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CQ VHF Ham Radio Above 50 MHz

April 1997

Springtime Mobile Special!

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- On the Road Without Repeaters
- Secrets of a Successful Rover

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- Exotic VHF DXpeditions
- Build an Antenna in a Pipe
- Find Yourself with GPS

On the Cover: Doug Johnson, KD4SQ, of Miami, Florida, operates from his airplane. Details on page 59.

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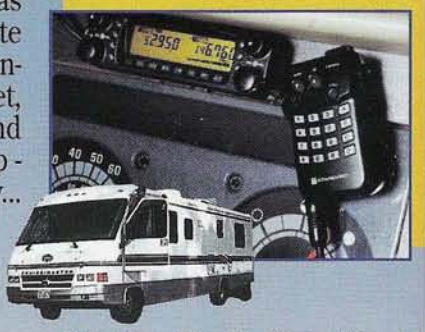

Big signal in the Ham Shack!

What's the most compact, economical, full featured tri-band mobile? Standard's C5900DA! 6 Meters as well as 2 and 70 cm, with crossband repeat, remote operation with detachable front panel, or wireless remote control from your hand-held's DTMF pad! Plus 1200-9600 baud packet, priority hyper memories for your seven most used frequencies, and up- and down- load frequencies to the optional 200 channel extended memory chip - without a computer! And there's so much more - just review the specifications below...

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STANDARD C5900DA FEATURES

- Tested tough against intermod with Double Balanced Mixer (DBM) and Tracking Front-End
- DTMF remote control with HT
- Cross-band repeat, 6M, 2M and 70cm with CTCSS encode/decode
- Full Duplex cross-band operation with CTCSS encode/decode
- 7 priority hyper frequencies
- 1200-9600 packet interface
- Antenna Triplexer Built-in one antenna for all bands
- Dual-frequency display; left side 6M, 2M and 70cm, right side 2M and 70cm
- Frequency Receive Range:
  Left band 44.000 - 99.995 MHz
  100.000 - 225.000 MHz
  240.000 - 530.000 MHz
  Right band 100.000 - 200.000 MHz
  260.000 - 510.000 MHz
  550.000 - 1020.000 MHz*
  (both including AM aircraft)
- 45 Watts 6M, 50 Watts 2M and 35 Watts 70cm (3W Low, 10W Medium selectable) transmit ham-bands

*cellular blocked on 800 MHz band

OPTIONAL ACCESSORIES

- CAW590 split cable for mic
- CAW591 3M extension cable for LCD display
- CAW592 5M extension cable with connection for mic and speaker
- CAW593 8M extension cable with connection for mic and speaker
- CMB5900 mounting bracket for display
- CMU161 200 channel memory chip

Size: 5.51"W 1.57"H 6.81"D
Weight=2.65 lbs.

MEMORIES

- 80 memories (each side); stores frequency, offsets, CTCSS tones and more
- Expandable 200 memories each side with optional, CMU161
- CTCSS Encode\Decode standard
- Frequency steps, 5, 6.25, 10, 12.5, 15, 20, 25, 30, 50 and 100 kHz.
- Paging\Coded squelch
- DTMF autopatch dialing, 12 memories, 6 per side, 15 digits
- Eight kinds of scan: 1 MHz, entire band, program, memory, block memory, program memory, memory scan memory and tone

DISPLAY

- Snap-on front display or remote the radio in the trunk or under the front seat
- Back-lit Keypad and Display
- MY key, store favorite function
- TX Time-Out-Timer 3, 5, 15 mins
- Auto power-off 3, 6, 9 hrs
- Auto mute opposite band -20dB
- Beep-tone off, low or high
- Cooling fan built-in.

Mobile bracket and power cord (2M) included

MARS and CAP modification available permit required

FCC Approval pending

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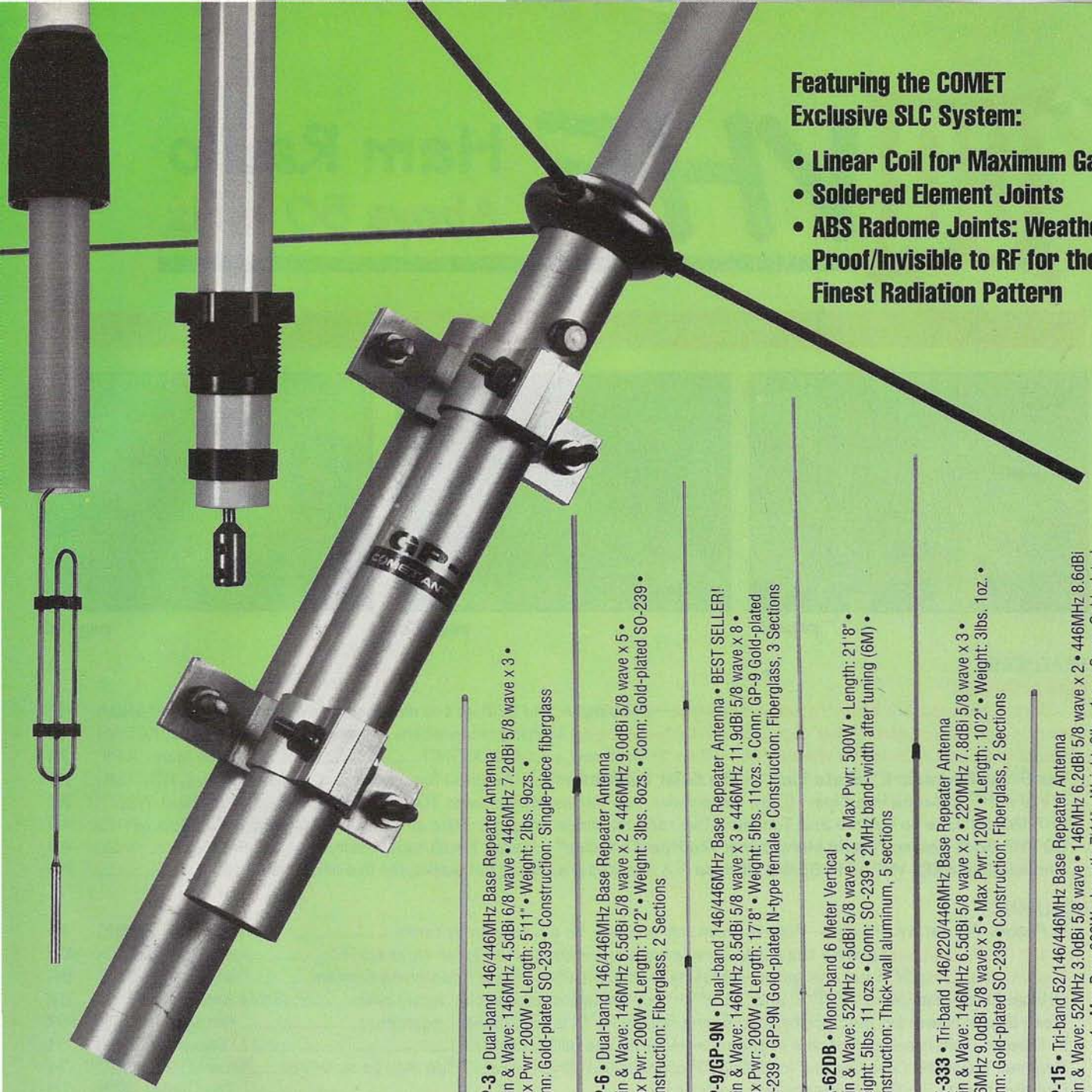
For more information on this and other STANDARD products, please contact your nearest STANDARD dealer. Specifications, price and features are subject to change without obligation or notice. Standard Amateur Radio Products, Inc. P.O. Box 48480, Niles, Illinois 60714. Tel (773) 763-0081 Fax (773) 763-3377



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- **ABS Radome Joints: Weather Proof/Invisible to RF for the Finest Radiation Pattern**

GP-3 • Dual-band 146/446MHz Base Repeater Antenna
Gain & Wave: 146MHz 4.5dBi 6/8 wave • 446MHz 7.2dBi 5/8 wave x 3 •
Max Pwr: 200W • Length: 5'11" • Weight: 2lbs. 9ozs. •
Conn: Gold-plated SO-239 • Construction: Single-piece fiberglass

GP-6 • Dual-band 146/446MHz Base Repeater Antenna
Gain & Wave: 146MHz 6.5dBi 5/8 wave x 2 • 446MHz 9.0dBi 5/8 wave x 5 •
Max Pwr: 200W • Length: 10'2" • Weight: 3lbs. 8ozs. • Conn: Gold-plated SO-239 •
Construction: Fiberglass, 2 Sections

GP-9/GP-9N • Dual-band 146/446MHz Base Repeater Antenna • BEST SELLER!
Gain & Wave: 146MHz 8.5dBi 5/8 wave x 3 • 446MHz 11.9dBi 5/8 wave x 8 •
Max Pwr: 200W • Length: 17'8" • Weight: 5lbs. 11ozs. • Conn: GP-9 Gold-plated
SO-239 • GP-9N Gold-plated N-type female • Construction: Fiberglass, 3 Sections

CA-62DB • Mono-band 6 Meter Vertical
Gain & Wave: 52MHz 6.5dBi 5/8 wave x 2 • Max Pwr: 500W • Length: 21'8" •
Weight: 5lbs. 11 ozs. • Conn: SO-239 • 2MHz band-width after tuning (6M) •
Construction: Thick-wall aluminum, 5 sections

CX-333 • Tri-band 146/220/446MHz Base Repeater Antenna
Gain & Wave: 146MHz 6.5dBi 5/8 wave x 2 • 220MHz 7.8dBi 5/8 wave x 3 •
446MHz 9.0dBi 5/8 wave x 5 • Max Pwr: 120W • Length: 10'2" • Weight: 3lbs. 1oz. •
Conn: Gold-plated SO-239 • Construction: Fiberglass, 2 Sections

GP-15 • Tri-band 52/146/446MHz Base Repeater Antenna
Gain & Wave: 52MHz 3.0dBi 5/8 wave • 146MHz 6.2dBi 5/8 wave x 2 • 446MHz 8.6dBi
5/8 wave x 4 • Max Pwr: 300W • Length: 7'11" • Weight: 3lbs. 1oz. • Conn: Gold-plated
SO-239 • 2MHz band-width after tuning (6M) • Construction: Single-piece fiberglass

COMET has an extensive line of Mono-Band/Dual-Band/Tri-Band Antennas for Base Station and Repeater use.

For a complete catalog of **COMET** Antenna products call or visit your local dealer. Or, contact **NCG Company** at 800/962-2611. Use **COMET** products, and enjoy amateur radio to it's fullest!

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CQ VHF Ham Radio Above 50 MHz

Volume 2, Number 4—April, 1997

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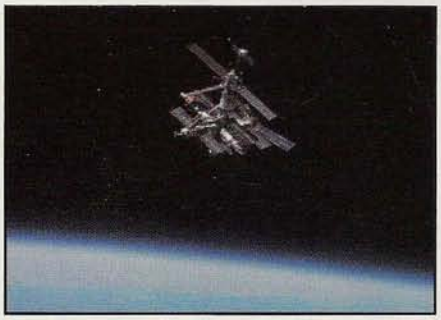

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page 40

FEATURES

COLUMNS

BASICS

DEPARTMENTS

Next Month: Sporadic-E—In Search of the Weather Connection

Freedom from High Prices!

New Alinco DJ-S41T UHF "pocket radio" A great radio for under $150!

The fun new radio everyone's talking about!

- Fits in pocket or purse, uses 3 AA cells
- 21 memories
- Large backlit display
- TX+RX range: 425~449.995 MHz
- CTCSS encode PLUS European tone burst
- "Swing Away" flex antenna resists loss and breakage
- Easy to program, easy to operate–one page operating manual!
- Use with speaker mic, headset, vox mic
- Big audio from a little radio
- Great for repeater, simplex or use through cross-band units!
- A great gift for the other hams in your life!

Alinco has introduced three new radios that allow you to own great equipment with advanced features at very "down-to-earth" prices. Before buying ANY new radio, you owe it to yourself to check out these value leaders from Alinco.

DR-605T full 2 meter/70 cm FM dual-band capabilities at a "super-low" price

The reviews are in and the DR-605T is a hit!

- Get more UHF–TX 430 MHz~449.995 MHz
- Can be used for FM satellite contacts!
- 102 memory channels (51 for each band)
- Cross band repeat feature
- MARS/CAP capability
- Extended receive on both bands
- Internal duplexer saves even more money!
- CTCSS encode PLUS European Tone Bursts
- Cloning capability
- 9600 bps packet ready
- Scanning functions

New DR-140T 2 meter mobile/base with alphanumeric display–under $289!

A full-featured FM mobile with many "extras"

- 51 memory channels
- Alphanumeric display up to 7 characters per memory
- Aircraft (AM) receive and extended FM receive
- MARS/CAP capability
- Scanning functions
- Cable cloning features
- CTCSS encode PLUS European Tone Bursts

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A Raw Deal for No-Coders?

Why does it seem that an ARRL committee plan for revamping amateur licensing will benefit everyone EXCEPT Technician-class hams who want to upgrade?

The same ARRL committee that recommended keeping the international Morse code requirement for HF operating (which the League Board of Directors adopted in January) has also recommended a complete overhaul of "low-end" amateur licensing.

Hallmarks of this proposal include the elimination of the Novice class license and the HF Novice subbands; expansion of HF phone subbands into the old Novice bands, greatly expanding the HF privileges of current Tech-Plus licensees; reducing the General class code speed requirement from 13 words-per-minute to 10, and renaming the Tech and Tech-Plus class licenses as "Basic" and "Intermediate" class, respectively. All this is great and we generally support it.

"...there's one...aspect of the [ARRL committee] proposal that seems punitive to Technicians trying to upgrade and a step backward designed solely to make upgrading more difficult."

A Step Backward?

But there's one more aspect of the proposal that seems punitive to Technicians trying to upgrade and a step backward designed solely to make upgrading more difficult. This is a two-pronged proposal to a) restore the code *sending* exam, which the FCC abandoned years ago, and b) return to a requirement that people taking code tests copy a minimum of one minute out of five *perfectly* in order to pass. Unlike the previous recommendations, which were explained in great detail by the committee, these were accompanied by no explanation whatsoever. Let's take a closer look at the problems with both of these suggestions:

a) A sending exam—For at least 20 years, the FCC has assumed that, if you could copy code at a certain speed, then you could send at that speed as well. While there are certainly a few exceptions, especially among people with physical disabilities, the FCC's assumption has been valid in the vast majority of cases. There seems to be no pressing need to change this policy.

Plus, there is a logistical concern: Just how will volunteer examiners know the speed at which a person is sending (is it 10 wpm or nine)? This will require a great deal of subjective judgment on the part of the examiners, and it will invite abuse, in addition to asking VEs to do something for which most of them are not equipped. *It ain't broke. Don't fix it.*

b) One minute of solid copy—Let me tell you about the first time I took my General class code test. This was back in 1971 at the FCC Field Office in New York City. One minute at 13 wpm came out to 65 consecutive characters. I copied 63 correctly, then missed one and got the next 40 or so correct. I failed, even though I definitely would have passed one of today's multiple choice or fill-in exams. In those days, you couldn't retest for 30 days...and it was four *years* before I next set foot in an FCC office. Today's exams are designed with comprehension in mind; that is, can you copy enough at the tested speed to understand the information being transmitted? After all, that's the goal on the air, isn't it? To get the message, even if you didn't copy 100% of the characters? Plus, the one-minute standard is maintained as a backup. Even if the person didn't copy enough of the five-minute test transmission to get seven of the 10 questions correct, the examiner can check for any one minute of solid copy, and, if one is found, the test is passed.

These procedures were put in place for one reason: to encourage *passing*. The implicit (and often explicit) attitude is that the examiners *want* you to pass, and, if you basically know your stuff, they'll do everything they can within the rules to make sure you do. The proposed change, if adopted, will turn the code test from one designed for success to one designed for failure. And chances are that the ones who'll fail most often will be the Technicians who want to upgrade.

Once again, the message from the ARRL leadership to Technicians seems to be, "You're not one of us, we don't really want you joining us on the "real" (read HF) ham bands, and, unless you jump through increasingly difficult hoops, we won't let you."

The ARRL Board wisely decided not to act on this proposal in January, opting instead to hear what members have to say before taking a vote at their July meeting. If you're a League member, we encourage you to read the full proposal in March *QST*, then let your division director know how you feel.

In This Issue

For a second straight year, we're pleased to help you get your hamming back in motion after the winter doldrums

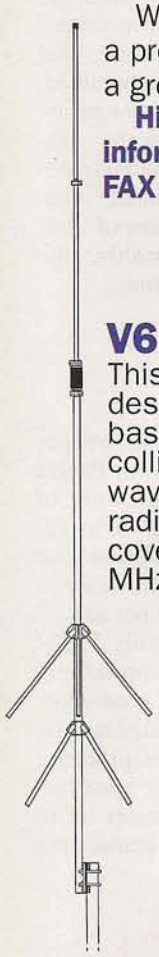
(Continued on page 77)

By Rich Moseson, NW2L, Editor

WORLD CLASS VHF ANTENNAS AND A WHOLE LOT MORE.

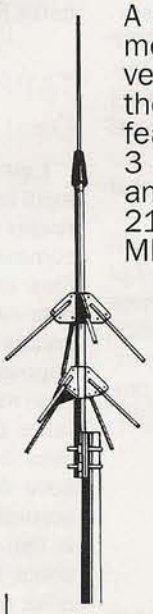
When you purchase an industry-leading antenna from Hy-Gain by Telex, you not only receive a product that provides exceptional performance and extraordinary reliability, you also receive a great warranty, after-sale support and knowledgeable, responsive customer service.

Highlighted here is just a sampling of innovative VHF products from Hy-Gain. For detailed information about these and many more Hy-Gain products and accessories, write, phone or FAX today.



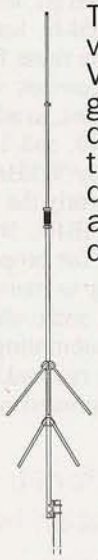
V6R

This antenna design is based on 2 collinear 5/8 wave vertical radiators and covers 51-54 MHz.



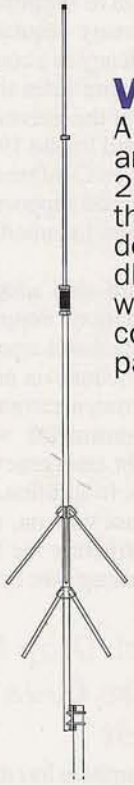
V3R

A 1 1/4 meter vertical, the V3R features a 3 dBd gain and covers 216-225 MHz.



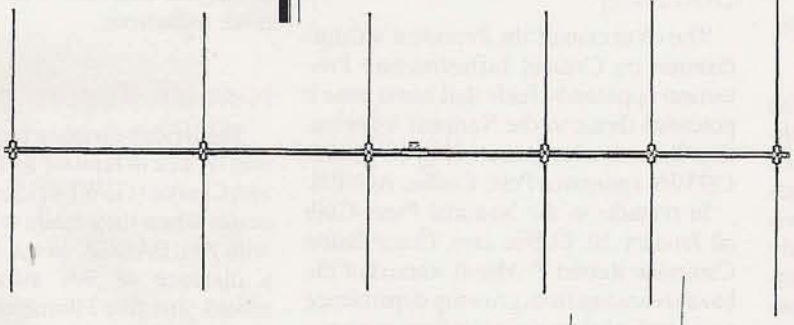
V4R

The 70 cm vertical V4R's 3 dBd gain is derived from the extended double zepp antenna design.



V2R

A rugged antenna for 2 meters, the V2R delivers 3 dBd gain with a wide coverage pattern.

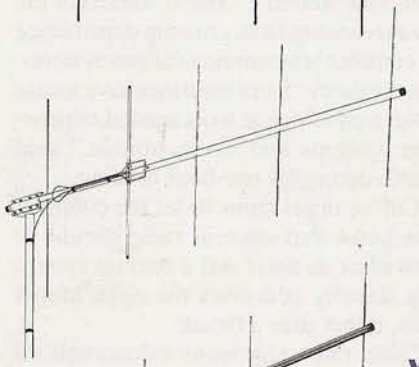


64DX, 66DX

The 4-element 64DX generates an impressive 8.2 dBd gain and the 6-element 66DX, an unprecedented 10.3 dBd.

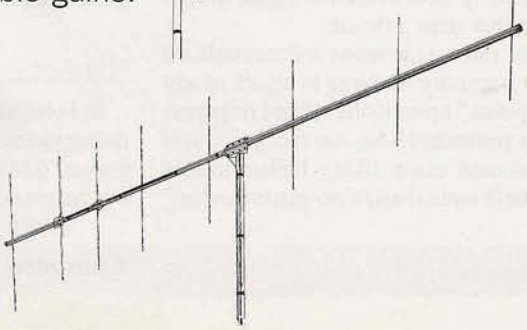
25FM

A 9.1 dBd gain antenna for 2 meters featuring Hy-Gain's exclusive Beta Match for exceptional F/B ratio and maximum obtainable gains.



28FM

This 11.8 dBd gain antenna also features Beta Match and offers unrivaled 2 meter beam performance.



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VHF News

ARRL Says "Know Code"

The ARRL will oppose any efforts to drop Morse code as a licensing requirement, both internationally and domestically. The League Board of Directors, at its January meeting, adopted a committee recommendation to support retaining the international treaty requirement for Morse code proficiency as a condition for HF operation. The committee also recommended that, even if the international requirement is dropped by the 1999 World Radiocommunication Conference (WRC 99), the League should support a continued code requirement for amateur licenses in the U.S.

The ARRL Board also adopted committee recommendations supporting the concept of an international amateur radio permit, easing restrictions on international third-party communication and encouraging all governments to support training amateurs in emergency communication techniques. In addition, the Board accepted, but did not vote on, a committee proposal to restructure the lower levels of amateur licensing (see next item).

League Panel: Drop Novice License, Make Code Tests More Difficult

If an ARRL committee has its way, the current Novice, Technician, and Tech-Plus licenses will be replaced by two license classes, called Basic and Intermediate, with greatly expanded HF privileges for Intermediate class (currently Tech-Plus) licensees. Under the committee's proposal, the Novice class license would be eliminated, and current Novices would be given a choice of upgrading to Intermediate with an open-book exam, or losing their ham licenses when they expire. The current HF novice bands would be carved up between general CW use and expanded phone allocations.

The committee proposed reducing the General class code requirement from 13 to 10 words per minute, but also wants to see all code exams made more difficult by returning to the requirement for one minute of perfect copy and reinstituting a sending exam (see this month's "Line of Sight" for a discussion of this recommendation). Specifics of the plan include granting Intermediate (Tech-Plus) class hams the full range of General/Advanced class CW privileges on 80, 40, 15, and 10 meters; digital privileges on 80 (3.600 to 3.625 MHz), 15 (21.100 to 21.125), and 10 meters (28.100 to 28.189); new phone privileges on 160 (1.950 to 2.000 MHz), 75 (3.900 to 4.000), and 15 meters (21.350 to 21.450); and expanded phone privileges on 10 meters (FM on 29.500 to 29.700 MHz). Intermediate class licensees would be limited to 200 watts PEP output on these frequencies, but higher-class licensees would not have power restrictions. In addition, the phone bands on 80, 40, and 15 meters would be expanded by 50 kHz each, moving into what are currently the Novice subbands.

The ARRL Board of Directors will vote on the proposal this summer, after listening to member input, and perhaps making some changes in the specifics, before submitting it to the FCC as a petition for rulemaking. The complete proposal is printed in the March issue of *QST*.

U.S. Panel: Hams Could Threaten Internet Security

The chairman of the President's Commission on Critical Infrastructure Protection apparently feels that hams pose a potential threat to the National Information Infrastructure, according to former *CQ VHF* columnist Peter Coffee, AC6EN.

In remarks to the National Press Club on January 30, Coffee says, Commission Chairman Robert T. Marsh warned of the hazards arising from growing dependence on complex telecommunications systems. Among them: "Even amateurs have access to the technological tools needed to penetrate systems and cause trouble," said Marsh during his one-hour briefing.

Coffee urges hams to let the commission know that amateur radio should be viewed as an asset and a backup system that directly addresses the risks Marsh cites, rather than a threat.

"Ham radio represents a decentralized system, virtually immune to attack at any single point," notes Coffee, "and [is] operated by personnel who can recognize and work around many likely failure modes due to both natural and man-made threats."

Commissioner Marsh's remarks are posted on the World Wide Web at <http://www.pccip.gov/pccip/npc.html>, and the commission's charter and other information are online at <http://www.pccip.gov/pccip>. Coffee notes that the commission's final report is due out this summer, so it's not too late to educate commission members and Members of Congress about amateur radio's positive role in the information infrastructure.

TAPR Digital Radio Deal Seems Dead

Last month, we reported on an arrangement reached by Tucson Amateur Packet Radio (TAPR) with a manufacturer of commercial spread-spectrum (S/S) radios to purchase 115.2 kilobit/second data radios for its S/S experiments at greatly reduced prices ($400 per unit as opposed to $1,250 per unit retail). TAPR now reports that the deal has apparently fallen through and that, as of press time, even those radios initially ordered had not been delivered. One apparent problem, according to the manufacturer involved, is that its commercial customers heard about the deal and started demanding price reductions.

New UK Record on 24 GHz

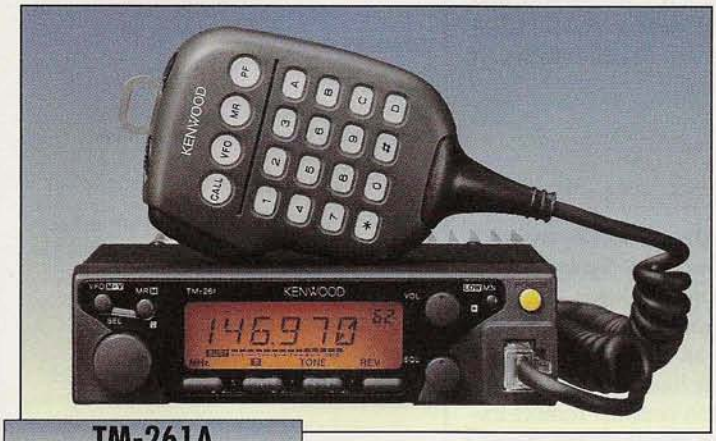
The British distance record on 24 GHz was broken in January by Petra (G4KGC) and Charlie (G3WDG) Suckling of Towcester when they made two-way contact with Ari, PAØEZ, in the Netherlands, at a distance of 391 kilometers (234.6 miles), just five kilometers (three miles) short of the world record for the band, according to a bulletin from *European Microwave News* editor Simon Lewis, GM4PLM. The contact was made in CW, under clear skies and a temperature of approximately 9° C (about 48° F). Petra and Charlie were running 400 milliwatts of power and Ari was running only 100 milliwatts on his end.

Update on 624 Kits

In February, we reported that rumors of the apparent demise of South Carolina kitmaker "624 Kits" were exaggerated. Then we received conflicting e-mail from a

Compiled by the CQ VHF Staff

The Ultimate Choice in Amateur Radio

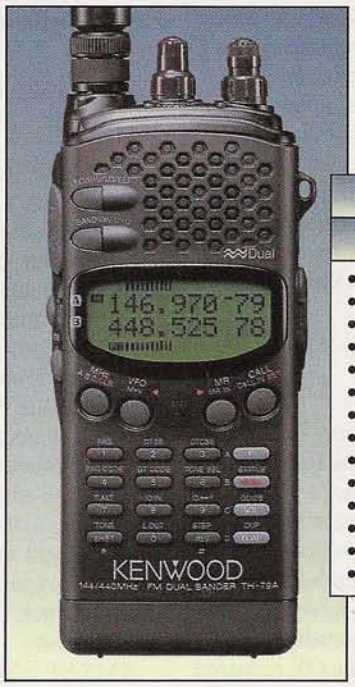


TM-261A

FM Mono Band Mobile

- 144 MHz operation
- 62 memory channels
- 6 character alpha-numerics
- DTMF memory for autopatch
- 50 watts output power
- Multi-scan capability
- Backlit microphone
- MIL-STD 810C and 810D
- Dual menu system
- Repeater reverse switch
- DTSS selective calling
- Built-in CTCSS encoder
- Wireless cloning

"Super! I can use alphanumeric memories to store names, call signs, and repeaters on my TM-261A."

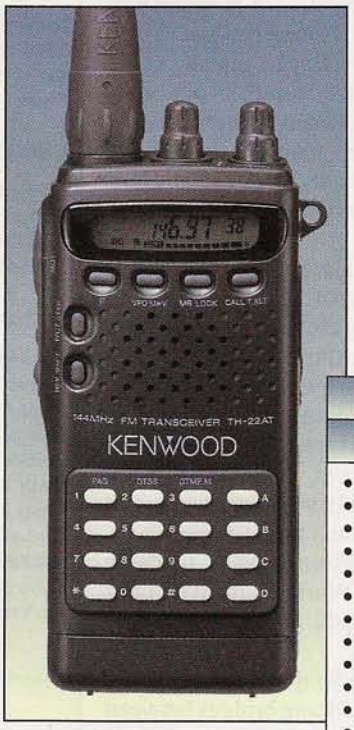


TH-79A(D)

FM Dual Bander

- 144 MHz / 440 MHz operation
- Dual receive on 2 bands
- Dot-Matrix LCD display
- 7 character alpha-numerics
- 82 memory channels
- Operator's Guide function
- DTMF memory for autopatch
- Wireless cloning
- PC programmable
- MOS FET power module
- High performance antenna
- CTCSS encode/decode
- Remote control feature
- Airband receive

"Great! My TH-79A(D) receives on 2 bands at the same time. Comes in a 5W version too."



TH-22AT

FM Mono Bander

- 144 MHz operation
- User friendly operation
- 40 memory channels
- Compact rugged design
- DTMF memory for autopatch
- MOS FET power module
- Direct DC input
- Luminescent DTMF keypad
- Multiple scan modes
- Auto battery saver circuit
- Built-in CTCSS encoder
- Battery voltage indicator
- 3 or 5 watt versions

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reader. *CQ VHF* spoke recently with 624 owner Pat Bunn, N4LTA, who said the reports are partially correct. Bunn says he has phased out most of his QRP kits and the "624 Kits" name, but he's continuing to sell 6-meter amplifiers and receive converter kits, along with Svetlana tubes, power transformers, and vintage radios, under the name STF Electronics.

Bunn notes that his kits never included detailed step-by-step instructions and that the 6-meter amplifier kit, for example, consists of all the necessary parts plus a reprint of the magazine article in which it was described. It is not, he cautioned, a project for the first-time kitbuilder.

Linenger OK'd for Third-Party QSOs from Mir

Astronaut Jerry Linenger, KC5HBR, and his successor aboard the Russian Mir space station have been granted permission for third-party contacts with unlicensed students during school QSOs. Special permission is needed because Russia and the U.S. don't have a general third-party agreement. According to a report in *The ARRL Letter*, the OK required approval from three countries—the U.S., Russia, and Germany, the latter of which supplied the amateur equipment aboard Mir. Linenger is scheduled to be aboard Mir until May, when he's due to be replaced by Astronaut Colin "Michael" Foale, KC5UAC. The special operating permission applies to Foale as well.

School contacts with Mir must be prearranged, says Miles Mann, WF1F, Director of Educational Services for the Mir International Amateur Radio EXperiment (MIREX) program. Applications for school contacts with Mir are available through the ARRL. If you'd like one, send a self-addressed, stamped envelope to Educational Activities Department, ARRL, 225 Main St., Newington CT 06111. *(Be sure to see Part 2 of Miles' primer on making contacts with Mir, elsewhere in this issue.—ed.)*

RS-16 in Orbit?

As of press time (mid-February), there was still no official word on the launch of RS-16, the newest Russian ham satellite, whose launch had been expected in January or February. RK3KPK of the RS3A satellite command station in Russia told the AMSAT News Service that the launch had originally been scheduled for last December but had been delayed "due to some problems with the satellite." Keep tuned to AMSAT bulletins for updates, or listen in on the RS-16 beacon frequencies of 29.408 and 29.451 MHz on 10 meters, and 435.504 and 435.548 MHz on 70 centimeters (it has a 2-meter uplink).

Pssst! Kid! Wanna Fly Your Own "Satellite"?

A joint venture by AMSAT, workers from NASA's Goddard Space Flight Center, Washington, D.C.-area teachers, parents, and community leaders will allow elementary and secondary school students to simulate launching and tracking a satellite and to conduct remote experiments. Dubbed "SimSat" for "Simulated Satellite Project," the program will allow students to fly experiments to altitudes of 60,000 feet and higher, using small high-altitude weather balloons. According to the AMSAT News Service, students and adult mentors design and build the experiments, then use amateur radio to track the balloon as it's carried by the wind.

AMSAT officials say that the project "simulates many of the practices and remote observing challenges inherent in working with satellites and that it offers a unique hands-on experience for students in K-12 Earth science, physical science, physics, and aerospace programs." In addition, ANS says, "The experiences gained are valuable stepping stones into amateur satellites and future career choices." Additional information is available from the SimSat World Wide Web page at <http://garc.gsfc.nasa.gov/~simsat/simsat.html>.

In addition, ANS reports that AMSAT is working to build more bridges between ham radio satellites and ham radio balloon projects, with Doug Howard, KG5OA, serving as an informal liaison. As a first step, Doug has established a ballooning resource page on the AMSAT World Wide Web site, at <http://www.amsat.org/Amsat/AmsatHome.html>.

Get in Touch

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Letters

Your Spot to Speak Out

CQ VHF *welcomes comments and suggestions from readers. We'll print a representative sampling each month, and we reserve the right to edit letters for length or style. All letters must be signed and show a return mailing address or valid e-mail address. Writers' names will be withheld from publication upon request. Address letters to: Letters,* CQ VHF, *76 N. Broadway, Hicksville, NY 11801; or via e-mail to <CQVHF@aol.com>; <CQ@genie.com> or <72127.745@compuserve.com>. Please specify that it is a letter for* CQ VHF.

Spreading the Magic

Dear *CQ VHF*:

THANK YOU for the comments in the (February) issue of *CQ VHF*! ("Line of Sight"). With all the garbage I have seen that moans about how ham radio has "lost its technical edge" and is "obsolete," etc., ad nauseam, you have said what I tried to say in a number of (Internet) postings about this, and you said it well!

The *magic* is in the fact that any average Joe who can pass a fairly simple test can have his own transmitter, can work satellites *himself*, can build equipment and try different ideas *himself*, have his *own* part to play in communications of all kinds from the simplest "two-way" contacts to advanced space and EME (Earth-Moon-Earth) communications!

The *magic* is that only here can an individual actually take part in all this; *every* other commercially established mode makes you just a dumb subscriber, not expected to know anything. And most often, they don't *want* you to know anything about it either!

There is *no* substitute for ham radio, regardless of the glitz and glamour and bells and whistles or even the reliability the commercial modes may offer. It's simply not the same issue here; comparing our hobby to anything else that technically resembles it is like comparing bananas and platypuses...they are just *fundamentally* different!

I just wish that all the people from among our own ranks who complain so much would stop and think, and figure this out! Hopefully a lot of hams—and maybe others as well—will read the magazine this month!

73,

Harry Chase, WA1VVH

Ham PACs—The ARRL Responds

Dear *CQ VHF*:

The editorial comment on Kris Harrison's letter (January, 1997) advocating an ARRL Political Action Committee seems to imply that since some other non-profit organizations have PACs, ARRL should also have one.

Your readers should know that there are 28 different non-profit classifications under IRS Code Sec. 501, plus many other non-profit classifications under other sections of the Code. Some permit partisan political activities, some don't. ARRL is designated a 501(c)(3) organization, which expressly may not "participate or intervene in any political campaign." The law is clear; so are the court interpretations. This isn't just my opinion...we've had some very tough legal minds at nationally prestigious law firms conclude that as a 501(c)(3) we can't legally be involved in any form of PAC nor publish the sort of political acceptability ratings you mention.

This begs the question of whether ARRL should have a PAC even if we could. The answer is, nobody knows. Despite lurid headlines about political contributions, the average association PAC is not very big. Most support a candidate here, a candidate there on a tactical basis. The Federal Election Campaign Act permits organizations to solicit only their own members. So we couldn't solicit all U.S. Amateur licensees, as Mr. Harrison's letter suggests.

Even without a PAC, ARRL's 501(c)(3) status permits us to talk freely with elected and appointed representatives involved with telecommunications policy. We attend hearings on Capitol Hill. We visit with members of Congress. We are active at the Federal Communications Commission, the National Telecommunications and Information Administration and other U.S. telecommunication entities. And (through IARU) we participate in deliberations of the International Telecommunication Union. I'm not sure the big money interests get much more access to the policy process than ARRL, although I'd be willing to concede that their phone calls probably get returned a bit faster.

We are listened to because the Amateur Radio community enjoys a reputation for knowing what it's talking about in telecommunication matters. In fact, policy makers return our calls not because we are political fat cats, but because ARRL professional staff efforts are supported by thousands of members who take the time to write intelligent and informed letters. My thanks to them, and may their numbers continue to multiply.

73,

Steve Mansfield, N1MZA
Mgr. of Legislative & Public Affairs
American Radio Relay League
Newington, Connecticut

Steve—Thank you for clarifying this matter and educating us all about not only the tax code's restrictions but also about the ARRL's efforts in Washington.

Recruiting More Women—Not!

Dear *CQ VHF*:

I was just flabbergasted by your "Op-Ed" column in the February 1997 issue of *CQ VHF*.

First of all, I am a woman. I find the reason for most women not being interested in ham radio is that the hobby is just too "techie" for them. The complaints I hear most often about women hams is that they don't know anything but how to turn the radio off and on and talk, and, when they have problems, they don't know what to do. I'm sorry, but I did not get into ham radio just to have another means of communication. I have a cellphone for that.

As a woman, I find that it is very difficult to prove to male hams that I am indeed capable of all aspects of the hobby, not just the "talking" part. There are too many women in the hobby now that only got into it so they could talk to their husbands on the commute to/from work. I put up my own antennas, solder my own connections, can put a kit together and make it work, build/upgrade my own computers, and am heavily into packet radio. Packet radio is a way for me to combine

(Continued on page 80)

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Product Update

ICOM IC-821H All-Mode Dualband Transceiver

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Built-in satellite functions include normal and reverse tracking, independent uplink/downlink control for Doppler shift compensation and separate satellite VFO. Ten satellite memories let you quickly switch from normal to satellite operation, plus easily recall satellite uplink and downlink frequencies. In satellite mode, the subband is set to the transmitter (uplink) frequency and the main band is set to the receiver (downlink) frequency. CW (including optional CW narrow) can be used with an electronic keyer. A transmit/receive frequency tracking function with shift tracking is standard.

The IC-821H covers from 144 to 148 MHz VHF and 430 to 450 MHz UHF. Each bands has two VFOs. Independent controls and indicators for both bands let you change from the main band to the subband with the push of a button. You can even receive simultaneous signals on each band and monitor the signal strength of both signals on separate S-meters. The sub-tuning function and RIT or SHIFT control lets you tune automatically at variable tuning speeds. This eliminates the need to rotate the main tuning dial frequency when trying to find a signal over a wide frequency range.

Additional features include IF shift that electronically adjusts the center frequency of the receiver pass-band for interference reduction and a noise blanker to eliminate pulse-type noise. A memory allocation function divides memories between bands. The 821H also has AF speech compressor, auto repeater and one-touch repeater functions, built-in high-stability crystal unit, and RIT (Receive Incremental Tuning). CW enthusiasts will appreciate the built-in keyer, optional narrow CW filters, and adjustable keying speed and dot/dash ratio. In addition, the delay time for semi break-in operation is adjustable and the side-tone circuit is synchronized with the transceiver's volume. The IC-821H is also

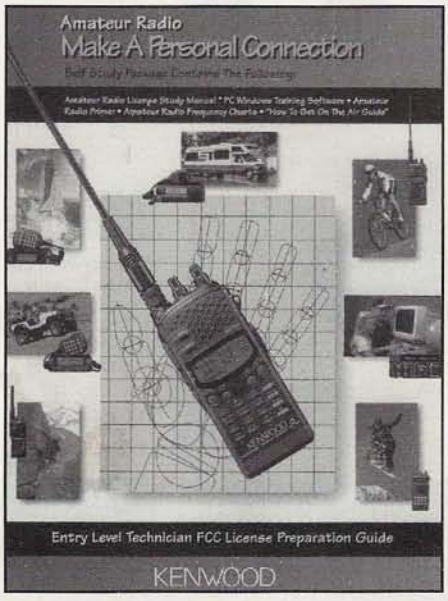
equipped for 9600-baud packet operation.

Suggested retail price for the IC-821H is $2,040.00. For additional information, contact your dealer or ICOM America, Inc., 2380-116th Avenue NE, Bellevue, WA 98004, or call (206) 454-8155.

Circle 100 on reader service card

No-Code Tech Self-Study Package from Kenwood

A new self-study package, "Make A Personal Connection," for the Technician FCC license is currently available from Kenwood. Included in the package is "EZ-PASS," a PC Windows-based training program covering sample tests and the complete question pool for the No-Code Technician exam; questions are followed by the correct answer and an easy-to-understand explanation. There's also a license study manual, the *Technician Exam Review Guide*, which supports the software with information on operating rules and electronics theory. An amateur radio primer, *How To Get On The Air Guide*, and color-coded amateur radio frequency charts are included to help you prepare to quickly pass the test and get on the air. You also receive information on how to get a copy of the FCC Part 97 and an application to join the ARRL.



