.

WESTERN USA

GMT	PST										
	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	1:00	2:00
0000	40	30	30	30	30	30	30	30	30	40	40
0100	40	40	40	40	40	40	40	40	40	40	40
0200	40	40	40	40	40	40	40	40	40	40	40
0300	40	40	40	40	40	40	40	40	40	40	40
0400	40	40	40	40	40	40	40	40	40	40	40
0500	40	40	40	40	40	40	40	40	40	40	40
0600	40	40	40	40	40	40	40	40	40	40	40
0700	40	40	40	40	40	40	40	40	40	40	40
0800	40	40	40	40	40	40	40	40	40	40	40
0900	40	40	40	40	40	40	40	40	40	40	40
1000	40	40	40	40	40	40	40	40	40	40	40
1100	40	40	40	40	40	40	40	40	40	40	40
1200	40	40	40	40	40	40	40	40	40	40	40
1300	40	40	40	40	40	40	40	40	40	40	40
1400	40	40	40	40	40	40	40	40	40	40	40
1500	40	40	40	40	40	40	40	40	40	40	40
1600	40	40	40	40	40	40	40	40	40	40	40
1700	40	40	40	40	40	40	40	40	40	40	40
1800	40	40	40	40	40	40	40	40	40	40	40
1900	40	40	40	40	40	40	40	40	40	40	40
2000	40	40	40	40	40	40	40	40	40	40	40
2100	40	40	40	40	40	40	40	40	40	40	40
2200	40	40	40	40	40	40	40	40	40	40	40
2300	40	40	40	40	40	40	40	40	40	40	40

MID USA

GMT	MST										
	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	1:00	2:00	3:00
0000	40	40	40	40	40	40	40	40	40	40	40
0100	40	40	40	40	40	40	40	40	40	40	40
0200	40	40	40	40	40	40	40	40	40	40	40
0300	40	40	40	40	40	40	40	40	40	40	40
0400	40	40	40	40	40	40	40	40	40	40	40
0500	40	40	40	40	40	40	40	40	40	40	40
0600	40	40	40	40	40	40	40	40	40	40	40
0700	40	40	40	40	40	40	40	40	40	40	40
0800	40	40	40	40	40	40	40	40	40	40	40
0900	40	40	40	40	40	40	40	40	40	40	40
1000	40	40	40	40	40	40	40	40	40	40	40
1100	40	40	40	40	40	40	40	40	40	40	40
1200	40	40	40	40	40	40	40	40	40	40	40
1300	40	40	40	40	40	40	40	40	40	40	40
1400	40	40	40	40	40	40	40	40	40	40	40
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1600	40	40	40	40	40	40	40	40	40	40	40
1700	40	40	40	40	40	40	40	40	40	40	40
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1900	40	40	40	40	40	40	40	40	40	40	40
2000	40	40	40	40	40	40	40	40	40	40	40
2100	40	40	40	40	40	40	40	40	40	40	40
2200	40	40	40	40	40	40	40	40	40	40	40
2300	40	40	40	40	40	40	40	40	40	40	40

EASTERN USA

GMT	EST										
	7:00	8:00	9:00	10:00	11:00	12:00	1:00	2:00	3:00	4:00	5:00
0000	40	40	40	40	40	40	40	40	40	40	40
0100	40	40	40	40	40	40	40	40	40	40	40
0200	40	40	40	40	40	40	40	40	40	40	40
0300	40	40	40	40	40	40	40	40	40	40	40
0400	40	40	40	40	40	40	40	40	40	40	40
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0600	40	40	40	40	40	40	40	40	40	40	40
0700	40	40	40	40	40	40	40	40	40	40	40
0800	40	40	40	40	40	40	40	40	40	40	40
0900	40	40	40	40	40	40	40	40	40	40	40
1000	40	40	40	40	40	40	40	40	40	40	40
1100	40	40	40	40	40	40	40	40	40	40	40
1200	40	40	40	40	40	40	40	40	40	40	40
1300	40	40	40	40	40	40	40	40	40	40	40
1400	40	40	40	40	40	40	40	40	40	40	40
1500	40	40	40	40	40	40	40	40	40	40	40
1600	40	40	40	40	40	40	40	40	40	40	40
1700	40	40	40	40	40	40	40	40	40	40	40
1800	40	40	40	40	40	40	40	40	40	40	40
1900	40	40	40	40	40	40	40	40	40	40	40
2000	40	40	40	40	40	40	40	40	40	40	40
2100	40	40	40	40	40	40	40	40	40	40	40
2200	40	40	40	40	40	40	40	40	40	40	40
2300	40	40	40	40	40	40	40	40	40	40	40

The italicized numbers signify the bands to try during the transition and early morning hours, while the standard type provides the MUF during "normal" hours.
 *Look at next higher band for possible openings.

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3 @ 22 Gauge	3 @ 18 Gauge	3 @ 18 Gauge	3 @ 18 Gauge	3 @ 18 Gauge
3 @ 20 Gauge	3 @ 20 Gauge	3 @ 22 Gauge	3 @ 20 Gauge	3 @ 20 Gauge
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RG62A/U 96% shield mil spec 93 ohm 12¢/ft.	
RG174/U min. 50 Ω mil spec 10¢/ft.	
RG213 noncontaminating 96% shield mil spec 36¢/ft.	
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band-by-band summary

Ten and twelve meters, the highest day-only DX bands, are nearest the MUF for southern hemisphere paths. They will be open most days when the solar flux is above 75 during the 7 to 10-hour period centered on local noon. These bands open on paths toward the east and close toward the west. The paths are up to 4000 km (2400 miles) in single-hop length, and on occasion double that during evening trans-equatorial openings.

Fifteen meters, a day-only DX band open most of each day, has lower signal strengths and greater multipath variability than 10 and 12 meters. It will be best when the MUF is just resting above this band, until it drops below it — a transition period that occurs right after sunrise and just before sunset. Transequatorial openings will occur, with distances similar to 10 and 12 meters.

Twenty, thirty, and forty meters are both day and nighttime DX bands. Twenty is the maximum usable band for DX in the northern directions during daytime. In combination with 30 meters, it provides nighttime paths for the day-only bands. Forty meters becomes the main over-the-pole DX daytime band, with some hours covered by 30 meters. This path may be affected by anomalous absorption during a few days of the month.

