MARCH 1996
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International Edition

73® Amateur Radio Today

The Truth About Preamps

Build:
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2 Preamps
Capacity Meter

Reviews:
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Stealth 10-40m Antenna
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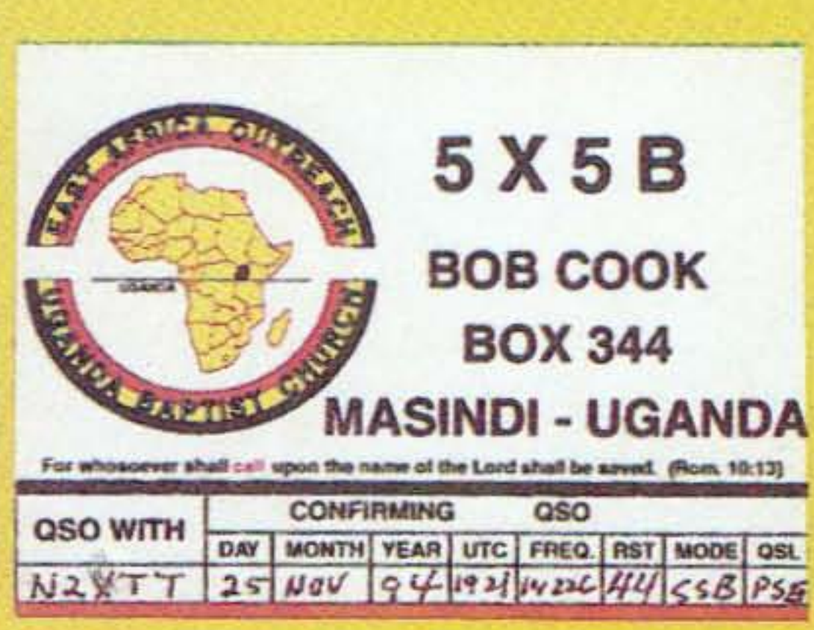

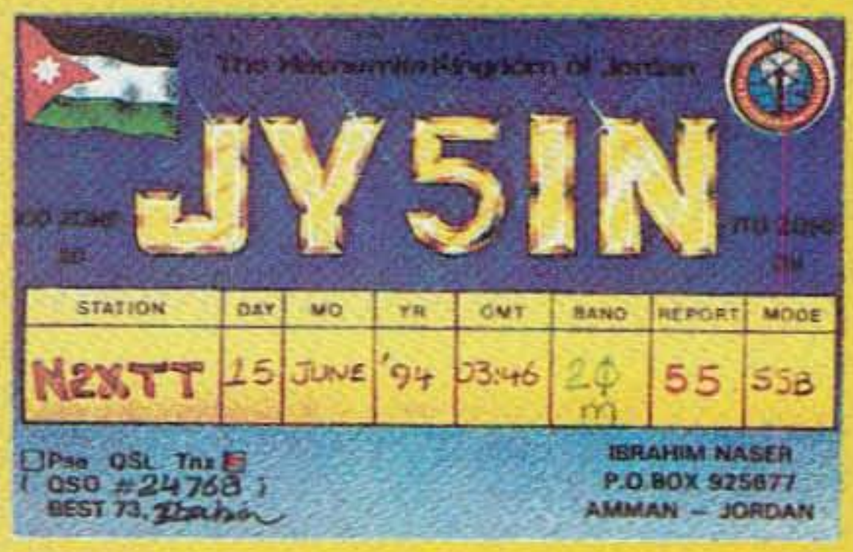

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★ JST-145 COMING SOON ★

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

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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.

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CIRCLE 159 ON READER SERVICE CARD

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Exceptional Bandwidth
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Your antenna makes all the difference at VHF and UHF—It determines transmitting range. It sets the limit for weak signal reception. And it decides what interference you'll hear & create.

An omnidirectional antenna radiates uniformly in all direction, and it also hears noise and interference from every direction.

A directional antenna not only sends your signal where you want, it hears the signal it's pointed at, rejecting others.

Gain really counts when you have to reach out across large distances to make contact. It also lets you operate with minimal power and cuts the interference you inflict on other stations.

Directionality is desirable in high activity locations. A clean sharp pattern without sidelobes or spikes reaches past the noise and interference to get the message through. Wide rear rejection lets you null out strong nearby signals to reduce interference.

CornerBeam vs. Yagi

When you want to contol your signal, think CornerBeam, not yagi. Take a look at what CornerBeam will do:

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- •40 dB Front-to-Back
- •60 degree Half-power Beamwidth
- •SWR <1.1:1 across the band
- •No dimension over 4 ft
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- •No need for offset or side mount for vertical polarization
- •Vertical or horizontal polarization
- •weighs only 10 pounds

Make the comparison with a yagi. A yagi with the same gain would have a boom 10 feet long. And yagi bandwidth would beless than half. Unlike a yagi, CornerBeam's pattern has no unwanted spikes or bustles to the side or behind.

Symetrical Pattern

CornerBeam's gamma match is engineered to be in-line rather than displaced from the element axis. The result is a distortion-free measured pattern that is precisely equal on each side of the antenna center line.

Bandwidth Counts

With its exceptional bandwidth, your CornerBeam can be put to work right out of the box without special tweaking. It can serve you now when you're working repeaters with an FM handheld, and later when you go after small signal DX at 144.05 or set out to work satellites.

CornerBeam can still be your beam when you join MARS at 143/148 MHz, team up with the Civil Air Patrol to locate downed aircraft at 154 MHz.

Scanning Too?

CornerBeam's directionality and gain extend your monitoring range on public service, marine, and aircraft frequencies.

CornerBeam for Repeaters

If your repeater shares a frequency with another, the deep wide null toward the rear could keep your signal out of the neighboring repeater's receiver and turn a deaf ear to its signal. A pair of CornerBeams can be combined to privide special radiation footprints. A CornerBeam aimed at an area your repeater hears poorly could improve service where incoming signals from HTs are presently too weak. CornerBeam makes it possible to increase repeater density while reducing interference.■

Corner Beam Models

Band	Max Dim	WindLd	Price
2 meters	4 ft	<2 sqft	$145
220 MHz	4 ft	<1 sqft	$145
70 cm	3 ft	<1 sqft	$115
Dual 146/435	4 ft	<3 sqft	$165

Construction: Aircraft aluminum. Booms are square. Elements are solid rod. Stainless hardware included for tower and mast mounting accepts up to 1.5" dia. mast and may be rotated for vertical or horizontal polarization. Connector is SO-239 for VHF, N female for UHF. Dual-Band antenna has separate driven elements, both with N connector.

Dimensions given in table are for reflector booms and reflector elements.

Options: Commercial Frequency $45.

Duplexer: Add $80 for VHF/UHF Duplexer and cabling for single coax feed of Dualband 146/435 Corner.

Shipping: UPS ground to continental USA ($11 S&H). Air Parcel Post to HI, AK, & Posessions ($14 P&H). Canada ($16 P&H). Allow 2 weeks for delivery.

Can You Find theTiger'sTail?

If your eyes are sharp you can spot the **TigerTail**™ in the photo above. It puts extra growl into the signal from the Hand Transceiver it's attached to.

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___Send my CornerBeam: __2m, __220MHz, __70 cm, __Dual 146/435.
___Options: __DualBand Duplexer, __Commercial/Marine Frequency:_____
___Send my TigerTail. (1 for $7.95, 2 for $15, 3 for $21. Specify band.)

☐ **Yes, I circled the TigerTail! Knock $5 off my order.**

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CIRCLE 57 ON READER SERVICE CARD

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73® Amateur Radio Today

MARCH 1996
ISSUE #426

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On the cover: Peter Summers N2XTT shared with us a few of his QSL cards to make our attractive cover this month. We are especially interested in his creative card made for Jordan . See story on page 10.

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

Wanted: Role Models

A Silent Key note, sent in by a friend of the deceased, cited the wonderful things the SK had done. My reaction was one of frustration and disappointment. Why in blue blazes did this "friend" wait until the guy died to write something nice about him?

One of my readers recently sent me a tape of a "Nova" program about Dick Feynman, the Nobel Prize-winning physicist. I'd seen the program when it originally was shown, but it was fun to see it again. Too bad if you missed it. Even more too bad if you haven't bought any of the Feynman books. I tried to get you to buy *Surely You're Joking Mr. Feynman.*

Anyway, Feynman explained that he had no interest in honors. That resonated with me. That's one thing about working with my old college that has annoyed me. Colleges tend to think almost totally in terms of honors. Phooey.

Sure, I'm a past president of the Peterborough Chamber of Commerce. Big deal. But I am happy that as president I was able to build the membership up by over ten times. And when I was on the local hospital board I helped them save nearly a million dollars. When I was a member of the board of the NH High Tech Council I came up with the program that is now the mainstay of the organization.

Look, if you've got a ham hero around your area who has been accomplishing things, why wait until the guy dies to let the world know what he's done and doing? I don't want honors and titles, but that doesn't mean I wouldn't like to be recognized for some of the things I've done to help inch the world along a little. I'll bet you've got some movers and shakers who would appreciate knowing that their work hasn't been totally unnoticed. So let's see some articles submitted for *73* which will both help thank them (while they are still alive) for their accomplishments, and maybe serve as role models for the rest of us.

Maybe the chap has held an ARRL position. Like an SCM. Fine, but what did he accomplish of some lasting value as a result of that? How specifically has he or is he helping to improve our hobby? Very few hams I can think of who have contributed significantly to our hobby were ever publicly thanked while they were alive.

Gus Browning W4BPD gave tens of thousands of DXers a bunch of new countries. He then entertained hundreds of thousands of us with the wonderful published stories of his adventures. As far as I know Gus never won any honors. No awards. But he contributed enormously to our hobby. I don't remember anyone writing an article about Gus, thus helping us to thank him for what he did for us.

You write the articles and I'll make the space available to help let the hams who are working to make this a better hobby know we appreciate what they're doing and have done. How about an article on Bill Pasternak WA6ITF and his Newsline work? Or Dave Bell W6AQ and his ham promotional films?

Now get your word processor busy and don't forget some good pictures and a disk copy of the text. We've got a bunch of unsung ham heroes who should be sung about before they die.

Are You Illiterate?

My dictionary defines "illiterate" as "lacking education, untaught, and unable to read and write." Since you are reading this, we can eliminate the "unable" part. But that still leaves us with "lacking education." The current term for this is "functionally illiterate." So let me get in your face and ask a rude question. I've been recommending quite a few books in my recent editorials. Okay now, how many of them have you bothered to buy and read? Hmm, I thought so.

Sure, I get a scattering of letters from readers thanking me for putting them onto the books I've recommended, but the other 99% of you have been silent. Which is a blessing, since my mail is already more than I can handle. And some readers wonder why I'm not answering e-mail hourly. Zut, alors!

It's bad enough that our terrible school system has turned most of us into turnips...now they're doing it to our kids and we're too brain-dead in the water to even put up a whimper. And the government, in league with the teacher's unions, is all geared up to turn your grandchildren into turnips too. Lacking creativity, a knowledge base, or even the interest to build one. Did you see the movie "Clueless?" Or "Kids?" Oh, you're waiting for the video version so you can sit and watch it at home, eating chips and drinking a few cold ones, right?

There's a tape I'd like you to send for. It's a lousy $5 (that just helps cover the costs of mailing) and if it doesn't shake you out of your torpor and get you interested in finding out more about what's gone wrong with the American school system (note: I can't honestly call it an educational system), then you deserve to be a dedicated League Life Member.

The tape is by the president of Hillsdale College. That's in Michigan. In it he explains what's gone wrong with our colleges...which are educationally, financially, and spiritually bankrupt. As President George Roche puts it, Hillsdale is the most politically incorrect college in the country. Well, he's an iconoclast. He's been president of the college for 24 years and it's one of the most outstanding colleges in the country. Yes, I know you're a ham and therefore you are cheap, but this one time spring the $5 and find out what's going on. It's a tape I think you'll play over and over in your car. I know I have. Send your $5 to Hillsdale College, Hillsdale MI 49242-1298.

Once I have your attention, I'm hoping to get you to get a copy of Thomas Sowell's *Inside American Education,* Free Press 1993, 368p, ISBN 0-02-930330-3, $25. I hope you've been reading Sowell's columns in *Forbes* and *Conservative Chronicle*. You can find *Forbes* on any newsstand, but the *Chronicle* is by subscription only, at $42 a year; call 800-888-3039. It's weekly and has some good stuff in it, though as you say about my editorials, I sure don't agree with everything conservatives hold dear.

The most important thing you leave behind in this life is your kids. So why aren't they more important to you? Today's parents (a product of our school system) are largely ignoring their kids. They start out by permanently harming their children by smoking and drinking before and during pregnancy. Then they let the hospital put the babies into their nursery instead of staying with the mother. Then comes four years of almost total neglect known as day care, followed by 12 years of our mind-numbing school system (did you read *Dumbing Us Down,* like I asked?). All, including massive parental neglect, at every step of the way. So we end up with exactly what we've nurtured: unmotivated, ignorant, unruly kids. And we wonder why they "go bad." Why they are into drugs and getting pregnant. Gee, big surprise!

Look, we got rid of King George and what used to be Great Britain, but is now Britain, a couple hundred years ago. If we can take our eyes off our TV soaps and sitcoms long enough, we can work together and fix our school system...and all the other niggling problems we've let our government create and nurture for us while we've been too busy enjoying life to pay attention...like drugs, crime, welfare, the deficit, a bureaucracy that's now larger than our manufacturing industry base, our crooked Congress, and so on.

You can start by getting the tape. And then drop me a line telling me how you don't always agree with me. About what?

Just A Coincidence

Have you been keeping up with your reading? There are several good books on chaos theory. Read any of them? How about synchronicity? You know, coincidences.

How about this one, from *Incredible Coincidences* by Alan Vaughan. In 1893 Henry Ziegland, of Honey Grove, Texas, jilted his sweetheart, who then killed herself. Major bummer. Her brother tried to get even by shooting Ziegland, but the bullet only grazed his head and buried itself in a tree. The brother, thinking he'd killed Ziegland, committed suicide. Guess it ran in the family. In 1913 Ziegand was cutting down the old tree with the bullet in it. It was a tough old tree, so he used some dynamite. The explosion sent the bullet through his head, killing him.

The book is full of such remarkable "coincidences."

Another book, Serendipity... Accidental Discoveries in Science,

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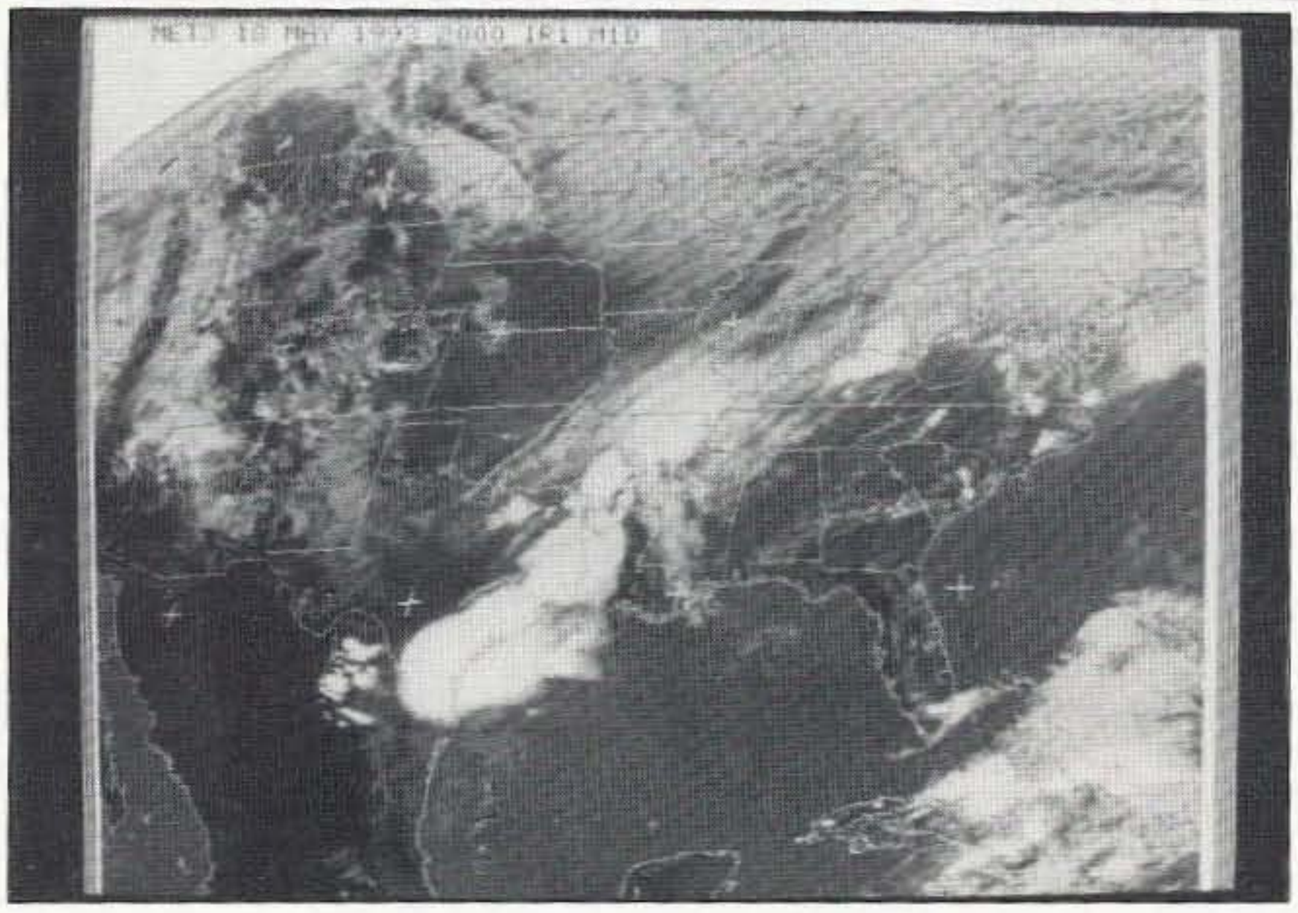
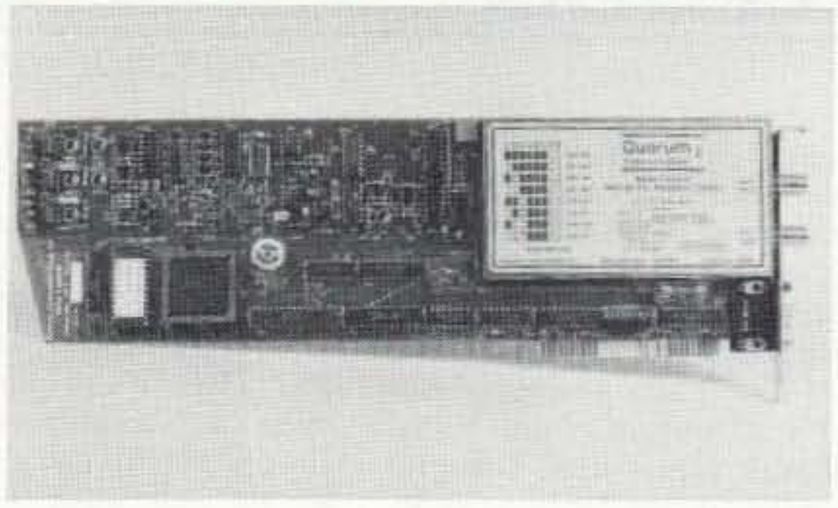
Explore The World of Quorum Wefax





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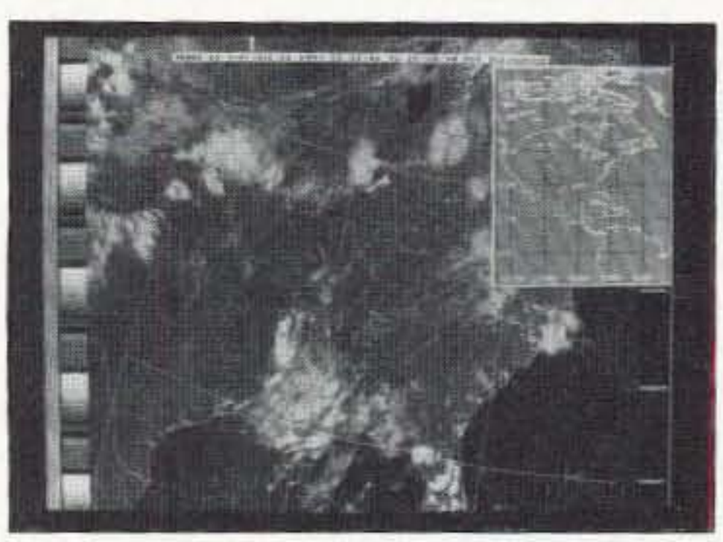

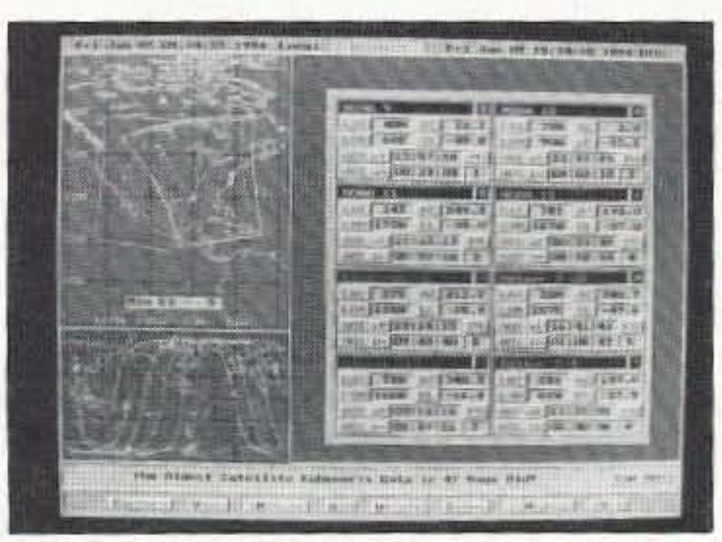

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CIRCLE 257 ON READER SERVICE CARD

LETTERS

From the Ham Shack

Raphael Escoe DDS WA2MMT. Re your editorial on AIDS, the law requires that medical workers wear gloves when working with patients to prevent the spread of AIDS, TB, etc. My electrical tests show that three of five brands of latex gloves leak after 20 minutes of use. All vinyl chloride gloves leak. This presents an opportunity for hams to design and sell a gadget which will sound a buzzer if the gloves leak. One electrode would be hooked to the doctor or nurse, perhaps with a wrist band, and the other to the patient. This would make a great how to build it article and a great little gadget to manufacture. It might also be used to verify condom integrity.

How about it? Will I be seeing some articles on clever alarm designs? . . . Wayne

Mel Mahler WB9MAF. Your December editorial leaves the wrong impression as to the purpose of CTSS and who may use a frequency. Twenty years ago it was evident that when one lived eighty miles from a swamp full of alligators (Chicagoland), something was required to maintain the sanity of control operators. The answer was to require CTSS to activate repeaters. It didn't stop high powered ops in the city from capturing the repeater receiver, but there was no transmission until a local station had access. Over the years most rigs now come with capability built in (if you can find the book to translate the settings) and consensus was reached on a plan (one CTSS tone per area code in Indiana). No reasonable amateur mentality should ever construe that requirement for CTSS equals a "private" repeater. In fact, there is much doubt in my mind that such a thing can or should exist on the amateur bands. Private repeaters sound much more like a commercial service and private frequencies don't even exist there. Those amateurs that don't fit in the above mentality are left to their own groups, usually around repeaters that are so antagonistic as to account for only their presence. I know you write editorials to cause thought, but please start the process from a reasonable point.

Yes, I'm well aware of the legitimate use of CTSS, but when I visit city after city where there are no such extenuating circumstances and find the repeaters almost 100% CTSS restricted, some other explanation is inescapable . . . Wayne

Larry Reitz WA8CWD. Earlier this month I had a problem with my Ramsey FX-146 transceiver. After replacing the T/R switching transistor I found the receiver had gone deaf. After further examination I found the preamp transistor was dead, probably from my having pumped the transmitter output into it. Unable to find a replacement for this transistor I called the Ramsey tech support. To my surprise their receptionist had a replacement sent the same day. Two days later it arrived and I installed it and was back on the air. Not only was I surprised to get such a fast answer, but to receive the part that fast was amazing. The Ramsey staff is really on the ball. Not having to run up a monstrous phone bill running through a dozen touch tone sequences to finally be told to leave a message that no one ever responds to was a pleasant surprise. All ham radio and computer manufacturers should look to them as an example of how to treat cuslomers. You can bet that I'll be buying more Ramsey equipment. Ramsey not only sells high quality kits, but they provide superb support when you need it.

Name and Call Withheld By Request. Wayne, if we could eliminate federal welfare this would help eliminate crime. People would have to go find work. They wouldn't have so much time to get into trouble. Additionally, they might be too tired when they clock out to go out somewhere and start some trouble. They would have more self respect and maybe, just maybe, some of that would be directed to more respect for society at large. It wouldn't work for everyone, of course; no program would be 100% effective. What about those people that really need help? The churches and charitable organizations can step in; some of them already do. I have a tremendous amount of respect for the work the Salvation Army does.

I used to be the editor for the local ham club newsletter. I quit, both being editor and being a club member. I'm 48, and was one of the youngest members. If anybody read the newsletter, I couldn't tell. I put out questionnaires, held contests, asked for volunteers to be technical assistants, tried to set up Saturday workshops to introduce members to packet, satellites, computers, 220 or 440 MHz activity. The end result? Zilch, zero, nada. No one would even submit articles on any item they had bought or constructed, or any interesting QSOs they had experienced. Unfortunately, in talking with members of clubs in other cities, they say the same holds true everywhere: Old white men set in their ways. What can we do? Leadership is the key. Dynamic young(-minded) people need to join the stagnant clubs, and get involved. You don't have to try to get the old-timers interested in something new; just get acquainted. Bring in new members who have an interest in newer ideas, like packet or satellites. You need not push the dead weight aside; just make room for the newbies. I used to write in the newsletter and say out loud at the monthly meeting that there was plenty of room in the club for different interests. There might be more people interested in DX contests than in packet, but you could do both if you wished. It was your choice; participate in any aspect you wish. For a while, with the no-code Techs, we got some fresh blood in the club. We even had enough volunteers to provide communications for a city event. However, there was no encouragement from the older members, so the younger ones lost interest and drifted away. The only school-age members we picked up (two!) were children of adult members. There are a few interesting people in the club, even now, but they don't take an active part. The same people stay in the same offices. Maybe we should have term limits! Well, the city is a retirement community, so most of the people who join the club are retired; when they die off, other retirees take their places.

How do we get in the schools and attract kids? I don't know. Some of us members went to the local schools, public and private, and gave short presentations on amateur radio. The end result? You guessed it: No response; no questions from the audience; no comments. In one instance, they showed up just to get out of history class. The few young people I meet are not interested, especially when they hear the terms "study" or "exam." This leads us back to the fault of public (mis-)education. A kid can do nothing more than sit in a room for 12 years and he knows that he won't be denied a diploma. He never considers landing or keeping a job. This might date me as middle-aged, but it seems most young people are interested in chemical entertainment (drugs or alcohol), sex, and the acquisition of material goods (cars or clothes). So many don't want to work for anything anymore. Perhaps they realize that the main qualification to get a job is to be a member of a "minority" group. Yes, that's a barb. Point made, most employers won't keep an incompetent worker; maybe government or teaching jobs, but not privately owned smaller businesses. Fundamentally, the problems with public education begin with the parents. As they turn more and more responsibility over to others to raise their kids, so the kids become a product of the system. If the parents are interested in their kids and their kids' future, it shows, and the kids are more interesting to be around.

That's enough for now. I will write again sometime. Hopefully, you will read this letter and want me to write again. Keep writing in your column about books that you find interesting; I have been able to find a few of them at the used book store.

Before welfare we didn't have people starving, even in the depths of the Depression. We had soup kitchens and so on. Rather than being a safety net, welfare has become an easy alternative to working. I hope some readers bothered to watch the TV program on welfare, showing two big, fat, lazy Lebanon, NH, women who had no interest in ever working. Now, I can understand why you couldn't get the club members to write. I have about 100,000 ham readers and I can't get many of them to write either. So I can imagine the problems you had with a club of 30-50 . . . Wayne

Arthur Harris KC6WZJ. The other night, suffering with insomnia, I turned on the radio and very luckily caught the beginning of your conversation with Art Bell. I listened to the whole three hours of your complete talk. Very enlightening to say the least. I heard what I never thought I would ever hear...a keypounder saying that code was anything less than God's gift to mankind. Boy, you must really catch a lot of flak for that heretical point of view. The boys down at ARRL and all the other keynuts must be demanding that your license be permanently revoked. I am subscribing precisely because of that view. As an older ham, but young as a licensee, I really resent the fact that as a no-code Tech I have such restricted band availabilty. I got my license soon after the no-code became available. I especially resent that individuals with higher class licenses have such doubtful technical competance. Recently at a ham meeting during a conversation I referred to three-phase power. Another ham (with HF privileges I don't have) asked what three-phase power was. He not only didn't know what three-phase power was, he didn't know what single-phase power was either! Boy, it's a good thing I didn't bring up wye and delta three-phase.

I feel that the difference between CB and amateur radio is technical ability and radio discipline. Basically, code is obselete. The code requirement is analogous to requiring the 1st Cavalry Division to wear riding pants and high boots and ride horses every day. Some people enjoy riding horses and some people enjoy code. This is their right, but to force it on others is not.

Art obviously has never read 73 or he'd never call me a keypounder. Computer keys, sure. Teletype keys, absolutely. But instead of no-coders griping about the code barrier I wish they'd either shut up, buy my $7.95 blitz course in learning the 13 wpm code the easiest way known to man (or even woman), or start doing something to get the ARRL to recognize that the day of radio relaying by Morse code may soon be over . . . Wayne

Continued on page 38

WWV RECEIVER

NEW

Get time & frequency checks without buying multiband hf rcvr. Very sensitive and selective xtal controlled superhet, dedicated to listening to WWV on 10.000 MHz. Performance rivals the most expensive receivers. ..... **only $59 kit, $99 w/t.**

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FEATURES:

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- **Wide dynamic range** - resist overload
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**Specify tuning range: 26-30, 46-56, 137-139, 139-152, 152-172, 210-230, 400-470, 800-960 MHz.*

LNW-(*) MINIATURE PREAMP

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Helical resonator filters may **reduce your intermod & cross-band interference.**

MODEL HRF-(*). *$59 vhf, $99 uhf.*

**Specify tuning range: 136-140, 142-150, 150-162, 162-174, 213-233, 420-470.*

RECEIVING CONVERTERS

Low noise converters to receive vhf & uhf bands on a 10M receiver.

- Input ranges avail: 50-52, 136-138, 144-146, 145-147, 146-148, 220-222, 222-224 MHz, 432-434, 435-437, 435.5-437.5, and 439.25 (atv conv. to chan 3).
- **Kit less case *$49*, kit w/case & BNC jacks *$79*, w&t in case *$99*.**

TRANSMITTING CONVERTERS

XV2 for vhf and XV4 for uhf. Models to convert 10M ssb, cw, fm, etc. to 2M, 432, 435, and atv. 1W output. **Kit only $89 (vhf), $99 (uhf).** *PA's up to 45W available.*

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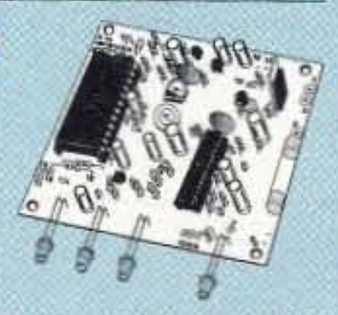
NEW **CWID-2.** Eprom-controlled, miniature, easy to build, low power CMOS, (specify call)..... **only $54 kit, $79 w/t**

COR-6. COR & Real Voice ID on one board. Digital ic records up to 20 seconds of your voice. Can record multiple id messages. Tail and time-out timers, courtesy beep, solid-state relay to key transmitter.



.....**kit $99, w&t $149**

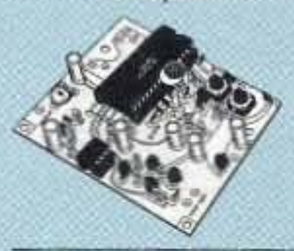
COR-3. COR, timers, court.beep .... **kit $49**

CWID. Diode programmable ..... **kit $59**

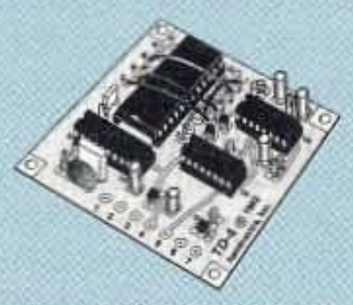
COR-4. Complete COR and CWID all on one board. CMOS logic for low power consumption. EPROM programmed; (specify call) .....**kit $99, w&t $149**

ACCESSORIES

DVR-1 DIGITAL VOICE RECORDER. Records up to 20 sec. of your voice with built-in mic. or external mic. Terrific as voice ID'er for repeaters or fox hunt xmtr, contest caller, radio notepad, etc. Extensive manual tells how to use multiple messages adapt to many applications. .....**kit $59, w&t $99**



TD-4 SELECTIVE CALLING MODULE.



Versatile dtmf controller with 1 latching output. **Mutes speaker until someone calls** by sending your 4-digit tt code. Or use it with a **long tt zero** digit to alert anyone in club for emergencies. Also may be used to **control autopatch or other device**, like TD-2 except only one output. .....**kit $49, w&t $79**

TD-3 CTCSS DECODER/ENCODER. Prevents access to repeater or receiver unless proper tone is present. Tone output for transmitters, too. ..... **kit $29, w/t $59**

AUTOPATCHES

AP-3 REPEATER AUTOPATCH. Reverse patch and phone line remote control. .....**kit $89, wired & tested $139**

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MO-202 FSK DATA MODULATOR & DE-202 DEMODULATOR. Run up to 1200 baud digital signals through any fm transmitter & receiver .....**kits $49, w&t $79**

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Kit still only $1095
w&t still only $1295
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- Available for the 50-54, 143-174, 213-233, 420-475, 902-928 MHz bands.
- **FCC type accepted** for commercial service in150 & 450 bands. *(Request catalog for details.)*

REP-200T Voice Message Repeater. As above, except includes Digital Voice Recorder. Allows message up to 20 sec. to be **remotely recorded off the air.** Play back at user request by DTMF command, or as a periodical voice id, or both. **Great for making club announcements!**.....**adds only $100!**

REP-200C Economy Repeater. Uses COR-6 Controller (no DTMF control or autopatch). Features **real-voice ID.** .....**Kit only $795, w&t $1195**

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XMTRS & RCVRS FOR REPEATERS, AUDIO & DIGITAL LINKS, TELEMETRY, ETC.

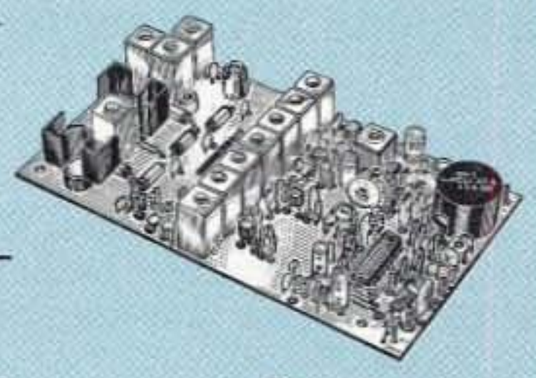
Also available in rf-tight enclosures, and with data modems.

FM EXCITERS: 2W continuous duty. *FCC type accepted for com'l bands.*

- **TA51**: 50-54, 143-174, or 213-233MHz.
- **TA451**: 420-475 MHz . *New low price!*

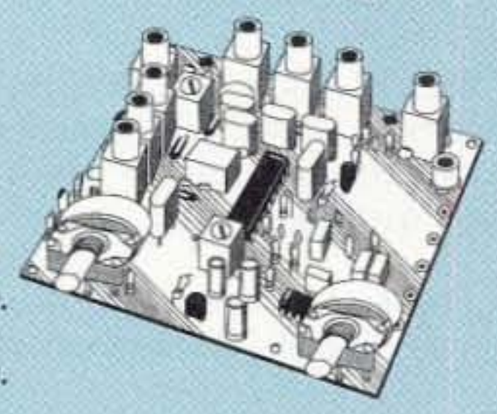
Either model: .....**kit $99, w/t $169.**

- **TA901**: 902-928 MHz, (0.5W out); *New low price!* ..... **w/t $199.**



VHF & UHF AMPLIFIERS. For fm, ssb, atv. Output levels from 10W to 100W. Models **starting at $99.**

FM RECEIVERS:



NEW **R100 FM RECEIVERS** for 46-54, 72-76, 140-175, or 216-225 MHz. **Very sensitive** – 0.15uV, **exceptional selectivity** – both crystal & ceramic if filters for >100dB at ±12kHz (best available anywhere), **flutter-proof** squelch. .....*New low price!* **kit $129, w/t $189.**

- **R451 FM RCVR,** for 420-475 MHz. Similar to above. *New low price!* **kit $129, w/t $189.**
- **R901 FM RCVR,** for 902-928MHz. Triple-conversion. *New low price*.... **$159, w/t $219.**

NEW **R150 MONITOR RCVR** for 143-164 or 216-225 MHz. 4-channels. Great for monitoring repeaters, amateur calling frequencies, packet radio, commercial two-way radio, police/fire frequencies, or weather forecasts. **Good starter kit,** easy to assemble and align..... **kit only $99, w/t $189.**

- **R120 AIRCRAFT RCVR** for 110-136 MHz ..... **kit only $99, w/t $219.**

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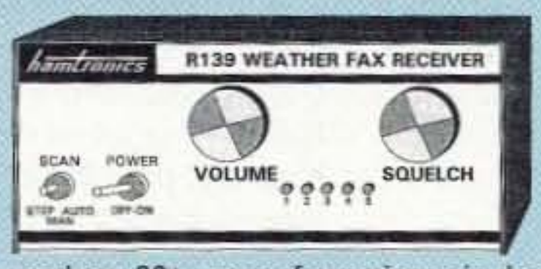

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Fight Winter Blues

If your DX life has been in the dumps due to the solar lull and winter conditions you might find the following bulletin of interest. It was pulled from rec.radio.amateur.misc, one of the Internet news groups dealing with amateur radio. If you point your web browser at the URL (universal resource locator or web address) http://solar.uleth.ca/solar you will find yourself at an almost real time propagation forecast site. The available information can be used for everything from aiming your beam for that great circle route to deciding if you should just stay in bed, read the latest issue of *73* and wait for conditions to improve.

New WWW Radio Propagation and Ionospheric Services Are Now Available

http://solar.uleth.ca/solar

Our main homepage has been supplemented with several new ionospheric services that should be of wide interest to radio communicators (amateur and professional).

Every hour, approximately 15 to 20 minutes past each hour, our system regenerates five real-time globally contoured maps of various important and useful quantities:

1. Global Maximum Usable Frequency Maps.
(http://solar.uleth.ca/solar/www/realtime.html)

2. Global Maps of the F2-Layer Critical (Penetration) Frequency.
(http://solar.uleth.ca/solar/www/fof2.html)

3. Global Maps of the E-Layer Critical (Penetration) Frequency (foE).
(http://solar.uleth.ca/solar/www/foe.html)

4. Global Maps showing the Height Maximum of the F2 Layer (or the altitude above the surface of the Earth where the ionospheric electron density is highest). Information regarding the likelihood of non-great-circle propagation can also be determined.
(http://solar.uleth.ca/solar/www/hmf2.html)

5. Global Maps of Solar Zenith Angles, or the distance of the Sun away from the zenith (the point in the sky that is exactly overhead). Shows the elevation angle of the Sun above or below the horizon for any location on the Earth.
(http://solar.uleth.ca/solar/www/zenith.html)

Each map includes the plotted solar terminator (sunrise/sunset line), the gray-line corridor where the Sun is up to 12-degrees below the horizon, the location where the Sun is directly overhead, and the locations of the auroral ovals based on the latest 24-hour planetary A-index (updated every 3 hours).

To our knowledge, these services form one of the most extensive set of near-real-time maps pertinent to radio propagation and radio navigation on the Internet.

FAR Scholarships Available

The Foundation for Amateur Radio, Inc. plans to administer 57 scholarships for the academic year 1996-1997 to assist licensed radio amateurs. The Foundation, comprising more than 75 local area amateur radio clubs, fully funds eight of these scholarships with the income from grants and its annual hamfest. The remaining 49 are administered by the Foundation without cost to the various donors.

Licensed radio amateurs may compete for these awards if they plan to pursue a full-time course of studies beyond high school and are enrolled in or have been accepted for enrollment at an accredited university, college or technical school. The awards range from $500 to $2,000 with preference given in some cases to the pursuit of certain study programs or to residents of specified geographical areas such as Delaware, Florida, Maine, Maryland, New Jersey, Ohio, Pennsylvania, Virginia and Wisconsin. Amateur radio clubs are encouraged to announce these opportunities.

The Foundation for Amateur Radio, incorporated in the District of Columbia, is an exempt organization under Section 501 (C)(3) of the Internal Revenue Code of 1954. It is devoted exclusively to promoting the interests of amateur radio and those scientific, literary and educational pursuits that advance the purposes of the amateur radio service.

Information and application forms may be requested prior to April 30, 1996 from: FAR Scholarships, 6903 Rhode Island Avenue, College Park MD 20740.

Hams In The Snow

In typical fashion, the amateur radio community mobilized and provided coordination and emergency communications for the blizzard that hit the east coast in early January. In places like Montgomery County, Maryland and Suffolk County, New York hams in four wheel drive vehicles helped out area hospitals, provided coordination of food and supplies for the sick and elderly and did the things that amateur radio operators do every time an emergency comes up.

So... what's so special? What's the big deal? Nothing except that with all the intense media coverage no one took the time to tell the story to the public. Based on a sampling of hams talking about this no-press phenomenon, feelings are mixed. Many hams think its part of the package - if you have a license you should be there to help by using your skills, equipment, training and time. This, indeed, is the true spirit of amateur radio and should be commended. But there are a good number of operators who feel a little publicity wouldn't hurt when antenna restriction time or band allotment discussions come around. The answer as to what to do is best explained by a ham who posted on an internet discussion group, "Do the best you can to help your community in an emergency but also keep your local and state media outlets aware of Who's doing What, Where, When and How. Names, addresses, telephone numbers! Make it easy for the media to tell a positive human interest story and they will!" 73

NEVER SAY DIE

Continued from page 4

by Royston Roberts, John Wiley, 1989, $13, 270p, ISBN 0-471-60203-5, has a bunch more "coincidences." Like the way Daguerre invented the Daguerreotype, the first practical photographs. He'd been able to make faint photos on silver-coated copper plates, but they weren't bright enough to be seen easily. He tried every way he could think of to intensify the image. Then, one day, he put an exposed plate in a cupboard which had some chemicals in it, planning to clean the faint image off and reuse the plate. When he took it out a few days later he found the image had been intensified!

So he tried each of the chemicals in the cupboard, but none worked. He then looked closer and found some drops of mercury which had come from a broken thermometer. And that's how the Daguerrotype was invented. Unfortunately, mercury is very poisonous, so many early photographers died of mercury poison. These days we're still making people sick and killing them with mercury, courtesy of your local dentist, who is still using it in your amalgam fillings. Well, at least it's a slow poison.

I remember running an article in *73* many years ago about the almost discovery of the transistor. A couple hams had run into the semiconductor phenomenon while experimenting, but the importance of it had escaped them. You have to have curiosity and be open to new paradigms. Velcro was invented by a chap who wondered why cockleburs stuck to his clothes so tenaciously.

Serendipity can give you the hints, but it's up to you to turn this into inspiration. Take off your blinders! Whatever it is that causes these coincidences is still at it and will work for you, if you'll only let it. Or maybe you honestly believe that every single one of the tens of thousands of sincere stories about angels helping people are bogus.

Ancient History

First, I'd like to tell you about the time I called an admiral a traitor, and then, to how this led me to get the inside scoop on ARRL General Manager Budlong, W1BUD.

This all started when I was the editor of *CQ*, one of the ham magazines. I'd been summoned to the Pentagon for a briefing. Briefing? It was anything but brief. An Air Force colonel obfuscated for over an hour, speaking Air Force jargon, which I translated as best I could into English. It had to do with the Air Force needing to take over our 450 MHz band for a new radar project.

When he got through, I asked if what I'd heard translated into the Air Force, faced with the problem of the Russians using radar jamming equipment in their bombers, was being countered by our setting up so many radar systems that even a fleet of bombers couldn't jam them all? To make room for this mass of radar systems we hams would have to give up our 450 MHz band to make

Continued on page 28

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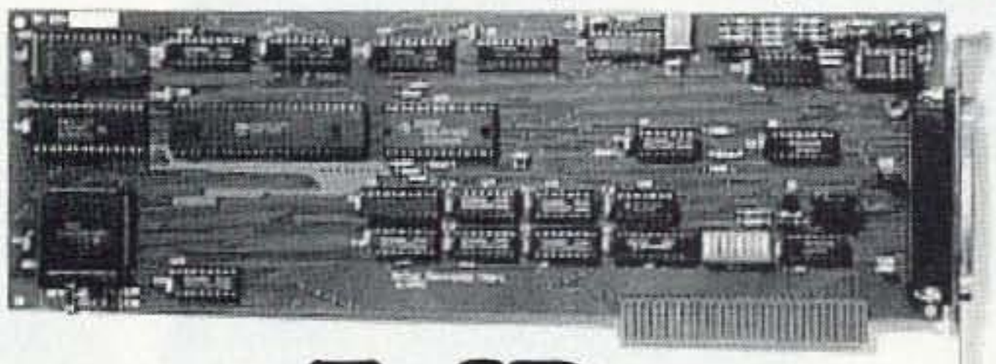

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Parts of the following article are reprinted from the *HaGal International* newsletter.

JY74X-JY74Z: A Joint Jordanian-Israeli Operation

One peace process dividend: DXpeditions to Amman and Mt. Nebo, celebrating the first anniversary of the "Washington Declaration" peace accords.

Joe Obstfeld 4X6KJ-JY8KJ
PO Box 873
Kiryat Ono 55000 Israel

The preliminary arrangements had been going on for a very short period of time. Everything was set and the final word would be coming from the Royal Palace in Amman, depending on His Majesty's schedule. Word of the proposed date was transmitted by fax to Amir 4X6TT, and he made all the calls and arrangements.

On Wednesday evening I received a call, just stating that I was requested to join this operation, and that the team was leaving on Monday the 24th of July. I asked just a few questions: Who is going? Where do we stay? What about a visa for Jordan? What about transportation? etc. The answer was simple: "It's all been taken care of, just come."

I was doubtful and couldn't believe it until I phoned the Secretary of the Jordanian Amateur Radio Club, Mohammed JY4MB, with whom I've been in regular contact. We'd met many times at international conferences and had spent many hours planning and discussing joint cooperation between our two societies.

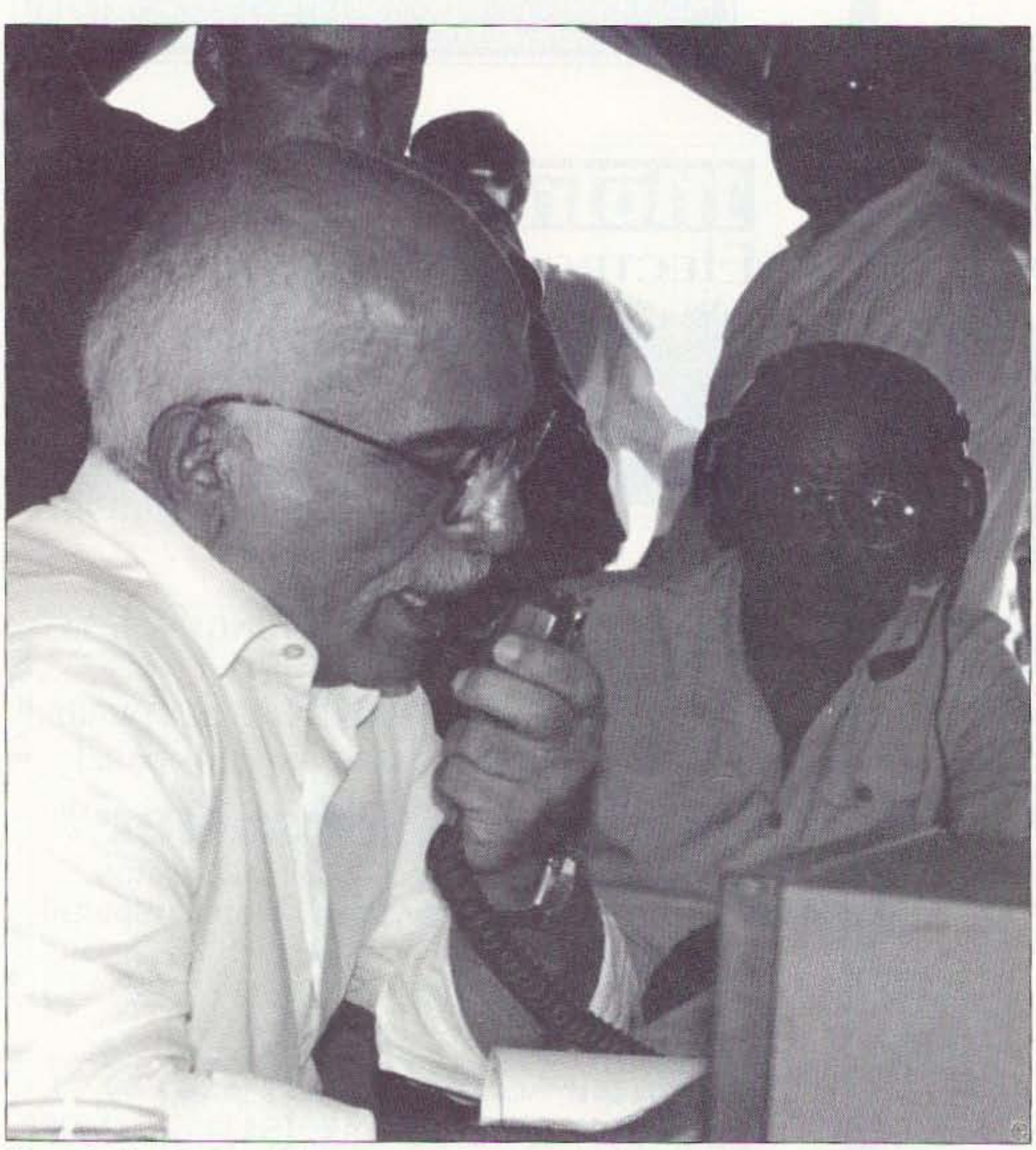

***Photo A.** King Hussein JY1 operating JY74Z on Mt. Nebo.*

"What resulted was monstrous; it unleashed a free-for-all."

He was pleased to tell me, "I'll see you in a few days here in Amman." He confirmed the entire plan, saying, "What are you worried about? Everything is taken care of, just make sure that at 10 a.m. on Monday you're at Allenby crossing. Salaam, Shalom, see you on Monday!"

After checking my passport's validity, I dug up a small suitcase, prepared film and batteries for the picture and video cameras, and I was ready to go.

JY74X Amman

At precisely 7 a.m. the rented minivan limousine passed through the heavy early morning Tel-Aviv area traffic and continued on to Jericho in the Jordan Valley. The van was loaded to the brim with equipment for the mission, as well

MFJ *HF/VHF* SWR Analyzer™ with RF Resistance Meter

Read your antenna SWR from 1.8-170 MHz . . . 10-digit LCD frequency counter . . . RF Resistance Meter™ . . . smooth reduction-drive tuning . . . simple-to-use . . .

MFJ-259 **$239.95** If you work with antennas, MFJ's revolutionary new *SWR Analyzer™* is the best investment you'll ever make! Now you can diagnose a wide range of antenna problems instantly with one easy-to-use instrument.

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The MFJ-259 gives you a complete picture of your antenna's performance anywhere between 1.8 and 170 MHz -- you can even check SWR outside the ham bands without violating FCC rules. Set the bandswitch and tune the dial--just like your transceiver. SWR is displayed instantly!

RF Resistance Meter™

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Find your antenna's true resonant frequency from the shack.

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Tune critical HF mobile antennas in seconds -- without subjecting your transceiver to high SWR.

Measure your antenna's 2:1 SWR bandwidth on a single band, or analyze multiband performance over the entire spectrum from1.8 to 170 MHz!

Measure inductance, capacitance, resonant frequency of tuned circuits, transmission line velocity factor/impedance/loss.Test RF chokes, transformers, baluns.

Adjust your tuner for a perfect 1:1 match without creating QRM.

And this is only the beginning! The MFJ-259 is really *four* test instruments in one: an accurate RF signal generator, a high resolution 170 MHz frequency counter, *RF Resistance Meter™* and an *SWR Analyzer™*.

Free Manual

MFJ comprehensive 18 page instruction manual is packed with useful applications -- all explained in simple language you can understand! **For** free manual write or call MFJ.

Take It Anywhere

The MFJ-259 is fully portable, powered internally by 8 AA batteries or 110 VAC with MFJ-1312B, $12.95. It's in a rugged all metal cabinet that's a compact 4x2½x6¾ inches. Take it to remote sites, up towers, on DX-peditions -- anywhere your antennas are located.

For rough service, pick up a convenient **MFJ-29B**, $24.95, padded carrying pouch to keep your MFJ-259 close at hand and looking like new.

How Good is the MFJ-259?

MFJ SWR Analyzers™ work so good, many antenna manufacturers use them in their lab and on the production line -- saving thousands of dollars in instrumentation costs! Professional installers and technicians use them worldwide.

Get More by Paying Less

With the MFJ-259, you get full 1.8 to 170 MHz coverage, simple operation, instantaneous readings, a high accuracy frequency counter and MFJ's exclusive *RF Resistance Meter™*-- all for a low $239.95.

1.8-170 MHz *SWR Analyzers™*

MFJ-249 **$219.95** **MFJ-249** *HF/VHF SWR Analyzer™* has all the features of MFJ-259 but less RF resistance meter. Includes 1.8-170 MHz *continuous* coverage, 10-digit LCD frequency counter and smooth vernier tuning.

MFJ-209 **$109.95** **MFJ-209** *HF/VHF SWR Analyzer™* is same as MFJ-259 without LCD frequency counter and RF resistance meter. Has jack for external frequency counter. MFJ-249/MFJ-209 are 4x2½x6¾ inches and uses 8 AA cells or 110 VAC with MFJ-1312B, $12.95.

Carrying Pouch with Window

MFJ-29B **$24.95** **Tote** your MFJ-259/249/209 *SWR Analyzer™* anywhere with this custom Carrying Pouch. **Made** with a special foam-filled fabric, it cushions blows, deflects scrapes, and protects knobs, meters and displays from harm.

Clear protective frequency display window and cutouts for knobs let you use it without taking it out of pouch. Fully-adjustable webbed fabric carrying strap has snap hooks on both ends. Wear around waist or over shoulder.

Keep your analyzer safe and looking new!

MFJ-29, $19.95, no window or cutouts.

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MFJ-66 **$19.95** **Plug** a dip meter coupling coil into your *MFJ SWR Analyzer™* and turn it into a sensitive and accurate bandswitched dip meter.

With a dip meter you'll save time and take the guesswork out of winding coils, measuring inductance and capacitance, measuring velocity factor and electrical lengths of coax. Determine resonant frequency of tuned circuits and measure Q of coils. Set of two coils cover 1.8-170 MHz depending on your *MFJ SWR Analyzer™*.

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MFJ-207 **$79.95** **If** you're an HF man, this compact MFJ-207 *HF SWR Analyzer™* will help you build 10-160 Meters antennas that'll make working DX almost routine.

Just plug in your coax to find the SWR of any HF antenna on any ham band 10-160 Meters. Has jack for external frequency counter. 7½x2½x2¼ inches.

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MFJ-203 **$99.95** **The** MFJ-203 is a sensitive *Bandswitched Dip Meter™* that covers all ham bands from 160-10 Meters. There are no plug-in tuning coils to keep up with or break.

Has detachable coupling coil, dual FET oscillator, op-amp meter amplifier and jack for external frequency counter. 7½x2½x2¼ in.

2 Meter *SWR Analyzer™*

MFJ-208 **$79.95** **MFJ-208** 2 Meter *VHF SWR Analyzer™* finds the SWR of any antenna from 138-156 MHz. Jack for external frequency counter. 7½x2½x2¼ inches.

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Same as MFJ-208 but for commercial VHF. **MFJ-217**, $79.95, covers 30-50 MHz and **MFJ-218**, $79.95, covers 150-170 MHz.

MFJ Antenna Bridge

MFJ-204B **$79.95** **Great** for determining feedpoint resistance of antennas and for designing impedance matching networks. Measure RF resistance up to 500 ohm. Covers all ham bands 160-10 Meters. Built-in resistance bridge, null meter, tunable oscillator-driver, frequency counter jack. 7½x2½x2¼ inches. Use 9 volt battery or 110 VAC with MFJ-1312, $12.95.

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MFJ-219 **$99.95** **Read** SWR of any antenna 420 to 450 MHz -- just plug coax of your antenna into SO-239 connector, set frequency and read SWR. Uses microwave integrated circuits and microstrip technology. Jack for external frequency counter. 7½x2½x2¼ in.

MFJ-219N, $99.95, sames as MFJ-219 but with "N" connector.