"Make A Personal Connection" is available in Windows 95 and DOS versions; price is TBD.

For more information, see your dealer or contact Kenwood Communications Corp., P.O. Box 22745, Long Beach, CA 90801-5745, call customer support at (310) 639-5300, visit their World Wide Web site at <http://www.kenwood.net> (news and products) or ftp to <ftp://ftp.kenwood.net> (bulletins).

Mapping Program Available Online

Joe Mack, NA3T, announces the availability of version 1.04 of "AZ_PROJ," an azimuthal-equidistant mapping program for hams. The latest upgrade includes a display of broadcast stations, such as European TV stations that operate on the 6-meter band, and can be used to indicate transatlantic openings.

"AZ_PROJ" is free for personal use (contact the author regarding commercial use) and is available online (only) from several FTP sites and on the World Wide Web at <http://www.xray.duke.edu:1080/>. For more information, visit the Web page or send e-mail to Joe at <mack@xray.duke.edu>. Be sure to mention reading about the program in *CQ VHF*.

MFJ-711 High-Pass TVI Filter

MFJ has introduced another weapon in the battle against TV interference (TVI): the MFJ-711 high pass TVI filter. Used between your cable and VCR or TV set, it will help reduce TVI from nearby radio transmitters, broadcast, commercial two-way, amateur, and CB radios operating below 30 MHz.

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MFJ's new high-pass TVI filter has an impedance of 75 ohms un-balanced/300 ohms balanced and uses CATV (type F) connectors. Dimensions are 2 x 3.625 x 1.125 (HWD) inches.

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K-Six Company

A variety of ham-related publications and software is available from the newly-formed K-Six Company, headed by Dale Kubichek, N6JSX.

Information and how-to booklets include *HF/VHF/UHF Antenna Designs* ($10.00); *Good Ham Station RF Grounding plans* ($7.00); and *Improve Scanner/FM Radio Reception* ($7.00). Software diskettes include HAM/CW/T-Hunt Program, Packet Programs & Info, and QuickBasic/Basic Programs/files ($10.00 each). To order, send a check or money order to K-Six Company, P.O. Box 2174, Manitowoc, WI 54221-2174.

Circle 102 on reader service card

Parabolic AMSAT Mode S Converter

Hear "Mode S" satellite signals on your 2-meter multimode rig with this 2.4-GHz to 144-MHz down-converter designed and manufactured by Labetech of Sweden using the latest surface-mounted techniques. It uses an HEMT at the input stage and helix filters for excellent selectivity.

The converter is designed to be mast-mounted and the oscillator has a built-in crystal oven for stability even at low temperatures. DC power is supplied through the cable using an optional bias tee and the box is weather-proof.

Following are some of the converter's pertinent specifications. Input: 2400–2404 MHz (other frequencies between 2200–2450 MHz available on request); Output: 144–148 MHz; Noise figure: max 1.0 dB (typ 0.8 dB); Gain: 30 dB ± 3 dB; Image rejection: >35 dB; Supply Voltage: 11.5–15.5 Vdc (300 mA); Connectors: N-type, female; Size: 75 x 150 mm excluding mast clamp; Mast clamp: 50 mm, supplied (will accept up to 89 mm).

Suggested retail price is $359 U.S., including mast clamp. Bias tee: $33 U.S.

A 2400-MHz helix antenna will also be available as well as a mast-mounted power amplifier for 1268 MHz, driven by Parabolic's 144/1268-MHz Up converter. For further information, contact Bengt A. Jockert, SM6CKU. e-mail: <sm6cku@parabolic.se>

Circle 103 on reader service card

Oops...

An article in last month's issue, "Build a Low-Power Beacon for 6 Meters," had the wrong address for parts supplier Amidon. The correct address is Amidon, Inc., 240 Briggs Avenue, Costa Mesa, CA 92626; Phone: (714) 850-4660.

Moving Off Repeaters When You're on the Move

If you think operating mobile means you're limited to using repeaters, think again—and discover the fun you can have in your car on FM simplex and single sideband.

By Gordon West, WB6NOA*

Many 2-meter FM operators are switching from repeaters to simplex and are staying in touch over distances of 30 miles or more with complete FM quieting. And they're finding that going simplex has these distinct advantages over repeater operating:

- Frees up repeaters for greater-than-simplex-range contacts (the original purpose of repeaters)
- Less crowding during peak "drive time" operating hours
- Ability to talk as long as you want, without worrying about "timing out" the repeater or that someone else needs to use the "machine"
- Quick-paced exchanges without having to wait for a courtesy tone
- More acceptable for one-on-one personal communications

Let's look at that last one: one-on-one, such as husband-to-wife, or mom-to-licensed kids. Going through a repeater, everyone is listening. Some may grow impatient as you talk about things only of interest to you and your family members. Repeater conversations are more general in nature, and break-ins into the conversation are encouraged.

On simplex, there are still "roundtables," but, if you want to talk "one-on-one" without interruption, you can just slide up or down to another, unoccupied simplex frequency.

Designated Simplex Frequencies

Two-meter FM simplex frequencies are located in 15-kHz channels in two band segments: 146.415 to 146.595 MHz and 147.420 to 147.585 MHz (see Table 1). In some places, the frequencies between 146.415 and 146.505 may be used as repeater inputs or outputs, so you should check out local practices before operating simplex on these frequencies (you could unwittingly be interfering with a repeater). The simplex frequencies ending with a "0," such as 146.520, 146.550, etc., are typically spaced 30 kHz apart, allowing you to operate mobile-to-base and mobile-to-mobile at 45-watt levels without interference to other "0" simplex channels 30 kHz away. The simplex frequencies ending with a "5" are known as *interstitial*, which means they're in between the main simplex frequencies. These interstitial simplex frequencies are ideal for close-range, handheld-to-handheld contacts using low power.

Loop antennas, such as this KB6KQ "Super Loop," are popular among 2-meter SSB mobile operators who use horizontally polarized antennas. (All photos by the author)

There may also be simplex operation in your area on other channels. If a frequency is recognized locally as a popular simplex channel, then go ahead and join in on the fun. But be careful not to create your own simplex frequency, thinking that the channel you're on has absolutely no activity. It might be an input to a repeater or remote base system, or it might be in an area reserved for other types of communications.

Other VHF and UHF bands also have designated simplex frequencies, but, because those bands are less crowded, most activity is centered on a single "national simplex frequency," similar to 146.520 on 2 meters. According to the *ARRL Repeater Directory*, the national simplex frequencies on other VHF/UHF bands are as follows:

- 6 meters: 52.525 MHz
- 1.25 meters: 223.500 MHz
- 70 centimeters: 446.000 MHz
- 33 centimeters: None
- 23 centimeters: 1294.500 MHz
- 13 centimeters: 2305.200 MHz

Taking the Next Step

Moving to simplex has many advantages, but long-distance communication really isn't one of them. Even two base stations using beam antennas can't expect to make contact without a band opening if they're more than about 75 miles apart (see Table 2).

Gordon West, WB6NOA, is Senior Contributing Editor of CQ VHF.

Table 1. Recognized 2-Meter Simplex Frequencies (in MHz)

146.415 *	146.595
146.430 *	147.420
146.445 *	147.435
146.460 *	147.450
146.475 *	147.465
146.490 *	147.480
146.505 *	147.495
146.520 (National	147.510
Simplex Frequency)	147.525
146.535	147.540
146.550	147.555
146.565	147.570
146.580	147.585

* In some areas, may be used as repeater input or output frequency.

How would you like to double or triple your simplex range? A power amplifier won't make nearly as much difference as switching over from 10-kHz wide frequency modulation (FM) to 3-kHz wide single sideband (SSB). Two-meter SSB is a whole new world of longer range excitement. There are even repeaters on 2-meter SSB, called OSCARs (Orbiting Satellites Carrying Amateur Radio). While 2-meter SSB "repeaters in space" require a second receiver on another band, we're talking about ranges in the thousands of miles, not just local FM repeater distances.

But you don't need satellites to make reliable 2-meter SSB contacts 100 or more miles away. In fact, 100-mile contacts on SSB (without repeaters) are routine. Plus, spring and summertime high-pressure systems will often create *tropospheric ducting*, leading to extraordinary 2-meter SSB range. Other range enhancers used by experienced weak-signal operators include meteor scatter, aurora, and, occasionally, sporadic-*E*. But let's get started with everyday contacts.

Base stations using popular 150-watt solid-state "brick" amplifiers (they generally come in rectangular metal boxes and weigh about the same as a brick of equal size) can reliably work each other over distances of 250 miles or more, even under ordinary conditions. Mobile range is somewhat reduced, mostly because most mobile antennas are omnidirectional as opposed to the beams likely to be used in a home station.

"...be careful not to create your own simplex frequency, thinking that the channel you're on has absolutely no activity."

Lots of Elbow Room

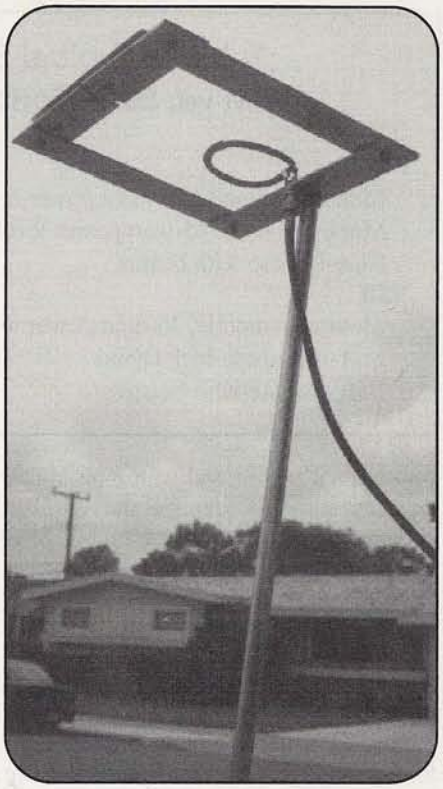
There's plenty of elbow room and privacy for "one-on-one" communications down on the SSB frequencies. In fact, it's estimated that only one of every 1,000 2-meter operators actively works sideband, so overcrowding isn't a problem. Also, 2-meter single sideband isn't channelized like FM. But most activity is centered on 144.200 MHz, the national SSB calling frequency.

Standard procedure is to make contact on 144.200 using upper sideband (USB) and then immediately switch off the calling frequency, preferably moving up or down at least 20 kHz to avoid QRMing (interfering with) others on 144.200. Don't operate voice below 144.110 MHz so you don't accidentally transmit in the CW-only subband between 144.000 and 144.100 MHz. You should also avoid operating above 144.160 MHz to protect the low-power propagation beacons that transmit continuously between 144.270 and 144.300 MHz. Finally, be courteous to FM operators by avoiding SSB operation in the FM portion of the band. And, by the same token, there should be *no FM operation from 144.100 to 144.300*—PLEASE! This area is recognized in all 2-meter band plans as being reserved exclusively for 2-meter CW and SSB weak-signal work.

Goin' Horizontal

Virtually all 2-meter SSB and CW stations run horizontally polarized antennas. This considerably reduces mobile noise in comparison to vertical antennas. Horizontal loop antennas, some round and some square, are popular for mobile use. Some mobile operators may even stack a pair of these omnidirectional antennas for added gain.

Some SSB operators use stacked loops for their home stations as well, but most use horizontally polarized beam antennas, either Yagis or quads, that can focus most of their signal in a specific direction. Vertically polarized antennas will *work* on SSB, but if you use one you won't contact many stations using horizontal polarization. This is because the *cross-polarization loss* can be as great as 20 dB, making all but the strongest of stations unreadable.



The M² "SqLoop" is another popular horizontally polarized mobile antenna choice for operating 2-meter SSB.

Turn Down the Squelch

Most 2-meter SSB mobile operators don't use their squelch. It makes things a little noisier in between contacts, but blocking out the background noise may also block out weak, but perfectly readable, signals. The nature of SSB detection in the receiver allows easy copy of weak signals that would be undetectable by an FM receiver. This is due to a combination of the reduced bandwidth of SSB signals and the different types of detector circuits used for the different modes. SSB receivers use *product detectors,* while FM signals are detected by an *Armstrong detector*, named for Major Edwin Armstrong, who developed FM.

Battle of the Modes

Repeated tests of 2-meter SSB mobile-to-mobile range compared to high-power FM mobile-to-mobile range show single sideband as the absolute winner in *every*

Table 2. Typical Simplex Range for FM vs. SSB Contacts on 2 Meters

FM	
Mobile-to-mobile, 45-watt power levels	10–20 miles
Mobile-to-base, 45-watt power levels	10–50 miles
Base-to-base with beams	50–75 miles
SSB	
Mobile-to-mobile, 45-watt power levels	50+ miles
Mobile-to-base with beams	75+ miles
Base-to-base with beams	100++ miles

test. Even a pair of 160-watt mobile FM stations couldn't manage the 75-mile contact that a pair of 40-watt mobile SSB stations with a single loop each was able to complete with ease.

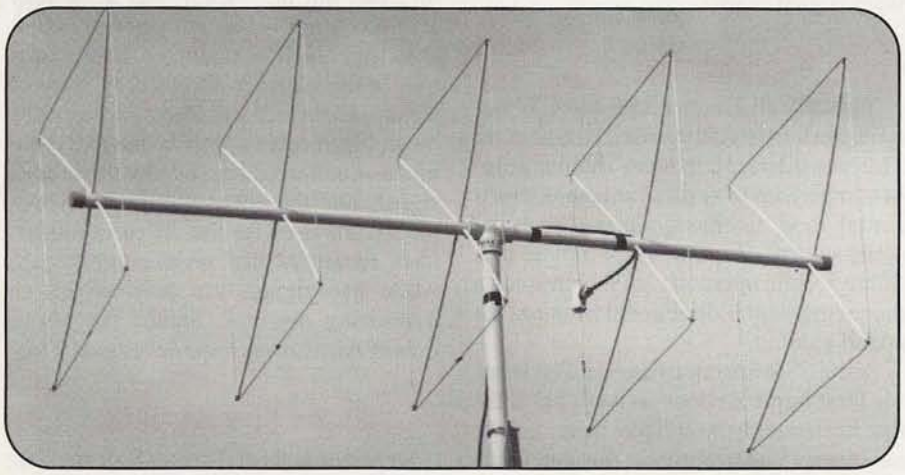
Another advantage to SSB is compliance with the FCC's new RF safety rules that take effect next year. Even though push-to-talk mobiles are exempt from the evaluation requirements, it's always wise to expose yourself and others to as little RF as possible. When you operate FM, there's a steady stream of radio frequency energy coming out of the antenna whenever the mic is keyed. On the other hand, the nature of SSB emissions is intermittent and proportional to your speech pattern. RF is transmitted only when you talk, dramatically reducing the overall amount of RF energy to which anyone is exposed.

Don't Bust Your Budget

Two-meter multimode equipment, purchased new, *is* more expensive than straight FM gear. But manufacturers are getting clever. For example, ICOM now incorporates 2-meter SSB capabilities (as well as 6 meters) in its IC-706 high-frequency transceiver. Kenwood offers the TM-255A 2-meter SSB and FM mobile, priced under a grand, plus the TS-790 all-mode base station, with both 2 meters and 70 centimeters (430 to 450 MHz), at around 2 "kilo-bucks." ICOM's new IC-821 covers the same territory and is in the same price range.

From a dollars-and-cents perspective, Yaesu has the best deal for a new 2-meter SSB set, the FT-290R, an all-mode, 12-volt mobile rig that can also be used as a portable unit. It's priced below $600—*new*. If you already have an HF rig, you can save money by purchasing a *transverter* from manufacturers like Down East Microwave or Ten-Tec. (At the moment, Ten-Tec only offers transverters for 6-meter operation).

You can also locate some fabulous used 2-meter mobile sets with SSB capabilities in the $400 range. The Kenwood 251A will be your ultimate find. It has a 2-meter SSB receiver squelch circuit that activates so smoothly that any type of weak-signal or propagational beacon will magically appear on your speaker and hold for a second to get your attention. Same thing with an older Yaesu 726 2-meter SSB base station—a slow hysteresis squelch circuit ideal for base station monitoring of distant signals. (*This type of squelch circuit is somewhat slow to respond, preventing it from quickly cycling in and out on a marginal signal and making it even more difficult to copy.—ed.)*



FM simplex contacts of 100 miles or more are possible on 2 meters with a quad antenna like this one. A quad will be vertically polarized if you feed it on the side; horizontally polarized with a feedpoint on top or bottom.

What Are You Waiting For?

So if you're looking for more excitement than just using repeaters, try FM simplex. And once you can see exactly how far you can go without going through a repeater, just imagine doubling, tripling, or quadrupling your FM range by switching over to single sideband and a horizontally polarized antenna! ■

Resources

FM transceivers for 2-meter simplex use are available from all amateur radio manufacturers. See their advertisements for contact information.

Multimode radios for SSB use are available from ICOM, Kenwood, and Yaesu. See your dealer or manufacturers' ads.

Transverters for use with HF radios are available from the following manufacturers:

Down East Microwave, 954 Rt. 519, Frenchtown, NJ 08825; Phone: (908) 996-3584

Ten-Tec (for 6 meters only), 1185 Dolly Parton Pkwy., Sevierville, TN 37862; Phone: (423) 453-7172

Antenna manufacturers offering horizontally polarized 2-meter mobile antennas include:

KB6KQ Antennas, c/o Norm Pedersen, KB6KQ, 14019 Charlemagne Ave., Bellflower, CA 90706; Phone: (310) 925-0733; e-mail: <KB6KQNORM@aol.com>

M² Antennas, 7560 N. Del Mar Ave., Fresno, CA 93711; Phone: (209) 432-8873; e-mail: <k6myc@aol.com>

Olde Antenna Labs, c/o Dave Clingerman, W6OAL, 4725 W. Quincy 1014, Denver, CO 80236

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Secrets of Successful "Rover" Operating—Midwest-Style

Mobile operating takes on a whole new dimension when you hit the road with a multiband contest station.

By Rod Blocksome, KØDAS*

Rover operation in the VHF/UHF contests is an exciting and challenging new aspect of our hobby. One reason for its growing popularity is that hams who live in apartments or housing with antenna covenants can still build a first class rover station and be competitive in the contests.

If you haven't tried roving yet, you might imagine it to be similar to mobile operation. And for a single band, it can be. But as soon as you attempt roving with multiple bands, high power, and gain antennas, the experience quickly turns into quite a challenge.

In this article we'll take a look at these challenges and describe ways to meet them head on. The techniques and strategies discussed are from the perspective of roving in the Midwest, where the landscape and population density greatly influence our rover procedures.

Exterior view of the author's rover van. A 6-meter whip and 2-meter M^2 Loop are mounted forward. At the rear, mounted on a telescoping rotatable mast, are Yagis for 144, 432, 903, and 1296 MHz. The rotator mounts on a plate bolted to the trailer hitch. A cross brace and mast bearing clamped to the top door hinges secure the upper part of the mast.

What Is Roving?

The major VHF/UHF contests include a "rover" category in which stations operate from a variety of locations with extra credit for each grid square from which they operate. Some rovers operate while on the move (usually with someone else driving), while others stop and set up more complex stations, operate for a while, then break down and move to another location. Roving has developed into a distinct contesting "art form," with its own specific station requirements.

Antenna Systems and Operating Locations

The antenna is the most important part of any station, and rover antennas fall into three categories: fixed-mount gain, rotatable gain, and small omni-directional. The small omni antennas are the easiest ones to start out with. In most instances, we're talking whips for 6 meters (though horizontal loop-type antennas are also available) and a squalo or dipole antenna for 2 meters and up.

All weak-signal CW/SSB work is horizontally polarized, but you can get away with a vertically polarized whip on 6 meters since the polarization is often scrambled by sporadic-*E* propagation. You will, however, be cross-polarized with respect to home stations working tropo or line-of-sight with horizontal Yagis, and you'll suffer a 20-dB cross-polarization loss. A horizontal dipole is better on 6 meters, although it's more difficult to mount on a vehicle. With these types of antennas, you can easily operate a single-person rover station, keeping on the move for the entire contest and maximizing the number of grids you can activate. But the range, and therefore the number of stations worked, will be limited with these lower gain type of antennas.

Challenging—and fun—rover operation really begins when you start using antennas with significant gain. Here, we're talking long Yagis, quagis, dishes, horns...anything that gives lots of gain and can be safely transported on the road. The most common approach is to build a rack out of wood or PVC pipe and secure it to the top of the vehicle; the larger the vehicle, the bigger the antenna rack can be. The antennas are rigidly mounted to

Rod Blocksome, KØDAS, is a veteran midwest rover operator. He lives in Robins, Iowa.

KØDAS/R interior. The rigs are secured to a plywood sheet laid across the rear bench seat. The operator here is Joe Culwell, WBØYFL.

this rack. Make sure it's sturdy and secure because you'll be driving down the road at 55 or 65 mph, and, if you encounter a head wind, your antenna array will see a steady wind load of 85 mph or more!

With this type of antenna array, you'll have to find operating locations with room to maneuver, since turning your vehicle is the only way of pointing the antennas. And if you have very high-gain antennas on the higher bands, the very sharp beam width can make it difficult to point the antenna with the vehicle. However, you do have the advantage of zero set-up time—you simply stop and operate. If the site doesn't allow pointing in *all* directions, you simply use it best you can and then move on to another that allows filling in the other azimuths. It's still easy for one person to operate this type of rover.

A rotatable array of high-gain antennas is the next step up the complexity ladder. There are basically three ways to accomplish the rotation: the "armstrong" method (turning by hand), which makes a two-person rover almost a necessity; a rotator, which means you must bring along a power inverter or generator to make 115 VAC; and a rotator modified with a 12-VDC motor. The "armstrong" method is the quickest for getting your feet wet with gain antennas on a rover, but it's cumbersome and slows down the QSO rate. The 12 VDC-to-115 VAC inverter powering a conventional rotator is a better route. An uninterruptable power supply (UPS) for a computer (often found at flea markets) can be a good, low-cost inverter. These usually operate off 24-VDC batteries. At first, this seems like another inconvenience, but, if you're building the rover station rather than buying a multiband appliance, you'll need to use 28-VDC surplus antenna relays. Several hams in my area—including me—run 24 VDC in our rover vehicles for just these two reasons.

The rotatable type of rover antenna array usually has a stowed configuration for travel as well as an operating configuration. For large arrays, a two-person rover team is required. Some set-up and tear-down time is involved at each stop, but, with practice, two people can usually finish the most complex system in about 15 minutes. Not only do you get the operational advantage of rotatable gain antennas, but the space you need to park your rover in is very small. We typically look for field entrances off the country roads that are just the size of the vehicle. Technically we're on public property and yet not interfering with any traffic on the road. Lacking that, we sometimes simply find a hilltop on a sparsely traveled road and pull off onto the shoulder.

Prime Power

Rover equipment that operates from 12 VDC is the most convenient. Care must be exercised not to run down the vehicle battery out in the middle of nowhere. Leaving the engine running prevents this, but runs up the fuel bill and typically gives you a dose of ignition noise to fight, especially on 6 meters. As I mentioned earlier, 24 VDC may also be required for things like surplus coaxial relays, surplus amplifiers, and a UPS to generate 115 VAC for the antenna rotator.

We run two deep-cycle 12-volt batteries in series. These heavy duty batteries cost about $70 each. The top battery in the series runs the UPS and the antenna relays and has a very light drain, making it available to jump-start the vehicle if necessary. The bottom battery runs the rest of the 12-volt station. We run the 6-meter and 2-meter rigs off the vehicle battery, as they're also used while mobile on omni-directional antennas.

Another rover, Bryan McCoy, KAØYSQ, has a switching system to put both of his deep-cycle batteries in parallel and across the vehicle charging system while driving between rover locations. If you're going to try this, though, be careful: the vehicle is capable of charging the deep cycle batteries at a much higher rate than is generally recommended for longest life. Longer runs of moderate sized wire for the charging feed can be used to drop the charging voltage at the batteries.

The 12/24-VDC power wiring and connectors are another challenge, especially if you're running any kind of real power. Pay attention to the amount of peak current drawn by your transmitters, and size the power wiring to minimize the voltage drop in the wire. This usually means working with AWG #12. We use high-quality (silver-plated) banana plugs and five-way binding posts, but they have the drawback that you must pay strict attention to the polarity as the connectors aren't polarized. The best insurance when using these connectors is to maintain a consistent color code; for example, red for +12 VDC, black for –12 VDC or ground, and another color for +24 VDC. Make sure you have "idiot" diodes after the fuses in all your equipment. Our rovers have a lot of power cabling and, so far, each rover expedition has experienced some "arcing and sparking" no matter how careful we try to be.

Rover System Issues

Several system issues tend to crop up when assembling a rover station. The first and most common is the old nemesis of HF mobile operating: ignition noise. It's usually the worst on 50 MHz and gets better as you go higher in frequency. The first line of defense is to use a rig with a good noise blanker. Examine the ground-

ing of the various parts of your vehicle (especially if it's more than a few years old), and make sure the engine block is well grounded to the chassis with flexible copper braid. Clean and tighten all ground strap connections. Shielding the distributor cap and the ignition wires is an effective solution, albeit a time-consuming and complex undertaking. "Noise suppression" or "resistance" spark plugs and wires will also help.

We've also found that, when different pieces of gear are assembled into the rover, several problems arise in the general category of RFI. The high RF fields just outside the vehicle sometimes couple into power supply leads, microphone leads, and keyer leads, causing all manner of strange behavior. These problems can usually be rectified by using RF bypass capacitors on power leads, ferrite cores on microphone cords, and careful grounding to the vehicle chassis. If a separate deep-cycle battery system is used, it must have a low inductance connection from the negative terminal to the vehicle chassis ground.

Self-interference is a another rover system issue. Rover antennas are usually closer together than a home station's. Mutual coupling between antennas can allow excessive power on one band to damage the low noise pre-amp on another. Interference between certain bands can be so severe that two rover operators can't operate simultaneously. Separating the antennas as much as possible, especially those for the lower bands, will help. If possible, use different IF frequencies on each band to avoid "IF feed-through" problems. Finally, additional harmonic filtering on the 144- and 432-MHz transmitters will help reception on the higher, harmonically related bands; for example, 432 and 1296 MHz.

Rover Strategies in the Midwest

There are many different strategies for roving, but we'll explore just three here.

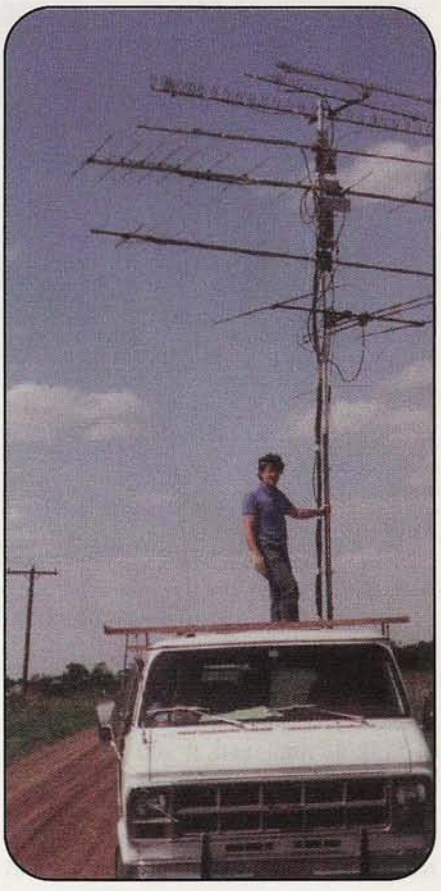
The first one is sometimes called *run and gun* and requires a lot of driving. The idea is to move quickly and operate from as many grids as possible. This means the station must require zero set-up time, and the route must be pre-planned for mostly north-south travel since the grid boundaries are closer in this direction. Highways near the grid lines are desirable because, if a band opens, you can make a bunch of QSOs and then quickly move to another grid and work the same folks again. If you can organize other rovers to run similar or parallel tracks and carry lots of bands, this strategy can also be a lot of fun on the microwave bands and generate a lot of points. If you give the driver a tape recorder for logging, he can operate one band while the second operator covers the rest of the bands as the rover is on the move. Operating near the grid borders requires good maps or a GPS receiver (*see this month's "Digital Data Link" for more on GPS—ed.*) to accurately determine your grid.

Another strategy is the *rare grid operation*. There's less driving involved, unless the rare grid you choose is a long distance from your home QTH. This approach also requires a lot of advance planning, commitment, and advertising (such as on VHF nets and the Internet) to be effective. Usually the rare grid is away from the ham population centers so you need to carry as much antenna gain and transmitter power as possible. Most of the QSOs will be long-haul contacts. You may not get the highest rover score, but your fellow VHFers will be extremely grateful for the chance to put a new grid in their logs.

But the rover strategy we gravitate towards here in eastern Iowa can best be described as *lots of bands from lots of grids*. We load the rover vehicle with as many high-gain antennas as we can safely mount, carry as many bands of equipment as we can beg, borrow, or buy, and bring as much deep-cycle battery power as we can find. We carry maps with known good sites marked (from previous rover expeditions) and sometimes a GPS receiver feeding a laptop computer. We also pack lots of coax adapters, spare parts, a few tools, plenty of duct tape, and food and drink. We operate 6 and 2 meters simultaneously while on the move. When stopped, the high-gain antennas are quickly erected and all bands are in operation. This continues until the QSO rate slows, which is our signal to move to another grid.

Problems Peculiar to Roving

A well-outfitted rover should be able to effectively compete with home stations. Consider that you can pick your operating location on a nice high hill clear of nearby trees. Your feedlines are short with low loss and you can check out the site for noisy power lines. If the site doesn't meet your expectations, you can simply move to a better one. It all sounds very attractive...so what are the drawbacks to rover operation?

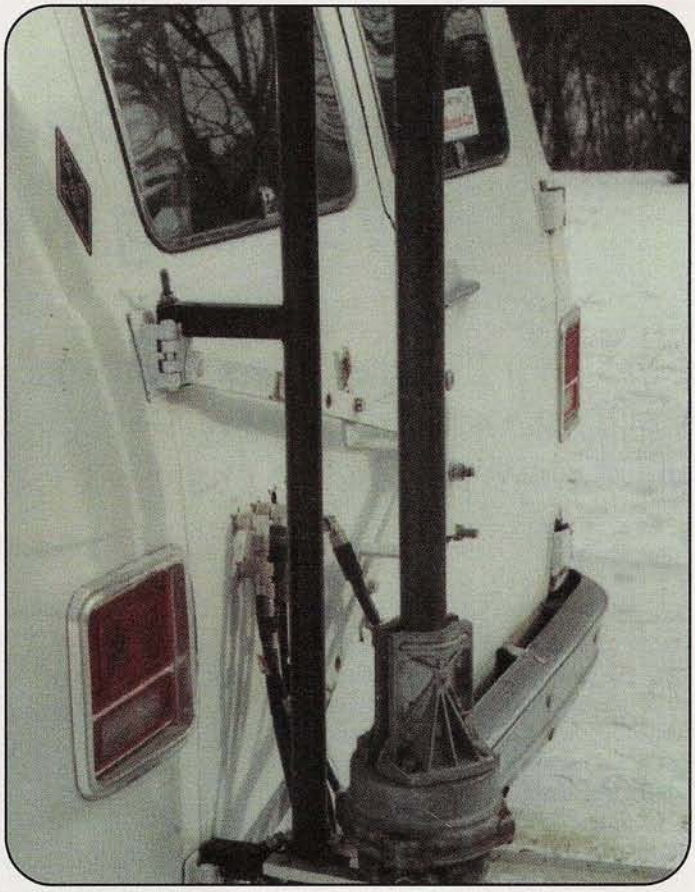


KAØYSQ/R in the northeast corner of EN40 during the 1995 June VHF contest. Bryan, KAØYSQ, says true ham priorities prevail in his setup—his equipment and antennas cost more than the vehicle!

Well, some of the best sites are on private property. Unless you obtain the owner's permission to operate on his or her land, you really should stay on public property. If you're picking sites on the fly, it's very difficult and time-consuming to locate the owners of farmland. Public parks are often low and surrounded by trees. As I mentioned before, we find that the small "turn-offs" from rural roads into farm fields are good choices, but the disadvantage is that a rover with a stack of fixed antennas doesn't have adequate room to "rotate" the antennas. That's why we use rotators on our rovers.

Also, in general, midwestern farm settlers established their farmsteads on high ground, meaning that the best rover locations are generally near them. Even when you have permission, though, farmsteads are notorious electrical noise generators.

Rear view of KAØYSQ's rover station. Bryan has a 20-foot-tall, tilt over, rotatable steel mast and carries Yagis for seven bands (50 through 2304 MHz) on the van rack. He and a trained accomplice can stop, mount all antennas (including mast-mounted pre-amps and power amplifiers for the top three bands) and be on the air in less than 15 minutes!



Close-up of KAØYSQ/R's rotator assembly. The rotator and main mast pivot at the lower door hinge. An eight-foot stub pipe, mounted to both door hinges, secures the main mast at the top. Half-inch super-flex hardlines to the antenna connect through bulkhead coaxial connectors in the rear door. No open windows for winter roving here!

Electric fences, water heaters, ventilation motors, and all manner of electrically operated farm equipment conspire against the sensitive rover receivers. Even the rural power lines are sometimes very noisy. You see why when a good, low-noise site is located it's carefully noted on the map for future rover visits!

Another problem is that the rover vehicle usually attracts a lot of attention wherever it goes. Mostly, people are just curious when they encounter you in daylight, but a rover sighting late at night, miles out in the country, will cause the farmers to be concerned. One will inevitably call the local law enforcement and they'll pay you a visit. It's best to handle these visits in your most professional manner, explaining exactly what you're doing, perhaps emphasizing the scientific aspects. A copy of your ham license and your call plates on the vehicle help establish your legitimacy.

Finally, a few words about rover logistics are in order. Besides all of the technical items covered above, the rover *operators* have their own needs that must be addressed. They are:

- Food—Take it along with you, and nothing messy;
- Sleep—There are three basic choices here: you can sleep in the rover, sleep in a cheap motel, or return home for the night. All are viable, some more expensive than others, and some minimize contest down time. Each is a compromise, and you've got to pick which is best for you; and
- Rest Rooms—There aren't any out in the country.

Hit the Road

As you can see, there's a whole realm of VHF/UHF operating fun to be had by building and operating a rover station. I wouldn't recommend an elaborate rover for your first attempt—it's better to start modestly with two or three bands at the most (*even one can be fun!—ed.*), and build up from there as you gain experience and enthusiasm. If you try to do it all the first time, there's a chance you'll become frustrated and discouraged.

"A well-outfitted rover should be able to effectively compete with home stations."

In the past, there has been a lot of debate over the rover rules, and, unfortunately, I think this controversy tended to dissuade many from trying it. The rules have now been modified and rovers compete in a class by themselves. The time is ripe for a large growth in rover operations during the contests, when plenty of rovers can really liven things up for everyone. Plus, it will increase VHF/UHF activity, giving us more ammunition for repelling attacks on our amateur bands by commercial interests.

So go out and build a rover, and then add a band or two! ■

Hams in Space: A Guide to Working Mir—Part 2

Getting a 2-meter signal up to the packet station on the Russian Mir space station is easy. Doing it RIGHT takes a bit of know-how, which we're pleased to share with you here.

By G. Miles Mann, WF1F*

Making "out-of-this-world" contact with the cosmonauts and astronauts on the Mir space station is becoming a popular pastime among many hams. And the Mir ham station is set up to encourage ease of contact.

In Part 1, we discussed Mir's station, along with the hardware, software, rig, and TNC settings you'll need to make a packet connection with the space station's *Personal Message System*, or *PMS*. In this installment, we'll walk you through the steps of making contact and what to do once you're connected. If you didn't read Part 1, we strongly recommend that you do so before attempting to contact Mir.

Picking a Pass

If you recall from Part 1, having a computer program to predict when Mir's orbits will bring it in range of your station is essential. If you weren't already experienced in using orbital prediction programs, I hope you've gotten one and have been practicing. Now it's time to make contact.

Use your computer program to select a good pass with high elevation angles. Look for a pass with a maximum elevation of over 40 degrees. These are typically the best passes because Mir will be closer to your QTH. When Mir first appears on the horizon, the satellite is 1,500 miles (2,400 km) away. When Mir is directly over your house, it is only 240 miles (384 km) away.

Kind of lonely up there...except for ham radio. This photo of Mir with the Earth below was taken from the U.S. space shuttle on flight STS-79 in September, 1996. (NASA photo S79E5355)

If you try to call Mir when it's low on the horizon, you probably won't succeed. As your signal travels along the ground, it's affected by trees, building, and hills. When Mir is high above the trees, you have a clear line-of-sight shot to its antenna. A 1,000-mile contact on 2-meters is easy if there's nothing between you and the other station.

A good pass is only 10 minutes long. Since Mir is low on the horizon during the beginning and end of each pass, you'll want to avoid calling during the first two and last two minutes of each pass. This will still leave you with a six-minute window of opportunity.

Calling Mir

Before you begin calling Mir on packet, make sure you're familiar with the operation of your packet system. Try experimenting with a local terrestrial Packet Bulletin Board System (PBBS) or connecting to a friend's TNC. Practice uploading short files from your disk to another station. See if you can log in, upload and log out in less than a minute. Once you've mastered this technique on a busy PBBS frequency, you'll be ready for Mir. Most TNC programs allow you to save packet files you've read to your disk. You can learn a lot from perusing your old data files of previous Mir passes.

When Mir first comes over your horizon, it will usually be already connected to another station. Before you transmit, monitor the data coming down from Mir. If you see any "UI" packets going from Mir to any other station, then Mir is connected to that station and is BUSY. If you attempt a connection to Mir while it is busy, you'll receive the message "RØMIR-1 Busy." When you receive a "Busy" from Mir, you must *stop* calling

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Mir-22 Commander Valerie Korzun operates the ham station aboard the Mir space station. This photo was taken by Astronaut Jay Apt, N5QWL, during the STS-79 docking mission in September, 1996. (NASA photo, courtesy N5QWL)

the Mir PMS. *Do not attempt to call Mir until you see the currently connected station log off.*

Remember: ONLY ONE STATION CAN CONNECT TO THE MIR PMS AT A TIME. If you continue your attempt at connecting to the Mir PMS while it is busy, the following will happen:

1. You will be causing intentional interference (QRM)

2. The station currently connected may not be able to log off, because of the QRM generated by your station. This will cause Mir to go into a time-out loop and prevent anyone from logging into Mir for an extra seven minutes.

3. Anyone within 3,000 miles of your station will be able to see Mir sending "DM" messages to your station. If you do not follow the correct procedures, everyone in the U.S. will know who is causing the QRM.

When to Call the Mir PMS

Set your terminal program to save all data to disk. This will help you look back and see a lot of good data. If you're unable to connect to Mir, you can read what other people were sending.

This is a sample of a station logging off from Mir:

RØMIR-1>WF1F/V [09/01/96 04:20:57]: <<I1>>: - Logged off
RØMIR-1>WF1F/V [09/01/96 04:20:58]: <<D>>: *** DISCONNECTED [09/01/96 04:20:58]
RØMIR-1>CQ/V [09/01/96 04:20:59]: <<UI>>: - Logged off "NOW YOU MAY BEGIN CALLING MIR, C RØMIR-1"

This is the only time that you can log into the Mir PMS port. You need to look for the "RØMIR>CQ/V <<UI>>" or "RØMIR-1>CQ/V <<UI>>" packet coming from Mir.

Another packet flag you should be aware of is the "<<D>>" Disconnect Request message. This packet message means that Mir is trying to disconnect from the station currently connected to this port. This is different from the "<<DM>>" Disconnect Busy message. If the station connected to Mir goes out of range, then an "Idle-timer" will force a log-out after seven to eight minutes. The Mir PMS will send several <<D>> messages to the connected station. Then Mir resets and sends out the desired "CQ , <<UI>>" packet (UI = unconnected information frame).

I've Connected, Now What?

Before you connect to Mir, you should have a plan of what you want to accomplish. Try to keep your connection time limited to two minutes or less. With this goal in mind you'll be limited as to what you can do during a single pass. Here are a few examples:

1. Log in, Send a short message to the crew (S RØMIR or just S) and log out.

2. Log in, List the last 10 messages (L

command). **R**ead a message addressed to ALL (R n, with "n" being the message number) and log out.

3. Log in, **R**ead mail to your station (R n), **K**ill your mail (K n) and log out.

After you've connected, keep your mail messages short (two or three lines). The packet TNC on Mir has a very limited amount of memory for mail messages (approximately 15,000 bytes). If someone sent mail to you via Mir, make sure to delete the message before you upload any more mail.

Please note: The Russian crews have asked users not to use the Mir PMS for mail between terrestrial stations. Also, please try not to use Mir's Help File. While there are a few differences between the Mir PMS and some of the more common PBBS systems (for example, the PMS does not support the RM "Read My Mail" command), it is similar to most PBBSs. I've included a printout of its Help File along with this article for easy reference (see "The Mir PMS Help File").

What Else Can I Do with the Mir PMS?

The Mir PMS was designed to give the crew of the space station a way to easily exchange personal mail messages with friends and family. Occasionally, the PMS has even been used to send priority traffic between the Mir crew and ground controllers. But the crew members also enjoy exchanging messages with hams around the world. You can send short mail messages to the crew members. If the crew is not too busy, you may even get a response. Mir Crew #20 routinely posted a "TGIF" message every Friday, telling the world what they had done that week. I hope future crews will keep up the tradition. Here's an example:

Posted : 02/23/96 21:58
To : ALL >
From : RØMIR
Subject: TGIF from crew #20 & #21 Mir, 23.02.96

Hello Folks! Today, at 1720 Moscow time, our follow-up crew docked to the Mir-station. We are now 5 onboard: 3 Juris, 1 Sergei and 1 Thomas. After finishing the initial checks and procedures, we already some time to celebrate their docking and, of course, to celebrate the imminent weekend.