Eighty and one sixty meters, the night-only DX bands, exhibit short-skip propagation during daylight hours, then lengthen at dusk. These bands follow the darkness path, opening to the east just before local sunset, swinging more to the north-south near midnight, and ending up in the Pacific areas for a few hours before dawn. On some nights, 80 meters, with its high signal strengths, will be the best band to use. One-sixty is also expected to provide good conditions. Please remember the DX windows of 3790 to 3800, 1825 to 1830, and 1850 to 1855 kHz.

references

- Garth Stonehocker, KØRYW, "DX Forecaster," *ham radio*, January, 1984, page 83, and February, 1984, page 79.

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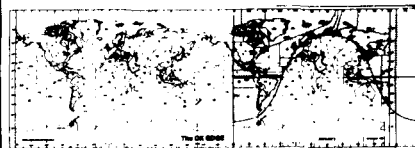
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106 118 130 142 154 166 178 190 202 214 226 238 250 262 274 286 298 310 322 334 346
107 119 131 143 155 167 179 191 203 215 227 239 251 263 275 287 299 311 323 335 347
108 120 132 144 156 168 180 192 204 216 228 240 252 264 276 288 300 312 324 336 348
109 121 133 145 157 169 181 193 205 217 229 241 253 265 277 289 301 313 325 337 349
110 122 134 146 158 170 182 194 206 218 230 242 254 266 278 290 302 314 326 338 350
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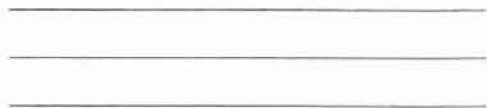
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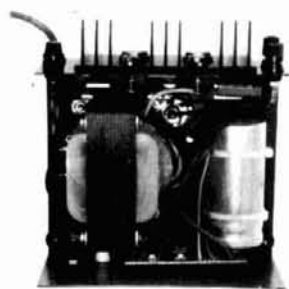
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RS-7A	5	7	3 3/4 x 6 1/2 x 9	9
RS-7B	5	7	4 x 7 1/2 x 10 3/4	10
RS-10A	7.5	10	4 x 7 1/2 x 10 3/4	11
RS-12A	9	12	4 1/2 x 8 x 9	13
RS-20A	16	20	5 x 9 x 10 1/2	18
RS-35A	25	35	5 x 11 x 11	27
RS-50A	37	50	6 x 13 3/4 x 11	46

RS-M SERIES



MODEL RS-35M

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MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H x W x D	Shipping Wt (lbs)
RS-12M	9	12	4 1/2 x 8 x 9	13
RS-20M	16	20	5 x 9 x 10 1/2	18
RS-35M	25	35	5 x 11 x 11	27
RS-50M	37	50	6 x 13 3/4 x 11	46

VS-M SERIES



MODEL VS-20M

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- Output Voltage adjustable from 2-15 volts
- Current limit adjustable from 1.5 amps to Full Load

MODEL	Continuous Duty (Amps)			ICS* (Amps)	Size (IN) H x W x D	Shipping Wt (lbs)
	@ 13.8VDC	@ 10VDC	@ 5VDC			
VS-20M	16	9	4	20	5 x 9 x 10 1/2	20
VS-35M	25	15	7	35	5 x 11 x 11	29
VS-50M	37	22	10	50	6 x 13 3/4 x 11	46

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MODEL RS-12S

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RS-7S	5	7	4 x 7 1/2 x 10 3/4	10
RS-10S	7.5	10	4 x 7 1/2 x 10 3/4	12
RS-10L(For LTR)	7.5	10	4 x 9 x 13	13
RS-12S	9	12	4 1/2 x 8 x 9	13
RS-20S	16	20	5 x 9 x 10 1/2	18

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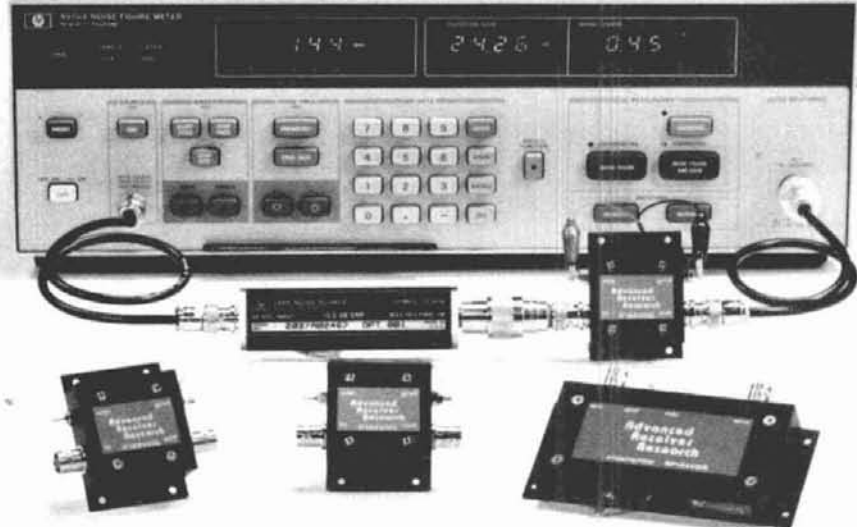
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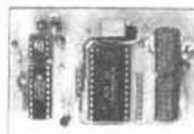
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First of all: The winner of our first Proofreading Contest is Bob Reinhart, K1KK. Bob will be receiving our CALRAD SWR meter, prepaid and free. If you didn't win, look at this ad. This is an ongoing contest. Send us a card. First card with most correct errors noted wins.

If you're a collector of old equipment, call us on your money, and we'll tell you if the prices you're paying is fair. Best new electronic notation: a supposedly old-time ham who came into the store with his parts list. At the top of his list was a peek-a-ferret capacitor. We told him we didn't sell small animals—even surplus ones. Also—we've been having some problems with the new address and get mail addressed to Phantom Avenue. It's F-A-N-N-I-N.

Have a great Christmas from everyone at Madison. Hope that Santa brings you a real nice transceiver—and buys it from us.

