Including Ham Radio Fun!

73 Amateur Radio Today

OCTOBER 1996
ISSUE #433
USA $3.95
CANADA $4.95

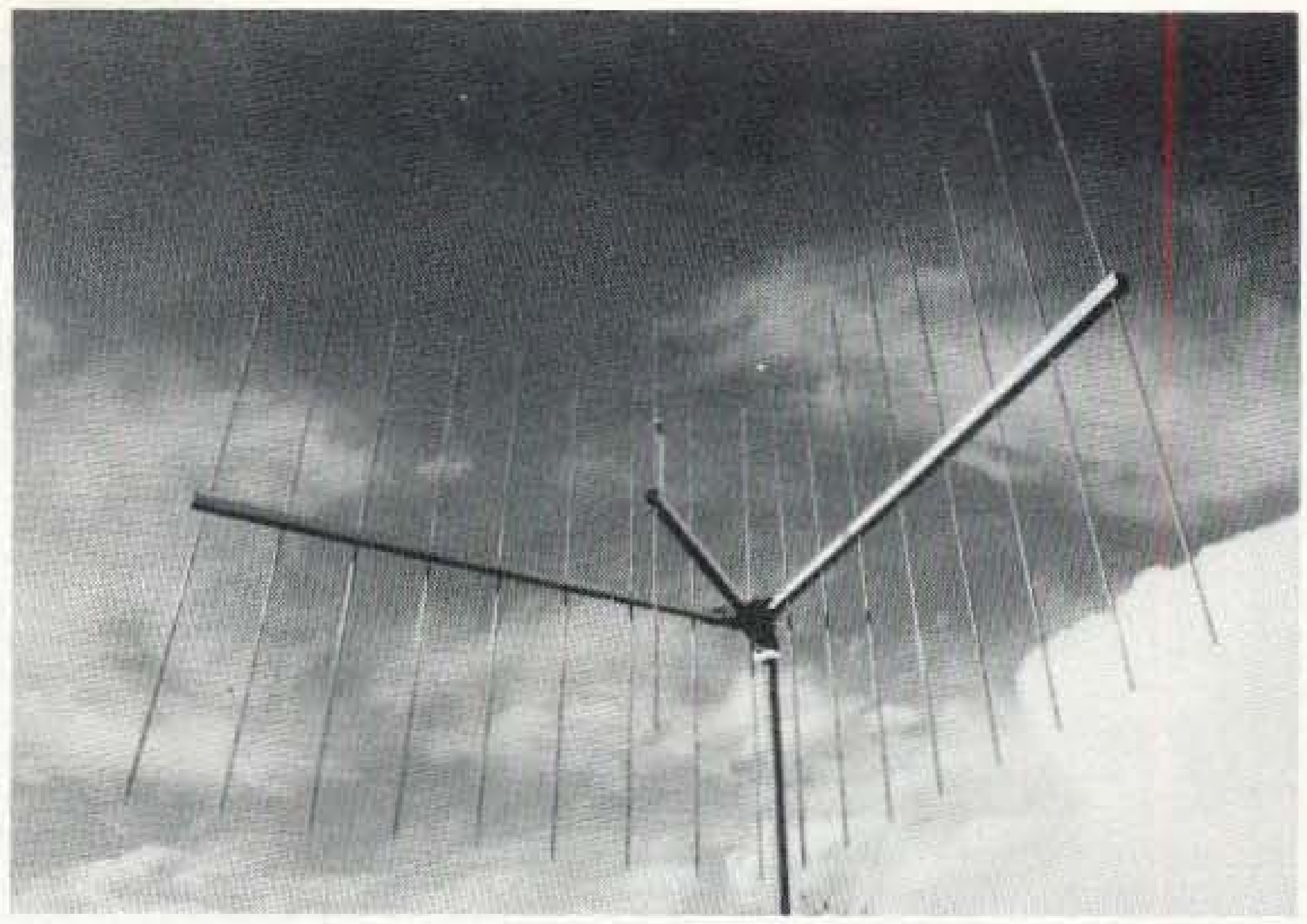
International Edition

QRP: Low Power Fun!

QRP Antenna Tuner
QRP Wattmeter
QRP Multi-Band Dipole
QRP Field Day

Corner Beam?

Big Forward Gain
Wide Backward Rejection
Exceptional Bandwidth
Distortion Free Pattern



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 and create.

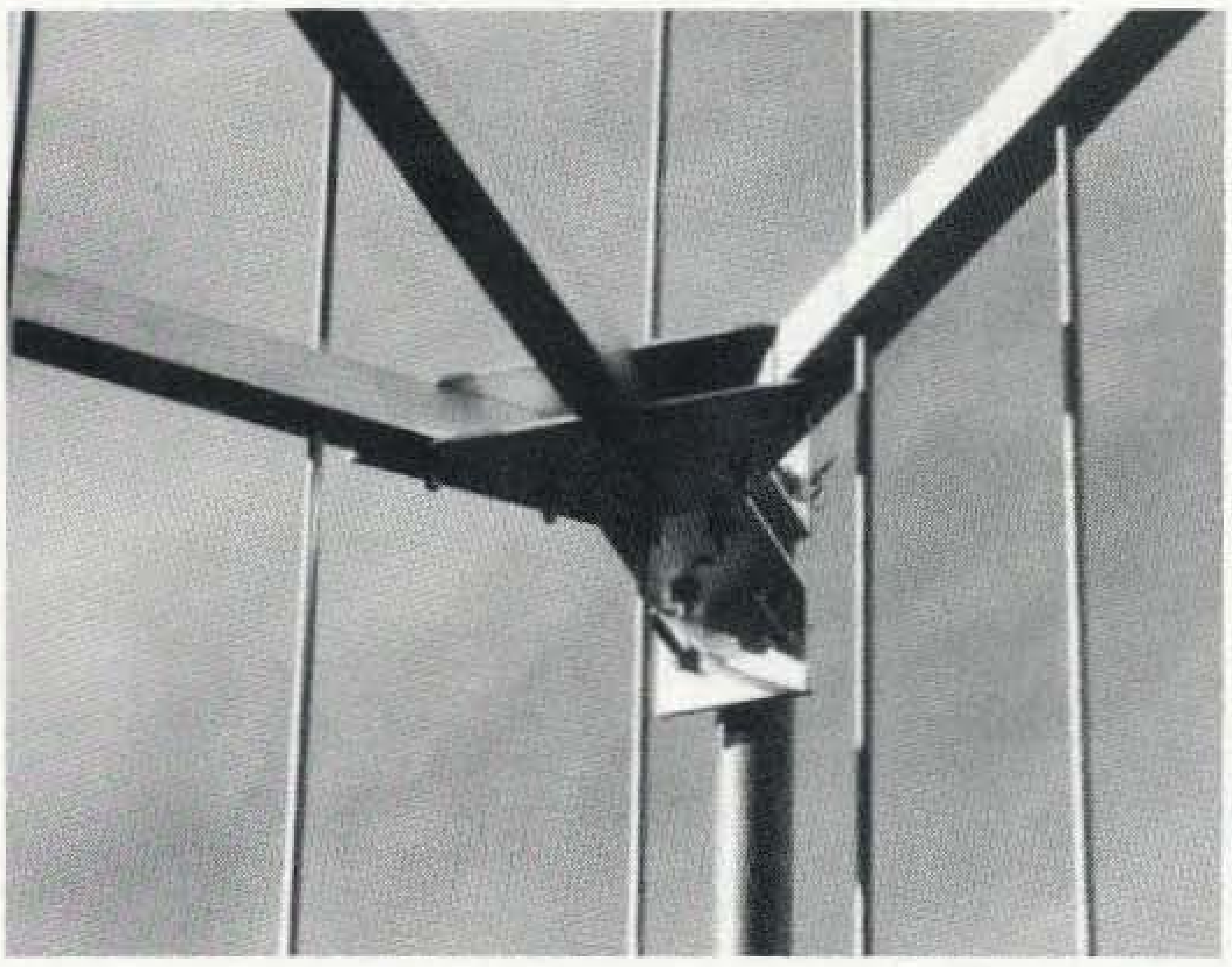
An omnidirectional antenna radiates uniformly in all direction, and it also hears noise and interference from every direction.

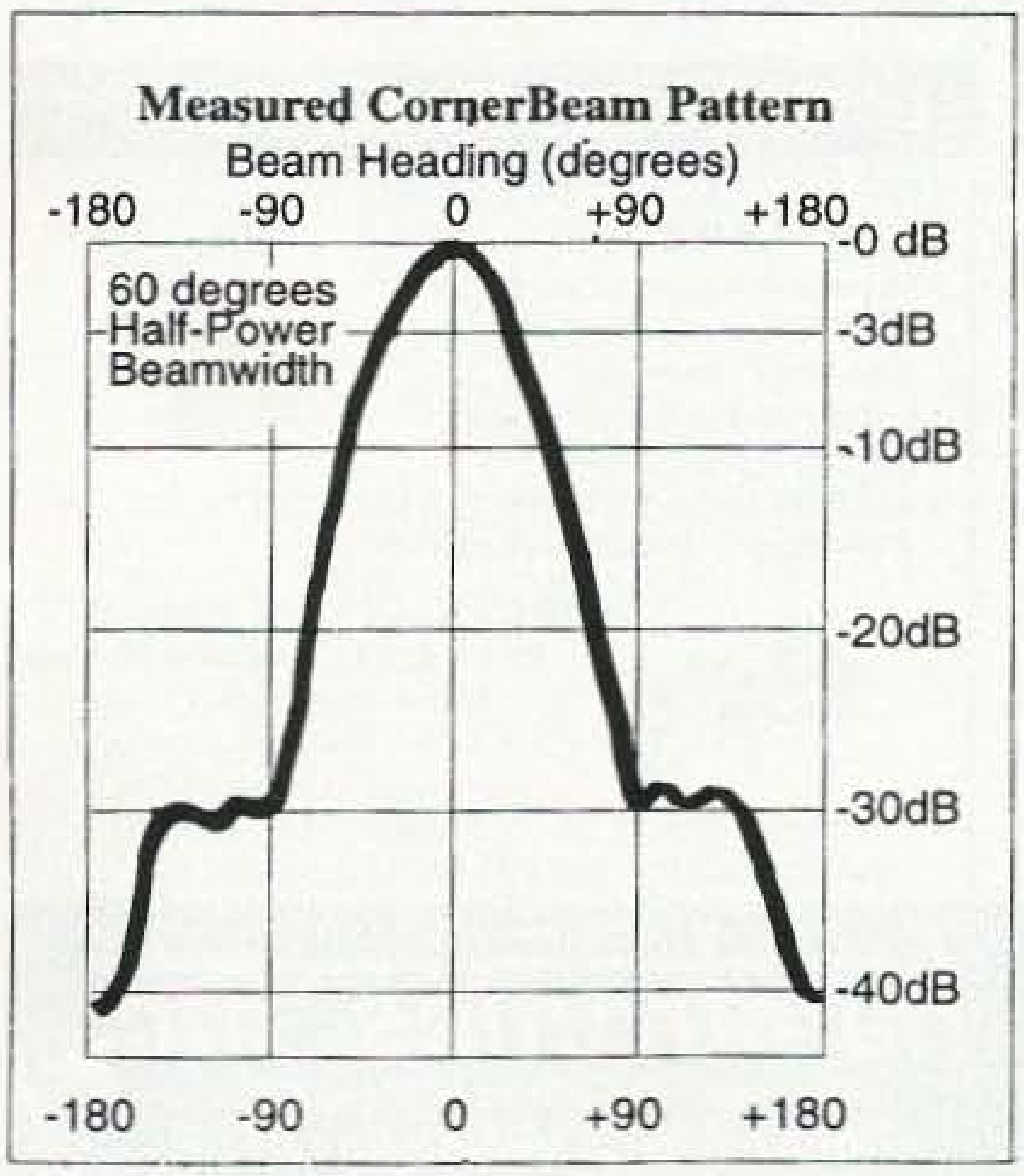
A directional antenna not only sends your signal where you want, it hears the signal it's pointed at, rejecting others. It also lets you operate with minimal power, cutting interference you inflict on other stations.

CornerBeam's clean sharp pattern without sidelobes or spikes reaches past the noise and interference to get the message through. Its wide rear rejection lets you null out strong nearby signals to reduce interference.

Look what CornerBeam does:

- 10 dB gain vs. dipole
- 40 dB Front-to-Back
- 60 degree Half-power Beamwidth
- SWR <1.1:1 across the band
- No dimension over 4 ft
- Mounts directly to mast or tower
- Vertical or horizontal polarization
- No need for offset or side mount





Corner Beats Yagi

A yagi with the same gain would have a 10-ft boom. Yagi bandwidth would be less than half. More important, CornerBeam produces no side lobes, no back lobes.

Improved Data Communication

Because CornerBeam's pattern has no unwanted side spikes, phase noise is reduced to a minimum. The result is reduced data error rate, faster packet circuits. When you want a distortion free signal, think CornerBeam, not yagi.

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.

Bandwidth Pays Off

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 set out to work satellites or go after small signal DX at 144.2 MHz.

CornerBeam can still be your beam when you join MARS at 143/148 MHz or team up with the sheriff's communications interface team at 158 MHz.

Scanning Too?

CornerBeam's gain & bandwidth extend monitoring range from aircraft to to marine & public service frequencies.■

On the Internet
www.itsnet.com/~radventr

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, weighs only 10 pounds.

Dimensions given in table are for reflector elements & booms.

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.

☐ Yes, I want Performance in My Corner!

__Send my CornerBeam: __2m, __220MHz, __70 cm, __Dual 146/435.

__Options: __DualBand Duplexer, __Commercial/Marine. Frequency:_____

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CIRCLE 57 ON READER SERVICE CARD

Finally – A Professional-Quality Receiver to Monitor Weather Broadcasts!

NEW **Our new RWX is a very sensitive and selective Hamtronics® grade receiver to monitor critical NOAA weather broadcasts.**

Excellent 0.15µV sensitivity provides good reception even at distances of 70 miles or more with suitable antenna. No comparison with ordinary consumer radios!

Automatic mode provides storm watch, alerting you by unmuting receiver and providing an output to trip remote equipment when an alert tone is broadcast.

Essential for airports, police and fire departments, CAP, broadcast stations, state and local emergency managers, amateur repeaters – anyone needing a professional quality receiver. Because of its reasonable price, it is also handy for bikers, hikers, boaters, hunters, farmers – or anyone who needs up-to-date weather info and emergency warnings, even from distant stations.

Small enough for emergency or portable use, it can even be powered from a small 9-12V battery when needed. Crystal controlled for accuracy; **all 7 channels provided** (162.40 to 162.55).

You can buy just the receiver pcb module in kit form or buy the kit with an attractive metal cabinet, AC power adapter, and built-in speaker. It is also available factory wired and tested.

- RWX Rcvr kit, PCB only $79
- RWX Rcvr kit with cabinet, speaker, & AC adapter $99
- RWX Rcvr wired/tested in cabinet with speaker & adapter $139

WWV RECEIVER

NEW Get time and frequency checks without buying multiband hf rcvr. Hear solar activity reports affecting radio propagation. Very sensitive and selective crystal controlled superhet, dedicated to listening to WWV on 10.000 MHz. Performance rivals the most expensive receivers.

- **RWWV Rcvr** kit, PCB only $59
- **RWWV Rcvr** kit with cabt, spkr, & 12Vdc adapter $89
- **RWWV Rcvr** w/t in cabt with spkr & adapter $129

WEATHER FAX RECEIVER

Join the fun. Get striking images directly from the weather satellites! A very sensitive wideband fm receiver **optimized for reception of NOAA APT and Russian Meteor weather fax** images on the 137 MHz band.

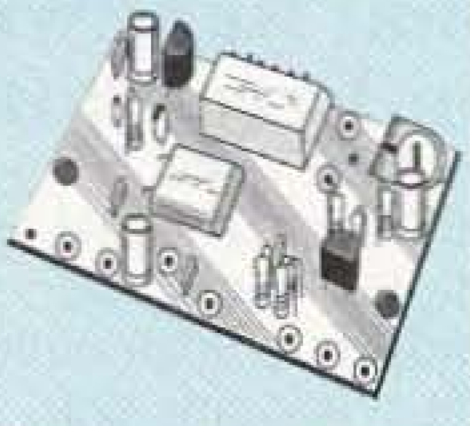
The R139 is lower cost and easier to maintain than synthesized units. And it is designed from the ground up for optimum satellite reception; not just an off-the-shelf scanner with a shorted-out IF filter!

Covers all five satellite channels. Scanner circuit and recorder control allow you to automatically search for and tape signals as satellites pass overhead, even while away from home.

- **R139 Receiver Kit** less case $159
- **R139 Receiver Kit** with case and AC power adapter $189
- **R139 Receiver w/t** in case with AC power adapter $239
- Internal PC Demodulator Board and Imaging Software $289
- Turnstile Antenna $119
- Weather Satellite Handbook $20

SUBAUDIBLE TONE ENCODER/DECODER

NEW **Access all your favorite closed repeaters with TD-5 CTCSS Encoder/Decoder**

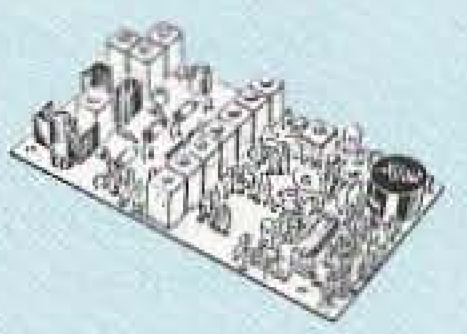


Encodes all standard subaudible tones with crystal accuracy and convenient DIP switch selection. Comprehensive manual also shows how you can set up a front panel switch to select between tones for several repeaters. Receiver **decoder** can be used to mute receive audio and is optimized for installation in repeaters to provide closed access. High pass filter gets rid of annoying buzz in receiver.

- **TD-5** CTCSS Encoder/Decoder Kit .... only $39
- **TD-5** CTCSS Encoder/Decoder Wired/tested $59

HIGH QUALITY VHF & UHF FM XMTR AND RCVR MODULES

FM EXCITERS: 2W output, continuous duty.

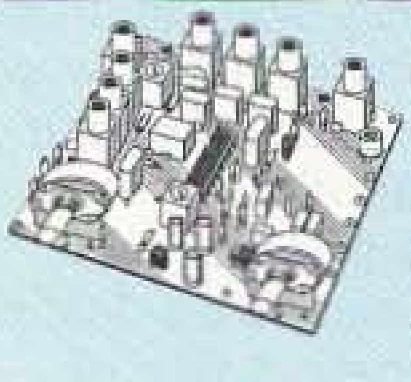


- **TA51:** for 6M, 2M, 220 MHz .. **kit $99, w/t $169.**
- **TA451:** for 420-475 MHz. .... **kit $99, w/t $169.**
- **TA901:** for 902-928 MHz, (0.5W **out**) .... **w/t $169.**

VHF & UHF POWER AMPLIFIERS.

Output levels from 10W to 100W **Starting at $99.**

FM RECEIVERS:



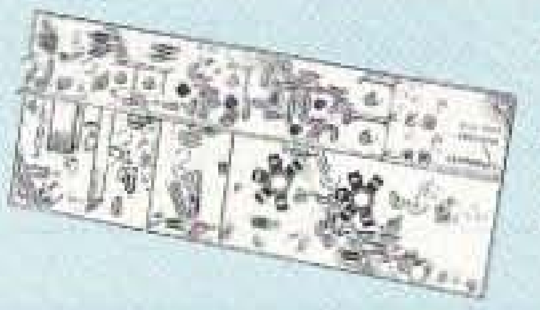
- **R100 VHF FM RECEIVERS** Very sensitive – 0.15µV. Superb selectivity – both crystal and ceramic IF filters, >100 dB down at ±12kHz, best available anywhere, flutter-proof squelch. For 46-54, 72-76, 140-175, or 216-225 MHz. .... **kit $129, w/t $189**
- **R144/R220 RCVRS.** Like R100, for 2M or 220 MHz, with helical resonator in front end..... **kit $159, w/t $219**
- **R451 FM RCVR,** for 420-475 MHz. Similar to R100 above. .... **kit $129, w/t $189**
- **R901 FM RCVR,** 902-928MHz .... **$159, w/t $219**

TRANSMITTING AND RECEIVING CONVERTERS

Go on a ham satellite adventure! Add another band for the next contest. Thrill in the excitement of building your own gear, and save a bundle.

No need to spend thousands on new transceivers for each band!

- Convert vhf and uhf signals to/from 10M.
- Even if you don't have a 10M rig, you can pick up very good used xmtrs & rcvrs for next to nothing.
- Receiving converters (shown above) available for various segments of 6M, 2M, 220, and 432 MHz.
- Kits from $49, wired/tested units only $99.

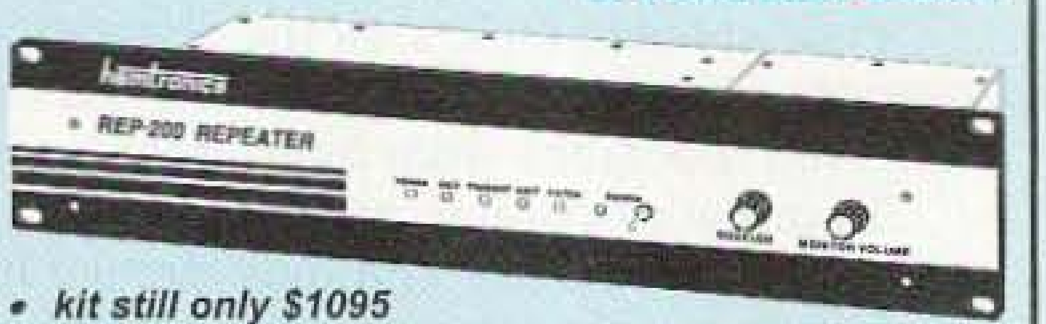


- Xmitting converters (at left) for 2M, 432 MHz.
- Kits only $89 vhf or $99 uhf.
- Power amplifiers up to 50W output.

Get more features for your dollar with our

REP-200 REPEATER

A microprocessor-controlled repeater with full autopatch and many versatile dtmf control features at less than you might pay for a bare-bones repeater or controller alone!



- ***kit still only $1095***
- ***factory assembled still only $1295***

50-54, 143-174, 213-233, 420-475 MHz. (902-928 MHz slightly higher.) **FCC type accepted** for commercial service in 150 & 450 MHz bands.

Digital Voice Recorder Option. 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!** .... only $100.

REP-200C Economy Repeater. Real-voice ID, no dtmf or autopatch. .... Kit only $795, w&t $1195.

REP-200N Repeater. Without controller so you can use your own. .... Kit only $695, w&t $995.

You'll KICK Yourself

If You Build a Repeater

Without Checking Out Our Catalog First!

Hamtronics has the world's most complete line of modules for making repeaters. In addition to exciters, pa's, and receivers, we offer the following controllers.

COR-3. Inexpensive, flexible COR module with timers, courtesy beep, audio mixer. .... **only $49/kit, $79 w/t**

CWID. Traditional diode matrix ID'er. .... **kit only $59**

CWID-2. Eprom-controlled ID'er. .. **only $54/kit, $79 w/t**

DVR-1. Record your own voice up to 20 sec. For voice id or playing club announcements. ...... **$59/kit, $99 w/t**

COR-4. Complete COR and CWID all on one board. ID in eprom. Low power CMOS. ...... **only $99/kit, $149 w/t**

COR-6. COR with real-voice id. Low power CMOS, non-volatile memory. .... **kit only $99, w/t only $149**

COR-5. µP controller with autopatch, reverse ap, phone remote control, lots of DTMF control functions, all on one board, as used in REP-200 Repeater. .... **$379 w/t**

AP-3. Repeater autopatch, reverse autopatch, phone line remote control. Use with TD-2. .... **kit $89**

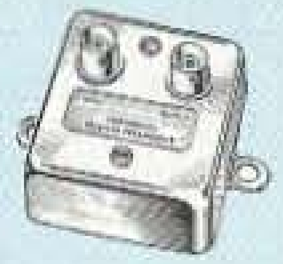
TD-2. Four-digit DTMF decoder/controller. Five latching on-off functions, toll call restrictor. .... **kit $79**

TD-4. DTMF controller as above except one on-off function and no toll call restrictor. Can also use for selective calling; mute speaker until someone pages you. .. **kit $49**

LOW NOISE RECEIVER PREAMPS

LNG-( ) G_AA_S FET PREAMPS

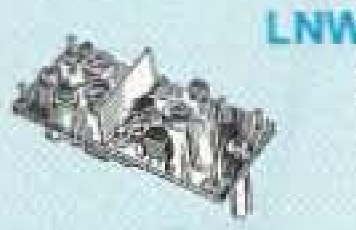
STILL ONLY $59!



- Make your friends sick with envy! Work stations they don't even know are there.
- Install one at the antenna and overcome coax losses.
- *Available for 28-30, 46-56, 137-152, 152-172, 210-230, 400-470, and 800-960 MHz bands.*

LNW-( ) ECONOMY PREAMPS

ONLY $29 kit, $44 wired/tested



- Miniature MOSFET Preamp
- Solder terminals allow easy connection inside radios.
- *Available for 25-35, 35-55, 55-90, 90-120, 120-150, 150-200, 200-270, and 400-500 MHz bands.*

- **Buy at low, factory-direct net prices and save!**
- **For complete info, call or write for free catalog.**
- **Order by mail, fax, or phone** (9-12 AM, 1-5 PM eastern time).
- **Min. $5 S&H charge** for first pound plus add'l weight & insurance.
- **Use VISA, Mastercard, Discover, check, or UPS C.O.D.**

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73® Amateur Radio Today

Including Ham Radio Fun!

OCTOBER 1996
ISSUE #433

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REVIEWS

DEPARTMENTS

HAM RADIO FUN SECTION

On the cover: VE6 Field Day: VE6LHW, VE6LGP, VE6BJE, VE6SKT and VE6RHS in action. Photo submitted by Earl Grotzki VE6ERL.

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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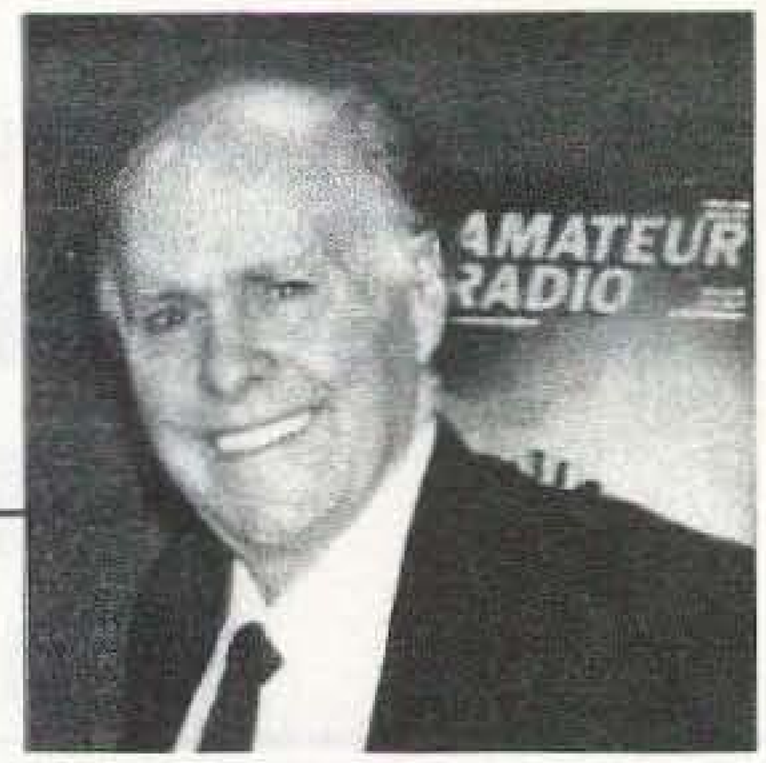
Contract: Upon reading this agreement, you have entered into a legally enforceable business arrangement whereby you WILL write a report on your latest ham gear and submit that manuscript for publication in *73*.

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1



Bioelectrifier Update

The May article by WA8YKN has generated a good deal of controversy. FAR Circuits is making a circuit board for the unit and has been doing a brisk business. One chap in Hollywood with a number of friends with AIDS bought a bunch of boards and put them together for his friends.

In another couple of months I hope we'll have laboratory-confirmed AIDS cures to report. One fellow, who was in bad shape with AIDS, used the unit for several weeks, then called Mike (who makes the units commercially) to say he had astounded his doctor by rebuilding his T-cell count. Another chap had a mother who was all bent over with Lyme disease. Two weeks later she was in excellent health and walking straight. But these, and a bunch more, are just anecdotes. I want to see carefully done lab reports of before and after. If this is the placebo effect, it sure seems to be powerful.