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as with the operators Ami 4X4DK, Amir 4X6TT, Moni 4X6ZK, Dov 4Z4DX, Eyal 4X6RE and me. All of us were fascinated with the speed and efficiency of the preliminary arrangements for this DXpedition. During the two hour trip to the border, the team was discussing in anticipation what might be awaiting us.

At the Allenby bridge, the Jordan-Israel border crossing, everyone involved did his utmost to make our passage as fast and easy as possible. No wonder! The border officials had received advance notice of our program and the intended operation by none other than the Royal Court in Amman, as we later found out. It was the first time ever that Israeli radio amateurs would be crossing the border to operate with Jordanian amateurs in their country.

"It was the first time ever that Israeli radio amateurs would be crossing the border to operate with Jordanian amateurs in their country."

Within 30 minutes of our arrival at the border the gate was opened and our minivan was allowed to bring our equipment to the other side. It was quickly transferred to one of the Jordanian vehicles that was awaiting us. After greeting Mohammed JY4MB, who came specially to welcome us, and be our escort, we made our way in a convoy of Royal Palace cars to Amman, the capital of the Hashemite Kingdom of Jordan.

First we checked into our hotel, put our personal belongings there, and after a quick lunch we made our way to the clubhouse of the Royal Jordanian Amateur Radio Society. We unpacked the equipment from the van and started to set up the different stations. Within an hour of our arrival, the first station, JY74X, was on the air. We were joined by our Jordanian friends, and as the day progressed more transceivers were pressed into service on different bands and modes.

JY74Z Mount Nebo

Three members of the group went with an escort to Mount Nebo, about 60 km. southwest of Amman, to check out the site and to start setting up so that on the 25th of July operation JY74Z from this site could begin. It was especially important to get on the air on this day, as the whole mission was dedicated to the first anniversary of the Washington Declaration, which was signed at the White House. One year after signing the Principles of Peace between Jordan and Israel, radio amateurs of both countries got together to put this DXpedition on the air and handle the pileups.

Early in the morning on Tuesday, July 25th, the entire team assembled in the hotel lobby and our awaiting Royal car and escort took us to Mount Nebo, elevation about 800 meters above sea level, an hour's drive from Amman. As soon as we arrived we began operating. One by one the transmitters fired up on the air on SSB and CW. Frequently we had to change operators, because of the terrible 40° Celsius (104° Fahrenheit) heat that prevailed at the time in our tents. The pileups were ear-shattering. After supper, provided by the Marriott Hotel Catering Service and brought to the mountain site, the team split into two groups. One stayed overnight on Mount Nebo, in the seemingly freezing cold. Temperatures in the desert change dramatically to extremes during day and night. The other group went down to the city, to operate from the clubhouse in Amman.

JY1 Incites Bedlam

The next day the program was the same as the day before, but the heat was worse. The highlight of the day was the appearance of none other than His Majesty King Hussein JY1 on the air on both HF and VHF. The excitement and enthusiasm increased as everyone of the team present had a chance to have a QSO with His Highness from his Palace in Amman. Afterwards the pileups doubled, the frenzy on the HFs went out of control and His Majesty decided to QRT and maybe appear later and try again.

Around 5 p.m. we were honored as His Majesty arrived in person at the Mount Nebo site. After introducing ourselves, he went on the air; "This is JY74Z, JY1 at the microphone." A few QSOs were made, but it was almost impossible to pick out a callsign through the roar of the pileup. The word most used during that half hour or so was "stand by, stand by." Amateurs around the globe just did not listen, each one thinking that he will make it through. But only those who have been on the other end of a pileup know that the colossal noise created at such moments gives cause for the big switch being pulled. His Majesty put down the microphone and signed the log. For a few lucky ones this will be the most unforgettable and special QSO ever. Meanwhile refreshments were being served, and a lively, pleasant eyeball QSO ensued.

The Final Day—Almost

Thursday July 27th was supposed to be the final day. During the morning hours our driver took all of us on a sightseeing tour of the city, after which we returned to The Mountain and continued working the pileups. As the day progressed it became clear to us that it could not be the final day of operation, as on Friday the Jordanian part of the border is closed and on Saturday the Israeli side is shut down. At various times during the day His Majesty JY1 came on the HF frequency and the frenzy on the bands continued. During the night it was the same. As word spread that there would be a special QSL card for this occasion, the amateur radio world tried to work the two stations on every band and mode possible.

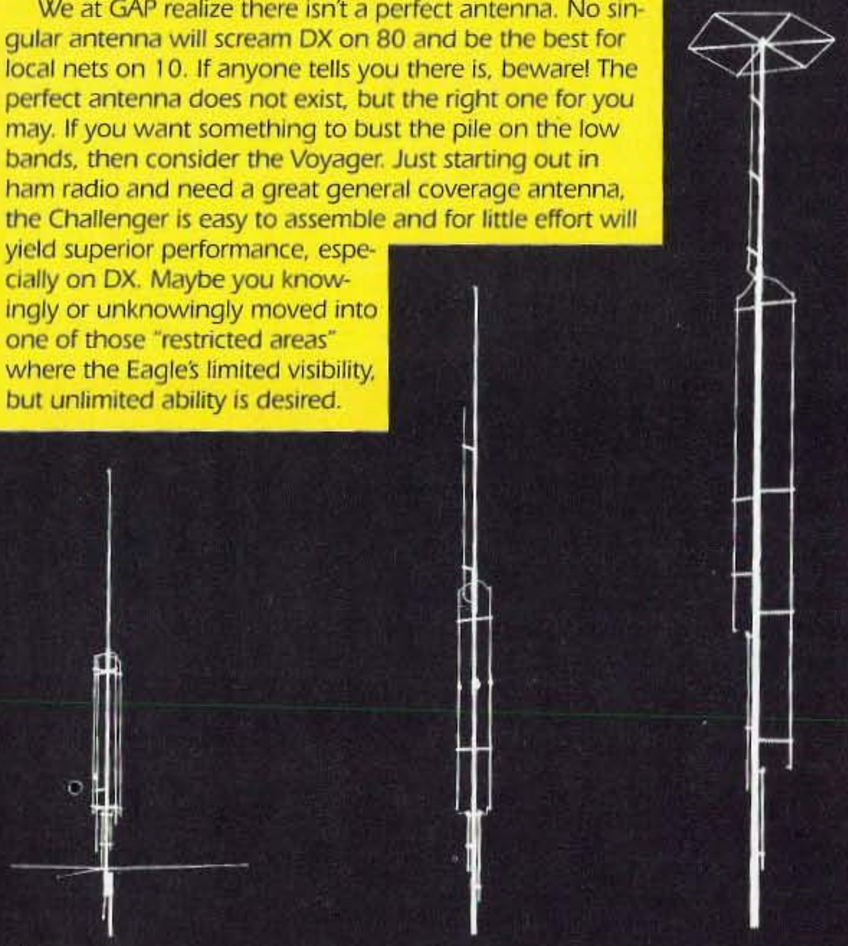
Friday July 28th, in the morning, we were summoned to the residence of His Highness Raad Bin Zeid JY2RZ, the Chairman of the Royal Jordanian Amateur Radio Society, to receive officially and personally our Jordanian operating licenses. At the end of this eyeball QSO it was decided to go back to work. His Highness JY2RZ would come on frequency and take some calls. Enthusiastically we went back to The Mountain and tried to regulate the pileup as the two most wanted Jordanian callsigns came on the air simultaneously.

What resulted that afternoon was monstrous; it unleashed a free-for-all on the HF bands, uncontrollable even by the best of operators. "Stand by, staaaaand by, quiet!" But nobody listened and the roar continued. The few very lucky ones who "made the contact" must still have adrenaline running through their veins.

At sunset, we took time out for a most elaborate barbecue, prepared for us by

GAP: THE PERFECT ANTENNA

We at GAP realize there isn't a perfect antenna. No singular antenna will scream DX on 80 and be the best for local nets on 10. If anyone tells you there is, beware! The perfect antenna does not exist, but the right one for you may. If you want something to bust the pile on the low bands, then consider the Voyager. Just starting out in ham radio and need a great general coverage antenna, the Challenger is easy to assemble and for little effort will yield superior performance, especially on DX. Maybe you knowingly or unknowingly moved into one of those "restricted areas" where the Eagle's limited visibility, but unlimited ability is desired.



Eagle DX

Challenger DX

Voyager DX

This chart helps you select the right GAP antenna. When comparing GAPs, bandwidth is not a concern. With few exceptions, a GAP yields continuous coverage under 2:1 for the **ENTIRE BAND**.

All antennas utilize a GAP elevated asymmetric feed. A major benefit is the virtual elimination of the earth loss, so more RF radiates into the air instead of the ground. This feed is why a GAP requires **NO RADIALS**. Just as elevating a GAP offers no significant improvement to its performance, adding radials won't either, making set up a breeze.

A GAP antenna has no traps, coils or transformers. This is important. The greatest sources of failure in multiband antennas are these devices. Perhaps you heard someone discuss a trap that had melted, arced or became full of water. Improvements to these inherent problems are the focus of the antenna manufacturer, while the basic design of the antenna remains unchanged. **GAP improved the trap by eliminating it!** Removing these devices means they don't have to be tuned and, more importantly, won't be detuned by the first ice or rain. The absence of these devices improves antenna reliability, stability and increases bandwidth.

Another major advantage to a GAP antenna is its NO tune feature. Screws are simply inserted into predrilled holes with a supplied nutdriver.

The secret is out and people in the know say:

CQ–"The GAP consistently outperformed base-fed antennas...and was quieter."

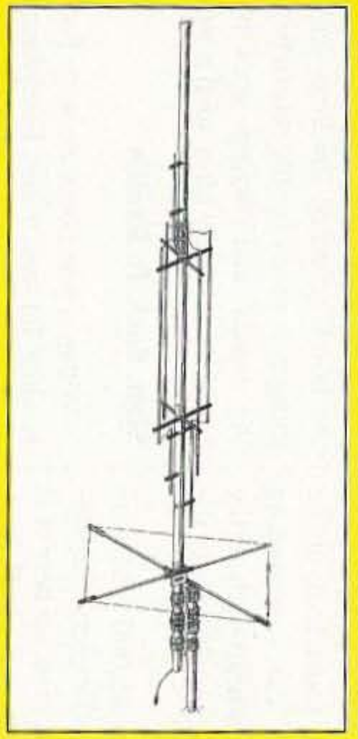
73–"This is a real DX antenna, much quieter than other verticals."

RF–"To say this antenna is effective would be a real understatement. Switching back and forth on 40m between another multiband HF vertical and the GAP, there was no comparison. Signals were always stronger on the GAP, sometimes by S units, not just DB's."

Worldradio – "These guys have solved the problem associated with verticals. That is, an awful lot of RF is wallowing around and dropping into the dirt instead of going outward bound. A half-wave vertical does need radials if it is end fed (at the bottom). But the same half-wave vertical does not (as much, hardly at all) if is fed in the center."

IEEE–"Near field and power density analyses show another advantage of this antenna (asymmetric vertical dipole): it decreases the power density close to the ground, and so avoids power dissipation in the soil below it. The input impedance is very stable and almost independent of ground conductivity. This antenna can operate with high radiation efficiency in the MF AM standard broadcast band, without the classical buried ground plane, so as to yield easier installation and maintenance."

New Release: TITAN DX



This all purpose antenna is designed to operate 10m-80m, WARC bands included. It sits on a 1-1/4" pipe and can be mounted close to the ground or up on a roof. Its bandwidth and no tune feature make it an ideal antenna for the limited space environment as well as a terrific addition to the antenna farm.

MODEL	BANDS OF OPERATION											HT	WT	MOUNT	COUNTER-POISE	COST
	2m	6m	10m	12m	15m	17m	20m	30m	40m	80m	160m					
Challenger DX	■	■	■	■	■		■		■	■		31.5'	21 lbs	Drop In Ground Mount	3 Wires @ 25'	$259
Eagle DX			■	■	■	■	■		■			21.5'	19 lbs	1-1/4" pipe	80" Rigid	$269
Titan DX (Just Released)			■	■	■	■	■	■	■	■		25'	25 lbs	1-1/4" pipe	80" Rigid	$289
Voyager DX							■		■	■	■	45'	39 lbs	Hinged Base	3 Wires @ 57'	$399

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the Marriott Catering Service, with a most unforgettable view as background. From Mount Nebo one can oversee the Jordan Valley, the Dead Sea on one side, Jericho and the river Jordan on the other. As the sun set, the colors of the landscape below and on the horizon were exquisite. Here on this spot Moses went to the top of Mount Nebo and The Lord said to him, "This is the land which I swore to Abraham, Isaac, and Jacob that I would give to their descendants" (Deuteronomy). Later that evening, the pileups reverted to the normal state that we had gotten used to during the days and nights before.

The Final Day—Really

Saturday July 29th, really the last day of this very special operation, we decided that later in the afternoon the stations would be dismantled and antennas taken down. The multitude of equipment that we brought had to be packed and made ready for the return trip. At approximately midday, once more the frenzy peaked, as one more time His Majesty JY1 came on the band from his Palace QTH in the southern city of Aqaba. Unfortunately, the HF propagation was very bad, and very few had a chance for a contact. We at Mount Nebo could not hear him, so the net control was done somewhere in Europe. We left Mount Nebo, had one more look at the unbelievable view of the surrounding landscape and went downhill with all the equipment that had accumulated at the site over the past days.

We made more than 15,000 QSOs on all the bands except 160 meters. Repeatedly we gave our QSL info, so here it is one more time: All QSLs go via JY6ZZ, direct or bureau.

We arrived at the hotel in the afternoon. Tired and dusty, we rested a bit, took a well-deserved shower, and prepared ourselves for the festive dinner that we were invited to by His Highness Prince Raad JY2RZ. At the appointed time we all assembled at his home, where our fellow Jordanian amateurs, who had been with us all the time, joined us. We discussed the pileups, the activity of the past days and the plans for the future.

We were taken completely by surprise when His Majesty King Hussein JY1 arrived and joined us for the evening dinner. Many anecdotes were told and pictures taken. For us six Israeli hams, it was the ultimate climax of an incredibly successful and special DXpedition. We hope that we will have many more opportunities to work together with our fellow hams from JY-land.

On Sunday July 30th we packed the equipment, cleaned up the mess, gathered and signed the logbooks, got our few personal belongings from the hotel, returned the keys and everything was ready for the return trip. Shaking hands and saying good-bye was certainly not easy after such a week.

***Photo B.** Mohammed JY4MB at JY74Z. The fan? It's 104° F!*

Sigh, Back To Reality

Within a few hours we were back in the bustling Tel Aviv traffic. Everything seemed like a dream—a dream that had come true.

Allow me a word of thanks to Amir 4X6TT, who coordinated the whole event, and to the wonderful team of Israeli operators for making this such a memorable week. Special thanks to the JY operators, friends, our partners in the task of controlling the pileups. It was great being together with you for this momentous and historical performance. Mohammed JY4MB, Secretary of RJARS, did an amazing job of orchestrating, guiding, and supporting the whole operation, from the beginning until the end. Special thanks for his endurance in staying with us the whole time. And thanks to Ibrahim JY5EV, for the endless technical support, for keeping the towers and antennas up and the amplifiers running.

Thanks too to Ali Shoukri JY3AK of the Royal Palace, for the intermediary, logistics and support. There are no words to describe the appreciation and gratitude from all of us to His Majesty, King Hussein of Jordan, JY1, for all you have done for us. Without your personal involvement and assistance this event could not have come to pass. Salaam—Shalom.

Editorial Note

Having operated from Amman as JY1 and JY8AA, it was particularly enjoyable for me to get this report of the joint JY/4X team at Amman and Mt. Nebo. I've been to Mt. Nebo and looked out over the biblical area. If you can, plan on a visit to Jordan, where you'll have no problem getting a JY8 call. And plan to see this small country from Irbid in the north to Aqaba in the south. You'll bring back wonderful pictures of the ruins at Jarash, the pink city cut out of the mountains at Petra, the view from Mt. Nebo, the crusader's fortresses, and the tiled floors of churches at Madaba going back to the Roman and Greek times. Heck, you may even be able to organize a visit with His Majesty! . . . Wayne. 73

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Hear exciting air-craft communications—pick up planes up to 100 miles away! Receives 110-136 MHz AM air band, smooth varactor tuning superhet with AGC, ceramic filter, adjustable squelch, excellent sensitivity and lots of speaker volume. Runs on 9V battery. Great for air shows or just hanging around the airport! New 30-page manual details pilot talk, too. Add case set for "pro" look.

AR-1 kit.....**$29.95** Matching case set, CAR ...**$14.95**

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Keep an ear on the local repeater, police, weather or just tune around. These sensitive superhet receivers are fun to build and use. Tunes any 5 MHz portion of the band and have smooth varactor tuning with AFC, dual conversion, ceramic filtering, squelch and plenty of speaker volume. Complete manual details how the rigs work and applications. 2M FM transmitter has 5W RF out, crystal control (146.52 included), pro-specs and data/mike inputs. Add our case sets for a nice finish.

FM Receiver kit Specify band: FR-146 (2M), FR-6 (6M), FR-10 (10M), FR-220 (220MHz).....**$34.95**
CFR Matching case set **$14.95**
FT-146 Two Meter FM transmitter kit **$99.95**

MICRO-MIKE

World's smallest FM wireless mike. Smaller than a sugur cube - including battery and mike. Two sets of SMT parts supplied in case you are clumsy! Terrific audio pick-up (pin drop at 5 ft) and transmit range of 300 ft. We include the battery (watch style), electret mike and even a tuning tool! Be a James Bond and learn SMT too!

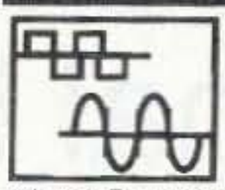
FM-5 Micro mike kit **$19.95**

FM WIRELESS MIKES

Pick the unit that's right for you. All units transmit a stable signal in the 88-108 MHz FM band up to 300' except for High power FM-4 and PB-1 Phone bug that go up to 1/2 mile.

FM-1 Basic unit **$5.95**
FM-2, as above but with added mike pre amp **$7.95**
FM-4, long range with very sensitive audio pickup **$14.95**
PB-1, Phone bug needs no battery, hooks to phone line **$14.95**
MC-1, Micro size sensitive mike cartridge for FM-1,2,4.....**$2.95**

SYNTHESIZED AUDIO GENERATOR



DDS (Direct Digital Synthesis) technology brings you a terrific audio generator at a fantastic price! Generates from 0. 01 Hz to 50 KHz with five digit LED display of frequency. Sine and square wave output adjustable 0-5 volt p-p. Frequency selected by direct keyboard entry and with handy continuous tune tuning knob. Crystal controlled accuracy of 10 ppm and two memories for rapid frequency changes. Retire that jury-rigged old generator and treat yourself to the pleasure of using a new state-of-the-art SG-550!

SG-550 Kit ..**$199.95** SG-550WT assembled **$269.95**

SHORTWAVE RECEIVER

Fantastic receiver that captures the world with just a 12" antenna! Can receive any 2 MHz portion from 4-11 MHz. True superhet, has smooth varactor tuning. AGC, RF gain control, plenty of speaker volume and runs on a 9V battery. Fascinating Scout, school or club project, provides hours of fun for even the most serious DXer. For the car, consider our shortwave converter. Two switchable bands (in 3-22 MHz range), each 1 MHz wide—tunable on your car radio dial. Add some interest to your drive home!

Shortwave receiver kit, SR1.....**$29.95**
Shortwave converter kit, SC1 .....**$27.95**
Matching case set for SR1, CSR **$14.95**
Matching case set for SCI, CSC **$14.95**

AM TRANSMITTER

High quality, true AM broadcast band transmitter is designed exactly like the big commercial rigs. Power of 100 mW, legal range of up to 1/4 mile. Accepts line level inputs from tape and CD players and mike mixers, tunable 550-1750 KHz. Complete manual explains circuitry, help with FCC regs and even antenna ideas. Be your own Rush Limbaugh or Rick Dees with the AM-1! Add our case set for a true station look.

AM-1 Transmitter kit.....**$29.95**
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SCANNER CONVERTER

Tune in on the 800-950 MHz action using your existing scanner. Frequencies are converted with crystal referenced stabilty to the 400-550 MHz range. Instructions are even included on building high performance 900 MHz antennas. Well designed circuit features extensive filtering and convenient on-off/bypass switch. Easy one hour assembly or available fully assembled. Add our matching case set for a professional look.

SCN-1 Scanner converter kit.....**$49.95**
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SCN-1WT Assembled SCN-1 and case.....**$89.95**

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Add concert hall realism to your stereo, TV or even 2-way radio! Easily sythesize a stereo effect from mono sources or richly enliven regular music. Add a big-voice reverb to your radio voice that others will envy! Our reverb/surround sound kit uses a Bucket Brigade IC Device for reliable solid-state performance. Adjustable reverb, delay and mix controls to customize your sound. Easily connected to radios, stereos, CB's and TV's. Plently of audio to drive a small speaker for stand-alone operation too. Experierence the fun and realism that surround sound provides - without spending hundreds! Add our case set for a neat, pro look.

RV-1 Surround Sound/Reverb kit.....**$59.95** CRV Matching case set.....**$14.95**
RV-1WT Assembled RV- 1 and case **$89.95**

TOUCH-TONE REMOTE CONTROL

Control virtually anything by Touch-Tone remote control. The URC-1 has 16 switched outputs, 4 adjustable voltage outputs (20 mV steps 0 to 5 VDC), two 10K digital pots (for volume, squelch, etc.) and 3 timers adjustable from 10 mS to 40 hours! Two level password control allows secure control and multi-level access. Six digit LED display shows currently entered codes and a crystal controlled touch-tone decoder provides reliable operation. There's nothing else like this unit, be in complete control of remote radios, thermostats, hi-fi's, homes or even factories with the URC-1. Add our matching case set for a handsome finish.

URC-1 Remote control kit .....**$129.95** CURC Matching case set **$14.95**
URC-1WT Fully assembled URC-1 and case **$189.95**

FM SUBCARRIER DECODER

Tap into the world of commercial-free music and data that is carried over many standard FM broadcast radio stations. Decoder hooks to the demodulator of FM radio and tunes the 50-100 KHz SCA subcarrier band. Many radios have a demod output, but if your radio doesn't, it's easy to locate, or use our FR-1 FM receiver kit which is a complete FM radio with a demod jack built-in. These "hidden" subcarriers carry lots of neat programming - from stock quotes to news to music, from rock to easy listening - all commercial free. Hear what you've been missing with the SCA-1.

SCA-1 Decoder kit.....**$27.95** CSCA Matching case set.....**$14.95**
FR-1 FM receiver kit.....**$24.95** CFR Matching case for FR-1 .....**$14.95**

L-C METER

Measure inductors from 10 uH-10mH and capacitors from 2 pF-2uF with high accuracy by connecting the LC-1 to any digital multimeter. Two pushbutton ranges for high resolution readings and we even give you calibration components to assure proper accuracy of your kit! Active filters and switching supplies require critical values, no one should be without an accurate LC meter. For a pro look, add our matching case set.

LC-1 LC meter kit .....**$34.95** CLC case set.....**$14.95**

MOTOR CONTROLLER

Control the speed and direction of any motor. Use our SMD-1 for those nice steppers you see surplus, and our MSC-1 for DC motors. The stepper driver features variable speed, half step rotation, direction and power down mode, can drive most any stepper motor. Our DC driver features pulse width modulation control allowing full motor torque even at low speeds and can drive motors up to 50 VDC @ 10 Amps! Add our case set for a professional assembly.

SMD-1 Stepper kit .....**$24.95** MSC-1 DC motor kit.....**$24.95**
CSMD SMD-1 case .....**$14.95** CMSC MSC-1 case.....**$14.95**

STEREO FM TRANSMITTER

Run your own Stereo FM radio station! Transmits a stable signal in the 88-108 MHz FM broadcast band up to 1 mile. Detailed manual provides helpful info on FCC regs, antenna ideas and range to expect. Latest design features adjustable line level inputs, pre-emphasis and crystal controlled subcarrier. Connects to any CD or tape player, mike mixer or radio. Includes free tuning tool too! For a pro look add our matching case set with on-board whip antenna

FM-10A Stereo transmitter kit **$34.95**
CFM Case,whip ant set.....**$14.95**

DR. NI-CAD CONDITIONER/FAST CHARGER

Quit spending big bucks for replacement battery packs, rejuvenate and condition your batteries for peak capacity. Advanced circuitry has optimized discharge before charge to eliminate memory effect and to condition batteries that have been poorly cared for in the past. Quick charge rapidly brings battery to full charge in less than an hour-just 15 minutes for some types! And "top-off" charge mode squeezes every last bit of energy into each cell for the absolute most capacity. Switch-mode regulator controls constant current charge while being monitored by a negative delta-V system that cuts off the fast charge at the exact point of full charge-batteries are charged, not cooked! Charges NiCads or NiMH packs from 2 to 10 cells (easily expanded) and current capacities up to 10 Amp-hours. Runs on 12 to 15 VDC. Quit cooking your batteries, buying new packs, waiting hours for recharge, get a Dr. Ni-Cad today! Available in money saving kit form or wired and tested with case at a special price. Kit builders: add our matching case set for a snazzy finish.

DN-1 Dr. Ni-Cad conditioner/fast charger kit.....**$49.95**
CDN Matching case set.....**$14.95**
DN-1WT Fully assembled Dr. Ni-Cad with case **$89.95**

SPEED RADAR

New low-cost microwave Doppler radar kit "clocks" cars, planes, boats, horses, bikes or any large moving object. Operates at 2.6 GHz with up to 1/4 mile range. LED digital readout displays speed in miles per hour, kilometers per hour or feet per second! Earphone output allows for listening to actual Doppler shift. Uses two 1-lb coffee cans for antenna (not included) and runs on 12 VDC. Easy to build—all microwave circuitry is PC stripline. ABS plastic case with speedy graphics for a professional look. A very useful and full-of-fun kit.

SG-7 Complete kit.....**$99.95**

STEREO PEAK HOLD BARGRAPH

Finally a dual LED bar graph with a peak hold display! Bar graph displays are neat and eye catching but their speed is their downfall - they just can't capture the peaks. Our kit is like two units in one, a fast display to show the signal and a long persistance display to capture peaks, similar units go for hundreds of bucks! We offer 3 models: Linear for general use, Semi-Log for audio VU meters, and Log for power displays. Dual - for stereo! - 10 segment multi-colored LED display for snazzy, eye grabbing display and easily set ranges for virtually any signals, from voltmeters to audio VU meters to audio power amps to SWR meters. Complete intructions for easy hook-up to most any device. Add our matching case set for a sharp looking unit.

PH-14 Dual Linear bargraph kit .....**$39.95** PH-15 Dual Log bargraph kit ..**$39.95**
PH-16 Dual Semi-Log bargraph kit.....**$39.95** CPH Matching case set **$14.95**

SPEECH SCRAMBLER

Descramble most scramble systems heard on your scanner radio or set up your own scambled communication system over the phone or radio. Latest 3rd generation IC is used for fantastic audio quality - equivalent to over 30 op-amps and mixers! Crystal controlled for crystal clear sound with a built-in 2 watt audio amp for direct radio hook-up. For scramble systems, each user has a unit for full duplex operation. Communicate in privacy with the SS-70. Add our case set for a fine professional finish.

SS-70 Scrambler /descramblerkit **$39.95**
CSSD matching case set.....**$14.95**
SS-70WT Assembled SS-70 and case set **$79.95**

CRYSTAL RADIO

Relive the radio past with a crystal set like your grandfather built. Uses genuine Galena crystal and catwhisker. Several different types of radios are built, including standard AM broadcast, shortwave and even WW II foxhole style. To compare modern semiconductor detectors, we include a diode for comparison. No soldering required and we even give antenna ideas. Radio for free, get it now before Clinton taxes it!

CS-1 Crystal set kit **$19.95**

TOUCH-TONE DECODER

Grab Touch-Tone numbers right off the air, phone or tape. A simple hook-up to any radio speaker or phone line is all that is required to instantly decipher touch-tone phone numbers or codes. A 256 digit memory stores decoded numbers and keeps its memory even in the event of power loss. An 8 digit LED display allows you to scroll through the memory bank to examine numbers. To make it easy to pick out number groups or codes, a "dash" is inserted between sets of digits that were decoded more than 2 seconds apart. A "central-office" quality crystal controlled decoder is used allowing rapid and reliable detection of numbers at up to 20 digits per second! For a professionally finished look, add our matching case set. Start cracking those secret codes tomorrow with the Tone Grabber!

TG-1 Tone Grabber kit.....**$99.95** CTG Matching case set **$14.95**
TG-1WT Fully assembled TG-1 and case **$149.95**

DIGITAL VOICE RECORDER

Chatterbox digital voice storage unit will record your message of up to 20 seconds. Time is split up into four 5 second blocks which can be played separately or cascaded for longer messages. An LED display shows message location and current mode for easy operation. Nifty built-in interfaces allow simple connection to transmitters for automatic keying when the PTT is initially closed or after it is released. You can even loop your rig's mike through the Chatterbox. For contest or fun use, the CB-1 can drive an external speaker. Includes a built-in electret mike. For that finishing touch, add our matching case set.

CB-1 Voice recorder kit.....**$59.95** CCB Matching case set **$14.95**

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CIRCLE 34 ON READER SEVICE CARD

Into Orbit with the Final Phase 3 OSCAR

It's a bird! It's a plane! It's...

Andy MacAllister WA5ZIB
14714 Knights Way Drive
Houston TX 77083

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 simple telemetry beacons, with voice and CW transponders like repeaters in the sky, and with complex, digital store-and-forward flying BBSs, or radio bulletin-board systems.

Phase 3-D is the largest, most complex and international "hamsat" project to date. It is scheduled for launch from French Guiana later this year on board an Ariane-5 booster. 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 around 500 pounds with an estimated program cost of 4.5 million dollars. When Phase 3-D achieves orbit it will be given an OSCAR number, perhaps AMSAT-OSCAR-29, or something in the low 30s, depending on the schedules of other projects waiting for launch in 1996.

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.

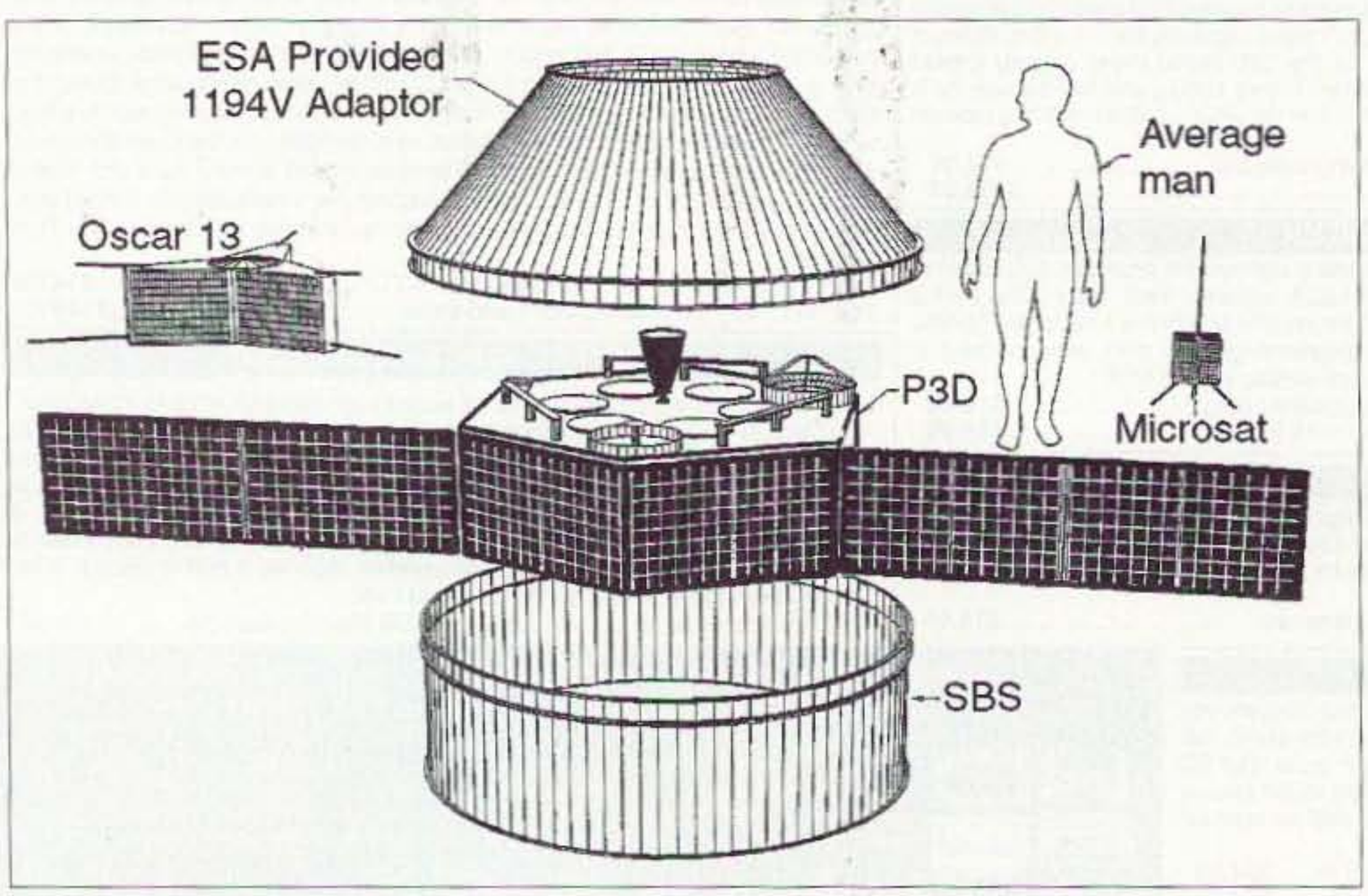

Fig. 1. The Phase 3D spacecraft.

What is AMSAT?

AMSAT stands for Radio Amateur Satellite Corporation. The original AMSAT was founded in 1969 in the District of Columbia as a non-profit educational organization dedicated to foster 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.

"OSCAR-1 weighed 10 pounds and cost about $64. Phase 3-D weighs around 500 pounds and the estimated cost is $4,500,000."

The second project for AMSAT was the first Phase 2-type satellite, AMSAT-OSCAR-6. The Phase-2 classification requires that the hamsat be designed for long life. A-O-6 was expected to last a year with solar cells and rechargeable batteries. It lasted over four years till the batteries shorted out. Today we have OSCAR satellites built by many groups around the world and the "numbers" are increasing rapidly. There have also been several RS satellites from the previous Soviet Union. With many groups using the AMSAT name, like AMSAT-DL of Germany and AMSAT-SA of South Africa, the original group in the United States is now called AMSAT-NA for AMSAT North America. Funding for Phase 3-D comes from membership dues, individual and

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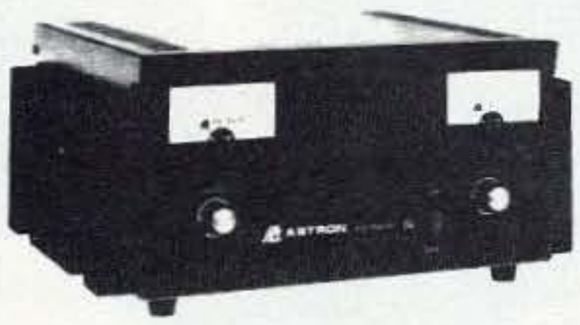

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SPECIAL FEATURES

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- 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

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- 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

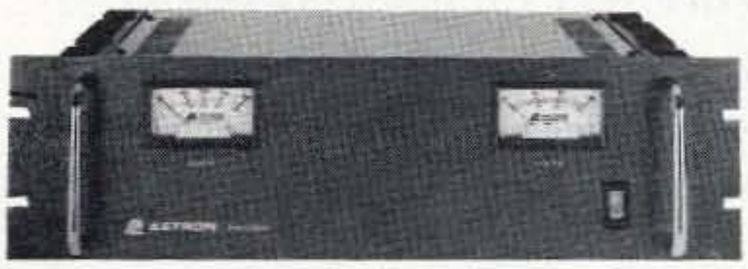
MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
SL-11A	•	•	7	11	2⅝ × 7⅝ × 9¾	12
SL-11R	•	•	7	11	2⅝ × 7 × 9¾	12
SL-11S	•	•	7	11	2⅝ × 7⅝ × 9¾	12
SL-11R-RA		•	7	11	4¾ × 7 × 9¾	13

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-7B	•	•	5	7	4 × 7½ × 10¾	10
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
• 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)

CIRCLE 16 ON READER SERVICE CARD

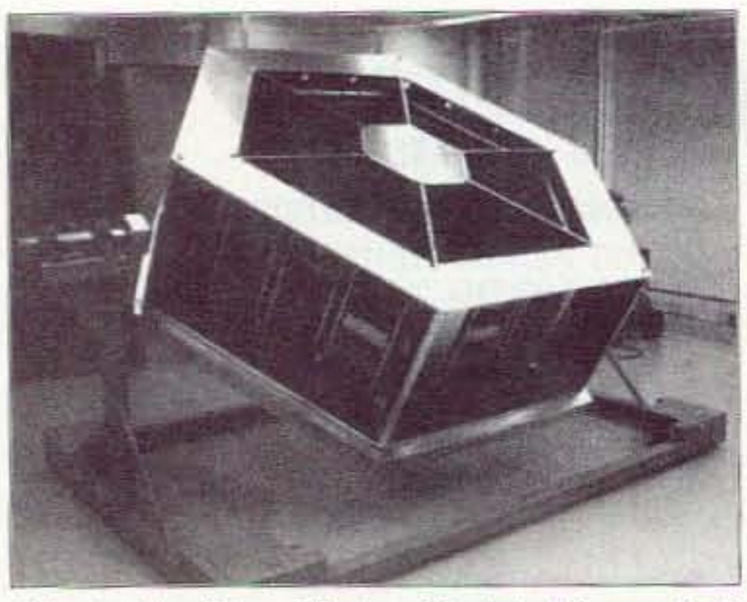


Photo A. *The Flight Model Phase 3-D Spaceframe inside the clean room facility. The specially built handling structure will allow easy access to all parts of the satellite during integration.*

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 AMSAT-NA.

AMSAT-NA 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-NA Field Organization is ready to help those looking for information on a more personal level. With over 100 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-NA sponsors regular HF nets with the latest news on satellite activity and Phase 3-D 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 with supplementary local items of interest. One local net, the Houston AMSAT Net, can be heard across most of North America at 10 p.m. Central Time via Anik E2, Transponder 18, 5.8 MHz audio subcarrier. It is also carried by various VHF and UHF repeaters in addition to a 160-meter feed on 1860 kHz AM from WAØRCR in Missouri.

Current AMSAT information is also available via the Internet. A World Wide Web page can be found at *http://www.amsat.org*. There is also a 'ftp' site at *ftp.amsat.org*, and up-to-date discussions about Phase 3-D and other topics can be checked out by subscribing to *amsat-bb@amsat.org*. Just send a message to *listserv@amsat.org* to subscribe. More information about AMSAT, telephone BBSs and nets can be obtained for a self-addressed stamped envelope to AMSAT, 850 Sligo Ave., #600, Silver Spring MD 20910.

Why Phase 3-D?

With so many amateur-radio satellites in the sky, why build such a large and expensive one? The current satellites have limitations that Phase 3-D is designed to answer. The Phase-3 series of amateur-radio satellites are designed for long-life and wide, simultaneous, geographical coverage. They are built to last several years and have high orbits.

The current Phase-3 satellites include AMSAT-OSCAR-10 and AMSAT-OSCAR-13. A-O-10 was launched in 1983. Although the on- board computer is no longer working due to radiation damage in the memory system, the UHF to VHF linear transponder is still operational when the solar cells are receiving enough sunlight to power the radio gear. A-O-13 went into orbit in 1988. Although most of the systems still work well, the satellite's orbit will decay in December of this year due to orbit instability caused by gravitational effects of the moon and sun. Phase 3-D is designed as a replacement for A-O-10 and A-O-13, with some significant extras.

A-O-10 and A-O-13 provide excellent coverage with their high elliptical orbits, but the orbital characteristics of both require significant tracking programs to predict future access from a specific point on the earth. The apogee or high point of their orbits also fluctuate over time from Northern Hemisphere to Southern Hemisphere coverage, and back again. The final orbit of Phase 3-D will not fluctuate over time, but will maintain stability and provide a repeating pattern that will allow users to predict where the satellite will be on any given day and time.

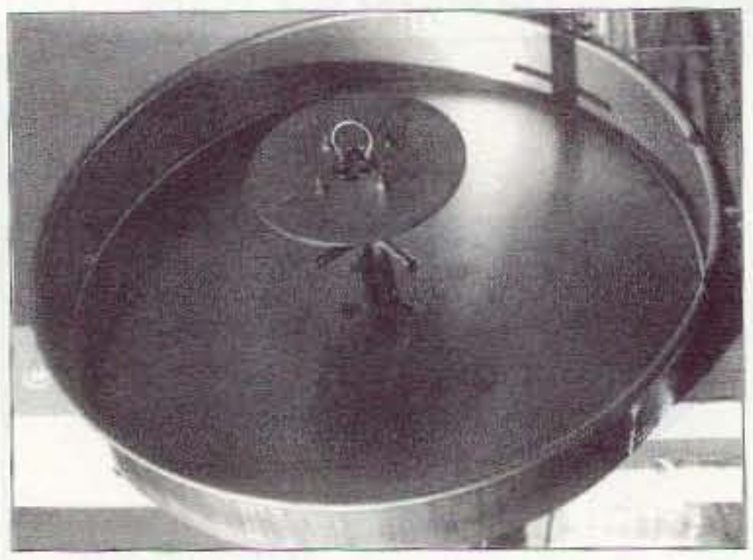


Photo B. *The completed Phase 3-D flight model L-band antenna undergoing gain and pattern testing at the integration facility's antenna test range. Preliminary gain measurements exceeded 15 Dbic with a surprisingly clean pattern.*

The orbit modifications that will be performed on Phase 3-D after launch is a two-year process to go from the original transfer orbit provided by the Ariane launcher to the final stable orbit. After launch the satellite will have a perigee, or low point, of only 200 kilometers with an inclination with respect to the equator of 10 degrees. The satellite's main motor will raise the perigee by 300 kilometers and the apogee by 8,000 kilometers. The long-duration ammonia arcjet motor will provide a very low-energy thrust to bring both the perigee height up to 4000 kilometers and adjust the inclination to 63.4 degrees. This inclination is stable and will not drift over time for the desired elliptical orbit. The satellite will provide optimum performance for users in the Northern Hemisphere.

A-O-10 and A-O-13 provide good signals for earth stations, but only when high-gain antennas are in use on the ground side. A primary goal of Phase 3-D is to improve link margins by 10 to 15 dB on all bands. This means that earth stations will need less power and lower-gain antennas for reliable communication. During periods when the satellite's antennas are pointed directly at the earth, effective communications may even be possible with only omnidirectional antennas, like those on a car.

"Every day large volumes of E-mail, pictures, voice files, programs, bulletins and telemetry are sent via low-earth-orbit digital satellites. Phase 3-D will also provide connections between ground-based computers and remote users in real time."

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Photo C. *The flight prototype U-band patch array undergoes testing on the Phase 3-D integration facility antenna range. The array exhibits measured gain figures comparable to that of a commercial 40-element crossed yagi. Actual on-the-air contacts, with surprisingly good results, have been made through the AMSAT OSCAR-13 satellite using this array as an uplink antenna.*

The low-earth-orbit digital satellites have shown the advantages and usefulness of computer-oriented bulletin-board systems in the sky. Every day large volumes of E-mail, pictures, voice files, programs, bulletins and telemetry are sent via these satellites. The opportunities have allowed a glimpse of what can be accomplished with orbiting "digi-sats," but data rates are still limited and the orbits are low, providing short access periods. Phase 3-D will offer several digital experiments, some at data rates that could support digital video, and access times that will be more akin to on-demand connectivity. Rather than acting only as a stand-alone flying computer BBS, Phase 3-D will also provide connections between ground-based computers and remote users in real time. Connecting to or through Phase 3-D via the Internet is a real possibility depending on the use of ground-based control stations.

Another limitation of A-O-10 and A-O-13 is the effect of high- power earth stations "hogging" the transponder. During normal operation, ground-based users share the transponder output power.

Photo D. *"Lights! Camera!" AMSAT-NExecutive Vice President Keith Baker KB1SF gives Dave Brody, Segment Producer of the Sci-Fi Network program* Inside Space, *an on-camera tour of the Phase 3-D Integration Facility in Orlando, Florida. The program is slated to appear in late spring 1996.*

Each uplink to the satellite's receiver is re-sent by the downlink transmitter, much like a typical VHF-FM repeater, but with a much wider bandwidth. A linear transponder can handle many stations simultaneously by transponding a range of uplink frequencies to a corresponding range in the downlink. When one station transmits excessive uplink power, the weaker users are "de-sensed," or just seem to disappear. Phase 3-D has a system called LEILA, a German acronym describing an "alligator" sniffer. An over-powered uplink will be isolated and notified by a series of beeps on the downlink to lower the power level. If the situation is not corrected by the ground user, LEILA will apply attenuation to the signal to even the load on the transmitter. Several levels of attenuation can be applied.

Getting Ready for Phase 3-D

Another goal of the Phase 3-D program is to retain enough commonality with existing hamsats so that current user equipment is not made obsolete. Many popular frequencies in the VHF and UHF bands will be used by the new satellite. A station that is set up to operate via A-O-13 Mode "B" (70 cm up and 2 meters down) will find the new satellite an easy transition. For those looking for new bands and higher frequencies, Phase 3-D offers a promising array of frequencies.

The radio system of Phase 3-D is set up as a matrix of receivers and transmitters. Uplinks and downlinks cover the satellite bands from 15 meters up through 24 GHz. Today's Mode "B" becomes Mode "UV." This stands for UHF (70 cm) uplink and VHF (2 meter) downlink. Typical voice and CW communications will be possible via most of the band combinations. Mode "LS" (1.2 GHz up and 2.4 GHz down) may become one of the most popular by the year 2000.

The anticipated lifetime of Phase 3-D is 15 years. It is truly designed for advanced communications into the next century. To prepare for the new satellite, potential users should begin with today's hamsats. Books and other publications are available from AMSAT and the American Radio Relay League. Start with the easy satellites, like RS-10, RS-12 and A-O-27. Then progress to the high-orbit "DX" hamsats, A-O-10 and A-O-13. A

Photo E. *A close-up view of Phase 3-D's flight model Propellant Flow Assembly (PFA). Valves and piping on the left side of the unit will be used to fuel the spacecraft's hypergolic propellant tanks on the ground prior to launch, as well as controlling the flow of propellants to P3-D's 400 Newton kick motor while in orbit. Likewise, valves and piping located on the right side of the PFA will be used to fill the spacecraft's ammonia tanks, and later will control the flow of ammonia to the satellite's arc-jet positioning motor.*

series of entry- level articles are in the works for *73's* "Hamsats" column throughout 1996. Start now to get ready for amateur radio's next great adventure.

Photos and figures for this article are courtesy of Keith Baker KB1SF, AMSAT-NA Executive Vice President, AMSAT-NA and AMSAT-DL. 73

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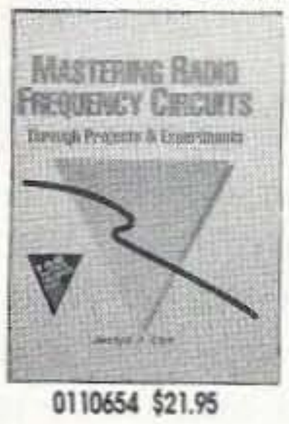

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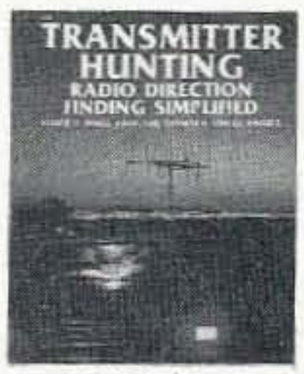

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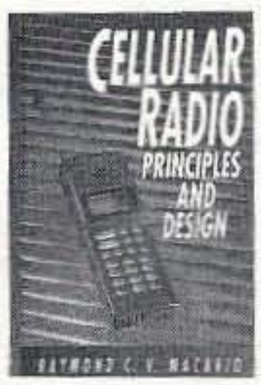

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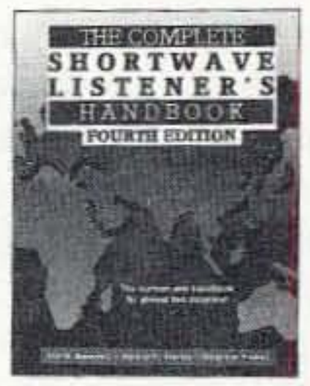

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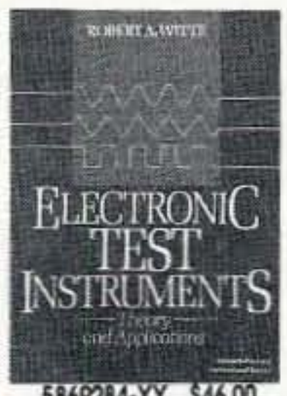

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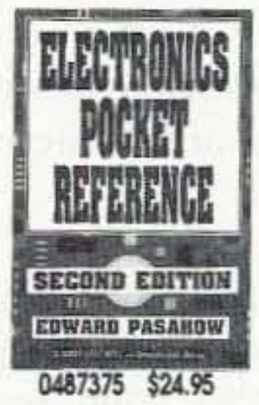

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Number 22 on your Feedback card

What's New In Kits?

Take a gander at some goodies.

Robert S. Capon WA3ULH
322 Burlage Circle
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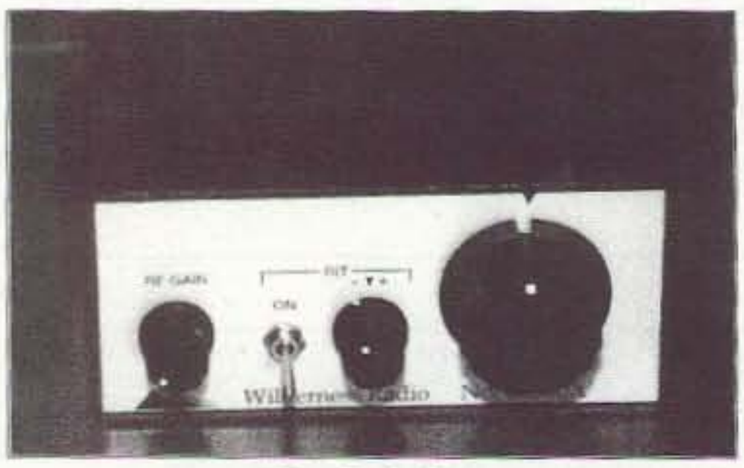
Kit enthusiasts have been rewarded this year with some new kits with great features, and they start at about $100, so there's never been a better time to discover the joy of building your own radio. Your knowledge of amateur radio will be greatly enhanced, and you may discover that one QSO made on your home-brew rig is more satisfying than 10 QSOs made on a commercial transceiver.

This article will provide you with a road map to the latest kits, along with tips and answers to the frequently asked questions for the first time kit builder.

Six Terrific Kits

This article takes a look at six kits: five hot new transceivers and a rather unusual memory keyer (see the full review of the **KC1** in this issue) with a built-in frequency counter. Each transceiver kit features a superhet receiver, and was selected because of its unique characteristics.

NorCal-40A, by Wilderness Radio. The NorCal-40, originally introduced by the Northern California QRP Club, has been reintroduced by Wilderness Radio, a newly formed kit company. The NorCal-40A is ideal for beginners; the jacks and switches mount directly to the board, so there is no point-to-point wiring. This feature makes the radio very easy to build (I put my NorCal-40A together in just two evenings). Wilderness Radio's NorCal-40A comes in a tiny 4 x 4 x 2 enclosure (weighing less than one pound) with a very snazzy two-tone blue paint job. The kit comes with a punched and silk-screened latched enclosure, jacks and knob set, and a first class silk-screened printed circuit board.



NorCal-40A.

" There's never been a better time to discover the joy of building your own radio!"

This 40 meter superhet CW transceiver, designed by Wayne Burdick N6KR, has been optimized for extremely low current drain of only 15 mA on "receive" using headphones. The radio features RIT, AGC, 400 Hz CW filter, and full QSK and delivers 3 watts output. The receiver is absolutely superb. The most challenging aspect of the NorCal-40A is that the builder is required to wind the toroids. First-time builders, however, should not be overly intimidated by this because the radio is supported with excellent documentation.

Sierra, by Wilderness Radio. Again, the Sierra, originally designed by N6KR and introduced by the Northern California QRP Club has been reintroduced by Wilderness. Despite its tremendous sophistication, the Sierra also has characteristics that make it an excellent kit for intermediate builders. Like the NorCal-40A, the jacks and switches mount directly to the board, so there is no point-to-point wiring.

The Sierra is ultra portable, measuring only 5.5 x 6.5 x 2.5 inches (weighing less than two pounds), and has extremely low current drain of 35 mA using headphones. This combination of factors makes the Sierra great for portable and backpacking use, and ideal for battery operation and Field Day.

The Sierra can be purchased with up to nine interchangeable band modules for operation on 10-160 meters. The band modules are gold-plated internal plug-in modules. Unfortunately, each band module has eight toroids, so if you intend to build the Sierra for operation on nine bands (like I have), be prepared to wind a lot of toroids. But aligning each band module is a snap, requiring about 15 minutes each to tune up against your main station transceiver.

The Sierra features RIT, AGC, 400 Hz CW filter, and full QSK, and delivers 2 to 3 watts output on all bands. The kit comes with a punched and screened latched enclosure, jacks and knob set, and silk-screened printed circuit board.

OHR-400, by Oak Hills Research. The OHR-400 is a new kit for intermediate to advanced builders. The radio has become my favorite base station QRP transceiver, because it is switch-selectable for operation on 80, 40, 30 and 20 meters, so band changing is effortless.

The OHR-400 also has a superb receiver with silky smooth QSK. The radio really excels at copying very light signals, and it compares favorably with my commercial HF transceiver at digging out stations at the noise level. This makes the radio ideal for milliwatting work. But the OHR-400 is not ideal for backpacking; it has a hefty cabinet measuring 8 x 8 x 4 inches (weighing almost four pounds), and the radio draws approximately 300 mA on receive.

The OHR-400 comes with excellent documentation, and was a pleasure for

OHR 400.

me to build. I really took my time with the radio, and savored the experience of building the kit. The radio has three printed circuit boards that mount on a solid internal aluminum chassis. The boards are the oscillator, receiver, and transmitter. Interconnecting the boards and panel components is accomplished with approximately 50 point-to-point color-coded wires. Again, the documentation for performing the wiring is first class, but this amount of wiring should typically not be attempted by first-time builders. (Oak Hills has other kits ideal for the beginner, like the single band Explorer described below.)

The OHR-400 features RIT, AGC, narrow CW filter, and full QSK, and delivers 5 to 8 watts output on all bands. The kit comes with a punched and screened enclosure, jacks and knob set, and the three printed circuit boards are silk-screened. It has nice finishing touches, including a phono jack on the back with VFO output for hooking up a frequency counter, a rear panel power level pot, an LED lamp, and a knob set and silk-screening on the front panel for an optional keyer. The toroids are pre-wound, clipped and tinned.

Cascade, by NorCal. SSB on 20 and 80 meters. The Cascade is the latest club project by the famous Northern California QRP Club, and was designed by John Liebenrood K7RO. The Cascade joins an elite group of SSB QRP kits, so now phone enthusiasts can discover the fun of building their own SSB transceiver. Despite its similarities to the Sierra in physical design (jacks and switches mount directly to the board, so there is no point-to-point wiring) the Cascade is a kit for advanced builders, and an oscilloscope is very helpful during the test and alignment process.

The Cascade is ultra-portable, with physical dimensions identical to the Sierra, and has extremely low current drain of 80 mA using headphones. So the Cascade is also superb for portable and backpacking use, and ideal for battery operation and Field Day.

The Cascade comes standard with two interchangeable band modules for operation on 20 and 75 meters. The band modules are gold-plated internal plug-in

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modules. Each band module has only six toroids.

The Cascade features AGC and speech synthesizer, and delivers approximately 8-10 watts output on each band. The kit comes with a punched and screened latched enclosure, jacks and knob set, and silk-screened printed circuit board. The Cascade's documentation takes the builder through 10 independent stages so that you can trouble-shoot and align the kit as you go.

TAC-1, by S&S Engineering. Synthesized CW transceiver with digital display for 80 or 40 meters. The TAC-1 is the latest in a worthy product line of synthesized transceivers offered by S&S Engineering. Unlike the thumbwheel tuning of its predecessor, the Ark-40, the TAC-1 comes with a convenient tuning knob. With a single press on the tuning knob, tuning toggles conveniently between 1 kHz and 100 Hz steps.

The TAC-1 is an excellent kit for intermediate to advanced builders. Like the NorCal-40A and the Sierra, the jacks and switches mount directly to the board, so there is no point-to-point wiring, and the documentation is excellent. However, the components density of the kit is high, and it would be rather difficult to align the synthesizer without the use of an oscilloscope.

The stability of the TAC-1 synthesizer and the digital readout make the radio ideal for serious beacon work. The radio is also very nice for operators who enjoy having a digital frequency display. The radio draws approximately 225 mA, which is needed to drive the synthesizer and LCD display. So the radio is still fairly well suited for portable use, albeit with a somewhat larger battery than the NorCal-40A or the Sierra.