73 & Good DX

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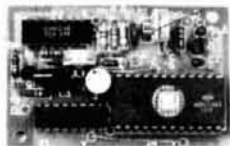
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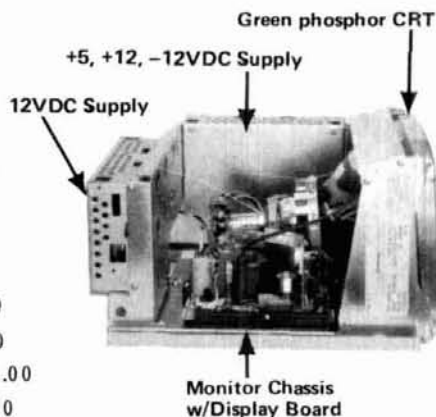
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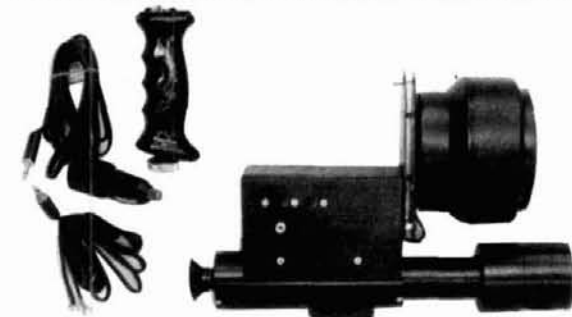
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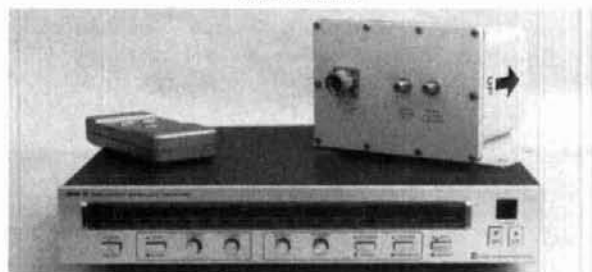
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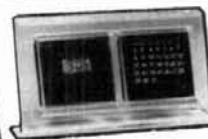
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REVIEW

Alpha Delta's multi-band twin sloper antenna

Sloper antennas have enjoyed considerable popularity over the past few years. Recently a number of different manufacturers have been producing several models of multi-band slopers that are fairly convenient to install and apply and give a pretty good accounting of themselves on the air.

The newest sloper is the DX-A from Alpha Delta, designed to cover 160, 80, and 40 meters. Alpha Delta is well known for its MACC power supply switch and transient protector and its Transi-trap antenna lightning protector. Don Tyrell, W8AD, president of Alpha Delta, was looking for a way to improve his low band signals and came upon the March, 1981, *QST* article by Doug DeMaw, W1FB, "More Thoughts on The Confounded Sloper." Don researched the sloper further and decided that the design could give him the kind of performance he was looking for.

Because he wanted a multi-band antenna, he had to make a few modifications. The first was to modify the basic design to configure it more like an inverted dipole rather than a single wire antenna (as described in the *QST* article and produced by other manufacturers.) This was done to broaden the bandwidth and improve the radiation efficiency of the antenna. As first designed, the antenna had one element that covered 160 and 80, while the other tuned 40 meters. However, after a number of these units were produced and out in the field, Don found that the antenna's performance could be improved if the 160-meter resonator was placed on the end of the 40-meter wire (see fig. 1).

Since I had the original DX-A antenna, I had to make a number of minor modifications before this review could begin.

Alpha Delta uses an aluminum tower bracket drilled to fit a Rohn tower bolt and has an SO-238, female UHF connector to simplify attaching the antenna feed line. The two antennas are fed from this common point and extend away from the tower just as a dipole would. If there's any question of a good ground connection, such as with a crank-up or older and possibly corroded tower, it will be necessary to run a grounding wire to ensure proper operation.

Alpha Delta recommends that the DX-A be placed between 25 and 40 feet up — 30 is suggested as optimum. The elements should be run as closely to 180 degrees apart as possible. (The test antenna was installed at 32 feet on a 56 foot

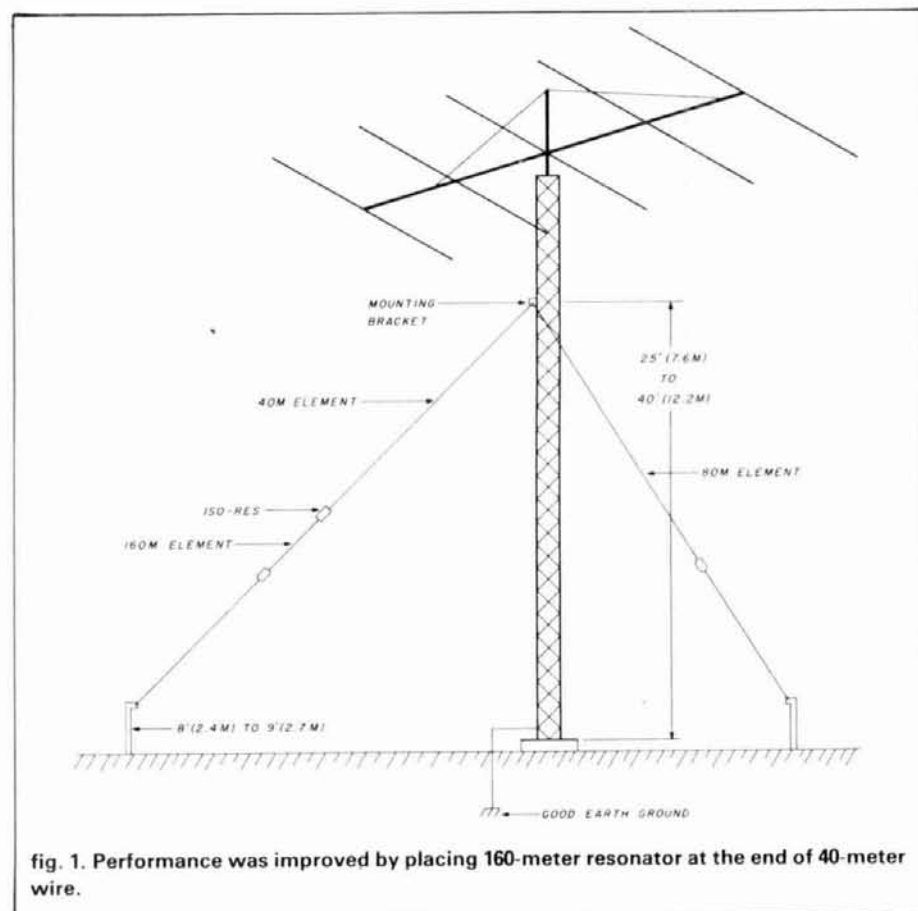


fig. 1. Performance was improved by placing 160-meter resonator at the end of 40-meter wire.