Mike reported one other effect. The unit apparently raises the temperature of the blood, which may also help to discourage viruses, as well as the 50 µA hotfoot.

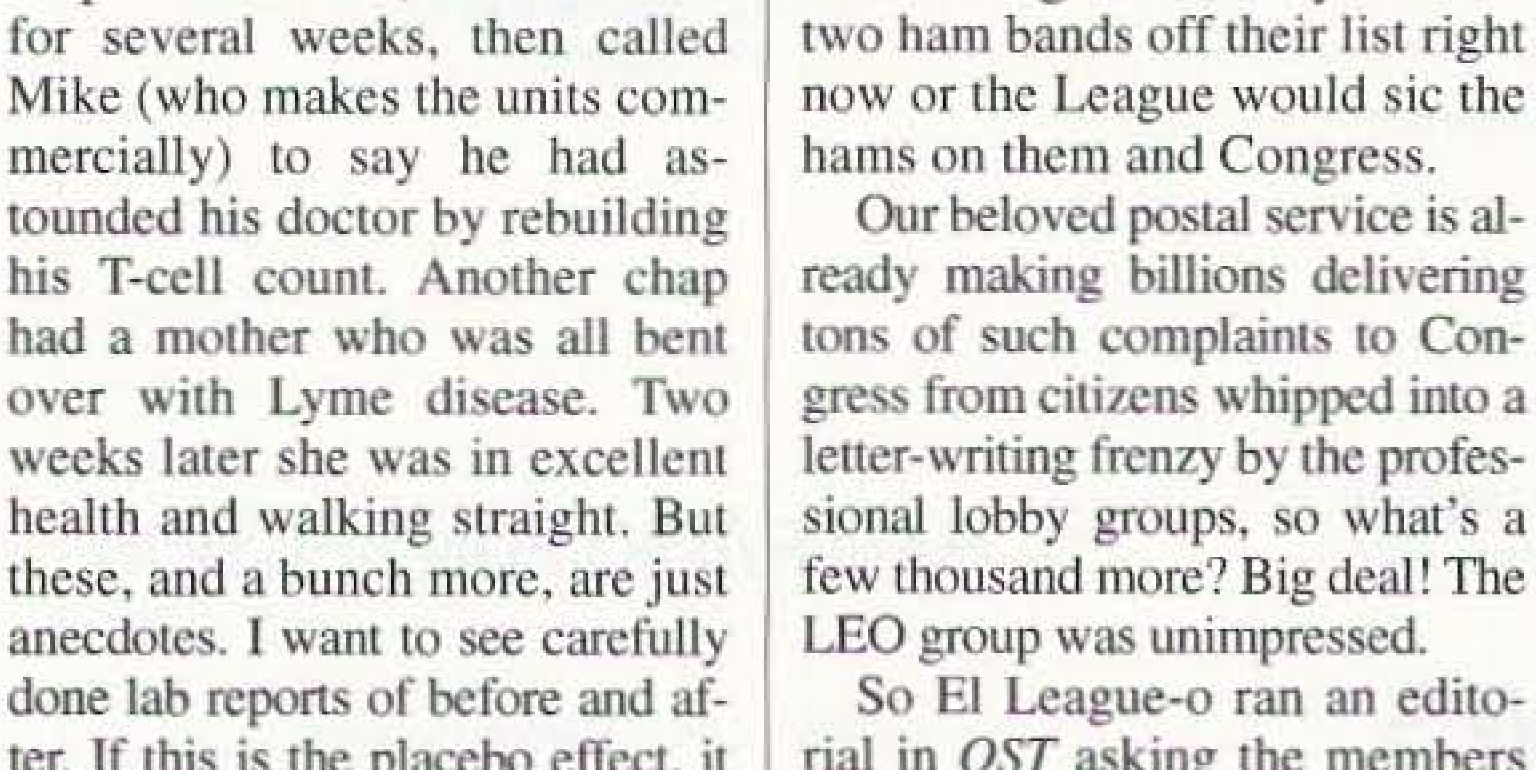
Mike sent me a copy of his Bob Beck-approved circuit, which is a little different from the Miller circuit in the May issue. Let me know if you're interested in my publishing it.

Diplomacy

Details are seeping out of the meeting between the League and the representatives of the group asking that the ham 144 and 450 bands be re-allocated for low Earth orbit (LEO) satellite communications. The League team went into the meeting angry as hell over the audacity of a commercial group even suggesting such a thing. Either they take the two ham bands off their list right now or the League would sic the hams on them and Congress.

Our beloved postal service is already making billions delivering tons of such complaints to Congress from citizens whipped into a letter-writing frenzy by the professional lobby groups, so what's a few thousand more? Big deal! The LEO group was unimpressed.

So El League-o ran an editorial in *QST* asking the members to flood the LEO group, the FCC and Congress with mail. This was repeated in hundreds of obedient club newsletters, with apparently no one involved giving any thought to the ramifications. Well, people often do really stupid things when they get mad, and the Leagsters were not just mad, they were outraged.



The predictable happened. The LEO group was not only not intimidated by the mail, they got mad and their interest in a diplomatic solution to the problem blew away as the war escalated.

The League initiated a war. An unnecessary war. Worse, they did it without any real ammunition. The League seems to have forgotten that amateur radio, for all the "service" rhetoric in the FCC rules, is a hobby, pure and simple. Oh sure, within my memory amateur radio contributed to the advance of communications technology, and helped save our country's collective ass in WWII by supplying some 40,000 hams for the military. But on a "what have you done for us lately" basis, we are running on empty.

Of course if you count providing communications for walkathons as public service, then we get a few Brownie points. Let me ask a question. How many of you even know a ham who has provided a valuable emergency service in the last five years? I doubt that 1% of us has provided a truly valuable public service in years.

The courts, by the way, have rejected our claim of being a service and have ruled that amateur radio is a hobby. Well, our courts aren't always wrong.

From the FCC's viewpoint we're a whole lot of trouble and expense, with few redeeming qualities. And please remember that like most of us, gratitude is one of the FCC Commissioner's least-felt emotions. So the marvelous things we were doing before the League's even less-thought-out "Incentive Licensing" debacle of 30 years ago gutted the hobby (and the industry), are no longer even talking points, much less ammunition for a war with commercial interests.

If the League officers and directors would get over their unfounded feelings of self-importance and recognize that the reality is that they are the publishers of a ham magazine devoted to a hobby which is of interest primarily to elderly white men, they might be in a better position to deal with what is obviously going to be a flood of seekers after our bands.

Sure, there are things the League could do which could rebuild the value of amateur radio as a true service, and I've discussed these in my editorials. But I haven't seen even a hint that the League (aka *QST*) is open to making any changes which would help our (and their) future.

Old QSLs

While looking through some boxes in the barn I came across a carton of old QSLs. Ah, memories. I'll never forget the morning in 1947 when I heard a faint signal in the 20m DX band calling CQ. I heard "W...portable...." I couldn't make out the call or where he was portable so I called "W question, portable question" a couple of times and stood by. His signal gradually got better and I found I was in contact with W7IMW/C7 in Tientsin, China. Wow! Bill was modulating a 10th-watt signal generator and using a longwire. AM, of course. His penny postcard arrived via an FPO in China. My signal with a kW was only S-5, so you can imagine how weak his was. Talk about QRP!

The PK1AW card isn't very remarkable except that I made the contact as a result of a CQ call for Asia. I'd just finished a round table where we had stations on five continents. I needed that sixth for a 20-minute WAC, so I called CQ Asia and back came PK1AW. A small coup, but memorable.

I also ran across some cards left over from my operating on Fiji, Tahiti, and the Samoan Islands. No, I won't forget one minute of those DX operations.

If I'd Only Known Then What I Know Now!

You *would* have known then—if you'd read my editorials. So I don't want to hear you whining when you have a heart attack, a stroke, or I visit you when you're tied to a rocking chair in a nursing home (like they did to my mother). But no,

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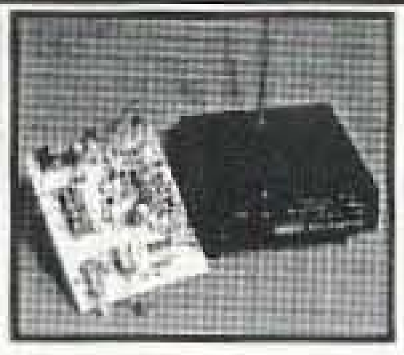
Synthesized FM Stereo Transmitter



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

FM-25, Synthesized FM Stereo Transmitter Kit........$129.95

Tunable FM Stereo Transmitter

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

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

RF Power Booster Amplifier

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

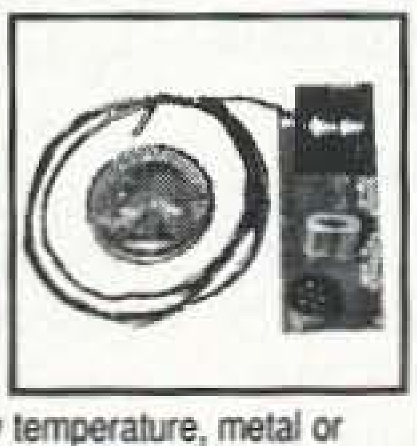
LPA-1, Power Booster Amplifier Kit..................$39.95
CLPA, Matching Case Set for LPA-1 Kit...............$14.95
LPA-1WT, Fully Wired LPA-1 with Case...............$99.95

Micro FM Wireless Mike

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

FM-5 Micro FM Wireless Mike Kit....................$19.95

Crystal Controlled Wireless Mike



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

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

Call for our Free Catalog !

RAMSEY

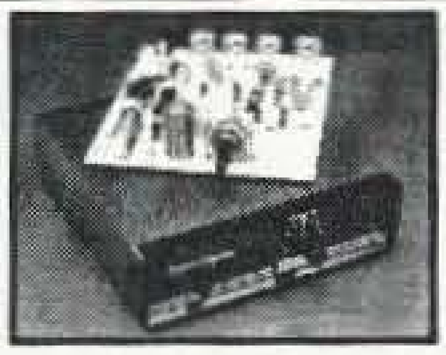
Super Pro FM Stereo Radio Transmitter

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

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

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

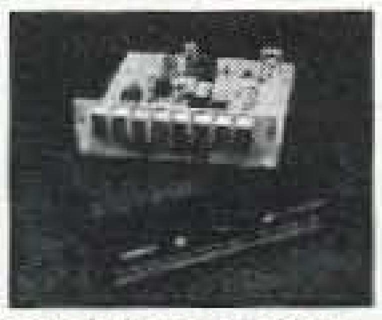
Speech Descrambler Scrambler



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

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

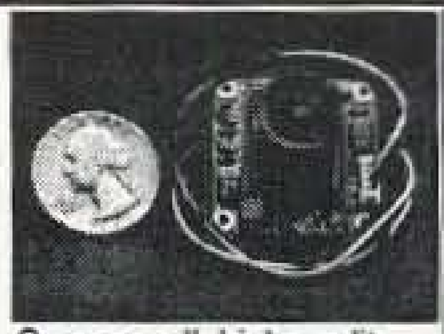
Tone-Grabber Touch Tone Decoder / Reader



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

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

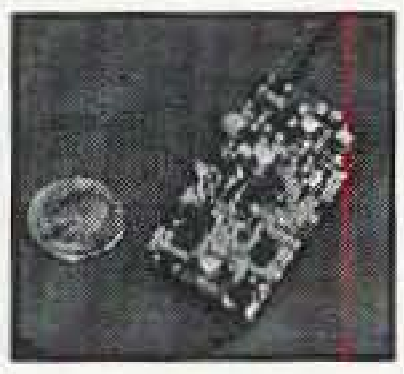
Mini-Peeper Micro Video Camera



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

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

MicroStation Synthesized UHF TV Transmitter



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

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

RAMSEY ELECTRONICS, INC.
793 Canning Parkway
Victor, NY 14564

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Sorry, no tech info or order status at this number

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ORDERING INFO: Satisfaction Guaranteed. Examine for 10 days, if not pleased, return in original form for refund. Add $4.95 for shipping, handling and insurance. Orders under $20, add $3.00. NY residents add 7% sales tax. Sorry, no CODs. Foreign orders, add 20% for surface mail or use credit card and specify shipping method.

LETTERS

Number 6 on your Feedback card

From the Ham Shack

Mike Woolard KE4MTM/DA4WM. I must say that I look forward to getting your magazine in the mail every month, second only to my paycheck. After reading your "Welcome Newcomers" column in January, I'm sure that the majority of the Techs shown in your graph felt put down! Please stop calling us CBers. We have as much ambition, interest, and learning ability as the next guy. I am now in my 40s, and a respectable GS-12 with the government as an Equipment Specialist. While I respect the skill and talent required in both golf and code, and see the enjoyment offered in both, for me and others they're about as interesting as watching mud dry! Don't take me wrong, I'm not knocking either one, they're just not appealing to everyone. Back in 1976 I got sick of CB but interested in electronics. I bought a used ham rig, book, code tape, and went for it. In a short time I was ready to ace the written test, but I had trouble with the code. Eventually I sold everything. In 1990 I heard that the code requirement had been dropped for the Tech license and there was a world of things I could get into—like packet, satellites, etc. In 1991 I took my no-code Tech exam in Savannah. My son (then 15) followed suit, prompting my wife to get her license as well. Meanwhile, I practiced the code, passed my written General exam, practiced the code, learned my Advanced material, and practiced the code! I know every square inch of the 10 wpm wall. Perhaps my trouble is ... I never intend to use code. I don't know; it's just a means to an end for me, and a silly one. Now I'm in Vilseck, Germany, and work right across from the MARS station, where I thought I would find a few hams. These young men do everything: packet, satellites, HF, digi-pictures, and have some real nice equipment. Yet, I haven't met one person there so far who knows code or what the ARRL is! I want to learn theory, application, fundamentals, and the like, not the code! I am never going to walk around with a key in my pocket, or report an accident with a key. With so much to learn, I prefer to use my time learning theory, thank you. I still enjoy turning on my Yaesu on 20m to listen, and would enjoy getting on if I could.

Two points, Mike. One, as I explained in my editorial, the license statistics tell us loud and clear that no-code Techs are not upgrading. There has been an enormous growth in the Tech ranks, and no change in the General growth. Second, if you have reached a code plateau that's proof positive that you have not been paying any attention to my editorials. With my code learning system there is no wall, no plateau. You and tens of thousands of Techs are being frustrated by trying to learn code the ARRL way (and most other code courses too), where you start slow and gradually speed up. That is a terrible way to try and learn the code. In a few hours, almost anyone can copy code at 20 wpm. Forcing you to learn the code is the ham radio form of hazing, like being paddled to join a college fraternity. And, for many, it's almost as painful ... Wayne.

Peter Bergman NØBLX. Thanks for the tip about cayenne pepper. I don't know what else it does for me, but it sure helps with my sinus problems.

I'm getting tired of the whining about the code. Like you've said many times, it isn't that tough to learn if you really want to. Unlike theory, code classes can coach you, but you have to learn it yourself. My biggest thing right now is coaching my six-year-old daughter for the Novice ticket. She nearly made the written on her first try! As a result, two of my junior ops and my XYL are working on it.

Have you read Temple's *Sirius Mystery*? It's the most scholarly book I've seen in the anomalous knowledge field.

Yes, I have the Temple book. I've also seen a couple of excellent TV reports on this incredible report on extraterrestrial contact. I may add this to my list of books you're crazy if you don't read. This is part of my fairly fruitless effort to get people to become better educated ... Wayne.

Roy Pollitt KD4HC. Wayne, your editorial in the August issue was dead-on and highly appropriate for amateur radio circa 1996. The Atlanta Hamfest, from what you described, sounds like just another proof of the impending demise of our hobby. The signs are all around: (1) No real participation or interest by anyone under the age of 30. (2) No activity on the non-phone portion of the low bands (160m through 40 m), 75% of the 24-hour day. (3) Club activity in most areas is either dull or non-existent. (4) Cliques and good-ol'-boy networks on VHF-FM. (5) The cancellation of the Novice Roundup due to a lack of interest. (6) The transformation of ham radio into CB.

I have not attended a hamfest since 1992 because I've heard nothing but complaints about hamfests from other hams since 1985, and the complaints keep getting stronger and more detailed. Why should I drive miles and spend money on a motel room, only to find a hamfest similar to the one you described in Atlanta? Ham radio community, wake up—the end is near, unless we do something to turn the situation around.

Some suggestions: Make sure your local and school libraries are well stocked with ham magazines and books (a good club project). Find an active local club and join it. If there isn't any, start one. Get on the air and do something more than rag-chew. Start sending QSLs for your new contacts. And join the ARRL. Sure, the League has done some stupid things, but how can you influence them if you are on the outside looking in? Join and make your viewpoints heard.

Those are some good ideas for attracting newcomers, but that isn't going to make hamfests more fun. Hamfest committees are running on empty when it comes to ideas, despite my many suggestions in past editorials. Hamfests have hardly changed since my first hamfest in 1938. One more thing: In the almost 60 years I've been an ARRL member I can't recall a time when the members were paid any attention. Most of the ARRL directors I've known have held the members in contempt as sheep. You have a lot more clout as a prospective member they have to woo. Once they have your money, you've lost your clout (voice). Please remember that the ARRL is primarily a multimillion-dollar publishing business ... Wayne.

Mike Grimes K5MLG. It is rare that an author can write about complex concepts using simple, understandable terms and be interesting without talking down to the reader. Such is the case with Peter Stark and his series of articles, "Communications Simplified."

I would like you to know how much I am enjoying the series and his approach. I have covered the literature for many years, and even though I am not a beginner, this series has been one of the best and well-written I have ever encountered. The illustrations and analogies support the ideas extremely well; and, although I know the subject, it held my attention, was not boring, and expanded my understanding. He must be an excellent teacher at the community college!

Thanks for an interesting set of articles. I hope there will be more.

Robert White DDS I read the "Bioelectrofier" article, which one of my referral patients brought to me, with great interest. He was referred by Paul Keys DDS, who is undoubtedly the world's foremost infectious disease expert in the dental field. Unfortunately, tooth decay and gum diseases have been treated, and continue to be treated, primarily as non-infectious diseases. In other words, dentistry targets fixing the damage, not finding the causes, which are specific microbes, fungi, protozoans ... maybe even viruses. I'd like to get a Bioelectrofier so I can begin to further my research with electrical current therapy. 73

QRX . . .

Number 8 on your Feedback card

Toby Metz KB7UIM named 1996 "Young Ham of the Year"

(Saugus CA) Toby Metz, a 16-year-old amateur radio operator from Meridian, Idaho and Agoura Hills, California, has been named the 1996 "Young Ham of the Year," according to Award Administrator Bill Pasternak WA6ITF. The award is jointly sponsored by Pasternak's Saugus, California-based *Amateur Radio Newsline*, Yaesu USA Corporation of Cerritos, California, and *CQ* Magazine of Hicksville, New York.

Metz, whose ham radio callsign is KB7UIM, recently moved to California from Idaho. He was selected based on his work with introducing amateur radio to the deaf in the community of Boise, Idaho. Toby explained that his involvement with the deaf came as the result of a scouting project that quickly became a public service.

"I knew I needed an Eagle project, so I began brainstorming with my friend Rich Dees (AA7WG) on how I could bring the handicapped into this picture while also using ham radio. We began talking about the possible ways that the deaf might use ham radio and realized that it would be natural for them to use packet radio."

Toby decided to start a ham radio training class for the deaf. He enlisted the help of a woman from his church who worked with deaf people in Boise. Through Toby's perseverance and her assistance, a small but enthusiastic training class came into being. Metz says that it was a class that quickly grew.

"We started off with three people but the class became larger when family members decided to come as well...(one student) even learned code using a device that converts sound to vibration that you can feel with your fingers."

Toby Metz's Eagle Scout project drew praise from the handicapped community in Boise. It also brought Toby to national prominence when he was asked to write up the project for last November's *73* magazine.

In addition to his work with the deaf, Toby assisted in the creation of a Ham Radio Explorer Scout Post in Meridian Idaho and spent over a year hosting an on-air discussion group known as the "Discovery Net." Toby presided over this gathering until a few nights before he departed Idaho late this spring. At its peak, Toby's "Discovery Net" had almost three dozen ham radio operators taking part.

New to southern California, and now a student at Agoura Hills High School, Toby says that two of his priorities are joining another ham radio club similar to the one he enjoyed in Boise and to become an Explorer Scout.

"Now I am interested in the adventure aspect [of scouting]. I want to do high-adventure camping, 50-mile hikes, rafting, and those kinds of things."

Toby Metz was nominated by Rich Dees (AA7WG) of Meridian, Idaho. Dees, who helped bring Toby into the exciting world of Amateur Radio, describes his young protégé as a born leader.

"Toby Metz KB7UIM epitomizes what young folks need to be like today. He is a hardworking young man and one of his goals is to make a difference. He took on a project aimed at making a difference [in these peoples' lives] and he did," says Dees.

Dees adds that Toby continues to want to make a difference in the world: "... and I think that young people need that as a role model."

Metz will receive his award on August 17th at the Huntsville (AL) Hamfest Grand Banquet. The presentation of the award as a regular feature of this prestigious amateur radio convention has been made possible through the generosity and kindness of the Huntsville Hamfest Planning Committee and its chairman, Scotty Neustadter N4PYD.

Making the presentation will be *Newsline* producer Bill Pasternak WA6ITF and Judging Committee chairman Larry Zettwoch KR4IF, along with representatives of Yaesu USA Corporation and *CQ Magazine*. These two companies are the corporate underwriters of the "Young Ham of the Year" award. They will be joined by three former award winners; Kevin Boudreaux N5XMH (1993), Allison Zettwoch KD4CKP (1994), and Adam Weyhaupt N9MEZ (1995).

As "Young Ham of the Year," Metz will receive (courtesy of Yaesu USA) an expense-paid trip to the 1996 Huntsville Hamfest along with a gift of Yaesu ham radio equipment. *CQ Magazine* will treat Toby to a week at Spacecamp-Huntsville, and will present him with a variety of *CQ* products. *Newsline* will provide Adam with a commemorative plaque at the award ceremony.

Both corporate underwriters of the "*Newsline* Young Ham of the Year Award" are world leaders in their respective areas of amateur radio product support. Yaesu U.S.A. Corporation is a trailblazer in the design, manufacture and distribution of high quality amateur and commercial two-way radio equipment. *CQ Magazine* is published by CQ Communications, Inc.

On learning of the selection of Toby Metz as this year's winner, Kevin Karamanos WD6DIH, Yaesu's Amateur Radio National Sales Manager, released a statement congratulating him.

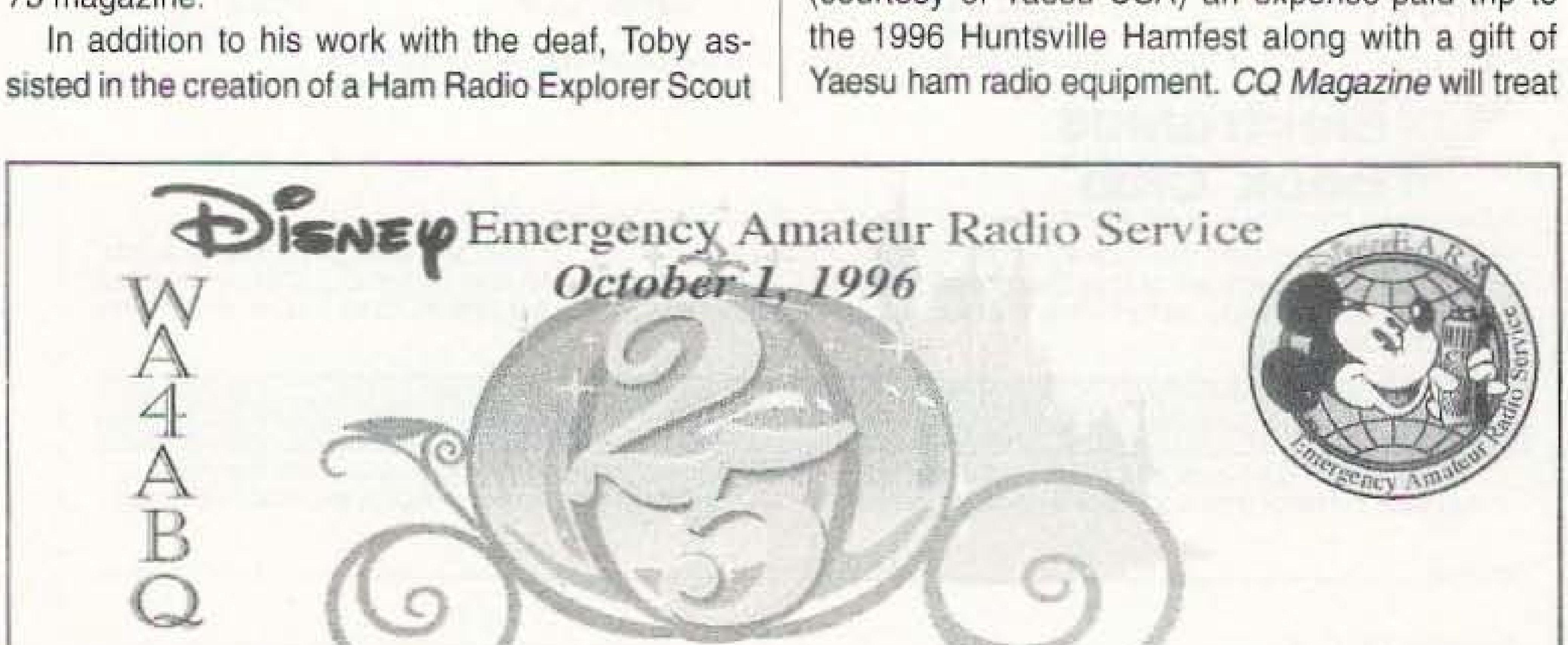
Karamanos said: "Yaesu is pleased to see so many fine young people nominated for this award and who have become so deeply involved with Amateur Radio. This is the primary reason that we support this award program. To us, Toby Metz is an excellent example of today's American youth and we join with all of the nation's radio amateurs, young and old, in commending him on his great public service and other achievements at such a young age."

CQ Publisher Richard Ross K2MGA agreed with nominator Rich Dees that Toby sets a good example for American youth: "Any time you worry about the youth of this country, and the kids with problems who are so often in the news," Ross commented, "you can look at kids like Toby and take heart. The kids in trouble are not typical. And while Toby is not typical, either, you realize that there are many more young people out there who are like Toby than those who are like the kids in trouble. They are tomorrow's mainstream and tomorrow's leaders."

The Amateur Radio Newsline is the premiere on-the-air news and information service to the worldwide ham radio community. The *Newsline* "Young Ham of the Year" award program, (formerly the *Westlink Report* "Young Ham of the Year") now entering its second decade, is presented annually to a licensed radio amateur who is 18 years of age or younger and who has provided outstanding service to the nation, his community or the betterment of the state of the art in communications through the amateur radio hobby/service.

Past recipients of the "Young Ham" award include Shawn Alan Wakefield WK5P, of Bartlesville, Oklahoma (1986); David Rosenman KA9PMK, of Muncie, Indiana (1987); Jonathan Binstock NK3D, of Potomac, Maryland (1988); Erin McGinnis KAØWTE, of Topeka, Kansas (1989); Mary Alestra KB2IGG, of Staten Island, New York (1990); Richard S. "Sammy" Garrett AAØCR, of St. Louis, Missouri (1991); and Angela "Angie" Fischer KBØHXY, also of St. Louis (1992); Kevin Boudreaux N5XMH, of New Orleans, Louisiana (1993); Allison Daneen Zettwoch KD4CKP, of Louisville, Kentucky (1994); and Adam Weyhaupt N9MEZ of Alton, Illinois(1995).

TNX to Bill Pasternak WA6ITF.



Isn't that just the DEARest thing?

D.E.A.R.S., Disney Emergency Amateur Radio Service, marks its 25th anniversary of public service this year. Does everybody have to transmit using the Mickey voice?

Ultimate Power!

Station power from a dead UPS.

Paul Blum KF9GQ
1138 Cardinal Lane
Green Bay WI 54313

One of the main reasons I became a ham is that I love to build elec tronic gadgets. This hobby gives me plenty of excuses to build things to better equip my station. Sometimes the gadgets I build actually work, and occasionally I build something that turns out better than "store-bought."

Recently I was offered a broken UPS (Uninterruptible Power Supply) for the right price (free). I gladly took it, thinking of salvaging some parts and that maybe the gel cells were OK (a free battery for my QRP rig!).