The TAC-1 features RIT, AGC, narrow CW filter, and full QSK, and delivers approximately 3 watts output. The kit comes with a beautiful extruded aluminum case that is punched and screened and features an attractive plastic bezel for the digital display. The TAC-1 also comes with jacks and knob set, and a first class silk-screened printed circuit board.

The finished TAC-1 is a work of art. The populated printed circuit board is a virtual fiesta of components and colors.

KC1 Keyer, by Wilderness Radio. Memory keyer with frequency counter. Designed by the legendary QRP designer Wayne Burdick N6KR, the KC1 combines an unlikely and extraordinary juxtaposition of functionality: a memory keyer with a frequency counter that reads the frequency in CW!

Measuring only 2.5 x 0.8 inches, and drawing only 4 mA, the KC1 has become the first accessory that I put in each of my home-brew QRP rigs. The kit comes with fewer than 20 components, and can be assembled in about a half hour. Interfacing it to your QRP kit is a bit trickier, because you have to identify the best places to obtain a VFO signal, and fiddle with values of coupling capacitors to make it work. The KC1 also lacks the audio output to drive headphones, so the audio signal of the keyer must be injected into the final audio stage of your rig.

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.

When finished, the KC1 can be programmed with up to four different VFO offsets to provide three-digit frequency readout accurate to 1 kHz. The KC1 also enables you to key in a three-digit frequency, and will give an alert tone when you dial to within 2 kHz of the frequency!

The KC1 is a respectable memory keyer, but lacks the dazzling array of keying features (like automatic sequencing of serial numbers) found in the Logikeyer III. The KC1 does include side-tone, weight control and multiple memory partitions. Keyer memories are stored in non-volatile 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.

Mounting the KC1 is very easy, because the momentary switches used to operate the keyer also serve to mount the unit directly behind the front panel, or beneath the top cover of your transceiver. The keyer can also be mounted internally at a remote location.

Oldies But Goodies

This article would not be complete without mentioning a number of the great "classic" kits:

WM-1 Wattmeter, by Oak Hills Research. QRP with power ranges of 10 watts, 1 watt and 100 milliwatts.

TAC 1.

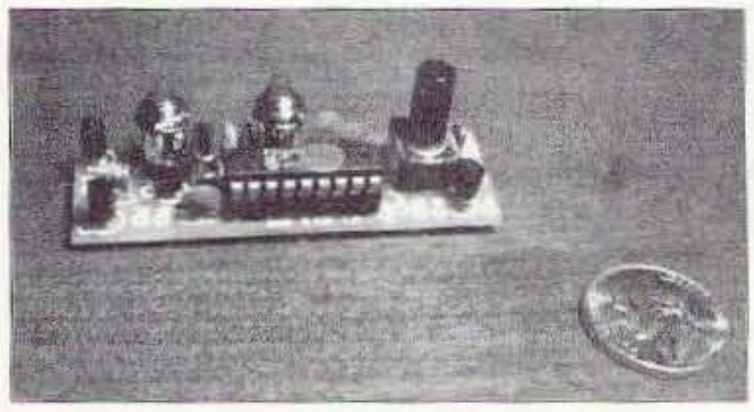
Explorer, by Oak Hills Research. Single-band superhet CW transceiver kit for 20, 30, or 40 meters. Features RIT, AGC and full QSK. 2-3 watts output. The kit comes with a punched and screened enclosure, jacks and knob set, pre-wound pre-tinned toroids, and silk-screened printed circuit board. Excellent transceiver for beginners.

PC1 Digital Frequency Counter, by S&S Engineering. LED display frequency counter with handsome extruded aluminum cabinet. Excellent frequency readout companion for home-brew QRP rigs, and a versatile piece of test equipment for your test bench.

Logikeyer III, by Idiom Press. The latest memory keyer in the Logikeyer series, the Logikeyer III now features six memory locations and non-volatile storage memory in EPROM. The postage stamp sized Logikeyer III has a robust array of superlative keying features and options such as automatic sequencing of serial numbers for contests.

I hope this article encourages you to build your first amateur radio kit, or to upgrade to build a new kit. Discover the joy of making a contact or working a new DXCC country on a radio that you built yourself. Happy building!

Very special thanks to my kit-building partner, Paul Stroud AA4XX, who built the TAC-1 and the NorCal-40A and who helped me troubleshoot the Cascade. Ernie AD4VA assisted me with the on-air testing of each of the radios.



KC1.

Getting Started: Tips for the Beginner

If this is your first kit, take a moment to prepare before building the kit. Before you open your first parts package, you may want to purchase a plastic compartmentalized parts box, which can be very handy for sorting and inventorying components. I found some nice boxes at a local housewares/kitchen supply store. Alternatively, Radio Shack™ has a suitable component box that costs a bit more (#64-552).

Read through the documentation very carefully *twice,* paying special attention to the information provided on component value data.

With every kit that I have built, there are at least a couple of components whose markings are hard to figure out. However, what seems complex when you first open the kit can be simplified by sorting out the parts, and checking off the items on the parts list supplied with the kit. When you've checked off all of the clearly marked items, you'll probably be left with only one or two confusing components, and it will be much easier to figure out which is which.

If you do not already own a soldering iron, I recommend a low wattage iron, (such as the Radio Shack™ #64-2067, a 30 watt pencil) with an extra fine pointed tip. This will be plenty of heat for fine printed circuit work.

I also recommend purchaseing a good soldering iron stand (such as the Radio Shack™ #64-2078) with a sponge tray. Using a good stand is an important safety consideration, and keeping the iron clean is one of the tricks to successful soldering. After every few solder joints, wipe the hot iron across the wet sponge to keep the tip clean.

Finally, you will probably need a good solder sucker (such as the Radio Shack™ #64-2098A). I have never completed a kit without soldering at least one component in the wrong place. The solder sucker will enable you to remove components with minimum wear and tear on the printed circuit board.

Answers to Some Frequently Asked Questions:

•*Can trim capacitors go in the wrong way?* No. Resistors and ceramic disk capacitors can't be put in the wrong way either.

•*Can electrolytic capacitors go in the wrong way?* Yes. Electrolytic capacitors have a positive and a negative side. The negative lead is shorter and is marked with a stripe and a "minus" mark. The positive lead is longer, and may have a small "+" sign, or may be unmarked. Tantalum capacitors also have a positive and negative polarity, with positive marked by a "+" sign.

•*Can integrated circuits go in the wrong way?* Yes. When you put in the ICs, be certain to match up the dot or notch on the IC with the dot or notch on the layout diagram. You may also notice that each of the sockets has a notch. Align the notch so that it is oriented with the dots.

•*How are crystals installed?* Crystals can go in the circuit in any arrangement, and they do not have a positive/negative polarity. It's helpful for crystals to be installed approximately 1/8-inch above the circuit board so that the crystals do not break if the printed circuit board is subjected to mild shock or vibration.

•*How are the diodes mounted?* For diodes that are lying flat on the board, match the black band of the diode with the band on the silk-screened board.

•*How is magnet wire on toroids soldered?* Theoretically, magnet wire uses a coating which is melted off during soldering. I have found, however, that the coating does not melt off completely, and that the resulting solder joint does not make a good connection in all circumstances. It is safer to carefully scrape away the coating with an X-acto blade prior to soldering.

Troubleshooting

If you are having any problems, remember that most problems boil down to a mistake in wiring, component placement, or a solder defect. Before calling tech support, check the following:

•*Solder defects*: The most common defect in soldering is a solder bridge. This occurs when solder connects two pads that should not otherwise be connected. Solder bridges can be fair-sized globs of solder that must be removed with a solder sucker or braid, but can also be tiny threads of solder that are easily removed with an X-acto knife. Study your work under a magnifying glass and good work light, and examine it carefully for solder bridges before you apply power to your kit.

•*Wiring:* It's very easy to reverse wires in the final hookup stage of your kit. Carefully check through all of your wiring for defects.

•*Components*: Carefully check your component placement and polarity one by one. Remember, transistors, integrated circuits, electrolytic capacitors and diodes have to be installed with the right orientation.

•*Lead Lengths*: Check to make sure that component lead lengths and wires are as short as possible.

•*Noise in the receiver*: Change the power supply or use a battery to see if the noise disappears.

•*Dead receiver:* Before you align your kit (usually peaking up a series of inductors and capacitors) it's not at all unusual for the kit's receiver to sound completely deaf. Patiently go through the alignment procedures to peak up your receiver before you decide that your receiver isn't functioning properly.

If you have double-checked all of the above items, it may be time to call the kit supplier. When you call, be sure to have a carefully prepared list of questions handy so that your tech support call is as efficient as possible.

You might also be able to get help from an experienced kit builder in your local radio club. If all else fails, most of the companies will troubleshoot and align your radio for a set fee.

Good luck! 73

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Number 26 on your Feedback card

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10. KZ2W
11. K9FD
12. WD5N
13. KA9TNZ
14. K9GBN
15. N5GAP
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17. NN6E
18. AL7HG
19. N6CGB
20. KI6AN
21. K9JPI
22. N4WF
23. K6PKO
24. KW7J
25. VE6JO
26. WA4IUV
27. W4ZFE
28. N4KMY
29. WØHBH
30. K8KJN
31. KG1V
32. K1KOB
33. KY3F
34. PY2JY
35. YB5BEE
36. YB5BEH
37. WB9SBO
38. NØAFW
39. KA9MOM
40. N3II
41. W6DPD
42. KE8GG
43. VE6VK
44. KD9RD
45. W4WJJ
46. KØHSC
47. KI6GI
48. IK1APP
49. KJ4RR
50. K8MDU
51. N1EIU
52. K1DRN
53. WD8REC
54. ZL2BLC
55. VE3EFX
56. W9MCJ
57. N6IV
58. KN8D
59. KC5YQ
60. WB6ITM
61. KA2AOT
62. K4LHH
63. VE2QO
64. KE5AT
65. W9SU
66. W3OOU
67. NR2E
68. KF5PE
69. N3FBN
70. KB4SJD
71. N3EZX
72. IK8GCS
73. WB4I
74. NG1S
75. WB7UUE
76. HK4EB
77. KØBFR
78. N7GMT(KF7SH)
79. AA4VN
80. KA1LMR
81. N8AXA
82. NM2I
83. KD9YB
84. HC2CG
85. VE1BXI
86. YC2OK
87. NRGNL
88. GM3UBF
89. 5Z4BP
90. IØAOF
91. VE1BN
92. KA2NRR
93. 5Z4DU
94. KB8ZM
95. HK4CCW
96. W2JQ
97. HC2AGT
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99. VE1BHR
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102. KW2D
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112. VE4SI
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117. IK1IYU
118. N6GCN
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120. KB8BHE
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125. KAØIAR
126. K9SM
127. W6BCQ
128. KA5MSL
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209. KD3CR
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212. FD1BEG
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217. KA8YYZ
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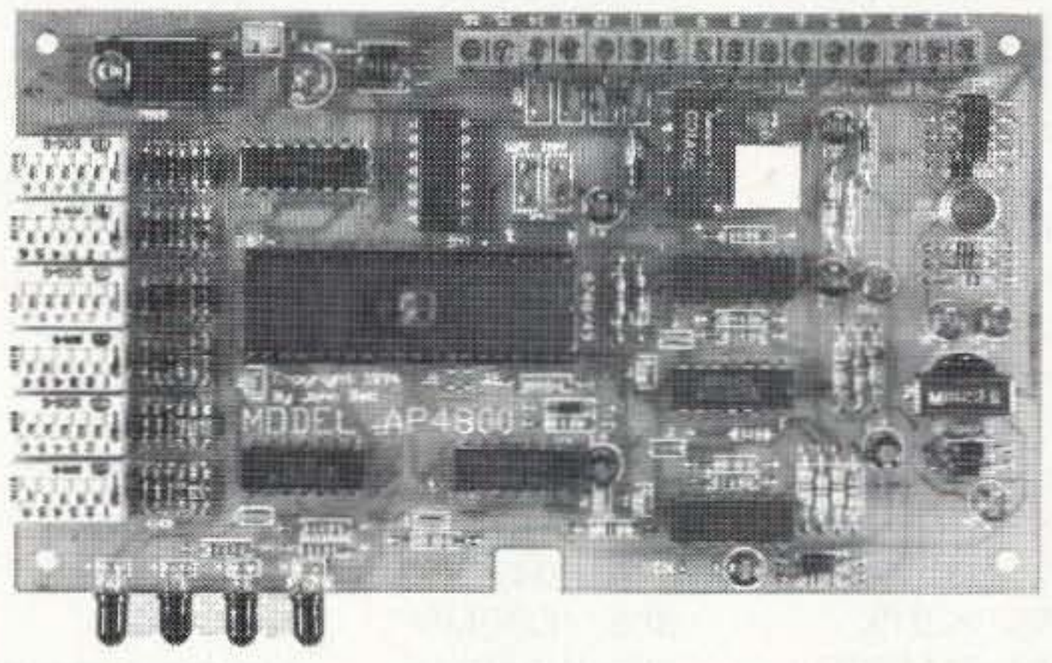

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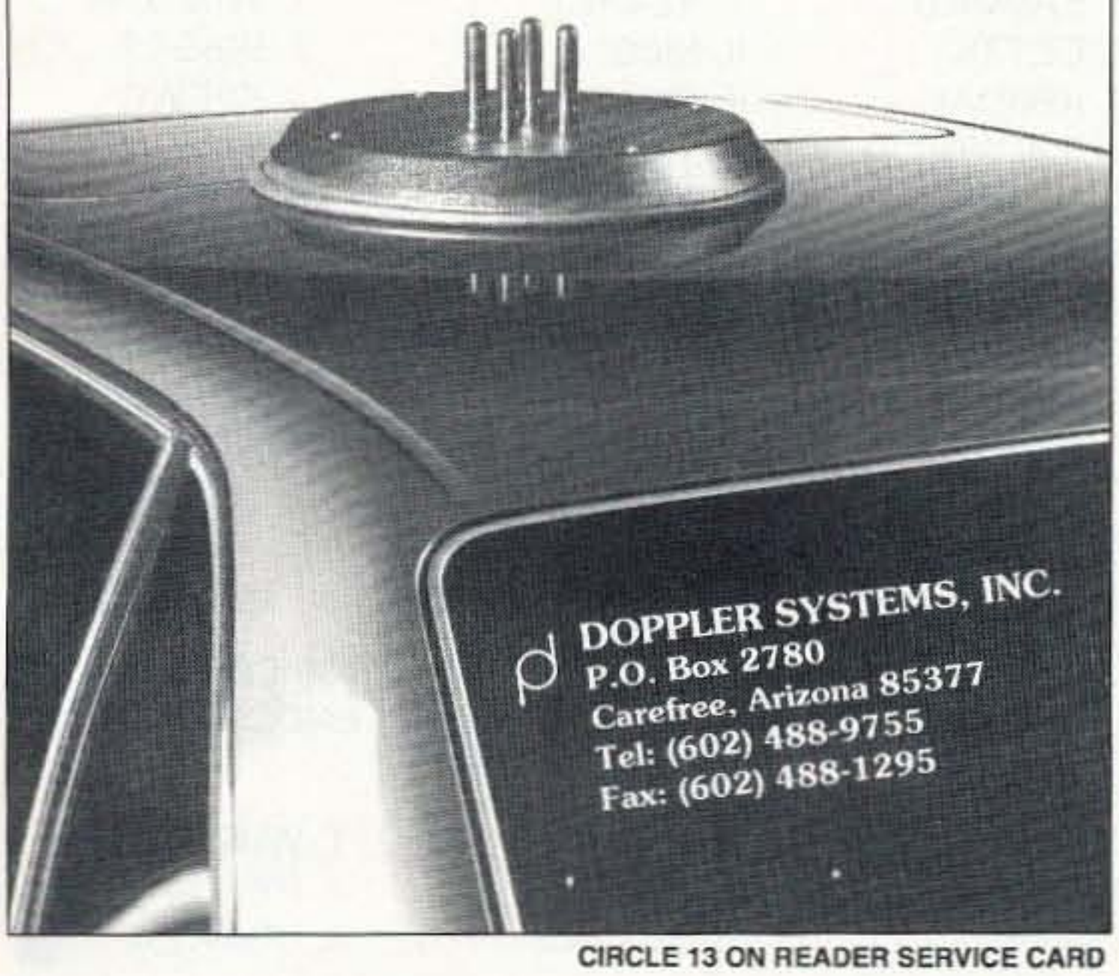

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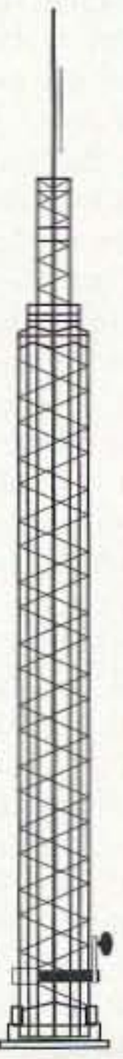

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379. KB2NEK
380. PY2DBU
381. WA2CKP
382. WB2PPN
383. JA1-2Ø762/BV
384. AB4ZD
385. YC8EMH
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389. KB4BCC
390. VE7GSE
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30. JA8CAQ
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36. F6IFE
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40. KD2WQ
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43. 9Q5NW
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46. KD3CR
47. N8IMZ
48. GØFWG
49. N2FPB
50. KE6KT
51. OZ9BX
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53. CE1YI
54. YBØHZL
55. JN3XLY
56. KA9MRU
57. CE7ZK
58. KB8DAE
59. K2EWB
60. NI5D
61. KD3CQ
62. KA4OTB
63. WB2VMV
64. KD4MM
65. KD9HT
66. KA3NIL
67. NØ1DT
68. KA1TFU
69. KA4TMJ
70. JA4TF
71. KA3UNQ
72. KB8ZM
73. K2EWA
74. WA1S
75. PY4OY
76. WCØA
77. OZ1FNX
78. KA7EXD
79. ON6DP
80. VE1RJ
90. N6WK
91. WA3KKO
92. KB9ABI
93. SMØBNK
94. WAØQIT
95. 5Z4BH
96. OA4ANR
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112. EA6AAK
113. N3IHS
114. WA2CKP
115. VE6AML
116. WAØCLR
117. WA1MKS
118. KD6MOS
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120. LU5EWO

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4. IK8GCS
5. NØAFW
6. WB1BVQ
7. VE4ACF
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9. N6GCB
10. K8MDU
11. YU2EJU
12. KE8LM
13. WD5N
14. F6IFE
15. 5NØWRE
16. KE2CG
17. I3VKW
18. CE1YI
19. W6BCQ
20. CE7ZK
21. KB8DAE
22. K2EWB
23. KD3CQ
24. KD4MM
25. KD9HT
26. KA4TMJ
27. N7GMT
28. JA4TF
29. K2EWA
30. WA1S
31. PY4OY
32. ON6DP
33. VE1RJ
34. WA3KKO
35. WAØQIT
36. 5Z4BH
37. HL5FRG
38. JAI-2Ø762/BV
39. VE6AML
40. LU5EWO

250 COUNTRIES ENDORSEMENT

1. WB2DIN
2. IK8GCS
3. WD5N
4. K8MDU
5. KE2CG
6. CE1YI
7. CE7ZK
8. K2EWB
9. KD9HT
10. N7GMT
11. KD3CQ
12. KB8DAE
13. WA1S
14. PY4OY
15. VE1RJ
16. 5Z4BH
17. N2BI
18. I75OI56
19. VE6AML
20. KB8ZM
21. LU5EWO

300 COUNTRIES ENDORSEMENT

1. WB2DIN
2. IK8GCS
3. K2EWB
4. K8MDU
5. N7GMT
6. WA1S
7. PY4OY
8. KD3CQ
9. VE1RJ
10. UY5XE
11. IK3ITX
12. VU2SMN

350 COUNTRIES ENDORSEMENT

1. WB2DIN
2. PY4OY
3. UB4WZA

NEVER SAY DIE

Continued from page 8

room? I forget how many hundreds of billions of dollars the whole thing was estimated to cost.

My question resulted in more obfuscation, and a shift to an even higher level of encrypted language. After my asking my question about four times I finally got a grudging yes, that's about what it all adds up to. I told the colonel he and the Air Force master minds who thought up this one were crazy. I suggested they use technology instead of brute force to solve their problems, and that if they insisted on pursuing this I'd raise all the hell I could, and do my best to embarrass them for such a stupid and expensive idea.

Well, it never happened, though I don't know if my grain of sand's worth of resistance had any part in their abandoning the project. Anyway, we didn't lose 450 MHz back in 1956.

While I was there they introduced me around. One of the chaps I met was in charge of assigning berths to the media on Navy ships. I said, hmm, what have you got open? Well, they had a supply ship going to Antarctica with an opening. I told 'em to hold it for me. It was a three-month trip, so I didn't have the time to go, much as I'd have liked to. But I thought I might be able to talk Jim Morrissett K2OLK, who'd been my assistant editor for a couple of years, into making the trip on assignment. I asked what the possibility was of my reporter taking along a ham station to use on the ship. No problem, except I'd have to get permission from the captain of the ship.

Sure enough, Jim liked the idea, so I sent him a Retina IIIc 35mm camera for the photos and arranged for a Hallicrafters transmitter and receiver for the ship. Then I set about getting permission from the ship's captain. He said he had no objection, but of course I'd have to get it okayed by the Navy Chief of Communications, Admiral Bruton. The Admiral nixed the ham station, for no reason I could see, and he flatly refused to discuss the matter.

So I wrote an editorial explaining exactly what had happened. And, since I had my editorial work done a few weeks ahead of schedule, I took off for a scuba diving trip to Acapulco. Well, there was this fantastically beautiful British girl I'd met in Bermuda who was also into diving, and who was working for a dive shop there. But that's another story. The diving was great and I got some spectacular pictures.

But when I got back to the US I found myself in Great Big Trouble. It seems that my assistant editor, Art Brothers W7NVY, thought my editorial didn't have quite enough zing to it, so he edited it a bit. The word "traitor" was added and Admiral Bruton was not amused. The publisher, Art, and I were soon facing

Continued on page 43

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In order to have time to return tickets to you, we must have advanced registration orders postmarked not later than May 3 (USA) or April 26 (Canada). Tickets will not be mailed before January 15th,1996. Ticket requests that are received **AFTER** the deadline will be processed and **HELD** for pick-up at the Hamvention Office in the Silver Arena. Tickets can be picked up beginning Thursday, May 16 at 8:00 a.m.

Flea Market

Flea Market Tickets (valid all 3 days) will be sold IN ADVANCE ONLY. No spaces sold at gate. A maximum of 3 spaces per person (non-transferable). Electricity is available in a portion of the last Flea Market row for $50 additional. Rental tables and chairs are not available in the Flea Market. Vendors ***MUST*** order an admission ticket for each person when ordering Flea Market spaces. Please send a separate check for Flea Market space(s) and admission ticket(s). Spaces will be allocated by the Hamvention committee from orders mailed by February 5. Please use 1st class mail *only*.

Notification of Flea Market space assignment will be mailed on or about **March 25, 1996**. Please indicate in the box below if you would like to attend regardless of Flea Market space assignment.

HAMVENTION Is sponsored by the Dayton Amateur Radio Association Inc.

Advance Registration

Enclose check or money order for amount indicated in U.S. dollars and type or print your name and address clearly.

Make checks payable to:

Dayton HAMVENTION Mail to -
Dayton Hamvention Box 1446, Dayton, OH 45401-1446

	How Many		
Admission (valid all 3 days)	_____	@ $12.00*	$_____
Grand Banquet	_____	@ $23.00**	$_____
Alternate Activities			
Saturday Luncheon	_____	@ $9.00	$_____
Sunday Luncheon	_____	@ $9.00	$_____
		Total	**$**_____
Flea Market ‡ (Max.3 spaces)	_____	$45/1 space	
	_____	$100/2 adjacent	
	_____	$200/3 adjacent	$_____
Electricity	add _____	$50.00	$_____
Covered tent	_____	$290.00 ea.	$_____
		Total	**$**_____

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❑ Send admission tickets **regardless** of flea market space assignment.

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* $15.00 at door
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Simple Secondary Frequency Standard

Stay within your legal frequency.

J. Frank Brumbaugh KB4ZGC
P.O. Box 30
Salinas PR 00751-0030

Every ham is required by the FCC to make certain his or her transmitted signals are entirely within the band or subband appropriate to the license class. Operating outside assigned frequency band segments invites "Pink Slips" from the FCC, requiring explanation as to why the offense occurred and what means are being used to prevent it happening in the future. Continued off-frequency operation can result in fines, possible jail time, and even cancellation of your license. Because of this, most hams have either expensive, fancy commercial transceivers with digital frequency readout controlled by a crystal, or they build and use a secondary frequency standard, commonly called a "crystal marker generator." It is for hams whose budgets don't include a thousand dollars or more for a fancy commercial transceiver loaded with bells and whistles that this article is presented.

"This marker generator provides accurate marker RF signals at 1 MHz, 100 kHz, 50 kHz, 25 kHz, and 10 kHz when the crystal oscillator is zero beat with WWV or otherwise set to exactly 10 MHz."

There are a number of marker generator circuits presented in the ham magazines as well as in the *ARRL Handbook*. Most, however, specify the use of a crystal at 100 kHz or 1 MHz. A glance at the listing of crystals for sale in any mail order parts dealer's catalog will show that crystals of these frequencies are rather expensive. It is possible (and very simple) to build a marker generator based on a much higher crystal frequency, *plus* it has advantages in long-term stability over the lower frequency crystals usually specified. It also saves money, because surplus microprocessor crystals usually cost only about $1.00.

Every crystal, regardless of cost, is subject to "aging" which results in a change in frequency, although some crystals are far more stable over time than others. Hams are interested primarily in 100 kHz and 25 kHz marker frequencies because these accurately mark the edges of most bands and subbands. A low-frequency crystal drifting off frequency causes these markers to drift, too, which could result in out-of-band operation, with the unfortunate consequences mentioned in the first paragraph. However, a crystal of a frequency of 10 MHz which also drifts a bit will not cause the same amount of error as the low-frequency crystal, because its frequency, and drift, is divided by a factor of 100 at 100 kHz, and 400 at 25 kHz. In "real life," after the 10-MHz crystal has been adjusted to exactly 10 MHz, either by using a frequency counter or by zero beating the crystal with the signal from WWV, any drift in crystal frequency due to aging will be so minute after being divided down to the desired 100 kHz or 25 kHz that it cannot be heard. For all practical purposes, the divided marker frequencies will remain accurate over time.

The secondary frequency standard—the crystal marker generator described here—is based upon the use of a 10-MHz surplus microprocessor crystal as its standard. It is called a "secondary" standard because it is set to frequency with a frequency counter or by zero beat with the carrier transmitted by WWV. Primary Standards are those maintained by the National Bureau of Standards, which are very precise and very expensive, and serve, among other things, to establish the carrier frequency of WWV and WWVH.

This marker generator provides accurate marker RF signals at 1 MHz, 100 kHz, 50 kHz, 25 kHz, and 10 kHz when the crystal oscillator is zero beat with WWV or otherwise set to exactly 10 MHz. It uses the fewest, most common, inexpensive, and readily available components: one crystal, one 5-volt regulator, five TTL logic ICs (commonly called "chips"), three 1/4-watt resistors, two disc ceramic capacitors, one small trimmer capacitor, one ON-OFF switch, one 9-volt battery, and one single-pole five-position wafer switch. The total cost, using all new "surplus" parts, will be less than $10.00. This is very inexpensive insurance to make certain all your transmissions are on legal frequencies!

Circuit Description

Fig. 1 is the schematic diagram of this instrument. Refer to this illustration for the following discussion. Battery B1 (9 V) provides power through S1 to a 5-volt regulator, U6, a 78L05, which provides regulated +5 VDC to the five ICs—chips—which provide all the marker frequencies from 1 MHz down to 10 kHz.

U1, a 74LS00, is a quad two-input NAND Gate. Two of its sections, U1a and U1b, are connected to form an oscillator circuit controlled by the 10 MHz crystal, Y1, which is adjusted to frequency by trimmer capacitor C2. 'The remaining two sections are connected to form inverters and provide the output signal of 10 MHz at pin 11.

The 10-MHz output from U1 is applied to the pin 1 input of U2. U2, a 74LS90, is a divider connected to divide by 10. U2 divides this 10 MHz to 1 MHz and provides its output at pin 12. This 1 MHz signal is routed to the first position terminal of S2, and also to the pin 1 input to U3.

U3 is a 74LS90 divider also connected to divide by 10. It divides the 1-MHz input to 100 kHz and provides its output at pin 12. This 100-kHz signal is routed to the second position terminal on S2, and also to the pin 11 input of U4.

U4 is a 74LS74, a dual flip-flop configured to divide by both two and four, producing 50 kHz at pins 3 and 9, and 25 kHz at pin 5. The 50 kHz from pins 3 and 9 is routed to the third position terminal of S2, and also to the pin 1 input of U5. The 25-kHz output from pin 5 of U4 is routed only to the fourth position terminal of S2. U5 is a 74LS90 configured to divide by five. It divides the 50-kHz input and produces a 10 kHz signal at pin 11. This 10 kHz signal is routed to the fifth position terminal of S2.

C3 connects from the wiper terminal of S2 to the output connector of the builder's choice. C3 also serves to block the DC voltages of the divider chips from appearing at the output.

Construction

This unit may be constructed on a piece of perfboard, or one of the general purpose printed circuit boards available from Radio Shack. It could also be constructed "dead bug" style by gluing the chips upside down on a piece of circuit board stock, perfboard, plastic, even wood. Lead lengths should be kept reasonably short, especially around U1. Other leads are not critical; just use common sense.

Caution: Pinouts of all chips and the 78LO5 regulator are illustrated in Fig. 1. Pinouts of all chips are shown from the top of the chip. Pinout of the regulator is shown from the bottom. Make certain you are connecting to the specified pins!

If you use perfboard or a printed circuit board you may install 14-pin DIP sockets and do all your wiring before plugging the chips into the sockets. Sockets are not necessary but you may use them if you wish.

In soldering to the pins on the sockets or chips, and to the pads on a printed circuit board, be extremely careful, not only to make solid, shiny solder joints, but to avoid "solder bridges," which occur when too much solder is applied, accidentally bridging two adjacent pads or pins. Use a 25- or 30-watt soldering pencil with a small tip, and always use rosin core solder, preferably marked "60-40" or "63-37," indicating the tin and lead proportions in the solder.

Warning! Never use acid core solder in electronics: It will corrode the connections and ruin anything built with it.

Before applying power, carefully inspect every connection, every solder joint. Correct any poor solder joints and eliminate any solder bridges. If you use DIP sockets, be absolutely certain the chips are inserted in the proper locations and in the proper heading—pin 1 on the chip to pin 1 on the socket. It will be helpful if you mark (with a dot of white paint, perhaps) the position of pin 1 on top of each chip, and also on the corner of each socket.

Because this marker generator is a digital circuit, it will either function perfectly or not at all. If it doesn't work you have made a wiring error, or you have plugged a chip into the wrong socket. Go back and check *everything* against the schematic diagram in Fig. 1.

Calibration

If you own, or can borrow, a frequency counter that you know is accurate, use it with a probe to measure the frequency at pin 11 of U1. Using an insulated screwdriver which fits the slot in C2, slowly adjust C2 for a frequency of 10.000000 indicated on the frequency counter. Then also check the frequency at each marker output from S2. You should find 1.000000, 0.100, 0.050, 0.025, and 0.010 indicated on the cou nter. If any output frequency is missing or in error, you have made an error during construction, which you will have to find and correct.

You can also zero beat this unit against the carrier of WWV. Usually, 10 MHz is the most likely frequency where WWV can be heard throughout the USA, Canada, and northern Mexico. Elsewhere in the world WWV also transmits on 2.5, 5.0. 10.0 and 15.0 MHz. Any frequency where WWV can be heard clearly can be used for calibration.

With a receiver tuned to WWV, and S1 on the marker generator in the ON position, either place the marker generator close to the receiver, or connect, with a piece of wire a couple of feet long, the receiver antenna connector to the whip antenna if you are using a typical "world band" portable radio. With an insulated screwdriver, adjust C2 as described above until you hear the squeal of the marker crystal beating against WWV. Adjust C2 until the signals are in zero beat or very close. Besides the time ticks at one-second intervals there is a 600-Hz tone transmitted most of each minute. The time in Coordinated Universal Time (UTC) is announced by a male voice (USA) or female voice (WWVH

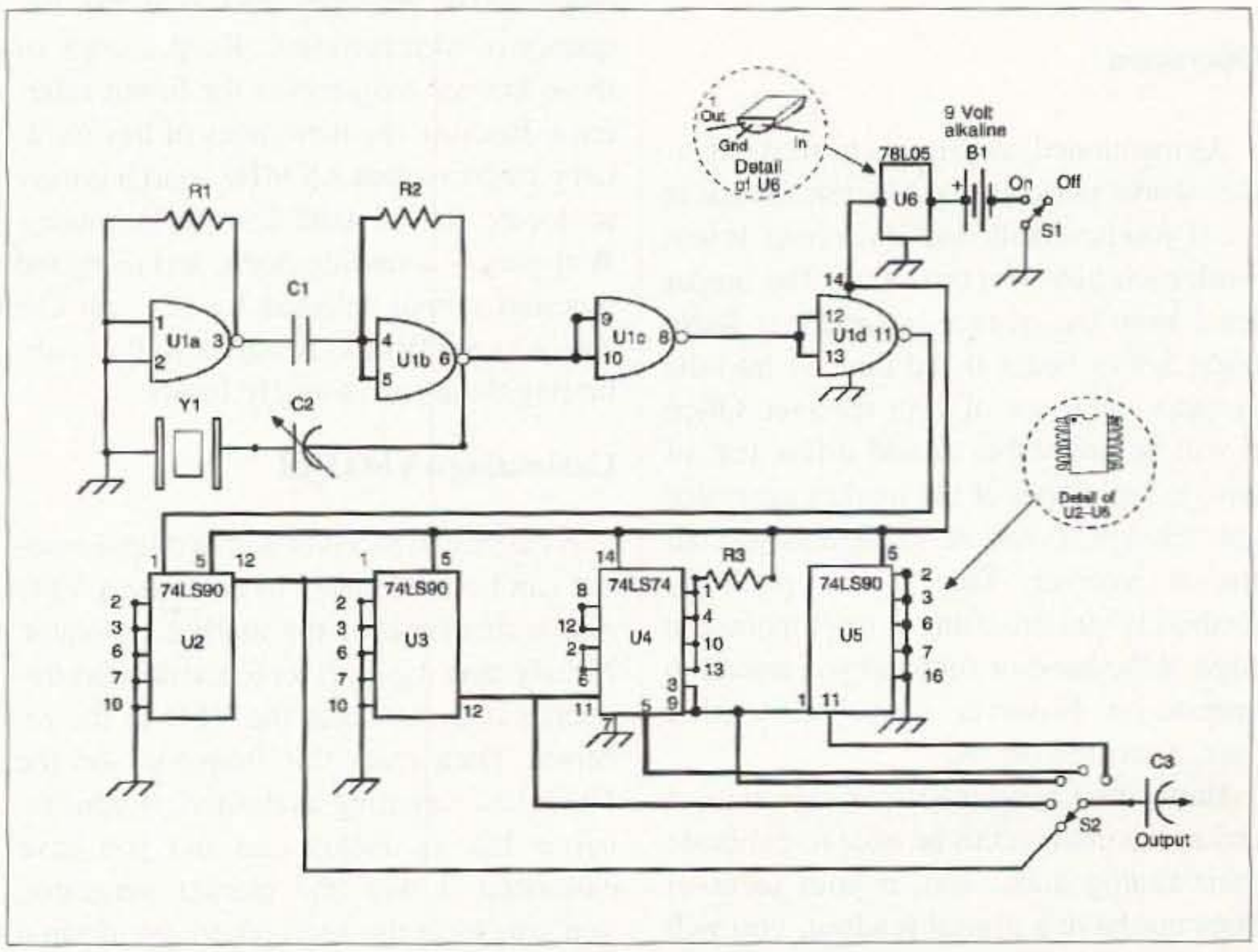

Fig. 1. Schematic for the simple secondary frequency standard.

Hawaii) at the end of each minute. Forty-five seconds after the voice announcement begins a silent (except for time ticks) period 7-1/2 seconds long. For greatest accuracy of calibration, adjust C2 to as close to a perfect zero beat with WWV's carrier as possible. This period should be long enough if you were close to zero beat earlier, but if necessary you can wait one or two minutes and recheck zero beat until you are satisfied it is the closest you can come.

Caution: Be certain the screwdriver you use to adjust C2 is non-metallic. C2 has both terminals floating and is a critical component in the oscillator. Using a metal screwdriver tip will make it impossible (due to "hand capacitance") to get to an accurate zero beat.

Now check the marker frequency at each position of S2 by tuning the receiver carefully and checking against its dial. Unless the receiver dial has a digital readout it will probably not be exactly accurate, but will be close enough that you can tell if the desired marker frequency is missing or if it is far off frequency. Either result indicates an error in construction which you will have to locate and correct.

This completes calibration of your secondary frequency standard. It can be used and totally trusted for years, although a recheck of the crystal frequency as described above should be made after six months, and then once every year from then on. A slight adjustment of C2 may be required to put the crystal frequency back "on the nose."

Operation

As mentioned earlier, this instrument either works perfectly or it doesn't work at all. If you have followed directions, it will work each time you turn it on. The output level from the marker generator is fairly high, S-9 or better if fed directly into the antenna connector of your receiver. Often it will be preferable to add a few feet of wire to the output of the marker generator and allow it to radiate its signals to your station receiver. This is the preferred method if you are using it to pinpoint the edge of the band or subband you intend to operate on. However, it has many other uses, discussed below.

Hams who build their own transmitters and receivers need to be able to calibrate their analog dials. Too, if your receiver does not have a digital readout, you will need to use the marker generator to locate specific frequencies—that is, within 10 kHz because the lowest frequency markers are 10 kHz apart.

Calibrating a Receiver Dial

To begin, you'll need a known frequency. The simplest way of determining this is to tune the receiver to around where you think the low edge of the ham band should be. Note the activity on the band. At the lower edge of this activity—1.8, 3.5, 7.0, 14.0, 21.0 or 28.0 MHz—turn on the marker generator and set S2 to 1 MHz. Tune the receiver for zero beat—it is assumed either a BFO or product detector is included in the receiver. Mark the dial with the proper band edge frequency. Then, selecting other frequencies with S2 you can locate and mark frequencies within the band, even down to every 10 kHz if desired.

A slightly more complicated way of locating known frequencies is to build a small crystal oscillator using a color-burst crystal whose nominal frequency as marked is 3.579545 MHz. Duplicate the U1 portion of the schematic diagram, Fig. 1, remembering to supply +5 VDC to the 74LS00 chip. Do not include C2, but connect the crystal directly between pins 1-2 and 6. This crystal will produce frequencies either within or very close to every HF ham band between 80 and 10 meters, including WARC bands. However, you will have to check the crystal fundamental frequency with a frequency counter because it *will not* be exactly 3.579545 MHz. When the fundamental frequency is accurately known, use a calculator to multiply the fundamental frequency and note the frequency of each harmonic. Keep a copy of these known frequencies for future reference. Because the harmonics of this oscillator are more than 3.5 MHz apart it is easy to locate the desired known frequency. With this as a starting point, and using the required output selected by S2, you can easily locate WARC bands as well as calibrating these and other HF bands.

Calibrating a VFO Dial

A calibrated receiver with a digital readout can be used easily to calibrate a VFO dial without use of the marker generator. Merely tune the receiver to the desired frequency and zero beat the VFO to the receiver. Then mark this frequency on the VFO dial, repeating as desired. If your receiver has an analog dial and you have calibrated it with the marker generator, you can tune the receiver to the desired frequency as described in the preceding paragraph, repeating this procedure as necessary. If the receiver you are using has an analog dial, such as a portable shortwave receiver that covers the ham band frequencies, you can locate the lower band edge by setting S2 at 1 MHz and tuning the receiver slowly while looking at the receiver dial closely until you achieve zero beat. Dial scales on these receivers are inaccurate but usually not so far off that the proper 1-MHz signal cannot be located accurately. It is assumed the receiver contains a BFO or product detector and is capable of receiving SSB and CW. If this is not the case it is not recommended that this receiver be used. While it is possible to locate—approximately—the 1-MHz signal by a peak in the level of the rushing noise from the receiver, this is not precise enough to be trusted. You'll have to either borrow a suitable receiver or take your VFO to a local ham who does have a usable receiver.

Conclusion

Although this crystal marker generator produces usable harmonics at frequencies well above and below the MF and HF ham bands, it is intended for hams operating from 160 through 10 meters. ("Lowfers," unlicensed but legal operators in the 160-190 kHz band, can also use this unit to calibrate the receivers and VFOs of their 1-watt stations.) Because it covers such a broad frequency spectrum with signals of known frequency, spacing and accuracy, the marker generator can take the place of a less accurate signal generator in general radio servicing, including calibration checking and alignment. Despite its many other possible uses, it is presented here primarily as a useful aid to prevent accidental operation on frequencies not available to your license class. 73

Parts List

B1	9-volt alkaline battery
C1	0.01-µF disc ceramic capacitor
C2	5-60-pF trimcap, Murata etc.
C3	47-pF disc ceramic capacitor
R1, R2	560-ohm watt 5% resistor
R3	1k-ohm watt 5% resistor
S1	SPST toggle or slide switch
S2	1-pole 5-position wafer switch
U1	74LS00 quad 2-input NAND Gate
U2, U3, U5	74LS90 Decade Counter
U4	74LS74 Dual-D Flip-Flop
U6	78LØ5 5-volt regulator
Y1	10.000000-MHz microprocessor crystal

NOTE: The output connector suggested in Fig. 1 can be a binding post, RCA jack, or any other type connector you wish to use.

The Tiny Tic-Tac Tester

This useful and easy-to-build tester is a good first-time project.

Sam Ulbing N4UAU
5200 NW 43rd St. #102-177
Gainesville FL 32606

It is often useful to be able to check the voltage of your batteries. For instance, you may wonder if your handie-talkie is charged or not. Unfortunately, most batteries, especially rechargeable batteries, do not change voltage much between being fully charged and nearly discharged, so a very accurate meter is needed. Good digital multimeters will work well, but they are expensive and bulky. The tiny Tic-Tac tester is an alternative that is very small (you can carry it in your shirt pocket), inexpensive and quite accurate. The tester doesn't require batteries to work since it takes the little power it needs from the source it is testing! Photo A shows one I built in a Tic-Tac container, hence the name. As you can see, it is small—about 1-1/2" x 2" x 1/2" thick. An experienced builder could put it in an even smaller case.

How It Works

Fig. 1 shows the schematic of the tester. The only parts used are one IC, 10 LEDs for display, four fixed resistors and one potentiometer. If you use the available (from me) PC board you will probably spend more time putting the project in an enclosure than you will soldering it together!

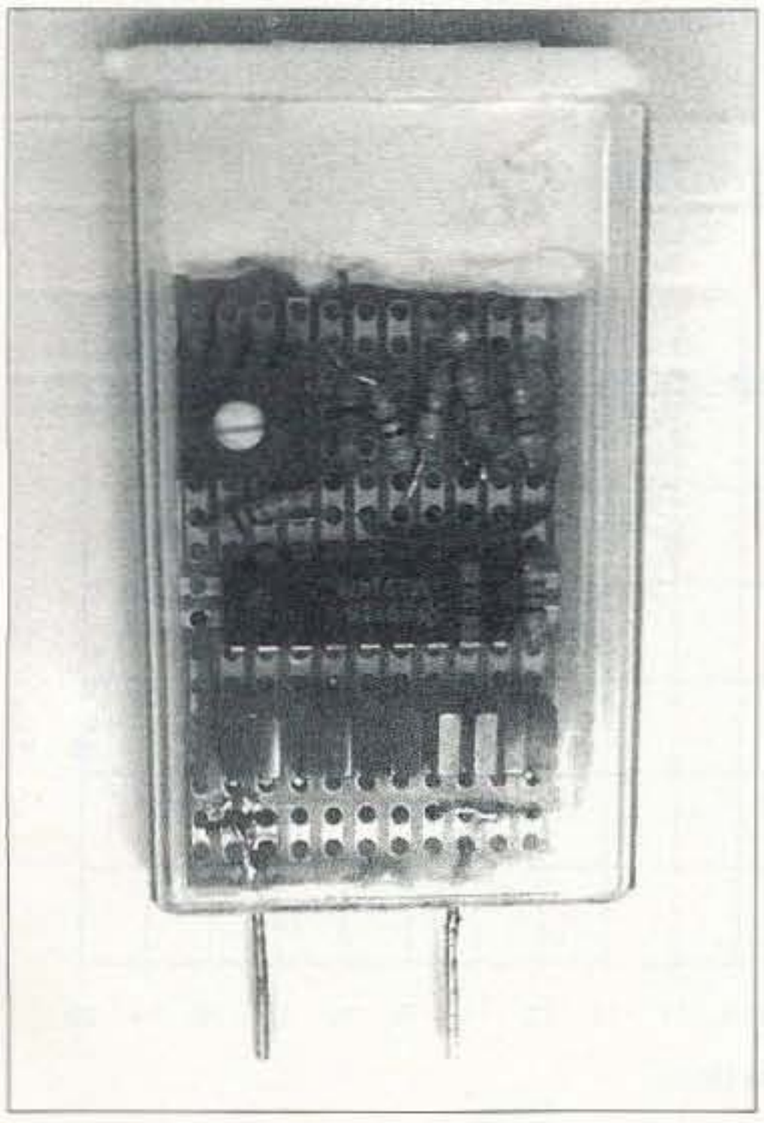

Photo A. The tiny Tic-Tac tester.

The heart of the tester is an IC called the LM3914 which contains 10 voltage comparators connected to a 10-step resistive divider and an on-board voltage reference. The comparators on the chip work like any standard comparator. When the voltage on the minus pin is greater than the voltage on the plus pin, the output of the comparator goes to ground and lets current flow through the comparator output port. When the minus pin voltage is less than the plus pin voltage, the comparator output floats and no current can flow to ground. The internal comparators are used to turn on the display LEDs. As the signal voltage increases, more LEDs will turn on. What values of signal voltage will turn on the LEDs depends on the "control voltage" at the positive terminal of each comparator. By setting a reference voltage across the internal voltage divider of the LM3914, the comparators can be made to turn on in 10 equal steps of one-tenth the voltage across the divider. The LM3914 makes it easy to set any desired voltage across the divider.

The voltage to be measured, which powers the chip, goes to pins 2 and 3 of the LM3914 (see Fig. 1). A voltage divider, formed by R4 and R5, reduces the voltage by half and applies it to pin 5, the buffered signal input pin. It is important to use this divider because the voltage to be measured must be at least 1.5 volts *less than* the voltage powering the chip.

R3 is connected between pin 7 and pin 8, which is the on-board reference voltage. Since the reference voltage is known and so is R3, a known current is

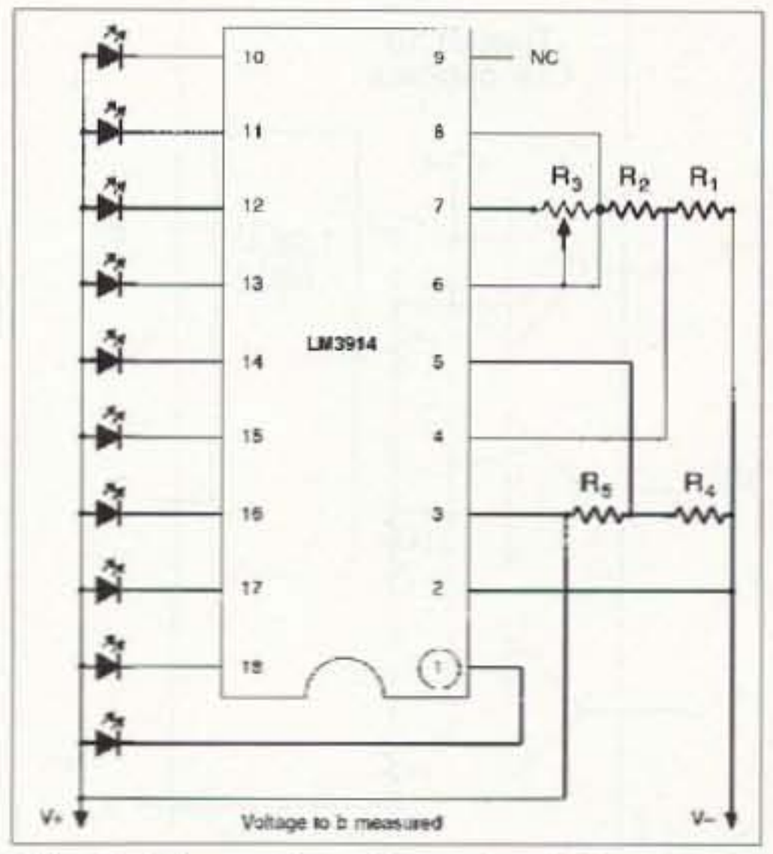

Fig. 1. *Shows the schematic of the Tic Tac Tester. It's easy to build, accurate and can be carried in your shirt pocket.*

generated through R3 (I1 = VRef ÷ R3). This current (plus a small current from pin 8) flows to ground through R2 and R1. By selecting R1 and R2, any desired voltage can be set at points VLow and VHi. Connecting pins 4 and 6 to VLow and VHi gives us the desired control voltages for the comparators.

A control switch not shown in Fig. 2 lets the user program how the LEDs are turned on. If pin 9 is left floating, only one LED at a time will be turned on (called dot mode). As the voltage increases and a new LED comes on, the last LED will turn off. This mode is useful for low power use. If pin 9 is connected to pin 3, each LED will stay on (called bar mode). When the input voltage reaches the VHi value, all the LEDs will be on.

The LED display has an advantage over a digital display because it is easy to read at a glance even from a distance. By making the LEDs different colors, it is possible, for example, to display low voltage as red, OK voltage as green, and high voltage as yellow.

Building A Tiny Tester

What follows is somewhat technical; if you are not interested in how I got my

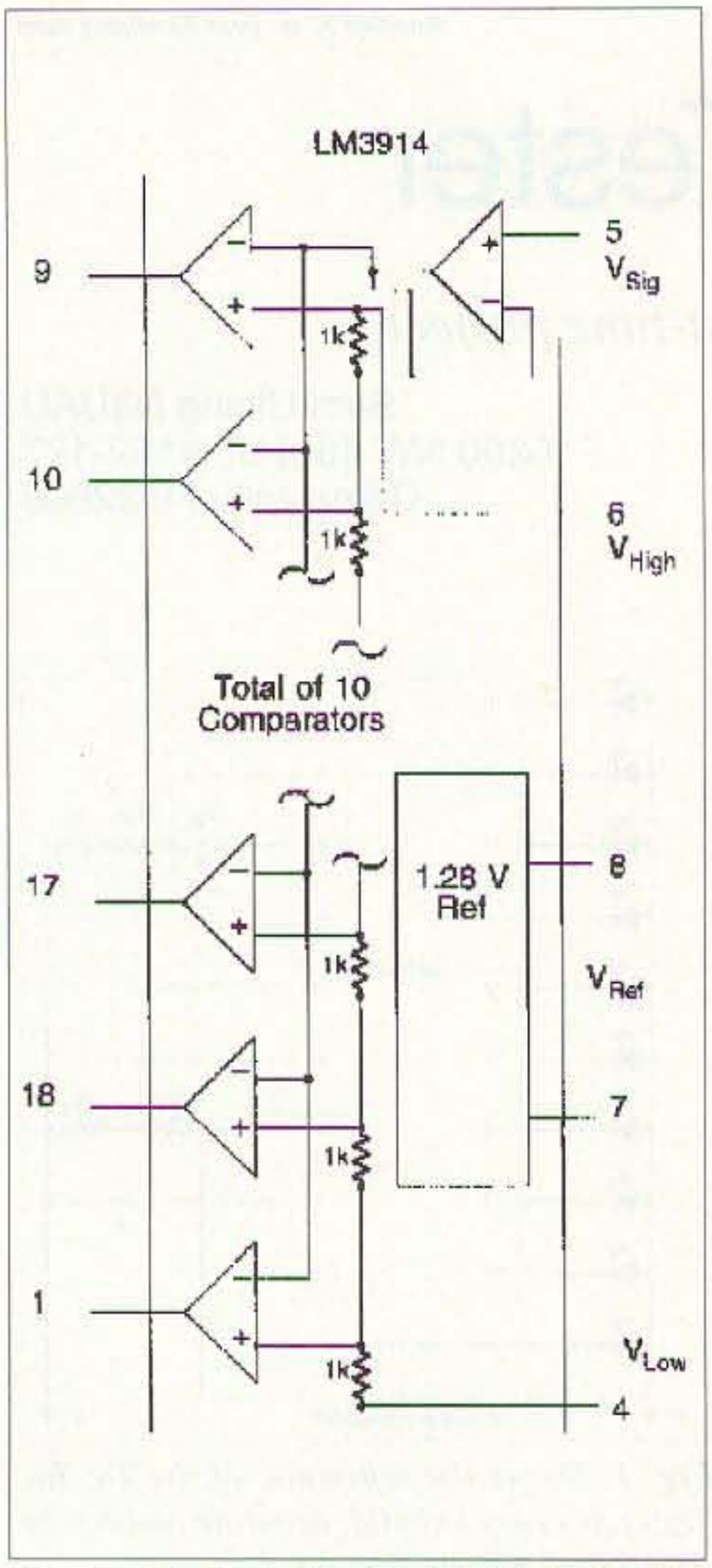

Fig. 2. A look inside the LM3914, the chip has a total of 10 comparators.

resistor values but only want to know what values to use for your tester, you can go directly to Table 2. Many variations of this meter can be built. I will discuss the one I built to check the voltage of my Kenwood handheld. It has nickel rechargeable batteries and the pack says it is 8.4 volts. Because "nominal" voltage for NiCds is 1.2 volts, I know it has seven cells.

A fully charged NiCd (see Fig. 3) is about 1.40 volts, and when it reaches about 1.14 volts it is pretty much discharged. For my tester, I chose:

$$V_{Hi} = 1.40 \times 7 = 9.80 \text{ volts}$$

I wanted the first LED to come on when the battery voltage was greater than

$$1.14 \times 7 = 7.98 \text{ volts}$$

As you can see from Fig. 2, the first LED will not turn on until the signal voltage is equal to V_{Low} plus one-tenth of the internal voltage divider difference. With a voltage across the divider of:

$$9.8 - 7.9 \approx 2 \text{ volts}$$

Each step is about 0.2 volts, so I set

$$V_{Low} = 7.98 - 0.2 = 7.8$$

Another design consideration was current draw. Since I was powering this meter from the batteries I was measuring, I wanted a small current draw. Obviously I chose "dot mode" rather than "bar mode." Further, the chip has built-in current limiting of the LED, which is why no resistors are needed in line with them. The current through an LED is limited to 10 times the current through R3. I decided to make LED current about 5 mA so the total current draw would be 10 mA. Although the LEDs are not as bright as if they had a full 20 mA, the LEDs I used are clearly visible in daylight. The value needed for R3 to get this current is:

$$R = f(V,I) = f(1.28 \text{ volts}, 0.5 \text{ mA}) = 2560\ \Omega$$

I used a potentiometer for R3 because the accuracy of the reference voltage is only about ±5% and to measure the NiCds I needed more accuracy. The potentiometer allowed me to fine-tune I1 for more accuracy on VLow and VHi.

Since I knew I1 and the voltages I wanted at points VLow and VHi, I could determine R1 and R2:

R1 = f(1.12 Volts,0.5 mA) and R2 = f((1.4 – 1.12),0.5)

It's that easy. Well, almost that easy. In fact better accuracy is obtained by including a few other factors. The internal 10kΩ divider acts as a parallel resistor to R2 and there is also a small current from pin 8 to drive the reference voltage. Table 1 shows the actual calculations I used to include these factors and Table 2 shows values for some common battery configurations.

Note in Table 2 that, for seven cells, the 10 steps from 1.12 to 1.40 are each about 200 millivolts. This is a precision of:

$$f(0.200, 8.00) = 2.5\% \pm 1.25\%$$

This is a pretty precise device. This fact needs to be considered when building the meter. Most resistors are ±5% resistors so they have four times the error of our meter. Obviously ±1% resistors will work much better. In fact, I put together several ±5% resistors and measured their actual values to get less than 1% error.

Once you have soldered the meter together, you need to make only one calibration. Connect the battery pack you plan to measure and measure V_{Low}. Adjust R3 until V_{Low} is the desired value. That's it.