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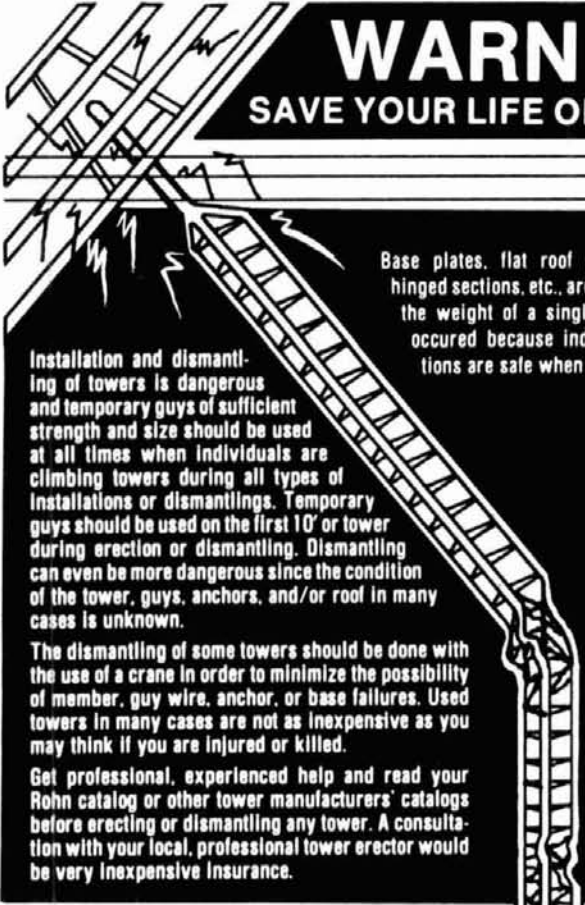
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The antenna is a single-wire radiator for 80 meters and a loaded radiator on 40 and 160. It uses a low-Q "iso-resonator" instead of an L-C trap to eliminate the problems of capacitor breakdown under high RF loads. This coil is rated at 1500 watts PEP. Don's new dimensions for the antenna are:

80 meters	67-69 feet
40 meters	34 feet
160 meters	18 feet

Tuning 80, I found that I was able to get an acceptable match at 3.6 MHz without too much difficulty. However, finding that the suggested dimensions for 40 meters were a bit too long, I spent a considerable amount of time pruning the antenna in an attempt to get the antenna to resonate. I was finally able to get the unit to cover the whole band when the antenna was approximately 32 feet long. Luckily at this point, the antenna was just about resonant at where I wanted it for 160. One cut and it was at 1.84 MHz.

Should you have any problems during installation or tune up, you can call Alpha Delta's technical department at 513-376-4180. Their representatives will be able to provide you with sound advice.

Less than 2:1 SWR bandwidth for this installation is:

160 meters	50 kHz	1.815-1.865 MHz
80 meters	200 kHz	3.5-3.7 MHz
40 meters	300 kHz	7.1-7.3 MHz

This antenna can also be tuned with open wire feeders or coax and a transmatch for greater frequency excursions. As modified, the DX-A will also tune the 30 and 17-meter Amateur bands with a reasonable SWR.

It is far too soon to tell how well this antenna will perform on long-haul DX contacts. However, early results indicate that it will be pretty good on 80 and 40 with credible results on 160.

The multi-band sloper won't give you the performance of full-sized antennas. But, if your space is limited or if you need a single antenna to get on the air, the DX-A is a perfect candidate for you to consider.

For more information, stop by your local dealer or contact Alpha Delta, P.O. Box 571, Centerville, Ohio 45459.

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(continued on page 124)

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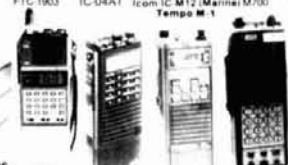
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MRF426,IA*	25W	18.00	42.00
MRF428**	150W	55.00	125.00
MRF433	12.5W	12.00	30.00
MRF435*	150W	42.00	90.00
MRF449,IA	30W	12.50	30.00
MRF450,IA	50W	14.00	31.00
MRF453,IA	60W	15.00	35.00
MRF454,IA	80W	16.00	36.00
MRF455,IA	60W	12.00	28.00
MRF458	80W	20.00	46.00
MRF460	60W	18.00	42.00
MRF464*	80W	25.00	60.00
MRF466*	40W	18.75	48.00
MRF475	12W	3.00	9.00
MRF476	3W	2.75	8.00
MRF477	40W	11.00	25.00
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MRF485*	15W	6.00	15.00
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		Rating	Match Pr.	
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MRF237	4W	136-174	3.00	—
MRF238	30W	136-174	12.00	—
MRF239	30W	136-174	15.00	—
MRF240	40W	136-174	18.00	—
MRF245	80W	136-174	28.00	65.00
MRF247	75W	136-174	27.00	63.00
MRF250	50W	27-174	20.00	46.00
MRF260	5W	136-174	7.00	—
MRF261	10W	136-174	9.00	—
MRF262	15W	136-174	9.00	—
MRF264	30W	136-174	13.00	—
MRF607	1.75W	136-174	3.00	—
MRF641	15W	407-512	22.00	—
MRF644	25W	407-512	24.00	54.00
MRF646	40W	407-512	26.50	59.00
MRF648	60W	407-512	33.00	69.00
2N3866*	1W	30-200	1.25	—
2N4427	1W	136-174	1.25	—
2N5591	25W	136-174	13.50	34.00
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2N5945	4W	407-512	10.00	—
2N5946	10W	407-512	12.00	—
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2N6081	15W	136-174	7.50	—
2N6082	25W	136-174	8.90	—
2N6083	30W	136-174	9.30	24.00
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VS 53	10/15/20/40/80	3	49	69.95

*Can be used without radials.