The unit sat around collecting dust for a while, until one day as I was cleaning up the shop I noticed it and decided to pop the cover off. There is quite a collection of parts to scavenge inside one of these, and I especially noticed a stout power transformer, and numerous power transistors mounted on heat sinks. There were also four 6-volt gel cells in good shape (yes!).

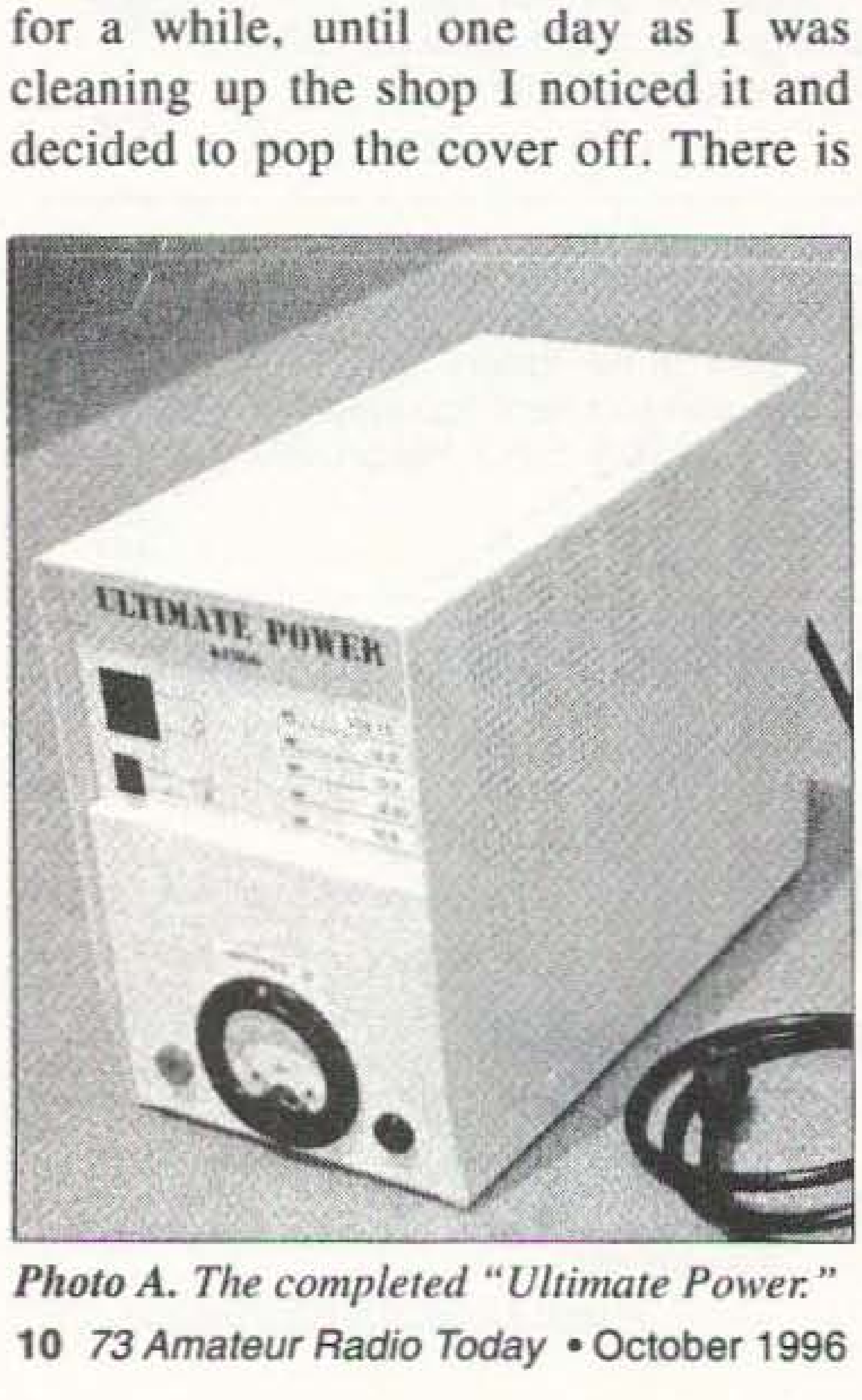


Photo A. The completed "Ultimate Power."

"The crowbar can save any equipment hooked up from destruction–especially your expensive radios!"

Inside the UPS

For those unfamiliar with UPS units, they are used to power critical electronics devices with 120-volt AC. If the commercial power fails, the UPS will provide power from batteries almost instantaneously. Usually they are used to provide short-term power for computers, providing power during an outage long enough for the computer to do a "clean" shutdown. This prevents "crashes" and data loss. Uninterruptible Power Supplies come in many sizes and shapes, depending upon current duty and battery size. Electronically, a UPS consists of a battery bank, a DC-to-AC inverter, and the sensing/switching circuitry. Some also "condition" the AC power, removing noise and RF, and also provide surge protection.

I looked up the numbers on the power transistors and found out they were N-channel power MOSFETs, with very good current handling specs. These transistors can be very useful, as they are high gain, low "on" resistance (less than 0.5 ohms), and you can parallel them directly without bulky current-balancing resistors. It turned out I had 16 of all the same type, already mounted on heat sinks.

I was intrigued by the large power transformer. In theory, the UPS takes low-voltage, high-current DC, switches it on and off to drive the transformer primary, and the secondary produces 120-volt AC. I wondered what voltage I would get if I reversed the transformer and powered it with 120-volt AC, so I tried it and got 14 volts AC (rms)! From the size of the secondary winding conductors I could see it would handle a lot of current.

A good estimate of the power handling capability of a power transformer can be found in the power supply chapter of the *ARRL Handbook*. Measure the central core of the transformer with a ruler and refer to the chart, which will give you a watt rating for the transformer.

MFJ ACCESSORIES

Compact Speaker/Mics

Here's a **Compact** *Speaker/Mic that fits comfortably in your hand and has a* **full** *size speaker for crystal clear audio.*

No need to remove your handheld from your belt to talk or monitor calls. Clip it near your ears so you can easily hear every call with the volume turned down.

First-rate electret mic element and full size speaker gives superb audio on transmit *and* recieve. Earphone jack, PTT, lightweight retractable cord. Gray. 1¼x2x3 in.

MFJ-284 fits Icom, Yaesu, Radio Shack, Standard; **MFJ-286** fits Kenwood.

MFJ-284 or MFJ-286 **$24.95**

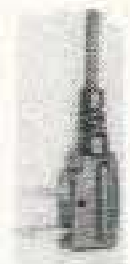
Mini Speaker/Mics

These **tiny** *MFJ Speaker/Mics are so small and so lightweight you'll forget they're there -- until you get a call.*

Excellent audio from electret mic element and speaker. Has swiveling lapel /pocket clip, PTT button with transmit LED, earphone jack, lightweight retractable cord. Available with L or regular connector. *Tiny* 2x1¼x¼ in.

Order MFJ-285/MFJ-285L for ICOM, Yaesu, Alinco, Radio Shack and Standard; **MFJ-287/MFJ-287L** for Kenwood; **MFJ-283** for split plug Alinco; **MFJ-285W** for IC-W2A.

MFJ-283, MFJ-285, MFJ-285L, MFJ-285W, MFJ-287 or MFJ-287L **$24.95**



L Connector also available - order L model.

MFJ Artificial RF Ground

MFJ-931 **$79.95**

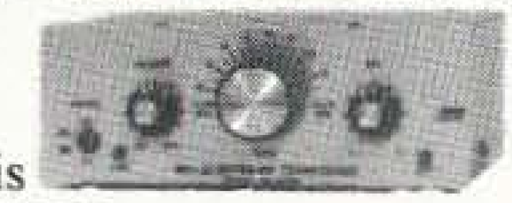
Creates artifical RF ground that eliminates or reduces RF hot spots, RF feedback, TVI/RFI, weak signals caused by poor RF grounding.

Greatly improves your signal if you're using a random wire or longwire antenna with an ineffective ground.

Electrically places a far away RF ground directly at your rig by tuning out reactance of connecting wire.

20 Meter CW Transceiver

MFJ-9020 **$189.95**



Throw this *tiny* MFJ 20 Meter CW Transceiver in a corner of your briefcase and enjoy DXing and ragchewing wherever you go. You get a high performance superhet receiver, crystal filter, RIT, AGC, vernier tuning, sidetone, speaker, up to 5 watts output, semi/full break-in, much more. *Free* manual. See *free* MFJ catalog for 40, 30, 17, 15 Meter versions, keyer, audio filter, power pack, tuner, antennas.

Super Active Antenna

"World Radio TV Handbook" says MFJ-1024 is a "first rate easy-to- operate active antenna...quiet...excellent dynamic range...good gain... low noise...broad frequency coverage... excellent choice."

Mount it outdoors away from electrical noise for maximum signal, minimum noise. Covers 50 KHz - 30 MHz.

Receives strong, clear signals from all over the world. 20 dB attenuator, gain control, ON LED. Switch two receivers and aux. or active antenna. 6x3x5 in. Remote has 54 inch whip, 50 ft. coax. 3x2x4 in. 12 VDC or 110 VAC with MFJ-1312, $12.95.

$129.95 MFJ-1024

Cross-Needle SWR Meter

MFJ-815B **$69.95**

Peak/ average Cross-Needle SWR/ Wattmeter. Shows SWR, forward/ reflected power in 2000/500 & 200/50 watt ranges. 1.8-60 MHz.

Mechanical zero. SO-239 connectors. Lamp uses 12 VDC or 110 VAC with MFJ-1312, $12.95.

"Teflon® is a registered trademark of Dupont"

MFJ Coax Antenna Switches

$39.95 MFJ-1701

$21.95 MFJ-1702B

$59.95 MFJ-1704

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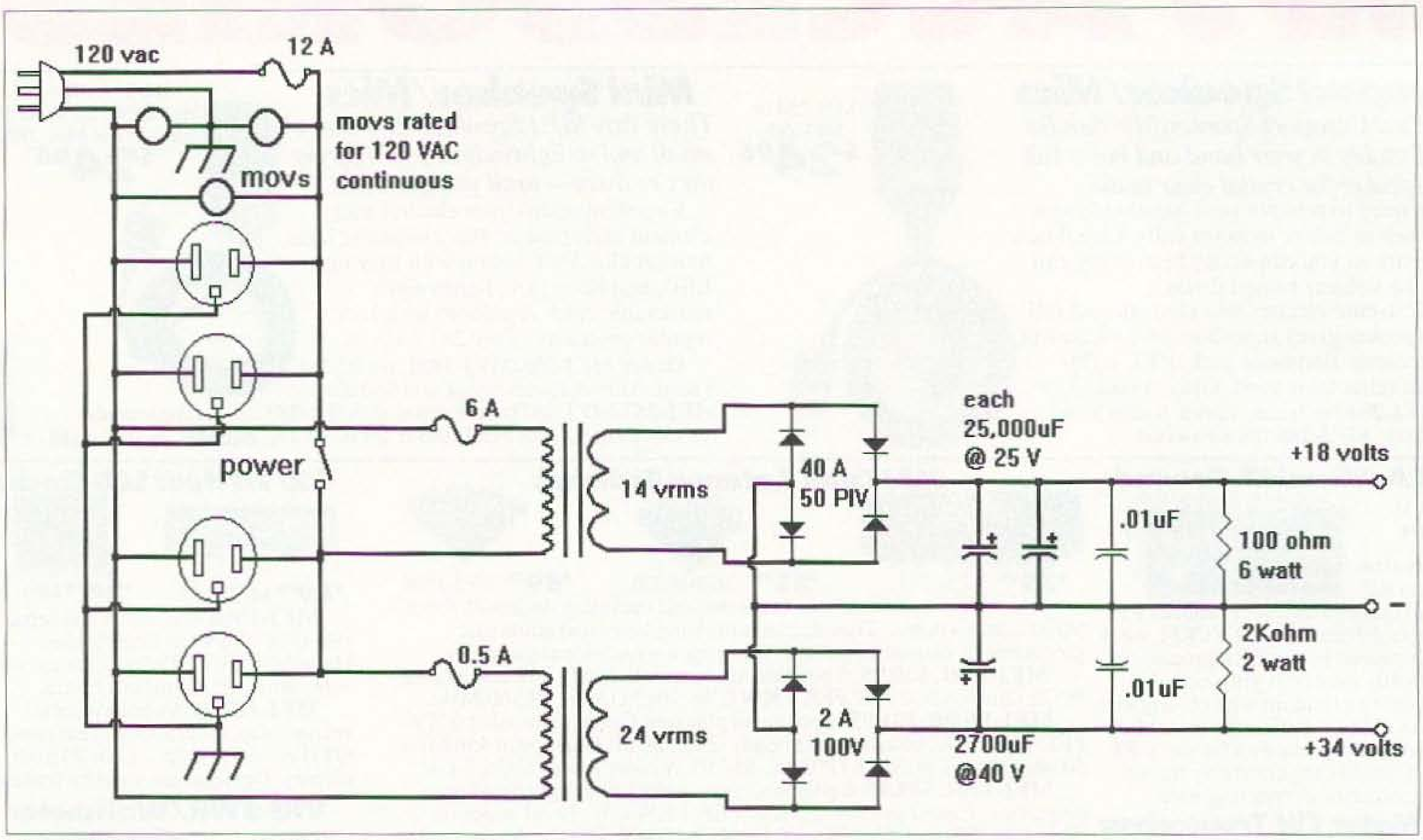


Fig. 1. "Ultimate Power" AC distribution/rectifier schematic.

Building the power supply

A UPS unit provides many of the components necessary to build a station power supply, all in one box. First, there is the box itself. If you've drooled over any parts catalogs lately, you know that a nice cabinet is expensive. Next is the power transformer, another expensive, hard-to-find item. Inside, there's a good supply of power transistors, already mounted and heat-sinked. Lots of other miscellaneous parts can be used as well. I found diodes, filter capacitors, MOVs for lightning protection, and other goodies. Best of all, mounted on the rear of the cabinet are a string of AC outlets, so I set about building a "central power source" for my ham station, providing switched and unswitched AC, and 13.8 volts DC at 25 amperes.

I started with the 120 VAC side of the circuit, wiring some outlets "on" all the time and some switched. I added three MOVs across the AC input for surge protection. I fused the AC input and the two transformers separately for safety. After stripping the chassis of its dead "brain" board, I began the low-voltage circuitry. I fed the 14 VAC to a set of four 40 ampere stud mount diodes, mounted to the chassis sheet metal to dissipate heat. The diodes form a bridge rectifier, giving me 18.5 volts across the filter capacitors. I used some computer surplus filter caps; approximately 2000 µF per ampere is a good rule of thumb.

In designing the regulator, I came upon a dilemma. The MOSFET transistors would work excellently as pass devices to reduce the voltage to 13.8, but required +3 to +5 volts gate-source for turn-on. This meant that I couldn't use the same supply for the regulator drive. The other alternative is to use P-channel devices, but I had none. Luckily enough, there was another small transformer in the UPS used for charging the batteries and powering the "brain" board. It just happened to be a 24-volt transformer, so the small transformer powers the 723 regulator and the gates of the MOSFETs.

Referring to the regulator schematic, I used the ever-popular LM723 voltage regulator IC in a standard configuration. For best accuracy and minimum temperature drift, use precision 1% or 2% tolerance resistors for the sample voltage divider (the 680-ohm resistors). The high side of the divider should connect directly at the output connector, after any ammeter used, for best regulation. Use a good quality trimmer pot (250-ohm) and adjust for 13.8 volts. Make sure the pass transistors (the power MOSFETs) are adequately heat-sinked, as they may need to dissipate significant power, depending on the transformer you have. I bolted a chunk of fin stock to the UPS heat sink (heat-sink grease is a good idea) as extra insurance. Use heavy-gauge wire for high-current circuitry (#10 or #8 for 25 amperes), to and from the pass transistors and the negative return wiring.

The extras

One item that separates good power supplies from the cheapos is a crowbar circuit. I have been the unfortunate repairman of a repeater powered by a supply without one more than once, and it's definitely worth the few dollars as insurance. The crowbar circuit senses when the voltage goes too high (when you short out a pass transistor) and becomes a short circuit, blowing the fuse. The other cheap insurance policy, of course, is to have the proper size fuse! The crowbar can save any equipment hooked up from destruction—especially your expensive radios! Hook up the crowbar circuit across the +13.8-volt output of your supply.

Other accents you may add to this project are an ammeter and some method of indicating output voltage. You may prefer analog meters, or some sort of digital meter or bar graph (the 3914 bar graph IC comes to mind). That's the fun of building things yourself—being creative and original.

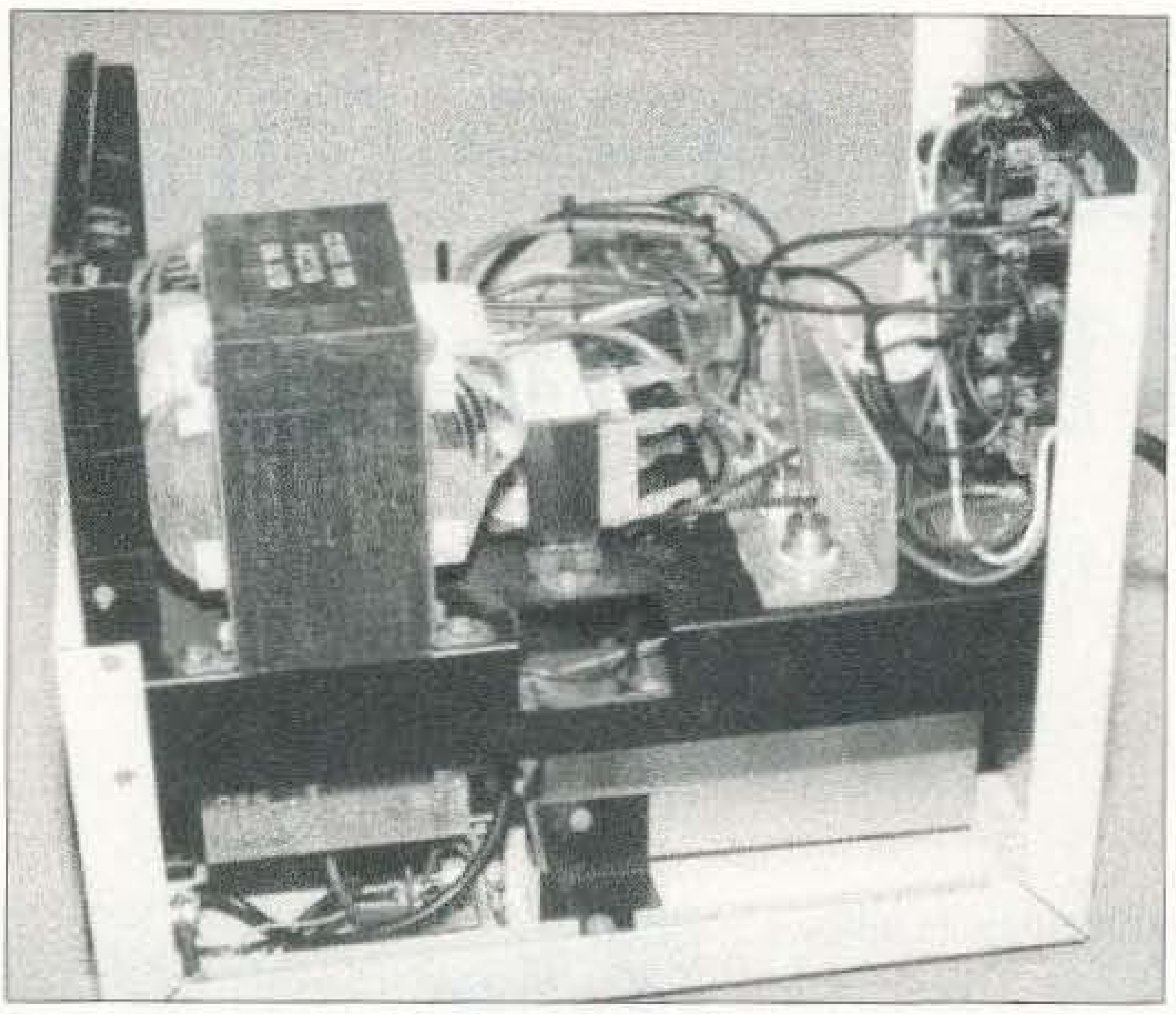


***Photo B.** Inside the "Ultimate Power."*

How does it work?

Well, by now you want to hear how it performs. I stress-tested the supply by powering my 100 watt 2 meter FM amplifier with it. From 0 to 23 amperes, I measured less than .05 volts change in output, and less than 10 mV of ripple. The heat sink became only slightly warm after three minutes keydown.

The AC outlets allow me to power other station goodies from the same box.

All in all, I am very pleased with the performance. Credit goes to my eight-year-old son, Jeffrey, for giving me the idea to name it "Ultimate Power."

So, keep your eyes open for surplus UPS units—hamfests, auctions, or your friendly neighborhood computer geek—don't pass up a real home-brewer's bargain!

NEVER SAY DIE

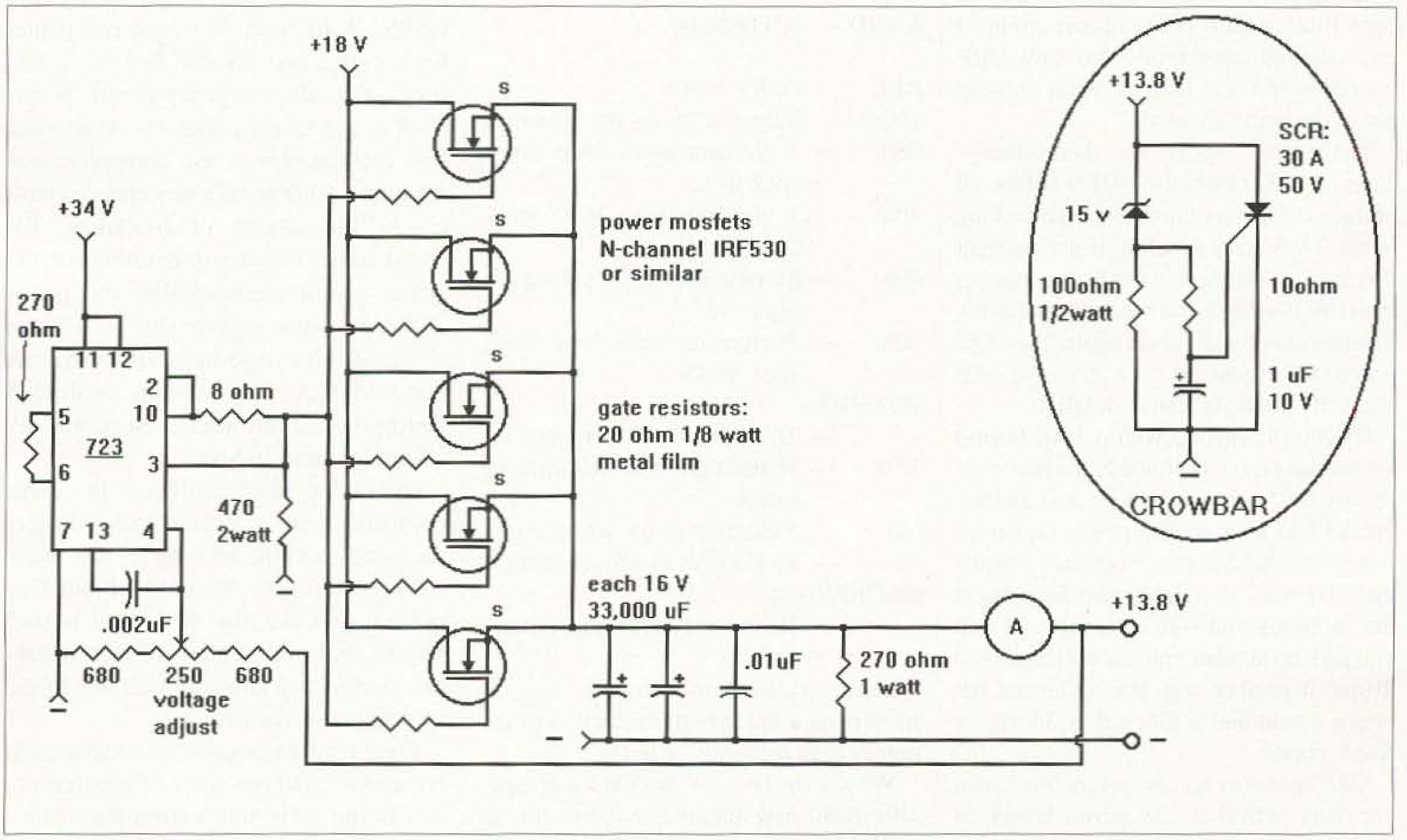
Continued from page 4

the stuff I sure wish I'd known years ago and am telling you about now is going in one eyeball and out the other, while you are foolishly depending on your doctor for your health as much as I was depending on mine. Well, the sad fact is that your doctor and mine don't know much about health. Doctors don't take any courses on health or its maintenance in medical school. Few are taught even one day about illness prevention or nutrition. The result is that doctors don't know a darned thing about health. They're taught how to make repairs when things finally break down and what sledge-hammer drugs to prescribe.

For instance, though it was considered totally crazy by the medical profession just a few years ago, now there's a grudging agreement that, yes, there's a (mumble) psychological component to every illness. But you aren't going to find any doctors anywhere who are making an effort to find these emotional triggers and treat them as well as the resulting physical symptoms. If it hurts, hey, take an aspirin, and never mind that the hurt is nature's warning signal that the body is in trouble. It's like the fuse in your rig. So, if the fuse blows, put in a bigger one, right?

Are you going to come bounding up to my table at the Dayton CompuVention in 2010, or will you be doddering with a walker to reminisce with me about how ham radio used to be before we lost our last two bands a couple years back?

Continued on page 49



Colorado QRP Club's Field Day Operation

Field Day the hard way.

Marshall Emm AAØXI
2460 S. Moline Way
Aurora CO 80014

Who says the bands are dead? We are at or near the absolute bottom of the barrel in terms of solar activity and, hence, HF propagation. The bands are dead, so this should be an extended period of thinking, and building, and saving dollars to buy kilowatts, right? Wrong! Once again the Colorado QRP Club* has proven that you can do with skill, persistence, and antennas what others do with power, even when the bands are "dead."

Field Day is a trial at the best of times, and the constraints on site preparation and the logistics of manning a club operation are a challenge, but operating QRP really separates the sheep from the goats. CQC (Colorado QRP Club) has a core local membership of experienced and talented operators, who saw QRP operation in Field Day as, well, nothing out of the ordinary at all.

The results speak for themselves—close to 1200 QSOs for 10,000 points, all of them at 5 watts or less, and high ranking in the 2A Battery division, if not outright dominance. The formal results are not yet in as this is written, but the QRP grapevine functions very well. Once again, the CQC proved that if you can do it at all, the odds are pretty good you can do it QRP.

Of course, anyone with a ham license knows that power is probably the least productive of the factors that go into a QSO. We all had to learn the power equations that prove the difference between 5 watts and 100 watts is roughly two S-points at the receiving end—go to a kilowatt and you pick up another one and half S-points! To put it another way, the difference between a watt and a kilowatt is 30 dB, or five S-points.

QRP operators are also aware that losses are more critical at low power levels, so there is a lot of concentration on antenna efficiency. It follows that a large part of CQC's Field Day effort centered around the antenna farm, and what an antenna farm it proved to be!

Photo A. The 60-foot tower, ready for launching. FD Chairman KF7MD, right background, looks a bit anxious. Photos by ABØCD.

Remember, we started "planting" our farm on Friday afternoon. Despite the traditional Field Day thunderstorm, we got our crop in and here's what we were ready to harvest when the starting gun went off:

BAND	ANTENNA
ALL	— G5RV @ 40'
160m	— Sloper at 55' on the 60' tower
80m	— 2 element delta loop array, apex @ 65'
40m	— 3 element delta loop array, apex @ 55'
40m	— Sloping dipole @ 60' on the high end
20m	— 3 element delta loop array apex @ 45'
20/15/10m	— Tribander @ 45' w/ rotator
15m	— Monobander @ 35' w/Armstrong rotator
6m	— 5 element @ 65' w/rotator
2m	— 11 element @ 65' w/rotator
6m/2m/70 cm	— Beams for packet and Novice stations

Three (count 'em!) towers, and for most of us a much better selection of antennas than we enjoy at home!