Well, as we have mentioned before, this will be our (i.e. Juri's, Sergei's and Thomas') last TGIF-message. But we certainly will introduce this habit to the new crew.

We are looking forward to the next Friday, not only because we will be together with our wives, children and friends again, but also because we will be able to take our famous TGIF-drinks in the old fashioned way in gravity! However, for today we still would like to ask you to have a few drinks for the five of us too (it might be a tough night ahead...). Thanks a lot for all the TGIF drinks you took extra for Juri, Sergei and myself during the last half year. We hope, no one of you became addicted.

Many greetings, 73's Juri, Juri, Juri, Sergei and Thomas.

The PMS can also be used to meet people in other parts of the world. If you do send a message looking for a foreign Packet Pen Pal, make sure to include your terrestrial packet address for reply messages. Once you've made friends around the world, you should keep in touch via terrestrial packet methods and *not via the Mir PMS*. One of the few exceptions may be if you're in a boat in the South Pacific and out of range of all other terrestrial PBBS systems. Other than that, use the terrestrial packet network. (*Worldwide links via packet satellites and "wormholes" are quite reliable.—ed.)* Trying to Work All States or DXCC via Mir is strictly taboo.

The PMS on Mir is *NOT* a PBBS. You should never post "For Sale," "Equipment Wanted," "Special Event Stations," etc. types of messages on the Mir PMS.

The Mir PMS station also supports the digital repeater option called *digipeating*. This feature should be used only when no one else is using the PMS mail ports. The one station actively using the mailbox has top priority. If the mail ports are not in use and you'd like to try using Mir as an orbiting digipeater, get out your TNC manual and read the section on using the UNPROTO option. With UNPROTO, you can bounce messages off the Mir PMS and chat with people thousands of miles away. Please practice using the option on a terrestrial packet station first before going on to Mir. Two-way full connects using the Mir digipeater are possible, but extensive testing has proved this feature is not as reliable as UNPROTO. *The sysops do not want anyone to use the digital repeater for two-way connects or for APRS packets. Transmitting APRS packets or two-way connects will be considered intentional interference and will be treated accordingly.*

The Mir PMS Help File

B(ye) B [CR] disconnects you from PMS.
H(elp) H [CR] or ? [CR] displays this help file.
J(log) J [CR] displays a list of callsigns heard (optional date/time)
K(ill) K n [CR] deletes message number n (only to/from your callsign).
KM(ine) KM[CR] deletes all READ messages addressed to your call sign.
L(ist) L [CR] lists the 10 latest messages.
M(ine) M [CR] lists the 10 latest messages to/from your callsign.
R(ead) R n [CR] reads message number n.
S(end) S (callsign) [CR] begins a message addressed to (callsign). Subject: maximum 28 characters ending with [CR]. Text: End each line with [CR]. End message by typing /ex [CR] or CTRL-Z [CR]at the beginning of a new line.
SR(eply) SR n[CR] sends a reply to message n prompting only for text.
V(ersion) V [CR] displays the software version of the PMS system.

The Future of Mir

Being the most popular amateur radio satellite does have its problems. There are too many people calling the Mir PMS. With the present hardware configuration, it's just not possible to support more than one user at a time. But our experience with Mir has taught us valuable lessons for the future.

Later this year, NASA is planning to begin launching sections of the International Space Station (ISS). The new space station will hopefully have an extensive inventory of amateur radio equipment on board, although the equipment list and modes have not been finalized at this time. My wish list would include a new PMS system specifically designed to handle four simultaneous users via multiple frequencies. The emphasis would be directed at keeping the 2-meter mono-band FM AX.25 packet station available to beginners around the world. This way, we can all use the International Space Station as our stepping stone to the stars. ■

The Great Sporadic-E Debate Part 1—The Solar Connection

What causes sporadic-E? No one knows for sure, but there are several theories. WB2AMU has been studying the phenomenon for years and shares one of those theories with us. We'll examine a different theory in Part 2.

By Ken Neubeck, WB2AMU*

Sporadic-*E* is, to me, one of the last frontiers in the area of scientific studies for amateur radio. While it's generally known that metallic particles make up the sporadic-*E* clouds, there are many questions concerning the exact nature of the phenomenon.

For instance, what is the origin of these particles and why do they form into clouds the way they do? What accounts for the unique yearly sporadic-*E* patterns for locations in the northern and southern temperate zones (where there's a major peak of activity during the summer months, a lesser peak during the winter months, and valleys during the equinoxes, with the spring equinox being deeper than the fall)? Why there are differences between locations even when they're on the same latitude line in the same temperate zone? Why is *E*-skip primarily a daytime phenomenon, with only some openings occurring during the early evening hours and very few beginning after midnight local time? And how do we explain the variations to our "normal" expectations, such as the unexpected openings that can occur during the equinoxes?

It's difficult to come up with one theory that explains all these nuances. So far, only one thing seems certain: sporadic-*E* is not a simple phenomenon and is almost certainly based on more than one geophysical factor.

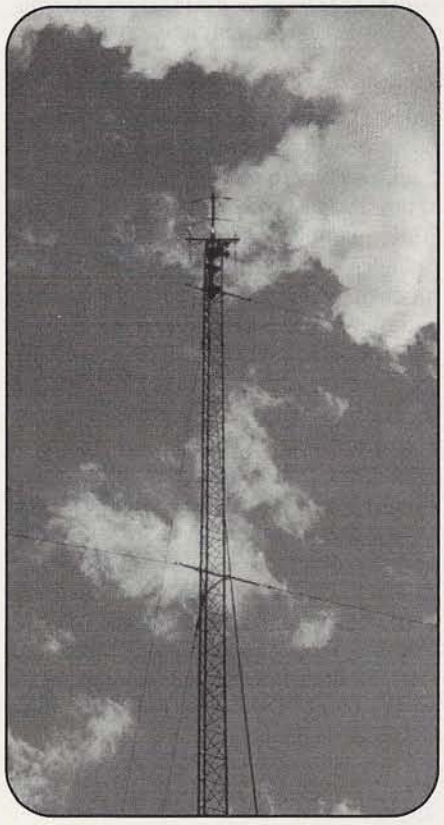
Years of Research

I've spent the last eight years researching sporadic-*E* propagation, primarily on 6 meters. Since 1993, the sunspot count has dropped significantly to where *F*-skip on six is virtually non-existent, leaving sporadic-*E* the predominant propagation mode on the band until the sunspots return. Luckily, this means we can make precise observations without confusing sporadic-*E* with other propagation modes.

"...one thing seems certain: sporadic-E is not a simple phenomenon and is almost certainly based on more than one geophysical factor."

In addition, I've been studying long-term ionosonde data from a number of different temperate zone locations. (*Ionosondes are special wideband radio transmitters used to measure RF reflectivity in the* E *and* F *layers of the ionosphere. See "A Visit to an Ionosonde Station."—ed.*) Looking at data from both sources over a period of one or two 11-year sunspot cycles clearly shows the basic yearly pattern of the sporadic-*E* phenomenon.

Both the 6-meter observations and ionosonde data have been consistent with each other[1], and several things can be determined from them in addition to the yearly pattern already described (see Figure 1). First, there's very little deviation from year to year in the number of summer days during which sporadic-*E* occurs. Typically, we'll see 60 to 70 days of 6-meter sporadic-*E* activity in the northern temperate zone from May to August, with over 20 days of occurrence each in June and July. The ionosonde data, which measure sporadic-*E* on frequencies above 27 MHz, show even higher numbers during this time.



Antenna array at the Boulder, Colorado, ionosonde station. The antennas create a conical pattern used for "taking pictures" of the ionosphere directly overhead. (Photos by the author)

Scientists strongly suspect that the increased intensity of the sun's ultraviolet rays due to the Earth's positioning is a factor in the high amount of sporadic-*E* during this period. Figure 2 shows a curve developed by Campbell[2] that shows the yearly solar radiation for different lati-

Ken Neubeck, WB2AMU, is a regular contributor to CQ VHF, *and author of* Six Meters: A Guide to the Magic Band *(Worldradio Books).*

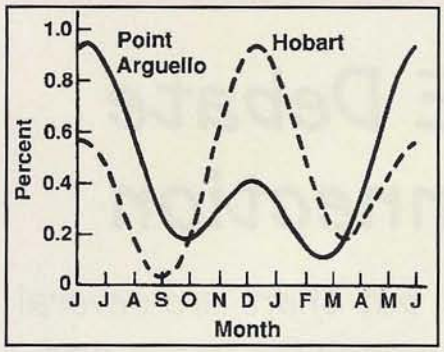


Figure 1. The basic curve for predicting monthly sporadic-E occurrences in the course of a year. It is based on 11 years of data for each of two ionosonde stations, Point Arguello, California, in the northern hemisphere, and Hobart, Tasmania, in the southern hemisphere. The patterns are six months out of phase between the locations, tracking with the seasons of the year.

tudes. It appears that when the intensity factor goes over a certain level, the curve tracks well with the four-month summer sporadic-*E* season of either temperate zone. I believe that when the daily solar radiation falls below this level, it's not much of a factor on sporadic-*E* formation and other factors take over.

I think of summertime sporadic-*E* much like a school of salt-water bluefish feeding on bait fish in a particular area. When there are sufficient quantities of bait, there's a wild frenzy of activity. Bluefish may linger in an area for several days while the bait fish are still there; once the bait moves on, the bluefish disappear as well. Likewise, for sporadic-*E*, if all of the conditions are present for an opening, there will be frenzied activity. And, if conditions are sustained, activity on the band may linger for a few days before disappearing.

Sporadic-E Cloud Formation

The formation of sporadic-*E* clouds is basically a group ionization process of particles in a given area. It's hard to say how long this process takes since we don't know how long certain conditions must be present before the cloud can form. For example, it's not uncommon to have three or four days during the heat of the summer with no sporadic-*E* activity at all. Is an inhibiting factor present? No one knows for sure.

The origin of the metallic particles is also uncertain. Some years ago, rocket probes into sporadic-*E* formation determined that the particles are typically composed of iron, magnesium, silicon, sodium, and other metals. Some scientists strongly believe that many of these particles are the result of *ablation* (vaporization) of meteors as they enter the Earth's atmosphere. However, other sources—such as the sun—cannot be ruled out, and a number of studies have been conducted on this theory as well, also with inconclusive results. Whatever the source of the particles, it's generally believed that the process of sporadic-*E* formation is not instantaneous; rather, that the cloud forms from a reservoir of particles that have been in the *E* region for some period of time.

The shack's not great, but what a tower! The NOAA ionosonde station outside Boulder, Colorado.

Tracking Sporadic-E

Here in the northern hemisphere, the winter months of November through January show significantly lesser amounts of sporadic-*E*, as measured by both radio and ionosonde sources. However, since wintertime openings tend to be of shorter duration than those in summer, there may actually be more of them than the data indicate. Ionosonde readings are recorded only at the top of the hour and amateur radio observations generally are not continuous, so many brief openings may never be recorded. Those wintertime openings that *are* noticed can be very intense. One recent example was the Christmas opening of 1995, when there were five consecutive days of activity from December 23rd and 27th.

At the other end of the scale are the months of March and September—the equinox months—which are generally the worst time for sporadic-*E* activity. Typically, a short opening may be seen in September, but both sources of data show that events in March are very, very rare...until the time of the sunspot minimum, that is. Both ionosondes and ama-

teur radio observations show unusual activity at these times.

The most recent solar minimum occurred during the latter part of 1996. I remember catching a big 6-meter opening, which lasted over two hours, on February 20th of that year. In my previous five years on 6 meters, I had never seen an opening that late into the winter season. So something unusual indeed seemed to be happening. But that wasn't all.

Unusual Springtime Openings

During March of 1996, some pretty intense openings were observed by U.S. radio amateurs and were also recorded by the ionosonde at Boulder, Colorado. When I came home from work on the afternoon of March 19th, I turned on my 6-meter rig to 50.125 MHz as part of my daily routine. I heard nothing on either 10 or 6 meters until shortly after 5:00 p.m. Then I started hearing some weak signals breaking through. I almost fell out of my chair when I heard W5FF from New Mexico (I live on Long Island, New York)! It was not only a sporadic-*E* opening but a *double-hop* one at that! I worked stations in Iowa, Nebraska, Indiana, and Minnesota. The opening became so strong that I worked most of the stations using 10 watts and a dipole! The Internet was buzzing with activity throughout the country, with reports of equally amazing results with stations in New England working into California.

This was the first real strong springtime sporadic-*E* opening that I've observed on 6 meters in my seven-plus years on the band. What happened to make such an extraordinary event occur? A number of hams pointed out some high X-ray activity that occurred during that month, but that didn't explain other strong openings that occurred in February and April. Interestingly, increased springtime sporadic-*E* activity was recorded in ionosonde data not only in 1996, but also during other quiet sunspot years, such as 1977 and 1978.

Here Comes the Sun

What accounts for increased sporadic-*E* activity during the solar minimum? And is there a direct correlation between sporadic-*E* and activity from the *active zone* areas of the sun, where most sunspot activity occurs? Perhaps there are other types of energy besides the sunspots themselves that might charge particles in Earth's atmosphere into sporadic-*E* clouds?

During a trip to Boulder in June of 1996, I obtained not only some ionosonde data, but also several years' worth of *Kp index* readings, which record geomagnetic activity, or changes in the Earth's magnetic field resulting from interaction with particles from the sun (*see last month's article on aurora—ed.*). In reading a number of books on the sun, I'd noticed that there's a higher incidence of geomagnetic storm activity during the equinoxes (when sporadic-*E* is at its lowest) than at other times of the year[3]. Similarly, the months of December and July—peak *E*-skip season—have the lowest incidence of geomagnetic storms. Could these storms of solar particles inhibit *E*-cloud formation?

It appears from the data that geomagnetic storms on Earth are strongly tied to sunspot activity in the active zone areas of the sun. Data show that the Earth is most affected by this activity during the equinox months. This is probably because of how the Earth is positioned in relation to the sun's active zones (see Figure 3), as those zones cross the plane of the Earth's equator during the time of both equinoxes.

When geomagnetic activity reaches storm levels, it does appear to inhibit the formation of sporadic-*E* as well as create a higher noise level on many bands. It's very rare for a 6-meter operator to hear

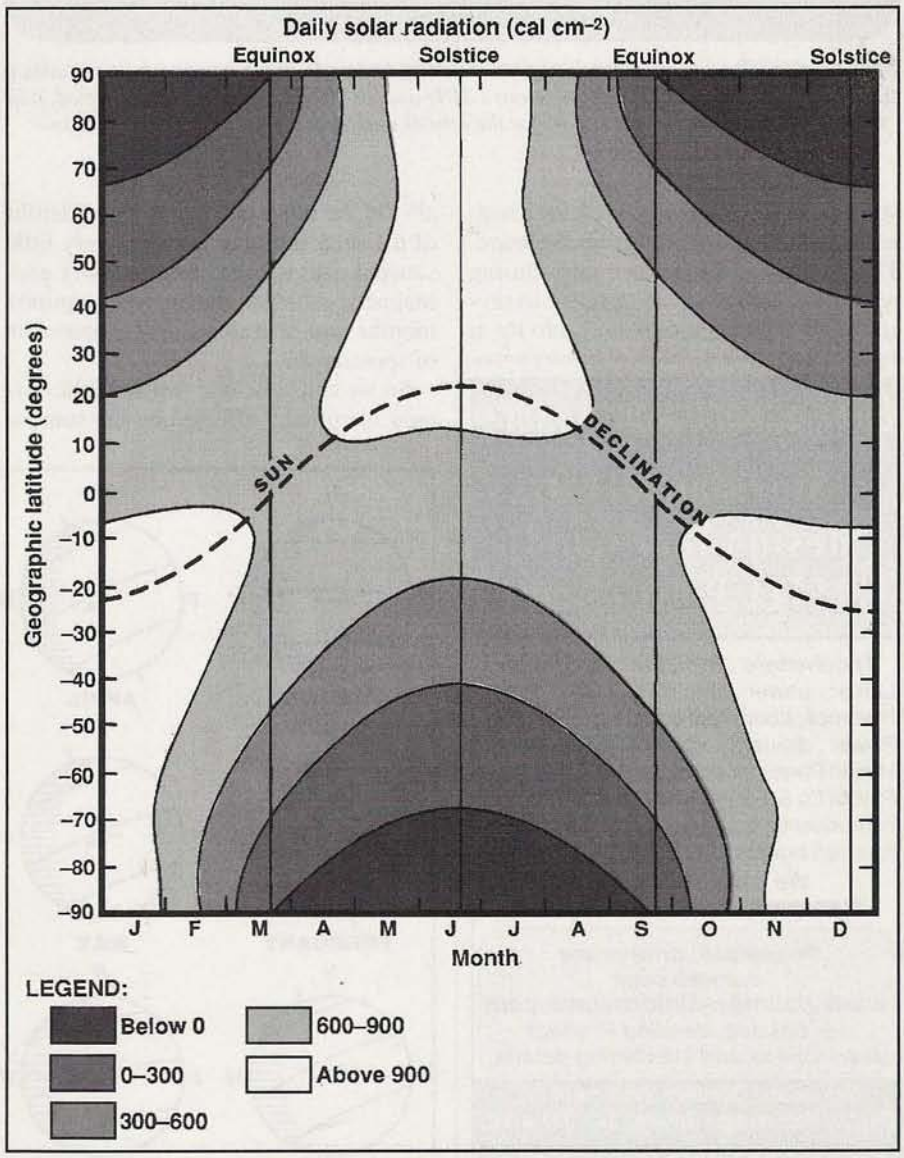


*Figure 2. Based on a figure developed by Campbell (see Note 2), this graph can be used to show that solar radiation exceeding 900 calories/cm² tracks well with summer sporadic-*E *seasons. For example, stations at 40° north latitude typically see moderate to intense levels of sporadic-*E *between May and August.*

Interior of the Boulder ionosonde station. Looking basically like a hamshack, it includes a transmitter that sends out signals between 1 MHz and 20 MHz over a two-minute period, four times per hour. The receiver listens for the echoes and feeds information to the computer.

"I think of summertime sporadic-E much like a school of salt-water bluefish feeding on bait fish in a particular area. When there are sufficient quantities of bait, there's a wild frenzy of activity."

strong sporadic-*E* when there's very high geomagnetic-related noise on the band. There have been some summers during which a major solar flare resulted in several days with no sporadic-*E* activity at all. On the other hand, during the depths of the solar minimum, there's very little sunspot activity, resulting in fewer geomagnetic storms during the equinox months and, therefore, less suppression of sporadic-*E*.

So we can conclude that sporadic-*E* is only marginally affected by the sunspot cycle. And any effect that *does* occur is indirect (for instance, high geomagnetic activity caused by energy from the active zones) rather than the direct effect of the sunspots themselves.

Plus, it does not appear that any other types of solar radiation are involved, since all types of energy from the active zones seem to follow the sunspot cycle. And, as we've seen, sporadic-*E* activity is reasonably consistent throughout the solar cycle.

Making Mathematical Sense of It All

If the Earth were not affected as it is by geomagnetic storms, it's likely that the curve in Figure 1 would be a simple cosine or sine curve in which the peak occured at the June solstice and the valley

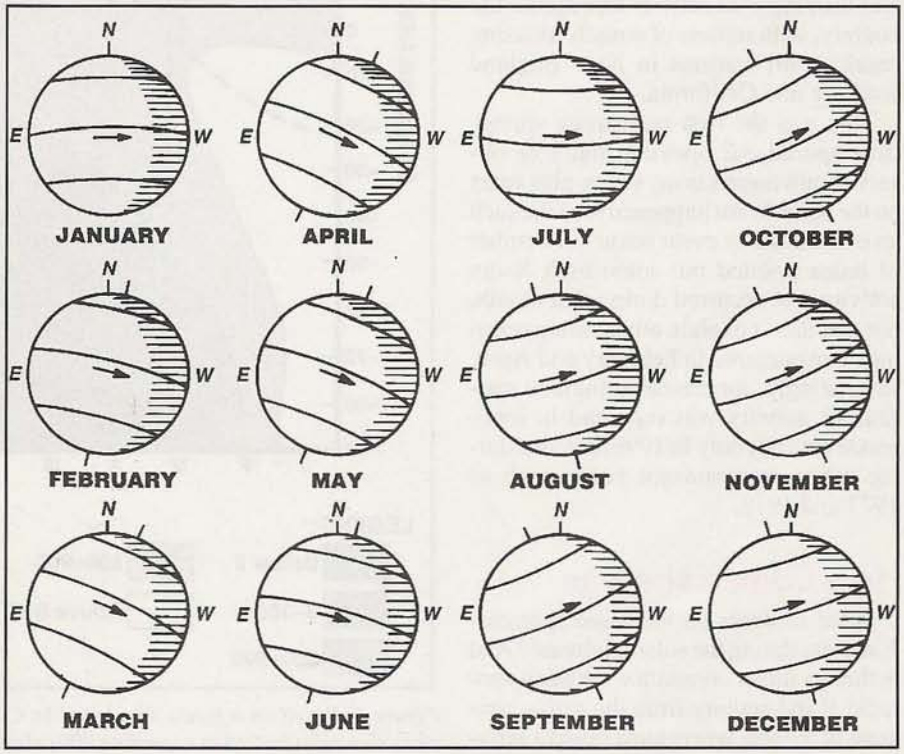


Figure 3. A pictorial representation of the sun's active zones as viewed from Earth, based on material in Stetson's Sunspots in Action *(1948).*

occured at the December solstice. The curve would then simply be based on the intensity of the sun, much like the seasons of the year.

However, the detrimental effects of higher geomagnetic activity in the equinox months can be roughly depicted as a trigonometric curve such as $cos^2 X$ where there are two valleys and two peaks during each yearly time period. The curve is rough since a lot of geomagnetic activity is based on solar flare activity, which itself is somewhat random. This fact, coupled with the fact that the maximum exposure occurs during the equinoxes, underlies why the curve is not necessarily smooth.

Figure 4 shows a curve based on the last 10 years of monthly estimated *planetary A* value averages collected from nine locations in the U.S. and Canada. The estimated planetary A values are based on the Kp index and are an indication of geomagnetic storm activity. It's significant that this curve is the negative complement of the curve for Point Arguello, as shown in Figure 1 (that is, when a peak in sporadic-*E* occurs in June and December, there's a dip in geomagnetic activity at the same time). Likewise, during the peak geomagnetic activity of the equinoxes, sporadic-*E* activity is in a valley. It appears that the negative complement of the yearly geomagnetic activity curve of Figure 4 by itself resembles the sporadic-*E* curve; however, an additional solar intensity curve (as shown in Figure 2) is added to account for the significant summer season. The end results are the curves shown in Figure 1.

Other Factors Must Be Present

Decreased amounts of geomagnetic activity alone may not be enough to cause greater sporadic-*E* activity. Other factors must be at work as well, including the amount of metallic particles, windshear activity in the upper atmosphere, and solar ionization. All of these have been shown to be necessary in the formation of sporadic-*E* clouds.

Conversely, it seems likely that in fall and spring there must be additional inhibiting factors because the absence of sporadic-*E* is near total. It may be that the angle between the Earth and the sun (with respect to their equators) may be a negative factor in windshear activity. Perhaps, the unique positioning of the magnetic fields of the two bodies causes changes, either in wind direction or velocity (both windshear components are major factors in the formation of sporadic-*E* layers).

A Thunderstorm Connection?

Many hams tout the idea that thunderstorms cause sporadic-*E* propagation since the two are seen frequently during the summer months. But thunderstorms also appear during the spring and fall equinoxes when there is little sporadic-*E* propagation, and there are regular openings during the winter months when thunderstorms are scarcer. Plus, the distances involved are just too great. Sporadic-*E* occurs about 70 miles above the Earth, while most thunderstorms are less than four or five miles above the surface. Others point to the "reverse lightning" phenomenon that has been photographed

A Visit to an Ionosonde Station

Ionosonde stations measure the reflectivity of the ionosphere through the transmission and reception of radio waves that bounce back to Earth. They provide valuable information on various phenomena, such as sporadic-*E*, aurora, and F2 skip, seen on HF and VHF bands. These stations are scattered across the world.

I recently had the opportunity to visit the one in Boulder, Colorado. This station is part of the National Geophysical Data Center (NGDC), which is a branch of the National Oceanic and Atmospheric Administration (NOAA), a federal agency that also runs the National Weather Service. At Boulder, I had a chance to take a look at some of their data, meet the people who process it, and observe demonstrations of some software packages developed at NGDC.

I was met at NGDC by George Talarski, one of the physicists with whom I've been dealing over the past few years in my research on sporadic-*E* propagation. One of his jobs at the station is to process ionosonde data, not only from Boulder but also from sources located around the world. George took me to the ionosonde station, two miles from the NGDC building on a hill at the base of the Rocky Mountains.

The station is essentially a small house-like structure with a tower attached to it; its antenna is positioned to send a conical pattern directly overhead into the ionosphere. Prior to my visit, I'd imagined the station would be housed in some elaborate government building, so it was surprising to see it was a humble looking house (essentially a ham shack!)

The ionosonde station is visited daily by the station master, who verifies that the equipment is working properly and retrieves the computer data for processing. This data has been collected at Boulder since the late 1950s.

What Do Ionosondes Do?

Let's take a look at what goes on at the ionosonde station and how the information collected here can be of use to hams.

An ionosonde station sends signals into the ionosphere every quarter of an hour, using a commercial transmitter with a power output in the order of kilowatts, that sweeps from 1 to 20 MHz during a two-minute interval. The antennas point the signals straight up, and the reflections of these straight up-and-

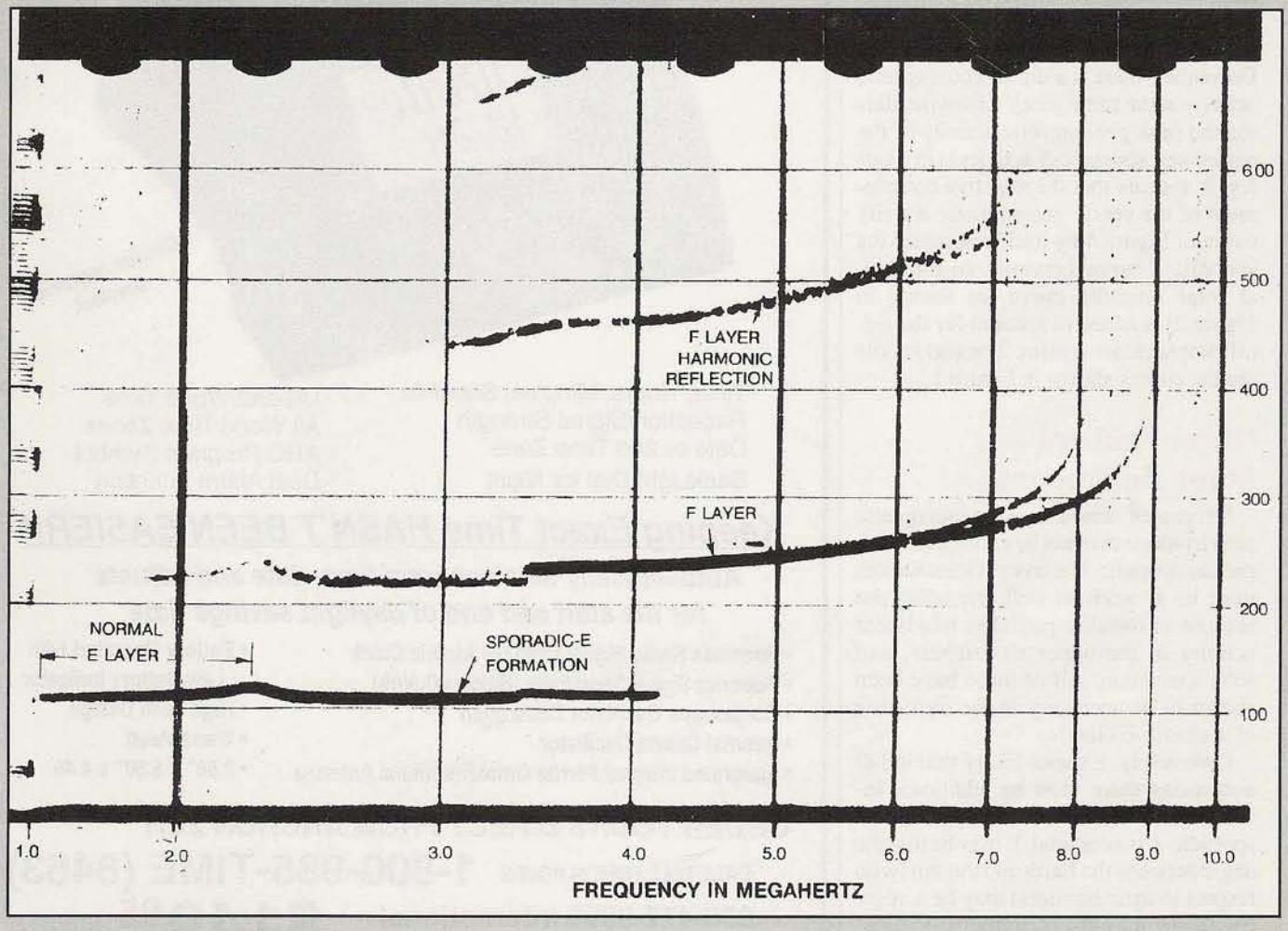


Figure 5. An "ionogram" showing ionospheric activity at different frequencies. This is what is produced by ionosonde transmissions, such as those measured at the station the author visited in Boulder, Colorado.

down signals are captured by a receiver that feeds data into a computer database and records the reflected signals onto 35-mm film called ionograms. Only the readings at the top of the hour are used in the main database, but quarter-hour data can be retrieved for special studies.

These transmissions on MF and HF frequencies are very useful to VHF operators because we amateurs communicate with signals that come down on an angle, rather than straight up and down. And there's a mathematical relationship between vertical signals on the *critical frequencies* at which the ionosondes transmit and the *maximum usable frequency,* or *MUF*, that tells us how high up in frequency we can expect to have ionospheric propagation with angled signals. The "magic number" in the mathematical relationship is 5.4. The MUF can be determined by multiplying 5.4 times the top critical frequency at which there are reflections. In other words, if the top frequency reflected by the ionosonde is 10 MHz, the MUF at that time is 10 x 5.4, or 54 MHz, indicating an opening on 6 meters.

Figure 5 is an ionogram that was taken at the ionosonde station in Boulder, Colorado, on March 3, 1978. The information is displayed on a semi-log scale with the frequency in MHz as the X axis and the height in kilometers as the Y axis. There are many types of sporadic-*E* formations which are identified with various labels (such as *Y-type* or *slant* sporadic-*E*), so it takes a bit of practice to read an ionogram. Fortunately for us, the folks at Boulder identified what's what on this particular ionogram. Note that the sporadic-*E* formation in this picture drops off just past 4 MHz. Using the magic number of 5.4, that gives us an MUF for sporadic-*E* propagation of about 21.6 MHz. So 15 meters was open at that particular time, but 6 wasn't.

I am grateful to George Talarski and the staff at NGDC for taking the time to show me the facility and for answering my questions. It was a real pleasure to see some of the faces that make up NOAA. I feel that the combined efforts of hams and scientists will prove helpful in further defining and understanding the sporadic-*E* phenomenon.

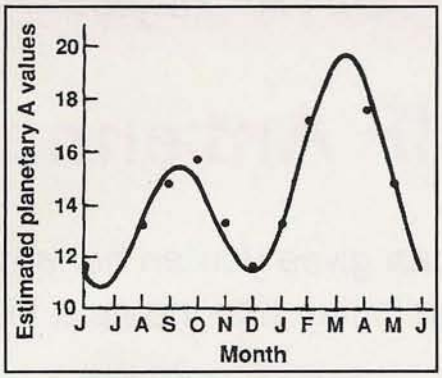


Figure 4. Ten-year average of estimated "planetary A" values in North America, plotted through the course of a year. The graph shows peaks of geomagnetic activity in March and September, months that traditionally have the lowest levels of sporadic-E propagation.

recently from space, but there is no proof that these upward flashes from the tops of thunderheads travel over 60 miles! What seems more likely to me is that some thunderstorms may be an indirect indication of the conditions in the *E* region of the ionosphere.

The Sum of Its Parts?

Simple geomagnetic factors alone may explain some things, such as why there are differences in sporadic-*E* between locations in the same temperate zone and at the same latitude. The Earth is not a perfect sphere and, consequently, geomagnetic factors for different parts of the Earth are different as well.

For example, South Africa is well inside the southern temperate zone, yet it sees very low amounts of sporadic-*E* throughout the year. Meanwhile, Japan, which is well inside the northern temperate zone, sees tremendous amounts of sporadic-*E* activity. Perhaps the physical composition of the land mass underneath the geomagnetic field is a factor (Japan's soil has a low mineral content while South Africa's is very high).

"...we can conclude that sporadic-E is only marginally affected by the solar sunspot cycle. And any effect that does occur is indirect (high geomagnetic activity caused by the active zones) rather than the direct effect of the sunspots themselves."

"...the ingredients for a sporadic-E opening seem to be reduced geomagnetic storm activity, the presence of windshear activity, ultraviolet exposure from the sun, and the right amount of metallic particle composition in a specific area."

But what explanation covers the greater picture of sporadic-*E*? The only reasonable one I can come up with to cover the stable yearly pattern as well as the predictable variations—such as increased activity near the equinoxes during quiet sunspot years—is the *interaction* of varying levels of geomagnetic activity (influenced by solar activity) with the daily ultraviolet ionization of metallic particles in the *E* region. The ingredients for a sporadic-*E* opening seem to be reduced geomagnetic storm activity, the presence of windshear activity, ultraviolet exposure from the sun, and the right amount of metallic particle composition in a given area.

I wish to thank Mark Schmidt for his help in preparing the graphs used in Figures 1 and 3 for this article. Also I wish to thank George Talarski and the National Geophysical Data Center (NOAA) in Boulder, Colorado, for the scientific data that was used in developing the various figures in this article.

Notes:

1. Neubeck, Ken, "Using the Combined Resources of Amateur Radio Observations and Ionosonde Data in the Study of Temperate Zone Sporadic-*E*," *Journal of Atmospheric and Terrestrial Physics,* Vol. 58, pp. 1355–1365, 1996.
2. Campbell, W., "Field Variation During Quiet Solar Conditions," *Geomagnetism,* Vol. 3, 1989.
3. Increased geomagnetic activity during the fall and spring equinoxes was first pointed out as a possible factor by Ernest L. Smith in 1957 in his book, *Worldwide Occurrence of Sporadic-E* (National Bureau of Standards Circular #582).

*Part 2 of our "Great Sporadic-*E *Debate" will feature arguments* in favor *of the thunderstorm connection, including an experiment which the authors say proves there's a definite link—but which turned up an unexpected twist.—ed.*

A VHF/UHF Antenna in a Pipe

This easy-to-build antenna gives you an honest 3 dB gain on 446 MHz—and the whole thing fits inside a piece of PVC pipe!

By Van Field, W2OQI*

Looking for an efficient antenna that won't call attention to itself? Look no farther. This simple, inexpensive antenna for UHF or VHF bands is easy to build and fits entirely into a PVC pipe. Everything but a coax connector and a short piece of cable comes from your local building supply or hardware store.

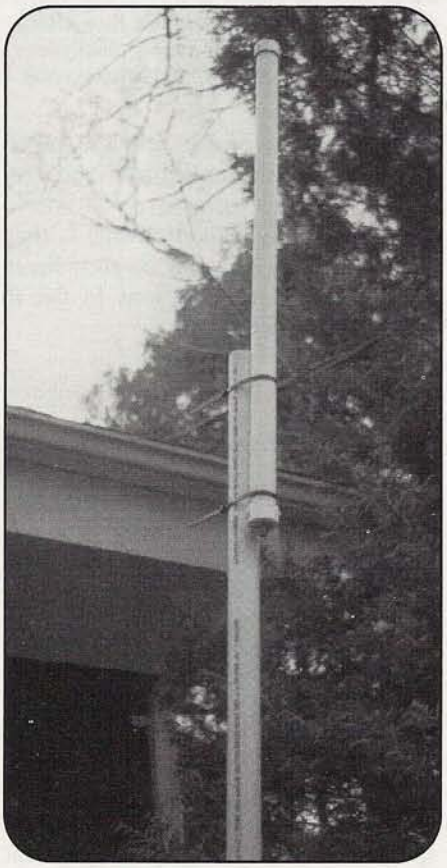
The antenna is called a *double extended zepp*. It consists of two 5/8-wavelength radiating elements, a phase-reversing stub, and a 1/4-wave linear transformer matching section—all cut from a single piece of #14 solid house wire. When the wire is cut and bent into shape and the feedline is attached, the whole antenna can be put inside a PVC pipe for easy and inconspicuous mounting.

How the Antenna Works

Antenna gain on transmit comes from concentrating the signal on the horizon. A gain figure of 3 decibels (dB) means that you are effectively doubling your power at the greatest line-of-sight distance from your antenna.

If two 1/2-wave dipoles are fed in phase, end to end, the gain (signal at the horizon) increases as the distance between the two antennas is increased until they are 5/8 wavelength apart. If they're farther apart, the signal splits and goes where it's not wanted. In the case of the double extended zepp, the 5/8-wavelength separation is accomplished by splitting the 1/4-wave "hairpin" phasing stub and bending half of it to be in line with the dipoles (see Figure).

This is not a 50-ohm antenna, so it's necessary to insert an antenna tuner between the end of the antenna and the 50-ohm coax to match impedances. In this case, the antenna tuner is a linear transformer called a 1/4-wave stub. That may sound technical, but it's really just a piece of wire cut to a 1/4-wavelength at the operating frequency. It's tuned by its length and the 50-ohm impedance match is obtained by adjusting the position of the coax tap (the point at which the feedline is connected). The SWR can be adjusted by moving the tap a bit, but the dimensions given should be close enough.



The double extended zepp antenna, mounted and ready for on-air testing. (Photos courtesy of the author)

If this antenna were to be used in the horizontal plane, then the 1/4-wave stub at the end wouldn't be used. In its place, the coax would be attached to the little 1/8-wave stub in the middle of the antenna. This gives a better distribution of RF in both halves of the antenna, making it *balanced*; but that won't work if the antenna is vertically polarized. The coax hanging down next to an element would detune the antenna and destroy its omnidirectional pattern. It's, therefore, more convenient to feed the bottom and keep the coax out of the antenna pattern.

Commercial antennas usually use coils to replace the stubs. They can be less efficient and it can be harder to calculate the number of turns needed for them. The linear approach is easier for the home builder. Now, let's build the antenna.

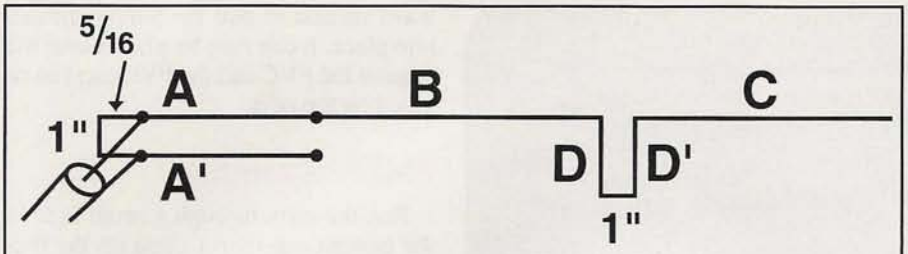
Construction Step-by-Step

If you're an old hand at putting things together, these instructions may be too long and detailed. But, in case you're new at this, I've tried to include enough detail to get you over any building bumps. Refer often to the illustration and measure all lengths CAREFULLY. It's also a good idea to work with a friend and make one each; plus, buying materials for two antennas at once will reduce the cost of each one, since there's bound to be stuff left over if you build just one.

The dimensions of the antenna I'm about to describe are based on a center frequency of 446 MHz (values are also provided in the Figure legend for 223 and 146 MHz, but the measurements in the text are for 446 MHz).

The first thing you'll need is about 53 inches of wire. It might be hard to buy #14 wire in less than a 100-foot length, but you can try to find an electrician who might come up with a scrap piece for you. You can also use Romex and strip the wire out of it. The ground wire will be

*Van Field, W2OQI, has written on antenna topics for a variety of ham radio publications.



Double Extended Zepp Antenna Measurements

Measurements of various parts of the double extended zepp antenna, keyed to diagram. Dimensions are included for 223 and 146 MHz as well as 446. On these two lower bands, it will be necessary to cut the PVC and insert a PVC TEE to extend the hairpin (D,D') straight out.

MHz	A,A'	B,C	D,D'	TAP*
446	6-3/4	15-3/4	3-1/8	5/16
223	12-9/16	31-1/2	6-1/4	3/4
146	19-3/16	48	9-9/16	1-1/8

measurements in inches
*measured from closed end of hairpin

Figure. The double extended zepp antenna consists of several parts. Dimensions vary according to band as indicated.

"Antenna gain on transmit comes from concentrating the signal on the horizon. A gain figure of 3 decibels (dB) means that you are effectively doubling your power at the greatest line-of-sight distance from your antenna."

bare and can be used to save stripping off internal insulation from the other pieces. Bare ground wire can also be purchased separately. The larger the diameter, the better it is electrically, but it becomes harder to work and solder. If the wire has insulation, one end has to be made bare for 15 inches (it'll be used for the 1/4-wave hairpin at the bottom end). Don't bend the 1/4-wave stub into shape yet (in fact, as you'll see, that comes last).