I put a couple of rather stiff wires off the edge of the PC board. By filing a small set of notches in the top of my

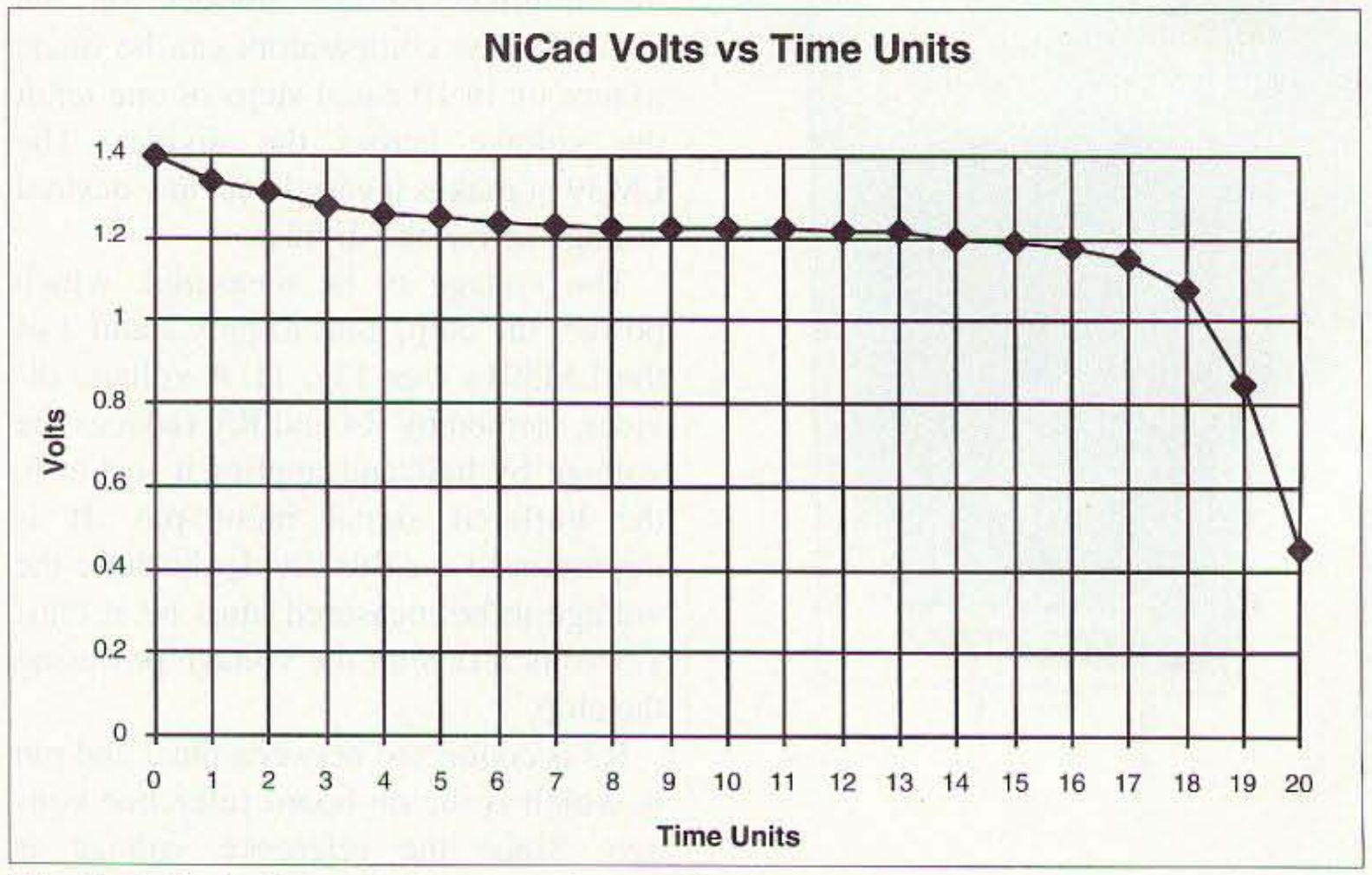

Fig. 3. Typical voltage vs. time curve for NiCd battery under load.

handheld's battery pack, I was able to insert the tester and touch the battery terminals. This makes it easy to check battery voltage.

Limitations And Constraints

Such a simple device naturally has a few limitations:

1. You need to measure at least 3 volts for the LM3914 to work.

2. Total divider voltage ($V_{Hi}-V_{Low}$) should be at least 200 mV in bar mode and 500 mV in dot mode for best results.

3. Absolute max for supply voltage is 25 volts.

4. To increase the accuracy I did not include a protection diode. Connecting a battery backward will likely destroy the LM3914. So far, I have not tested this feature!

5. The voltage to be measured at pin 5 must be at least 1.5 volts *less than* the supply voltage.

Obtaining the Parts

Parts are readily available from the usual suppliers: Mouser, MCM, JDR Micro Devices, etc. A PC board is available from me for $5. If you prefer to buy the PC board and all of the parts (except the Tic-Tac box), that'll be $15. Please specify which of the versions in Table 1 you want to build so I can send the correct 1% resistors. Prices include shipping in the US. Florida residents please add sales tax for your county *(or move to New Hampshire, where there is no sales tax...Wayne).* 73

Table 1 Equations to select resistors

$R_3 = f(1.28, I_1)$
$R_1 = f(V_{Low}, (I_1 + 0.075))$
$R_2' = f((V_{Hi} - V_{Low}), (I_1 + 0.075))$
R_2' is a temporary variable used to make calculating R_2 easier
$R_2 = f(R_2' \times 10, (10 - R_2'))$

I1 is in mA
R_1, R_2 R_3 are in kΩ
V_{Hi}, V_{Low} are in Volts
R2' is a temporary variable used to make calculating R2 easier.

Remember: because of the voltage divider, V_{Lo} and V_{Hi} will be half the voltage of the battery you are measuring.

Table 2
Some Component Values for Selected Battery Configurations

	Vlow*2 (see note) volts	Vhi*2 volts	LED CURRENT milliamps	R3 kohms	R1 kohms	R2 kohms	Vlow LED NUMBER	VOLTAGE 1	AT 2	WHICH 3	LED 4	TURNS 5	ON/OFF 6	(Volts) 7	8	9	Vhi 10
NICAD CELLS																	
4	4.44	5.60	5	2.560	3.86	1.12	4.4	4.6	4.7	4.8	4.9	5.0	5.1	5.3	5.4	5.5	5.6
5	5.55	7.00	5	2.560	4.83	1.44	5.6	5.7	5.8	6.0	6.1	6.3	6.4	6.6	6.7	6.9	7.0
6	6.66	8.40	5	2.560	5.79	1.78	6.7	6.8	7.0	7.2	7.4	7.5	7.7	7.9	8.1	8.2	8.4
7	7.77	9.80	5	2.560	6.76	2.14	7.8	8.0	8.2	8.4	8.6	8.8	9.0	9.2	9.4	9.6	9.8
8	8.88	11.20	5	2.560	7.72	2.53	8.9	9.1	9.3	9.6	9.8	10.0	10.3	10.5	10.7	11.0	11.2
9	9.99	12.60	5	2.560	8.69	2.94	10.0	10.3	10.5	10.8	11.0	11.3	11.6	11.8	12.1	12.3	12.6
10	11.10	14.00	5	2.560	9.65	3.37	11.1	11.4	11.7	12.0	12.3	12.6	12.8	13.1	13.4	13.7	14.0
Alkaline Cells																	
3	4.35	4.95	5	2.560	3.78	0.55	4.35	4.41	4.47	4.53	4.59	4.65	4.71	4.77	4.83	4.89	4.95
4	5.80	6.60	5	2.560	5.04	0.75	5.8	5.88	5.96	6.04	6.12	6.2	6.28	6.36	6.44	6.52	6.6
5	7.25	8.25	5	2.560	6.30	0.95	7.25	7.35	7.45	7.55	7.65	7.75	7.85	7.95	8.05	8.15	8.25
6 (9Volt battery)	8.70	9.90	5	2.560	7.57	1.17	8.7	8.82	8.94	9.06	9.18	9.3	9.42	9.54	9.66	9.78	9.9
Lead Acid 6 Cells																	
	11.80	13.00	20	0.640	2.84	0.30	11.8	11.9	12.0	12.2	12.3	12.4	12.5	12.6	12.8	12.9	13.0

NOTE: V.oltages shown are actual voltages of the battery being measured. When calculating resistor values remember to account for the voltage divider of R4 and R5.
R4 = R5 = 10.0 kohms

Table 2. Some component values for selected battery configurations.

A New Look at the VXO

80 through 10 meter coverage using a TV color burst crystal.

Ken Cornell W2IMB
225 Baltimore Avenue
Point Pleasant Beach NJ 08742

In my experimental endeavors with frequency generating devices I became very fond of the Pierce oscillator, not only for crystal control but as a VFO using a coil in series with a blocking capacitor in lieu of the crystal. The basic Pierce oscillator circuit is described in almost all radio handbooks, so it needs no detailed mention here. However, it is always shown as a crystal-controlled device. By using quality parts and voltage regulation, it can be used as a respectable VFO.

The Coils

I decided to experiment using a coil in series with the crystal and an adjustable ferrite core in the coil to see how much of a frequency change I could get. There is a similar circuit shown in my *ARRL Handbook*, but they use a split-stator variable capacitor for the tuning and claim a maximum swing of some 15 kHz. I was looking for a much higher frequency excursion. Years ago, I wound a series of "honeycomb" coils ranging in size from 50 turns to 450 turns. I connected the 50-turn coil in series with a TV color burst crystal (3.57945 MHz) and poked a 1/4" ferrite rod into the coil field. I was surprised to see a frequency swing of 30 to 40 kHz. I should mention at this point that my coils were wound with Litz wire. This is an important point!

I fooled around for hours winding many coils using #28 to #36 enameled wire, but could not get satisfactory performance. I finally found that a coil with 60 turns of 14/44 Litz wire did the trick; the result is shown in Fig. 2. Why the solid wire would not work is still a mystery.

The 14/44 Litz wire that I used may be hard to find, but I've noted that 10/44 Litz wire is available from LF Engineering Co., 17 Jeffry Road, East Haven CT 06512, and from Amidon Associates, Inc., 2216 Gladwick Street, Dominguez Hills CA 90220.

"This circuit could be ideal for QRP transmitters and transceivers."

The coil assembly shown in Fig. 2 should be closely followed as far as the coil, ferrite rod and 8-32 aluminum screw feed are concerned. The coil is wound between two flanges cut from cardboard and spaced 1/4" apart. The coil contains 60 turns. The coil form sleeve can be of any insulating material and should have an ID of 1/16" to 3/32" larger than the ferrite rod.

The most difficult part of the assembly is to cement the 8-32 aluminum screw to the ferrite rod and ensure perfect alignment. The screw I used had a round head. I wrapped several turns of masking tape on the threads and chucked it up in my drill press. I placed a flat file on the drill press plate and ground the head flat. I then used the file and ground the head diameter down to 1/4". Next I wrapped masking tape around a 1" length of #8 ferrule to make the OD 1/4", then slipped it onto the screw. I then inverted a length of aluminum angle to form a trough and placed the ferrite rod in it. I applied epoxy cement to the head of the screw and placed it with the ferrule in the trough, then pressed it to the rod. This completed the screw and rod assembly. The balance of the coil construction should be self-explanatory, as shown in Fig. 2.

In operation, the coil will exhibit some frequency change when tuned by hand more than 15 to 20 kHz from the crystal frequency. I tried shielding the coil with a 1-1/2" diameter aluminum can and it lost the frequency change ability. However, when mounted within a Radio Shack™ 3" x 5-1/4" x 5-7/8" cabinet (RS #270-253) with the oscillator circuit, it performed satisfactorily. There was no problem with hand capacity detuning. I see no reason why a larger diameter ferrite rod can't be used using the same basic design and I hate to discourage experimentation.

Assembly

The oscillator circuit is shown in Fig. 1. I assembled it, without the coil, on a piece of perf board. C1 and C2 are 100 pF NPO disc capacitors. C3 and C4 are disc type. C5 should be the smallest value that will still provide enough drive to a buffer or multiplier stage. Quality

Fig. 1. Oscillator circuit.

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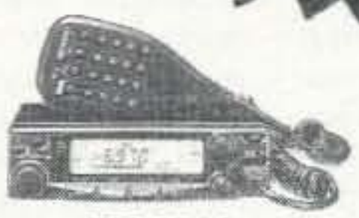

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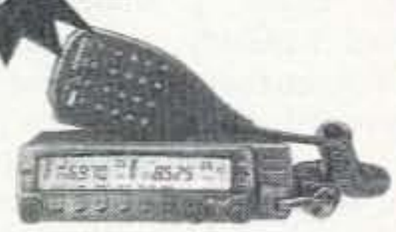

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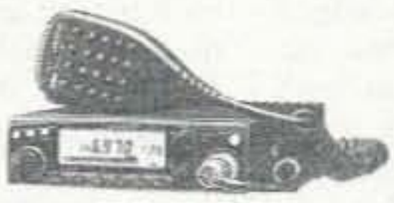

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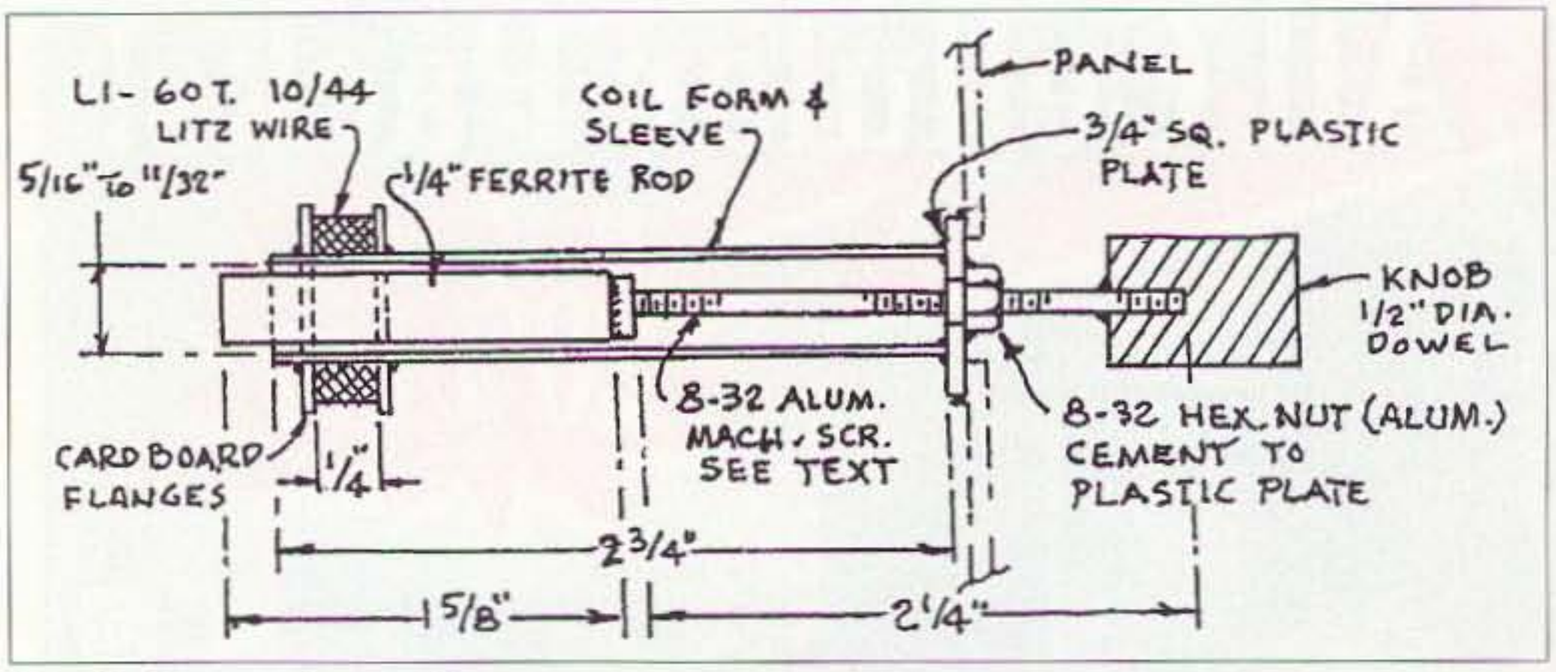

Fig. 2. Construction details.

parts and sturdy construction should be used, as well as voltage regulation.

For additional coverage of the 80 meter band, extra crystals could be used to suit the desired range.

With the ferrite rod withdrawn from the coil, the fundamental frequency is somewhat lower. Mine tuned to 3.578 MHz. At full penetration (the rod centered on the coil), to 3.489 MHz. Of course, the permeability (μ) of the rod will affect this. I would suggest, if possible, using a rod with a μ of over 800.

A frequency counter can be used on the output, or your receiver can be used to zero in on a desired frequency. Tuning is accomplished by turning the screw feed. It will take a little time to become familiar with the tuning as the feed vs. the frequency spread is not linear.

I used DURO™ "QUICK GEL" epoxy cement for all structural connections. It is the first single-solution epoxy cement that I have used that doesn't dry up in the applicator after a few uses. It is extremely strong and sets up fast. For cementing the coil flanges, I used household-type plastic cement.

I have not tried this scheme using other types of oscillator circuits, but you never know what a real "dyed-in-the-wool" experimenter will come up with.

While I don't claim extreme stability at the lowest frequency excursion, I do feel that this circuit could be ideal for QRP transmitters and transceivers.

I might note that many of the transistor AM radios use Litz wire for the antenna coil and some of the larger types use ferrite rods for the antenna (not the flat bar type). Check around for defunct sets. 73

LETTERS

Continued from page 6

Andris "Andy" Neimers VE7FJT. It did my heart good to see John Wagner W8AHB and you tackling the "studious indifference" shown Nikola Tesla by large segments of the US science establishment, even today. I first twigged to the fact that something really rotten was being perpetuated after reading an article on Tesla written by Commander E.J. Quinby in the November 1972 issue of *73*. (As a child he was an eyewitness to Tesla's radio controlled boat demonstration of 1898). Checking some scattered sources, I quickly concluded that a massive snubbing was indeed being perpetuated, given what this genius had invited in his lifetime. It also came to mind that even though I worked as a newspaper reporter for eight years in St. Catharines, Ontario, and visited Niagara Falls hundreds of times, I'd seen no evidence of Nikola Tesla acknowledged as the creative genius behind the power station complexes on both sides of the border. It's quite ironic since there is some evidence that this snubbing was, and still is, based on the hometown boy Edison versus offshore-born Tesla, in Smilijan, Croatia, even though Tesla himself said that getting his US citizenship in 1891 was one of the most cherished and proud moments of his life. The perpetuation of the Edison mystique, and the exclusion of Tesla, extends into US corporate speechwriting - something I am very familiar with. Even today, Edison quotes, wisdoms and sayings abound in speech reference materials, although I believe that some serious research would reveal that much of this Edison folklore is more "Hollywood" than from the man himself. For anybody who wants to get an insight of Tesla's brilliant range of inventions, I would suggest they read *Tesla - Man Out Of Time*" by Margaret Cheney: Dorset Press, New York 1981. I might warn you though that it is depressing reading since It brings Into sharp focus the struggle he had all his life for due recognition. Tesla had one serious weak spot which he wasn't capable of resolving, and it was the fact that his mind was so brilliant, creative, and quite easily bored, that he didn't and wouldn't take the time to bring too many of his projects to market before leaping off into another area of enquiry. Speaking of the "father of radio" aspect, John's short article also didn't have room to mention that among Tesla's accomplishment's was the first demonstration of remote control, by radio, of a model submarine he had built for the First Electrical Exhibition in Madison Square Garden in 1898. The US Navy seriously dropped the ball on that one and didn't pursue it even though they were given first options. I agree - let's grow up and give credit where credit is due - the true story of radio and electrical pioneering in America deserves better than this rather transparent and mean-spirited ignoring of historic facts.

Les Hannibal, Fair Oaks CA. The Tesla article by John Wagener is something I am quite familiar with, since in the early twenties an old friend told of being back in Colorado when Tesla's high voltage equipment blew the power company's generators by the unanticipated RF feedback. He helped rewind those generators. In the 1890s General Electric, under the Westinghouse-Tesla patents, built an experimental set of AC generators which they installed at Folsom prison, where a prison-built dam diverted the flow of the American River. It had two Francis turbines using a 10-foot head of water to run the generators. At the same time G.E. built a power plant in Folsom city, a half mile down stream, using the discharge from the prison installation, but with an 80-foot head. The primary function of the Folsom prison generators were to try out the various multiphase circuits as well as generator and transformer efficiencies. Three-phase delta was found quite effective, so the larger plant in Folsom used the same circuity when it went into operation on July 13, 1895. A three-phase transmission line was installed from Folsom to Sacramento, some 20 miles, and went into operation that same summer of 1895. All of this occurred several months previous to the Niagra Falls plant which Wagener mentions. Knowing the difficulty experienced with leaky insulators on the transcontinental telegraph lines the bar-stool engineers in Sacramento predicted near universally that most of the juice would leak off the transmission line long before it reached Sacramento. Actually, the line loss was under 10%, though the soft copper wire was subject to continual stretching and breakage. But the major difficulty occurred in dry years when there was insufficient flow in the American River for continuous operation. Storage behind the dam was limited, so it was not unusual to see the generators start up every two or three hours and run until the water failed. Streetcars in Sacramento were often stranded. After the tests the Folsom Prison plant was taken over and operated by the prison near continually until 1954, when the Bureau of Reclamation built the Folsom Dam for flood protection and added power. Unfortunately the prison plant with its ancient control panels was dismantled, and Pacific Gas and Electric contemplated doing the same for the Folsom plant. At that time I wrote an S-O-S to Gernsback. He and several associates contacted Black, the president of P.G. & E. I don't know the details, but the Folsom plant has been preserved as a historical monument and is part of the state park system.

Back in 1925 one of my high school teachers asked a class in general science to name the individuals whom they thought had done the most for mankind by their scientific discoveries and inventions. I named Louis Pasteur and Lister in sanitation, and Tesla for polyphase power distribution and equipment. Few of the class had any concept concerning the part that AC power had accomplished in a scant 30 years. How many think to thank Tesla today? 73

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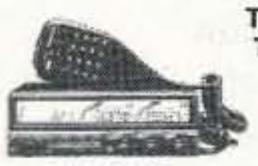
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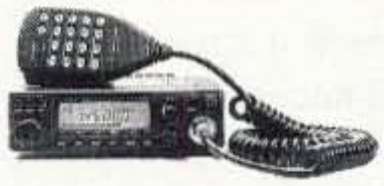
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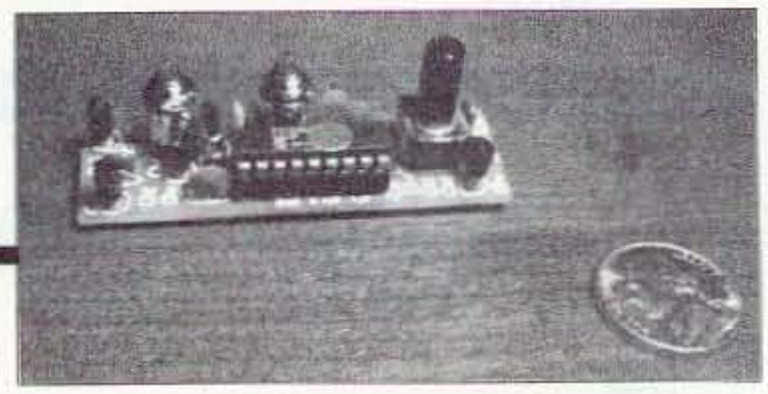
73 Review

The Wilderness KC1

An integrated keyer-displayless frequency counter.



Jeff M. Gold AC4HF
1751 Dry Creek Road
Cookeville TN 38501

Who says you can't take it with you? I love to pack a small QRP transceiver, battery and necessary accessories and take to the trails. Two of my favorite pastimes are hiking and ham radio. The sum of the two is definitely greater than either of the parts. I often make on-the-spot decisions to pack up the goods and get going to one of the many beautiful parks that are not far from my home. Since it is quite easy to forget one or more of the necessary station accessories, I was quite intrigued when I saw Wilderness Radio's first station accessory offering.

"The keyer goes from seven to 50 wpm, and can emulate the two most popular iambic keying modes."

The KC1 is a combined keyer/counter based on a PIC 16C84 microprocessor. The unit is extremely small, .08" tall by 2.5" wide. Though the KC1 wasn't designed to be a replacement for the do-everything home-station keyer or digital frequency counter, it does have a number of very good uses.

This accessory was designed by Wayne Burdick N6KR to be inexpensive and to keep current drain low. To accomplish this, the frequency is reported to the nearest kHz in Morse code through the rig's AF amplifier without keying the rig. You just push a button on the panel anytime you want to know the frequency.

A really neat feature is frequency search. Say you have a schedule to meet someone on a given frequency. You can set the counter to that frequency and when you get to it the unit will alert you. The keyer/counter can store up to four VFO offsets. The KC1 will work with almost any direct conversion or superhet QRP transceiver, whether it's a single or multiband rig. There are only three controls for the unit: a speed pot for the keyer, a message play/record button, and a frequency read/search button.

The second major function of this accessory is as a memory keyer. The keyer goes from seven to 50 wpm, and can emulate the two most popular iambic keying modes. The memory part has variable length message buffers with a total of 50 characters of message memory. It also has a word-repeat macro to save memory. The sending weight and QSK delay are both user programmable and the keyer has an optional sidetone and a tune mode (for use while adjusting an antenna tuner). You can also use a straight key with this unit, though I prefer to be able to have both a straight key and paddles hooked to a unit. I love freedom of choice and sometimes change sending devices mid-QSO.

Assembly

The kit comes in a tiny sealed package and the parts count is very low. You can easily build and install this kit in part of an afternoon without rushing. The printed circuit board is clearly silkscreened and solder masked. One aspect of building this kit is that in order to get the size as small as it is, the parts on the board are densely packed. This should not present much of a problem if you have had any building experience, but you need to make sure that you get the parts on the board correctly on the first try. The board doesn't take kindly to desoldering efforts.

I found the directions very clear and encountered no problems at all in construction. The biggest problem I had was deciding which rig to put this cute little critter in. The instructions tell you how to install the unit in some of the more popular QRP transceiver kits. In addition, there are schematics and information you would need to install it in a kit that isn't listed.

Installation and Operation

With construction completed I finally had to see the little contraption work. It is so small with so few parts that I was bewildered at how it could possibly do all the things the manufacturer claimed. I had recently built a Wilderness Radio NorCal 40A QRP/CW transceiver. It has been one of my favorite rigs to operate and I love to take it portable. It runs for a whole weekend on a very tiny Gel Cell. The rig comes with termination points already available on the printed circuit board to attach the KC1.

The instructions have a template you can cut out to install the KC1 board on either the front or rear panel of the NorCal 40A. Being something of a klutz with a drill, and not wanting to mess up the beautiful blue case of this rig, I chose to install it on the rear panel. I made sure to really take my time and I drilled into a piece of wood so that I wouldn't bend the case. I did manage to do a very neat job and it only took a few minutes to install the KC1 on the back panel. After another few minutes of attaching all the wires from the KC1 board to the NorCal 40A printed circuit board, I was ready for the smoke test.

Smoke tests have always caused me some anxiety. In this case there was double anxiety: Not only was it possible to fry the new accessory, but it was also possible to burn up one of my favorite rigs. I powered up the rig and the KC1 immediately started to speak to me in Morse code, one of my favorite languages. I read through the manual and next entered the command mode of the

Continued on page 43

Facts and Fibs about Preamps

Two do-it-yourselfers.

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Auckland 9
New Zealand

When a satellite downlink barely makes it through the noise, one immediately thinks of using a preamplifier. I have built two samples each, one using a bipolar transistor (MRF901), and the other using an FET (BF981).

Both types have a switched bypass to allow transmitting. It's important that the switching works well. "I have 30 dead preamps sitting on a shelf. All had RF up their rear ends," noted friend and fellow ham Irvin Spackman ZL1MO.

Switching

I use a type of single relay that local radiotelephone manufacturers also use. Common lore has it that this is a no-no: you must use a relay at each end. Figs. 1 and 2 show that I have added shunt trimmers at the antenna and at the transmitter end of the relay. These are adjusted for maximum power on a power meter. There is no discernible difference in power between that arrangement and a direct piece of coax.

I have used this switching for both types of preamp, and there is no instability. The amplified output does not talk to the input from the antenna.

"Bipolar transistors have a higher noise figure than FETs," we hear. So they have. But if you use them with an omnidirectional antenna into an untuned front end, the received noise will mask the noise of the active device, even at VHF levels. Hence, having an improvement of 0.6 dB in noise reduction is not going to make an improvement in recovered signal. You start worrying about noise figures when you use a helical array into a cavity filter.

I used the MRF901 with resistor biasing only, with Pi- matching. I can't measure gain, but the S-meter on the FT-290 and TR9130 goes from 0 to 9 when the preamp is switched on.

"You cannot use Vero-board construction at VHF," is another objection. My preamps are dashed off on Vero-board. I did need to solder together all unused tracks and tie them to ground through the stand-offs. The signal paths were kept short, as in "dead bug" construction. On the first FET preamp I had the two tuning

"The modern synthesized transceivers have untuned front ends. The mixer therefore has to discriminate from signals off the desired frequency."

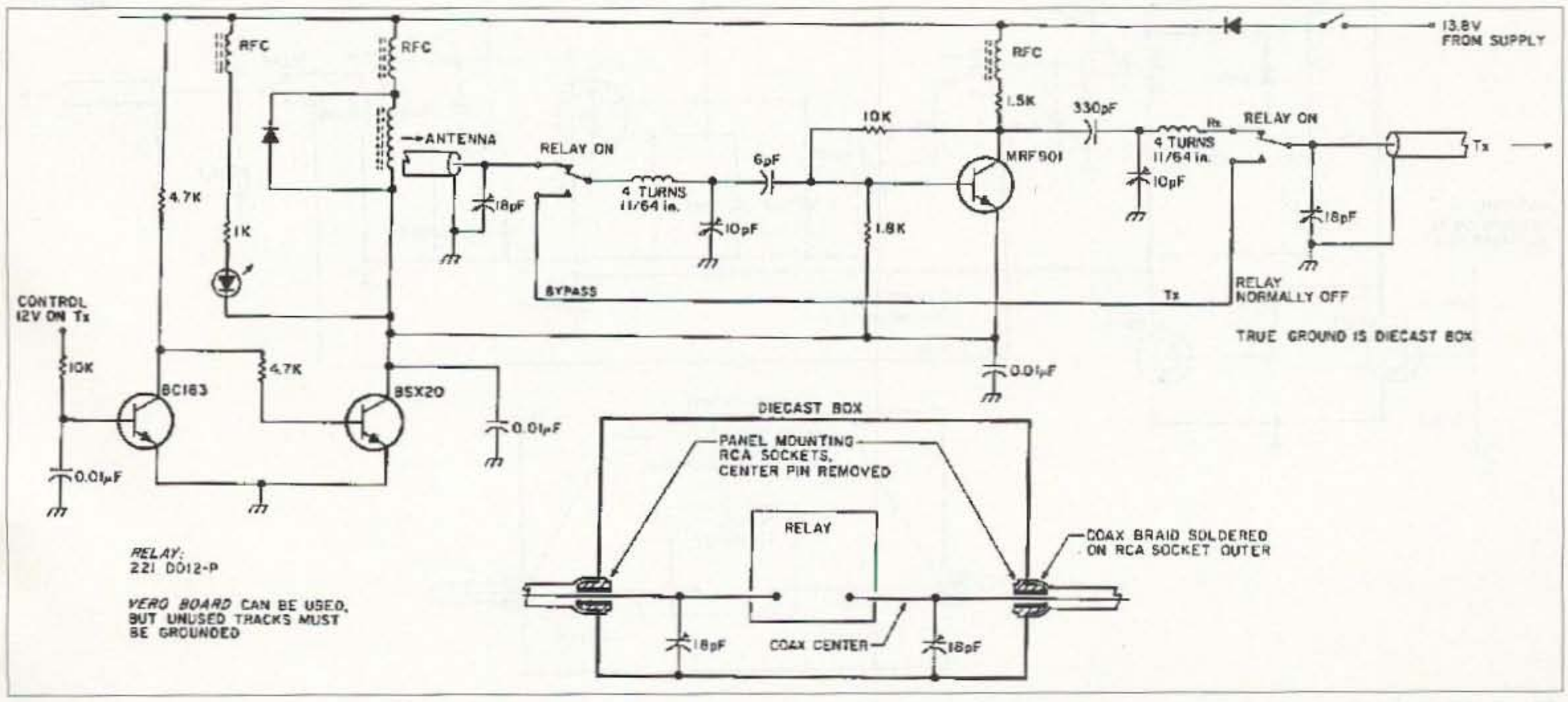

Fig. 1. A simple preamp that actually works.

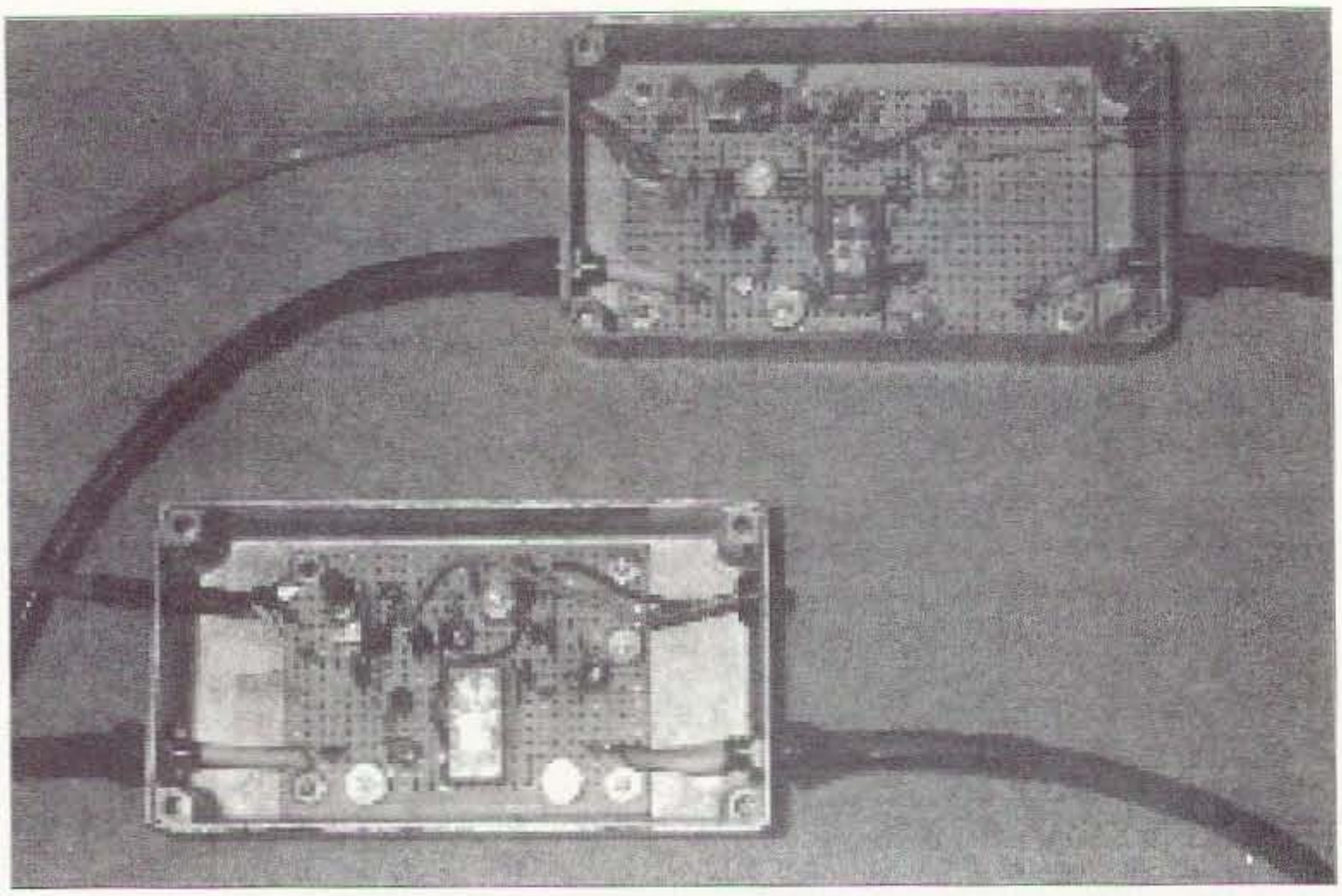

Photo A. *A bipolar transistor preamplifier at the top (MRF901), and an FET preamp at the bottom (BF981). Both have the same RX-TX switching using a single relay and the die-cast box as the ground reference for the preamp. The box also is in the direct return path from the antenna.*

coils too close together. The device became an oscillator. Screening between the two made no difference. The layout of the second FET preamp has the coils farther apart. Input and output signal paths are separated by grounded tracks, except within the relay. The preamp is stable, and the tuned circuits are non-critical.

Preamp Placement

"You must use preamps at the antenna feed point," say the Good Books. My feedlines are 25 feet of half-inch coax. The loss at 146 MHz is 0.7 dB for RG-8U. My preamps are a two-foot length of coax away from the transceiver. Power and transmit control voltage are brought out through the back of the linear amplifier of the FT-290ORII by a stereo lead and socket. The preamps have a stereo lead and plug, so they are removable. With a two-foot supply and control connection, the voltage drops are negligible.

I will allow that my first preamp had plenty of gain, but on FM there appeared to be no improvement in signal-to-noise ratio. The satellites did not open the squelch earlier with the preamp than they did without. It was a bipolar version, the board mounted on four metal stand-offs on the aluminum bottom cover of a plastic box. The box was lined internally with screening foil that touched the aluminum plate when closed. The braid from input and output coax was tied to the stand-offs.

Not Just a Container

I resolved to use a die-cast box, as shown in the photographs. I found panel-mounting RCA sockets, and removed the center contacts. I fed the coax centers through them and soldered the coax braid to the outer contacts of the RCA sockets. With the ground tracks of the PC board connected through metal stand-offs, the die-cast box was no longer merely a shell. It became the ground reference for the preamp and it substituted for the coax shielding in the return path from the antenna, without any discontinuity.

The resulting increase in signal over noise, together with a home-designed turnstile, allows me to decode ASCII from OSCAR-11 with as few as 50 errors over 10 kbytes, when the telemetry says the satellite is transmitting at 200 mW.

I built the FET preamp, with the same relay switching and the same boxing technique, because Irvin ZL1MO does not like

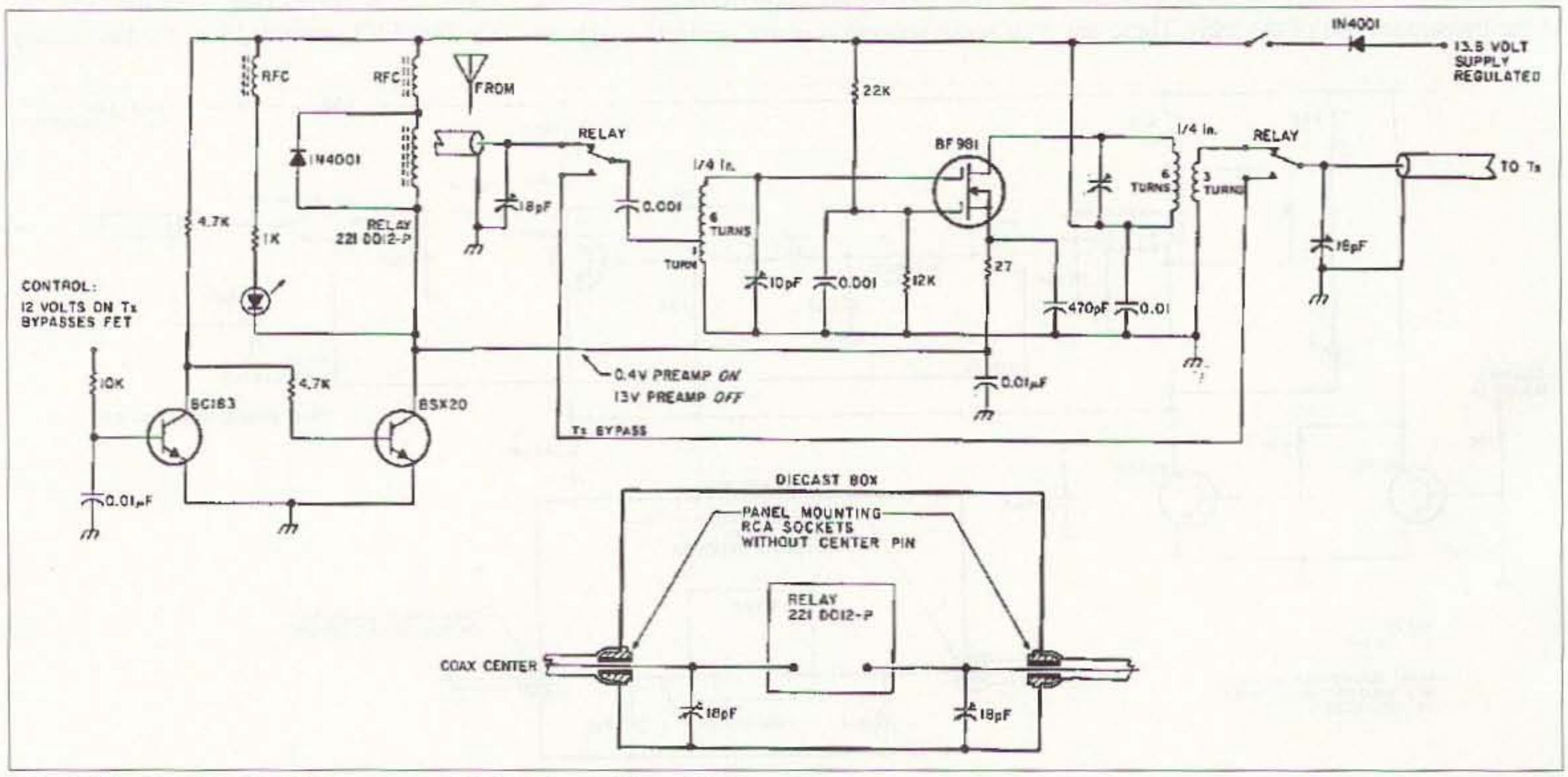

Fig. 2. The AMSAT-UK FET preamp with RX-TX switching added.

bipolar transistors with Pi-matching instead of tuned circuits. The FET version (BF981) does have a slight increase in gain, and improvement in signal-to-noise ratio. This is because tuned circuits do provide more rejection of out-of-band signals than Pi-matching does.

A Question of Gain

"You can't have too much gain," is another popular belief. Not true. The modern synthesized transceivers have untuned front ends. The mixer therefore has to discriminate from signals off the desired frequency. With more than 15 to 20 dB gain, your multimode rig will respond to the guy next door doing a bit of repeater-bashing, as well as to passing taxis and marine weather broadcasts. Handhelds convulse with any kind of preamp. My IC32AT even protests when I stick it on the slim Jim on the roof.

All being said, the two simple preamps described have become a useful addition to my shack. By taking into account what kind of antenna and transceiver they have to work with, and how the preamps are interfaced, I obtain results that compare well with what other amateurs achieve. Just yesterday a visiting British amateur, looking at an OSCAR-11 bulletin, remarked: "There's no error in it, is there?" 73

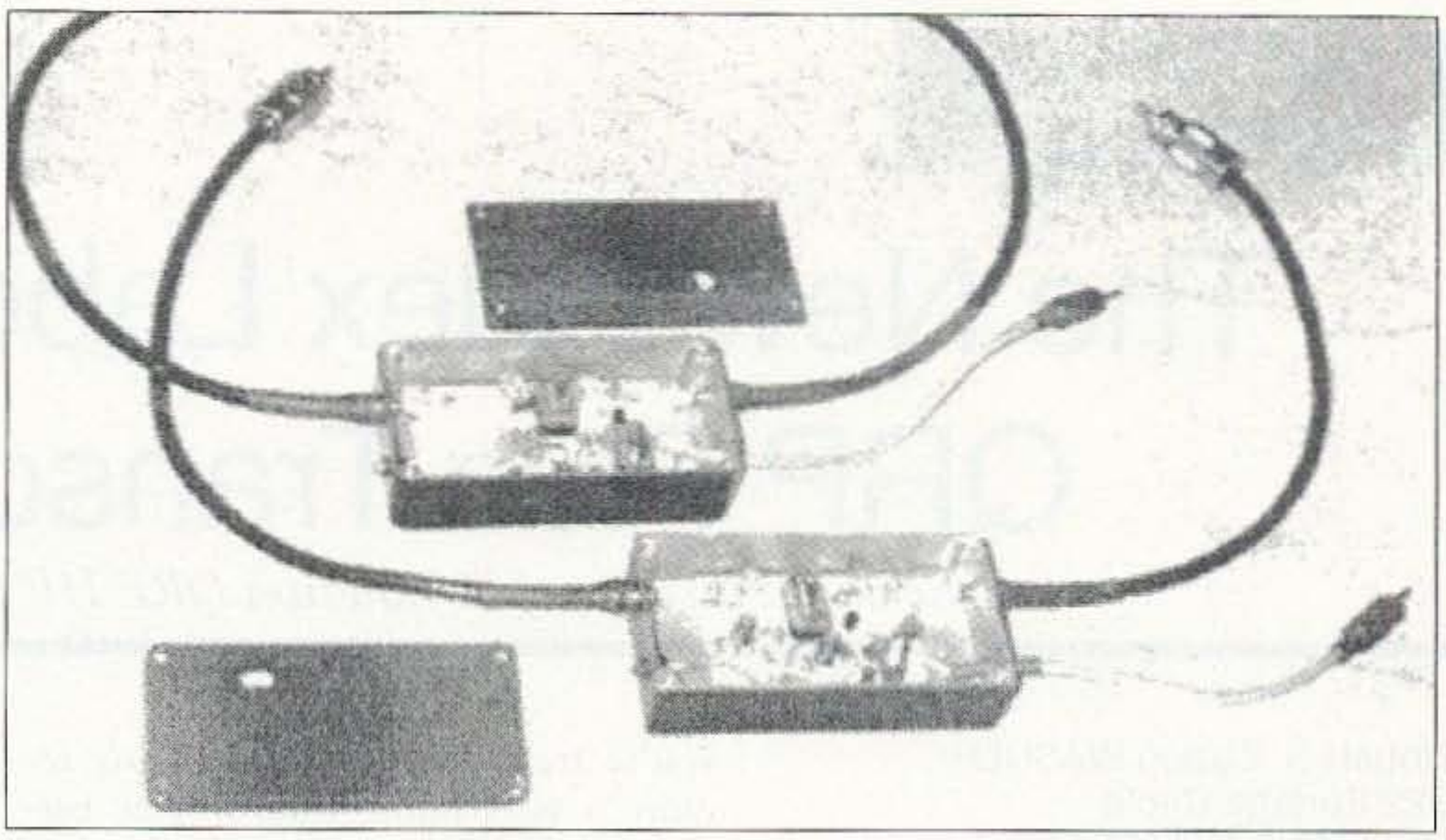

***Photo B.** These preamps can be used near the transmitter due to the boxing technique. Short stereo leads carry the power supply and the TX control voltage. With no voltage drop, the preamps and their switching work reliably.*

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AN779L	(20W)
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EB63	(140W)
AR305	(300W)
AN 758	(300W)
AR313	(300W)
EB27A	(300W)
EB104	(600W)
AR347	(1000W)

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NEVER SAY DIE

Continued from page 28

the Admiral in his office in the Pentagon. He was a short chap, so he had his desk up on a platform to add to his stature. Unless we published an apology immediately he'd see that no firm having any military contracts would ever advertise in the magazine.

We apologized.

Jim didn't get permission to use the ham station on the ship, but he did have a great trip to Antarctica and we got some good stories from it as he visited the Antarctic MARS stations.

Now cut to a couple years later, when I was the president of the Porsche Club of America and had an opportunity to visit the factory on a club-sponsored tour. I was happy with the Porsche Speedster I'd bought in 1957, so I arranged to pick up a new Porsche for a ham friend who couldn't get away for the trip. Our group of 150 flew over

Continued on page 48

73 Review

The New Index Laboratories QRP Plus Transceiver

Check out this tiny, full-function QRP HF transceiver

Robert S. Capon WA3ULH
322 Burlage Circle
Chapel Hill NC 27514

Index Laboratories has introduced a new version of its "QRP Plus" HF transceiver; an all-band, digital, 5-watt transceiver with many of the features usually found in full-sized transceivers. New features include a speech processor, improved AGC, and a significantly improved front end to the receiver.

The feature set is impressive:

- CW and SSB
- 10m - 160m
- Variable power output (0 - 5+ W)
- General coverage receiver (1.8 - 30 MHz)
- Variable bandwidth digital filter (100-2400 Hz)
- 20 memories
- Split frequency
- RIT/XIT
- Full QSK
- AGC
- Speech processor
- 2-function meter: S-meter, power meter
- Built-in keyer
- Current drain: 140 mA receive; 1.5 A transmit
- Dimensions: 5.5"w x 4.5"h x 6"d
- Weight: 5.0 lbs.

The major breakthrough is its exceptionally low current drain on receive, which is of critical importance for portable QRP operation, since the current drain determines the size battery you need. For example, most full-sized digital transceivers and miniature mobile HF rigs require 1-1.5A on receive. At this current drain you're using 24-36 amp-hours for 24 hours of operation, plus the added current drain when you're transmitting. These radios require a substantial sized marine battery or a generator for Field Day or for a weekend outing. For this reason, backpacking and bicycling aren't feasible with most commercial radios.

Index recognized the need for a full-function digital HF transceiver and designed the QRP Plus with low power drain as a central benefit in its design of the radio. It uses only 140 mA on receive! That's about 3 amp-hours for 24 hours. Thus, you can get through Field Day with a 6 amp-hour gel cell, even with a heavy-duty cycle of transmitting.

Getting Started

"Wow, is this a solidly built radio." The tiny steel cabinet fits neatly into my fishing tackle box, which I use for portable operation. It weighs in at five pounds; I had the feeling that I was holding a "radio brick." If you drop it on your foot, I'll bet on the radio.

It uses an SO-239 jack for the antenna, and a standard DC plug for the 12-volt input. It requires an accessory speaker-type microphone commonly used in VHF and UHF handie-talkies. Since there are no mounting holes or a mobile bracket, you will have to be resourceful to mount the rig in your automobile.

The radio's extremely small size required the combining of controls, making some functions of the radio not completely intuitive. For example, the keyer speed is displayed in words per minute by pressing both the Bandwidth and the Rev buttons at the same time. The main tuning knob adjusts the speed in 5 wpm increments. When the Bandwidth button is pressed the bandwidth is displayed, along with the SSB/CW display. To change modes you push the Fast button while holding in the Bandwidth button. The memory of frequencies is stored by pressing the Fast and Mem buttons simultaneously.

"Because of its exceptionally low current drain, this rig is a natural choice for backpacking, bicycle mobile, boating, taking on business or vacation trips, and of course, Field Day."

Most of the other functions of the radio *are* intuitive. For example, to change the bandwidth of the variable filter, you press the Bandwidth button and turn the main tuning knob. You press and hold the Fast button to tune quickly across the band. I quickly became accustomed to the radio, and found it to be easy to use. The built-in tilt stand is very handy for use in the field. Also, the tuning knob is very solid, and comes with a convenient dimple that makes it a pleasure to tune.

The power-efficient high contrast LCD display with large numbers is an excellent choice for use in sunlight. I tested the rig at night using only a single candle and was easily able to read the display. However, a small external

source of front lighting is needed to read the LCD display.

The radio automatically selects either LSB for the low bands or USB for the high bands, and you can't override the selection.

Operating Results

When using the radio I had the feeling that next year I can leave a lot of my favorite accessories at home because they're already built into this little radio. These built-in accessories include an power meter, electronic keyer, audio filter, and output attenuator.

I began putting the radio through its paces by checking its calibration against WWV, and against my big HF rig. The radio was in excellent calibration across all amateur bands, and on the WWV frequencies it was within 100 Hz. The receiver is on par with my full-sized HF transceiver. The AGC and the receiver front end showed significant improvement over the original version. It has excellent audio output to either a built-in 4-inch speaker or headphones. It's compatible with inexpensive *stereo* headphones rather than the harder to find *mono* headphones. I especially appreciated the variable bandwidth digital filter (100-2400 Hz in 100 Hz increments), which I wish I had on my full-sized HF rig.

I really appreciate having a general coverage receiver built into any amateur transceiver since I like to be able to listen to the news when I am out in the field or on a trip. The SSB sound is okay for news broadcasts, but for music an AM mode would help.

I fired up the transmitter and made some contacts. The QSK is very good, but is not the radio's strongest feature. I varied the power control on the back of the radio and found that the power output on 20 meters varied between zero and 7 watts, making the rig an excellent choice for QRPp work, especially as the solar cycle progresses and band conditions improve.

The original model delivered full power on CW, but had reduced power output on SSB, since it lacked a speech processor. The new model showed significant improvement in SSB power output.

My good friend Ernie AD4VA, who lives about two miles away and helps me test all of my ham radio projects, gave a critical listen to the CW signal and to the audio quality on phone. He couldn't distinguish between the CW signal of the QRP Plus and that of my full-sized transceiver. He also reported that it has very clear crisp audio on phone. Thumbs up.

I put the radio on the air to see what I could work running 5 watts into a run-of-the-mill tribander. I spent a few evenings working plenty of DX, including UA6HZ in European Russia, YQ9A in Romania, and SP9BRP in Poland who said: "Congrats on FB 5W QRP, Rob". On SSB I worked EA8BM in the Canary Islands, GIØAIJ from Northern Ireland and EA7AYD from Spain, who said: "Many congratulations with your 5 watts." EA8BM and GIØAIJ both gave me a signal report of 56.

The 20 memories, along with the fast slewing control, make it very easy to change bands. I set up the memories to the center of my favorite bands, and to WWV and the BBC.

Another nice feature is the radio's ability to toggle between the current memory frequency and the last frequency in the VFO, so you can quickly jump back to an interesting frequency. If used properly this feature is similar to having one band-stacking register, which can be very convenient.

Applications

Because of its exceptionally low current drain, this rig is a natural choice for backpacking, bicycle mobile, boating, taking on business or vacation trips, and of course, Field Day. It's also ideal for solar power applications. The radio can be operated at full break-even with a 5-10 watt solar panel charging on a sunny day.

Another application is as a second receiver to monitor the downlink during HF satellite operation on Russian satellite RS-12. In this mode, I uplink the signal using my base station, and monitor the downlink with the QRP Plus.

It can be used in the car, but the absence of a noise blanker is a problem. Even as a veteran QRP person, I find it challenging to work with a 12 dB power penalty combined with a 3 dB mobile antenna penalty. And the car is one place where I don't have to worry too much about current drain, because the car's electrical system can furnish all the current I need.

The Manufacturer

Index Labs is a small company new to the amateur radio business. When the QRP Plus first came out a year ago the company suffered from an inability to meet the demand. The company has matured during the past year and now maintains an inventory of radios so it is able to deliver from stock.

What's Missing?

Not much. A memory keyer would be a nice feature for QRP contests like Field Day. I predict that more and more commercial radios will include memory keyers as a standard feature. A noise blanker and an SWR function for the S-meter would be handy. Maybe on Version III next year? 73

The Wilderness KC1

Continued from page 40

KC1 and programmed in the offset. The numbers to send in Morse code to the KC1 were printed in the instruction manual so this only took a few seconds. I exited the command mode and pushed the frequency check button. To my great amazement it gave me the frequency. Not believing it right off the bat, I turned on my main station rig and tested the results across the NorCal's band. The little gadget was right on the money.

I next tested out the keyer memory functions. I found it very simple to program in a message and play it back. I used the NorCal 40A with the keyer in the ARRL Sweepstakes contest over the weekend and encountered no problems. As a matter of fact, I only had to repeat an exchange twice during the entire time I operated. This is quite good considering the length of the exchange in this contest and the fact that I was using 1.8 watts and a vertical antenna.

I was quite pleased building and operating this accessory and look forward to taking the rig hiking and camping.