We set up two HF stations with specific band and antenna assignments, as well as a separate VHF/UHF/packet station, and, of course, our Novices set up their own station (including the G5RV at 40 feet). We used computers for logging, and decided that we would forgo the all-emergency-power bonus for the sake of data security—it was our first real attempt to use computers and we didn't want to take any chances with power fluctuations or blackouts. We could have rented a generator, but the noise would have spoiled the peace and quiet of a superb site on a ridge about 50 miles southeast of Denver. A hundred feet of extension cord to a nearby house allowed us to power the computers and lights.

Operators were assigned in teams comprising an operator and a logger for each station, and the teams were rostered to cover the entire Field Day period, and we also had "site hosts," gofers, and even a chef. In fact, breakfast on Sunday morning was one of the highlights of the event.

Field Day is always a test of adaptability, and we had our share of problems to fix. Being forty miles from the nearest parts store or home QTH forces one to be prepared, and to be flexible. There's always something you have to cobble together, and you tend to hear a lot of guys going around muttering, "It's not a contest. It's NOT a contest."

Operationally, everything went pretty much according to plan apart from an emergency rig replacement on Sunday morning. And I was a bit late for a 3 AM operating shift because a small-town policeman took exception to my velocity (but fortunately my ham license plates or my Field Day mission convinced him to write a warning rather than a ticket).

The delta loop arrays on 80, 40, and 20 were the real powerhouse antennas for HF, and we noticed an average 1-2 S-point improvement toward the east using the 3 element deltas. If you want to refer back to what I said about QRP power levels earlier, you'll see that switching antennas was as effective as going from 5 watts to 100! No activity was noted on 160m and very little on 10m CW, but for the most part we were as busy as the QRO stations.

Conditions? Well, "conditions" turned out to be pretty good, but I remain convinced that they depend as much on good antennas and operating skills as on solar phenomena. And it's surprising how often you can call CQ on a "dead band" and get an answer.

QRP operation does indeed engender skill, and knowing how to break a dogpile or the ability to copy a "1/1/9" signal can make a big difference. Probably the only significant operational difference is that it's often difficult to "hold" a frequency with a QRP signal, so we spent more time in search-and-pounce mode than calling CQ TEST. If we could hear them, we could work them. As usual, 20m phone was an alligator pit (all mouth and no ears).

It was definitely a successful Field Day, a real team effort and a credit to all who participated. But if there is one person who should be singled out, it's CQC's Field Day Chairman, Paul (KF7MD), who was responsible for planning and coordination, and kept it from falling apart. As we took down the towers on Sunday afternoon I saw him staring off into the distance and asked him what he was looking at. He replied, "I think we could run a V-beam down there next year!"

* For more information, drop us a line at: Colorado QRP Club, P.O. Box 371883, Denver CO 80237-1883. E-mail: CQC@aol.com (Subs: $10.00 US $12.00 foreign). 73

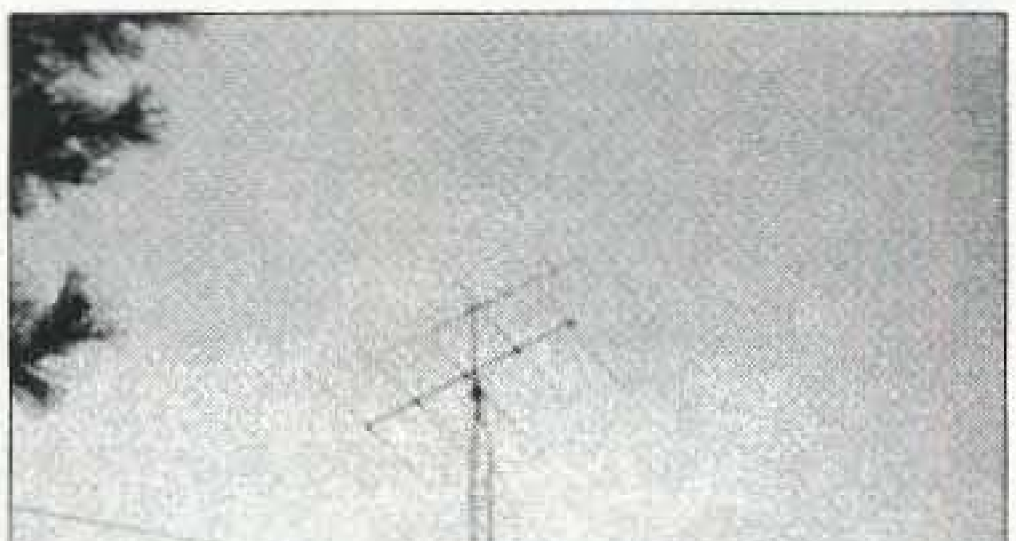


Photo B. "Now if we could just move this to my backyard on Monday...."

440 Yagi Link Antennas

Improve your repeater system by building new antennas for about $2 each!

Marty Gammel KAØNAN
1703 Hewitt Ave. West
St. Paul MN 55104-1128

Recently I was asked to make two pairs of link antennas for one of our local repeaters. The transmitter and receive sites were about three miles apart. The new receive sites were about eight and 10 miles from the transmitter, and only 3 watts of power was to be used between the links. (The old antennas had only three elements each, with a bad match.) Even white noise was present—not good for a repeater in the process of adding more receive sites, as well as a 6 meter input and output. So I had the task of coming up with better antennas to help improve the repeater system.

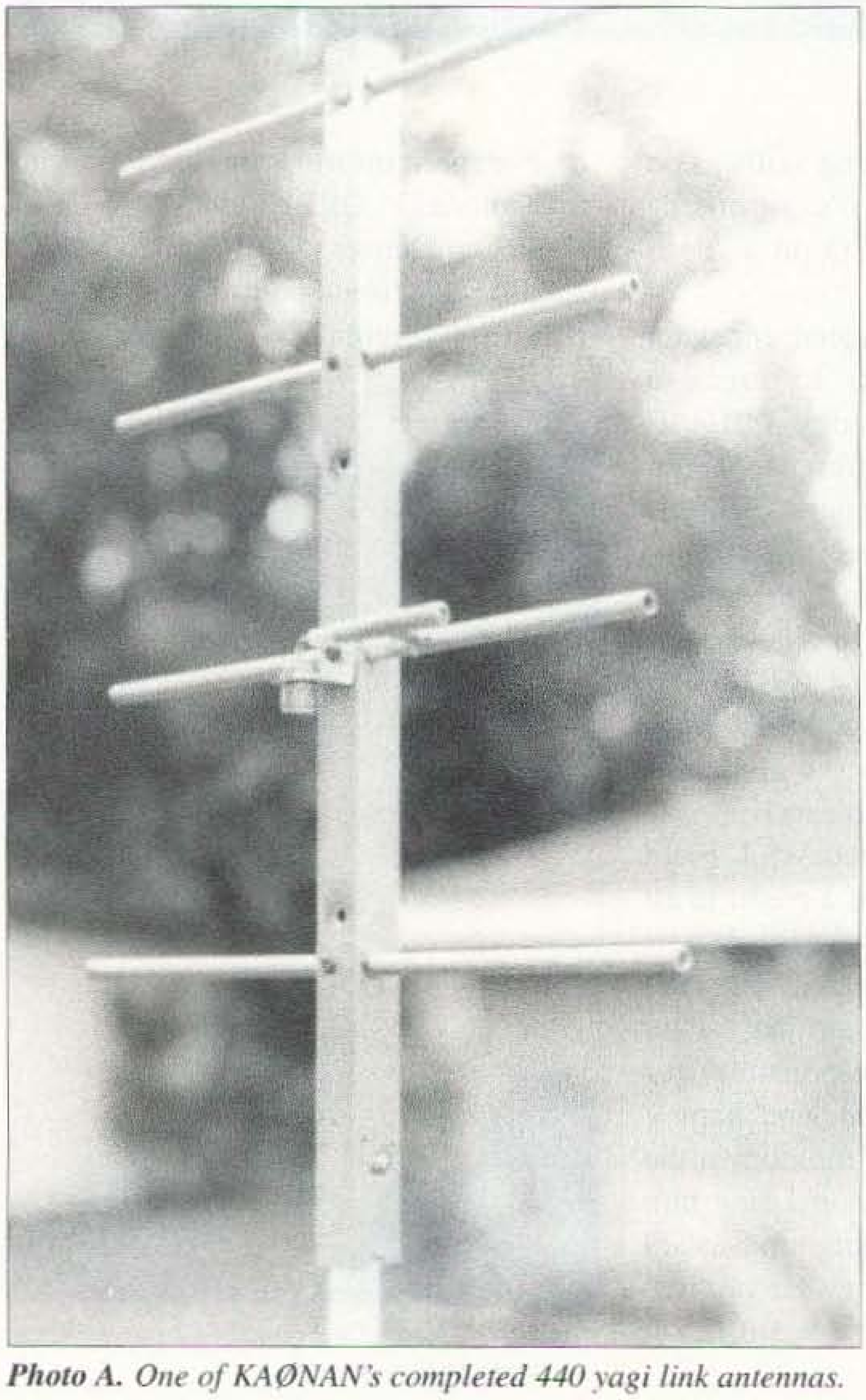


Photo A. One of KAØNAN's completed 440 yagi link antennas.

The new 434 MHz link antennas I came up with were each four elements. In accordance with good engineering standards, I chose to use different sized spacing between each of the elements for maximum forward gain on this point-to-point installation for repeater link use. I used simple gamma matches and old aluminum TV antenna booms. The new antennas worked perfectly, with a 1.1 to 1.2 SWR. They are full quieting; no more white noise on the system.

People are always giving me old TV antennas, so the only thing I had to go to the hardware store for was the stainless steel self-tapping screws. My junk box supplied the SO-239 fitting for the feed point, some RG-8 coax, some thin sheet aluminum for making gamma straps, and the SO-239 mounting bracket.

My cost for each antenna was a little over $2.

"My cost for each antenna was only a little over $2."

Building the antenna

I started by gathering together all the materials and tools needed to complete the project. First, I stripped the unwanted parts from the TV antenna boom. Usually, I drill out the rivets that attach the elements to the boom. Please remember to save all straight pieces of tubing for use in future VHF antenna projects (about the only things I throw away are the plastic element mounting pieces). If you don't have an old TV antenna to strip parts from, and you are having trouble finding 3/8" diameter aluminum tubing in your area, try your local scrap metal dealer or metals dealer. They usually sell this tubing by the pound.

Applying the formula

To determine the correct lengths for cutting your tubing for the target frequency, use the formula: 468 divided by the frequency times 12. This will give you an answer in inches. This will give the length for the driven element; for the reflector, add 5%; and for each director, take off 2% to 3% from the driven element length.

Cutting the parts

With a hacksaw, cut a 18" to 20" piece of boom material for each antenna you are going to build. You can use a hacksaw to cut the pieces of tubing, but a tubing cutter, like plumbers use, will give a much smoother cut.

Cleaning everything

If the boom material is very corroded, you may want to use a Scotch-Brite™ pad or fine steel wool to clean it; clean the tubing for the elements while you are at it. The few minutes you spend cleaning the parts will give you a more professional-looking antenna.

Drilling the holes

Measure in 1/4" from the edge of the 1" square aluminum boom, and scribe a line for drilling the holes to mount the elements. I use a small bit first, drilling a 1/8" pilot hole for the 3/8" drill bit. Place the element holes so you have the right amount of space between each element (see **Fig. 1**).

Mounting the elements

Make a mark 1/2" each way from the center of each element, then push each element through so that you can see your marks. At this point, drill a 3/32" hole through the boom and element to secure each element permanently to the boom, using the 1" #6 screws.

Making the gamma match

I had some short pieces of 3/8" aluminum tubing in my junk box, and RG-8 coax is the perfect diameter coax to fit inside 3/8" tubing to make the gamma. Cut a strip of thin sheet aluminum or brass for the gamma strap; a piece 3/8" by 3-1/2" will make a suitable strap (if you don't have any in your junk box, you can get some at a hobby shop or craft store). Bend one end of the gamma strap around the gamma tube, using pliers to get a snug fit. You will want 1/2" of space between the gamma tube and the driven element to get the antenna to

"You can use a hacksaw, but a tubing cutter will give a much smoother cut."

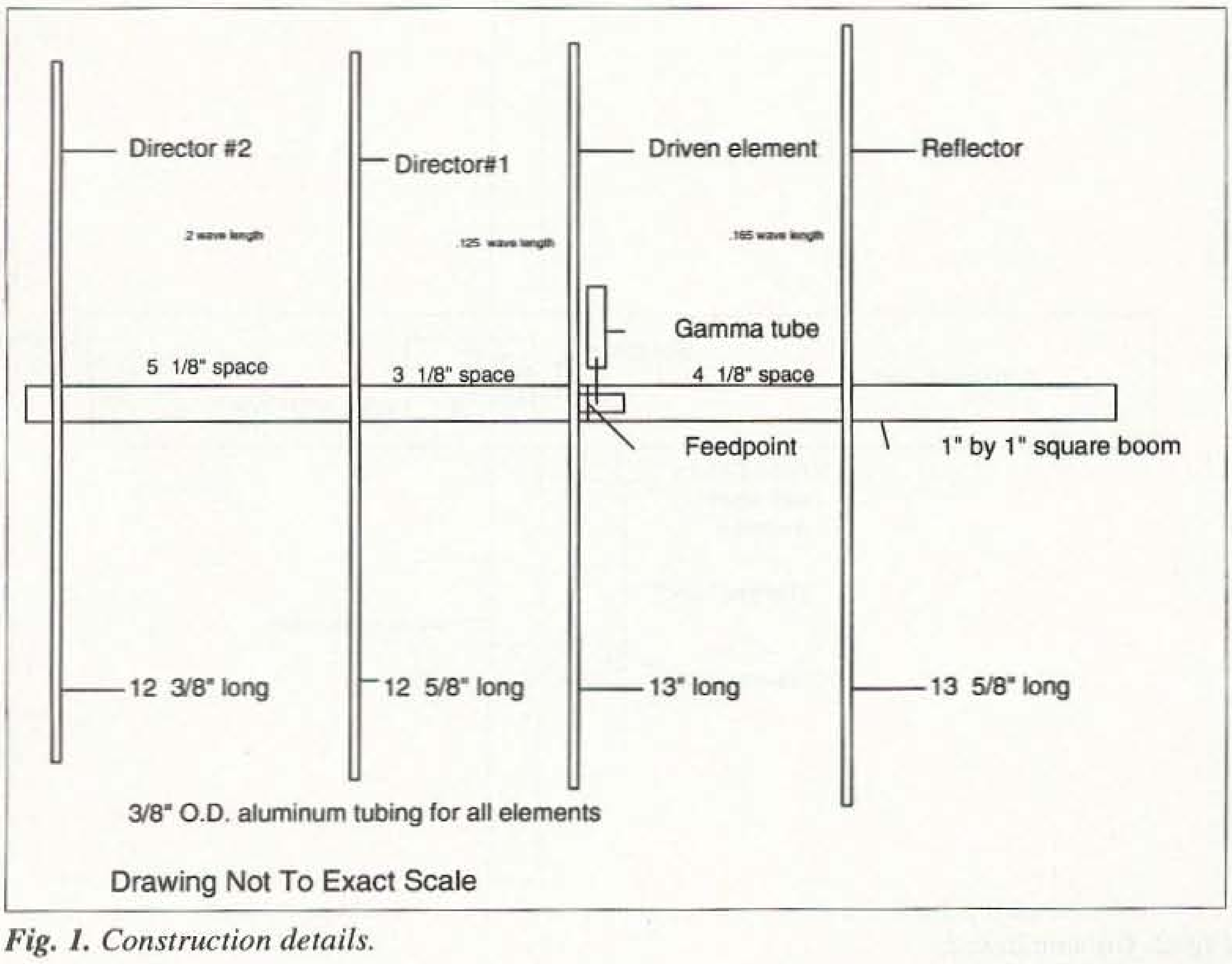


Fig. 1. Construction details.

load properly. Use the pliers again to bend the strap around the driven element to get a good snug fit. Drill a small hole through each end of the gamma strap as close to the tubing as possible, and install a small nut and bolt with a lock washer in each hole (see Photo A). Strip about 1/2" of the dielectric off one end of the RG-8 after the outer covering and the shield have been removed. Bend the stripped end of the RG-8 so that you can solder this end to the SO-239 fitting. Drill two small holes in the other end of the feed point mounting bracket, and attach this bracket to the boom with self-tapping sheet metal screws.

Making the feed point

While you still have the tin snips out, cut a piece about 7/8" by 2-1/2" for the feed point mounting bracket. Next, cut or drill a hole 1/2" in diameter to mount the SO-239 threaded fitting (this depends on the fitting you choose to use) near one end of the 7/8" by 2-1/2" feed point mounting bracket (look closely at **Photo A**).

Now compare your antenna to the one in the photo. Recheck all your measurements before proceeding with the tuning procedure.

Tuning the antenna

To check the SWR, I mounted the four-element yagi link antenna onto the end of a piece of tubing so that it pointed straight up, away from any nearby wires and objects. Then I slid the gamma strap along the driven element to find the best match. After that, I tried sliding the gamma tube in or out until I found the best SWR reading.

Anyone with questions about my antenna design may write to me at the address above. For a prompt reply, please enclose a #10 S.A.S.E. along with your questions. 73

Parts List

For <u>each</u> antenna:

Tools needed:

Hacksaw
Screwdriver
Pliers or wrenches
Drill bits
Tin snips or shears
Tape measure
Tubing cutter (optional)
Drill press (optional)
Scotch-Brite™ pad or fine steel wool

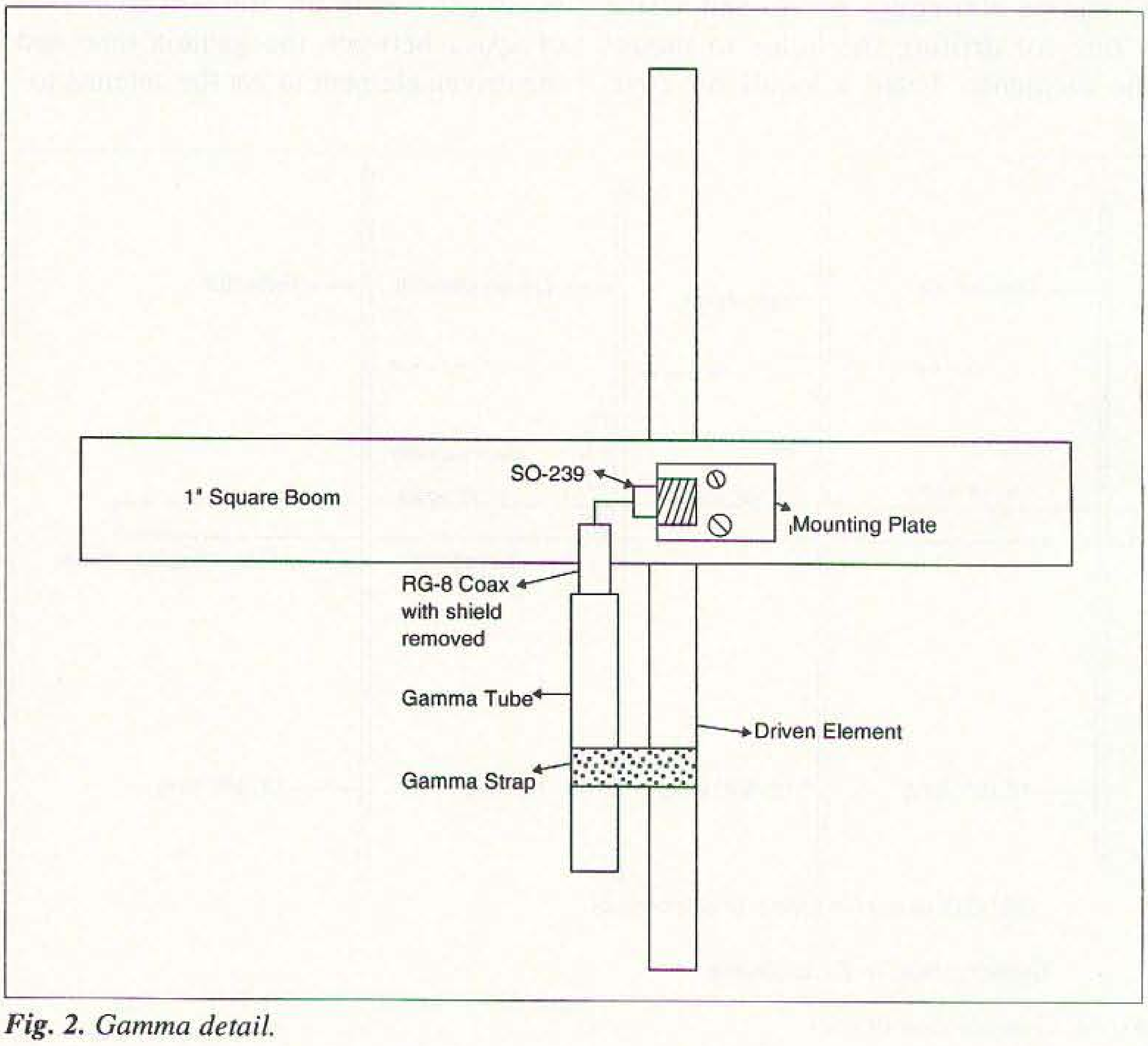


Fig. 2. Gamma detail.

A Versatile QRP Random-Wire Antenna Tuner

A quick way to tune up your QRP rig in the field.

J. Frank Brumbaugh KB4ZGC
P.O. Box 30 - c/o Defendini
Salinas PR 00751-0030

When QRP rigs are taken on camping trips, you usually use an end-fed random-length wire tossed up into a tree for an antenna. To match the unknown impedance of the antenna, a tuner is necessary, and an SWR meter is needed to adjust the tuner.

An L-network is the circuit normally used to match the antenna to the rig. However, there are three possible L-network circuits, only one of which will produce a minimum SWR match with a particular length antenna wire and operating frequency, especially when modified by local conditions and structures in the vicinity such as wire fences, trees, and overhead wires. The height of the antenna, the conductivity of the ground, and Murphy's law can also complicate matters.

Usually, L-network tuners require input and output connections among three specific points in the L-network to be swapped around until the proper circuit configuration is discovered. This is not only tedious and time-consuming, it is also no longer necessary.

The tuner described here is designed so that once input and output connections are made, a twist of a knob allows the operator to select among the three possible circuit configurations, allowing rapid tune-up using whichever internal circuit provides the best match and lowest SWR, which equates to the lowest reflected power.

This tuner also includes a simple circuit which allows you to monitor reflected power. It does not require calibration because it is the minimum reflected power which indicates the best match possible between your transmitter and the particular antenna in use. Further, the reflected power meter sensitivity is made variable with a panel control so this tuner can be used equally well by QRP and QRP_p operators. The reflected power meter doesn't measure SWR; it only shows the point of best antenna matching.

For those of you who say, "But I want to *know* my SWR!" I offer the following facts:

1. The rationale for using any antenna tuner is to obtain the *best match possible* between the rig and the available antenna.
2. Minimum reflected power indicates the *lowest SWR possible* with the rig and antenna.
3. *Knowing* the exact standing-wave ratio at the lowest reflected power will not reduce the reflected power even a microwatt.

The point is that you don't have to know the actual SWR figure in order to get the optimum match between your transmitter and a given antenna.

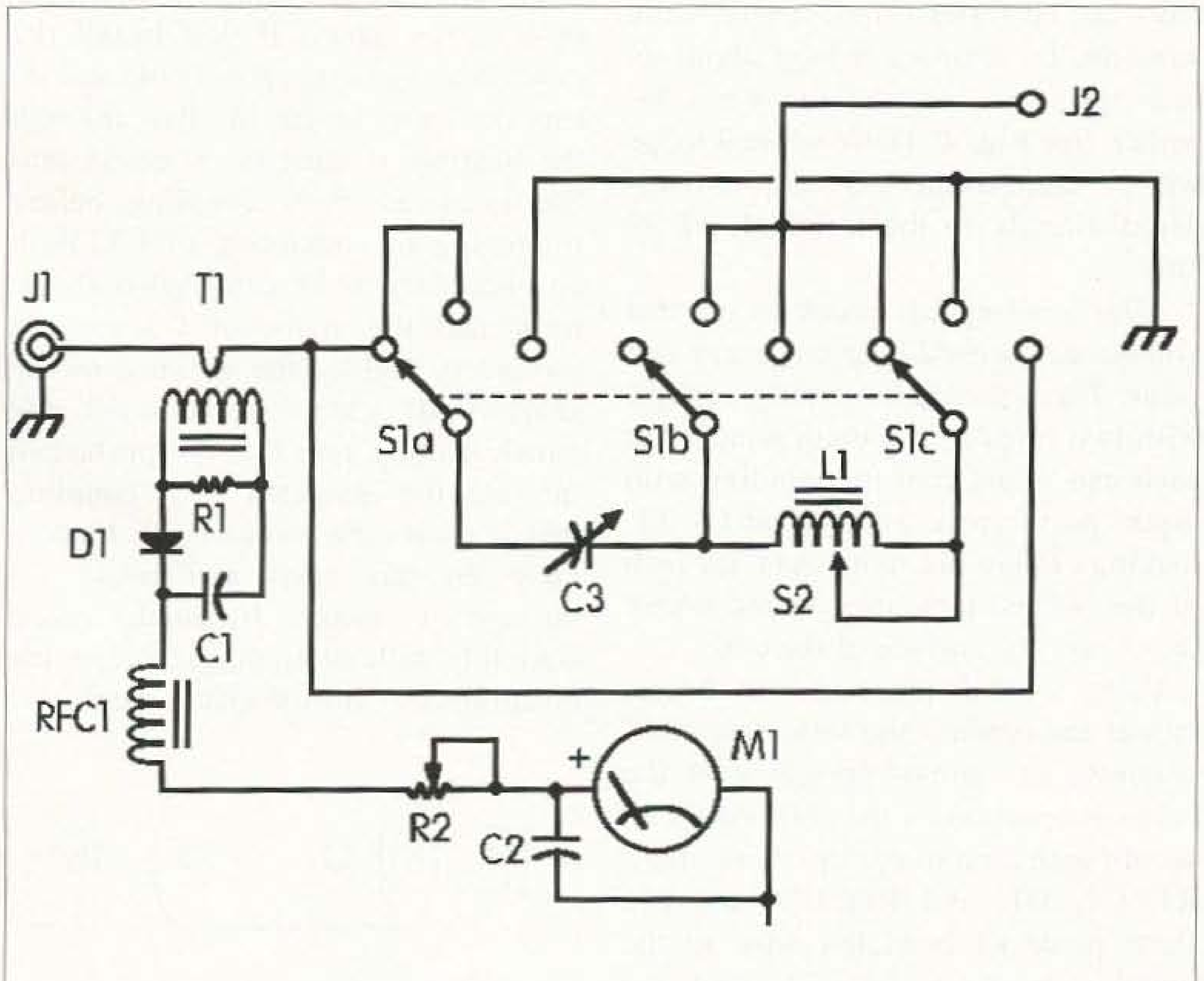


Fig. 1. Schematic diagram of the Random-Wire Tuner.

The circuit

Refer to **Figs. 1** and **2** for the following discussion. The heart of the circuit is the L-network, consisting of C3 and L1. Switch S1, a three-pole, three-position rotary switch, allows you to change the configuration of C3-L1 among each of the three basic circuits illustrated in **Fig. 2**. The numbers assigned to each circuit are the same as the positions of S1.

L1 is a tapped toroid with taps every two turns to allow the greatest flexibility in tuning. The taps are selected by S2, a one-pole, 12-position rotary switch. C3 is an air dielectric variable capacitor. Both capacity and inductance are controlled by knobs on the front panel.

RF applied at J1 flows through the primary of T1 to the L-network selected by S1, then to the antenna at J2.

The voltage developed in the secondary of T1 is rectified, filtered, and applied through sensitivity control R2 to meter M1. R2 allows you to keep the meter needle on scale while adjusting C3 and L1 to obtain the best match, indicated by the minimum dip of the needle on M1.

Construction

Although this tuner will function equally well if built on a breadboard, it's best to construct it in an enclosure so it will not be damaged when jammed into a backpack. I recommend using an aluminum box, or one made of blank printed circuit board material.

