Including Ham Radio Fun!

73® Amateur Radio Today

MARCH 1997
ISSUE #438
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CANADA $4.95

International Edition

ARRL Code Survey Exposed

ATV via Satellite

The TOP Antenna-
Power in a Small Package

The Secrets of Recharging Alkalines

Reviews:
KC2: Keyer- Counter-S & Wattmeter Combo
Dazzling New Satellite Tracking Software

GPS = Great New Toy!

see page 18...

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JRC

JST-245

160-10 Meters PLUS 6 Meter Transceiver

Fifteen reasons why your next HF transceiver should be a JST-245. . .

1 All-Mode Operation (SSB,CW,AM,AFSK,FM) on all HF amateur bands and 6 meters. JST-145, same as JST-245 but without 6 meters and built-in antenna tuner.

★ JST-145 COMING SOON ★

2 MOSFET POWER AMPLIFIER • Final PA utilizes RF MOSFETs to achieve low distortion and high durability. Rated output is 10 to 150 watts on all bands including 6 meters.

3 AUTOMATIC ANTENNA TUNER • Auto tuner included as standard equipment. Tuner settings are automatically stored in memory for fast QSY.

4 MULTIPLE ANTENNA SELECTION • Three antenna connections are user selectable from front panel. Antenna selection can be stored in memory.

5 GENERAL COVERAGE RECEIVER • 100 kHz-30 MHz, plus 48-54 MHz receiver. Electronically tuned front-end filtering, quad-FET mixer and quadruple conversion system (triple conversion for FM) results in excellent dynamic range (>100dB) and 3rd order ICP of +20dBm.

6 IF BANDWIDTH FLEXIBILITY • Standard 2.4 kHz filter can be narrowed continuously to 800 Hz with variable Bandwidth Control (BWC). Narrow SSB and CW filters for 2nd and 3rd IF optional.

7 QRM SUPPRESSION • Other interference rejection features include Passband Shift (PBS), dual noise blanker, 3-step RF attenuation, IF notch filter, selectable AGC and all-mode squelch.

8 NOTCH TRACKING • Once tuned, the IF notch filter will track the offending heterodyne (±10 Khz) if the VFO frequency is changed.

9 DDS PHASE LOCK LOOP SYSTEM • A single-crystal Direct Digital Synthesis system is utilized for very low phase noise.

10 CW FEATURES • Full break-in operation, variable CW pitch. built in electronic keyer up to 60 wpm.

11 DUAL VFOs • Two separate VFOs for split-frequency operation. Memory registers store most recent VFO frequency, mode, bandwidth and other important parameters for each band.

12 200 MEMORIES • Memory capacity of 200 channels, each of which store frequency, mode, AGC and bandwidth.

13 COMPUTER INTERFACE • Built-in RS-232C interface for advanced computer applications.

14 ERGONOMIC LAYOUT • Front panel features easy to read color LCD display and thoughtful placement of controls for ease of operation.

15 HEAVY-DUTY POWER SUPPLY • Built-in switching power supply with "silent" cooling system designed for continuous transmission at maximim output.

JRC *Japan Radio Co., Ltd.*

430 Park Ave., 2nd Floor New York, NY 10022 Phone: (212) 355-1180 Fax: (212) 319-5227

CIRCLE 159 ON READER SERVICE CARD

J-Pole in your Pocket?

Tough dual-band antenna for the travelin' man or the condo dweller. Hang-anywhere style and extra range can save life in an emergency.

James H. Gray W1XU

During my years of traveling around the eastern United States on business or vacation, I often wished I had a small, inexpensive and easy-to-use antenna to match my little hand-held 2 meter radio. Occasionally I had an HF rig in the car, but more often it was the little 2 meter radio which was useful and fun. On long road trips it alleviated boredom, kept me awake and almost always assisted me to find a motel, restaurant, or other ham's QTH. On such trips the mobile antenna was fine until I needed more range from the motel.

When I traveled by plane, the rig was the handheld with no amplifier. It had only a small telescoping whip that I could extend to about 19 inches. If I happened to be close enough to a repeater in a large city, that was fine and I managed to "work" the locals in spite of low power and a minimal antenna.

But there were occasions when there was no local repeater, or when I was inside a steel-and-concrete building. At such times I wasn't able to make any contacts at all and had to resort to dull tedious television programs before going to bed.

If you face similar problems when traveling light and by air, you know how it feels to be alone among the many.

The Pico Solution

Today, the travelin' man has a ready solution to the problem: a neat antenna produced by Antennas West and called the "Pico-J." It meets all the requirements set forth in the first sentence. Pico means "small," as in "picofarad," and "J" stands for "J-pole," the well-known low-angle, omnidirectional vertically polarized antenna—just what's needed for 2 meters.

Antennas West's Pico-J offers some features not found in the usual J-pole. For example, the feedpoint is already found and matched for you, and the antenna is small and light—so much so that it can be rolled up and slipped into a small eyeglasses case. It looks like a sleek black ribbon 55 inches long. A six-foot small-diameter coax feedline comes off the bottom. Its gold-pin BNC attaches directly to your radio.

A small loop at the top may be slipped over a curtain rod or a nail or any other suitable projection. But, if by chance you don't happen to find a suitable support, Antennas West thoughtfully provides a small suction cup with an embedded hook that can be slapped up on a window or any smooth surface, and presto!—you're on the air!

Pico-J is completely weather-sealed and could be hung outdoors if you wish. Otherwise, you can hang it in a closet or a doorway; in fact, anywhere that is convenient and where your signal won't be blocked. The extra reach provided by this beauty could save life in an emergency, and is always useful when just plain chatting with the locals.

Your Pico-J stretches range, improves reception, reaches far-away repeaters, and saves your battery pack.

The measured VWSR is less than 2:1 between 142 and 150 MHz—ideal for CAP, MARS, and other services near the 2 meter band—and is a very beautiful 1:1 at 146 MHz. Not bad, eh?

Best of all, considering the benefits, is the price: $19.95 for the 2 meter model, $26 for the 2m/70cm dual bander, both complete with the soft vinyl case to store your Pico-J when it's not in use.

On a recent trip I tucked Pico-J into my briefcase, right next to the handheld. No, I didn't even use the "duckie" or the telescoping whip because I had all I needed in this one neat antenna. Maybe you'll find the same.

–condensed from ***RadioFun***

No Antennas Allowed?

Who will see ***Pico-J*** *hanging in your closet or on the balcony? But your signal will be heard.* ***Pico-J****'s half wave radiator is sleek and unobtrusive. his thin flexible feedline is barely noticeable. When his work is done Pico-J rolls up and slides into his pouch like the Genie slipping back into the bottle.*

Carry ***Pico-J*** *on hikes or trips as you would carry a pair of glasses. Keep him in your emergency jumpkit. When you need gain and low angle omnidirectional coverage pull out* ***Pico-J*** *and be full quieting when it counts.*

New Pico-J's for 1995

PJ Packet $22—*Maximum efficiency on 2m packet frequencies.*

PJ 220 $19.95—*Go everywhere gain for the "private" band.*

Pilot's Pico-J $39—*Aviation band range booster for pilots on the go.*

ASTRON CORPORATION
9 Autry
Irvine, CA 92718
(714) 458-7277 • FAX (714) 458-0826

NEW
SWITCHING POWER SUPPLIES

	CONT.	ICS	WT.(LBS)
SS-25	20	25	4.2
SS-30	25	30	5.0

ASTRON POWER SUPPLIES
• HEAVY DUTY • HIGH QUALITY • RUGGED • RELIABLE •

SPECIAL FEATURES
- SOLID STATE ELECTRONICALLY REGULATED
- FOLD-BACK CURRENT LIMITING Protects Power Supply from excessive current & continuous shorted output
- CROWBAR OVER VOLTAGE PROTECTION on all Models except RS-3A, RS-4A, RS-5A, RS-4L, RS-5L
- MAINTAIN REGULATION & LOW RIPPLE at low line input Voltage
- HEAVY DUTY HEAT SINK • CHASSIS MOUNT FUSE
- THREE CONDUCTOR POWER CORD except for RS-3A
- ONE YEAR WARRANTY • MADE IN U.S.A.

PERFORMANCE SPECIFICATIONS
- INPUT VOLTAGE: 105-125 VAC
- OUTPUT VOLTAGE: 13.8 VDC ± 0.05 volts (Internally Adjustable: 11-15 VDC)
- RIPPLE Less than 5mv peak to peak (full load & low line)
- All units available in 220 VAC input voltage (except for SL-11A)

SL SERIES

• LOW PROFILE POWER SUPPLY

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
SL-11A	•	•	7	11	2⅝ × 7⅝ × 9¾	12
SL-11R	•	•	7	11	2⅝ × 7 × 9¾	12
SL-11S	•	•	7	11	2⅝ × 7⅝ × 9¾	12
SL-11R-RA		•	7	11	4¾ × 7 × 9¾	13

RS-L SERIES

• POWER SUPPLIES WITH BUILT IN CIGARETTE LIGHTER RECEPTACLE

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-4L	3	4	3½ × 6⅛ × 7¼	6
RS-5L	4	5	3½ × 6⅛ × 7¼	7

RM SERIES

MODEL RM-35M

• 19" RACK MOUNT POWER SUPPLIES

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RM-12A	9	12	5¼ × 19 × 8¼	16
RM-35A	25	35	5¼ × 19 × 12½	38
RM-50A	37	50	5¼ × 19 × 12½	50
RM-60A	50	55	7 × 19 × 12½	60
• Separate Volt and Amp Meters				
RM-12M	9	12	5¼ × 19 × 8¼	16
RM-35M	25	35	5¼ × 19 × 12½	38
RM-50M	37	50	5¼ × 19 × 12½	50
RM-60M	50	55	7 × 19 × 12½	60

RS-A SERIES

MODEL RS-7A

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-3A		•	2.5	3	3 × 4¾ × 5¾	4
RS-4A	•	•	3	4	3¾ × 6½ × 9	5
RS-5A		•	4	5	3½ × 6⅛ × 7¼	7
RS-7A	•	•	5	7	3¾ × 6½ × 9	9
RS-10A	•	•	7.5	10	4 × 7½ × 10¾	11
RS-12A	•	•	9	12	4½ × 8 × 9	13
RS-12B		•	9	12	4 × 7½ × 10¾	13
RS-20A	•	•	16	20	5 × 9 × 10½	18
RS-35A	•	•	25	35	5 × 11 × 11	27
RS-50A	•		37	50	6 × 13¾ × 11	46
RS-70A	•		57	70	6 × 13¾ × 12⅛	48

RS-M SERIES

MODEL RS-35M

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
• Switchable volt and Amp meter				
RS-12M	9	12	4½ × 8 × 9	13
• Separate volt and Amp meters				
RS-20M	16	20	5 × 9 × 10½	18
RS-35M	25	35	5 × 11 × 11	27
RS-50M	37	50	6 × 13¾ × 11	46
RS-70M	57	70	6 × 13¾ × 12⅛	48

VS-M AND VRM-M SERIES

MODEL VS-35M

• Separate Volt and Amp Meters • Output Voltage adjustable from 2-15 volts • Current limit adjustable from 1.5 amps to Full Load

MODEL	Continuous Duty (Amps) @13.8VDC	@10VDC	@5VDC	ICS* (Amps) @13.8V	Size (IN) H × W × D	Shipping Wt. (lbs.)
VS-12M	9	5	2	12	4½ × 8 × 9	13
VS-20M	16	9	4	20	5 × 9 × 10½	20
VS-35M	25	15	7	35	5 × 11 × 11	29
VS-50M	37	22	10	50	6 × 13¾ × 11	46
VS-70M	67	34	16	70	6 x 13¾ x 12⅛	48
• Variable rack mount power supplies						
VRM-35M	25	15	7	35	5¼ × 19 × 12½	38
VRM-50M	37	22	10	50	5¼ × 19 × 12½	50

RS-S SERIES

MODEL RS-12S

• Built in speaker

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* Amps	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-7S	•	•	5	7	4 × 7½ × 10¾	10
RS-10S	•	•	7.5	10	4 × 7½ × 10¾	12
RS-12S	•	•	9	12	4½ × 8 × 9	13
RS-20S	•	•	16	20	5 × 9 × 10½	18
SL-11S	•	•	7	11	2¾ x 7⅝ x 9¾	12

*ICS—Intermittent Communication Service (50% Duty Cycle 5min. on 5 min. off)

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FEATURES

REVIEWS

DEPARTMENTS

HAM RADIO FUN SECTION

Warning: Important construction correction—see page 88.

On the cover: John Williams N5SJZ launches the 500-foot antenna. Photo by Debby Williams N5SKA. Article begins on page 31.

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.

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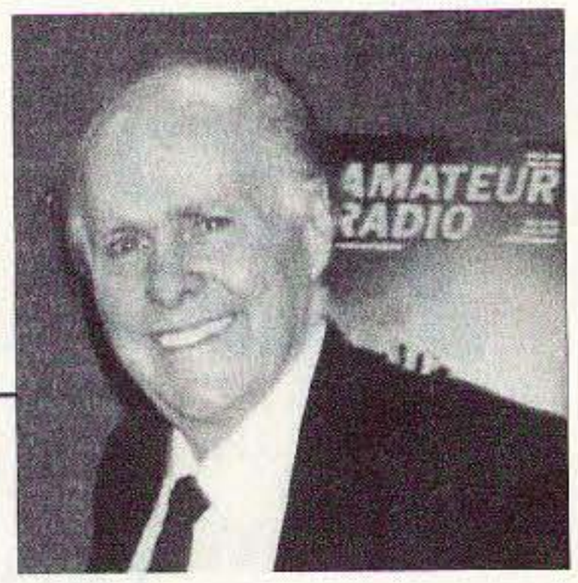
Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1



School Finally Reinvented

As I keep mentioning (endlessly, I guess), our compulsory public school system really sucks. And (ugh!) it's getting worse. Having totally failed to get you to do anything about this miserable situation, I've been doing a lot of research. I've written about what's going on and made some proposals for improving things in my *Declare War* book, plus also in several segments of my *20/20 Foresight* series. I'm busy updating both of these out-of-print books, by the way.

Many schools have been experimenting with ways to improve things, and in most cases their ideas have been helping. You know, it's been shown actually possible, even in the worst inner city ghettos, to get parents actively involved in their children's education.

But the best model school for the future that I've heard about, by a wide margin, is the Sudbury Valley School in Framingham, Massachusetts. I'd class this as the best school in the country. No, probably the best in the whole world! It's a model of iconoclastic, innovative thinking. A reader suggested I look into the school so I sent for a book about it and, when I read it, I got really excited. I'd say this is probably the single most important book I've ever read.

How about a school with no classrooms, no regular classes, no grades, no tests, and no curriculum? How about a school that is so superb that every graduate desiring to go to college has been accepted by a college (usually the one of their choice), despite there being no grade transcripts available, or even a teacher evaluation? How about a school for kids from four to 18 where they learn what they want to learn, when and if they want to learn it, and with no pressure from anyone but themselves to enforce learning? Not even the parents! How about a school where kids can learn eight years of math in 20 contact hours—just because they want to? Where kids read voraciously because they want to?

For most things the kids teach themselves, but when they want help from a teacher it's available. The end result is a bunch of very self-reliant, self-motivated kids with top notch educations, kids who keep right on learning all through their lives.

Spend the $7 for the book, plus $2 shipping for *Free at Last* by Daniel Greenberg, and eat your heart out that you didn't have the opportunity to go to a school like this. Maybe it's time to start one in your town. Order the book immediately, before you forget, from Sudbury Valley School Press, 2 Winch Street, Framingham MA 01701.

Here's a school where every decision is made by the students and teachers together, where there are no administrators, no graffiti, where the students do all the maintenance, where there is no government funding, yet the school costs less than half as much as a public school per student, and yes, it's accredited.

The fact undiscovered by our public school teachers, teachers' colleges, and school administrators is that you cannot *force* children to learn. Oh, under pressure (via ridicule and humiliation) they'll memorize enough to pass tests. But 95% or so of that stuff is gone by the next semester.

In college I began to understand this. When I'd have a problem with a course I was taking I'd ask an upper classman in my fraternity for help. The answer was always the same, "Oh, I passed that course. I don't remember much of it. Sorry."

It really came home when I went back to college after World War II. I'd gone for two years before the War came along and the local draft board decided I would be of more value in the trenches than sitting around in class. So I joined the Navy. You can read more about my exciting adventures (we came tha-a-at close to being killed several times) in my *Uncle Wayne's Submarine Adventures in WWII* book.

During the first two years of college I suffered through four semesters of calculus. I really suffered. I hated it. I wouldn't have hated it so much if the teachers had been able to give me any idea of what I might be able to use it for. Yes, I kept asking, and it just made them mad. The best explanation I was ever able to get was that if I wanted to find out how big a sphere I could put into a cone, calculus would help. You know, it's never come up! Nor, in my 45 years of publishing technical articles, has there been any serious need for me to deal with calculus.

Anyway, after being away for four years, when I went back to college (paid for by the government under PL-16) I still had one more term of required calculus to go. The trouble was, when I opened my old calculus book to refresh my memory, I found I had no memory. It was just as if I'd never been through those two years of misery. So I spent my summer going back over the old material, re-memorizing a bunch of stuff that didn't make much sense. I had to "learn" it all over again. Grumble. And all that for a totally useless differential equations course, which mainly involved my memorizing hundreds of equations. We never were given any practical applications, so I still don't know what that was all about.

College was an agonizing blizzard of memorizing for tests. I have little recollection of anything that went in and out of my memory at the time. Nor has much of that ever been of the slightest value to me in life.

The Sudbury Valley School has shown that if you leave kids alone they are harder task masters than teachers ever would be. They learn what they are interested in, when they are interested. Not one of the "buts" you're going to come up with is valid in the real world.

Our public schools, as I've discussed before, were modeled on the Prussian military schools, whose purpose was to turn out obedient soldiers who would follow orders without question. But is that really what you want for your kids? Well, that's what you're getting, and you're going along with it.

Most of you are too old to have kids in school, but you do have grandchildren, so send for a copy of the book for each of your children. It'll be one of the best $9 you ever invested.

Oh yes, my university. When I was back there recently as a member of the RPI Council, I was assured by the president of the student council that nothing has really changed, that the university still operates on the basis of memorization and tests. And sure enough, they're still teaching classes with rows of desks and blackboards. Wow! Right out of the 19th century.

One Sudbury Valley School graduate put it this way: "Public school systems are set up as dictatorships, which is why children who develop in public school systems end up the same way that prisoners in prisons develop: they tend to become mentally sluggish and submissive." Hmm, so *that's* my problem!

Mooned Again

Yes, of course I realize that the whole idea of all those moon landings almost 30 years ago being a giant hoax is so ridiculous that Wayne Green is off his rocker for even reading about such nonsense. I used to figure that the 30% of the American public who didn't believe we'd ever been to the moon must be a bunch of ignoramuses. Then René's book, *NASA Mooned America* arrived one day in the mail.

Well, I get all kinds of weirdo baloney in the mail. The Iraqis

Continued on page 17

RAMSEY

Synthesized FM Stereo Transmitter

Microprocessor controlled for easy freq programming using DIP switches, no drift, your signal is rock solid all the time - just like the commercial stations. Audio quality is excellent, connect to the line output of any CD player, tape deck or mike mixer and you're on-the-air. Foreign buyers will appreciate the high power output capability of the FM-25; many Caribbean folks use a single FM-25 to cover the whole island! New, improved, clean and hum-free runs on either 12 VDC or 120 VAC. Kit comes complete with case set, whip antenna, 120 VAC power adapter - easy one evening assembly.

FM-25, Synthesized FM Stereo Transmitter Kit $129.95

Tunable FM Stereo Transmitter

A lower cost alternative to our high performance transmitters. Offers great value, tunable over the 88-108 MHz FM broadcast band, plenty of power and our manual goes into great detail outlining aspects of antennas, transmitting range and the FCC rules and regulations. Connects to any cassette deck, CD player or mixer and you're on-the-air, you'll be amazed at the exceptional audio quality! Runs on internal 9V battery or external power from 5 to 15 VDC, or optional 120 VAC adapter. Add our matching case and whip antenna set for a nice finished look.

FM-10A, Tunable FM Stereo Transmitter Kit $34.95
CFM, Matching Case and Antenna Set $14.95

RF Power Booster Amplifier

Add some serious muscle to your signal, boost power up to 1 watt over a frequency range of 100 KHz to over 1000 MHz! Use as a lab amp for signal generators, plus many foreign users employ the LPA-1 to boost the power of their FM Stereo transmitters, providing radio service through an entire town. Power required: 12 to 15 volts DC at 250mA, gain of 38dB at 10 MHz, 10 dB at 1000 MHz. For a neat, professionally finished look, add the optional matching case set.

LPA-1, Power Booster Amplifier Kit $39.95
CLPA, Matching Case Set for LPA-1 Kit $14.95
LPA-1WT, Fully Wired LPA-1 with Case $99.95

Micro FM Wireless Mike

World's smallest FM transmitter. Size of a sugar cube! Uses SMT (Surface Mount Technology) devices and mini electret condenser microphone, even the battery is included. We give you two complete sets of SMT parts to allow for any errors or mishaps-build it carefully and you've got extra SMT parts to build another! Audio quality and pick-up is unbelievable, transmission range up to 300 feet, tunable to anywhere in standard FM band 88 to108 MHz. 7/8"w x 3/8"h x 3/4"h.

FM-5 Micro FM Wireless Mike Kit $19.95

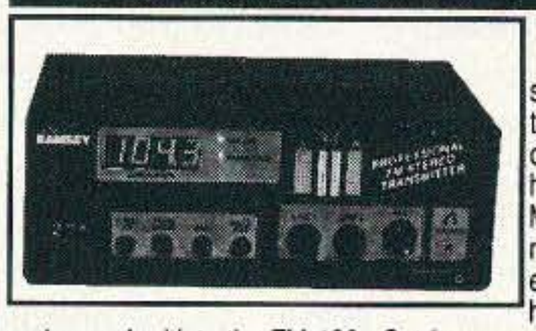
Crystal Controlled Wireless Mike

Super stable, drift free, not affected by temperature, metal or your body! Frequency is set by a crystal in the 2 meter Ham band of 146.535 MHz, easily picked up on any scanner radio or 2 meter rig. Changing the crystal to put frequency anywhere in the 140 to 160 MHz range-crystals cost only five or six dollars. Sensitive electret condensor mike picks up whispers anywhere in a room and transmit up to 1/4 mile. Powered by 3 volt Lithium or pair of watch batteries which are included. Uses the latest in SMT surface mount parts and we even include a few extras in case you sneeze and loose a part!

FM-6, Crystal Controlled FM Wireless Mike Kit $39.95
FM-6WT Fully Wired FM-6 ..... $69.95

Call for our Free Catalog !

Super Pro FM Stereo Radio Transmitter

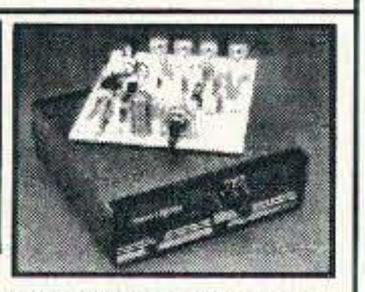


A truly professional frequency synthesized FM Stereo transmitter station in one easy to use, handsome cabinet. Most radio stations require a whole equipment rack to hold all the features we've packed into the FM-100. Set frequency easily with the Up/Down freq buttons and the big LED digital display. Plus there's input low pass filtering that gives great sound no matter what the source (no more squeals or swishing sounds from cheap CD player inputs!) Peak limiters for maximum 'punch' in your audio - without over modulation, LED bargraph meters for easy setting of audio levels and a built-in mixer with mike and line level inputs. Churches, drive-ins, schools and colleges find the FM-100 to be the answer to their transmitting needs, you will too. No one offers all these features at this price! Kit includes sharp looking metal cabinet, whip antenna and 120 volt AC adapter. Also runs on 12 volts DC.

We also offer a high power export version of the FM-100 that's fully assembled with one watt of RF power, for miles of program coverage. The export version can only be shipped outside the USA, or within the US if accompanied by a signed statement that the unit will be exported.

FM-100, Professional FM Stereo Transmitter Kit $299.95
FM-100WT, Fully Wired High Power FM-100 ..... $429.95

Speech Descrambler Scrambler



Decode all that gibberish! This is the popular descrambler / scrambler that you've read about in all the Scanner and Electronic magazines. The technology used is known as speech inversion which is compatible with most cordless phones and many police department systems, hook it up to scanner speaker terminals and you're in business. Easily configured for any use: mike, line level and speaker output/inputs are provided. Also communicate in total privacy over telephone or radio, full duplex operation - scramble and unscramble at the same time. Easy to build, all complex circuitry contained in new custom ASIC chip for clear, clean audio. Runs on 9 to 15VDC, RCA phono type jacks. Our matching case set adds a super nice professional look to your kit.

SS-70A, Speech Descrambler/Scrambler Kit $39.95
CSS, Custom Matching Case and Knob Set $14.95
SS-70AWT, Fully Wired SS-70A with Case $79.95
AC12-5, 12 Volt DC Wall Plug Adapter $9.95

Tone-Grabber Touch Tone Decoder / Reader

Dialed phone numbers, repeater codes, control codes, anywhere touch-tones are used, your TG-1 will decode and store any number it hears. A simple hook-up to any radio speaker or phone line is all that is required, and since the TG-1 uses a central office quality decoder and microprocessor, it will decode digits at virtually any speed! A 256 digit non-volatile memory stores numbers for 100 years - even with the power turned off, and an 8 digit LED display allows you to scroll through anywhere in memory. To make it easy to pick out numbers and codes, a dash is inserted between any group or set of numbers that were decoded more than 2 seconds apart. The TG-1 runs from any 7 to 15 volt DC power source and is both voltage regulated and crystal controlled for the ultimate in stability. For stand-alone use add our matching case set for a clean, professionally finished project. We have a TG-1 connected up here at the Ramsey factory on the FM radio. It's fun to see the phone numbers that are dialed on the morning radio show! Although the TG-1 requires less than an evening to assemble (and is fun to build, too!), we offer the TG-1 fully wired and tested in matching case for a special price.

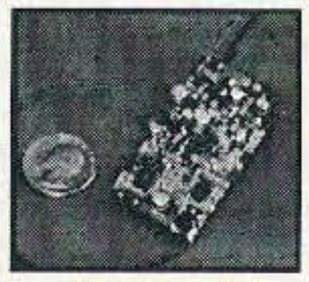
TG-1, Tone Grabber Kit $99.95
CTG, Matching Case Set for TG-1 Kit $14.95
TG-1WT, Fully Wired Tone Grabber with Case $149.95
AC12-5, 12 Volt DC Wall Plug Adapter $9.95

Mini-Peeper Micro Video Camera

Super small, high quality fully assembled B & W CCD TV camera the size of an ice cube! Provides excellent pictures in low light (2 lux), or use our IR-1 Infra-Red light source to invisibly illuminate an entire room on a pitch black night! Imagine the possibilities... build it into a smoke detector, wall clock, lamp, book, radio. Exact same camera that's in big buck detective catalogues and stores. Kit includes: fully assembled CCD camera module, connectors, interface PC board kit with proper voltage regulation and filtering, hook-up details, even a mini microphone for sensitive sound! Two models available: Wide Angle Lens 3.6mm/f2, adjustable focus lens, 92 degree view; Pinhole Lens 5.5mm/f4.5, 60 degree view. The Pinhole Lens is physically much flatter and provides even greater depth of focus. The camera itself is 1.2" square. The Wide Angle Lens is about 1" long, Pinhole Lens about 1/2", interface PC board is 1" x 2" and uses RCA jacks for easy hook-up to VCRs, TVs or cable runs. Power required is 9 to 14 VDC @ 150 mA. Resolution: 380 x 350 lines. Instruction manual contains ideas on mounting and disguising the Mini-Peeper along with info on adding one of our TV Transmitter kits (such as the MTV-7 unit below) for wireless transmission!

MP-1, Wide Angle Lens CCD TV Camera Outfit $169.95
MP-1PH, Pin-Hole Lens CCD TV Camera Outfit $189.95

MicroStation Synthesized UHF TV Transmitter



Now you can be in the same league as James Bond. This transmitter is so small that it can fit into a pack of cigarettes - even including a CCD TV camera and battery! Model airplane enthusiasts put the MTV-7A into airplanes for a dynamite view from the cockpit, and the MTV-7A is the transmitter of choice for balloon launches. Transmitter features synthesized, crystal controlled operation for drift-free transmission of both audio and video on your choice of frequencies: Standard UHF TV Channel 52 (which should only be used outside of the USA to avoid violating FCC rules), and 439.25 MHz or 911.25 MHz which are in the amateur ham bands. The 439.25 MHz unit has the nifty advantage of being able to be received on a regular 'cable-ready' TV set tuned to Cable channel 68, or use our ATV-74 converter and receive it on regular TV channel 3. The 911.25 MHz unit is suited for applications where reception on a regular TV is not desired, an ATV-79 must be used for operation. The MTV-7A's output power is almost 100 mW, so transmitting range is pretty much 'line-of-sight' which can mean many miles! The MTV-7A accepts standard black and white or color video and has its own, on-board, sensitive electret micorphone. The MTV-7A is available in kit form or fully wired and tested. Since the latest in SMT (Surface Mount Technology) is used to provide for the smallest possible size, the kit version is recommended for experienced builders only. Runs on 12 VDC @ 150 mA and includes a regulated power source for a CCD camera.

MTV-7A, UHF TV Channel 52 Transmitter Kit $159.95
MTV-7AWT, Fully Wired Channel 52 Transmitter $249.95
MTV-7A4, 439.25 MHz TV Transmitter Kit $159.95
MTV-7A4WT, Fully Wired 439.25 MHz Transmitter $249.95
MTV-7A9, 911.25 MHz TV Transmitter Kit $179.95
MTV-7A9WT, Fully Wired 911.25 MHz Transmitter $269.95
ATV-74, 439.25 MHz Converter Kit $159.95
ATV-74WT, Fully Wired 439.25 MHz Converter $249.95
ATV-79, 911.25 MHz Converter Kit $179.95
ATV-79WT, Fully Wired 911.25 MHz Converter $269.95

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LETTERS

From the Ham Shack

George Bergstrom, Rancho Cordova CA. Your appearance on the Art Bell show was fascinating. Being an electronics hobbyist I decided to build a "purifier" from your description. Here's the schematic I put together (**Fig. 1**). Your "AIDS Info" booklet recommendation to drink 8 oz. of water before and after is apparently important since I don't drink much water unless it has Sanka in it and ended up with two nearly painless boils on my back, which quickly cleared up. I've already noticed improvements in my skin and nails. I started with one salt pad at the ankle and the other just below the knee, but now I'm using one at the left arm wrist and the other above the elbow.

Ron Gang 4X1MK. As I look through the different amateur radio publications, indeed almost all of them, I see some interesting soul-searching. Ideas which not too long ago would have been considered heretical have now even popped up on the pages of the rather conservative *QST*. To sum it up: You can now pass messages and even voice to any spot in the world on the Internet. The financial outlay on the hard and software, plus local telephone calls, is cheaper than that of a ham station with good worldwide communications capabilities. And, of course, the Internet isn't affected by sunspots and doesn't cause TVI. Emergency communications? Cellular telephones are almost universal, so help can be easily summoned. No need to hope that someone else is on the repeater and can make a phone call for you when you're in trouble.

Now, as you probably know, this past spring we experienced some ghastly terror bombings. When the bombing massacre occurred at Tel-Aviv's Diezengoff Centre shopping mall during the Purim school holiday, the national telephone network became so overloaded by phone calls that the system crashed and all telephones were temporarily rendered useless. Hams jumped in to help on the Tel-Aviv 2 meter repeater, this being the only workable communications at the time.

A week later, after driving some friends to the airport, my car broke down. On the Tel-Aviv repeater one ham took care of the phone calls to my home while another ham, a mechanic in the general vicinity, drove over to where I was stuck to help me out. The day before that I was in Jerusalem, and accompanied by a non-ham friend, I dropped in to an informal ham get-together. My friend was impressed by the warm manner of the group, and commented on our way home, "You must be really good friends with all these people." Actually, I had only seen them face-to-face on a few occasions, but we had been talking together on the radio for years.

Then it hit me. Ham radio is much more than just a mode of communications. Ham radio is friendship. Ham radio is a fraternity. Ongoing contacts build a community of people who are not strangers to each other. Ham radio counters alienation. Thus the willingness to help each other, to host visiting amateurs from other countries. People is what ham radio is all about.

The actual mode of communications via radio was not long ago technically beyond the general public. But for most of us that was not necessarily the attraction of it. Now that the Internet and cellular phones have liberated amateur radio from having to be "useful," it is simple to see what distinguishes it from the former. Ham radio is an art form. We are into it because we like it for what it is. In the words of the "global village" guru Professor McLuhan, "The medium is the message." Long live ham radio!

Yep, Ron, we certainly have a great fraternity. Now all we have to do is convince the FCC and Congress that international conviviality is worth a few billion dollars worth of radio spectrum... Wayne.

Mike Miller WA8YKN. Just a quick update. I recently sent a Bioelectrifier to Dr. Val Hutchinson of Amarillo, Texas. Last night he called to say that while monitoring his body during using the device, that his temperature went up 1.5 degrees. This was repeatable. This might explain in part the results, since viruses and bacteria are easier to kill at an elevated body temperature.

I've been getting calls about successes with a variety of ills with the device, and no reports of failure so far... Wayne.

Ernie Stricklin, Cherry Grove AB. I just wanted you to know my results with the Bioelectrifier. I just used 2N2102 transistors in a multivibrator. Being silicon, they can stand up to 50V on the collector. I used 30V and took off from the collectors of the two transistors with electrodes made of two pennies with 68K resistors in series for pulsing my veins. It works perfectly and reduces the circuitry to just a multivibrator. If you use MOSFET circuitry the multivibrator can be two NAND gates in an IC. The results? Well, I don't have AIDS, but after less than two weeks I've gone from 183 pounds to 167, and I've never felt better in my life. It's a big relief to get rid of those extra pounds.

Curses, Foiled Again!

In the August issue I ran a letter from W4FA grumbling about

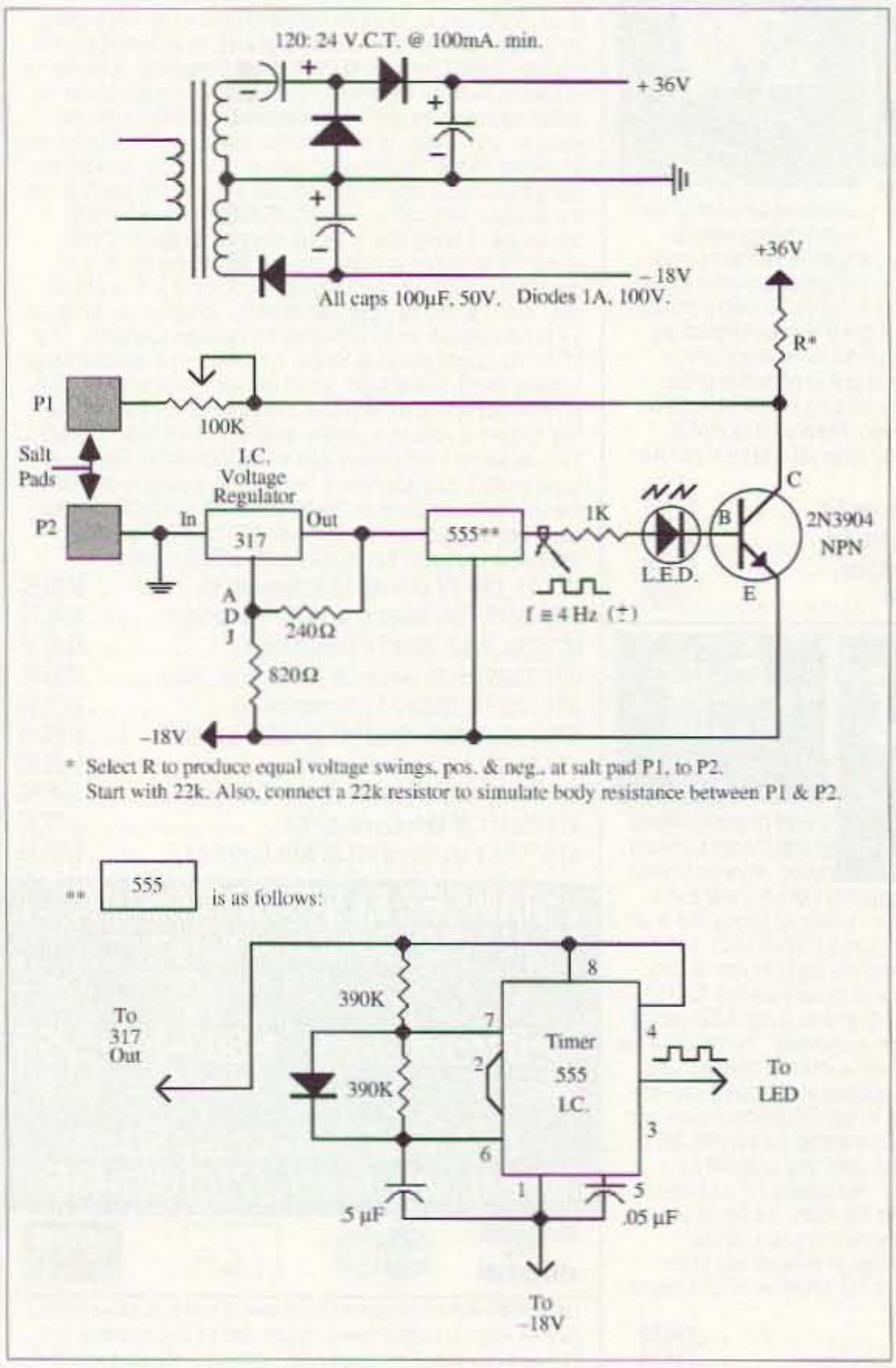


Fig. 1. George Bergstrom's purifier.

finding copper foil for making weenie antennas. Both W4FA and I should read the ads more closely, for there, on page 71, was an ad by Hamco, offering copper foil tape at reasonable prices. Call 303-795-9466 and ask Larry Feick. If you're too cheap to call, invest a lousy 32 cents in a letter to 3333 W Wagon Trail Drive, Englewood CO 80110.

Get yourself in gear and start peppering me with articles on the great antennas you've designed with this stuff. We're into good antenna weather, when there's lots of snow and ice to make antenna raising memorable. I know I'll never forget putting together a twin-three antenna in the yard of my fraternity house wallowing around in three foot of snow. Every time I put the soldering iron down it disappeared. But, hoo boy, did that antenna ever work out! I've put up some pretty big beams since then, but none have ever given me the reports I got with two of those wire antennas hung at 90° from each other from the fraternity house to trees on the edge of our yard. My ham station filled the basement.

Okay, you have your instructions. Design, buy foil from Larry, build, check it out, write, take some darned good pictures, and don't forget to send me a disk copy of the text... Wayne.

Phillip Holmes, Van Wert OH. Jim Gray gives more credit to HAARP than the project deserves. There seems to be some eagerness to attribute capabilities of Dr. Bernard Eastland's patents to this classified project. Unless HAARP is somehow manipulating the Earth's magnetic field to produce much higher energies than the system itself is broadcasting—well, the power is just not available to carry out the controversial aspects.

There is no doubt in my mind that a BLACK PROJECT EXISTS and has existed since at least the early 80s, that can do some very spectacular geophysical alteration for a variety of national security reasons. This black system is most likely space-based, operating in conjunction with the Space Shuttle fleet.

According to my local paper, dated 1991, atmospheric scientists from nine federal laboratories including Los Alamos and Philips Laboratory (the HAARP manager) created artificial Northern Lights and auroras in the Earth's magnetic field. A scientist called the displays "as bright as any phenomenon in the sky outside of the sun itself." This astounding airglow experiment would seem to require a much larger system than the proof-of-concept system that HAARP actually is! Without the attenuating effects of the atmosphere, a space-based system could be smaller, require much less power and be highly portable.

From my study, I believe Challenger, 41-C, in conjunction with Solar Max, carried out a classified deep-Earth tomography mission, utilizing the natural electrical forces of the Earth (the polar electrojet) on 9 April 1984, near the Kuril Islands off the northeast coast of Japan, over Soviet territory. The goal of the mission was to locate a secret underwater submarine pen housing the then new titanium-hulled Typhoon missile boat by using an ELF radio-wave technique. There was a spectacular geophysical anomaly that appears to be related to this mission—The Mystery Cloud of 1984. Hope you find this of interest.

Jeff Anglesey KB7TJM. Your magazine is most excellent, and I buy it instead of *CQ*—too boring. Your technical contributing editors are great. Each issue always has something I can use. How about doing an article on low budget satellite operating? I use an HTX-202 running 5 watts to a 5/8-wave mag mount for the uplink and an AOI AT-400 HT and homemade 6-element yagi for the AO-27 downlink.

You forgot to mention how much you enjoy my editorials... Wayne.

David Borba KC6UMX. Great magazine! I first heard Wayne on the Art Bell (W6OBB) radio show, bought one of his magazines and was hooked. It is educational finding grid squares from coordinates, and the *Radio Fun* section describing types of emissions, and also it is open forum—like W5UOJ's treatment of closed repeaters in the July issue—something I always agreed with, but never said anything about because I thought it was "status quo." I would rather see a magazine like this with articles on HAARP, Tesla, cold fusion and other diversions from radio than to read a magazine with pages and pages of contest news and name lists. Hang in there, Wayne, I want to read "Never Say Die" for many years to come.

Non illegitimi carborundum... Wayne.

Michelle "Missy" Hollenbeck AAØOF. Today, Joseph, one of my eighth grade students, just passed the Novice theory test and the 5 wpm code test. Joseph, his family, his classmates, and the area ham radio operators (including me, of course!) are proud of his accomplishments. Joseph has learned that patience, practice, and extraordinary work do bestow a sense of self-satisfaction.

I'm writing you, Wayne, to reassure you that my students are exposed to as much technology as possible. I know that you are truly concerned about today's youth involvement in amateur radio.

Many skeptics say that the Internet will replace amateur radio, but in my classroom, the Internet and amateur radio work hand-in-hand. All the great things that we do in amateur radio are "highlighted" on the

Continued to page 63

QRX . . .

New FCC RF Safety Rules

As of the beginning of 1997, hams are responsible for new exposure limits (see **Table 1**). Maximum Permissible Exposure (MPE) limits have been set for electric and magnetic field strength and power density for transmitters operating between 300 kHz and 100 GHz. This ends a long waiver of these limits for ham operators.

We must ensure that if our stations operate with more than 50 watts of output power the listed MPE limits are not exceeded.

TNX to *Hill Country ARC Newsletter*, December 1996.

FEMA Backs Hams On Spectrum Sharing

The Federal Emergency Management Agency, better known as FEMA, is saying no to sharing or reallocating the 2m and 70cm ham bands to Low Earth Orbiting satellites. In a letter to the FCC task force currently evaluating new spectrum for use by LEO satellites, FEMA Manager Paul Reed tells the committee that his agency opposes any such change.

Reed says that Amateur Radio operators have a history of supporting state and local government emergency operations by providing needed communications. He says that many local communities served by ham radio have extremely limited resources and would be without any form of backup communications without Amateur Radio.

Reed says that FEMA has been in contact with its state and local emergency management partners across the nation. It is their belief that authorizing access to the mobile satellite service in the 2m and 70cm bands will seriously degrade the ability of these groups to support their public service requirements.

The FEMA Manager ends his letter by strongly urging the FCC task force to remove both of these ham bands from any further consideration as a new home for Low Earth Orbiting Satellites. He says to leave them for use by ham radio and its emergency service partners nationwide.

From *The Tuned Circuit*, monthly bulletin of L'Anse Creuse ARC, Utica MI, January 1997.

Limits for Occupational/Controlled Exposure (Environments where people are aware of the potential for exposure and can exercise control over their exposure)				
Frequency Range (MHz)	**Electric Field (V/m)**	**Magnetic Field (A/m)**	**Power mW/cm2**	**Averaging Time (min)**
0.3 - 3.0	614	1.63	(100)*	6
3.0 - 30	1842/f	4.89/f	(900/f)*	6
30 - 300	61.4	0.163	1.0	6
300 - 1,500			f/300	6
1,500 -100,000			5	6
Limits for the General Population/Uncontrolled Exposure (Environments where the general public may be exposed)				
0.3 - 1.34	614	1.63	(100)*	30
1.34 - 30	824/f	2.19/f	(180/f)*	30
30 - 300	27.5	0.073	0.2	30
300 - 1,500			f/1,500	30
1,500 - 100,000			1.0	30
f = Frequency in MHz * = Plane-wave equivalent power density				

Table 1.

Iran May Issue Ham Tickets

Iranian hams may soon be heard on the air. The British Broadcasting Company's monitoring service reported in November that the Iranian Ministry of Post, Telephone and Telegraph soon will issue Amateur Radio licenses to Iranian citizens. The BBC quoted the Teheran-based English-language newspaper *The Iran Times*. According to the report, the Iranian Ministry has invited radio enthusiasts over the age of 16 to sign up for special Amateur Radio license training.

From December's *The Garden City Wireless*, newsletter of Garden City ARC, Garden City MI, who got it from *Amateur Radio Newsline*.

(*Will women be licensed as hams in Iran, too?* —Ed.)

Does Your Bread Land Jelly-Side Down?

- Mobile antennas fail in the first 100 miles of a 1,000 mile trip.
- Manuals mysteriously disappear just before you want to sell a radio.
- Sellers always have whatever you want back at the shop.
- Rotors fail on contest day at 2 AM.
- As a seller, you never arrive early enough at the hamfest for a cool shady spot.
- You never have the correct value replacement fuse.
- Battery chargers are always left at home.
- CW is never slow enough to copy at Field Day.
- No two Atlas 210s work the same.
- You always find that other lost gizmo while you're looking for the first lost gizmo.
- The accessories for your old HT or mobile are never compatible with your new HT or mobile.
- Elements of antennas that need to be adjusted are always just beyond your reach from the top of the tower.
- Women and children grasp CW faster than the OM.
- The polarity of the radio's power cord connector of the unit you want to demo is always wired opposite to the one you have with you.

Borrowed from October 1996's *Squelch Tale*, newsletter of the Chicago FM Club, who lifted it from WCRA's *Stray RF*.

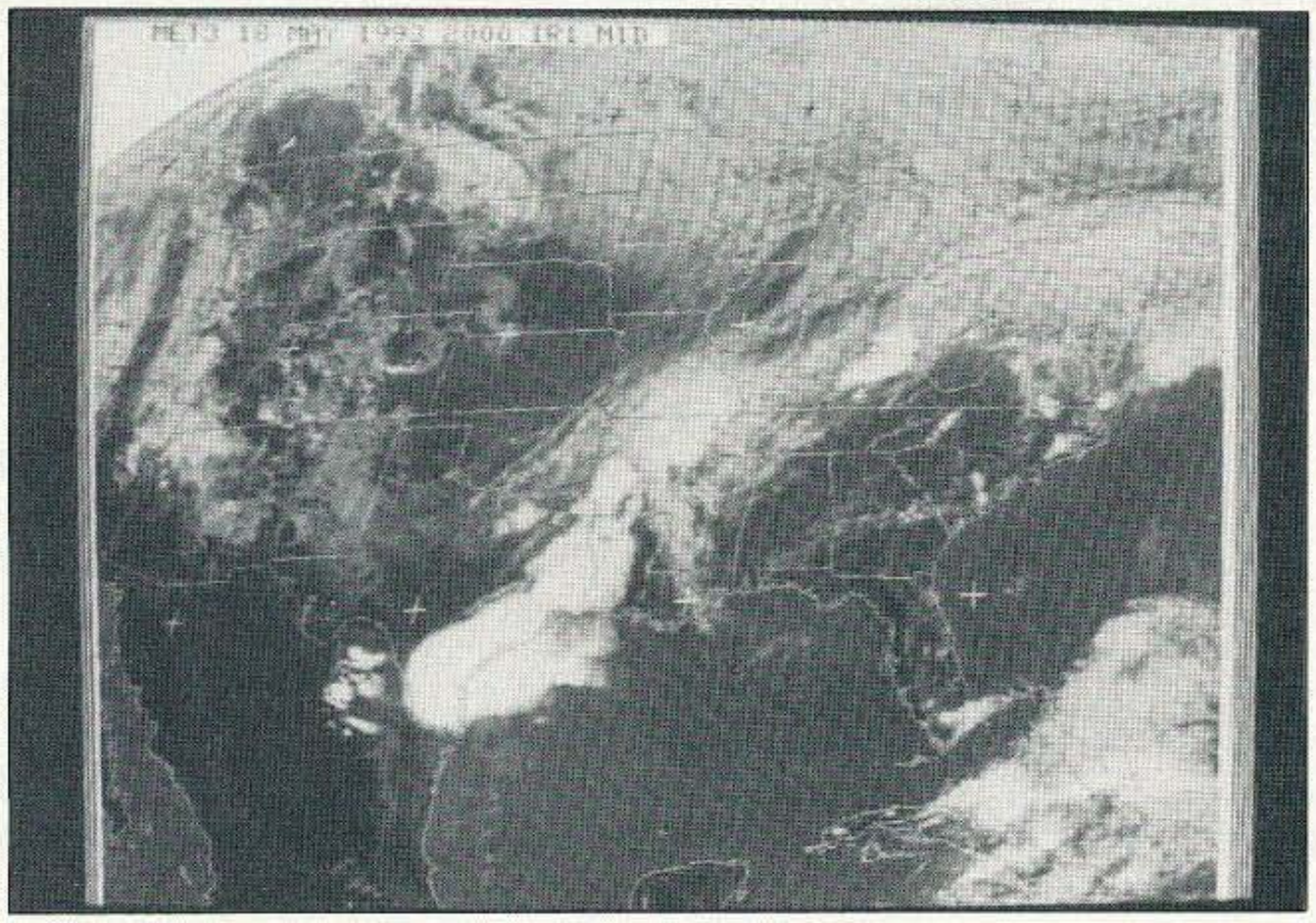
New FCC Web Searcher

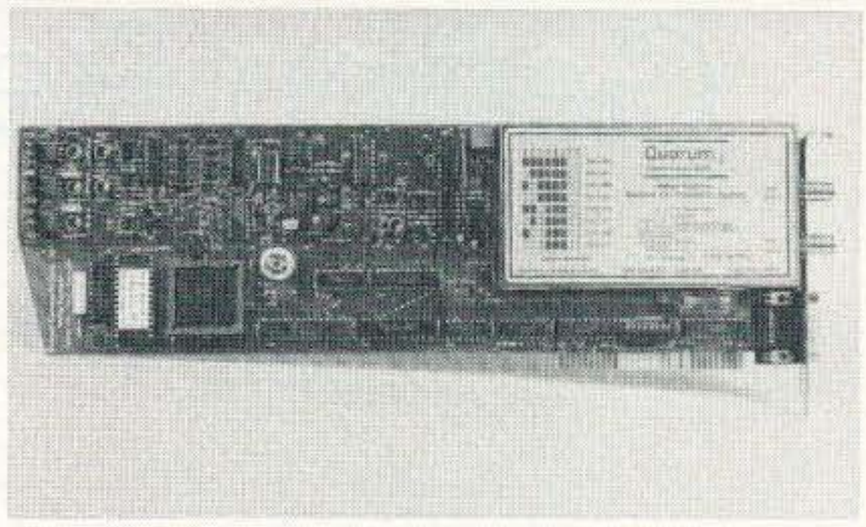
The FCC has installed a new search engine for use on its World Wide Web site at http://www.fcc.gov. It supports both concept and keyword searches to help Web users find FCC documents quickly and easily. The search utility also supports Boolean operators (and, not, or, etc.). Details on how to use the new search tool are located on the search page, http://www.fcc.gov/search.—[de] FCC.

Taken from November 1996's *Squelch Tale*, newsletter of the Chicago FM Club.

Continued on page 81

Explore The World of Quorum Wefax





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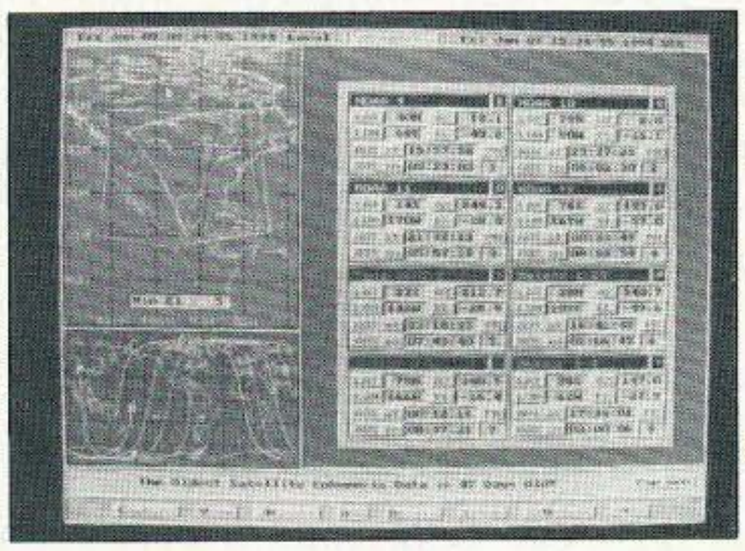

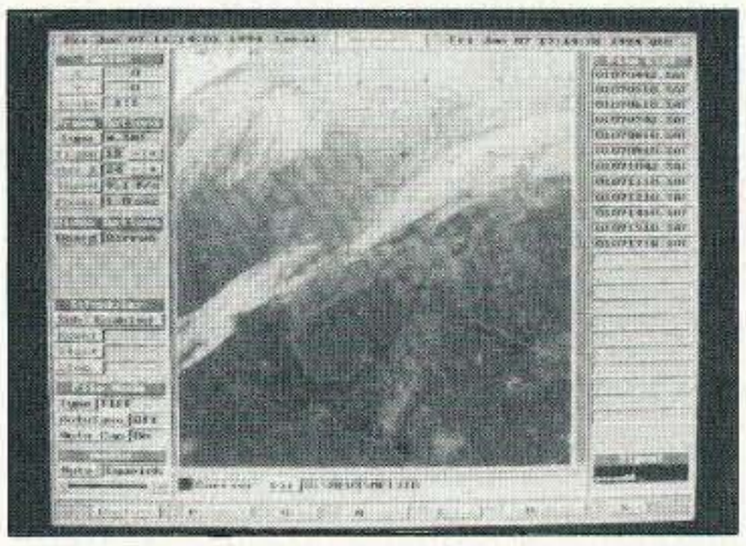

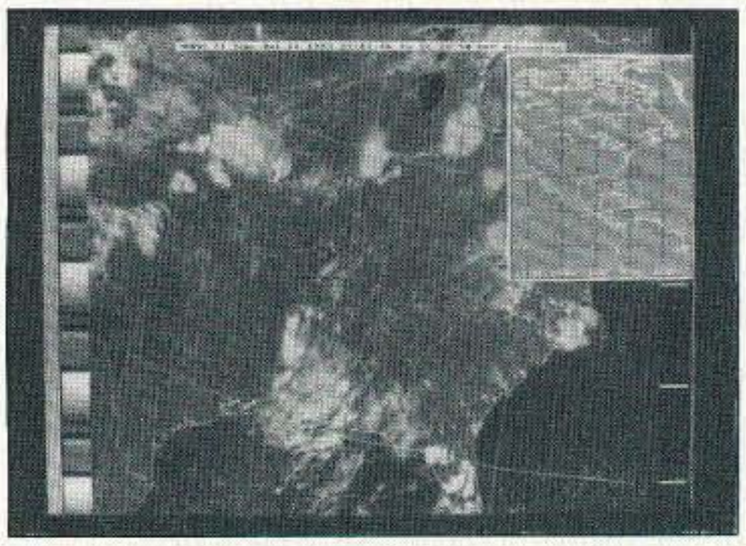

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Getting Ready for Phase 3D

Start now to be prepared for amateur radio's next great adventure.

Andy MacAllister WA5ZIB
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Houston TX 77083

Phase 3D is the largest, most complex international hamsat project to date. This amateur radio satellite is currently under construction and in final test at the AMSAT lab in Orlando, Florida. It is scheduled for launch from French Guiana in July on board the Ariane 502 booster. This will be the second flight of an Ariane 5 rocket, hence the "502" designation.

The first flight of an Ariane 5, on June 4, 1996, failed. Only 37 seconds after ignition, at an altitude of 12,000 feet, the launcher veered off its flight path, broke up and exploded. This has caused significant delays for the flight of Ariane 502. An inquiry board investigated the failure, furnished an analysis and provided recommendations for subsequent operations.

The Ariane 501 flight exhibited nominal behavior up until 36 seconds after initiation of the flight sequence. At that point there was a simultaneous failure of the two inertial reference systems, which caused the nozzles of the two solid-rocket boosters, and then the main liquid-fueled engine, to swivel into an extreme position. This made the rocket veer abruptly and triggered an automatic self-destruction sequence due to the rupturing of the electrical links between the solid boosters and the vehicle core.

The post-flight analysis report from the independent inquiry board concluded with, "The failure of Ariane 501 was caused by the complete loss of guidance and attitude information 37 seconds after start of the main engine ignition sequence (30 seconds after lift-off). This loss of information was due to specification and design errors in the software of the inertial reference system. The extensive reviews and tests carried out during the Ariane 5 development program did not include adequate analysis and testing of the inertial reference system or of the complete flight control system, which could have detected the potential failure."

Spaceflight is risky business. AMSAT's Phase 3A spacecraft was lost on the second flight of an Ariane 1 booster 17 years ago. When the Ariane 501 booster failed last year, it was a major setback to the European space program. The loss was estimated at nearly a half billion dollars. The Ariane 5 program is pivotal to the planned manned-space activities from Europe. The success or failure of the Ariane 502 launch will determine whether Europe moves forward with their ambitious goals, or regroups. The launch campaign will begin on Wednesday, April 9th. Efforts to ensure that all goes well are at an all-time high.

"Spaceflight is risky business."