The kit is offered in two versions. There is a complete kit which has the PCB and all board mounted components. You may still need to provide a few components, such as the key jack of your choice and a resistor or capacitor or two to match the accessory to your QRP kit. There is also a partial kit which includes the programmed microprocessor, 4 MHz crystal, all three transistors and the manual. 73

Official DX Dynasty Countries List: 3/96

AFGHANISTAN	YAØ
AGALEGA ISLAND	3B6
ALAND ISLANDS	OHØ
ALASKA	AL7, KL7, WL7
ALBANIA	ZA1
ALGERIA	7T-7Y
AMERICAN SAMOA	KH8, AH8
AMSTERDAM & ST PAUL ISL.	FT8Z
ANDAMAN ISLAND	VU
ANDORRA	C3
ANGOLA	D2, D3
ANGUILLA	VP2E
ANNABON ISLAND	3CØ
ANTARCTICA	CE9, KC4
ANTIGUA	V2
ARGENTINA	LO-LW
ARMENIA	EK
ARUBA	P4
ASIATIC RUSSIA	UA-UI8,9,0, RA-RZ
ASCENSION ISLAND	ZD8
AUCKLAND ISLAND	ZL9
AUSTRALIA	VK
AUSTRIA	OE
AVES ISLAND	YVØ
AZERBAIJAN	4J, 4K
AZORES ISLANDS	CU
BAHAMA ISLANDS	C6
BAHRAIN	A9
BAKER ISLAND	KH1
BALEARIC ISLANDS	EA6-EH6
BANABA ISLAND	T33
BANGLADESH	S2
BARBADOS	8P
BARBUDA	V2
BELARUS	EU-EW
BELGIUM	ON-OT
BELIZE	V3
BENIN	TY
BERMUDA	VP9
BHUTAN	A5
BOLIVIA	CP
BONAIRE, CURACAO	PJ2,4,9
BOTSWANA	A2
BOVET ISLAND	3Y
BRAZIL	PP-PY
BRIT CYPRUS	ZC4
BRITISH VIRGIN ISLANDS	VP2V
BRUNEI	V8
BOSNIA-HERZEGOVINA	T9, 4N4, YU4
BOUVET	3Y
BULGARIA	LZ
BURKINA FASO	XT
BURUNDI	9U
CAMBODIA	XU
CAMEROON	TJ
CAMPBELL ISLAND	ZL9
CANADA	VE, VO, VY
CANARY ISLANDS	EA8-EH8
CAPE VERDE ISLANDS	D4
CAYMAN ISLANDS	ZF
CENTRAL AFRICAN REPUBLIC	TL
CENTRAL KIRIBATI	T3
CEUTA AND MELILLA	EA9-EH9
CHAD	TT
CHAGOS	VQ9
CHATHAM ISLAND	ZL7
CHILE	CA-CE
CHINA	BY, BT
CHRISTMAS ISLAND	VK9X
CLIPPERTON ISLAND	FOØ
COCOS ISLAND	TI9
COCOS KEELING ISLAND	VK9C
COLOMBIA	HJ, HK
COMOROS	D6
CONGO	TN
CONWAY REEF	3D2
COOK ISLAND	ZK1
CORSICA	TK
COSTA RICA	TI, TE
CRETE	SV9
CROATIA	9A, YU2
CROZET ISLAND	FT8W
CUBA	CM, CO
CURACAO	PJ
CYPRUS	5B
CZECH REPUBLIC	OK, OL
DENMARK	OZ
DESECHEO ISLAND	KP5
DJIBOUTI	J2
DODECANESE ISLANDS	SV5
DOMINICA	J7
DOMINICAN REPUBLIC	HI
EASTER ISLAND	CEØ
EAST KIRIBATI	T32
EAST MALAYSIA	9M6, 9M8
ECUADOR	HC, HD
EGYPT	SU
EL SALVADOR	YS
ENGLAND	G, GX
EQUATORIAL GUINEA	3C
ESTONIA	ES
ERITREA	E3
ETHIOPIA	ET
EUROPA ISLAND	FR/E
EUROPEAN RUSSIA	UA-UL1,3,4,6, RA-RZ
FALKLAND ISLANDS	VP8
FAROE ISLANDS	OY
FERNANDO DE NORONHA	PPO, PYO
FIJI ISLANDS	3D2
FINLAND	OF-OI
FRANCE	F
FRANZ JOSEPH LAND	4K2, UA1
FRENCH GUIANA	FY
FRENCH POLYNESIA	FO
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GABON	TR
GALAPAGOS ISLAND	HC8, HD8
GAMBIA	C5
GEORGIA	4L
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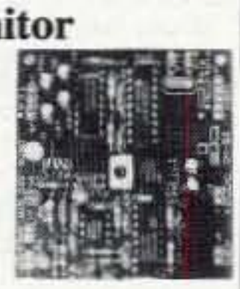

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NEVER SAY DIE

Continued from page 43

on Lufthansa and were met by the Porsche people, who delivered our cars to us in front of nearby Solitude Castle. Then we got to drive them on the Solitude race track, which was closed to traffic so it formed a track about five miles around. Porsche had their top racing drivers there to teach us how to handle the cars at speed on the tight curves.

From there I drove to Paris, where the local hams had organized a party for me. And Admiral Bruton, who was now the head of American Expeditionary Forces in Europe, came to the party just to see me and we had a great time. All was forgiven. From there I drove to Geneva to meet the hams at 4U1ITU.

The ITU hams showed me all around the place and then filled me in on what was happening. It seems that the next major ITU meeting was next year (1959) and that they felt amateur radio was in serious trouble. Many countries were petitioning the ITU to cut the ham bands significantly, plus we had almost no support from the smaller countries of the world, where amateur radio was either unknown, or was an annoyance. To make it worse, when American hams visited these small countries they'd promise them anything to get a license and then would ignore their promises and violate their rules, running excess power and making phone patches. So amateur radio had left a bad taste with these countries.

These are the same small countries who'd been shafted by the previous ITU conference when the frequency allocations had been made. The big countries grabbed anything of any value, and left the small countries with the scraps. India was coming to the conference officially requesting that all ham bands be cut to 50 kHz, which was more than enough for their few hundred hams. Australia was officially requesting that our bands all be cut to 100 kHz. And not one country, including the US, was suggesting they be enlarged. What a terrible bargaining position!

But what about the ARRL, I asked? Sure, I'd had serious problems fighting the ARRL to get RTTY permitted below 2m. They had pulled every dirty trick they could to stop RTTY from being used on the HF bands, fearing that it was a threat to their CW traffic system. I knew how the chaps at the FCC hated the League for their arrogance, but I was unprepared for the anger and disgust the ITU people expressed.

They told me how Budlong, the ARRL General Manager for around 20 years, had represented the US at a previous conference and had had to be thrown out of meetings because he arrived drunk and brought local prostitutes with him. And all this, plus a sumptuous suite in the most expensive hotel in town, all unquestioningly paid for by the ARRL members.

This didn't really surprise me because, though I'd met Budlong many times at hamfests, I'd never seen him sober.

When I got back home I called Budlong offering, in light of the

Continued on page 56

HAMS WITH CLASS

Carole Perry WB2MGP
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A Vacation To Remember

One of the best perks of teaching ham radio classes is the fun of tracking the children's adventures once they're on their own with radio. One of last year's graduates that I took a particular interest in was Jesse Warren KB2VAK. Jesse was in my radio class at our school—Intermediate School 72 in Staten Island, New York.

Most of the 400+ students who come through the ham radio program each term find something in the curriculum that they can have fun with and relate to. Every once in a while, however, a student really distinguishes him- or herself with an exceptionally enthusiastic attitude towards ham radio. These are the students who give up lunch periods to come back to my room and sit in the "shack" to both listen and speak. I can spot that eagerness a mile away. They just can't get enough!

Jesse impressed me with his enthusiasm right from the beginning. His questions were always intelligent and thoughtful. He is definitely the kind of youngster who will contribute to and benefit from our hobby and service. While he was studying for his novice ticket in my class, he took my advice and "hooked" a parent into studying with him. Jesse's dad Richard enjoyed studying with his son, and was soon totally caught up in the wonderful world of ham radio. Richard is KB2VAM and has his General license.

As luck would have it, Jesse's family moved to Long Island, New York after he completed 7th grade. We stayed in touch via radio and phone. Last summer, Jesse very excitedly informed me that he and his family were planning a trip to Israel and Austria. I was delighted to learn that part of their preparations included trying to get reciprocal operating privileges in these countries. Unfortunately they weren't able to get operating privileges in Israel in time for the trip. Both Jesse and his father did, however, enjoy listening while they were there.

In Austria, Jesse had a big thrill when he spoke on a Vienna repeater to a ham in Slovakia. Can you imagine the enrichment the radio provided to a 13-year-old from New York? Not only did Jesse and his dad have a more exciting vacation because of their radio contacts, but so did the rest of the family. Younger brother Zach was totally intrigued by the excitement generated by the ham contacts. Mother, Barbara, who is a former colleague of mine, has resisted the urging to get her own license so far but enjoyed watching Jesse and his dad reaching out together for all these wonderful experiences.

During the six week trip, Jesse made contacts with many stations, and listened to many more. Some of the more memorable contacts were with stations in Vienna, Luxembourg and Slovakia. Some were on simplex and others were on repeaters.

Jesse offers the following advice: "Prior to leaving on a trip, it's important to apply for your reciprocal license well ahead of time. Leave a minimum of four weeks for processing. You may also have to list a local address on your application. Although I didn't receive my license in Israel because I hadn't allowed enough time, I did receive it in Austria because I was staying with my cousin and he received it at his local post office. I found it interesting to learn that Austrian regulations for radio are much stricter than in the United States. For example, you have to copy code at 20 words per minute without making a mistake. In addition, there is no third party traffic. Also, if you are caught listening to a ham radio without being licensed, you must pay a large fine. You must be 16 years old to get a license in Austria."

Jesse and his dad were pleased to learn that many hams in Israel and Austria spoke English. On the two Vienna repeaters 146.625 and 146.75 MHz, hams were eager to speak with them because of their American callsigns—KB2VAK/OE. When Jesse got home and contacted me, he told me he was very excited about increasing his code speed so that he could get more HF privileges by upgrading from Tech Plus to General and even higher.

"In Austria, Jesse had a big thrill when he spoke on a Vienna repeater to a ham in Slovakia."

I often wonder about the influence of ham radio classes on my former students, influences as varied as the children themselves. Each one finds his own particular niche and relevance. Many of the older children choose a particular course of study in college as a result of something they remembered that they liked in ham radio class. Others go the route of getting involved in community events such as walk-a-thons, parades, and other fund raisers. Some youngsters help provide communications during certain holidays with the REACT group in our area. Many, like Jesse, incorporate the radio into their daily lives. Events like family vacations become more fun and more meaningful to them because they're able to meet new friends in new places right from the palms of their hands. 73

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Photo A. *Jesse and Zach in Vienna under a statue of Johann Strauss.*

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A 40 meter dipole is approximately 66 feet long. Used with an antenna tuner it will do a fine job from 40 through 10 meters, an excellent selection of frequencies now that sunspots are once again decorating Old Sol. But for those unfortunate hams who live where space, zoning laws, deed restrictions or the regulations of Homeowners' Associations prevent the installation of outdoor antennas, there are a number of possible antennas which, while not as effective as outdoor antennas installed high and in the clear, will still produce a respectable number of QSOs.

Most of us are aware of such antennas: dipoles in the attic; flagpole antennas; fine gauge wire running out a window to a handy tree; mobile whip antennas; tuned high-Q loops; a weighted wire dropped out of an apartment window at night; rain gutters and downspouts; etc. Some work better than others. A few require good ground systems (often more of a problem than the antenna itself). However, balanced antennas do not require a ground, so let's go that route.

The part of the antenna that does most of the radiating is the high-current portion. In a dipole this is the wires on either side of the center feed point insulator. For a horizontal antenna this portion of the wire should be as horizontal as possible, and at the highest point above ground that you can manage. If there isn't sufficient space in a horizontal line for all of the antenna wire, and there won't be, the ends can be bent to fit the antenna into the available space. Since it's a balanced, center-fed antenna, a dipole does not require a ground system.

"It blends into the background so well your XYL won't even notice it!"

Of all the possible configurations of indoor antennas made of wire, the dipole in the attic is probably the best because it is as far above ground level as possible, and usually less of the ends must be bent to fit the space. However, if heating or air conditioning ducts run through the attic, they may absorb much of your RF, cutting your antenna off at the knees, so to speak. AC wiring running through the attic can also absorb your power.

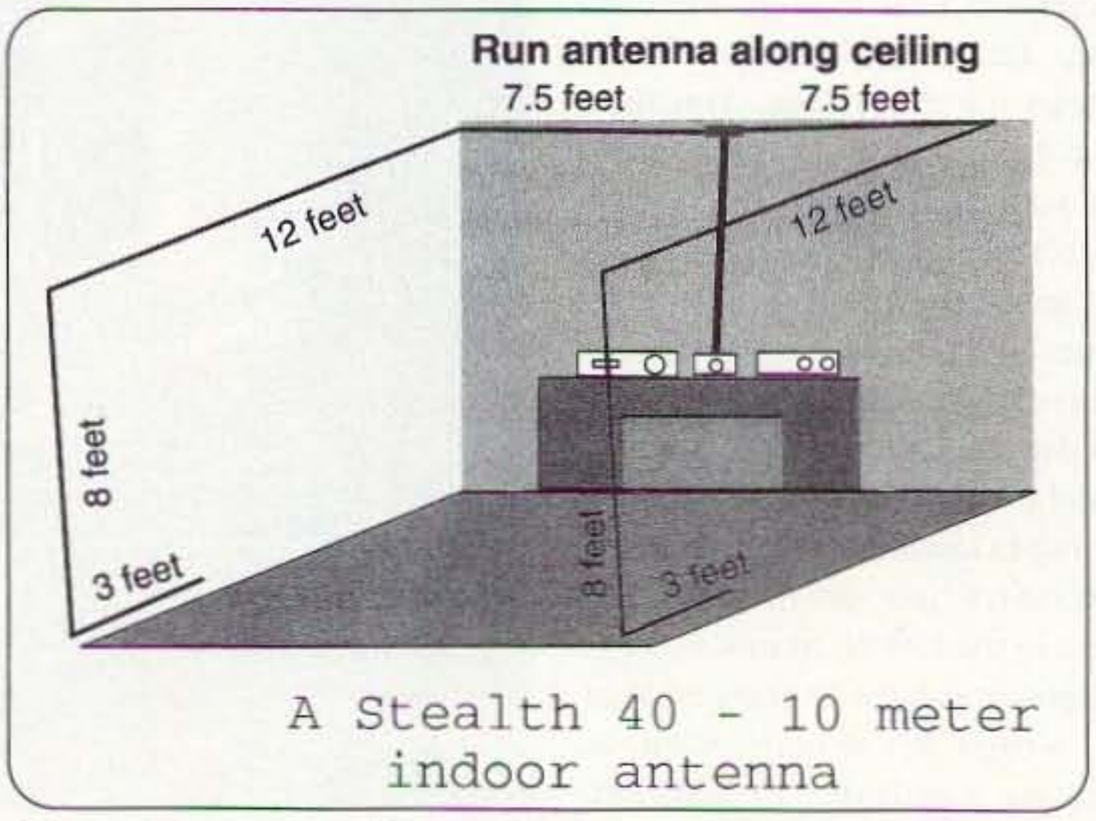

Fig. 1. *Antenna installation diagram.*

Another Dipole Option

For hams who don't have access to an attic, but do have one room at least 12 feet by 15 feet, with an (approximately) 8-foot ceiling, the 40 meter antenna I used will provide very good results from 40 through 10 meters when used with an antenna tuner. It also blends into the background so completely your friends may not even notice it!

Fully 39-feet of the radiating section of this 66-foot dipole are horizontal at the top of the room. See the drawing, which illustrates the entire installation. The insulator at the feed point is centered along the 15-foot outer wall, up against the ceiling. The center span is 15 feet long. From the ends of these points, where the wires meet the end walls, they turn 90 degrees and run along the tops of both 12-foot side walls, leaving approximately 11 feet of wire at each end. These wires are then dropped to the floor, and the remaining three feet at each end is bent along the baseboard in any direction. *Caution:* Be sure to tape the antenna ends with plastic tape so children or pets can't touch them accidentally and get an RF burn. The antenna ends develop high voltages when transmitting; keep them away from anything metal so you won't start smelling smoke.

Of course, insulated wire—ordinary hookup wire—should be used for this antenna. The insulation should match the

Continued on page 55

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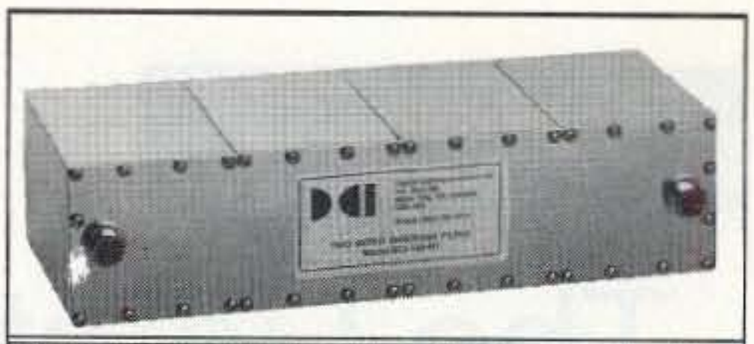

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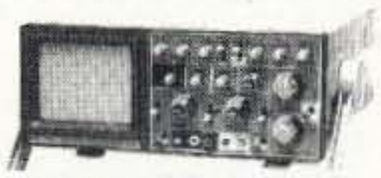

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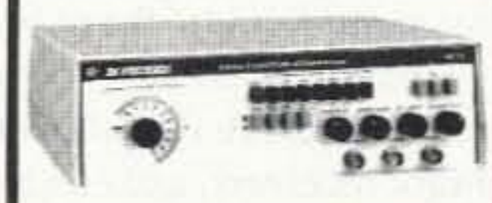

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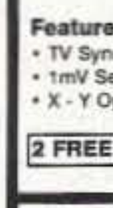

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The Hamtronics TD-4 Selective Calling Unit Kit

A tiny package of fun!

Larry Antonuk WB9RRT
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In general, ham radio operators do just about everything with their radios. If a mode exists, there's a ham somewhere using it. However, one of the most interesting modes of radio operation also happens to be one that most hams know little about. That mode is the field of radio telemetry—the process of measuring and controlling values and processes via the radio waves. This mode is a little less understood than most, perhaps because the equipment necessary to implement it is fairly expensive and more complicated than simple voice gear. Also, the commercial market sources of used telemetry equipment are somewhat tighter than for voice radios, because less of this equipment is in use. So what does the ham who's interested in remote control do to learn more about this facet of ham radio?

The answer, as usual, is to build it yourself. An excellent product to start with is the Hamtronics TD-4 Selective Calling unit. The TD-4 provides a means to decode a four-digit DTMF tone, and use it for a single task. For the average ham, this represents the easiest way to perform a remote control operation. Since you probably already have a DTMF pad on one of your rigs the encode half of the system is set up. All you need is a receiver to hook the TD-4 up to, and you can use it to turn on or off anything, as long as you're within range of the radio. What you do with the output of the TD-4 is up to you—use it to open the garage door, turn on the lights, start the coffee, disable the local repeater, fire up the autopatch—it really doesn't matter. As Archimedes said, "Give me a relay closure and I'll move the earth." The hard part is getting that initial closure, but the TD-4 makes it easy and inexpensive.

"All you need is a receiver to hook the TD-4 up to, and you can use it to turn on or off anything, as long as you're within range of the radio."

Possible Uses

Before we get into how the TD-4 does its job, you may want to note that it's actually called a Selective Calling Unit. This controller was designed to mute a receiver speaker until a certain series of tones was received, at which point it would open the speaker and let the radio operator hear the message. That is identical to the operation of fire department pagers and monitor receivers, and can be used in the same way by hams. If you're tired of listening to chatter on the local repeater, just install the TD-4 on your base station. Give the four-digit code to your buddies, and have them call you by keying the repeater and dialing in your code. (Of course, you won't pick a code that will mess up the autopatch, and you need to know how to get the tones to pass through the repeater.) The Hamtronics unit will hear the code, decode it, and open your speaker. Carry on your conversation, and hit the "reset" when you're finished.

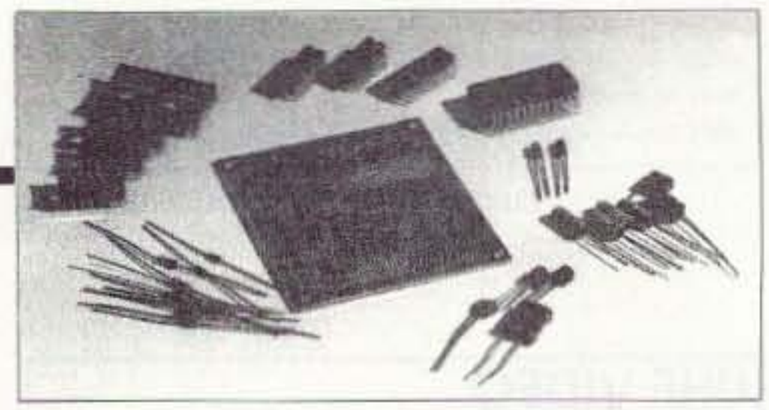

Photo A. *The Hamtronics TD-4 board and components awaiting assembly.*

A good application, but not very exciting. Why not install the TD-4 on your local repeater, and use it to detect "911" calls? If it hears one, have it start a tape recorder that will run until the patch drops, in order to record the call for training and liability purposes. (Does your state require the beep every 15 seconds?) How about a remote controller for that foxhunt transmitter? Turn it on or off as the hounds get closer. More diabolically, use the controller to raise and lower the power level.

The list of applications is limited only by your imagination. In any case, the controller will decode up to four DTMF tones in a sequence, and uses a set/reset latch arrangement. The first three tones of the *on* and the *off* sequences will be identical, and the last digit will determine whether the latch is set or reset. In other words, you can set up the decoder outputs to make a code of 123A to turn something on, and 123B to turn it off.

How It Works

So how does the TD-4 do it? All the circuitry is performed by four integrated circuits, with most of the work done by a G8870 DTMF decoder. This chip was originally designed for central office decoding applications, and takes care of all of the DTMF signal processing and decoding. It can accept a signal level from 100mV to 2V p-p, so no external audio signal conditioning is required. Valid DTMF tones are passed from the G8870 as hex digits to a one-of-16 decoder. Output lines from this decoder are jumpered to

a series of AND gates, which ensure that the tones are in the proper sequence. The final tone is used to "steer" the output of the prior AND gate to either the SET or RESET input of a simple latch. The output of this latch drives a single open-collector transistor, which controls the output of choice.

Kit Assembly and Documentation

The TD-4 is built on a high-quality glass epoxy double-sided circuit board, using plated-through holes. All jumper and input/output leads are marked on the board. The components are high quality, clearly marked, and easy to install. IC sockets are provided for all chips, making future troubleshooting a breeze. Due to the capabilities of the 8870 IC, the TD-4 decoder does a lot of work with just a few chips. This keeps the component count low, making it an ideal kit for the first-time builder. In addition, the circuit is so straightforward that even an inexperienced troubleshooter should be able to locate and correct any wiring problems.

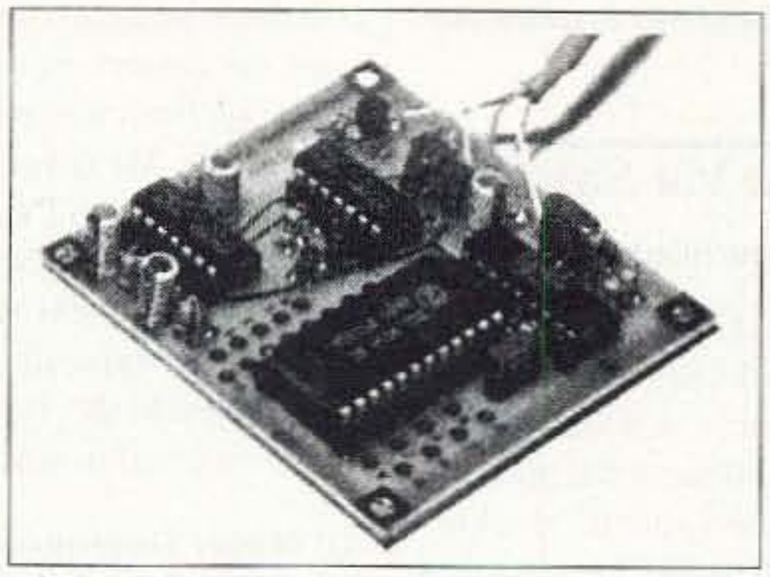

Photo B. *The completed TD-4 board, just prior to installation of the programming jumpers.*

"The circuit is so straightforward that even an inexperienced troubleshooter should be able to locate and correct any wiring problems."

The Hamtronics documentation is refreshing. The schematic and parts layout diagram are well done, and simple to follow. The instructions are clear, but assume that you've got a little intelligence. You won't find any of that "Insert left end of R1. Now insert right end of R1." stuff in this manual. As a matter of fact, the manual is nine pages long, and the entire construction section takes up about one-third of one page. So what's on all the other pages?

Well, useful stuff. Information on how to test the thing once you've built it. An explicit section on how to set the jumpers to program different codes. How to hook the decoder up to your radio. How to drive a relay, without blowing up the output transistor. Detailed selective calling applications. A serious troubleshooting section. And best of all, modifications. Not too many kit manufacturers give you the information you need to start hacking right off the bat (OK, so they call it *customizing*). They even give detailed instructions on how to convert the TD-4 into a "LiTZ" (long tone zero) decoder, for use on the nationwide repeater emergency system. In any event, the manual for the TD-4, while somewhat lacking in photos and drawings, treats the builder as if he or she knows something about electronics, and wants to learn more. More manuals should be like this one.

While Hamtronics gives the builder information on how to modify time sequences, etc., they don't get into any serious hacks, and the TD-4 is just asking for some. If you don't need the single function on/off arrangement provided, a couple of relocated jumper wires will allow the controller to provide pulses to two separate devices, allowing you to pulse on either of two timed functions. Need more functions? Hamtronics doesn't give you any more room on their circuit board, but considering that additional AND gates go for about 50 cents, why not add on an auxiliary board to give you a few more options? By duplicating the existing AND gate circuitry on another PC board you can control as many functions as desired. (Why not set up that foxhunt transmitter for on/off, high/low power, and even flip the frequency 5 kHz in either direction? *That* should keep 'em on their toes.)

As we said, the Hamtronics TD-4 is a great way to get into remote control with a single function, but it also provides a neat base for future expansion. Remote control applications haven't been fully explored by most hams, but equipment like the Hamtronics TD-4 makes experimentation easy. Compatible with gear that most hams already have, the TD-4 is a good entry-level project for the beginning remote control enthusiast. 73

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HAMSATS

Amateur Radio Via Satellites

Andy MacAllister WA5ZIB
14714 Knights Way Drive
Houston TX 77083

AMSAT's (the Radio Amateur Satellite Corporation) newest and most complex satellite, Phase 3-D, is scheduled for launch later this year. Check out the article "Into Orbit With the Final Phase 3 Satellite" in this issue. Even with a few schedule slips, the event is less than a year away. In preparation, this month starts a series of columns for the newcomer to this fascinating segment of the amateur radio hobby. It will take time, information and energy to get ready for Phase 3-D, but there are several easy steps that can get a potential enthusiast on line with the OSCAR (Orbiting Satellite Carrying Amateur Radio) program.

Getting Started

You may already have everything you need to join in the fun on the amateur-radio satellites. It is a common misconception that satellite chasing is expensive and only for the technically elite. Even if your only "rig" is a 2 meter handie-talkie or a shortwave receiver, there are signals from space that you can monitor right now.

If you have a computer (most hams do these days) the chore of knowing when to listen for an OSCAR becomes a simple task. Many programs are available to find and track the satellites.

If your only antennas are attic dipoles or omni-VHF types, it's easier than you think to get involved. Some hams have only mobile and portable systems for their hamsat pursuits and still do remarkably well.

Finding detailed information about the ham satellites used to be a significant chore. Today that's not the case. Many books and articles have been written covering the myriad facets of satellite work. Some may be found at well-stocked bookstores or ham radio distributors, while others are only a phone call away.

2 Meter Downlinks

Satellites that provide 2 meter FM downlinks are very easy to copy with only a handie-talkie and an omni-directional antenna. Although the typical "duckie" antenna will work, one that has at least zero-dB gain (a quarter-wave whip) is better. Set the frequency of the HT or other 2 meter receiver (a scanner will do) to 145.825 MHz. Two satellites, U-O-11 and D-O-17, use this downlink frequency for their telemetry and digital message outputs.

UoSAT-OSCAR-11 was launched in March 1984. Built by the University of Surrey in England and launched by NASA from the Western Test Range in Lompoc, California, it is still operational today, sending 1200 baud ASCII data using Bell-202 compatible tones. The power output is only 400 milliwatts, but from a polar orbit of 680 km, this low-power signal can be heard with ease when the satellite is above the horizon. For most locations, four to six passes per day (about 10 to 18 minutes each) can be monitored. The satellite is also capable of limited digital speech using a National Semiconductor Digitalker chip set. Short messages are occasionally programmed by the ground-control station in Surrey.

DOVE-OSCAR-17 was sponsored by AMSAT-Brazil, but was designed and constructed by AMSAT North America (AMSAT-NA). Launch was on an Ariane 4 from Kourou, French Guiana, in February 1990. DOVE is an acronym for Digital Orbiting Voice Encoder. Although it is capable of complex voice synthesis, it normally transmits packet telemetry at 1200 baud with up to 4 watts of output power. A standard packet-radio TNC (Terminal Node Controller) can be used to view the messages and telemetry from D-O-17. The polar orbit is slightly higher than U-O-11, at 800 km, and can also be heard between four and six times per day.

Another source of signals from space comes from the Russian *MIR* space station. Many ham radio experiments are being tested from *MIR*, but the most popular activities include voice contacts with the cosmonauts and packet operation from the on-board PMS (Personal Message System). Voice and even SSTV (Slow-Scan TeleVision) can be heard on 145.550 or 145.800 MHz. Packet operation is typically on 145.55 MHz. RØMIR is the most common callsign sent from MIR.

10 Meter Downlinks

The two most popular satellites with 10 meter downlinks include RS-10, launched in June 1987, and RS-12, launched a few years later. The signals from these Russian hamsats are not FM. They transmit CW telemetry and act as communications transponders for CW and SSB signals. The satellites are controlled by RS3A in Moscow and are in polar orbits at about 1,000 km altitude. Even though power output is only 1 watt, both can be heard on a typical shortwave receiver with a simple dipole.

RS-10 transmits its telemetry on 29.357 MHz. The transponder downlink range is from 29.360 to 29.400 MHz. During a typical 10- to 20-minute pass, CW and SSB conversations can be monitored in the 40-kHz wide transponder passband. The stations heard are sending their signals to the satellite on 2 meters. The uplink passband goes from 145.860 to 145.900 MHz. Most RS-10 users only need about 25 watts to an omnidirectional base antenna to get into the satellite.

RS-12 telemetry can be heard on 29.407 MHz. The transponder downlink range extends from 29.410 to 29.450 MHz. The uplink, however, is on 15 meters from 21.210 to 21.250 MHz. While many stations using RS-12 employ newer 100 watt transceivers that can transmit on one band (15 meters) and then receive on another (10 meters), it's not uncommon to find QRP (low power) stations employing very simple transmitters running only a few watts on the uplink and inexpensive 10 meter rigs on the downlink. Dipoles in the attic on both the uplink and downlink bands will work with RS-12.

Tracking

While it is possible to set up a receiver and wait for a satellite to come by, it can be frustrating. The easiest way to find the hamsats noted above is to use a computer and a good satellite tracking program. Many programs can be found on BBSs (telephone Bulletin Board Systems) or via the Internet (ftp.amsat.org or http://www.amsat.org) as shareware or freeware that will perform the basic function of providing dates and times of the passes over a specific ground location. There are also companies and organizations like AMSAT-NA that sell software packages for most popular personal computers. Some programs provide real-time maps and coverage projections in addition to tabular time and antenna-pointing information.

Information Sources

Columns and articles dealing with hamsats have appeared in all the major ham-radio magazines since OSCAR-1 was launched in 1961, but for the newcomer, some good reference books provide more perspective. The suggested titles below can be purchased through AMSAT-NA. Write to AMSAT at 850 Sligo Avenue, Suite 600, Silver Spring MD 20910-4703, or call (301) 589-6062 to get the latest prices and information about membership and other publications.

1. *The Satellite Experimenter's Handbook,* 2nd Edition (1990; ARRL, 350 pages) by Martin Davidoff K2UBC.

2. *How to Use the Amateur Radio Satellites,* 5th Edition (1995; AMSAT, 32 pages) by Keith Baker KB1SF.

3. *The RS Satellites Operating Guide* (RS-10/11; RS-12/13 and RS-15), (1995; AMSAT, 30 pages) by G. Gould Smith WA4SXM.

This month was an overview. Next time, and in the months to follow, specific topics about the high-orbit satellites, rigs, antennas, coax, Doppler shift, Faraday rotation, the digisats, and many more facets of the hamsat chase will be investigated. 73

A Stealth 40-10

Continued from page 50

wall/ceiling color. A stapler can be used to secure the wire in place so it will be practically invisible.

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Continued on page 82

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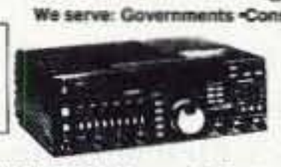

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I love gadgets. I'm not afraid to admit that. After all, in this crazy hobby of ours it's an affliction that insinuates itself into our very fiber. This month, let me tell you about a new toy that can breathe new life into many forms of digital communication.

For a tad under two hundred dollars, I got the "Snappy Video Snapshot" from Play, Inc. For that money, you get the digitizer itself, a battery, cable, and three software packages. One of those runs the unit, but the other two are nifty graphics manipulation packages; more about them later.

Physically, the Snappy device looks like a fat candy bar with a DB-25 plug on one end. It plugs into the parallel port on your PC compatible computer, which needs to be at least a 386 running some flavor of Windows©, with 4 Mb of RAM and 4 Mb of free space on the hard drive. Video may be supplied "live" from the video output jack of almost any camcorder or VCR.

Once you load the software, you are able to "snap" a picture from moving video, or take a longer exposure, with higher resolution, from still video. The results are truly amazing. Photo 1 is a picture of the Snappy unit, taken with my VHS camcorder and digitized. The picture was then saved as a TIFF file, sent to 73 electronically, where it was placed onto this page. Neat, huh?

As I said, the source can be a live camera or VCR, and the "shutter" speed can be set to stop a moving video, or progressively longer exposure for higher quality with non-moving images. Image size may be scaled at 320x240, 640x480, which is full screen VGA size, or an astonishingly beautiful 1500x1125, all saved as 24 bit true color files, even on a monochrome machine. That last option does take up a bit more disk space, of course.

Now, if just snapping video is not enough for you, the two packages which accompany the digitizer are really something. For me, the more useful of these is Fauve Matisse, a graphics manipulation and drawing package which allows the creation, editing, and alteration of images from the Snappy Video Snapshot, along with other sources. It accepts and saves images in most of the popular formats, such as JPG, BMP, EPS, GIF, PCX, TGA, and a few others. You can retouch photos, produce comic shots with switched heads, or use the tools to paint pretty pictures, as my nine-year-old does.

Photo 1. Pretty neat, huh?

The other program, not as useful to me but you might like it, is Gryphon Morph, one of the classic programs used to "morph" or change one picture into another. Starting with one photograph, key points are identified and corresponded to points on another photograph. The program then generates intermediate images which effectively change one into the other. The results can be astounding and fun to watch.

For the money, this is really a neat way to generate the digital images that are becoming necessary in electronic communications. While you may be inclined to get a scanner, they are typically more expensive, and can only copy flat objects. With the Snappy you can digitize your kids! Now, to be honest, there are a few glitches. Because it uses your parallel port, you cannot print with the Snappy installed unless you have two parallel ports or print to a serial port or network printer. I use an A/B switch to select the Snappy or my printer. The quality is good, but a 1200 dpi scan of an 8x10 photo on a thousand dollar scanner may be better, albeit for more money and a slot on your motherboard for the interface card. As the saying goes, "You pays yer money and takes yer choice."

To help you decide if the Snappy will fill the bill, Play, Inc., has a web site at: http://www.play.com where you can read a bit more and download a slide show of Snappy images. You will need a SVGA screen for the demo, but it is worth a look. Let me know what you think. If you get a Snappy, use it to take pictures of yourself and station, and send them to me by E-mail. Who knows? You might just see yourself here in RTTY Loop!

As long as I'm on the subject of "high tech," this month's web find addresses the cutting edge of packet communications. Mike Curtis WD6EHR, has placed a "9600 Baud Packet Handbook" at: http://inss1.etec.uni-karlsruhe.de/~df0uk/96man2.txt. This handbook for K9NG protocol 9600 baud packet addresses the questions raised by those inclined to exceed the 1200 baud speed barrier, without wanting to hear "But Cap'n, it canna go that fast without breaking up!" Take a look, it's an interesting work.

As I write this month's column, last month's column announcing the RTTY Loop Home Page, at: http://www2.ari.net/ajr/rtty/ has yet to be printed, and yet we are averaging about a dozen or so hits a day. I don't know where these folks are finding out about the page, but I anticipate the count will be much higher by the time this column sees printer's ink. On the home page, I have several past columns, with current ones as well, a full listing of the RTTY Loop Software collection, interesting ham radio related links, along with a few other strange sites, and a few things for direct download. Take a look, tell your friends, and drop me a line.

For those not online, the full listing of the RTTY Loop Software Collection may be yours for a self-addressed stamped envelope, sent to the address at the top of the column. E-mail may be sent to me via the Internet, at: ajr@ari.net; on America Online at: MarcWA3AJR; or on CompuServe at: 75036,2501; although that may be a bit simpler as well by the time this is published.

I'm accumulating quite a few cards and letters from some of you, with which to fill the April basket. Don't miss next month's column, when I shower you with answers. 73

NEVER SAY DIE

Continued from page 48

seriousness of the international situation, to try and work with him toward saving the hobby at the next conference. He told me to go to hell. Well, actually, that was what he meant, only he didn't use nearly as polite words. He explained that he had been running amateur radio for years all by himself and he would continue to run it, and I could go...well, you know.

Some hams in the State Department put on the pressure and I was

Continued on page 63

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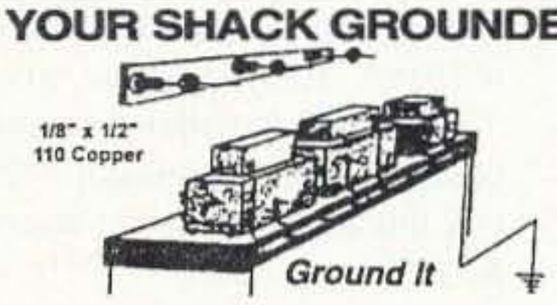

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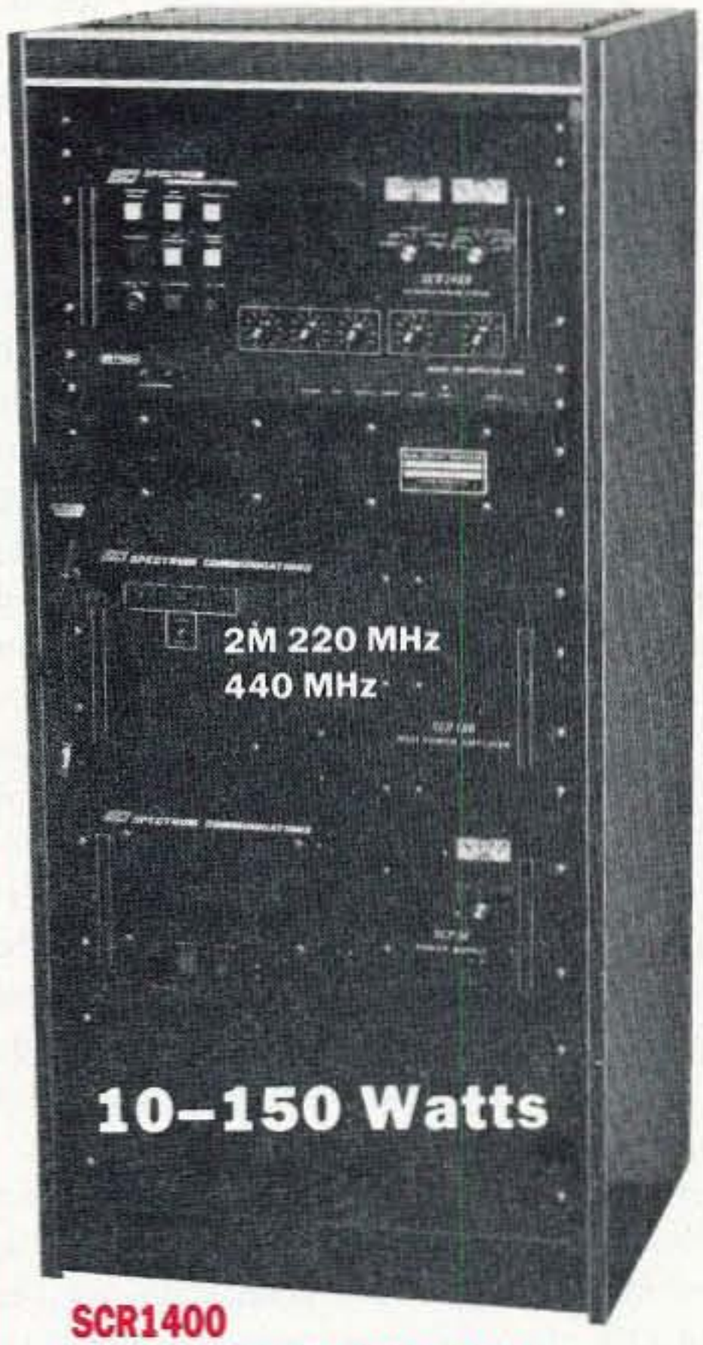

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HAM TO HAM

Special Six-Month Anniversary Column

Dave Miller NZ9E
7462 Lawler Avenue
Niles IL 60714-3108

"Ham To Ham" is in its sixth month of life within the pages of *73 Amateur Radio Today* and the tips, suggestions and ideas keep coming in...good ones, at that. Uncle Wayne and I had originally given the column six months to get off the ground, to see if it's what the readers want, and we've made it! Please keep the ideas flowing this way. It's your column; I'm acting as intermediary, putting all the ideas into one place and editing the text for uniformity, but it's an open forum for everyone to share. In celebration of the six-month mark, the column is a bit longer this time, to give you more of the information you've said you want, and as a "thank you" to the many who've sent in contributions. Thanks also to Uncle Wayne Green for providing the forum.

By now you are able to see the direction that the column is taking, so you'll know pretty much what we're looking for. But even if you'd like to see it take a somewhat different avenue, send me your favorite tip and let me know what direction you feel the column should be moving...I'll try to keep an open ear for any serious suggestions for improvements.

Poor Solder Joints

I've personally run into a number of poor solder joints in well-known commercially-made ham gear, and I know others have, too. The solution in all of these cases was to reheat, and perhaps rewet, the offending connection. Rewetting a solder connection is just another way of saying "put a bit of new solder on it as the connection is reheated." If the connection looks mottled (marked with spots) or lumpy and dull, then removing the old solder with wicking-braid or a "solder-sipper," and applying all new 60-40 solder to the connection is the answer.

Just because a radio "came that way from the factory" doesn't mean that it was made perfectly. Here's part of the reason: between any two copper connections, such as the copper foil pad on a PC board and a copper wire or component lead attached to a board by a solder connection, there are: 1) the copper foil pad, 2) an alloy layer, 3) the solder mass itself, 4) an alloy layer, and 5) the copper component lead or wire. This is true of every good solder joint. If something happens to prevent that alloy layer from forming at either copper junction, or if it degrades with time, then a high-resistance or intermittent solder connection is the result.

One cause of a defective alloy layer is movement during the "plastic" phase of the solder cooling process ("plastic" meaning capable of being altered or changed). As solder goes through the liquid (melted) state to the solid (hard) state, in all but one solder formulation there is also a plastic-state temperature range. The length of time of the plastic state will vary with the respective amounts of tin and lead in the solder you're using or reheating. As an example, at the extreme end of the formulation scale there is 90-10 solder, 90% tin and 10% lead. 90-10 has a 700°F plastic range, between approximately 4300°F and 3600°F. Any movement of either of the pieces being soldered during that cooling range will result in a poor solder joint.

At the other extreme is 10-90, 10% tin and 90% lead. Its plastic state is from about 5800°F to 4400°F, or 1400°F of cool-down range, when the solder is still plastic. Movement anytime during this plastic state results in what's commonly called a cold solder joint. Insufficient heat at the joining of the two copper pieces during soldering can cause the same condition. To make a good connection, the solder must go far enough into the liquid range, drop down through the "plastic" range, and then enter the solid range without movement. And those two good alloy layers must exist for the lowest-resistance electrical connection to exist. If more than two wires or component leads meet then a good alloy layer must exist between each and the rest of the solder mass forming the connection.

Most of us use 60-40 solder, 60% tin/40% lead, because it has the best "wetting" characteristics. That also helps to provide a good alloy layer. 60-40 only has a 90°F or so plastic state, from 3700°F to 3610°F, so it's also helpful from that standpoint. There is a 63-37 solder formulation, 63% tin/37% lead, that has virtually no plastic state. It's called eutectic solder because the liquid-to-solid state is direct; that's the eutectic point. But that's the *only* formulation that skips over the plastic state.

Another reason why the alloy layer may not form properly is oxidation on either of the two copper parts, or some foreign substance on the parts that doesn't allow proper wetting and flowing of the solder. That's the prime reason why parts should be bright and clean-looking, and why only solders containing rosin flux should be used on electrical connections. The rosin flux, in the solder, or applied externally via soldering paste or liquids, is not a part of the connection itself. It "floats" the surface oxides from the two copper pieces and holds those impurities in suspension until the joint is alloyed. Remnants can then be cleaned away with a flux remover.

So why would a factory-made rig have poor solder joints? Perhaps the parts weren't clean enough when assembled onto the boards, or the board itself was contaminated. Perhaps there was some movement of the parts during the plastic stage of the cool-down period, perhaps not enough heat penetrated to the two copper connecting metals, perhaps the flux used wasn't doing its job, perhaps the solder formulation was off-specifications...any of these situations is possible. The issue is less "why" and more "where," since finding and fixing the poor connection(s) is the job at hand. Knowing why the factory-made connection failed is more academic than pragmatic once a piece of equipment is in our hands.

There are a couple of other caveats in soldering, though admittedly one may not run into them often. The first concerns a connection's heating as large amounts of current pass through it. All solder joints have some amount of finite resistance, but it becomes important when a connection must handle higher currents, such as in a high-power linear's plate tank circuit; the solder connection can actually soften or melt if special precautions aren't taken. A higher melting point solder would be a 5-93.5-1.5 formulation: 5% tin, 93.5% lead, and 1.5% silver. This formulation raises the solder's melting point to about 6000°F. Another special situation exists when soldering silver-plated components. To prevent the silver-plating itself from migrating, a high silver formulation solder can help. 96-4, which is 96% tin and 4% silver (no lead), will prolong the "wetting" time before silver migration takes place. It requires a higher melting temperature, about 4300°F, but provides a stronger connection. Radio Shack™ carries this under their part number 64-025.

Easy Backyard Coax Cable Protection

From Ken Guge K9KPM of Lombard, Illinois: With spring not too far away, here's an easy-to-implement tip for protecting a surface backyard coax cable from pedestrian damage and lawn-mowing hazards:

"When I originally installed my 40-meter horizontal wire dipole antenna in my backyard, the center-feed coaxial cable ran down the trunk of a large tree, across the grass to the house, and then through a small hole in the above-ground portion of the basement wall. Wanting to protect the coax from people walking on it, as well as from other yard activities, I made a simple three-sided wooden cover to lay over the top of the cable. It worked for a while, but keeping the wooden cover looking good with paint and, more importantly, keeping it from rotting underneath, became a too-often-avoided task!

"While browsing through an office supply store one day, I spied the cable protection strip material used in many offices to hide across-the-floor cabling, and I immediately visualized it protecting my backyard above-ground coax instead. One brand goes by the name SL Waber Cordgard®, and is usually available in 6-ft. or 15-ft. sections. It's a rugged vinyl casing that covers the entire cable, and has a curved top surface that helps to prevent tripping, if someone doesn't happen to notice it running across my yard! Just as important, it requires absolutely no maintenance and should last for a number of years, even outdoors, before a replacement might be needed. It's a big improvement over the wooden cover that I was using before, from the standpoints of protection for the coax, pedestrian safety and appearance."

Good application, Ken. The same type of product could, of course, be used in the ham shack itself, if a cable or two are needed on the opposite side of the room from your ham station operating position, providing the same protection and safety Ken has found it does outdoors. It could also be run up a wall if a cable "drop," either indoors or out, needs to be hidden.

Extending the Fun

From Mike NØALJ of Rogers, Arkansas: Wire yourself into your hobby without having to stay in the shack.

"Here's an idea I've used to enable me to enjoy my various radios in places other than my ham shack. I've set up a speaker in the garage so that I can listen to my favorite ham bands while I'm working on my HO train layout there. I've also extended a speaker out to the patio deck, so that I don't miss anything when relaxing in the open air or working around the yard. I've also found that in the ham shack itself a local extension speaker there can enhance the sound significantly.

Sure Seal for Outdoor Connectors

From Bill Thim N1QVQ of Broad Brook, Connecticut, try this tip for permanently sealing outdoor connections, such as those that might be used for coax, power, control cabling, etc.:

"I recently had some work to do on my well and came across a power cable splicing scheme that could also be useful with coax and other types of cabling used for outdoor ham antenna work. Some home improvement centers (Home Depot, in this case) sell a splicing kit for submersible pumps that is truly watertight when used as directed. After the splice is made electrically sound, the connection point is coated with a silicon-type sealant, then a six-inch-long section of heat-shrink tubing is carefully slid up the cable to cover the joint and sealant. When the tubing is shrunk with a small torch or heat gun, until the sealant can be seen oozing from both ends, you'll have a connection that defies the worst of the elements. The tubing supplied with the kit is large enough in diameter to fit over a PL-259 or SO-239, so it's just the ticket for ham antenna use as well. Once the process is completed, you'll have to cut the connection apart if you ever want to get into it again, because it is meant to be completely permanent!"

Good find, Bill. Read the cautions on the label before using any silicone-type of sealant on antenna and other connectors, though. Some sealants warn against their use directly on certain metals (in many cases, brass and copper). Perhaps wrapping the connection first with electrical tape, or a thin application of a flexible coax-seal product, to avoid direct contact with the metal, would offer enough protection to avoid the corrosive effects of some of these silicone-based sealants. Furthermore, if you are unable to locate the kit Bill mentioned, you might be able to purchase the essential parts separately. It's a worthwhile process to remember next time you need to waterproof antenna connections. Fast-setting epoxy might work in place of the silicone adhesive, but it wouldn't have any flexibility when cured, and epoxy often cracks if subjected to mechanical strain.

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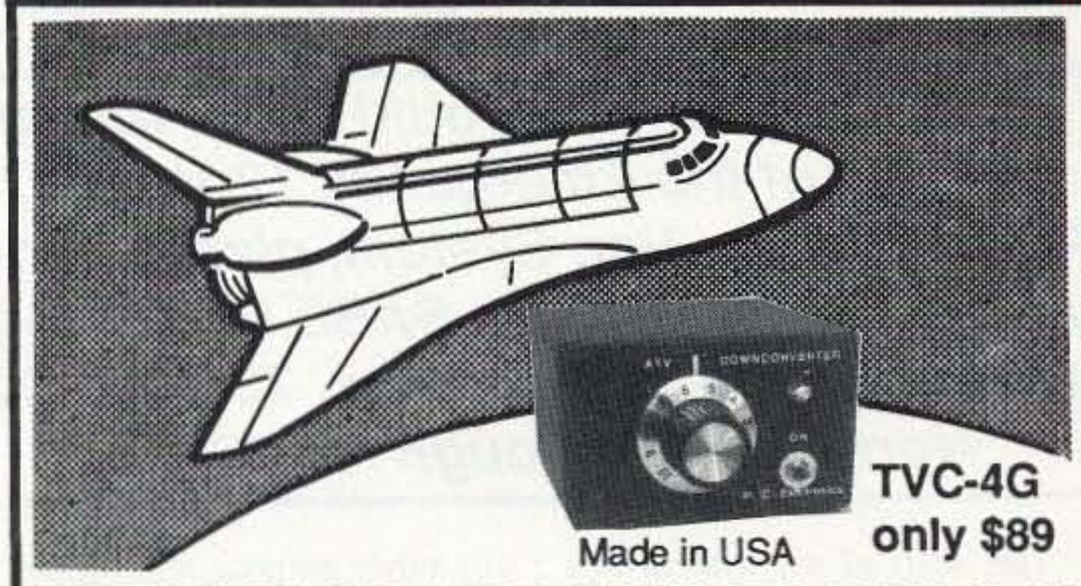

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An Emergency 12-Volt DC Power Distribution System

From Erling Gruel WB9OJD of Fond du Lac, Wisconsin: Looking for a nice layout for an uninterruptable, emergency 12 Volt DC Power system?

"Here's an idea that's reasonably easy to duplicate for those who don't have a gas- or diesel-powered generator to allow them to stay on the air during power outages. Emergency preparedness has been a long-standing traditional part of the amateur radio credo, and this solution is economical, straightforward and, I've found, very functional.

"I was mainly looking for a means of powering my 50-watt, 2 meter solid-state transceiver, a couple of scanners, simplex autopatch, CB radio, some limited lighting and an elapsed-time 12 volt DC automobile clock (or an interval timer/clock such as the Radio Shack™ #63-884) so that I know how long the emergency backup system has been running. Some of the newer 12 volt DC HF radios could also be powered from this setup if transmissions are kept brief or minimum power is used.

Editor's note: if you would like a wiring diagram of the Emergency 12-Volt DC Power Distribution System, please send a large business size SASE to "Wiring Diagram," c/o 73 Magazine, 70 Rte. 202 North, Peterborough NH 03458.

"The heart of my system is a wooden box, attached to the shack wall near my operating desk, approximately 8" high by 7" deep by 12" wide, that contains all the necessary metering, toggle switches, fuse holders and a four-pole, double-throw relay whose 12 volt coil is normally held up by an AC mains-powered 12 volt DC power supply. However, when the power fails, the relay drops and transfers everything normally powered by the station's 12 volt DC supply to the 12 volt DC backup system instead. A master cutoff switch disconnects the emergency backup battery if the relay de-energizes for some other reason, or if I turn off the main 12 volt DC station supply. The emergency backup battery is kept charged by a continual constant-voltage trickle charger during the norm, when commercial power is available.

"I've also extended the battery supply leg of the system into my garage so that if the ham shack backup battery runs down I can quickly and conveniently utilize my car's battery to keep the equipment going! The car, of course, can be started and backed out of the garage ahead of time, so that it will supply charging current to its battery, giving me virtually endless power....at least until the car runs itself dry!

"From the garage to the basement ham shack, I used heavy Romex cable to keep the losses as low as possible, and I've terminated the cable in steel electrical boxes at each end, clearly marked as being 12 volt DC only. I have a cord and connector coming directly from my automobile's battery to the front grill, and an extension of this cable to get from the car's front grill over to the garage wall feed box. Whatever type of connectors you decide to use to implement the system, they should not be easily mistaken for any other purpose and should be husky enough to carry the current that you anticipate your particular system will draw under maximum usage.

"I found that a marine type of deep-cycle lead-acid battery works best for the basement backup battery. Not-including the battery, the whole system cost me under $100 to implement...not a bad price for the extra sense of operating security that it provides. The drawing in Fig. 2 pretty well shows my own particular setup, but I'll be happy to answer any specific questions from *73* readers as best I can."

A 12 volt DC to 120 volt AC inverter could also be included in your system for powering 120 volt AC only equipment but, of course, that would up the final cost. Also keep in mind that in any system like this, everything should be made easily and quickly disconnected, clearly marked and neatly installed, so that in an emergency you'll waste as little time as possible having to figure things out! We all tend to forget the details if a system isn't frequently used. Making a diagram of the entire system, and posting it in both the shack and the garage, would be time well spent. Erling also mentioned that he's willing to supply more information to any reader having a sincere desire to duplicate his idea. It's nice when contributors are willing to help others in similar situations, so please be polite and appreciative of the free assistance...and always include an SASE (self-addressed stamped envelope) for a reply.

Editor's note: if you would like a wiring diagram of the Emergency 12-Volt DC Power Distribution System, please send a large business size SASE to "Wiring Diagram," c/o 73 Magazine, 70 Rte. 202 North, Peterborough NH 03458.

SCR Testing Idea

From Herb Foster AD4UA of Melbourne, Florida: A suggestion for a simple method of SCR testing.

"In my experience working on RCA television receivers on a part-time basis, I've come across an easy way to determine the proper operation of any suspected silicon-controlled rectifiers in the circuit. It isn't hi-tech but it's worked for me every time! All you'll need to duplicate this method is a source of 12 to 20 volts DC, a digital multimeter, and a 470 ohm 1/2 watt resistor. If the SCR happens to have a PIV rating of less than 12 volts DC, use that lower voltage, but most will not be harmed by the 12 to 20 range specified.

"Completely remove the SCR from its circuit, connect the 470-ohm resistor in series with the device's anode lead, then to the DC power source. The sample diagram in Fig. 1 shows the test circuit schematically. Connect the cathode of the SCR to the minus of the power source. Clipping the digital multimeter across the resistor, with the power source tuned on, there should be no voltage drop across the resistor because the SCR should not be conducting (or leaking). Now connect the gate of the SCR to the anode just momentarily. The meter should read a 1- to 3-volt DC drop across the resistor if the SCR is conducting normally. Momentarily disconnecting the SCR's anode from the source voltage should again cause the device to stop conducting.

"This simple test effectively checks the SCR for opens, shorts, leakage, and the ability to fire normally and latch up, then return to its static state when the anode is momentarily opened...all you'll need to know about it. If it passes this test, then without question, it's good."