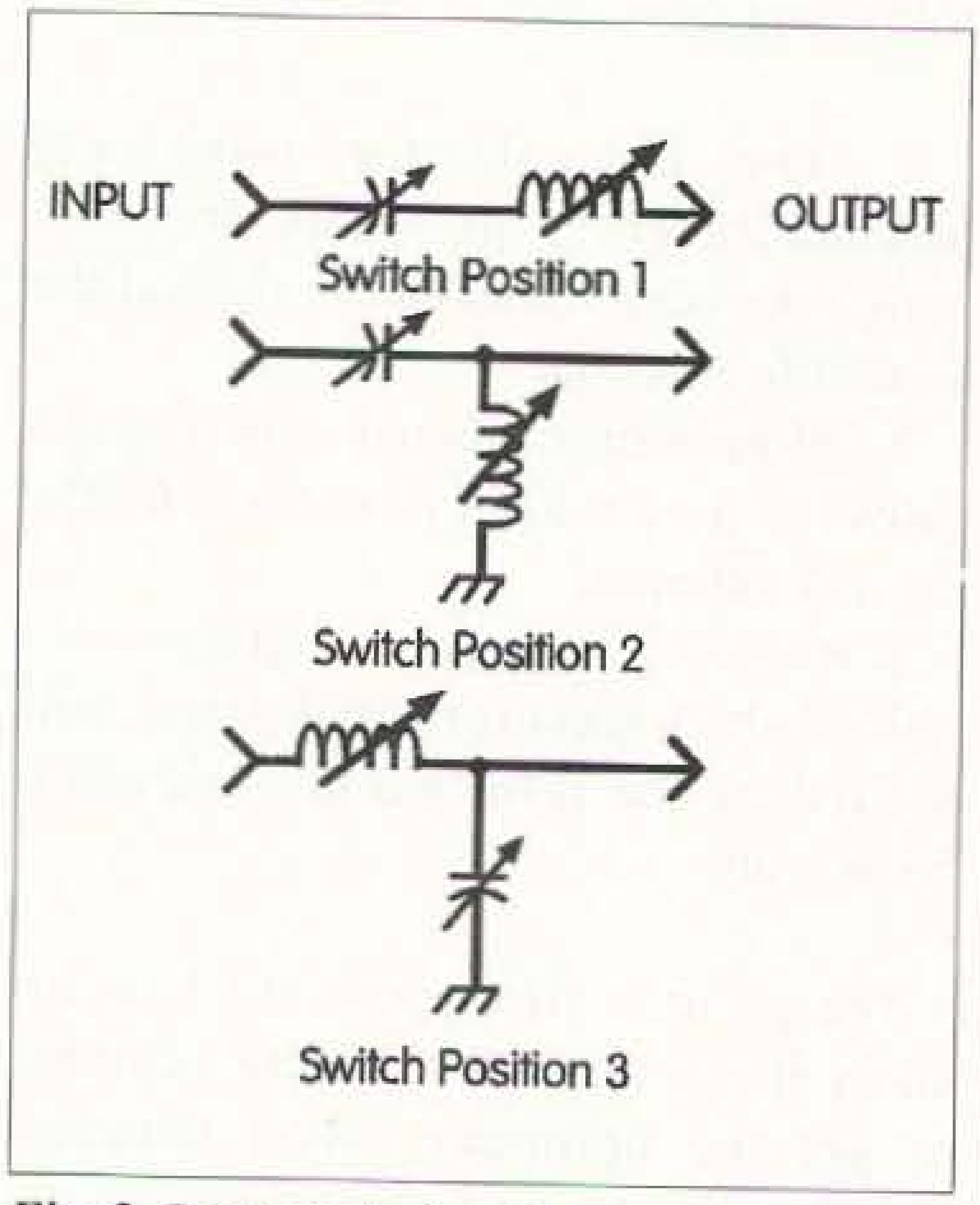


Fig. 2. L-network circuits.

C3 *must* have both rotor and stator insulated from ground! If possible, use an insulated shaft coupler and a short piece of 1/4" rod through the panel; the control knob can be affixed to this rod later.

You can make an insulated shaft coupler from a short length of 1/2"-diameter Plexiglas™ or Lucite™ rod, available from hobby and model shops (see **Fig. 3**). Drill a 1/4"-diameter hole lengthwise through the center (use a slow speed so the drill bit does not melt the plastic!). Then drill and tap setscrew holes through one side of the rod to accept 6-32 screws to secure the shaft of C3 and the short rod extending through the panel. Taking apart a defunct potentiometer will supply both a short piece of 1/4" shaft and a panel bearing.

To prepare T1, wind six spaced turns of AWG-22 wire on an FT37-43 ferrite toroid core. Space the turns evenly to cover about 70% of the core. Leave an inch or so of wire at each end for later connection. Coat the winding with liquid polystyrene, such as General Cement Q-Dope®. Allow it to dry for several hours, then add a second coat and allow that to dry.

L1 must be wound with 24 turns of AWG-24 wire on an FT50-43 ferrite toroid core, tapping it every two turns. Taps can be formed most easily while winding, by forming a loop about an inch long and twisting the wires together. See **Fig. 4**. These twisted loops will be cut, stripped, tinned, and soldered directly to the terminals of S2 later.

After winding L1, check to see that you have a twisted loop tap every two turns. There should be exactly 11 taps, with two turns of the main winding at each end. Then coat the winding with liquid polystyrene as detailed for T1, making certain not more than 1/4 inch of the twisted taps are covered where they leave the surface of the core.

Using a small piece of perf board, mount and connect the following components: T1 (mount upright with the bare core portion on the perf board and secure with a bit of epoxy or hot glue), R1, C1, D1, and RFC1. Connect a short piece of insulated wire to the junction between R1, C1, and the ground end of T1, and leave the other end free. Connect another short piece of insulated wire to the bottom end of RFC1 and leave the other end free. These two wires will be connected later. Set this assembly aside.

Prepare the panel and cabinet as desired, with the proper holes for C3, S1, S2, R2, and M1. Lead lengths are not important but should be made as short and direct as possible when wiring later.

Since the capacitor you will use for C3 is unknown, you will have to make certain it is mounted so it will be *insulated* from ground, as well as lined up so its shaft is directly in line with the panel hole for its control.

Connect jumpers between the proper terminals of S1 as shown in **Fig. 1**. Solder insulated wires a few inches long to each of the wiper contacts of S1a, S1b, and S1c. Leave the other ends free. Now mount S1 on the panel.

Mount the following components: J1, J2, R2, and M1. Solder a length of wire between J2 and the point indicated in **Fig. 1** on S1. Double-check to make sure that you have connected this wire to the proper point on either S1b or S1c, which are jumpered together.

Secure the insulated coupler to the shaft of C3. Mount C3 on its insulated mount and make certain its shaft is lined up exactly with the matching hole in the panel. If you install the panel bearing in this panel hole and insert the short length of shaft through the bearing, it must insert easily into the insulated shaft coupling before tightening the mounting of C3. With an ohmmeter make sure that both the rotor and the stator of C3 are not grounded. Tighten the setscrew on the short shaft extending through the panel, making sure it is not pushed so far into the insulated shaft coupling that it shorts the rotor of C3. Place a knob on this shaft and rotate C3 through its range. It should rotate smoothly without binding. Correct any misalignment until it rotates freely.

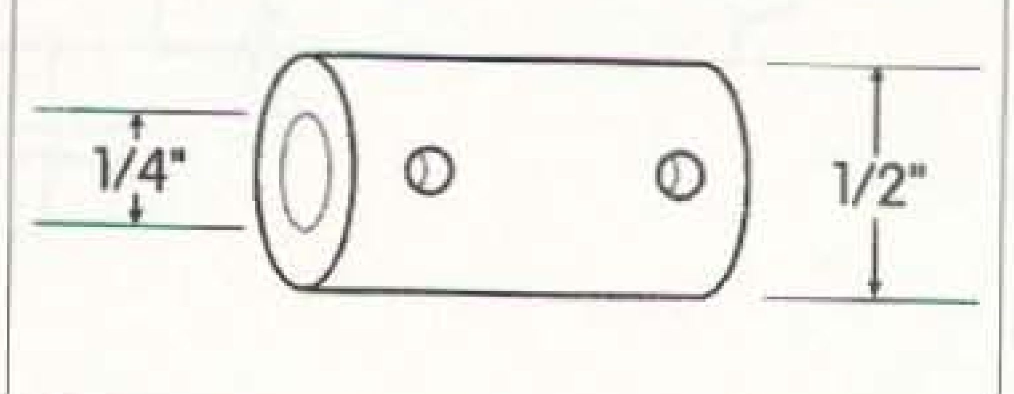


Fig. 3. Home-brew insulated shaft coupler.

When L1 is dry, clip the loops of each tap at its outer end. Strip the enamel off both wires of each tap, twist them together, and tin them with solder. Leave them long; they will be trimmed later.

Bend each tap so it is perpendicular to the flat surface of the toroid. Refer to **Fig. 5**, which shows the proper connection of L1 to S2, with the switch terminals assigned numbers. Carefully slip the taps, and the end of L1 connected to terminal 1, into the switch terminals. Use care so each tap enters its assigned switch terminal.

Snug L1 to within about 1/4" of the rear of S2, which will support L1. Solder taps 2 through 12 only. Clip off the long ends of the tap wires extending through the switch terminals.

Connect a short length of wire between the wiper terminal of S2 and terminal 1. Solder the wiper terminal only. Mount the S2-L1 assembly on the panel.

Route the free end of the wire connected to the wiper terminal of S1c and connect it to S2, terminal 1, then solder. Clip off any excess wire. Locate the loose end of L1 near tap 12 and route it to the wiper terminal of S1b, then solder it. Connect the free end of the wire connected to the S1b wiper terminal to *either* the rotor or stator terminal of C3, then solder. Clip out excess wire.

Connect the free end of the wire from wiper terminal 1 of S1a to the remaining unused terminal of C3, then solder. There is a jumper already installed between terminal 3 (clockwise, looking from shaft end) of S1a to terminal 2 of S1c. Connect a wire from either terminal to ground and solder both connections.

Mount the perf board assembly previously wired so a wire from the center connection of J1 can pass directly through the center hole of T1; this will form the primary winding. Solder a wire to the center conductor of J2, route this wire through the center of T1, then solder it to S1a, terminal 1 or 2, which are already jumpered together.

Connect the wire leading from RFC1 to terminal 3 (clockwise looking from the shaft end) of R2, and solder. Strip about half an inch of insulation from a short length of wire and feed this bare

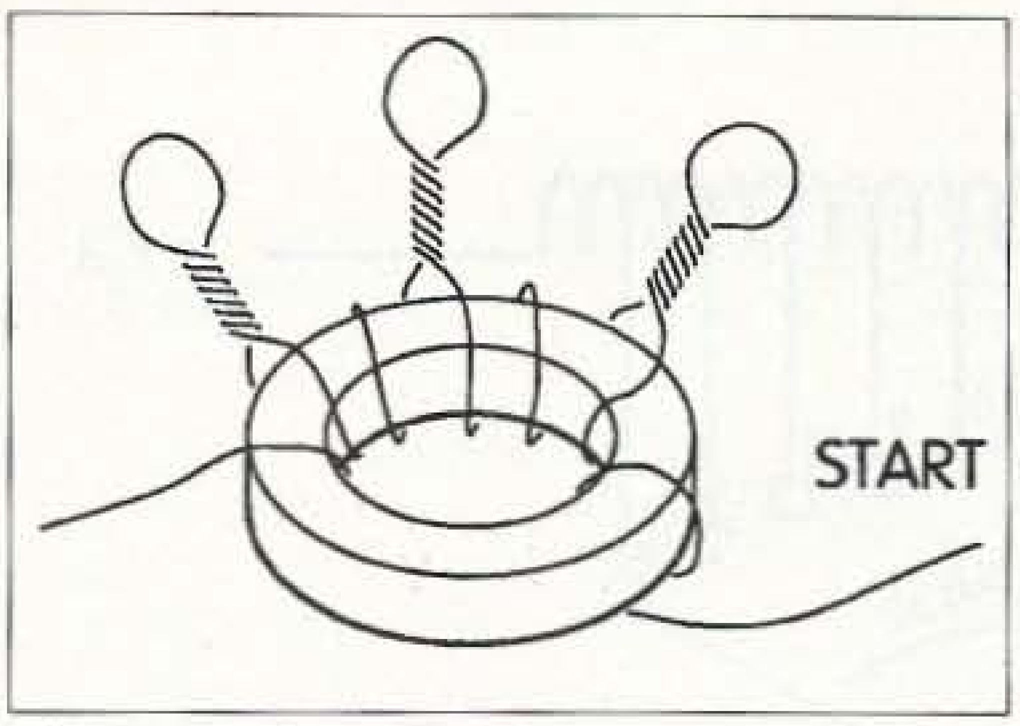


Fig. 4. Winding L1 with taps (partial).

end through the remaining two terminals of R2, and solder both terminals. Connect the other end of this wire to the positive terminal of M1. Connect C2 between both terminals of M1. Connect a short length of wire to the negative terminal of M1 and solder both terminals of M1. Connect the free end of the wire from the negative terminal of M1 to ground.

Check all solder connections and compare your wiring to the schematic in **Fig. 1**. Repair any errors and double-check to make certain that both terminals of C3 are insulated from ground *only* with S1 in position 1, furthest counterclockwise. One terminal of C3 connects to ground through L1 at S1 position 2, and directly at S1 position 3.

Operation

Connect the output of your QRP transmitter to J1 and an end-fed wire antenna to J2. Rotate R2 fully counterclockwise (maximum resistance). Set C3 at mid-range and S2 at position 6.

Key the transmitter and adjust R2 for an indication of reflected power on M1. Switch S1 back and forth, watching M1 for any dip, however slight. Leave S1 where the dip occurred, and adjust C3 and S2 for the deepest dip, adjusting R2 clockwise a bit as the meter needle falls.

Although this is probably the best match, leave R2 where it is after noting the position of the needle on M1, and try adjusting C3 and S2 with S1 at each of the remaining positions. If either position of S1 provides a *deeper* dip—less reflected power—than that first obtained, this is the correct S1 position for the best obtainable match.

It should be possible, adjusting the tuner as just described, to get the reflected power indicated by M1 at or

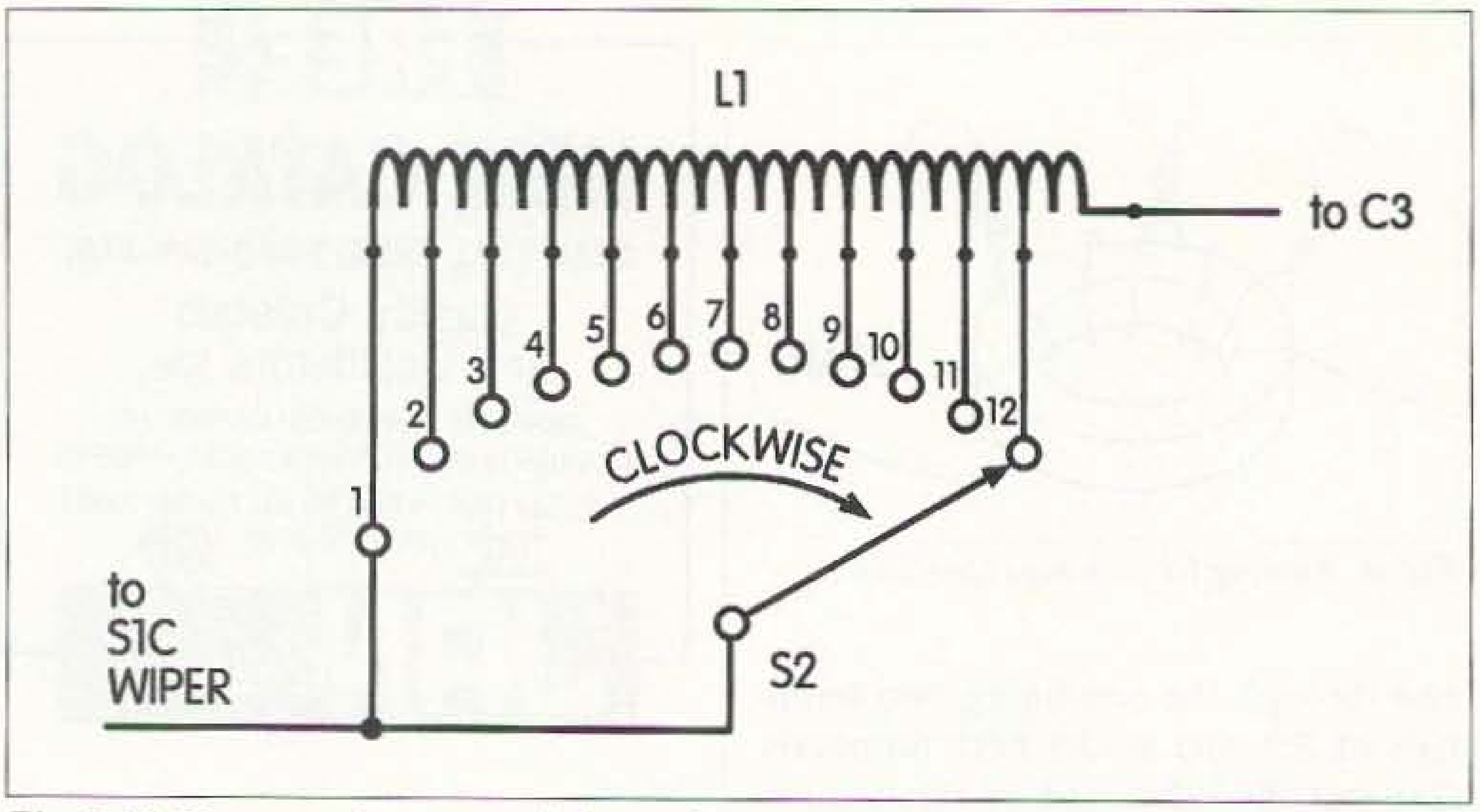


Fig. 5. S2-L1 connections, expanded rear view.

very near zero, even with R2 fully clockwise (minimum—zero—resistance). You may or may not achieve an exact 1:1 SWR—no reflected power—but properly adjusted, this tuner can achieve less than 1.5:1 SWR with just about any combination of transmitter, antenna and frequency over the HF bands, and usually *much* less than that.

It may be impossible, because of the simplicity of the reflected power circuit and the RF inside the tuner, to achieve a zero reflected power indication on M1, especially with R2 set for maximum sensitivity—no multiplier resistance in series with M1. Normally, there would be a fixed resistor in series with R2, or R2 would be a set-and-forget trimpot establishing the maximum reflected power at full scale of M1 in a calibrated circuit. However, I purposely made this circuit to have the maximum sensitivity possible, controlled by the operator, so the reflected power circuit would produce meaningful results when operating in the milliwatt range.

Regardless of the above, when you have achieved tuning which provides the deepest dip on M1, this is the *best match* you can achieve with the antenna and frequency in use. When you have achieved the deepest dip you can, adjust R2 to place the meter needle on any convenient scale marking. Then as you operate, especially if you change frequency by very much, check the position of the needle. If it has risen higher, a slight tweaking of C3 will usually return it to its previous setting.

A few hints

Some operators stick a long nail into the earth to ground their outdoor stations. Others use a wire counterpoise in addition to an earth ground, or instead of one. Properly chosen, a counterpoise will work very well, as long as *it is not a multiple of a half wavelength at the operating frequency.* A half wavelength or multiple thereof of wire, open at the far end, places a very high impedance at your station ground point, the exact opposite of the low impedance necessary. A counterpoise a quarter wavelength or an odd multiple thereof in length and open at the far end is also an impedance transformer, but in this case it inverts the high impedance at its open end to a very low impedance at the station ground post, exactly what is desired. However, when changing bands, make sure your quarter-wave counterpoise is not a half wave long on the new band!

If you use a monoband rig, carry a quarter-wavelength counterpoise for that band, regardless of the length of your random wire antenna.

If yours is a multiband rig, prepare a quarter-wavelength counterpoise for *each* band. Connect them together at one end and attach to your station's ground post. This way you will always have the correct length counterpoise as you hop from band to band.

Rather than using separate wires to make the multiple counterpoise, consider using a length of indoor telephone wiring cable which contains four, six or eight separate wires. Cut it to the length needed for the lowest frequency band. Choose the number of wires needed—one for each band—and connect them together to a spade lug or similar which will connect to your station ground. With a pocket knife or X-Acto® knife, make a slit a quarter wavelength from the ground post end in the outer insulation, clip one wire, and remove the unwanted portion of this wire from the other end of the cable. Do this for each band for which you need a counterpoise. Now you have a neat insulated cable which contains all the counterpoises your multiband rig will need in the wild. This cable will be equally useful at the home station, especially if you live above the ground floor or your ground connection is fairly long. 73

Parts List

C1, C2	0.01 µF disc ceramic
C3	Variable capacitor, 300 pF to 400 pF maximum
D1	Germanium diode (1N34, 1N60, 1N90, 1N270, etc.)
J1	RF connector, builder's choice
J2	Insulated binding post
L1	24 turns AWG-26 on FT50-43 core, tap every two turns
M1	100 or 200 µA DC meter
R1	51 Ω 5% 1/2W carbon resistor
R2	25k Ω linear taper potentiometer
RFC1	1 mH miniature RF choke
Toroid	FT50-43 (L1)
T1	6 turns AWG-22 on FT37-4 core (see text)
S1	3P3T rotary switch
S2	Single pole 12-position rotary switch

Operating RS-12

It's easy!

Luis F. Orozco N5UHB/XE2MXU
Montes Claros 3413
Monterrey NL 64949
Mexico

Whenever someone mentions satellite communications, we tend to think about expensive rigs and complex antennas. Fortunately, there is one satellite out there for those who don't have a "satellite station," or who just want to get started in satellite communications. The minimum equipment required to use RS-12 is an HF radio capable of operating "split" on 10 and 15 meters, and a 10/15 meter dipole. This means that most people who use HF already have all they need to get on the air with RS-12!

How do I do it?

RS-12 was launched on February 5, 1991, and it orbits the earth at an altitude of about 1,000 kilometers. You probably won't work any "long haul" DX (maybe in a few years!), but you should have no problem making cross-country contacts (see **Fig. 1**).

Presently, RS-12 operates in Mode K. The uplink frequency is from 21.210 to 21.250, and the downlink from 29.410 to 29.450. The ideal setup to work this bird would be to have two different radios with two different antennas. However,

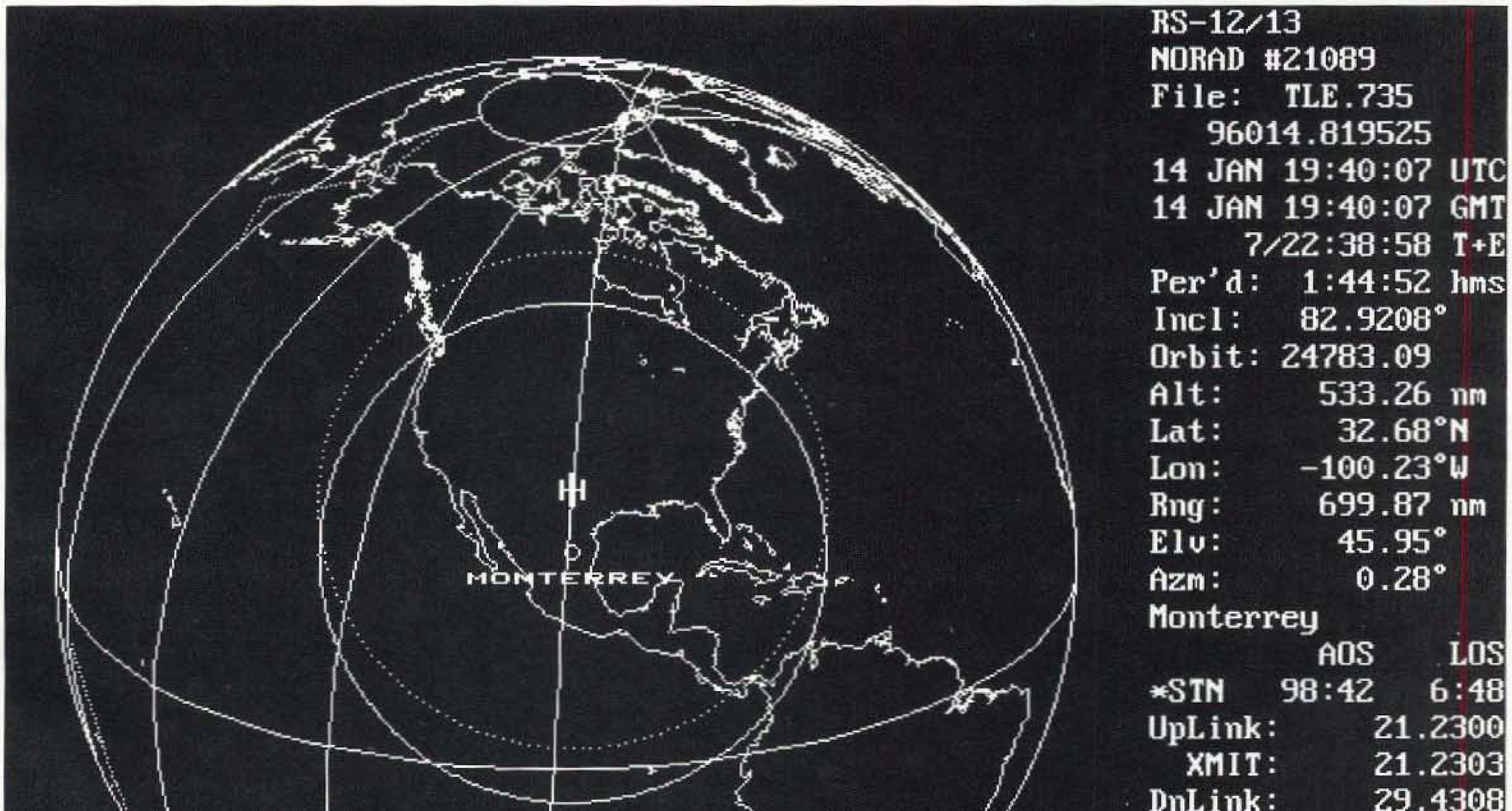


Fig. 1. Screen dump from STSPLUS's orthographic projection showing RS-12 passing over northern Mexico and the central US.

most hams have just one HF radio, which is fine as long as it has two VFOs. You still have the choice of what kind of antenna configuration to use. You could use just a 15 meter dipole since you won't be doing any transmitting on 10 meters. However, if you want to pull all the weak signals out of the noise, I would recommend making a dipole for each band and feeding them with the same coax. The antenna height is not very important here, as long as it has a somewhat clear view of the horizon (well, as clear as you can practically get without buying a new tower).

In order to know when the satellite will pass over your QTH you will need a satellite tracking program. There are quite a few of them out there, but I would recommend using STSORBIT PLUS, by David Ransom. Besides having great graphics, it is very accurate and fairly easy to use. If you have Internet access you can get the latest version at http://www.ozemail.com.au/~dcottle/. **Fig. 1** is a screen dump of STSORBIT PLUS's orthographic projection. If you don't have Internet access, find a local ham who does and ask him to get the program for you.

In order to make accurate predictions with STSPLUS, or any other tracking program, you will also need Keplerian elements. These are a specially formatted set of numbers that specify the location of the satellite at a particular time. You simply plug them into the tracking program and let it do the number crunching. Files with Keplerian elements for all amateur satellites (plus many, many other satellites!) are also available at the above address. Keplerian elements are also distributed through packet bulletins, so you don't need Internet access to get them.

Getting to work

Now that you have all the gear set, you need to know how to use the satellite. This is fairly simple, and you should have no problems working anyone you hear after a little practice. First, put your radio in "split" mode and set the transmit frequency to 21.230. Your signal should be "coming out" on 29.430 (plus or minus the Doppler shift; more on this later). From there you can move up or down to whatever frequency you want (within the satellite's passband, of course). Since this satellite has a linear transponder, if you move your uplink up by 1 kHz you should also move your downlink up 1 kHz.

One final thing that you should take into account is the Doppler shift, which is caused by the satellite's motion. If you're using STSPLUS ORBIT, enable the Doppler shift prediction feature using the F8 key while the map is displayed. If your program doesn't have a Doppler shift feature, you can operate by trial and error. First choose an uplink frequency and tune your receive VFO to your corresponding downlink frequency, without taking into account the Doppler shift. Then make a call, and start tuning around your downlink. When using RS-12, the Doppler shift can be up to about 2 kHz, so tune 2 kHz up and down from the initial frequency until you hear someone answering your call. As the satellite goes by the Doppler shift will change, so you will need to continually readjust your receive frequency. You should also make sure you are not transmitting on top of someone else.

> ***"Besides having great graphics, STSORBIT PLUS is very accurate and fairly easy to use."***

Finally, a word about power: Don't run the linear when 100 watts will do the job just fine. And don't run 100 watts when 10 watts will do it! If too many people get on the satellite and are using too much power, signals will start to fade and it will be a lot harder to work other stations.

Working satellites is a lot of fun, and RS-12 is the perfect bird for those of us just starting out. See you on the air!

Number 25 on your Feedback card

A Multiband Trap Dipole Antenna System

This easily-constructed HF antenna system is a perfect combo for use with portable rigs.