Then and now

The Amateur Satellite Program has come a long way since the launch of OSCAR-1 on December 12, 1961. OSCAR stands for Orbiting Satellite Carrying Amateur Radio. OSCAR-1 was built by Project OSCAR, a West Coast group. The launch took place only four years after that of Sputnik-1 from the Soviet Union. OSCAR-1, weighing in at 10 pounds and costing about $64, carried a 140 milliwatt CW beacon transmitting "HI" on 145 MHz. The transmissions lasted 22 days till the satellite re-entered the atmosphere from its very low Earth orbit.

Since then there have been many amateur satellites: some simple, and others supporting many complex experiments and transponders. We have had satellites with CW telemetry beacons, several with analog transponders like repeaters in the sky, and others with complex, digital store-and-forward flying BBSs, or radio bulletin-board systems.

Work on the Phase 3 series of hamsats began in 1975. While Phase 1 satellites were designed for low orbit and short life, and Phase 2 types were low orbit and long life, Phase 3 was initiated to provide high elliptical orbits, long life and reliable communication. AMSAT-OSCAR-10 (Phase 3B) was the first Phase 3 satellite to achieve orbit. It was launched in 1983. Although the batteries have quit, the satellite still works when the solar panels are properly illuminated. AMSAT-OSCAR-13 was sent to orbit in 1988. Due to the gravitational effects of the moon and sun, it re-entered the atmosphere in December 1996.

When Phase 3D achieves orbit it will be given an OSCAR number. It is much larger, heavier, more complex and more expensive than its predecessors. The main body is nearly seven feet in diameter and three and a half feet tall. With solar panels extended, the wingspan is over 20 feet. The satellite weighs in at around 500 pounds with an estimated program cost of 4.5 million dollars.

Support for this immense program comes from AMSAT groups around the world. No one ham organization has the resources to plan, build and get a ride to orbit for a satellite of this magnitude. Funding for Phase 3D is

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The custom inductor switch is built to withstand extremely high RF voltages and currents.

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Lighted Cross-Needle Meter reads SWR/forward /reflected/*peak*/average power in 2 ranges. Current balun reduces feedline radiation and forces equal currents into unbalanced antennas.

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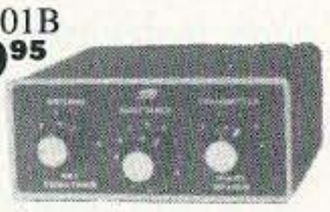
MFJ-903 **$49.95**

MFJ-906 **$79.95**

MFJ's smallest Versa Tuner



MFJ-901B **$69.95**

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MFJ-16010 **$39.95**

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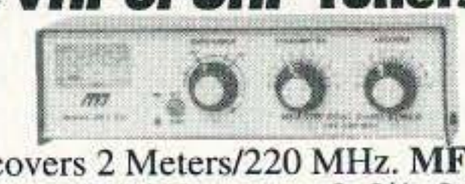

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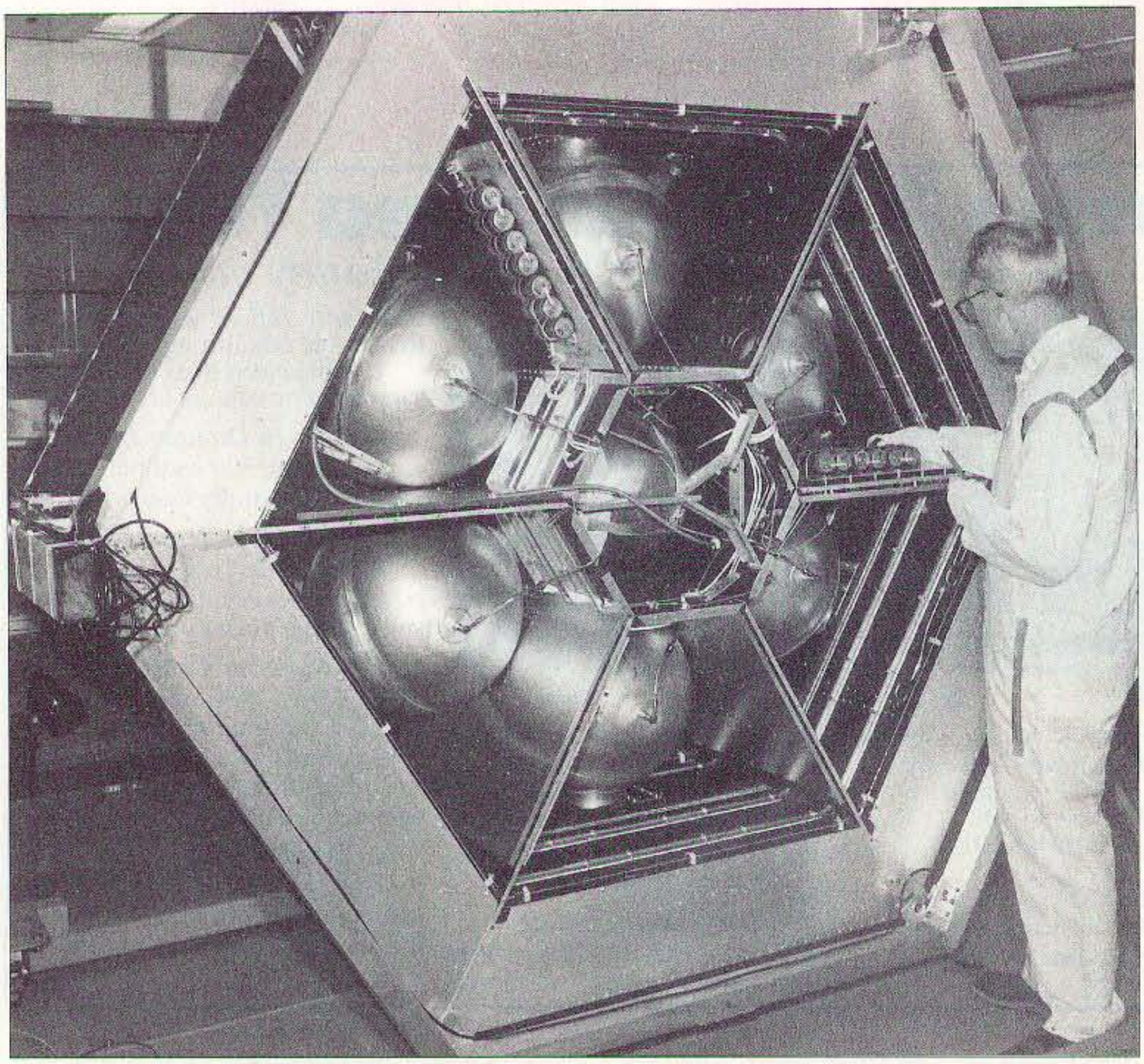

Photo A. *Dick WD4FAB adjusts the mockup battery pack on the -Z axis of Phase 3D.*

derived from membership dues, individual and corporate donations. The American Radio Relay League has been instrumental in financial support of the 1.5 million dollars (cash, labor and components) pledged by the North American AMSAT.

What is AMSAT?

AMSAT is a worldwide assembly of amateur-radio operators who share an active interest in building, launching and then communicating via non-commercial, amateur radio satellites. The collective groups of AMSAT organizations and companies around the world have been responsible for the design, construction and coordination of over two dozen amateur radio communications satellites in the last 28 years.

The original AMSAT (Radio Amateur Satellite Corporation) was founded in 1969 in the District of Columbia as a non-profit, educational organization dedicated to fostering amateur radio's participation in space research and communication. The first project for the new corporation was getting a launch for Australis-OSCAR-5 in 1970. This was to be the last Phase-1-type satellite, i.e., low-Earth-orbit and short life. Today AMSAT still exists as a non-profit organization with the same objectives and goals—the satellite design, construction and control continues.

"Phase 3D uses a unique 3-axis platform stabilization system in conjunction with two hexagonal rings of computer-controlled magnetorqueing rods."

Our North American AMSAT provides a vast array of services to support those interested in learning about amateur radio satellites. To help track each satellite, the AMSAT Software Exchange makes tracking software available for most popular personal computers. AMSAT also runs its own QSL bureau and awards program for satellite users.

The AMSAT Field Organization is ready to help those looking for information on a more personal level. With over 150 Area Coordinators, there are some in most localities willing to answer questions about the satellites, arrange for demonstrations or provide talks for local clubs and ham conventions.

AMSAT sponsors regular HF nets with the latest news on satellite activity and Phase 3D progress. One of the most popular nets is held every Sunday at 1900 UTC on 14.282 MHz USB. In addition there are many VHF nets around the country with similar information coverage and supplementary local items of interest. One local net, The Houston AMSAT Net, can be heard across most of North America at 8 p.m. Central time via SBS-6, Transponder 13B, 6.8 MHz audio subcarrier. It is also carried by various VHF and UHF repeaters in addition to a 160-meter retransmission every Saturday night at 9 p.m. Central time on 1860 kHz AM from WAØRCR in Missouri. For those who cannot get the satellite feed or the other local sources, there's the Internet. The Houston net is recorded for off-line listening via Real-Audio. The easiest way to get this service is to go to the URL (Universal Resource Locator) http://www.amsat.org. Find the link to "other sites," and check out "The Houston AMSAT Net."

Lots of current AMSAT information is available at www.amsat.org. There is also an FTP site at ftp.amsat.org, and up-to-date discussions about Phase 3D and other topics can be checked out by subscribing to AMSAT-bb@amsat.org. Just send a message to listserv@amsat.org to subscribe. This is not an automatic system. Paul KB5MU handles all subscribe and unsubscribe requests by hand. More information about AMSAT, telephone BBSs and nets can also be obtained for a self-addressed, stamped envelope to AMSAT, 850 Sligo Ave., #600, Silver Spring MD 20910.

Phase 3D overview

Phase 3D is designed as a replacement for A-O-10 and A-O-13, with

some significant extras. Key points include the orbit, the transponder scheme, the spacecraft orientation system and some exciting experiments.

The final orbit for Phase 3D is to be elliptical with a perigee, or low point, of 2,400 miles, and an apogee, or high point, of 29,000 miles. The apogee will always occur over the northern hemisphere. There are several steps required to reach the final orbit. After launch, Phase 3D will be in a geosynchronous transfer orbit with a very low perigee just over 100 miles and an inclination with respect to the equator of about 10 degrees. The main 400 Newton motor on Phase 3D will be used to bring the perigee up to 2,400 miles. Another firing will raise the apogee to 29,000 miles. A final firing of the main engine will be used to raise the inclination to 60 degrees. Over a period of two years the ammonia arc-jet motor ATOS(*Arcjet-Trìebwerk auf OSCAR-Satellit*) will be used to adjust the final inclination to 63.4 degrees. This small motor (100 millinewtons) will also be used for minor orbital changes. The final orbit allows the ground track and rise and set times of the satellite to repeat every 48 hours.

Of the many facets of Phase 3D, Integration Manager Lou McFadin W5DID finds the transponder matrix to be one of the most exciting. Unlike previous satellites, Phase 3D has an array of radios from 21 MHz up through 24 GHz. The satellite receivers are on 21, 145, 435, 1268, 1269, 2400, 2446 and 5668 MHz. The transmitters start on 29 MHz and continue with 145, 435, 2400, 10451 and 24048 MHz. Transmitters and receivers are paired via ground control, with one exception—a transmitter cannot be paired with a receiver on the same band. The opportunities for some very interesting combinations abound and are augmented by the satellite's ability to run multiple combinations simultaneously or to match one receiver with multiple transmitters, or multiple receivers with one transmitter.

The transmitters and receivers on Phase 3D are connected to gain antennas that will greatly enhance

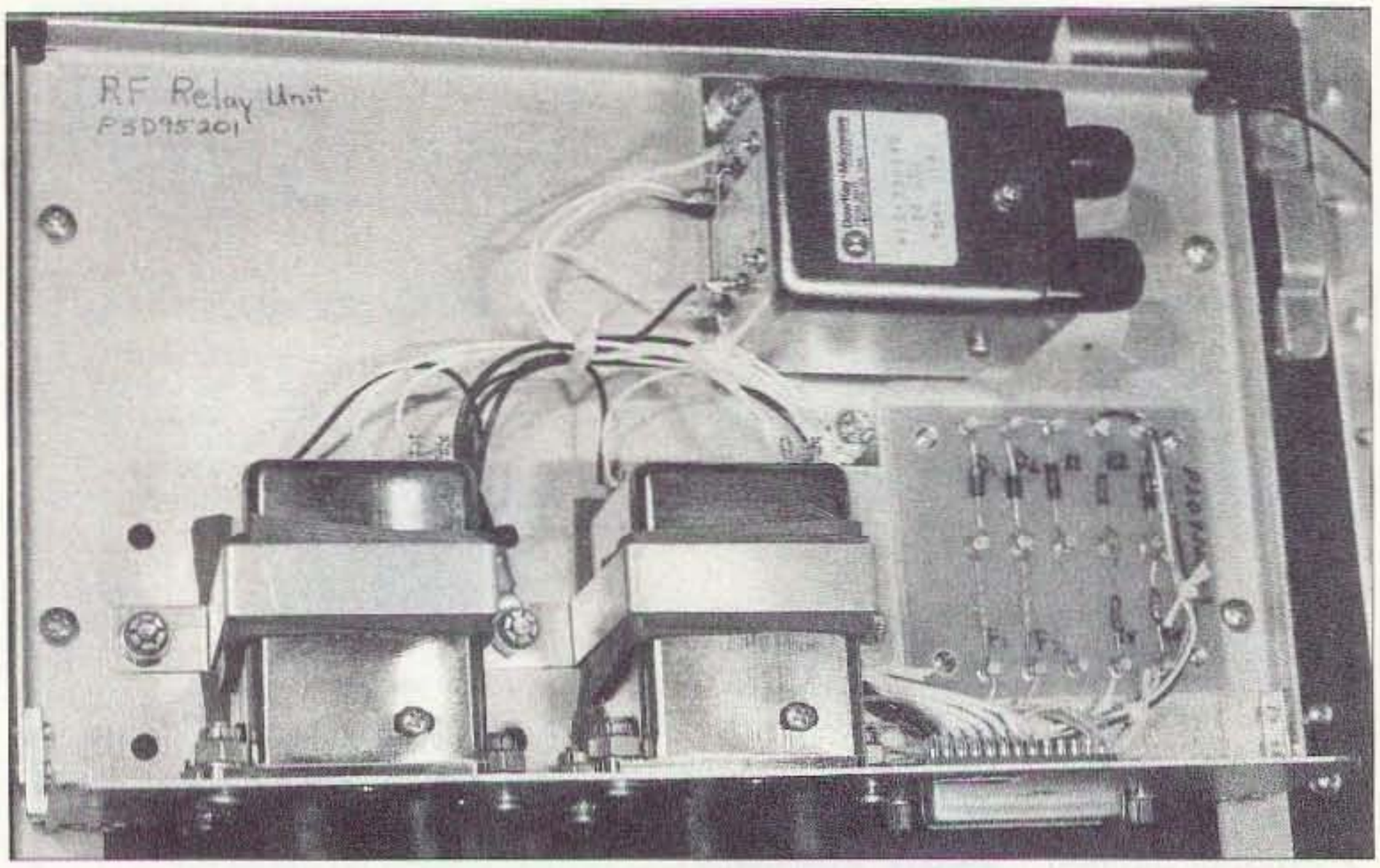

Photo B. *RF relay assembly mounted in side 3 of the Phase 3D spacecraft. All photos courtesy of AMSAT.*

communications for those on the ground. Most onboard systems provide at least a 10 dB improvement over the previous Phase 3 satellites. This means that omniantennas will work in place of beams in many cases. On some bands the improvements will be dramatic. One of the two 10 GHz transmitters runs 40 watts to a horn antenna. A surplus DSS TV dish with appropriate hardware may be able to pick up these signals. Small "stealth" Earth stations will be a distinct possibility.

Phase 3D uses a unique 3-axis platform stabilization system in conjunction with two hexagonal rings of computer-controlled magnetorqueing rods to control both the spacecraft's attitude and spin rate. Phase 3D will not be spin-stabilized after the solar panels are deployed. Three magnetically suspended reaction wheels mounted at 90 degrees to each other are used to keep the craft properly oriented. Commercial TV satellites depend on precise and expensive bearings for their reaction wheels; Phase 3D uses a combination of rare-earth magnets and electromagnets to suspend and spin up the wheels. Each wheel is expected to consume about five watts of power for a total consumption of 15 watts.

A few of the experiments on Phase 3D include the Japanese SCOPE (Spacecraft Camera experiment for Observation of Planets and the Earth) and an array of GPS (Global Positioning System) receivers. SCOPE includes two high-resolution image sensors to provide a wide-angle and zoom view to take pictures of the Earth. The GPS experiment has changed in the last year due to difficulties with implementation of the AMSAT GPS receivers. The current system includes a pair of Trimble TANS Vector units. Each has four antennas and consumes about 7 watts of power.

Numerous papers have been written with in-depth descriptions about the features of Phase 3D. A good recent one, "Phase 3D Update," by the Phase 3D design team, compiled by Dick Daniels W4PUJ, appeared in the *Proceedings of the AMSAT-NA 14th Space Symposium and AMSAT General Meeting*. This publication, dated November 1996, contains many articles on current hamsat topics and is available from the American Radio Relay League or AMSAT for $12.00.

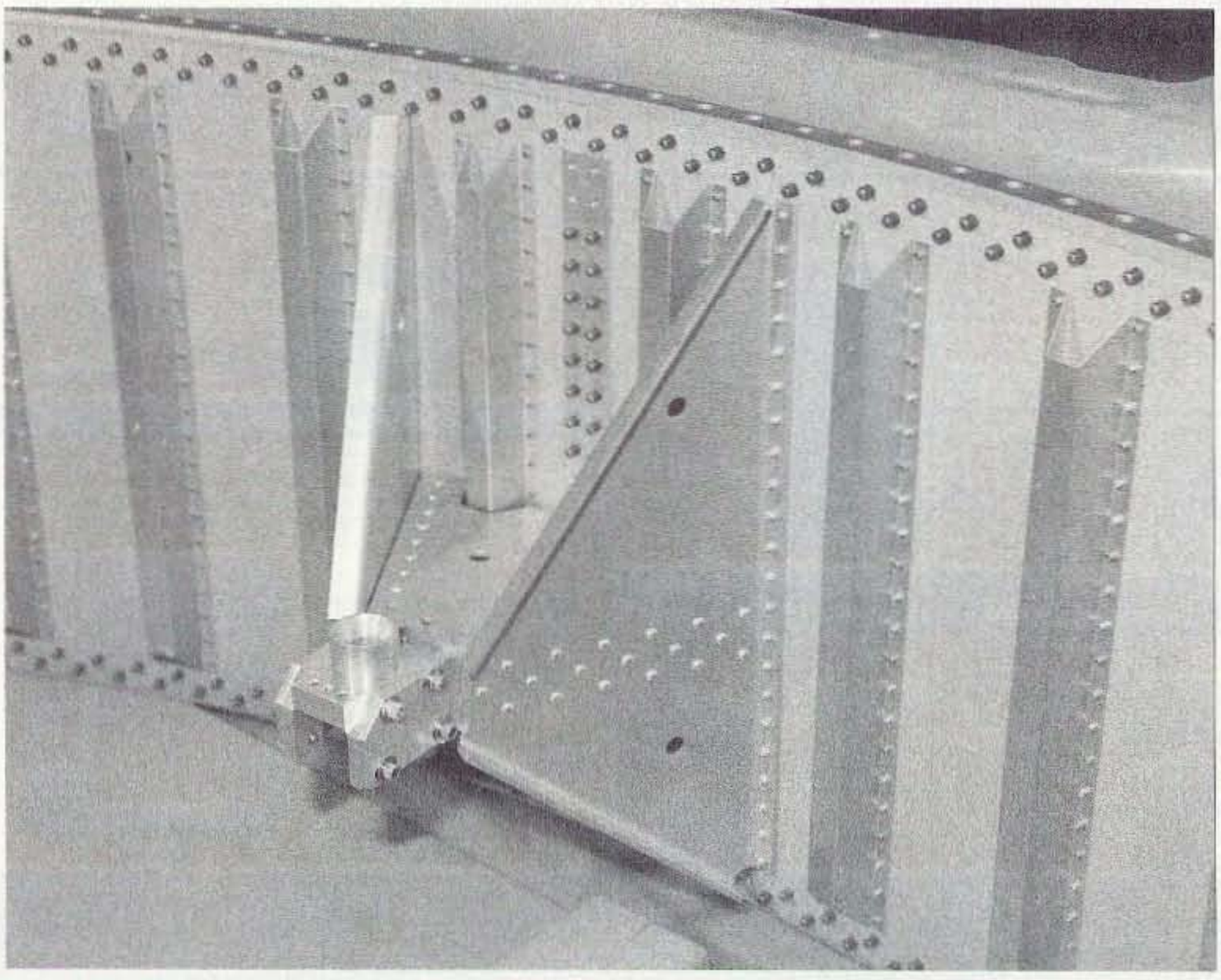

Photo C. *Close-up view of one of the four spacecraft mounts inside the SBS ring.*

Phase 3D project status

Late last year, efforts were underway to complete all aspects of the satellite, test it, and ship it by the end of February 1997. With the recent launch delay (from April to July), more time is available to finish integration and get everything ready. A few of the December activities included work on the gas generator controller and the command arbitrator module. The SEU (Sensor Electronic Unit) had been received and work was underway to adjust antenna locations for the new Trimble GPS units. Several receivers and transmitters were scheduled to be at the lab

soon and some circuit boards for control units were nearly finished. The SBS (Specific Bearing Structure) is complete and has been approved for use on the launch. Phase 3D is to be placed inside this cylindrical structure. A conical adapter will then be bolted on top of the SBS. This will allow another satellite or test system to be mounted above Phase 3D in the payload stack.

The few remaining months before launch promise to be exciting but hectic. In order to properly test the GPS system, the satellite must be able to "see" the GPS satellites. That means that Phase 3D must be taken out of the clean room, or the clean room must be moved outside, or the antennas must be remotely located during tests. The same situation exists for a full test of the complete communications transmitter/receiver and antenna system. There are still issues to be resolved, but with dozens of successful satellites on the roll, the collective worldwide AMSAT will invent methods to handle the situation.

Getting ready for Phase 3D

Time is running out, so get your station ready for Phase 3D. After launch there will be a month or two of study and control efforts before the communications channels are opened for use. This will be a good time to monitor telemetry from the satellite. The 70 cm beacons on 435.450 and 435.850 MHz will be most likely to be used by ground controllers for satellite monitoring. After release, some restrictions will be placed on operation during periods when the ammonia arcjet motor is on, due to its high power consumption and RF noise generation.

Note: If you are not familiar with hamsat communications, you may want to start with the easier satellites, like RS-10, RS-12 and A-O-27.Then progress to the high-orbit world of A-O-10. Check out the entry-level articles presented in the "Hamsats" column during 1996. 73

DXing 10m FM From Perth

The sunspots are rising, so 10m will be coming back.

Graham Rogers VK6RO
22 Grace Street
Ferndale, Western Australia 6148

At the Perth International Airport, Western Australia, sitting in the waiting room of the international arrivals section opposite the customs exit door in April 1993 was an exciting time for me as I was about to welcome Bill G4TQV and his XYL Jean to Australia. Bill and Jean had flown 12,000 miles to visit and this meeting was the culmination of our many contacts on 10m FM since 1988. If it had not been for my keen interest in FM HF DX I would never had met young Bill.

I have had a great time working many UK stations over the years, many of them mobile, using just a few watts from modified UK CB FM rigs. Back in the early 1980s I would hear all these wobbly signals just above 29 MHz on my SSB-CW rig. I was intrigued as to what was going on; then I discovered they were JAs making local contacts.

Not many rigs in those days were fitted with FM on HF. In 1982 I invested in a Kenwood TS660, plugged it into my 2-element 10m quad and called CQ DX on 29.600 MHz. To my great surprise JE6QJV came back to me and we exchanged 5 x 9 reports. I was hooked!

We all know FM is used on 2 meters for local work and here I was talking to Japan on FM. The technical aspects of FM on HF make for rather interesting propagation and signal reception. Phase distortion or the capture effect can make signals hard to copy and stronger signals can completely swamp weaker signals.

I have used as little as one watt and had nice contacts with friends in the UK. An output power of 50 watts seems sufficient for working most DX. On this band the power doesn't seem to make a lot of difference. I've worked many mobile stations around the world who were running 10 watts or so to a modified CB rig.

Lengthy rag chews are not uncommon over great distances. I even worked Bill G4TQV/M through several countries over a 2-hour period as he drove across Europe, with his callsign changing as he crossed borders. Bill surprised me by becoming GM4TQV/M as he entered Scotland on several occasions. Other regulars were Bill GØRUB and Jan PA3FAO. Then there was Roomy VU3RMS, who often surprised me with a booming signal when I thought the band was dead.

There's no shortage of DX. I worked 1SØXV in the Spratley Islands for my 100th country. Some of the rarer stuff I've worked has been A2, A9, BV, BY, CN, CU, EA6, EA9, FT8X, FT8Z, H44, HZ, J2, KX6, SV5. TA, TL8, VQ9, XX9, T30, S21, 5X, Z21, V51, 3B8, 3B9, 3D6, C21, 4S, 5H, 5W, 7Q, 7X, 8Q, 9J, 9M2, 9M8, KH8, 9Q5, 9V, etc. I'm now at 132 worked on 29 FM.

The international calling channel is 29.6, but don't use it for rag chewing, just calling. Hey, don't forget to listen for me on 29.6, or talking away on 29.51.

Repeaters

There are a number of 10m FM repeaters around the world—DU, W, JA, VK. They mostly use 29.6 input and usually output on 29.7. Some use 88.5 Hz or a 1250 Hz tone burst (Ed. note: the Boston repeater inputs on 29.62 and outputs on 29.52). Some repeaters are linked to 2m, so you can find yourself talking with someone using a 2m HT. 73

NEVER SAY DIE

Continued from page 4

are about to spread anthrax all around America, killing millions of people. Aliens will be here in a 100-mile-long spaceship on December 17th. You name it, I get 'em. But, being pragmatic, I sat down and read René's book. He presented one scientific fact after another, undermining my faith in NASA's credibility. It sure seemed like he had made an airtight case for the Apollo missions to all have been a giant hoax.

My next step was to write an editorial about it so others could read René's book. I wanted to see if they could find holes in René's scientific logic. Now, with several hundred *73* readers having read the book, I don't think I've had anyone seriously challenge René's data. Could it be that it's the believers in the moon hoax who are the ignoramuses?

And, as I've reported, I've had letters from several readers who have been involved with either NASA or a NASA supplier, and who also have had their own serious doubts about the moon landings. One chap who helped build the LEM unit said that no one at his company that he knew believed for a minute that the flimsy module they'd made could have possibly made the trip. I got similar letters from hams who'd worked for other suppliers.

I heard about another earlier book which was similar to René's, *We Never Went to the Moon*, by Bill Kaysing. This, too, is self-published, since the publishers he approached with the manuscript were afraid to touch it. Who needs the CIA, DIA, FBI, IRS, NSA, and so on down the alphabet on your case? Plus there are too many dead whistleblowers when people start to reveal government secrets.

It took me a while to track Bill down and get a copy of his book. It's 8-1/2" x 11" and runs 200 pages. And while Bill makes a few of the same points René does, he mostly has his own set of reasons for doubting the reality of the moon missions. He does a good job of explaining how the whole deal was pulled off, and the secret base in Nevada where the filming was done. He also points out the incredible series of accidents that killed so many astronauts just before the Apollo missions—something that didn't happen before and hasn't happened since. Were they reluctant to go along with the charade?

Then there is the strange death of Tom Baron and his wife. Not long after Tom blew the whistle on the Grissom "accident" his car "stalled" on a railroad crossing and they were killed. Even though the state law requires autopsies in all accidental death cases, his and his wife's bodies were hurriedly cremated. When's the last time your car stalled? And imagine this managing to happen on a railroad crossing just as a train is coming. What are the odds? And what happened to Baron's 500-page report which has now totally disappeared? For that matter, how come NASA's Apollo records, while not classified,

Continued on page 38

The Whole World— In the Palm of Your Hand!

And you thought 007 had some neat stuff.

Dave Miller NZ9E
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dmiller14@juno.com

The government's acronym GPS is for their NAVSTAR GLOBAL POSITIONING SYSTEM constellation of satellites—21 navigational satellites, along with 3 spares, slowly circling the Earth, twice in a 24-hour period. With a hand-held GPS receiver, about the size of a current dual-band amateur HT (and costing roughly the same), you can determine exactly where you are, anywhere in the world.

GPS is fun!

Ham radio operators have always been curious by nature. That's pretty much how the hobby started; curious private citizens picking up the necessary parts and pieces, assembling working transmitting/receiving stations just for the fun of becoming involved in an emerging technology (and that was before anyone knew what "emerging technology" meant!). If you've ever regretted the lack of really new fun things for the ham experimenter to tinker with, take a closer look at GPS and APRS, the Global Positioning System and Amateur/automatic Packet Reporting System. APRS is an already growing branch of GPS that has some fascinating ham radio applications. I'll bet you knew that somehow we hams would be involved; we can't let a curious new technology get away! (For a detailed article on APRS, take a look at the excellent piece written by Bob Bruninga WB4APR in *73 Amateur Radio Today*, December 1996.) I'll try to introduce you, if you haven't already looked into APRS and GPS, but my approach will be a little different. Instead of just briefly mentioning what features are available on a current GPS receiver, I'll try to describe what it's actually like to operate one. Too many articles use terms and descriptions that can only be understood by the actual owners of the equipment being described—but that doesn't help the folks being exposed to the idea and the equipment for the first time.

Why do I need it?

If we hams need to ask, then perhaps we've lost some of that inherent ham curiosity. As a good friend of mine, K9KPM, always says, I suppose I don't really "need" very much of any of the electronic gear that I have, but if I enjoy having it, that's reason enough! Ken's right—what do we really need? Ham radio, and its many-faceted side interests, are interesting in and of themselves; they don't have to be justified. They're usually educational, recreational, sometimes even inspirational, but most often, they're just fun things to do. When it comes to new toys, most of us are just little boys in bigger jeans! For those who don't understand that kind of need, there are lots of other ways for them to fill their time ... anyone for stamp collecting? So if you can assume that mindset while reading this piece, not one centered on absolute need, but rather on learning a new science and perhaps applying it to amateur radio, then you'll understand. This concludes the lecture!

By the way, I can remember Uncle Wayne writing in his editorials about the fun that he had a number of years ago participating in sports car road rallies. Too bad GPS wasn't around back then—I'll bet he wouldn't have asked about a need!

The government's satellite system

The U.S. Department of Defense does have a definite need for accurate navigational positioning information; U.S. troops in all corners of the world must know exactly where they are for strategic and logistical reasons. Army troops, Navy ships, Air Force planes and Marine battalions in the field have a need to know exactly where they are at any given moment in time, so our government committed to a new, highly accurate system for navigation that they termed GPS. Unlike the older ground-based systems of Loran C and Omega, or the peripatetic early Sat-Nav navigational satellites, the NAVSTAR GPS constellation is available 24 hours a day, worldwide, and isn't affected by static, stormy weather or outside radio interference. In all honesty, there can be the occasional ionospheric anomaly that will absorb, scatter or duct even a microwave band signal, but as we hams know, these anomalies are rare. NAVSTAR GPS does operate in the microwave region at 1.575 GHz, using spread-spectrum formatting (see Peter Stark K2OAW's treatment of spread spectrum in *73 Amateur Radio Today*, December 1996). The NAVSTAR satellites are in polar orbits about 10,900 miles up, so very few ground-based interference sources bother it.

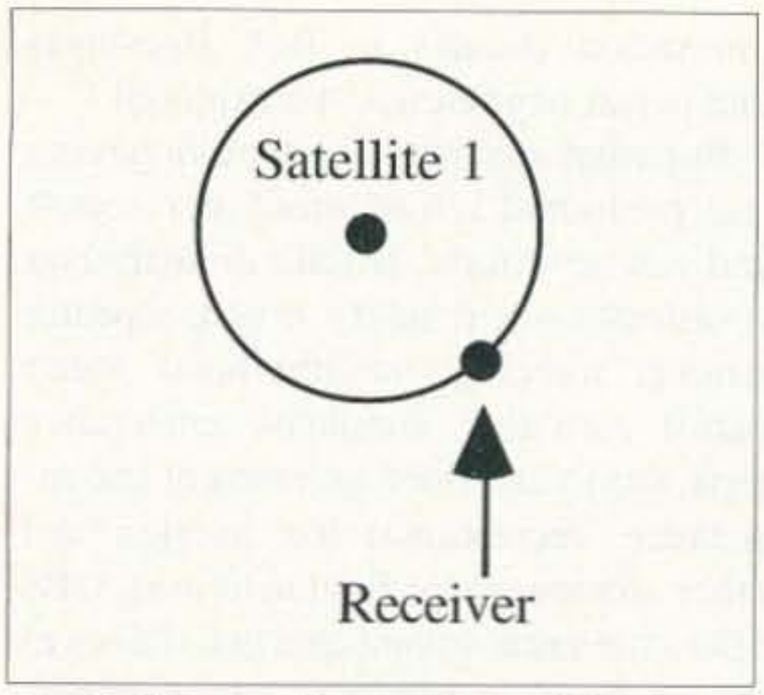

Fig. 1. The signal from one satellite doesn't tell you much—maybe just how far away it is from your position.

The constellation presently consists of 24 satellites and five ground stations at different venues around the globe. Of those 24 NAVSTARS, 21 satellites are kept active; the remaining three are orbiting spares. If one or more of the active satellites becomes "unhealthy," a spare can be moved in to take its place so that the full constellation remains operational. The ground stations monitor the accuracy of the system, and perform adjustments as needed. The government seems fully committed to maintaining the system, which began deployment in 1984 and has been estimated to cost somewhere in the neighborhood of $10 billion; the yearly maintenance alone is some $500 million or more. At those figures, it almost seems unpatriotic not to fully utilize it!

The GPS concept is workable from orbiting satellites because it's possible to receive exact positional data when a ground receiver can lock onto several satellites at the same time; when those satellites are located at different points in the sky; and when the receiver can triangulate a positional fix by receiving accurate geographical and time data from those satellites.

Let's break down those "whens" a little further. When the receiver knows how far away each satellite is, where it is, and what the exact time is, an imaginary circle can be drawn around each satellite being tracked. The receiver is located where those imaginary circles intersect.

Fig. 1 shows where the signal from a single satellite (the circle) would intersect your ground receiver. The signal from just one satellite doesn't tell you very much; perhaps only how far away the satellite is from your location (determined by the time it took for the signal to arrive). If two satellites are being tracked (**Fig. 2**), you can get a little better idea of your position, but since there are two points of intersection, you still can't be sure—it might be either. When three satellites are locked onto, however (**Fig. 3**), even though there are several points of intersection, only one is common to all three—that's your exact position! Having more than three satellites gives even better data.

Each NAVSTAR GPS satellite knows precisely where it is at all times, and where its neighboring satellites are, as well as the exact time, down to atomic accuracy. Knowing these facts, and transmitting them to your GPS receiver down on the ground, will allow the GPS receiver to calculate the time it took for the signal from each satellite to reach the receiver, and thus the distance that the various satellites are from the receiver (remembering that radio waves travel at 300,000 kilometers per second). Because the satellites are at different positions in the sky, a triangulation fix can be made on the location of the receiver, accurate to within 49 feet (15 meters). The actual location of the satellites making the fix can affect the final accuracy of the receiver's position to some degree, but that "final" accuracy can then be further improved. One way is to compare the positional data at two receiving sites that are tracking the same satellites, and then calculate (automatically) a differential that can be applied to the calculated data as a correction factor. That differential (number) can be sent over terrestrial radio and is usually referred to as DGPS (Differential GPS). It can often

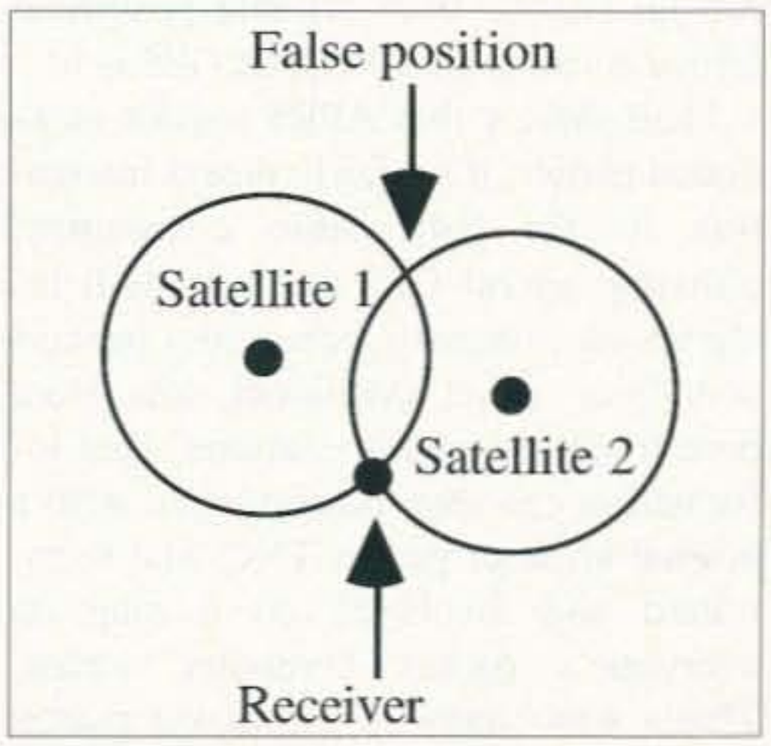

Fig. 2. With two satellites being tracked, since there are two points of intersection, you can get a better idea.

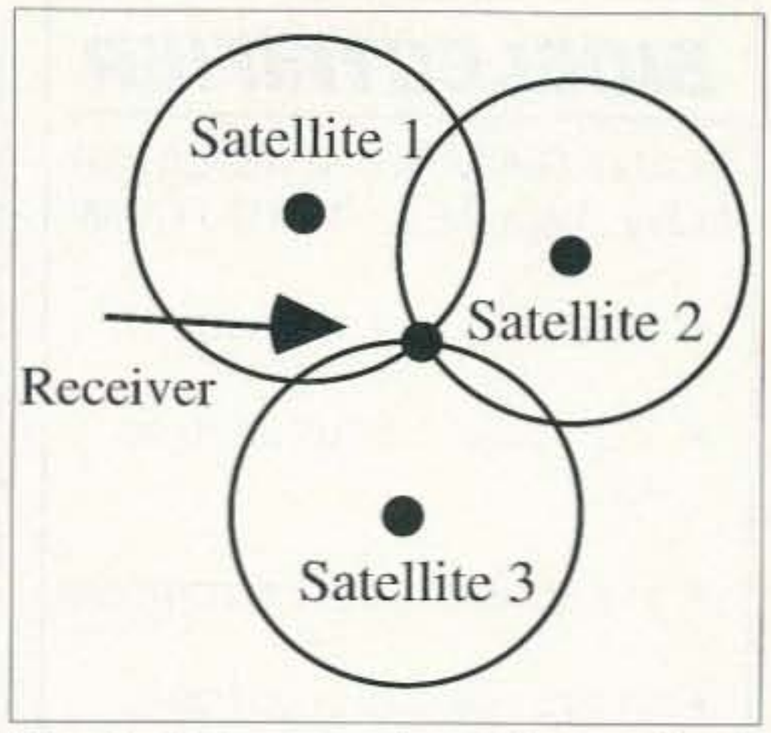

Fig. 3. Only one point of intersection is common to all three—and there you are! More than three satellites can provide even better data.

improve on the final accuracy down to an error of only 16 feet or so. Here's the second part of the equation: The U.S. military deliberately throws some inaccuracy into the GPS system available to civilian users; it's called SA and stands for "Selective Availability." U.S. military users have GPS receivers with a special code that overcomes SA, but civilian units don't, so they're automatically less accurate than their military counterparts. This gives our military a slight advantage over other (enemy) troops that might be bootlegging our satellite positioning information to use against us. The amount of SA inaccuracy introduced is controllable from a ground-based satellite command center that monitors the GPS satellite constellation. During times of troop movements or armed conflict, more SA can be introduced to make it still more difficult for the enemy to profit from our NAVSTAR system. SA inaccuracy is scheduled to be phased out over the next ten years by a law recently signed by the President. Since the SA differential can also be calculated by the means mentioned above (a second receiver site transmitting DGPS information), its value in giving our military personnel an advantage has become somewhat questionable, since the enemy knows how to get around it too, and Congress reasoned that it might as well be phased out so that higher accuracy could be made available to legitimate civilian users. Of course, GPS will also be beneficial to drug runners, smugglers and other nefarious types, but every worthwhile advancement can be abused in the hands of criminals. We can't keep technological advancements away from

the legitimate users just because there is the potential for illegal use—at least that shouldn't be the only consideration.

By the way, the NAVSTAR satellites have also been hardened (as much as is currently possible) to damage from enemy ground-based laser and particle beam attack as well as command control interception that could result in erroneous readings being transmitted from the constellation. They're also EMP (ElectroMagnetic Pulse) hardened and are designed to degrade gracefully, even if ground communication with them is lost. Aerospace design teams have to think of everything these days. The time delay in launching a replacement satellite from the ground is estimated as not exceeding two months, if and when that should prove necessary. Satellites don't last forever; high energy radiation particles from outer space, damage from small meteorites and other space debris and realistic design life of batteries and solar panels all take their toll on even the best satellite hardware.

Uses

The NAVSTAR GPS concept has tremendous potential for the recreational boater, private pilot, Civil Air Patrol volunteer, hiker, backpack camper, explorer, fisherman, climber ... and Uncle Wayne's road rally team! Anyone who strays from home can appreciate the hand-held portable GPS, just as hand-held portable transceivers are commonplace today. And of course we can't overlook the potential commercial users—commercial airliners, passenger and cargo ships, railway trains, over-the-road trucking, delivery services, etc., can all benefit from reliable positional information, and NAVSTAR GPS is it!

Then there's that APRS aspect mentioned earlier; it's a fairly recent innovation in the ham radio community, utilizing current GPS technology. It includes automatically generating packets containing exact positional data from both fixed and mobile stations. That information can then be combined with a normal amateur packet TNC, and transmitted and displayed on a map on everyone's packet computer screen. That's why many of the newer packet and multimode TNCs routinely include GPS capability within their TNC firmware these days. It's an amateur radio innovation (thanks to Bob Bruninga) that is just beginning to be explored.

But what advantage is there in having that positional information? For search and rescue efforts, parade or marathon coordination and safety watch, repeater jammer tracking, neighborhood watch patrol activities, simulated emergency tests, storm and flood assessment and assistance, recreational fox hunting and other amateur radio field activities, GPS offers the same advantages that it does to the military, recreational and commercial users: obtaining and relaying accurate positional data on and to the participating stations. If we still have that ham spirit of discovery and innovation, then it won't be long before even more innovational uses for GPS will emerge within our hobby—and *73* will publish them as they're presented.

So what's out there now?

As to what you can expect to buy right now, I'll use the features of my own (a Garmin GPS 45) in the examples, not because I'm trying to convince anyone to buy the same unit, but because it's the one I'm most familiar with. Other brands and models will have similar operating modes and features, but of course the details will vary.

I thought that my instruction manual was lacking somewhat in its guidance for beginners, especially for something as new and innovative as GPS. I would have preferred that the manufacturer had been more informative in the operator's manual, but there is an optional, well-produced instructional videotape available. The manual assumes that the operator is already familiar with the basics of navigation, waypoints and route planning. For those who aren't, a supplemental book on general navigating techniques from your local library may be worth reading first. I've always felt that tech-manual writers should make sure that they're doing the best job that they can in clarifying all of the questions the beginner might ask. I think the practical way to do this is to test the product, and the manual, by giving units to a few beginners for a week or so, along with the preliminary manual, and asking the beginners to keep accurate notes on the problem areas. A tech writer who's intimately familiar with a unit can't write a basic enough manual, one that's

completely understandable to the beginner. We see this all the time with complex ham gear manuals; not enough forethought is given to explanations that require more detail or practical examples. With modern microprocessor-based equipment, usually with multiple-function keys, a thorough manual is an absolute must!

Some initial details

The first thing you'll notice about GPS receivers: They're amazingly compact, about the size of a current dual-band talkie (my own is just 6 1/4" high by 2" wide by 1 1/4" deep). It's incredible that you can hold a true satellite tracking receiver in the palm of your hand—no dishes, no az-el steering needed. Mine operates from four internal AA batteries that will power it for 10 to 20 hours depending upon the mode chosen (normal or battery saver mode). It has a small detachable antenna (with a BNC connector on it so that an external antenna can be used) and a built-in 4-pin male socket on the back of the unit for inputting outside power (five to 40 volts DC) and ground. There's also a pin for data input and one for data output, for interfacing with a computer or to an external differential or beacon receiver. There are (or soon will be) computer-generated maps of various locations that will allow you to plot exactly where you are on a moving map of your area (or a strange area) so that, with a laptop or notebook computer, and your GPS, you'll really have to work at getting lost! All of these amenities have a price, of course, but they'll probably be within everyone's reach over the next few years if the past is any indication of the future (look at how computer prices have plummeted over the years).

For the boater, camper or hiker, many GPS receiver models are considered waterproof, often being pressurized from within, using dry nitrogen to prevent the infiltration of outside air or water. Mine is, since it was designed for the marine environment, plus it weighs a mere 10 ounces with the four AA batteries installed.

Operation

Here's the good stuff! When a GPS receiver is first powered on (or when all of its memories have been erased), it will take 7 1/2 to 15 minutes to acquire all of the satellites that it can, storing them in an almanac in its memory, and displaying its new home latitude and longitude. This auto-locate initialization is good for up to about 300 miles from home base even if the receiver is off. If you travel farther than that with the receiver off, you'll have to let it auto-locate again or you can enter the new rough latitude/longitude data manually. If you travel with the receiver turned on, or turn it on every now and then, it will re-locate itself as it goes along.

While it's auto-locating, my unit shows a nice graphical view of the sky (**Photo A**), plotting up to 8 NAVSTAR satellites on a sky map; the satellites are graphically depicted as being either on the horizon, at 45 degrees up from the horizon or overhead. The display indicates the satellite's ID number (each satellite has its own identification number), along with a relative signal strength bar for each of the satellites being tracked. This allows the user to move somewhat in various directions, or to reorient the side-mounted antenna, to achieve the best signal reception from the constellation of satellites in view.

***Photo A.** Satellites are graphically depicted as being either on the horizon, at 45 degrees up from the horizon or overhead. The display also indicates the satellite's ID number, along with a relative signal strength bar for each of the satellites being tracked.*

At least three satellites are needed to obtain a fix on your latitude and longitude; a fourth is required to give your altitude above sea-level data (providing that the unit has that 3-dimensional capability). The more satellites you can acquire at any given time, the better the positional and altitude data will be, because, again, the triangulation will be done with better geometry. I've found that it's not unusual to get good signal strength readings from six, seven or even all eight satellites in reasonably open areas, and at certain times of the day, remembering that 1.575 GHz radio waves are fairly easily absorbed or scattered by ground-based obstacles.

Once the auto-locate initialization stage is finished, and the receiver is satisfied with the data from the satellites that it can see, the page automatically changes and a moving compass dial is displayed (showing your cardinal heading anytime you're in motion; walking is good enough). It also shows a digital readout of your true bearing (a three-digit numerical display of the linear compass dial); it shows your speed of movement when in motion, and of course your latitude and longitude, out to three places, in seconds. It even tells you the accuracy of the latitude and longitude measurement as plus or minus so many feet. It automatically indicates if it's operating in the two-dimensional or three-dimensional mode and your altitude in feet above sea level when it's in the 3-D mode (with a plus or minus altitude error factor, in feet, also displayed). The exact time of day in 24-hour UTC time is displayed, or the time can be read in local time (that is, so many hours differential from UTC). Finally, the condition of the internal batteries is shown on a nice bar-graph gauge ranging from full to empty.

Stepping forward to another page, many GPS receivers will automatically map your path of travel, whether on foot or in a moving vehicle. This moving map shows every twist and turn that you might make along the way (see **Photo B**). The map (actually it's more of a where-I've-been course plot), looks something like a doodle you might have drawn on an Etch-A-Sketch™—at least that's what it reminds me of. But it's a lot more powerful than my Etch-A-Sketch ever was! When you arrive at your destination, you can follow the doodle and retrace your exact path back home. Rather than following the exact course home, you can opt to take the shortest route back instead (if you're in open country, on the open water or in the air). The map will show you the heading for that shortest course and it will display your return trip on the same map page, so that you can see immediately if you happen to stray off your mark. You can zoom in and zoom out (in 12 different steps) on the map to see every twist and turn, and you can pan across to see where various zigzags were necessary. **Photo B** shows a little doodle-map I made coming home from the store one day. It's zoomed to the 1.0 mile scale and you can see the little zigzags needed to get to my home. They're even more pronounced when zoomed into the 0.2 mile scale. My home QTH is shown in the center. The scale in miles is displayed at the top and changes as you zoom in and out. You can pan across the map to measure the exact distance from one point to another or to find those little details mentioned when you're zoomed all the way in. The map page also shows the bearing you should be taking to get back home on the return trip, the one you're actually on, the distance in miles to your destination and the speed at which you're currently moving. Everything you might possibly want to know—except perhaps where the radar speed traps are (there's other gear for that!). Incidentally, I *do* know the way back home from the store on my own, but it's a whole lot more fun this way.

"This gives our military an advantage over enemy troops that might be bootlegging our satellite positioning information to use against us."

If you decide to take the exact (retrace) course back to home base, as you might when hiking overland with natural obstacles to maneuver around, you can switch to a roadway style of display. As you can see in **Photo C**, the display looks something like a highway drawn in a perspective view, with a center line right down the middle. To retrace your exact original course, simply keep the little cursor arrow right on the center line of the roadway; you'll end up exactly where you started. There's even a finish line that appears across the roadway in case you've forgotten what home looks like.

I've mentioned only a very few of the navigational features found in a modern GPS receiver. There are a number of others. As the menu page shows in **Photo D**, you can set and store waypoints and routes, naming each one for easy recall. A waypoint is a specific location that you would like to head toward and at which something will occur. A route is a number of waypoints strung together. Putting it in understandable terms, when you drive to work each morning, you probably follow pretty much the same route. Beginning from home, you might head down Street A to Street B, making a left turn on Street B. That intersection is a waypoint. You then take Street B to Street C and turn right; that's another waypoint, a point along the way where something happens. Stringing all the waypoints in series is your route. On the open water, in the air or out in the wilderness, where streets and intersections don't exist, longitudinal and latitudinal waypoints become very important when you can't navigate by visual landmarks. They provide points of significance, where a turn or course

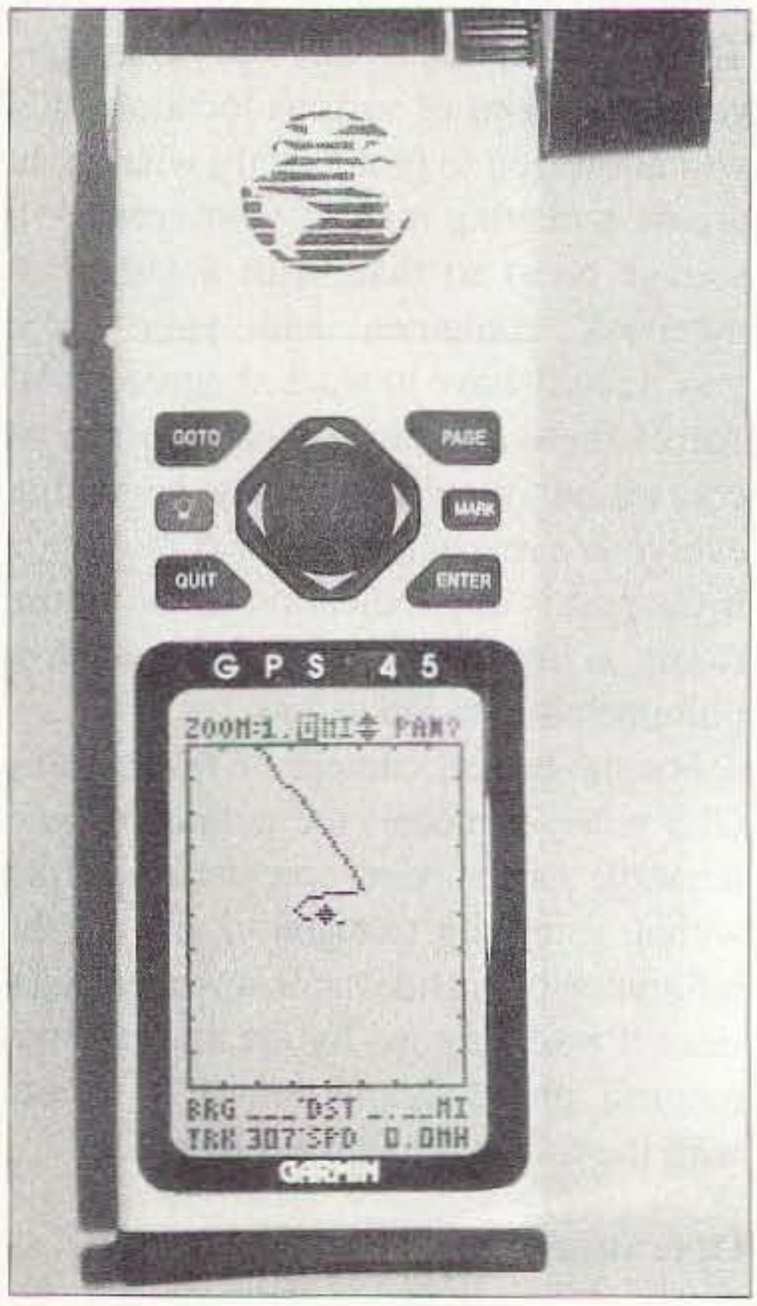

***Photo B**. The "Map Page" capabilities of the unit with the "moving" map readout of my trip home from the store.*

change should occur, perhaps to avoid some obstacle (such as a reef while sailing). It's vital for the navigator to know when he or she has reached a waypoint, and a GPS receiver will tell you that with class. Mine will store 250 waypoints, each with its own unique name (such as HOME, FUEL, REEF, etc.). It handles 20 routes (collections of waypoints) which are reversible. If a storm suddenly comes up, there's a "nearest waypoints" page that can be called up, providing you with and guiding you to the nearest of nine safe haven waypoints (providing you've stored them in memory). There's a CDI (Course Deviation Indicator) display, an ETE (Estimated Time Enroute) display and an ETA (Estimated Time of Arrival) display at your disposal when you need them. There's a sunrise/sunset indicator that will even tell you the time of these events at the destination you're navigating toward. There are also internal messages that may be displayed from time to time: "Poor GPS Coverage" or "Accuracy Has Been Degraded" are displayed when satellite coverage is poor or non-existent.

In general, GPS receivers are meant to be used out in the open. If the 1.575 GHz signals from the satellites are blocked by buildings, mountains or even dense forest, reception will be degraded. It's still amazing that sometimes I can actually receive three or four satellites at our kitchen table—because of a large picture window facing due north.

All of these GPS functions—predetermined waypoint plotting and storage, routing information, track logs, etc., can vary from one unit to another. Some GPS receivers are aimed at certain outdoor activities or sports, such as boating. Those functions are determined by the firmware chosen by the manufacturer for a particular GPS unit, so, depending upon your own interests, you can often find a model aimed more at your own outdoor activity (I've always loved sailing). However, even a GPS aimed at the nautical crowd can be used for any general purpose navigation exercise—even just a Sunday afternoon walk through the woods. Anyone want to start an orienteering club?

***Photo C.** The "Go-To-Waypoint Page" helps you to retrace your route home or to find a specific stored waypoint.*

There's also a menu screen that allows the user to call up other submenus to assign the names to waypoints, enable or disable some of the functions, clear memories, define the functions (such as reading out in nautical miles as opposed to statute miles) and to access stored tracking information. You can keep a stored record of your excursions so that you can call on them in the future if you'd like to follow the exact same route, or just to revisit some enjoyable spot.

Mine even has what's called a MOB (Man OverBoard) function, which will allow you to zip back to a particular geographical spot in an emergency...say if your mother-in-law happens to fall over the transom of the boat and you hadn't noticed. Of course, it's entirely up to you if you choose to enable that MOB option or not!

A practical example

A GPS receiver in the mobile can come in very handy. My wife and I took a long-weekend motor trip into the hinterlands of Wisconsin shortly after I bought mine and installed the optional dashboard mount for the GPS-45 in our car.

Photo D. *The "Menu Page" capabilities of the Garmin GPS-45 NAVSTAR satellite Global Positioning System receiver.*

Even though Sue has her General Class ham license, I have the feeling that she doesn't always see the complete sanity in every electronic purchase I make. She seemed to appreciate (on the surface) the practicality of our GPS receiver, but it wasn't until we started taking some really off-the-beaten-path scenic roads that she commented, without any prompting from me, that having a GPS onboard was a nice idea. We had no fear of getting lost down those twisting, turning country roads because we knew that we could always find our way back if we ended up hopelessly lost. We saw some mighty pretty fall colors too! In fact, we spent most of the trip on those scenic back roads, and we'll do it again! The map that we had wasn't nearly detailed enough, so we followed our noses and ended up driving around one city in a large circle. We followed a route bisecting the circle and ended up where we wanted to be originally—without going all around the circle again—a first for us!

I found that just mounting the GPS up on the dash, with the windshield curvature overhead and around the sides, gave us reliable satellite coverage. The 1,100 mAh nickel metal hydride AA cells that I'm using in the GPS-45 will power it for a full day's driving on the battery-saver mode and I simply recharged them overnight in our lodgings. It's nice to have an accurate compass onboard too (one that doesn't dance around), and I discovered that the car's speedometer is actually three miles per hour slower than true. But just having an accurate map of where we had been, and knowing that we could always get back again, was very comforting, and as Sue put it, a nice idea. In unfamiliar territory, it only takes one wrong turn to become disoriented; but with your GPS receiver, you can find your way back easily.