Start with the first 5/8-wave section. Measure exactly 15-3/4 inches and make a right-angle bend. This bend starts your 1/8-wave hairpin. At 3-1/8 inches, make another right-angle bend, then a third bend one inch later. This makes a hairpin loop with a one-inch-long square bottom. Continue bending, making the bends sharp by using a pair of pliers (electrician's preferred). After you've made all the bends, the top of the 1/4-wave stub should be a little longer than 6-5/16 inches. Trim it to exactly 6-5/16 inches.

Now, measure 5/16 of an inch up on the inside of the bend, then use a soldering iron or gun to "tin" (coat with solder) the area on both sides. Make sure the solder flows around the wire and doesn't leave "balls" of solder. If this can't be done, your iron may not be heavy enough. You want a thin, even coat of solder on that segment of the wire.

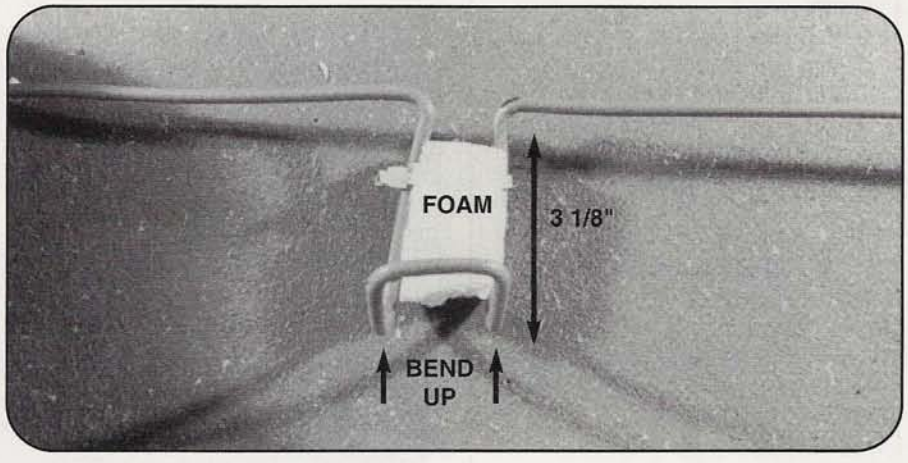
Attaching the Feedline

Carefully strip one end of a short piece* of RG-58/U coax. (I find it easiest to take off the outer vinyl, take a sharp pick, and carefully unbraid the outer conductor for a good inch. Then I twist the braid together to make a wire.) Next, strip about a 1/2-inch of insulation from the inner conductor. Wrap the inner conductor around the tinned portion of the long wire exactly at the 5/16-inch mark you measured. Then wrap the twisted braid around the parallel short wire opposite the inner conductor and solder. Make sure that a piece of the braid wire doesn't short to the center conductor at this point and that the solder flows to give you a good connection; remember, heat the wires, not the solder. To keep the weight of the coax from pulling the solder connection loose, you can fasten the coax to the center of the bottom of the stub with a tie wrap as a strain relief. Make sure the vinyl insulation is on the coax where it touches the bottom of the stub.

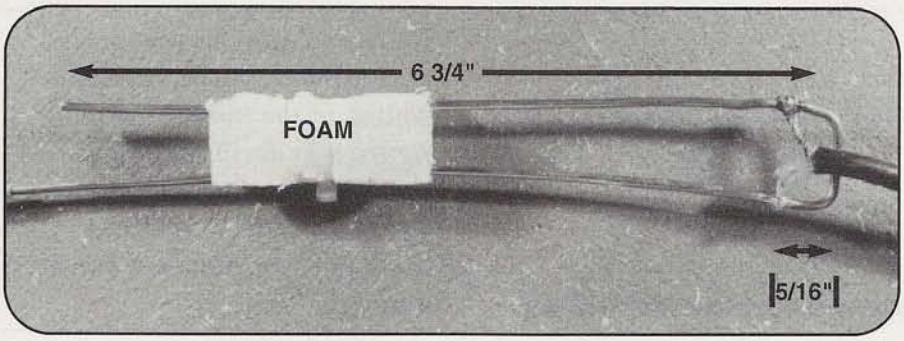
(*The length of this piece of coax is dependent on how long you make the bottom of the PVC pipe that holds the antenna. This portion is the area where you grab the pipe to mount it. It can be left five or 10 feet longer to act as a mast, but be aware that long lengths of PVC tend to be rubbery and bend in the wind.)

An Antenna in a Pipe

The next step is to bend the 1/8-wave hairpin loop in such a way that it will fit



Detail of the 1/8-wave hairpin matching section in the middle of the antenna. The dimensions shown are for the 446-MHz version.



Detail of the 1/4-wave matching stub at the bottom of the antenna. The foam insert helps stabilize the wires. The feedline is connected 5/16 inch from the bottom in the 446-MHz version. (For horizontal polarization, the 1/4-wave stub is not used and the coax connects to the 1/8-wave stub at the center.)

into the PVC tubing and yet still be a stub. Take something round like a soda bottle and bend both sides of the loop together, keeping the sides parallel so that it will fit into the PVC. Your antenna is now finished, except for the final connections and mounting in the PVC holder.

There's one important precaution to take when sliding the antenna into the PVC pipe: The 1/4-wave hairpin stub will be detuned by the PVC unless it's held in the center with some foam, such as that used to insulate pipes (see photo). It's not necessary to do this to the antenna itself, just to the 1/4-wave stub. (The foam can be used to support the 1/8-wave section on 223 or 146 MHz if the antenna is constructed for these bands.)

"If you're an old hand at putting things together, these instructions may be too long and detailed. But, in case you're new at this, I've tried to include enough detail to get you over any building bumps."

If it's too difficult to bend the 1/8-wave stub so that it slides in easily, try using a piece of scrap polyfoam, like the stuff your rig came packed in. Cut a small piece to fit in the middle and then use a tie wrap to hold it in place. Do the same thing with the 1/4-wave stub. Cut a piece of foam to cover the stub and fit it on, placing it about 2/3 of the way up from the bottom. Sometimes it helps to tie a string to the top 5/8-wave section to pull the whole antenna into place. It can then be placed over the edge of the PVC and the PVC cap can be glued on top of it.

Parts List

5 feet of #12 or #14 bare solid copper ground wire (insulated may be used, but it requires stripping away some of the insulation. See text.)
1-1/2-inch PVC (length depends on band)
1/2-inch foam pipe insulation (comes in a package of four 3-foot lengths)
2 PVC end caps
PVC glue or sheet metal screws (see text)
RG58/U coax, enough to reach a foot beyond the end of the pipe
RG-213/U or 9913 coax, enough to reach from the antenna to your rig

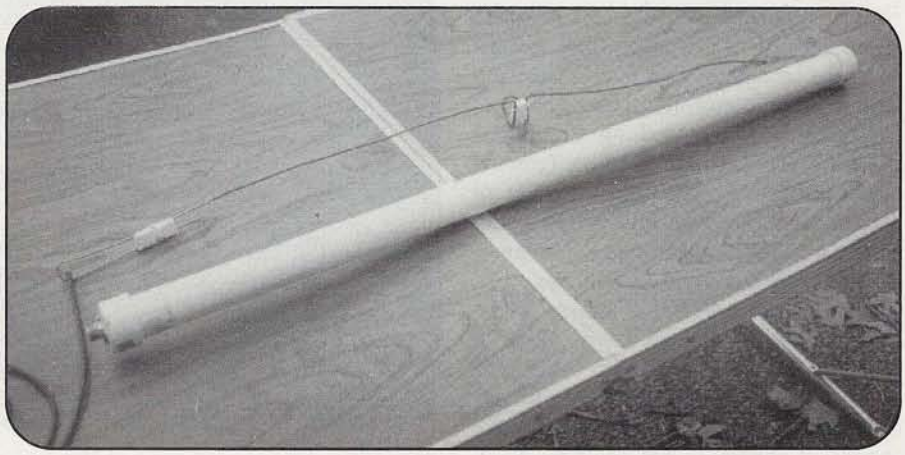
Suggested Tools

Flat-nosed electrician's pliers
35-watt soldering iron and 60/40 rosin core solder
Screwdriver
Electric drill and an assortment of small bits
Hacksaw
Wire strippers
Knife or Xacto blade
Ruler

Final Assembly

Run the coax through a small hole in the bottom cap (don't close up the bottom cap yet) and bring it about 12 inches out of the cap. Solder a male UHF connector to the end of the coax *(a BNC or N connector would be better. See this month's "Beginner's Corner"—ed.)*. At this point, you can stand up the PVC away from surrounding objects and measure the SWR. If it's greater than 2:1 at any point in the range in which you want to transmit, first determine the resonant frequency by finding the spot at which the SWR is lowest. Then adjust the coax tap (remember the coax tap?) to shift the resonant frequency either up (by moving the tap up and electrically shortening the antenna) or down (by moving the tap down). Your goal is to have the lowest SWR at the center of your chosen range of frequencies. If you've done that and still have an SWR above 2:1 at certain frequencies, you've exceeded the "2:1 bandwidth" of the antenna and will have to come up with a smaller range of frequencies or be willing to accept an SWR above 2:1 (rigs with automatic SWR protection may start reducing power when the SWR is above a certain level).

Once you've got the SWR below 2:1 (and if you've followed these directions closely, then it'll probably start out that way), you're ready to close up the bottom cap and mount the antenna. The bottom cap should not be sealed tight. A *weep hole* should be drilled on the bottom to allow condensation to escape, and,



Shown on top is a completed antenna ready for insertion in PVC tube; below that is a fully assembled antenna ready for mounting.

of course, you'll need a hole for your coax. You may seal the bottom cap with PVC glue (available where the PVC is sold), but, just remember, once this stuff hardens (fast), it's there to stay. You can't get it apart. For this reason, I hold the caps in place with a couple of sheet metal screws on each end instead of PVC glue. The fit is tight enough, yet it can be taken apart in case of problems.

All that remains is to fasten the PVC to a support structure, keeping in mind that the bottom of the antenna inside the PVC should be above any support. If the PVC is left at 10 or 12 feet, it could be mounted to a chimney with a couple of chimney straps. Be aware, however, that if soot from an oil burner coats your antenna, it will eventually degrade its performance. *(It's not just oil burners. I have "clean" gas heat and had a 220 Isopole strapped to my chimney. After about five years, it simply fell apart. The constant heating and cooling of the air as the heat came on and off apparently caused condensation that froze and melted and froze again, eventually destroying the insulator inside the antenna. I don't recommend chimney-mounting any antenna.—ed.)* If you decide to bolt the PVC to another pipe structure by bolting through it, plan ahead and drill the holes before the coax is in the way; otherwise, you may nick the cable while drilling the finished product.

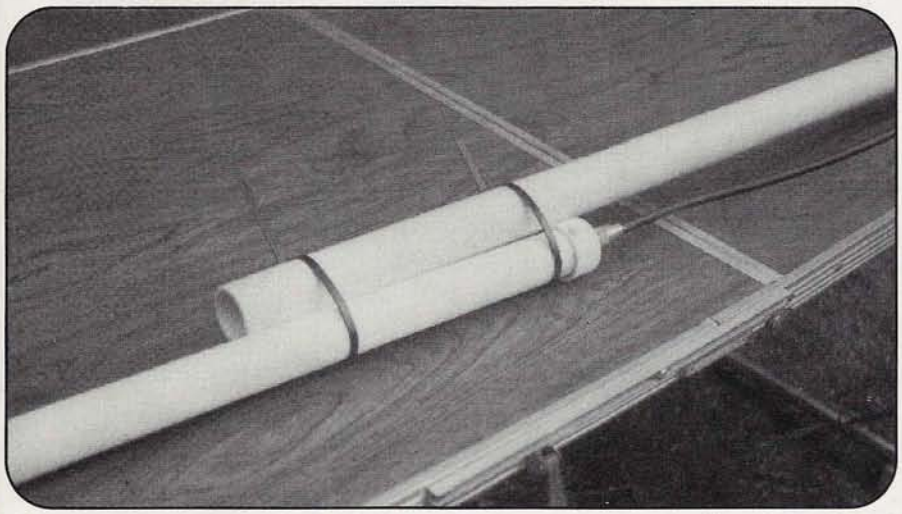
Adding Quality Feedline

When the antenna is mounted, some heavy-duty coax can be brought up to it and connected with a barrel adapter. RG-213/U or Amphenol 9913 cable should be used if possible. Anything but a *very* short length of RG-58/U is too lossy for UHF use, so you should use no more than the foot or so that's coming out of the PVC pipe. Whatever coax you use, be sure to secure it to a support along the way or its weight will pull apart your antenna.

"I hold the caps in place with a couple of sheet metal screws on each end instead of PVC glue. The fit is tight enough, yet it can be taken apart in case of problems."

On the Air

If you build the antenna to the dimensions in this article, it should be resonant on 446 MHz, right in the middle of the 70-centimeter repeater subband. You should mount it vertically for FM and repeater use since most FM stations are vertically polarized. If you're planning to use it for SSB or CW work, mount it horizontally (most SSB stations are horizontally polarized) and refigure the dimensions for resonance at 432 MHz, the center of SSB and CW activity. While it's not really suitable as a DXing or satellite antenna (not directional enough), this simple design *can* serve as an excellent beacon antenna. However you choose to use it, enjoy it—along with the satisfaction of having built it yourself. ■



The finished antenna attached to PVC mast for testing. Any more than 10 to 12 feet of PVC can become unstable if not secured.

What You've Told Us

Our January survey sought your opinions on the American Radio Relay League (ARRL), with most of its questions for League members (February's survey had questions for non-members). The replies to the first question demonstrate how the structure of a survey can skew the responses.

The first question asked if you are currently an ARRL member, and 86% of those responding said yes! Does this mean that 86% of *CQ VHF* readers are League members? No. It means that, since the rest of January's questions were for ARRL members only, very few non-members bothered to reply at all.

Among readers who are ARRL members, two-thirds (67%) said a major reason you joined was "to support the League's representation of amateur radio before government and international agencies." Forty-four percent said "I generally support and agree with ARRL positions," and 39% of you said "ARRL member services and benefits are of significant value to me." Only 17% of you said you often disagree with League positions, but felt it was important to belong anyway (these numbers add up to more than 100% because multiple replies were allowed).

On the next question, more than half (52%) of you who belong to the League feel that it offers "quite a bit" to VHF-only operators. Another 25% said "not very much," 13% said "very little," and 3% said "nothing."

Finally, most of you plan to renew your League membership, even with the upcoming dues increase to $34. Nine percent of you are ARRL life members who don't need to renew. Among the rest, 55% said they would definitely renew and 22% said "probably." Only 8% are undecided, 5% probably won't renew, and only 1% definitely won't.

Next month, we'll see how non-members feel about the League. Our latest winner of a free *CQ VHF* subscription/renewal for responding to our survey is Jan Anderson of Aloha, Oregon. Congratulations! And thanks to all of you who responded.

Reader FEEDBACK!

Readers Won't Take Horizontal Noise Lying Down

Dear *CQ VHF*:

Your February, 1997, issue was very good. I've been a long-time subscriber. I especially liked the SSTV articles. The one on the decaying OSCAR-13 orbit was fascinating.

Please correct the error, though, on page 50, where the author states that ignition noise is horizontally polarized. It is not, it is vertically polarized. The 1994 *ARRL Antenna Book* alludes to this fact on page 18-2 under polarization, "Man-made noise, especially ignition interference, also tends to be lower with horizontal antennas."

And if you can scare up a copy of the old *ARRL VHF Manual* circa 1972, on page 157, it plainly states "...mostly ignition racket from our own car and others. Such noise tends to be vertically polarized, so in areas of appreciable motor traffic horizontal antennas yield considerably higher signal-to-noise ratios than vertical ones. The vertical antenna on a vehicle is a compromise between poor signal-to-noise ratio and ease of installation."

I know that you folks are sticklers for "TC," or "technical correctness" (I just made that up), especially for the newcomers whom I know read your fine magazine because it is very easy to understand.

Dick Linder, WB7OND
Fayetteville, North Carolina

Dick—You're one of several readers who caught this error, which slipped by all of us here. We couldn't find the 1972 ARRL VHF Manual, *but our 1994 (current edition)* ARRL Antenna Book *agrees with yours. In fact, there's a additional reference, on page 23-6, under "Propagation Factors Above 50 MHz," stating that "Horizontal systems are popular, in part because they tend to reject man-made noise, much of which is vertically polarized."*

Of course, the most important point is that the two stations on each end of a contact should have antennas of matching polarization, or they'll risk a cross-polarization loss on the order of 20 dB. So, if you're operating FM, run vertical polarization; for SSB/CW, use horizontal; and for satellites, the best option is circular *polarization.*

CQ VHF Ham Radio Above 50 MHz

Reader Survey—April, 1997

We'd like to know more about you...about who you are and where you live, about the kinds(s) of work you do, and about your ham radio interests and activities. Why? To help us serve you better.

Each month, we'll ask a few questions, and ask you to indicate your answers by circling certain numbers on the Reader Service Card and returning it to us (we've already paid the postage).

As an incentive, we'll pick one respondent every month and give that person a complimentary one-year subscription (or subscription extension) to CQ VHF. *This month, we continue repeating last year's questions to see how our readership has changed from the magazine's earliest days.*

A. Tell us about yourself:

1. Please indicate your highest level of education:

If you are...	Circle Reader Service #
in elementary or middle (jr. high) school:	1
in high school:	2
out of school (did not finish high school):	3
a high school graduate	4
in technical school (post high school)	5
a technical school graduate	6
in college (undergraduate)	7
in graduate school	8
Please indicate college degree(s) held	
Associate	9
Bachelors	10
Masters	11
Doctoral	12

2. Please indicate the job category that most closely describes your work:

If you are a...	
student	13
homemaker	14
professional/executive	15
educator/writer/creative	16
technical	17
service industry worker	18
government worker	19
factory worker	20
unemployed	21

B. Tell us about your ham radio interests/activities:

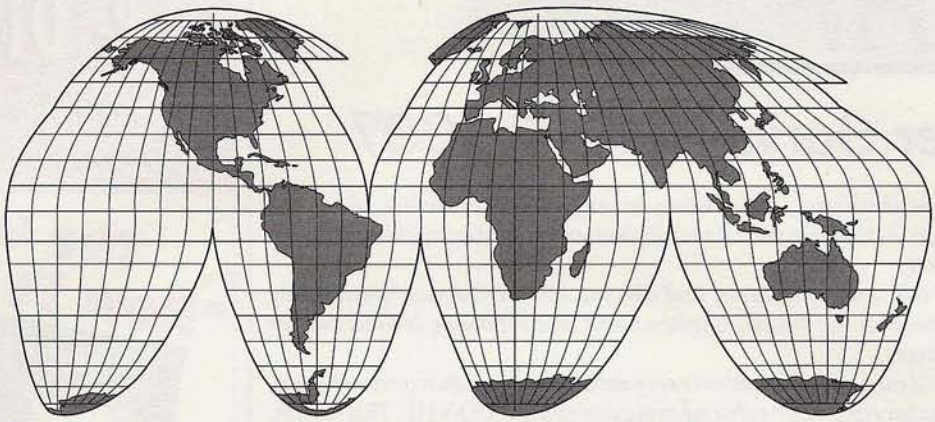
1. Do you plan to upgrade your ham license in the next two years?

If your answer is...	
yes	22
no	23
Extra-class, can't upgrade	24

2. Please indicate all modes on which you are active on VHF/UHF.

If you are active on...	
APRS	25
ATV	26
CW	27
FM	28
Packet	29
SSB	30
None	31

Thank you for your responses. We'll have more questions for you next month.



VHF DXpeditions to Cyprus and Tunisia

How'd you like to work Tunisia and Cyprus? Even if you live within VHF range of those countries, they're still pretty rare. Here's the story of two DXpeditions to put them on the air—on 2 meters.

By Alessandro Della Casa, I4YNO*

In the summer of 1996, hams in Europe got the opportunity to work two very interesting DXpeditions aimed at activating two rare countries on 2 meters—Cyprus, 5B4, and Tunisia, 3V8. Both expeditions were made by German hams: Wolfgang, DL5MAE, went to Cyprus, while Maik, DJ2QV, Frank, DL8YHR, and Heiko, DK3DM, traveled to Tunisia. Demand for these two countries was huge in Europe and these guys really put on big efforts to give many deserving hams a new one (or two).

Cyprus (KM65FA)

Wolfgang, DL5MAE, lives in Erding, a small town near the south German city of Munich. Wolfgang is an avid EMEer (moonbounce operator) and a veteran of this kind of VHF DXpedition. He has operated in past years from Malta, Crete, and the Dodecannese Islands, just to name a few of his most successful activities.

EME was at the top of Wolfgang's list as he overloaded his trusty Mercedes-Benz and got on the ferry to Cyprus, leaving the Italian coast on 17th May '96. Five days later, he arrived in Limassol on sunny Cyprus! Fortunately, everything went smoothly at customs, and, a few hours later, antennas were already up at the chosen QTH in the northwestern part of the island—grid square KM65FA. Wolfgang's callsign: 5B4/DL5MAE.

EME and HF, Too

For EME, two 17-element M^2 antennas with full elevation control were erected in the back garden, while an HF vertical was used for the talk-back frequency on the VHF-EME net, on 14.345 kHz +/- QRM. The antennas were mounted in 30° C. (86° F) heat, and it was probably one of the toughest moments of the whole expedition. (I had the chance to meet Wolfgang on his return trip to Munich soon after he arrived back in Italy and I'll never forget the color of his nose!)

Wolfgang was quite surprised when he switched on his rig to test the newly erected antennas around 15:30 UTC (18:30 local time), to discover that an excellent sporadic-*E* (Es) opening was in progress on 144 MHz between Cyprus and central Europe! After the initial shock, and well before the amplifier was warm (actually it was switched on only 30 minutes later...) and with just 30 watts output, several OK1 and OK2 stations (in the Czech Republic) were logged from JO70, JN69, and JN89. Later, the band also opened to Austria (JN88) and eastern Germany (JO60, JO61). This first opening lasted until 17:30 UTC.

The best QSOs were made with DL7AKA in Berlin and DL8LAQ near Hamburg in northern Germany. Also some Hungarian, Yugoslavian, Italian, and Polish stations were logged. In that

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**Alessandro Della Casa, I4YNO, is a* CQ VHF *foreign correspondent.*

DL5MAE's Mercedes on Cyprus. It was a five-day ferry ride from Italy to Cyprus, and that was after Wolfgang first drove across the Alps to Italy from his home in Germany.

opening on 2 meters, some Europeans managed to work OD5, Lebanon, and 4X6UJ in Israel. Particularly nice was to work DF4MAA from his home QTH near Munich, Germany.

Unfortunately the unusual callsign provoked a lot of "huh...what is your call??? QRZ again 5B4AE ???" and so on, which slowed down operations during the Es event. Some bad HF habits obviously die hard.

This first opening on 23rd May '96 netted the following score: 65 x DL (Germany); 60 x OK (Czech Rep.); 26 x HA (Hungary); 21 x OM (Slovakia); 9 x OE (Austria); 6 x SP (Poland); 5 x I (Italy); 4 x YO (Romania); 1 x YU (Yugoslavia), and 1 x S5 (Slovenia). (An Es opening with results like this is just a dream for a guy living here in northern Italy, believe me.)

After the band closed, FAI (Field Aligned Irregularities) showed up and S53VV, from JN65, and DF7KF, from JO30 (2726 kilometers!) were worked on CW with an aurora-like sound.

Noise-Free QTH

The operating location on Cyprus was absolutely noise-free, which helped a lot with EME activity. Two hours after the first mighty Es opening faded away, a first CQ toward the moon on 144.082 was answered by W5UN at 19:27 UTC. From then until moonset, an additional 12 stations were logged on EME, including the first-ever moonbounce QSOs from Cyprus with Switzerland (HB9CRQ) and the Netherlands (PE1LCH). Conditions were excellent, and IK5UBM with just two Yagis was worked without problem. A total of 80 different stations was worked off the moon during this expedition!

More E-Skip!

On 27th May, a new Es event took place in the direction of Italy and southern France. Those worked included TK5JJ from Corsica and French stations F9HS in JN03GL (2,890 kilometers!) and F6DRO in JN03SM (2,811 kilometers!).

After this opening ended, FAI appeared again and several Italian stations, approximately 2,000 kilometers away, were worked. Some FAI signals from Italy were unusually strong, with IK5OIY from JN53 peaking at RST 599! Wolfgang's antenna was pointing at 320°, while the Italian stations had to beam 90° (about 30° offset from direct path), meaning that the scatter point was probably over southern Romania.

Long-Haul Meteor Scatter

Meteor scatter (MS) was a real challenge since Cyprus is quite far from the densely populated areas of Europe. Nevertheless, some very long haul MS

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QSOs were completed, the best one being with the author, I4YNO in JN54KP, for a total QRB (distance between stations) of 2,122 kilometers, although good reflections were also received from TK5JJ, 2,160 kilometers away, but without completing the sked. High-speed CW (200 wpm or more) was used for nearly all the MS skeds, as SSB would have been almost useless due to the very short reflections peculiar to the May/June sporadic meteors.

On tropo, there was not much to work (look at a map—there's not much within tropo range). But a handful of Israeli and Bulgarian stations (roughly 1,000 kilometers away) was put in the log. Highlight on this propagation mode: TA1D.

Wolfgang was particularly satisfied with his stay in Cyprus and found DX conditions from 5B4 absolutely great. But he recommends such a seaside resort for "DXpeditions—without-radios" too!

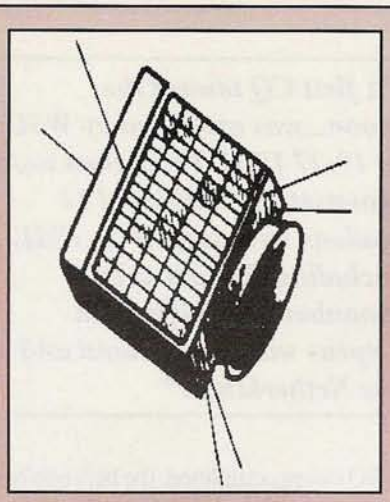
• • •

Tunisia (JM56EQ)

The last VHF operations from Tunisia date back to 1979 when a big group of Italian, Danish, and German hams, under the flag of UNICEF, was QRV (on the air) from HF to microwaves with the call 3V8ONU. Since then, the North African country was totally silent above 30 MHz. The recent appearance on HF of the new club station 3V8BB and the growing number of foreign guest operators who were allowed to be active from there gave us all new hope. Frank, DL8YHR, and Maik, DJ2QV (along with Heiko, DK3DM, the HF guy), decided to make things happen and announced activity on 144 MHz for the beginning of July '96.

Shootin' for the Moon

The main aim of the expedition was to activate Tunisia on EME, a goal that un-



Space Software Upgrades Available

Two software programs used by satellite enthusiasts have been upgraded and are available for free downloading, according to AMSAT.

The satellite tracking program STSPLUS (version 9650), by David Ransom, Jr., has been released with several new features added, including "night vision" capability in which a red screen is used for better visibility on a laptop operated outside at night, and a "location map mode" with greater map flexibility (requested by many teachers for use as a geography teaching tool).

There are four files connected with the upgrade: "stsplus.new" contains version 9650 update notes; "sop9650u.zip" is an upgrade-only file for users of version 9610 or later; and the complete package comes in two files, "sop 9650a.zip" and "sop9650b.zip." All may be downloaded from <ftp://ftp.mindspring.com/users/dransom>.

Version 9648 of N2WWD's "Vector to Two-Line Elements" ("VEC2TLE") program includes automated updates of space shuttle Keplerian elements for more accurate tracking. VEC2TLE translates "State Vectors" into the NASA two-line or AMSAT format Keplerian element sets, which are then used by tracking programs to follow the course of a spacecraft.

The new version of VEC2TLE may be downloaded on the World Wide Web from AMSAT <http://www.amsat.org/> or NASA Spacelink <http://spacelink.mfsc.nasa.gov/>, or may be purchased by mail from AMSAT, P.O. Box 27, Washington, DC 20044. The program may be registered free of charge for use in support of a hobby such as amateur radio.

"Tropo conditions were excellent over the Mediterranean Sea, especially in the first few days. Italy could be worked from Sicily to the Alps and so could some stations in southern Germany, at a distance of about 1,300 kilometers."

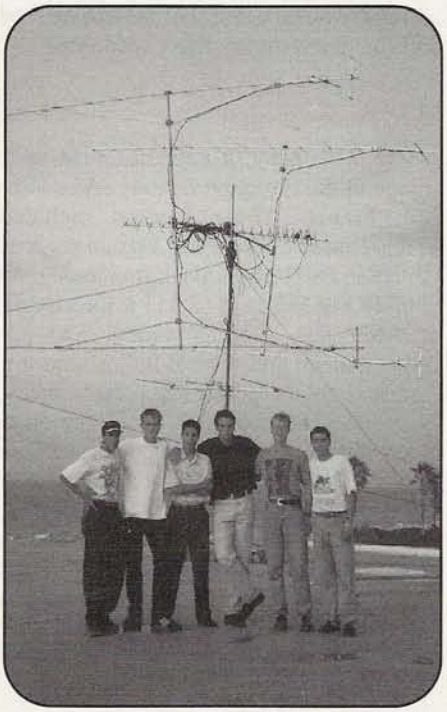
fortunately was only partially achieved. However, it would not be fair to define this expedition as unsuccessful, since our German friends really made a lot of us Europeans happy with a new country on 2 meters using tropo, MS, ionoscatter, and FAI propagation modes!

Their difficulties started at the moment of clearing customs with all the "heavy metal" they brought from Germany—four F9FT-type Yagis, a big power amplifier (PA), transceivers, cables. and so on. The list of equipment they produced to customs officers at the Tunis airport was far from being sufficient, and they learned that a number of other papers were necessary. After long hours and with a certain amount of good luck, customs was cleared, but the antennas remained there. The customs officers were afraid that our fellow hams might interfere with police radio.

On arrival at club station3V8BB, a 10-element, 2-meter Yagi was discovered on the roof of the building and MS activity could start immediately.

Eventually, customs allowed all the other antennas to be picked up and erected on top of the institute hosting the club station, but high wind caused an elevation rotator failure, so only moonrise/moonset EME QSOs could be run. Altogether, only 10 EME QSOs were made, but DL8YHR says this could be a good reason to go back again this year!

The station was also QRV on 70 centimeters, although activity there was a kind of marginal compared with 2 meters (35 QSOs on 432 versus 600 on 144 and about 7,000 HF QSOs made by DK3DM). The first QSO on 70 centimeters was with HV4NAC at the Vatican. In addition, there were many FM QSOs with the Rome area—much to participants' surprise—especially since the only other North African station that could be worked at that time was 7X2DS in Algeria.



The 3V8BB DXpedition group in Tunisia. In addition to 7,000 HF QSOs, the hams made 600 contacts on 2 meters and 35 on 70 centimeters. EME performance was disappointing, with only 10 successful contacts via the moon.

MS and Tropo Come Through

Meteor scatter played the best role of the whole expedition with several dozen complete QSOs. The best QRB was with OZ1FDJ in JO65 (on the outskirts of Copenhagen, Denmark), at a distance of 2,138 kilometers!

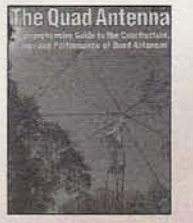
Tropo conditions were excellent over the Mediterranean Sea, especially in the first few days. Italy could be worked from Sicily to the Alps and so could some stations in southern Germany, at a distance of about 1,300 kilometers, thanks probably to the addition of some ionoscatter-enhanced conditions as well. HB9CQA/portable was also worked in JN45MU, where he was running 5 watts from a mountain peak in the Swiss Alps.

Future VHF Operations?

All the antennas are still in Tunisia, but the local hams there are interested only in HF at the moment, and none of them is a keen CW operator. So all we can do now is wait to see if something interesting will happen in 1997...unless, of course, some of us really want to *make* things happen again. ■

CQ BOOKS

The Quad Antenna



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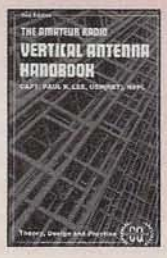

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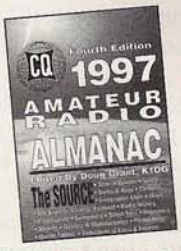

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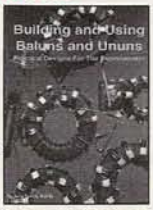

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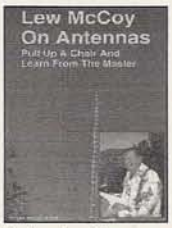
by Lew McCoy, W1ICP



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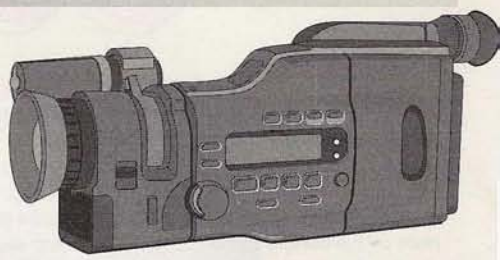
The Nature of Video—Part 2



In Part 1 of our introduction to television transmitting, we learned about the voltages and circuit components needed to generate quality video and audio signals. This month, we'll look at getting those signals on the air.

Generating a picture with a video camera or computer is only the first link in a chain of events required to put a video signal on the air.

In Part 1 (February, 1997), we covered the process of generating video and audio signals within a transmitter, including proper termination impedance at the transmitter input, maintaining a constant sync amplitude, controlling video gain, maintaining proper AC and DC voltages, and keeping the audio under control. This month, we'll look at the process of getting the television signal out of the transmitter cleanly and up to the antenna. We'll focus on the following areas:

- Subcarrier frequencies
- Intermodulation
- Subcarrier injection levels
- Sync buzz, video frequency response
- Harmonic and spurious signal generation
- Power bandwidth, and
- SWR

Subcarrier Frequencies

When we transmit video, we also send along a couple of other signals: *color* and *sound*. The frequencies of these additional signals were carefully chosen to produce the least amount of interference to the video. In the equipment we generally use today, we don't need to worry about the color frequency being correct because one oscillator is used to generate both the color and sync frequencies. We *do* need to pay attention, however, to maintaining the proper audio (sound) carrier frequency.

First, because the receiver compares the audio carrier with the video carrier to demodulate the FM sound, and it's tuned for 4.5 MHz, we want our transmitter always to be sending a 4.5-MHz sound carrier. Second, because we use 25-kHz audio deviation in TV transmissions, we don't want to be far off frequency or the sound will be distorted. Finally, most receivers have circuits which notch the video at 4.5 MHz, and, if we're off frequency, the sound trap won't remove the audio from the video and it will be seen as an audio disturbance (squiggles) in the video signal!

For all of these reasons, it's important that the transmitter have a stable oscillator circuit. While a phase-locked loop (PLL) or crystal control isn't required, it's generally better than a simple L/C (inductance/capacitance) tuned circuit.

Intermodulation

Intermodulation, also known as *intermod* or *IM*, occurs whenever there's a non linear amplification of the signal. This can be from a filter response or from mix products generated in an amplifier device. The most common cause of IM on a television signal is *triple beat*. This is a 928-kHz signal which occurs when the color and sound carriers mix in bad proportion to the video carrier, causing the 928-kHz signal to appear in the video as a series of diagonal lines (herringbone).

While there's little you can change in the basic design to make this better, the transmitter design should present few places where intermodulation can occur. Because the three signals (video, sound, and color) are usually modulated and amplified by the same final RF device(s), careful attention must be paid to the levels of these signals, and a means of adjusting the injection levels in order to minimize the IM products must be provided.

Subcarrier Injection Levels

Because we use common amplification (see above), it's easy to generate not only undesired IM products but also buzz or noise in the audio and video. If you recall, in Part 1, I stated that we never want zero carrier, and for that reason, we hold the white level to a minimum of 10% carrier level. When the audio subcarrier is added to the video carrier, the amplitude of the FM carrier is riding on top of the video waveform. Therefore, we need some amount of power for the audio. The typical level of ham audio is 15 dB below the video carrier, written as -15 dBc. If separate audio and video RF amplifiers are used, a full -10 dBc (100 watts video, 10 watts audio for example) can be used. (Broadcasters may use audio carrier levels up to -7 dBc.)

By holding the peak white level to 10% power and the sync to 90% power, we have 10% at each extreme for the FM sound carrier. The sound can now be received and demodulated without noise from the video. If the sound carrier is compressed (reduced) during either the sync or white periods, we have amplitude modulated the FM carrier, which will appear as "incidental AM modulation

***"When we transmit video, we also send along a couple of other signals:* color *and* sound."**

By Henry Ruh, KB9FO

"A properly designed TV transmitter has a video low pass filter built in. If it doesn't, don't buy it or use it."

noise," a fancy way of saying *buzz*. The subcarrier level may be set by the manufacturer or may be adjustable to compensate for the use of external amplifiers.

Sync Buzz and Video Frequency Response

Although I have already covered the primary source of buzz in the audio caused by the video modulation, there's another source of this annoying problem—the so-called *aliases*, or false image edges caused by insufficient video frequency response.

The NTSC television system (the standard in North America and much of South America) specifies an RF bandwidth of 6 MHz. Within this, we can safely modulate up to 4 MHz with video information. The amount of video information we have depends on the *resolution* of the camera or other video source.

The resolution of a picture is determined by the number of TV lines the image can display. For example, a camera can be said to have 250, 400, or more lines of resolution. This refers to the *horizontal resolution*, as the number of scan lines (*vertical resolution*) is fixed by the scanning system at 525 per *frame*, or 262.5 per *field,* since the picture is made from the interlace of two fields per full frame, at the rate of 60 fields, or 30 frames, per second. (29.94, to be precise). With a camera, the higher the resolution, the better the picture, since it means a sharper image and more detail. Many professional cameras today have 850 or more lines of resolution.

A TV *line* is considered the black line, or the white space between lines, so a system with 800 lines could actually capture and display 400 black and 400 white alternating "lines." The number of lines of resolution converts to frequency at the rate of 80/MHz. So a 5-MHz video bandwidth equates to 400 lines of resolution. The topic of resolution could be a book in itself, covering the actual frequency response, aspect ratio, depth of modulation, and aperture effects.

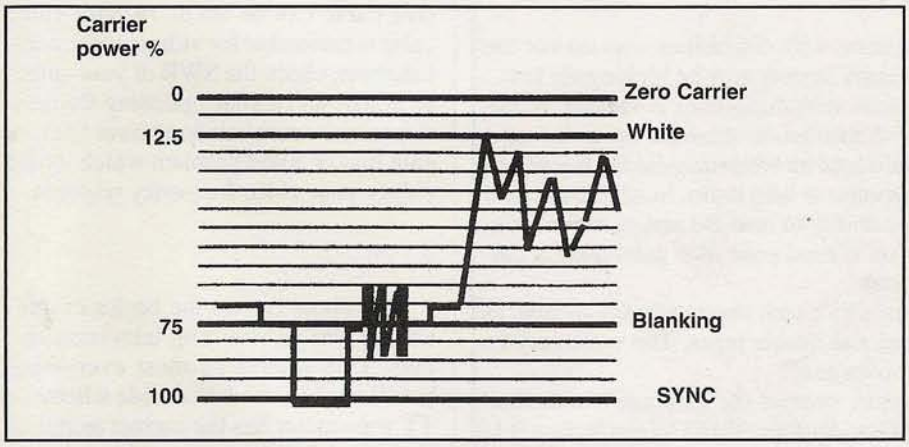
Electronic generation of a video signal is different from optical generation, since any optical system must divide the image into pixels, or picture elements, the size of which is determined by the number of CCD (charge-coupled device) sensors in the lens or the size of the electron beam spot on a vidicon tube. Because of the finite size of the physical device pixel, certain effects occur.

For example, as the image detail increases, the ability to generate a complete transition from black to white decreases. Eventually the detail is too small to be discernible and the picture becomes a flat gray field. The detail can no longer be represented by black/white transitions. This is the *cut off frequency* or *limit of resolution* of the pick-up device. Long before this happens, the image will generate an *alias*. An alias is a *false edge*, or edges. If the edge of the object is not in perfect alignment with the scanning direction, a diagonal line is created at the edge of the image. This occurs because, on successive scans of adjacent lines, the image will first be in a position where it is seen by a whole pixel, then less and less, then not at all, then more and more until it's seen by the adjacent pixel. At the high scanning rate of a TV, this appears as a diagonal line.

The electronic generation of a signal, such as in a character generator (title making device) is limited only to the electronic rise time (volts per second) of the components. It's, therefore, quite possible to generate a signal which has a rise time equal to a sine wave of 10, 15, or more MHz. Some cheap units have energy to over 100 MHz! Since these frequencies are outside the bandwidth of the receiver, they represent segments in time when the signal cannot be fully demodulated. Because of this, the audio demodulator has nothing to work with, and it generates a buzz from the "holes." (This is a simple way to explain the problem without getting into Nyquist filter response for the math-minded.)

The problem is easily solved by using a video low pass filter, which limits the video to signals of 4.5 MHz or less. Since your receiver cannot discern a higher value than its IF bandwidth can pass, there's no loss in picture quality. Most home TV sets cannot demodulate video signals with a bandwidth of more than 2.5 MHz because of the methods used to separate the color from the luminance information. This is also why a computer screen in a high resolution mode always looks sharper than a TV screen. The computer image is not being transmitted and does not have a bandwidth limitation from RF channel width. But it's also why your computer can generate interference from its higher scan and video and data signals! A properly designed TV transmitter has a video low pass filter built in. If it doesn't, don't buy it or use it.