L. VanProoyen K8KWD
8330 Myers Lake NE
Rockford MI 49341

It's been said, "there's nothing new under the sun," and so it is with this antenna system—its basic design dates back more than 40 years. What's unique about this antenna, however, is that it's a complete system, including a matching unit that I've found ideal for use with the newer compact HF rigs that do not include a built-in tuner (Kenwood's TS-50, ICOM's IC-706, etc.). And it's easy to build using components and parts which you should be able to locate at your local hardware store and/or in your junk box.

Trap dipoles

I've built several trap dipole antennas over the years, but the design that's worked best for me is that originally described by C. L. Buchanan and subsequently modified by Arthur Greenberg a number of years ago (see Bibliography). It used a single pair of traps resonating somewhere around 7.2 MHz to give "five-band" coverage, and this basic design, or some modification of it, has been carried for many years in various handbooks and antenna manuals. I've further modified this original design to use coaxial-cable traps in place of the open-wound inductor style originally used, to make the antenna a bit more rugged. **Photo A** shows the construction details of the traps I currently use.

While the original traps worked fine, but turned out to be high-maintenance items. No matter how well I tried to shield them, water invariably found its way in. Also, the originals, having a somewhat larger diameter, were good wind-catchers, which caused the antenna to come down a lot—usually resulting in something getting broken, like one of the ceramic capacitors. This type of capacitor has proved to be somewhat hard to find, and is usually expensive when you *do* find one. Since changing to coaxial cable traps, I've had a version of this antenna up for several years without having any of these problems.

"A multi-tapped coil, selector switch, variable capacitor, and a couple of coax connectors are all the components needed to build this L network."

Most trap dipole antennas represent a compromise over a full-length antenna, either in terms of bandwidth or performance, or both. This antenna by itself really worked satisfactorily on 40 meters and on a portion of the 80/75 meter band. Operation on other bands and/or full 80/75 meter coverage really requires the use of some type of matching unit. Previous rigs I've used having internal tuners worked fine, generally managing to load the antenna even on WARC bands. Since acquiring a TS-50, I needed some kind of external matching unit in order to use this antenna effectively, but I didn't want to use some big, bulky, or expensive tuner—thus the L network. **Photo B** is a picture of the L network matching unit I came up with.

L networks

L networks have been used as effective matching devices for a number of years. Their popularity fell off some during the heyday of TVI, however, because an L network's attenuation of harmonics or other spurious signals is not as good as that of a Pi or T network. From a simplicity standpoint, though, an "L" is hard to beat. Also, newer rigs typically use well-designed bandpass filters that do an excellent job preventing radiation of harmonic signals, making this shortcoming somewhat less of a concern.

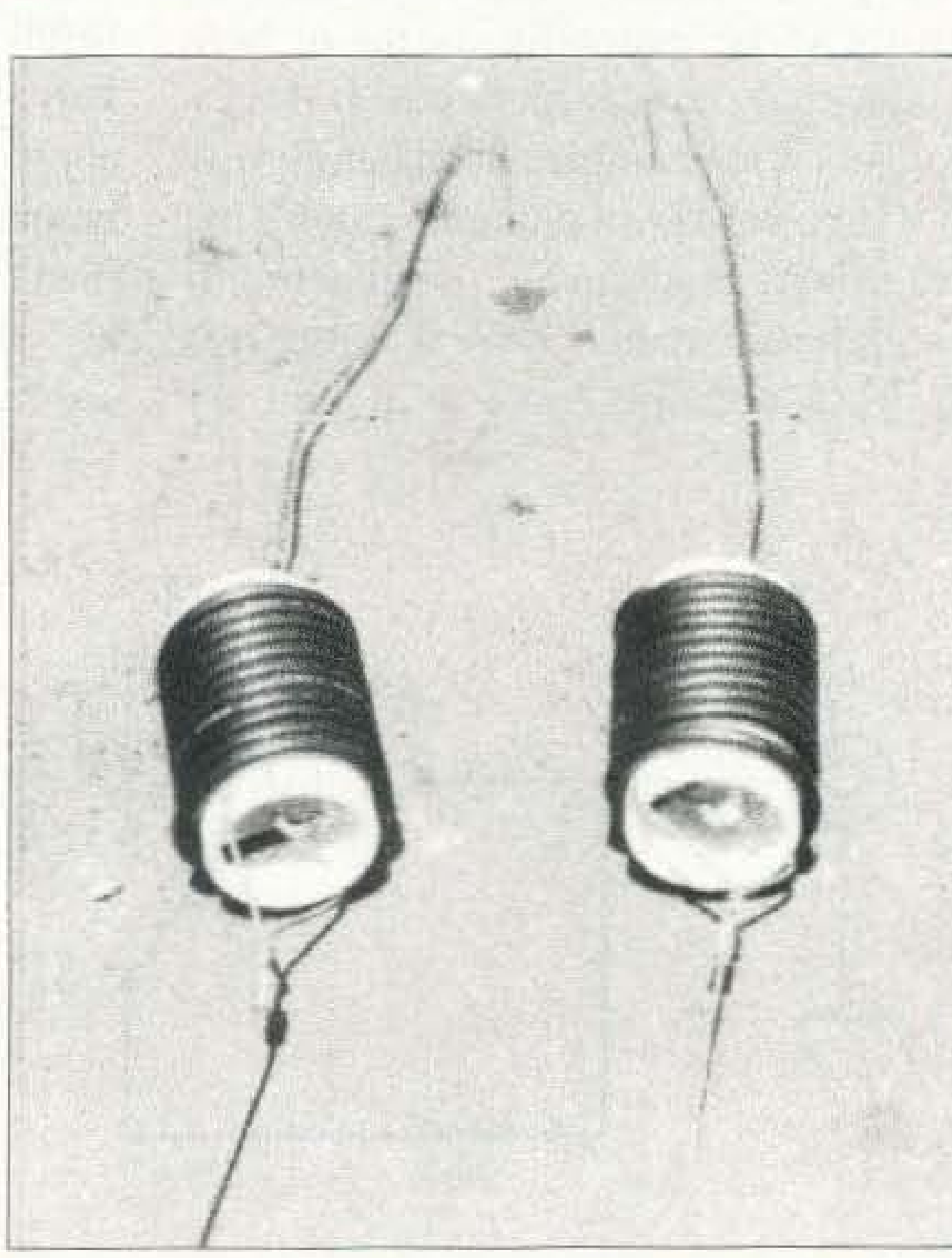


***Photo A.** Coaxial cable trap construction details.*

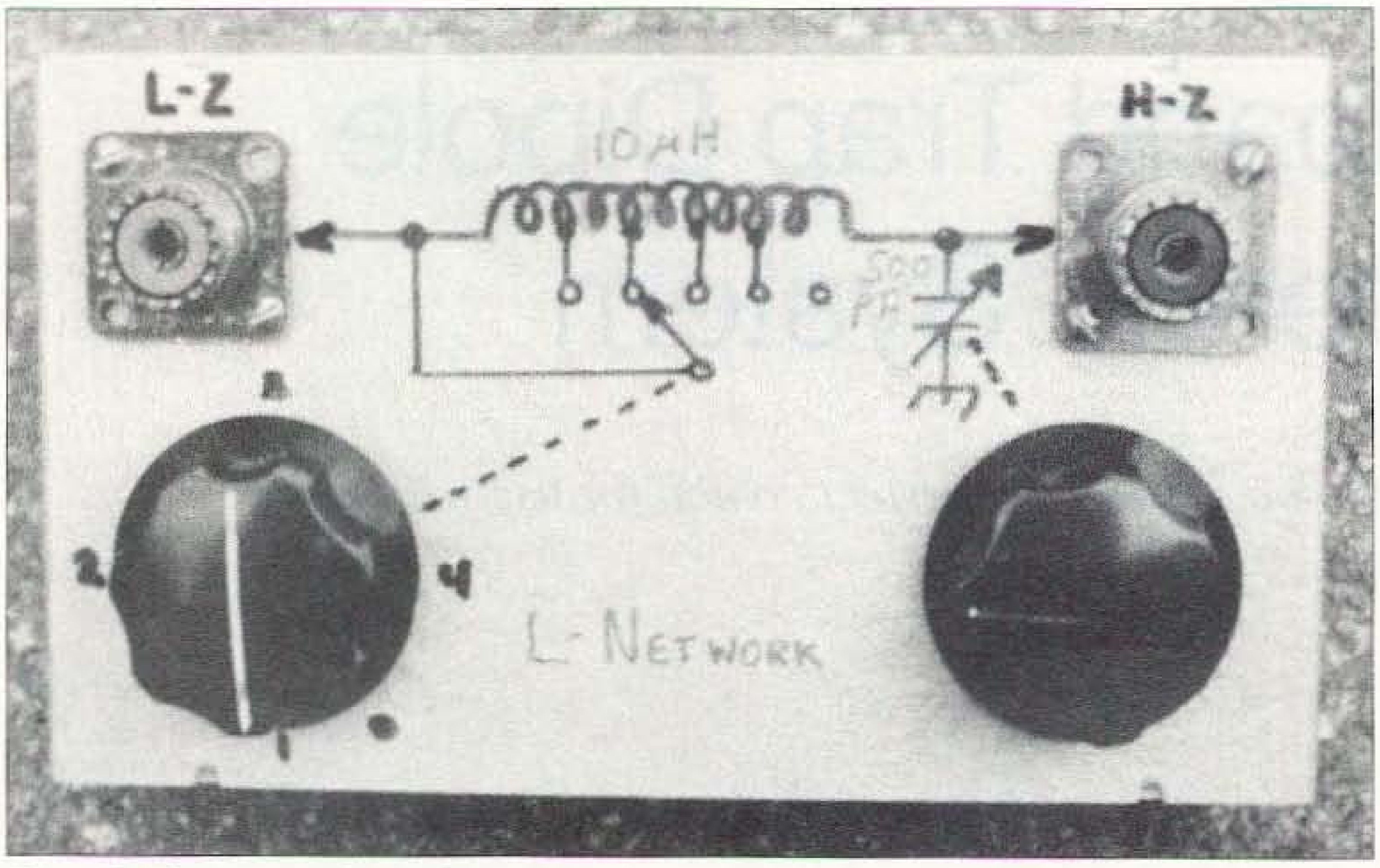


Photo B. The L network matching device.

The unit I use is small (see **Photo B**), measuring just 2" x 3" x 5", so it works quite nicely for portable operation. L networks can be arranged in a series/shunt (or shunt/series) fashion using capacitor-capacitor, inductor-inductor, or inductor-capacitor arrangements. The configuration I used has a series inductor with a shunt capacitor (see **Fig. 1**). This style permits matching low impedances to high when connected normally, and high to low when reverse-connected. L networks are bidirectional in terms of input and output, which makes them extremely useful in a variety of matching applications.

While originally intended for use with my trap dipole, I've since found this L network to be generally useful in both portable and mobile operation. It does a good job, for example, in matching my TS-50 to a variety of antennas, including random wire types and a mobile whip. If I can't find a match with it connected one way, I simply reverse it and try again. However, 75 meter mobile operation does require use of an additional base loading coil.

Building the L network

As shown in **Photo C**, a multi-tapped coil, selector switch, variable capacitor, and a couple of coax connectors are all the components needed to build this L network. It's built in a mini-box enclosure similar to one available from Radio Shack (#270-238, which is 5-1/4" x 3" x 2-1/8"), and wired as shown in **Fig. 1**.

The inductor used was made from an available section of mini-ductor stock, but a custom-wound coil can be made using a 3" piece of 3/4" PVC tubing as a form. It should be 23 turns of #16 or #18 wire, spaced to fill the 3" form to give approximately 10 µH inductance. (Some brands of PVC tubing are more suitable than others for RF applications. A quick test can be made by heating a sample section in your microwave for 15 to 30 seconds. If the sample appears to have warmed appreciably, I'd recommend trying another brand. I'd also suggest using some technique other than touching the sample to determine if it has been warmed by the microwave—the wrong stuff could be *very hot!*)

For my matching network, a five-position ceramic switch was used to select five tap points on the coil. The tap points were distributed evenly along the coil every four to five turns to match the switch positions. A switch with more positions would be better, as finer inductance steps could be selected, but this one was available from the junk box. A suitable substitute would be the 12-position switch sold by Radio Shack™ (#275-1385). Using a switch like this would require tapping the coil about every second turn, but would give great incremental resolution.

The capacitor used is an old broadcast replacement type having a maximum capacity of around 500 pF. Capacitors like this are getting harder to find but show up frequently at hamfests. Should your junk box fail you, Antique Electronic Supply of Tempe AZ carries a capacitor similar to the one used here, as well as others, as standard catalog items.

"I've found this system ideal for use with the newer compact HF rigs that do not include a built-in tuner."

Another viable option for the required shunt capacitor would be using the 12-position switch previously mentioned to select a series of 50 pF fixed capacitors. This switch is a shorting type which would make wiring something like this fairly easy. Should you try this option, I would suggest selecting capacitors with 500-volt or higher ratings.

Constructing the antenna and traps

My original five-band antenna's traps used a pair of 5 µH inductors shunted with 100 pF capacitors. Since the overall length of a trap dipole is largely governed by the inductive component of the trap coils, I wanted to get as close to the original design parameters as possible because I didn't want to alter the antenna's size significantly (at just over

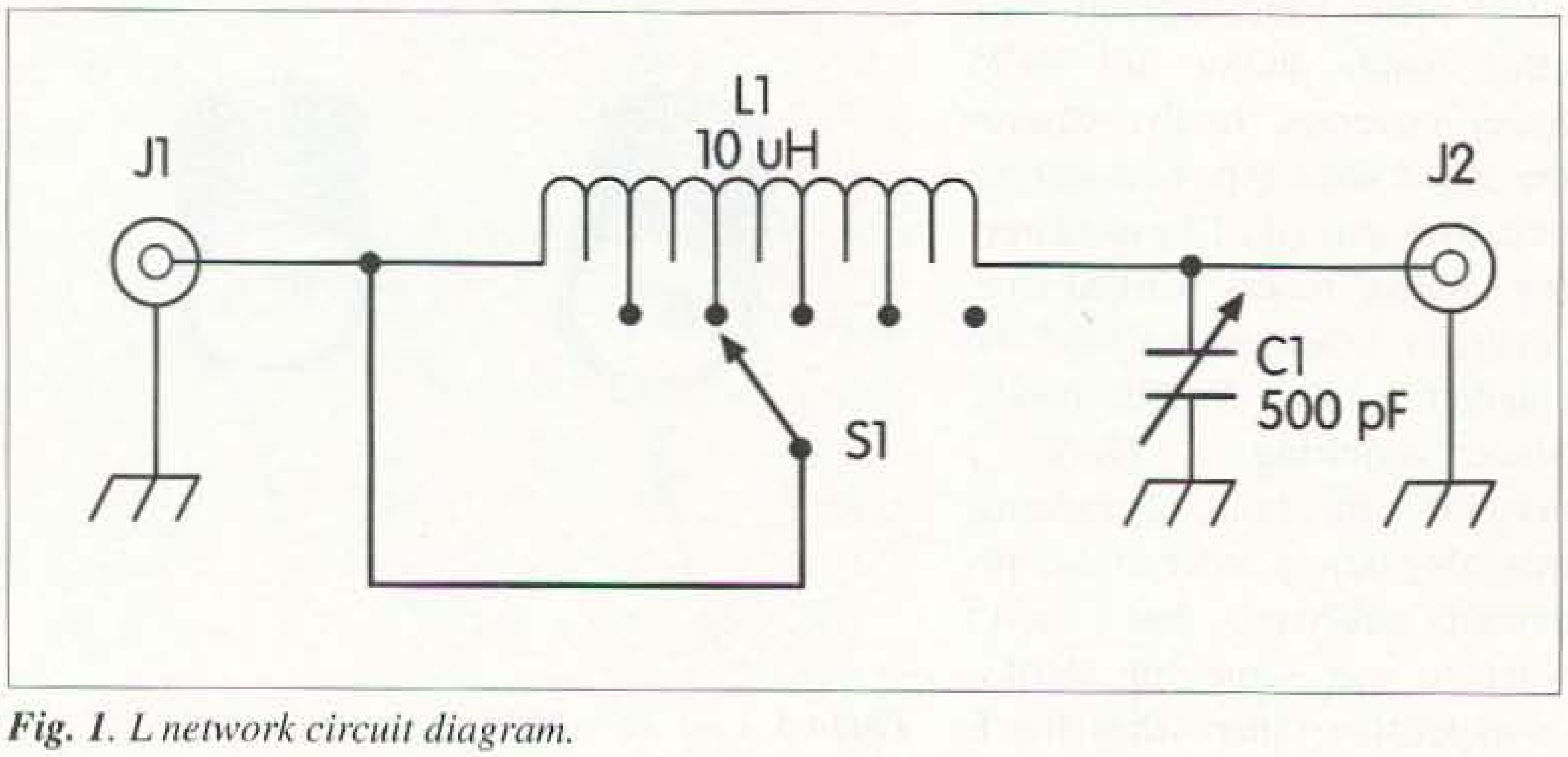


Fig. 1. L network circuit diagram.

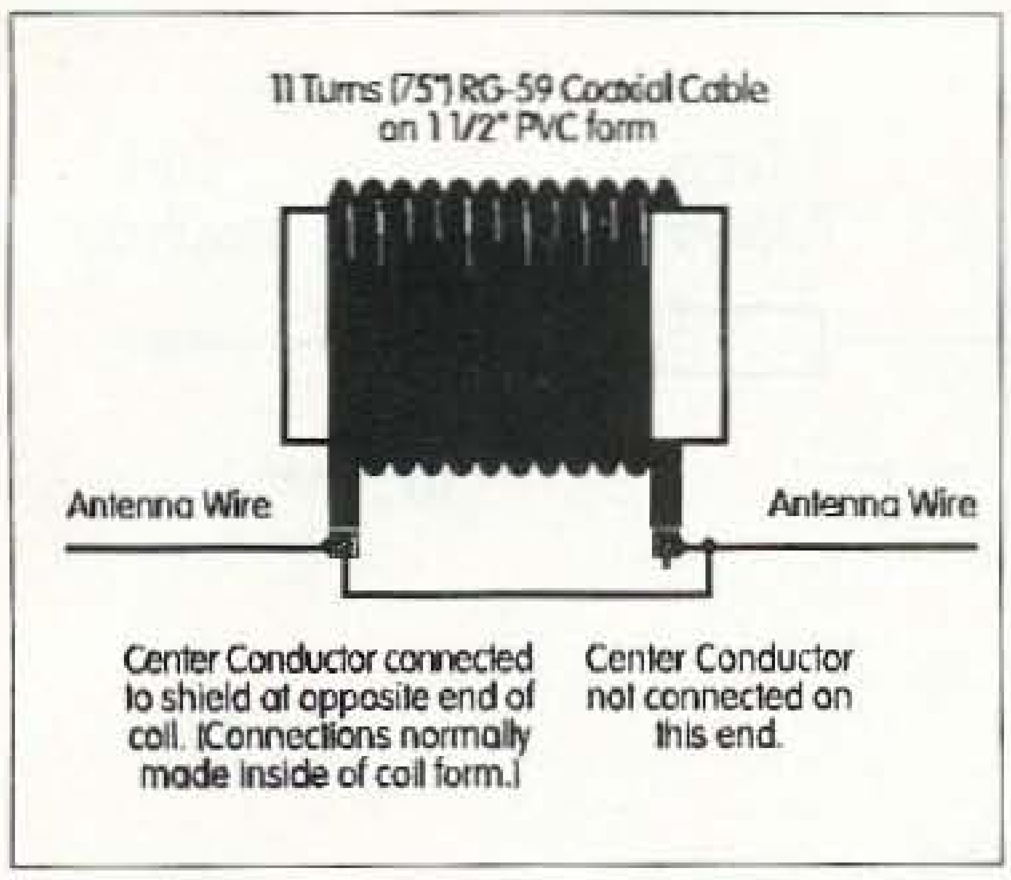


Fig. 2. A) Coax-cable trap circuit.

100 feet overall length, it fits nicely in the space I have available for it). With this objective and a desire to build traps with reasonable "Q," I chose RG-59 foam cable which has about 17 pF per foot as a good compromise for my new traps.

The traps are wound on a 1-1/2"-diameter by 4-1/2"-long PVC pipe forms which have a 2" outside diameter. I ended up using 75" of cable per trap in 11 close-wound turns to resonate near 7.15 MHz. This works out to approximately 100 pF and 5 μH, which is very close to the original design values and doesn't significantly affect my overall antenna length (or performance). **Fig. 2a** shows the trap circuit, and the construction details are shown in **Fig. 2b**.

After winding the cable on the forms, I drilled termination holes for the cable and wired the shield from one end of the coax to the center conductor of the other end, as shown in **Fig. 2a**. I then drilled two 1/8" holes, directly across from each other, at each end of the PVC form and ran some bare #12 wire through to form connecting points to tie the traps to the antenna wire. Finally, after soldering all connections, I sealed the coax cable ends with RTV sealant, coating everything completely to ensure that no water would get into the cable. **Photo A** shows details of the completed traps.

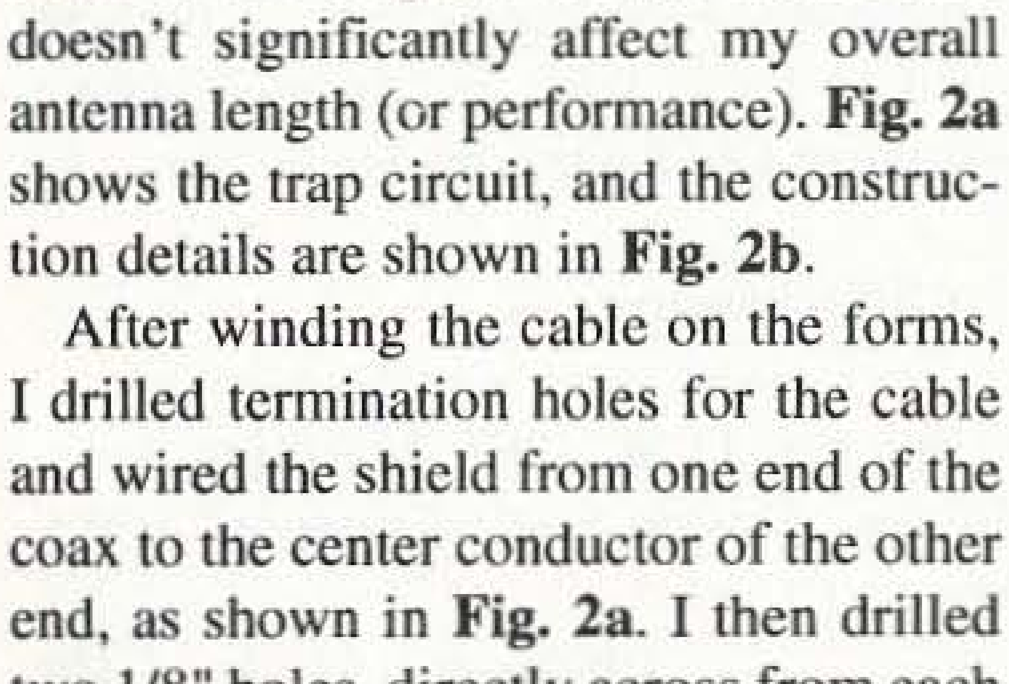


Fig. 2. B) Trap construction details.

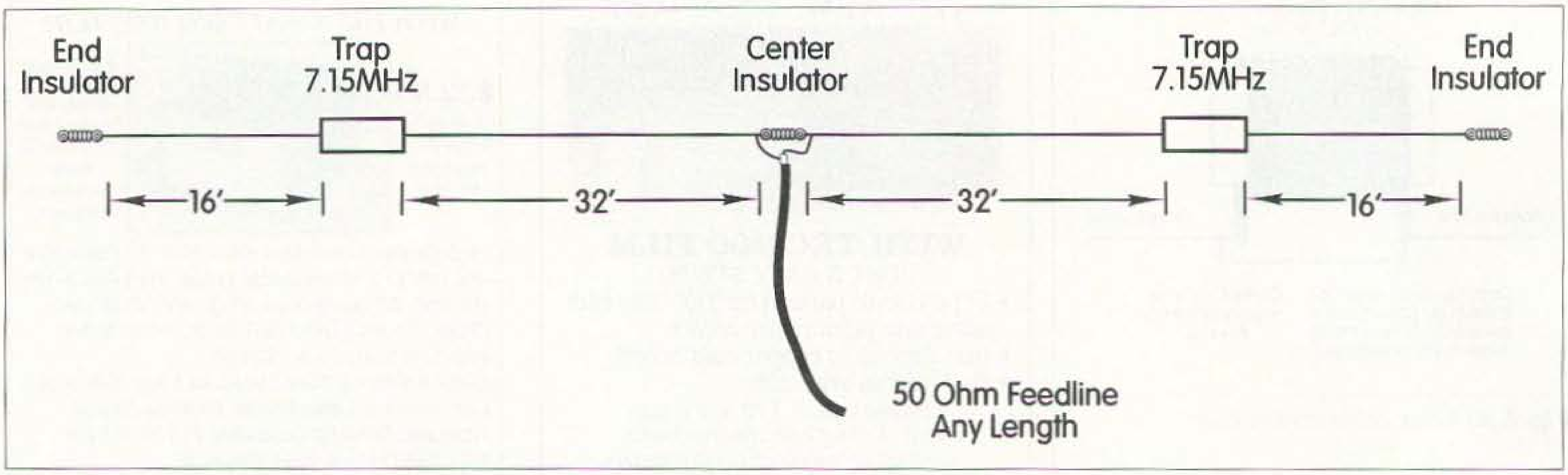


Fig. 3. Trap dipole construction details.

I originally intended to run egg insulators through the centers of my traps to provide strain relief, but I never got around to it. So far, the 1/8" holes in the PVC forms have not pulled out, and the antenna is still up, but using some type of strain relief is a good idea.

The antenna wire was attached to the traps using the dimensions shown in **Fig. 3**. I used #12 electrical wire with the insulation left on for the actual antenna wire. I typically buy Romex™ cable and strip it down to recover the individual wires. This stuff is cheap and makes good antenna wire.

I'm currently using RG-8 cable to feed the antenna, but I have used RG-58 or RG-59 (70-ohm) in the past with equally good results. In fact, the 70-ohm stuff is probably a better choice for this antenna, especially when using it with an L network matching device.

Tuning and operating

If this antenna is built using the dimensions shown and used with the L network described, no further antenna tuning should be necessary. Should you want to fine-tune it a bit, the 32' lengths (see **Fig. 3**) could be adjusted for resonance at 7.2 MHz or so, and the 16' lengths adjusted for your favorite part of the 80/75 meter band. If you have access to a grid-dip meter, you might also want to check the traps for resonance. However, I've built several sets of these traps and have found that when using 75" lengths of RG-59 cable (Radio Shack #278-1319), they always resonate where expected.

Having a built-in SWR indicator would probably facilitate adjusting the L network since my TS-50 does not include this metering function. I initially used an in-line meter with it until I became familiar with its operation. Now, I simply tune it for maximum output power as indicated by my TS-50's meter (relying on its SWR protection power cut-back circuitry). I generally use the 50-watt power level when tuning in order to offer some protection to the transceiver.

As previously mentioned, I've had this antenna and matching system for a few years now, and its performance has been excellent. I have on occasion had a full-length 80 meter dipole up, and in most instances my signal reports have been as good or better with this antenna system whenever I've made comparison tests. 73

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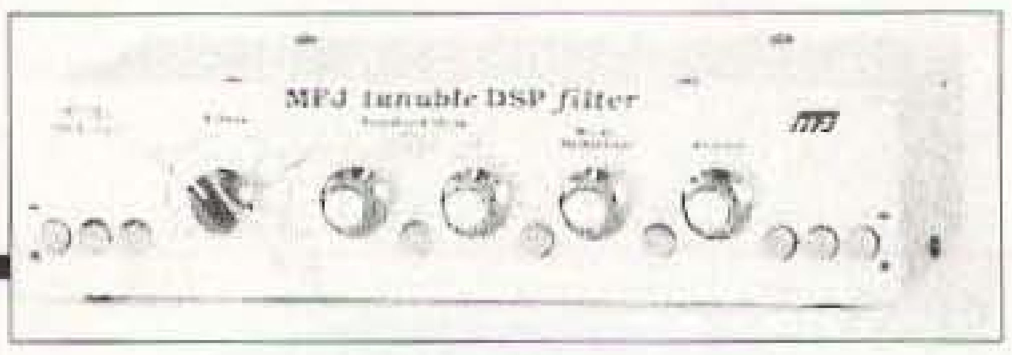
***Photo C.** L network construction details.*

Number 30 on your Feedback card

73 Review

The MFJ Tunable DSP Filter

So little noise, you might think you're the only one out there.