As an aside, I did notice some RFI in our 2-meter mobile transceiver, on certain frequencies, attributable to the GPS receiver's oscillators. The solution was to avoid those frequencies, but it was somewhat surprising. I've not tried to work out another solution yet; the problem isn't serious for us since it doesn't affect the channels we're most interested in monitoring. There may be conflicts like this on other bands as well; I've not checked them, but don't be too surprised if you find some birdies somewhere.

Other interesting asides

GPS technology has a number of diverse potential uses for the future. It can be used for tracking endangered species, with exact positional data always available on the monitored animals, as well as auto-mapping of a particular animal's recent roam-area. GPS has seen duty on high altitude balloon flights investigating the much publicized ozone layer depletion studies and it was used to record the undersea resting position of the famed passenger ship *Titanic*. It can be used in forestry and geological survey studies, accurately mapping the boundaries of areas of natural resources as well as in locating and documenting small villages and remote population concentrations in obscure parts of the world. Since one of the side benefits of GPS is high accuracy time keeping, anyone who needs that advantage (radio amateurs included) can benefit from this important aspect of the orbiting satellite PVT (Position-Velocity-Time) technology. Mapping flood- or hurricane-ravaged areas anywhere in the world by air and helping to deploy and direct firefighters to forest fires also requires accurate positional data, in the air and on the ground; GPS answers those needs. There's progress being made to use GPS as an aid to the blind, which is yet another reason for doing away with the intentional inaccuracy of SA (discussed earlier). Coupled with a voice synthesizer, the waypoint and routing features of a GPS receiver can potentially be used to prompt blind people to reach a predetermined goal.

The Russians are coming!

Orbital placement of a second constellation of global positioning satellites has been underway for several years now, initiated by Russia. It was begun before the breakup of the Soviet Union and goes under the name GLONASS. When fully operational, GLONASS also promises to provide position, velocity and time information to users worldwide (most current GPS receivers will probably not be usable with the Russian system, though the frequencies used are relatively close—GLONASS is said to be just above 1.6 GHz).

As you can see, the average GPS receiver is versatile, affordable, and works by reading the data from orbiting satellites 10,900 miles or more away ... all in the palm of your hand. To me, that's pretty exciting. What do *you* think? 73

Communications & Live ATV Via Outer Space

Some real-life use of the ham satellites.

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During the 1996 Dayton HamVention, a short movie was discovered running at the AMSAT booth. This movie showed two amateur stations involved in a Q5 QSO utilizing the AO-27 satellite.

Several months earlier, W8ZCF and his son, KB8VCO, had been trying to come up with a plan for communicating while KB8VCO was on vacation with his family in Juarez, Mexico and El Paso, Texas. They considered several of the HF bands, but decided that unless enough power and suitable antennas could be set up by KB8VCO on a portable basis, that such an arrangement didn't seem feasible, at least on a consistent basis.

The AMSAT movie raised the possibility of using AO-27 for the communications link. Tests were made just before the trip to Juarez; KB8VCO used a Yaesu FT 530 dual-band HT which provided about two watts output on two meters, along with 70 cm reception. The antenna was a Cushcraft A270-6S, consisting of a pair of three element yagis on a single mast for transmitting on the two meter uplink frequency and receiving on the 70 cm downlink frequency. It was used as a handheld antenna and manually pointed towards the satellite. **Photos A** and **B** show KB8VCO's setup. A tracking program was used for initial antenna orientation with signal strength indication from the satellite to maintain tracking.

***Photo A.** KB8VCO's equipment for AO-27 voice contact (photo by Vicky Winder).*

"Those pictures were sent over 2,000 miles round trip using 1/2 watt on 70cm!"

Upon arrival in Juarez, and for a period of more than two weeks, contacts were made on a daily basis from the Juarez/El Paso area to and from Cincinnati, Ohio. During the return trip, contacts were continued from Texas and Arkansas. Those contacts were so successful that an idea emerged for an experiment while W9NTP and W8ZCF were in contact during regular early-morning ATV exchanges between Waldron, Indiana and Cincinnati, Ohio. The idea was to try sending a live picture via AO-27.

Initial experiments were encouraging. On the third attempt, complete pictures were sent and received by both W9NTP and W8ZCF. Photographs of these pictures are shown in **Photo C** and **Photo D**—remarkable, considering the very low output power of the AO-27 which is only 1/2 watt on 70 cm! This microsat satellite is a cube-shaped package approximately 5.9 inches on a side and in a nearly circular polar orbit at about 500 miles above the Earth. The actual distance covered in transmission to and from the satellite to create these pictures was over 2,000 miles, round trip!

The uplink frequency for AO-27 is 145.850 MHz and the downlink is 436.800 MHz. Approximately 20 kHz of Doppler was observed over the longest AOS to LOS footprints. W9NTP's setup used an OSCAR circular polarized antenna for 2 meters. A

Photo B. *KB8VCO tracking AO-27 (photo by W8ZCF).*

vertically polarized FO-22 (22 element yagi) antenna, (with az-el rotators) feeding a KP-1 preamp into an ICOM R7000, was used for receiving 70 cm. A Robot 1200C Color TV Scan Converter was used to process the video sent to and from W8ZCF. A Yaesu FT 736 was used to transmit video on two meters to the satellite.

W8ZCF's setup used the basic antenna setup used regularly every morning for "earthbound" ATV contacts. This consists of a Cushcraft 13B2 (13 element) yagi, vertically polarized antenna on two meters and a Rutland FO 22 (22 element) horizontally polarized yagi for 70 cm. The FO 22 fed a KP-1 preamp to an FT 736R for 70 cm receiving. A Tasco TSC-70U SSTV Scan Converter was used to process the sending and receiving of pictures to and from W9NTP. The transmission mode used by both stations was Robot 36 Color.

Over the course of this experiment, several local stations became interested and engaged in voice contacts on AO-27. Dick Goode W8RVH, in New Carlisle, Ohio, did an analysis with a 7 element home-brew yagi for the 70 cm signal from the satellite. He discovered that the satellite transmitting antenna consistently enters the descending pass with vertical polarization and rotates to a nearly horizontal polarization during the completion of the pass. W8ZCF's FO 22 horizontally polarized antenna without an elevation rotor therefore gave best performance at low (under 5°) elevations which occurred during the latter part of the westernmost passes. Signal strength on the lower part of these western passes often yielded readings of S9 +10 to 20 dB.

"This satellite provides pleasure and experimentation to many."

W8ZCF used the STSORBIT PLUS Tracking Software Program written by David Ransom, Rancho Palos Verdes, CA. The initial position of the satellite during the start of the video transmission of the picture to W9NTP is shown in Photo E (the STSORBIT graphic presentation). W9NTP used the Instant Track satellite tracking program.

The picture received by W9NTP is regarded as almost a "perfect picture." A partial single horizontal noise line appeared in the original picture just above the W9 portion of the call letters. This was corrected by using the "Fix Glitch" feature of the HIRES-70 program developed by Tom Jenkins N9AMR of Indianapolis for use with the TASCO TSC-70 Scan Converter. The picture (**Photo C**) received originally by W9NTP was later retransmitted to W8ZCF from Waldron, Indiana and photographed from a 14-inch TV Screen using a Pentax ME Super Camera with 1/4 sec. exposure. **Photo D**, received direct by W8ZCF, was photographed using the same TV/camera setup.

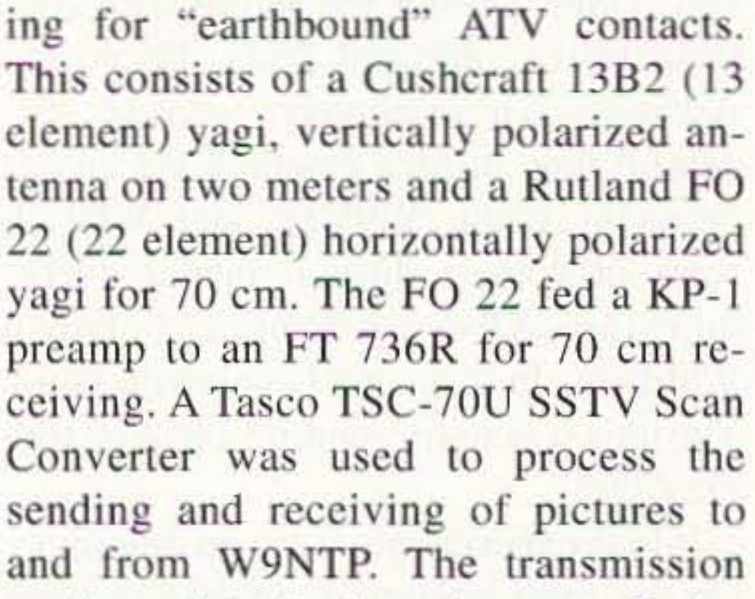

Photo C. *Picture received by W9NTP using a Robot 1200C Converter (Mode: Robot 36 Color).*

Photo D. *W9NTP's picture as received by W8ZCF using a TASCO TSC-70 (Mode: Robot 36 Color).*

This project proved to be challenging, fun and rewarding to the parties involved. Several bystanders also followed this experiment—and as a result, a number of new satellite communicators have emerged. All of these operators may now be better prepared to utilize the future multimode satellites, such as Phase 3D, that are in progress.

Thanks go to the many innovative engineering designers and developers who have made the AO-27 satellite with its performance capabilities possible. Obviously, this satellite provides a great deal of pleasure and experimentation to many amateur radio operators. 73

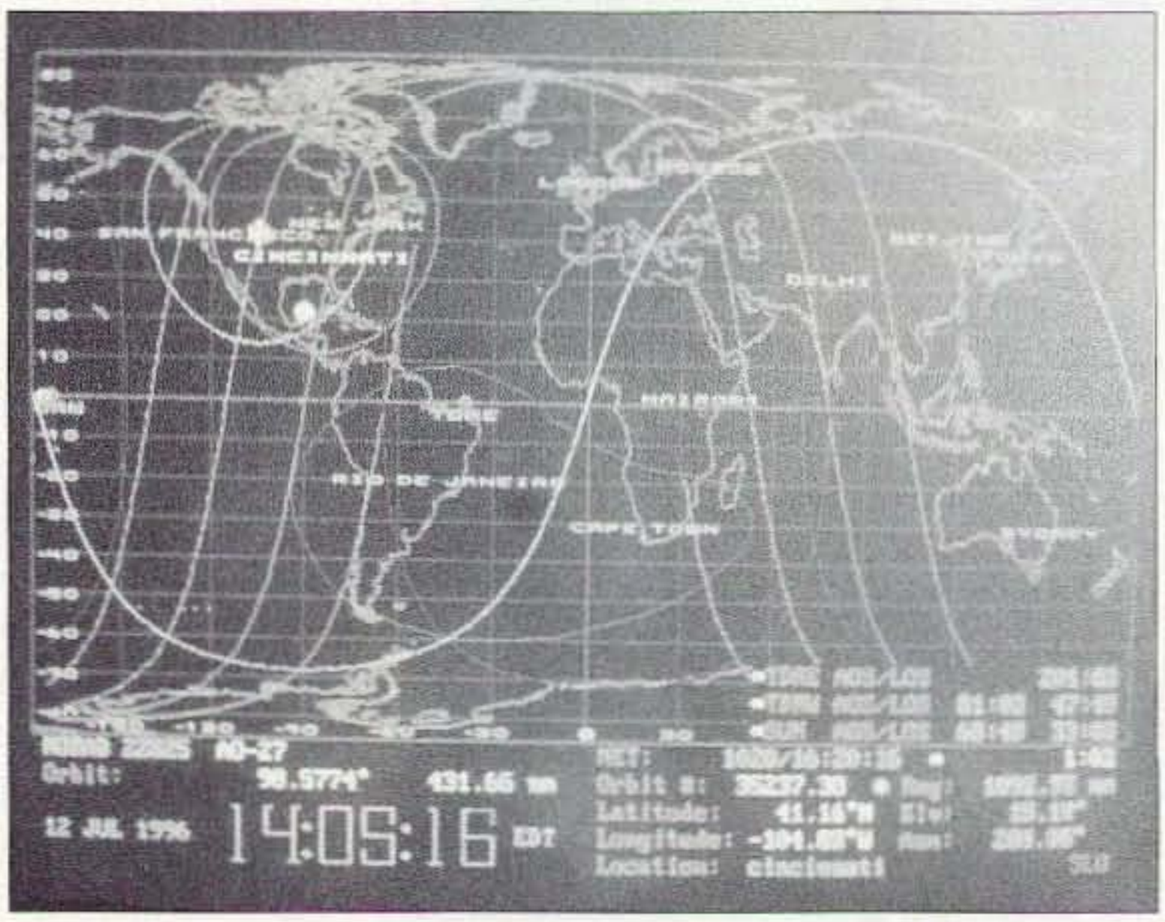

Photo E. *STSORBIT tracking presentation of AO-27 (photo by W8ZCF).*

73 Review

Satellite Tracking With Style

Nova for Windows©

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Every once in a while a piece of software comes along that makes me glad I own a computer, or might prompt me to buy one if I didn't. Nova for Windows© is just such a program. This full-featured satellite tracking program from Northern Lights Software is not only useful to diehard satellite enthusiasts and EME operators, but is also a fantastic educational tool for anyone interested in satellites and space activities in general.

This program, written by Dr. Michael Owen W9IP and Dr. C.J. Knickerbocker, is a giant leap forward in quality and capability over most other current Windows tracking programs. The fact that you've got something new and different is boldly obvious as you look at the opening screen. Displayed is a gorgeous full-color map of the Earth with a constellation of satellites whizzing around it. This color map is different from other, cartoonish displays, since it is actually a composite satellite photograph of Earth, showing the varied terrain—including mountains, rivers, deserts and even snow in the extreme northern and southern hemispheres.

This display is also customizable to your heart's content. You may choose between a flat map of the Earth with the satellite footprints projected on it, or a 3D space view with footprints. There is an *incredible* 3D view with the orbits for each satellite shown and labeled. This view is a great learning tool for beginning satellite operators or for student education. It allows you to visualize the satellite in orbit and helps make sense out of those abstract numbers (Keplerian elements) used for satellite tracking.

In addition to the basic screens there are a couple of unique views that are harder to visualize until you actually use the program. First is the radar view which gives you a radar screen image with satellites plotted in an azimuth-and-elevation display, showing their paths across the sky from your location. Also available is the sky view, mainly of interest to moonbounce operators, which plots a selected satellite (or the moon) on a map of the sky showing the natural background noise sources such as the center of our galaxy. Not only can Nova for Windows track satellites but also the sun, moon, planets and a handful of other celestial bodies. The overwhelming thing about all of these views is that you can have them onscreen one at a time, or in any combination, even all at once. The program has no limit to the number of satellites you can track or display views you can have running simultaneously. You can track to the limits of your computer capability and display readability.

Besides the flashy new displays and functions, the program has a solid base of features, as we've come to expect from satellite software. A printed table of upcoming passes for a satellite, two-observer mutual windows, squint angle information and two-satellite mutual visibility are only some of the basic features. A quick visibility check feature allows you to see at a glance which satellites are above your horizon at the present time. Of course, automatic antenna tracking is also supported for those of you using the Kansas City Tracker, SASI Sat-Tracker or AEA's ST-1 rotor control interfaces. These are just a few of the functions available—there are simply too many to list!

Even though there are dozens of features and new capabilities, the program's operation is pretty straightforward. The software takes advantage of the standard Windows user interface so it has a familiar look and feel. Some users may wish for a user's manual or more extensive on-line help files, since there is no manual and help files are absent from some screens. However, a little time spent exploring the program will have you operating comfortably in a short

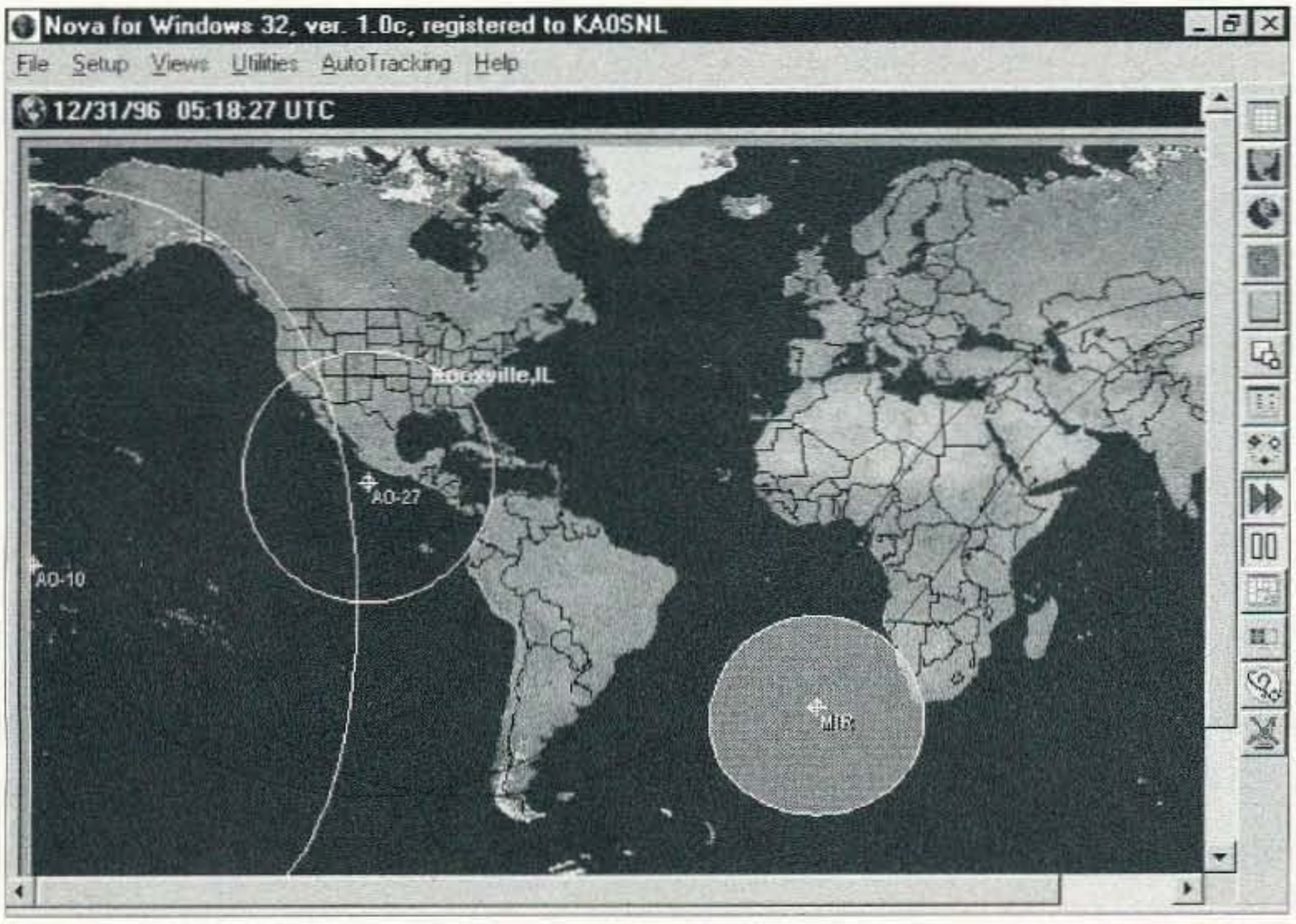

***Fig. 1.** Map from Nova showing footprints of AO-10, AO-27, and Mir.*

time. Many of the commonly used features are available on a toolbar. This toolbar allows changing displays, and accessing some of the setup options from a simple point-and-click interface. Functions such as modifying the observer database, and updating the satellite element files, that are not reachable from the toolbar, are accessed from a menu at the top of the screen or by right-clicking on a particular item.

Nova for Windows allows most users to get up and running quickly. There are only a few things to accomplish to make the program immediately useful, and a quick tip sheet (included with the program) provides basic information to get you started. After completing installation, make sure your station location is in the observer list. Go to the menu at the top of the screen, click on "setup," then "observers." Find your city from the right side main database and drag it to the left observer database. If your city is not listed you must manually enter the coordinates in the lower left panel, enter the location name and save it as a new observer site.

Also, to ensure that you have up-to-date Keplerian elements you will need to update that file with the most current set. Get your keps from your usual source and save the text file in the Data folder of Nova's directory. To update Nova go to the menu at the top of the screen. Click "setup," then "satellites." This brings you to the satellite editor screen. Now click "update," and find the file you want to use for the update. Select "open" and your file is automatically updated. Simple as that.

To configure your tracking screen or create additional views, you can right-click on the map screen or use the button on the toolbar. In either case select "configure current view"; this takes you to the individual view configuration screen. Simply drag and drop observers and satellites from the respective lists. Select a map display option and right-click to customize that map to your needs. When you're done click on the new button and type in a name for this view. Select "OK" and you're set. You can create as many configurations as you like for different situations. For instance, I have one for the microsats, one for high-orbit birds and another with the shuttle and *Mir* only, for use during Sarex missions.

Nova for Windows is available in both 16-bit Windows and 32-bit Win 95 versions. The programs are nearly identical. The 32-bit version for Windows 95 does take advantage of Win 95's multi-threading and multitasking features for smoother operation when autotracking. Additionally, new add-ons such as Nova FTP and Nova GPS are designed to use the 32-bit Win 95 version. Nova FTP automates the process of updating

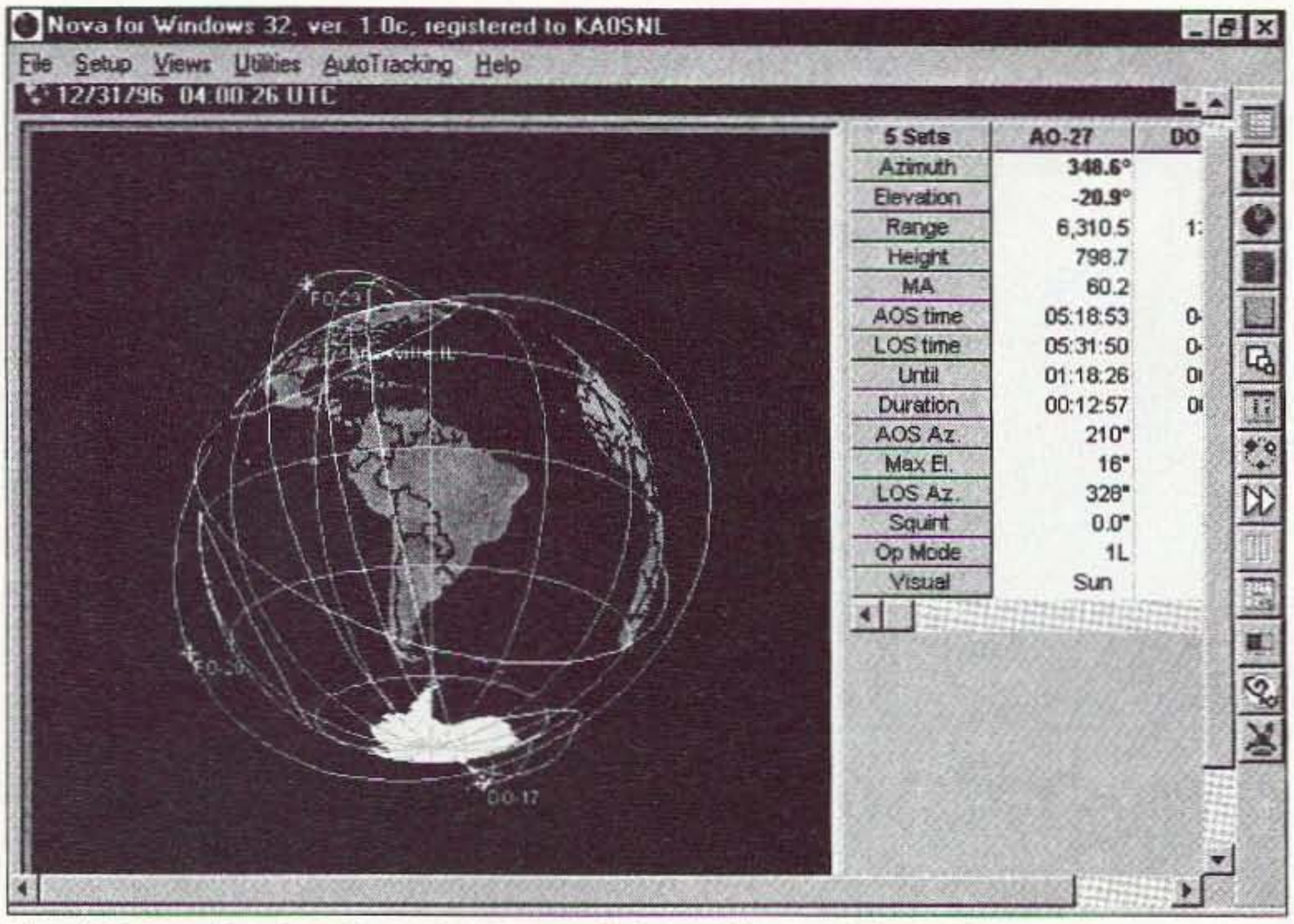

Fig. 2. Space view from Nova showing multiple satellites and their orbits.

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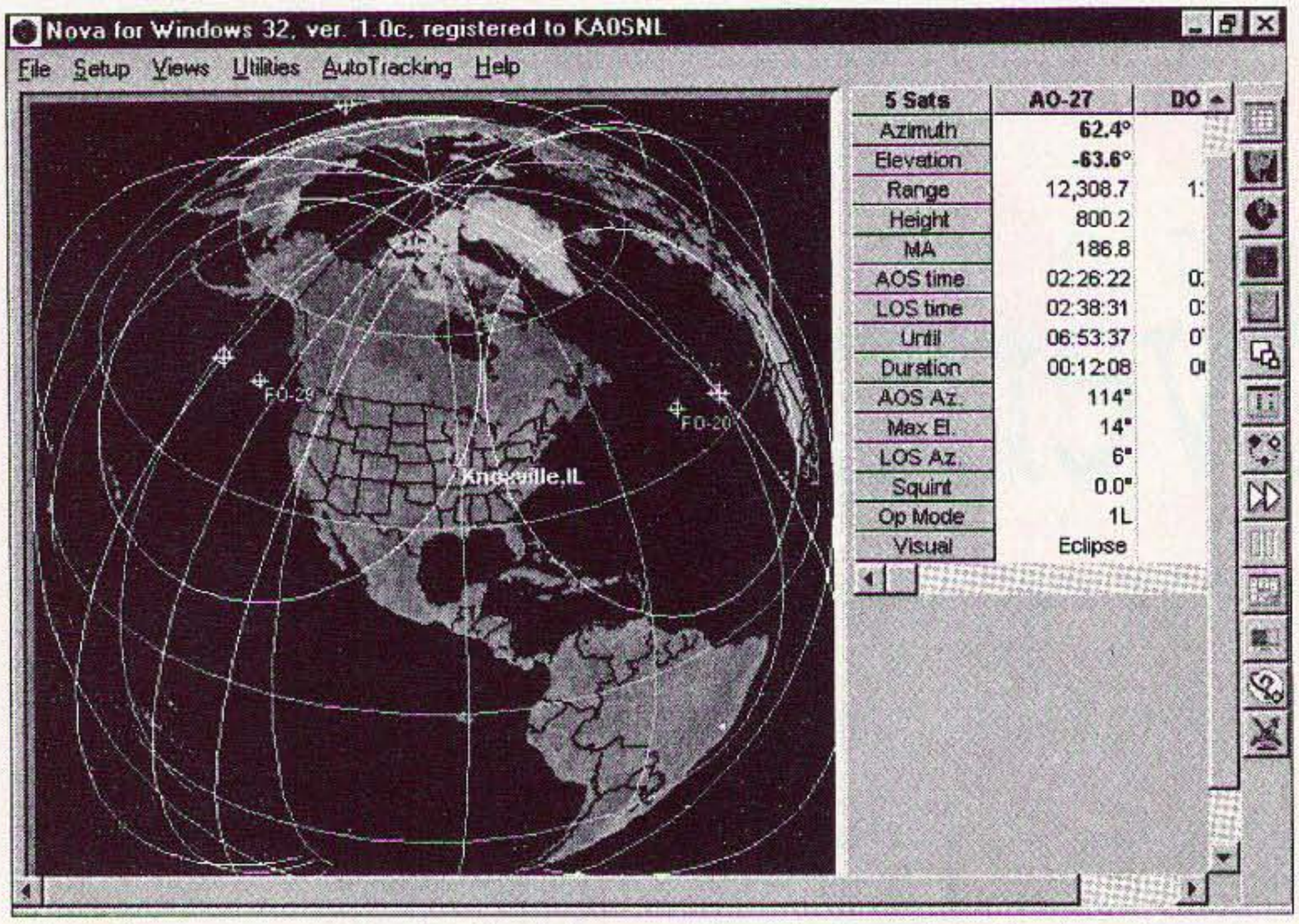

Fig. 3. *Nova screen capture showing the space with orbit view and satelite footprints.*

Keplerian elements and Nova GPS reads information from a portable GPS receiver and updates station time and location information. Contact Northern Lights or visit the Web site for the latest information. I have both versions of the program, running on a 120 MHz Pentium™ with 16 MB of RAM and the Novawin folder occupies approximately 13 MB of space on my hard drive. However, the minimum system requirements call for at least a 386 with coprocessor, 10 MB of hard disk space and a VGA display with 256 colors or more.

I still sit amazed as I watch the microsat satellites marching in order, coming up over the pole in almost single file, their orbits displayed along with their footprints, all being tracked at once, in real-time. I have seen nothing like it before and friends, even non-hams are enthralled at the display quality. It has become a favorite demo to show off the computer to visitors and I can see its usefulness in education as well. This program is a must-have for anyone interested in satellites, moonbounce and other space-related activities.

Nova for Windows is available from AMSAT for a donation of $50 for members and $60 for non-members. Currently only the 16-bit version is available through AMSAT but you can easily upgrade by going to the Nova Web site and downloading the 32-bit upgrade. A portion of the proceeds will go to benefit the amateur space program, so your money does double duty. You get a great piece of software and the amateur space program gets your support.

To order, contact:
AMSAT
850 Sligo Avenue Suite 600
Silver Spring MD 20910
Ph. 301-589-6062

For more information, contact:
Northern Lights Software
2881 CR 21
Canton NY 13617

Nova for Windows (16- or 32-bit) $59.95ppd

E-mail: nlsa@northnet.org

Internet: www.webcom.com/w9ip

An E-mail mailing list for Nova is also available; check Web site for details. 73

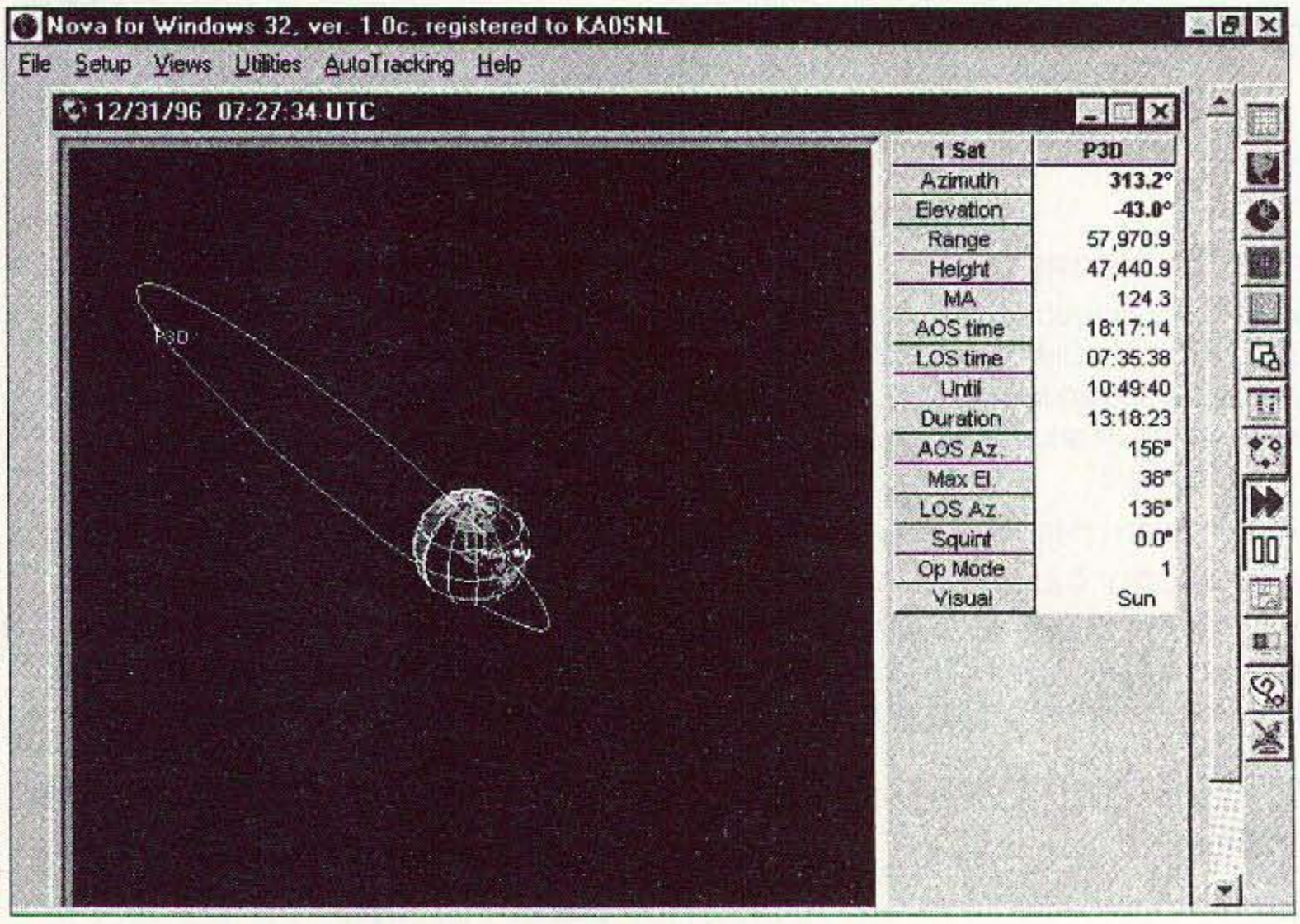

Fig. 4. *The proposed orbit of the soon-to-be-launched P3D spacecraft.*

A 500-Foot Antenna?

Going to new heights in Maryland.

Joe Nunemaker KD3VR
9303 Calanda Street
Lanham MD 20706

John asked, "What kind of signal would you get with a 500-foot antenna?"

"A great one," I said.

"Hmmm," he said, pondering the idea. "How would you support a 500-foot antenna?"

I considered for a moment. "A balloon would do nicely," I said.

"Do you think a kite could take up 500 feet of wire?" he asked.

John Williams N5SJZ called me a few days later with some exciting information. He had visited a kite store where he had researched a number of kites and their flying abilities. I drove to his home to see his space-age kite and listen to him describe its performance characteristics. The kite was made of rip-stop nylon, shaped in a combination delta and box form. This type of kite is specifically designed for stability and strong lifting ability in high winds. I agreed we should give it a shot, so we made plans to try it out as soon as possible.

We put together a nice portable station and waited for a good day. Our station consisted of my TS440S, an antenna tuner designed to load a longwire, a four-foot copper ground stake, an antenna insulator, a fishing swivel to prevent twists in the wire, and assorted hardware to connect everything together.

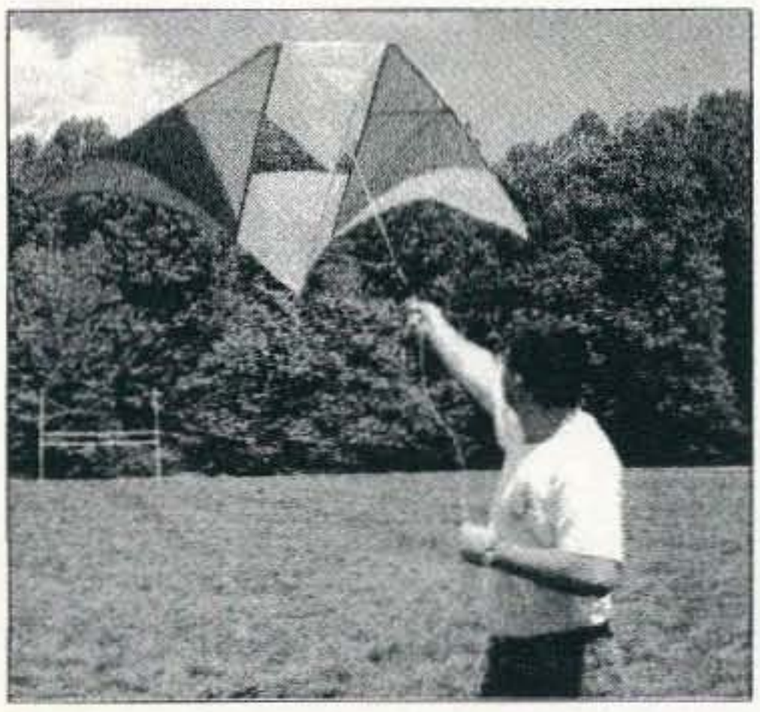

***Photo A.** John Williams N5SJZ launching the 500-foot antenna.*

"Do you think a kite could take up 500 feet of wire?"

We looked at various types of wire. We thought 500 feet of copper wire (even 20 gauge) would be too heavy, so we looked around to see what else was available. Aluminum electric fence wire was light, cheap, and readily available in 500-foot rolls. A good solution.

During the course of our on-the-air discussions we were joined by Glenn Garnes N3UCE, who wanted to participate in our adventure—and let's not forget John's wife, Debby N5SKA.

***Photo B.** Glenn Garnes N3UCE, Joe Nunemaker KD3VR (back), Debbie Williams N5SKA, John Williams N5SJZ (front), working the pileups.*

Did it work?

It was not long before we had a perfect weekend afternoon—sunny, windy and warm. What more could we ask for?

We found a great location for our adventure—the US Naval Academy in Annapolis. The Academy has a large field area right next to Chesapeake Bay, with no power lines anywhere around. We set up the kite in a few minutes and it hauled our antenna up without a hitch. The signals were so strong we had to use the radio's attenuator.

"The signals were so strong we had to use the radio's attenuator."

Our CQs resulted in some nice contacts, and within an hour we had a waiting list. In order for everyone to operate on HF, I was the control operator and we worked under my call for the day. Working 80 meters. we covered mainly the eastern half of the U.S., along with several stations from Canada. Signal reports were 5/7 or above. The antenna and its mount were the topic of the day!

It was an exciting day and we plan to do it again soon. After our outing Glenn N3UCE visited a kite store and bought a 14-foot kite that I'll bet could lift a small child. We're planning to send up 1,000 feet of antenna wire with that kite. Listen up for us. Better yet, buy a kite and join the fun! 73s.

Photos by Glenn Garnes N3UCE and Debby Williams N5SKA.

[Editor's Note: This article originally appeared in *Green Mountain News,* official newsletter of the Green Mountain Repeater Association, Inc. Spring/Summer 1996 edition.] 73

***Photo C.** The rig and antenna tuner. Yep, that's all it took to have a fantastic time—plus the kite, 500 feet of wire, and a breeze.*

Number 33 on your Feedback card

KC2 Multi-Function Transceiver Accessory

The tiny kit that does it all!

Robert S. Capon W3DX
(formerly WA3ULH)
107 Cavalier Drive
Charlottesville VA 22901

If membership in the three-year-old Northern California QRP Club (NorCal) can be used as an indicator, interest in QRP kit-building is making a strong comeback. This year, NorCal membership quietly zoomed past 2,000 members.

One of the key reasons for this enthusiasm in NorCal is the series of innovative QRP kits designed by Wayne Burdick N6KR, made available to club members by NorCal and to the general public by Wilderness Radio. These kits have included the NorCal 40, a 40-meter transceiver that draws only 17 mA, and the Sierra, a multi-band QRP transceiver with band modules, featured on the cover of the *1996 ARRL Handbook*.

Wayne's latest kit is the KC2, a unique multi-function transceiver accessory. The KC2 combines a memory keyer, 4-digit LCD frequency counter, bar-graph S-meter, and a digital wattmeter in a package that draws a meager 7 mA and measures 1.1" x 2.9" x 0.8". This combination makes the KC2 an ideal accessory for QRP transceivers.

Three KC2 innovations

The KC2 employs a number of innovations to address the common problems traditionally associated with QRP frequency counters: size, current consumption, and noise.

To achieve its small size, the KC2 uses two printed circuit boards that are stacked like a sandwich, and held together by nylon nuts, bolts and spacers. Further, the two largest components are mounted piggyback.

To reduce current consumption, N6KR employs carefully chosen power efficient CMOS components, and uses an LCD display. The KC2's current consumption of only 7 mA compares to 100-200 mA for comparable frequency counters. As a result, my Sierra QRP transceiver draws a total of only 40 mA, including the KC2 frequency counter and keyer!

Perhaps the most novel innovation employed within the KC2 is in the area of noise reduction. Most frequency counters must be mounted in an external enclosure because of microprocessor noise leaking into the radio's receiver. N6KR discovered that he could eliminate noise by running the KC2's 4-MHz microprocessor at a sluggish 100 kHz. As a result, the KC2 can be mounted inside a transceiver without the need for any special shielding.

"My Sierra QRP transceiver draws a total of only 40 mA, including the KC2 frequency counter and keyer!"

Frequency counter

The KC2 display default is the frequency counter. The counter is a four-digit LCD display with 0.1-kHz resolution. The display numerals are approximately 0.35-inch in height. A hysteresis technique is used to eliminate flicker of the last digit.

The counter will read VFOs in the range of 300 kHz to 6,400 MHz, making the KC2 usable for most QRP rigs. But be sure to check the user's guide on your QRP rig to make sure that the VFO falls within this range.

The KC2 features four programmable offsets stored in nonvolatile memory to work with multiband, multi-offset radios. This should prove to be overkill for most QRP rigs. The Sierra eight band radio has the most complex assortment of VFO offsets (three) of any rig in my collection. The Oak Hills OHR-400 four-band rig uses the same offset for all four bands.

Programming the KC2 is a snap! To program it, you set your rig to a convenient frequency as measured by your main station transceiver, scroll the KC2 display to match the frequency, and exit set-up mode to accept the frequency. That's it.

Keyer

The KC2 is a respectable memory keyer, but lacks the dazzling array of keying features (like automatic sequencing of serial numbers) found in the CMOS Logikeyer III, which is still my favorite high performance memory keyer.

However, the KC2 does include a 50-character keyer memory with a useful repeat word function and multiple memory partitions. Keyer memories are stored in nonvolatile memory; however, memories do not have separate buttons for each partition. For example, to access memory partition number three, the user presses the keyer button three times.

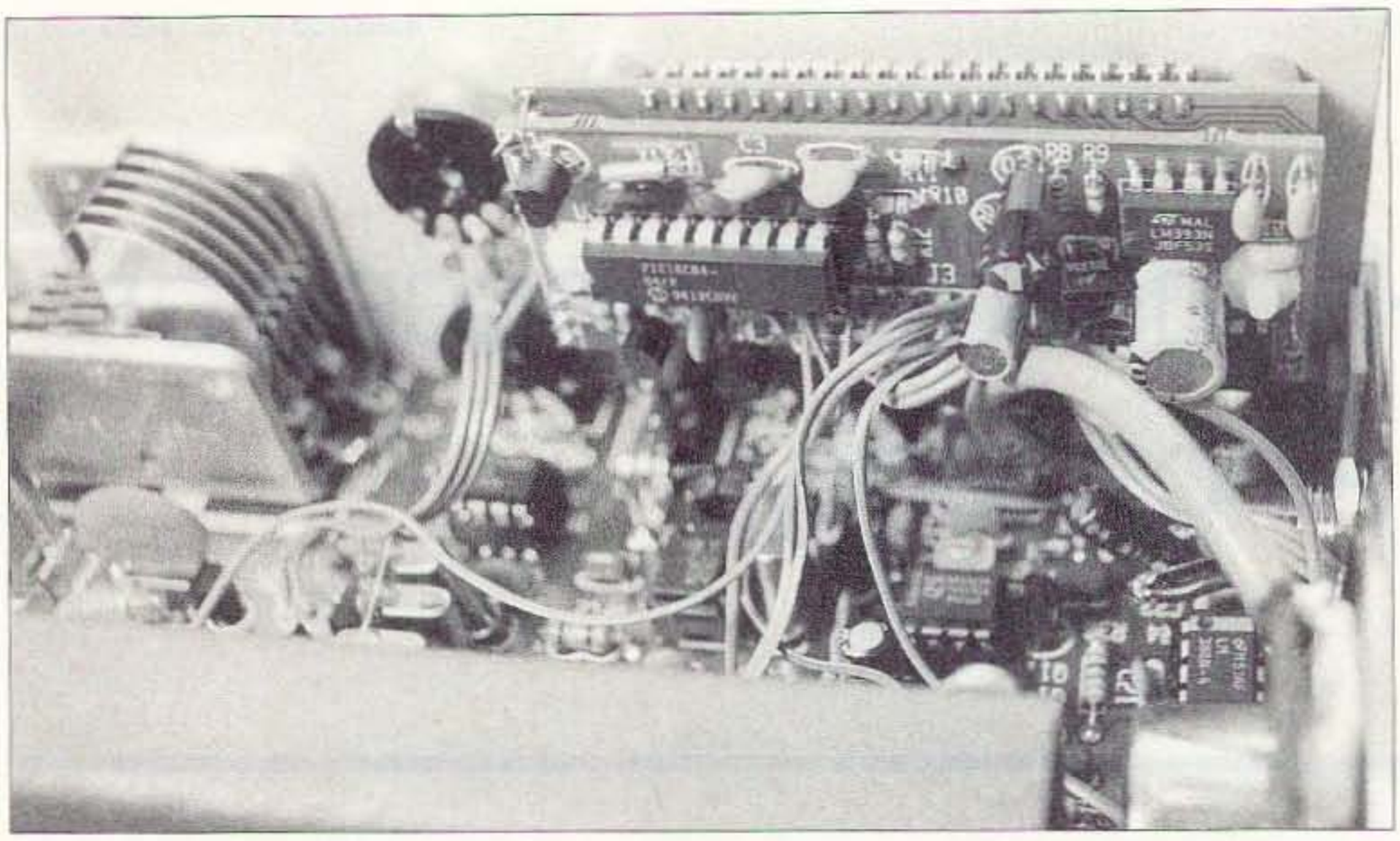

Photo A. The KC2 installed in the Sierra. The board measures only 1.1" x 2.9" x 0.8".

Other KC2 features include emulation for Curtis mode A, CMOS Super Keyer II, and Curtis mode B. The speed range is eight to 50 WPM in two-WPM steps using push-buttons supplied with the kit, rather than a knob. The KC2 also features a weight control with eight selectable keying weight levels.

S-meter

The KC2 includes a nifty S-meter bar graph, along with built-in S-meter circuitry. To access the S-meter, the user pushes a button to toggle between the S-meter and the frequency counter.

The input requirements are an audio signal, in the range of DC to 20 kHz, with any rig that uses audio-derived AGC.

Wattmeter

The KC2 also includes a digital RF wattmeter that measures power in the range of zero to 9.9 W in 0.1-watt increments. To access the wattmeter, the user presses the Speed-up and Speed-down push-buttons at the same time, which holds the key-down in a tune function, and measures the power.

The wattmeter is a little more difficult to use with rigs other than the Sierra, because the builder has to put together a small RF detector circuit with five components (these components are already built into the Sierra).

Construction

The kit comes with only 51 components, and can be assembled in one to two hours by an experienced builder. Interfacing it to your QRP kit is very easy, because you have only a few inputs: 12 Volts, ground, dot, dash, VFO, key, S-meter, RF power.

Mounting the KC2 is also very easy. The unit has four momentary SPST switches that mount on the board, and are used to mount the unit behind the front panel of your rig. The user's guide includes a handy template to locate the mounting holes, which are very easy to locate and to drill. The rectangular opening is much trickier. I cut the rectangle by using a Radio Shack™ nibbling tool to nibble the approximate opening, and care-fully filed the opening to the exact dimensions.

As of the writing of this article, Wilderness Radio was gathering user comments from many of the popular QRP kits, and furnishing interface instructions with the kit. Wilderness Radio has also developed an optional front panel for the Sierra, which is custom punched and silk-screened for the KC2.

On the air

On the air, the KC2 is a pleasure to use. It's really fun to operate my QRP rigs with digital readout. I've especially enjoyed using the RIT feature in my Sierra with digital readout to work split frequency QRP DX with more precision.

The KC2's unique combination of memory keyer, 4-digit LCD frequency counter, bar-graph S-meter, and a digital wattmeter makes it the ideal multi-function transceiver accessory for most QRP rigs. Its low power consumption and small size mean that it can fit in a very small enclosure, bringing the power of digital frequency readout and a memory keyer to field applications like backpacking trips and Field Day.

For more information, contact Northern California QRP Club (NorCal), c/o Jim Cates WA6GER, 3241 Eastwood Road, Sacramento CA 95821, (916) 487-3580. To order ($75 plus $3 shipping & handling), contact Wilderness Radio, P.O. Box 734, Los Altos CA 94023-0734, (415) 494-3806. 73

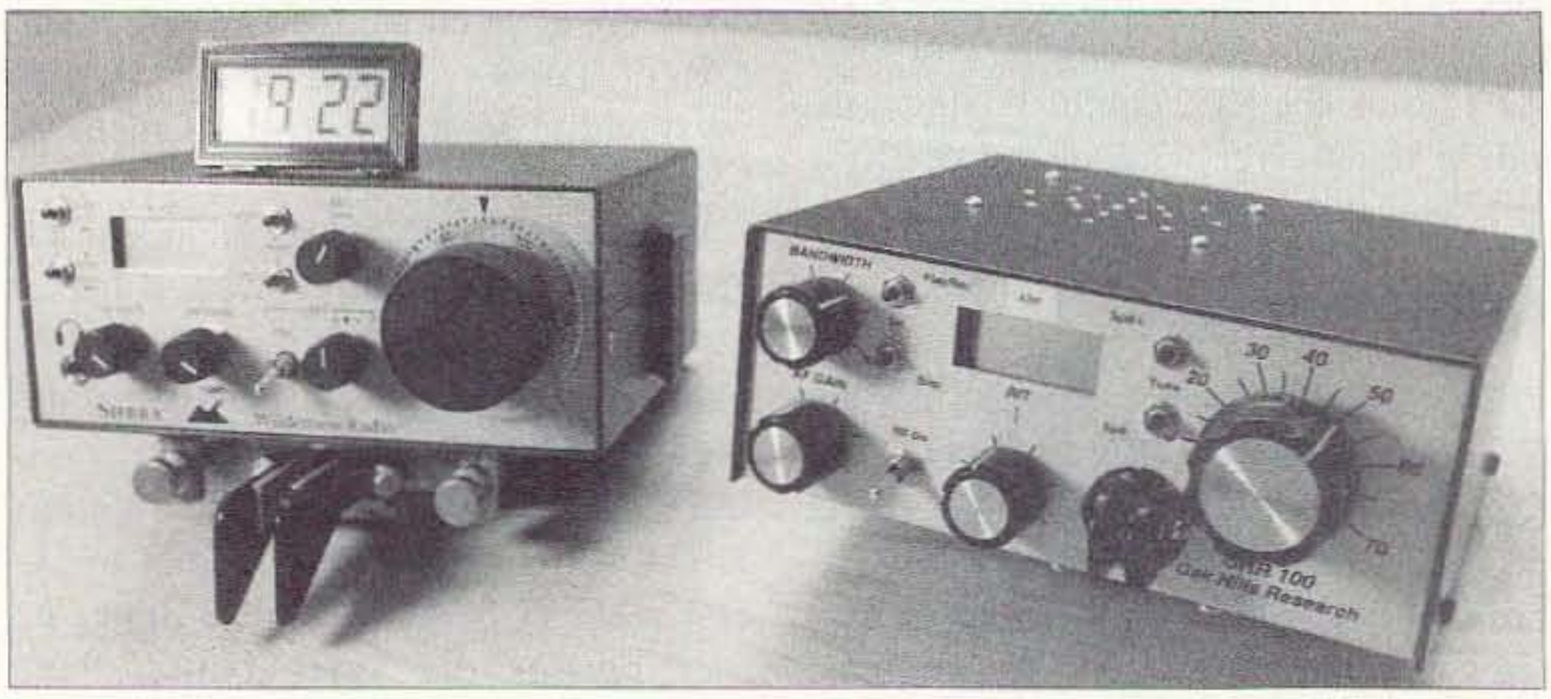

Photo B. The author's highly modified Sierra and Oak Hills Research OHR-100 with KC2.

ARRL Code Survey

Should code be kept as a license requirement?

Alex Haynes AC5HU
Rt. 2, Box 87-C
Eureka Springs AR 72632

It might be news to many of you who are not members of the ARRL, but they are doing an opinion survey about keeping the fast code requirement for earning a ham license.

It may just be my dislike of code showing through, but it seems to me we are long overdue in reassessing the demand that fast code be a requirement for a U.S. amateur radio license.

While code was a necessity for communication in the very early days of radio, it was overtaken long ago by superior technology. And although it is a wonderfully nostalgic way to communicate, in this day and age there is no longer a technical justification for requiring a code proficiency for an amateur license. Sure, I've heard all the arguments over the last 50 years. Some used to make sense, some never did, and a few shouldn't even be mentioned in polite company—so let's leave those until last.

As I understand it, the most important reason code came into use in the early days of electrical communication was the compatibility with the needs of a simple wire-type telegraph system. An on-off signal was the only way to send information, and it worked well. Along came radio and simply turning the carrier wave on and off became the accepted way of transmitting intelligence, just as it had on the telegraph system. Soon, equipment was developed to modulate the RF carrier with sound and AM radio was born. Then FM, single sideband, digital encoding and many other ways were developed to impress intelligence on an RF carrier. My point is, there are many different ways of electronically transferring intelligence and each has its own advantages and disadvantages. Why then should one of them be singled out as the *only* one necessary to master, at a specific speed yet, in order to obtain an amateur license? Code isn't even a technology; it's a psychomotor skill. Thank goodness we don't have an ARRL-like organization controlling our computer hobby, for we all might have to prove we could type 20 wpm on a mechanical computer just because "that's the way Babbage did it." Maybe it's time for the ARRL to adopt a new name more in fitting with their quaint position on code—how about the Antique Radio Relay League? A bit harsh? Perhaps, but at least it would clear the way for a new organization that could speak from a wider perspective, reflecting the views of the vast majority of hams who have chosen not to join the ARRL.

"Maybe it's time for the ARRL to adopt a new name more in fitting with their quaint position on code—how about the Antique Radio Relay League?"

But let's try to understand the logic for keeping a code requirement for ham radio. One claim is that it's a more efficient use of radio spectrum. Something like a 500-Hz bandwidth compared to a 2.5-kHz for SSB. True enough, but since people talk 5 to 10 times faster than they can send code, the real-time bandwidth requirement is comparable for both code and phone. And for digital transmissions, the efficiency of data transfer is many times that of manual CW or phone. But the real hypocrisy of this CW efficiency claim becomes obvious by simply looking at the portions of the 15, 20, 40 and 80 meter bands the code advocates have set aside for themselves. Of course those frequencies are shared with RTTY/DATA, but certainly a "more efficient mode" should not require half of the available spectrum.

Well then, how about communication range: CW is much better, right? Sure, you can often get through with code when you can't on phone and if DXing is your bag, then use the best way available (including digital packet, spread spectrum or whatever) if you want. But why should this justify requiring a code proficiency in order to be granted an amateur license? Why should we even want to force a particular mode of communication on hams? In a free marketplace of ideas, if CW is the best way, wouldn't it come out on top anyway?

All right then, how about "national emergency" communications? Isn't that one of the main justifications for allocating RF spectrum to the Amateur Radio Service? That may have been an

important consideration at one time—long ago. But even our Armed Forces, the Coast Guard and ships at sea have decided to drop code. About the only other people you could communicate with using code would be other hams. Besides, wouldn't the larger number of hams entering the hobby in the absence of a code barrier be a much greater communications asset in an emergency?

Let's face it, for communicating on the go, ham radio has been left in the dust. Most people who want to communicate from cars use cellular telephones. This ought to suggest something to us about where ham radio is headed and just how secure our current frequency allocations might be in the future. Either we increase the size of our lobby or we risk losing our hobby.

How about international treaty requirements? Well, yes, there is an international requirement to send and receive code manually—but there is no speed requirement. The 5, 13 and 20 wpm requirements are arbitrary (and capricious, I believe). They are being forced on the amateur community by a small minority of old fogies in the ARRL and a few dupes at the FCC. The main effect of the code requirement is to reduce the number of licensed amateurs in the U.S.

And now comes the time to discuss what we shouldn't have to discuss. I'd hate to count the times I have heard the sentiment "I had to learn code and so should every one else who wants to be a ham—besides, it cuts down clutter on the bands." A shameful attitude, to say the least. And, of course, readily denied on every official level. Look, the ARRL will say, we sponsor an extensive amateur licensing program intended to increase our ranks. But who, nowadays, really doesn't understand the concepts of hidden agendas, countervailing policies and just plain old-fashioned doublethink? It strikes me that many hams have abandoned most intellectual arguments for code, but still cling to this selfish "I got mine the hard way and so should you" attitude. Many bright young potential hams reject the notion of being forced to master a skill they see as irrelevant—they just don't have time for this nonsense.

Without this unnecessary barrier, how many more hams could we have had by now to build, experiment, innovate, manufacture and buy equipment? Take a look at all the domestic parts and equipment manufacturers that have folded over the last several decades. Then look at some of the Asian countries with minimal code requirements and large ham communities—the ones that produce most all of our new ham equipment.

I certainly don't want to leave the impression I am totally anti-ARRL, because I am not. But it just seems so obvious the ARRL is on the wrong side of the code issue, and they have been for so long, it is difficult to give them the credit they deserve for all the other good they do.

The ARRL's intransigence on the code requirement has caused the unfair exclusion of a significant portion of the public from equitable access to a public resource, and for this the ARRL should be held accountable; it is why I dropped my ARRL membership more than 20 years ago. For this and a variety of other reasons many hams refuse to support the ARRL (only about a quarter of all licensed hams are members) and their claim to represent a consensus of opinion among hams needs to be closely scrutinized. We should not forget the ARRL is a *private* organization and is answerable only to its members, virtually all of whom are licensed amateur radio operators. So how is the voice of the rest of the American public and the other 75% of hams represented in this equation? Well, supposedly through the FCC. But wait a minute, who does the FCC depend on to advise them in setting public policy for amateur radio? Who else but the ARRL?