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Unique in terms of small size and low current drain, the PK1L is designed for portable use and for remote digipeater operation. At a current drain of only 25 mA, the PK1L can even be operated on a 9-volt transistor radio battery. PK1L also has self-contained "watchdog" and power-down sensing circuits with a lithium battery backup for memory. When power is disconnected all parameters and modes that have been set up are retained and become available again when power is restored. For remote digipeater operation in the event of malfunction due to nearby lightning strikes, etc. the watchdog automatically resets the CPU, ensuring continued operation for anything short of physical damage to the unit. The PK1L also provides a "connected" signal, plus two spare inputs and outputs that can be programmed for custom applications. A "remote command lockout" input can be used to prevent unauthorized stations from sending control commands.



The PK1L is housed in a rugged, all-metal, shielded enclosure measuring only 4.6 x 5.9 x 1.0 inches. The PK1L is entirely self-contained with an onboard CPU, 8K of memory, pre-programmed 32K ROM, RS-232 interface and packet MODEM weighing only 12 ounces. Both connectors are DR-25s, chosen for ready availability. Pinouts were chosen to preclude damage due to improper insertion. One connector is for transceiver and power supply and the other for a computer, a computer terminal, or a teletype machine, either ASCII or Baudot. The CPU is a CMOS Z80A microprocessor operating at 3.58 MHz.

For further information, contact GLB Electronics, Inc., 151 Commerce Parkway, Buffalo, New York 14224.

Circle #303 on Reader Service Card.

ICOM IC-R7000 receiver

A new continuous-coverage receiver from ICOM monitors all Amateur Radio frequencies, from 25 MHz through 2000 MHz in FM, AM, and SSB modes. (Specifications guarantee from 25 to 1300 MHz.) The unit also covers aircraft, marine, government, emergency services and television bands.

Nintey-nine memory channels are featured. Frequencies are accessed by either keyboard or tuning knob. Scanning speed is adjustable. Five

tuning speeds (0.1 kHz, 1.0 kHz, 5 kHz, 10 kHz, 12.5 kHz, and 25 kHz) are available. The fluorescent display includes a dimmer switch for comfortable viewing.

The compact unit measures 4 3/8 x 11 1/4 x 10 7/8 inches and is priced at \$899. Infrared remote controller and voice synthesizer are optional.

For details, contact ICOM America, Inc. 2380 116 Avenue N.E., Bellevue, Washington 98009-9029.

Circle #304 on Reader Service Card.

AZDEN 2-meter transceiver

Amateur-Wholesale Electronics has announced the new AZDEN PCS-5000 2-meter microcomputer FM transceiver.

The PCS-5000 has an unprecedented frequency range of 140.000-152.995 MHz, allowing the unit to be used for CAP and all MARS frequencies. Its small size — only 2 inches high by 5-1/2 inches wide by 7-1/4 inches deep — allows the radio to be placed almost anywhere.

The microcomputer facilitates features not previously available, including up to 11 nonstandard splits, 20 channels of memory in which offset and PL information can be stored, dual memory scan, scan lockout in memory mode, two ranges of programmable band scanning, with selectable scan increments, busy scan and delay scan in both the memory and band-scan modes, discriminator scan centering (AZDEN exclusive patent), priority memory with alert tone, state-of-the-art lithium battery for memory backup, repeater reverse, acquisition tone, programmable PL generator, and direct frequency entry.

The crisp, easy-to-view backlit liquid crystal display shows operating functions as well as frequency and S/Rf bar-graph meter. The keyboard is backlit for easy viewing even in total darkness.

Other features of the PCS-5000 include high/low power (25 watts and 5 watts, fully adjustable), a superior receiver with *unprecedented* sensitivity and dynamic range, true frequency modulation, 16-key touchtone pad, a rugged multi-function dynamic microphone, a built-in speaker, mobile mounting bracket, remote speaker jack, and all cords, plugs and fuses.

For further information, contact Amateur-Wholesale Electronics, Inc., 8817 S.W. 129 Terrace, Miami, Florida 33176.

Circle #305 on Reader Service Card.

new Heathkit catalog

More than 400 kit and assembled electronic products — including a new personal LORAN navigational computer suitable for boating or backpacking — are showcased in the latest Heathkit catalog.

Many new products are featured; for example, Heath's instrument line has been expanded to include the ID-4801 EPROM Programmer,

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used to program, duplicate, verify, and simulate single-power supply 2500 and 2700-series EPROMS. A new version of the H/Z-100 Desktop Computer is also available, featuring 8MHz operation and equipped with a minimum of 256K bytes of RAM.

Of special interest to readers is an FCC-registered phone patch that employs a new design and special speech transmission circuits that allow the patch to be directly connected to the phone line, thereby eliminating conventional hybrid transformers used on four-wire to two-wire conversions.

For a free copy of Heathkit's new catalog, contact Heath Company, Dep't 150-585, Benton Harbor, Michigan 49022.

Circle #306 on Reader Service Card.

2-position coax switch

The new MFJ-1702 two-position coax switch features one pole, two output positions, and low insertion loss — less than 0.2 dB. Its maximum frequency range is 500 MHz, and it has less than 20 milliohms contact resistance SO-239 connectors.

The MFJ-1702 is designed for high-performance at a reasonable price. It has a VSWR of 1:1.2 and gets better than 60 dB isolation at 300 MHz and better than 50 dB at 450 MHz. The power rating is 2.5 kw PEP, 1 kw CW. Unused terminals are also automatically grounded for protection from static, lightning, and RF.

Hams will find that they can rely on this durable two-position coax switch because MFJ includes a one-year unconditional guarantee and an additional 30-day money-back guarantee if the product is purchased directly from MFJ Enterprises.

For more information, contact MFJ Enterprises, P.O. Box 494, Mississippi State, Mississippi 39762.

Circle #307 on Reader Service Card.

plug-in encoder-decoder

Communications Specialists has introduced another new direct plug-in encoder-decoder for three popular radios. Based on the proven TS-32 programmable encoder-decoder, the TS-32JRC plugs directly into the J.R.C. JHM-45S50, Sonar FM-2112/FM-2114, and Repco RSM. No modifications to the radio are necessary.

The TS-32JRC allows individual selection of all 32 standard EIA CTCSS tones on any of the radios' channels. The send and receive tones may be the same or different on each of the 16 channels. The TS-32JRC is available for immediate delivery from factory stock and sells for \$62.95. A catalog is available on request.