The video filter also helps protect other spectrum users from unnecessary sideband splatter caused by computer graphics or title generators, since anything outside of the receiver bandpass is just wasted energy and has the potential to create QRM for others.



Television signals actually have three components that are transmitted together: video, color, and audio. Proper filtration is needed to keep them from interfering with each other.

Harmonics and Spurs

Modern transmitter design minimizes the generation and radiation of *spurs* (spurious signals) and *harmonics* (signals on frequencies harmonically related to the desired frequency). There is neither the need nor any desire to transmit more than the information we want to transmit, and it should be contained within the bandwidth of the mode, regardless of whether it's FM, packet, SSB, or video.

Modern transmitters can eliminate these problems by design. Two common methods are *heterodyne process* (starting at a low frequency and then converting to the operating frequency) and *direct frequency synthesis* (with the master RF oscillator operating directly at the operating frequency). Using multiple frequency multiplier stages is no longer necessary nor desired as an improperly designed circuit can be the source of spurs, harmonics, and other interference.

There's a large number of IC oscillators which will operate directly in the frequency range desired, even for UHF and SHF operation to 2.5 GHz and beyond. This also reduces the parts count/cost of a project since the frequency multiplier stages and their multitude of parts are replaced by a single IC chip, a handful of frequency-determining components, and a master oscillator. The PLL is the most common method of generating direct on frequency RF signals. The device allows both easy selection of operating frequency and ease of modulation for FM-mode video as well. With proper selection of loop time constants and output passband filters, the chip can produce a very clean carrier, and the problem of harmonics or spurs from multiplier stages is eliminated. Oscillator noise is a consideration for critical designs, but, for our purposes, it can be ignored. By adding a passband filter and a MMIC (brick amplifier), the output of the PLL can be increased to the operating power desired.

The older method (still in wide use) generates the TV signal at a low frequency, typically 45 to 70 MHz, and then heterodynes (up-converts) it to the desired operating frequency. By tuning the local oscillator of the converter, you can select the desired frequency on your band of choice. This also enables a multiband transmitter to have just a single common modulated exciter, with operation on 70, 33, 23, 13 centimeters, or higher achieved by using different converters and power amplifiers. This method has long been the choice of SSB and CW VHF/UHF/SHF DXers, since it offers a clean signal with no harmonics or "birdies" to cause confusion in reception or QRM to other users of these frequencies.

AEA used this technique in its ATV transmitter and also incorporated an additional filter to provide vestigial sideband filtering inside the unit. Reduction of the lower sideband can also be achieved by phase cancellation, modulating both the driver and final stages so that the lower sidebands are attenuated, as is done in the PC Electronics designs.

In any case, it's good practice to have a VSB filter in the output of your system or otherwise limit the bandwidth of your signal to prevent unnecessary QRM. For a repeater, having a VSB conforming output should be considered mandatory.

Power Bandwidth

This applies more to tube amplifiers than to solid state. It refers to the ability not only to generate the carrier power desired, but also to generate it across the entire bandwidth of the signal. Generating a signal with a few-kHz-wide sideband for voice is no trick. ETO/Erhorn makes very nice amplifiers and has written about the necessity for peak power in excess of 1500 watts to prevent distortion of the SSB signal because of instantaneous peak power requirements. The same is true for television signals, except that our modulation can have sidebands across 4 or 5 MHz, requiring the generation of power across the entire bandwidth without loss of main carrier or low frequency sideband power (sag).

"A high SWR in either the antenna or the video input cables will result in a loss of picture fidelity."

Remember, there's a DC component to the video signal. If the DC component is altered by the power amplifier, the picture brightness and contrast will vary accordingly. In commercial TV, it's not unusual to use a 5-kW amplifier circuit to generate a 1-kW video signal so that there's adequate reserve for peak power/bandwidth demands.

Lack of bandwidth in a modulated amplifier stage will also affect the video response (resolution) and the ratio of color and sound subcarriers. In extreme cases, usually in old tube RF power amp designs, you cannot obtain sufficient bandwidth to transmit color or sound!

SWR Considerations

Standing Wave Ratio is a concern not only for RF and coax, but also for video. A high SWR in either the antenna or the video input cables will result in a loss of picture fidelity. Typically, you'll see ringing (or ghosts) or smearing (loss of "focus") in the picture. While inexpensive cable can be used, 75-ohm video cable is preferable for video connections. Likewise, check the SWR of your antenna across all of your operating frequencies to make sure you don't have a severe gain loss or SWR problem which would reduce your video frequency response.

In Closing

That about covers the basics of generating and transmitting television signals. This should be most everything you'll need to know to decide whether a TV transmitter has the correct technical characteristics for good results and good engineering practice.

73, Henry KB9FO

Handi-Hams Seeking Volunteer Readers

If you'd like to help hams and potential hams with disabilities who cannot use regular printed books, the Courage Handi-Ham System may be looking for you.

The Minnesota-based organization for hams with disabilities is seeking volunteer readers to record ham radio books and instruction manuals on audio tape. According to Handi-Hams, volunteers should hold an amateur radio license and be familiar with the terms and expressions common to ham radio. In addition, you'll need to have a clear speaking voice and the ability to read the text of radio books and describe the diagrams and pictures. You'll need your own good-quality cassette tape recorder and a quiet place to record.

Handi-Hams will provide new volunteers with a tech sheet and sample tape, as well as a copy of the publication to be read and master tapes. The work may be done in any quiet place you'd like, at your own pace.

To volunteer, or for additional information, contact the Courage Handi-Ham System by mail at Courage Center, Handi-Ham System, 3915 Golden Valley Rd., Golden Valley, MN 55422; Phone: (612) 520-0515; Fax: (612) 520-0577; e-mail: <handiham@mtn.org>; World Wide Web: <http://www.mtn.org/handiham>. (From the ARRL Letter)

Book Review: "Radio Monitoring: The How-To Guide"

A broad-brush guide to the radio hobby, this book by T.J. "Skip" Arey, WB2GHA, will be equally at home on the shelf of a ham, SWL, or scanner enthusiast.

By Rich Moseson, NW2L

In my experience, it's the rare ham who's interested in only one aspect of the radio hobby. Most hams got their start in some other area of radio communications, such as CB, scanning, shortwave listening, or, the easiest starting point of all, medium wave broadcast band DXing. And I know very few hams who, once they receive their amateur licenses, completely lose their earlier interests.

So, when a copy of Skip Arey's new book, *Radio Monitoring: The How-To Guide* appeared on my desk, I thought it might be of interest to more than a few *CQ VHF* readers—even though it's not strictly about either ham radio or VHF (both are included, of course). In fact, the book contains quite a bit of valuable information for any VHF operator.

"I know very few hams who, once they receive their amateur licenses, completely lose their earlier interests."

First Impressions

The first thing that caught my eye about *Radio Monitoring* was the extensive coverage given to medium wave (AM broadcast band) listening, a topic usually given short shrift by other listening publications (I'm glad to see a regular "Broadcast DXing" column in our sister magazine, *Popular Communications,* and hope it will soon include material on equipment, tips, and techniques, along with its current content). Close to one third of Skip Arey's book is devoted to broadcast band DXing, and it includes a great deal of information to get the beginner off to a good start. In my view, the weight given to medium-wave DXing, which is equal to that given to SWLing and scanning, is a big plus.

A Full-Spectrum Guidebook

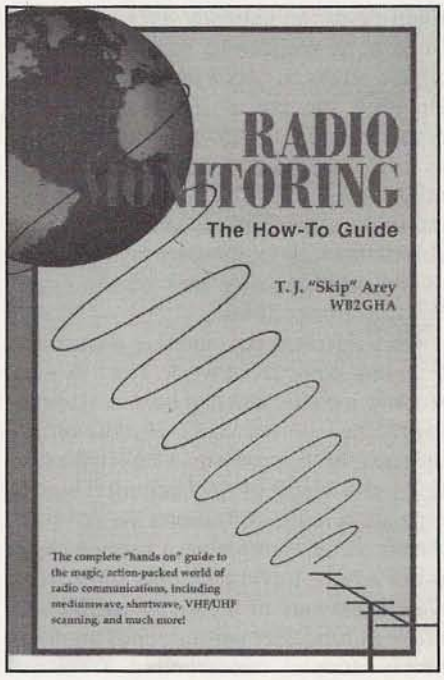
After an introduction that includes a brief history of radio and an overview of the listening hobby, the author begins the "meat" of the book with "A DC to Daylight Frequency Guide." Starting down at 10 kHz in the VLF range, and climbing through the hertz to the top of the EHF range at 300 GHz, this includes a brief description of each segment of the radio spectrum, including the distances normally covered and the types of communication you can expect to hear in each segment. Where warranted, band-by-band breakdowns within each segment are included. You'll find the explanations to be clear, concise, and accurate.

The main body of the book is split into three segments, one each for medium-wave, shortwave, and VHF/UHF monitoring. Within each segment are chapters devoted to what you can hear, cost issues, receivers, antennas, accessories, propagation, and monitoring techniques. Plus, there are "off-the-air" chapters in each segment about monitoring organizations, publications, and other resources.

Finally, there's a potpourri segment at the end of the book with chapters on amateur radio, station setup, safety, legal issues, and other topics.

What's in It for Hams?

Information about propagation and operating techniques applies to people who *transmit* as well as those who only listen. This is an excellent introductory handbook on these topics for hams and potential hams, as well as those hobbyists who are happy just to listen. Overall, *Radio Monitoring: The How-To Guide* is an excellent guidebook for *all* radio hobbyists. It's found a permanent home on my reference shelf. ■



Radio Monitoring: The How-To Guide, by T.J. "Skip" Arey, WB2GHA, is $19.95 from Index Publishing Group, Inc., 3368 Governor Drive, Suite 273, San Diego, CA 92122; Phone: (619) 455-6100; Fax: (619) 552-9000; Internet:<http://www.electriciti.com//~ipgbooks>; 337 pages © 1997.

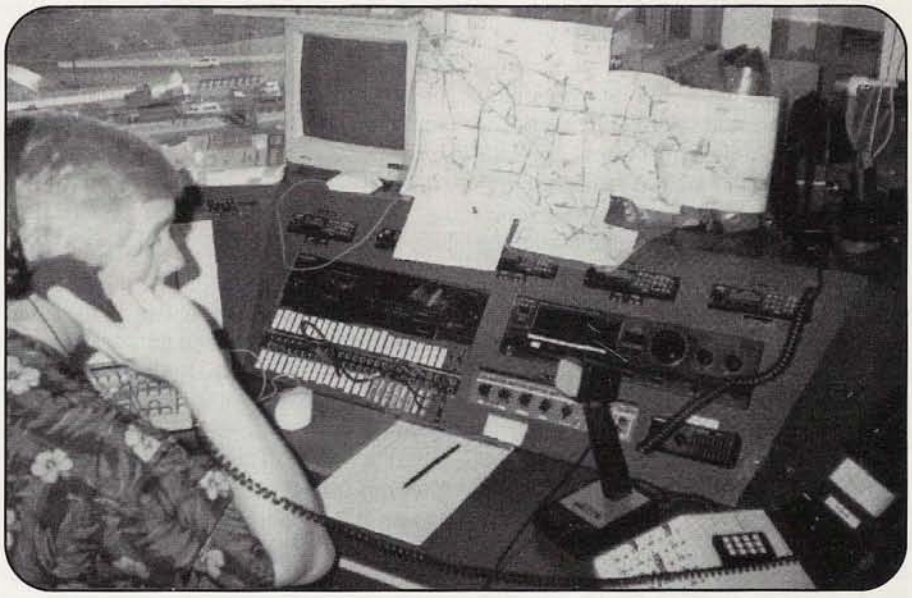
Driving the Public Service Highway

Hams can be a great source of traffic info...but only if we let others in on our secrets. This month, guest columnist KO6UX tells us how some hams are doing it right, and how you can do it, too.

On his way to work, an amateur radio operator discovers that his usual freeway route is gridlocked. Even though he's already stuck in the traffic jam, he realizes he might be able to advise others to avoid the problem area. He turns on one of the local 2-meter repeaters and broadcasts the traffic tie-up as a QST (general announcement). Ten minutes later, another ham, who was listening to a different repeater, begins his commute on the same freeway, unaware of the problem until he sees the brake lights in front of him....

On a different day, another amateur is traveling home from work. He, too, gets stuck in a traffic jam and he, too, decides to give the report as a QST. He determines the cause of the problem (a stall in the fast lane), the length of the back up (about a mile and a half), and reports the tie up on the air. A half hour later, a woman (who is not a ham) traveling on the same freeway is unaware of the delay and fails to brake in time. Her car rear-ends another, nearly-stopped car, creating a six-car chain-reaction accident. The woman is killed and several other people are severely injured....

Could the unsuspecting amateur in the first example have avoided the traffic jam? Could the accident in the second example have been prevented? Of course—if the information collected had been given better exposure than it received on the local repeater. One solution to both of these problems is something called a *highway net*.



The radio desk at Air Traffic in Santa Ana, California. The desk mic is hooked to a GMRS radio over which calls from hams, CBers, and others are relayed. (See text for details.) (Photos courtesy Bob Leef, KB6DON)

Such nets are usually conducted on repeaters during drive times (typically between 6:00 and 9:00 a.m. and 4:00 to 6:00 p.m.), and they provide a central place for amateurs to pass traffic information to other hams, helping their reports reach more people who can use the information to avoid highway hot spots. But the value of these nets can—and should—go beyond ham radio. Highway nets can also be a great example of how amateurs can provide direct public service communications on a daily basis.

Broadcast Traffic Reporting

Think about it. If the traffic QSTs transmitted by the amateurs in the examples above had been relayed to or overheard by a broadcast traffic reporter, the information could have been used on the air, giving non-ham commuters warning as well. Much inconvenience, even loss of life and property, can be avoided by passing this information on to the public.

While many think of broadcast radio and TV traffic reports as just a tool to get to work and home faster, they *do* save lives. If more people know about a nasty freeway problem, more people can avoid it, or be better-prepared to stop or slow down as they approach it. This means that fewer people will reach a tie-up at freeway speeds and be forced to jam on their brakes. Thus, fewer accidents will happen as a result of traffic problems, and fewer lives will be lost.

Traffic reporters generally prepare their reports from three sources. Many

Ken Collier, KO6UX, is a college student and aspiring journalist in California. A ham since 1994, he says radio has been part of his life since he was old enough to talk. Ken has also written for QST *and other radio publications.*

By Ken Collier, KO6UX

"Could the unsuspecting amateur in the first example have avoided the traffic jam? Could the accident in the second example have been prevented? Of course—if the information collected had been given better exposure than it received on the local repeater."

reports that reach the air are the result of *intercepted communications*, either police or highway patrol communications, or traffic reports from other stations. Information might also come from the local *Department of Transportation*. (Here in California, for instance, CalTrans maintains an extensive camera system on the freeways, which it uses to monitor traffic flow. This information is also made available to traffic reporters.)

But by far the best source of traffic information is *"tipsters"*—commuters on the freeway who use their cellular phones to call in reports about traffic conditions. This is where ham radio operators with mobile equipment represent a great resource. Our mobile stations can be just as valuable an aid as cellular phones in helping the media gather reports of traffic incidents and disseminating them to the general public!

In fact, some groups are already working with traffic reporters in their area. Here are a few examples of how hams around the U.S. have incorporated traffic reporting into their daily activities.

Traffic Reporting, NJ-Style

Hams in northern New Jersey have developed an interesting approach to traffic reporting. The New Jersey Traffic Net meets each weekday on the Mount Freedom (K2BF) repeater (146.895-) from 7 to 9 a.m. and 4 to 6 p.m.

"The net is very informal," according to Dave Struebel, WB2FTX, who is one of the machine's control operators. "There's no net control, and anyone can start the net."

Reports of traffic tie-ups are collected on the hour and at 20 and 40 minutes past the hour. According to Struebel, each net session usually lasts just two to three minutes as stations list reports of the incidents they've encountered. During inclement weather, however, one session of the net can sometimes run into the next.

Having such a net serves several purposes. It gives hams a central place to both list and listen for reports of traffic jams. This is an improvement over most areas, where traffic reports are given haphazardly on many repeaters, and it improves the chances that a given report will reach the ears of someone who can use it to avoid trouble spots.

The net also gives the local broadcasters a place to listen for reports. In addition to monitoring the local and state police frequencies, Shadow Traffic (see "Traffic Brokers" below) also monitors the net frequency and uses the hams' information in its on-the-air reports in the New York metro area.

The New Jersey Traffic Net is just one way this group of amateurs is serving the public. The Morris County Office of Emergency Management (which operates the repeater) has dedicated the system to highway and other types of emergencies, 24 hours a day. Personal users

"Hams in northern New Jersey have developed an interesting approach to traffic reporting. The New Jersey Traffic Net meets each weekday on the Mount Freedom (K2BF) repeater (146.895-) from 7 to 9 a.m. and 4 to 6 p.m."

are asked to keep their QSOs brief in order to leave space for stations with emergency traffic.

Direct Media Links

Industrious amateurs in some areas have also begun passing traffic reports to the news media directly. Rather than just allowing the media to eavesdrop on their reports, some groups actively collect reports and pass them on, either by phone or by radio.

One example is a group of hams in upstate New York's Capital District (Albany, Schenectady, Troy, and their suburbs) who maintain a motorist assistance network that uses both 2 meters and CB. These hams use the Niagara Mohawk ARC's repeater on 145.330 MHz and CB Channel 9 to provide motorist assistance and to contact emergency services. They also help stranded motorists get roadside assistance from the CVS "Samaritan" vans that patrol the area as a public service *(CVS is a chain of pharmacy/convenience stores with locations throughout the eastern U.S.—ed.).*

During drive times on the repeater, base stations with telephones collect traffic reports and pass them along to the local broadcasters. This approach is quick and easy, especially if the traffic reporters have toll-free phone numbers that tipsters can use, and it makes for timely, helpful traffic reports.

In some areas, hams collect traffic reports on 2-meter nets and phone them in to broadcast stations' traffic departments or to "traffic brokers," such as Air Traffic (pictured here).

From East to West

A group in Southern California, called RUG (the Repeater Users' Group), has a similar system. But, instead of phones, its members use the General Mobile Radio Service, or GMRS (a UHF service that operates more or less as a licensed Citizens Band). GMRS radios in the newsrooms of traffic organizations provide a direct link for reports gathered via amateur radio and other services. When a "hot" report is received, one of the group's members alerts traffic reporters by using DTMF (Touch Tone®) paging on the group's GMRS repeaters. The reporters then tune in and copy the information.

Similar systems are in use in numerous other parts of the nation, using a variety of methods to contact the media.

You Can Do It, Too

A traffic reporting net can be easily worked into any repeater system, and it's especially useful on those repeaters that already provide direct Highway Patrol access. All you need is a report of an incident from a mobile station and an organization to which you can pass it on.

A few days of listening to the local stations should provide you with a list of useful phone numbers. Some broadcast stations have toll free phone numbers that can be used to relay incidents to them. If not, call the radio station's switchboard. The operator there should be able to connect you to the traffic department, or give you the department's number.

When calling in a report of a traffic incident, always include the following information: the location (which freeway, which direction, and near what on/off ramp), type of incident (accident, stall, etc.), what lanes are affected (count from left to right), the length of the backup, and the approximate average speed through the area.

It's also a good idea to listen to the traffic broadcasts during the net. That way, you avoid calling in reports that have already reached the reporters' desks. Call in only new reports, or to amend reports that they are giving incorrectly.

If you start providing a high volume of consistently good reports, the station will almost certainly take note of your service.

Information is typed into a computer as it's received at Air Traffic, making it instantly available to the organization's on-air reporters.

It may even give your group a number where you can reach one of the area's local *traffic brokers*.

Traffic Brokers: A Shared Resource

What are traffic brokers? While many TV and radio stations have their own traffic departments that compile information for on-the-air reports, not every station can afford one, and competing stations generally don't share their information with each other. That's where traffic brokers come in.

These organizations, such as Metro Traffic, Air Traffic, and Shadow Traffic, generally have no broadcasts of their own and no direct line to the public. Instead, they collect information from a variety of sources and pass it on the individual news outlets, which in turn pass it to the public.

Because it's possible to reach so many groups with just one phone call, these brokers are by far the most effective means of reaching the public with traffic information collected via amateur radio.

In some cases, all of the traffic reporting groups in an area have one centralized organization to pool their information. This is the case in Southern California, which is home to a group called the "Traffic Information People," or *TIP*. This group includes members from the area traffic brokers, broadcast stations (KFI, KNX, etc.), the Highway Patrol, and several other interested parties. Similar groups exist in many other areas, and if your organization continues to provide excellent service through its traffic reporting, you may even be invited to join—an extremely prestigious honor for an amateur group.

Reaping the Rewards

In addition to providing a worthwhile service to the public, traffic reporting can also generate a lot of positive publicity for amateur radio. For instance, many broadcast stations are quite gracious about crediting the sources of the reports they receive, and a few well-placed plugs about amateur radio could reap untold benefits. ("Turning to the traffic, we have a report via amateur radio that [insert incident here]....") Such publicity will help inform non-hams about just what it is our service does. (Yes, folks, there's a reason why we have those "eyesore" antennas on our houses.) All of this can go a long way toward increasing public awareness of, and positive feelings toward, amateur radio—and that's going to become essential as commercial interests continue to covet our frequencies.

In addition, reporting traffic incidents to broadcasters and the Highway Patrol is excellent practice for disaster communications. Since these events are live, they give both the mobiles calling them in and the base stations passing them on a good idea of what it's like to communicate in a real emergency.

Get Your Traffic Net in Gear

Any repeater can establish a traffic net to give hams a known place to listen for and list reports of incidents and to make it more likely that "traffic QSTs" will actually be put to use. Better yet, such a net can easily be worked into one of the many repeater systems that already provide travelers' and emergency assistance, making it a doubly-effective public service. It's time we shifted amateur radio traffic reporting into high gear. ■

Ham Radio and Women—Part 2

We figured VE3SRE's February "Op-Ed" would generate response from female hams. And we were right.

I have been a subscriber and an avid reader of *CQ VHF* since your first issue. The February 1997 "Op-Ed" article, entitled "Marketing Ham Radio to Women," by Robert Chandler, VE3SRE, caught my eye.

I am part of the 10 percent group Mr. Chandler wrote about in his article. I am a second generation ham. I grew up with fond memories of amateur radio. I remember many a winter's night watching my dad, Charlie Brown, WB8FAI, operate "Mid Cars" or the Ohio SSB Net on the old tube radios that would warm the whole room and send off a mysterious glow. Mysterious to a five-year-old, anyway. My favorite childhood memory of amateur radio is sitting on my dad's knee talking to Santa Claus and Mrs. Claus. (Everyone knows they are both avid amateur radio operators, as are several of Santa's elves!)

A Natural Progression

It was only natural for me to follow my parents into the hobby. (My mom is Ann Brown, WB8RYH). I got my license in 1977 when I was 12 years old. I had a lot of help from my parents, an old family friend, Dallas Mansell, K8RLT (who is now a silent key), and several members of the East Palestine Amateur Radio Club in northeastern Ohio. I had positive encouragement from everyone who helped me in those early days.

Shortly after I received my license, my family moved to Columbus, Ohio, and I became inactive. Thanks to my mother, I kept renewing my license when it expired...for whenever I might want to get involved in the hobby again. That time came after I got married and got the bug to upgrade so I could use 2 meters.

**Terri Berchak, WD8LQH, is President of the Buckeye Belles, an organization of female hams in Ohio.*

"I wanted to use 2 meters mainly for the reasons Mr. Chandler mentioned in his article, safety and someone to talk to during the 45-minute drive between home and work. That is how it started out, anyway."

I wanted to use 2 meters mainly for the reasons Mr. Chandler mentioned in his article, safety and someone to talk to during the 45-minute drive between home and work. That is how it started out, anyway. Thanks to William "Trigg" Tabor, K8NIO, I got involved in a few of the local amateur radio clubs. This progressed into attending the monthly pizza parties for one of the groups and then becoming social chairperson for the Capital City Repeater Association. That "little" involvement mushroomed into becoming the first female net control operator of the Central Ohio Severe Weather Net; Vice President and then President of the Buckeye Belles, the Ohio women's amateur radio organization; and a member of the Young Ladies Radio League, the national group of female amateur radio operators. (Canada also has a national group called CLARA, for Canadian Ladies Amateur Radio Association.) All of this happened because of the positive influences I continued to have from other amateur radio operators.

Reach Out to New Hams

I believe that if we nurture new hams and extend a welcoming hand in getting them involved with the hobby, they will *stay* involved. Look at me. We need to remember that some amateurs, both men and women, are happy with the No-Code Tech license and have no desire to upgrade. That is their choice, as it should be! However, if we expose them to different aspects of the hobby, *maybe* the bug to upgrade will catch on. If not now, maybe in the future. But, it needs to be *their choice*! After all, we don't like other people living our lives for us. We need to give others the same respect.

In my view, if we encourage people in a positive way, and don't push or criticize, they will upgrade if they have the desire to. The bug finally bit me and I am working on my upgrade now. I also know of several other ladies who are actively pursuing their upgrade since the Buckeye Belles worked the Islands On The Air (IOTA) contest last September on Kelly's Island, Ohio.

Don't Assume

Another little side note: Most amateurs assume that my husband was licensed be-

"If we nurture new hams and extend a welcoming hand in getting them involved with the hobby, they will stay involved."

By Terri Berchak, WD8LQH*

"Don't assume someone will or will not be interested just because of gender. Take the time to ask someone to become involved."

fore I was. I have the honor of being part of the few amateur radio couples in which the wife was licensed before her husband.

My husband, Walt Berchak, N8VQO, is happy being a No-Code Tech and has no desire to upgrade. He talks to a handful of people on the repeater and that is all he wants to do. At amateur radio gatherings, when other hams start to talk to him about contesting, Field Day, rare DX, and all that other "amateur radio stuff," as he calls it, he tells them to go talk to his wife! So don't assume someone will or will not be interested just because of gender. Take the time to ask someone to become involved. Who knows, that person may one day be the editor of this magazine or the president of the ARRL. All because you took the time to positively encourage him or her in the hobby! ■

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The opinions expressed in this column are those of the author and do not necessarily reflect the views of CQ VHF *or its publisher, CQ Communications, Inc.*

If you have an opinion on this issue or another matter of importance to the VHF ham community, we'd like to hear from you. Well-reasoned, well-written commentaries will be considered for our "Op-Ed" page. If we publish your "Op-Ed" article, we'll give you a complimentary one-year subscription (or extension of your current subscription) to CQ VHF. *Submissions not accepted for the "Op-Ed" page may also be considered for our "Letters" department.* CQ VHF *reserves the right to edit all submissions for length and style.*

Announcing

ARRL VHF/UHF Spring Sprints

Wake up to spring with the Spring Sprints—a contest a week for five weeks, with a different band active each week.

Following are the complete rules for the 1997 ARRL Spring Sprint competitions:

1) Object: To work as many amateur stations in as many 2 degrees by 1 degree grid squares as possible, using authorized amateur frequencies on the 50, 144, 222, 432, 902, 1296, and 2304 MHz bands.

2) Contest Period: The 144 MHz Sprint will be from 7 p.m. until 11 p.m. local time on Monday, April 14, 1997; the 222 MHz Sprint will be from 7 p.m. until 11 p.m. Tuesday, April 22, 1997; the 432 MHz Sprint will be from 7 p.m. until 11 p.m. local time Wednesday, April 30, 1997; the 50 MHz Sprint will be held from 2300 Z Saturday, May 17 until 0300 Z Sunday, May 18, 1997; the 902 MHz, 1296, and 2304 MHz Sprints will each be held on Saturday, May 10, 1997. The 902 MHz, 1296 MHz Sprint, and 2304 MHz Sprint will run from 6 a.m. until 1 p.m. local time: you may operate any five consecutive hours during this time period. These Sprints are separate, but run concurrently.

3) Exchange: Grid-square locator (see April, 1994 *QST*, page 86). Example: W1AW in Newington, Connecticut, would send FN31. Exchange of signal report is optional.

4) Scoring:

(A) QSO Points: Count one point for each complete QSO.

(B) Multiplier: The total number of different grid squares worked. Each 2 degrees by 1 degree grid square counts as one multiplier.

(C) Final score: Multiply QSO points by multipliers. Each Sprint is scored separately.

5) Reporting: Entries must be postmarked before 30 days after the contests. No late entries can be accepted. Official entry forms, available from ARRL HQ in the ARRL Contest Yearbook, are recommended. The results will be listed in the *National Contest Journal*.

(Rules courtesy ARRL)

GPS Fun and Games

Did you ever wonder where you were? Are you sometimes lost, yet not lost enough to ask directions? This month, we'll look at one of the cheapest available ways to find yourself.

Last August, I wrote about APRS for Windows. That's the *Automatic Position Reporting System*, a neat packet application that lets you use your computer and packet radio to display the location of objects on a map, and more. Automatic displays of location data are made possible by linking your APRS transmitter to a *Global Positioning System (GPS) receiver.*

This month, we'll be looking at GPS receivers and how to put one to work in your ham station. But first, we'll introduce GPS itself and show you how hams can use it to great benefit! (If you're unfamiliar with APRS, refer back to the August, 1996, issue of *CQ VHF*.

The Garmin GPS 20, as received from TAPR. The antenna cable with the MCX connector is shown. Since the unit is not weatherproof and is static-sensitive, you must mount it inside a case.

The Global Positioning System

Some time ago, the U.S. Government figured it would be useful to have an automatic system for global navigation and positioning. It launched a whole bunch of satellites with really accurate clocks in them and arranged them in the sky so that no matter where on Earth you are, there are always three or four of them in view overhead (caves don't count!).

GPS receivers listen for signals from as many of these satellites as possible, calculate distance based on variations in time reported from those really accurate clocks, and tell you—in just a few seconds—exactly where you are in terms of latitude, longitude, and altitude (*some even report your grid square!—ed.),* with an accuracy of a few dozen yards or better. The system is capable of much better accuracy, but the government deliberately distorts the data a little for us regular civilians, for security reasons. And, best of all, getting a GPS receiver won't cost you an arm and a leg.

The GPS/APRS Connection

How can hams use GPS receivers? Well, this is a pretty extreme example, but it bears repeating. In case you missed our report on this story in January's "VHF News" column, there was a ham in California who installed his GPS receiver in his car, along with a TNC set up for APRS, to use with his radio—and accidentally left everything turned on. To his dismay, the car was stolen. The local police didn't believe him when he told them exactly where his car was, instead sending an officer to take a report. The officer, after seeing the APRS screen in the ham's shack, radioed in the stolen car's position. As luck would have it, another police car was stopped at a traffic light *right next to the stolen car!* The thieves took off when they noticed the officer's interest, then abandoned the car in the middle of the street. They got away, but our ham got his car back, thanks to GPS and APRS!

Besides recovering your stolen car, having a GPS receiver can be a lot of fun. As long as you have a map, you'll never be lost again! Foxhunting (looking for hidden transmitters) becomes a lot easier if you know precisely where *you* are. Contest "rovers" use them to know when they've crossed into a new grid square. Plus, the receivers' extremely small size

By Don Rotolo, N2IRZ

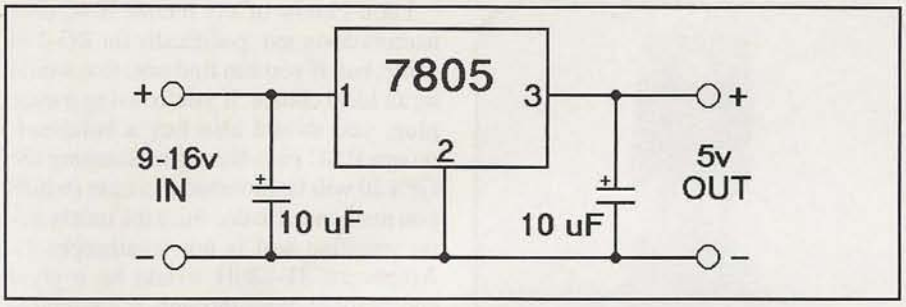


Figure. Schematic for a simple 5-volt power supply, which can be built "dead bug" style (see photo). All of these parts are available at RadioShack. Use electrolytic capacitors with at least a 20-volt rating, and mount the regulator to a heat sink.

and weight make them ideal for tracking race runners, animals, and balloons. See "Resources" at the end of this article for Web sites where you can get more ideas about using a GPS receiver.

GPS Receivers

There are literally dozens of GPS receivers on the market, ranging in price from about $200 for the very basic models, to thousands for ones with all the bells and whistles. The basic units have a simple coordinate display and are limited in some ways, such as in maximum tracking speed. The more expensive units have the all-important *NMEA-0183 data output port*, which we hams use to generate data for our TNCs and computers. These more costly units also have better displays and greater capabilities, such as the ability to make navigational calculations like estimated time of arrival. But the basic accuracy is the same, no matter what you pay.

I won't go into the details of which unit you should buy because there are so many choices. Plus, Gordon West WB6NOA, took a look at some GPS receivers last January. I will, however, offer two caveats: First, make sure that any unit you buy has a standard NMEA-0183 output. Without it, you're lost (no pun intended). Second, make sure the unit can track at speeds faster than the fastest object you'll ever want to track. Many low-end GPS receivers for the boating industry are limited to 99 knots, which is really too slow for some uses, such as hang-gliding or driving in Montana.

You can buy GPS receivers from many amateur radio dealers as well as from boating and aviation stores. Some electronics hobby shops may also carry them, and even RadioShack can get you one by special order.

The TAPR Special

One place you can get a good quality GPS receiver at a good price is from TAPR—yep, Tucson Amateur Packet Radio (*see "Club Spotlight," February, 1997* CQ VHF—*ed.*). Some months ago, TAPR made a deal with Garmin, a receiver manufacturer, to buy 100 of its GPS 20 receivers. There's a hitch, of course—to quote the toy ads, "some assembly is required." These are bare-bones GPS engines, intended for integration into some other product. They don't have a display,

power supply, case, or antenna. But you can't beat the price: $179 with shipping.

TAPR sold out the first batch, and two more batches since then, and is working on batch number four as I'm writing this. Let's just say the idea was more popular than they thought it would be. I guess the low price, combined with the very easy integration into a working unit, made sense to a lot of people.

Now let's look at how to interface this bargain-basement GPS receiver to the real world.

Getting One

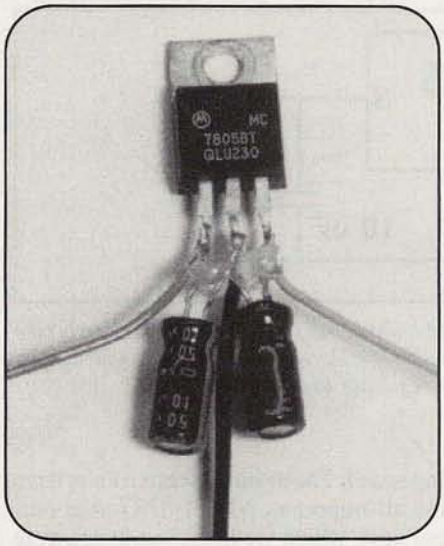
First, you have to get one. Send a check to TAPR and, in a few weeks (assuming they haven't run out again), a small white box will arrive. Inside is the GPS 20 itself, an antenna cable, a tiny interface cable, documentation from Garmin, and some notes from TAPR. *Don't open the GPS 20 anti-static envelope yet.* Wait until you're finished with everything else you need to do to minimize handling—to find out what that is, read on.

The Power Supply

The first thing you'll need is a good, low-impedance 5-volt power supply capable of delivering 200 mA. The Figure shows the simplest power supply you can make, using a 7805 regulator IC. This power supply will safely power your GPS 20 from any reasonably clean source of 9- to 15-volt DC. Be absolutely sure to check the output voltage before connecting it to your GPS 20...or you might be out $179 with shipping.

The supply is very easy to put together, even if you're not an experienced builder. I built one "dead bug" style (using the component leads as connection points—the name comes from the look of an IC with its "legs" sticking up in the air like a dead bug) and mounted it onto the aluminum cover of my project box, which served as my heat sink. You absolutely *must* use a heat sink or the regulator will fry. Also, to avoid thermal drift problems, try to keep whatever heat is generated away from the GPS 20.

In addition to the 7805 regulator IC and heat sink, all you'll need are two 10-µF electrolytic capacitors with at least a 20-volt rating. Connect the + lead from your 9- to 15-VDC power source and the + lead of the first capacitor to pin 1 of the IC. Your +5-VDC output lead and the + lead of the second capacitor go to pin 3 of the 7805. Everything else (the leads of the two



A close-up of the assembled power supply. Note the small dabs of hot-melt glue, used to stabilize the components to avoid short circuits.

capacitors, a lead from IC pin 2, and the -5-VDC output lead) connects to the – lead from the 9- to 15-VDC power source. Once all the connections are made and soldered, use a few small dabs of hot glue to stabilize the components and avoid short circuits (see photo and Figure). Again, be sure to check the output voltage before connecting the GPS 20.

As of this writing, TAPR is considering offering a very inexpensive power supply and RS-232 interface kit for the GPS 20. Check the TAPR Web page for the latest information. If it's available by the time you read this, check into it—it could save you some extra work.

The Antenna Cable

Once you have the power supply working, take a look at the antenna cable. What you get from TAPR is a piece of RG-174 coax with an MCX connector at one end. A similar cable is shown in the GPS 20 photo, but the one from TAPR has the 90° version connector, which makes things easier. The MCX connector attaches to the circuit board, and the other end is bare. At that end, you'll need to attach a BNC connector (or whatever your antenna takes) made specifically for RG-174.

Unless you have the proper crimping tool (which costs over $100—ouch!), get the clamp-type BNC plug. You can make do without the crimping tool, but it takes much more work and doesn't come out as nicely; I know this from personal experience. Amphenol part number 69475 is a good choice, which Digi-Key sells for around $6 as part number ARF1157-ND.

I don't know of any female BNC connectors designed specifically for RG-174 cable, but, if you can find one, that would be an ideal choice. If you're using a male plug, you should also buy a bulkhead-mount BNC pass-through, assuming the GPS 20 will be mounted in a case (which you really *need* to do, since the unit is static-sensitive and is not weatherproof). Amphenol 31-220H would be a good choice for the pass-through. It's available for $7 from Digi-Key as part number ARF1129. You mount the bulkhead connector into your project box (after drilling a hole of the appropriate size) and secure the antenna wire inside. By the way, Digi-Key also sells MCX connectors, but they aren't cheap and you *really* need to use a crimp tool.

DCE or DTE?

Now you have to decide just how you're most likely to use the GPS receiver. If you basically want to know where you are, like I do, then you'll want to connect to a computer running a terminal program. This lets you see your position information directly. If that's the case, you'll want to connect the GPS receiver as a *DCE* (Data Communications Equipment) device. If, on the other hand, you want to connect it to a TNC so you can track some object (or be tracked) using APRS, then you have to connect it as a *DTE* (Data Terminal Equipment) device. Whatever your choice, if you want to use it differently, you can always buy a null modem from RadioShack (or other suppliers) to convert from one type of connection to the other.

I recommend a female DE-9 connector. Most computers and TNCs use male connectors, allowing a direct connection. However, you can use whatever suits your application best.

That @%*#$! Little Header

Now comes the hardest part: that tiny little header connector which connects power and data to the GPS 20. This header, with 1.5-mm spacing, is small, but not impossible to work with. The little sockets are very tiny, and the solder likes to wick into them, closing them off. It took me seven tries to assemble four wires. Further complicating things is the fact that all the crimping ears must be crimped inward, in order for the socket body to fit inside the plastic connector body. If just one of those ears is sticking out, the whole thing won't go in.

With that in mind, you now have to attach the ends to four pieces of wire. Take your time, or borrow some younger eyes. TAPR gives you a dozen sockets, and you really need only four (five if you want the 1 pulse-per-second output), so there's some room for error.

Once you have your end pieces with four (or five) wires on them, and not filled with solder by mistake, you can insert them into the plug connector body. Study the connector body and the contact sockets carefully. The sockets have a "tunnel" through them, which is where the male pin on the GPS 20 enters and connects. This tunnel must line up with the hole in the plastic connector body. If you insert the sockets the wrong way, the connector will not mate. Don't force it!

Connecting Everything

Put the contacts into the plastic connector housing in positions 10, 8, 5, 4, and, if you have the fifth wire, 3. These are the connections for +5 volts, ground, RXD (receive data), TXD (transmit data), and 1PPS (1 pulse per second), respectively. The documentation that TAPR includes is very clear on which position is which.

Now, connect the wire from pin 10 (+5 volts) to the output of the power supply. Connect the wire from pin 8 (ground) to both the power supply ground *and* pin 5 of the DE-9 connector. If you decided to use the 1PPS output (from pin 3), connect that wire to pin 1 of the DE-9. If you decided upon a DCE connection, which goes directly into a computer, connect the RXD wire from pin 5 on the GPS 20 to pin 3 of the DE-9, and the TXD wire from pin 4 to pin 2 of the DE-9. For a DTE connection, which goes directly into a TNC, connect the RXD wire from pin 5 to pin 2 of the DE-9, and the TXD wire from pin 4 to pin 3 of the DE-9.