"A 'more efficient mode' should not require half of the available spectrum."

Most hams (and non-hams) have very little direct voice in setting public policy for amateur radio, except for the occasional congressman who might take an interest in a specific issue (but who probably is also a ham) or a manufacturer with a proprietary interest. So, because of this typical incestuous relationship in which the "public regulator" (in this instance the FCC) becomes a pawn of the supposed "regulatee" (amateur radio special interests), many aspects of public interest issues are never fully explored. If code is so important, why is there no requirement for periodic testing to prove continued proficiency? After all, high speed code is a skill of the use-it-or-lose-it type. It is not the kind of logical intelligence that is learned once and retained for a long time. Fast code must be routinely exercised or is rapidly lost. And this leads to perhaps our dirtiest little secret.

My guess would be that at least half of U.S. amateurs (probably far more) currently are unable to copy code at the speed required by their license class. I doubt the ARRL could prove otherwise. I would go even further and claim most hams don't use any code at all and have lost virtually all ability to send and receive code. So, are we in violation of the intent of "international treaty"? Does it matter? Does anyone care?

Surely the FCC must know the vast majority of licensed hams can't effectively communicate using code. So how can our government continue to bend to the hypocritical demands of the ARRL? The simple answer is they should not and in the long run, they cannot! I would hate to be the bureaucrat assigned to defend the code requirement in court if it ever comes to that. There is no significant data to support the continued need for code, no logical justification based on current technology and, quite to the contrary, a strong case can be made that the code requirement is clearly discriminatory against certain categories of protected individuals.

Don't get me wrong here—I'm all for an incentive licensing system based on technical merit as it relates to the real needs of our hobby—but I do take issue with the requirement to master a long-irrelevant psycho-motor skill which unfairly excludes otherwise fully qualified and capable people from the hobby.

The survey

So now the ARRL has decided to fund a study of our current opinions about retaining the fast code license requirement in preparation for the upcoming World Radio Conference, WRC-99.

Although I have not been solicited to respond to the survey by their contractor (the READEX Company) and am apparently excluded also from replying to their request in *QST* for input from members (presumably ARRL members,

which I am not), I would like to take this opportunity to express my thoughts on the issue.

My initial impression upon reading through the survey form was that several of the questions are so poorly worded as to be misleading and likely will be misinterpreted by many of the respondents. Other questions have multiple premises which offer the possibility of at least four conditions, the responses to which will be impossible to accurately interpret. Many of the other questions seem to be asking virtually the same thing over and over, with most of the possible answers indicating a preference for at least some level of code speed proficiency—not a very good way to get unbiased results.

The likely results of such a survey are rather predictable—ARRL members who have already passed their code test will favor its retention and nonmembers who aspire to upgrade will tend to vote in the opposite direction. Unfortunately, the voice of the vast majority of technically qualified but as yet unlicensed individuals will be virtually unrepresented in the results of the survey. And it is among this last group that we suffer our greatest loss, for it includes many of our newly trained scientists, engineers and technicians, who could contribute greatly to the hobby but who are excluded by the outdated, outmoded and just plain foolish code speed requirements.

The ARRL survey has three sections covering the international requirement for Morse code, U.S. licensing requirements and personal data. The questions are repeated below, along with my comments.

PART I. Morse Code

1. Which of the following two statements is closer to your opinion with regard to a possible change in the international regulations?

A. The Morse code requirement for Amateur Radio licensing is no longer relevant, or soon will not be relevant, in the international regulations. *Comment: This option requires the respondent to make a conclusion about the current position and future action of an international body—a speculation which is beyond his reasonable knowledge. The question is confusing and does not give him a real opportunity to simply select his position, thus likely biasing the overall result.*

B. For the foreseeable future, it is important to retain the Morse code requirement in the international regulations. *Comment: This option, in comparison to the previous one, gives the respondent a simple and direct way to state his opinion—in favor of code.*

2. Please SUPPORT the reasons for your position by indicating your agreement or disagreement with each of the following statements:

A. Each country should be able to make up its own mind whether to have a Morse code requirement, or not. *Comment: Presumably this refers to each country that is a party to the agreement. Since not all countries are, and all countries have a sovereign right to do what they want about requiring code anyway, it seems like sort of an odd issue to pose to U.S. amateurs. Since it is a truism, most U.S. amateurs would probably agree we should not attempt to tell other countries whether or not they should have a code requirement. The real issue is, should the FCC (at the ARRL's urging) require U.S. citizens to learn code at a specific speed of up to 20 wpm? Since the FCC has been requiring this for many decades without any international requirement to back them up, can we now expect the FCC and ARRL to be preparing the way to continue a code requirement in the U.S. even if it is dropped elsewhere around the world? This of course would be really dumb, but it also would be in line with the ARRL's long-standing preference for fast code.*

B. The Morse code is still important because it helps amateurs to communicate across language barriers. *Comment: While it is undoubtedly true that code is "still" used, the issue is one of "importance." Computers and other types of digital communications are far more efficient in this regard. To cling to a requirement for a manual capability to communicate in code for this reason, to the exclusion of other far better methods, is misguided.*

C. The Morse code requirement helps insure that radio amateurs are disciplined operators. *Comment: Clearly, this one is not verifiable in any way, shape or form, and there are just too many glaring examples to the contrary. I also wish all hams to be good and decent people, but code is not the answer to any part of society's ills and it's embarrassing to see hams being asked to parrot such ridiculous claims.*

D. The Morse code is a good thing to know, but it should not be a licensing requirement. *Comment: This is one of several two-part questions that offer four possible outcomes. Suppose someone thinks code is dumb, never uses it and has even lost all code capability, but selfishly wants it retained as a license requirement in order to reduce clutter on the bands? And regardless of how he checks the boxes, they won't have the foggiest idea of what he really thinks. It simply is an example of a bad question.*

E. Knowing the Morse code just isn't important any more. *Comment: This question is an excellent example of steering the respondent to the desired conclusion by a variety of preceding questions stated in such positive terms as to elicit a desired reaction type response. Besides, as in the previous question, simply "knowing Morse code" isn't the issue—using it at a specific speed is, and the speed requirement has nothing to do with international agreements.*

F. If rules for Amateur Radio were being written for the first time today, there would not be an international requirement of Morse code ability for access to the HF bands. *Comment: Again, as in Question 1, the respondent is being asked to speculate and make predictions about the possible actions of an international body of which he has very little knowledge. The value of any response to such a statement is questionable. If the word "should" had been used rather than "would," at least the respondent could have reflected his own opinion in his response.*

PART II. License Requirements

Comment: Almost all of these questions are concerned with current FCC requirements (instigated by the ARRL) relating to code speed and incentive licensing, neither of which results from or has any impact on international agreements. This unfortunate juxtaposition under the guise of preparing for WRC-99 serves to reinforce the erroneous association in many hams' minds that code speed licensing requirements are somehow a result of international agreement. Again, this is an example of steering the respondent and, unfortunately, there is no way to eliminate the resulting bias from the results.

PART III. Personal Information

Comment: Somewhere among all these demographic questions about age and license class, etc., it would have been instructive to have asked about the respondents' real code capabilities at present, educational attainment and technical contributions to the hobby, such as patents and papers.

So what will the survey really contribute to the body of facts that should be used in developing our position on code for WRC-99? Apparently very little. Our position should be based on what is good for amateur radio, and not on the desires of a small proportion of hams—hams who simply want to protect or enhance their own privileges.

The real issues used to decide our position should be ones of fact, such as:

• How does a code proficiency contribute to amateur radio?

Facilitates international communications.

Provides somewhat longer-range communications.

• How does a code requirement detract from amateur radio?

Excludes a large number of technically qualified individuals from the hobby.

Has resulted in underutilization of frequencies and their loss to commercial interests.

Has contributed to the erosion of U.S. amateur radio equipment development and manufacturing capabilities.

Has slowed the development of competing technologies for impressing intelligence on RF carriers.

Discriminates against some handicapped individuals.,

Too bad the ARRL survey will not be able to provide meaningful data on the really important issues. Let's hope the U.S. representatives to WRC-99 will be able to see beyond any misguided attempt to influence their recommendations with "cooked" survey results and act in the best interests of all our citizens, not just currently licensed hams. 73

NEVER SAY DIE

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are also not available to the public? That's weird! It's almost enough to make someone suspicious.

Bill, who worked for Rocketdyne for seven years, designing and building rockets for NASA, had his curiosity aroused when he heard that the lunar missions would be using rocket engines which he knew were far too small to lift the lunar payloads. The larger engines, which had been designed to take people into space, had all failed. 13 consecutive failures! He knew that the smaller engines that were being used couldn't possibly do more than lift a rocket with no payload. Hey, what's going on here? And then, after this long string of failures, the moon missions came off one after the other like clockwork. Hmmm.

It's sure an interesting book, but since you know that your government could never keep anything this big a secret, you probably won't want to bother reading it. Just chalk this up to poor old Wayne falling out of his rocking chair and probably hitting his head. Or being incredibly gullible.

If you'd like to read Bill's book I'll have him make up some copies. $25, plus $3 s/h from Radio Bookshop, 70N202, Peterborough NH 03458. Cash, check, money order, Visa, MasterCard, or what have you to swap?

Scientist Welfare

Congress sure has a lot of fun spending our money. Being interested in science, I almost get upset when I see Congress throwing money away on projects that don't make good scientific sense. Sure, I realize that Congress is made up mostly of used lawyers who haven't a clue when it comes to science, so they can be easily gulled by our beloved scientific establishment. You know, the turkeys who have managed to ignore virtually every major scientific discovery in history.

So they blew a few gigabucks on that big hole in the ground down in Texas. The supercollider. And they're still throwing gigabucks at the NASA Mars project. Did

anyone notice that Russia got all over their desire to send men to visit other planets when they found out that their astronauts would get fried by solar flares if they ever ventured outside the protection of the Van Allen belt? The Russian space effort is just about closed down now. Oh, they have the money, if they want to use it—I notice that they haven't slowed down on their building of new and more advanced nuclear submarines. Hmm, I wonder what they need *those* for?

Then there's that $200 million shoulder of pork being spent on the HAARP deal in Alaska. I've mentioned this scam before. The idea is to shoot 1.7 billion watts of RF into the ionosphere and let's see what happens. That's a lot of juice, but it's a piffle in the wind compared to the soup arriving from the sun from solar flares.

There are a bunch of basic research projects which really could use some funding, so I hate to see Congress blowing money on pork fat like the Alaskan HAARP and Mars charades.

Pork Chop Hill

Despite all that campaign rhetoric about the deficit and cutting the budget, the guys you recently blindly re-elected (despite my warnings), have been busy pigging out on your money. As hams, I suppose we should be tolerant of pork, such as the $25 million for our wonderful friends in North Korea. Hey, we sure don't want to watch our good communist buddies go broke building tunnels under the DMZ, right?

How about $1.9 million to supervise a Teamsters election? Or $3 million for a New Orleans Jazz Historical Park. And $1 million for the Center for Irish Management. Hmm, are those pesky Irish getting that far out of hand? Or around a half mil for the Applewhite Picnic Area in California. And $8.6 million for anti-terrorist operations by the National Park Service. So *that's* where the terrorists are concentrating their efforts! Manhattanites, you can relax.

Hey, it's *your* money they're having all that fun with. Next time get out there and vote and be sure to Never Re-elect Anyone (NRA). Let's flush that lousy Washington toilet and send all those professional politicians home to find honest work. Back to their law firms.

Superhuman

Every now and then I read about someone doing something superhuman under extraordinary circumstances. A mother lifts a car off her child, for instance. And many hypnotists have demonstrated amazing feats of strength or enhanced other abilities with their subjects. LSD users will tell you about their incredibly enhanced senses of taste, smell, hearing, and extrasensory perception (yes, I did LSD back in 1960 and it was an incredible experience!).

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Are You Ready To Recharge?

Learn about a new battery technology—then build the project to utilize it.

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One of the fun aspects of ham radio is that electronics technology changes so fast. It seems every week a new product is announced that can affect ham radio—I recently learned about a relatively new battery technology and discovered a chip that I could use to build a charger for this battery. If you're not familiar with "rechargeable alkaline batteries," read on. I think you'll agree that they offer advantages for the radio amateur.

Building the charger is an easy project and the batteries are inexpensive. Once you've built the charger you can try using rechargeable alkaline batteries and see how well they perform for your applications.

What are rechargeable alkaline batteries?

The technology for these batteries is quite new—it was developed in 1986 by Battery Technologies, Inc., and the batteries were first introduced in September of 1993 by Rayovac™ under the brand name RENEWAL© (several other manufacturers are also producing rechargeable alkalines now). A charging chip, the bq2903, was released to the industry and to the public by Benchmarq™ in the spring of 1996. Prior to this only the Rayovac recharger was available.

Normal alkaline batteries are "primary" batteries; that is, you use them until they are dead, then throw them away and go buy more... and more and more. Rechargeable alkaline batteries are modified alkaline batteries which, like NiCds, are "secondary" batteries that can be used over and over, but their features are quite different. Under the right conditions rechargeable alkaline batteries can be used and recharged hundreds of times. Under the *wrong* conditions they can be destroyed after only a few uses.

These batteries are still new enough that you might have to hunt a little for them; they can be found at mass marketers like Wal-Mart™, KMart™, Target™ and ACE™ hardware. I also found some at the local supermarket but could not find any at Radio Shack™. To raise consumer awareness, Rayovac has been running an ad campaign for them featuring Michael Jordan, so you may soon be seeing more of them.

"If you use a NiCd charger to charge rechargeable alkaline batteries you'll kill them."

Why would you want rechargeable alkaline batteries?

• Compared to using alkalines, you could save money. A package of 4 primary AA alkalines costs about $2.80, while four rechargeable alkaline batteries cost about $5.50 and four NiCds are about $10.50. If you have an application that needs 5 volts at 125 mA and runs only half an hour a day, over three years you will have to buy 34 sets of 4 alkaline batteries at a cost of $95.20. With proper care, the rechargeable alkaline batteries should still be good and you will have saved $90. The NiCds would also be good but the rechargeable alkaline batteries are still less expensive.

• Compared to NiCds, they have a much longer shelf life. This means you can depend on them when you need them. Fully charged rechargeable alkaline batteries will still have 96% of their charge after sitting around for a year. If you leave fully charged NiCds unused for only three months, you will have to recharge them before you can use them because they will only have about 25% of their capacity left.

• They are environmentally friendlier than NiCds because they contain no cadmium—and you discard fewer of them than you do primary alkaline batteries.

The right conditions

Each battery system has different strengths and weaknesses. Selecting the best battery for a particular application requires knowing the right conditions for a particular battery. Rechargeable alkaline batteries work best under the following conditions:

• *Low current use*

Because of their construction rechargeable alkaline batteries have a rather high internal resistance. For this reason they work best when the current draw from them is limited to a few hundred milliamps. A continuous current draw of less than 400 mA is best although they can supply up to 1 amp in instantaneous peaks with a reduced voltage. Studies done by Rayovac show that a rechargeable alkaline battery which is always deeply discharged (to 0.9 volts) before it is recharged will lose about half of its initial capacity by the 25th use. Even so, at low current levels the overall capacity available for the first 25 uses of rechargeable alkaline batteries is about equal to that of 10 primary alkalines and as good as or better than NiCds, even

assuming NiCds lose no capacity with use (see **Table 1**). This might be considered a worst-case use (under proper use) of the batteries.

• *Recharge often*

Rechargeable alkaline batteries like to be recharged often—exactly the opposite of NiCds which can lose capacity from "memory" effect if they are not fully discharged before being recharged (see Author's Note). Rechargeable alkaline batteries gain capacity from frequent recharging so you don't have to worry about doing it too often.

Rayovac conducted a test in which batteries were discharged at 400 mA for 10 minutes and then immediately recharged. This cycle was repeated several hundred times with no significant change in cell response observed. In this case the battery capacity was greater than 53,000 milliamps/hours, 26 times as much as for a primary alkaline battery. This is probably a best case for the battery, but under proper care you could get somewhere between 10 and 25 times the life of a primary alkaline battery.

• *Recharge properly*

NiCd chargers use a constant current charge technique and measure either cell voltage or temperature to terminate the charging. If you use a NiCd charger on rechargeable alkaline batteries you'll kill them quickly. The proper method is to pulse the current to the battery and in between pulses check the no-load cell voltage. The average pulse current needs to be reduced as the battery voltage increases to avoid overcharging. This project uses the proper charge method.

• *Avoid deep discharging*

Rayovac and Benchmarq both clearly state: "The most important factor in maximizing the cycle life of reusable alkaline batteries is the avoidance of overdischarge or cell reversal." We have seen that cycling batteries to 0.9 volts gives less capacity than short cycling. Discharging below this voltage level will significantly shorten battery life. NiCds, too, are injured by overdischarging and cell reversal, but it appears that for rechargeable alkaline batteries the damage is much more severe; that's why the Benchmarq charging chip is designed to be used *with* the battery pack, when the battery pack is in use, to prevent overdischarging.

We've focused on AA batteries. C and D cells will have more capacity than AA cells but the optimum rate of charge and discharge appears to be about the same as for AA cells. This means that you will get more hours of use from the larger sizes—but probably not much more peak current output. The charging circuit (**Fig. 1**) will work with the larger sizes but it will take longer to fully charge the batteries.

Current Demand	100 mA	300 mA
Alkaline Primaries	2,100 mAh	1,550 mAh
Rechargeable Alkalines	25,000 mAh	15,000 mAh
NiCds	17,500 mAh	15,000 mAh

Table 1. *Comparison of cumulative battery capacity over 25 uses (discharging to 0.9 volts with each use).*

Charging the batteries

When you first power up the charger, it checks to see if any cell has a voltage of less than 0.4 volts, and indicates a defective cell fault by flashing the "CHG" LED. If no cell is less than 0.4 volts and the voltage at pin 13 is 2.7 volts or more, it starts the charge cycle (the "CHG" LED is on continuously, not flashing). The bq2903 uses a pulsed current charge method. An internal FET is switched on for 7.5 ms and then off for 2.5 ms by circuitry internal to the bq2903. The chip monitors the voltage of each cell between pulses.

Note that the charge current is applied to the whole stack of cells at pin 14 and not to each individual cell. Pins 1, 2, and 3 are used only to monitor each cell's voltage—a compromise, because ideally each cell should be charged and monitored. This compromise is quite acceptable as long as cells are matched. Charging new and old batteries in the same stack is not recommended, because of their change in capacity. If, during charging, the bq2903 measures any cell voltage greater than 1.63 volts, it skips charge pulses until all the cells drop below 1.63 volts, or until so many pulses are skipped that the average pulse charge rate is 6% of the maximum charge rate. At this point charging is terminated. The "CHG" LED turns off and the "DONE" LED turns on.

After charging, the charger stays in the monitor mode checking battery voltage. A trickle charge is not needed as it is for NiCds because of the very low discharge rate of rechargeable alkaline batteries. If the batteries were left in the charger for a very long time, and all cells fell below 1.4 volts, the charger would initiate another charge cycle.

R3, R4, and R5 limit current to the chip. The capacitors are for transient suppression.

If you wish to modify the circuit to charge only three cells, you can do this by disconnecting Nsel (pin 4) from Bat1p (pin 14) and connecting it to Vss (pin 10 or 11). You also need to connect pins 2 and 3 since only 3 cells are in use.

The maximum recommended charge rate for the bq2903 is 400 mA and the maximum voltage is 10 volts. The power source must limit both. A minimum of 8 volts is necessary for four cells. Lower charge currents will permit deeper recharging. I decided to limit current to about 300 mA. 12-volt transformers are inexpensive and readily available so I used one for my power source. Since wall transformers do not regulate the output voltage nor limit the current, I used two LM317 regulators to limit the maximum current to 300 mA and maximum voltage to 9 volts.

It is possible to use a standard four-cell battery holder with the charger but it must be modified—and that may be difficult. The need to measure the voltage of each cell requires that a wire be soldered to each spring terminal of the holder. I succeeded once but another time the heat melted the plastic and I ruined the holder. Using four single-cell holders will permit access to each cell (**Photo A**, **Photo B**).

Using the bq2903 to control end-of-discharge voltage

You can remove your batteries from the charger and use them when they are charged. If you follow the guidelines, you should get a long life from them.

If your application has room to include the charger circuit, the bq2903 will also monitor the cell voltages as they are discharged and disconnect the battery source from the load when the voltage drops to a set level. Pin 5 is used to set the shutdown level. Because the voltage is being monitored under its discharge load, the measured voltage will appear lower than the actual cell voltage. For best results, that end of discharge voltage should be set as shown in **Table 2**.

The bq2903 terminates discharge by disconnecting the internal discharge FET and entering a standby mode drawing only 1 µA.

Component Values for Schematic (all 1/4 watt)	
R1, R2	620 ohm
R3, R4, R5	1 k
C1	1 µF
C2, C3, C4, C5	0.1 µF
D1	Red LED
D2	Green LED

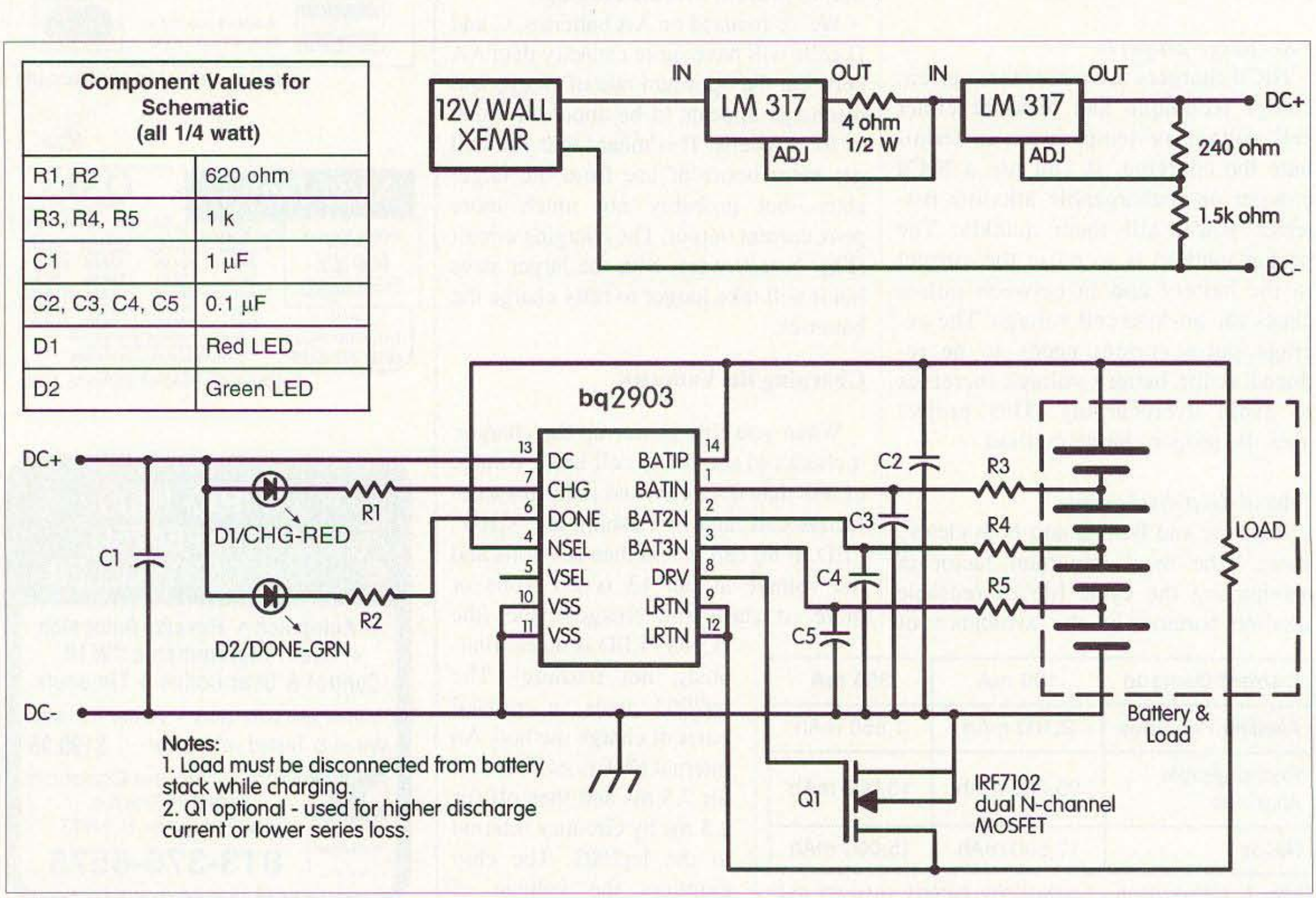

Fig. 1. The author's charging circuit.

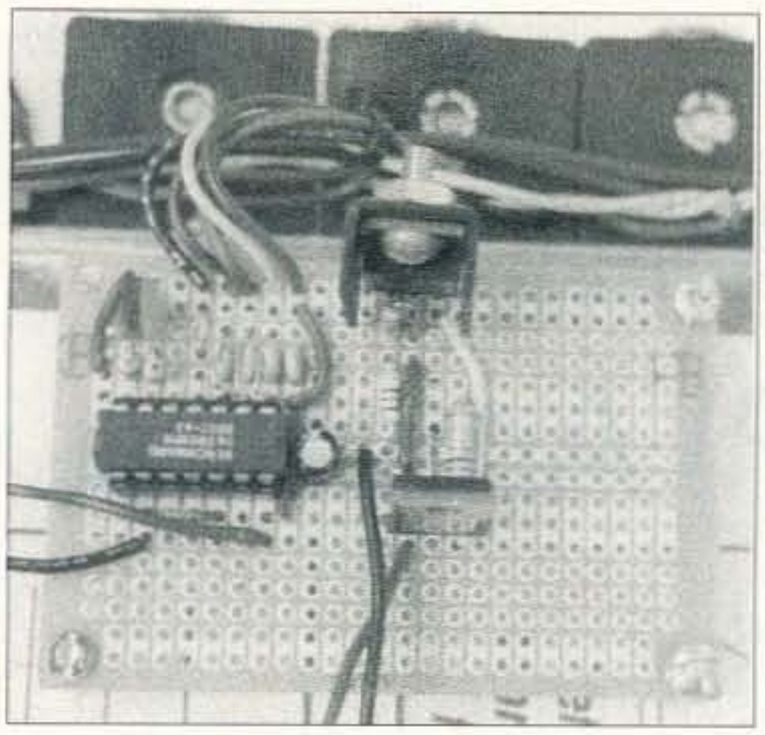

Photo A. *A prototype recharger, built on a Radio Shack universal PC board.*

The discharge FET is between the load return and Vss (the bottom of the battery stack). The resistance of the internal discharge FET is about 1/2 ohm. Discharge loads should be limited to 500 mA. At higher loads it is possible to use an optional external FET in parallel with the internal FET. Pin 8 is used to control the gate. If you are not using an external FET then leave pin 8 unconnected. The external FET must be a low resistance logic level FET, like the type shown in the schematic.

I've been using rechargeable alkaline batteries for about a year. I have not done scientific testing—I'll leave that to the engineers, but I *have* tried them in a variety of situations.

I've used rechargeable alkaline batteries to power the "SMALL" audio amplifier circuit (*QST*, June 1996) I built (with the 7805 removed). The "SMALL" can require peaks of 400 or more mA. I found no difference in audio volume (which depends on input voltage) between using rechargeable alkaline batteries and NiCds. I have let it sit for long periods with rechargeable alkaline batteries in it and occasionally turn it on. It still sounds good.

I've used rechargeable alkaline batteries in my handheld GPS. If you have one you know that they eat up batteries at a rapid rate. Primary alkalines lasted about 10 hours. NiCds and rechargeable alkaline batteries both lasted about half as long. If you plan to use your GPS only for short periods and then store it for a few weeks, rechargeable alkaline batteries will keep it ready to go.

Life-testing batteries takes a long time and there are many variables. I'd be interested (and I suspect *73* would be, too) in hearing what those of you who do this project learn. No one battery is perfect, but knowing *which* one is the best for an application can help you get the most from these expensive power sources. For those of you who are inter- ested, more information may found on the World Wide Web: http://www.rayovac.com/business or http://www.benchmarq.com.

The bq2903 is only available from wholesale distributors at this writing. However, a parts kits with PC board and all the parts shown in **Fig. 1** except Q1 and the wall transformer are available from me for $17.50 including shipping (Florida residents please add sales tax).

Author's Note: There are various opinions on memory effect: Recently a column in QST *(October 1996) suggested that memory effect does not normally occur. I offer this, based on a statement by John Wettrroth of MAXIM, who wrote in "Ideas For Design"* (Electronic Design *Magazine, January 22, 1996): "The microcrystalline cadmium in a NiCd battery's anode will slowly begin to change if left undisturbed. Tiny crystals in the metal coalesce into larger ones, producing an increase in battery resistance that lowers the terminal voltage. This effect can become noticeable when repeated partial discharges leave the lowest layers of cadmium unaffected ... as a result, a full discharge eliminates the reduction in terminal voltage, sometimes (erroneously) called the memory effect."* 73

For discharge rate of	End of discharge voltage (per cell)	Connect Vsel to
50 mA	1.1 volts	pin 14
100 mA	1.0 volts	not connected
more than 200 mA	0.9 volts	pin 10 or 11

Table 2. *End of discharge voltage.*

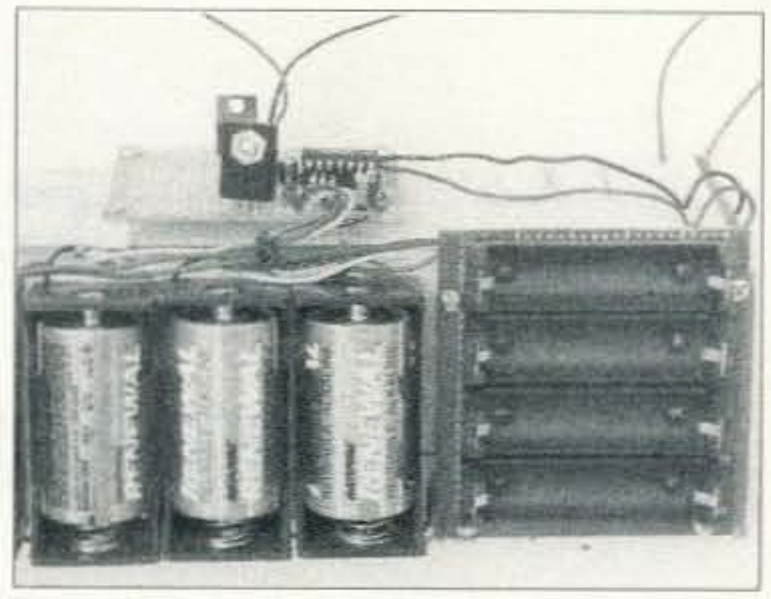

Photo B. *Notice the recharger is set up to charge either "AA" or "C" batteries.*

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Then there are people with special abilities—math, memory, musical, etc. Prodigies.

All these experiences tell us what the human body/mind is capable of doing. The question is, how? If we can understand how people can do these things, perhaps we can harness it for everyone's benefit.

Let's also include "spontaneous cures" for serious illnesses, while we're at it.

You don't have anything better to do, so get busy on this.

Virus!

We all catch colds and the flu every now and then, right? While we're able to catch germs and viruses in different ways, generally we think of it as being through physical contact, or perhaps airborne (like from a sneeze or cough).

I've had less trouble with catching colds since reading an article which recommended shaking hands with the right hand and using the left to touch my nose or lips. At trade shows, hamfests, and conferences I try to remember this warning, and it's pretty well ended my coming back sick after shows.

Of course another pretty good way of avoiding colds and flu is to keep your immune system strong and avoid stress. I do my best to keep my immune system strong by getting the best air, water, and food I can, by adding missing minerals and vitamins to my diet, and by avoiding obvious poisons such as nicotine, alcohol, mercury (via dental fillings), root canals, aspartame (a.k.a. NutraSweet™) and electromagnetic fields.

I get out there and exercise every day, letting some of those valuable sun UVs into my eyeballs.

But there's another source of viral contagion which has been hushed up by our trusted medical industry. I got the first hint of this when I read the Hoyle-Wickramasinghe book, *Diseases From Space*, which showed that most of the world's more serious plagues started

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Top-Fed, Out-of-Phase, Phased-Verticals (TOP) Antenna

Computer simulated and field tested.

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Here's a new, simple phased-verticals antenna that is easy to build and which does not require ground radials or a counterpoise. The antenna consists of two half-wave radiators with a 180-degree phase difference that is fed at the top with 50 ohm coax. Computer simulations and prototype tests show an SWR of less than 1.4 to 1 and the radiation to be a bi-directional figure-8 pattern that is in line with the two vertical radiators.

HF possibilities are appealing because no radials are required and the separation between the verticals is quite small. In fact, it can even be made to rotate (only for an unguyed tower) by attaching the antenna to the boom of a yagi. Or, the antenna can be turned to the horizontal position for an end-fed two-element out-of-phase bi-directional antenna.

In the VHF frequencies, where the antenna is suspended several wavelengths above ground level, the TOP antenna will not match up to the gain of a yagi; however, it will have a couple of dB gain over a J-Pole antenna. The bi-directional nature of the radiation pattern makes it an ideal antenna for stations located between two major cities.

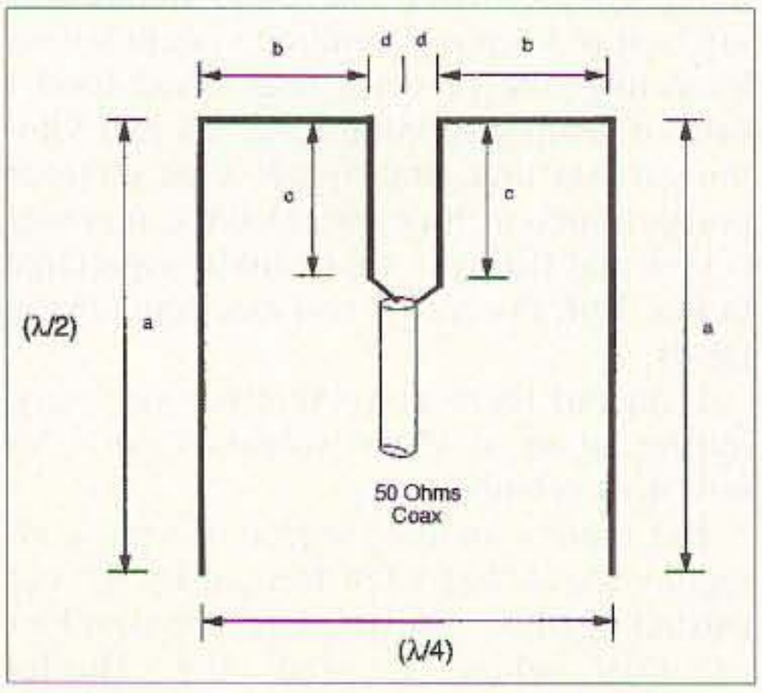

Fig. 1. *The TOP antenna, showing the approximate dimensions and the feedpoint. Values for the different lengths and spacing are shown in* ***Table 1****.*

Just the facts

Radiation patterns from phased verticals vary, depending on the spacing between the verticals and the phasing of the radiators. The feedline coming from the transmitter has two lines which are 180 degrees out of phase at any one time. Therefore, feeding the two vertical elements with each end of the feedline automatically causes a 180-degree out-of-phase feeding of the two elements of an antenna.

Most phased verticals have feedpoints at the bottom, with feedlines of different lengths to provide the phasing and extensive ground systems. Unfortunately, the wires that connect the vertical radiators carry a fair amount of current close to the ground and the radiation from these wires is absorbed by the ground. Feeding the antennas from the top elevates the high current points to a higher level away from the ground and keeps the current at the ends near the ground very low. Therefore, most of the radiating power of the antennas is raised above ground level for effective radiation of the signal and no ground radials are required. The design described here is simple, easy to build, and provides some gain and directionality in-line with the two phased elements. Additionally, it can be fed directly with 50 ohm coax for a low SWR, and overcomes some of the complexities inherent in these antennas.

The design of the TOP antenna is shown in **Fig. 1**. The antenna is basically two half-wave vertical radiators fed at the top with a feedline and impedance matching section that is part of the antenna. The shape of the antenna resembles the letter "m" and is symmetric about the feedpoint. The dimensions of the antenna are shown in units of wavelengths for illustration purposes. In theory, the lengths of the vertical and the horizontal sections can be any size; however, the radiation pattern and the feed impedance will change depending on these dimensions. With larger spacing, a significant amount of horizontally polarized signal will be radiated by the top horizontal feed section. Closer spacing will increase the gain but lower the feed impedance.

Getting creative

Using the AO computer program, I simulated a compromise design which trades some of the gain for ease of feed of the antenna. This design utilizes two half-wave verticals with a spacing of a quarter wavelength, and a feed system with impedance matching, to provide a feed impedance of 50 ohms. The matching section is folded down from the top as shown in **Fig. 1** to keep the total design compact.

Dimensions of Sections **a**, **b**, **c**, and **d** can be computed easily using the following equations, but there will be some deviation from these values, especially in the spacing **d** (impedance at the feedpoint). The values below will also need to be adjusted for the thickness of the wires used in the antenna. The values

shown below are for use with #12 wire.

$$a = \frac{468}{f} \qquad b = 0.160a$$

$$c = 0.36a \qquad d = 0.05a$$

where f is the frequency in MHz , and a, b, c, d are in units of feet. The size of the conductor will influence the above dimensions, especially d, which is responsible for the impedance matching.

Computer simulations of the TOP antenna

The computer simulations for **Fig. 1** (AO Program) were carried out for a perfect ground system with the antenna being one inch from the ground. A similar set of simulations were carried out for a quarter-wave ground plane antenna at the same height above ground for comparison purposes. Simulations were carried out for several different HF and VHF frequencies and the typical values useful for different bands are shown in **Table 1**. Additionally, the VHF antenna was built and tested and the results are compared to the simulations.

Computer simulations of the 20-meter TOP antenna

Using normal ground rather than perfect ground, initial computations for a 20 meters version were done using the AO program, but the final results were made using the NEC-2 program, which is better for computing the losses due to close proximity of an antenna to the ground. A center frequency of 14.2 MHz was used and the dimensions used for the antenna are as shown in **Table 1**. A quarter-wave ground-plane antenna was also simulated and the results of the two antennas are shown in **Fig. 2**. Both antennas were simulated with their lowest point being one foot off the ground. Horizontal radiation patterns show a classic figure-8 radiation pattern in-line with the two vertical radiators for the TOP antenna. (The radiators are positioned north-south.) Vertical radiation patterns show the higher gain for the TOP antenna compared to the quarter-wave ground-plane. At the five-degree angle of radiation, the TOP has approximately 4.5 dB more gain than the quarter-wave ground-plane. Also, the front-to-side comparison for the TOP antenna shows a 13 dB difference.

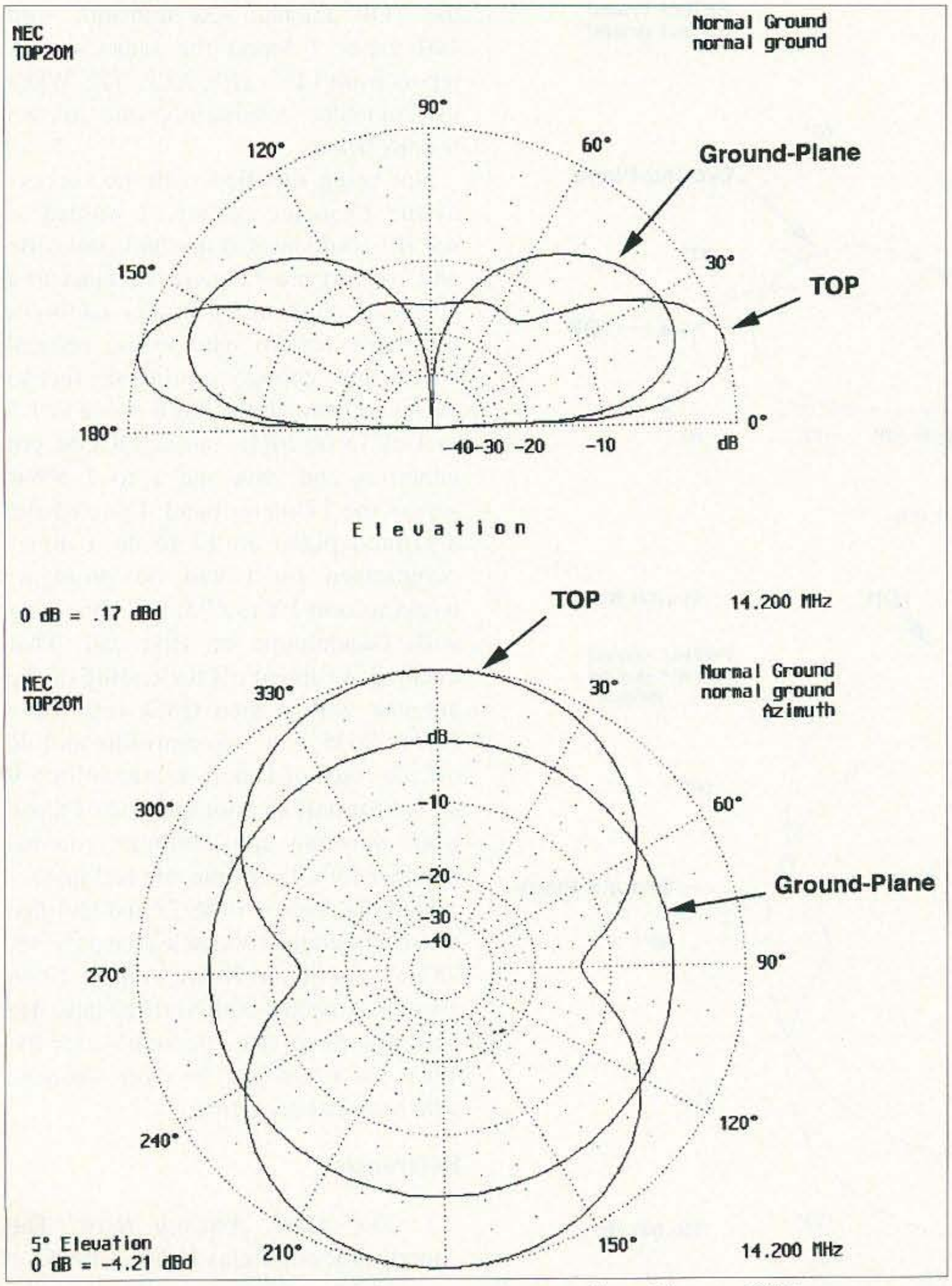

Fig. 2. Simulations using the NEC-2 computer program for a 20-meter TOP antenna compared to a quarter-wave ground-plane at a height of one foot above normal ground for both antennas.

Computer simulations of the 2-meter TOP antenna

The TOP antenna was also simulated for VHF operation, using a center frequency of 146 MHz (dimensions used in this simulation are shown in **Table 1**), along with a quarter-wave ground-plane antenna. Both antennas were positioned one inch above perfect ground for gain calculations. The radiation pattern is shown in **Fig. 3** with superimposition of the radiation pattern of a quarter-wave ground-plane antenna as a comparison. As expected, the two half-wave radiators provide a lower angle of radiation with a gain of approximately 4.5 dB over a quarter-wave vertical antenna. The radiation pattern is a figure-8 shape with the maximum radiation occurring in-line with the two vertical elements. According to the simulation program, the impedance at the feedpoint is approximately 45 ohms for 3 inch separation (d=1.5 inches) of the wires in the matching section. This impedance increases to 51 ohms with 4 inch spacing (d=2 inches) between the wires. Additionally, the SWR can be adjusted by increasing or decreasing the length of the vertical radiators.

Testing the 2-meter antenna

I built (with the help of WA5TWT) a 2-meter TOP antenna using the

dimensions shown in **Table 1**. The basic structure was built of wood and #12 wire. The antenna was fed directly with 50 ohm coax and the length of the vertical section was adjusted to lowest SWR by pruning the length. The measured SWR was less than 1.4 to 1 for operation within 2 MHz of each side of the center frequency. Rotation of the antenna yielded a bi-directional figure-8 field-strength pattern, as expected from the simulations. Field strength meter readings showed a front-to-side ratio of ten to one. Operation of the antenna at approximately six feet off the ground, with 3 watts of power, produced full quieting signal into a repeater 15 miles away and repeaters as far away as 40 miles could be used. When the antenna was rotated 90 degrees, the signal level decreased by approximately 15 dB and white noise was noticeable on the signal (courtesy K5HFY and N5EM).

Author's Note:

Since the original writing of this article, I have built 15-meter and 17-meter TOP antennas and tested them. The 15-meter was first laid out on the ground, assembled, and then raised over two branches of a tree in my back yard with the help of a slingshot and rope. The antenna was pointed north-south, of necessity.

I connected the coax to my Autek SWR analyzer and adjusted the lengths of the vertical sections to get the lowest SWR of 1.4 to 1 at 21.15 MHz. I fired up my ICOM 738 and it showed an SWR of less than 1.7 to 1 across the whole band with an SWR of 1 to 1 from 21.1 to 21.4 MHz. I didn't even need my automatic tuner to load up this antenna.

I always test my antennas using a reference quarter-wave ground plane antenna. First, I did a receive test, switching back and forth between the TOP and the quarter-wave ground plane. The South American stations were coming in one to two S-units stronger with the TOP antenna. On transmit, with 100 watts, I found the same sort of report from LU7, ZP5, XE2, TI2, WDØ in Colorado; consistently one to two S-units better.

Not being satisfied with the success of the 15-meter antenna, I wanted to see if I could stretch my luck and little and convert the 15-meter antenna to a 17-meter antenna by simply adding a few more feet of wire to the vertical wires. Sure enough, adding six feet to each end brought the SWR down to 1.5 to 1 at 18.09 MHz and my ICOM got generous and gave me 1 to 1 SWR across the 17-meter band. I don't have a ground plane on 17 to do a direct comparison by I had no problems working into PY1, ZP5, or connecting with Guadeloupe on first call. That evening, I capped off the testing of the antenna with a nice QSO with Tony N5ZIT/MM, who was maritime mobile off the coast of Brazil. It was solid 5-9 signal for half an hour and one of those heart-warming conversations you remember for a long time. He had just received his August 1996 *73* and had just finished reading my article (see page 16, *73 Amateur Radio Today*, August 1996) about Vee beams with vertical tails. He was pleased to meet an author over the ether and I was glad to meet someone who had read my article.

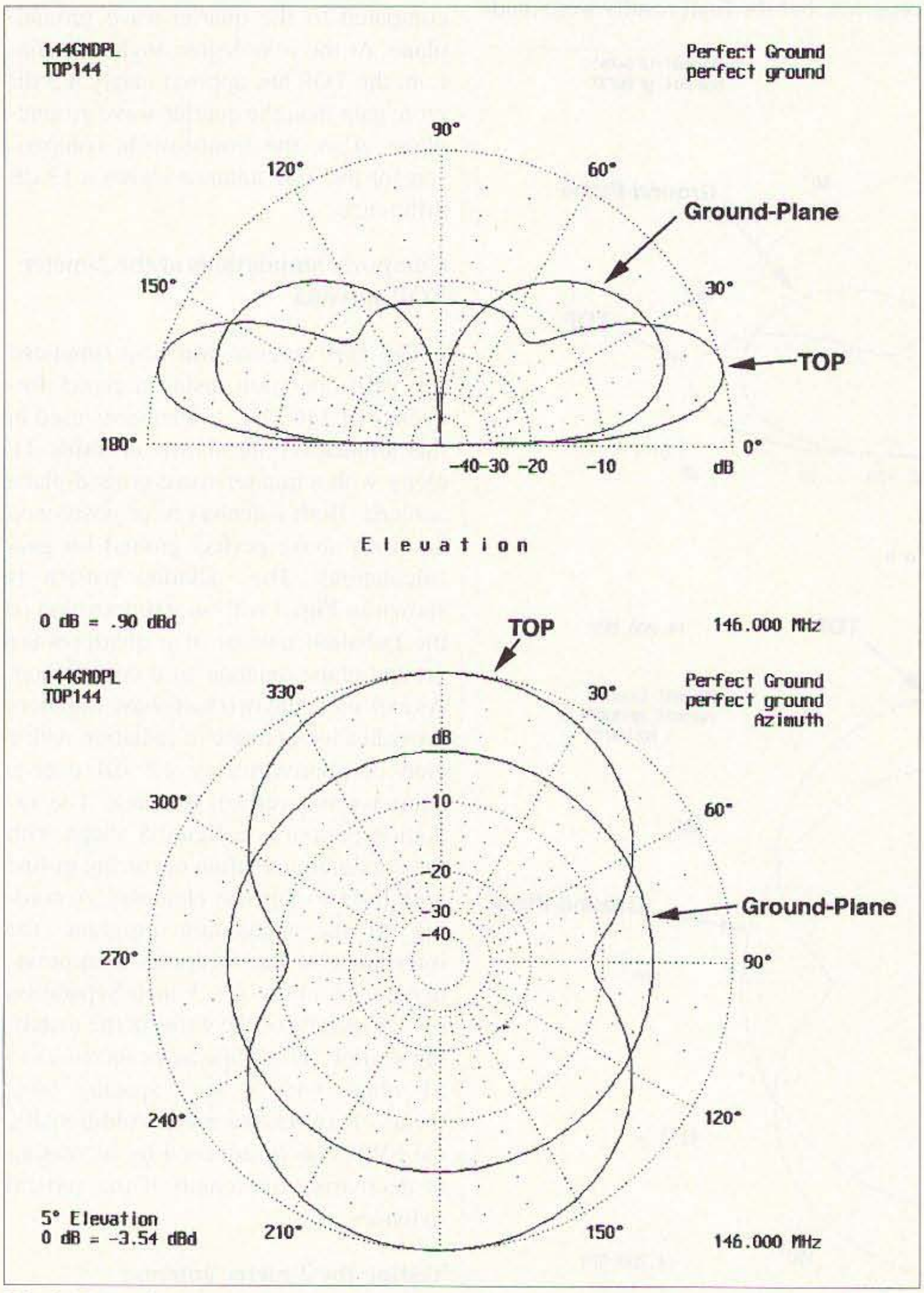

Fig. 3. *Using the AO program for a 2-meter TOP antenna and a quarter-wave ground-plane antenna one inch above ground. The TOP shows approximately 4.5 dB more gain in the direction of maximum gain and approximately 13 dB front to side difference in gain.*

References

1. *The ARRL Antenna Book*. The American Radio Relay League, 1995.

2. Kraus, J.D. *Antennas*, McGraw-Hill, 1950.

Frequency (MHz)	a (feet)	b (feet)	c (feet)	d (feet)	Feedpoint Impedance (Ohms)
28.2	16.5	2.65	6.0	0.825	51 + j4.9
24.93	18.77	3.0	6.75	1.0	50.6 - j5.3
21.1	22.0	3.65	8.0	1.15	50.1 - j6.0
18.1	25.9	4.15	9.3	1.3	50.1 + j6.7
14.2	33.0	5.23	11.75	1.65	50.9 - j4.5
10.1	46.0	7.36	17.0	2.3	50.2 - j4.6
7.2	65.0	10.4	23.5	3.25	53.7 - j0.5
3.7	126.5	20.25	45.5	6.3	56.0 - j5.2
Frequency (MHz)	**a (inches)**	**b (inches)**	**c (inches)**	**d (inches)**	**Feedpoint Impedance (Ohms)**
52	108	17.4	38.9	5.5	48.4 - j0.9
144	38.5	6.5	13.0	2.0	51.5 + j8.7
444	12.5	2.0	4.25	0.9	49.8 - j2.9

Table 1. *Computer-simulated values for the TOP antenna designed for different frequencies. The values for the HF bands are in feet and those for the VHF antenna are in inches. The parameters a, b, c, and d are shown in Fig. 1. Some adjustments were made to these values in order to achieve a compromise between gain and SWR. Spacing d can be varied after the antenna is built to influence the impedance at the feedpoint. Also, the length a can be adjusted for best SWR measurement.*

3. Beezley, B. The AO Program and NEC-2.

Acknowledgments

I want to thank my son Ethan and my wife Linda for putting up with the sticks and pieces of wire I stuck together as prototype antennas around the house. 73

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simultaneously in many different areas, all right after the passing of a comet. They then rapidly spread out, often much faster than they should have if they were just being carried by people traveling.

Here's something to think about. Twenty-five years ago S. P. Shchurin, with two colleagues at the Institute of Clinical and Experimental Medicine in Novosibirsk, Russia, placed two identical tissue cultures in sealed glass jars. They introduced a lethal virus into one of the jars which promptly destroyed the tissue colony. The second jar remained unharmed, as you would expect.

Then they repeated the experiment, but with a quartz divider between the two cultures instead of glass. Not only did the infected colony die, but so did the second colony, even though there was no way physically for the virus to get into the other sealed jar. Somehow the virus was able to go via UV light from one colony to the other. Think about the implications.

Yes, of course they repeated the experiment, and they found that when the first colony started to die that the UV radiation from it increased significantly.

It's easy to understand why our medical industry has chosen to ignore this, with no follow-up which I've ever seen reported. Check it out in *Alternative Science* by Milton. This book will have to be added to my list of books you're crazy if you don't read. It's full of stuff our scientific betters would prefer to ignore. $15 plus shipping from Park Street Press, Rochester VT 05767. Fascinating book.

DX News

I've got some permanent scars where the DX bug bit me—and a world of memories of working DX, and then being DX. Like operating from a desert island (KC4AF and KC4DX), like operating from a King's palace (JY1), like operating from the famed American Embassy in Tehran and the DMZ in Korea. Bragging? Of course I am. But more to goad you into having fun, too, than in fluffing up what's left of my tattered ego.

Anyway, I see that *The DX Bulletin* has merged with *The DX Reporter* into *59(9) DXReport*. For $36 a year (a little more outside the US) you can keep track of the DXpeditions and any unusual countries that show up. Check with Box 73, Spring Brook NY 14140. Wayne sent you.

Yes, it's a ball to work DX, and I'm looking forward to old Sol getting acne to perk things up for us. But, like any other enthusiasm, please keep DXing in perspective. When conditions are good it's easy to work 100 countries in a weekend (during a contest, natch). 200 took me a couple months. 300 took me a year. Somewhere around 340 I stopped counting. Working DX should be fun, not a dominating factor in one's life.

Almost anyone can work a station anywhere in the world if the time and bands are right, so all a big DX score proves is that you've spent one hell of a lot of time doing something of almost no consequence or redeeming value. And you know as well as I that most of your contacts over 300 countries were momentary signal reports. Piffle.

I have a secret for you. I've visited hams in well over a hundred countries and with almost no exceptions they are interested in talking with people, not in providing them with a rare QSL card. Hams in the rarer countries really hate what DXCC and the Honor Roll has done to them. It just isn't any fun to make contacts solely to fill out and send QSL cards.

But what a great feeling it is when you've made a friend in some country and then visit him in person. I loved it when VK6RU pulled out my QSL to show me. Ditto 5Z4ERR, 9N1MM, YK1AA, and a bunch of others.

Bum Tubes

You remember tubes, right? Well, if you can find replacements for bum tubes there are tons of old ham rigs which are as good as gold. Pennies on the dollar at flea markets. But, alas, getting working replacement tubes is not easy. You have to go to antiques dealers for 'em now, and that's no guarantee that what you get will work. Maybe you'd better look for a tube tester at the next flea market so you can check out the tubes you buy. I have a very frustrated letter from a reader who had endless trouble getting good tubes from an antiques dealer (not one of our advertisers, thank heavens). For my part, I'm having a lot of trouble finding a reliable replacement quenched-gap for my narrow-band spark rig.

Death Sentence or Wakeup Call?

As Andy used to say to Amos, "I'ze regusted." The more I learn about our overly expensive and monumentally ineffective medical industry, the more regusted I get. The only reason you're putting up with all their baloney is because you've been conned into trusting doctors and you haven't bothered to do your homework, despite my nagging.

And one of the best examples is the

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cancer industry. With there being around a 50-50 chance that you're going to have to deal with cancer personally, how long are you going to wait before you take the time to learn about it?

The cancer *industry*? You bet! It's a $40 billion industry and the insiders know the whole works is a scam. The fact is a bunch of doctors already know what causes cancer, and I mean 100% of all cancers, not just one or two flavors. They also know how any cancer can be cured—simply and inexpensively—but that would put thousands of doctors out of work and raise holy hob with the whole medical industry. Golly, I wish I were exaggerating!

And the same thing holds for AIDS, the acquired immuno-deficiency syndrome. The secret for curing AIDS lies in the name of the "disease" itself. And this also provides a powerful clue for how to treat the Big C.

Sure, we've all heard about the immune system, but it's been kept mystically buried under layers of medical jargon. So let's lay out the situation simply. We have a blood system which takes the raw materials for our body which have been processed by the lungs, stomach, liver and intestines, and distributes them to the cells so they can live and divide into more cells. The lymph system fights off the invaders, and there is no shortage of them. It also rushes to repair damage to the body. Even under the best of circumstances the immune system is kept busy handling damage repair and dealing with invaders.

So what happens when we overwhelm the immune system? It breaks down and is unable to fight off its foes as well. A strong immune system quickly detects mutant cells. In any really large factory there are always some defective products. Here we're dealing with around 75 trillion cells, all busy replicating each other from every few minutes to weeks. The immune system is a quality control supervisor, checking for defective products and destroying them. Maybe one cell out of a million will make a mistake during replication. A mutation. And if this is allowed to grow it can get out of control and you have a cancer. The body is continually generating these small potential cancers and the immune system keeps finding and destroying them.

This is the source for *all* cancers.

The immune system has been designed to cope with the level of damage which human bodies have had to deal with over the last million years or so—just as the other bodily systems are designed to work with the food, water, air, etc., which human bodies have grown used to using for fuel.