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

If you can't hear 'em, you can't work 'em, so your receiver has to be able to separate the noise and signals. Sometimes the unwanted noise appears in the form of adjacent signals, especially during contests. There have been considerable advances in using computer technology to help you zero in on the signal you want and get rid of other signals and noise. Many new transceivers come equipped with Digital Signal Processing (DSP).

What are the rest of us to do? You add a good DSP unit to your existing rig. MFJ's 784B is a tunable DSP filter that has many functions. It is a 16-bit machine that runs at a 12 MHz clock speed. This allows the DSP to interpret the incoming data very rapidly and decide what is information and what is noise.

This unit has so many noise fighting features that the manual is more like a textbook. The good news is that there is an easy-to-follow section in the beginning of the manual that allows you to get up and running right away. I work with computers for a living, so I hate to read manuals when I get home. I unpacked the MFJ filter and wanted to get it on the air in about ten minutes. I chose to use the quick start suggestions and had it in line in a very short time. You will find that to take advantage of many of the features, you *will* need to read the manual. It is reasonable to expect to put in 8-10 hours to really master all the functions of this filter.

The MFJ DSP unit is made to work with SSB, CW, AM, packet, AMTOR, PACTOR, RTTY, SSTV, WeFAX, FAC, weak signal VHF, EME, and satellite modes. The filter has fifteen pre-set filters for these modes. Five of these filter settings are locked in. You can customize filter settings using ten programmable filters. The custom settings allow you to save desired center frequency/bandwidth, low pass/high pass cutoffs, auto/manual notch, noise reduction or other settings. You can select a pre-set filter and then kick in some of the other noise-fighting features to meet the current band conditions.

The unit goes in between your transceiver/receiver and an external speaker or headphones. It uses 12 VDC or you can buy the MFJ-1315 ($14.95) adapter. The unit comes with MFJ's one-year "No Matter What" guarantee. They will repair or replace the unit for one year, no matter what you've done to it. The filter lists for $249.95, and it's an experimenter's dream. If you like to fiddle with knobs and buttons, this unit will keep you busy for quite some time.

"It's excellent for contesting because it allows you to get rid of overlapping signals."

General features

- 5 factory pre-set filters
- 10 programmable pre-set filters
- Tunable spotting tone—works even in narrowest CW filter position
- Adaptive tuning—center frequency tuning automatically becomes finer as you narrow the bandwidth; makes it easier to use very narrow filters
- Automatic notch—can vary aggressiveness
- 2-1/2 watt audio output
- Ability to turn speaker off and use phones, or use both phones and speaker
- Reporting of active filtering (uses Morse code)
- Automatic filter bypass during transmit to monitor CW sidetone, voice or data
- Manual notch in CW mode
- Noise reduction, automatic notch and tunable notch can be used in memory mode
- Mark-Space frequency and baud rates for data modes
- Adjustable line level output
- Self-testing for all digital circuitry, switches and controls

Automatic notch filter

This filter is designed to find and eliminate unwanted heterodynes very rapidly. CW and RTTY signals can also be eliminated. The filter is extremely narrow, yet doesn't degrade voice signals. This filter is also useful for getting rid of unwanted tuner-uppers (a favorite pastime of a number of operators on 20 meters). In addition to the automatic notch, there are two manually tunable notch filters. These can be effective for separating out a CW station you want to talk to from other unwanted CW stations. On SSB the DSP did the best job when set at the least aggressive setting.

Adaptive noise reduction

This filter gets rid of background noise. In many instances during noisy band conditions, it can make the difference between picking a signal out of the noise or not. The noise reduction mode works with all the other filter modes and will work on random noise, white noise, static, ignition noise and power line noise. The filter gives up to 20 dB of noise reduction.

Tunable high-pass/low-pass filters

These filters work for both voice and data. The lower cutoff frequency can be tuned from 200-2200 Hz and the upper cutoff frequency from 1400-3400 Hz.

You can tune out unwanted signals very close by. This is an effective filter for SSB contesting because it allows you to get rid of overlapping signals. I found this filtering ability to be excellent. On shortwave listening it helps kill heterodynes from stations 5-10 kHz away.

Tunable bandpass filters

These filters work well with narrow band signals such as CW and RTTY. You can tune the center frequency from 300-3400 Hz and then vary the bandwidth from 30 Hz-2100 Hz, which gives you very sharp CW filtering (good for contesting), and wider sharp RTTY, etc. filtering. By narrowing the bandwidth you can eliminate signals that are 60 Hz away. The filters don't appear to have much problem with ringing; I used them quite a lot on CW.

Comments

One important factor with the DSP unit is to set the input level correctly. The procedure for doing so is quite clear in the manual. If you start to use the DSP and think it isn't working right, you most likely have the level set incorrectly. In most cases the pre-set filter settings did what I needed to operate in almost any type of band condition. In the two months I tested it, the unit did everything the other DSP units I have used did and a whole lot more.

The one area where this filter really excelled was when using it with the digital modes. "Out of the box, the pre-set digital modes sounded like a commercial tape. That unit works the digital modes like nothing I have ever used," Conard WS4S commented. Using the double bandpass (dbp) filter capability you can set separate Mark and Space frequencies and really get rid of unwanted signals.

I tested the filter on a Yaesu 757GXII, a Ten-Tec Argosy II, and a Kenwood 930S. Conard WS4S summed up the testing in these words: "You can get real lonely using this filter. You can crank up the filters to the point where you think there's no one else on the band. Then before depression sets in you take the filter out of line and realize that you are not alone."

For more information, see your dealer or contact MFJ Enterprises, Inc., Box 494, Mississippi State MS 39762. Phone (601) 323-5869 or FAX (601) 323-6551. 73

Number 32 on your Feedback card

Build the FOX Controller

A sneaky device to make foxhunting even more fun.

Bob Johansen WB2SRF (Sly Red Fox)
61 Burnside Ave.
Staten Island NY 10302

Once upon a time, the Staten Island Amateur Radio Association (SIARA) held a foxhunt in the Great Kills Park on Staten Island to test the DF units several club members had made. George (The Bear) NA2V volunteered to be the fox. He hid in the woods and periodically transmitted on his HT. We took bearings to determine his location, but we didn't locate him very quickly because we were getting many false nulls that were probably due to multipath.

I can still hear George growling that he had outfoxed us. Rich KB2OH finally located him. After the foxhunt was over we discussed how we might improve our direction-finding technique. Sy AA2RT asked if the transmitter could be operated automatically. Sure, with an automatic ID unit. I set out to build one.

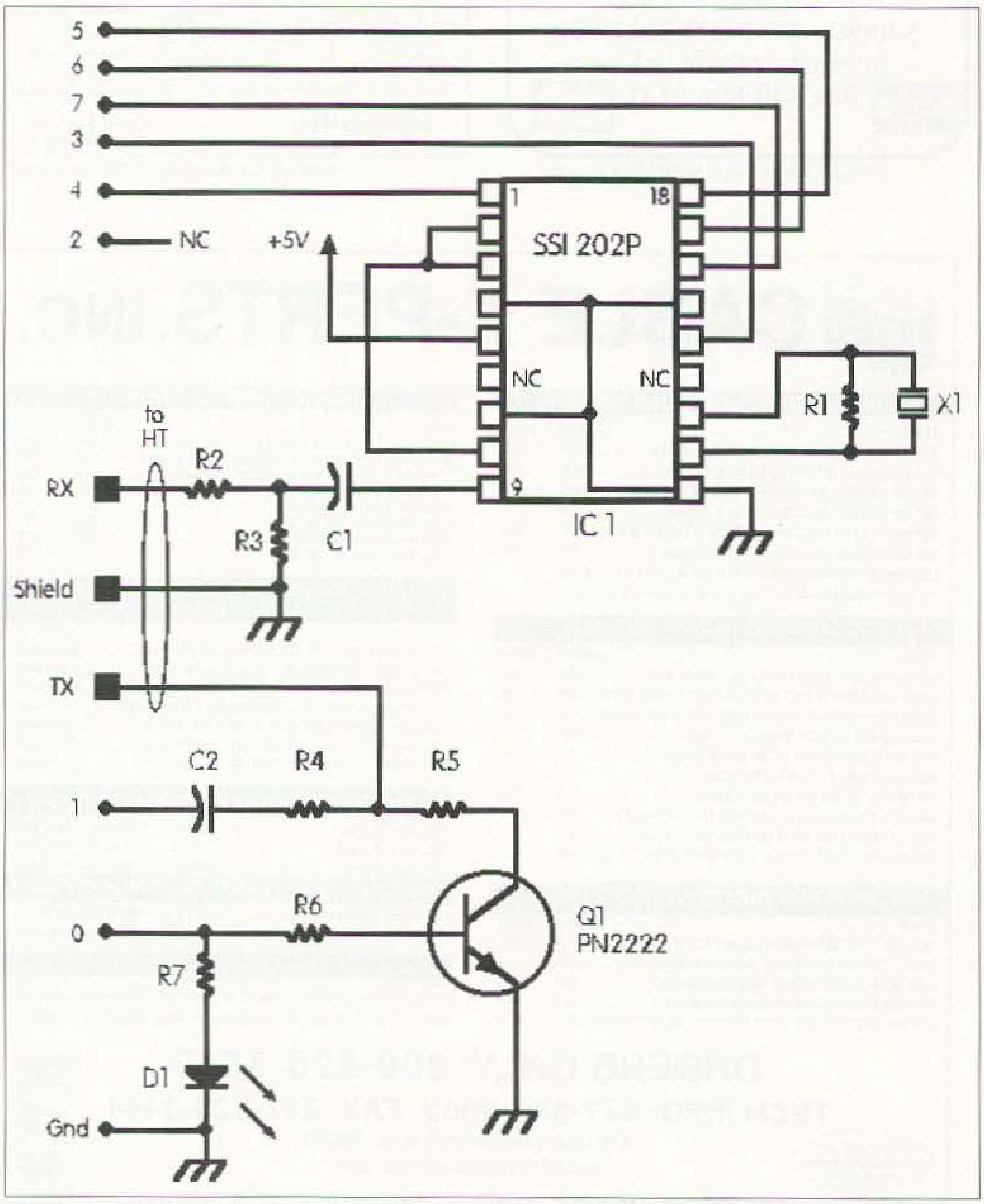


Fig. 1. Circuit for the FOX Controller. *Numbered terminals indicate connections to BASIC Stamp module.*

The BASIC Stamp

Through *73* I have learned about control circuits using devices like the 555 timer, counters, gates, and a diode matrix (a type of ROM) to serve as a controller and ID unit for experimental beacons and repeaters. Then I read about a new toy that I just had to get, Parallax Inc.'s BASIC Stamp, so I ordered one complete with the development system, from Digikey. Application Note #8, "Sending Messages in Morse Code," provided a flash of inspiration, so I adapted this program to suit my foxy needs.

The BASIC Stamp is a really neat 9V battery-powered computer/controller about the size of a large postage stamp, hence the name. It has eight I/O lines and 256 bytes of memory that can be programmed in the BASIC language using a PC development system. The BASIC Stamp board has a small prototyping area that can be used for adding custom circuitry. I used this area for a DTMF decoder and the PTT keying and audio coupling components. The FOX controller decodes DTMF commands received on a separate receiver, and keys the foxhunt transmitter accordingly. This provides for wireless remote control that can be very handy during a foxhunt. Alternately, the FOX controller can receive commands on the fox's own receiver.

Construction

You should be able to build this project for under $50 if you have any kind of a junk box. There are three different versions of the BASIC Stamp. I used the original discrete component version, which has a removable 93LC56 EEPROM and PIC16C56 BASIC interpreter IC. There are newer SMD versions that allow for a more compact assembly, but these versions do not have

```
'Program FOX.BAS version 7  for text rev 2  3/27/96 by R. Johansen WB2SRF
adapted from Parallax Inc. application note # 8
'Improve DTMF Noise Immunity
' When dtmf * is received the FOX activates the transmitter carrier
'then a high beep tone then a low beep tone carrier drops for 5 sec.
' When dtmf # is received for 5 seconds after low beep operation is cancelled
'signals OK to check operation
' When dtmf 0 is received unit sends Hi Hi (laughter)
'This program applies PTT, five tones, pauses 4.5 minutes then sends the ID.
'The five tones are generated 200 mSec apart useful for determination
' of either Tx or Rx delay.

Symbol Tone= 100
Symbol Quiet = 0
Symbol Dit_length = 7 'Change these constants to
Symbol Dah_length = 21 ' change speed. Maintain ratios
Symbol Wrd_length = 42 ' 3:1 (dah:dit) and 7:1 (wrd:dit)
Symbol Character = b0
Symbol Index1 = b6
Symbol Index2 = b2
Symbol Elements = b4
DIRS=%00000111 'define input/output pins

'pin 0= PTT pin 1= sound output pins 3-7 dtmf input


DTMF:
pause 50
b8=pins/16 'sets up pins 4-7 for binary input
if pin3=0 then dtmf
rem debug#$B8 'displays dtmf in hexadecimal form
If B8=$0A then HIT
IF B8=$0C OR B8=$0B then OK
goto dtmf


OK:
pause 2000
if pin3=1 then OK 'strobe loop to holdoff ok
high 0
pause 500
for index1= 0 to 1
lookup index1,(227,163),Character
gosub morse
next
low 0
if B8=$0C then dtmf
pause 1000


Identify:

high 0 'Holds PTT
Sound 1,(110,20,105,20,100,20,95,20,90,20) 'Tones to evaluate PTT delay

for b10 =  0 to 17  ' 18 beeps x15.5sec = approx.  4 minutes 39 sec
high 0
pause 500
sound 1, (110,10)
```

Listing continued on page 34

Listing continued from page 33

```
pause 10000
sound 1, (90,10)
low 0
pause 5000
if pin3=1 then dtmf
next

high 0
pause 5000

' send the word WB2SRF/fox in morse

for Index1 = 0 to 9 'change for number of characters
lookup Index1, (99,132,61,3,67,36,149,36,227,148) , Character
gosub Morse
next
low 0
goto dtmf

HIT:
pause 2000
if pin3=1 then hit ' loop to holdoff hit
high 0
pause 1000
for index1= 0 to 3
lookup index1, (4,2,4,2), character
gosub morse
next
low 0
goto dtmf

Morse:
let elements = Character & %00000111
if elements = 7 then adjust1
if elements = 6 then adjust2
Bang_key:
for index2 = 1 to elements
if character >=128 then dah
goto dit
Reenter:
let Character = Character * 2
next
gosub char_sp
return
adjust1:
elements = 6
goto Bang_key

adjust2:
Character = Character & %11111011
goto Bang_key
end

Dit:

sound 1, (Tone, Dit_length)

sound 1, (Quiet,dit_length)
goto Reenter
```

Listing continued on page 35

a removable EEPROM (see note in Parts List).

Install and wire the DTMF decoder, PTT keying transistor and audio coupling components into the prototyping area (see **Fig 1**). I used #30 insulated wire-wrap wire as jumpers soldered between the connections. A three-pin header was used to make the connections to the HT's audio, PTT, and ground. I put the HT and controller inside a surplus ammo box equipped with a BNC antenna connector and it was all set.

Operation

Once you've built your foxy controller you'll need two HTs to transmit and receive on the same frequency. You'll probably want to offset the frequency of the fox's receiver or use the tone decoder mode of your HT so that only you can control the fox. Sneaky, huh ? The FOX controller can also listen for commands on one band (UHF) and control the fox on another (VHF).

Set your HT's volume control to the middle of its range and attach the plugs from the controller. The controller then listens for a DTMF command to start the operation. When a "*" is received the PTT line is enabled, "OK" is transmitted in Morse code, a high-pitched beep is emitted, followed by 10 seconds of carrier, then a low-pitched audio beep, then the carrier drops five seconds before resuming. This lets you know that you've contacted the FOX controller, and that it's about to key up for 4.5 minutes. If a "#" or "0" is sent at this time the operation is canceled. After 4.5 minutes it sends an ID message (WB2SRF/FOX in my unit) before releasing the carrier.

When a "#" is received, the unit will test the operation without going through the long sequence above. The PTT line is enabled, "OK" is sent, and the carrier is released.

When a "0" is received, the unit will transmit "HI HI" and then silence the transmitter (this is for when you feel someone is getting too close). Of course, when using a single HT as both the fox and the FOX controller receiver, you need to wait until the 4.5 minute timer expires before sending additional commands.

Use the lowest output power setting of the fox HT to conserve battery life and make it more difficult to find.

What next?

The BASIC Stamp/DTMF decoder combination can be used for all kinds of things. For instance, I intend to write software for selective calling and a DTMF display using a LCD panel. The EEPROM can be overwritten or removed and replaced with one loaded with different programs to suit different applications. What applications can *you* think of for this neat hardware? 73

Acknowledgment: Thanks to Chantal and Jim at Parallax for giving me permission to use and adapt Application Note #8.

Footnotes:

See *QST*, May 1993 pg. 35, "Build the Handifinder," by Bob Leskovec K8DTS.

See *73 Amateur Radio Today*, June 1994, pg. 46, "The Morse Messenger," by Scott Edwards.

See also *Nuts & Volts* magazine, May 1994, pg. 35, "Counterfeit Stamp Development System," also by Scott Edwards, a good tutorial on how the BASIC Stamp works.

The following sources will offer you a free catalog upon your request:

Parallax Inc., (916) 624-8333
Digikey Corporation, (800) DIGIKEY
JDR Microdevices, (408) 494-1400
BG Micro, (800) 276-2206
Scott Edwards Electronics, (602) 459-4802

Listing continued from page 34

```
Dah:

sound 1, (Tone, Dah_length)

sound 1, (Quiet,dit_length)
goto Reenter
Char_sp:
sound 1, (Quiet, Dah_length)
return

Word_sp:
sound 1, (Quiet, Wrd_length)
return
```

Parts List

X1	3.579545 MHz crystal, 17pF load capacitance
C1, C2	.01µF 50V ceramic capacitors (2)
R1	1M 1/4W resistor
R4	100k 1/4W resistor
R2	4.7k 1/4W resistor
R3, R5, R7	1k 1/4W resistors (3)
R6	10k 1/4W resistor
Q1	PN2222
D1	Red LED indicator

Miscellaneous

20" lengths of RG-174 or miniature audio coaxial cable (2)

Mini phone plug "receiver audio (earphone) output"

Submini phone plug "transmitter audio (mike) input"

3-pin header plug and socket part of 929974-01-36-ND and PZC36SAAN from Digikey

18-pin IC socket

Digikey #STAMP-ND kit (includes one Basic Stamp); use with your own PC to program your own functions: also available from Parallax (includes blank EEPROM socketed 8-pin dip)

SSI202P DTMF decoder

Note: If you do not wish to purchase the Development Kit to program the BASIC Stamp a programmed EEPROM for the discrete component version is available from the author, at the address above, for $10 postpaid (US delivery). Some hard-to-find parts such as the SSI202P and completed units may be available; contact the author for price and availability.

A 30m Through 80m Loop

Great indoor antenna for QRP.

Jay Jeffery WV8R
3819 Parkdale Road
Cleveland Heights OH 44121

The reasons for designing a relatively small antenna for 80 meters are usually to get around antenna restrictions or to solve the problem of lack of space. There is another good reason, however, and that is convenience.

Consider an antenna that fits easily into a room of a house, is easy to build and repair even during the worst weather, and is simple to tune. Isn't that convenience? The difficult thing is coming up with one that's small but capable, even at QRP levels of power (5 watts or less).

The design

Having had good QRP results on 40 meters with a small, single-turn loop based on standard designs, I decided to try to scale it up to 80 meters. Using proportions, I estimated the size needed and laid it out on the dining room floor using ordinary zipcord and a 250 pF variable. I was lucky and was able to tune up on 80 meters the first try. By pruning it, I was able to use the full extent of the capacitor. I found that I could tune the 30 and 40 meter bands, as well as the 80. I also found that the loop, though technically a small loop, was not exactly tiny. It was approximately 64 inches square.

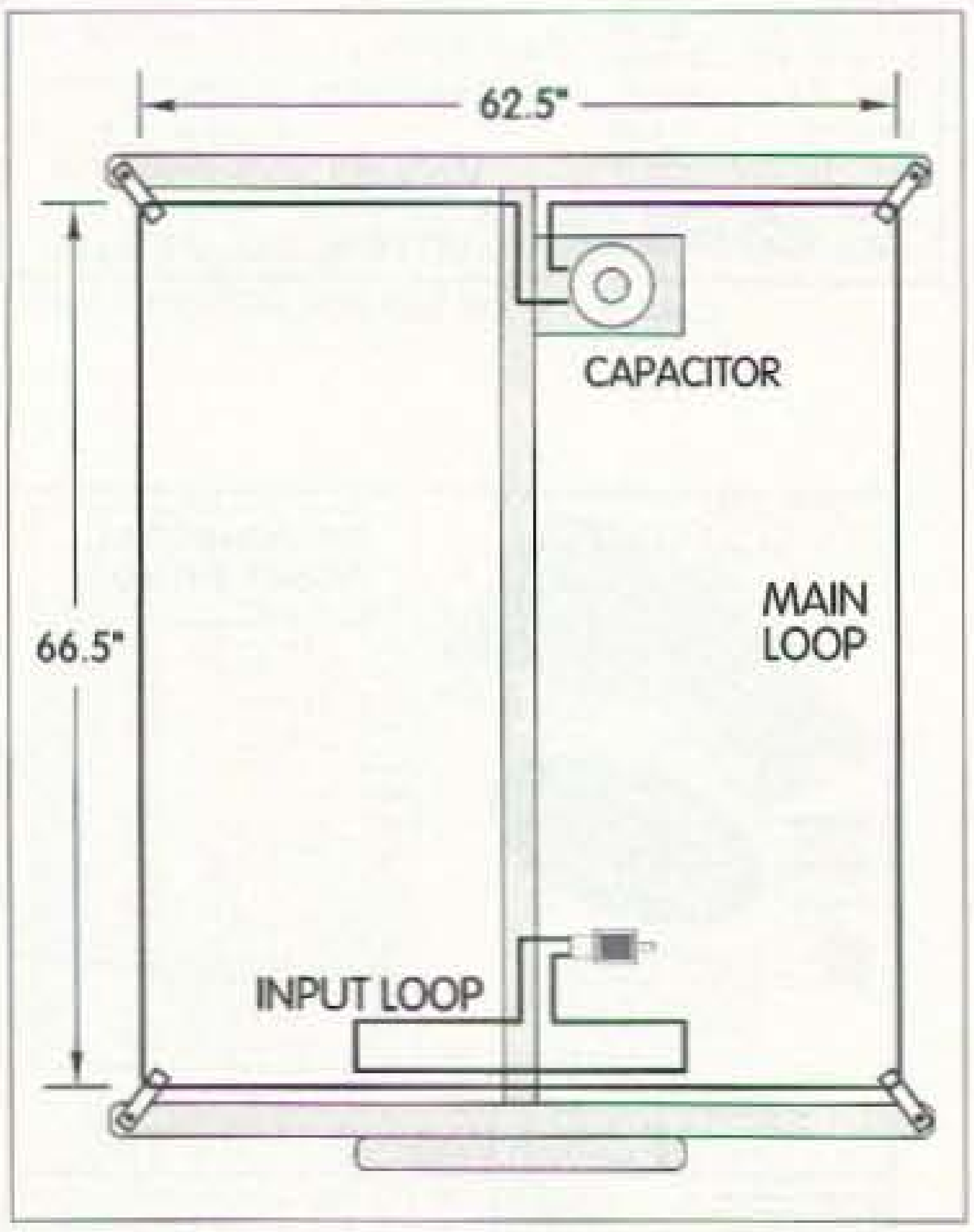


Fig. 1. The 80 meter loop antenna, showing the construction details.

Since the antenna was to stand upright to save space, I made it 66.5 inches high and 62.5 inches wide. This favors the vertical wires, which do most of the radiating. Two advantages of having the loop upright are that it is less sensitive to being near ground level than a horizontal loop, and it has some gain along the plane of the loop. Also, interference can be reduced because of the sharp tuning characteristics of a small loop and by means of the null associated with this type of antenna.

"This antenna fits easily inside a house, is easy to build and repair even during the worst weather, and is simple to tune."

Since my house is constructed of wood, the antenna works well in almost any location; some homes or buildings have a lot of metal in their construction that could shield the antenna and cause it to work poorly. Even so, there may be a spot that will work, such as a porch or an attic space above the metal.

One drawback of an antenna in the home is the danger of an RF burn. Insulation of the exposed parts of the antenna can help prevent this, but an indoor antenna must be treated with respect when it is being used to transmit.

Construction

Insulated house wire (#12 stranded) was used to form the loop. However, a wire loop requires a frame to hold it. I built a simple frame of furring strips designed to put as little wood between the radiating wires as possible. The frame holds the loop, the variable capacitor (240 pF), and the coupling loop firmly in place, yet it is lightweight and easy to reposition. See **Fig. 1.**

The sides of the loop are separate pieces of wire, supported and connected with plastic terminal blocks (Radio Shack™ #274-678). Since bolts and screws hold the frame together and the wire sides are held by the terminal block screws, it is easy to disassemble the whole antenna to move it. The capacitor is mounted on a Plexiglas™ plate screwed to the central support. (A plastic enclosure would be safer, but the plate was quicker.) The actual construction took about two hours.

Looking at the circuit design in **Fig. 2**, you can see the small loop that couples the coax to the main loop. The coupling loop is made of solid insulated #12 wire. This makes it more rigid for easy shaping and positioning. The top of this loop is held by part of a

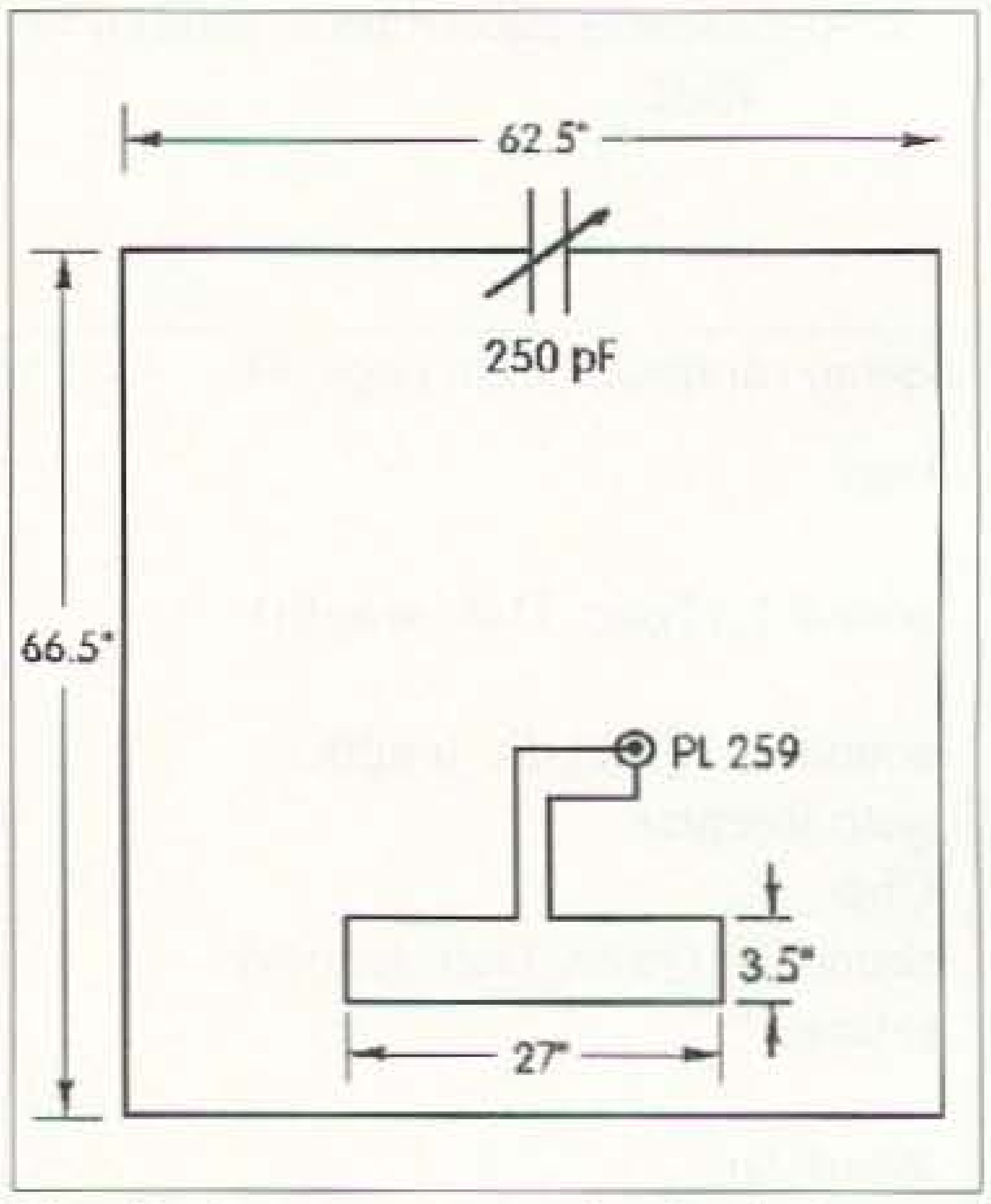


Fig. 2. Loop antenna circuit design and dimensions.

terminal block. The bottom is taped to the main loop itself. The small loop is 27 inches by 3.5 inches.