Herb has submitted a couple of good ideas to this column. Here's

Continued on page 82

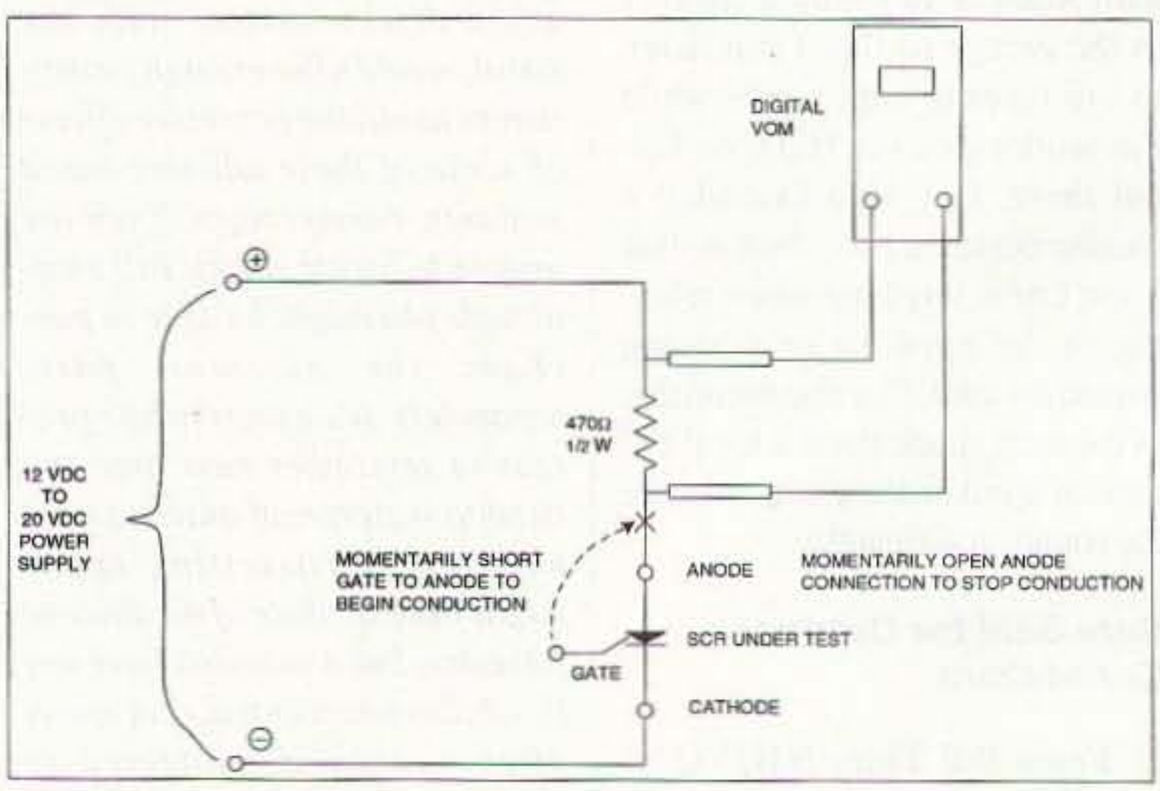

***Fig. 1.** AD4UA's simple SCR test circuit.*

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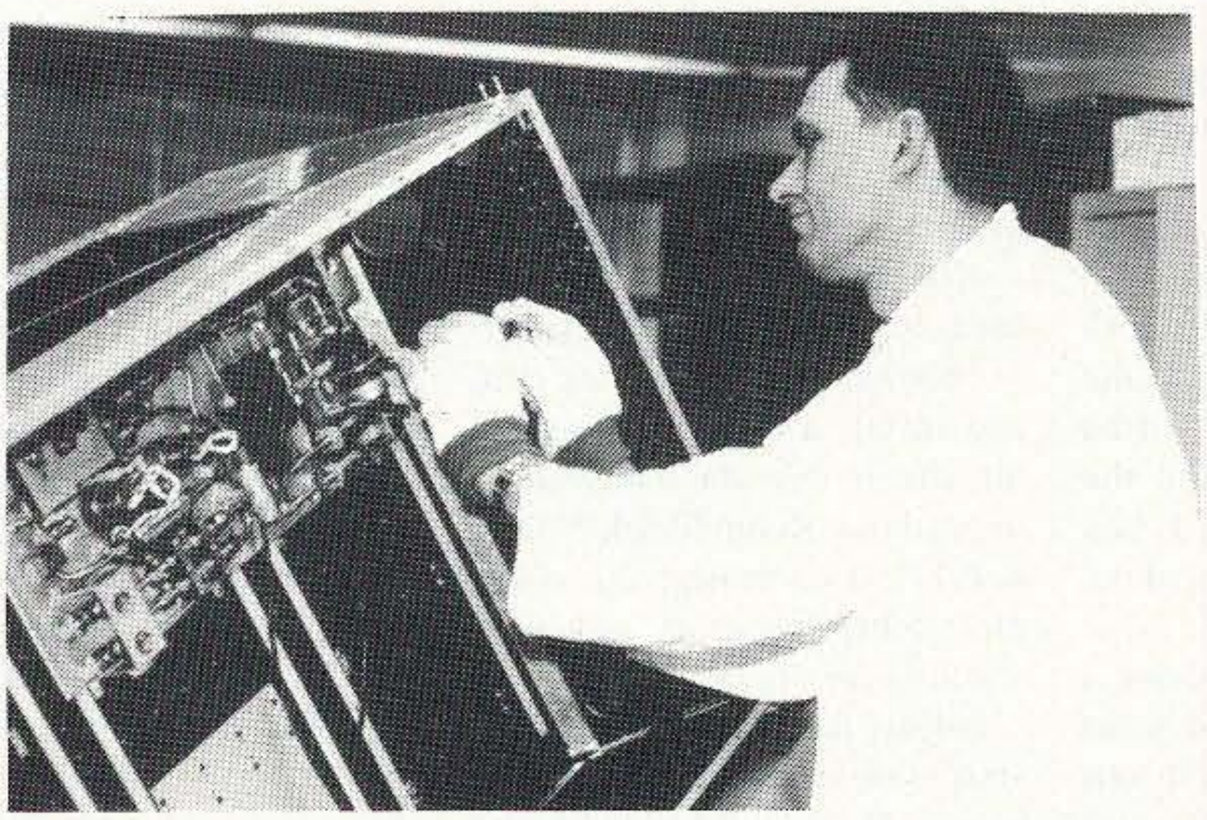

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More Century 21

Remember where we left off last month?

Inside the power amplifier of the Century 21 you'll find four active devices: two drivers and a pair of final transistors. Looking inside the PA compartment of my unit, it became quite clear to me that I was not the first person to visit. It seemed that at one time, or more, the two final transistors had been replaced. In fact, the solder pads for one device had been lifted from the Fiberglas board.

The two final transistors are MRF475s. They are available from Ten-Tec for about $5 each. I'm sure you could get the replacement parts from Digi-Key or Mouser; both stock the NTE replacement series. I don't have a recent copy of the NTE replacement guide, so I don't know the proper NTE replacement number.

Both final transistors are insulated from the heat sink by a mica insulator and hardware. If you have to remove one of the finals, don't lose the hardware; you'll need it when installing the new devices.

Repair Work

Since I had no idea which one of the finals produced all the smoke, I decided to order a pair and install them both. To remove the final transistors from the Century 21, start by removing the hardware securing the device to the heat sink.

Now, carefully unsolder the wires from the larger transformer and bend them out of the way. You have to do this so you can gain access to the transistors. There are two 2 watt resistors also connected to the transformer's leads. Unsolder these as well and push them aside for now.

Next, you'll need an extra heavy duty soldering iron to unsolder the emitter leads from the ground plane on the circuit board. I find it easier to grab hold of the emitter lead with needlenose pliers and gently pull up on the lead while applying heat from the soldering iron. There is not much room to work with desoldering braid. Do the same for the base lead, but be careful you don't pull up the copper pad from the board. You can now lift the device out of the PA compartment.

Installing the new transistor is a bit easier. First, take your soldering iron and smooth out any rough spots on the PC board where the emitter lead will go. Do the same for the base lead as well. You want these two connections to be as flat as possible to ensure good contact with the ground plane. The emitter lead must be soldered as close to the ground plane as possible.

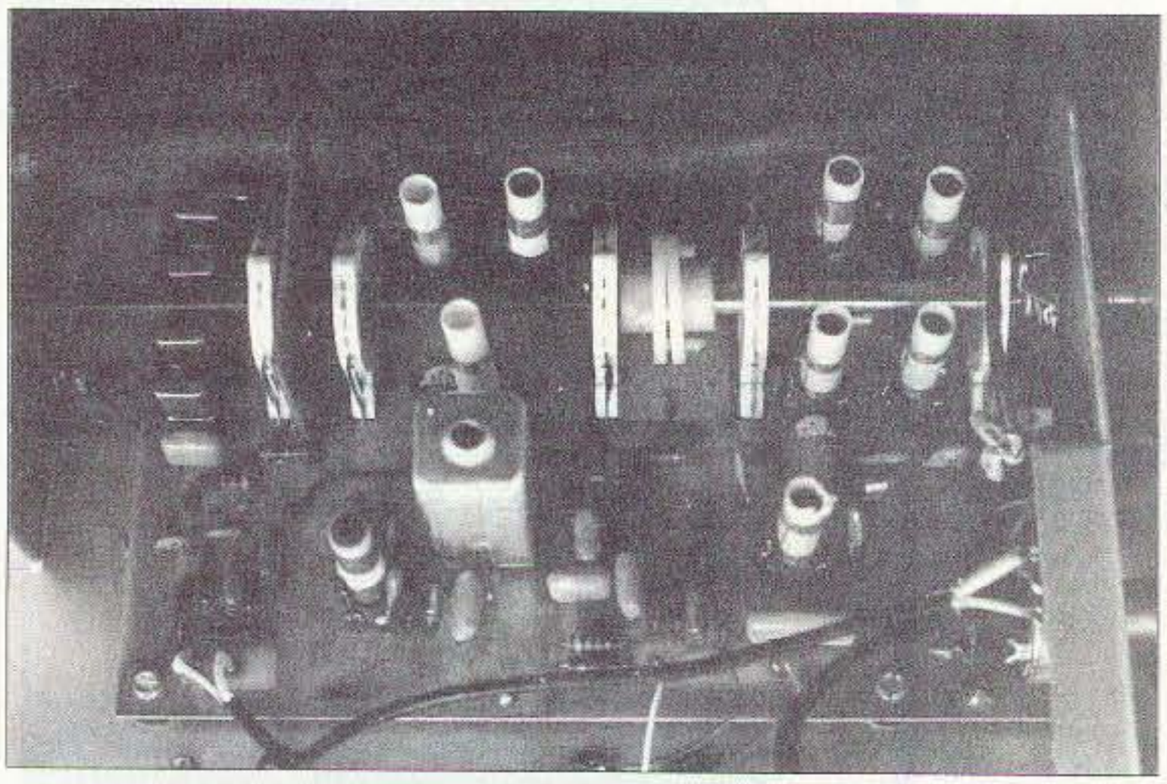

***Photo A.** The mixer/oscillator board contains most of the band switching components.*

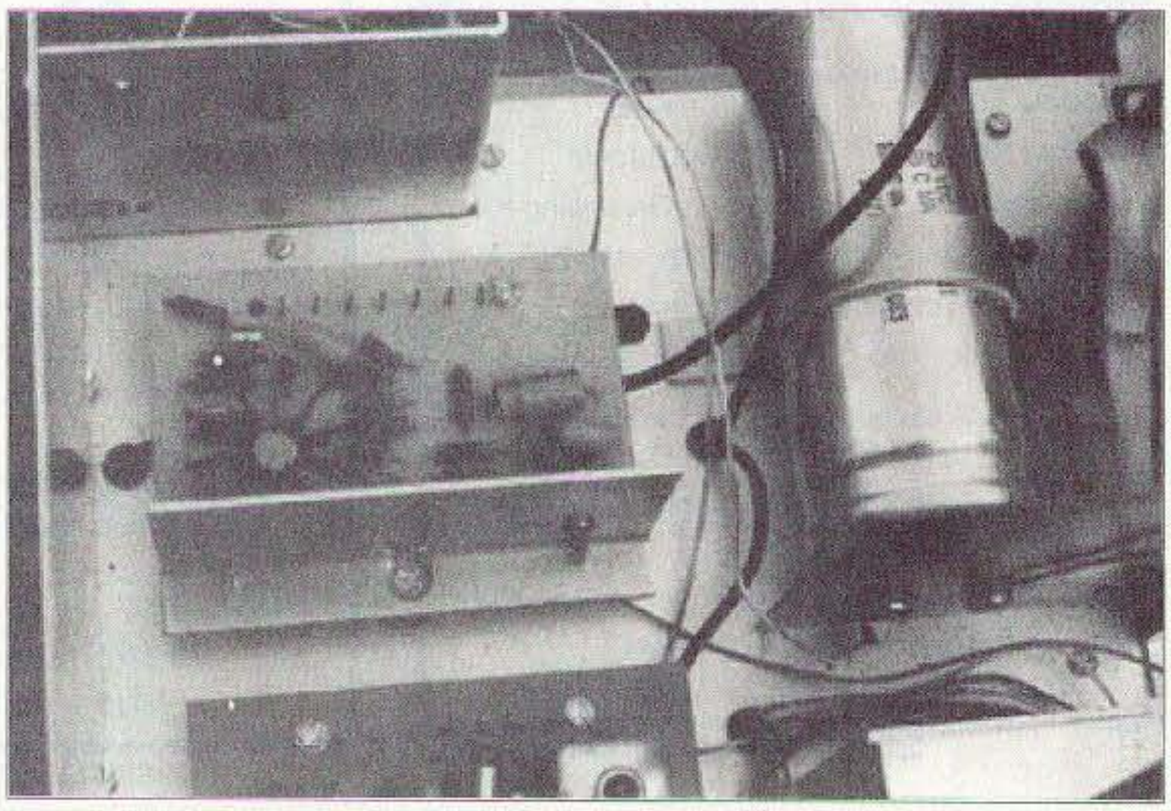

***Photo B.** The low level RF driver is mounted to a small heat sink. This board plugs into a chassis-mounted socket.*

"The mixer worked and had output on all bands."

After you have prepped the areas to be soldered, put a glob of thermal goo to the heat sink and install a new mica insulator. Just in case the hardware is beyond use, Radio Shack™ sells a TO-220 mounting kit, complete with insulators and mica washers for about a buck.

Adjust the leads of the transistor so they match the PC board. Now, tighten down the hardware. Check to see if you have the transistor twisted in such a way as to short the tab (collector) to the ground plane on the PC board. After you have check one more time for alignment, solder the leads down. Installing the transistor this way prevents adding stress to the body should you install the transistor slightly off square. Finish up the job by installing the other transistor.

As a precaution against cooking the power supply, check the collector of each transistor for continuity to ground. Do this *before* you finish reinstalling the various transformers. If you have a collector shorted against the ground foil, it's best to fix it now.

After replacing the finals, I attached the PA to the back of the Century 21. I then attached all the interconnection cables and applied power to the rig.

At key down, the RF drive was slowly increased until the output meter began to show and increase. For a few seconds, I had about 40+ watts of RF output, until the smoke came billowing out of the PA compartment once more. Now, I don't know about you, but I really don't care for 40 meter CW with a smoke detector blaring in the background.

The first thing I thought of was the new finals going up in smoke again. However, after opening the PA compartment once more, I found the final transistors in good shape. The two driver transistors and their emitter resistors were history!

Replacing the drivers' transistors requires the same amount of work as replacing the finals. The drivers are in a smaller case and thus are a bit harder to get in and out of the circuit board. The driver transistors are MRF 472s.

Again, the drivers are not on the shelf at the local Radio Shack™ so another call to Ten-Tec was in order. The 1 ohm half watt resistors were made of carbon and not metal film. I ordered a handful just in case. Nothing was left of the originals except some burned leads and dust.

Since the drivers must be replaced, the driver bias must be

set. You accomplish this by inserting an amp meter in series with the +12 volt lead of the PA. You then apply power, and adjust the bias trimmer for about 6 mA.

One more time, the PA was reassembled and tested. On all bands, except 20 meters, I had 40+ watts.

A Dead 20 Meter Band

The Century 21 mixes the VFO with an external signal provided by a separate heterodyne oscillator to produce the desired transmitter signal. This oscillator and its associated components are located on the 80358 mixer board. (Photo A).

The mixer uses a single MPS3563 transistor. A rotary switch selects the proper crystal according to the band selected. The output of the oscillator is then mixed with the incoming VFO by IC1, a MC1496. The out from the mixer is routed through a series of tuned circuits.

Since the oscillator is common to all bands, and every band worked except for 20 meters, I suspected that the 20 meter crystal was kaput. Checking the output of the oscillator with a scope showed plenty of oomph from all bands. The mixer worked and had output on all bands. That had to mean the signal was stopping someplace in the tuned circuit for 20 meters.

I've mentioned this before many times: Never start messing with alignment settings. But in this case, I did notice the slug of the 20 meter coil was at the very bottom of its core. With a scope, I adjusted it until I could see some output. The coil is fairly broad, so there is no peak to the adjustment. The mixer board also supplies the required signal to the receiver section.

That seemed to fix the problem on 20 meters. I never did connect the antenna to the rig, so I *may* have fixed two problems!

Since I had to tear down the Century 21 for most of these repairs, I decided to replace the spot and drive pushbuttons on the front panel. Ten-Tec no longer stocks replacements for these switches. They suggest a switch available from Radio Shack™, a 275-618 momentary contact type. You must remove the knobs, control nuts and front panel to get to the switch mounting clips. Since the spot switch was broken, I cut the switch clips with a pair of side cutters and saved myself some time.

"I found it a pain in the butt to wrestle with the speaker..."

I found it a pain in the butt to wrestle with the speaker while working on the Century 21. I added a small 156 header and socket so I can disconnect the speaker from the rig. The connector pair is made by AMP, but you need a special tool to crimp the wires. A trip to Radio Shack™ will yield a nice selection of AMP connectors which are easier to install.

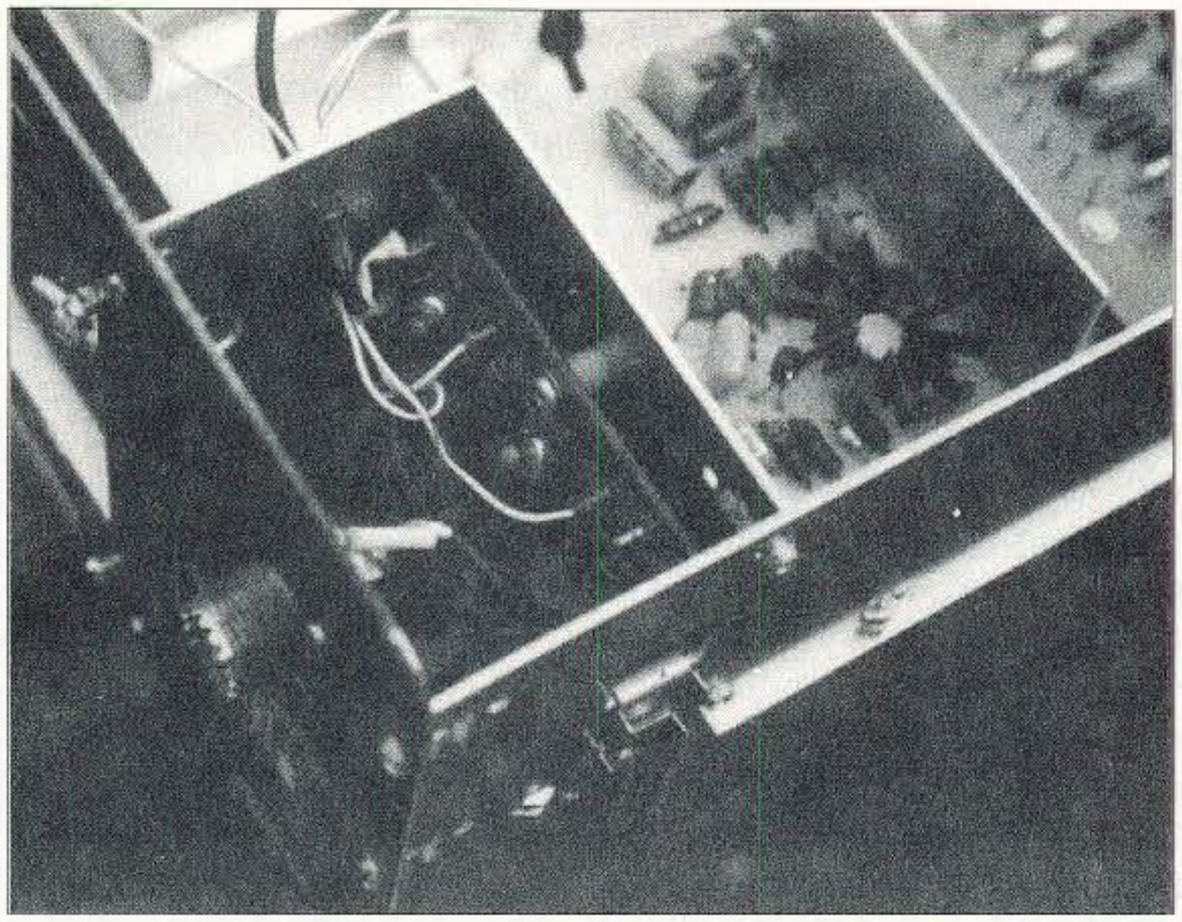

Photo C. *Looking down inside the output filters. The driver can be seen sitting just behind the filter.*

There are two other items worth taking a look at. One is the offset balance control located on the control board. You can adjust this trimmer by listening to the pitch of the signal when the ZERO BEAT switch is closed. Adjust the trimmer so the pitch between the two conditions is the same.

The second check is the PTO. There are no adjustments inside the PTO that you should mess with. But do check the condition of the PTO shaft. If it is dry, apply a very light coat of lubricant. Don't get carried away; too much goop and it will end up on the display and inside the PTO.

The Century 21 by Ten-Tec is easy to work on. Its open chassis and plug-in boards are simple to remove and repair. In operation, the design is simple to operate. You can reduce the drive and run the 21 at QRP power levels. Or, if you're one who likes a change of pace, bypass the PA and route the low level driver directly into the filter stages. The driver should be able to do about a watt or so. 73

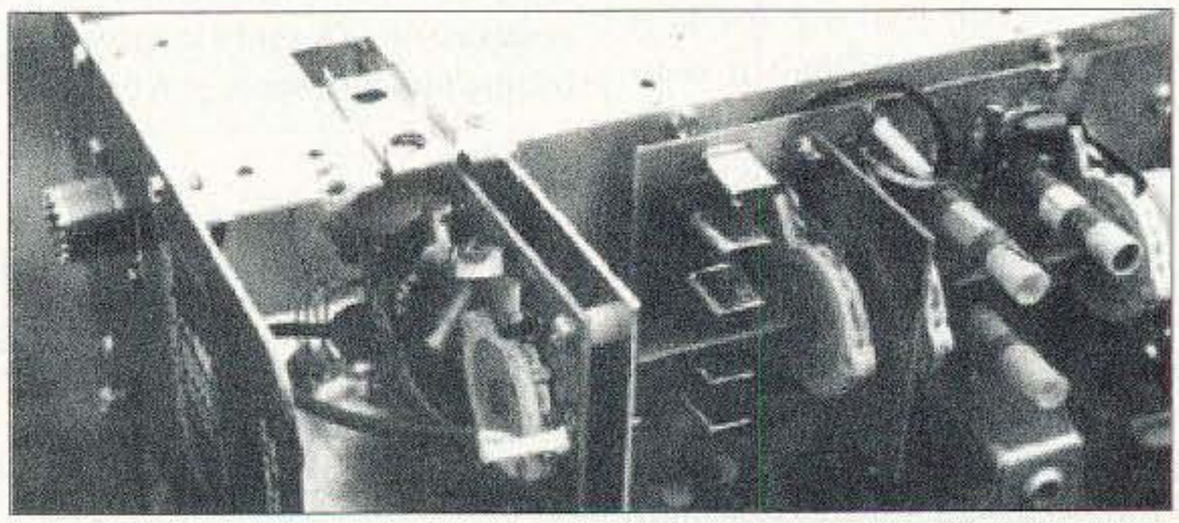

Photo D. *Output filters looking for the bottom chassis. The mixer/oscillator board is behind the filter box.*

NEVER SAY DIE

Continued from page 56

selected, in addition to Budlong, to represent the US at the 1959 world ITU conference in Geneva. When I got there I read through a three-foot stack of papers to find the proposals from the attending countries for the redistribution of the 3-30 MHz spectrum. It looked really serious for us. The ITU hams had been right on target. I attended the US delegation meetings, where I heard the delegates representing the other radio services promising to support the retention of the ham bands. But then, when I took them individually out to dinners to talk, I found that every one of them had confidential private instructions that if their service turned out to be in danger of losing any frequencies, the losses would be taken from the nearest ham band so as to prevent their service from any losses. Some support!

The only hope for saving the ham bands lay with getting the discussion for the redistribution of the 3-30 MHz segment to be postponed until the next conference, which was ten years away. The American delegation members got in touch with the other country delegates, trying to get support for this strategy. They got nowhere. After all, virtually all of the other countries had proposed either getting rid of the ham bands, or cutting them way back.

Finally, they put on some really heavy pressure and got The Netherlands to back us up. Thus, when the conference officially opened, The Netherlands representative got up and dutifully made a motion to put off the re-allocation decisions until the next conference. And, to everyone's amazement, the USSR representative got up and seconded the motion. Since he had a whole string of Soviet and communist countries in his pocket, that was the end of it.

Later I talked with one of the USSR delegates to find out what had happened. He explained that it had to do with Kruschev recently visiting the US and talking with Ike. The USSR wanted to show that they were being more friendly to the US, and thus, being the first international conference to come along, we were the winners. A few weeks later Powers' U2 was shot down over Russia and the frost was back on the US-USSR relations. Whew, were we incredibly lucky at that timing! We came *that* close to losing amateur radio in 1959.

I visited Budlong's hotel suit, again in the most expensive hotel in town. Luxurious! I stayed at a modest hotel, but once the main event affecting amateur radio was over I flew back home to work. Bud stayed on for the whole conference, flying many of the League directors over for lavish parties, all at the members' expense.

Continued on page 75

Above & Beyond

VHF and Above Operation

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San Diego Microwave Group
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San Diego CA 92119

Lasers and Power Supplies

Last month I brushed lightly over several comparisons between microwave operation and laser operation. These factors included pointing dish alignment and laser beam accuracy. This month I want to expand on some of those ideas.

One concept I would like to make clearer is the comparison of microwave radiation from dish-type antennas to laser energy as emitted from a laser or optics system that collimates the laser beam. If we compare HF operation on 3 to 30 MHz to operation with a dipole antenna, our antenna pattern is bidirectional. If we change the antenna to a yagi-type beam for the same frequencies, it becomes quite large and cumbersome but does increase the forward radiation of power into a more directional pattern, say 15 to 20 degrees or less for a good system.

Now, if we were to increase the frequency to the microwave realm of 10 GHz and use a dish antenna 30 inches in diameter, this would limit our front radiation of energy to about 3 degrees of beamwidth. Now what does that mean if we are positioned remotely at a distance of 10 miles? Well, we can calculate the answer from the known fact that our angle is 3 degrees and our distance is 52,800 feet (10 miles). You have the top of a triangle and know its angle (3 degrees) and the distance (10 miles or 52,800 feet), making the base of this triangle the radiation hot spot at 10 miles of our dish antenna. The hot spot in this case is our triangle base of 2,767 feet—we can refer to this hot spot as the microwave *footprint* —so, the microwave footprint at 10 miles distance when using a 30-inch dish is about a half mile across.

How do you obtain gain at microwave levels, using this same scenario? Well, let's increase the size of the microwave dish from 30 inches to 48 inches in diameter and watch what happens to power antenna gain. When we increase the size of a microwave dish antenna to 48 inches in diameter, its radiation pattern is focused into a beam something less than 1 degree (that's 1/360th of a circle). What is the footprint at the same 10-mile distance of this arrangement? Its hot spot is about 921 feet, or one-third as big as our previous example, and there is a significant increase in power because it's condensed into a smaller area. Hence, the receiving antenna can capture more of the transmitter power, making for an overall power gain on the transmitter to receiver path. In actual practice, a 30-inch dish exhibits about 35 dB gain while a 48-inch dish has 40 dB gain measured at 10 GHz.

A general rule of thumb is: As frequency is increased, antenna gain also increases when the antenna size remains the same for each frequency. If the frequency remains the same, and the *antenna* is increased in size, there will be an increase in antenna gain.

How Does Microwave Compare to Laser Operation?

Let's look into the optical laser world and do the same type of comparison between a sample microwave system and a laser. What we are looking for is a handle on how difficult it is to focus a spot of light on a distant object. A laser would be focused into a beam much the same as microwave energy. As a matter of fact, the relationship is exactly the same—it's just that the laser is vastly higher in frequency than the microwave system. In this example the microwave transmitter operates at 10 GHz and the laser operates at 470,000 GHz or 632.8 nanometers. Its beam of light is dispersed or spread out approximately 1 millirad. Why did they shift gears and call beamwidth 1 millirad instead of measuring it in degrees? At light frequencies "degrees" is a very large number; millirads are parts of a degree, and more useful.

What, you say, is a millirad? Take my word that it's quite a bit smaller than 1 degree of compass bearings. *Everything* is smaller up in the optical and non-optical light world. Very low frequency operation is our power distribution system's 60 Hz. We all know where HF, VHF, UHF and our microwave SHF bands are. But even higher are the infrared, the narrow visible light spectrum we see, and the higher ultraviolet, X-ray, and Gamma ray spectrum.

"The ignitor circuit is quite ingenious in its function: It's another voltage multiplier circuit, connected in series with the main power supply load."

The laser's 632.8 nanometers (nm) falls in our visible spectrum, and while most lasers have a beam dispersal of about 1 millirad, how do we figure this in degrees?

We'll go through the math nosebleed again. Dividing 180 degrees by π (3.14159) equals 57.29577 degrees, or one radian. How many radians in 360°? We have 2 x π, or 6.28 radians in one circle. Check me out—divide 360 by radians. You'll get 1,600 mils in 90° or 6,400 mils in 360°; so in 57.29° (1 radian) there will be 1,018.6 mils. For our purposes, 1,000 mils in 1 radian is close enough. Now, if you factor all this out you'll conclude that a typical laser beam of 1 mrad (millirad) is about .05°. A quick calculation by comparison of laser to microwave beamwidth will show you that the laser is *60* times smaller than the beamwidth at 10 GHz using the 30-inch dish. That relates also to being about 60 times harder to focus the beam spot on a target when measured at great distances. See why we had so much trouble trying to place the spot on a target four miles distant? It took a good part of an hour to accomplish the task when the microwave aiming was done in seconds.

Now, let's look into what it takes to make up a laser power supply. See Fig. 4 for distance measurements comparing a VHF yagi to 30- and 48-inch dish antennas, and finally to a HeNe laser whose beamwidth is rated at 1 millirad.

Laser Power Supplies

A laser power supply to power a glass Helium Neon (HeNe) laser tube requires two power supplies to function. One supply is used to ionize the HeNe gas and the other is required to ignite and maintain the laser in its normal operational mode emitting a laser beam.

The ionization of the gas takes a very high-voltage, low-current pulse type of supply, while the ignition of this ionized gas requires a more stout low-voltage medium-current supply. Voltages for ionization are near 8 to 10 kV at extremely low current. The ignition supply must be capable of supplying about 1,000 to 1,500 volts of DC power at about 10 milliamperes. The intriguing thing about these two power supplies is how they are integrated into one package.

There are several variations, depending on input power requirements. For most industrial applications where there is AC power available, that is what is used. I have observed power supplies that have individual transformers with wiring feeding the

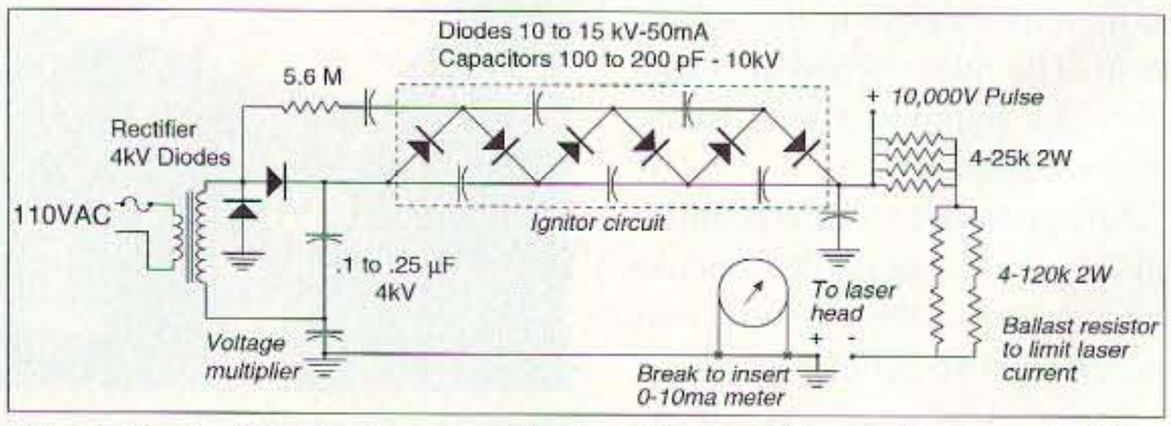

Fig. 1. Basic laser power supply showing rectifier, voltage multiplier, ignitor and ballast resistor circuit.

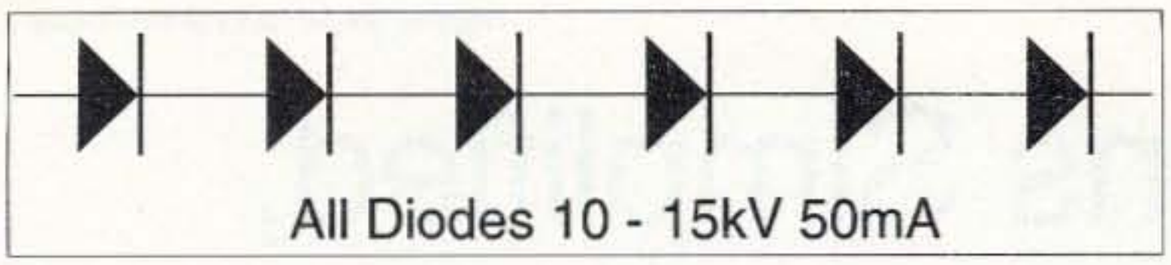

Fig. 2. Series diode rectifier before addition of voltage multiplication circuitry.

high voltage rectifiers and associated circuitry. This type of circuitry usually lends itself to easy component troubleshooting as everything is out in the open.

There are other types of supplies that have integrated all the materials, including the transformer, into a solid block of potting compound, making the unit a single-shot device. "If something breaks replace it" is the right motto for this unit. It does, however, offer reliability and is physically much smaller, making it very attractive (especially in surplus).

Power supply pricing for surplus devices of the open transformer type runs about $20 or less, whereas a similar potted unit can go up to $45 or so. It seems that they are the power supply of choice among power-supply scavengers. Another variation of the potted supply would be one that operates from low-voltage DC input (12 volts), converting the input 12 volts, through a switching supply circuit, to the higher voltage AC, then rectifying it for use. These are most desirable for portable use.

Power Supply Innards

The basic circuitry is varied but the basic type of circuit, in principle, is the same, high voltage of 1,000 volts at several mA of current, with a pulse of 10,000 volts to ionize the HeNe gas inside the laser tube. See Fig. 1 (basic schematic diagram for a laser power supply). As you can see, the circuit is a straightforward rectified AC transformer type of supply, except for the small circuitry attached in the positive lead that's connected to one side of the laser.

This circuitry produces the very high-voltage pulse at microamp low-current levels to ionize the gas inside the laser tube. Here is what is happening: The basic power supply circuit is a standard step-up transformer, feeding a diode rectifier and capacitor voltage multiplier, to produce a steady DC output of 1,000 to 1,500 volts. In series with the power supply is the ignitor circuit which connects to the ballast resistor circuit.

Three main components form a laser power supply: the high-voltage rectifier multiplier; the ignitor; and the ballast resistor circuit. Refer to Fig. 1 for the demarcation points for these three different parts of the circuit. The voltage multiplier portion steps up the input voltage from a low AC value to about 500 volts AC in the transformer. The diode rectifier converts it to DC and the voltage is further multiplied in the capacitor voltage doubler diode rectifier circuit to the 1,000 to 1,500 volt region.

The ignitor circuit is quite ingenious in its function. In fact, it's another voltage multiplier circuit, connected in series with the main power supply load (the laser tube and ballast resistor circuit). The ignitor circuit is constructed with a series string of six special very high-voltage diode rectifiers. See Fig. 2. Alone, these diodes in this configuration only provide a voltage drop across each diode junction, and reduce the power supply output by a few volts.

However, by adding small-value capacitors (100 pF), as shown in Fig. 3, to the series diodes changes the whole picture. We still have the small voltage drop across each diode, but during the period when the laser tube is in a static cold non-light-emitting period, drawing virtually no current, this network multiplies the power supply voltage from 1,000 volts to a pulse of high voltage near 10,000 volts.

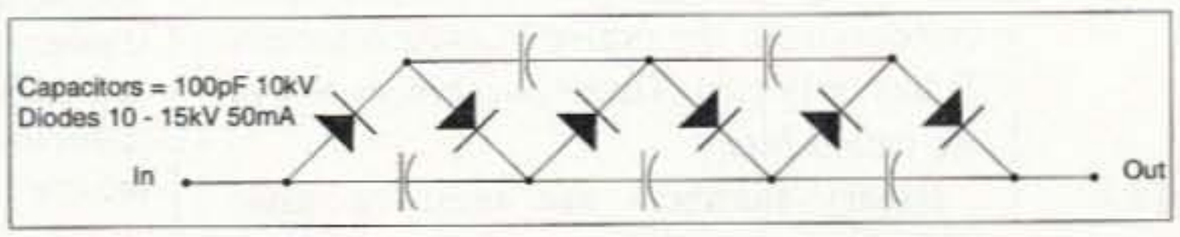

Fig. 3. Complete circuit of voltage multiplier used for laser ignition. Voltage required: approximately 10 kV.

The current that this circuit can furnish is minuscule in the microamp range but is enough to ionize the HeNe gas in the laser tube, allowing it to function with the lower-voltage DC power supply which furnishes current now conducted via the ionized gas in the laser tube. The ignitor circuit cannot supply voltage multiplication with any applicable current flowing, due to the very low value of capacitors and the efficacy of this high-order multiplier. When low voltage (1 kV) current starts to flow through the ignitor series diode circuit towards the laser tube load, the ignitor multiplier action ceases to multiply.

Blame it on the low capacitance of the 100 pF capacitors and the poor ability of the multiplier to supply any amount of current. Electronically speaking, it sort of disconnects and becomes just a series of high-voltage rectifier diodes. (I hope I haven't tripped over myself trying to explain the operation of the ignitor circuit while explaining its function.)

The last portion of the laser power supply is the ballast resistor, one or a series set of several resistors whose primary purpose is to limit current to the load. The load in this case is the laser tube whose gas is already ionized placing the tube in a conductive state. The ballast resistor will limit the current flowing through the laser tube to a safe level, as specified by the tube manufacturer.

How do you test a laser power supply (if you can get to the various parts of the circuit), and what type of meter do you use? Safety is *always* the foremost concern, so you want to use a testing setup that is suitable for operation at the highest voltage rating of the

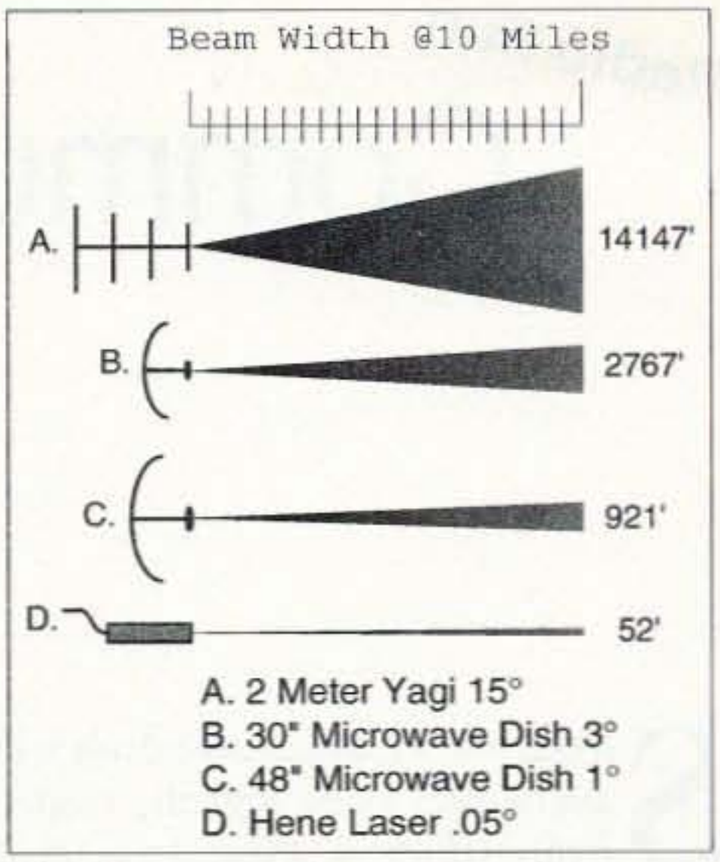

Fig. 4. Beamwidth comparisons between an HF or VHF yagi, a microwave dish antenna, and a HeNe laser. Beamwidth or spot patterns were measured at a target 10 miles distant.

system, and that's 10,000 volts. I do not recommend trying to use voltmeters and DVMs that are in popular use today. I prefer to use an old RCA Voltohmist VTVM with a 50,000-volt high-voltage probe much like what you would use to check a TV CRT anode high-voltage circuit. Sure, it's yesteryear's circuitry, but for voltage in the 15-kV range it can't be destroyed and affords you, and the meter being used, a high degree of protection.

I can't neglect to mention the basic protection and caution when working with lasers: *The voltage being used is deadly.* Precautions should always be taken to ensure proper grounding of all equipment, as well as insulating yourself against accidental contact with any of the high voltage circuitry. This equipment operates with high voltage in the 1- to 2-kV range and should *not* be treated lightly. Yes, it would be safer to employ solid-state laser diodes, as they operate on much lower voltages, but their biggest drawback is that they haven't become available on the surplus market at a reasonable price.

Well, that's it for this month. Next month I'll get into how to start a society or group of amateurs such as our group, the San Diego Microwave Group. I will get into the care and feeding of this group, and the projects that bind us together. 73 Chuck WB6IGP. 73

Radio Fun

Number 66 on your Feedback card

Communications Simplified, Part 3

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So far, parts 1 and 2 have dealt with audio and video signals, respectively. Both of these have dealt with analog waveforms. In this part we discuss digital signals.

Digital Data

In its simplest form, digital data is simply a series of numbers. Those numbers could simply be data (such as some company's payroll records), or they could be a digitized analog signal (such as a digitized telephone signal.) As far as sending those numbers from one place to another, it doesn't really matter what these numbers represent, so we won't worry about that at this point.

Although we humans generally use decimal numbers, both computers and communications equipment use binary numbers. The most important reason is that these numbers are less likely to be misread as errors.

Suppose someone asked you to count the beans in a jar, but specified that you are not allowed to use any number that has a 2, 3, 4, 5, 6, 7, 8, or 9 in it; only numbers with a 0 or a 1 are allowed. How would you count?

Like any good computer person, you'd start with zero, and count

0
1

But now you realize you're not allowed to use anything from 2 through 9, and so you skip ahead to

10
11

Now you're stuck again. You can't write down 12, 13, or even 20 or 30 or 90, so you skip ahead to

100
101

Now you again have to skip ahead to

110
111

and now you must skip a whole series of numbers until you get to

1000
1001

and so on.

Congratulations. In writing down the numbers

0
1
10
11
100
101
110
111
1000
1001
1010

you have just invented the *binary number system*. Each of the counts in this table corresponds to one of the numbers of our decimal number system, as shown in Table 3-1.

Table 3-1

Binary	Decimal
0	0
1	1
10	2
11	3
100	4
101	5
110	6
111	7
1000	8
1001	9
1010	10

The decimal number system (from the prefix *deci*, which means 10) has ten different digits, whereas the binary number system (from the prefix *bi*, which means 2) has only two. These two binary digits are called *bits*.

Binary numbers are used because, with just two different digits, it's less likely that they will be confused. For example, in a typical digital circuit, the 0 bit might be something "near" 0 volts, while the 1 bit might be something "near" 3 or 5 volts. As long as the 0 voltage doesn't get too big, or the 1 doesn't get too small, circuitry can still reliably tell the difference between them. If you tried to represent decimal digits with voltages, it might be too difficult to tell the difference between one digit and another if the voltage changed a bit as it travels from one place to another.

DETOUR

There was a very fast swing to the use of digital circuitry back in the 1960s and '70s, when digital integrated circuits (ICs) became cheap enough for common use. The most common digital ICs were called Transistor-Transistor Logic, or TTL.

TTL ICs work on two different voltage levels. Anything between 0 and 0.8 volts is one voltage level, while the other is anything between 2.0 and 5.0 volts. Many users call the near-zero voltage level a 0, and the 3–5-volt level a 1. But this is a bad practice, because many designers use the near-zero voltage to stand for a 1, and the 3–5-volt level be a digital 0 signal, which happens to be the exact opposite. (And many designers even switch back and forth between the two systems, sometimes just a few tenths of an inch apart in a circuit.)

To stay out of trouble, don't use the terms "zero" and "one" to refer to digital signals. Instead, call the 0 to 0.8-volt level a *low*, and call the 3–5-volt level a *high*. This is always safer.

TTL voltage levels are still common today; even though many ICs are no longer TTL, they still usually use the same voltage levels.

Incidentally, the words high and low can be used with other voltages as well. For instance, a high might be +15 volts, while a low might be -10. The only thing required is that the high voltage really be higher than the low.

END OF DETOUR

Although the numbers in Table 3-1 are all different lengths, note that the value of a number doesn't change if you put extra zeroes in front of it. In decimal, for example, 7, 007, and even 00000007 all have the same value. In computers, binary numbers are often stored in groups of eight bits, called a *byte*. Thus the binary equivalent of a 7 would usually appear as 00000111, rather than just 111.

Looking at Table 3-1 again, we note that, if you were limited to one-bit-long numbers, you could only express two different ones: 0 and 1. If you used two-bit-long numbers, then you could express four different numbers: 00, 01, 10, and 11, which correspond to the decimal numbers 0, 1, 2, and 3. Likewise, a three-bit number can have eight different values, which correspond to the decimal numbers 0 through 7. We can generalize this rule as follows: a number with n bits can have 2^n different values, corresponding to the decimal numbers from 0 through 2^n- 1. For example, an eight-bit byte can have 28 or 256 different values, which correspond to the decimal numbers from 0 through 255.

A typical byte in a computer could represent one of three things:

A number, or part of a number, used in some computation,

An instruction, or part of an instruction, telling a computer what to do, or

A letter, number, or punctuation mark, coded in ASCII (which stands for the American Standard Code for Information Interchange) These are often called *alphanumeric characters*, or just *characters*.

Serial and Parallel Data Transfer

When binary data is moved from place to place, it is most often moved in bytes. A byte can be transferred from place to place in one of two ways:

Parallel transfer: all eight bits of a byte move at the same time along eight separate wires.

Serial transfer: the eight bits travel on one wire, but in sequence ("serially"), one after another.

Actually, parallel data transfer requires more than eight wires. For example, the most common parallel connection is from a PC computer to a printer; this connection usually involves a 25-pin connector and cable:

8 wires carry the eight bits of data

1 wire carries the data-ready strobe, a signal that tells the printer that a byte is ready

1 wire carries a data-received signal from the printer back to the computer

1 wire carries an out-of-paper signal from the printer back to the computer

1 wire carries a busy signal telling the computer that the printer is busy

1 wire carries a ready signal, telling the computer that the printer is on-line and ready to receive data.

12 wires connect the grounds of the computer and printer together.

The data-ready, data-received, out-of-paper, busy, and ready signals are often called *handshaking* signals because they allow the computer and printer to agree on when and how fast to send data. The reason for twelve ground wires is that the printer connection is often done with a ribbon cable; in order to prevent interaction between closely-spaced adjacent wires, the 13 signal wires are separated by 12 ground wires.

A parallel connection can be quite fast since (1) all bits travel simultaneously, and (2) the handshaking signals allow the computer and printer to communicate at their maximum speed, yet still slow down if one falls behind. On the other hand, the parallel connection requires a lot more wires (even if you cut it down to the bare minimum number of wires needed.) Hence parallel connections are only used for short distances.

All long-distance data transfer is therefore done through serial connections. In these, all data bits as well as some simplified handshaking signals travel along one wire (although there is also at least one additional ground or return wire.)

RS-232 and Asynchronous Serial

The most common serial connection is known as RS-232. Although it also often uses either a 25-pin or 9-pin connector, only two wires are absolutely necessary in an RS-232 connection: one for signal, the other for ground.

For example, the ASCII code for the lower case letter *a* in a personal computer is 01100001. If you looked at the letter *a* carried on an RS-232 signal wire, with an oscilloscope, you would see the waveform in Fig. 3-1.

First, you note that although the code is 01100001, the bits shown in the figure are 10000110, which is backward. That is because they really *are* sent backward. The rightmost 1 (at the end of 01100001) is called the *least significant digit* or *lsd*, and is sent first; the leftmost, called the *most significant digit* or *msd*, is sent last. There is a historical reason for this, which we'll see in a moment.

Next, you will note that a 1 is a negative voltage, labeled as -V in Fig. 3-1, while the 0 is a positive voltage labeled +V. The precise voltages are not specified, and could be anything from 3 volts up to 15 volts. Hence, in one system the voltages might be -5 and +5 volts, while in another they might be -12 and +10, or whatever.

There is room for some confusion here, since many people wrongly think that a 1 has to be more positive than a 0, which of course is not the case here. To avoid that problem, many communications people therefore call the 1 signal a *mark*, while the 0 signal is called a *space*. (To use our earlier terminology, a the mark or 1 signal is the low here, while the space or 0 signal is high.)

At the top of Fig. 3-1 is the notation "1 bit time" which shows the length of one bit. Within the byte, each bit has exactly the same length, which we call a *bit time*. The string of four zeroes in the middle, for example, is exactly four bit times long. Both the sender and the receiver must agree on the exact length of a bit so that, when a string of ones or zeroes arrives, the receiver can determine exactly how many bits there are in that string.

Once we know the length of one bit, we can calculate the maximum number of bits per second. For example, if each bit is 1/300 second, there could be a maximum 300 such bits sent per second. Thus the *bit-per-second* or *bps* rate is defined as

bits-per-second = 1/(1 bit time)

Since both the sender and receiver have to agree on the bit-time (and therefore the bps rate), there are certain bps rates which have become

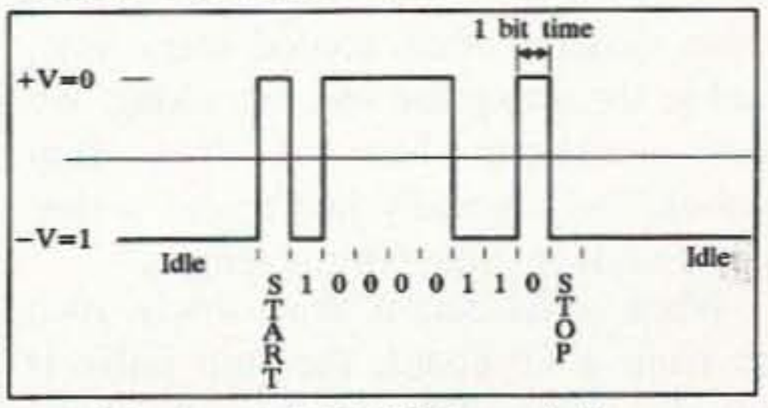

Fig. 3-1. A serial RS-232 letter "a"

standardized over the years. These are 300, 600, 1200, 2400, 4800, 9600, etc. You can see the pattern in these. Incidentally, you often see the bps or bit-per-second rate referred to as the *baud rate*. This is not entirely right, since baud rate has a different meaning from bps; still, it's a common use, and we might as well live with it. (When we get to discuss modems, we will see what the difference is.)

Although the timing of the bits within a character is very exact, the timing between characters is not. For instance, if the signal is coming from a keyboard, there might be long spaces between characters as the typist is searching for the next key. For that reason, this kind of serial data transmission is called *asynchronous*, meaning not synchronized. The bits are carefully timed (synchronized to a clock), but the characters are not.

Thus there has to be a way of telling the receiver when there is nothing being sent, and when the next character begins. The "nothing is being sent" condition is called an *idle*, shown as a 1 or mark signal in Fig. 3-1. Note that there can also be a 1 or mark signal inside a character, but that will generally be shorter.

The "character is starting" code is called a *start pulse*, and is always a 0, or space, which follows the idle. Thus a long mark (1) followed by a space (0) pulse marks the beginning of a character.

Since the sender and receiver will always agree beforehand on the number of bits in the character (usually eight), they can count bits from the start pulse and figure out when the character is over. Hence they don't really need a stop signal. Nevertheless, there is always a *stop pulse* sent at the end, which is always a 1. This is another of those historical things, dating back to when mechanical distributors (much like the distributor in a car) were used to convert to and from serial data in teletype machines. These distributors were run by a motor, and a clutch needed time to start and stop the distributor for every character. In fact, these systems often needed extra time, and so the stop pulse was extra long. We still sometimes hear of "two stop pulses," which really just means a stop pulse of double the normal length.

When serial data is sent slowly, such as from a keyboard, the stop pulse is usually followed by another idle signal of some unknown length. But when the data comes from a computer, it can come at maximum speed. In that case, the stop pulse might be immediately followed by another start pulse, with no idle between them. If you start watching such a data stream in the middle, things can get somewhat confusing since you can't tell which zeroes are start pulses, and which zeroes are data bits. To be really sure, you have to go back to the last previous idle time, and start counting bits from there. Computers also often get confused—if you temporarily break the connection in a serial line you mess up the timing, and all the following data may be wrong until things slow down and the next idle reestablishes synchronization.

In any case, we now see that an eight-bit byte sent on a serial line actually takes a total of ten bits. The addition of the two start and stop bits adds a 25% *overhead* which slows down the transmission. (Hence computer-to-computer data transmission often uses *synchronous* transfer, which doesn't waste as many bits.)

Parity

Let's return to ASCII for a moment. As mentioned earlier, ASCII is a code for encoding letters, numbers, and punctuation marks into binary bits. Although we earlier said that the code for the letter *a* is 01100001, that's not quite true. The true ASCII code is just seven bits, and so it's really just the seven bits 1100001. So where does that eighth bit come from?

Since computer memory locations (at least, those of smaller computers) come in eight-bit bytes, there is an extra bit left over when storing a seven-bit ASCII character in such a memory location. This extra bit can be treated in several ways.

It can be left unused. But since you can't just leave the bit empty, you must put something into it. Hence you could routinely just force it to be a 0 or a 1. In this case, the letter *a* could be stored as 01100001 in some computers, and 11100001 in others.

It can be used to increase the number of available characters. For instance, in PC-clone computers, this extra bit is a 0 for all normal characters, but becomes a 1 for special characters. For example, 01100001 in such a computer is still an *a*, but 11100001 is used to store the Greek letter ß This allows the computer to use an extended character set which includes symbols like ±, π, √, ≥ and °, which are not in the regular ASCII code. This code is sometimes called *extended ASCII*.

It can be used for *parity* error checking. This is not usually done in small computers, where errors tend to be rare, because signals travel shorter distances or because other methods are used to check and correct errors. But parity checking is common when data travels a long distance.

Parity comes in two types—*even parity* and *odd parity*. In even parity, the eighth bit is chosen so that the total number of ones in the character is even; in odd parity it is made odd. For instance, the ASCII code for *a* is 1100001, which has an odd number of ones. For even parity, an extra 1 would be added so that the total number of ones in 11100001 is even; in odd parity the extra bit would be 0 to keep the odd number of ones in 01100001. Another example is the capital letter A, whose ASCII code is 1000001. This would become 01000001 in even parity, and 11000001 in odd parity.

If you've ever seen abbreviations like 8N1 or 7E1, now you can understand what this means:

8N1 means eight data bits with No parity bit, and one stop pulse.

7E1 means seven data bits plus an Even parity bit, and one stop pulse.

Note that the circuitry can't generate or check a parity bit until it has the remaining seven bits of the character. This is the reason why each byte in an RS-232 serial line is sent backward—to put the parity bit at the end, after all the previous data bits.

Error correction and error detection

The idea behind using parity is that every character sent has a specific 0 or 1 bit in that eighth or parity position, determined by the rest of the bits. If any one of the bits in that group somehow gets changed due to an error in transmission, the number of ones will add up to the wrong number, and the receiver can detect that an error has occurred. But note that if two bits (or any even number of bits) get changed, the error can't be detected. For instance, if the 01100001 for an odd-parity *a* gets changed to 01100111, the number of ones is still odd, but the *a* was changed to a *g*

without the receiver being able to detect a parity change. The reason is that with just one parity bit, the chance of an error occurring but the parity still accidentally being right are 50%.

Detecting, and even possibly correcting, errors in digital data is important, because an error in just one bit can make a huge error. Hence the parity bit is a useful step, but not enough.

There are a number of ways of handling errors. The most important step is to be able to detect them, because once you know an error has occurred, you can take steps to fix it. One way is to increase the number of parity bits to reduce the chances of an error going by unnoticed; in this case these bits are usually just called error-detection bits, rather than parity bits.

One common way to do this is to generate a CRC or *Cyclic Redundancy Check* number with a CRC generator. The CRC generator is basically a number of computer building blocks called *flip-flops* (usually 16, although more or fewer can be used), which are interconnected using additional computer components called *gates*.

The flip-flops are computer circuits which can store either a 0 or a 1 bit. Initially, all the flip-flops are set to hold a 0, and then the outgoing string of bits in the sender is passed through the chain of flip-flops. After all the bits pass through, some of the flip-flops wind up holding a 0, while others hold a 1. The precise bit pattern in the flip-flops depends on what data went through and how they are interconnected. If there are 16 flip-flops, then they wind up holding a 16-bit number called the CRC, which is then sent after the data as an extra set of bits.

In the receiver, an identical CRC generator circuit receives the data, and also generates its own CRC. If there was no error, the CRC sent by the sender should therefore be identical to the CRC generated in the receiver. If they are different, then an error occurred somewhere along the way.

When 16 flip-flops are used to generate a 16-bit CRC, the CRC number itself could have any one of 2^{16}, or 65,536 different values. When an error occurs, there is only 1 chance out of 65,536 that the resulting CRC will accidentally be the same as the correct CRC that was generated by the sender. This means that only 1 out of 65,536 errors is likely to sneak through without being caught; in other words, 65,535 times out of 65,536 the error will be detected, which means that the data has a 99.998% chance of being correct. That's a lot better than the 50% chance with just a single parity bit!