Now let's go to 1997 and the many poisons which we inflict on our bodies; poisons with which the immune system has to cope. Between immunization shots, mercury from dental fillings, chlorine and fluorides in the water, all kinds of pollutants in the air, dioxin in the water, antibiotics and hormones in our meat, pesticides on our fruits and vegetables, hefty doses of nicotine, alcohol, poisons from root canals, and so on, our immune systems are up against a barrage of enemies far beyond their design limits for coping.

And that doesn't even count the effects of stress, which alone can incapacitate even a fairly healthy immune system.

So when the immune system breaks down and cancers get started in the weaker parts of our bodies, what do doctors do? Chemotherapy! Right! They inject a new load of deadly poisons. And they radiate. It's no wonder there are so few survivors of this madness. If you look at the statistics you'll see that our trusted medical professionals have not added one day to the life of cancer patients in the last 30 years.

So what's the answer? Good grief, do you even have to ask? If you want to cure cancer (or AIDS, for that matter) you want to rebuild your immune system. This means stopping the poison input and making sure your body gets the raw materials it needs to repair itself. Clean air, distilled water, UV rays in your eyeballs, the 90 minerals, enzymes and vitamins your body was designed to use (many of which are long gone from our supermarket food shelves), and as little stress as possible. Maybe you remember Norman Cousins and his miraculous recovery just by watching comedies and reading humor books? Laugh it up. Oh yes, and exercise. Shake your cells.

Now, the choice we all have is to either continue to beat the heck out of our immune system and wait until the wakeup call comes, forcing us to either contemplate death or a change in our habits, whichever we consider less of a problem. If we choose life we have to get busy making sure we give our immune system the best break we can right now. Hmm, will it be leukemia, perhaps aggravated by EMFs? Or maybe a brain tumor (a shortage of vanadium)? I've lost some good friends to those. Or perhaps it will just be something slo-o-w and painful like arthritis.

I don't know about you, but I'm not about to wait for the Grim Reaper to take away my mike and hand me my Silent Key. So I'm eating mostly raw food, drinking plenty of distilled water, getting my exercise every day, avoiding sugar, white flour, and poisons such as aspartame (NutraSweet), adding the 90 minerals and stuff which are missing from supermarket foods to my diet, and hyperventilating every time I think of it (our air has less oxygen in it than it used to). I also laugh a lot. Hey, have you read the Dilbert book yet? And check out the humor section of my $5 (and worth $5,000) book list.

Not only am I convinced that just about anyone can regain robust health, even if near death from cancer or AIDS, but probably from almost anything else, if they give their immune system a break. But, hey, it's your body and our culture encourages a wide variety of destructive behavior. Like Big Macs and fries, or beer and Fritos. Or (sob) Haägen Dasz coffee ice cream. When your wakeup call comes, start reading the health oriented books on my recommended list and outlive your doctor.

I wonder if you know that despite billions of dollars having been spent on cancer research that no cancer incurable 25 years ago is curable today. There has been some progress with some rare types of cancer, but for over 95% of all cancer patients all that research hasn't influenced their survival one bit. Chemotherapy? No matter how many drugs or how high the dosage, it doesn't really work (Ref: *What Doctors Don't Tell You*, July 1996).

Money Is The Root

A letter from a reader read, "I think money is the downfall of our civilization." That's empty-headed blather.

Money was a great invention. It's a way to be rewarded for your skills, knowledge, and labors. Before money people traded goods or food with each other. Trading gave people access to the fruits of other people's skills, knowledge and labors. And money just makes trading simpler.

Some things are more difficult than others to make. These days an IC factory costs billions, all to provide us with very inexpensive Intel Inside™ equipment for work and play. These billions come from the pooled money of hundreds of thousands of people—pooling their labors, so to speak, to provide even better tools for us.

Money is the root all right, but not of evil. From the money root we can grow better skills, more knowledge and more productive labor. So let's not disparage money any more than we should disparage amateur radio because we have that cesspool stinking up 14,313.

NOYB

In the it's none of your business department, a reader alerted me that Lexis-Nexis has a P-Trax data base available to the public which will provide your name, current address, your previous address, your social security number, your mother's maiden name, your birthdate, and other personal information. That's a great source of information for credit card fraud, etc.

If you'd like to request that your name be deleted from this data base you can call 888-965-3947 toll free. Wait out the message about applying in writing and stay on the line for a representative. Or fax 800-470-4365. Or write Lexis-Nexis, Box 933, Dayton OH 45401.

I'm getting too old to appreciate the benefits of a big brother snitching on me. How about you?

Star Trek Nonsense

When we finally manage to invent a space drive which will get us to the stars without taking years for the trip, I hope

we'll also have developed enough smarts not to zoom into some other solar system, look for a bright blue planet, land and ask whatever life forms we find to be taken to their leaders. That's the swash-buckling way of fiction.

Reality tells us that any civilization we approach is either going to be way, way ahead of us or way behind. And I don't mean a hundred years, or even a thousand. The difference is almost inevitably going to be millions to even billions of years, and that's beyond our imagination. Even the oldest records we Earthlings have only go back a few thousand years, so we have very little data to go on as to what humans were doing 10,000 and 100,000 years ago, much less a million.

When we take an objective look at our progress in the last hundred years as compared to the last thousand, we can see the acceleration of learning. Do we think this is going to slow down or stop in the future?

No, when it comes to our dealing with a new civilization the prudent approach will be to hang around behind an outlying planet and check things out ver-r-ry cautiously. If the place looks primitive we'd then move in, perhaps behind a moon, and send down a landing party to take a closer look. At night and in a remote area.

If they're millions of years ahead of us they'll have known all about our approach early on and they'll have already contacted us. If they're millions of years behind us we might want to set up a small base on their planet and go about helping whatever life forms we find develop into something along the line of humans, using a bit of genetic engineering. We'd probably keep a small outpost there to guide their development and keep them subtly under control. If we find the planet overrun with huge beasts which could be dangerous to human-type life development, we might want to get rid of them. You know, like dinosaurs.

Now, have I fallen off my rocker again, or does that scenario make sense? If you've been doing much reading, you know that just such a scenario is not inconsistent with Earth's archeological and paleontological record. If you haven't been reading, what *have* you been doing? That 12 years of compulsory school and maybe four years of further optional time-wasting in college were only the priming of your intellectual pump. When we get out of school we are *not* educated, we only have the tools with which to educate ourselves. Alas, most people promptly throw these tools away and settle down to a life of the three Bs: bars, ballgames, and bowling. Most of the people who've worked for me down through the years have vigorously resisted any actual education once they finally got out of school. They had somehow been totally convinced that our schools had provided the only education they would ever need and no amount of reasoning could change this deeply inculcated belief.

Unless quite a bunch of pretty sharp scientists are also off their rockers, the ETs have been here for a long, long time. It doesn't make any sense that they haven't.

The Fat Life

After having spent about 40 of my years as a fat person, from about the ages of 10 to 50, I (pardon the expression) got fed up with being fat. Sure, I'd dieted and fasted all through those 40 fat years, always bouncing (oops) back to el bloato shape (250-260). When I was 50 I spent about nine months on a 1500 calorie a day regimen and dropped 85 pounds. That's about two pounds a week. I didn't want to take off the weight any faster because I was concerned that this might put an undue strain on my heart.

No, it wasn't easy. There were endless enticements to splurge, but I managed to stick at it and the fat melted away. Even better, I'd changed my eating habits enough so that once the flab was gone it stayed off. It does mean taking home larger barf bags from restaurant meals. Okay, so I get three or four meals from one restaurant dinner this way, plus plenty of exercise for my microwave.

Maybe you've noticed that there are very few fat old people. Most fatties die in their 50s and 60s, forcing the thinnies to live into their 80s and 90s in order to bring the average life span to 75. Well, that helps stave off the collapse of the social security facade. It also keeps down the queues at golf courses. Say, how old are *you*?

Hamfests

There are probably several factors which are gradually eroding hamfest attendance, and that's bad news for the health of the hobby. If amateur radio is going to

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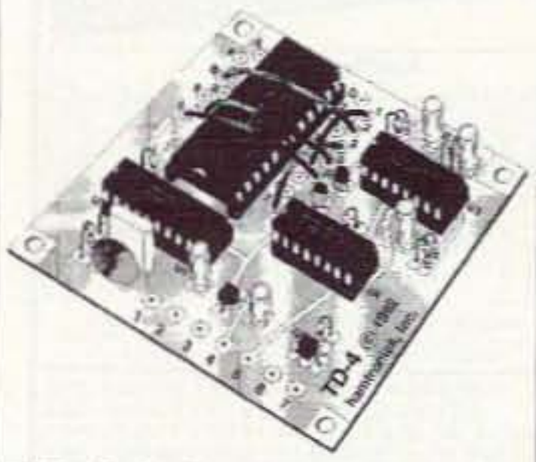
Number 50 on your Feedback card

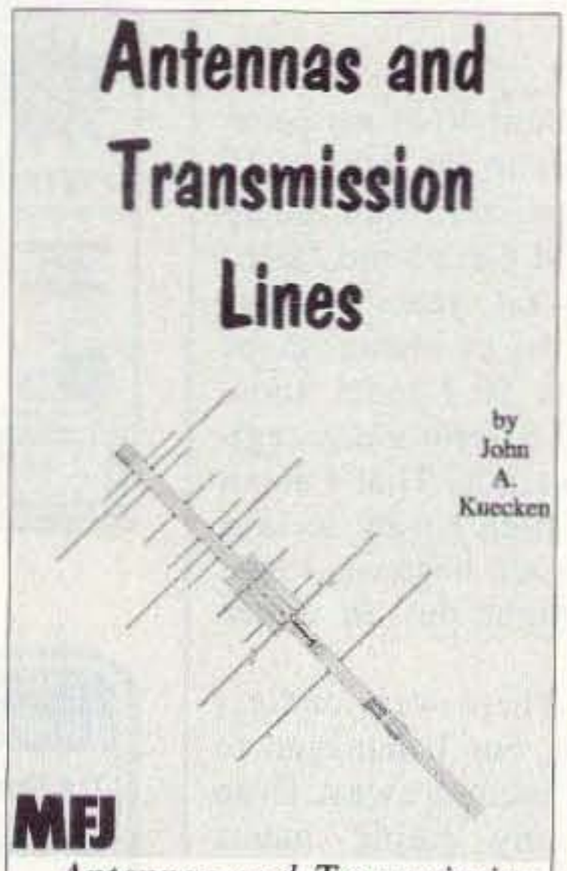
NEW PRODUCTS



TD-4 Selective Calling Module

Hamtronics, Inc. recently announced its new TD-4 Selective Calling Module, an economy touch-tone decoder with one latching output. Now it's unnecessary to listen to all the activity on a channel just so someone can call you once in a while. It's easy to modify the latch input circuits on the TD-4 to perform a LiTZ (long tone zero) function for emergency use, and it can be set to turn on/off an autopatch or any other device requiring a simple ground to activate.

The 2-3/4 inch PC board is ideal for custom installations, and it operates on 12 VDC. The TD-4 is only $49 in kit form or $79 wired and tested. For more details, write to Hamtronics, Inc., 65-F Moul Rd., Hilton NY 14468-9535 or call (716) 392-9430. Ask for a catalog and tell them where you got the phone number.



Antennas and Transmission Lines, by respected author John A. Kuecken, is the newest release from MFJ Publishing. Amateur operators, technicians, engineers and students will find this book an invaluable resource. It's a handy reference guide with lots of diagrams and graphics, and direct, clear information on the theory of antennas and transmission lines.

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Audio Transformers Catalog

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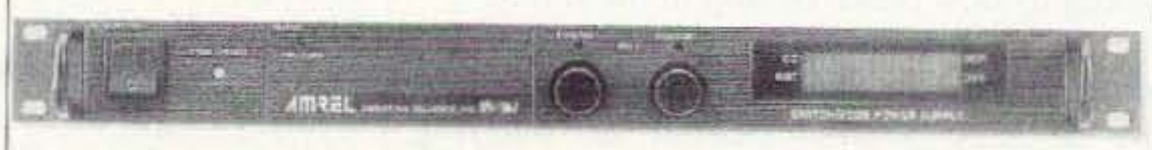
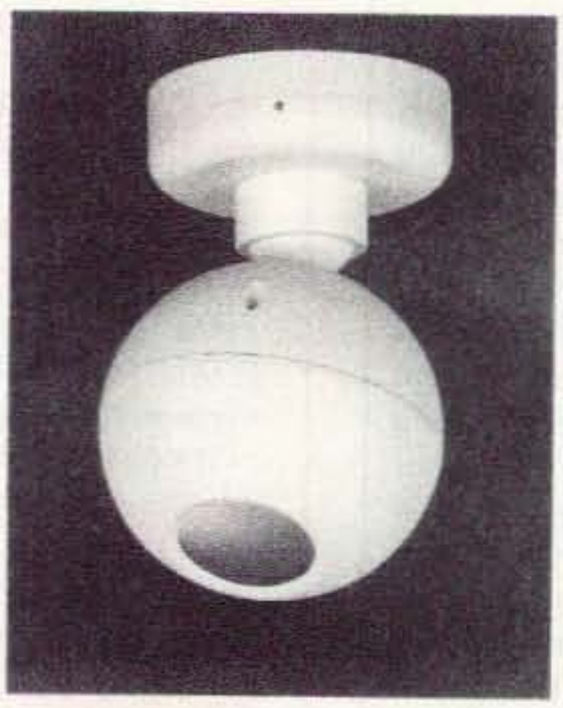


SPS Series Switch-Mode Power Supplies

Starting as low as $1,195, the SPS Series of switch-mode power supplies from AMREL/American Reliance Inc. is a no-compromise solution for your budget.

Innovative design and versatile features include: Programmable protection modes (voltage, current, temperature), fast down programming rate (1ms), low noise output (3mVrms and 30mVpp), and more.

The SPS series exceeds industry standards and offers a wide range of features for ATE, engineering, manufacturing, and scientific applications, along with a three-year warranty and toll-free technical support. For more information, contact AMREL/American Reliance Inc., 11801 Goldring Road, Arcadia CA 91006. Phone (800) 654-9838 or (818) 358-3838. E-mail: amrel@amrel.com.



Eyeball Spyball

Cool, huh? The "Smart Value" Color BC-865C from GBC ColorSentry™ is infinitely adjustable, indoors or out. You can angle the camera plus or minus 90° in any direction; look sideways or down from walls or from ceilings. The weatherproof housing means you don't have to worry about exterior installations.

The BC-865C has more than 325 lines of resolution and a sensitivity of only .4 lux. Its built-in electronic shutter and dynamic through-the-lens automatic white balance allow for true color rendition under all lighting conditions. It comes with a 6mm lens (others are optional) and a 12 VDC power module—get a high performance color ball camera for the price of black and white!

See your dealer or contact CCTV Corp., 280 Huyler Street, South Hackensack NJ 07606. Phone (800) 221-2240 or (201) 489-9595; FAX (201) 489-0111.

Continued on page 69

A Full-Time Space Shuttle Monitoring Station

Other obligations won't keep you Earthbound!

Grover C. Huckabee III K4DRF
95 Simpson Drive
Kennesaw GA 30144

It's a shame that things like making a living or family matters should interfere with our hobby—but a good ham is a well-rounded ham, and being surrounded by ham radio twenty-four hours a day is not only impossible, it's unhealthy. Still, there are things happening on the bands that would be nice to investigate, even when we must be involved in other pursuits.

Something I like to do in my shack is listen in on two-meter conversations from space. The space shuttle missions usually carry at least one licensed radio amateur, as does the Russian *Mir* Space Station. Listening to and trying to contact the Astro- and Cosmonauts is exciting, but they have limited operating time up there, and our schedules here on the ground limit us.

One way to keep in touch, even when you're not at your station, is to build a simple automatic monitoring station that will record the space side of the two-meter QSOs on audio tape. Then you can review the tapes in the quiet of the ham shack, or even in a traffic jam on the way to work. Putting together such a monitoring station can be easy and inexpensive.

You need a receiver capable of covering the frequency of interest, a carrier-operated relay, an audio cassette recorder, and a simple antenna. If you are really interested in tracking the space signals from horizon to horizon, a home-built or store-bought low noise preamplifier can be added, but it's not necessary for basic operation.

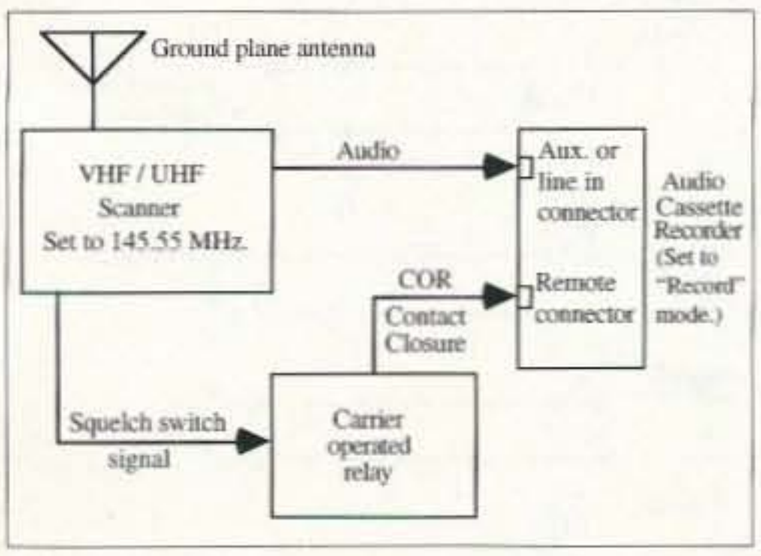


Fig. 1. *Block diagram.*

The heart of the system shown in **Fig. 1** is the Carrier Operated Relay. This is a simple device, and basic circuits have been described in many publications. Most applications of the COR have concentrated on its use in VHF and UHF FM repeaters, where the relay is used to turn on the repeater transmitter when the repeater receiver hears a signal. In our application, we will use the COR to turn on a tape recorder, which is listening for a signal from our receiver or scanner. A home-built ground plane or turnstile antenna, cut for the two-meter band, is connected to the antenna input of a VHF/UHF scanning receiver. The receiver I used is a Uniden Bearcat BC560XLT ($69 from a mail-order firm). The selectivity is excellent for the price, as is its sensitivity—two things to look for in a scanner. There are a couple of modifications that must be made to the scanner in order to drive the COR and the tape recorder, but most scanners are similar in construction, and a little probing with a voltmeter and/or scope should let you know where the mods must go. Basically, they consist of locating two points within the receiver and attaching two wires to bring these points *out* of the receiver and to the COR and tape recorder. The points of interest are the receiver discriminator output or squelch switch circuitry, and the audio output *before* the volume control. The discriminator of an FM receiver is the part of the circuitry which demodulates or recovers the audio from the RF signal. When there is a signal present, a positive-going voltage is usually generated in addition to the audio signal. This voltage is used to open the squelch circuit of the receiver, allowing the audio signal to be amplified and directed to the speaker. Only when an RF signal of sufficient strength is present will the squelch open and allow the audio path to function. The other factor that influences the opening of the squelch is the setting of the squelch control itself.

This control sets the threshold at which the squelch switch will open, allowing the audio path to the speaker to be completed. The tighter the squelch control is set, the more RF signal is needed to open the audio path. We can use this information to find the location of one of the wires we need to attach to make our system work, and we don't even need a schematic of the receiver to do it! We will use the fluctuating voltage that makes the squelch work to also make our COR work. The same voltage that makes the audio path of the scanner open will also be used to make our carrier operated relay close, starting our tape recording.

The only other addition necessary for a working system is to supply audio from the scanner to the audio input of the audio cassette tape recorder. Be careful to supply the recorder with audio that is always there, rather than being dependent upon the setting of the scanning receiver's volume control. Again, we will use a voltmeter to determine this point, *before* the volume control, a point where the internal audio level of the receiver is always constant. Once these two circuits are extended to the outside of the receiver, it is a simple task to make our system work.

The carrier operated relay turns on our tape recorder, to record the audio from

our scanner, once a signal is present at the discriminator. Our device will take the positive-going voltage at the discriminator or squelch switch, a voltage only present when there is a signal present at the discriminator, and convert that voltage to a contact closure for starting our audio recorder. When there is a signal present, the recorder runs, and when there is no signal the recorder stops. Also present in the COR circuit is a built-in delay that keeps the recorder running for a second or two *after* the signal disappears, so that on fading signals the recorded signal will not be choppy because of the recorder's starting and stopping rapidly. In repeater use, this circuit is usually included so that the repeater stays on between transmissions of two or more stations, so as not to overwork the mechanics of the repeater, and again to avoid the choppy audio that would result from the repeater being turned on and off rapidly, if the input signal should be weak or fading.

Putting it together

Construction of the COR (**Fig. 2**) is straightforward—it can be built on a small piece of copperclad perfboard. Layout is not critical, and neither are the parts. I chose 2N3906 and 2N3501 transistors since I had plenty of them on hand, but any switching transistors of the right polarity will do. Just make sure that the transistor chosen as the relay driver is hefty enough to dissipate the power required to run the relay continuously, since it will be turned on for long periods of time. The COR requires +12 VDC, which can be derived from the power supply that runs the scanner, or as I did it, from a separate small three-prong 12-volt regulator (7812) supply.

If you choose to run the COR from the scanner supply, make sure that the supply can handle the extra load without overheating.

R1 sets the input sensitivity to the COR. Its setting is usually not critical, but is included to allow for the variations of positive voltages available from a wide range of scanners. Q1, a 2N3906 transistor, amplifies the positive voltage from the scanner discriminator or squelch switch and delivers it to Q2, a 2N3501 transistor. This stage is used to form a delay circuit that holds the relay on, after the input signal has disappeared, for a time determined by R2. This delay time can be set from almost zero delay to several seconds. The signal is then delivered to Q3, a second 2N3501 device (the relay driver), which supplies the voltage and current necessary to close the relay. K1, the relay, can be any small 12 VDC unit.

Mods

A voltmeter is a necessity for the two modifications to the scanner (an oscilloscope is helpful, too). Most inexpensive scanners can be easily disassembled. Once that is accomplished, carefully disconnect the speaker wire plug, or better yet, position the scanner with the bottom of the PC board up, and the speaker plug still attached. This will allow you to monitor the squelch action while probing for the two mod points with your voltmeter. Find the volume potentiometer. Turn the volume up to about halfway, and open the squelch. Be sure that you are monitoring an empty channel, so you can hear nothing but noise with the squelch open. Set the voltmeter to the AC mode, lowest scale available. If you have a scope use it instead of the voltmeter to monitor the receiver audio noise. Probe each side of the volume control, while turning the volume control up and down. On one side of the volume control you should see the metered AC voltage go up and down as you move the volume control. On the other side of the volume control you should see the voltage remain constant as you turn the volume control up and down. This is where you should pick off the audio for feeding the input to the tape recorder. Make sure that when you run a wire out the rear of the scanner (to a jack or whatever) that you also run out a companion ground return. Mini-coax or shielded mike cable works well for this application.

To find the squelch switch, locate the squelch control on the front panel. Pay careful attention to how it's wired to the PC board. If you trace one side of this control you will probably see that it goes to either an integrated circuit or to a switching transistor. This control sets the threshold that determines how much signal it takes to open the squelch circuit.

Set the voltmeter to DC Volts, lowest scale, and carefully probe around the integrated circuit and switching transistor while alternately squelching and unsquelching the radio. On some pin of the IC or around the associated transistors you will find a point where the DC voltage is HI when the radio is unsquelched, and goes LO when the radio is squelched. We are looking for a point that is less than seven-tenths of a volt when the unit is squelched and more than seven-tenths of a volt when it is unsquelched. The typical swing is from near zero volts squelched to around a volt and a half when unsquelched. This is the point that should be pinned out to the rear of the radio to deliver the control voltage to the input of the COR. Again, make sure that an accompanying ground return is also delivered to the COR. Mini-coax or mike cable works well.

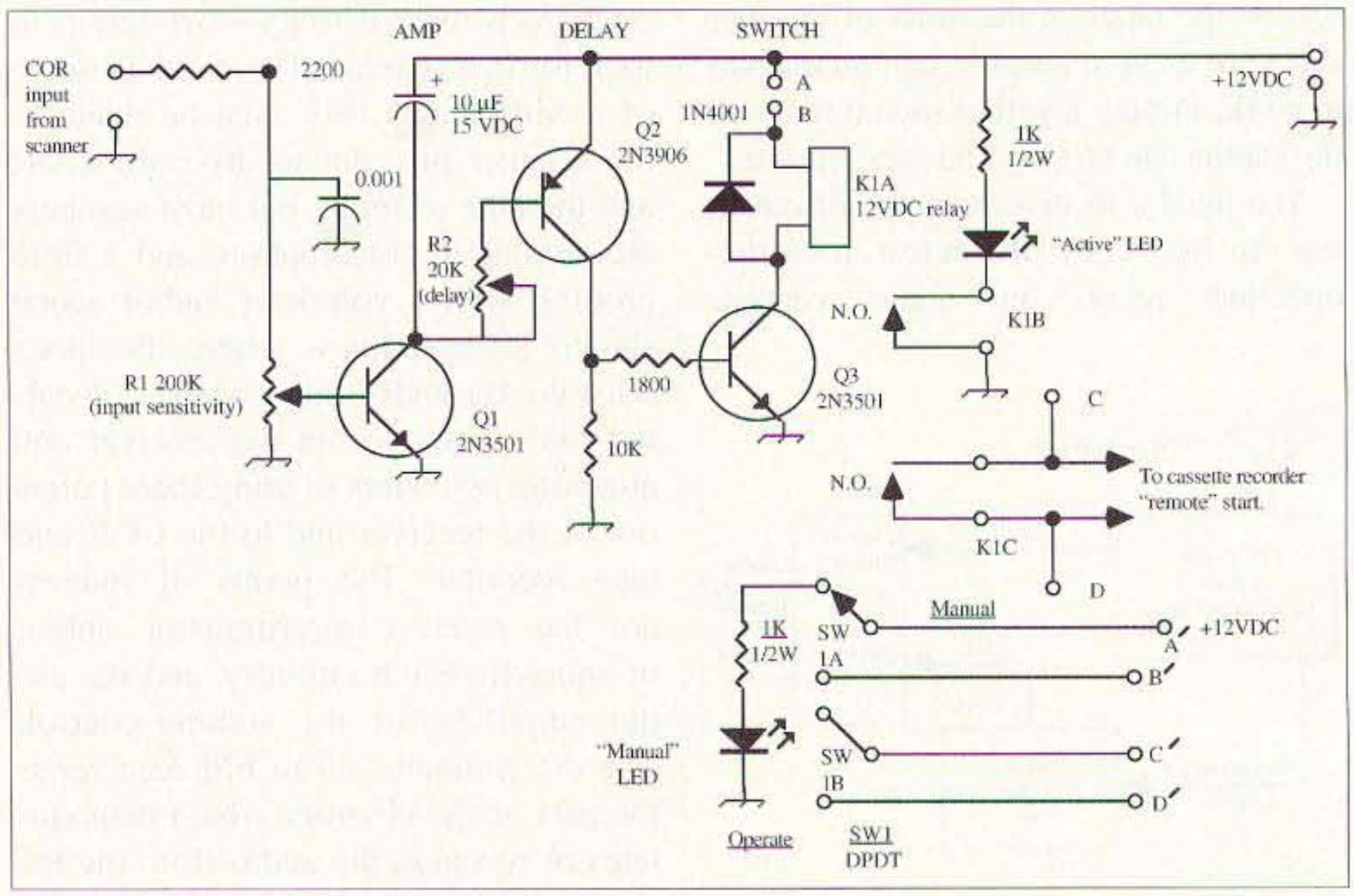


Fig. 2. COR.

Making it work

Now hook it all up and test it. Before connecting the scanner to the COR, check for short circuits with an ohmmeter across the supply voltage input and the signal input of the COR. If all looks good, then apply power. *Nothing* should happen, including smoke. Now the scanner can be mated to the COR. Turn both units off and connect the squelch switch mod output to the signal input of the COR. Turn it all on again. If it still looks good, with minimum smoke (hopefully, *no* smoke), unsquelch the radio. The "ACTIVE" LED on the COR should light, and you should hear the COR relay click. These are good signs!

If nothing happens, try adjusting R1 on the COR until something *does* happen. Leave the radio unsquelched while adjusting this control until the COR lights and you hear the relay click. Now alternately squelch and unsquelch the scanner while observing how long the LED stays lit after you have squelched the unit. Adjust R2 for a delay of at least a second and a half to two seconds. Adjustments to the COR are now complete.

Next, connect the cassette recorder to the COR and to the scanner. The output of the COR, which is the relay contact closure, should be connected to the "REMOTE" connector of the recorder. This will start your recorder when the scanner hears a signal. Make sure that the recorder control buttons have been put into the "RECORD" mode. Connect the audio mod extension from the scanner to the input of the recorder. There is usually a "LINE" or "AUX" input, on even the cheapest of portable cassette recorders. This is where the audio should be fed. If there is only an external "MIC" input, it may be necessary to make an audio pad to attenuate the audio level.

Designs for pads are available in ham publications, and consist of three or four quarter-watt resistors set between the audio source and its destination. Tune the scanner to an active repeater channel and verify that when the channel is busy, the COR "ACTIVE" LED lights, the tape machine cassette moves and that audio is being recorded (the switch on the front of the COR allows you to put the cassette recorder into a manual mode so that you may rewind and play the tape without having to pull the connection out of the "REMOTE" port each time you want to manipulate the deck).

What about antennas?

A simple ground plane antenna up about 40 feet does an acceptable job. Keep in mind that the spacecraft will be coming at you from many different angles, so a directional antenna such as a yagi will have to be constantly adjusted. If you would like to play with a better antenna than a ground plane, consider some of the turnstile designs or modified weather fax antennas described in recent ham publications.

Where are the Astronauts?

The SAREX (Shuttle Amateur Radio EXperiment) site of NASA's home page on the World Wide Web (http://spacelink.msfc.nasa.gov) will give you news about current NASA programs, activities, and even entire publications. It's an excellent way to find out about uplink/downlink changes on a particular mission. Short of that, listen in on 145.55 MHz, the worldwide FM downlink frequency, as well as the worldwide FM packet frequency.

Information on *Mir*, including predictions of when it will cross over specific worldwide cities, can be had on the Internet from the DL5KR SatTrack Prediction with modifications for WWW use by KE4AR. Just type in a key word on your favorite Web browser.

Other stuff

This system was built for monitoring manned spacecraft, but might be used for other unmanned monitoring, such as listening in on hamsats or monitoring your local two-meter net. The only limiting factor on the system is that you can only get 45 minutes of recording time per side of a cassette tape (perhaps you would like to add another timer with a loud buzzer to alert you when it's time to flip the cassette!).

Ed. note: Any modifications you make to a manufacturer's product may invalidate the warranty, so be sure of your intentions before you start your project. 73

NEVER SAY DIE

Continued from page 49

even survive we need to bring it together and get it growing again—and hamfests can be a powerful element in this mix.

Sure, I have a bunch of ideas on how hamfests can be made more fun, but only *you* know the bottom line answer to how hamfest committees can start rebuilding attendance. When is the last time you went to a hamfest? Why haven't you been to one recently? What would it take to get you to drive a hundred miles to a hamfest? Maybe even 200 miles?

What kind of activities might make you think seriously about taking a weekend off for hamfesting? Are there any ham speakers you'd drive a hundred miles to hear? How about an ARRL forum? No, I thought not. I went to one once and still haven't fully recovered. Have you got a special ham interest which might get you off dead center for a weekend: packet, satellites, emergencies, DXing, computers, certificate hunting, the ham aspects of the Internet?

Give this some thought. Hey, you might even bring it up on the air and bounce ideas around that way. Then get your word processor busy and send me a disk and hard copy. Stop making me do all the thinking. Lend a hand.

You might consider what hamfests could do to attract the no-coders, which now make up over 50% of all hams, and represent the only area of growth in the hobby. The rest of us are growing older and more crotchety, with the smokers and fatties getting their Silent Key awards from the ARRL, along with that final listing in *QST*.

And how about using hamfests as a way to get youngsters interested in the hobby? That might help bring us badly needed young blood, and thus interest a bunch of kids in getting involved with high-tech careers—something our country needs desperately.

I was 15 when I went to my first hamfest and I still remember it! Wow, I can still see that Hallicrafters Skyrider Diversity receiver, and I remember meeting McElroy, who was sitting there casually copying code at about 60 wpm while keeping up a conversation with passing hams. And one of the hams I went with (W2ECL) won the code copying contest.

What's the most fun hamfest you've ever attended? And why? Maybe we can revive the excitement that used to get us to go to hamfests.

One suggestion I've made to hamfest organizers (and in my editorials) is to offer manufacturers a forum where they would be able to explain what they've built into their newest piece of equipment. 60 years ago the features of a new receiver could be explained in a few minutes. Now, with our equipment beyond description in complexity, I'd need a half hour and a projector just to begin to explain what a new transceiver can do.

Continued on page 55

Number 54 on your Feedback card

SPECIAL EVENTS

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the July issue, you should send it in before the first of April. Provide a clear, concise summary of the essential details about your Special Event.

MAR 1

COMER, GA The N.E. GA "Bubba" Net Hamfest will be held 9 AM–3 PM at Madison County Fairgrounds, 1/2 mi. south of Comer, on GA Hwy. 22. Adm. $5; camping w/all hookups $6. VE Exams. Contact *James Daniel AE4HS, 152 Windfall Dr., Winterville GA 30683. Tel. (706) 742-2777.*

MAR 8

HAZARD, KY The Kentucky Mountains ARC will sponsor an Amateur Radio Hamfest at Hazard H.S. Cafeteria, Hwy. 15 South and Bulldog Rd. Time: 8 AM–2 PM. Adm. $2. Tables $3. ARRL Forum. VE Exams by WCARS; reg. 10 AM, testing 10:30 AM. Requires 2 IDs, license and copy, CSCEs, etc. For info contact *John Farler K4AVX, (606) 436-5354;* or *Sid Adams WI4M, (606) 439-3589.* Talk-in on 146.07/.67.

MAR 9

INDIANAPOLIS, IN Indiana Hamfest and Computer Show. See advertisement in Jan. *73*, page 43 or Feb. *73*, page 43.

MAR 13 & 27

FT. WORTH, TX The Lockheed ARC and the Kilocycle Club of Fort Worth will sponsor VE Exams for all classes at the Lockheed Rec. Area Facility, 2400 Bryant Irvin Rd. at 7 PM both nights. For details, call *Ted Richard AB5QU at (817) 293-6745.* G.R.D.L. testing done by appointment only.

MAR 15

LINDA, CA The Yuba Sutter ARC will sponsor a Swapmeet at the American Legion Post, 5477 Feather River Blvd. Hours are 8 AM–1 PM. Tailgate and commercial ham dealers welcome. An all-you-can-eat breakfast will be served 8 AM–10 PM. Talk-in on 146.085 (+) WD6AXM Rptr. Contact *Ron W6KJ, (916) 674-8533;* or *Clara KC6JPP, (916) 742-2674.*

MAR 15–16

MIDLAND, TX The Midland ARC will hold their annual St. Patrick's Day Hamfest 9AM–5 PM on Sat., Mar. 15th, and 8 AM–2:30 PM Sun. Mar. 16th, at the Midland County Exhibit Bldg. Inside Flea Market, Dealers, Tailgating, T-hunts and more. Pre-reg. is $7, $8 at the door. Tables are $12 ea. for the first four and $17 for each additional table. VE Exams at 1 PM on Sat. Contact the *Midland ARC, P.O. Box 4401, Midland TX 79704;* or contact *Larry Nix N5TQU* by E-mail at: *oilman@lx.net.* A registration form can be downloaded from *http://www.lx.net/edge/midswap.htm.*

TULSA, OK The 1997 ARRL Oklahoma State Convention will be located in the Maxwell Convention Center, Downtown Tulsa, Exhibit Hall B (near the corner of West Seventh St. and South Houston Ave.) Flea Market spaces $6 in advance, $8 at the door. Limited to four. Banquet $20. Dealer booths $45 each sq. ft. VE Exams 1:30 PM Sat., and 9:30 AM Sun. Covered parking and RV hookups available. Talk-in on 145.27(-) and 443.750. Set up Fri., Mar. 14th 1 PM–10 PM. Call the Hamfest Hotline, *(918) 622-2277* voice mail/fax (24 hr.). E-mail *megriffin@ionet.net.* The Web site is *www.greencountry.com/hamfest.*

MAR 15 & 22

CLAYTON, MO The annual St. Louis County SKYWARN Severe Weather Observation Training Seminars will be held on these Saturdays: Mar. 15th, Mar. 22nd, Apr. 5th, and Apr. 12th. For locations, call the Severe Weather Info Line, *(314) 889-2857.* All are welcome including those from outside the area. No advance reg. required. Free parking. Certification provided free of charge, for R.A.C.E.S. and SKYWARN. Level 1 Training will be presented in the morning, with classes resuming in the afternoon for the SKYWARN Level 2 Program.

MAR 16

MAUMEE, OH The Toledo Mobile Radio Assn. will hold the 42nd Annual Hamfest/Computer Fair 8 AM–3 PM at the Lucas County Rec. Center, 2901 Key St. For details send SASE to *TMRA, P.O. Box 273, Toledo OH 43697-0273*, or *Paul Hanslik N8XDB, P.O. Box 273, Toledo OH 43697-0273; (419) 243-3836.*

STERLING, IL The Sterling-Rock Falls ARS 37th annual Hamfest will be held at Sterling H.S. Field House, 1608 4th Ave. There will be an indoor Flea Market, radio, electronic, computer and hobby items. Free parking, including areas to accommodate self-contained campers and self contained mobile homes. Dummy load available to test equipment. Tickets $3 advance, $4 at the door. Tables $5 without elec., $6 with. In groups of tables, the first table is $6, each additional will be $5. Bring your own cord. Set up Sat. 6 PM–9 PM, and Sun. starting at 6 AM. Doors open to the public at 7:30 AM Sun. VE Exams, walk-ins only. Bring current license, plus copy and photo ID. For advance tickets and tables, write to *Sterling-Rock Falls ARS, P.O. Box 521, Sterling IL 61081-0521;* or call *Lloyd Sherman KB9APW AC (815) 336-2434. E-mail lsherman@essexl.com.* Make checks payable to *Sterling-Rock Falls ARS.* Talk-in on 146.25/.85 W9MEP Rptr. Advance tickets due to be received by Mar. 1st. Please send SASE.

MAR 22

WEST ORANGE, NJ A Hamfest will be sponsored by the Roseland Radio Club, 9 AM–2 PM at West Orange H.S., 600 Pleasant Valley Way. Adm. $5 at the door. XYL/Children under 12, free (with regular adm.). Reserved tables $12 for first, $9 ea. additional. $15 for first, $10 ea. additional table at the door. Reservation deadline is Mar. 15th, after that, first come, first served. Set up at 7:30 AM for sellers only. Special vendor parking lot. Talk-in on 147.415/146.415 and 146.520 simplex. For more details call *Jim Howe N2TDI,* or *Liz Howe N2WGH at (201) 402-6066.*

MAR 23

TRENTON, NJ The Delaware Valley Radio Assn. will host a Special Event at Tall Cedars of Lebanon Picnic Grove on Sawmill Rd., starting at 8 AM. Setup at 6:30 AM. Tailgating, covered spaces, ARRL Div. Official. Adm. $5, non-ham spouses and children free. 8 ft. tailgating space $10, includes one adm. Limited 8 ft. covered spaces $15, includes table and one adm. Limited electricity available. Advance reg. available. Talk-in on 146.670(-). For more info, write to *Hamcomp '97, P.O. Box 7024, West Trenton NJ 08628. Tel. (609) 882-2240.*

MAR 29

MICHIGAN CITY, IN The annual Michigan City Hamfest and Computer Flea Market will be held at Michigan City H.S., 8466 W. Pahs Rd, 8 AM–2 PM CST. Early set up provided for vendors. Adm. is $4, children under 12 are free with a paid adult. Table reservations and general info available from *Ron Stahoviak N9TPC, 5802 N 400 W., La Porte IN 46350. Tel. (219) 325-9089.*

APR 5

LONGMONT, CO The Longmont ARC will sponsor their annual Hamfest/Swapfest at the Boulder County Fairgrounds, corner of Hover and Nelson Rds., 8 AM–4 PM. Adm. $4, tables $8. Table reservations taken at *(303) 817-5526,* or write to *LARC, P.O. Box 86, Longmont CO 80502-0086.* Talk-in on 147.27. VE Exams, free parking. Contact *Jim Deeming, (303) 651-7764;* or E-mail at *jwdeeming@ compuserve.com.*

APR 5 & 6

TIMONIUM, MD The Baltimore ARC, Inc. will host their 26th Greater Baltimore Hamboree and Computerfest, and the ARRL Maryland State Convention, at the Timonium Fair Grounds. There will be a giant amateur radio, computer and electronic Flea Market, Show and Sale. Vendors, reserve early. ARRL Convention Program and Banquet, Huge outdoor Tailgate area. Indoor Tailgate area. VE Exams. Show hours are Sat., 8 AM–5 PM; Sun. 8 AM–4 PM. Adm. is $5 each day. Weekend adm. ticket is just $8 by advance sale. The show will be held in any weather. Dial *(410) HAM-FEST* for voice or FAX-back info anytime! Outside the State of Maryland, dial *1-800-426-3378.* Please make check payable to *GBH&C,* and mail it to them at *P.O. Box 95, Timonium MD 21094-0095.*

SPECIAL EVENT STATIONS

MAR 9–10

MILWAUKEE, WI The 1997 Wisconsin QSO Party will be held by West Allis RAC, 1800Z Mar. 9th–0100Z Mar. 10th. Modes CW and Phone. Request rules by writing to *West Allis Radio Amateur Club, WIQP Information, P.O. Box 1072, Milwaukee WI 53201.* Please remember to send an SASE.

MAR 15

MACON, GA The Macon ARC will operate W4BKM 1500 UTC–2300

UTC in conjunction with the 15th annual Cherry Blossom Festival. Phone 7.235, 14.240 and 21.335; CW 7.135, 14.035 and 21.135. For a certificate send QSL and a 9x12 SASE to *Macon ARC, P.O. Box 4862, Macon GA 31208.*

APR 5–6

PISCATAWAY, NJ The Piscataway ARC will operate their annual Special Event commemorating the Voice of America Relay station, WBOU, which operated during WWII in the Bound Brook section of Piscataway. The club station will operate under the club call K2VOA, and members of PARC will operate under their own callsigns signing /VOA. Operation will be 0000Z Apr. 5th–2400Z Apr. 6th. Suggested freqs. are: CW–Novice portions of 80, 40, 15 and 10 meter bands; RTTY–RTTY portions of the 40 and 20 meter bands; Phone–the lower third of the General portion of the bands on 75, 40, 20, 15, and the Novice portion of the 10 meter band. For a certificate, send a #10 or for unfolded, a 9x12, SASE and 2 units of first class postage, with your QSL, to *PARC, Attn: VOA, P.O. Box 1233, Piscataway NJ 08854.*

NEVER SAY DIE

Continued from page 53

I can see why the manufacturers aren't bothering to exhibit at many hamfests—there's no way to really cover a product's features and benefits in the usual minute or two a ham stops by a booth. I've attended a couple of in-depth product demonstrations and I'll tell you, by the time they're through I'm pawing the ground to buy the rig. Hey, I *want* to be sold. One of the most exciting things in our hobby is buying or building something new and putting it on the air.

Think. Write.

Speed

Are you doddering along with a 14.4 modem on the Internet while the rest of the world is running 28.8 and even 33.6? Okay Buster, then how are you doing on packet? Blazing along at 33.6 yet? D-u-u-h? Sure, on the HF bands, where you have to deal with multipath and fading, speeding up presents some interesting challenges. But up on VHF and UHF? Give me a break!

An ISDN line provides 56K, and some new fiber lines are offering 1,544K. The question is, how far are we amateurs going to lag behind commercial technology? Heck, I'm old enough to remember when hams led technology instead of trailing it by an ever-widening gap. But I also am old enough to remember the nasty fight to replace spark with CW, and stabilized rigs on 2m. Now we're seeing the fight to retain 5 wpm CW in the face of 1,544,000 bps communications systems.

I'd sure like to see some articles on faster packet systems, both for VHF and HF.

The challenges for faster packet on HF call for some creativity. Diversity systems? Spread spectrum? Multi-frequency transmitters? What'll it take? Some of our very weak signal CW techniques might help here. Bill Ashby K2TKN, where are you when we need you? And what a shame that Sam Harris W1FZJ smoked so much.

If we're not going to lose the race to the Internet we've got to get packet up to speed.

Half Our Population

What country with half our population has over three times as many licensed hams? Yep, it's the same country that's been whupping our ass in electronics ever since they took the lead in licensed hams. The latest issue of the JARL magazine runs 452 pages and it's packed with construction projects.

But most awe-inspiring for me are the hundreds of pictures (in color) of ham groups they publish every month. When I look more closely I can see that most of these hams are youngsters. This is the way amateur radio was when I got involved in the 1930s. In those days, as I recall, the average ham age was 28. No wonder 80% of us

Continued on page 69

Number 55 on your Feedback card

BARTER 'N' BUY

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Hamfest, Trenton NJ, March 23, 1997. TCL picnic grove. Setup 6:30 AM, open 8:00 am. Admission $5.00, tailgating $10.00, covered space and table $15.00. Talk-in 146.67 (-). **Hamcomp '97**, DVRA, P.O. Box 7024, West Trenton NJ, 08628. (609) 882-2240. http://www.voicenet.com/~acelog. BNB909

Above & Beyond

Antenna Construction for VHF/UHF

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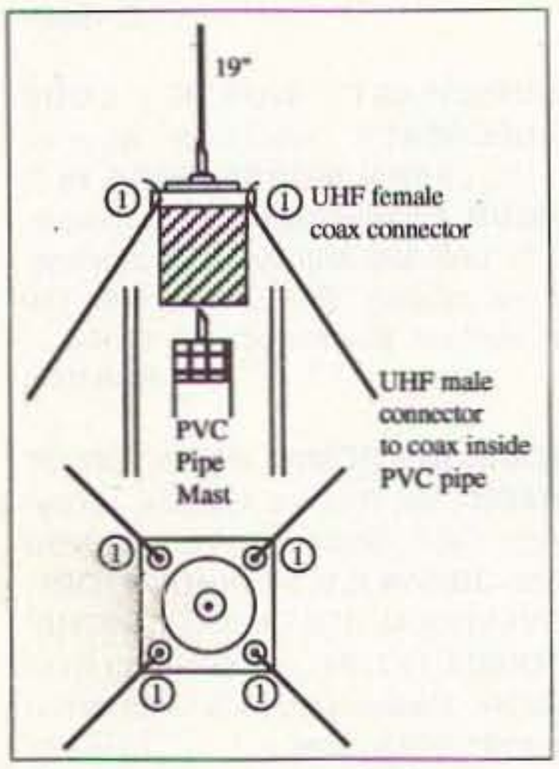

Fig. 1. *Basic ground plane antenna for two meters. "1" = (4) 19" radials soldered at approximately 45° angle.*

I thought that I would give some attention to simple antennas that can be constructed for our VHF/UHF bands. In a future column I will go into several other commonly-used antennas and pass on some construction techniques that I have used—but let's start out with the most basic, simple-to-construct antenna. I'll describe several methods of construction and then move on to the antenna testing vehicle, the SWR bridge that is used to adjust these antennas for optimum performance.

First let's get into some very basic structures and cover the simplest of all antennas for VHF operation—the ground plane antenna. This antenna has been the main performer for many stations, including SWL listeners in the VHF frequency ranges. The prime reason for the ground plane antenna's popularity is that it can be constructed out of common hardware store materials, at a very low cost. The basic ground plane antenna is not a gain antenna. It's a basic zero gain device.

There are several construction variations of the ground plane antenna. Let's start with the basic model. This can be built from a UHF female coax connector and five pieces of #12 electrical wire with or without the insulation. Fabricating the antenna is very simple. Cut the #12 wire to a 19-inch length for the main element and 19 1/2 inches for each of the four radial elements.

Each of the four radials is inserted into one of the four bolt holes in the UHF coax connector by bending them through and over the bolt hole. Each element is then soldered to make a firm connection to the ground portion of the connector. With the coax connector upside down (center connection pointing up), bend the four elements downward to a 45-degree angle (approximately). Then solder the fifth element (19-inch) to the top center connection of the coax connector to complete the antenna.

Keep it simple

Mounting the antenna is made simple by using a three-foot section of PVC pipe. The pipe, with the coax running through its center, is used to support the bottom section of the UHF connector. Two muffler clamps can be used to attach the PVC pipe to an antenna mast. The weight of the coax naturally holds the ground plane antenna in place. You can strengthen the #12 wire used as the vertical element by cutting a small round insulator and drilling a hole to fit the #12 wire.

Ream out a small clearance on one side of this insulator material to fit over the center connector pin of the female UHF connector. Secure in place with a silicon RTV. This short section will help to relieve strain on the solder connection of the vertical element. See **Fig. 1** for details on the basic ground plane element—the picture tells the whole story.

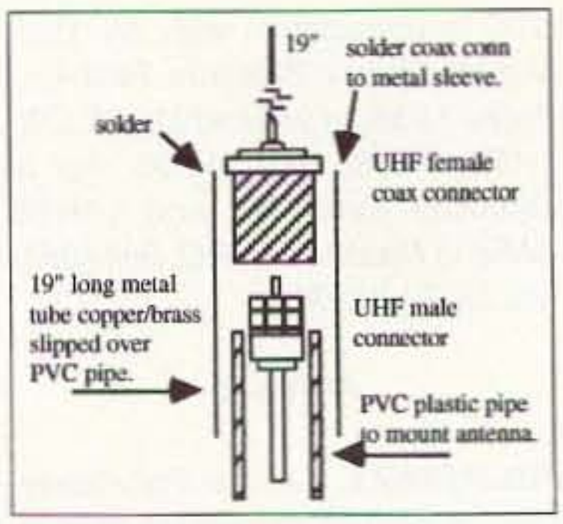

Fig. 2. *Simplest two-meter ground plane sleeve design.*

OK, now

You've got your antenna; you want to find out how well it matches to the frequency range at which you expected it to function. With the ground plane antenna it is almost assured that it will function well at 146 MHz. There are several methods to prove that it will function well at 146 MHz or your designed frequency.

One is to use your transmitter and an SWR bridge. This can require two people; one to operate the transmitter, and the other to adjust the antenna. Those two people could use handhelds to communicate as the antenna is trimmed for best minimum SWR on reflected power, a method that works well but may not always be convenient.

You could, alternatively, mount the antenna on a temporary test ladder over your lawn area and then adjust the length and angle of the radials for minimum SWR readings on the SWR bridge.

Another method is to purchase a commercial SWR analyzer (MFJ makes one covering 1.8 to 174 MHz, their MFJ-259). A little hand instrument replaces the transmitter and uses a internal source, which can be attached to the antenna, allowing a one-instrument test configuration to trim antennas to minimum reflection or best SWR ratio. I picked one up, and after many years of using the transmitter SWR meter method I find this instrument to be the best method available for HF through VHF.

Operation is so simple it's a snap to adjust almost any antenna to proper match—I wonder how I got along without one for so long! An added bonus is that if you make a gross error in calculations for home-brew antennas

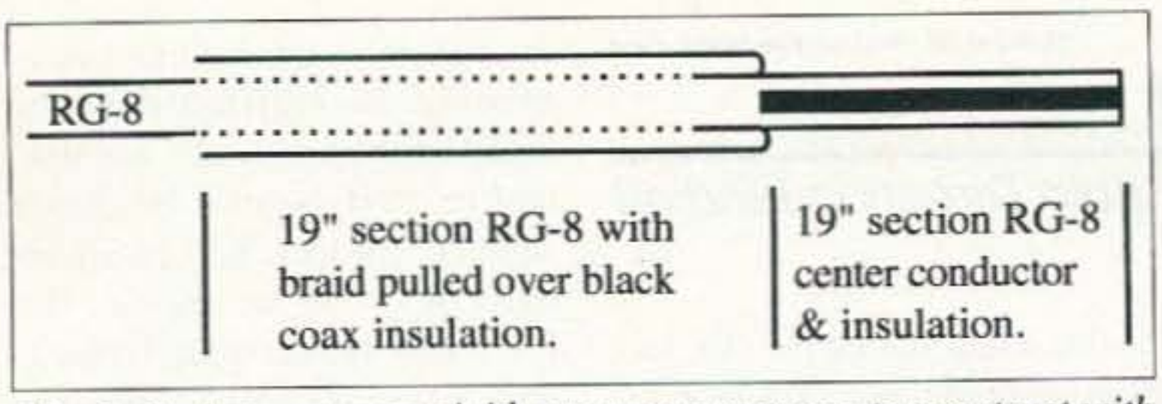

***Fig. 3.** Easiest, yet most rigid, two-meter antenna to construct with minimum parts.*

and don't find a good SWR in the amateur bands, the MFJ-259 is not restricted to amateur frequencies and will tell you how far out of band your adjustment is. This makes it quite simple to know where you are resonant and what needs to be done to bring it into the amateur bands. You know right off the bat if you need to lengthen or shorten elements at your desired resonant frequency.

The basic ground plane antenna for two-meter operation works well for SWL receiving operation from 100 to 174 MHz, transmitting throughout the two-meter band with less than 1.5 to 1 SWR. Cost of construction of this antenna for two meters is about $3 and it is a very forgiving, easy-to-duplicate antenna.

The next generation

The ground plane sleeve antenna uses a metallic sleeve over the coax in place of the four radial ground elements. This metallic sleeve acts in much the same manner as the previous example's four elements and is the ground opposition to the radiating element. Electrically both antennas are quite similar even although they do not look alike.

The top or vertical element remains the same. The sleeve is soldered to the bottom side of the coax connector and is the same length as the vertical radiating element. The coax runs through the inside of the copper pipe and it is placed on a short section of PVC plastic pipe to mount the antenna. The copper pipe is connected to the same ground portion of the coax connector that the radials previously were connected to. See **Fig. 2** for details.

Going solo

The third variation of the ground plane antenna is to make the antenna out of a section of RG-8 coax by itself. This is the easiest and most quickly constructed antenna you will ever see, at least for two meters. At one end of your RG-8 cable, strip and remove about 22 to 25 inches of the outer black insulation (depending on your brand and the thickness of the insulation jacket).

I advise going long as you can always cut back on the length of braid when finished. When this length of outer insulation is removed, slowly fold back the ground braid over itself and down on over the remaining black outer insulation. It's a little tricky at first but it will go on with a little adjustment here and there.

What you want to end up with is the braid extended backwards over the insulation for a distance of 19 inches. If it's too long, cut to a 19-inch length. The center conductor and its inner insulation remain, and are also trimmed to 19 inches, for our starting point. Use the SWR bridge to adjust to precise frequency. When you have trimmed or adjusted the length of braid to your selected two-meter frequency, wrap the braid in electrical tape to hold the length adjustment you made in tuning.

If you don't tune the antenna, it will work quite well at two meters as is. Keep in mind it's not perfect—but very close. The entire antenna (modified RG-8 section) is inserted in a section of 1/2-inch PVC pipe long enough to fit the antenna and give some room to use mounting clamps below the braid. See **Fig. 3** for details.

I recommend leaving at least a foot or two of unmodified coax below the bottom of the braid before attaching mounting clamps to the PVC pipe. This helps to avoid interference from the main mast and the antenna. Use a PVC cap on top to waterproof the antenna, and on the bottom cut a small notch to allow the RG-8 to exit the side of the PVC pipe just above the bottom connector. Nothing is critical in construction or in how you run the coax through the PVC. Use any method you like to hold the cable inside the PVC pipe—after all, you don't want it to slip out.

The MFJ-259

A little horn-tooting about the MFJ-259, which I mentioned earlier. It places a small RF signal generator, with frequency counter, SWR meter, and antenna resistance meter all in one small battery-operated package. For instance, it can generate a test signal (taking the place of the transmitter), read the frequency on a internal frequency counter, indicate minimum SWR and display this frequency. It also tells you what your RF resistance is, at the RF frequency. Operation is a two-knob operation. One knob sets the frequency range and the other controls the frequency fine tuning. Simply adjust the fine-tuning knob and look for minimum SWR and 50 ohms of resistance.

This little device is quite a good adjunct for any station. I tested my unit by placing various loads and conditions of known and unknown impedances; it passed all with flying colors—and one knob/one switch operation, on the 1.8 MHz to 170 MHz frequency ranges in six bands of operation.

To test the unit for accuracy, I used several different loads, including a few very reactive complex ones, in addition to perfect terminations at 50, 75 and 100 ohms to test the resistance meter and SWR meter basic operation. Using the perfect resistance loads the SWR meter indicated near-perfect 1:1 SWR and 50 ohms RF resistance on all frequencies with the 50 ohm load. Indication was 2:1 SWR and 75 ohms RF-resistance with pure 75 ohms and 3:1 SWR and 100 ohms RF resistance

with the pure resistance of 100 ohms. Testing with proven external antennas at 7.3, 4, 14.3, 29.3, 50.1 and 146.5 MHz gave me exactly the results I had expected on six and two meters—and showed me that my inverted "V" on 80 and 40 meters was not in true resonance and RF resistance at 50 ohms.

My dipole for 10 meters was not exactly on the correct center frequency, as it was 200 kHz higher than where I wanted it—not exactly the information I wanted to hear about my existing antenna farm. I removed all the suspect antennas, performed repairs and made adjustments with the analyzer. I found a broken, half-missing ferrite core transformer (balun) and 20% of the 80 meter loading coil was shorted. I repaired the balun, rewound both 80 meter loading coils, and retested the antennas. Retesting the 80 and 40 meter antennas showed good SWR and 50 ohms RF resistance at their (previously set) proper frequencies.

Now that I have climbed back down from my roof and finished with the short antenna project that turned into a all-day repair job, I am only more convinced of the value of the MFJ-259 or at least of leaving a good SWR meter in the line at all times to spot defects. By tuning the MFJ analyzer I did not have to use a transmitter to perform tests on antenna conditions, and the portable unit worked flawlessly.