For further details, contact Communications Specialists, Inc., 426 West Taft Avenue, Orange, California 92665-4296.

Circle #308 on Reader Service Card.

PK-64 packet system

The PK-64 form AEA is the first Packet System with both hardware and software optimized for the Commodore-64 computer.

On the hardware side, the PK-64 includes Western Digital 1935 HDLC chip for full-duplex operation. The modem is based on the Exar 2206 and 2211 chip set including a 6-pole post detection filter for improved HF and VHF performance. The PK-64 is designed for small size and light weight, for convenient use. AEA designed the PK-64 to operate from 12 volts DC for maximum flexibility in powering the unit. An AC Adapter is available for those wishing to use a 115 volt AC power source. The PK-64 will work with virtually any voice transceiver.

The hardware is only half the story. No Packet Radio Controller is complete without appropriate communications software. Existing terminal emulation programs used with present Packet Controllers were not designed with Packet Radio Communication in mind and are not optimum. The PK-64 includes its own MBA-TOR™ style communications software which has been optimized for Packet Radio.

The PK-64 software allows Split Screen operation for more efficient Packet Radio communications. This is a valuable feature since it allows receiving and displaying packets while the operator is typing a message or response to be transmitted. There is a built-in word processor file text editor that allows disk or cassette files to be created, edited, or deleted. Commodore 64 text and executable files may be transferred error-free with the PK-64. Ten command and message buffers are available for traffic, bulletins, or often used connect paths, etc. A software clock is included which automatically logs the connect and disconnect times and dates. PK-64 commands are the same style as the TAPR family of commands.

The price is less than \$220.

For more information, contact Advanced Electronic Applications, Inc., PO Box C-2160, Lynnwood, Washington 98036.

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See September 1984 issue of 73 for TIMEX/RTTY article

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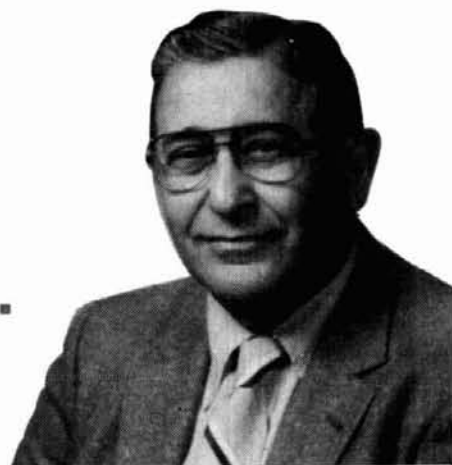
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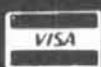
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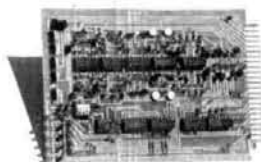
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BACK ISSUES QST, 73, Ham Radio. Stamp for list. Koepke, 6 Katherine Rd., Albany, NY 12205.

WANTED: Regency XL2000 transceiver or new 10 channel 148-162 MHz or Wilson WH2510. PO Box 929, Blacksburg, VA 24060-0929. (703) 382-4458.

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OLD RADIO transcription discs wanted. Any size, speed. W7FIZ, Box 724 HR, Redmond, WA 98073-0724.

RUBBER STAMPS: 3 lines \$4.50 PPD. Send check or MO to G.L. Pierce, 5521 Birkdale Way, San Diego, CA 92117. SASE brings information.

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WANTED ANY CONDITION WWV/WWVB receivers made by Specific Products, kinematics or parts, manuals, etc. Gil Barber, POB 31654, Aurora, CO 80041.

ANYONE INTERESTED in starting a rag chew net on 6 meter FM simplex. 52.660 in San Diego County, San Diego North County and beyond! B. Kirschner, WB0YCO, 266 Carissa Drive, Oceanside, CA 92056.

COMING EVENTS

Activities — "Places to go . . ."

MASSACHUSETTS: The MIT UHF Repeater Association and the MIT Radio Society offer monthly Ham Exams. Novice through Extra. Wednesday, December 18, 7 PM, MIT room 1-134, 77 Mass. Ave, Cambridge, MA. Reservations requested 2 days in advance. Contact Ron Hoffmann at (617) 253-5820/646-1641. Exam fee \$4.00. Bring copy of current license, two forms of picture ID and completed form 610 available from FCC in Boston (223-6609).

VIRGINIA: The ninth annual Richmond Frostfest, sponsored by Richmond Amateur Telecommunications Society, Sunday, January 12, Virginia State Fairgrounds, 8:30 AM to 3:30 PM. General admission \$4.00. Flea market spaces \$4.00; with 8' table \$8.00. Dealer/exhibitors booths available. All indoors. No outside tailgating. Deadline for booths and reserved flea market spaces December 31. Buildings open Saturday for setup. VEC exam on Saturday. Write Richmond Frostfest, PO box 1070, Richmond, VA 23208 or call Bill Scruggs, N4DDM (804) 272-8206.

SOUTH BEND, INDIANA: Hamfest Swap & Shop, January 5 (first Sunday after New Year's Day) Century Center downtown on US 33 oneway North between St. Joseph Bank Building and river. Industrial history museum in same building. Carpeted half acre indoor. Open tables \$1 per ft. Four lane highways to door from all directions. Talk in freq: 52-52, 99-39, 93-33, 69-09, 145.29.

WISCONSIN: The annual Midwinter Swapfest, Saturday, January 11, at the Waukesha County Expo Center Forum at 8 AM. Admission \$2.00 advance; \$3.00 at door. 4' tables \$3.00 advance; \$4.00 at door. Dealers welcome. Sponsored by the West Allis Radio Amateur Club. For tickets or information write WARAC SWAPFEST, PO Box 1072, Milwaukee, WI 53201. Please SASE.

OPERATING EVENTS

"Things to do..."

21st annual Telephone Pioneer QSO Party The John D. Burle Chapter invites all Telephone Pioneer Amateur Radio Operators in the U.S. and Canada to participate in contacting as many members as possible in as many different chapters. (ITPA members are also invited to participate. 1900 UTC Saturday, December 7 to 0500 UTC, Monday, December 9. Exchange contact number and chapter number. (ITPA Club or Chapter name). Return log sheets via PAR Coordinator. Send logs no later than January 15, 1986 to Ted Phelps, WB7P, c/o John D. Burle Chapter 89, Telephone Pioneers of America, 6200 East Broad Street, Columbus, OH 43213.