The Antenna

Now you have to think about an antenna. The patch antenna described by Harold Ward, W1GE, in the October, 1995, issue of *QST* has been found to work well outdoors and is easy enough to construct (see his article for details). Under most conditions, however, commercial antennas work best, especially amplified versions. Unfortunately, they are also the most expensive. I paid $130 for the Garmin GA 28, a marine antenna intended for mounting on a threaded pole. Their GA 27 is a magnetic-mount style for car top use, if that's where you want to use your GPS system.

I've experimented with a variety of antennas, including a simple ground plane, crossed dipole, quadrifilar helix, the W1GE patch, and a Garmin GA 28 (see photo). I found that the commercial antenna did work best, followed closely by the patch. I recommend avoiding the helix, as it requires a DC block (the GPS 20 has +5 volts on the center pin of the antenna connector to power an amplified antenna; shorting this out could cause problems or damage the GPS 20). The ground plane and crossed dipoles had no special needs, but were no match for the others in terms of performance.

A Final Check

Once all the pieces are properly in place, you can try a smoke test. Again, before risking your GPS unit, verify 5 volts on pin 10, ground on pin 8. Unpow-

On the Cover

Doug Johnson, KD4SQ, a commercial pilot-turned-attorney from Miami, Florida, manages to combine both ham radio and flying with his legal career. Doug says his work takes him all over the Southeast, and much of the traveling is done in his 24-year-old Cessna 210 Centurion. His 2-meter handheld always comes along.

"I do a lot of hamming from the air," says Doug, "nearly all simplex. I get about a 100-mile range with the HT from 5,000 feet." His best DX from that altitude was about 250 miles. And back when he was a commercial pilot—and when it was legal for the pilot to do anything other than flying the plane during a flight—he regularly worked 400 to 600 miles on his HT from 30,000 feet!

Doug explained that he stopped using repeater frequencies some years ago when he realized just how far his signals carried. "I was flying over Cleveland, Mississippi, one night, and I got on the .82 repeater there and said 'Anyone awake in Cleveland?' Well, a guy came back to me and said Cleveland's on a different frequency—and always had been. Turns out he was in Cincinnati and thought I meant Cleveland, Ohio!"

His most interesting contact from the air? "A Navy hydrofoil," remembers Doug. "I saw an overturned boat in the Florida Straits and couldn't raise anyone on commercial frequencies. The Navy hydrofoil answered me on .52!" The boat turned out to have been abandoned.

Johnson has been a ham since 1970 (although he first became interested in radio in the 1950s), and currently holds an Advanced class license. His most frequent ham activity is working public service events on 2 meters, although he also enjoys packet and likes to look for DX opportunities on the band. "We get some interesting ducts here across the Gulf [of Mexico]," says Doug. "I've worked back to Miami from New Orleans, operating mobile on 2 meters." (Cover photo by Larry Mulvehill, WB2ZPI)

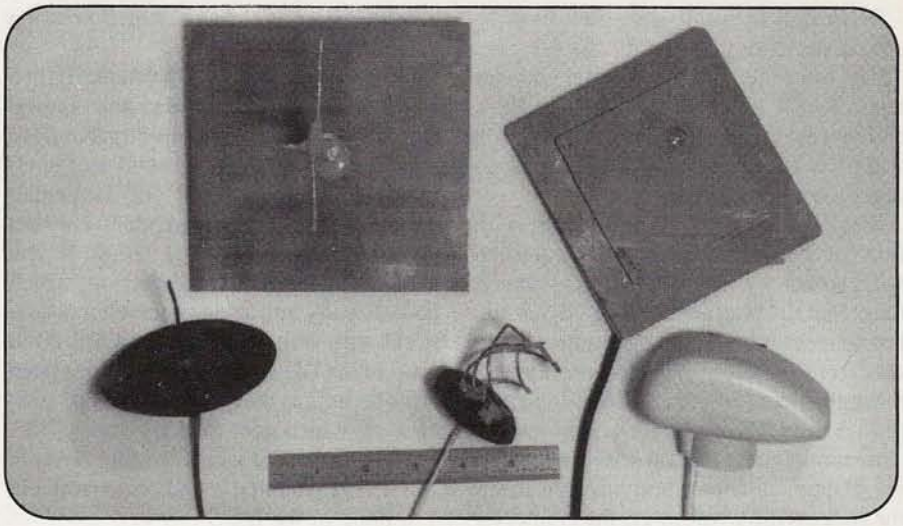
ered, connect the GPS 20 to the power supply and antenna, and a computer to the DE-9 connector. Start up a terminal program (such as *Windows Terminal*, *Bitcom*, *Crosstalk*, or even the terminal window in APRS) on your computer and set the communications for 4800 baud, 8 data bits, no parity, 1 stop bit (8n1).

Unless you have a commercial antenna, you should also check that the antenna has no DC continuity from center conductor to shield (remember the +5 VDC on the antenna center pin).

It Works!

As soon as you apply power, the GPS 20 will start spewing data. If it doesn't, first make a quick check of pin 2 of the DE-9 with a voltmeter (about 3 volts AC), and then fiddle with your terminal program until you see the data. If you've wired it for DTE, you'll need a null modem, with pins 2 and 3 crossed, for this initial setup.

The documentation from Garmin explains just what all that data means. You probably won't have a *fix* or determination of your location, but that's normal. Take the unit somewhere where you have a clear view of the sky from horizon to horizon. Even trees should be avoided. Let the receiver gather its initial data for a while. Garmin says a maximum of 15 minutes, but mine took nearly an hour. Of course, sky view and antenna quality strongly affect this.



Here are some of the antennas that I've been playing with. From left to right: a simple ground plane, a crossed dipole, a quadrifilar helix, the W1GE patch, and a Garmin GA 28. See text for my recommendations.

The Fix Is in...

Once you have a position fix, you're all set. If all that data is too much for you, you can select which data "sentences" the unit sends. Each GPS NMEA-0183 "sentence" provides different positional data, such as latitude and longitude, altitude, speed, time, date. The standard for APRS is the "GPRMC" sentence. (APRS, however, is smart enough to look at only what it needs, so the default sentences are just fine and there's really no need to switch off any of the GPS sentences that aren't being used.)

If you decide you *do* want to limit the data displayed, you have to start by telling the unit to stop displaying all data. You do this by sending "$PGRMO,,2<enter> <Ctl-J>" (without the quotes). See the documentation for how to do this. In case you're new to this sort of notation, <enter> means pressing the enter key, and <Ctl-J> means hold the Control key and tap the J key. Once the GPS 20 hears the <Ctl-J>, it will stop sending data. Then, you can have it output only the "GPRMC" sentence, for example, by sending "$PRGMO,GPRMC,1<enter> <Ctl-J>". This is explained in the documentation as well, but it can be confusing. Just remember that APRS will work fine without changing any of the settings. Also keep in mind that the default settings return if power is disconnected.

Make Tracks to Dayton

Well, that's all the time we have for this month. Dayton is coming up soon (May 16 to 18), and if you plan on driving, you should consider using your GPS unit and APRS to transmit your position as you drive there. At the least, listen with APRS on 145.79, and track everyone else! *(I can just see all those little dots converging on Hara Arena!—ed.)*

Until next time, 73 and keep those data pipes humming. ■

Resources

Here's how to contact the various sources of materials and information referenced in this month's column:

Digi-Key: Phone: (800) 344-4439; World Wide Web: <http://www.digikey.com>

Tucson Amateur Packet Radio: Phone: (817) 383-0000; World Wide Web: <http://www.tapr.org>

American Radio Relay League (*QST* Reprints): Phone: (860) 594-0200; World Wide Web: <http://www.arrl.org>

RATS (Radio Amateur Telecommunications Society) World Wide Web Home Page, links to APRS: <http://www.rats. org>

Hamfest Calendar

The following hamfests are scheduled for late March and April, 1997:

March 29, 9th Annual Hamfest, Texas Army National Guard Armory, Weatherford, TX. For information, contact Allen Griffith, KB5UNY, at (817) 441-9114, 1260 Wallis Rd., Aledo, TX 76008. (exams)

April 4–5, 6th Annual Sand Mountain Hamfest, Albertville Recreation Center, Albertville, AL. Talk-in: 147.200, alternate 145.110. For information, contact Marshall County ARC, P.O. Box 2811, Albertville, AL 35950; or call Buddy Smith, KC4URL, at (205) 593-2516. (exams)

April 5, 4th Annual Fleamarket, Twin Mountain Town Hall, Twin Mountain, NH. Talk-in: 145.43. For information, contact Richard Force, WB1ASL, 12 Cottage St., Lancaster, NH 03584; (603) 788-4428; e-mail: <bhabooks@together.net>. (exams)

April 5, Hamfest/Swapfest, Boulder Cnty Fairgrounds, Longmont, CO. Talk-in: 147.27. For information, call Jim Deeming, (303) 651-7764; e-mail: <jwdeeming@compuserve.com>. (exams)

April 5, Ham Radio Auction, Waterford Senior Center, Waterford, CT. Talk-in: 146.730(-). For information, call Tony, AA1JN, at (860) 859-0162.

April 5, 51st Hamfest/Computer Fair, Comanche Country Fairgrounds, Lawton, OK. Talk-in: 146.91/31. For information, contact Bob Morford, KA5YED, 1415 NW 33rd St., Lawton, OK 73505, or call (405) 355-6120; (405) 353-8074.

April 5, 14th Annual Hamfest, Bartholomew County 4-H Fairgrounds, Community Bldg., Columbus, IN. Talk-in: 146.790/146.910. For information, contact Marion Winterberg, WD9HTN, 11941 W. Sawmill Rd., Columbus, IN 47201-8000 or call (812) 342-4670 or e-mail at: <winterbe@hsonline.net>.

April 5–6, Greater Baltimore Hamboree/Computerfest, Timonium Fair Grounds, Timonium, MD. For information, call (410) HAM-FEST; outside MD: (800) HAM-FEST.

April 6, Framingham Fleamarket, Framingham High School, Framingham, MA. Talk-in: 147.15+ MHz. For information, contact Martin Bayes, AA1ON, FARA P.O. Box 3005 Framingham, MA 01705, or call (508) 435-0564. (exams)

April 11–12, North Mississippi Hamfest/Computer Expo, Mississippi Bldg., Tupelo Furniture Mrkt Complex, Tupelo, MS. Talk-in: 147.38+. For information, contact Jack Ellis, KI5QV, Rt. 4, Box 198-B, Tupelo, MS 38801; (601) 842-7255. (exams)

April 12, Amateur Radio Hamfest and Electronics Fleamarket, University of Southern Maine Sullivan Gym. For information, call Martin Feeney, K1OYB, (207) 839-5072 or Ron Levere, KA1FI, (207) 846-9090.

April 13, 25th Annual Madison Swapfest, Dane Cnty. Expo Ctr. Exhibition Hall, Madiosn, WI. Talk-in: MARA repeater, W9HSY, 147.75/15. For information, contact MARA, P.O. Box 8890, Madison, WI 53708-8890, or call (608) 245-8890.

April 13, Raleigh ARS 25th Hamfest/Computer Fair, Jim Graham Bldg., NCS Fairgrounds, Raleigh, NC. For information, contact Ronnie Reams, WA4MJF, 3509 Rolesville Rd., Wendell, NC 27591, or call (919) 217-0263.

April 13, Southington Amateur Radio Assoc. Fleamarket, Southington High School, Southington, CT. Talk-in: 147.345 - 224.80 - 444.25 - 145.49 PL 77 Hz. For information, call Chet, KA1ILH, at (860) 628-9346. (exams)

April 18–19, All Arkansas Family Hamfest, Sherwood Forest Convention Center, Sherwood, AR. Talk-in: 146.94-. For information, call JC Smith, N5RXS, (501) 568-7982.

April 20, GAARC's Hamfest, Karyae Park, Gastonia, NC. For information, contact GAARC, P.O. Box 85, Iron City, NC 28080-0085 or e-mail at: <kf4r@cetlink.net>.

April 20, Penn-Del ARC Hamfest, Nur Temple, New Castle, DE. Talk-in: 147.225+ or 224.220/R. For information, call Hal Frantz, KA3TWG, (302) 798-7270; e-mail: <hfrantz@magpage.com>; Web Site: <www.magpage.com/penndel>.

April 20, 13th Annual Hamfest, Canfield Fairgrounds, Canfield, OH. Talk-in: 145.275- 224.420- 442.750+. For information, contact Don Stoddard, N8LNE, 42 S. Whitney Ave., Youngstown, OH 44509 or call (330) 793-7072.

April 25–26, Hamboree 19/Iowa State Convention, Marina Inn, South Sioux City, NE. For information, contact Mike Nickolaus, NFØN, 316 East 32nd St., South Sioux City, NE 68776, or call (402) 494-6070; e-mail to: menicko@avalon.net> or packet <NFØN@NFØN.NE.USA.NA>.

April 26, AARC's Swapfest/Fleamarket, St. Paul's United Methodist, Albuquerque, NM. Talk-in: 147.06(+), 100 Hz tone. For information, call Chuck Opdyke, KC5GA, (505) 858-0306.

April 26, Washington Cnty ARC/Fidelity ARC Hamfest, West View Inn, W. Greenwich, RI. Talk-in: 145.130 (151.4)+ 147.165+ and 146.580 simplex. For information, contact Bill May, WA1WM, 20 Montana Ave., Coventry, RI 02816 or call (401) 822-0520. (exams)

April 26, Cherryville Hamfest, Warren County Farmers Fairgrounds, Harmony, NJ. Talk-in: 147.375+ and 146.52 simplex. For information, contact Charlie Kosman, WB2NQV, at (908) 788-4080. (exams)

April 26, ARRL Hamfest, McDougal Hall, Sonoma Dev. Center, Glen Ellen, CA. Talk-in: 145.35, -600, PL, 88.5. For information, call Darrel, WD6BOR, at (707) 996-4494. (exams)

April 27, Smartsfest, Canterbury Park (formerly Canterbury Downs Racetrack) Shakopee, MN. Talk-in: 147.165+ 600 repeater. For information, call Tim, (612) 474-9232. (exams)

April 27, 35th Annual Hamfest, Moultrie/Douglas County Fairgrounds, Arthur, IL. Talk-in: 146.055/146.655 and 449.275/444.275. For information, contact MARK, P.O. Box 91, Lovington, IL 61937, or call (217) 543-2178 (days) or (217) 873-5287(evenings). *There will be no exams this year at the hamfest.

April 27, Mt. Beacon Hamfest, John Jay High School, Fishkill, NY. talk-in: 146.97-. For information, contact Ken Akasofu, KL7JCQ, 316 Titusville Rd., Apt. 4, Poughkeepsie, NY 12603-2944 or call (914) 485-9617; fax: (914) 485-2402 or e-mail to: <Ken.Akasofu@bbs.mhv.net>. (exams)

Operating Notes

For April 1997:

April	
4	Moon Perigee
14	ARRL Spring Sprint (144 MHz), see rules this issue
22	ARRL Spring Sprint (222 MHz)
22	Lyrids Meteor Shower peak
30	ARRL Spring Sprint (432 MHz)

Using "PB/PG" and "WiSP"

Champing at the bit to get on the digital "birds"? Good. Now let's take look at some of the software you'll need to operate the digital amateur satellites that use the PACSAT Protocol Suite.

Digital satellite operation isn't difficult, it just requires you to absorb a great deal of information beforehand. So just take it in small steps, experiment with a defined area until you're comfortable, then move on to the next area. This way, if your attempt at digital communication with the satellites fails, you'll be able to isolate, diagnose, and solve the problems.

That said, let's make sure you're ready for the next step. In order to work the digital satellites, you should:

- Be competent in operating a computer, DOS, Windows, and tracking software;
- Have read your TNC manual cover to cover and have a working knowledge of all of the TNC commands;
- Understand how to interface a PSK modem or DSP unit to the TNC and control them via the computer (understanding the hardware makes it less likely you'll blame the software when it may actually be a connection or setup problem).

Have You Mastered the Basics?

Now for a quick refresher of the basic digital satellite system (if you *know* you know this, you can skip ahead). The SSB RF signal from the satellite goes from the antenna to the pre-amp, and then to the receiver on the ground. Here, the audio output is connected to the PSK modem, which sends digital data to the TNC (which was placed in KISS mode by a serial connection to a computer). The AX.25 packet data is passed to the computer, where a special program processes the information and displays it on the screen.

On the transmit side, another program adds a header to any outgoing messages, which are then compressed. The zipped message is then sent to the TNC, which passes it on to the Manchester encoder section of the PSK modem. The signal is

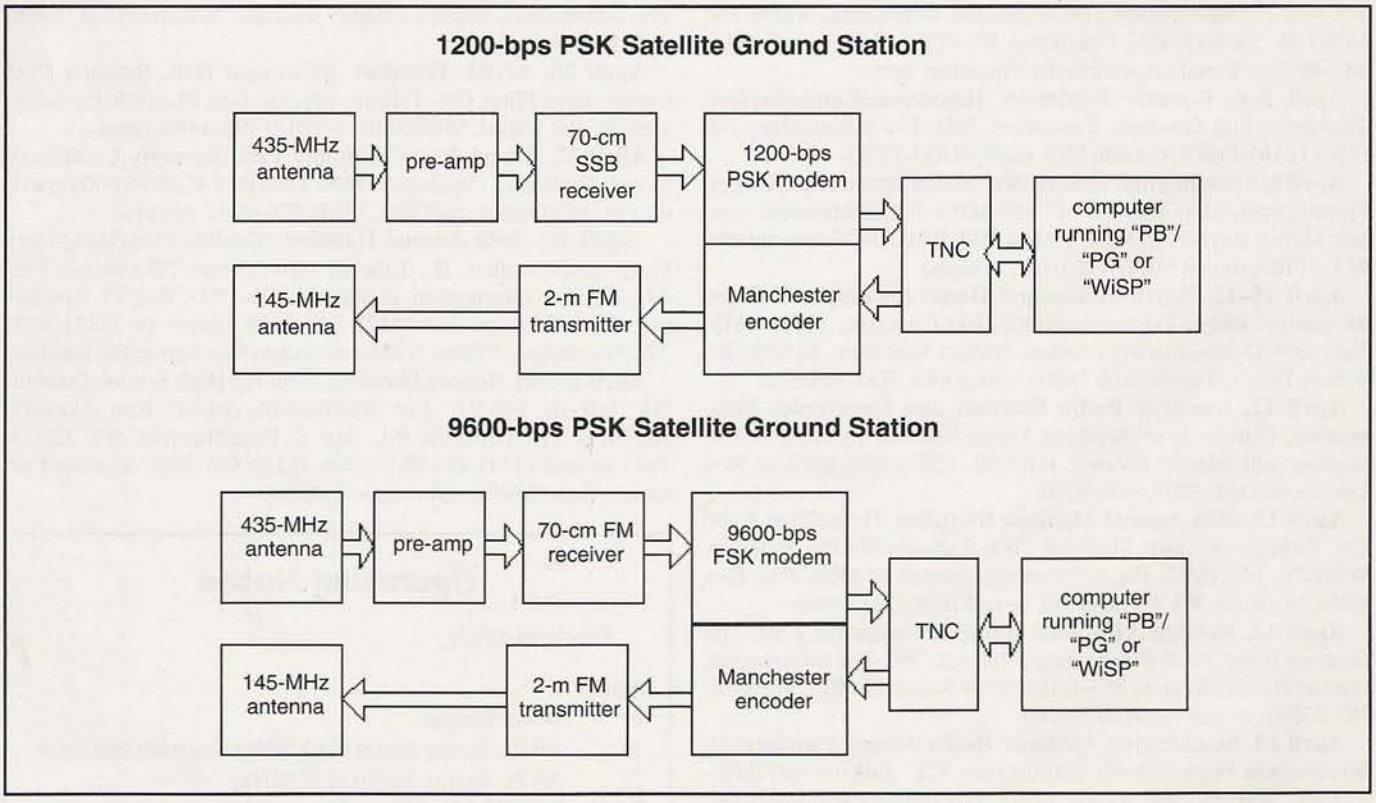


Figure 1. Basic PACSAT Protocol satellite ground station configuration.

By G. Gould Smith, WA4SXM

Figure 2. Sample "PB" screen during a KO-25 pass.

then modulated by the transmitter, sent to the antenna and up to the satellite (see Figure 1). Each box in Figure 1 could take more than a column to adequately explain, so I'll instead refer you to the *AMSAT-NA Digital Satellite Guide* for more in-depth information (see "Resources"). However, most of the fields from all of the Figures in this article are defined in the "Software Glossary."

Let's Go to the Videotape

To assist you with both the hardware setup and the operation of the software, I recommend that you record a good (strong signal, long duration) pass on tape. The 1200-bps PSK signals will record fine on an audio cassette. If you want to record a 9600-bps pass, though, you'll need a HiFi VCR and a good quality videotape. Making a recording gives you a reference against which you can test most of your system, even when a good satellite signal isn't available. This will be an invaluable resource and a great time saver down the road when, all of a sudden, you can't decode any data and the satellite is gone. Often, the problem is only a switch in the wrong position or a disconnected cable, and having a signal you can play back repeatedly into your modem lets you find the problem quickly.

Once your hardware system is in place, cabled, and configured correctly, you're ready to work with the software. So let's take a look at the *PACSAT Protocol Suite.*

(Note: The majority of tools available for the digital satellites are provided for the IBM personal computer platform because it's the most widely used. Those of you using Apples, Suns, or other computers will find *some* programs available on the AMSAT World Wide Web site to allow you to communicate with the satellites using the PACSAT Protocol Suite, but not enough volunteers have stepped forward so far to provide a great deal of additional tools.)

What Is the PACSAT Protocol Suite?

The PACSAT Protocol Suite is a series of protocols developed by Harold Price, NK6K, and Jeff Ward, G0/K8KA, to maximize the data transfer between ground stations and LEO (Low Earth Orbit) digital satellites. It's composed of four programs: "*PB*," "*PG*," "*PFHADD*," and "*PHS*." The "PB" program handles the data broadcast from the satellite to everyone located in the footprint (the area "seen" by the satellite at any given moment). These broadcast packets are UI (Unnumbered Information) frames, which need no acknowledgment from the receiving station.

The "PB" software on the ground station computer receives the satellite packets, sorts them by message ID, and stores them on the hard drive. Each packet of a file that is *not* received by the ground station forms a "hole." This information is kept by the ground station, and these holes can be specifically requested from the satellite on a later pass to complete the file. Only one station needs to request a file to allow all the stations receiving the satellite to store the data from that file, markedly decreasing the need to send the same file over and over.

The directory of all of the current files on the satellite is automatically broadcast, so everyone's directory is constantly updated during a pass. The satellite software that selects the files to transmit is called the *server*. The satellite's server software gives each of the files slated to be broadcast a time slice, during which a few of the packets of that particular file are transmitted. The server software sends the requested files in a round-robin fashion: a little of this file, a little of that file, a little directory, then back to this file, etc. This allows maximum access to

"To assist you with both the hardware setup and the operation of the software, I recommend that you record a good (strong signal, long duration) pass on tape."

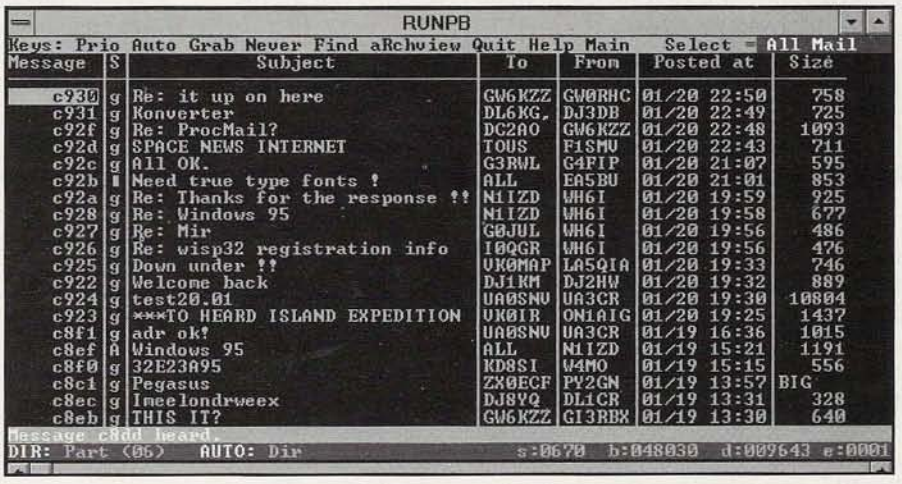


Figure 3. Sample "PB" directory screen during the same KO-25 pass.

Software Glossary

AUTO:—Message stating that the automatic directory hole-filling process is operating.

AX.25—Amateur Radio X.25 packet protocol

b:—Count of the number of bytes received in broadcast message frames, found on the bottom of the "PB" screen.

c91a—The hexadecimal file ID number, found on the "PB" screen under Message.

Client—The ground station running "PB"/"PG"; see *Server*

d:—Count of the number of bytes received in the directory broadcast frame, found on the bottom of the "PB" screen.

D:—Number of bytes received for Directory data, from the bottom of the MSPE screen.

DIR: Part <06>—Message stating that the directory is not up to date, only partial, with six missing holes.

e:—Counts the number of data bytes corrupted between the TNC and the "PB" program, found on the bottom of the "PB" screen.

F:—Number of bytes received in Broadcast Files, from the bottom of the MSPE screen.

F: ("From")—Abbreviation preceding the originating station, found on the "PB" screen.

FTL0 (File Transfer Protocol)—PACSAT protocol for sending files from a ground station to a satellite.

GSC (Ground Station Control)—Includes station setup, satellite scheduling, housekeeping.

Holes—The number of packets needed to complete the file, found on the "PB" screen.

LEO (Low Earth Orbiting)—Satellites in orbit from 500 to 1500 kilometers (300 to 1,000 miles) above the Earth.

Manchester encoding—An FM data modulation technique in which digital ones and zeros are associated with the transition from one tone to another, rather than the frequencies of the tones themselves.

Message—The hexadecimal file ID number, found on the "PB" screen.

MsgMaker—Message creation and replies ("WiSP" function).

MsgView—View any ASCII messages received from the satellite ("WiSP" function).

MSPE (MicroSat Protocol Engine)—Uploading and downloading functions to access the digital satellites ("WiSP" function).

OK AL7MM—FLT0 response to station AL7MM that his file request was processed.

Open 12a:—FLT0 message informing the "PG" program that there is an open slot in the queue, so attempt to connect.

PACSAT Protocol Suite—A series of protocols developed by Harold Price, NK6K, and Jeff Ward, G0/K8KA, to maximize the data transfer between ground stations and LEO digital satellites.

"PB"—PACSAT Protocol Suite program to receive all broadcast information, display directory information, and select files to download from the satellites.

PB:—Stations currently connected to the FLT0 server (those with \D are getting requested directory updates to fill holes).

"PFHADD"—PACSAT Protocol Suite program to add a file header to the data file to be uploaded to the satellite.

"PG"—PACSAT Protocol Suite program that implements the connected mode file transfer protocol (FTL0) program to automatically upload files to the satellite.

"PHS"—PACSAT Protocol Suite program to display and remove the file headers that have been inserted by the "PFHADD" program before uploading to the satellite.

ProcMail—Processes messages as they are downloaded and places into directories. ("WiSP" function).

PSK *(Phase Shift Keying)*—Type of modulation where the phase of the signal is shifted to convey the digital information.

Rcvd—The percentage complete in receiving the entire file, found on the "PB" screen.

RUNPB—A batch file that runs the "PB.EXE" program.

S—Message status, found on the "PB" Directory screen (g = grab, grabbed if heard, but not automatically filled; white block = message completely downloaded; A = automatic, message will be downloaded and automatically filled).

S: ("Subject")—Abbreviation preceding the file title, found on the "PB" screen.

s:—Speed at which you're receiving data in bytes/sec, found on the bottom of the "PB" screen.

Server—The program running on the satellite, serving the client.

T:—Total number of bytes received, from the bottom of the MSPE screen.

T: ("To")—Abbreviation preceding the destination station, found on the "PB" screen.

TNC (Terminal Node Controller)—A combination modem and AX.25 packet protocol processor.

UpdKeps—Automatically updates the Keplerian element database with keps from the satellite ("WiSP" function).

View-Dir (Directory Viewing)—Message viewing and reply ("WiSP" function).

"WiSP" (Windows Satellite Program)—A multi-program software package (suite) for communicating under Windows with amateur digital satellites.

WiSP-TLM—Displays real-time telemetry from the satellite, from "WiSP."

the satellite and very efficient data transfer for all. One operator in Jacksonville, Florida, another in St. Charles, Missouri, and a third in Indianapolis, Indiana, can all receive a specific file at the same time, from one request.

Back on the ground, the "PG" program, or client software, is sending to the satellite files that contain messages, images, programs, or whatever information the operator wants uploaded. The protocol to send these files to the satellite is called *FLT0*, for FiLe Transfer protocol 0. The files are broken up into packets, each of which contains the message ID, the message type, which packet in the total file it is, and the information contained in this chunk of the file.

To give the ground station software enough information to recognize the different files and to be able to reassemble them from random pieces, a special header is necessary. So, before uploading any files, the "PFHADD" program must be run to attach a header to the file to be uploaded. Then after a complete file is received by the ground station, the "PHS"

```
;SAMPLE PB CONFIGURATION FILE (PB.CFG)
;these are the only things you MUST have in your PB.CFG file.
;PLEASE BE SURE TO PUT YOUR CALL AND ADDRESS/ALIAS HERE!
mycall WA4SXM
myaddr gould
bdcstcall HL01-11
port 1
speed 9600
```

Sample PB.TNC file

```
RETRY 4
FULLDUP ON
FRACK 2
MAXFRAME 7
PACLEN 254
PACTIME AFTER 1
TRACE OFF
```

Figure 4. Sample "PB" and "PG" configuration files.

program is used to remove this special header, leaving only the original file.

Figure 2 shows a sample "PB" screen during a KO-25 pass. You can see some message information, who is connected to the satellite, as well as statistics on the data transfer. The hexadecimal message numbers, file subjects, To, From, and size fields can be seen in Figure 3, the "PB" Directory screen. Notice the call-signs from stations all around the world using KO-25 to send and receive mes-

A "WiSP" List

Roy Welch, WØSL, AMSAT's software "guru," has given me his Top Ten list of problems people encounter when using "WiSP." Look these over and prepare yourself well before assuming there's a problem with the software.

Top Ten Most Common Problems Using "WiSP"

1. Not knowing DOS: how to use and make directories, etc.
2. Not knowing Windows
3. Buying your first PC and trying to run "WiSP" in the same week.
4. Failing to read all the enclosed "WiSP" electronic documentation.
5. Failing to perform ALL the Setup Menu items.
6. Failing to understand the operation of the TNC; for instance, matching the bps rate, parity, stop bits, etc. between the PC and TNC; not knowing the procedure to set up KISS mode in the TNC; selecting the active radio port on two-port TNCs; not knowing how to set up the TNC, not reading the TNC manual.
7. Setting up the wrong satellite callsigns, such as HL-O1 (oh 1) instead of HL-01 (zero 1)—hint: the zero character is generally more oval shaped, compare with number sequences or words that begin with O, to be sure). [When a new digital satellite appears for which you don't know the callsign, you can turn on the "Print Headers" option in the "WiSP" MSPE General Setup Window and look at the displayed headers in the downlink data. You'll see the satellite callsigns in the headers.]
8. Confusing UTC/Local time setup in "WiSP" with the corresponding PC clock time. Also failure to set up the set tz= parameter in the AUTOEXEC.BAT file.
9. Failure to set the PATH to "WISP," etc.
10. Failure to edit the PIF files (WIN3.1) to point to the PKUNZIP, LHA, etc., files if they haven't been put in the (default) **c:\utils** directory.

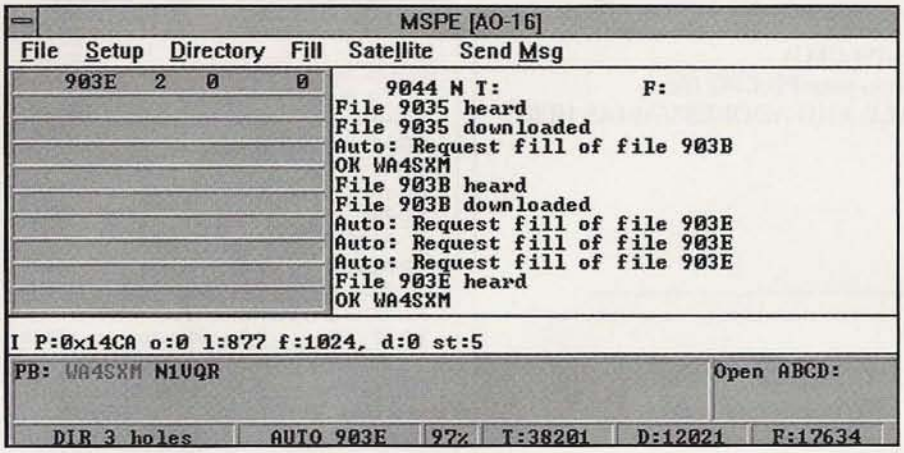


Figure 5. Sample MSPE screen from "WiSP" during an AO-16 pass.

SATELLITE	BDCSTCALL	BBSCALL	Data Rate
AO-16	PACSAT-11	PACSAT-12	1200bps
LO-19	LUSAT-11	LUSAT-12	1200bps
KO-23	HL01-11	HL01-12	9600bps
KO-25	HL02-11	HL02-12	9600bps
UO-22	UOSAT5-11	UOSAT5-12	9600bps

Figure 6. Digital satellite calls and data rates.

sages. Before running "PB" or "PG," you'll have to make a configuration file for each satellite. The configuration file for "PB" is fairly straightforward, but selecting the correct settings for the "PG" TNC configuration file requires you to fully understand the settings of your TNC. Figure 4 shows sample "PB" configuration files.

And What about "WiSP"?

"WiSP" is a multi-program package, or suite, used to access the amateur satellites, especially the digital satellites. This extraordinary collection of software was written by Chris Jackson, ZL2TPO, and donated to AMSAT. It's available for both Windows 3.1 and Windows 95 and is updated regularly, with current versions or changes readily available on the digital satellites as well as on the AMSAT Web site (see "Resources").

"WiSP" provides the standard visual tracking information, plus antenna tracking and transceiver tuning control. It performs all the digital satellite functions of "PB," "PG," "PFHADD," and "PHS" simultaneously, and it also updates the Keplerian elements. "WiSP" can even decode and display satellite telemetry.

Figure 5 shows a sample "WiSP" *MSPE* (MicroSat Protocol Engine) screen, captured during an AO-16 pass. There wasn't much activity on this particular pass, but you should be able to correlate many of the fields with those seen in the "PB" screens.

Using the PACSAT Protocol Suite

Your first goal should be to get a directory from a PSK satellite using "PB." Again, make a good audio recording of a pass so you can concentrate on working with the software without having to track the satellite, tune the signal, or wait for a satellite. Then, as you get more familiar with the operation of "PB" under DOS, you'll learn what you need to know to set up "WiSP" in Windows.

A program with so many features requires a savvy operator to correctly enter a great deal of setup information. An important example of this is making sure you've entered the correct satellite callsigns (see Figure 6). The key to entering this data correctly is understanding what information the setup routine is asking for, which is why I recommend that you get familiar with digital satellite operations by using the "PB/PG" suite before trying to set up and use "WiSP." It's imperative to read *all* the online documentation (several times) and to set up *all* the necessary parameters before using "WiSP" on the air.

Your Just Deserts

After doing all your digital satellite "homework," you'll be rewarded with a nice, easy-to-use interface to most of these amateur satellites. Then you'll be able to fully enjoy everything these "birds" have to offer. ■

"The server software sends the requested files in a round-robin fashion: a little of this file, a little of that file, a little directory, then back to this file, etc. This allows maximum access to the satellite and very efficient data transfer for all."

"'WiSP' is a multi-program package, or suite, used to access the amateur satellites, especially the digital satellites....It's...readily available on the digital satellites as well as on the AMSAT Web site."

Resources

The PACSAT Protocol Suite of satellite software and current versions of "WiSP" may be downloaded from AMSAT's World Wide Web site at <http://www.amsat.org>, or ordered by mail from AMSAT (see below).

The AMSAT-NA Digital Satellite Guide may be purchased from AMSAT, P.O. Box 27, Washington, D.C. 20044; Phone: (301) 589-6062.

From Spring Sprints to Falling Rockets

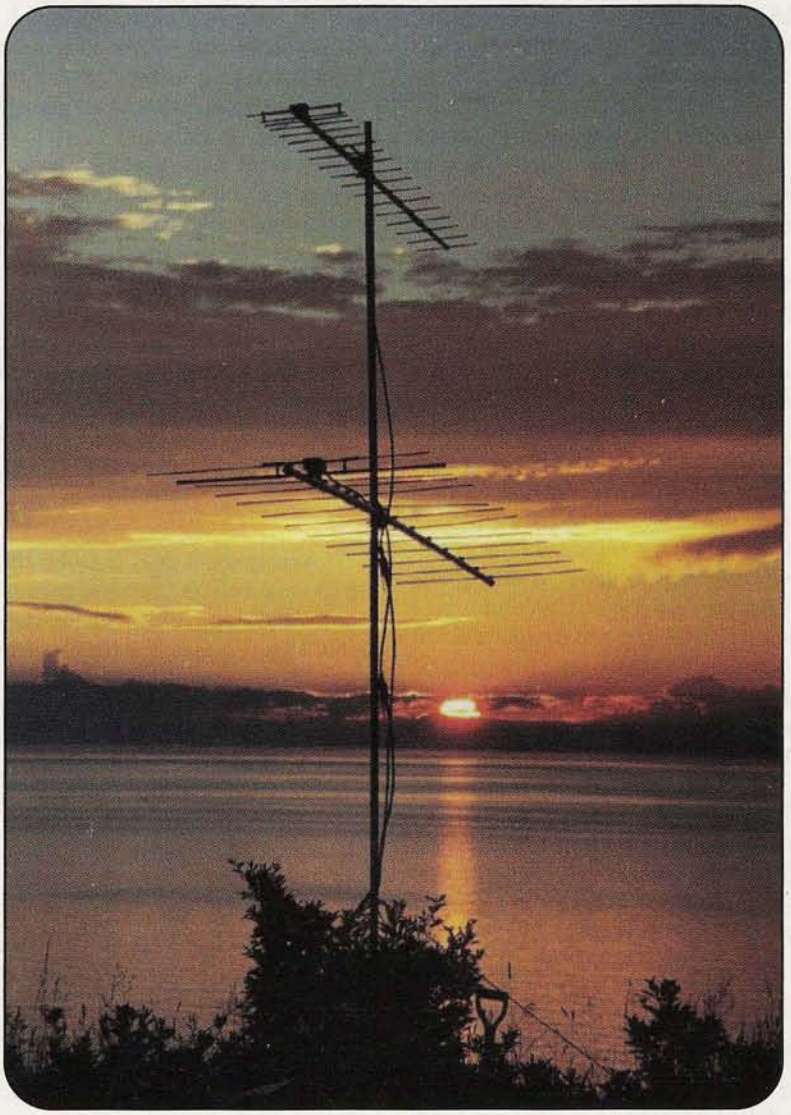
We've all seen signs that tell us to watch out for falling rocks...but how about falling rockets? NC7K shares his discovery of a new (for him) aspect of our hobby.

April brings us spring in full bloom with longer days, warmer temperatures, and melting snowpack in the high country. With the VHF/UHF Spring Sprints just around the corner, it seems like the right time to get started assembling your antenna projects for the upcoming June VHF Contest. (*See the rules for the Spring Sprints elsewhere in this issue.—ed.*)

Going Out to Launch

Spring revives many more activities than amateur radio. Last year, while selling some surplus microwave equipment, I met a fellow from the San Francisco Bay area who was in town for the "Aeropac" high-powered amateur rocket launches, held four times a year on the Black Rock Desert about 80 miles north of me. He purchased a 240-inch nose radar antenna assembly from me and planned on building an amateur radio 10-GHz doppler radar system to track the rockets his club launches (see "10 GHz: A Good Band for a Rainy Day," in the February, 1997, issue of *CQ VHF* to learn more about doppler radar on 10 GHz).

These folks are for real! Several of their ships are over 30 feet tall and can reach altitudes of over 100,000 feet! My new friend became a ham only to support his rocket hobby. Having never heard of, let alone seen, anything like this, I was intrigued. They make their first launches of the year in May (the launches are suitably called "Mud Rock") and finish in late July/August when they hold "FIREballs," their largest (and most dangerous) launches of the year. That clinched it. I



Just to remind you that summer will return, we bring you this photo from N8PVT/KC8ALA's limited multi-op setup for the 1996 CQ Worldwide VHF Contest. These are their 2-meter and 70-centimeter Yagis. (Photo courtesy N8PVT/KC8ALA)

By Tim Marek, NC7K

"He...planned on building an amateur radio 10-GHz doppler radar system to track the rockets his club launches."

made plans to be there, and, since it was a rare grid square (DN00), I planned to bring along the tower trailer and M² 2M5WL antenna as well.

In between work and preparations for Perseids '96 (it was a good year for the rocks), I did some investigating of the group's activities via the World Wide Web. The national amateur rocket society is called "Tripoli" and is based in the Midwest. "FIREballs" is run by the two west coast chapters, "AEROPAC" and "LTRS." Their Web sites were chock full of fascinating stuff. I spent three days just reading about this new hobby (yep...I want to do this, *too*!).