I started to verify short antennas, namely, my vast collection of "rubber duckies" for six and two meters, and found a few two meter units better suited for FAA use in the aircraft band, as they were resonant in the 120 MHz range. Pulling the black cap off the end of the antenna, removing a few coil turns, and retesting on the analyzer returned resonance to the 146 MHz frequency range. Again, I had never tested my rubber duckies, and have even interchanged them among the myriad of HTs I have owned. All I can say is that after resetting them to frequency and minimum SWR, HT operation *is* somewhat improved.

Coming up

What started out to be a simple article on two meter antennas has given me a new perspective on, and respect for, the MFJ-259 SWR bridge/signal generator. I am already thinking about some interesting additional features and sidecar attachments to make this device more useful than it already is—I will explore the possibilities further in another column. I had hoped to cover some "J" antennas and beam antenna construction for two meters and above, but I will pick that up next month.

I have started construction of a 432 beam antenna. The comparison I wish to draw is to the cost of commercial ready-to-use vs. home-brew construction. I plan to keep track of all efforts to locate materials and the costs accumulated in the beam antenna construction project. I anticipate a lot of fun in trying to convert myself, a workbench rosin addict, into a junior-grade machinist. More next month on antennas for VHF and UHF, and the dangers of the drill press. 73

HOMING IN

Homing In Radio Direction Finding

Joe Moell P.E. KØOV
PO Box 2508
Fullerton, CA 92637

Testing N6BG's PicCon

"I need a fox!" That's one of the most common requests in my E-mail in-basket. It also shows up regularly on the Internet mailing list for radio direction finding (RDF) enthusiasts. Usually the requester has just won his first hidden transmitter hunt, which might be called a T-hunt or foxhunt, depending on where he lives. He is looking for a transmitting device because it's now his turn to hide for the next hunt.

A special "fox box" isn't always a necessity. For some hunts, all you need to do is find an unusual spot, set up a portable transmitter/antenna, and yak into the mike at intervals called for by the hunt rules. But it's more fun when you automate the process. An unattended fox (or "T") frees you to move around, drawing attention away from the transmitter's location. You can enjoy the spectacle of the hunters scurrying to locate it. It saves your voice, too. The easiest audio source for this purpose is an endless loop tape recording. Unfortunately, cassette decks don't fare well outdoors during damp evenings and they don't have provision to cycle the T on and off.

"Want to bury your T on Thursday and have it come on at hunt time on Saturday?"

Mobile T-hunts around the country have an endless variety of rules, calling for transmissions ranging from a few seconds every few minutes to continuous. On the other hand, championship on-foot foxhunts under International Amateur Radio Union (IARU) rules require several synchronized fox transmitters sending a prescribed CW message for 60 seconds each in numbered sequence.

The optimum solution for most hunts is a device with no moving parts that provides distinctive audio and versatile on/off cycling for ordinary portable and handheld transceivers. Several designs for such fox controllers have appeared in recent years, but none has been ideal for both mobile and international-rules hunts, until now.

Byon's new baby

Byon Garrabrant N6BG (formerly KD6BCH) is a software engineer and an active T-hunter (**Photo A**). He teamed up with Marty Mitchell N6ZAV to create the RaCon 6805 three years ago (see "Homing In" for July 1993). RaCon (short for Radio Controller) uses an MC68HC705C8 microcontroller IC and supporting circuits. It outputs several built-in tone sequences and timing choices plus a user-programmable sequence. CW identification is included too, of course.

RaCon became quite popular among T-hunters in Southern California, but Byon wanted something better. When PIC microcontrollers became inexpensive, he realized that one could be the brains of a fox controller that would be much smaller, cheaper, and easier on batteries. Byon chose the PIC16F84 by Microchip Technology Incorporated of Chandler, Arizona, which uses flash memory for the program and a electrically erasable PROM for data retention.

Byon polled local T-hunters for ideas for the ideal fox box. They asked for non-volatile memory, fully programmable transmit on/off timing, and a delay feature to start transmissions automatically at hunt time. The ability to change programming from a remote location during the hunt was also desirable. I suggested adding timing and CW transmissions in accordance with IARU rules for international foxhunts, plus provisions for easy synchronization of multiple foxes for championship competitions.

Before long, Byon emerged from his shop and passed out beta test kits to eight regular RDFers. Every tester met with success, only minor revisions were needed, and PicCon (pronounced "PICK-on") was born.

An easy kit

Byon says PicCon takes less than 30 minutes to assemble. He's right. There are no surface-mount parts (good!). However, you will need a fine-point soldering iron because the parts are packed onto the 1-7/8-inch by 1-3/4-inch circuit board (**Photo B**). The board is high quality, single-layer, with solder mask. All parts for the board and a RJ25 output cable are supplied. You must supply your own connectors for the mike, speaker and push-to-talk (PTT) lines of the transmitter you will be using for your hidden T.

If you're like me, it will take more than another half hour to figure out all the intricacies of programming your PicCon. The unit is so versatile that it took

***Photo A.** PicCon designer Byon Garrabrant N6BG likes both mobile T-hunting and international-style foxhunting. He had the best score out of 27 entrants at the 1996 West Coast VHF/UHF Conference Foxhunt.*

several read-throughs of the beta test manual. (The new Version 1.0 manual is easier to understand.)

When you first activate a new PicCon, it sends a pre-programmed 3-second tone sequence over and over for 30 seconds and then identifies in CW with the software version number. Your first task is to change the CW message to your callsign and set the transmission on and off times as appropriate for your local hunts. You do this by sending DTMF commands to the fox transceiver connected to PicCon using another radio that transmits on the frequency where the fox rig is listening.

As an example, the DTMF sequence A20130 tells PicCon that tone sequences are to last for one minute and 30 seconds each. Program your callsign in a similar manner by sending numbers representing the letters and numbers in the call per the "cheat sheet" in the manual. Each command is stored into the PIC's EEPROM, so the information is not lost when the unit is powered down.

Upon application of power, PicCon waits silently. A DTMF command or push of the momentary switch on the board starts the transmission sequences. Alternately, you can program the board to begin transmitting immediately upon power up. To ensure that only you are in control of your transmitter, PicCon has a lock command. When you lock it, you enter a private numerical code that you will send to unlock it later.

Next, you can get fancy by designing your own tone sequence. You have 99 tone pitches to choose from and the sequence can have up to 28 tones before repeating. The speed of the tone sequence is programmable, as is the speed of the CW ID. You can even program a repeating 8-event series of tone sequences, off times, and IDs.

Want to bury your T on Thursday and have it come on at hunt time on Saturday? One DTMF command lets you specify a delay of up to 100 hours before the first transmission. If the hunt must end at a certain time, another command will terminate all transmissions after a pre-programmed duration.

If you use a single-band transceiver with PicCon, don't program continuous transmissions if you need remote control during the hunt. Set up at least a short receive period every few minutes. If your fox rig is a dual-band transceiver with duplex capability, you can control PicCon via one band while it transmits simultaneously on the other band.

PicCon includes a 78L05 voltage regulator and operates from a DC supply of 7 to 35 volts. It draws only 12 milliamperes, so an ordinary 9-volt alkaline battery will power it for over 24 hours. If you disable the LED via a DTMF command, current drain is only 9 mA. Even when battery voltage plummets, PicCon won't go berserk. The CMOS microcontroller is tolerant of low supply voltage. My unit worked down to 3.5 volts, though audio level diminished somewhat below 6.5 volts.

IARU mode, too

PicCon makes it easy to field up to nine foxes for radio-orienteering (ARDF) competitions. You'll need one PicCon and one transceiver for each. With a DTMF mode change command, fox #1 sends "MOE" over and over in CW. Fox #2 sends "MOI," fox #3 sends "MOS" and so forth, in accordance with IARU rules.

With other commands, you can set PicCon to send the MO sequence for 55 seconds at 5 wpm, then callsign in CW at 20 wpm, then shut off so the next fox can transmit. Program into each fox the appropriate wait time before first transmission, then start them all at once using the on-board push-buttons or a DTMF command. The foxes will cycle in perfect sequence for the duration of the hunt.

For IARU championship foxhunts on 80 meters, on/off CW is used instead of tone modulation. PicCon provides a separate 80-meter mode that keys CW transmitters via the PTT output line. There are several other useful options such as random tone sequences and rates that you can read about by downloading the latest PicCon User's Manual from Byon's Web site. Go to URL http://www.kvoa.com/byon/piccon/ or get there via the link from my "Homing In" site.

I couldn't find any faults or bugs in the PicCon hardware or firmware, but it has a few limitations. The repeater mode that was in RaCon is not in PicCon. To minimize current drain, the PTT drive transistor is small and lightly driven. You won't have any trouble keying a handie-talkie, but older mobile radios with high current PTT relays are too much load for it. So are the stamp-sized micro-Ts that have been described previously in this column. However, it's easy to solder up simple adapters with one or two transistors to key these rigs.

Byon has packed lots of features into the 1,024 words of firmware memory in the microcontroller. That didn't leave enough memory space to include error-trapping routines. If you enter an undefined command or parameters that are outside the specified range, PicCon will react in an unpredictable manner. Fortunately, there is an easy procedure to reset the EEPROM that

you can use to bail out and start over if you program yourself into a corner.

Other than listening and checking with a stopwatch, there's no way to verify the timing you have programmed with DTMF. The LED on the board flashes at various rates to indicate power turn-on initialization, DTMF being received, waiting for completion of a command, and PTT activated.

PicCon kits are available for $49 each plus $2 for shipping/handling from Byon Garrabrant N6BG, 1150 N. Harding Street, Orange CA 92867. There is a 10% discount for purchases of three or more PicCons. Built/tested/packaged units are not available at this writing, but may be in the future. N6BG's E-mail address for inquiries is: byon@netcom.com and his phone is (714) 538-0203, evenings only.

News from Down Under

Thanks to editor Wally Watkins VK4DO for sending a copy of *Radio Sport News* from Australia. In this publication, Wally reports that the European ARDF championships in Bulgaria were a huge success. Nineteen countries took part. "The location was a ski resort in the mountains south of Sofia at an elevation of 1300 meters," he writes. "The hotel was first class. Food and drink were very cheap by our standards.

"Coffee was 25 cents and beer 40 cents in the lounge," Wally continues. "At a roadside cafe, the dearest (most expensive) item on the menu was steak and chips at one dollar US currency. The courses for the events were well selected and ranged over the undulating countryside, either open or heavily timbered by pine plantations. On both days, there was one steep hill to climb. The only casualty was a DL (German ham) who was bitten on the leg by a farm dog."

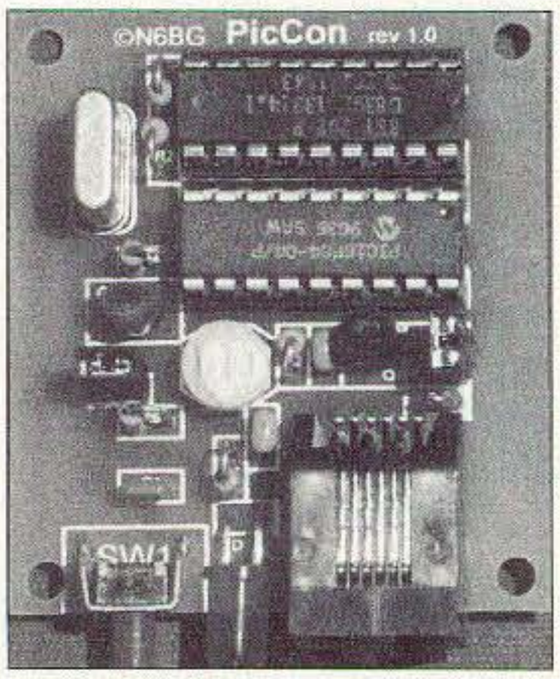

***Photo B**. This little circuit board plus a 9-volt battery and a transmitter/antenna are all you need to make a hidden transmitter for a mobile T-hunt or on-foot foxhunt.*

"The only casualty was a DL (German ham) who was bitten on the leg by a farm dog."

The first New Zealand national ARDF Championships will be March 28 through 31, 1997 in Christchurch. Separate events will be staged with 80-meter CW and two-meter AM foxes. The 1997 Friendship Radiosport Games in Kanagawa Prefecture, a suburb of Tokyo, Japan, from August 18 through 25 will include a championship radio-orienteering contest on two meters.

The next ARDF World Championships will be in Germany at St. Engelmar ski resort in the mountains near the Czech border. The World Championships after that will be held in IARU Region 3 in the year 2000. Australia is the prime candidate host country for that meet, because it could be held just before or just after the Olympic Games there.

If you are interested in attending any of these international ARDF events, write to me and I will try to put you in contact with the organizers. Send E-mail to: Homingin@aol.com or postal mail to the address at the beginning of this article. Also be sure to check the "Homing In" Web site (http://members.aol.com/homingin/) for current ARDF news. You'll also find lots of information on how to get started in both international-style on-foot foxhunting and American-style mobile T-hunting. 73

Number 60 on your Feedback card

HAMSATS

Amateur Radio Via Satellites

Andy MacAllister WA5ZIB
14714 Knights Way Drive
Houston TX 77083

Satellites made easy

One visit to a satellite enthusiast's station or a look at photos of ham-radio satellite stations gives the impression that it takes a lot of gear to get on the air via the OSCARs (Orbiting Satellite Carrying Amateur Radio). In many cases it can be expensive and complex to chase the satellites. There are several that are either very high tech or use uncommon frequencies requiring specialized equipment. Fortunately there are other satellites of a simpler nature.

The Mode A (two meters up and 10 meters down) satellites like the RS series used to be the satellites of choice for beginners and portable operators. These satellites have been called "EZ-sats." All that is required is a two-meter transmitter capable of CW or SSB at a reasonable power level (10 to 25 watts) with a ground-plane antenna and a ten-meter receiver hooked to a dipole. A few mag-mount antennas even allow mobile operation.

"Except for the antenna and the charger, everything fit in a small, soft-sided camera case."

New devices have been placed in orbit that have changed the definition of the "EZ-sat." AMRAD-OSCAR-27 (also known as EYESAT-A) is the best example.

A-O-27/Eyesat-A is based on the AMSAT (Radio Amateur Satellite Corporation) microsat design. The satellite was built by Interferometrics, Inc., as a commercial demonstration of the capabilities of a small satellite for digital store-and-forward communications. The amateur-radio portions of the satellite were built by the Amateur Radio Research and Development Corporation (AMRAD), a technology-oriented amateur radio club near Washington, DC. More information about AMRAD can be found at their Internet URL (Universal Resource Locator) http://www.amrad.org.

Launched on September 26, 1993, the satellite has performed well in its circular 800-km high orbit. It is a nine-inch cube weighing about 20 pounds with a single whip antenna for two-meter reception on top and four 70-cm downlink antennas on the bottom. While the amateur-radio segment of the satellite was designed to provide digital communications from 300 to 9600 baud, the favorite mode has been the analog FM "bent pipe."

A-O-27's "bent pipe" acts as a flying crossband FM repeater. The uplink is on 145.850 MHz with a downlink on 436.800 MHz. The repeater is usually on for daylight passes over North America. Many stations have made contacts through the transponder with simple home stations, mobile setups and even portable systems.

The two-meter receiver on A-O-27 is quite sensitive. The casual user may disagree, however, based on personal observations during a typical pass. Since A-O-27 offers only one FM channel, it is like a repeater with too many users all trying to talk at once. Even weekday passes during work hours can be congested. For a low-power station using simple antennas, persistence, location and cooperation from the other users are necessary conditions to make contacts. Most of the regulars on A-O-27 are aware of the problems and try to give the newcomer or low-power operator a chance.

On vacation

I recently had the opportunity to take a week off with the family. Some great rates on a cruise

***Photo A.** Back on land with a Yaesu dual-band HT and Mirage dual-band amplifier for mobile/portable A-O-27 operation.*

to the Caribbean, good timing, and an enthusiastic crew, kids and wife included, decided the issue.

My wife Heather WB5RMA asked if I would be taking any radios. At first I thought it would be too inconvenient on a cruise, but after listening to a talk about portable operation by Ray Soifer W2RS at the AMSAT Space Symposium in Tucson, I decided to put together a small portable satellite station. Ray used a Kenwood TH-26AT hand-held transceiver for CW uplink to RS-10 and a Sony SW-100E miniature portable shortwave receiver for the ten-meter downlink. Details on his activity can be found in the November/December 1995 issue of *The AMSAT Journal*. His article is called "The World's Smallest Satellite Station?" I started planning for an even smaller setup.

I've been on a lot of boats and offshore drilling rigs during my years in Gulf of Mexico offshore field work. I used to listen to AMSAT-OSCAR-7 with a two-meter, all-mode rig and a ground plane antenna during down time on the rigs. Once I even got a visual sighting of A-O-7 when conditions were right.

Radio frequency noise was usually not a problem for VHF reception. Although there are a lot of potential noise sources on the man-made islands, the higher frequencies are not as susceptible as the shortwave bands. Attempts to receive ten-meter satellite signals were usually not worth the trouble.

While Ray could get away from most noise sources with his simple station, I could not. The cruise ship, with its generators, lights and electric motors, could be quite a problem for my simple Grundig YB 400 shortwave receiver.

The station

To save on space and keep things light, I tried my Alinco DJ-580T dual-band HT on a good A-O-27 pass before setting sail. The downlink on 436.800 MHz FM was good, but competition on the 145.850 MHz FM uplink was fierce. A brief contact was made,

"Those dual-band HTs are good for a lot more than just talking to someone on the other side of town."

but a few station improvements were needed.

A Diamond RH778 dual-band antenna (15 inches long) was loaded in the suitcase along with an external Alinco microphone, an E.H. Yost 1000 mAh, nickel-metal hydride 12-volt battery pack (model EBP-22nh), a small wall charger, a Garmin GPS-45 receiver and some stereo ear-bud headphones. The antenna and high-voltage battery provided a better uplink signal, while the phones and microphone allowed easier orientation of the HT for best signal during a pass. Except for the antenna and the charger, everything fit in a small, soft-sided camera case.

Rather than take along a laptop computer to make predictions, I plotted out orbit listings on paper at home, based on the cruise

Photo B. *No CW keys or spark-gap transmitters in the ship's radio room.*

itinerary. Since I would not be trying to use directional antennas, prediction errors derived from approximate locations would not be a problem. Latitudes and longitudes for Miami, San Juan, St. Thomas, Sint Maarten/St. Martin and points in between were used. Only daylight passes for A-O-27 were printed.

The list was a bit short, so I included predictions for the *Mir* space station. The onboard, 70-cm repeater has been activated and available for use almost every time I have listened. Although the Doppler shift has been a challenge, downlink signals are quite readable. The repeater uplink is on 435.750 MHz FM, and the downlink is 437.950 MHz FM. A CTCSS (PL) tone of 141.3 Hz is required to access the system. More information on the *Mir* repeater and the history of ham activities on *Mir* can be found in the October 1996 "Hamsats" column.

Licensing issues

At some point it occurred to me that I might need to consider the potential legal ramifications of my maritime-mobile operation. With the exception of Sint Maarten/St. Martin, all the ports were U.S. Rather than try for a license on the Dutch/French island, I decided to be a good tourist that day, and just see the sights.

Our cruise ship, the Carnival *Sensation*, is registered in Panama, so I checked with the ship's radio operator about my potential ham activity when I got on board. After a brief explanation of what I had in mind, the operator's only concern was for my activities on land and the few HF and VHF frequencies that the ship used for port communications and emergency activity. Apparently my VHF/UHF ham activities would not be a problem. The operator was fascinated by the fact that I would be using a small HT and whip antenna to attempt satellite contacts.

The equipment in the ship's radio room included a few control panels and two personal computers. The ship's HF distress frequency was 2182 kHz and the two VHF-FM frequencies to avoid were 156.525 and 156.800 MHz. Everything else onboard used geostationary satellites. The automatically-steered satellite dishes on the ship were encased in weather radomes and were quite impressive. I was assured that there were no spark-gap transmitters or CW keys in use. Telephone rates to the U.S. were about $5.00 per minute via the satellite links.

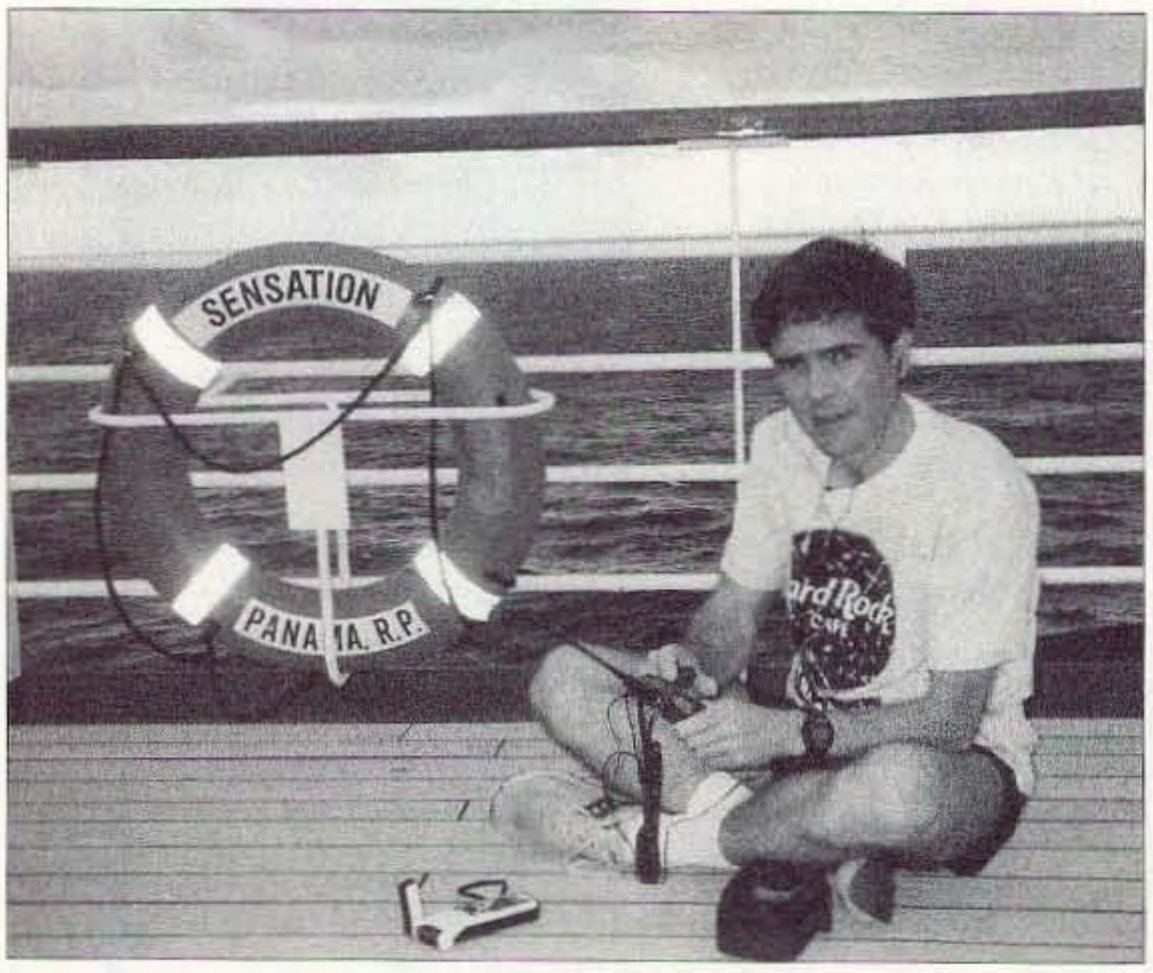

Photo C. *WA5ZIB on deck, getting ready for AMSAT-OSCAR-27.*

The results

One of the less-populated sun decks became my "ham shack." While there were plenty of activities on board ship, there were also plenty of leisure moments. The Garmin GPS-45 receiver made a good paperweight for the orbit listings while the HT was configured for A-O-27 or *Mir* repeater operation. During the cruise several contacts were made with stations from Vermont to Texas via A-O-27. Each time I made a contact, I marked the position in the GPS (Global Positioning System) receiver. Many of the A-O-27 operators collect grid squares, and it was also a fun exercise to keep up with the ship's progress. I even had a visitor in "the shack." Frank WØAJY and his wife Nancy noticed my operation and came by to say hello and discuss ham activity and the computerized ship's radio room. While in port, family activities took priority.

I tried a few Puerto Rico and St. Thomas repeaters, but it wasn't nearly as exciting as the satellite contacts with the HT. Results with the *Mir* repeater, however, were disappointing. While I could key the repeater with the HT and short antenna, few stations were heard and no contacts were made. To properly track *Mir*, recent orbital element data is needed, and due to the 70-cm uplink and downlink, it's not possible to operate full duplex. The necessity for significant Doppler correction to stay in the repeater passband and the apparent lack of sensitivity in the repeater's receiver makes operation via this system more difficult.

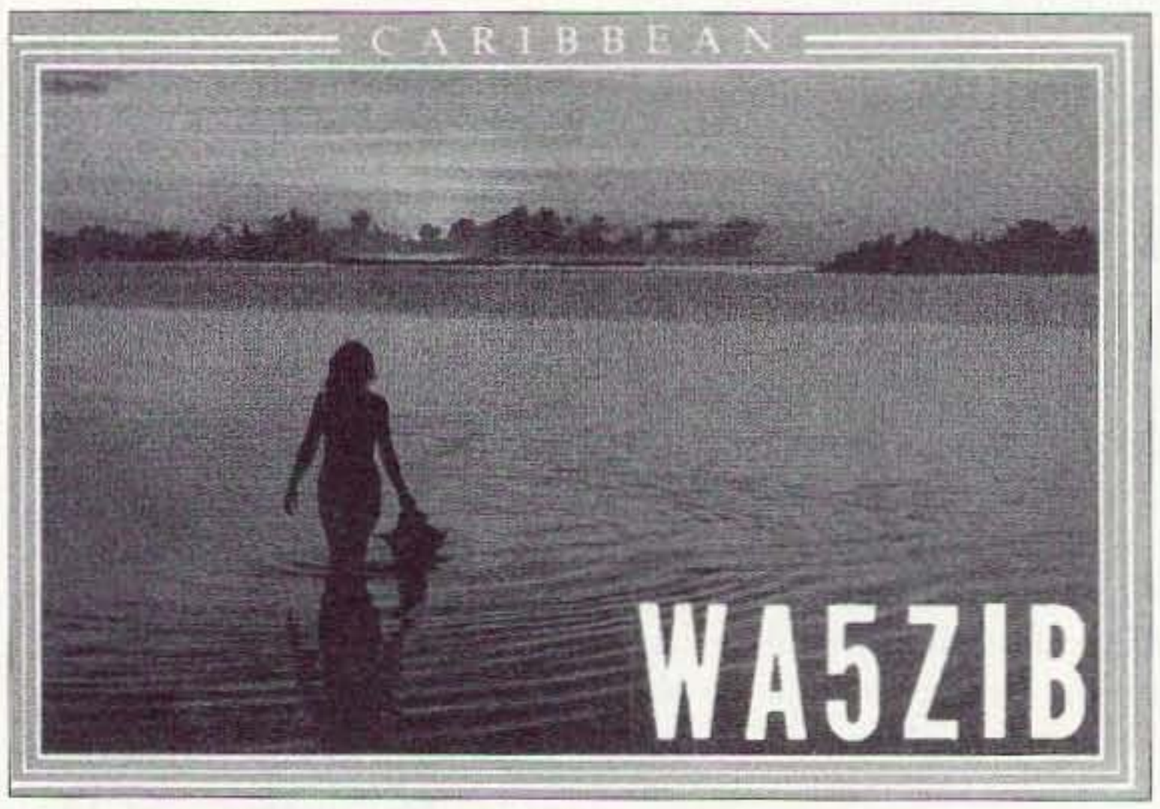

Photo D. *The WA5ZIB QSL card for A-O-27 contacts made during the cruise.*

Back on land

Taking satellite operation along on the family vacation turned out to be a lot of fun. I wasn't on a DXpedition and I didn't make that many contacts. It was just an entertaining experiment for those moments that would have gone to waste in front of a TV or a gaming table in the casino.

Since the cruise I have noticed other stations trying out HTs and mobile rigs on A-O-27. Many have been doing this for quite a

LETTERS

Continued from page 7

Internet through our home page (http://www.feist.com/~aa0of).

You can breathe a sigh of relief, Wayne, because my teaching methods would please you. My students are given numerous opportunities to experiment and discover. The basis, of course, is amateur radio, but their imaginations are free to create and design.

Wayne, the Andover Schools Amateur Radio Club would like to extend you an invitation to come and visit us. I think you'd be proud.

Hmm, maybe I'll get invited to a Wichita hamfest and have a chance to meet your students. I hope so... Wayne.

Fred Ordway KI6QK: I'm the Official Observer Coordinator for the ARRL Los Angeles Section. I believe that the OO program has been designed for failure. It is a stalling and pass the buck vehicle for the local FCC engineers-in-charge. The system fails because the FCC does not enforce the rules.

Now the ARRL in its meddling (by a radio club that represents less than 20% of amateur radio operators) is pushing its way into the regulatory process with National Repeater Coordination.

If you look at the amount of amateur radio spectrum that's available for coordination you'll see that in the three main VHF/UHF bands approximately 66% is subject to coordination.

Many of the coordination groups are made up of the Good-Old-Boy network. They started their own frequency coordination group to meet their special interests. They do not represent the amateur community and tend to protect their own self-interests. When an amateur has to pay membership to belong to a frequency coordination group to get his repeater coordinated, and only coordinated repeaters may vote for the officers and rules, it is obvious that the program is a sham.

Part 97 and specifically §97.101(b) states... "No frequency will be assigned for the exclusive use of any station." The FCC has made the regulations so that everyone can participate in the hobby. §97.205(a) says that any amateur station licensed to a holder of a Technician, General, Advanced or Extra Class operator license may be a repeater.

Now the ARRL and the frequency coordinators that are made up of repeater owners are attempting to gain a vehicle to maintain their status quo and deny or attempt to deny others full participation.

I urge everyone to study the ARRL and National Frequency Coordinators proposals to see how a private group will take away our rights and limit our participation in the hobby. This is bad for amateur radio. The ARRL must be stopped.

If coordination could be done the way GMRS repeaters are licensed, there would be no problem and no one would be denied. On the GMRS channels it is only a matter of filling out the papers and writing a check. Everyone is on the a level playing field. If the ARRL gets its way there will be no level playing field, only a continuation of a system of corruption, bribes and favoritism. If you are not in the clique, you can lose.

The band plans are established for everyone and that enables all of us to participate in the various areas from CW, weak signal, ATV, digital, SSB, FM and repeaters. This proposal will significantly diminish the level of participation of every amateur operator for the benefit of a few. I do not want to relinquish my freedom to a bunch of self-serving, self-appointed Good-Old-Boys (and -Girls).

Troublemaker... Wayne.

Carlton Davis NQ3Y. I read Marshall Emm's review of the Green Mountain 20 Meter CW QRP transceiver in the June '96 issue. The review and the low price inspired me to go out and buy one from Small Wonder Labs. The kit was easy to build, but I would not recommend it to an inexperienced builder. A beginner can probably assemble the kit with the aid of a more experienced builder. I purchased the 30 meter version. 30 meters has the long range capabilities of 20 meters and the short to medium range capabilities of 40 meters. In addition, since contesting is not allowed on 30 meters, it is easier for a QRP station to have weekend rag chews without battling the kW boys. Since I check my work as I assemble, the kit went together in three evenings. It took me

Continued on page 75

while. At my office in Houston Ken KC5WXV and I have tried a few more experiments with A-O-27 during coffee breaks. Using his Yaesu FT51R dual-band HT and a Larsen dual-band mag-mount whip antenna we could easily hear activity on A-O-27, but had marginal success getting through the FM pileup to make a QSO. We then added a Mirage DD-35 dual-band amplifier and had success. The Mirage amplifier is advertised as a full-duplex unit. When using full power output on two meters (about 45 watts), we noticed some desensing of the 70-cm downlink signal from the satellite. An AOR AR-8000 scanner on a separate antenna did not exhibit any desense, but there are some issues with the power connections and ground points that may provide some cures for the single HT/amp/antenna system.

There have been complaints about the congestion on the single channel FM transponder on A-O-27, but it's in orbit, it's sensitive and it works. While we wait for the launch of Phase 3D, there's still a lot of activity via low-earth-orbit hamsats. Plot some A-O-27 orbits and listen. Those dual-band HTs are good for a lot more than just talking to someone on the other side of town. 73

Ham Radio Fun

Communications Simplified, Part 15

Antenna basics.

Peter A. Stark K2OAW
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Mt. Kisco NY 10549

It's time to look at antennas. Although we'll look primarily at transmitting antennas, it's important to note that a good transmitting antenna will also generally work well for receiving (though not always the other way around).

The dipole antenna

Previously, we learned that a 1/4-wavelength section of transmission line that is open at the far end looks like a short at its input. Let's now take such a section of balanced line, and connect it to an RF signal generator, as at **Fig. 1a**.

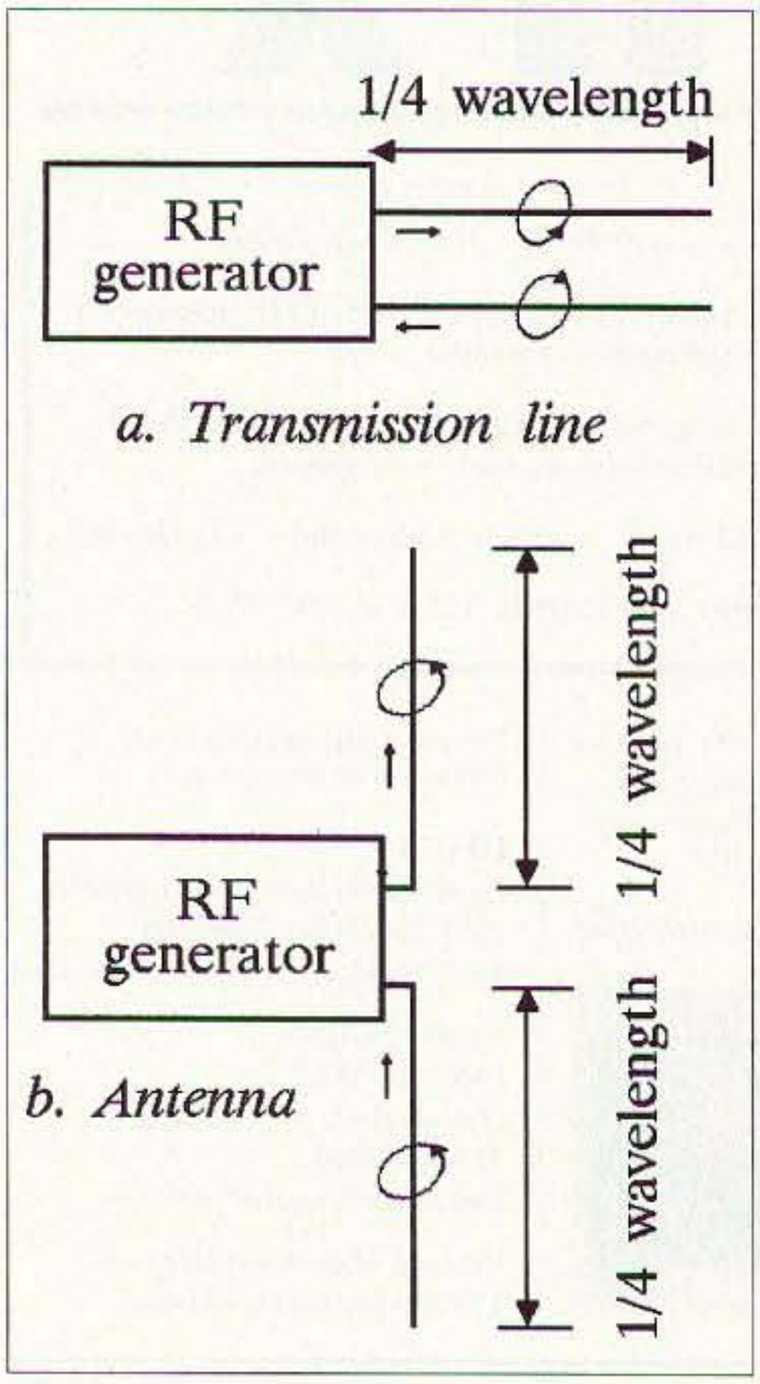


Fig. 1. *A transmission line vs. an antenna.*

Since the generator sees a short circuit, it is not feeding any power into the cable. That is, there is current, but no voltage; since the power is the product of current times voltage, the power leaving the generator must be zero. That makes sense, since there is no place for any power to go.

Now let's separate the two wires of the balanced line, bending them completely out so they point in opposite directions, as in **Fig. 1b**. If we now take some measurements, we will see that there is not only current flowing out of the generator, but there is also a voltage across its output. (And, for the purists among our readers, the current and voltage are in phase.) There is thus power leaving the generator and going into the wires. So where is it going?

What is happening is that, by opening up and separating the two wires, we have changed the transmission line into an antenna. The power coming out of the generator is being transmitted out into space. If we actually measured the impedance looking into the antenna of **Fig. 1b**, we would measure a resistance of about 73 ohms, rather than a short circuit. If the generator outputs the voltage V, then the power going into the antenna is

$$P = \frac{V^2}{R} = \frac{V^2}{73}$$

Look back at **Fig. 1** again. The small straight arrows along the wires show the current direction at some particular instant of time. In each case, the current on the top wire comes out of the generator, while the current in the bottom wire goes back into the generator. In the transmission line, the two currents go in opposite directions, while in the antenna, the two currents both go in the same direction—up.

These two currents both cause magnetic fields to go around the wires; these go in a circle around each wire, and are shown in **Fig. 1** as small circles, with tiny arrows indicating the direction of the magnetic field.

In the transmission line, **Fig. 1a**, the two currents go in opposite directions, and so the two magnetic fields also go in opposite directions. Moreover, the two currents are equal, so the two magnetic fields are also equal. So they cancel. That is, if you were to stand a few feet away from the wires, you couldn't measure any magnetic field because the two cancel.

In the antenna, however, the currents in the two wires always go in the same direction. Hence the magnetic fields also go in the same direction. So, if you were to stand back a few feet, you would be able to detect the magnetic fields (if you have sensitive enough equipment) because they add, rather than cancel.

In addition to generating a magnetic field, the antenna wires also generate an electric field.

DETOUR

The concept of a *field* is hard to explain, yet important for us to understand. In simple terms, a field is a system of forces filling some space, which can cause something to move. An analogy is the wind in a storm. At any particular spot, the wind has a certain strength and a direction. If you let a balloon loose at that spot, the wind will move it. How fast it moves depends on the strength of

the wind (field) at that spot, and the direction it moves depends on the direction of the wind (field) at that spot. Moreover, as it moves from one place to another, the balloon may change its motion because the field at the new location may have a different strength and direction.

The current through the wires causes a magnetic field which, at any particular spot in space, has a certain strength and a certain direction. **Fig. 1** doesn't show the strength, but the arrows on the circles show the direction. If you place a compass on the field, the arrow shows which way the compass would point.

We can also generate an electric field, in a different way. Suppose we have two metal balls, as in **Fig. 2**, and place a lot of negative charges (electrons) on the top ball, and a lot of positive charges (protons) on the bottom ball, as shown. If you now place a single electron at the spot labeled "A," that electron will move (assuming there's nothing in its way). The famous rule in electricity is that "Unlike charges attract, while like charges repel each other." The protons on the bottom ball will attract the lone electron, while the electrons on the top ball will repel it, so the electron will move down, in the direction of the arrow. So the charges on the two metal balls generate a field which can cause that electron to move.

In the same way, electron B will move down and to the left, also in the direction of the arrow, and electron C will also move in the direction shown by the arrow. The thin curved lines going through electrons B and C show the direction of that field—the path that the electron would take. We could draw an entire series of lines in **Fig. 2**, which would show the path an electron would take if dropped anywhere in the space around the two balls. These lines would then specify the direction of the field.

END OF DETOUR

So let's take another look at the antenna shown in **Fig. 3**. Imagine that the small arrows along the wires indicate the flow of electrons along the wires. Electrons flow up on the top wire, eventually generating an excess of electrons at its

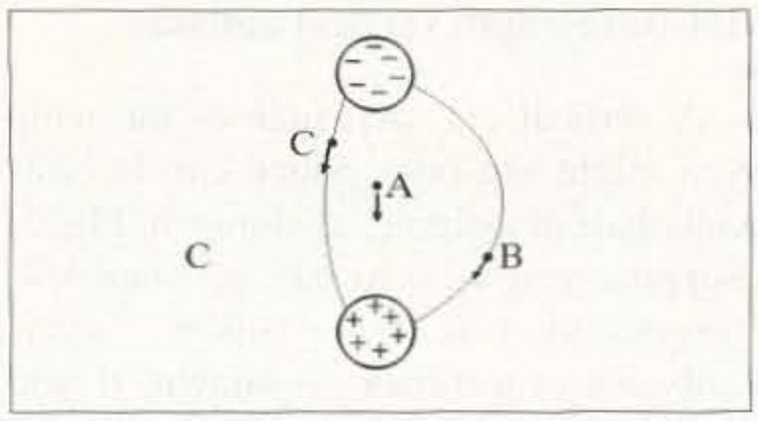


***Fig. 2.** An electric field.*

tip. At the same time, electrons flowing upward on the lower wire leave a lack of electrons—or an extra number of protons—at the end of the bottom wire. So we now have a negative charge at the top, and a positive charge at the bottom. This generates an electric field, just as the two charged balls generated in **Fig. 2**.

At the same time, the currents in the two wires generate the magnetic field, which circles the wires as shown by the arrows on the circles around the wires.

"AM broadcast stations often float their antenna towers on a raft in the middle of a swamp, since the water in the swamp makes it a good conductor."

Remember, though, that the voltage and current are constantly changing. The generator is sending out a high frequency carrier—a high frequency sine wave with some modulation on it. So both the magnetic and electric fields are constantly increasing and decreasing, and even changing direction, as the voltage changes from positive to negative and vice versa.

The next step in our explanation requires a leap of faith; it can't be justified without a lot of math. In 1873, James Clerk Maxwell published a set of equations called (surprise!) *Maxwell's Equations*, which show that the magnetic and electric fields interact. What essentially happens is that buildup and collapse of the electric field pushes the magnetic field away from the antenna; in exactly the same way, the buildup and collapse of the magnetic field pushes the electric field outward. The result is an *electromagnetic* field which radiates outward from the antenna into space, like a radio wave. This electromagnetic wave explains not just radio and TV waves, but even light, which is just another kind of electromagnetic wave, though of much higher frequency (and shorter wavelength) than even microwaves.

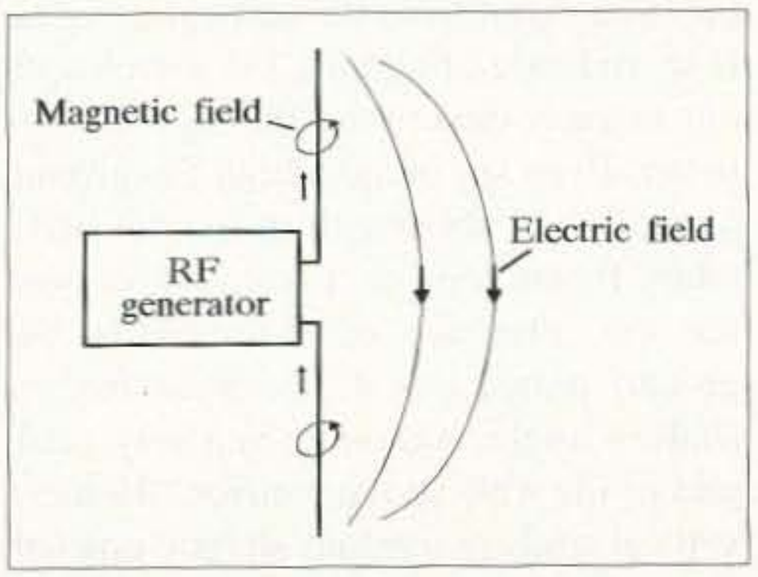


***Fig. 3.** Fields around a dipole.*

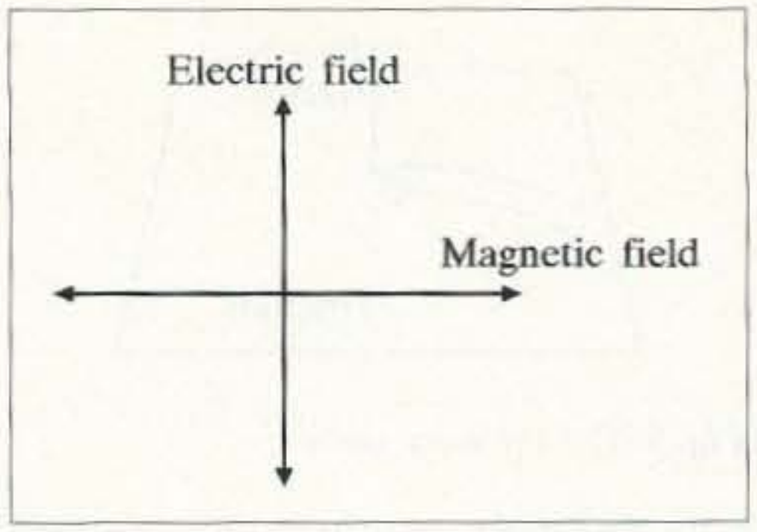


***Fig. 4.** Fields with vertical polarization.*

In short, the two 1/4-wavelength wires in **Fig. 3** make up the simplest kind of antenna, called a *dipole*. Most dipoles, however, rather than consisting of vertical wires, are horizontal. Note that the currents in the two halves of the dipole need to be equal but opposites. The dipole therefore needs a balanced transmission line; it cannot be properly fed by a coax cable.

Antenna polarization

If you stand back from the vertical dipole antenna of **Fig. 3** and watch the electrical and magnetic fields go through space past you, because the dipole antenna goes up-down, you will note that the electric field is always up-down, while the magnetic field goes left-right, as shown in **Fig. 4**. This is called *vertical polarization*, and the antenna is *vertically polarized*. If the antenna was horizontal, then the signal would be horizontally polarized as well.

The best way to receive a vertically-polarized signal would be with another vertically-polarized antenna. The electric field will make electrons in the antenna move up and down (causing an electric current), and the magnetic field changing around the receiving antenna

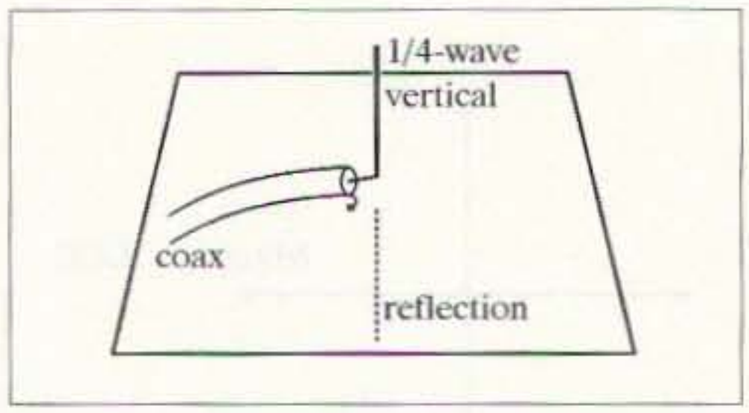


Fig. 5. The 1/4-wave vertical.

will also make electrons move up and down (also causing an electric current). If the receive antenna were horizontally polarized, then the current flow in the wire would be across the diameter of the wire, not along it, and the receiver would receive very little signal. So we need to pay some attention to the polarization of antennas. For example, most AM broadcast stations use tall towers as the antenna; these are vertical, and so a vertical antenna (like a car antenna) works well. TV stations, on the other hand, always use horizontal transmitting antennas, so you need a horizontally-polarized antenna to receive them.

Satellite communications are a problem, since satellites sometimes rotate in space, and signal polarization is also affected by traveling through the earth's atmosphere. So satellites often use *circular polarization*. This involves two antennas, one horizontal, the other vertical, positioned 1/4 wavelength behind each other, and both transmitting the same signal. The signal from the closer antenna arrives first with one kind of polarization; the signal from the other arrives 1/4 of a cycle later, but is polarized at 90 degrees from the other. So it looks as though it has turned 90 degrees. Depending on how you position the antennas, you get either right-hand or left-hand rotation.

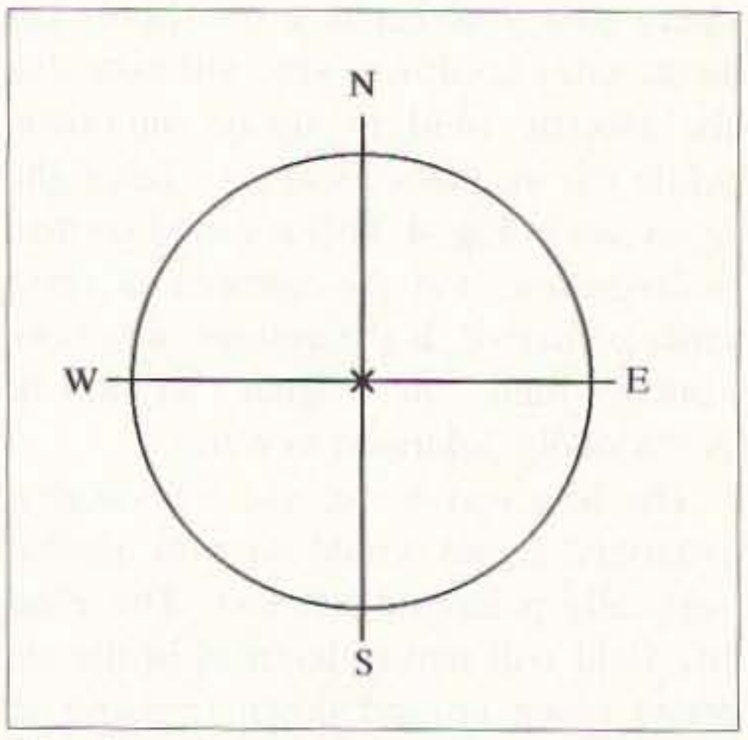


Fig. 6. Radiation pattern around a vertical dipole.

1/4-wavelength vertical antenna

A vertical antenna, such as the whip you might see on a police car, is basically half of a dipole, as shown in **Fig. 5**. Suppose you were to take just one 1/4-wavelength wire, but position it vertically above a mirror, as shown. If you then look at the wire's reflection in the mirror, you would think that there are in fact two wires—a dipole. The "mirror" under the antenna is called a *ground plane*, and it makes the vertical antenna look like a dipole.

Because radio waves reflect from a conducting surface, any large sheet of metal will act as a ground plane. So mounting a 1/4-wave whip on a metal surface, such as a car roof, works well. If a vertical antenna is mounted on the ground, it's necessary to make the ground under it more conductive so it acts as a better mirror. Commercial AM broadcast stations often float their antenna towers on a raft in the middle of a swamp, since the water in the swamp makes it a good conductor. (Incidentally, the tower doesn't actually touch the ground under it. The base of the tower sits on an insulator.) Amateur radio operators, on the other hand, often bury wires (called *radials*) in the ground around the vertical antenna. They are called radials because they spread outward from the antenna, like the radii of a circle. Radials are also needed when mounting a whip antenna on the body of a car with a Fiberglas™ body; hams often use conductive aluminum tape for that purpose.

"If you could see the three-dimensional radiation pattern, it would look like a donut."

In order to "see" a full reflection of the wire, the ground plane has to extend far enough out from the vertical antenna. It should extend at least 1/4 wavelength out in each direction, although more is better. Even so, imagine that the ground plane is, say, the length of the 1/4-wave whip. If you look at it from above, you see the reflection of the whip in the ground plane, but if you look from a shallow angle, you only see a very small part of the whip in the "mirror." Hence a vertical tends to transmit slightly upward, rather than horizontally along the ground.

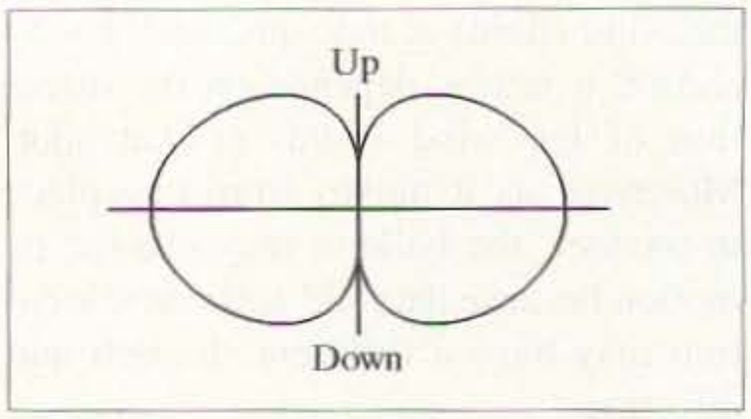


Fig. 7. Dipole vertical radiation pattern.

Since there is no bottom wire to the antenna, there is no place to connect the second wire in a balanced transmission line. Hence vertical antennas are usually fed with coax cable. The inner conductor goes to the vertical, while the outer shield connects to the ground plane just under or next to the whip. Since there is only half of a dipole, the impedance of the whip is 1/2 of the dipole's impedance, or about 37 ohms.

Radiation patterns

The term "radiation pattern" describes the directionality of an antenna. An antenna which transmits (or receives) equally in all directions is called an *isotropic antenna*. But there is no such thing—it is impossible to build one. Instead, every real antenna transmits better in some directions, and worse in others.

Consider, for example, a plain vertical dipole as shown in **Fig. 3**. You might see such an antenna, for instance, hung from a weather balloon, with the transmitter actually hanging in the middle of the antenna. Such an antenna would transmit equally well in all horizontal directions—north, south, east, and west. If you imagine that we're flying above the antenna, looking down at it, we would draw the horizontal radiation pattern as in **Fig. 6**. The small X in the middle signifies the position of the antenna, and the circle around it shows the directions in which it transmits. Because the radius of the circle is the same in all directions, the signal strength is also the same in all directions. We say that such an antenna is *omnidirectional*. (On the other hand, an ellipse which was longer north-south

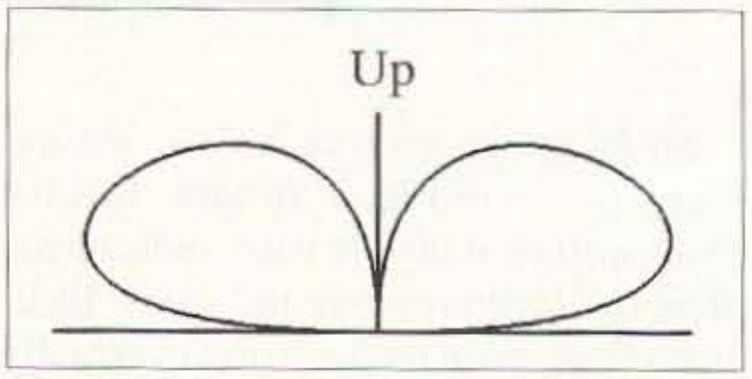


Fig. 8. 1/4-wave vertical radiation pattern.

than east-west would mean that there is more signal going north and south than east and west.)

If, on the other hand, you look at the antenna from the side, you would note that it transmits fairly well horizontally, but not at all up or down. That is because the dipole doesn't send (or receive) any signal off the ends of the wire. In this case, the vertical radiation pattern (as seen from the side) would look like the figure-8 pattern in **Fig. 7**. Since the pattern is actually three-dimensional, it looks more like a donut; what we see in **Fig. 7** is just a cut through the donut.

A 1/4-wavelength vertical antenna, has the same omnidirectional horizontal radiation pattern as **Fig. 6**, but its vertical radiation pattern is more like **Fig. 8**, since it transmits slightly upward rather than straight to the sides.

Directional antennas

Although a single vertical antenna has an omnidirectional horizontal radiation pattern, it is possible to change that by using two or more vertical antennas. You may have noticed that many AM broadcast stations use more than one tower. This allows them to tailor their radiation pattern to their coverage area. If the station is on one end of a city, it may want to direct more of its power toward that city, and less to other, less-populated areas. In addition, some radio stations must reduce their transmitted power in some directions so as not to interfere with stations farther away.

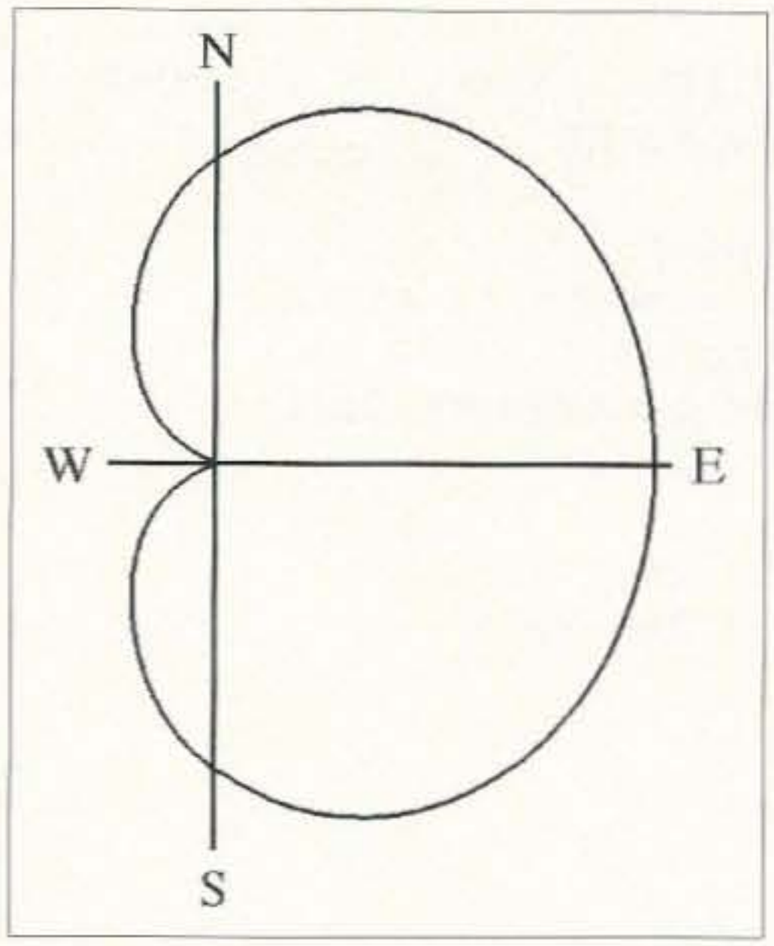


Fig. 10. Cardioid pattern from the antennas in Fig. 9.