THE CONCORD BRASSPONDERS will operate W10C to commemorate Christa McCauliffe's "First Teacher in Space" flight, 1300Z Saturday to 1259Z Sunday during the first weekend following the launch of the space shuttle with Christa aboard. Anticipated launch date January 22. For 8-1/2 x 11 certificate please SASE to W10C, PO Box 2214, Concord, NH 03301.

Farmington, Maine: The members of the Sandy River ARC will operate the Chester N. Greenwood memorial station to honor the inventor of the Earmuff, 1700Z December 20 to 2359Z December 22, 10 kHz up from lower edges of General bands 160-10 meters. QSL and large SASE to KA1CNG via Callbook.

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by John Haerle, WB5IIR

This book has been published as a memorial to WB5IIR's work as an Amateur Radio teacher. Originally given as a series of speeches or papers, this tutorial is an excellent source book on antenna theory and applications. Examples of areas covered are: *Fundamentals*, antenna and feedline

terminology, baluns, ground systems, lightning protection, *The Basic Antenna*, the dipole, the zepp, G5RV, Windom, *Special Antennas*, the sloper, DDDR, Beverage, folded unipole, *Beams*, W8JK, Yagi, two element quad, and the *160 meter band story*. John's writing is in an easy-to-understand conversational style and is full of examples and handy tips and hints. There are no drawings or illustrations but John's prose paints pictures for clear and complete understanding of the information being presented. ©1984 1st Edition.

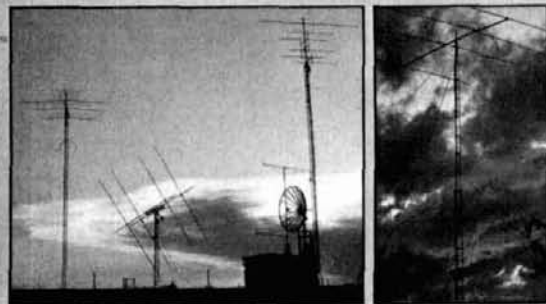
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THE ARRL 1986 HANDBOOK FOR THE RADIO AMATEUR



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The ARRL 1986 Handbook for the Radio Amateur takes over where the 1985 Edition left off. Each of the 40 chapters has had some revision, and there are more than 500 new or revised figures. The new edition will contain 1184 pages — way up from last year's count of 1024. Many key chapters with "hot" topics among today's radio amateurs have been completely revised and rewritten. In fact the new material represents 532 text pages.

An understanding of digital electronics is a must these days since such circuitry has so many practical applications in station control, frequency synthesis, telemetry, word processing and other information-handling systems. The Digital Basics chapter will help you to understand what is going on in everything from simple keyers to sophisticated microcomputers. Packet-radio enthusiasts will find the most up-to-date information available in the Digital Communications chapter. There are new sections on data interfacing and modems, 50 new and revised figures, plus an expanded bibliography and glossary.

The Special Modulation Techniques chapter has the latest on spread-spectrum. On the fun side, we've added a new section on remote control of model aircraft and vehicles.

On the practical side, you will find many of the 27 new projects described in October *QST*. There are new power amplifiers for 1.8, 50, 144 and 1296 MHz, plus preamplifiers and transverters for the VHF/UHF enthusiast. The new digital PEP Wattmeter - SWR Calculator will be one of the most popular projects.

We've only scratched the surface in describing what is the standard manual of RF communication. Over 5.7 million copies of *The Handbook* have been published in 63 editions since 1926. The new edition is must reading for today's radio amateur!

The *1986 Handbook* is available now. Paperbound prices are \$18.00 in the U.S., \$19.00 in Canada and elsewhere. Cloth prices are \$27.00 in the U.S. and \$29.00 elsewhere. Prices in U.S. funds. Foreign remittance should be in the form of an international money order or a check drawn on a bank account in the U.S.

THINGS TO LOOK FOR (AND LOOK OUT FOR) IN A PHONE PATCH

- One year warranty.
- A patch should work with any radio. AM, FM, ACSB, relay switched or synthesized.
- Patch performance should not be dependent on the T/R speed of your radio.
- Your patch should sound just like your home phone.
- There should not be any sampling noises to distract you and rob important syllables. The best phone patches do not use the cheap sampling method. (Did you know that the competition uses VOX rather than sampling in their \$1000 commercial model?)
- A patch should disconnect automatically if the number dialed is busy.
- A patch should be flexible. You should be able to use it simplex, repeater aided simplex, or semi-duplex.
- A patch should allow you to manually connect any mobile or HT on your local repeater to the phone system for a fully automatic conversation. Someone may need to report an emergency!
- A patch should not become erratic when the mobile is noisy.
- You should be able to use a power amplifier on your base to extend range.
- You should be able to connect a patch to the MIC and EXT. speaker jack of your radio for a quick and effortless interface.
- You should be able to connect a patch to three points inside your radio (VOL high side, PTT, MIC) so that the patch does not interfere with the use of the radio and the VOL. and SQ. settings do not affect the patch.
- A patch should have MOV lightning protectors.
- Your patch should be made in the USA where consultation and factory service are immediately available. (Beware of an inferior offshore copy of our former PRIVATE PATCH II.)