Even with just an 8-bit CRC which has 256 possible values, there is a 255 out of 256 probability, or 99.6% of an error being detected.

When an error is detected, how do you correct it? There are two ways: *backward error correction*, and *forward error correction*.

In backward error correction, when the receiver detects an error it asks the sender to transmit the data again. Forward error correction involves sending enough extra (called *redundant*) bits right away so that the receiver can correct an error without asking for a retransmission.

Backward error correction is fairly straightforward. It's what we use every day when we say to someone, "Huh? What was that? Say it again?" The only catch with it is that we need what is called a *reverse signal path*; that is, we need some way of getting a message from the receiver back to the sender. In many communications methods there is a two-way path, so it's easy to get that message back to the sender; sometimes, though, that reverse path may not be present. For example, if a sender (such as a pager transmitter) sends a signal to many different receivers (such as pagers), it's not practical for each receiver to be able to reply to the sender.

Even in simple cases, sending a reverse message asking for a correction takes extra time. Thus backward error correction is more useful if there are relatively few errors so you don't have to ask for too many repeats.

Forward error correction is more interesting, and more difficult. It uses a class of *error correcting codes* or ECC which have built-in redundancy.

Redundancy means including more information than really necessary. For example, the English language has a lot of redundancy, because you can often remove a lot of letters from a message without losing essential information. Consider the sentence "Ths sentins has a lutt of errurs." Even though there are missing letters, extra letters, and even some wrong letters, you know what it says. That's because of redundancy.

The same can be built into computer messages. As a really simple example (since most ECC codes can be quite complex), consider what is called *longitudinal parity*. Let's say you send the word Help in ASCII with even parity:

H = 01001000
e = 01100101
l = 01101100
p = 1111000

so the message reads

01001000
01100101
01101100
11110000

If one single bit somewhere in the four bytes gets changed, you can detect the error and you know which *letter* is wrong, but you cannot correct it because you don't know which *bit* of the eight in that letter is wrong. But suppose you add an additional set of even parity bits, called longitudinal parity, going down the list, like this:

01001000
01100101
01101100
11110000
10110101

The fifth group of bits has been chosen so that *the number of ones reading down any column is also even*. Now suppose an error occurs so *one* of the bits somewhere gets changed, such as the fourth bit in the third row, which got changed from a 0 to a 1:

01001000
01100101
01**1**1100
11110000
10110101

As a result, the third row now has the wrong parity because it has an odd number of ones; the fourth column now also has the wrong parity. We therefore know that the error is in the third row and fourth column, and so we can change the bit in that position from a 1 back to a 0.

This kind of error checking can detect and correct a single bit error, and can detect (but not always fix) a two-bit error. That isn't good enough for most communications applications, because quite often noise bursts and other problems cause an entire series of bits to be wiped out. Hence more sophisticated error correction methods are used, but other than knowing about them, we need not really study them further at this point.

Synchronous Serial Data Transfer

The asynchronous serial method we've discussed so far has the advantage of being simple, but it also has a number of disadvantages. The primary one is that it is inefficient—not only are there two overhead bits for every eight data bits (which wastes time), but the parity bit (if used) adds still another wasted bit that doesn't really do a good enough job of detecting errors. Synchronous data transmission is a way around that. But because it is more complicated, it is generally only used in high-speed applications, such as when two computers are communicating directly with each other. You will seldom see it in a home or small office PC.

In the synchronous method, many bytes of data (usually some power of 2, such as 128 or 256) are sent, one right after another, without separating them by stop and start bits. But now timing becomes very important because a very large number of bits is sent in arow, and even a slight error in timing them could cause a miscount. Error detection is also important, because in a long string of bits there is a greater probability of something going wrong. Synchronous data transmission therefore usually works something like this:

When there is nothing to send, the sender sends an idle signal. What this is depends on whether there is only one sender on the line, or whether the same line might be used by several senders. If there might be multiple senders, then the idle is nothing—not mark or space, but literally nothing—an open connection. If there is only one sender, then the idle is more likely to be a continuous string of bits rather than a continuous mark or 1 signal. For example, the system might send a continuous string of 01010101…bits.

To signal the start of data, the sender sends a different series of easily recognizable bits, instead of a start pulse as in asynchronous data. For example, the sequence 00111100 or 10010110 might be used; both of these are sufficiently different from the idle to be easily recognized as something new.

Next comes the data, generally as a fixed-length group of bytes. Typically there might be 128 or 256 bytes, though it might be some other power of 2.

After the data would come a CRC, usually a 16-bit number, which provides a fairly good probability of detecting errors. The CRC might be followed by another short idle signal, or there might be another start sequence.

Back to bandwidth

In previous parts, we discussed the bandwidth needed for audio and video signals. What about the bandwidth for digital data?

Although digital signals don't exactly consist of square waves, they look close enough to square waves that we suspect that there are a lot of harmonics. Although we haven't specifically said so before, a general rule of thumb is that the faster signals change—the more kinks and corners they have—the higher the frequencies in that signal. This almost certainly means that there will be a lot of harmonics, and so it implies that we need lots of bandwidth.

That is generally true; fortunately it's not as bad as it seems. As we mentioned earlier, the reason that binary numbers are used instead of decimal numbers is that it is easier to tell the difference between a 0 bit and a 1 bit than to have to tell the difference between ten different digits. Even if a digital signal gets all distorted, it may still be possible to read it without errors as long as the ones and zeroes do not get totally confused with each other.

For example, Fig. 3-2 shows a "before" and "after" comparison of a digital signal that went through a communications circuit whose bandwidth was too low, so that many of the harmonics were reduced or eliminated. This much distortion on an audio or video signal might be disastrous; yet the digital signal can be recovered from the "after" signal with fairly simple circuitry. The timing will be slightly changed, but even that can be fixed. As a result, the digital data would go through this system without major errors.

Let's keep in mind that there is no such thing as a perfect communications circuit. There is never enough bandwidth, always a bit too much distortion, always a bit too much noise. These will always affect an audio or video signal in some way; in fact, they will affect all analog signals, and once some noise or distortion affects an analog signal, it is almost impossible to clean it up again.

Digital signals, however, behave differently. As long as the 0 and 1 bits are recognizable, they can usually be recovered and the original digital data will come through without change. And once recovered, that same data can be sent once again through another circuit. Thus, as long as you *regenerate* the data often enough, you can send it as far as you'd like without its being corrupted. This is one big advantage of digital data transmission over analog data.

Claude Shannon, a Bell Laboratories mathematician, calculated back in 1948 the absolute maximum theoretical number of bits that can be sent through a communications circuit in one second as

max bps = $BW \log_2 (S/N + 1)$ where BW is the bandwidth, and S/N is the signal-to-noise ratio—the ratio between the signal power and the noise power.

Mathematicians call the expression $\log_2$ in this equation the "logarithm base 2." Calculating it is somewhat difficult, so for a good approximation let's think of it simply as the number of bits needed to represent the value of $(S/N + 1)$. For example, let's consider a telephone line with a bandwidth of 3000 Hz, and suppose the power of a telephone signal is 30 times higher than the power of the noise, so $S/N = 30$. We need 5 bits to represent the number 31 (which is 30 + 1), so the theoretical maximum number of bits per second in a telephone connection would be 3000 times 5, or 15,000 bps. (With modern telephone lines, and with some tricks to compress data, it is possible to go somewhat higher.)

Depending on the quality of the connection, sometimes the data may have to be sent too slowly to be of use, and sometimes error correction may be needed. But digital data can be sent almost unlimited distances almost without errors—as long as it goes slow enough.

For this reason, sending audio and video analog signals digitally is a useful technique. We will return to this concept later; for now we need just say that the idea is to take the audio or video signal, digitize it with an *analog-to-digital converter*, send the digital information,

Continued on page 82

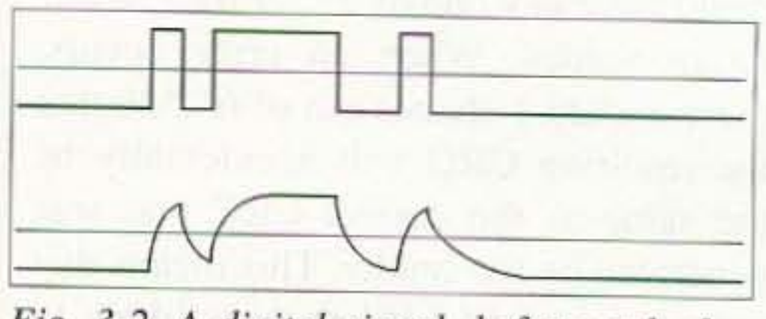

Fig. 3-2. A digital signal, before and after distortion

A Simple Capacity Meter

Have fun building your own with this simple construction project.

J. Frank Brumbaugh KB4ZGC
Box 30
Salinas PR 00751-0030

Grab bags of capacitors, as well as similar assortments of small components including capacitors, are often offered at low prices by mail-order surplus parts dealers. Similar opportunities for stocking up cheaply on small parts present themselves at every hamfest flea market. Different methods used for marking capacitance values, usually consisting of a code indicating the value in picofarads or nanofarads, etc. Sometimes they are marked only with a manufacturer's "house" number. The codes are all different and are often confusing. We need something to bring order out of chaos and allow easy determination of capacity values.

"This simple capacity meter uses the fewest, least expensive, component parts, most or all of which can be found in any ham's junk box."

There are, of course, very expensive LCR meters available commercially, at prices well over $100, which measure capacity as well as inductance and resistance. Full-function digital multimeters (DMMs) with prices starting around $75 usually provide a means for measuring capacitance, but instruments such as these are usually beyond the average ham's budget. What is needed is an inexpensive, simple to construct and use, instrument to measure capacity over the most important range used in ham equipment.

The instrument described here uses the fewest, least expensive, component parts, most or all of which can be found in any ham's junk box. It measures capacity over the range of approximately 25 pF to 0.002 µF, the range which encompasses those capacity values which usually must be known. In only a few circuits—AF and RF filters, for example—is it necessary to select specific, usually nonstandard, capacity values. Often a trimmer capacitor is added, such as in VFO circuits, to adjust capacity to a specific value. But all components in a circuit have tolerances of 5, 10, 20 percent or more, and because electronics is a world of varying tolerances it is not necessary to know the value of a capacitor to the last picofarad. You only need to discover where in the table of standard values an unknown capacitor belongs, considering its manufacturing tolerance, which is often unknown.

For example, an 820 pF ±5% capacitor can have a capacitance between 779 pF and 861 pF and still be considered an 820 pF capacitor. If the tolerance is ±10%, which is more common, its actual value could be anywhere between 738 pF and 902 pF. But it is still an 820 pF capacitor and is so marked.

Stray (unwanted) capacitance is added to every circuit whenever a wire or component is added. You can't avoid it; usually it's not important except in a few circuits, particularly at VHF and above.

As an example, this instrument is *theoretically* capable of measuring to as low as 1 pF, but in the real world stray capacity prevents measurement much below 25 pF. It could be easily modified to measure much larger capacitances, but since capacitors of 0.001 µF and larger are usually used in bypassing and decoupling where tolerances of the circuit are so great, whether you use a 0.01 µF or 0.1 µF capacitor, the circuit will function correctly.

The Circuit

Fig. 1 shows the schematic diagram of the Simple Capacity Meter. Ul (a 74LSOO logic chip), two resistors, a capacitor and a crystal form a crystal oscillator operating near the marked frequency of the crystal.

The RF voltage is taken from pin 8 through isolation capacitor C3 and applied to the modified Wheatstone bridge circuit. R3 forms two arms of the bridge, with the arms ratio variable through the position of the wiper of R3. C5, which should be the stable capacitor specified in the Parts List, and the unknown capacitor to be measured form the remaining bridge arms. R3 is adjusted for bridge balance, indicated by a dip–minimum shown on microammeter Ml, and the value of the unknown capacitor is indicated on the calibrated dial attached to R3.

The instrument is powered by BT1, a 9-volt battery, controlled by ON-OFF switch Sl. This 9 volts is reduced and regulated by U2, a 78LO5, to the +5 volts required by Ul.

Construction

The circuit should be constructed on a piece of perfboard, or on one of the small general-purpose printed circuit boards available at Radio Shack. It should be mounted in a plastic enclosure rather than an aluminum case, or one made from printed circuit material. This will greatly reduce the unwanted stray capacity.

Leads from the top of R3 through C5 to Jl must be as short and direct as possible. Leads connecting to Jl and J2 should be of solid wire, run as directly as possible. Leads of D1, especially the anode lead, should be very short. Hold the diode leads close to the diode body with needlenose pliers or an alligator clip to serve as a heat sink to protect the diode when soldering its leads. The leads of C6 should also be as short as possible.

Meter Ml can be any of the inexpensive plastic edgewise or square surplus tuning meters originally made for CB or home entertainment equipment. They are available at hamfests and also from several mail-order surplus parts dealers for $2 or $3 each. Movements are d'Arsonval and usually between 200 and 300 microamperes. However, if you own an analog VOM with a current range scale of 100 to 300 microamperes, you could install another pair of binding posts instead of Ml, and use the VOM on the proper scale in its place, saving the cost of a meter.

You will have to make a dial for R3. Most hams save the circular metal cutouts resulting from holes for meters and speakers. These make ideal dials when white card stock is glued to one side, trimmed, and the blank dial centered and cemented or epoxied to the bottom of the knob for R3.

If you do not have such a circular cutout you can scribe a circle on a sheet of heavy, stiff plastic or cardboard, cut it out carefully with scissors or a hobby knife, then cut a hole in the exact center the diameter of the shaft of R3. If your dial does not have a clean white surface, glue a piece of white paper or index card on it. Trim it when the adhesive has dried, and cement or epoxy it to the bottom of the knob for R3.

Mount the completed knob and dial on R3. Scribe or otherwise draw an index line on the enclosure extending a short distance from the edge of the dial.

"This capacity meter measures capacity over the range of approximately 25 pF to 0.002 μF, the range which encompasses those capacity values which usually must be known."

Calibration

You will need to borrow or purchase several fixed capacitors to use in calibrating the dial. The following values, all expressed in picofarads, are suggested: 33, 47, 68, 100, 150, 220, 330, 470, 680, 820, and 1,000. Because polystyrene and mylar capacitors are usually very close to the marked values, this variety will provide the most accuracy. Dip mica capacitors with a 5% tolerance is a second option. If you can't get all the suggested values, get what you can and use them. You can calibrate other values any time a suitable capacitor becomes available.

Switch Sl to ON. Connect a calibration capacitor between Jl and J2. Rotate R3 for a dip in the indication on the meter, either Ml or your VOM if used. Mark a short line on the dial in line with the index mark on the panel. Number it with the value of the calibration capacitor. Continue calibrating the dial as just explained, using the remaining capacitors.

The dial will be nonlinear, being crowded at the high capacity end where accuracy is less important, but expanded at the low capacity end where accuracy may be of greater importance.

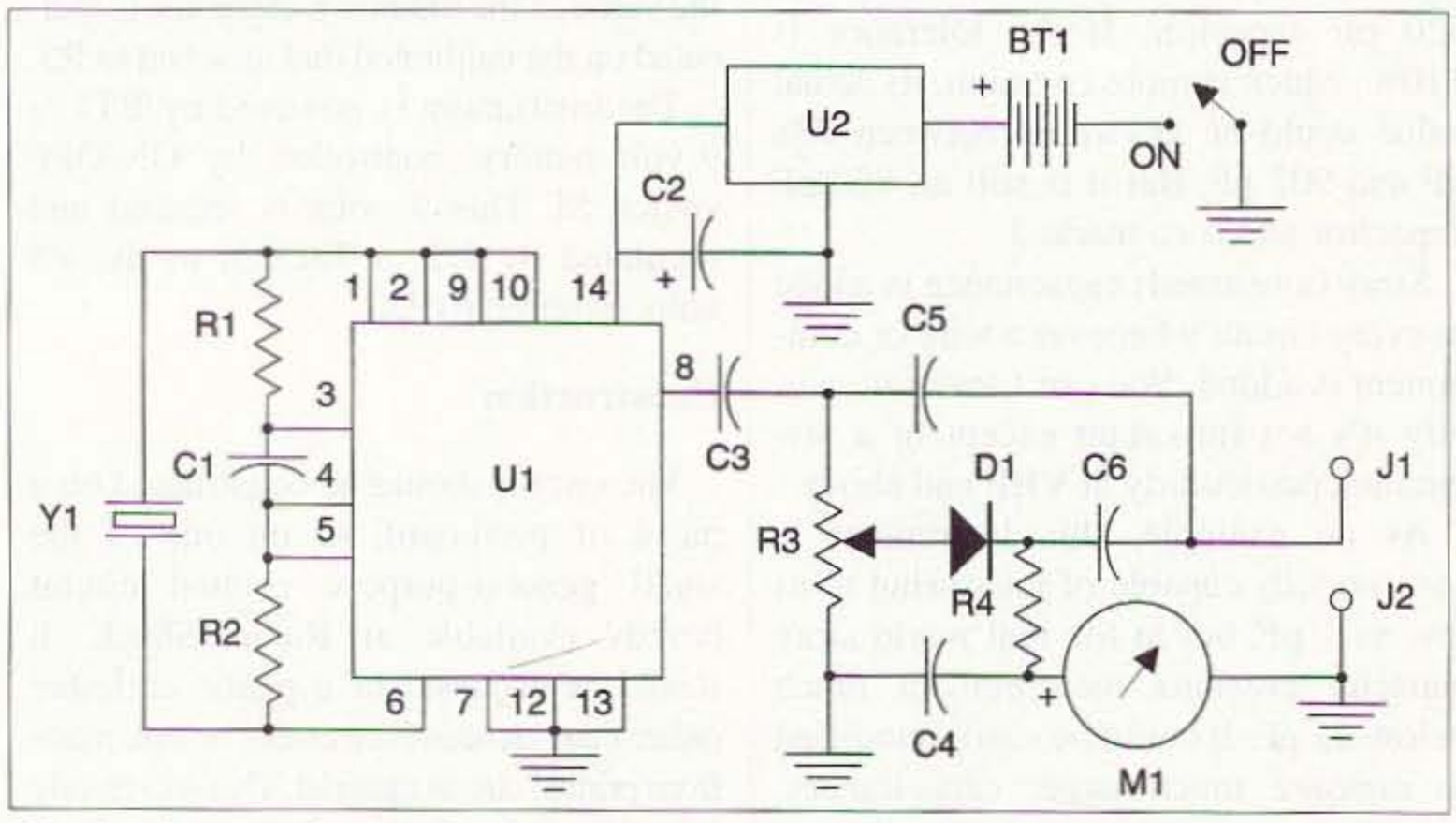

Fig. 1. Schematic diagram for the simple capacity meter.

Operation

Switch S1 to ON. Adjust R3 so its wiper is away from ground. An indication on the meter shows operation to be normal. Connect an unknown capacitor between Jl and J2. Adjust R3 for a dip on the meter. Read the capacity on the dial opposite the index mark.

Because of normal tolerances, few capacitors will measure exactly at the calibrated values. If the indication is quite close, that is the nominal value of the unknown capacitor. Extrapolate between calibrated values as necessary to identify the capacitance of capacitors lower or higher in the table of standard values. If you cannot get a dip within the range of R3, first check to see that the capacitor leads are firmly connected to Jl and J2. If you still cannot get a dip, the capacitor is probably larger or smaller than can be measured with this instrument. It also may be defective (usually open or shorted).

Switch Sl to OFF when measurements are completed, to save the battery from an untimely demise.

Comments

In the vast majority of circuits, if, for instance, a 47 pF capacitor is specified but you don't have one, you can probably substitute any value between about 33 pF and 68 pF without any adverse effects. Murphy's Law will always prevent you from finding all the parts values called for on the schematic diagram, regardless of how extensive your stock of parts may be. So don't hesitate to substitute, within reason.

When a mica capacitor is called for you can usually substitute a mylar or polystyrene capacitor, and vice versa. If an NPO or COG capacitor is specified, these two types are interchangeable, but do not substitute a different type. Some ceramic disc capacitors are NPO and will look as if the edge opposite the leads has been slightly dipped in black paint. Other than NPO, ceramic disc capacitors are not temperature-stable and their values shift as temperature varies. If an ordinary ceramic disc capacitor is specified, you can substitute any other kind of capacitor for the disc without any problem.

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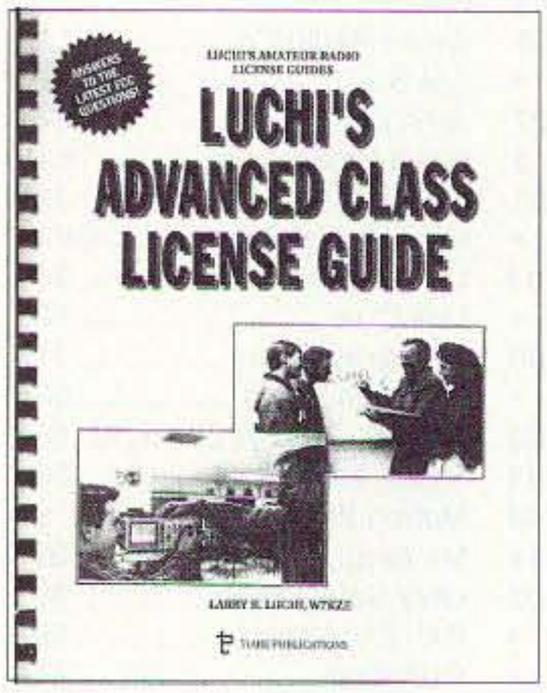

This 185p Luchi (W7KZE) 1995 guide covers the latest FCC question pool, with the questions you'll be facing, the answers, and the explanations. Call it a speed course in radio technology. No fair just memorizing this stuff since you're going to need a real understanding of it to go on to your Extra ticket. And it isn't all that difficult. After all, we have some seven-year old girls with Extras. You're not going to let a 7-yr old kid fake you out, are you? Spend the $23 (+ s/h). Tiare Publications, Box 493, Lake Geneva WI 53147. Get your Advanced ticket and come up and play with the big boys.

New Version of Computer-to-Scanner Interface Software

DataFile Inc. has released a new version of its computer-to-scanner interface software, Probe Version 2.0. The program will allow scanning enthusiasts to lock into active sets of frequencies, and return to normal scanning when traffic diminishes.

Probe was developed exclusively for Optoelectronic's OptoScan 456 and 535 Computer-to-Scanner interfaces, which work with Radio Shack's Pro-2005, 2006, 2035, and 2042 scanners. Over 70 new features and enhancements have been added to Probe.

SmartScan™ allows the operator to select a set of key frequencies. When a key frequency becomes active, SmartScan calls up a database of frequencies related to it and begins scanning them. When activity settles down, SmartScan returns to normal scanning.

Using SmartScan, the operator could select an air emergency frequency as a key frequency. When that frequency becomes active, Probe would begin scanning the local air tower, ground control, fire squad and airport security channels, for example.

The program will run on virtually any DOS-based computer, and is capable of scanning up to 50 channels per second on AT/12MHZ machines without additional memory, graphics cards, or operating systems.

The frequency database engine uses the dBASE format, allowing management of up to 4,000 groups of 99 banks. Each bank may contain up to 1,000 frequencies.

Rubber Duckie Antennas

MFJ has released three new flexible antennas for multi-band and 2M HT users. The MFJ-1717 is 15.75 inches in length, covering 440 MHz (where it is a half-wavelength) and 2M, where it operates as a quarter-wave.

The MFJ1716 is a quarter-wave on 440MHz, and a loaded quarterwave on 2M. It measures 8.75 inches. The MFJ-1718 is a helically wound high-Q antenna for 2M only. All antennas feature a high strength, high flex design with a new rubber coating. Contact MFJ Enterprises, P.O. Box 494, Mississippi State, MS 39762. Tel 800-647-1800.

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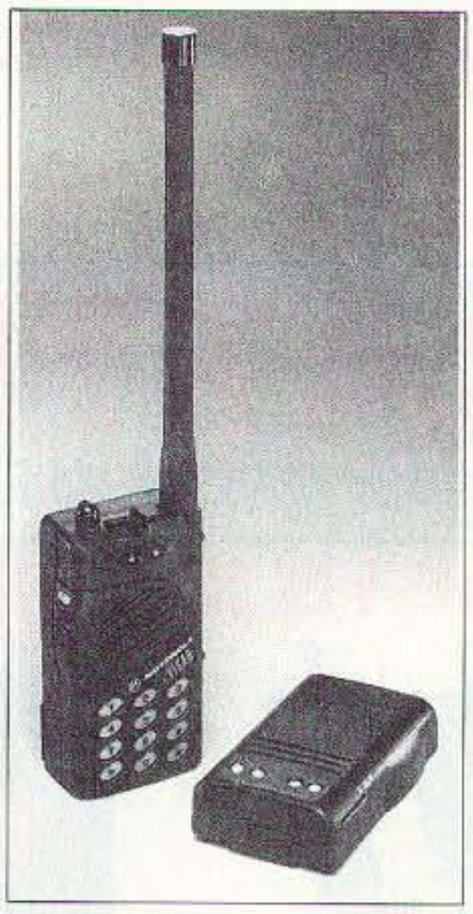
W & W also now stocks batteries for the Yaesu FT-10R/40R, The Icom series IC-W31, IC-21A, IC-T22A, IC-T42A and Alinco DJ190/DJ-G5

W & W can be reached at 516-942-0011 and is located at 800 South Broadway Hicksville, NY 11801-5017.

New HS-1000All-Band HF Mobile Antenna.

Mobile HF operators have a new choice of antennas. High Sierra Antennas has introduced its new HS-1000 all-band HF mobile antenna.

The design incorporates features such as new low-cost mounting options, center-loading coil for high-power and high-temperature applications, a decoupler system, and improved matching system and a remote control panel with limit indicator.



The antenna provides coverage from 3.5 MHz to 30 MHz and beyond without sacrificing performance on any frequency. The variable loading coil is remotely controlled, so the operator can tune the entire HF spectrum without leaving the driver's seat.

The HS-1000 uses two basic mounting systems. The Easy-off mount allows the entire antenna to be removed in about 30 seconds for safety or security. This method uses a tapered stud at the based of the antenna together with an upper clamping mechanism.

The new single point mounting method allows the antenna to be attached to horizontal surfaces.

The antenna can be purchased as a complete package, or in its component pieces for those who already own some of the hardware.

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NEVER SAY DIE

Continued from page 63

So what happened at the next conference ten years later, when the chickens came home to roost? That's another fascinating story. Remind me to write about that. I kept in close touch with the ITU hams for many years, so I knew what was going on from the inside. Also, remind me to write about how I engineered Budlong's forced retirement.

Sue Your Parents

If I weren't an orphan, I'd sure haul my parents into court and sue them for child neglect. This has to do with my reading an excellent instruction book on prenatal care. You're probably too busy in the hamshack to do what it takes to have any kids, but if you do ever decide to take a few minutes off from DXing to have a junior op, get this book and read it or I'll put you high on my list of hams to haunt with high line noise and defective transistors after I win my Silent Key award from the League (which I'm sure they have ready, just awaiting the date).

The book is *Prenatal Classroom, a parents guide for teaching your baby in the womb.* It's by Van de Carr and Lehrer, ISBN 0-89334-152-5, 161p, $13, published by Humanics Learning, Box 7400, Atlanta GA 30309. It doesn't say much that I didn't know before, but it is an excellent instruction book on how to communicate with your unborn child. How to teach it around 50 words, to like music, and stimulate brain growth before birth.

Back in 1950, when I got interested in Dianetics and studied at the Hubbard Dianetic Research Foundation, I found out how much that happens during the prenatal months affects us later on. It is really simple, under hypnosis, to regress anyone to the prenatal period and find the causes of many current-life psychological problems. It's also easy to erase these devilish influences, once you learn the tricks. As far as I know, this stuff hasn't been taught since the late Ron Hubbard, who I knew quite well, started Scientology and using the technology more for brainwashing than helping people. Well, he made hundreds of millions.

Instead of loading up your child with bad baggage, you can give it one heck of a head start by following the instructions in this book. The AMA says this results in significantly higher IQs, which means that if you don't use these techniques, you are permanently robbing your child of mental ability that is inherent. It's bad enough with our schools dedicated to dumbing our kids down without parents adding to the mess.

You can teach your unborn child to communicate with you, to recognize words, and even to like certain foods. One mother, who ate a lot of doughnuts during her pregnancy, had a child whose favorite food was doughnuts. Still is. They call her blimpy. One thing I know for sure, my mother didn't eat much eggplant.

And yes, if you let the poor kid hear a lot of CW, it'll probably grow up to be an ARRL director. I think that's probably what happened to poor old Harry Daniels W2HD, the ex-president of the League and internationally noted Wayne Green fan.

If you're into the grandfather class, be sure your kids get copies of this book to help guide them with your grandchildren.

The one aspect of the book that disappointed me was the lack of any attention to the pre-conception things you can do to give your kids the best chance at not screwing up their lives the way you have. My folks smoked and drank, and look at me, and sigh for what I might have been without the pre-conception destruction of many good traits and zillions of potential brain cells.

It shouldn't be any surprise that what happens during the nine months of pregnancy, when the child is growing from a pin-point fertilized ova into a baby, is going to be a big part of the programming of this new computer. Sure, the genes are like the ROM programming, giving us instincts, but from then on it's RAM memory and little Ickie can hear and record everything going on after just a few weeks. And, after twelve weeks, start tasting. Ickie feels pain, is sensitive to drugs in the mother's blood, and can be seriously traumatized by ultra-sound or the missionary position.

Since Dianetics is a lost art, as far as I know, your best bet is to create as little bad programming as you can and not count on being able to erase it later. I hope that makes sense. Anyway, I think you'll enjoy the book.

Tapping ET's Phone

Cosmologists are having bitter arguments over the age of the universe, complete with wild credential waving to back up unfounded theories. But, whether it's five, ten, or fifteen billion years, or even ageless, the odds seems heavy that (a) there is other intelligent life, and (b) that it is probably millions to billions of years ahead of us in technology.

Radio has been around for about a hundred years. Two hundred years ago anyone predicting that people anywhere in the world would be able to see and talk with anyone else at will would have been locked up in an insane asylum. Well, that was before mental hospitals. Considering that technology developments have been speeding up, I suspect that any predictions we might make for 2096 would be as far off the mark as the 1896 predictions for 1996, where they thought we would be up to our armpits in horse manure in our cities. Instead, it's exhaust fumes.

As soon as a communications medium which is instantaneous and unlimited in bandwidth is discovered, radio will be quickly phased out, just as were smoke signals, then signal lights, and spark transmissions.

Meanwhile, science has, for the most part, turned a blind eye and deaf ear to the tens of thousands of reports from seemingly sincere and sane people who claim to have had contact with visiting ETs, and millions of people who have seen UFOs. Look, once we get far enough developed so we're able to visit planets in other solar systems, I doubt we're going to go in like Captain Kirk and offer to share our advanced technology with some species which hasn't even learned to fly. And how long have we been flying? Well, sure, the Wright Brothers got off the ground in 1908, but I was on the very first commercial flight between Philadelphia and New York, so practical aviation isn't very old.

My dad designed and built the Philadelphia Central Airport (in Camden), so I was right in the middle of the early days of commercial flight. All of the well-known aviators of that era used to come over to our house to visit.

It seems likely that any civilization advanced enough to travel to other solar systems will also have survived their natural warrior background and developed a more peaceful system for living with their advanced technology, so they'll probably visit more out of curiosity than a need to conquer more worlds. And this would mean a low profile, which seems to fit exactly what we're experiencing.

Quantum mechanics is giving us some hints on the possibility for instantaneous communications, and perhaps even space travel over any distance. But QM seems to be a link between matter and thought, so scientists are very uncomfortable with it. We're not sure what matter is yet, and we haven't much in the way of clues about thought. We're like people 200 years ago in this respect, and still ready to crucify any scientist daring to look deeply into these matters. Like the Harvard professor and his recent book on his interviews with contactees.

How about you? Are you a UFO believer? Or skeptic? Do you really believe that every single one of the expert observers who have reported in detail on UFOs has been mistaken or is lying? That every single report, with many based on observations by hundreds to thousands of people, are baloney? How about contactee stories? They are now into the thousands, with most of the people involved keeping quiet about it and wishing it had never happened. Are every one of these people deluded or liars?

Sure, as with any such field, there are a bunch of weirdoes and

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Number 76 on your Feedback card

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So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham sure it still works right and maybe you can help make a ham newcomer or retired old timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to: *73 Magazine*, Barter 'n' Buy, 70 Rt. 202N, Peterborough NH 03458 and get set for the phone calls. The deadline for the May 1996 classified ad section is March 12, 1996.

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NEVER SAY DIE

Continued from page 75

nut cases. But then we have those in just about every field. You should see the stuff I get in the weird science and health fields! But the trouble is that in amongst the crazies and scam artists there are some serious and dedicated people who should be heard. Sorting the wheat from the chaff isn't easy.

I have a file drawer full of alternative health claims. The part that worries me is that I doubt that 100% of them are phony. So how are we going to find out what's worth while and what isn't? In the health field we know that the medical establishment, which includes our government, isn't going to even try. And we've seen what happens when the government gets involved with UFOs: cover-ups and obfuscation. They throw dedicated scientists into prison and destroy their laboratories, as they have with Wilhelm Reich, Royal Rife, and many others. And tried to do recently with Naessens.

If you are interested in getting involved with the SETI project and lending your radio ear to the multitudes scanning the heavens for errant ET signals, call 800-AU-SETI for instructions. This is a private group, so at least you won't be messing with the government, which I don't trust any further than my vote goes. Which isn't very far. I'm trying to remember if I've ever had a pleasant meeting with government people. Yep, I've had many very positive contacts with the FCC and, since Prose Walker got canned, few negatives. I can't say the same for the IRS, FDA, FBI and a few of the other government strong-arm outfits. But, even if the project fails to detect any ET signals, you'll have had an adventure trying if you get involved. And you'll learn a lot about weak signal reception and antennas.

Frankly, I doubt that SETI is going to accomplish much. We'd do a lot better to look for clues as to a new communications medium. It's really arrogant of our scientists to believe that they've now invented all there is to invent in communications systems. It reminds me of the attempts a little over a hundred years ago to build better telescopes so they could look for smoke signals or mirror reflections from other planets.

Psychic Pets

Have you got a dog? A cat? Some other kind of pet? There's a couple of books I somehow have to get you to read. Yes, I know, you only read technical magazines. Or novels. So how am I going to break you loose and get you to read some non-fiction? Sure, I've read some wonderful novels. I've got 22 shelves of 'em in my library. But few of them added much to my life in the way of understanding. Well, maybe Sinclair Lewis and John P. Marquand's novels were worth while long term.

Back in February I tried to get you to read *Kinship of All Life* by J. Allen Boone. But my recommendation just went in one eyeball and out the other. I know that for a fact because if you had read the book you'd have written, thanking me for allerting you to such an incredible treasure. It's not only an interesting story, it's true, and even worse, it is an instruction manual on how you can communicate with your pet. If you have a problem finding the book you can try Item #5280, Laura Lee Books, Box 3010, Bellevue WA 98009 - 800-243-1053. A reader let me know about that. Get their catalog...it lists several of my recommended books.

You see, animals, lacking speech, communicate on a more psychic level. And they communicate very well without being able to talk. I've had a lot of pets down through the years, so I sure wish I'd known more about how to communicate with them. Let's see, we had a blue and yellow macaw for about 30 years. And there was a rhesus monkey. A six-foot indigo who was very friendly. Greyhounds, Italian Greyhounds, Afghans, Burmese cats, a couple goats, a couple horses, a turkey, an African swan goose, and so on.

While I was down at the Virginia Beach hamfest to give a couple talks, I made my usual pilgrimage to the Edgar Cayce book shop. This time I only found one new book that looked interesting. It was *Psychic Pets* by Wylder, on sale for $6. It was a 1995 reprint of a 1978 book. ISBN 0-517-69265-1; 150p; hardbound. It's packed with stories of psychic performances by pets. Like the pet canary that tapped on the window of the next door neighbor one cold, rainy night. The neighbor opened the window to let it in, but it died at that moment. The neighbor recognized the canary and went next door to tell the owner and found she had fallen and was helpless.

Then there was Sugar, a Persian cat, who was terrified of being in automobiles. When his owner had to move from California to Oklahoma, he gave Sugar to neighbors who wanted him rather than try to force him to make the 1,500-mile car trip. Fourteen months later Sugar showed up at the Oklahoma farm and moved right in. He had an odd hip deformity, so they knew it had to be Sugar, and not a cat that looked like him. They called the family they'd left him with and they said yes, Sugar had left 13 months ago. He walked 1,500 miles and found his family in a place he'd never been before. Sugar had to average about four miles a day, plus somehow get food and water, for over a year!

The book is filled with stories of animals being clairvoyant and warning their owners in time to save their lives, of animals helping each other, and so on. If I run into you on 20m I'll tell you a few more of the amazing stories. Like how cats in London knew a half hour or more before radar was able to pick up incoming raids and headed for the bomb shelters, thus warning the people.

I'll bet you've got an animal ESP story I'd enjoy. The next time I'm in your area, if you have an open repeater that doesn't time out in one minute, I'd love to hear it.

League Bummer

Here goes Uncle Wayne, attacking the poor old League again. So who else has the stupidity to attack a religion in print? This time I thought you ought to know about a letter to *QST* that they're surely not going to publish. It's from Steven Morris K7LXC, griping about the April article, "Dialing For Deals." The article encouraged their readers to whipsaw ham dealers to get the lowest possible price...thereby eventually putting all but the few dealers with the lowest overhead out of business.

As Steve points out, the end result of us always shopping for the lowest possible price forces dealers to give less and less service to compete. Thus the article does a serious disservice to both ham dealers and amateurs. Of course, if you aren't ever going to want any service and are happy to buy everything by mail order from the manufacturer, then perhaps forcing most of the ham dealers out of business isn't a problem. Eventually all manufacturers will have to sell directly via mail order. And that would mean even more ads for *QST*, which could be exactly what the League has in mind in pursuing this tack.

Meanwhile, I'm sure that the few ham dealers left will continue to advertise in *QST*, thus showing their continuing support for the League, just as the whole ham industry did 30 years ago when the League put 85% of the retailers and manufacturers out of business within a couple of years. There isn't the slightest hint that anyone in the ham industry has leared anything from history.

Your First QSO!

I'll bet you can remember your first contact, just as I remember mine. Oh, I'm not counting the times I used fictitious calls and made contacts on 40m CW (called bootlegging in those days). No, my first legitimate contact, license in hand, was on 2-1/2 meters.

The rig was a 1G4GT oscillator-super-regenerative detector, with a 1Q5GT modulator-amplifier. The whole works was built into a one cubic foot walkie-talkie, complete with batteries and a handle. It was a

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Number 78 on your Feedback card

Ask Kaboom

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

More Monitors

Last time, we were investigating the repair of hamfest-procured computer monitors. We got as far as replacing the horizontal output transistor. Let's take up where we left off:

Why?

Before we move on from the horizontal section, it would be a good idea to ask just why those output transistors blow out. As I mentioned, they work very hard, and at fairly high voltages and currents. Those factors alone are enough to ensure higher-than-average failure rates. In many cases, the transistor can be blown without the monitor's having any other problems. Sometimes, though, it isn't that simple.

A while back, I ran across a monitor with an odd problem. It was stone cold dead and, sure enough, the horizontal output transistor was popped. A new one brought the set back to life, with a pretty decent picture. Case closed, right? Well, not quite. The seller had been honest and told me that he'd replaced that same transistor just a few weeks earlier. The set had worked for those few weeks and then died again. What was taking out the transistors?

One touch with my finger told me the answer. The heat sink was *hot!* Of course, dissipating heat is the purpose of a heat sink, but this was ridiculous. Within one minute of turning the set on, you could have fried eggs on that aluminum sheet. Heck, my stove doesn't work that fast! (By the way, if you're going to try this test, be darned sure that heat sink is at ground potential first—some of them have serious voltage on them and will give you a lot more than a burn.) What could be causing the heat sink to get so hot, especially considering that the darned monitor worked?

Clues

I was puzzling over this when I took a good look at the screen. The picture looked pretty nice, but the image was a little squashed at the edge; the horizontal linearity was poor towards the right side of the scan. Did that mean anything? I visualized the horizontal current waveform driving that scan. Knowing that TV images are scanned from left to right (as viewed from the face of the tube in the normal position), I realized that the right side of the screen is reached when the current through the yoke (magnetic deflection coils) is at maximum (when the transistor is working the hardest, and its input is at maximum). That non-linearity meant distortion of the scanning waveform. But what would make it distort? Transistors become non-linear when they reach their minimum and maximum limits of amplification. Rather than simply cutting off completely or swinging to the full supply voltage, they begin to amplify less. This occurs only over a very narrow region. Since I knew the transistor was distorting at its maximum point, that suggested that it was being overdriven, out of its linear region. However, if the drive signal were simply too big, the image should have been too wide, perhaps even off the screen. If anything, this one was a little narrower than it should have been. Only one thing was left: the bias had to be too high. In other words, the DC level on the transistor's base had to be too high, causing the transistor to conduct too much, and driving it out of its linear region. That sure would explain the heat!

A quick glance at the circuit board, however, showed that there were no bias resistors going up toward the power supply. The only resistor was from the base to ground. Could it be bad? It checked out right on the money. What else could supply DC to the base of the transistor? Hmmm, there was an electrolytic capacitor coupling the signal to the base. If it were leaking, it might leak some DC from the previous stage, raising the bias. I put in a new cap and, *voila*, all the symptoms went away! The heat sink stayed at finger-touch levels, and the distortion in the scan disappeared. The monitor has worked fine for over a year now. Case closed.

The moral? Sometimes those transistors really do have a reason for blowing out! Usually, though, they just go.

Consequences

Last month, I mentioned that the horizontal outputs generally fail open, not shorted. In hindsight, I think that's not strictly true. What probably happens is that they do indeed short, and all that current going through them then blows them open. But, for perhaps a second or two, they're pretty much a dead short to ground. So what?

That scenario explains the power supply failures often associated with blown horizontal outputs, that's what! Very often, you'll find a blown fuse, which is what leads me to suspect the temporary short; an open circuit won't blow a fuse! Sometimes, there's more damage. Frequently, the power supply is damaged, and replacing the fuse results in another blown one within milliseconds. *Now* what?

Usually, the problem is another blown transistor! Most monitors use switching power supplies. Those things operate at high frequencies, and they work quite hard. In fact, they're a lot like horizontal circuits. Just about every personal computer out there uses one, and millions of them are humming along, year after year, with no problems. So, why do they die in monitors? Many computer supplies have built-in short-circuit protection, and will simply stop and start until the short is removed, with no damage. If you've ever heard a computer supply go "squeak squeak" or "tick tick," you know what I'm talking about.

Monitor supplies, though, rarely have such protection. When a short is placed at the output, the fuse blows. Shouldn't that protect the supply? Yes, but anyone who's spent much time working on solid state gear knows that transistors often wind up protecting fuses! In a monitor, the usual victim is the supply's switching transistor. Like a horizontal output, it's attached to a heat sink. It may be bipolar or FET, but you must replace it with a compatible part; most general-purpose transistors can't take the voltages encountered in these circuits.

Be sure to replace the switching transistor *after* replacing the horizontal output; if you do it the other way, you may just blow the switching transistor all over again, faster than you can shut off the power. Yet another word of caution: Switching power supplies are especially dangerous to service. That transistor is not isolated from the AC line, and touching it is no different from sticking your finger in a lamp socket! Be sure to unplug all power and discharge the supply's electrolytic capacitors before attempting to change the transistor.

Your monitor should be working now! If not, it could have other, more serious problems. If the fuse still blows, there's another short somewhere. Unfortunately, a likely candidate is the high-voltage transformer, or "flyback." Especially on old sets that have been on for thousands of hours, this part can break down. The flyback is what generates that 30,000 volts, so you can imagine the stress on the insulation separating its thousands of windings of very fine wire. Also, there's an integral high-voltage rectifier, and that can short out, too. Testing for a bad flyback isn't easy, because the windings may break down only when high voltage is applied to them, but if the flyback shows burn marks, there's a good chance it's the culprit. I have seen some pretty ugly ones that still worked, though. If the horizontal output blows again as soon as you apply power, suspect that flyback. The unfortunate part is that flybacks are expensive and, unless the monitor is particularly valuable, you won't want to invest the money to try a new one in a set which could still have other problems. Usually, a bad flyback means a ruined set.

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HOMING IN

Radio Direction Finding

Joe Moell P.E. KØOV
PO Box 2508
Fullerton CA 92633

Doppler Antenna Update

"What's the best equipment for winning 2 meter T-hunts?" That's the question I am asked most frequently by hams contemplating their first search for a hidden transmitter. As you might expect, there is no simple answer. I have seen the VHF radio direction finding (RDF) setups of hundreds of hams and they're all somewhat different, just like snowflakes.

To narrow the field, let's presume you're preparing for a beginners' mobile T-hunt. You will probably have to drive at least 10 miles, so you need an RDF setup that mounts on your car so you can find the signal direction while moving along. You don't want to be constantly stopping and getting out to take bearings. This eliminates the "body shielding" technique and simple "bat-wing" buzz-box attachments for your handie-talkie.

The favorite mobile RDF antennas in my area for the bands from 144 to 450 MHz are homebrew quads of three to six elements. Yagis of the same boom lengths are also common. No RDF device in the ham market has more sensitivity than a simple yagi or quad and nothing works better when the hidden signal is horizontally polarized. That's why Southern California hams prefer this method; weak signals are common on our hunts. Of course, a rotating four-element quad is a bit cumbersome to mount on a car, but that's what almost every hunter does.

On the other hand, the T-hunting conditions in your area might be more like those in Phoenix, where hiders usually put out strong signals with vertical polarization. You can use a beam there, as many do, or you can use another popular RDF method that's based on the Doppler effect.

Typical Doppler RDF sets for VHF have from three to eight equally-spaced quarter-wave vertical whips arranged around an imaginary center point on a ground plane. An RF switching circuit connects whips to the narrow-band FM receiver, one at a time in sequence. This makes the receiver think it is connected to a single whip that moves in a circular path around this imaginary center point.

When this pseudo-rotation is done at high speed (approximately 500 times per second), the Doppler effect causes frequency modulation to appear, superimposed on the received signal's audio. It sounds like a tone at the array's spin frequency. The phase of this tone, relative to the whip switching sequence, is processed to determine the direction of the incoming signal. Doppler bearings are usually displayed on a ring of eight to 32 light-emitting diodes. The number of LEDs is independent of the number of whips.

Doppler sets are appealing because they provide instant bearing readout. They are great for tracking short transmissions because they update the bearing many times per second. Since they have no moving parts, Dopplers are easy to install and use on almost any vehicle. RDFers involved in volunteer enforcement like them because they are much less conspicuous than beams. One of the most popular designs for hams is the inexpensive Roanoke Doppler (see sidebar).

Is the Doppler Working?

A lot of my e-mail in recent months has been about my new wideband antenna switching circuit for the Roanoke Doppler. It uses PIN diodes at each end of the four whip coaxes to improve isolation and control impedance at the whip bases. Plans for it are in "Homing In" for April and June 1995. If you missed it, I'm sure the folks in Peterborough have back issues to sell. For the most part, everyone who has written is enthusiastic about its performance.

Jim Baremore K5QQ sent some pictures of his version made from Hustler UGM magnetic-mounts (Photo A). They cost about the same as the CB mounts that I used and he says there is plenty of room to add the resistor and PIN diode in the base. You'll find these mounts at many ham radio stores.

Some correspondents noted that mobile Doppler indications on 440 MHz signals fluctuate much more than on 2 meters. This is normal. RDFers who hunt both bands have seen this phenomenon with both beams and Dopplers. It occurs because multipath becomes more prominent as you go higher in frequency.

Multipath causes several apparent simultaneous bearing directions due to signal reflections from buildings and other nearby terrain features. Since the ability of a surface to reflect a radio signal is proportional to its size and smoothness in terms of wavelengths, there are far more objects around that will reflect 70 centimeter wavelength signals, compared to signals of 2 meter wavelength. The best way to combat multipath is to keep moving and "eyeball average" your direction indications as you go along.

It's always best to verify proper operation of any RDF setup before going out to hunt a signal in an unknown location. The obvious way to check your Doppler would be to take a quick walk around the car with a transmitting hand-held, watching the LED display to see if it follows along. But this is not a reliable method, particularly on UHF. A perfectly good antenna system is likely to give bad results, for two reasons. First, the display electronics and switcher diode currents may be upset by the intense RF field from the HT.

More important, a Doppler array is designed to work with a "planar" wavefront in the "far field," to use some terms that $100-an-hour antenna engineers like to toss around. Put more simply, the wavefront coming off your HT's "duckie" is a circle that expands outward. It's just like the ring of ripples you get when you toss a rock into a still pond. When the transmitter is very close to the receiver (in the "near field"), the part of the wavefront that strikes the receiving antenna has a lot of curvature to it. When the T is many wavelengths away ("far field"), the wavefront circle has become so big that the segment reaching the receiver has very little curvature and appears to be planar.

Another factor to consider is that Doppler accuracy can be degraded by proximity to anything that disrupts the planar characteristic of the incoming wavefront. Other communications antennas on your car may "pull" the Doppler indication in their direction. The effect is most detrimental when whips are in front of the Doppler array or when you have a rotatable beam mounted on the car.

When correspondents tell me that their Dopplers just don't seem to work right, I urge them

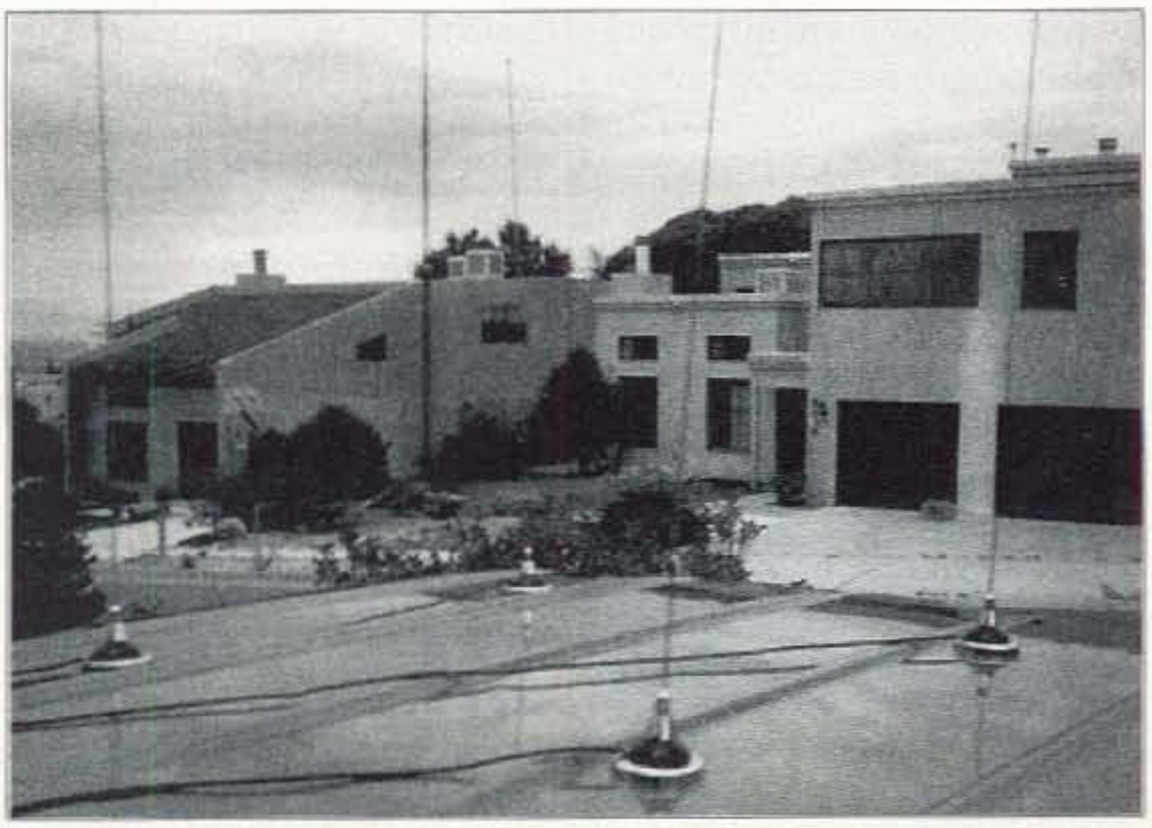

Photo A. *A four-whip magnetic-mount Doppler array is easy to install on just about any vehicle. Jim Baremore K5QQ uses these inexpensive whips with his home-built Roanoke Doppler.*

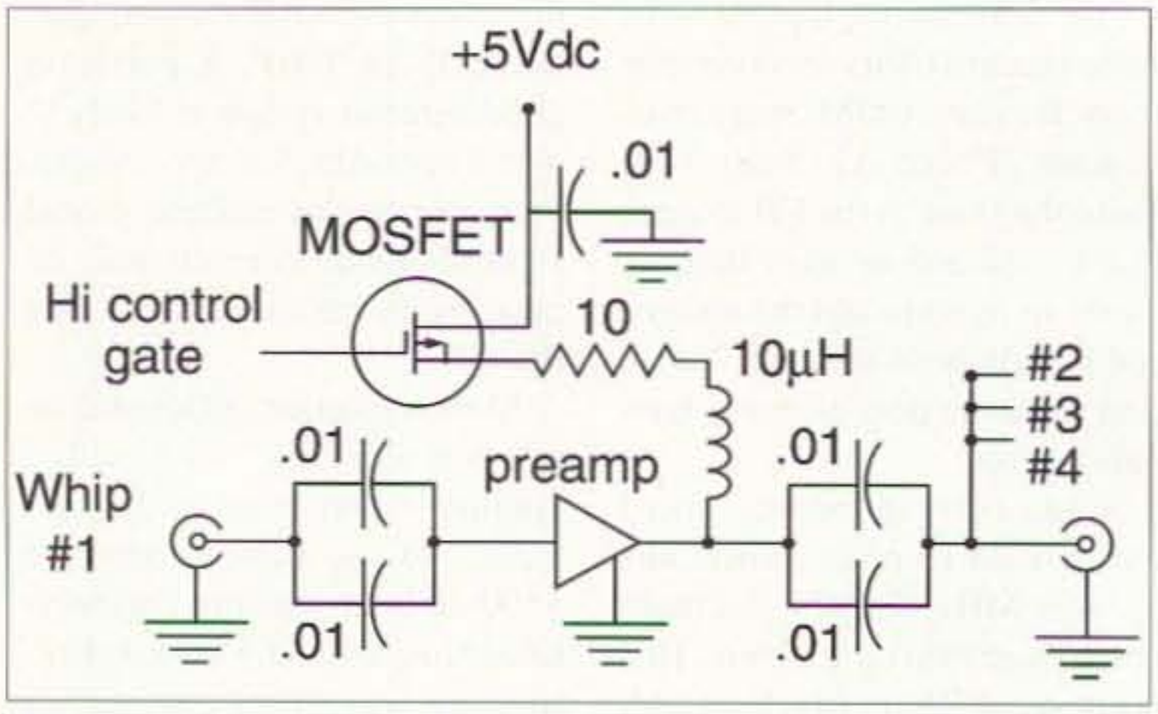

Figure 1. *Schematic of the Doppler switcher/preamp designed by Jim Sorenson KA4IIA. All four preamps are identical, so only one is shown. All capacitors are surface-mount chip types.*

to check over their antenna system very carefully. Then I recommend having another ham check to see if there is something they are consistently missing. Murphy must like Doppler arrays, because there are lots of ways to make mistakes in hooking up a switcher. Besides the usual shorts to ground and bad connections, I have seen units with reversed wiring of logic lines, two logic lines shorted to one another, failed PIN diodes due to overheating during soldering or accidental high-power transmissions, and incorrect placement of whips on the vehicle.

An oscilloscope is the best instrument for checking antenna set switching waveforms, but you can often find a failure or wiring error with just a digital voltmeter. To check your wideband Roanoke Doppler switcher quickly, verify the +3.5 VDC bias on the shell of each coax connector with respect to circuit ground. With pseudo-rotation turned on, the average DC voltages on the four whip rods should be within 50 millivolts of each other. Voltages at the inductors (L101-L104) should also be within 50 millivolts of each other. On the other hand, voltages on the center conductors of the four coaxes (between the series PIN diodes) may not be equal even on a working unit due to minor differences in diode leakage.

I regularly check my Doppler's operation by taking bearings on a repeater atop Mount Baldy. One day I observed that the display did not track the repeater as usual. It just bounced around in one quadrant of the display, no matter which way the car was traveling. I checked the DC whip voltages and noticed that one was different from the others. Sure enough, a resistor lead in one antenna base was poorly soldered (oops!) and had lost contact, keeping the two PIN diodes in series with that whip from conducting. On another occasion, a voltage check caught a short from coax center conductor to shield at a whip base.