The smallest rockets these folks launch are in the "K" motor class. They're approximately six feet high, six inches in diameter, and propelled by a reloadable solid rocket motor about one foot long. If you remember the "Estes" model rockets that many of us had as kids, they had "A" motors, then "B" motors, etc. Each successive size up has twice the thrust of the previous one. So you can imagine the power of a "K" motor. A typical load was designated "K550" for 550 Newton-seconds of energy. *(If I'm following my dictionaries correctly, one Newton-second should be the force required to accelerate one kilogram of mass at a rate of one meter per second for one second.—ed.)* Depending on weight and design, a K550 rocket would typically reach heights of 10,000 to 18,000 feet! Remember...these are the *small* rockets. The larger "O" and "P" rockets are more complex and much more dangerous. It seems these folks are into their hobby as much as we amateurs are into ours—some rockets were so large that, for safety reasons, they had to be launched five miles away from the main rocketeering encampment.

What I Did on My Summer Vacation

The big weekend finally came. Sadly, I was delayed leaving Saturday morning and didn't arrive until 2 p.m., missing the biggest of the big. One group had a full telemetry package onboard that included full color fast-scan amateur television (ATV). They estimated that their ship reached 100,000 feet since they saw the curvature of the Earth on the video downlink. They were removing the gantry when I drove up, asking "what's up?" They described the flight with the same passion that I have for meteor scatter or VHF contesting. Looking over my tower trailer in tow, they asked, "What are you tracking with *that*?" "Nothing," I told them. "That's what I use to 'play radio'." I got the distinct impression they viewed me as crazier than themselves!

As I approached the main encampment, it became clear that this was a serious event. Cars, trucks, buses, motorhomes, trailers, and tents were arrayed in a half-mile-long arc, smack dab in the middle of a 30-mile-wide dry lake. Not knowing anyone, I was wary of just busting into someone's camp when I spotted...*amateur call plates* on a couple of trucks belonging to the "JP Aerospace" group. I stopped, introduced myself, and again asked "what's up?"

They were most gracious hosts, welcoming me with open arms and taking great care to explain to this newbie "rocketeer" the ins and outs of their hobby. What immediately impressed me was the fact they became radio amateurs to support their rocketry hobby and were doing it correctly and efficiently (unlike the hang gliders I've met here in northern Nevada, most of whom are unlicensed and uninterested).

A Lofty Goal

JP Aerospace's goal is to be the first group to launch an "amateur rocket" into space. Achieving orbit with off-the-shelf technology requires that they be *very* creative. They were making their first attempt here in the desert to launch the "Rockoon," a rocket in a box full of telemetry and control electronics. It was to be lifted to over 100,000 feet by six eight-foot-diameter helium balloons and then fired from that altitude. I missed their Saturday morning launch attempt, but, from their descriptions, it was "ugly." The usually tranquil desert was beset with 50-plus mile per hour winds just as they were to release the package. Rather than see their hard work dragged across the dry lake, they popped all the balloons and scrubbed the attempt. Undeterred, they planned a static launch of the rocket from the box, mounted on a test stand.

As they made their preparations, others were assembling and launching their rockets. I must have seen over 100 launch attempts Sunday morning alone, with a full 50% of them failures of one type or another. Several exploded on the launch pad, showering the desert with fire; others failed in flight (usually the parachute recovery system accidentally deployed under power, destroying its only hope of recovery and causing the rocket to become a ballistic missile!).

The most memorable failure was a three-stage K-series rocket about 22 feet tall. It looked flimsy for such a tall rocket, but, hey, I'm just a newbie, right? WRONG! The second stage lit off *before* the first was done, causing the whole thing to explode 10,000 feet above our heads. Over the PA system, we heard "OK, folks...I don't care what you're doing, but get outside and look up NOW! We've had a major failure of a rocket ship approximately 10,000 feet straight up and we have debris falling, several large pieces. Keep your eyes open!" This particular craft was made from a special type of plastic tubing, called phenolic, that shredded to very small pieces. But that wasn't the real problem: it was the solid fuel rocket motors that we were worried about. For the next five minutes, I was reminded of the Challenger disaster as we kept track of the falling debris. One motor impacted only 150 feet from our group!

The Rocket "Bowl"

Next up was the "bowling ball" competition. These were some of the largest ships sent aloft that day, each over 25 feet tall. One was an all-metal craft made from aluminum, the other was made from standard phenolic tubing. Each was at least 18 inches in diameter and sported the largest motors seen that day: "M" and "O" sizes. How big is that? So big that it takes several federal permits to obtain the raw materials to fabricate the fuel. These were spectacular! The contest was to see who could loft a 16-pound bowling ball to an altitude of 60,000 feet or higher, eject the payload, and recover their rocket. The winner was the group whose bowling ball took the *longest* amount of time to return to Earth.

Feeling a bit gun-shy after the three-stage rained on us (and the next one being all metal!), I took down my antenna, loaded the truck, and was ready to run. But the launch went off beautifully! It reached altitude, pitched over, popped the nose cone/parachute, and ejected the bowling ball. Unfortunately, the parachute was fouled and acted more like a

"One group had a full telemetry package onboard that included full color fast-scan amateur television (ATV). They estimated that their ship reached 100,000 feet since they saw the curvature of the Earth on the video downlink."

big baggy streamer than a parachute. Still, it took three minutes and 58 seconds for the ball to hit the desert floor! Amazing! The next ship took off and, almost immediately, the nose cone blew while still under power, ripping off the parachute and creating...you guessed it...a ballistic missile! I heard it break the sound barrier before it impacted 20 miles downrange to the northeast. (*Now* that's *a strike!—ed.*)

Rockoon—Take Two

Back to the JP Aerospace launch. Finally ready around 3:30 p.m., it was the last launch of the day. The rocket employed two K550 motors in its base and its 12-foot length was filled with electronics for telemetry and control. Right out of the box I could tell something was not right, as it zigged and zagged at wild angles. One motor lit two seconds after the other, breaking the rocket in half. After that, it flew straight as an arrow, pitched over, and impacted down range. Sixty-seven minutes later, all we found sticking out of the ground were the motors and tail fins, and they were bent beyond hope of repair.

Quite a show! Obviously, not for everyone because of the very real danger involved in just being a spectator. But it was most enjoyable and well-run, with safety in mind.

Operating?

Yes, I did manage to get on the air at least a little (remember, DN00 is a rare grid). But it took a definite back seat to the rocket show. On Saturday night as I was setting up the Yagi and tower trailer, they must have lit 20 night launches. With a flashing beacon in the nose cone, they were some of the most memorable events of the trip. If you'd like to learn more about this fascinating hobby, visit the Aeropac Web page at <http://www.aeropac.org>. There are plenty of links to keep you busy for some time. I know I'll be back!

Activity Reports

1997 ARRL January VHF Sweepstakes

Thankfully, this year's contest weekend fell in a lull between winter storms here in the west. Activity was up on both coasts, with many folks reporting fun times and good scores. Here are some preliminary reports from the Internet VHF Reflector:

From Brian, K3VGX:

2 meters—234 Qs 39 Grids = 9126, 90 watts, 8-element beam @ 15' (no mountain!)

From Steve, WA9JML EN51:

The temperature outside was about 4° above zero, but the 2-meter band seemed to be open. Some of the nearby folks worked all the way to Kansas. I managed to get out to St. Paul, MN, and near Detroit, MI. Much of this was on CW. It was a great time. It's too bad that we cannot have activity like this on a more frequent basis.

From Jim, WB9AJZ/6 CM87:

Limited Single Op—277 Qs 47 Mults = 13,019 pts. *Very good activity for January.* Lots of first-timers on the band. Patience is rewarded! Finally worked CN84 from CM87 on tropo to W7PUA! Laser is very enlightening!

From Alf, NU8I DM43an:

Conditions from central AZ were lousy. Even the normally reliable paths to Las Vegas and Tucson were poor. We heard no-one from California, except for a brief opening on Sunday afternoon. No *Es* on 6 meters at all, and only a couple of short MS bursts. Still, we had fun. We used Burke's new IC-821 on 2 & 70 centimeters, and a very nice radio it is. (Lack of) propagation gave us a chance to relax Saturday evening, drink some beers, and watch the Suns clobber the Knicks....Summary: 50 MHz 17Q 8G; 144 MHz 35Q 12G; 432 MHz 19Q 6G. Final Score: 2,340 Ops: KE7OT, KF7NP & NU8I

From Larry Hogue, WB5OMF CM98:

Please note to all a *very hearty thanks* for your participation in the Sweepstakes. The rovers out here were great. NC7K put on his road show and did an outstanding job. KE6ILX, after work, made sure grids were available that wouldn't otherwise have been there for us. Many thanks, Jeff. Had a great time and see ya in June. My Single Op score....284 Qs 464 Points 64 Mults = Final Score: 29,696.

From Dick, K3MQH:

Greetings from the frozen Multi Op crew at South Mountain. Rather than bore everyone with a litany of things that broke, burned up, or failed (we *always* have our share of system failures but see no need to report every problem we had)—Raw Score: 1897 QSO Points, 254 Mults = 650K +/-

From Del, KD1DU FN31fh:

It was a fun contest! The activity seemed to be up but the band conditions were not, except for a short opening on six. The splatter from local overdriven transmitters was down, making things much more enjoyable. My results are considerably up from last year. The changes to the station were moving antennas for 222, 432, 903, and 1.2 from a temporary 30' location to the top of the tower and changing from RG-8 to 1-1/4" hardline on 144. Had a new copy of "CT" and a digital voice keyer. The voice keyer, by the way, was an egg-shaped digital recorder by Olympus for $19.95 at Staples office supply. Worked great. Single operator totals: 839 Qs 1243 Points 137 Mults = 170,291.

From Jay, KØGU DN70mq:

Single Op: Totals, 208 Qs 231 Points 75 Mults = 17,325. Nice 6-meter *Es* opening Saturday night for about an hour to IL, IN, OH, and PA. Fairly good 6-meter scatter Sunday morning. Activity seemed low with few rovers. EME Qs with SM5BSZ and SM5FRH were 10% of my grid total on 2 meters.

From Russ, N2ODK FN12hn:

Here's a preliminary report for our multi-op: 885 Qs 188 Mults Total Score= 298,168 points Operators: N2ODK, KD2YB, N2JQR, W3OAB, N2HLT

From John Walker, WZ8D EM79:

Here are the results of my Rover trip last weekend. I activated 11 grids: EM67, 66, 76, 77, 68, 78, 79, 89, 69 & EN60, 70. Under the new Rover score criteria: 468 Qs 75 + 11 Mults. 732 Points x 86 = 62,952. Under the old Rover score criteria: 468 Qs 250 Mults 732 Points x 250 = 183,000. This is why I only go out and Rover during the contests one time or less a year. It is a shame the ARRL had to screw up another good thing. The only good a rover is any more is to help the big multi-op stations run up big scores. That's OK, but it does not give the ham who doesn't belong to one of these big multi-op efforts much incentive to go to very many grids. I only did it to help the hams in the Midwest. If I really wanted to win this thing, I would be better off just going to a few grids and spending more time looking for Qs and multipliers. My score would be a lot better with these rules that are in place. The old rules gave us more incentive to go to as many grids as possible. That was good for everybody. What do others think about this? (P.S.: I didn't make any contacts on the cellphone.)

Testing the Mettle

The recent flooding of downtown Reno and the adjoining industrial complex in Sparks, Nevada, have brought home to me how much we take for granted the infrastructure around us.

We experienced an entire winter/spring cycle in 1-1/2 weeks beginning December 28, 1996. We got four feet of heavy wet snow that Saturday, followed by four days of 100-plus miles per hour gusts. Many power poles went down, not to mention trees, antennas, etc. The winds were the worst I can ever remember here and I've been here almost 20 years. Then the temperatures shot up into the high 50s and low 60s and it began to rain, and rain, and rain. With the snow level over 9,000 feet, all the new snow pack from five days earlier was literally swept off the mountain and into the Little Truckee River. Within 12 hours of 1997, downtown Reno was impassable. Harrah's Casino shut down its entire operation for the first time *ever*. RACES was activated with volunteers sent to the various evacuation centers to handle health and welfare traffic. And it kept on raining.

Reno-Tahoe Airport looked a lot like Johnston Island, with only part of the main runways above water. My home was never threatened, but I was locked out of my office for five days until the water receded and the Hazmat (hazardous materials) team did a survey for contaminants. Our plant was unaffected, but others closer to the river were not so lucky. Several of my vendors and competitors were flooded with at least two, and as much as six, feet of water and mud.

For several days, there was literally no way in or out of the area via *any* road. Part of Highway 80 was falling into a gravel pit east of town and a massive mud slide near the Nevada/California border shut down the western end. Six miles of Highway 395 South through Walker Canyon no longer exist! I never knew there were so many bridges on my commute until I tried to reach my office on January 3. After four detours, I was turned around and told to stay home.

"Throughout this mess [caused by the flooding in Reno], the equipment and training from my VHF contesting proved most valuable."

Contesting Experience Pays Off

Throughout this mess, the equipment and training from my VHF contesting proved most valuable. I was ready to deal with the lost power, wind, rain, mud, snow, etc., on a moment's notice. Contests were started to provide a medium of adversity in which to train operators. Don't let anyone ever tell you contests have no real meaning...they do.

My rover trip for the January VHF Sweepstakes was a success. More later as space permits. 73 for now and keep the reports coming in! Tim, NC7K; e-mail: NC7K@VHF.RENO.NV.US; Fax: (702) 972.5011; Phone: (702) 972-4722; Snail Mail: Tim Marek, 360 Prestige Ct., Reno, NV 89506 USA. ■

A Few Words about Transmission Lines & Impedance

It's measured in ohms, but it's not resistance. Transmitters, transmission lines, and antennas all have it. But many of us really don't understand very much about this month's topic—impedance.

Many times, when looking over ham literature, you'll see the word *impedance*. Usually the term is used in conjunction with transmitters, transmission lines, and antennas. In ham radio applications, the purpose of a transmission line is to carry radio frequency (RF) energy from one place to another—usually from a piece of radio equipment to an antenna which is mounted in some remote location.

All transmission lines, also known as *feedlines*, consist of two conductors and a dielectric, or insulating material, to keep them apart. The dielectric may be polystyrene, foam, or even air, which is the most efficient (but it's not weatherproof). Most feedlines also include additional insulation to keep the conductors from coming in contact with people, animals, etc. One of the most commonly used transmission lines, even at VHF where it's not particularly efficient, is RG-58 coaxial cable, also referred to as *52-ohm coax*. Are there resistors in the coax? Where does the term "52 ohms" come from? When we speak of 52-ohm coax, just what does the 52 ohms refer to?

The 52-ohm value is the *impedance*, or, more correctly, the *characteristic impedance* for the cable. It is not the resistance specification. The characteristic impedance is the impedance measured at one end of an infinitely long piece of transmission line. If you were to test the impedance of a piece of RG-58 coaxial cable a zillion miles long (see Figure 1), it would measure 52 ohms.

Measuring Impedance

How is the characteristic impedance of a feedline determined? In the case of coaxial cable, it's a ratio between the sizes of the center conductor and the outside conductor or braided sheath, plus the spacing and the type of insulation (*dielectric*) between the two conductors. You can't measure the characteristic impedance of a transmission line with an ordinary ohmmeter, as if it were a resistor. This is because impedance is *the resistance to alternating current* and a volt-ohm-milliammeter (VOM) measures things with *direct current*. On the AC scale, it's only capable of measuring low frequencies like the 60-Hz power that's available in your home.

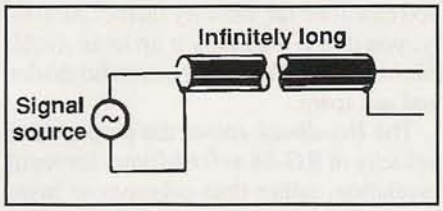


Figure 1. The characteristic impedance of a transmission line is the impedance measured at one end of a cable of infinite length. Since there are no infinitely long cables, this measurement is made in theory only.

You can, though, measure the characteristic impedance of a transmission line with a setup similar to that shown in Figure 2. The signal source could be your transmitter. The variable resistance would be adjusted until the RF voltage across the resistor (point A) is exactly the same as it is for point B. Then you can measure the DC value of the resistor, and this will approximate the characteristic impedance of the line. Don't worry; you won't need to test the coax cable you buy. If it carries an "RG-" number, the impedance is probably listed in the *ARRL Handbook*.

If the line is something less than infinitely long, it must be terminated in a *load*, such as an antenna, that matches its characteristic impedance or there will be a *mismatch*. (Next month, we'll talk about what happens to your transmitted energy when a mismatch does occur. But for this discussion, let's fill in your knowledge on some things about impedance and transmission lines themselves.)

Matchmaker, Matchmaker...

If you connect a short length of 52-ohm cable to a load, such as a 52-ohm resistor, the characteristic impedance at the transmitter will be 52 ohms at all frequencies for which the cable is rated. In this instance, all the impedances are *matched* (see Figure 3).

Obviously, there's no point in connecting a resistor to the far end of the cable unless you're trying to measure something or don't want your signal to radiate. But it illustrates the point that the antenna connected to the cable should match, as closely as possible, the characteristic impedance of the transmission line. An antenna will provide a perfect match if it appears to the cable to be a 52-ohm resistor. However, if the transmission line is terminated in some value *other* than its characteristic impedance, the input impedance at the transmitter end may be widely different from the characteristic impedance. The impedance that the transmitter "sees" will depend on the amount of mismatch at the load or antenna end and the physical length of the cable.

This mismatch is most striking when the cable is one-quarter wavelength (or

By Donald L. Stoner, W6TNS

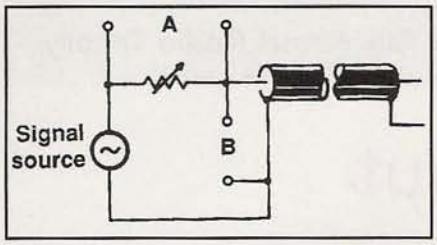


Figure 2. You can measure (approximately) the impedance of a piece of unknown feedline by putting a variable resistance (potentiometer) in series with the output of your transmitter. See text for details.

some odd multiple) long at the operating frequency. In this example (see Figure 4), let's say you cut a length of RG-58 for 144 MHz and short circuited one end. If you measure the impedance at the other end at 144 MHz, it will be so high that there would be *no effect* if you connected this "stub" in parallel with the transmission line between your radio and the antenna. Incidentally, in this drawing, the symbol for impedance is Z; the symbol for wavelength is λ.

Notching Out Interference

On the other hand, if you were to leave one end of a quarter-wave stub open (Figure 5), and connect the other end in parallel with the line connecting your radio to the antenna, it would appear as a short circuit at 144 MHz. This effect can be more than just a technical curiosity—you can use it to solve a problem.

Let's say there's a paging station on 155 MHz that's really nailing your handheld radio when you have it connected to an outside antenna. Every time the paging station sends out its coded message (usually several times a minute) it creams the station you're trying to hear. By calculating a quarter wavelength at 155 MHz and cutting a piece of coax to this length, you can make an excellent *trap* to get rid of the paging station interference. Leave one end open and install a connector on the other end of the stub. Use a "T" fitting near your radio and connect the stub in parallel with the line going up to your antenna. If you get the dimensions exactly right, the short circuit at 155 MHz will almost completely short out the line (and "notch out" any signals at that frequency), without materially affecting your operation at 144 MHz.

I use a stub just like this to get rid of the signals from a local paging company. When I connect my Alinco DJ-580 to an AEA "Isopole" antenna, the signals from the paging transmitter blast my radio into oblivion. With the stub connected to a BNC "T" fitting on the radio antenna connector, the interference is nonexistent.

Measuring Up

How do you get the dimensions "exactly right?" Well, a quarter wave at 155 MHz is about 18 inches, but this is *not* the right dimension. Why? Coaxial cable (in fact, almost any transmission line) has a *propagation velocity* or *velocity factor*. This means that RF energy does not travel as quickly through the cable as it does through free space. The formula for calculating the length of the stub in inches is *2952 times the velocity factor, divided by the frequency in megahertz*. How do you calculate the velocity factor? Actually, you don't. You look it up in an *ARRL Handbook* or call your ham radio dealer and ask them.

The *Handbook* shows the propagation velocity of RG-58 as 0.66 (note, for foam insulation, rather than polystyrene insulation, the propagation velocity is 0.79). So the answer for the correct stub length to trap a 155-MHz signal is *2952 times 0.66 divided by 155,* or 12.57 inches. Stated another way, the *resonant frequency* of this trap, made from coaxial cable, is 155 MHz.

You can also make the stub any odd multiple of a quarter wavelength (for example, 3/4 wavelength. Or, instead of a quarter-wave line, you can use a half-wave (or a multiple of a half wave) and *short* the end of the cable, rather than leaving the end open (as in Figure 5). A half-wave line will always reflect the conditions at the far end, at the resonant frequency (the frequency for which it was cut). So, if you used a half-wave line, it would be 25.14 inches long (twice the number calculated above for a quarter-wave at 155 MHz).

If the propagation velocity is slightly different from the calculated value, or if you didn't get quite the right frequency, the trapping of the unwanted signal will not be complete. But you can also make an adjustable trap by substituting a variable capacitor for the shorted end of the cable. You'll need to shorten the cable an inch or two for this to work. In operation, you simply connect the half-wave stub in parallel with the transmission line (using a "T" fitting) to the antenna. Then, when the interference occurs, adjust the capacitor for minimum interference. If the interference nulls with the capacitor at maximum, make the line slightly longer; if the interference is at minimum with minimum capacitance, make the line slightly shorter.

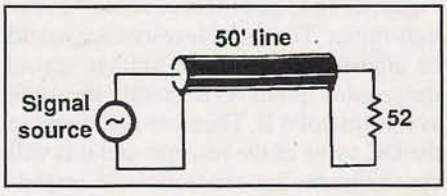


Figure 3. It's a match! If a 52-ohm load is connected to a short length (no more than 50 feet or so) of 52-ohm cable, the transmitter will "see" a 52-ohm load at any frequency for which the cable is rated.

The Right Cable for the Job

If a transmission line is terminated in its characteristic impedance, the sending end will always "see" the same impedance, no matter how long the line may be. This is referred to as an *untuned transmission line*. However, if the termination is some other value, the impedance seen by the transmitter will vary with the length of the line. In order to transfer the most energy from the source (the transmitter) to the load (the antenna), each end of the line should be terminated in the characteristic impedance of the transmission line. In the example above, this should be 52 ohms.

I've used RG-58 in these examples, but there are several other types of 52-ohm coaxial cable available as well. For example, RG-8 exhibits the same characteristic impedance but is twice the diameter of RG-58. Why would you need the bigger cable? The smaller RG-58 (0.195 inches) will only handle 100 watts or so. If you try to feed 1500 watts of power through RG-58, nearly 5.5 amperes will flow in the center conductor. This high current will heat up the center conductor and melt the polystyrene insulation. The cable will ultimately arc between conductors or actually short out. The larger center conductor of RG-8 permits more RF current to flow in the wire with less heating. Amateurs who run a "full gallon" on the high frequency bands often use RG-213. This 52-ohm cable is 0.405 inches in diameter and is rated at 5000 volts breakdown.

Most amateurs who operate VHF and want the maximum power delivered to the antenna use Belden 9913. In addition to the polystyrene dielectric, this cable (and the equivalent made by Carol and other companies) uses a spiral filament of polystyrene so that there is a minimum of contact between the center conductor and

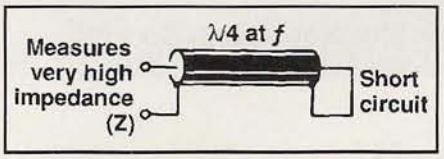


Figure 4. A quarter wavelength of feedline shorted at one end presents such a high impedance that, if it's connected in parallel with your antenna cable, the transmitter won't even notice that it's there. But see Figure 5.

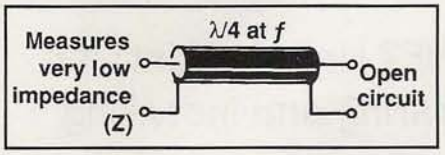


Figure 5. The Ultimate Mismatch. A quarter-wave "stub" with an open circuit at one end appears to the transmitter as a short circuit at the resonant frequency. You can take advantage of this to "notch out" interference on a specific frequency (see text).

the support insulation. Air is the best dielectric there is.

In addition, there are many common transmission lines with impedances of other than 52 ohms. For example, your cable TV system probably uses RG-6 or RG-59 coax. Both cables are rated at 73 ohms. RG-6 uses foam dielectric and has a propagation velocity of 0.75, while the velocity factor of RG-59 is the same as for RG-58 (0.66; 0.79 for foam dielectric).

There's another type of transmission line, rated at 300 ohms, which is referred to by several names. It consists of two identical copper wires separated by a plastic dielectric (usually chocolate brown in color) and is called *twin-lead* or *ribbon line*. It's used mostly to connect television and FM radio antennas with home entertainment equipment, but some hams also use it, especially on HF. In ham radio applications, you may see ribbon line with pieces of insulation punched out or a larger line using two copper wires separated by ceramic or plastic spacers; it's then referred to as ladder line because of the similar appearance. Since both conductors are identical, twin lead is also known as *balanced line*. On the other hand, coaxial cable with conductors of *different* sizes is known as *unbalanced line*.

Power Loss

No transmission line is a perfect transport medium. No matter how good a cable you use, there'll be less power coming out the far end than is delivered to the sending end by your transmitter. Some of this is due to the *resistance loss* of the copper center wire. In other words, the resistance of the cable diminishes the voltage delivered to the antenna just as the resistance of your battery cable diminishes the voltage delivered to the starter motor in your car.

Most of the loss, however, is a result of *dielectric loss*. No matter how good the cable quality, the dielectric of the insulation separating the center conductor and the outer sheath will always absorb some power. The least absorption occurs when air is the dielectric. Broadcast stations and amateurs who want the last possible drop of RF energy delivered to the antenna will use a transmission line consisting of copper tubing and ceramic beads every few inches to support the center conductor. Sometimes these lines are even gas filled and pressurized to prevent the entry of moisture which can also sap power from the line. This type of feedline is known as *hardline*.

Dielectric loss increases with frequency. If you look at the specifications for coaxial cable, you'll usually see a figure giving loss per hundred feet at 30, 150, and 450 MHz. Polystyrene cable is very lossy and it's not at all uncommon to have only a fraction of the transmitter power appearing at the antenna on UHF and SHF frequencies when you use this type of cable. When operating on UHF, amateurs should always use cable with a foam dielectric or the Belden cable mentioned earlier. For super high frequencies, the transmission line takes the form of a waveguide. This is a rectangular-shaped metal tube that carries the signal from transmitter to antenna. In this transmission line, air is the dielectric.

Surface Transportation

One last bit of information to add to your storehouse of transmission line knowledge: RF energy travels on the *surface* of a conductor. For this reason, the very highest quality cable is silver plated to reduce the losses at radio frequencies. You'll find foam cable with silver plated braid and center conductor at hamfests and ham convention flea markets. This is often military surplus and is a good investment for your VHF/UHF station.

But What If...?

Next month, we'll discuss what happens when the antenna and transmission impedances don't match and explore the fascinating subject of standing waves.

73, Don, W6TNS

Choosing and Installing RF Connectors

What's the best coax connector for VHF and UHF? Here's a hint: it's NOT the "UHF" connector! Here are tips on preparing and installing the most common connector types.

Last time, we took a look at transmission lines—coaxial cable primarily. This month, let's look at those little devices that connect the cable to the various parts of the station, that is, coax connectors of one sort or another.

If you're a new ham, your mind probably jumps instantly to the ubiquitous PL-259 (plug)/SO-239 (socket) family of connectors. A more technical name for it is *UHF connector*. Actually, it would be hard to come up with a worse (or more unfortunate) name for this series. Of the common connectors in use, it's probably the *worst* of the lot for VHF/UHF work.

We'll take a look at this "worst-case," but all too-wide-spread scenario first, then move on to some other popular connector types.

Why NOT to Use PL-259s

This connector was designed in the earliest days of using coaxial cable for radio work (early 1930s), back when "shortwave," say 20 meters, was among the most exotic forms of radio. Test equipment was extremely crude or non-existent. Little was known about impedances or how to minimize unwanted "lumps" of impedance along a transmission line. So, this family got tagged with the "UHF" name by people who sincerely believed that it was a good connector for RF well up into the UHF bands. Pity.

These days, people experienced with RF know that PL-259s have a multitude of shortcomings. But they do have one main advantage: there are so many of them around that they've become very inexpensive, usually costing no more than a $1 per connector.

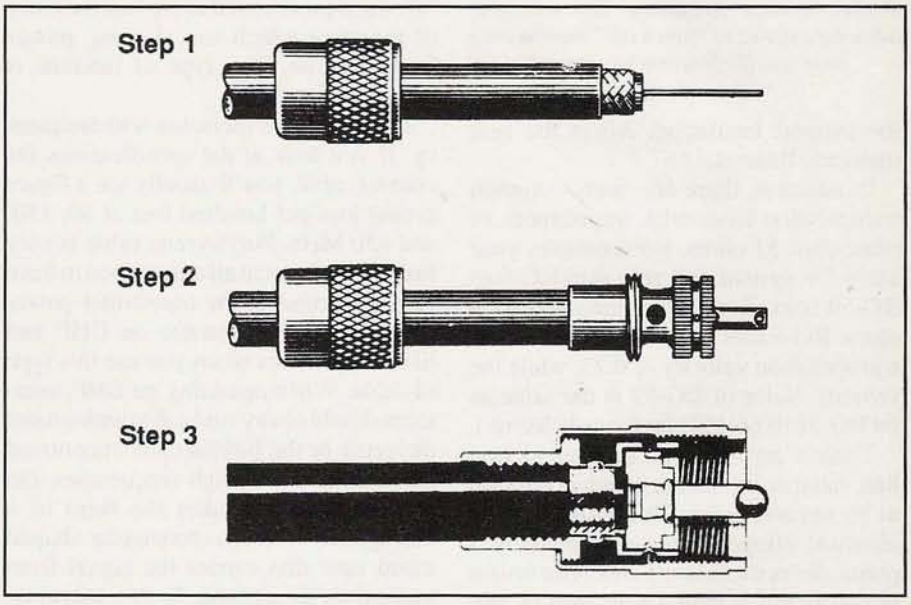


Figure 1. The ubiquitous PL-259, also known as a "UHF" connector, even though it's inferior for VHF/UHF use. Nonetheless, follow these steps for the best possible connection.

If you're beginning to get the idea that I don't like this connector, you're right! Ham radio could get along just fine without it. Over the years, I've installed more than my share of antennas and connectors. Early on, I noticed a pattern developing when I had problems with a new antenna or cable. I could almost always fix the problem by cutting off the old UHF connector, throwing it away (they're so cheap, why would you risk trying to reuse a defective one?), and putting on a new connector from scratch. I'd say that 90 to 95% of my antenna problems have been due to bad UHF connectors.

What's Wrong with UHF Connectors?

How can they go bad? Well, it's not so much that *they* go bad as that the *installation* goes bad. It's very easy to make a

"...PL-259s have a multitude of shortcomings. But they do have one main advantage: there are so many of them around that they've become very inexpensive, usually costing no more than $1 per connector."

By Peter O'Dell, WB2D

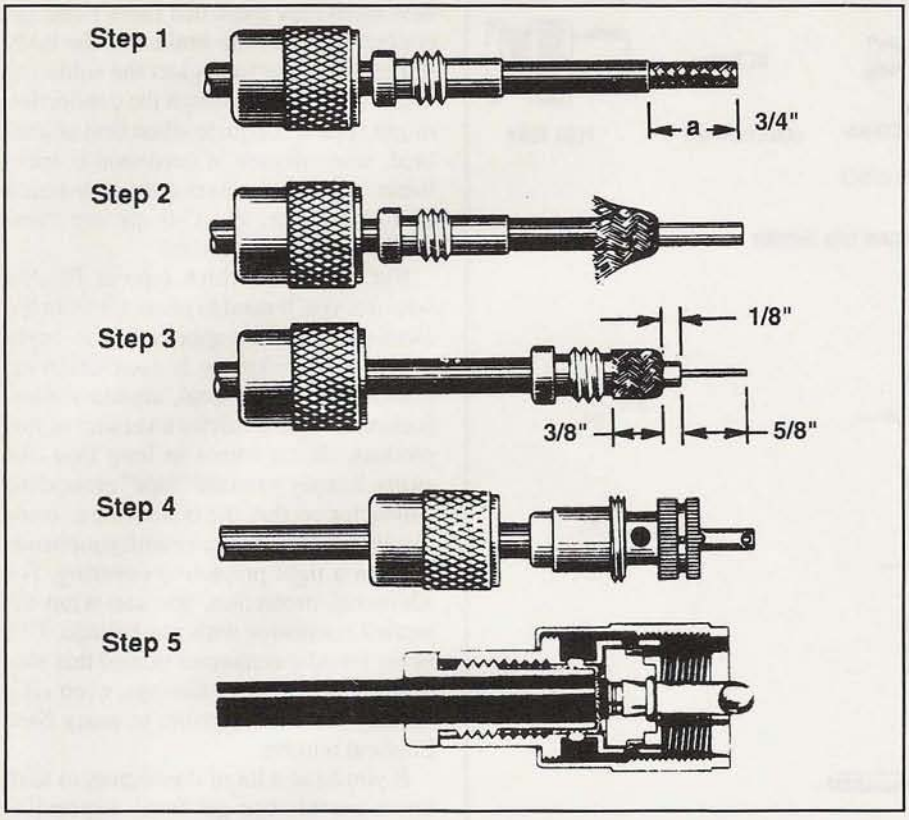


Figure 2. Preparing and installing a PL-259 on smaller cable. See text for details. (Courtesy Amphenol Electronic Components)

mistake with them during installation. First of all, you must solder the body of the connector to the braid. Relatively speaking, this is a lot of metal—metal that conducts heat very well—so, you have to use a lot of heat. But you don't want the soldering iron to linger on the connection. The center insulator is made of plastic and is easily melted, allowing the conductors to move closer together. At the very least, any distortion in the shape of the cable causes an impedance lump. At HF, such a lump might be almost unnoticeable or undetectable, but, at VHF/UHF, such lumps can play havoc. Worse, if you have stray strands of wire from the braid or center conductor, they might migrate through the insulation and short out the center conductor to the braid. That is not a good thing to have happen.

Another major source of problems is that the UHF connector is not weatherproof—not at all! For any kind of outside installation, you need to add some sort of weatherproofing. One common approach is to wrap the junction with plastic electrical tape. This technique does provide *some* measure of protection. But there is a tendency for tape to slowly disintegrate over time—particularly the bargain basement brands—allowing moisture to enter the connection and destroy it. Moisture may even get inside the coax. If only the connection has been compromised, you can cut off the old PL-259 and replace it. You may need to also replace the SO-239, or at least clean it. If moisture has made it inside the coax, you should replace the contaminated piece of coax as well. You can usually tell if the cable has been compromised by peeling back just a little of the outer casing. If the braid is tarnished, discolored, or corroded, the cable is worthless. Throw it away.

Connecting PL-259s

Even though PL-259 connectors are far from ideal, most radios come with SO-239 sockets, giving you little choice at the radio end of your cable, although adapters are another option (see below). *(Plus, despite all of its flaws, a properly-prepared and installed PL-259 will be* adequate *for use up to 225 MHz.—ed.)* If you follow these simple steps, you should have a PL-259 that's as good as it gets.

Let's start by preparing the coax. PL-259 connectors are designed for RG-8 type cable (see Figure 1). Measure 3/4" from the end of the coax and lightly score the outer plastic casing all the way around. This gives you a "trail" to follow in the next step. Now, using a really sharp knife, cut through the casing, the braid, and most of the dielectric material, being careful not to score the center conductor. When you have cut all the way around in this manner, begin twisting the end of the coax in the direction of the twist of the strands in the center conductor. This should remove the end and keep the center conductor tightly twisted together. If the cut end (all three layers) does not twist off, go back and cut deeper into the dielectric. Now score the outer casing 5/16" back all the way around, making sure that you do *not* score the braid. If you do score it, cut the tip off and start over. Next, remove the outer casing and *tin* the braid and center conductor with a good grade of solder. *(If you're new to soldering, "tinning" means applying a thin coating of solder to a surface. This helps make stronger connections later.—ed.)*

"You can usually tell if the cable has been compromised by peeling back just a little of the outer casing. If the braid is tarnished, discolored, or corroded, the cable is worthless. Throw it away."

Now to the connector itself. You should use a silver-plated PL-259 if at all possible. It's not much more expensive than the nickel-plated variety but is much easier to solder. You can buy the silver-plated versions at most hamfests and from some of the vendors that sell wire antennas and parts. If you buy 25 or 50 at a time, the cost is about the same per unit as buying the nickel-plated ones singly. It's well worth the investment. You'll be surprised how many of the little devils you'll probably use in a year, too.

First of all, slide the coupling ring of the PL-259 onto the cable, making sure that the threaded end is facing the end where you're attaching the connector. Now, screw the body of the PL-259 onto the prepared end of the cable. Before soldering, double-check that the coupling ring is there and that it also faces the end where you're attaching the connector (you wouldn't believe how many times I've...I just don't want to think about it).

If you have the silver-plated type PL-259, use the biggest iron that you can find and solder the body to the tinned braid

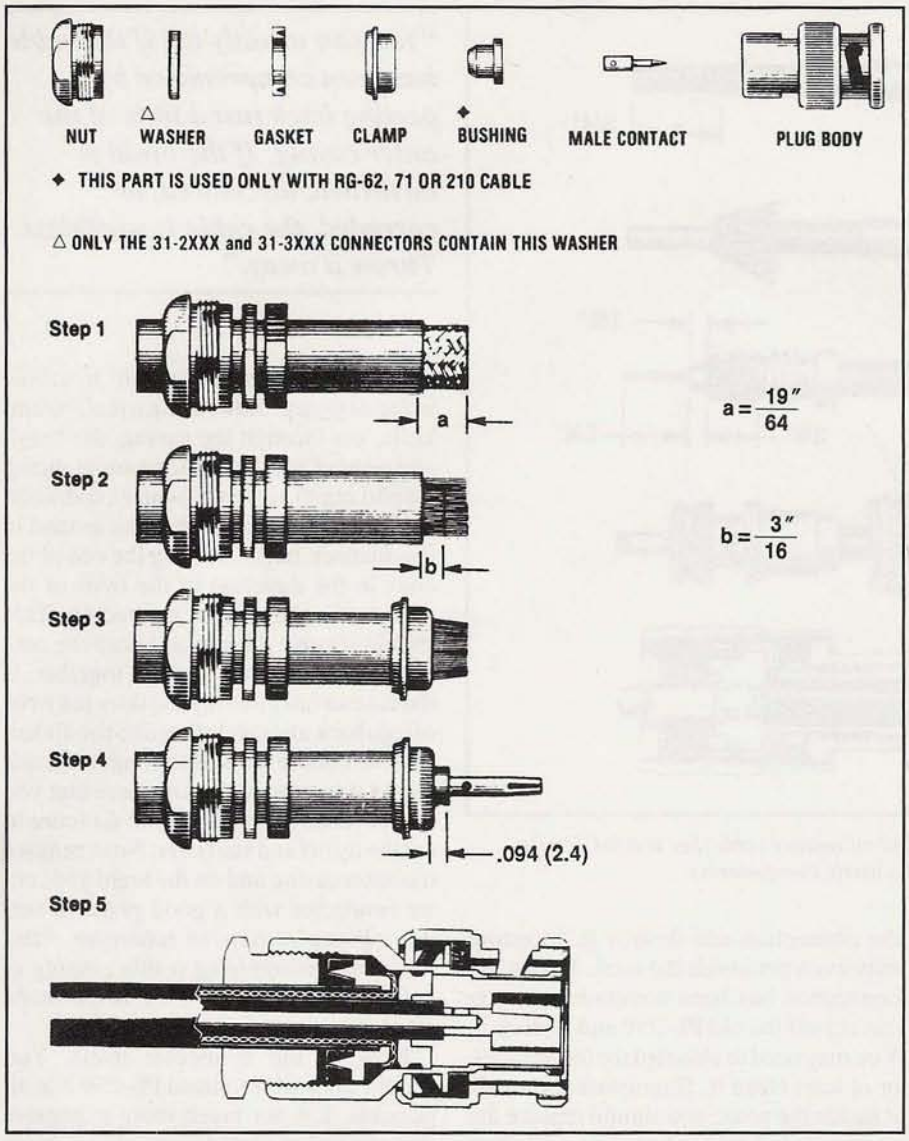


Figure 3. BNC connectors come in several styles of construction. These are the assembly instructions provided by Amphenol. (Courtesy Amphenol Electronic Components)

through the four holes in the body. Do this as quickly as possible, but make sure you get a good flow of solder on both the body of the connector and the tinned braid. Wait a few minutes to allow some cooling to minimize the possibility of heat damage to the unit. Now solder the center pin, tilting the tip downward at about a 45° angle to allow the molten solder to be sucked up into the center pin.

How big should the soldering iron be? Well, one of those standard issue 140-watt soldering guns is marginal for this work—the tip just doesn't have enough mass. I have an ancient soldering iron with a tip that's about 1/2" in diameter. If you can find something similar at a hamfest, grab it—by the handle! You may also be able to use a medium-sized propane or butane torch for this work.

If you didn't take my advice and have the nickel-plated type connector, you should take a metal file and "rough up" the surface area around each hole before screwing the body onto the prepared end of the coax. Also, tin the roughed area before attaching it to the prepared end of the coax and attempting to solder to it.