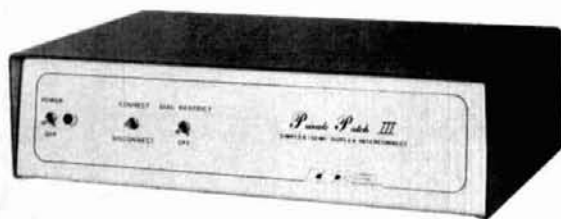
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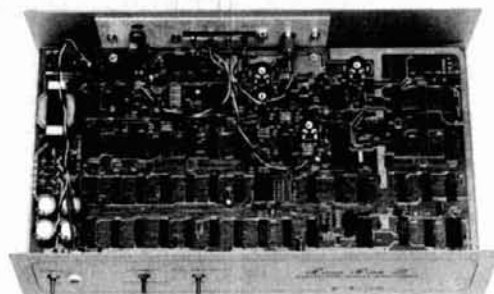
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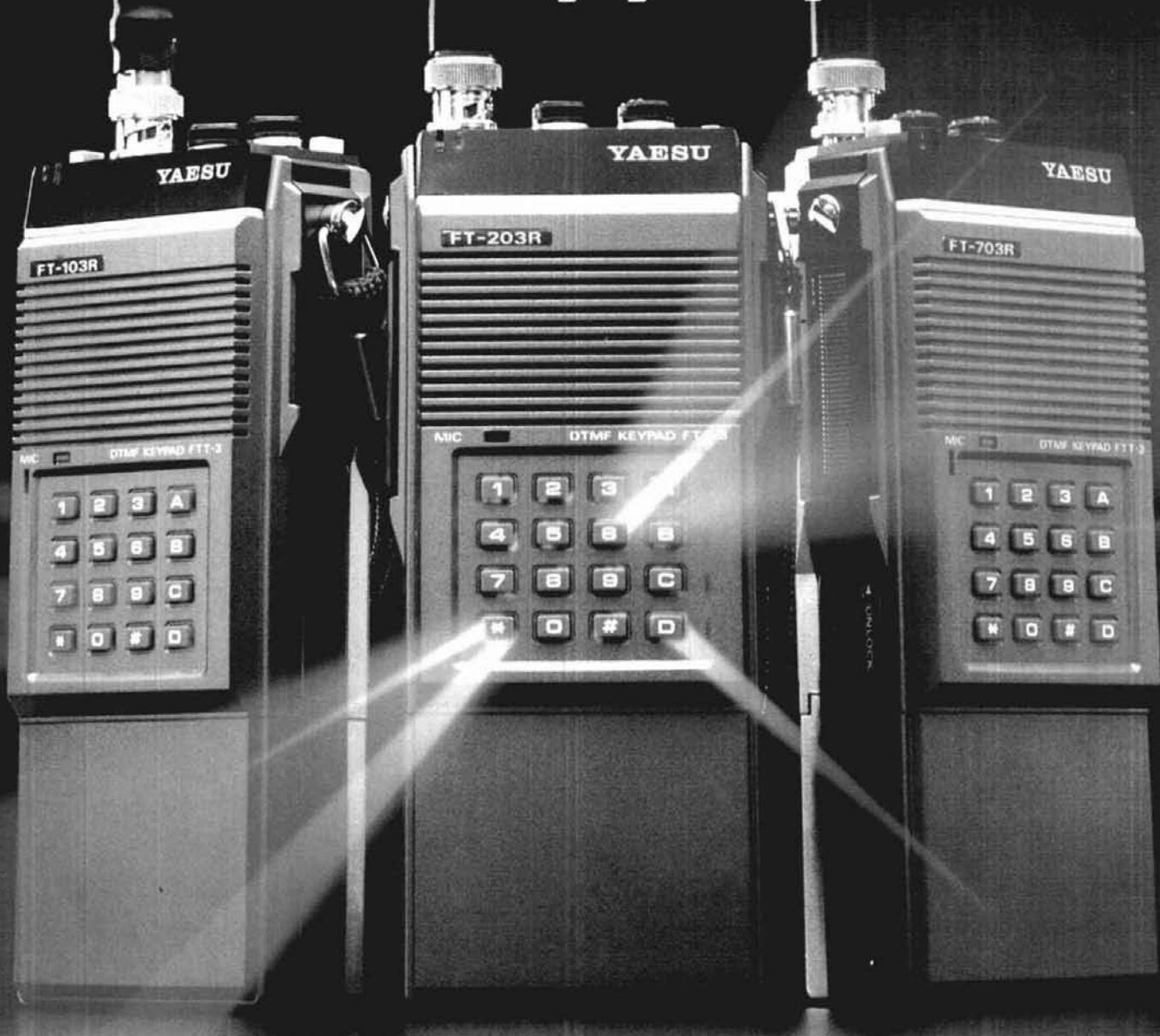


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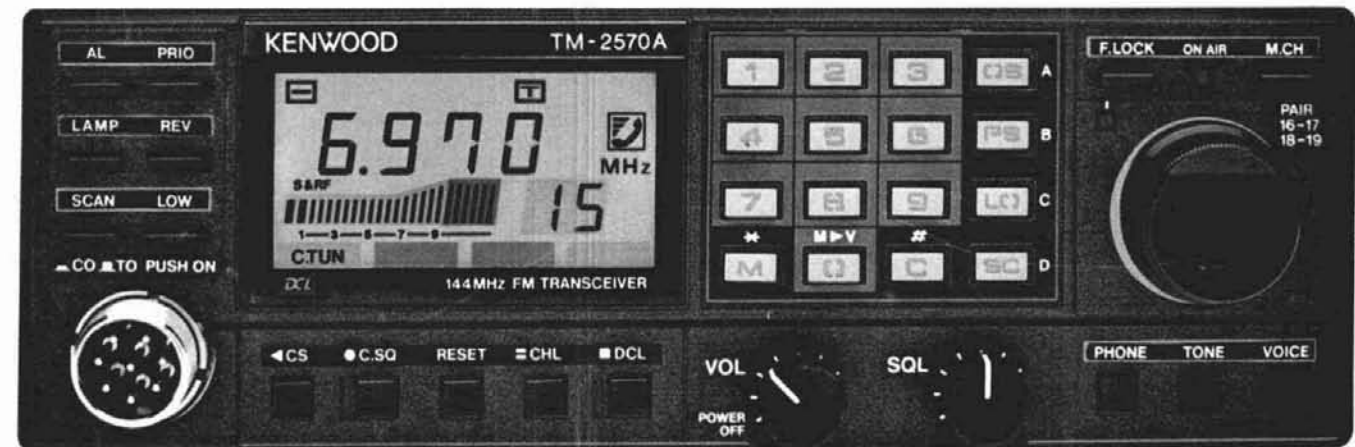
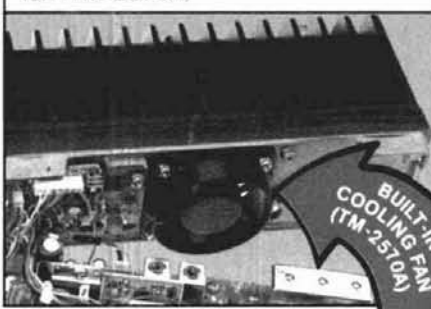
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- **PS-430** DC power supply for TM-2550A/2530A
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