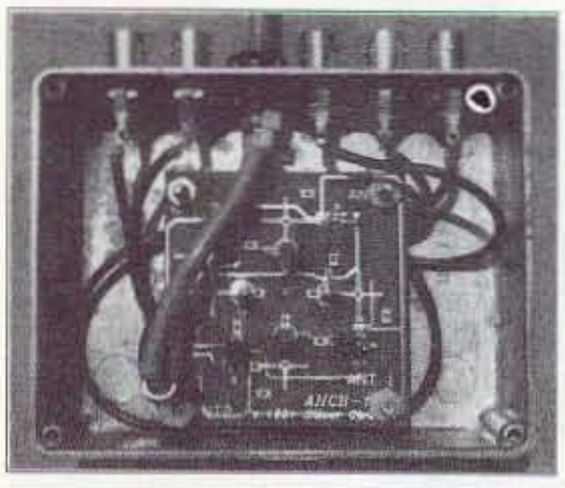

Photo B. *KA4IIA's switcher is laid out on a 2-1/2 inch square board. The MOSFETs and RF chokes are visible. Monolithic amplifiers are on the other side.*

A Switcher With Gain

Over the years, Doppler users have looked for ways to overcome the inherent RF losses of antenna switching circuits. Jim Sorenson KA4IIA began experimenting with monolithic RF gain blocks from Mini-Circuits Laboratories in the antenna switcher of his Roanoke Doppler about six years ago. He found that these tiny preamps are manufactured to very close tolerances, so the signal phase shift through each of the four whip channels can be made nearly identical. This is very important because any difference in phase or time delay will adversely affect bearing accuracy.

Jim selected the MAR-4 amplifier, which has 8.2 dB specified gain in the 140 to 450 MHz range. Specified noise figure is 7 dB. Fig. 1 shows the schematic of KA4IIA's antenna switch, which has a separate monolithic preamplifier for each whip. Selection in sequence is done by keying each MAR-4 on and off with Zetex ZVP-4105A metal-oxide semiconductor field-effect transistors (MOSFETs), available from Digi-Key. Circuit layout must be done carefully such that path length through each of the four preamp channels is exactly equal. The best way to control path length is to use an etched board, as Jim did.

I was eager to compare Jim's antenna switcher against my wideband PIN diode switcher. I tested both in my T-hunt van and I also measured overall sensitivity of each on the bench with a calibrated VHF/UHF signal generator. I use a Regency MX-7000 continuous coverage scanner for receiving with my Dopplers, because I want to be able to perform RDF on any frequency from 120 to 500 MHz. It has 0.2 microvolts for 10 dB FM quieting sensitivity in this frequency range. That's more sensitive than many other scanners, but not nearly as good as most ham-band mobile and hand-held receivers of this decade.

When I fed the 146.565 MHz signal generator output though each of the two switchers (with rotation stopped), I discovered that the MX-7000 could detect a 7.6 dB weaker signal with the KA4IIA switcher than with the new Roanoke PIN switcher, for the same amount of quieting. This approximates the gain of the MAR-4 amplifier stage, with coax losses.

Does this mean that you can gain enough sensitivity to double your Doppler's range by simply changing from a PIN switcher to one with MAR preamps? Not necessarily. The receiver you use makes a big difference, as I found when I replaced the MX-7000 scanner with my IC-32AT handtalkie and repeated the sensitivity measurements. The IC-32AT has a much "hotter" receiver,

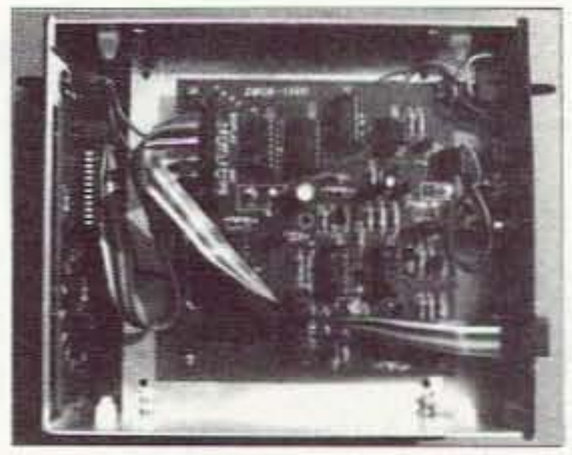

Photo C. *Processing and display electronics are on separate boards in the Directional Systems Doppler unit.*

giving 10 dB quieting with only 0.125 microvolts at the antenna jack. With it, the Doppler sensitivity difference between the two switchers was only 2.3 dB. This makes sense when you realize that the noise figure of a MAR-4 preamp is not nearly as good as that of the IC-32AT front end.

In summary, changing to Jim's switcher circuit will give an overall sensitivity boost of 7 dB or so if the receiver in your Doppler setup is average. But the improvement will be much less if you're using a receiver with high sensitivity and an excellent noise figure with your Doppler. With a "hot" receiver, it may be difficult to tell the difference in sensitivity when T-hunting. My on-the-road experiments confirmed this.

Over the years, KA4IIA has built about two dozen antenna preamp/switchers for hams in his area, with help from Andy Glass WD4MYL, who helped test the circuit and write the documentation. Jim has formed his own company, Directional Systems, to distribute his Doppler products. They are popular with ham balloon trackers in the Atlanta area. According to KA4IIA, multipath isn't a big problem when the target signal is coming from a parachute payload thousands of feet in the air. "When it's above you, the Doppler just locks in solid," he says.

Jim's preamp/switcher covers the 2 meter, 125 cm and 70 cm bands, requiring whips of appropriate length and spacing for each band. In addition to the switcher (Photo B), he also sells a set of two circuit boards for Doppler processing and display, based on the Roanoke design. These high quality boards are double-sided with solder mask and silk-screen

markings for each component (Photo C). A matching enclosure is also available (Photo D). Depending on your home-brewing abilities, you can buy bare boards, board/parts kits, or fully assembled/tested Doppler sets from Directional Systems. Write to the address in the sidebar for prices.

Directional Systems kits and boards include detailed parts lists and assembly instructions. Completed units have a professional look. The biggest gripe I had after testing Jim's version of the Roanoke Doppler was that the direction-indicating LEDs are quite small. The front panel does not include the scan-stop switch and indicators for Low Signal and Overload, but they can be incorporated by drilling some more holes and adding the parts.

Keep the letters and e-mail coming with your experiences using all kinds of RDF equipment. I still occasionally experience short-term e-mail outages, so if you're expecting a reply and don't get one within two weeks, send your message again. E-mail goes to: Homingin@aol.com on Internet or 75236,2165 on CompuServe. Send postal mail to the address at the beginning of this article. 73

This Month's Resources

Directional Systems
P.O. Box 81881
Conyers GA 30208-9426
E-mail: ka4iia@radio.org

Mini-Circuits Laboratories
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Brooklyn NY 11235
(718) 934-4500

Digi-Key Corporation
701 Brooks Avenue South
P.O. Box 677
Thief River Falls MN 56701
(800) 344-4539

Complete plans for the basic Roanoke Doppler RDF set with single-band PIN diode antenna switcher are in T*ransmitter Hunting—Radio Direction Finding Simplified* by Joe Moell KØOV and Tom Curlee WB6UZZ. This 323-page reference book (TAB/McGraw-Hill #2701) covers all aspects of RDF and is available from Radio Bookshop.

Photo D. *The complete Directional Systems Doppler display is in a 7-1/2 x 6-1/2 x 2-1/2 inch enclosure.*

Radio Bookshop

Phone 800-274-7373 or 603-924-0058, FAX 603-924-8613, or see order form on page 88 for ordering information.

Wayne Writes!

WG5 **Submarine Life In World War II** by Wayne Green W2NSD/1 60p. Wayne's stories of his adventures on the USS Drum SS-228 on five war patrols in the Pacific in 1943-1945. What's it really like on a submarine when you are being depth charged? And what's the day to day life on a submarine like? $7.50

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NEVER SAY DIE

Continued from page 77

circuit from *Radio* magazine, which ran circles around *QST* in those days when it came to fun building projects. And we all built our own transmitters. Heck, we had to, since almost none were available commercially until well after WWII.

Hams originally built their own receivers, but then the day after the first commercial receiver came on the market, they stopped building them. I wasn't there when it happened, but it was about the time the National SW-3 arrived. Many hams I visited were still using the SW-3 in the late 1930s.

My first contact was with W2MSV, Dexter Miller. Dexter was mostly active on the 160m and was forever discussing which new receiver he was going to buy. But he couldn't make up his mind and eventually died without ever having enjoyed his dream. Dexter had a generous stomach and smoked, so he didn't make it much past his early 50s.

Yes, my first contact was made with me carrying my walkie-talkie, walking down the hill in Troy, New York.

Actually, I got my license almost by accident. I'd tried a couple of times, but through panic had failed the 13-per code test. Then a friend asked me to go along with him while he took the test. Why not? So I practiced my code for a few minutes the night before, but I didn't expect to pass, so I didn't bother looking at the Q&A manual.

My friend sat behind me during the test. I couldn't believe how easy the code test was! I had no problem copying it 100%, but that was because I'd expected to fail, so I wasn't tense or stressed. When it was over my friend had almost a blank paper. Yet the night before he was copying 15-per with no trouble. He never did get his ham license and we lost an excellent and creative engineer. He later opened a well-known audio laboratory in New York.

I was also active from the college dorms on 2-1/2m with a regenerative receiver I'd built and a pair of 76s with a long-line tank circuit. And on 160m with a T-125 final. Boy, did that raise Cain with the little AC/DC broadcast radios around the dorms. I had to operate mostly after midnight. Well, that's when you work the best DX on that band anyway. I won the 1941 Sweepstakes for my section just on 160m! And I was talking away on 160m on December 7th 1941 when I got word from a ham in western New York about Pearl Harbor. We were put off the air that same day, with W1AW chasing everyone off.

Well, Have You Read It Yet?

Several hundred *73* readers have read my book, *Declare War*. Alas, several thousand haven't...an egregious, inexcusable and disappointing oversight.

In it I propose a simple, inexpensive way to cut our American prison costs by at least 90%, while at the same time providing unlimited prison space and an actual re-education for the inmates. With 1.1 million Americans in prison, and at a cost of around $30,000 a year each, that's $33 billion going down the tubes just because we're too lazy to change our prison system. I also propose a painless way to cut the costs of our federal, state and local bureaucracies by 50% within three years. It's a bureaucracy that has a larger labor force today than is working in manufacturing. Then there's a novel way out of our welfare misery; a way to cut crime by at least 80%, and so on. I've been getting wonderful letters from people who've read the book. You know, I haven't had one letter yet saying my creative approaches to these currently insoluble problems won't work. They just want to know how come Clinton hasn't read the book. Or Perot.

This all started almost three years ago when Governor Gregg (now Senator Gregg) called and asked if I would serve on a New Hampshire Economic Development Commission. Since around 30 other businessmen and politicians had been tapped for the "honor," I explained that I would probably be more of a trouble-maker than the others combined. I was right.

It didn't take very many Commission meetings for me to discover that precious little would ever be accomplished with 30 people sitting around a big table. That meant that while one pontificated at length, 29 sat there not listening to what was being said because they were busy thinking about what they wanted to say, should they ever get a chance. Naturally we made zero progress.

So we split into subcommittees, each of which held hearings. I attended as many of these as I could and asked endless questions. The experts we invited in to testify did their best to explain their problems and failed solutions, and then gave me lists of books to read so I could learn more. I read 'em. I read a couple hundred books over the next two years, and I'm still at it in every available moment.

The Commission was formed because New Hampshire was suffering by far the worst of all 50 states from the recession. The Governor and the Legislature said they were looking for guidance, but they salted the Commission with enough politicians to eventually sink it without leaving a ripple...except for my reports. The Commission never even handed in a final report. The meetings just sort of quietly petered out.

Once I had a good grasp of the main problems facing New

Continued on page 87

HAM TO HAM
Continued from page 60

another suggestion to make remembering Herb's tip easier: Make up a cardboard card with a schematic diagram and description of Herb's testing steps on it; epoxy a 470 ohm, 1/2 watt resistor to the card over the schematic's resistor symbol. Then when you next need to test an SCR, you'll have all of the info handy (and even the correct resistor!). I've used this method for other little test circuits that I use infrequently, and it's worked well for my not-always-perfect memory!

This ends another month of "Ham To Ham"...and our goal of keeping "Ham To Ham" viable for at least six months. Thanks to all who've submitted their tips, ideas, suggestions and operating procedures; you've made it work. Let's hear from more of you! The more input we have, the longer the column will go on and the more we can expand its scope. Let me hear from you at the address above; sending your suggestions and ideas to 73's offices in Peterborough only delays them since they have to be forwarded here.

We've all run into tips and shortcuts that we wish someone had told us about sooner; that's pretty much what we're looking for in "HTH." Don't be shy, send in anything that you think might have value to others in the hobby. If your writing skills aren't your strong point, don't worry, I'll rewrite your text so it conforms to the conversational style that I'm trying to maintain for "HTH." And be sure to look for a number of good new ideas here next month.

Note: The ideas and suggestions contributed to this column by its readers have not necessarily been tested by the column's moderator nor by the staff of *73* and thus no guarantee of operational success is implied. Always use your own best judgment before modifying any electronic item from the original equipment manufacturer's specifications. No responsibility is implied by the moderator or *73* for any equipment damage or malfunction resulting from information supplied in this column.

Please send all correspondence relating to this column to *73's* "Ham To Ham" column, c/o Dave Miller NZ9E, 7462 Lawler Avenue, Niles IL 60714-3108, USA. All contributions used in this column will be reimbursed by a contributor's fee of $10, which includes its exclusive use by *73*. We will attempt to respond to all legitimate contributors' ideas in a timely manner, but be sure to send all specific questions on any particular tip to the originator of the idea, not to this column's moderator nor to *73*. deDave NZ9E. 73

A Simple Capacity
Continued from page 72

If you used the specified colorburst crystal, chosen because it is the least expensive surplus crystal available, you have also constructed a signal source which produces known frequency harmonics in or near every ham band from 80 through 10 meters. For this "free signal generator" to be useful to you requires measuring the fundamental frequency with a frequency counter. This will *not* be the same 3.57955 frequency marked on the crystal!

Connect the frequency counter to Jl and J2, with R3 adjusted so its wiper is roughly centered in its range. Note the reading on the frequency counter. Using a calculator, multiply this frequency to determine the exact frequency of each useful harmonic. Keep this list for future reference.

A short piece of wire attached to Jl should allow you to hear the harmonics in your receiver. Because each frequency is accurately known, you can check dial accuracy or use the signals as an aid in alignment, or just tweaking for maximum gain. 73

Parts List

BT1	9V alkaline battery
C1, C3, C4, C6	0.01 µF disc ceramic capacitors
C2	10 µF 16V electrolytic capacitor
C5	220 pF polystyrene, mylar or dip mica capacitor
D1	Germanium diode: 1N34, 1N60, 1N90, 1N270
J1, J2	Binding post
M1	Meter, 100-300 µA full scale (see text)
R1, R2	560 ohm 1/4W 5% resistor
R3	Carbon potentiometer, 200 to 300 Ohms
R4	1K 1/4W 5% resistor
S1	SPST toggle or slide switch
U1	74LSOO
U2	78LO5
Y1	3.57955 MHz crystal (see text)

A Stealth 40-10 Meter
Continued from page 55

want, but, since you'll be using a tuner so you can use several ham bands, the wire length isn't particularly important.

It 's better to operate from a room other than the one in which your antenna is installed. Why expose yourself to RF if you don't have to? (But this isn't very important if you're running under 50 watts.)

Disclaimer: This antenna may not work well if you have a metal roof (maybe try loading the roof as an antenna); or there is metal mesh holding the stucco on the outer wall; or a metal heating or air conditioning duct runs above the ceiling near your antenna; or Murphy got there first. 73

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ASK KABOOM
Continued from page 78

If the power light comes on and the fuse doesn't blow, but you still don't get a picture when you connect a computer, take a look at the back of the picture tube. If you don't see an orange glow from the filaments, they aren't lighting. Many are driven by the horizontal output circuit, via a fast-recovery rectifier. This is a special part, and an ordinary 1N4000-type part won't work. I recently ran into this problem, and replacing the diode brought the set to life.

Hopefully, your monitor is now fixed. If not, you've got a standard troubleshooting job ahead of you. If the set seems dead, check specifically for activity in the horizontal oscillator circuit; no signal, no high voltage and no picture! On many sets, even the power light is driven from this circuit, and that's a valuable clue. If the power light is on, the horizontal is running! Some sets, though, drive the light from the switching power supply, so follow the wires back to the board to be sure.

Set 'Em Up

Once you get your monitor working, you'll want to adjust it for the best picture. Next time, we'll explore how to set up the focus, screen level and color balance. Until next time, 73 from KB1UM. 73

Communications
Continued from page 70

and then at the receiver convert it back to the audio or video signal with a *digital-to-analog converter*. This method is currently used in compact discs, in digital audio (such as the WAV files in computers), and in digital radio. It is also now used in telephone systems, for sending voice signals through fiber optic cables, and for an entirely new telephone system called ISDN or the Integrated Services Digital Network. ISDN will eventually provide direct digital connections to your home, which can be used not just for phoning your friends, but also for sending digital data and pictures. 73

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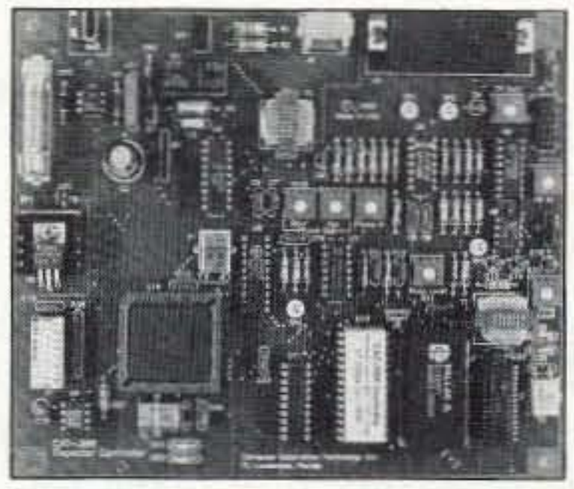

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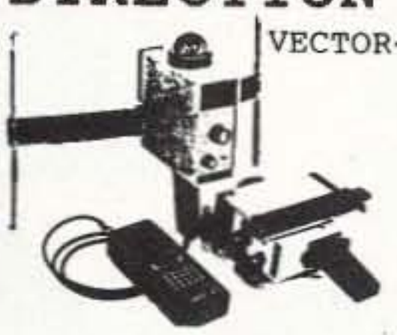

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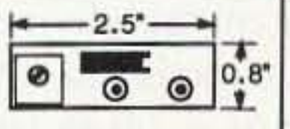

*SHIPPING AND TAXES NOT INCLUDED.

BARC Jr.

by Ben Fenster KBØOVM

What is BARC Jr.? It's the Boulder Amateur Radio Club Junior. Founded in 1993, it is a club for kids under age 18. Today, three years later, it is a club with more than 40 kids ranging in age from 6 to 16. Its purpose is to get more young people into ham radio. This is done by demonstrations, participating in Field Day, and so on. At swapfests, BARC Jr. sells J-pole antennas made by the members, plus donated items, and uses the money to buy kits for the kids to build, buying loaner equipment, funding social events, and most of all, funding an annual Dayton HamVention trip. Every year one member is sent to participate in the Youth Forum. Besides this, there's a class every week where they study the code, have a technical session, and witness a demonstration. BARC Jr.'s 15-20 Elmers teach the Novice through General classes. At some classes operating procedures are covered, such as how to use and what can be said on an autopatch. Once a month a speaker comes in to talk on anything from antennas to repeaters to autopatches. And every Sunday the group gets together on the 146.700 BARC repeater.

We occasionally take field trips to participate in contests or see repeater sites. Once we took a trip to the Big Horn museum in Byers to see old radio equipment. Around Christmas we have a party, every August we have a family picnic and foxhunt, and now and then we have a group dinner.

We also have red BARC Jr. T-shirts, hats and pins, and various other things are sure to come up soon. As you can see, BARC Jr. is a well-identified club.

This year at Field Day we had a visitor. Wayne Green was in the area and stopped to see our Field Day activities, and asked for an article about BARC Jr. I am the editor of "Yip Yap" (the BARC Jr. section in BARC Sr.'s newsletter), so I was given the job, and here is the finished product. 73

Kelly Woo KE6KJU was featured in the cover picture for the July 1995 Radio Fun which had an interesting article on page 12 written by KN6MG about her. Kelly convinced her dad, KN6MG, that she wanted to get her ham license. Kelly dropped by the 73 booth on the Queen Mary and had her picture taken with W2NSD/1. The article is in Radio Fun #47 and is available postpaid for $4 from Radio Book Shop (order form on page 88.)

QSL Contest

Did you buy your QSL off a rack,
or did you put some thought
and creativity into it?
If you think you have a winner,
send it in and let us have
a look at it. Who knows, it might make the cover.
Well, maybe page 85 or so.Or maybe Wayne's wastebasket.
If it's declared a winner, you'll get a CD
of your choice of any of 26 kinds of music, as listed in Wayne's
November editorial. You'll also see it in 73! Send it to
QSLContest, 73 Magazine,
70 N202, Peterborough NH 03458-1107.
Bribery?
You Bet!

Dots and Dashes

Hal Goodman W3UWH
Box 942
Bala Cynwyd PA 19004

As I think back over the nearly fifty years I have spent as a ham, few things seem as thrilling as my first few CW contacts on 80 meters. My very first contact was with a ham who lived only two blocks away. I had made arrangements with him at the local radio club meeting as to time and frequency. I only had one crystal, so picking the frequency was easy. As the time approached, I plugged the eighty meter coil into my three-tube super-regenerative receiver and turned the power on to my two-tube (rectifier and oscillator) transmitter. My transmission was only at about four or five words a minute and filled with many errors. However, he was very patient and I was able to complete the contact.

Today, I frequently tune the eighty meter Novice frequencies and really enjoy helping some youngster feel the thrill of making a CW contact. Even though many people today say that CW is obsolete and should no longer be required, it is an accomplishment. After all, being able to communicate by CW is something that 99.965% of the world's population cannot do. And, besides it's fun.

I was talking with a youngster recently who told me he had just gotten his ticket and that I was his third contact. He asked how long I had been on the air and when I told him, he asked what class license I held. When I told him that I was an Extra Class, you could almost hear the excitement as he asked if that meant he could send faster. When I said yes, he started sending faster, though the first thing he said was, "Don't you send faster."

However, there is a down side for us old timers when it comes to working today's new hams. Our reflexes are not as fast as they used to be. You might ask, what do reflexes have to do with copying CW? It's not the copying, it's the trying to make sense out of what you are copying quickly enough to understand what is being said. Most youngsters are in too much of a hurry to build their code speed up to where they can pass the code test, and then never have to use code again. They are not willing to put in the time and effort to develop a "good fist." Instead, they get an electronic keyer, thinking it will make up for their lack of skill.

"Relax, there is nothing more enjoyable for most of us "old timers" than joining in the excitement a new ham experiencing the joys of ham radio."

Unfortunately, it only makes matters worse. Let me give you an example. About two weeks ago, I made contact with a Tech-plus op. I looked him up later and found his name was Bill. What follows is an exact transcript of what I copied. Only the call sign is omitted to protect the guilty.

"W3VWH/lt di N2— fb om dami is 6anl, buel. qt5 is roc5ehtil, ny rochismir, ny ur rht 58e9e rsm 5891, ho bx tu 6k"

No, I'm not kidding. That is exactly what I copied. I may be getting senile, but I can still copy ten words per minute accurately. He was using one of those electronic keyers without knowing how to use it. The key speed must have been set for at least 25 words per minute. Now had I been younger and had faster reflexes I might have been able to ignore the extra dots and occasional extra dashes. As it was, he seemed to have turned it back to me and I was sitting there looking at what might as well have been hieroglyphics. What do you answer? 'N2— de W3UWH/1 severe lightening, must QRT immediately, 73 de W3UWH/l."

Back in the old days, when you took your code test you had to both copy and demonstrate your ability to send code. Speaking for us senior hams, arthritis and all, I think we should reinstate that requirement. Let those who don't want to do code content themselves with no-code Tech licenses or type their messages on the Internet.

Another area of CW communications that is becoming lost, is the ability to use the English language. Now don't get me wrong, I have no objection to, "fb om es tnx for the qso." It's when the messages start to look like, "tnx it wznce of u to ans my cl, sd cpy. rghr knwd to a bazk up 40f, rn 70wts." Yes, I know we can all take a minute and figure out what was sent. But the purpose, for me at least, in making a CW contact is to enjoy the experience, not a test of cryptography skills. It seems that the current crop of new hams is laboring under the misconception that if they don't abbreviate absolutely everything, they will look foolish. It reminds me of the time when as a youngster, before my voice changed, I would practice trying to talk in a deep voice, because I wrongly believed that no "old timer" would talk to me if he thought I was a kid.

Relax, there is nothing more enjoyable for most of us "old timers" than joining in the excitement a new ham experiencing the joys of ham radio. Most of us are retired or at least have lots of spare time and you don't need to rush. Take your time, develop a "good fist," and only use common radio abbreviations. If you do that, then there will be no "generation gap" within the ham fraternity. 73

Number 86 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 April issue, we should receive it by January 31. Provide a clear, concise summary of the essential details about your Special Event.

MAR 2

BISMARCK, ND The Central Dakota ARC will hold its annual Hamfest at the Radisson Inn, 800 South Third St., 8 AM–4 PM. Talk-in on 146.85/.25. VE Exams and Ham/Computer Swapmeet. Call *Tim NØSDB, (701) 663-6620.*

COMER, GA The 1st annual Bubba Hamfest, sponsored by the N.E. Georgia Bubba Net, will be held 9 AM–3 PM at the Madison County Fairgrounds, 1/2 mi. south of Comer GA, on Hwy. 22. Talk-in on 147.315(+). Dealers indoors and covered Flea Market. VE Exams. Set up and camping available Fri. night. For reservations and info contact *Dan Daniel AE4HS, 152 Windfall Dr., Winterville GA 30683. Tel. (706) 742-2777.*

TWIN MOUNTAIN, NH The North Country ARC and Littleton ARK will host their 3rd annual Ham Radio and Computer Flea Market, to benefit the North Country D.A.R.E. Program. The event will be held at Twin Mountain NH Townhall, near the intersection of Routes 2 and 3. Setup at 8 AM, public admission 9 AM–3 PM. Bring your own tables. For more info, contact *Richard Force WB1ASL, 12 Cottage St., Lancaster NH 03584-1903. Tel. (603) 788-4428. E-mail r_force@moose.ncia.net.*

MAR 3

CLEVELAND, OH The Cleveland Winterfest will be held at the Cuyahoga County Fairgrounds in Berea OH, 8 AM–2 PM. VE Exams; have proper IDs, copy of license, and $6.07 check payable to ARRL/VEC. DXCC/WAS QSL Checking before 10 AM. Talk-in on 146.73. Write to *Don Ritchie K8ZGW, Hamfest Assn. of Cleveland, P.O. Box 81252, Cleveland OH 44181-0252;* or call *(216) 999-7388* in Cleveland, elsewhere *(800) CLE-FEST.* Leave message on pager.

MAR 9

VICTORIA, TX Victoria Swapfest 1996 will be held by the Victoria ARC at Knights of Columbus Hall, 3610 N. Ben Wilson. Door opens at 8 AM. VE Exams begin at 9 AM. General admission is not required to take the exams. Talk-in on 145.190(-) or 145.130(-) (PL 103.5). For tables and info, contact *Victoria ARC, 121 South Main St., Suite 205, Victoria TX 77901. Tel. (512) 573-0821.*

WEST PALM BEACH, FL The West Palm Beach ARC will hold their semi-annual Free Flea in John Prince Park, Lake Worth FL, at Mound Circle, 8 AM–2 PM. Free to buyers and sellers. Talk-in on 147.135 (+600). Contact *Marvin Kaskawits KD2CK@KB4VOL. Telephone (407) 683-2930 p001471b@pbfreenet.seflin.lib.fl.us.*

MAR 9–10

CHARLOTTE, NC The Mecklenburg ARS Hamfest and ComputerFair will be held at The Charlotte Merchandise Mart, Liberty Hall. Setup times: Dealers and Manufacturers: 9 AM–9 PM Fri.; 7 AM Sat. Flea Market Dealers 3 PM–9 PM Fri., 7 AM Sat.; Flea Market Individuals: 5 PM–9 PM Fri., 7 AM Sat. For info regarding space availability, call *Ken Boyd or Jim Crisco at (704) 377-8873.* A copy of your NC Sales and Use Tax license will be required prior to exhibit.

MAR 10

BRISTOL, CT The Insurance City Rptr. Club annual Hamfest and Flea Market will be held at Bristol Eastern H.S., King St., 9 AM–1 PM. Snow date is Mar. 17th. VE Exams at 10 AM by pre-reg. only. SASE to *ICRC, P.O. Box 165, Pleasant Valley CT 06063.* For Flea Market reservations, contact *Pete Brcunelli, 358 Andrews St., Southington CT 06489. Tel. (860) 620-0176.*

WAUKESHA, WI The SEWFARS Rptr. ARC will hold a Swapfest at the Waukesha County Expo Center, 8 AM–2 PM. Talk-in on 146.82/.22 PL 127.3 Hz. VE Exams, bring original license. For info call *(414) 650-0724,* or write *SEWFARS, P.O. Box 102, Delafield WI 53018.* Reservation deadline is Feb. 23rd.

MAR 16

WESTBORO, MA The Minuteman Rptr. Assn. (MMRA) will hold their Ham Radio Flea Market at the Westboro H.S., 90 West Main St., 10 AM–2 PM. Setup 8 AM–10 AM. Contact *Andy N1BHI, (508) 489-2282.* Talk-in on 146.61(-), 146.82(-), 449.925(-), 223.94(-), 224.70(-). Walk-in VE Exams (ARRL-VEC) at Noon (tentative).

MAR 16–17

FORT WALTON BEACH, FL The Playground ARC will hold their 26th annual North Florida Ham/Swapfest at the Ft. Walton Beach Fair Grounds, Sat., 8 AM–5 PM; Sun., 8 AM–3 PM. Indoor Flea Market. Call *Bud K8YNU, (904) 243-5404, 9 AM–5 PM CDT;* or *Scott KE4BFT, (904)244-3182* for tables. For RV space only, call *Roberta* at *(904) 862-0211.* Commercial space, meetings, forums. Address inquiries to *P.A.R.C., P.O. Box 873, Ft. Walton Beach FL 32549.*

MIDLAND, TX The Midland ARC will hold their annual St. Patrick's Day Swapfest 9 AM–5 PM Sat., and 8 AM–2:30 PM Sun., at the Midland County Exhibit building. Indoor Flea Market, Covered outdoor Flea Market. T-hunts. VE Exams 12 PM on Sat. Contact the *Midland ARC, P.O. Box 4401, Midland TX 79704,* or by E-mail: *oilman@marshill.com.*

MAR 17

MAUMEE, OH The Toledo Mobile Radio Assn. will hold their 41st annual Hamfest/Computer Fair from 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 *Robert N. Hanna K8ADK, 2154 Circular Rd., Toledo OH 43614-4205. Tel. (419) 382-2529.*

MONROEVILLE, PA The 24th Two Rivers ARC Hamfest/Computer Show will be held at ExpoMart, 8 AM–3 PM. VE Exams, pre-reg. required one week before tests. Talk-in on 146.13/.73 and 147.72/.12 Rptrs., and 146.52 Simplex. For info, write to *Two Rivers ARC, Inc., P.O. Box 225, Greenock PA 15047;* or FAX *William Hetrick & Assoc., (412) 754-0562.*

YORK, PA The Keystone VHF Club will host a Hamfest/Computer Show at Dover Fire Hall, Rt. 921 (Canal St.), in Dover PA, 8 AM–4 PM. VE Exams at 10:30 sharp, Log House Rec. Area, 2481 W Canal St. (free parking at testing site, or free shuttle service from the Hamfest). For advance table reg., contact *York Springfest, P.O. Box 266, East Berlin PA 17316-0266;* or call *Ted Rodes KE3SO, (717) 259-8063; FAX (717) 259-7870.*

MAR 18

CLAYTON, MO The annual St. Louis County SKYWARN Severe Weather Observation Training Seminars will follow this schedule: Mon., Mar. 18th, Level 1 at 6:45 PM–10 PM; Wed., Apr. 3rd, Level 1 at 6:45 PM–10 PM; Sat., Apr. 13th, Level 1 at 8:45 AM–12 Noon; Sat., Apr. 13th, Level 2 at 1 PM–4:15 PM; Mon., Apr. 15th, level 2 at 6:45 PM–10 PM. All training is held at St. Luke's Hospital, Education Center, Hwy. 141 North of Hwy. 40-61 in Chesterfield MO. No advance reg. required. All are welcome. Certification provided for R.A.C.E.S. and SKYWARN. For more info, contact *St. Louis County Police, Office of Emergency Management, 7900 Forsyth Blvd., Clayton MO 63105.*

MAR 23

WEST ORANGE, NJ Irvington-Roseland AC will sponor a Hamfest 8 AM–2 PM at West Orange H.S., 600 Pleasant Valley Way (Exit 7 off of Intertate Route 280). All indoors. Amateur Radio. Computers. SWLers. Electronic Hobbyists. Vendors *must* pre-register for tables by Mar. 15th. Talk-in on W2QR Rptr.: 147.415/146.415, and 146.520 simplex. For info, contact *Jim Howe N2TDI, (201) 402-6066;* or *Liz Howe N2WGH, (201) 402-6066.*

MAR 23–24

TULSA, OK The 1996 ARRL Oklahoma Section Convention will be located in the Maxwell Convention Center, Downtown Tulsa, Exhibit Hall A. (near corner of West Seventh St. and South Houston Ave.). Indoor Flea Market. VEC Exams Sat. at 1:30 PM; Sun. at 9:30 AM. ARRL forum and HQ Personnel present. Digital Forum. SKYWARN School with the Nat'l. Weather Serv. MARS, AMSAT, DX meetings and more. Talk-in on 145.27(-) and 443.750. Roy Neal K6DUE will be the keynote speaker. For Hotel info, call Doubletree, (918) 587-8000 or Howard Johnson's, (918) 585-5898. Ask about Hamfest rates. Dealer/Flea Market setup Fri., Mar. 22nd, 1 PM–10 PM. Call *Merlin Griffin WB5OSM, (918) 272-3081,* leave a msg., or *E-mail 73564-1063@compuserve.com.* The convention will be sponsored by Green Country Hamfest Inc.

MAR 24

STERLING, IL The Sterling-Rock Falls ARS 36th annual Hamfest will be held at the Sterling H.S. Fieldhouse, 1608 4th Ave. Indoor Flea Market. Radio electronic items, computer and hobby. Dummyload available to test equip. Doors open to the public 7:30 AM Sun. VE Exams, walk-ins only. Please bring original current license plus copy, and photo ID. Talk-in on 146.25/.85 W9MEP Rptr. Contact *Lloyd Sherman KB9APW, Sterling-Rock Falls ARS, P.O. Box 521, Sterling IL 61081-0521. Tel. (815) 336-2434.*

WEST TRENTON, NJ The Delaware Valley Radio Assn., Inc., will host its 24th annual Flea Market "HAMCOMP '96" at Trenton State College Student Rec. Center, 7:30 AM–2 PM. Setup at 6:30 AM. Talk-in on W2ZQ Rptrs. 146.67 (2m) and 442.650 (70 cm). Reserve indoor space before Mar. 17th. Make checks payable to *Delaware Valley Radio Association,* and mail to *HAMCOMP '96, P.O. Box 7024, W. Trenton NJ 08628.*

YONKERS, NY Westchester Emergency Comm. Assoc. will hold "WECAFEST 1996" 9 AM–2 PM at Yonkers Raceway, Central & Yonkers Ave. Talk-in on 147.06/.66. Contact *Tom Raffaelli, (914) 741-6606.*

MAR 30

ELIZABETHTOWN, KY A Hamfest sponsored by Lincoln Trail ARC will be held at the Pritchard Community Ctr., 8 AM–4 PM. Setup Fri. Mar. 29th, 7 PM–9 PM (security provided overnight). For advance reservations, contact *Leon Priest, P.O. Box 342, Vine Grove KY 40175. Tel. (502) 351-4721.* Talk-in on 146.98.

MICHIGAN CITY, IN The annual Michigan City Hamfest/Computer Flea Market will be held 8 AM–2 PM CST at Michigan City H.S., 8466 W. Pahs Rd. Table reservations and info available from *Ron Stahoviak N9TPC, 213 S. Dickson St., Michigan City IN 46360. Tel. (219) 872-6594.*

ORADELL, NJ The Chestnut Ridge Radio Club will hold its annual Flea Market 8:30 AM–2 PM in the Education Building, Saddle River Reformed Church, East Saddle River Rd. (corner Weiss Rd.), Upper Saddle River NJ. Talk-in on 2m 146.955 Rptr. Contact *Andy Woerner K2ETN, (201) 261-3783, FAX (201) 261-1038;* or *Dick Colten K1JMI, (201) 837-0555, FAX (201) 837-2969, E-mail K1JMI @aol.com*

WATERFORD, CT The Radio Amature Soc. of Norwich will hold a Ham Radio Auction at the Waterford Sr. Ctr. on Rt. 85. The Auction starts at 10 AM, setup at 9 AM. Bring your gear to sell (10% commission to RASON). Talk-in on 146.730(-). Contact *Tony AA1JN, (203) 859-0162;* or *Mike N1HFX, (203) 546-9498* for info.

SPECIAL EVENT STATIONS

MAR 10

WATERFORD, WI The 1996 Wisconsin QSO Party, sponsored by West Allis RAC, will be on the air 1800Z Mar. 10th–0100Z Mar. 11th. For rules and info, contact *Mr. Lynn Tamblyn K9KR, 5436 Scenery Dr., Waterford WI 53185. Tel. (414) 895-6574;* or write to *West Allis Radio Amateur Club, Wisc. QSO Party, P.O. Box 1072, Milwaukee WI 53201.*

MAR 16

MACON, GA The Macon ARC will operate W4BKM 1500 UTC–2300 UTC at the 14th annual Cherry Blossom Festival. Phone 7.235, 14.240, and 21.335; CW 7.135, 14.035, and 21.135. For a certificate, send your QSL and a 9" x 12" SASE to *Macon ARC, P.O. Box 4862, Macon GA 31208.*

MAR 23-24

GLENDALE, AZ The Center for Amateur Radio Learning
will operate Station KC7LUL 1300Z Sat.–2200Z Sun., in the phone portion of the Novice 10m band, and General 15 and 20m bands. Operation will be in conjunction with HamDaze weekend at the Arizona Science Center. For a certificate, send a QSL and 9" x 12" SASE to *C.A.R.L., P.O. Box 51048, Phoenix AZ 85076-1048.*

VIRGINIA BEACH, VA and **MOSS, NORWAY** The Virginia Beach ARC will operate WA4TGF, and the Moss ARC will operate LA5M, 1400Z Mar. 23–2000Z Mar. 24th, to commemorate the 105th Anniversary of the "Norwegian Lady." CW: 10 kHz up from the bottom of the Novice subbands, and 7.040, 10.120, 14.040. Phone: 3.878, 7.278, 14.278, 21.278, 28.363, 146.550. For a certificate, send QSL and SASE to *VBARC, P.O. Box 62003, Virginia Beach VA 23462.*

MAR 30-31

TIMONIUM, MD The Baltimore ARC will operate W3FT to commemorate the 25th Anniversary of the Greater Baltimore Hamboree and Computerfest. W3FT will operate on 14.240, 7.240 and 146.535 MHz from 1200Z–2000Z Mar. 30th; and from 1200Z–2000Z on Mar. 31st. For a certificate, send a 9 1/2" x 12" SASE, QSL card, and contact number to *The Greater Baltimore Hamboree and Computerfest, P.O. Box 95, Timonium MD 21094.* 73

Radio Bookshop

Phone 800-274-7373 or 603-924-0058, FAX 603-924-8613, or see order form on page 88 for ordering information.

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AR3851 **Hints and Kinks** Ideas for setting up your gear for comfortable efficient operation. $10.00

ARRL **License Manuals:**

AR4181 **Technician Class** $6.00

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AR4483 **Weather Satellite Handbook** by Dr. Ralph Taggart WA8DQT. Expanded and revised to reflect today's weather-fax satellite technology. $20.00

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AR2973 **Complete DX'er** by Bob Locker W9K1 Learn how to hunt DX and obtain hart-to-get QSL cards. $12.00

New Product reviews and reviewers are welcome. Write to Richard at 73.

Number 85 on your Feedback card

HAM HELP

We are happy to provide Ham Help listings free on a space available basis. To make our job easier and to ensure that your listing is correct, please type or print your request clearly, double spaced, on a full 8 1/2" x 11" sheet of paper. Use upper- and lower-case letters where appropriate. Also, print numbers carefully—a 1, for example, can be misread as the letters l or i, or even the number 7. Please remember to acknowledge responses to your requests. Thank you for your cooperation.

Can anyone supply me with an operating manual and schematic for a **PAL 200 MDX** 12 volt mobile Linear Amplifier? I will pay a reasonable amount for photocopies and postage. *Al Cikas KA9GDL, 412 Radford Dr., Sherman IL 62684.*

During the past year I have received about a dozen QSL cards stating that the operator copied my call (WN8F) as QSL manager for Paul 9L1PG, from Sierra Leone. In most cases, I have returned the cards stating that there must be a misunderstanding of the call, as I am not, nor have I ever been a QSL manager. I know this is a disappointment for these operators and trust the correct QSL manager for 9L1PG can be copied correctly in the future. *Ken Massie WN8F, 115 Woodlawn Dr., Ironton OH 45638-2355* 73

NEVER SAY DIE

Continued from page 82

Hampshire and America, I tackled each of them and came up with a creative solutions based on things I'd read about or seen working in other countries. Being an entrepreneur, my proposals were for ways to solve problems spending the least amount of money, and for ways to cut our taxes and reduce government. You see, I have this crazy idea that the government should be working for us instead of us for them. It'll never sell, I know.

Instead of trying to break through the endless talkers (though saying little) on the Commission with my ideas, I decided to write reports of what I'd discovered and present my proposed solutions that way. Several of the Commission members were very enthusiastic about my reports, while others said nothing. When I met or called those I hadn't heard from and asked what they thought, they said that golly, they really hadn't had a chance to read my reports yet. They still haven't, as far as I know.

I've reprinted my reports in a book and I'd like to have you read it and start sewing the seeds of my ideas all around the country. The book runs 360 pages and I think you'll find it fun to read. Yes, I do fulminate about the damned Commission members and their inactivity. Heck, half of them dropped out in the first few months, after having contributed little, if anything.

The book has been selling in New Hampshire book stores for $13, or from Uncle Wayne's for $16, including shipping. I'll tell you what, I want you to enjoy the book, so while they last you can get one for $13 postpaid. Further, if you are in any way disappointed, send it back for $13 credit toward anything else Uncle Wayne's Bookshelf has in stock. You can't lose, and you could win big. And so could our country.

The proposals I've made to help New Hampshire are just as applicable to any other state.

20/20 Foresight

After reprinting the first year of my reports in the book I couldn't keep myself from continuing even more reports. 21 of 'em before I slowed down. I should put these into a book too, and probably will, eventually. These reports are packed with more ideas for businesses. How about a way for us to double or triple our foreign aid, but instead of giving the money away to despots who don't even thank us, how about making a huge profit on every aid dollar we spend? You're going to love my proposals. I've written extensively on solutions to our school problems, and on health. While copies last, $10 for the 336 pages.

PROPAGATION

Number 88 on your Feedback card

Jim Gray W1XU
210 Chateau Circle
Payson AZ 85541

This month is expected to provide some excellent DX on the HF bands. Good days are distributed throughout the month as shown on the chart, but the Poor days are concentrated around the 4th, 15th and 22nd–25th. The remainder will be Fair or trending. You may also find some geophysical effects on earth and in the ionosphere around the 23rd or 24th.

It appears that Cycle 22 is bottoming out as you read this, and Cycle 23 has already begun. Although it will take a while for solar flux levels to increase significantly, the trend is upward...and rise time of a cycle is faster than decay time...so rejoice!

10–12 Meters

Occasional trans-equatorial F-2 layer openings during daylight hours, with 12 meters to show greater signal strengths.

15–17 Meters

Circuits from the Northern Hemisphere to Africa and South America should open on Good days, and daytime short-skip openings will also be present on Good days. Performance of these bands will be sporadic, but on some days will sparkle.

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			40	40	20	20				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	
SOUTH AFRICA									15	15	15	
U.S.S.R.							20	20				
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
SOUTH AFRICA										15	15	20
U.S.S.R								20	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
SOUTH AFRICA										15	15	
U.S.S.R.									20			
EAST COAST		80	80	40	40	40	40	20	20	20		

Where 10 meters is shown, also check 12 meters. Where 15 meters is shown, check 17 meters too. Where 20 meters is shown, be sure to look at 17 as well. Always check the bands above and below the indicated bands for possible openings to the areas shown. Remember that DX is where you find it, and not always where it is predicted to be.

MARCH 1996

SUN	MON	TUE	WED	THU	FRI	SAT
					1 G-F	2 F
3 F-P	4 P	5 P-F	6 F	7 F	8 F-G	9 G-F
10 F-G	11 G	12 G	13 G-F	14 F-P	15 P	16 P-F
17 F	18 F-G	19 G	20 G-F	21 F-P	22 P	23 VP
24 VP	25 P	26 P-F	27 F	28 F	29 F-G	30 G
31 G						

20 Meters

This will be your most consistent band of choice for DX opportunities from sunrise until after sunset. Expect DX from Northern to Southern Hemispheres with decent signal strengths on most days, and short-skip openings to 2,000 miles as well.

30–40 Meters

DX from just before sunset until shortly after sunrise will provide enjoyment on the Good days. However, be aware of seasonal QRN interfering with weak signals. Signals peak to the east before midnight and peak to the west before dawn. Daytime short-skip will be good out to 1,000 miles or so.

80 and 160 Meters

DX during hours of darkness will be available, but not as prevalent as during the winter months. QRN may become a problem for weak signal reception. Some daylight short-skip on 80 will be present, but none at all on 160. 73

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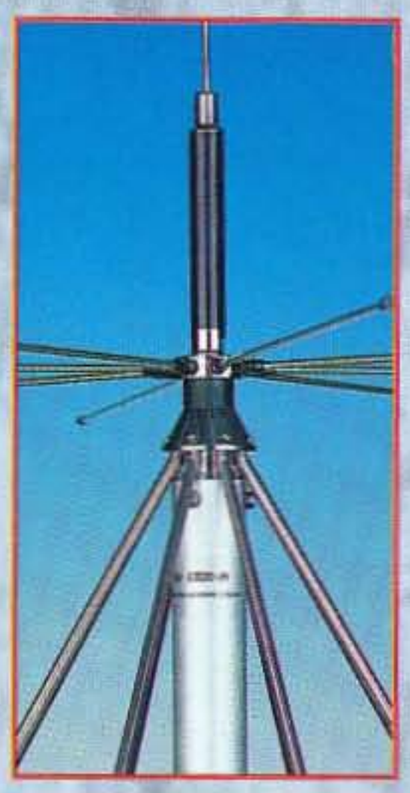
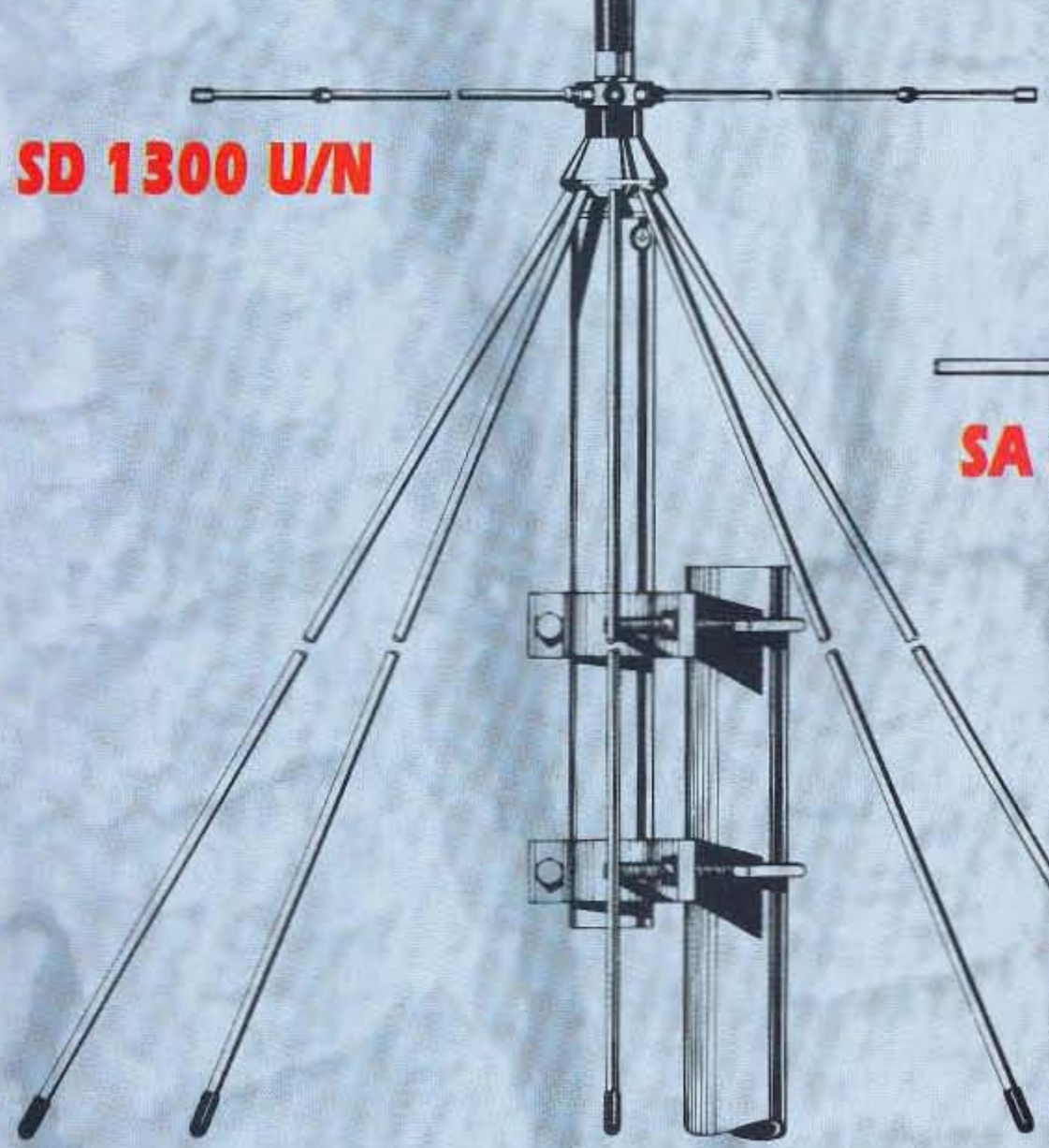
TECHNICAL DATA

Type:	VHF - UHF wide-band DISCONE
Impedance:	50 Ω
Frequency range:	Rx 25-1300 MHz
VHF Tx Band:	49-51/120-180/215-300 MHz
UHF Tx Band:	415-465/610-650/710-1000/1130-1300 MHz
Polarization:	vertical
V.S.W.R.: at freq. res.:	≤ 1.3:1
Gain:	0 dBd - 2.15 dBi
Max Power:	VHF 300 Watts ,UHF 200 Watts
Connection:	
SD 1300 U:	"UHF" female
SD 1300 N:	"N" female
Wind resistance:	40m/second
Length (approx.):	1700 mm
Base diameter:	850 mm
Weight (approx.):	1300 gr
Mounting mast:	ø 25-54 mm



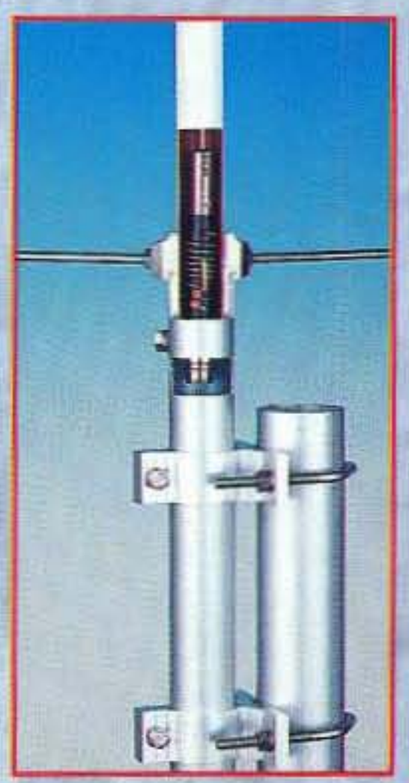


SD 1300 U/N

TECHNICAL DATA

Type:	VHF 6/8 λ UHF 3 x 5/8 λ Ground Plane
Impedance:	50 Ω
Frequency range:	VHF 142-148 MHz UHF 430-440 MHz
Polarization:	vertical
V.S.W.R. at freq. res.:	≤ 1.2:1
Bandwidth: at VSWR 2:1:	VHF 6 MHz, UHF 15 MHz
Gain:	VHF 4 dBd - 6.15 dBi UHF 6 dBd, 8.15 dBi
Max Power:	200 Watts
Connection:	"N" Female
Wind resistance:	60m/second
Length (approx.):	1800 mm
Radial length (approx):	170 mm
Weight (approx.):	950 gr
Mounting mast:	ø 35 - 54 mm

SA 270 MN



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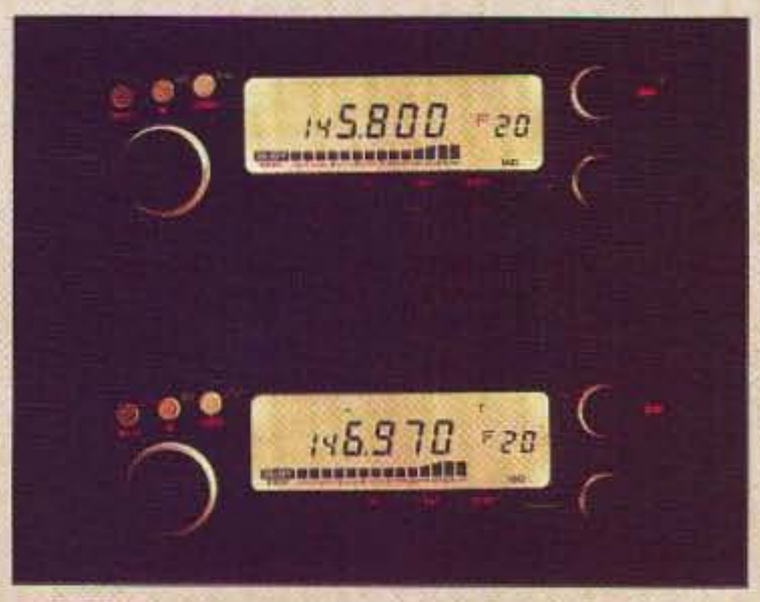
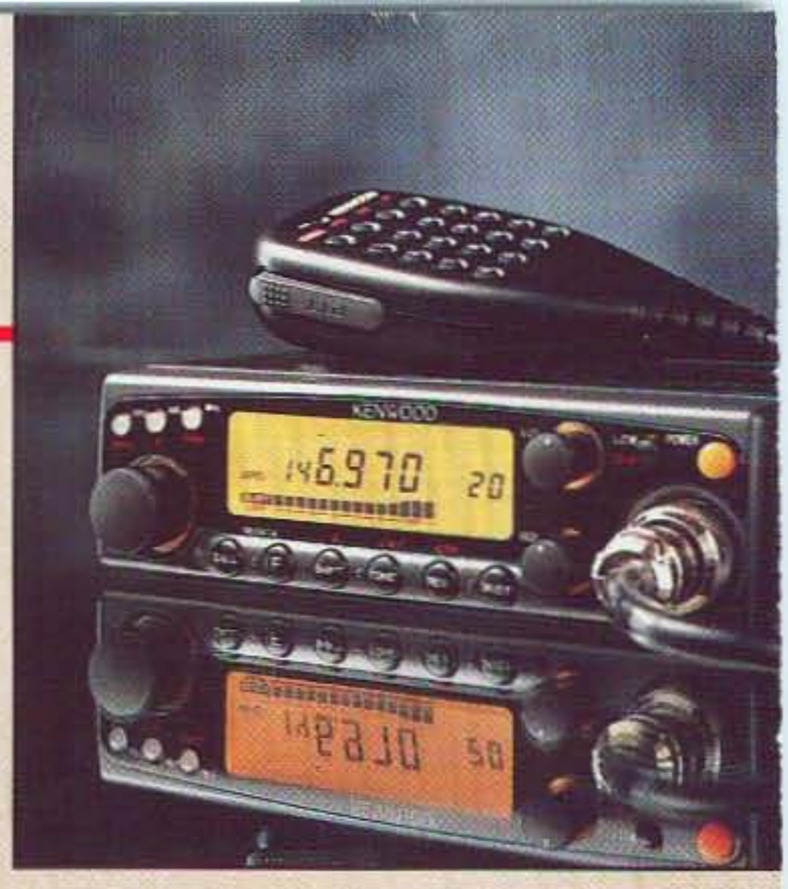
Military Specifications*

To ensure that it can withstand the toughest assignments, the TM-241A has been engineered to meet US military standards 810C, 810D & 810E for shock and vibration resistance (*current K/K2 versions with serial #5080000 or later).

User-Friendly Design

The ergonomically designed control panel is easy to see as well as to operate: it features illuminated keys and an extra-large LCD with 4-step dimmer to suit various lighting conditions.





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- Repeater reverse switch
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- DTSS for selective calling and page (with optional DTU-2)
- Time-out-timer
- Auto power-off with warning beeper
- Modifiable for MARS/CAP*

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