Fig. 9 shows an example. Suppose a station has two towers, A and B, separated by 1/4 wavelength from each other, fed by two different lengths of coax cable, so that the cable to tower A is 1/4 wavelength shorter than the one to tower B.

Now imagine that you are at the far right of the drawing, east of the antennas. The signal from tower B gets to you 1/4 cycle sooner than the one from tower A (since it is closer to you), but since it had a longer cable, it was transmitted 1/4 cycle later. So the transmitted signals from the two antennas arrive at your location at the same time—in phase, and they add.

On the other hand, suppose you are at the far *left* of the drawing, west of the antennas. The signal from tower B gets to you 1/4 cycle later (since it is farther away.) It was also transmitted another 1/4 cycle later (because of the longer cable), so it arrives at your location 1/2 cycle later than the signal from tower A. The two signals are therefore out of phase, and they cancel. So the station transmits well to the east, but not to the west. The resulting radiation pattern in **Fig. 10** is called a *cardioid* because it resembles a heart shape.

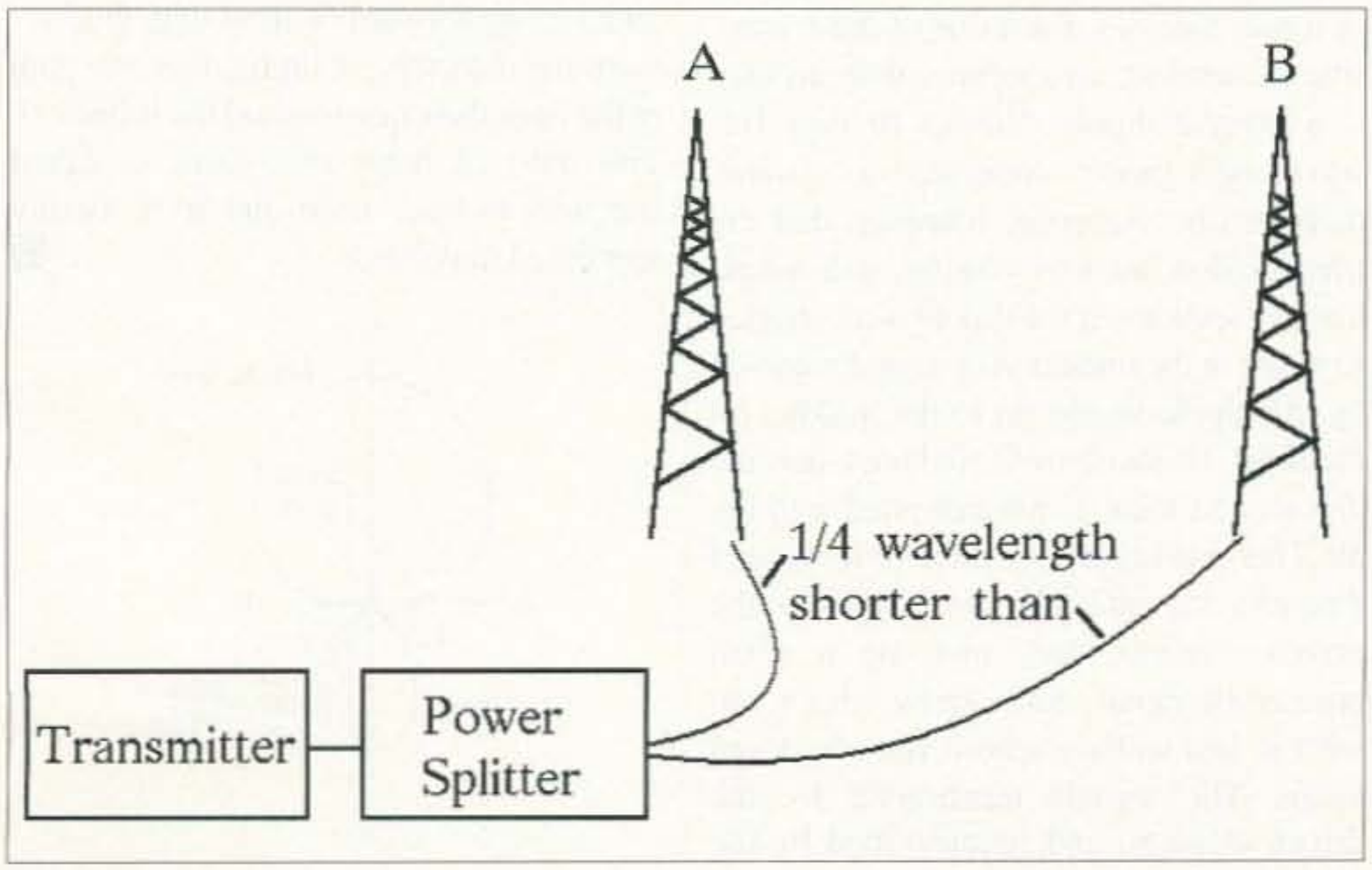


Fig. 9. Typical AM broadcast station towers.

DETOUR

The accompanying program, written in plain IBM BASIC, lets you plot the radiation patterns of various combinations of vertical antennas.

To run it, you must first specify how many vertical towers or whips there are. Then for each one you must specify where it is in relation to the transmitter (compass direction in degrees, and distance from the transmitter in wavelengths), the length of the feed cable from the transmitter (in wavelengths), and the attenuation in the cable (including any attenuation added on purpose—for example, one of the towers may purposely be getting reduced power to change the pattern).

Fig. 11 shows the radiation pattern for a two-tower setup, where one tower is 1/4 wavelength north (0 degrees) from the transmitter, and the other is 1/4 wavelength south (180 degrees). Both are fed with a cable 1/4 wavelength long, and both get equal power (assuming 0 dB loss). You see that we get a figure-8 pattern. Listeners to the east and west get the same signal from both towers, so the two signals add. Listeners north and south, however, get the two signals 1/2 cycle apart (because one tower is 1/2 wavelength closer than the other) and so the two signals cancel. You can experiment with different combinations in the program.

END OF DETOUR

The above examples were all based on AM broadcast station towers; in that case, the towers are actually fed from the transmitter through some sort of a matching network. It is possible, however, to build a directional antenna without actually supplying power to the other components. **Fig. 12** shows how; it's a

```
10 ' PROGRAM TO GRAPH    ANTENNA RADIATION PATTERNS
20 INPUT "number of towers = "; NR
30 FOR I=1 TO NR
40 PRINT "For tower"; I; "enter:"
50 INPUT " Angle (0 degrees = north)"; ANGLE
60 INPUT " Dist. (in wavelengths)"; DIST
70 INPUT " Cable length (wavelengths)"; TL(I)
80 INPUT " DB attenuation"; DB
90 GAIN(I)=10^(DB/20)
100 Y(I)=DIST * COS(ANGLE/57.2957795)
110 X(I)=DIST * SIN(ANGLE/57.2957795)
120 NEXT I
130 ' SET UP SCREEN
140 KEY OFF
150 SCREEN 2
160 CLS
170 'calculate and plot
180 LINE (0,100)-(639,100)
190 LINE (320,0)-(320,199)
200 FOR D=0 TO 360
210 XSUM=0 : YSUM=0
220 X=1000 * COS(D/57.2957795)
230 Y=1000 * SIN(D/57.2957795)
240 FOR R=1 TO NR
250 DIST=SQR((X-X(R))^2 + (Y-Y(R))^2)
260 PHASE=DIST + TL(R)
270 MAG=GAIN(R)*3000/SQR(DIST)/NR
280 XSUM=XSUM+MAG * COS(PHASE*2*3.14159)
290 YSUM=YSUM+MAG * SIN(PHASE*2*3.14159)
300 NEXT R
310 TOTAL=SQR(XSUM^2+YSUM^2)
320 X=320+2.4*(TOTAL*COS(D/57.2957795))
330 Y=100-TOTAL*SIN(D/57.2957795)
340 IF D=0 THEN LINE -(X,Y),,,0
350 IF D0 THEN LINE -(X,Y)
360 NEXT D
370 IF INKEY$="" THEN 370 ELSE SCREEN 0:STOP
```

beam antenna, also often called a yagi antenna. In the center we have a boom, which holds a number of elements. One of these, connected to the transmitter by the feedline, is called the *driven element* because it is actually driven by the transmitter signal. It essentially acts as a dipole.

Mounted parallel to the driven element are one or more *parasitic elements*, which are not directly connected to the transmitter. There is usually one *reflector*, and one or more *directors*. Each one of these parasitic elements acts as a separate little antenna.

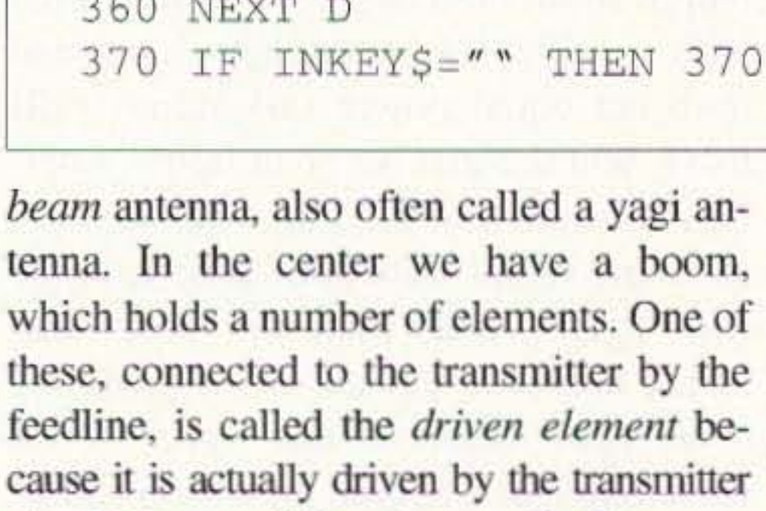


Fig. 11. A figure-8 pattern from two towers.

A normal dipole consists of two 1/4-wavelength pieces, connected to a transmission line. Suppose, however, that the transmission line was missing, and instead the two sections of the dipole were shorted together in the middle. Any signal received by the dipole would go to the middle, hit the short, be totally reflected back into the dipole, and then be retransmitted into the air. This is precisely what the reflector and directors do—since they are so close to the driven element, they pick up a small amount of signal, don't know what to do with it, and so they send it right back out again. The signals transmitted by the driven element, and retransmitted by the parasitic elements, then add or subtract to make the overall antenna directional.

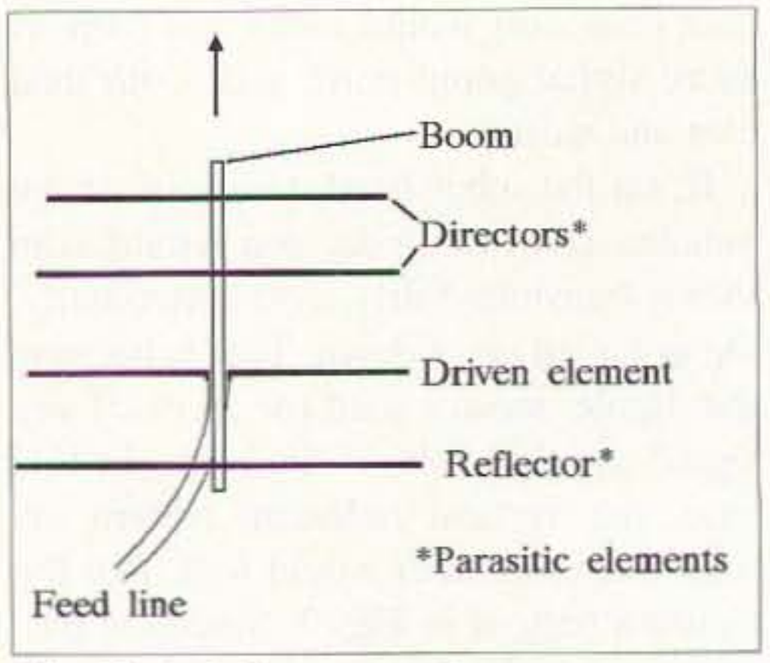


Fig. 12. A 4-element yagi beam.

Looking at **Fig. 12**, you'll note that the reflector is slightly longer than the driven element, while the directors are slightly shorter. The different lengths change the phase angles of the preflected signals to make sure that the signal is sent in the correct direction. The reflector reflects the signal, whereas the directors act as a lens to direct the signal forward. The arrow in **Fig. 12** is at the front of the antenna—it shows the direction where most of the signal goes (the other end is obviously called the back).

Fig. 13 shows the radiation pattern of a typical yagi; we assume that the antenna is aimed north in this case. We see four lobes: one *major lobe* which shows that most of the power goes north, and three *minor lobes* which show other directions where some of the other power goes. Between these lobes are directions which get no power; these are called *nulls*.

The length of a lobe represents the gain of the antenna in that direction. We will define the gain of an antenna next time; for now, let's just note that the gain of this antenna in the forward or front direction (toward the directors) is higher than the gain in the back direction (toward the reflector). The ratio of these two gains is called the *front-to-back ratio* and it is usually expressed in decibels. 73

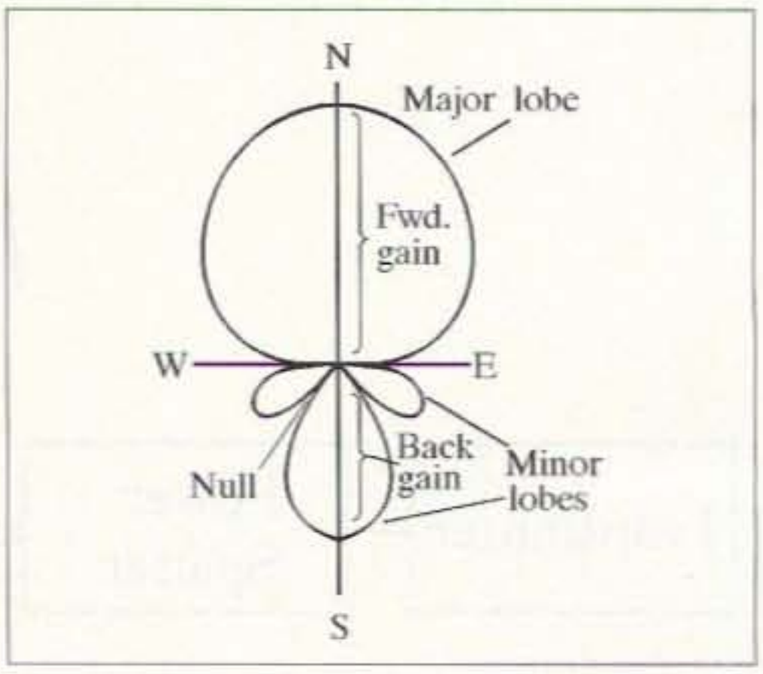


Fig. 13. Radiation pattern of a yagi.

NEVER SAY DIE

Continued from page 55

were able to join the military in World War II. When I went all around Brooklyn on my roller skates, visiting the hams listed in the Callbook, I found that virtually all were active, and almost all were in their teens or 20s.

Today, being generous, maybe one in four American licensees is active, while in Japan almost all of their hams are active. For me this explains why, though we have almost three times as many licensees as we did 30 years ago, the ham bands don't sound any more crowded.

What would our bands be like if we had five million hams? Five million *active* hams? It sure would put the pressure on our developing more efficient communications systems. We'd also be far more active in our microwave bands. The JARL magazine devotes a half page to 10 GHz activity! Here, other than as a way to pick up a few extra multipliers in a VHF contest, what activity are we seeing on the band? Yawn.

With 5 million American hams—young hams—the danger of losing our bands would evaporate, and we might even generate enough high-tech career youngsters to regain our lost electronics industries.

If you're interested in helping do something about this situation let me know.

Intruders

You're probably not going to believe this, but I have it on good authority that several hams are selling ham gear for pirate use, and in most cases the buyers aren't even being made aware that they are doing anything wrong. This has to do with 420 MHz ATV transmitters used being used for surveillance. Some ads even claim that the equipment has a range of 50 miles, with the really small print explaining that this requires the use of yagis, though it doesn't explain that the yagis required are huge antennas, and not well suited to hidden TV surveillance work.

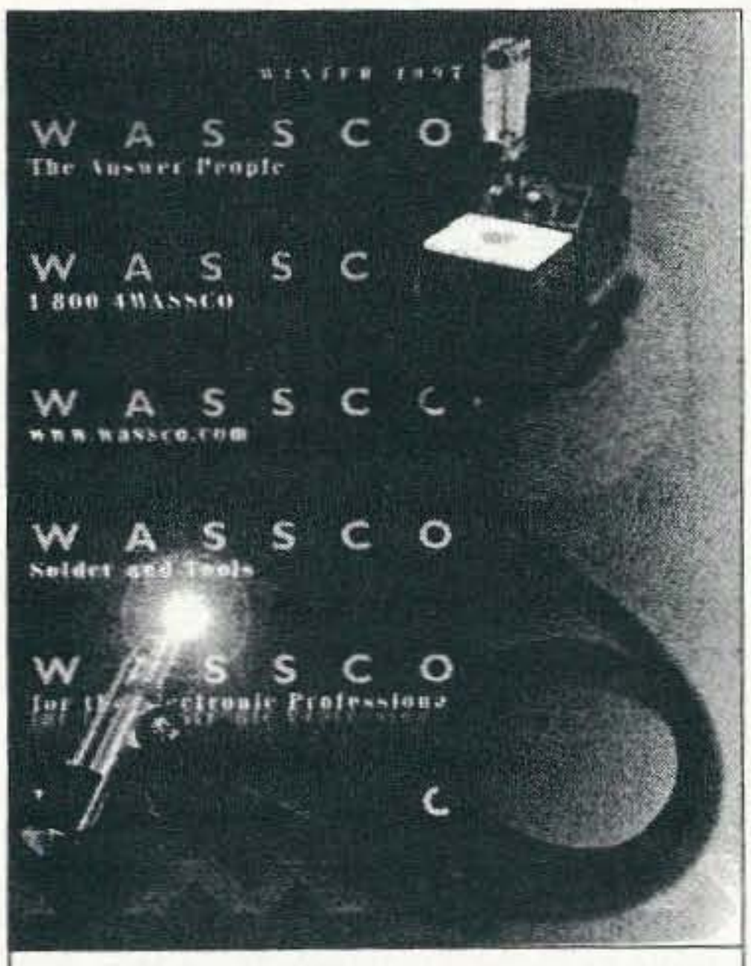
Further, both the ARRL and the FCC have been made well aware of all this problem, but neither seems to care.

Since there's so little actual ham activity on our UHF bands they are wide open for illegal commercial uses.

Is this all a matter of crooked hams doing this? No: As I understand it, Ham Radio Outlet™ got taken to court for refusing to sell a ham rig to a non-ham. And lost. 73

NEW PRODUCTS . . .

Continued from page 50



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The new 148-page WASSCO catalog is chockful of great doodads, gizmos and stuff for the electronics professional. There are tools and equipment for soldering, testing, static control—you name it! New products from Chemtronics™ are featured, as well as Plato™ shears and Weller™ fume extractors. These fume extractors reduce harmful soldering emissions by 99.99%—before they can be released into the environment.

For your free catalog, write WASSCO at 12778 Brookprinter Place, Poway CA 92064. Phone (800) 492-7726 or (619) 679-8787; FAX (619) 679-8909, or visit the Web site at http://wassco.com. 73

New Product reviews and reviewers are welcome. Write Joyce Sawtelle at *73*.

Optimizing the Hamfest Experience

The next hamfest flea market you surf can be even more rewarding.

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No one can deny that certain individuals experience pleasure when they visit a flea market, shell out some bucks for an item, and subsequently display their bargains with great pride. Sometimes it's just junk, but who will argue the truism that beauty is always in the eye of the beholder? The same phenomenon holds true for the hamfest participant who plans to visit an event that some (even my wife) have characterized as organized chaos. Perhaps, but there are redeeming qualities. In order not to be overwhelmed by the size and complexity of the activity, it's a good idea to know what to expect and to develop a plan that will ensure that if one attends a hamfest, one's efforts will be rewarded.

For the first-time "hamfester," the primary order of business is to check the newly arrived issues of *73* and other radio-amateur–related publications for the listings of area hamfests. The dates are published well in advance of the event. You will probably have developed a long list of wants, since few retail sales outlets exist to offer the specialty components required to complete that unique project.

If the event is not local, you may consider car pooling or traveling with friends or radio club members to save money. It takes some planning to coordinate this activity, especially if a group is involved. I've found that the trip's logistics are the least complicated aspect of this adventure. Once you've struggled through the nightmare of getting four or five hams to agree on a single travel strategy, the remaining details are difficult but not impossible to resolve. At worst, it may result in a migraine or a bit of indigestion, but the obstacles are surmountable.

"As a veteran of many hamfests in the northeastern areas, I have developed a strategy for getting the most out of this activity."

As you arrive at the parking area, it will become abundantly clear that you're in the right place. You'll be greeted by a veritable sea of mobile antennas and a host of callsign license plates. Just about now you'll begin to wonder where all these people came from—they're seldom seen during the year. It has been my experience that only on rare occasions will you encounter a ham when driving. In any event, try to park close to the entrance so shuttling back and forth with purchases is not a marathon run.

***Photo A**. PL259s with short cut-off lengths of 8u cable attached, 25¢ each.*

Where to begin?

Techniques for maximizing the positive experiences of participating in a hamfest visit begin when you arrive at the gate. It's amazing, but no matter what time you get to the entrance, there's always a bunch of hams queued up and chafing at the bit to get inside. You'll see an array of people, including spouses, XYLs and children, bustling about anxious to double-time the area, on the alert for that elusive bargain. They're easy to recognize. The vast majority of them are sporting baseball caps emblazoned with names and callsigns. Handhelds are either strapped to their belts or stuffed in breast pockets. The conversation is lively but the hamfesters are focused on two things: They've got one eye on their WWV coordinated watches, while the other scans for any initial movement through the entrance gate. Getting past that obstacle with the minimum of delay is top priority at this point.

Here's the dope!

As a veteran of many hamfests in the New York City, Connecticut, New Jersey, Maryland, and Pennsylvania areas, I have developed a strategy for getting the

most out of this activity. It's been refined and tuned and works well for me; I am certain that it's worth a try on your part. Primarily, I'm addressing those who are looking for particular pieces of equipment, or who perhaps need to acquire a discrete component to repair or complete a piece of gear. If, on the other hand, you're just out for an interesting and pleasurable day (with no particular motives for the visit), just go, browse, and enjoy. You'll be in the company of thousands of hams, each with a unique agenda for the day.

Oddly enough, you'll begin what will be a most enjoyable and rewarding amateur radio experience by paying your entrance fee at the gate. If you begrudge them that token amount, keep in mind that it's a pittance for so many hours of fun. If you had to pay even minimum wage to the tireless army of volunteers and coordinators of the event, the price could easily be tenfold. You'll save time

"Socializing ends as you pass the main gate."

if you have the correct dollar amount handy. The fee is usually listed in magazines and newsletters, along with other important information related to the event.

It's always a good idea to get there as early as possible. You'll find that almost everyone in attendance has the same game plan; it must be intuitive with hams. They know very well that high interest items go quickly so you've got to be Johnny-on-the-spot.

Once you're through the gate, dispense with the preliminaries as quickly as possible by filling out your door prize ticket stub and depositing it in the appropriate container. Bring a pen (and pad) with you in order to avoid the crowd jockeying for the writing implements tied to the ends of strings at the sign-in table. You'll find 50 hams waiting to use a couple of pencils. Don't forget to complete this chore, and determine whether you must be present for the grand prize drawing. During the course of the day, stubs are pulled and winners of prizes are announced via loudspeaker. During your visit, remember to keep an ear open for the announcements of the lucky ones. Somebody's got to win the door prize and it might be you!

Focus clearly on your objectives

Socializing ends as you pass the main gate. Save that for later when you'll need to make a pit stop or break for lunch! I would strongly suggest that you travel alone from here on in. If you need any counseling from your Elmer regarding a purchase, keep a handheld strapped to your belt and prearrange the monitoring of an odd simplex frequency to call for a rendezvous. If you're in pairs or small groups, time will be wasted as you wait for the gang to reassemble and move on after visiting each vendor. It's vital that you first transit the entire area quickly, especially if you're looking for items that are not generally offered by a slew of vendors. It's those dead-special, one-of-a-kind deals that you want to scoop up as quickly as possible. Do not hesitate to negotiate; there's no law that says you must pay the sticker price. Make reasonable counteroffers but avoid denigrating or otherwise badmouthing the item. Be aware that the seller usually has a good idea of the ballpark value of the component so compromise is an essential element in the process. If you're successful in locating that dead-special piece of gear and you're close in the price negotiations, I suggest you buy it. You'll kick yourself doubly hard if you return and it's gone. That has happened to me on too many occasions. I've reasoned afterwards that spending the extra dollar or two would have been worthwhile to eliminate the grief of continuing the search for an item that I may never again find.

Strategies are somewhat different for the more readily available items offered by larger numbers of vendors. As you continue your reconnaissance, use your

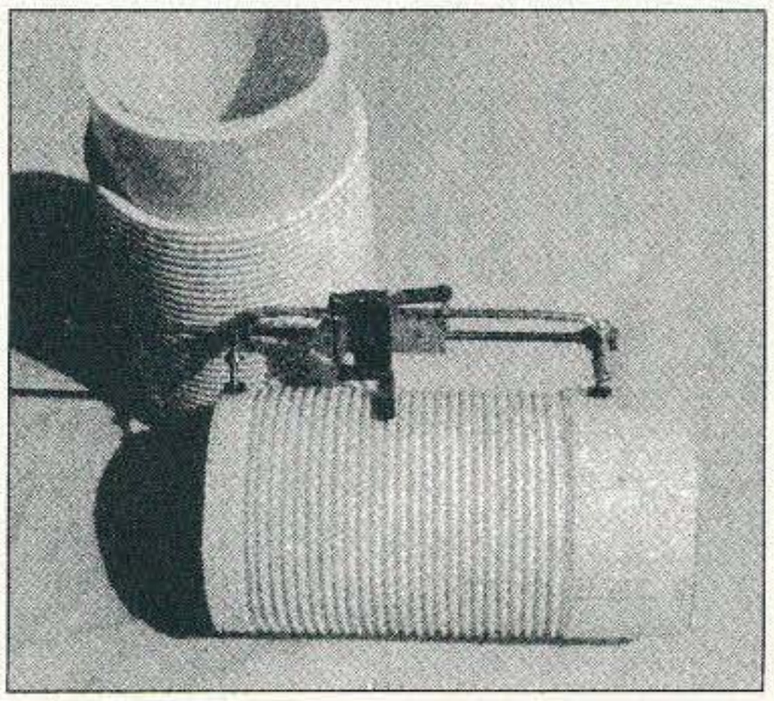

***Photo B.** The author's plan for a remotely tunable coil wound on a length of 3–4-inch PVC.*

notebook to jot down prices and vendor locations. For example, don't buy microphone connectors from the first person you approach. These items are extensively offered and the prices may vary by 30–40%. Obviously, you want the best deal you can get. Continue your first sweep of the hamfest without any undue delay. Make whatever notations you need in order to quickly return to the vendor who's offering the best deal.

Keep in mind that some hamfests are enormous in scope. Generally aisles and rows are not identified or marked. It's easy to become disoriented and often difficult to return to a vendor quickly if at all. Latitude/longitude of GPS bearings don't work well here. Preferably, use cruder but more realistic location reminders, e.g., mid-aisle two rows from hot dog stand, or main building—rear wall. I'm certain you get the idea.

Avoid chatting during this first run. Check your want list to make certain you haven't forgotten anything of importance. If you've offered to pick up an item for a friend, make that your secondary effort. It's OK to be somewhat selfish at this point. If your pal wanted the item badly enough, he would have come himself.

During that first pass, keep a watchful eye on the equipment and components offered by the "tailgaters." These are the individuals who are cleaning out basements and shacks and lightening up on their junk box inventory. Bargains are available simply because many spouses have decreed that the beleaguered amateur may not return home until all that junk is dumped.

Here are the ingredients that make for mutually rewarding transactions. However, be a gentleman—make reasonable offers and avoid nasty confrontations. If your offer is refused, ask if and when you return whether a counteroffer would be entertained. By using this tactic, you've left the transaction open-ended rather than putting closure on what could be by this time a dead deal. Again, if you're close on the price, don't take a chance on losing out on the purchase opportunity.

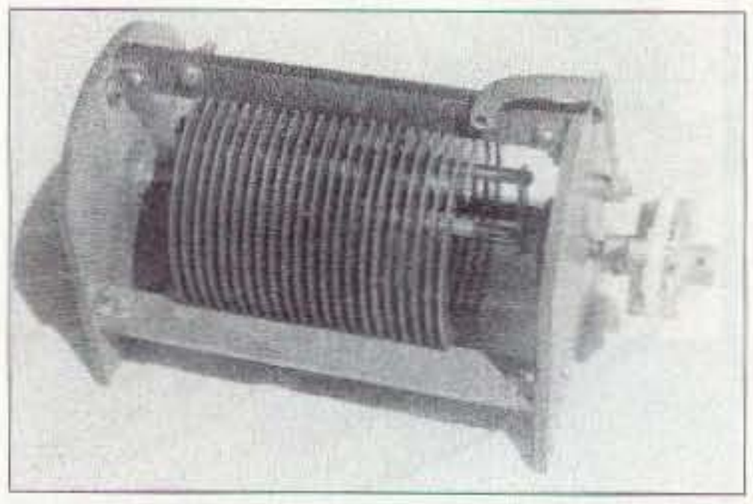

***Photo C.** A bargain variable inductor.*

The second and third round

Once you've completed the first round, it's time to check your notes and revisit only those vendors you identified as having the best prices. Pick up your coax connectors, meters, circuit board components, power supply diodes, jumper cables, etc., and don't hesitate to ask for a special volume price. For example, you may work a deal for a dozen PL-259s for $7 rather than buying them singly or in pairs for 75¢ to 80¢ each. Certain items will always be used in the shack. Even though the up-front price may be a little more, you'll have the component when it's needed. The same holds true for volume purchases of bypass capacitors or mini 12 VDC DPDT relays, but not necessarily for a bushelful of 8-pin mike connectors or a gross of tube sockets. A bargain is a bargain only if it has utility.

Take a break at this point and bring the collected goodies out to the car. Remember: You'll need your ticket stub or hand stamp for re-entry. There's no need to lug around a bunch of plastic bags filled to the brim. Enjoy a snack and drink from the cooler you remembered to stock earlier that morning. Briefly relax and don't hesitate to reflect on the good deals you made. The day's important business being completed, it's now time for the fun part of the outing. Hopefully you have the energy, especially if it's been a hot summer afternoon. During the third, but leisurely, walk around visit the vendors with the interesting items that require more careful scrutiny. It's also the opportune time to return to those vendors who encouraged a return visit for further negotiations. You'll remember you didn't burn any bridges when there was no agreement on price for a particular item that piqued your interest. By this time, the crowds will have thinned and the frenzied feeding abated. Take some time to look through boxes for any special items of interest. Use your imagination to envision how a piece of esoteric equipment could be purchased for peanuts and utilized for a worthwhile project. I recall I once purchased the hand portion of a fighter pilot's steering control. It was a molded hand grip with a series of switches to control airplane functions (guns, etc.). If you've seen any of the World War II movies, there's always a close-up shot of this grip just as the pilot, with the enemy in sight, squeezes the trigger and the guns begin blazing away. In my application, the unit was mounted on an old wooden trophy base with a D-104 lollipop mike attached at the top. It was wired using the trigger to activate the push-to-talk circuit. I didn't shoot down any planes but I did make a few interesting DX contacts.

If on your third round trip you notice that an item you wanted is still available, spend some time with that vendor. Be honest and express your interest but suggest that the price may be unrealistic. Most probably, the seller has come to the same realization as evidenced by the fact that it didn't sell. Ask politely if he has some "room to move" on the offering price and subtly suggest that it will have to be lugged home and only brought back for the next hamfest. At this point, an Academy Award-quality performance may help. Whatever tactics you use, remember to be persistent in a dignified manner, and if you're at an impasse, suggest splitting the difference between the bid and asked price. If a deal can't be struck, leave your name and address (E-mail, etc.) in the event the vendor might reconsider. You might even take his card or telephone number and ask if you could call at some time in the not-too-distant future and check on the disposition of the component and whether the asking price has been moderated. It makes good sense to keep the dealing friendly since there is always that possibility that your paths will cross again and the deal will come to fruition.

Caveat emptor!

Purchasing electronic items at a hamfest is a ticklish issue that requires a more heightened awareness of the potential for a bad deal. Let's address the easy ones first. If the item you are considering needs a battery or AC power to operate and evaluate, take the time for a test. The condition of a keyer or a low voltage power supply is also easy to verify. There's always an outlet around

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for a quick check. If it's sold *as is* then the price should be commensurate with the risk of possible damage. Agree on the terms of the transaction and make certain to take the dealer's card. Have him jot down the particulars of the sale including serial numbers and have him list the alternatives for refund or replacement if it's lugged home and it goes up in smoke or is simply inoperative. For example, it's almost impossible to test the 2 kW scale of an SWR bridge at a hamfest so it's important that you do your best to protect the cost of your investment. You'll want to know if it can be returned for refund or replacement and who will pay the cost of shipping. Do the same thing even though the component is in a sealed carton and includes a warranty. You'll need a bill of sale if it's returned to the manufacturer under normal procedures. If the vendor is reluctant to agree to reasonable terms (which is not often the case), simply say NO to the deal and walk. An intransigent dealer unwilling to offer reasonable assurance about a product may be signaling that an underlying problem exists. You don't need the grief so pass it by and wait for the next opportunity. For the purchase of any large-ticket item, it's a good idea to bring cash. Nothing works better in eyeball-to-eyeball encounters than the sight of the green stuff. Forget about checks. Remember the adage that money talks and everything else walks!

It's a learning process, too

Let's not forget another dimension of hamfesting, one that I find most interesting. After completing the regular order of business as outlined, you may want to stop and chat with some of those special participants who are clearly recognizable because of the equipment they are selling or the quality of the wares they are offering. For example, I recall a discussion with a gentleman offering homebrew tank circuits with integral band switching for 160–10 meters. He had cloned, with some modifications, a unit which had been available commercially a number of years ago. I had been working on a similar project and recognized the fact that we were indeed, because of our common interests, kindred spirits. Our discussions covered inductance measurements, impedance, and circuit *Q*. We were both concerned about the changing tank circuit electrical characteristics in older linear amplifiers when re-tubing with newer and more efficient finals. We were both aware of the fact that increased voltages cause strange things to happen as power is raised to accommodate the updated designs. I also mentioned that I planned an article discussing silver-plating homebrew wound coils. He'd already made the calculations and determined that the impedance change was only a fraction of a percent on the low bands and probably not worth the effort. It gave me food for thought about embarking on what might be just a fool's mission. He very much appreciated my comments on the quality of his efforts; however, when I asked how many of the units he sold, the answer was "none." So much for good old-fashioned linear amplifier building in this current day and age. Although I did not purchase any of the items he had for sale, for both of us it was one of the highlights of that afternoon.

Noteworthy hamfest bargains

Keep a watchful eye open for bargains. For example (**Photo A**), PL259s with short cut-off lengths of 8u cable attached were offered at 25¢ each. Clean plugs were 85¢. I opted for the less expensive units. Removing the coax occupied me as I monitored the Traders' Net and waited my turn to list. I bought all he had and received an additional bargain for the volume purchase. I've already removed the coax on two of the plugs.

I have been experimenting winding coils on PVC tubing for 160–80m applications. Coils are expensive (especially variable inductors) when purchased commercially. My plan was to design a remotely tunable coil wound on a length of 3–4-inch PVC. The plan included utilizing a 10 amp relay contact riding along a length of threaded rod to vary inductance (see **Photo B**). It was evident from the partially completed prototype that it would be great for receiving but only marginal for transmitting other than low power. During a recent hamfest visit, I spotted the variable inductor shown in **Photo C** on a vendor's table. I swooped in on my second turn around and negotiated—I paid $40 and saved 33% in the bargain. Contrast this with the purchase of a plain old 3-inch air-wound coil offered in the classifieds at $45. The inductor has no marking but is easily rated at 10 kW and can be used as a tank circuit component in an RF deck, an antenna tuner or, for my immediate needs, a most vital element in my remotely tunable base loaded inverted "L" for 160–80 meter operation.

See **Photo D**. This small variable inductor coil and flexible shaft has a wealth of parts just waiting to be stripped down and refitted in an alternative configuration. Both the support and roller shaft must be lengthened to accommodate a longer coil form. Since both shafts are tapped at the ends, that presents no problem. Larger vertical supports will be fashioned from plastic and the pilot shaft bearing from the old unit reinstalled. I'll add small pieces of metal to lengthen the coil supports and shaft to accommodate the larger diameter inductor. The flexible shaft and crank are great additions to any number of projects. This was truly a great bargain at $7.00.

Photo E shows a DP3T. This well-designed and heavily-built ceramic RF switch (75¢) was purchased for a contemplated project to control the input from an exciter to two linears. The porcelain shaft insulator pictured to the left was included in the deal. A couple of bargain hamfest SO-239s and a minibox is all that is needed to complete the project. One of the poles will be tied together with a wire bus and one position locked out. The result will be a silver-plated SPDT coaxial switching unit with a 2 kW+ rating, and a savings of a bunch of dollars over a commercially-built component of lesser quality.

Keep on the lookout for switches with a greater number of contacts (**Photo F**). They can be used on the output end of your transceiver or

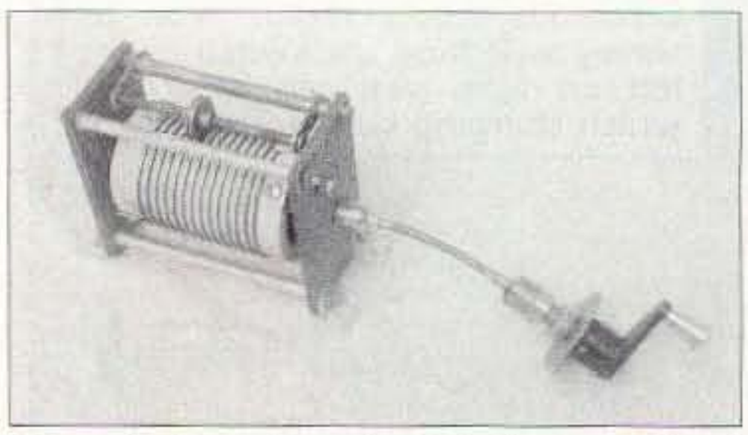

Photo D. *A small variable inductor coil and flexible shaft just waiting to be stripped down and reconfigured.*

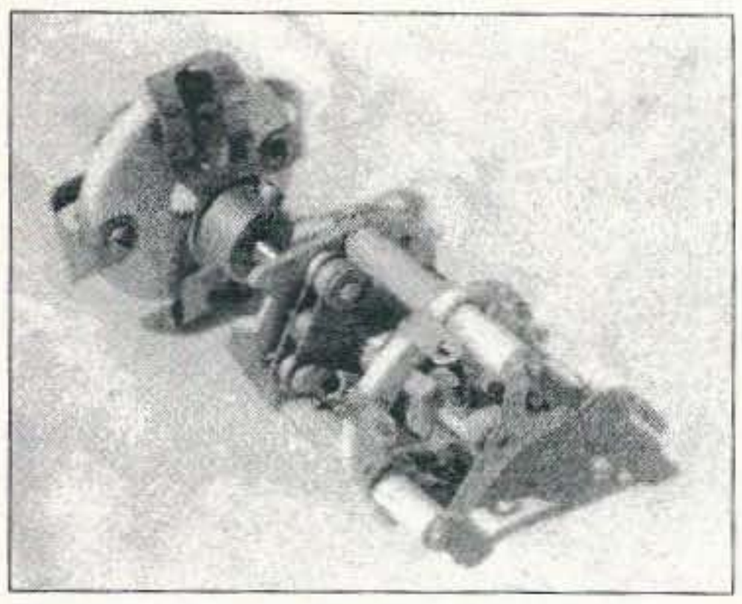

***Photo E.** Another hamfest bargain destined for a project!*

linear amplifier for antenna selection, or wired into the tank circuit for band switching.

Give it a try

For both the beginner and the experienced hamfester, these strategies are offered as a starting point from which to develop a personal perspective. Just keep a clear focus on the purpose of your visit. Try not to be involved in circumstances that will tend to distract you. Wear comfortable shoes and a hat if it's a summer event. Even though XYLs (non-hams) and children are generally not charged an entrance fee, don't take them along if you're not certain it will be enjoyable for them. Many men know the equivalent misery they experience as they tag along with their spouses from store to store as the gals surf the mall. If they do not have your level of interest, leave them home. Basically, you must move through the labyrinth of vendor stalls and automobile trunks as quickly as possible. To accomplish this you must do what you have to do in order to remain unencumbered. Doors open early and the activities begin to slacken at about 12 p.m. It's obvious that there's a lot to do in a limited amount of time. Give it a try, and good hunting! 73

***Photo F.** Another find—a versatile switch.*

LETTERS

Continued from page 63

another evening to install the transceiver in an enclosure. The kit does not include the potentiometers for the main tuning, RIT and the volume control. I would recommend the builder use multi-turn potentiometers for the main tuning and the RIT. Multi-turn pots make the tuning easier and more precise.

I was impressed by the on-the-air performance. The output power with a 12 volt battery is about 2 watts. The receiver is real sensitive and can pick up anything my $700 commercial receiver hears. With my quarter wave vertical antenna, my first three contacts were with stations which were greater than 800 miles from my location. Even though my reception reports were mediocre, we were able to carry on a decent rag chew amongst the fading.

I was also impressed by the quick service provided by Dave Benson NN1G of Small Wonder Labs. The kit was missing one transistor when I received it. After a phone call to Dave, I received the transistor in the mail in two days. I would recommend this kit to anyone interested in QRP operation. I understand that Dave is now offering a 20 meter and 75 meter SSB QRP transceiver for about $100. I don't know how he can afford to sell these kits at such low prices, but I am happy he does.

Listening

Most of us started out as shortwave listeners. I know I did. My grandfather had an all-wave radio and it didn't take long for me to find the 20m ham band and want to know more. Wow, South America, Europe!

Well, you know, most of us have receivers that will tune more than the ham bands, so maybe you'll want to invest in a new book, Radio Monitoring, by Skip Arey WB2GHA. This is a great how-to guide, even for the rank beginner. It explains what's out there to hear and where to find it. 337 pages, $20. Yes, it goes from 10 Hz right on up to the GHz bands. There's a lot of interesting stuff out there when you know what, when, and where to look for it. It covers the various receivers, antennas, and so on. The book is published by Index Publishing of San Diego and should be available in most ham stores... Wayne. 73

Number 76 on your Feedback card

CARR'S CORNER

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More neat stuff for radio science observing

This month we revisit a couple of topics that are interrelated, but may not appear so initially. By combining the FMG-3 magnetic sensor and the VLF receiver, you will have an interesting method for studying the effects of solar events on radio propagation.

More on magnetic sensors

Not long ago this column discussed the magnetic sensor called the FGM-3 by Speake & Co. Ltd. in Wales, United Kingdom. The FGM-3 and other magnetic sensors are available in the United States from Fat Quarters Software [24774 Shoshonee Drive, Murrieta, CA 92562; 909-698-7950 (voice) and 909-698-7913 (FAX)]. These sensors can be used in a magnetometer circuit to measure the Earth's magnetic field. If you would like to do a bit of scientific investigation, then let me suggest that you build both the magnetometer circuit (contact Fat Quarters) and the VLF receiver we have discussed in this column in the past. Monitoring 10-30 kHz VLF shows a strong increase in distant signal levels when a solar flare occurs. Solar flares lead to Sudden Ionospheric Disturbances (SIDs), which basically wipe out high frequency shortwave propagation.

I'd like to see the correlations between the magnetic event and the onset of the flare as indicated by the magnetometer. Fat Quarters now sells a printed circuit board and parts kit that will allow you to rapidly put a magnetometer into service. The output of the Fat Quarters magnetometer is an analog voltage that is proportional to the applied magnetic field.

More on the VLF receiver

In case you missed the VLF receiver design, I am reproducing the schematic in this month's column. **Fig. 1** shows the circuit diagram for an operational amplifier version of the VLF receiver. This receiver was first designed by Art Stokes for use by members of the American Association of Variable Star Observers—Solar Division. I first saw these designs in Peter Taylor's column in *Communications Quarterly*, and in an article by Stokes. I added the RF output stage, as well as buffering, to the precise rectifier. The RF output stage was added because I found it easier to tune the receiver using an oscilloscope to view the RF signal 2E. A meter connected to the DC output can also be used, but the high value integrating capacitor (C7) makes the tuning peak broad.

The circuit in **Fig. 1** uses a virtual inductor front end. A "virtual" inductor is a circuit that acts like an inductor, but isn't. Operational amplifiers A1A and A1B form a gyrator circuit. The inductance of this circuit is the product of the components shown between A1A and A1B [C3 x 3300 x (R2 + R3)].

Capacitor C2 resonates with the virtual inductance produced by the gyrator circuit to tune the desired frequency. For the values of C2, C3, R2 and R3 shown, the circuit will tune from about 15 kHz to more than 30 kHz. Resistor R3 is the tuning control. It is a potentiometer, and should be either a multi-turn model or connected to the tuning knob via a vernier reduction drive. I elected to use a ten-turn trimmer potentiometer because it is rare to retune the unit after homing in on the station that you want to monitor.

The receiver front-end amplifier consists of amplifier A1C, which has a maximum gain of x101 [i.e., (R7/R6) + 1]. The output of A1C is an RF signal with a frequency equal to that tuned by the gyrator and C2. This signal is coupled to the RF output stage (A2A) through capacitor C5. The RF output stage shown here is a noninverting operational amplifier circuit with a gain of x2. I found that this gain was a little too much for power stations, so eventually I eliminated R14 and R15, and connected the output of A2A (pin 7) to the inverting input (pin 6). This changes the circuit from a gain-of-2 noninverting follower to a unity gain noninverting follower. Some people might want to keep the amplifier if they are in a weaker signal area.

The DC output circuit consists of a precise rectifier (A2B). The precise rectifier works like a regular rectifier, but does not have the low-voltage "knee" between 0 and 0.6 volts (for silicon) or 0 to 0.2 volts (germanium). The pulsating DC from the precise rectifier is filtered and smoothed to straight DC, at a value proportional to the signal strength, by an R-C integrator consisting of R12 and C7.

The buffer amplifier (A1D) is used to isolate the precise rectifier from the RF output amplifier. Before incorporating the RF amplifier I found that the action of the precise rectifier distorted the RF output waveform.

The VLF receiver can be built using ordinary operational amplifiers, provided they have the gain at the desired frequencies. The pinouts shown in **Fig. 1** assume a type 4136 for A1, and a CA-3240 for A2. Both are available from Digi-Key and in Jim-Packs at electronic supply stores. If you want to use all CA-3240, or single CA-3140 devices, simply adjust the pinouts accordingly. The CA-3240 is a twin CA-3140, much like a 1458 is like a twin 741.

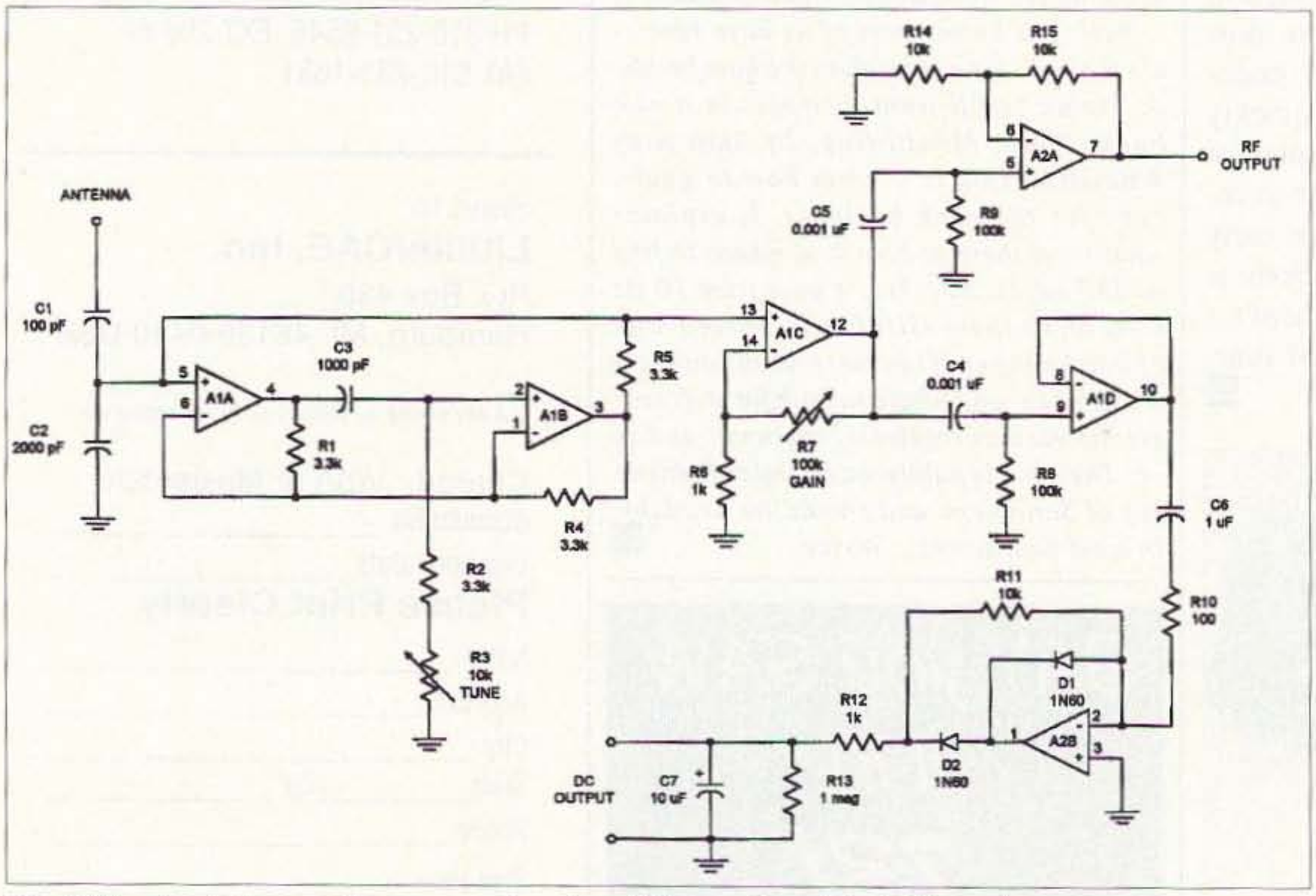

Fig. 1 The circuit diagram for an operational amplifier version of the VLF receiver.

Your setup

The next step is to obtain a means for recording the voltages from the FGM-3 and VLF

receiver. If you are lucky enough to own (or can get) either a strip-chart recorder or X-Y recorder, especially a two-channel instrument, then your problems are solved. *If* you can get pen and ink supplies for it. Otherwise, might I suggest looking in the various magazines for an A/D converter? What you want is an A/D converter with at least two channels, that will convert the 0-5–volt DC range, at a rate of at least one conversion per second.

The A/D converter that I use works through the serial port of a personal computer. The software is DOS-compatible, so it will work with either DOS only or Windows 3.x machines. The device is made by Pico Technology Ltd. (Broadway House, 149-151 St. Neots Road, Hardwick, Cambridge, CB3 7QJ, England). They can be E-mailed at post@pico tech.co.uk, or via the World Wide Web at http://www.picotech .co.uk/. Pico Tech accepts Visa, Master Card and American Express, so you can order from the USA. I have had no problems ordering from UK firms via credit card, so don't anticipate any in the future. Also, I have never been charged import duty… all came "passed free" by the US Customs Service. I cannot guarantee that yours will come that way, but it's likely.

New books

I recently published three new books under the Newnes imprint. *Linear IC Applications* and *Linear Integrated Circuits* are published by Newnes/Butterworth-Heinemann in England, but should be available from their US office. *Microwave & Wireless Communications Technology* is published by Newnes/Butterworth-Heinemann in the US. All three books can be ordered in the US by calling 1-800-366-2665. If you want additional information, the op-amp books can be viewed at World Wide Web site: http://butter worth.heinemann.co.uk. Click on "technical books" and follow that or the new titles pathway to find my two mini home pages.

For viewing the microwave book, try site http://www.bh.com. This is the US site. In both cases, you can order through the Internet by either filling out the form and mailing it in via snail mail, or supplying your credit card information via E-mail. Because of security problems, however, I strongly recommend against ordering by sending your credit card data via the Internet. I would rather lose the sale than have you in trouble because of a credit card cyber-thief.

Connections

I can be reached via snail mail at P.O. Box 1099, Falls Church VA 22041, or via Internet E-mail at: carrjj@aol.com 73

Ask Kaboom

Number 77 on your Feedback card

Your Tech Answer Man

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Peterborough NH 03458

Whether via ham radio or the Internet, one subject with which we're all becoming more familiar is video. From JPG and GIF to ATV and SSTV, picture transmission is coming into its own—so I thought it would be fun to take a break from our usual repair topics and examine video: its history, its signals and its peculiarities. Let's have at it:

The big difference

Video signals are vastly unlike audio signals. Why? It all comes down to one essential difference between sound and light: Light travels in straight lines and sound does not. Thus, light can form spatial patterns far more detailed than can sound.

This doesn't mean, of course, that dimension is not an issue with sound. We are born with two ears for a reason: Localization of sound arises from differences in amplitude and phase as the sound arrives from various locations to our ears. With only one ear, it is nearly impossible to know from what direction a sound is arriving. There are some secondary effects due to the curvature and asymmetry of the outer ear, and they can give some clues, especially regarding front and rear. But, without binaural reception, you can't get much localization. After all, can you tell whether somebody's sitting to the left or right of his radio's microphone when he's talking to you on it? Nope.

Although you certainly can hear two sounds at once, or even many of them, in reality, they're a combination of the waveforms of each sound into one composite waveform which has a definite value at any given moment. The separation of this waveform into its constituent parts is due to a miraculous feat of the human brain, which is way more powerful than any DSP chips we've yet created. So, even though you can hear an entire orchestra playing together, it's reasonable and fairly correct to think of sound as a serial, or one-at-a-time, medium, and it can easily be transmitted as such.

Because of light's traveling in straight lines, it has the capacity to form detailed spatial images. The implications of that are tremendous. Suddenly, you can't describe the whole of the information in serial fashion, because, in addition to having colors and intensities (roughly analogous to sound's pitches and loudnesses), you've also got variations of these things happening *next* to each other! In other words, you have serial events happening in parallel. That added dimension complicates matters quite a bit.

Way back when

Believe it or not, people were experimenting with television before the turn of the century. (Hmm, I guess in another couple of years, that phrase will mean something entirely different.) Even in such a technologically

primitive time, it was recognized that there was no practical way to transmit parallel events, whether over wire or, later on, via radio. There had to be some way to serialize a picture for transmission. There was, and it's essentially the same one we use today.

The concept of scanning an image and sending it serially, dot by dot, goes back to the earliest experiments with picture transmission in the late 1800s. Breaking an image up into dots had some limitations, notably in how many dots you could send per second, but it seemed the only choice. In pre–vacuum-tube days, the only way to do it was mechanically, so TV pioneers did just that!

One early experimenter by the name of Nipkow proposed a workable TV system using a rotating disk with holes in it, in 1883. By arranging the holes in a spiral pattern, he was able to scan an image, line by line, much as we do today with electron beams. It took a big disk to make a small picture, though, so his pictures were limited to under 40 lines of scanning, whereas ours can be in the hundreds or even thousands. Did it work? You bet it did! Of course, at that time, it was limited to being a laboratory curiosity, with pictures sent over wires to a nearby receiver, since radio wouldn't get off the ground until Marconi "invented" it in 1895. Imagine: People were playing with TV before radio! Even more amazing, a Scotsman by the name of Campbell-Swinton proposed the fundamentals of modern, electronic television in 1908, long before the equipment to produce it would exist. (Actually, the cathode-ray tube was invented in the late 1800s, but it took great imagination to envision using it for the display of pictures, and the concept of storing an optical image on a charged plate in the camera was wild and unique. Yet, that's exactly how it would eventually be done, nearly 25 years later.)

"Can you tell whether somebody's sitting to the right or the left of his radio's microphone when he's talking to you on it?"

As early as the 1920s and 1930s, Baird in England and Jenkins in the USA had created working Nipkow-disk–based TV sets, and some radio stations were broadcasting TV programs, with the viewers connecting homemade disks with neon bulbs (which, unlike incandescents, can turn on and off fast enough to form the picture dots) to their radios' speaker leads, via step-up transformers. The bulbs would flash on and off with the received signals, and the spinning disks would form those flashes into images by scanning the same line pattern as the transmitter's disk. Synchronization of the disks was accomplished by the viewer's speeding up and slowing down the receiving disk until the image looked right. The resulting pictures were crude, but they were *pictures!* Baird sold finished sets, had his system adopted by the BBC, and even demonstrated a disk-based color TV system. Further, he invented and actually sold the first videodiscs, which stored programs on phonograph records, all in the 1920s! These brazen beginnings set the stage for the television revolution, and we've never looked back.

Seeing pictures transmitted from far away was a tremendous thrill, but there were serious inherent limitations in the mechanical system. In addition to its huge cabinet-to-picture size ratio, mechanical TV had very limited resolution (number of dots per picture), poor gray scale (it was hard to get the brightness of neon bulbs to track that of the received signals), and there was no persistence of the dots between scans, resulting in a very dim, flickery picture. Clearly, the scanning concept was right, but the moving parts had to be done away with. Zworykin and Farnsworth were working on all-electronic television in the 1920s, and finally succeeded in making practical, all-electronic TV ready for the masses by replacing the scanning disk with a moving electron beam in a tube. It wasn't until after World War II that TV really got off the ground, though. The 1950s became the "golden age of television."