If you're using a smaller cable like RG-58, as is often the case in mobile installations, you'll need to use an adapter (UG-175/U or UG-176/U). Figure 2 details assembling the PL-259 with these units. Besides some slight variation in cutting dimensions, the biggest difference is that you'll leave the braid untinned. However, you do want to solder through the four holes of the connector body to the braid, just as when installing the connector on RG-8-style cable. Some new hams may think that there's enough contact between the braid and the body of the connector to neglect the soldering stage. Not true! Although the connection might appear adequate when first assembled, some degree of corrosion is inevitable, and that means that the connection will deteriorate. PL-259s are *not* compression-type connectors!

But no matter which type of PL-259 you use, you'll need to protect it from the elements. The best approach is to apply a layer of sealant putty. It's sold under the brand name Coax-Seal, among others. RadioShack also carries a version of this product, which comes in long tape-like strips. Simply wrap the "tape" around the connector so that the connector is completely covered. Squeeze with your hands to form a tight protective covering. For additional protection, you can wrap the puttied connector with plastic tape. I've never found a connector treated this way to show any weather damage, even after several years of exposure to nasty New England winters.

If you have a lot of connectors to seal, however, this can get fairly expensive. You can also use a less expensive putty sold in hardware stores to seal ductwork (usually called "duct seal" or some similar name). Typically, this material comes in small "bricks" and is a little less pliable. You'll need to cut off a small chunk of the putty and roll it around in your hands until it becomes workable. Then wrap it around the connector and form it into a tight seal as mentioned above. It's probably a good idea to add electrical tape to this treatment, as well.

What's a Better Connector?

So what connectors are best for VHF/UHF work? There are a number of different ones on the market, but the most popular are the BNC units for the smaller cables (RG-58, -59, etc.) and Type-N for the RG-8 sizes. Both of these styles are weatherproof when properly installed. In both cases, the only soldering to be done is the center pin, so there's far less chance of damaging the cable with excessive heat. Furthermore, they're constant impedance devices, minimizing impedance lumps. And, finally, both styles offer both male and female terminations for cable attachment.

BNC and N connectors are the most common of the "good" connectors, but there are a number of other types on the

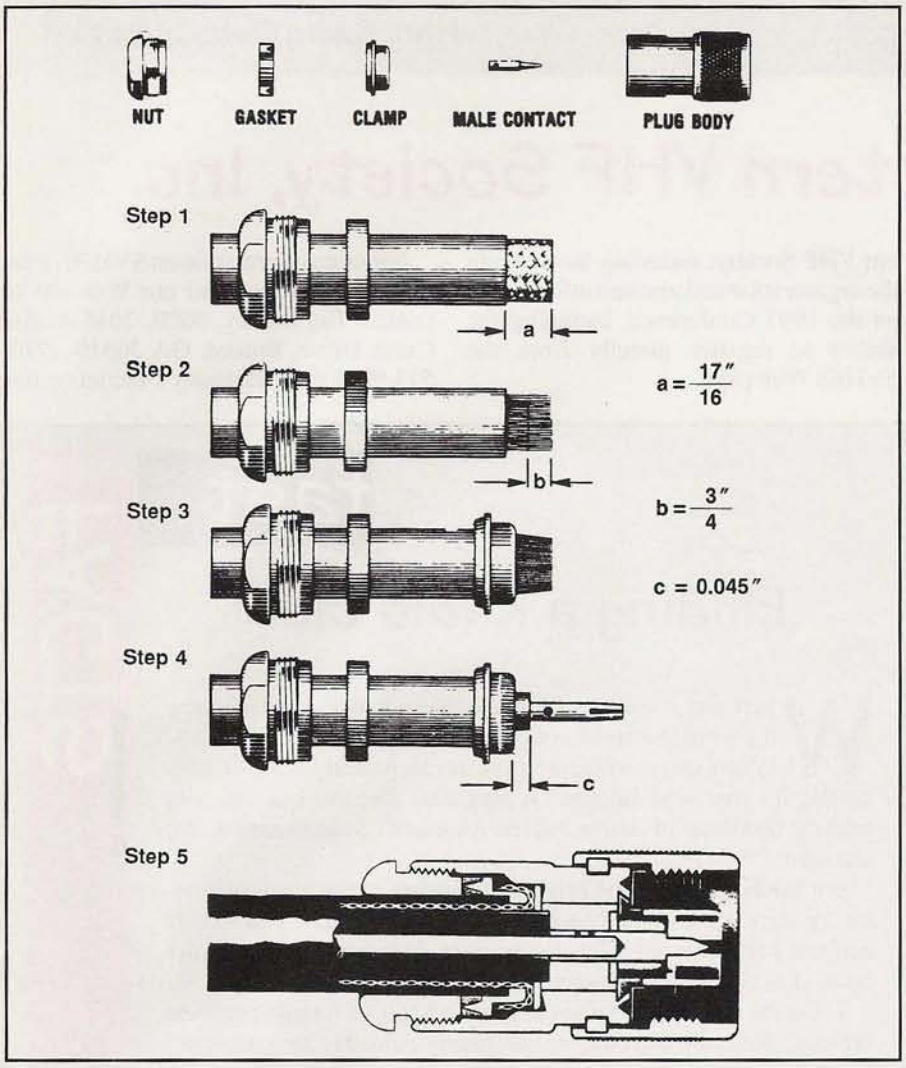


Figure 4. You'll find that Type-N connectors also come in several popular construction styles. These are the assembly instructions provided by Amphenol for this series. (Courtesy Amphenol Electronic Components)

market. If you have equipment that comes with yet another type of connector, such as an SMA, you may want to consider converting it to a BNC. An alternative is to use adapters. Good adapters work quite well without introducing a lot of loss or impedance lumps into the system. Like the PL-259s, adapters often come in either silver-plated or nickel-plated versions. Again, go for the silver; trust me, you'll have fewer problems.

Figures 3 and 4 detail the assemblage of BNC and N connectors, respectively. Keep the measurements as exact as possible. Several versions of each connector are available. We've included the most popular ones in the diagram, but it's always possible to find one that's constructed slightly differently. If you do, you may want to contact the manufacturer directly and ask for a diagram showing the exact measurements for such a model. Also, make sure that you have a connector designed for the cable size that you are using. BNC connectors designed for RG-59 cable will fit onto RG-58, but you *won't* have a secure weatherproof connection and you *will* have an unwanted impedance lump. Not good.

Caveat Emptor (Buyer Beware)

Finally, if you're buying surplus connectors at a hamfest, be sure you know what you are getting. Always buy new connectors, and make sure they're designed and sized for the cable on which you will be using them. And if you insist on staying with UHF connectors, *good luck*. You'll need it. ■

Line of Sight *(from page 4)*

with an April "Mobile Special." Several of our features and columns this month cover a mobile theme, including KØDAS's "Secrets of Successful Rover Operating," WB6NOA's look at "Moving Off Repeaters When You're on the Move," and "In the Public Interest" guest columnist KO6UX's "Driving the Public Service Highway." Plus, we take "going mobile" to new heights with the conclusion of WF1F's series on contacting the Mir space station, NC7K's report on amateur rocketry (including amateur radio), and N2IRZ's look at using GPS satellites to tell you just where in the world you are.

So buckle up and enjoy the ride!

73 de NW2L

Help Wanted

If you're involved with a project or activity that you think would be of interest to your fellow *CQ VHF* readers, we'd like to hear from you. Article submissions are welcome, as are "Op-Ed" opinion pieces if you have a point of view you'd like to share about a VHF-related topic. You can contact us by mail at 76 N. Broadway, Hicksville, NY 11801 (send an SASE for writers' guidelines), by e-mail to <CQVHF@aol.com>, or via our World Wide Web page, <http://members.aol.com/cqvhf/>. We look forward to hearing from you.

Southeastern VHF Society, Inc.

The Southeastern VHF Society, Inc. (SVHFS) was formed in December, 1995 to promote weak-signal modes of operation and experimentation on the VHF, UHF, and microwave bands and to sponsor a technical, educational, and operating conference yearly in the southeast beginning in the spring of 1997. SVHFS held its latest meeting on August 17, 1996 at the Huntsville Hamfest in Huntsville, Alabama. Several important achievements were announced there.

- The 1997 Southeastern VHF Society, Inc. Conference will be held on Friday and Saturday, April 4 and April 5, 1997, at the Atlanta Marriott Northwest, Windy Hill, located between Atlanta and Marietta, Georgia. A special conference rate of $69 per night plus tax is being offered. Attendees may make reservations by calling the hotel directly at (770) 952-7900 or by calling Marriott's toll free number (800) 228-9290. Make plans now to attend! (See March, 1997, *CQVHF*, p. 80, for additional conference information).
- A call for conference papers was announced by Dick Hanson, N4HSM, with a submission deadline of January 31, 1997.
- Jim Worsham, WA4KXY, was elected Conference Chairman. Jim brings broad experience in organizing professional technical conferences and in weak-signal VHF work to SVHFS. He's actively involved in working with all committee chairpersons to plan and organize the event and to ensure a first-rate conference for all attendees.
- SVHFS President, Steve Adams, WS4F, announced that the articles of incorporation had been filed with and approved by the State of Georgia. This is an important step in the growth of SVHFS and the Conference.

You're invited to visit the Southeastern VHF Society, Inc. on the World Wide Web site at: <http://www.akorn.net/~ae6e/svhfs/svhfs.html>. You can get additional information on the Southeastern VHF Society, including how to join the organization and updated information on the 1997 Conference, including the ability to register directly from the SVHFS Web page.

For more information on SVHFS or the 1997 Conference, visit our Web site or contact Tad Danley, NZ3I, 2045 Amber Creek Drive, Buford, GA 30519, (770) 513-9252 or <tad.danely@nextel.com>.

fast FACTS!

Finding a Radio Club

Where can you find experienced hams to help you learn new things or to answer your questions when you're confused? Where can you find used gear at reasonable prices? Or help putting up your new antenna? A magazine like this one can help with the first three, of course, but sorry, we don't do antennas (except our own).

For hands-on, in-person help and education, not to mention interesting activities and the chance to make new friends, you simply can't do better than your local radio club. But clubs can sometimes be hard to find. Here are some suggestions:

1. On the air—if you've got a radio and you've found your local repeater, listen for announcements (many repeaters are sponsored by clubs) or get on and simply ask someone.

2. The ARRL (American Radio Relay League)—many of the most active clubs are affiliated with the ARRL. A list of affiliated clubs in your area is available by calling (860) 594-0200, or via e-mail request on the Internet to <armentan@arrl.org> (ignore the < and > in the address; they're just there to set off the address from what's around it.).

3. Try the phone book—some clubs have their own phone numbers (often hooked to an answering machine) and separate listings in the directory.

4. Your local Radio Shack or ham store—these are often sources of information on area clubs.

5. Online—America Online's Ham Radio Club offers a directory of ARRL-affiliated clubs, broken down by state.

Once you find a club, get in touch with a member or just show up at a meeting. If you do just show up, be prepared to take the initiative to introduce yourself and let people know you're a new ham. Many hams are friendly but shy, and they may not feel comfortable approaching a stranger. (If that description fits you as well, you'll probably do best to contact a member before the meeting so that someone is expecting you and can begin introducing you to other members.) In nearly all cases, you'll be warmly welcomed both to the club and to the worldwide community of ham radio.

By Ted Danley, NZ3I

Q & A

Q: I was wondering if there is an online manual somewhere about using the Kantronics KISS mode so I could get my graphical TCP/IP packet program working. Plus, I know that my TCP/IP system (44.112.0.95) is marked in the tables on the Internet as <n3tav.ampr.org>, because I tried getting a Web page off of it. I couldn't get to it because my local TCP/IP gateway is being worked on. But if I could, would I do the same things as on the Internet for http addresses, such as <http://n3tav.ampr.org/mainmenu.htm>. What I am trying to do is make a more user-friendly packet-type server that normal AX25ers could see as a strictly ham radio BBS. Then maybe I could get a new (miracle) network going which is easy to use.

On another topic, I was wondering if it would be possible to have an IP router on a satellite, so we TCP/IPers don't have to use the Internet to "assist" us in our QSOs.

By the way, I am 15 years old and have been a ham for over 2 1/2 years. I have been on packet for just over 2 years. I am a member of the TeenNet (amateur radio), and its Web page is <http://fibo.hogent.be/~on4bds/teennet.html> (might be only .htm). I go to Central Catholic High School in Pittsburgh, PA.

73,

Joe Malingowski, N3TAV
Pittsburgh, Pennsylvania

A: *Joe—The answer to your first question comes from "Digital Data Link" columnist Don Rotolo, N2IRZ; Phil Karn, KA9Q, who wrote the ham radio version of TCP/IP fields the second. Our thanks to both Don and Phil.*

From N2IRZ:

I'm not aware of any Web pages that cover the use of KISS mode, specifically in Kantronics products, but you might want to try contacting Kantronics with your questions.

KISS mode is really simple, though. After all, KISS stands for "Keep It Simple, Stupid." Basically, once you put the TNC into KISS mode (and all TNCs are supposed to be exactly the same), it sends as a packet whatever comes into the RS-232 port. It does not look at the data, does not react to any characters (except for those TNCs on which a specific character takes it out of KISS mode), nothing—whatever comes in goes out the radio port, and vice versa.

On to your question about sending Web-type pages via packet. *If* there is a physical connection between the amateur station and the wire Internet, and all the servers are configured to both recognize that *and* allow connections into it, then, yes, you can do just what you say. Any Web pages on that server (the one that actually is n3tav.ampr.org) that you put there can be seen with an http:// address. Two problems, though: Most sysops don't allow Internet people access to amateur stuff, because it could then possibly go out over the air, and that would let a non-licensed person use amateur frequencies without a control operator present, which isn't allowed. The other problem is that your server *must* be running Web *Server* software as well, so it knows what to do when a Web request comes in.

My advice, though, is to not try reinventing the wheel. Search for ham radio Web sites, because there are other hams out there who are doing just what you want to do—essentially, use a TCP/IP network to allow typical Internet applications over packet radio. Remember, though, that most amateur networks don't have the bandwidth (capacity) to run a Web page through them. (As an experiment, try accessing the Internet at 300 baud, a typical throughput speed for a 1200-baud amateur network).

The second question wasn't addressed to me, but here's my two cents: Ah, yes—a TCP/IP router in a satellite. Of course, that's best asked of the satellite people, especially AMSAT. I think (but am not sure) that the main problem is that a TCP/IP router can't reconfigure itself on the fly: the routing tables are static, and unfortunately its view of available stations (things to route to) on the ground is constantly changing. One thing TCP/IP does *not* like, especially the routers, is stations that come and go. So, unless you have a geosynchronous satellite, a TCP/IP router might not work at all.

From KA9Q:

I don't know if the idea of putting an IP router on a satellite has been seriously discussed in detail, but my initial reaction is that it would not be a good idea. In general, if you have a choice between putting a function in orbit and leaving it on the ground, it's better to leave it on the ground where it can be fixed and upgraded. Computer hardware, especially the kind of hardware necessary to run a full-blown Internet node, tends to advance so rapidly that it's invariably obsolete by the time it reaches the launch pad. And, of course, on the ground, you can use cheap commodity hardware from the local swap meet; in orbit, the demands of reliable space operation generally require a custom design with a far lower "bang for the buck."

So I am a "minimalist" when it comes to the functions you put in a satellite. The minimal function for communications is of course a "bent pipe" linear transponder like those AMSAT has flown on many satellites. A linear transponder is simple, reliable, and flexible; it repeats whatever it hears, including new modes and modulation methods that didn't exist when the satellite was launched. The complexity is left on the ground.

There is a case for placing more "intelligence" in orbit than a bent pipe transponder, as in the Microsats and the RUDAK experiments on the Phase 3 satellites. The potential benefits of doing this include:

- support for non-real-time store-and-forward communication, as on the Microsat satellites. This makes low earth orbit launch opportunities more interesting than they otherwise might be;
- digital regeneration, which avoids wasting downlink power on repeated noise and collisions;
- improved uplink contention resolution (for example, by having multiple uplink receivers feed a common downlink transmitter, as in the Microsats);
- the ability to use different modulation and coding methods on the uplink and downlink, each one optimized for the specific task (you might use spread spectrum on the uplink for its

multiple-access benefits while using a nonspread spectrum downlink, for instance).

Another possible benefit of an "intelligent" satellite is support for direct intersatellite relaying, which implies circuit or packet switching of some sort. This is a rather advanced notion that AMSAT has never seriously pursued, mainly because it generally takes a Herculean effort to get a single satellite to the launch pad, much less a whole fleet of them launched and into coordinated orbits.

The Iridium system is perhaps the first commercial implementation of a sophisticated switched intersatellite linking system. I note that its major competition, my own company's (Qualcomm's) Globalstar system, has decided to forego intersatellite links in favor of a cheaper bent pipe approach where all the modulation and linking is done on the ground. Time and the marketplace will tell which approach works best.

Having discussed "intelligent" satellites, I point out that even an "intelligent" network of packet-switching satellites need not actually implement an IP router in space in order to support an IP network on the ground. It would probably make more sense to design a set of "subnetwork" protocols specifically for an orbiting constellation of satellites that presents what appears to be a fully connected network to the IP routers on the ground that talk to the satellites. Again, this follows the principle of leaving as much on the ground as possible unless some clear benefit can be obtained by placing it in orbit.

Thanks for your question, it was a most interesting one!

Q: How do you go about joining SMIRK (Six Meter International Radio Klub)? I'd appreciate any help you can give me.

Marc Grossman, N2OHM
Brooklyn, New York

A: Marc—First of all, don't ever trade in that callsign. You can qualify for membership in SMIRK, the major organization of 6-meter enthusiasts, by contacting six SMIRK members on 6 meters and collecting their SMIRK membership numbers. Your list of stations worked, along with annual dues of $6 should then be sent to SMIRK Secretary/Treasurer Pat Rose, W5OZI, P.O. Box 393, Junction, TX 76849. For more information on SMIRK, see the "Club Spotlight" column in the August, 1996, issue of CQ VHF *(p. 74).*

Do YOU have a question about any aspect of "Ham Radio Above 50 MHz"? We'll do our best to give you a clear, concise answer—or if it's not a question that has just one easy answer, then we'll invite readers to offer their solutions. Send your questions to us at: "Q & A," *CQ VHF* magazine, 76 N. Broadway, Hicksville, NY 11801; via e-mail to <CQVHF@aol.com> or <72127.745@compuserve.com>; or via our Web page at <http://members.aol.com/cqvhf/>. Be sure to specify that it's a question for "Q & A."

Letters *(from page 10)*

the two "technical" hobbies that I am very involved in.

Another point: If I were interested in finding a new hobby, i.e. amateur radio, I would not go and buy the latest issue of *Cosmo* or *Woman's Day*. I would look for an amateur radio-related magazine and learn all I could from that. If we start advertising/promoting ham radio to women in women's magazines under the auspices outlined in Mr. Chandler's article, I think we will have more people involved in this hobby who don't really want to be in it. Like I said earlier, a cellphone would do the trick.

On that note, I was going to renew my subscription to your magazine. When it first came out, it had some good information in it. It seems though, that over the year, the articles have gotten less technical and geared more toward beginning hams. Now, after reading the "Op-Ed" column, I shredded my renewal. Sorry, but I've been offended by the no-code bashing. Now you've gotten personal.

73,

Jackie R. Burton, KC5OHJ

Jackie—We're sorry to lose you as a reader. The "Op-Ed" column exists as a forum for all responsible points of view and to initiate discussions on various topics of interest or concern to our readers. See this month's "Op-Ed" for a somewhat more positive response to Mr. Chandler's column.

"A Silly Code Debate"

Dear *CQ VHF*:

With all the threats to our bands and hobby, it's time to quit the bickering over code and pull together as a brotherhood and stand up for our hobby. If we put as much energy into writing our government officials as we put into the code debate, they would be hearing our message Q5 (loud and clear) in Washington. I would hate to see our 2-meter and 70-centimeter bands go flying away while we're fighting over a silly code debate.

Dale Urban, NØKQX
Garden City, Kansas

Politically Incorrect

Dear CQ VHF:

The reader survey in the October, 1996, issue of *CQ VHF* asks several questions about our voting status. I do not feel that those questions or answers should affect the data printed in our magazine. Amateur radio is, as I understand it, non-political; and if it is political, it should not be. I have many friends around the world whose political outlook is not the same as mine, but their interest in amateur radio is the same as mine. I once changed churches because the preacher started practicing politics instead of preaching. In my opinion, neither politics nor religion has any place in amateur radio.

73,

Ernest E. Orman, Jr., W5OXA

Ernest—The purpose of this survey was to gauge the degree to which our readers, as a group, participate in the democratic proces. We know that the commercial interests that are eyeing our bands participate. It's not our purpose or intent to advocate any political agenda beyond the preservation and advancement of amateur radio. But it is becoming essential, in the effort to do so, for each of us to understand and participate in the democratic process.

We don't care who you vote for, but we do care that you vote.

Basics

Packet Bulletin Boards—Ham Radio's "General Store"

Today's digital communications networks—including ham radio packet networks—fall under the buzz phrase of the "information highway." The reason you get onto a highway, any sort of highway, is to go somewhere. Usually, on a real highway, we have a specific destination in mind before we ever leave home. It's not much different on packet. Most of us turn on our packet stations to make contact with another specific station. In many cases, that station is our local *PBBS*, or *Packet Bulletin Board System*.

Since we're using a travel analogy, let's think of our PBBS as a small-town general store. In many towns, the general store is a combination post office, newsstand, and gossip center. If you want to find out what's happening, you stop by the general store.

On the ham bands, you can "stop by" your PBBS to pick up your mail, send off a note to a friend across the country or across the ocean, find out the latest ham radio news, and see if anybody knows where you can find that elusive piece of gear you're looking for. See the similarities?

In many ways, ham radio's general store is better than a real one. It's open 24 hours a day, seven days a week, you don't have to leave home to get there, and all the local stores are hooked together in a global network that automatically forwards messages and bulletins around the corner or around the world.

Using a PBBS

Let's take a look at how you connect to a packet bulletin board and what you can expect to find there. Like other specialized packet stations, most bulletin boards are either identified by a ham radio callsign followed by a dash and one or two numbers, or by an *alias* that generally includes the letters BBS (for example, the WA2SNA BBS in northern New Jersey uses the alias "BBSNNJ").

There are several different types of bulletin board software and each one is a little different. But they all have some features in common. When you log on for the first time (by typing "C," a space, the callsign or alias of the BBS, and pressing "enter"), you'll get a "new user" screen that asks a few questions, such as your name, location, and "home" BBS.

That last one's important. Your "home" BBS is where you want to receive your packet mail. Generally, it's the board you check into most frequently. If you check into a different board sometime, don't worry—you won't insult it by telling it you "live" someplace else. But you will let that system do two things: First, on some systems, any messages you send out from the board you're "visiting" will direct the receiving station to reply to your "home" BBS. And second, if a message coming to you without a full address happens to reach this bulletin board, it will automatically forward it to your correct "home address." *Please*...have just one "home" BBS.

Once a bulletin board "knows" who you are, it'll let you see what's there. The basic command for "listing" messages is "L." Just press "L" and "Return" or "Enter." The board will send you a list of all bulletins plus personal messages to or from you that have been posted since your last check-in. If this is your first, prepare for a long list. If you only want to see your mail, type "LM." It means "List Mine."

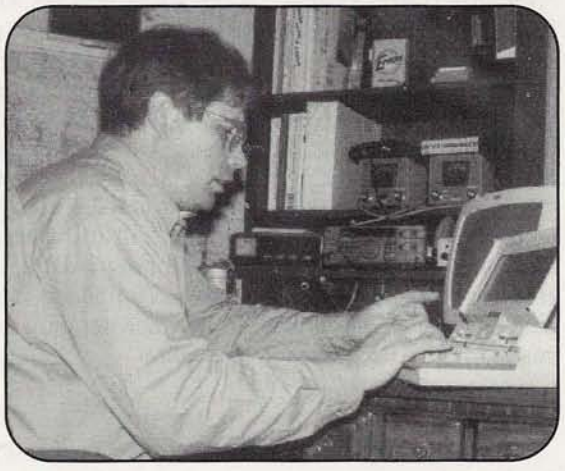
What Does It Mean?

On a typical listing of messages, each line represents one message. The information you'll see includes the message number, the type of message (is it "P" for personal or "B" for bulletin?), and a status code ("Y" or "N" to indicate whether it's been read), its size in bytes, the message address, including callsign and destination, plus the return address, the date and time the message arrived on this BBS, and a brief description of what it's about.

To read a message, type "R," space, and the message number. You can string together several numbers to read a group of messages with just one request. After you've read a message addressed to you, it's a good idea to delete it by typing "K" for kill, followed by the message number and a "return."

Sending a Message

To send a message, the basic command is "S." For a personal message to another ham, type "SP," space, that ham's callsign, and, if he or she is at a different bulletin board, the "@" sign, followed by the call of the destination BBS. Don't include the dash and SSID number, but it is good practice to provide routing information—basically a two-letter state abbreviation, the country and the continent, each separated



Checking into your local packet bulletin board will let you send and receive mail, get the latest ham news, see what other hams want to buy and sell, and even download files and computer programs. This is Tom Klimala, KM4LB, of Raleigh, North Carolina, at his packet terminal.

by a period. A typical address would be <NW2L@WA2SNA.#FN21.NJ.US.NA>. This would tell any forwarding station that the message is heading—in reverse order—to North America, the United States, New Jersey, Grid Square FN21 (different systems use different regional identifiers), and finally, the WA2SNA bulletin board. WA2SNA will hold the message for NW2L until he checks in, and then will list it as a waiting message.

After you tell the BBS you want to send a message and who you want to send it to, it will ask you for a short description, then tell you to type the message. When you're finished, type "CONTROL-Z" or "/EX" on a separate line. Your message will now be automatically forwarded by the BBS to its destination.

Sending a Bulletin

Sending a bulletin is pretty much the same, except that you type "SB" instead of "SP" and the address generally isn't a call-sign. It's either "All" or some descriptive name, such as "Info." "Info@ USBBS" will send your information request to all packet bulletin boards in the U.S.

Please think carefully before you distribute a message widely; for instance, do you *really* need to send this to the whole country? And try to avoid "ALL@ ALLBBS," or "ALL@WW," world-wide, unless it's truly important for hams everywhere to see your message. If it isn't, then your message just becomes clutter on the airwaves.

Files and Programs

Most bulletin boards also include file sections which contain either computer programs or long text files which you may download. One example is a file which will give you schedules and beam headings for working amateur satellites. You may also be able to download a public-domain program for tracking those satellites. Procedures vary on different systems, so check the help screen of your BBS or ask the *sysop* (system operator) how to access and download files on your system.

Handling Traffic

You can't travel on any sort of highway without seeing other traffic. In ham radio, the term *traffic* usually refers to radiogram messages sent via the American Radio Relay League's "National Traffic System." Many BBSs forward ARRL message traffic (generally addressed to "XXXXX@NTSzz," where the Xs are a Zip Code and the "z"s are a state abbreviation. A radiogram going to Hicksville, New York, for example, would be addressed to <11801@NTSNY>. There's a whole separate procedure for handling ARRL messages. We won't cover them here except to say that, if you see a message for someone local to you, feel free to pick it up (read it) and deliver it (generally by phone). If you do, be sure to then "kill" the message (using the procedure outlined above) so it's not picked up and delivered a second time by a second ham. To find out about traffic-handling, check into a local VHF voice net on a repeater, or contact your ARRL Section Manager.

Exit Ramp

When you've gotten your mail, checked the latest news, and maybe picked up a new program for your computer, it's time to leave "Ham Radio's General Store." That's the easiest command of all. Simply type "B" or "Bye" and press "return." The BBS and your TNC will do the rest. ■

CTCSS Tone Frequencies

The following is a listing of the 42 standard CTCSS (Continuous Tone-Coded Squelch System) tone frequencies, along with the Motorola PL® designators often used to describe them. Many repeaters require that you transmit a CTCSS tone along with your signal in order to have your signal retransmitted by the repeater. CTCSS is usually used to minimize interference to and from other repeaters, not to restrict access.

Frequency (Hz)	"P/L" Designator
67.0	XZ
69.3	WZ
71.9	XA
74.4	WA
77.0	XB
79.7	WB
82.5	YZ
85.4	YA
88.5	YB
91.5	ZZ
94.8	ZA
97.4	ZB
100.0	1Z
103.5	1A
107.2	1B
110.9	2Z
114.8	2A
118.8	2B
123.0	3Z
127.3	3A
131.8	3B
136.5	4Z
141.3	4A
146.2	4B
151.4	5Z
156.7	5A
162.2	5B
167.9	6Z
173.8	6A
179.9	6B
186.2	7Z
192.8	7A
203.5	M1
206.5	8Z
210.7	M2
218.1	M3
225.7	M4
229.1	9Z
233.6	M5
241.8	M6
250.3	M7
254.1	ØZ

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LOOKING AHEAD in CQ VHF Ham Radio Above 50 MHz

Here are some of the articles that we're working on for upcoming issues of *CQ VHF:*

- "The Great Sporadic-*E* Debate—Part 2: In Search of the Weather Connection," by Rita (KB5KYN) and Owen (KI5JD) Williamson
- "First Person: Rescue on Mt. Evans," by Randy Simons, NØLRJ
- "Converting to *Very* Narrowband FM," by Rod Wheeler, WA6ITC
- "Turn Your 'Power Station' into a Workhorse," by Gordon West, WB6NOA

Plus these projects...

- "Build a 2-Meter Notch Filter," by Jim Ford, N6JF
- "An Experimental 6-Meter Noise Blanker," by Bob Witmer, W3RW
- "Build a 25-Amp, 12-Volt Power Supply," by Chuck Pearce, K3YWY

If you'd like to write for *CQ VHF*, you may download our writers' guidelines from the *CQ VHF* World Wide Web site at <http://members.aol.com/cqvhf/> or FTP to <ftp://members.aol.com/cqvhf/general> and look for the file named "writguid.txt". Or you may send a written request with an SASE (self-addressed stamped envelope) to *CQ VHF* Writer's Guidelines, 76 N. Broadway, Hicksville, NY 11801.

HAM SHOP

Advertising Rates: Non-commercial ads are 20 cents per word including abbreviations and addresses. Commercial and organization ads are $1.00 per word. Boldface words are $1.50 each (specify which words). Minimum charge $2.00. No ad will be printed unless accompanied by full remittance. All ads must be typewritten double-spaced.

Closing Date: The 1st day in the third month preceding date of publication (example: Jan. 1 for the March issue). Because the advertisers and equipment contained in Ham Shop have not been investigated, the Publisher of *CQ VHF* cannot vouch for the merchandise listed therein. The publisher reserves the right to reject any advertisement. Direct all correspondence and ad copy to: CQ VHF Ham Shop, Attn: Bernadette Schimmel, 76 N. Broadway, Hicksville, NY 11801.

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ALUMINUM chassis & cabinets, assembled and kits, UHF-VHF antenna parts. K3IWK, 5120 HARMONY GROVE ROAD, DOVER, PA 17315 PHONE/FAX: 1-717-292-4901 EVENINGS.

FOR SALE OR TRADE: 126' spool of RG-225 teflon coax (high-power, high-temperature, good for ***indoor*** use up to 450 MHz). Will sell for $200 + shipping (or you pick up in Metro NYC/NJ area). Prefer to trade for 6/2-meter transverter of similar value. Rich Moseson, NW2L, c/o CQ VHF, 76 N. Broadway, Hicksville, NY 11801.

HAM Location, beautiful all brick rancher, 4700 sq. ft. home includes home office, HAM shack (radio room), antennas, 3 tiled full baths, 3 or more bedrooms, 3 dens. The 3 car garage and smoking room are not included in the 4700 sq. ft. Sturdy quality construction. Type of heat is great for sinuses and very warm. Acre lot, back fully fenced and very quiet and private, secure gates, separate dog kennel, Olympic size well kept swimming pool. Located on mountain ridge, quiet prestigious neighborhood, nice homes all around, great schools. Located 55 miles from Baltimore and Washington, DC. Ideal location to work in DC, with easy accessibility by train. House and property will be inspected, one year warranty. Pictures, property plan, layout, amenities list, and features in a booklet available to serious buyers for $5.00 cash, check, or money order. Contact: W3BAG, Box 609, Braddock Heights, MD 21714, or call (301) 473-5825.

Connect-O-Clean Not hearing weak signals anymore? Clean your antenna's SO-239 connector with our custom sized bronze brush. $4.95 pp. 189 County Road 674, Valley Head, AL 35989.

Weather satellite and Mir/Shuttle 2M antennas. Woodhouse Communication, PO Box 73, Plainwell, MI 49080. Voice (616) 226-8873; FAX: (616) 226-9073, or e-mail: <view2earth@aol.com>.

WANTED: Older model bugs, unusual bugs, and miniature hand keys. State price, condition. Dave Ingram, K4TWJ, 4941 Scenic View Drive, Birmingham, AL 35210

FOR SALE: New, Unused, in original cartons: Radio Shack DMP 130A dot matrix printer, PTC-64, C-64 printer controller. $160.00. K2EEK, CQ Magazine, 76 N. Broadway, Hicksville, NY 11801.

WORK RARE CW DX? CW CONTESTS? Contest Code is the answer. Powerful hypnosis audio tapes teach you to copy High Speed (30/40 wpm) or Ultra High Speed (50/60 wpm). Subliminals speed you along! 20 min/day for 30 days yields results. Each tape $15.95 pp U.S. (WV add $0.96 tax). $3.00 for optional 2-day delivery. Specify 30/40 or 50/60 tape. VISA/MC Order now! 304-422-2767; Alternative Arts, 4601 Rosemar Road, Parkersburg, WV 26101.

FOR SALE, Service Monitor—Ramsey COM-3, 2 years young, excellent condition. AM/FM, Frequency, Modulation and Signal Generator. Certification 1/97. $1850 plus shipping. Call day (609) 692-8448, night (609) 645-8277.

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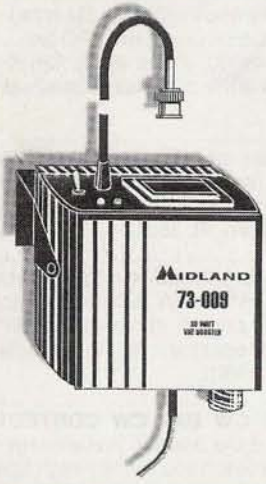
Contact: *CQ VHF* Ham Shop, Attn: Bernadette Schimmel, 76 North Broadway, Hicksville, NY 11801. Call today (516) 681-2922 or Fax: (516) 681-2926.

MIDLAND EQUIPMENT

MODEL 73-030

Micro Miniature 2 meter VHF transceiver.

Covers 144-148 transmit and 138-174MHz receive. Palm size...only 4 1/2 x 2 1/4 x 1" with battery, yet loaded with features. Two watts output with battery supplied but 5 watts is available with an optional 9.6V battery. Features included several battery save modes, 72 user programmable memories, scanning, built in DTMF with auto dial memories. Full LCD panel with frequency and function, channel steps from 5 to 50kHz, keyboard entry, repeater splits, three power ranges, priority channel scan and more. Supplied with 6V-600MA rechargeable battery, flexible antenna. Wall battery charger, belt clip and instructions. Jacks for speaker/microphone, antenna and power.



MODEL 73-009

Car adapter plus linear amplifier 135-170MHz The 73-009 is a wide band linear amplifier allowing you to convert handheld transceiver into mobile units. The installation of the 73-009 on the vehicle's driver side window makes the unit even more handy, in a place which is not usually used for other accessories but very close to the driver's side. Adding a speaker microphone and an external antenna, completes the mobile station. Voltage 13.8VDC. Current drain 5A. Frequency range 135-170MHz. Max output power 30W. Impedance 50 Ohm. In/Out Connector BNC/SO239. Size (4 3/4 x 4 3/8 x 1 3/4"). European craftsmanship.

MODEL 73-007

Miniature 70 CM (440MHz) UHF Transceiver

Same as the 73-005a but covers 430-450 transmit and 420-470MHz receive.

MODEL 73-005A

Miniature 2 Meter VHF Transceiver

Covers 144-148 transmit and 130-170MHz receive. Backlighted keyboard. Two watts of power output expandable to 5 watts. Miniature 9 cubic inch size, 18 function LCD multi-function readout. Three power levels. Keyboard or rotary frequency entry. Multi-function scan. 20 independent memory channels. Frequency steps of 5-10-12.5-20-25 or 50kHz. Built-in DTMF and paging. Optional tone squelch. Multifunction dial lamp. Dual watch. Battery save feature. Auto power off. Repeater offset and reverse. Monitor switch. Frequency/function lockout. Jacks for external antenna, speaker, microphone. Supplied with 7.2V 700mA rechargeable battery, flexible antenna, wall style battery charger and belt clip.

MODEL 75-510

14 Channel PLL Family Radio

The 75-510 offers maximum channels, power and control. All 14 channels are included in this PLL handheld. Maximum allowable power output. Full FM. 39 frequency CTCSS tone code included for ultra privacy. LCD control panel. Other features include fully automatic squelch control, LCD ON/OFF light, scan, busy channel bypass and delete, channel up-down controls, mode function, battery low indicator, keylock system, transmitter time out timer for safety and memory retention. Jacks are provided for an earphone or speaker/microphone. The unit is supplied with a flexible antenna and belt clip. Size: 2 1/4W x 4 3/4H x 1 1/4D. Weighs 1 lb.

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"Advanced performance, and simple to use. I knew Yaesu would be first with this."

"Yaesu did it again!"

Continuing Yaesu's leading edge engineering philosophy, the FT-8000R Compact Dual Band Mobile introduces industry-first features and no-nonsense operation for today's demanding Amateur. No puzzling key combinations on the FT-8000R; eight clearly marked keys and Yaesu's exclusive Omni-Glow™ display make operation a snap. Want to change bands? Just push the VHF or UHF Volume control!

The FT-8000R is the first mobile to provide superwide receiver coverage – from 110 to 550 MHz and 750 to 1300 MHz*, receiving public safety, marine, and weather channels. Using Yaesu's exclusive Enhanced Smart Search™, the FT-8000R automatically seeks out and loads active simplex channels into up to 50 ESS memory channels in just seconds – ideal when traveling.

Built-to-last, the FT-8000R brings together the most-requested dual band features and a MIL-STD 810 rating for enduring performance. Dual receive (V+V, U+U or V+U), Crossband Repeat (bidirectional or one-way), up to 50 Watts of VHF power output (35 Watts on UHF) with High/Medium/Low selection on each band, and "plug and play" 1200 or 9600 bps packet are just a few.

Clearly a standout, the FT-8000R boasts 110 memory channels (55 per band including one-touch "Home" channels) that store repeater shift, CTCSS encode tone, and packet baud rate. Other essential features include a backlit microphone (another Yaesu first), Time-Out Timer, and an all-new S-Meter Squelch that opens based on the S-meter reading. And, for a programming alternative, the optional ADMS-2C Personal Computer Programming Kit simplifies operation even more.

The FT-8000R dual band mobile is easy - to operate -- and one of the most affordable radios on the market. Bring its high-tech performance home with you today! Available at your Yaesu dealer now!

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Features

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  TX: 144~148 MHz
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- 3 Power Output Levels
  2m 50/10/5 Watt
  70cm 35/10/5 Watt
- 110 Memory Channels (55 per band, including "Home" channels)
- Enhanced Smart Search™
- CTCSS Encode
- Time-Out Timer (TOT)
- S-Meter Squelch
- Dual Receive (V+V,U+U,V+U)
- Crossband Repeat (bidirectional or one-way)
- PC Programmable w/optional ADMS-2C
- Intelligent Band Display (IBD)
- Receiver Muting
- Auto Power Off (APO)
- MIL-STD 810 Rating
- Omni-Glow™ Display
- 1200/9600 bps Packet Compatible
- Alternating-Band Memory Selection (ABMS)
- DTMF Autodialer (one memory per band)
- Accessories

Consult your local Yaesu dealer.

*Cellular blocked.

FT-8500
Dual Band Mobile
Detachable remote front panel, Alphanumeric Display, Spectra-Analyzer™, Digital Voltage Display, 110 memories in 5 banks, choice of microphones, offers high performance operating flexibility.

NEW

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TM-V7A Dual-Band Mobile

Kenwood continues its renowned dual-band mobile tradition with the revolutionary TM-V7A. Large, cool-blue reversible LCD, ergonomic control panel, 280 memory channels, and computer programmability are just some of the many exciting features. Kenwood's engineering expertise, advanced design reputation and outstanding quality are amply evident in the fun-to-operate TM-V7A dual-band mobile transceiver.

- **Alphanumeric memory capability allows you to recall up to 180 memory channels by name. Frequency, memory channel number, and name (up to 7 characters) are displayed simultaneously. Store call signs, repeater names, cities, etc.**

Backlit microphone with convenient operator functions including power on/off, volume and squelch controls and direct frequency entry.

TM-V7A

FM Dual Bander

Performance, quality, and innovation briefly describe the new TM-V7A dual-band mobile. Look at the easy-to-read large blue LCD display! Storing all of your favorite frequencies is a snap with 280 memory channel capacity (alphanumeric to 180). Unique programmable memory function allows you to store virtually all operating data such as frequency, offset, DTSS code, display setting, and beep function in 5 special channels. Visual scan allows you to graphically see band activity near the current operating frequency. Other features include a user-friendly menu and guidance system, 1200/9600 bps packet, AM aircraft band receive, CTCSS, DTSS, paging, backlit DTMF microphone, detachable control panel (with cable option), and voice synthesizer (VS-3 option). The TM-V7A is truly in a class by itself.

The TM-V7A has not been approved by the F.C.C. This device is not, and may not be, offered for sale or lease, or sold or leased until the approval of the F.C.C. has been obtained. Pending approval (11/96).

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