Faster is better

What made the electronic system so superior to the old mechanical one? There were several factors, including phosphor persistence that made for bright, flicker-free pictures, good gray scale, a much better cabinet-to-image size ratio, automatic synchronization, and no whirring mechanical disks. Far and away, though, the biggest improvement was in the amount of information each picture could contain. Without the need for a giant disk, the number of lines scanned went from about 40 to 525, with 30 complete frames every second! And, each line could contain many dots of information, making for a vastly more detailed image. With the small screen sizes then available, it looked nearly as good as a film shown in a movie house, and you could see it all for free in your living room. It was irresistible.

Providing so much detail on the screen each second required a lot more information to be transmitted in the first place. TV could no longer be broadcast in the 5 kHz bandwidth of an AM radio station. The new electronic system needed 6 MHz of bandwidth for each station, which is about 12 times the size of the *entire* AM band! So, TV stations had to move to VHF and UHF frequencies, with today's channel 2 starting at 54 MHz. (There was once a channel 1, but it was lost to changes in the frequency allocations.)

Lock on

Automatic synchronization was a must for electronic television. With the scanning disk, you could play around with its rotational speed and position until you got a synced picture. And, if you were lucky, it might not drift out of sync for a few minutes. With electronic circuits, that was impossible; without the mass of the disk, the drift rate was intolerable. So, while the mechanical TV's signal consisted entirely of picture information, the modern signal was devised to contain sync pulses that told the set where and when to start the scan, both for the beginning of each frame and for each line within it. They were called, appropriately, vertical and horizontal sync. Even with all this, though, there was still one problem.

I said before that electronic TV gave flicker-free pictures. That wasn't entirely true at first. The decay rate of the phosphors in the picture tube (how long it took for them to lose brightness after being struck by the electron beam) wasn't really long enough to keep the top of the picture bright by the time the beam had gotten to the bottom. Early experiments found that the resulting flicker was troublesome, so a clever, essentially free solution was found: First the set would scan all the odd-numbered lines, and then go back to the top and scan all the even-numbered lines in between them. The amount and rate of information transmission and display was the same, but the beam got to the bottom of the screen twice as fast and twice as often, tremendously reducing the amount of flicker. This breaking up of the 30 frames into 60 fields was called "interlaced scanning," and has remained an important feature of TV systems all over the world, to this day.

Well, I think we've done enough TV history for one month. Next time, we'll look more closely at the television signal, color and recording. Until then, 73 de KB1UM. 73

73 wants your feedback...we've been improving *73* for the past months with more articles, easier reading type, etc. And honestly, we *need* your feedback (in detail) if you have any critique either for or against the subtle changes that we've made. We know we can't please everyone everytime, but if you tell us what you want *73* to be, we'll at least try to head in the direction for further "improvements" that might be most appealing to you. Thanks.

Number 79 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

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As I write this, there are developments on the digital front I find rather troubling that shall form the nucleus of this month's column. While they may not concern everyone, their implications may well be far-reaching.

Little Orphan AEA

Back in July, 1996, I received a piece of E-mail from the folks at AEA, makers of the popular PK-232 multimode terminal unit and other digital devices, eager to link with the RTTY Loop Home Page on the World Wide Web. As many of you who have visited the page know, I maintain a variety of links to various sites related to amateur radio in general, and digital communication in particular, on the Web site. Anyway, we established such a link.

Then, in November, I heard from John P. Skubick K8JS, who wrote: "I browsed your Web pages again after a long hiatus. Nice! I read RTTY Loop each month and enjoy it.

"Actually, for your pages I prefer my usual browser, Netscape Gold 2.02©; it's better than IE 3.0© and is also very stable. IE 3.0 and previous versions of it have always been new and unwelcome 'adventures' the few times I have booted them up.

"I've been digitally inactive from ham radio for about 1-1/2 years. Before then, I was almost exclusively digital with PACTOR, AMTOR, and some packet—lots of fun, especially the long PACTOR/AMTOR ragchews with the VKs & ZLs on 20m.

"My trusty and reliable and 'stable operating' Amiga got zapped from one too many hits from the local power company's outages. Six months later I got a new 'P100' and installed OS2 Warp. (After that terrific Amiga system, I just could not put up with the archaic Win3.xx.) Warp 3.0 was not without its 'unique' logistical problems (software & drivers), so I switched over to Win95© and its subsequent enhancements & updates. Over all, W95 is very nice for me. Olde Windows? Yuk!!

"I have been active all of this time using 'basic digital' (CW) and some SSB. I have largely procrastinated [in using] the digital modes because I had drastically re-done the operating position with roll-top cabinets and hesitated to re-do 'all of those TNC cables' from the PK-232 to the HF and 2-meter rigs. Yes—a poor excuse.

"Now, I got interested in digital hamming again and was planning to get a shiny new PK-232. And, guess what? AEA. just went out of business a few days ago! Can you believe that? It's true, all right. I wonder what the heck happened to them? They had the best TNCs as far as I'm concerned. I may get that German-made PTC-II TNC; I just don't know yet. PACTOR II seems promising, but I have reservations about G-Tor's future."

Well, I enjoyed the comments about the column and Web site, of course, but was a bit taken aback by the news of AEA's demise, so I asked John where he had heard the news.

He replied: "About a week or so ago I read this about AEA on the Web-based *Ham Radio Online* magazine. A few days later, AEA's Web pages disappeared. I noticed that *QST* and a few other mags did not have any AEA ads in their respective November issues. The December *QST* just arrived, and not only are the usual AEA ads missing, but not a word anywhere in it about their demise. It's the same with the December *73 Magazine* that just arrived. No info. Nothing."

Oh, well, I guess I didn't need that new DSP-232 after all.

With this information, I checked the blurb on *Ham Radio Online*, an online magazine which can be found at: http://www.hamradio-online.com, which reported that as of November 15, 1996, AEA closed its doors and went out of business. While there are suggestions that they have been looking for a buyer, I have been unable to turn up any new information about the company from my perspective.

So there you have it. A manufacturer whose product was positioned at the top of the amateur radio market bites the dust. Of course, this is nothing new. Those of us in the hobby for many years recall legions of amateur radio names that no longer claim shelf space. From Hallicrafters to Heathkit, or Hammarlund to Gonset, many a company has either bailed out of ham radio or folded altogether.

"There have been some rather troubling developments..."

So if AEA joins them, farewell—it's been nice. Or if a company like G & G steps forward, as it did to rescue Microlog customers, there may be some life in the 232s yet. Only time will tell, and I will keep my eyes and ears open for news. Watch here, and on the Web site, for further information.

In the meantime, we are all going to have to help out those who are new to these modes. To wit, a letter from Clarence Hermance W6RRN, of Stockton CA. He writes:

"I have been a fan of your column since I had my first model 19, so long ago. I have made some of the modems I have used over the years from your column. Now as time has passed, I have been buying the equipment instead of building from 'scratch.' My first purchase (years ago) was a CP1 for my Commodore. Worked great until I got the 'IBM clone.' Then your column showed how to put a RS-232 port on it—which I built. Haven't got it to work as yet with Hamcomm 3.1©, but I will figure it out. I think something was left out of the directions for making the jumpers on the CP1.

"Now for my latest problem. I purchased an AEA PK-232MBX with the PACTOR chips installed. It was the only one I could find in November, 1996. It was sold to me as a clearance item, as the salesperson said it was discontinued. They never told me the company had closed up. After getting it home, I found that it had apparently been a used unit or a demonstrator which would not work PACTOR. The program said it 'does not support PACTOR,' yet I was using Packratt II version 5.5a. Apparently the chips are bad, but with the company closed up, I have no way to get new chips or have the unit repaired if that is what is wrong.

"Do you have any information on where we (I and others) can get our AEA equipment worked on? This sure poses a problem to me and a few others who will need to get our equipment serviced in the future."

As I have no good information on the PK-232MBX, I turn it over to you all. My only hope is that, if nothing else, a users' group will arise to help Clarence, and others who have problems with their AEA units.

I look forward to hearing from any of you by snail mail at the above address, or via E-mail at ajr@ari.net, MarcWA3AJR on AOL, or 75036,2501 on CompuServe. Check the RTTY Loop Home Page at http://www2.ari.net/ajr/recs/ for further developments as well. 73

PROPAGATION

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March may turn out to be a very exciting month for HF-band propagation and also for ionospheric, atmospheric and geophysical activity. It looks as if the first two weeks of the month may be rather bland and quiet, with only seasonal improvement in DX potential. The last two weeks, however, could be wild. There is a good chance of the ionosphere exhibiting active-to-minor storm levels on or around the 17th to 19th, the 26th, and again around the 29th and 30th. These periods may also bring some atmospheric storms and other geophysical events to various locations.

Seasonal increases in daylight hours in the northern hemisphere bring more UV stimulation of the ionosphere—hence greater DX potential. Also, an expected increase in solar flux due to the anticipated increase in sunspots as Cycle 23 begins its five-year rise, should help DX chasers. It is sometimes noted that the occurrence of ionospheric storms, accompanied by high signal absorption, is followed soon after by exceptional DX propagation opportunities...so don't be discouraged by poor conditions.

As you scan the band-time-country chart, be aware that when 15 meters is indicated, check 12 meters, too; when 20 meters is indicated, check 17 meters. If 40 meters is shown, be sure to try 30 meters, too. Propagation is where you find it, and forecasting is often as much an art as a science. Surprises can and do occur, so it pays to be alert and do some searching above and below the noted frequencies, and also before and after the noted times.

10 meters

DX possibilities are poor, but occasional openings across the equator may be possible to tropical areas.

12–15 meters

Circuits to Africa and South America can occur on Good days as shown on the chart, and short skip out to 1000 miles or more will be frequent on Good days.

17–20 meters

Twenty should be the best band for DX, with 17 coming a close second. The band should be open until after dark, with long openings into the southern hemisphere. Short skip from a few hundred to about 2,000 miles will be frequent during daytime.

30–40 meters

These bands should remain open for DX from sunset to sunrise. Signals from the east will peak between dark and midnight, while signals from other directions will peak between midnight and dawn. Daytime short skip from 100 to 1000 miles and nighttime short skip from 1000 to 2000 miles can be expected.

80–160 meters

Increases in QRN may limit DX opportunities to "quiet" evenings, and short skip between 500 and 2000 miles will be common on 80 meters. On 160, short skip and DX during hours of darkness, peaking around midnight and again at dawn, should be a regular occurrence... limited only by QRN. There will be *no* daylight activity, due to absorption. 73

MARCH 1997

SUN	MON	TUE	WED	THU	FRI	SAT
						1 G
2 G	3 G	4 G	5 G	6 G	7 G-F	8 F
9 F-G	10 G	11 G	12 G	13 G	14 G	15 G-F
16 F-P	17 P	18 VP	19 P	20 P-F	21 F-G	22 G
23 G	24 G-F	25 F-P	26 P	27 P-F	28 F-P	29 P
30 P	31 P-F					

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII	20		20		40	40	80	20			15	15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40			20	15	15	15	15	
RUSSIA							20	20				
SOUTH AFRICA									15	15	15	
WEST COAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
RUSSIA								20	20			
SOUTH AFRICA										15	15	20

WESTERN UNITED STATES TO:

ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
RUSSIA									20			
SOUTH AFRICA										15	15	
EAST COAST		80	80	40	40	40	40	20	20	20		

QRX . . .
Continued from page 8

RFE/RL Assists Banned Serbian Reporters

On December 4, 1996, Radio Free Europe/Radio Liberty began expanded news and current affairs programming, in cooperation with Radio B92, the last independent broadcaster in Belgrade, which Serbian authorities silenced on Tuesday, December 3.

RFE/RL's Belgrade news bureau is working with journalists from B92 to provide impartial and uncensored news, interviews, analysis and discussion of the current political situation in Serbia.

A 30-minute program is broadcast daily from 21:00 to 21:30 Belgrade time on 1593 kHz from a 150,000 watt AM transmitter at Holzkirchen, Germany. An additional 30-minute daily program is broadcast 19:00 to 19:30 Belgrade time, on 792 kHz from a 500,000 watt AM transmitter at Kavala, Greece. Both stations are operated by the U.S. Information Agency's International Broadcasting Bureau.

On the air since January, 1994, RFE/RL's multiethnic South Slavic Language Service—staffed with prominent Serbian, Bosnian and Croatian journalists—currently broadcasts two and a half hours daily to the former Yugoslavia. Director of the service is Nenad Pejic, former program director of independent Sarajevo TV.

The service has become a leading source of unbiased news and current affairs from throughout the former Yugoslavia, the neighboring region and the world at large. From two and a half hours daily, broadcasting has now expanded to three hours.

Based at RFE/RL's broadcast center in Prague, the service draws on more than 30 correspondents working through bureaus in Belgrade, Sarajevo and Zagreb, and from Washington, Brussels, London, Moscow and other major capitals.

Since 1994, radio B92 has broadcast one hour of RFE/RL's program daily. The service's programs continue to be broadcast on seven other independent local FM stations in Serbia and Bosnia. RFE/RL also produces a half-hour weekly television program that airs on independent stations in Bosnia.

RFE/RL is a private, non-profit public service broadcaster funded by the U.S. Congress. Relocated from Munich, Germany, to Prague in 1995, its 21-language services broadcast 700 hours weekly to eastern Europe and the former Soviet Union.

From *RFE/RL News*.

Computerspeak

Keypad: An apartment with a lock.

Keyword: "Your place or mine?"

Light Pen: A minimum sentence prison.

Line Feed: "I've never met anyone as interesting as you before," etc.

Machine Independent: The goal of all computer haters.

Machine Language: "Zoom, Putt-Putt, Chug-a Chug-a," etc.

Memory: The part of a computer where data is placed prior to destruction.

Multipass: To try again after she turns you down the first time.

Menu: An itemized list of ways to make a mistake on a computer.

Microminiaturization: "Get small" in computerist's language.

Mnemonic: Said of someone suffering from mnemonia.

Monitor: The first iron-clad CRT.

Multi-processing: To cook statistics more than once.

Multi-programming: To watch all three networks at once.

Multi-tasking: When one "tsk" won't do, e.g., "Tsk-tsk-tsk."

(Note: Under the most rigorously controlled conditions of pressure, temperature, humidity and other controllable variables, a computer will do what it damn well wants to do.)

n: After x, the second most popular number that doesn't mean anything.

Nanosecond: A witness to a duel between grandfathers.

Night Mode: computing in pajamas.

Network: What fishermen do when not fishing.

Non-Impact Printer: One whose signs go unnoticed.

Nybble: What an unsuspecting customer does to a line dangled by a computer salesman.

Overstrike: To tempt fate, e.g., air traffic controllers.

Office Information System: The word processor who knows the most gossip.

Ohm: Where the 'eart is.

Note: These definitions are not intended to offend anyone. They are taken from *The Computer Hater's Handbook* (1983), as printed, and it is hoped they will be taken lightly and with humor, as intended.

By Vince WA8BIJ, from *The Tuned Circuit*, monthly bulletin of L'Anse Creuse ARC, Utica MI, January 1997. 73

HAM TO HAM

Your Input Welcome Here

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This month's "Ham To Ham" has an interesting potpourri of ideas, so let's get right to it.

Stud power

From Mark Marholin KE6JJR: "If you're faced with having to replace a stud-mounted RF transistor in your commercially-made rig, or perhaps you're building an add-on 'brick' amplifier for your VHF or UHF low-power transceiver, here are some points to keep in mind before starting the job. I've hard-won these ideas over my own years of building RF amps in the 50 to 450 MHz range.

"Before mounting the ceramic-bodied, stud-mounted 'final' transistor(s), try to form the flat copper leads (bands) on the transistor as closely as you possibly can to fit the board foils and the opening in the circuit board which the transistor body occupies. This may require first bending the flat leads up at an angle, then down somewhat again for the right fit. It's much easier to do all of this pre-fitting ahead of time. Once the leads are preformed, trim off the excess to avoid unexpected additional inductances ... especially in UHF circuitry.

"Now, pre-tin the undersides of the flat leads so that when the transistor is finally in place, solder will flow smoothly and easily underneath the flat leads without the need to apply excessive amounts of heat (which might be bad for both the board and the transistor itself).

"A good quality thermal-conducting grease (silicone grease) should be applied to new transistors and any mica washers or insulators that might be involved, but don't overdo it—too much thermal grease can actually hamper heat transfer, or worse yet, can deform the flanges on some devices when they're finally torqued down.

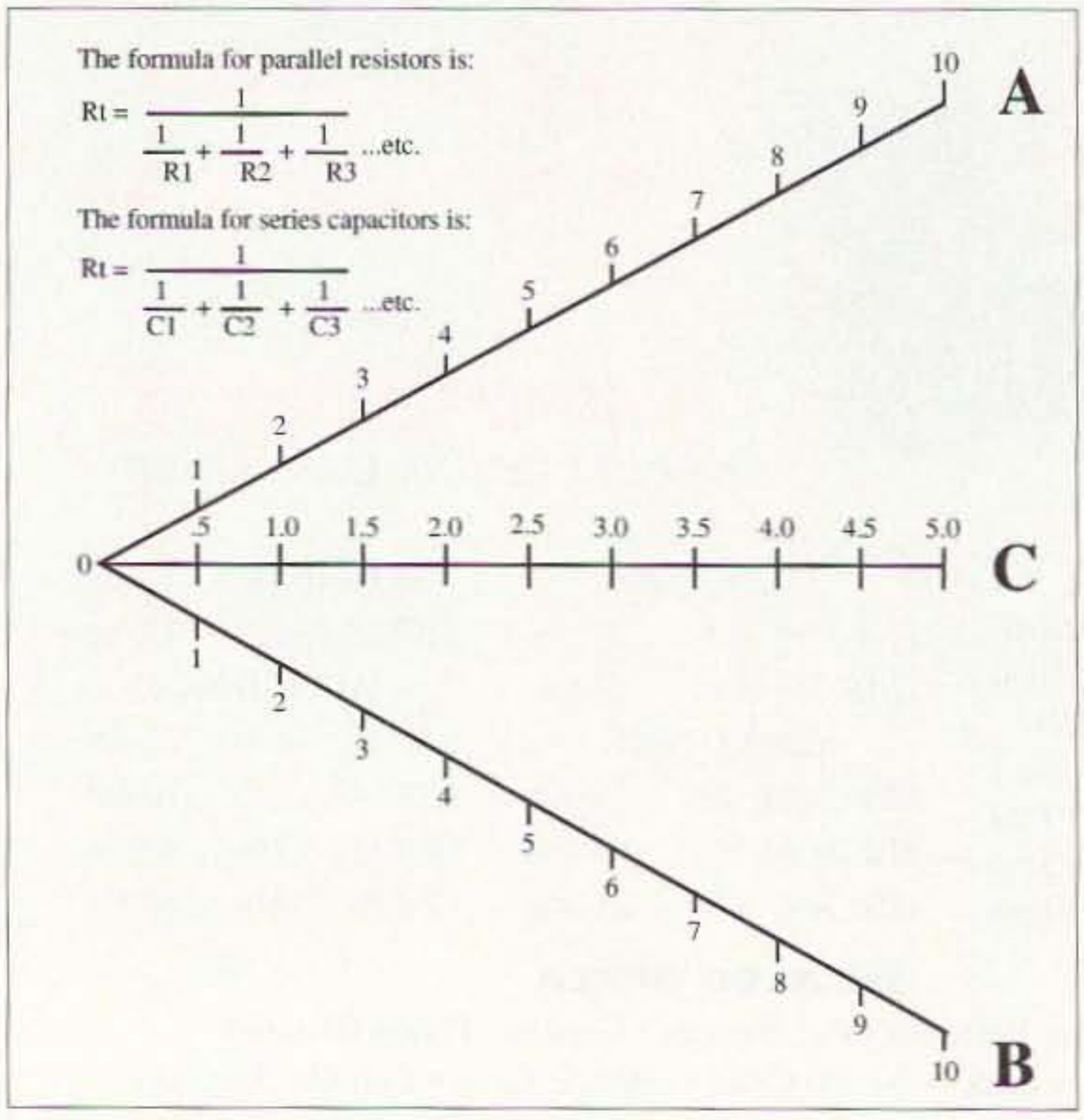

Fig. 1. *John Nix's nomogram for approximating the value of parallel connected resistors or series connected capacitors. Lay a straightedge across the graph from Scale A to Scale B at the point representing the two component values, and the resulting equivalent circuit value of those two components is read from Scale C.*

"And speaking of that final torquing down of the nut on the transistor's mounting stud, try not to apply counterpressure by holding the device by its leads; they're not meant to stand that degree of strain. Even after soldering the leads in place, don't depend on them to prevent the transistor from twisting during the stud-tightening procedure. Stud-mounted devices usually have a flattened end on their threaded studs; hold the stud in place by that flat—that's why it's included. I hope that some of these tips prove to be worthwhile for your next power transistor installation."

Reducing heat buildup in tube amplifiers

From Richard Measures AG6K: "Excessive heat buildup, within any piece of ham radio gear, can greatly affect the trouble-free equipment life expectancy period of that equipment. In case you're in doubt, it's generally accepted that electrolytic capacitors can be expected to decrease in life expectancy by one-half for each 10 degree Celsius rise (18 degrees Fahrenheit) above normal room temperatures. This alone should be enough to convince most of us of the importance of keeping the tube compartments in older HF transceivers, and in amateur linear amplifiers, as free from heat buildup as possible.

"Another reason is the often self-destructive effects that too much heat can have on higher-power amplifier tubes—such as the popular 3-500Zs—used in many ham linears. These tubes will normally run with an orange glow on the anode material, with the expectation from the tube's designer that much of the internal heat will be dissipated by radiation and absorbed by the cooler surrounding metal chassis structure. Just as often, however, those surrounding metal parts are shiny reflective aluminum or steel, and send a large amount of that radiant energy right back into the tube instead of dissipating it as the designer intended.

"By painting the insides of these tube compartments a flat black, considerably more of the radiant energy will be absorbed and safely carried away than if the metallic surfaces are reflective and force the energy to bounce back and forth between the tube(s) and the enclosure. This is a simple point of physics that some product design engineers overlook: Bright or shiny surfaces always reflect, and dark dull surfaces always absorb radiant energy, and heat is radiant energy. Kenwood's TL-922 linear amplifier, as an example, *does* have flat black tube compartment walls.

"If your particular amplifier doesn't, black liquid shoe polish is one simple answer. Apply it evenly to all of the reflective compartment surfaces, especially those that would reflect radiant energy right back into the tubes themselves. This simple step will help the equipment's cooling fan to do its job, and help to keep your gear functioning longer, cooler and more trouble-free."

Moderator's note: I've applied Rich's idea to my own Heath SB-1000 and can vouch for its effectiveness. I painted the internal walls of the tube compartment with flat black paint and immediately noticed a substantial increase in the amount of heat absorbed by the compartment walls; very little of that heat will find its way back into the 3-500Z itself. What modification could be simpler? Just make sure that the power is unplugged and the power supply's capacitors are completely discharged when you're working inside any compartment that carries high voltage. I always clip a jumper from the anode of the tube to ground whenever my hands are in or near the final RF compartment. I learned the value of that years ago when working inside broadcast transmitters. "Inside" is the right word; you could actually walk inside our VHF TV transmitter!

Workbench pin-up

From John Nix: "Fig. 1 shows a handy nomogram to keep near your workbench. The dictionary definition of a nomogram is 'a graph that enables one, with the aid of a straightedge, to read off the value of a dependent value when the values of two or more

independent variables are given.' This one allows you to quickly approximate the equivalent value of two or more parallel resistors or two or more series capacitors. Simply lay a straightedge between the values that you want to combine on the top and bottom angled lines (Scales A and B), then read the equivalent combined value on the straight line in the middle (Scale C). It's much faster and easier than struggling with the all of the division needed for the 'standard' parallel resistor or series capacitor equivalency formulas (also shown in **Fig. 1**).

"For instance, a 270 ohm resistor in parallel with an 820 ohm resistor is 203 ohms. A .022 µF capacitor in series with a .047 µF capacitor is .015 µF. Remember that the value will always be lower than the lowest of the two individual component values for resistors in parallel and capacitors in series.

"To figure multiple resistors in parallel or capacitors in series, simply use the first two values and find the equivalent on the nomograph, then use that answer plus the third value for the next equivalent and so on until all of the values have been accounted for. The final value is the overall equivalent circuit value of all of the components in that parallel (resistor) or series (capacitor) circuit."

Moderator's note: The nomograph in ***Fig. 1*** *is only useful for values within the same power of 10, i.e., when all of the resistors in a parallel circuit are in ohms, hundreds of ohms, thousands of ohms (k), etc. To find the equivalent of a 470 ohm resistor in parallel with a 10k ohm resistor, best use the longer formula (by the way, the answer is 448.9 ohms!). Thanks for another nice chart, John.*

Big dipper

From Phil Salas AD5X: "For waterproofing outdoor connections and connectors, I've had very good luck with a product called Plasti-Dip™. It's a fast-curing liquid plastic material that's intended primarily for coating tool handles. A can of it costs about $7 at hardware and home centers, but it should last you a good long while. I usually put two coats of it on all of my outdoor connections. For wire connections, such as separating a coax shield and center conductor for feeding a dipole antenna, I immobilize the point where the shield and center conductor separate with hot glue (hot glue guns are great for a lot of things like this). Then I attach solder lugs to the ends of the shield and center conductor as the connection point to the antenna's balun. Finally, I dip the entire end of the coax (including the solder lugs) into the Plasti-Dip and let it cure. After curing, I use a hobby knife to trim off the excess Plasti-Dip insulation that covers the ends of the solder lugs. Neat, easy and if done correctly, waterproof!"

TTT (transformer test tip)

De your moderator, Dave NZ9E: Here's a tip for easily and accurately testing the insertion loss of transformers, whether they are AF transformers or RF transformers. Testing the actual dB loss in step-up or step-down transformers is tricky because of the different impedances presented by the primary and secondary windings; dB loss formulas assume like impedances on the input and output of any device where dB gain or loss is to be calculated. But with transformers, this criteria is easy to meet, simply by using two identical transformers (same type number) and hooking them up back-to-back (see **Fig. 2**). Now the input and output impedances are identical, so the loss can be measured by simply comparing the differential in voltage between the input of the two and their cascaded output, then dividing that result by two. If your measurements indicate a 6 dB loss using two identical transformers back-to-back, it's safe to assume that each is responsible for 3 dB of that loss, certainly close enough for all but the most exacting applications.

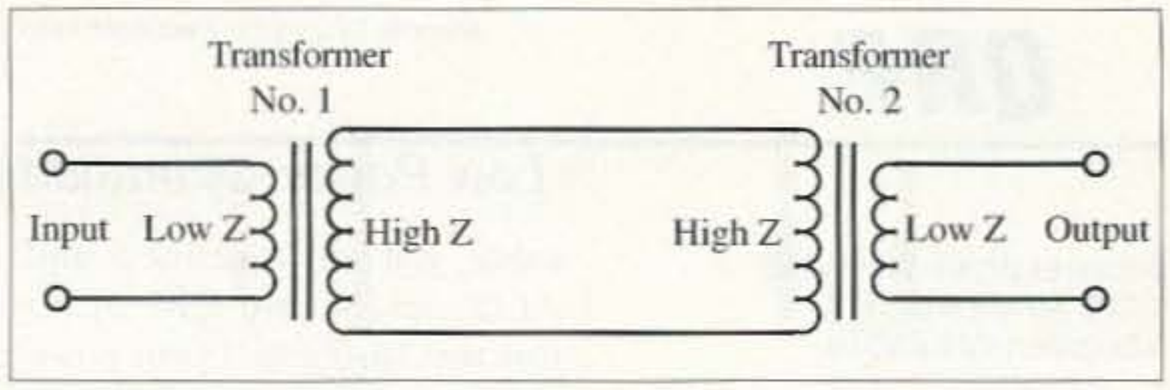

Fig. 2. *Two identical transformers connected back-to-back for easily checking their insertion loss in dB. See NZ9E's tip in the text for further details.*

Hidden QRP wattmeter

From Ken Guge K9KPM: "Wanting to accurately measure the 2 watt RF output from my Kenwood HT, I spotted the Daiwa CN-550 cross-needle VHF SWR/Power meter sitting on my operating bench. The Daiwa CN-550 measures forward and reflected power directly in watts, with two separate meter needles, and then it 'computes' (on the meter's scale) the SWR by where those two separate needles cross. I'm sure everyone's seen this type of meter even if you don't currently own one. The forward power scale has a range of zero to 20 watts on its most sensitive range, but even at that, the 2 watt point for my HT's RF output is only about the lower one-fifth of the full 20-watt scale markings—OK, but not great for accurate QRP measurements.

"You've just uncovered your 'hidden' QRP meter and you didn't even have to lift your soldering iron to do it."

"It occurred to me that the reflected scale, zero to 4 watts, would be the perfect one to use, with the zero to 2 watt portion on the scale covering about three-quarters of the meter's range; several magnitudes better than the forward scale. It's amazingly simple to use that reflected scale for measuring low power outputs—simply hook the unit up backwards!

"Instead of having the HT's output cable going to the 'TX' connector on the CN-550, connect it to the 'ANT' connector instead. Then put your dummy load (a low power one is fine) on the 'TX' connector of the meter. You won't be able to see your SWR correctly, but you no doubt already know that your dummy load is very close to 1:1, so it's no loss. What you will see, though, is your forward power—now on the 'reflected' scale—in far greater detail. Small adjustments can be made to your low power HT and the results will be easily visible on the zero to 4 watt right-hand reflected scale. You've just uncovered your 'hidden' QRP meter and you didn't even have to lift your soldering iron to do it."

Moderator's note: I've had a Daiwa meter like the one that Ken mentions above for years, and have never really seen it in that light before! Ken's idea clearly illustrates what 'ham ingenuity' means: Looking at an item from another point of view and 'inventing' a new use for it. Of course you can apply the idea to any of Daiwa's (or other manufacturers') dual-needle meters, in any frequency range. Another nice tip, Ken.

That wraps up this month's column; does anyone have any ideas on "different" uses for common items such as K9PKM gave us? Send them, or any other ham-related tips, ideas, suggestions or shortcuts to me at the address in the masthead, and I'll share them with the rest of *73*'s readers. That's our purpose, sharing practical ideas Ham To Ham.

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73

QRP

Number 84 on your Feedback card

Low Power Operation

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Well, it looks like we made it through another winter in the Midwest. Lucky for me, this year I don't have to fix the damage old man winter did to my antennas. On the other hand, I spent most of the winter with nary an antenna. What little hamming I've been able to do has been with a mobile HF antenna affixed to the car—with a run of coax into the apartment. Needless to say, I can't wait for the house to be finished. But while I wait, I can plan my dream antenna farm. During the best of times, I've never really had a "really good" antenna system. With three acres on the new home site, I can grow lots of antennas.

Even if you don't plan to redo your entire antenna farm, if you're running low power you need to get every last milliwatt in the air. Winter can be really tough on your antenna farm. So, before the grass starts to grow, let's look at what is left, and the best place to start is the feedline.

You get what you pay for

And when it comes to feedline, if you try and save a few nickels here, the results will surely bite you in the butt! Lossy cable may work if you're running 100 watts. Even if you are using really bad coax and lose half your power to the cable, you only lose one S-unit. At the levels most QRP operators use, losing half your power to lossy feedline (and that same S-unit) would be a death blow to your signal.

So, if you purchased your feedline new with the rig, and that rig has tubes in it, replace the coax! Unlike fine wine, coax does not get better with age.

So when should you replace your coax? I really can't say. Coax used up and down the tower should be checked/replaced every five years or so. If you live in a climate having lots of sun or salt mist, perhaps you should change it more often.

"Unlike fine wine, coax does not get better with age."

The outside jacket should be free of cracks and abrasions. If you find your feedline looks fine except in one or two sections, don't try to splice in new runs. Aside from the extra work, it's not really going to fix the problem. Water may have seeped into the line and ruined it. Damage from rabid ice weasels may go unnoticed as well. Run your hand along a section of coax. If your hands turn the color of the coax, UV damage has occurred; replace it.

Check the connectors at both ends (see **Fig. 1**). The jacket should be inside the barrel of the connector. Any exposed braid means there's a good chance water may have entered the coax. Of course, if you can see the connectors, why didn't you seal them off with some tape and coax sealer after you installed the coax in the first place?

What coax to buy?

Always buy a name brand. I don't care what the guy behind the counter says; if the stuff is any good, the manufacturer will put his name on it. You really do get what you pay for. Don't go for the surplus coax either, unless you know where it came from. Fresh surplus is fine, but stuff from World War II is just wasting your money.

For runs up the tower, I always recommend and use RG-8 cable. Another really good cable to use is the RG-213. It's about the same price as the RG-8, but with slightly lower loss specifications, especially on the upper frequencies. 9913 is also a good choice for HF. Check out the *ARRL Handbook* for a listing of different coaxes and their losses at various frequencies.

Just like chocolate, there are zillions of varieties of RG-8. You'll see UV resistant, direct burial and abrasion resistant, among others. Get the kind you need, but don't pay more for something you don't need.

Connectors

While shopping for new coax, how about the connectors on the ends? Please don't waste your money and get those cheap imported guys with the plastic centers. They're just not worth the hassle. I always choose amphenol RF connectors. And I always go with the silver-plated connectors, too. The last ones I used had the Teflon™ center. I highly recommend you do the same. If you're not an expert at attaching an SO-239 connector, the Teflon will allow you some leeway when soldering. The plastic center connectors will melt! Get the connector hotter yet, and the center of the coax will melt as well!

Is the gold SO-239 any better? Well, *I'm* not going to spend the extra money to find out. The gold would prevent the connector from becoming corroded, but other than that, I'm not sure they are worth the money.

There's been a lot of paper consumed showing hams how to put on an SO-239 connector. I suggest you take a look in the *ARRL Handbook* for a step-by-step walkthrough. I can tell you those small holes around the barrel of the connector are not to let the steam out.

To install a connector onto an end of coax, you'll need the following: First, use a clean connector free of dirt and corrosion. The silver plating makes soldering much easier. Next, you'll need a high wattage soldering iron. I like to use a 45-60 watt iron. A soldering gun won't cut it. You need to heat the connector up as fast as possible to avoid damage to the coax.

A good grade of solder is also important. I use a low flux solder by Kester™. It's called the "no clean 245." Digi-Key™ handles it. The Digi-Key catalog number is KE1400-ND, and it costs about ten bucks a pound. With this stuff, there's no big glob of solder flux hanging on the end of the connector after you're done. The connector is not as slimy with flux, either, when you're done.

Don't cheapen up on the inserts required with smaller diameter coax. It makes little sense to spend three bucks on a silver-plated connector and then use a 20-cent insert.

And for reasons known only to some hams, don't reuse old SO-239 connectors. They're just not that expensive, so splurge and get new ones when updating or repairing your antennas.

If your plans include connectors outside, first wrap the connector with a layer of black electrical tape. Then apply a layer of coax seal. That first layer of tape will allow you to undo the connection without trying to clean off the coax seal.

Open wire feed

I use two kinds of open line feed. For temporary installations, I use cheap 300-ohm TV line. This stuff is great for Field Day! I also use 300-ohm TV line when

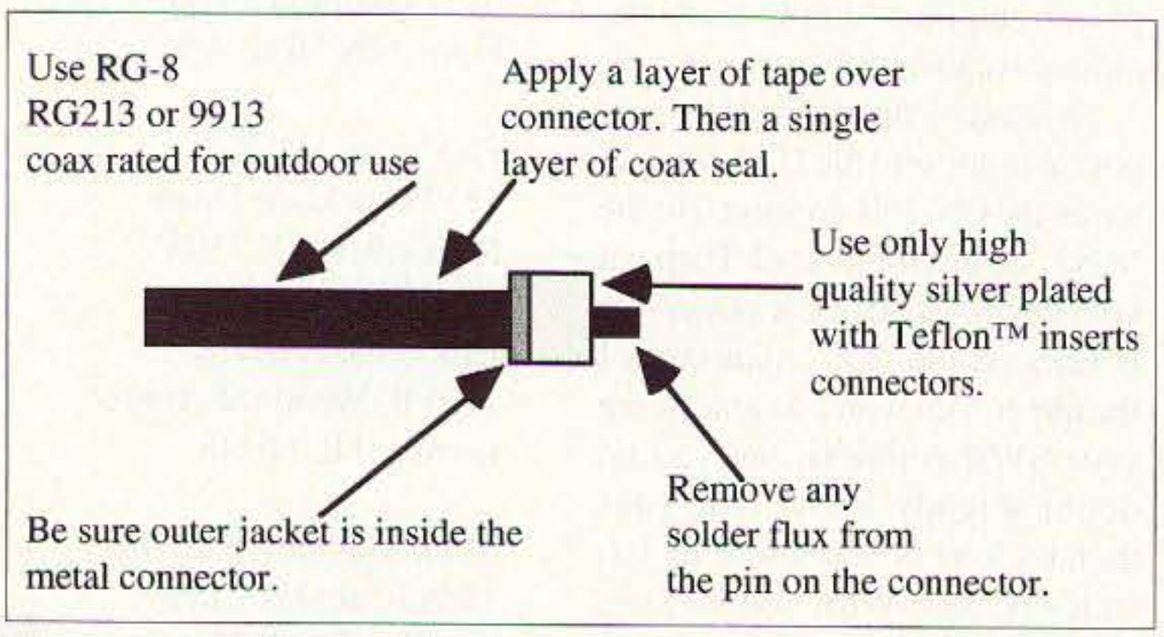

Fig. 1. *Proper protection of outdoor coax connectors.*

testing new antennas. Of course, this assumes the antenna requires open line feed. Although I know there will be some difference in performance between the 300-ohm and 450-ohm feed, it will be fine for a test or two. At the home station, I use 450-ohm ladder line. I can tell you to get the stranded type and not the solid. The stranded line is *so* much easier to use.

If you use ladder line, check the connections at the top of the tower. It's not uncommon at all to have one side of the ladder line break off. That's why it's best to use some sort of hanger to support the line from above.

Use TV-style standoffs to keep the ladder line away from the tower legs. Don't overlook the aluminum spouting and siding. Newer homes use all-plastic downspouts and siding, but check anyway.

It's the little things

While you are out working on the antennas, check any balun(s) you may have in your system. Although you can't do much in the way of electrical checks, give them a good going over with your eyes and fingers. I've never come across a water-cooled balun, so if your balun sounds like a half-filled bottle when you shake it, trash it! Check for loose-fitting hardware and broken wires. Make sure the connector is dry and fully encased in coax seal. Retape and reseal if needed.

How many coax switches do you have? Check them for proper operation. One very old Heathkit switch I had developed a low resistive short to ground on two outputs. Opening the switch revealed a splatter contact or two. Perhaps the switch had taken a lightning strike.

If you put in new coax or open line feed, how about making up some new jumper cables? If you're like Randy KD8JN, you'll need some RG-8 cable to connect the Argonaut 515 to the SB-220. But those are usually way too large and bulky for most QRP rigs. Some of the micro rigs aren't heavy enough to hold the coax down on the table, so don't forget to make up some RG-8 mini cables, too.

Don't overlook your ground system. Many QRPers don't even have a good RF (or DC) ground in their shacks. That's wrong. If for nothing else, it's a good safety feature and is required in most cities. Check the connection between the ground rod and the cable connected to it. It's possible the cable has corroded through. Tighten up any clamps on the grounding rods. This is especially true if you live in California. Those earthquakes have a tendency to loosen up just about everything.

I prefer to use the braided copper straps for ground runs. This stuff is very flexible and easy to work with. Copper ground bus strips are ideal, too. They allow you to connect all your equipment together. Don't daisy-chain your grounds together—you'll open up the possibility of ground loops. Use a single-point ground (see **Fig. 2**). And for goodness sakes, don't ground your gear to the gas pipe. The sewer pipes are another no-no. Also, don't depend on the ground or common wire inside your electrical service.

Mike's dream system

Right now, as I type this, my new shack is nothing more than a very expensive muddy hole in the ground. As spring approaches, things should start to take shape. So, here are my plans for my QRP shack.

For openers, I plan to install a 60-75–foot free-standing tower. The 10-foot difference between 60 and 70 feet is very costly. The tower should be able to hold 20+ square feet of antennas.

For 20 through 10 meters I decided on a log periodic array. For weak signal two meter work a 17-element boomer is planned. Also on two meters will be a Ringo Ranger for repeater use.

I'm planning a solar-powered weather system on the south forty. This will be linked into the Skywarn network via packet, so a small vertical antenna will be installed just for this weather system. Right now, this idea is still very much in the planning stage.

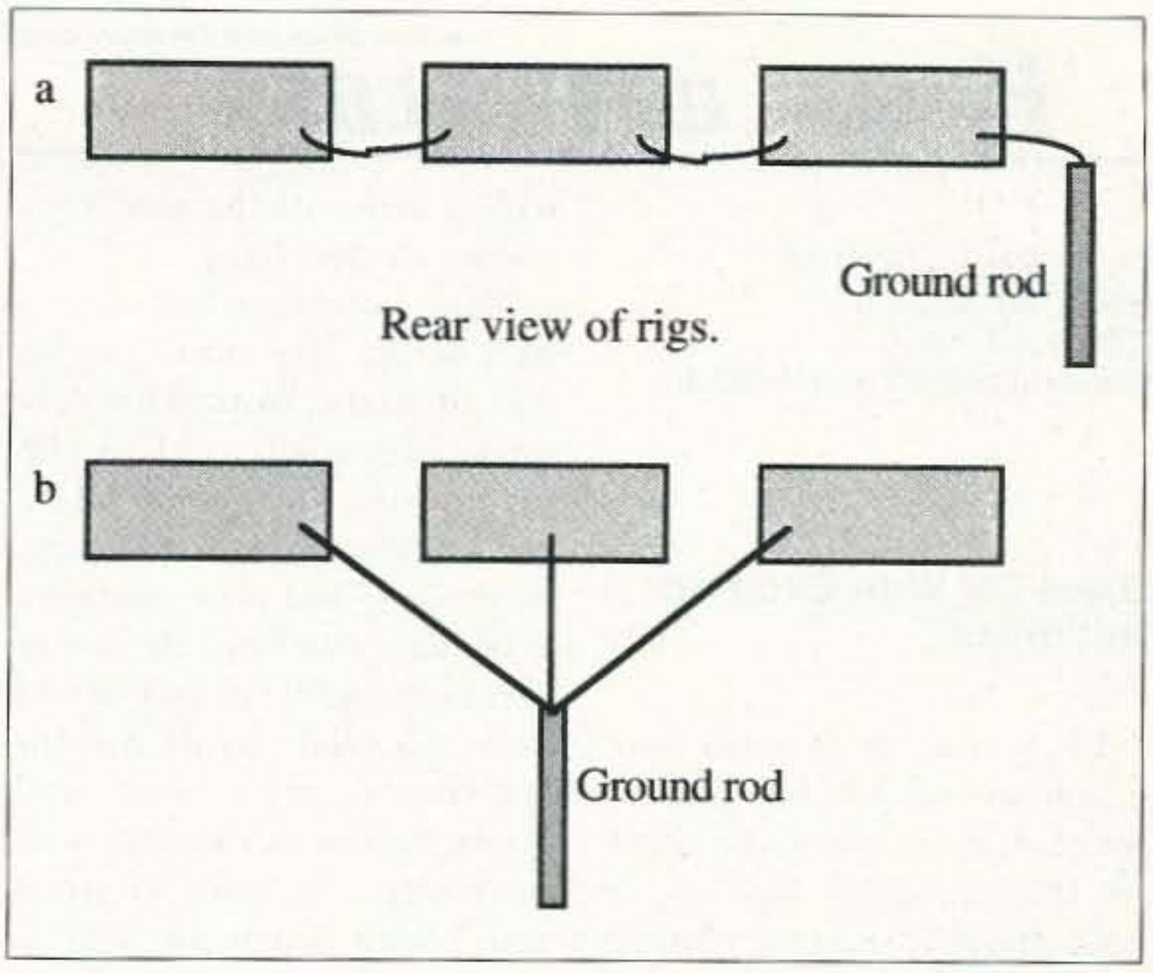

***Fig. 2.** a) The wrong way of grounding your station equipment; b) A better way of grounding. This is called single point grounding.*

On the low bands, a full-wave 80 meter dipole up at the 60-foot mark on the tower. For 40 and 30 meters, there will be centerfed zepp antennas fed with open line feed. Since there are no trees on the land, these dipoles will be configured as inverted "vees."

My only problem so far is finding a way to pay for all this stuff! On the other hand, it costs nothing to dream.

Next month I'll give you the information about the Four Days in May QRP forum to be held again at the Days Inn during the Dayton HamVention. 73

HAMS WITH CLASS

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Blast Off With Exciting Activities

Every year, one of the favorite enrichment units in our ham radio class is the one we do about the space program. Maybe you can't always be speaking with one of the astrohams, or maybe your school won't get picked to participate in the SAREX program, but you certainly can provide a stimulating and exciting series of activities involving space and communications.

Twenty-eight years ago, on July 20, 1969, an estimated one billion people around the world—a quarter of the Earth's population—watched the first manned moon landing on television. If your students can learn about the Apollo 11 mission and the moon, they'll come away with a sense of the mission's impact on their lives.

Plan your research strategies well before you introduce this unit of study. Work with your school's librarian as well as with local library personnel. Help gather videotapes, newspapers, magazines, and documentaries to be made available. Be sure to check out organizations that will have materials available for classroom use, such as The Young Astronaut Council, with its Young Astronaut Program and Young Astronaut Clubs. They can provide information, curriculum materials, activities, and lots of ideas for your Apollo 11 and other space-related school projects (**Photo A**). Contact the Young Astronaut Council at 1308 19th St. NW, Washington DC 20036; (202) 682-1984.

"Ellie Van Winkle NØQCX and her husband Rip NVØM created the BARC Jr. club for youngsters interested in ham radio."

NASA Teacher Resource Centers in 11 locations around the country offer educational videotapes, slides, audio tapes, publications, teacher guides, and more. Call the NASA Goddard Space Flight Center Teacher Resource Laboratory at (301) 286-8570 to get the location and phone number of the center nearest you.

***Photo A**. Seventh graders James and Matt enjoy space-related activities like building dioramas.*

Event	Famous Words	My Famous Words
The moon landing	"Houston, Tranquility Base. The Eagle has landed." (Neil Armstrong)	
The first step on the moon	"That's one small step for a man, one giant leap for mankind." (Neil Armstrong)	
The plaque	"Here men from the planet Earth first set foot upon the moon. July, 1969 A.D. We came in peace for all Mankind." (NASA)	
A description of the moon	"Beautiful! Beautiful! Magnificent Desolation!" (Edwin Aldrin)	
Presidential phone call to the astronauts	"Because of what you have done, the heavens have become a part of man's world. For one priceless moment in the whole history of man, all the people on this earth are truly one." (President Richard Nixon)	

***Table 1**. Do-it-yourself quotation chart.*

For a 26-minute video of the Apollo 11 mission contact NASA Center for Aerospace Information at (301) 621-0390.

One fun activity you can do with your class is to have them write the famous sayings associated with the landing. Talk about those famous quotations and what they mean. Why is each quote so memorable? Then have the students put themselves in the place of each author. What would they be seeing, hearing, and feeling? Make a chart and have the children add their own quotes (see **Table 1**).

A good magazine to subscribe to for your classroom is *Odyssey*, published by Cobblestone Publishing, Inc., 7 School St., Peterborough NH 03458. Copies of the issue titled "Magnificent Moon" may still be available. Call (800) 821-0115.

It's also fun to have the kids bring in models they've built. Commercial plastic model kits of the Command Module, Lunar Module, and Saturn 5 rocket (stock numbers 5083, 5081 and 5082, respectively) are available at local hobby stores from Monogram Models. Have fun!

Ham Radio Family Night

Like most hams, one of the things I like best about going to the Dayton HamVention every

***Photo B.** Elmira Bebe Greenlee KDØGE elmering Tracy Shelton (now KBØBX) for her Novice license. Photo by Ellie Van Winkle NØQCX.*

year is making so many new friends. I met Ellie Van Winkle NØQCX from Boulder, Colorado, nearly five years ago at Dayton. She is a retired kindergarten teacher, and she and I bonded instantly. Ellie and her husband Rip NVØM created the BARC Jr. club for youngsters interested in ham radio (**Photo B**).

Over the past few years, the Van Winkles have become good friends who share all of BARC Jr.'s activities with me. With their tremendous efforts, and the help of interested parents and other club members, they have provided me with some of the best presentations at the Dayton Youth Forum in the past four years. For Dayton HamVention '96 they outdid themselves by training and bringing the BARC Jr. Dayton Team to do a presentation. The children had a roundtable discussion about why their club was so successful and how they managed to raise money to come to Dayton. It was a wonderful and informative presentation.

Last month, Ellie sent me a videotape of the BARC Jr. Family Night. There are so many good things that come out of a night like this that I decided to share it with the readers of this column. Certainly modifications to suit individual club needs should be considered by any club with a growing number of young people in it. It's important for the children coming into amateur radio to know that they are welcome and that they are encouraged to participate.

Why a "Family Night"?

The purpose of the club's Family Night is to share the BARC Jr. activities with other family members. It provides a chance to enlighten parents about the ham radio teaching program, the progress of their children, and to introduce them to the Elmers and Elmiras who provide the instruction. Ellie also likes to have the parents get an understanding of the value of the hobby to young people.

After three years of operation with BARC Jr., the Elmers and the children felt a need to share with the involved families what and how the kids learn, and why the kids and Elmers so enjoy getting together each Saturday at 2:00 p.m. for one and a half to two hours.

According to the Van Winkles, and what I observed on the tape, the children really enjoy Family Night. It gives them an opportunity to discuss community service activities, share stories about speaking around the world, tell about their young ham net and foxhunts, and talk about learning CW and theory. The children explain to their families all about Field Day, building kits, designing and building antennas and fund raising projects. They also speak proudly of their wonderful presentations at the Dayton Youth Forum and of how to get more youngsters into the hobby.

As seen through Ellie's eyes, the value of a Family Night comes from:

1. Educating the families about their children's activities and gaining an appreciation of the dedication of the adults who provide the instruction.

2. Cross education—parents educating one another, kids educating other kids, and parents, kids, and Elmers all educating each other in a variety of ways.

3. The socialization aspect—the getting together of everyone with the children's best interests at heart is extremely valuable.

4. Family Night helps parents, kids and Elmers evaluate possible candidates for the Dayton Youth Forum, as well as for local speaking engagements.

By sponsoring the very successful BARC Jr. group, the Boulder Amateur Radio Club has provided the rest of us with an excellent role model. Getting youngsters caught up in the excitement of wholesome and stimulating activities with adults can only have positive ripple effects which will keep going on and on for years to come. I am delighted and proud to feature the outstanding work of this group. I know we all wish them continued success. See you at Dayton! 73

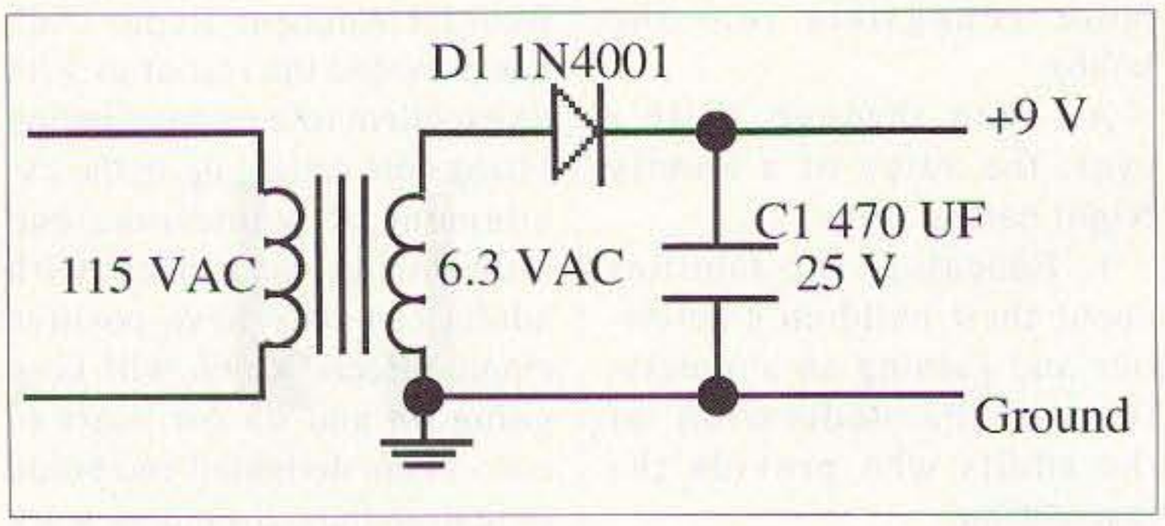
"The children explain to their families all about Field Day, building kits, and foxhunts, and speak proudly of their accomplishments."

UPDATES

Danger!

In "Build This Receiver Preamplifier," which appeared in the January issue, beginning on page 26, there are a couple of weird glitches in the schematics. One of them could be dangerous to the builder.

Most importantly, **Fig. 4** should look like this:



The transformer is not supposed to have connections from the transformer primary to the secondary. This is a dangerous error and could cause serious problems if built the way it is shown in the January issue.

Then, the other points. In **Fig. 1**, the unidentified resistor in the lower left (from **Q1** to ground) should be **R2** (5.6k). **C5** should show a connecting dot to **+9V**, and the device identified as "**02**" is actually **Q2**.

Finally, in **Fig. 3**, the words "flat side down" were omitted. We apologize for these errors.

Enhanced Schematic

Also in the January issue, in N4UAU's "Enhanced Automatic Voltage Controller" we have a few things to straighten out. On page 42, in the schematic:

Pin 3 should not be connected to ground. If it is built as shown, there will be a big puff of smoke and one very unhappy builder.

The unlabeled resistor by **T1** is **R11**.

The unlabeled resistor near **C1** is **R15**. It has a value of 0 for the Bar Mode and 360Ω for the Dot Mode.

On page 45, in the Parts List, the values for **R4** and **R5** are reversed.

J. Frank Brumbaugh KB4ZGC also brought something to our attention from the same parts list—all resistors should not be 1.4 watt; they should be **1/4** watt. This was a computer translation error, but we apologize for any confusion. 73

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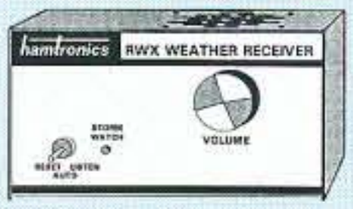

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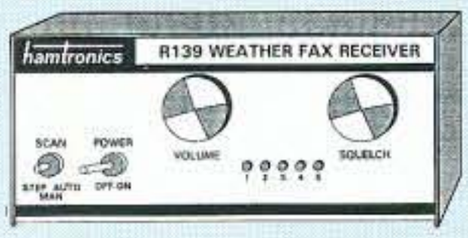

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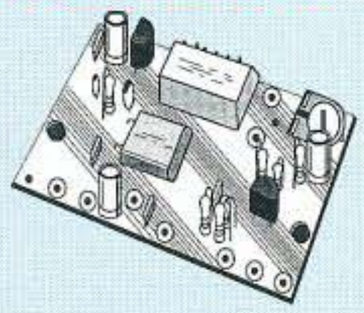

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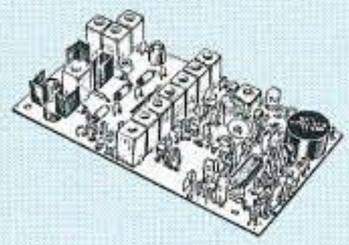

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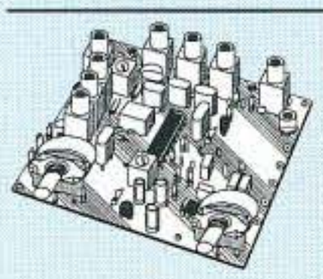

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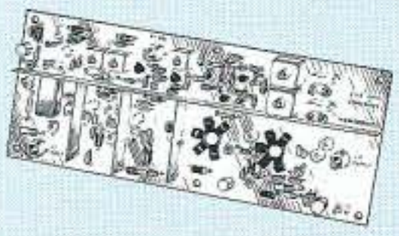

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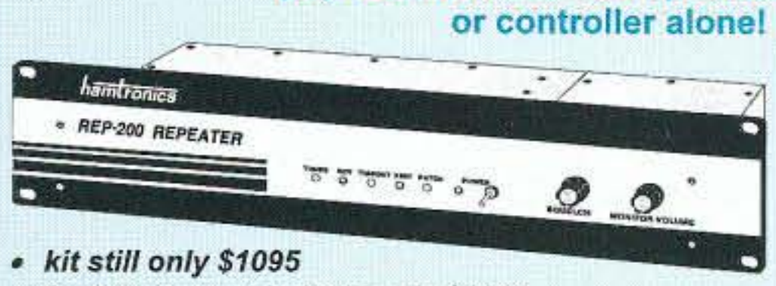

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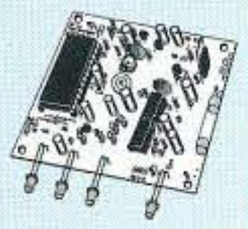

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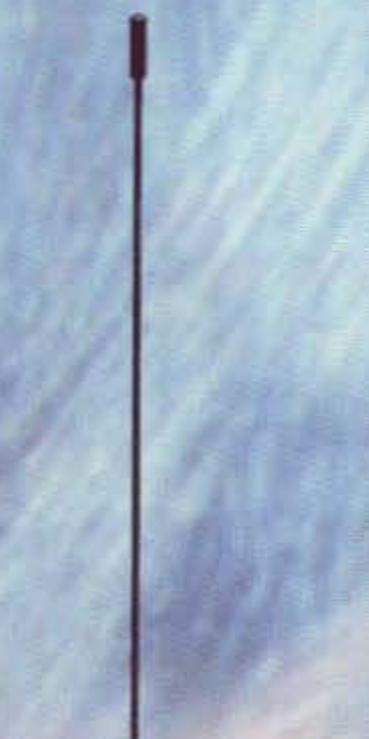

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