Operation

The antenna must be tuned to the frequency to be used, by connecting the antenna to a transceiver set for the desired frequency. Turn the knob on the capacitor until resonance is reached. At this point the background noise or signals will be heard, and they will be at a maximum. If the frequency is clear of traffic you can transmit briefly at low power to peak the output, using a field-strength meter. Marking resonance points on the plate that holds the capacitor makes retuning very quick and simple.

By inserting a tuner and an SWR meter in the circuit, the impedance seen by the transmitter can be improved and a wider range of frequencies can be used without retuning the antenna. Only the tuner needs to be touched up if the changes in frequency are not drastic. Recording tuner settings for future use will allow you to leave the tuner in the circuit, set it, and then resonate the loop.

Using an antenna analyzer, the resonance can be found more quickly and accurately without having to transmit.

The antenna sends out maximum signals along the plane of the loop. At the same time there is a pronounced null perpendicular to the plane at its center. These properties can be employed to enhance received and transmitted signals. Also, aiming the null at a noise source can cut down or eliminate that noise. I keep the antenna flat against a wall in an upstairs bedroom. By moving the left side or the right side out, I can easily change direction.

Since this antenna was intended for QRP use, or as much as 10 or 15 watts, the capacitor from an old 300-watt tuner served the purpose. At greater power levels a capacitor with a higher breakdown voltage should be used. Also, much more care should be given to safety considerations.

Comments

It's a pleasure to operate CW or SSB QRP on 80 meters using a relatively small antenna while still getting very good results (not getting TVI complaints is also pleasant, even when the TV is in the next room). The antenna works as well on 30 and 40 meters as it does on 80. Give it a try.

Number 38 on your Feedback card

Desoldering

Damage control for the PC board.

Michael Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

A lot of paper has been run through the world's printing presses describing how to solder electronic components onto a circuit board. Now, I'm going to tell you how to *unsolder* those same components.

The process of removing solder from a PC board can be as basic as reheating a connection or as advanced as using surface-mount hot air desoldering equipment. Surface-mount parts are not that hard to replace, but most of us don't have access to the replacements needed. For now, let's just keep to through-hole construction. That's what most of us come up against when working on a home-brew project or a kit.

Through-hole desoldering

As the name implies, through-hole desoldering involves removing solder from a hole on a PC board. There are several methods used today, and I've added a few hints and described some kinks I've discovered along the way.

You're building a kit and you have noticed a solder bridge between two adjacent pads. The kit uses a single-sided PC board.

Now, I get madder than Jim Bowie with a dull knife over solder bridges on a circuit board! It only takes a whisker of solder to stop a circuit dead in its tracks. They're so easy to make and so hard to spot! But once you have found the solder bridge, it's usually easy to get rid of.

To remove this kind of solder connection, you can try a few tricks. First, wipe off all the solder on the soldering iron's tip. The tip should be hot, clean and dry. Now, apply heat to *one* side of the solder bridge. In most cases, heating up the pad will cause the solder to wick up the tip of the soldering iron, removing the solder bridge.

If that doesn't work, clean the soldering iron tip again and apply heat to the *middle* of the bridge. Again, the solder should wick up the tip, eliminating the solder bridge.

Here's another variation you can try: Turn the PC board over, so gravity helps the molten solder move towards the soldering iron's tip. Using these methods, you can remove a solder bridge between IC pins and adjacent solder pads without much fuss. However, there are times when you need a bit more help.

"My SBY method really works."

Desoldering braid

Several different manufacturers make desoldering wicks. I use a product called "solder wick." I also have had good luck with Chem-Wik™ brand. Basically, a desoldering wick is a web of fine copper wires braided together and soaked in a chemical flux. As a matter of fact, you can use the braid from a piece of junk coax and some soldering flux to make a hunk of emergency solder wick. To remove solder from a PC board, you apply heat to melt the solder and the braid wicks the molten solder up.

The first step is to determine the proper size of the wick braid. The stuff comes in various widths. Desoldering wick is not a one-size-fits-all product. The thinnest material is great for removing solder between IC pins. The larger width is used for larger and more heat-resistant joints. You can purchase desoldering wick in .030" through .190" widths.

The idea is to heat up the wick and the solder joint at the same time. If you use a wick that is too large, you risk damage to the PC board. Plus, if you've inserted a part backwards and plan to use the part again, too much heat can damage it. Also, too wide a wick will suck up the heat from the iron, making it more difficult to remove the part. I use .062"-wide desoldering wick for most IC pins and quarter-watt resistors.

Let's say you want to remove an IC chip from your circuit board using desoldering wick. Select the proper size wick for the job. If you can, replace the soldering iron tip with one that is wider than it is pointy. You want to get heat to the joint in the shortest time possible. A needle-type iron tip is fine for soldering the part in, but you need something blunt to remove it. Be sure the tip of the soldering iron is clean and dry. You may want to "tin" the tip by melting solder onto the tip and then wiping off the molten solder. Excess solder on the tip will just get sucked into the soldering wick, leaving the solder on the PC board untouched!

Now, put a clean piece of desoldering wick on top of the joint. Apply heat to the joint and in a second or two the solder will melt and be sucked up into the desoldering braid. You may have to repeat this procedure if the joint had an excess amount of solder.

The secret to using desoldering wick is getting the joint hot as quickly as possible. In most cases a 15 watt soldering iron will not have enough "oomph" to heat up the joint, the solder, and the wick. As a rule of thumb, if it takes longer than three seconds to desolder a joint, then the iron is too small or the joint is too large. I keep a soldering iron at my side just for desoldering—a 45 watt iron with a large flat tip.

Tools, tips and suckers

All the examples I've given so far deal with single-sided PC boards. Double-sided PC boards with plated through holes require an entirely different approach.

As the name implies, plated through holes have a layer of copper deposited in each hole on the PC board. This plating is about .003 inch thick and connects the top half of the PC board to the bottom half. For most of us, that's all we'll ever see. However, it is possible to have up to 16 different layers connected to each other by plated through holes. But for right now, let's just worry about double-sided boards with plated through holes.

Unless you're really into pain, using desoldering wick on a double-sided PC board with plated through holes can be a real pooper! The wick will get the solder from the top side. Flip the board over and you can get the solder off the bottom side. However, you'll still have solder hiding inside the hole, clinging to the copper plating.

All right, here's how to get a part out of the PC board without spending a bundle on vacuum-desoldering equipment. Well, actually, there are two ways. The first is my personal favorite: the slash/burn/yank or SBY method.

Resistors are the easiest to remove using my SBY method. Since resistors are cheap, it doesn't pay to save them. So grab your side-cutters and clip one lead of the resistor as close to the resistor's body as possible (you can also just cut the resistor in half). With needlenose pliers, hold the resistor's lead and apply heat to the lead from the *top* side of the PC board. When the solder melts, yank the lead out of the hole.

Now that the leads are out of the board, you need to remove the solder from the holes. This is the second part of my SBY method.

You'll need a stainless steel needle. A needle, not a pin. You'll need something small to hold the needle, and the best tool to use is? Needlenose pliers, of course! From the top side of the PC board, place the tip of the needle on top of the hole. Heat the needle with your high-wattage iron. As the solder begins to melt, push the needle through the hole. Remove the needle. Since the needle is made out of stainless steel, the solder will not stick to it. This opens up the hole, allowing you to install the replacement part.

As simple as my SBY method sounds, it really works. But what about those parts whose leads you can't get to? Crush 'em! For disk capacitors, cut them in half. Use a small screwdriver to pry off the tops of electrolytic capacitors, leaving only their leads. Use slip-joint pliers to crush the bodies of tantalum capacitors.

For ICs you'll need a small sharp side-cutter. At the *body* of the IC, clip off its leads. Now you can remove the pins one at a time. Clean out the holes and install the new IC.

It doesn't take Mr. Wizard to tell you that the parts you remove are history when using my SBY desoldering method. However, there is a certain amount of vengeful pleasure in crushing the dog snot out of a part that took three hours to find!

> ***"Neglecting this simple cleaning step will destroy most irons."***

You always want to apply enough heat to the joint to have the solder flow freely inside the hole. If you don't, you may pull the copper plating out of the holes. You can easily tell by looking at the leads of the part you just removed: If you see a copper ring around the leads, you've pulled the plating out of the hole. With the plating no longer inside the hole, you must solder the top and bottom foils to the component lead of the replacement part. And sometimes you can't get to both sides of the board, so be sure to use enough heat to get the solder molten before you start yanking out the leads.

Super suckers

Using the needle works for small jobs, but it's time-consuming. There are other methods of getting the solder out of a hole.

The cheapest is a desoldering bulb. You squeeze the bulb, heat up the joint and place the tip of the desoldering bulb on the hole. When the solder is molten, you release the bulb. In theory, the molten solder is sucked up into the bulb. In real life, I find, it works better if I *blow* the solder out of the hole from the top side.

Spring-loaded solder suckers work just like the bulb, but are spring-loaded to supply a faster and more powerful sucking action. Alas, these things work even worse for me than the desoldering bulb! I'm sure there are many hams using these things with great success, but I'm not one of them.

Super super suckers!

If you have the money, the best bet is to get a vacuum desoldering station. Usually they come with interchangeable tips and heater elements. Always be sure to check out replacement tips if the price of the iron seems unreasonably cheap.

I purchased a unit with a built-in pump. I chose a Weller model. Other companies, such as Pace and OK Industries, also make desoldering equipment.

Because the desoldering irons have higher wattage heating elements and an instant vacuum they are able to suck the solder out of a hole in a few seconds. It's best to allow the iron to heat up the joint until the solder becomes molten. Then hit the vacuum. In an instant, the hole is clear. Sometimes it helps to wiggle the lead with the iron's tip to make sure the lead is clear from the sides of the hole. They are worth the money if you need to repair double-sided PC boards on a daily basis.

Because of the flux and old solder, desoldering equipment can be a maintenance problem. Be sure you always have gaskets, seals and other necessary replacement parts on hand.

Unlike that old soldering iron, desoldering irons need to be cleaned each and every time they are used. Neglecting this simple cleaning step will destroy most irons. In some cases, if you use the desoldering iron for hours on end each day, you may need to run some thinner through the vacuum pump to prevent the pump from seizing up. Just don't do it with the heating element on!

The best way to prevent damage to a PC board and to find the screwups is to put the right part in the right location the first time. But then you would miss all the fun of troubleshooting your own gear!

Number 40 on your Feedback card

NEW PRODUCTS

Peaceful Coexistence

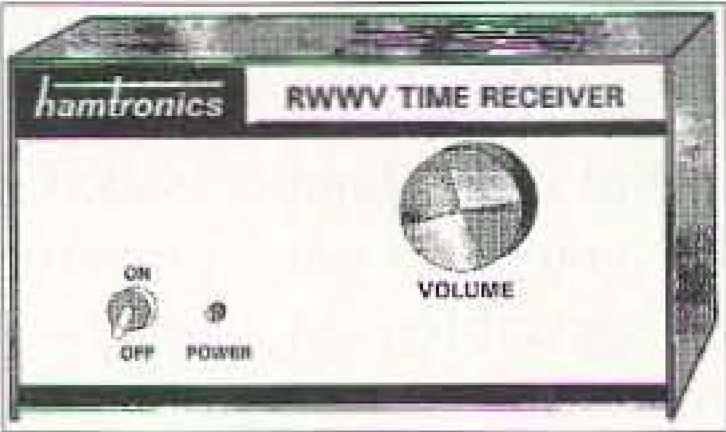
Russian manufacturer Svetlana announces the new 4CX400A high performance tetrode designed for linear service. Svetlana's innovative electron focusing and trapping configuration

reduces anode secondary electron emission, achieving increased conversion efficiency, with low intermodulation distortion. A single 4CX400A will produce 600 watts PEP at only 2500 volts DC, and three in parallel will conservatively produce the legal limit of 1500 watts PEP and key down CW with bullet-proof reliability.

The inexpensive but rugged Svetlana SK2A ceramic socket is available for use with the 4CX400A tetrode, and together they will withstand severe shock and vibration. Contact Svetlana for technical information and a list of other Svetlana products for amateur radio applications. Svetlana Electron Devices, Inc., 3000 Alpine Road, Portola Valley CA 94028. Phone (800) 578-3852/(415) 233-0429; FAX: (415) 233-0349.

License Certificate

The classic FCC Amateur Radio License certificate is back! Originally issued only to Amateur Extra Class licensees until government cutbacks in the 1980s, FCC-approved certificates are now available for every amateur class. These license certificates have been meticulously recreated and are printed on the same high-quality paper as the originals. They are $14.95. Contact License Certification Service at 800-79-CERTS (792-3787) or on the web at: http://www.quiknet.com/certs.

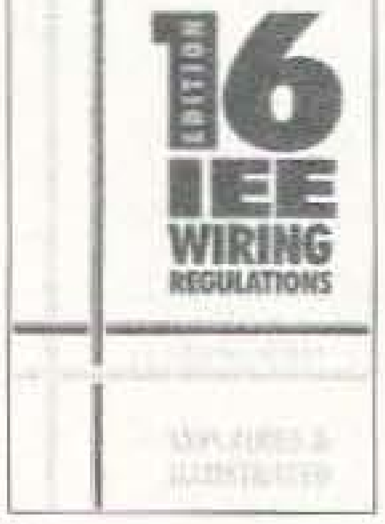


Listen In on the World

Hamtronics, Inc., has just announced a new low-cost dedicated receiver for listening to the 10.000 MHz WWV broadcasts. Don't let its small size fool you—the model RWWV is a very sensitive and selective AM superhet receiver PCB module, crystal-controlled on 10 MHz. Easy to build and align, it's a fun project, even for beginners.

The RWWV operates either on a 9-12 VDC power supply or a 9V battery. It has a 50Ω input so you can connect it to any type of HF antenna, and it's so sensitive you can get good reception with just a small length of wire or an indoor whip antenna. And the complete kit is only $89! You can also get a kit to build just the PC board module for $59, or buy the unit factory-assembled in a cabinet with speaker and AC power supply for a very reasonable $129.

For details, write to Hamtronics, Inc., 65-D Moul Rd., Hilton NY 14468-9535, or call (716) 392-9430; FAX (716) 392-9420. Be sure to tell them where you found out about the RWWV, and while you're at it, ask for a complete catalog.

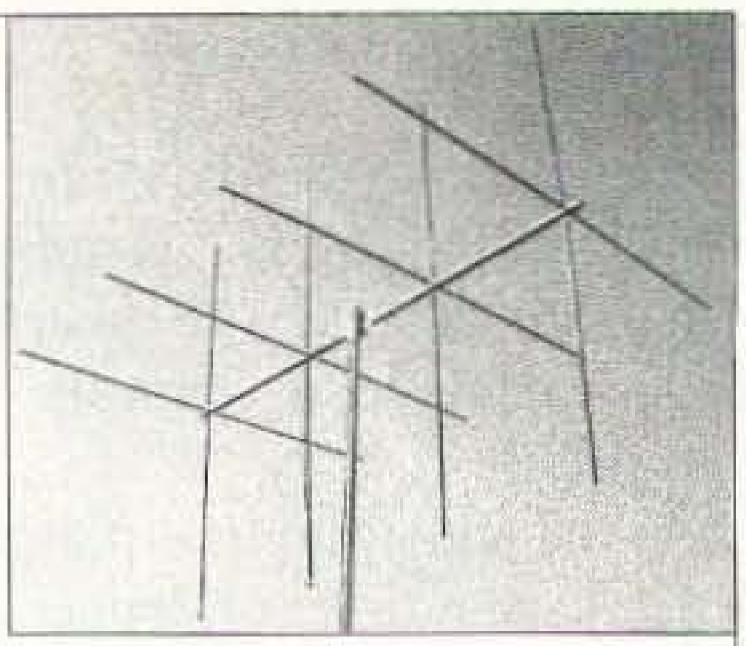


When You Have To Wire

We hams, being experts with electricity, can get drafted to deal with electrical wiring. If (or when) *you* do, you're going to need to know something about wiring regulations. For $29.95 you can invest in Brian Scaddan's *16th Edition IEE Wiring Regulations*, from BH Newness. 96 pages of everything and a half you need to know when dealing with the 120-volt monster.

New from the Cubex Hive

Cubex's new sideband antenna, the "Queenbee," is a 6 meter 4-element pretuned quad antenna, all Fiberglas™ construction with a heavy-duty aluminum mast-to-boom coupler. The Queenbee is fed directly with 52 ohm coax and features Cubex's exclusive tuning block, which allows the antenna resonance point to be adjusted slightly without completely changing the wire elements. Plus, the "Queenbee" comes with the driven element premarked for a resonant frequency of 50.2 MHz, giving the antenna a bandwidth of slightly less than 1 MHz at an SWR of less than 1.7 to 1.



The Queenbee is easily assembled and adjusted, but the best feature is the price: only $159.95 plus s&h. For more information, contact Cubex, 2761 Saturn St., Unit E, Brea CA 92821. Telephone (714) 577-9009); FAX (714) 577-9124.

EDX-2 Automatic Antenna Tuner

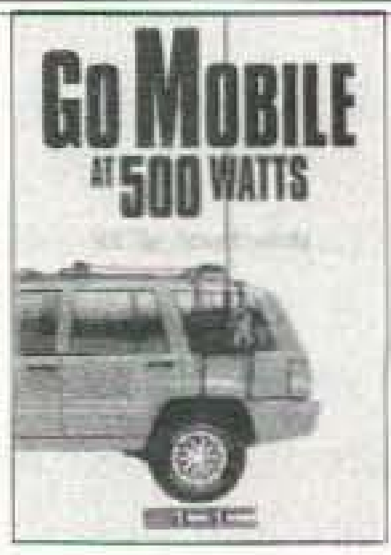
Alinco Electronics' new EDX-2 is designed to provide a quick match between antenna and transceiver, with the ability to match a length of antenna from eight to 80 feet, on bands from 10 to 160 meters (a minimum antenna length of 40 feet is required for 160 meter operation).

The EDX-2 uses computer logic to operate a network of capacitors and inductors to find the combination presenting the lowest possible SWR to the radio. Mobile users have added flexibility in using an eight-foot whip when in motion, or adding a length of wire to the stationary whip to improve HF operating performance.

The EDX-2 comes equipped with a control cable interface designed to plug directly into the Alinco DX-70 HF radio, but the unit can be adapted for use with other manufacturers' radios. It is enclosed in a weather-resistant case, suitable for use in mobile, base and marine operations, and can be operated in a horizontal or vertical position.

The suggested list price is $344, but check with your dealer because you may be able to pick up this briefcase-sized unit for less.

For more information, contact your dealer or Alinco Electronics, Inc., 438 Amapola Ave., Ste. #130, Torrance CA 90501. Phone (310) 618-8616; FAX (310) 618-8758.



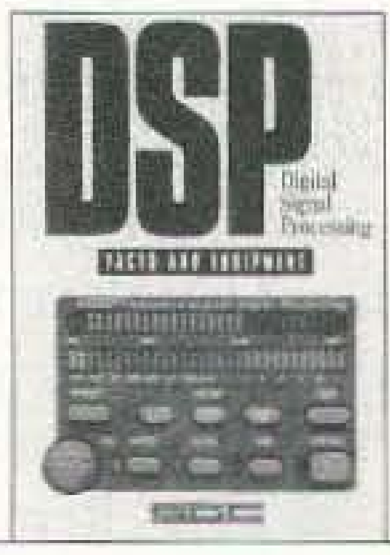
Two Pocket-Size Winners from SGC

SGC, "the SSB people," announce the publication of two new HF-SSB-oriented books: *Go Mobile at 500 Watts* and *DSP: Facts and Equipment*.

Go Mobile has chapters on the basic layout of a mobile system, on power for a 500-watt mobile system, antennas and grounds, noise and vibration, and on installation, with instructions based on SGC's own technicians' experiences in four specific vehicles—but their tips can be applied to any manufacturer's high frequency gear.

DSP is an education in how sound is recorded and reproduced, on the comparison of analog to digital filtering, on DSP in high frequency communications, and on the future of DSP.

Both books are available (suggested retail price $19.95 each) from ham dealers and from SGC, Inc., P.O. Box 35326, Bellevue WA 98009. For more information, call the SGC Marketing Department at (800) 259-7331.



Number 41 on your Feedback card

Atomic Keyer from Embedded Research

A lot of BANG! for your thirty bucks.

Marshall G. Emm AAØXI/VK5FN
2460 S. Moline Way
Aurora CO 80014
75230.1405@compuserve.com

As we used to say in the Air Force, close doesn't count, except in three sports: horseshoes, cowpie fights, and nuclear war. For us old Cold Warriors, it's a huge relief that nuclear war is less likely with every passing month. But we must still be vigilant—any nuclear detonation could send us back to the Stone Age of radio, and we Morse operators may have another heyday. I, for one, will be prepared, because I have an Atomic Keyer from Embedded Research. The AK comes close to being the perfect keyer for field and emergency operation.

No, the Atomic Keyer is not nuclear-powered. As far as I can tell it isn't even radioactive, though it will certainly help you to be "radio active." The AK-1 is a $30 kit which lets you build the least expensive memory keyer on the market, with a surprising number of features and specs, all the result of clever PIC programming. The catchy name comes from the secrecy surrounding its development by designers Gary Diana N2JGU and Brad Mitchell WB8YGG. They began working on the project early this year, and QRP guru, Bob Gobrick VO1DRB, asked them what they were working on: "...some kind of atomic keyer or something?" The name stuck.

By the time Dayton rolled around, the project was finished. A prototype had already been reviewed electronically on the QRPer's Internet lifeline, QRP-L*. Brad and Gary sold most of their first production run at Dayton, and a bunch since, mostly via mail-order and their Web home page: http://www.vivanet.com/~gmdsr. I mention this because the timing is amazing—from concept to packaged kits in about three months—and we're going to see a lot more of this in the years to come!

The Atomic Keyer features two static memories, two dynamic memories (total 64 bytes), a piezo transducer for audio output, switchable send/practice/tune modes, and variable speed iambic keying with standard 1:3 weighting. Current consumption is very low—typically around 300μA when idle and about 1mA key-down when operated from a pair of AA batteries—giving a useful battery life of about six months under normal operating conditions. Because the power requirements are so modest, no on/off switch is required (or supplied), but I added one for reasons which will be discussed later. As supplied by Embedded Research, the AK-1 kit includes everything you need except for a power source (3-5V supply, e.g. 2 AA or AAA cells), battery holder, and an enclosure.

"The least expensive memory keyer on the market, with a surprising number of features and specs."

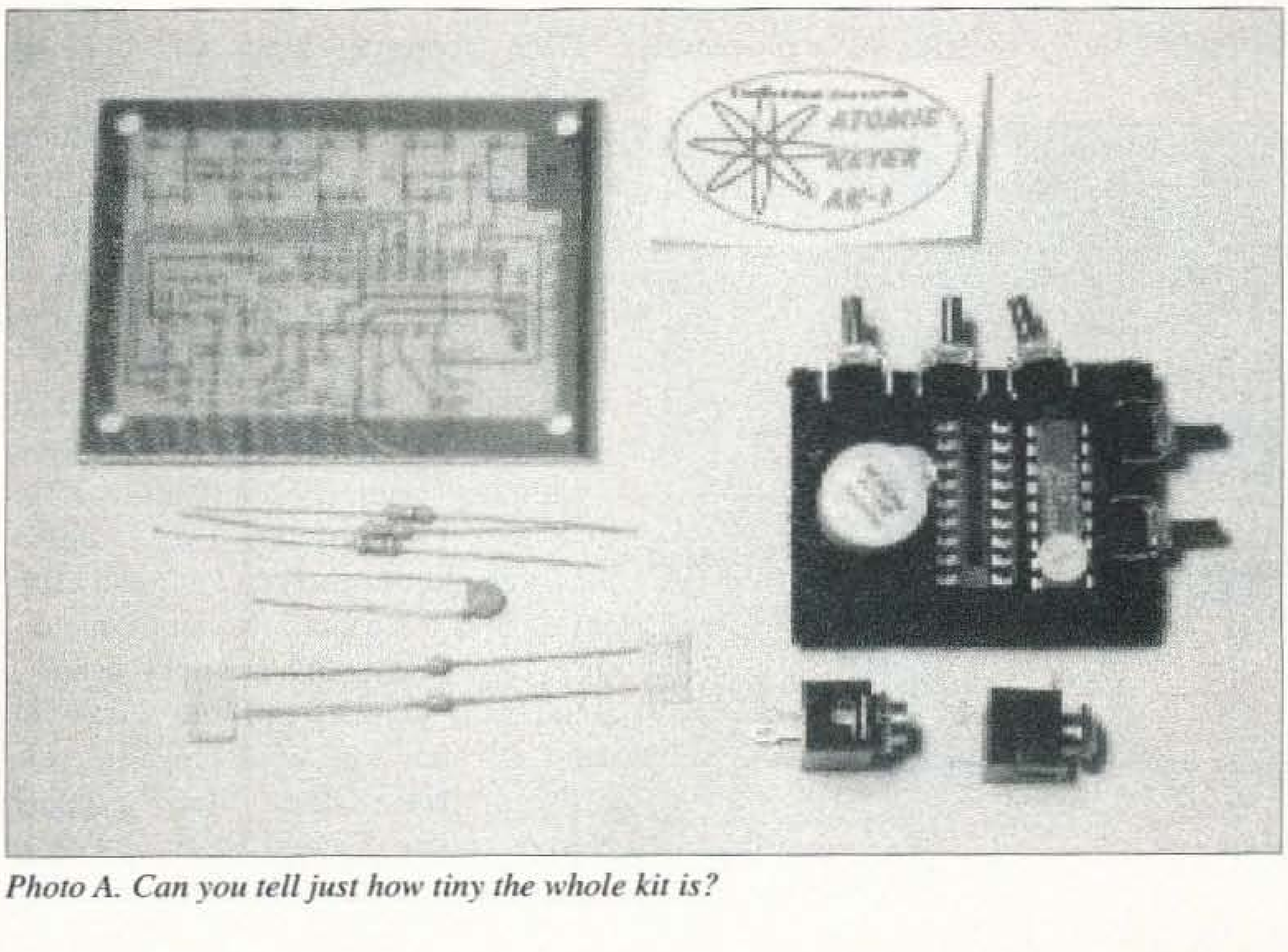


Photo A. Can you tell just how tiny the whole kit is?

Construction

You might be a bit surprised to find the kit supplied in a 6- by 9-inch catalog envelope, and you'll be astounded to find that the board and all the parts are in a tiny brown envelope. Apart from the board itself and the five push-button switches, there are only 10 components, including the microprocessor chip!

All of the components except for the (supplied) jacks for paddle and key-line are mounted on the circuit board, which measures about 2 by 2.75 inches.

Step-by-step instructions are included, and a builder with modest skills will have no trouble completing the project in less than an hour. The PIC16LC58A is an 18-pin CMOS device, so you want to be careful with its installation and handling. It is socketed, so you should leave insertion until everything else is done, and take the usual precautions against static when handling it. Soldering the pins on the IC socket is the only tricky assembly step. The solder pads are very close together, so it would be a good idea to solder under some sort of magnification and check each connection very carefully.

The instructions go into quite a bit of detail regarding the installation of the push-buttons. Read that part carefully, and do some measuring before you install the buttons! Theoretically, the buttons can be soldered directly to the component side of the board for mounting through a panel that is 1/8-inch thick. I took them at their word and found, to my chagrin, that there was not adequate clearance. One limiting factor (which was probably too obvious to mention in the instructions) is the height of other components—make sure the IC socket is mounted flush with the board, and that the chip itself is fully inserted. The switching transistor, Q1, also needs to be mounted as low to the board as possible. The manual gives you instructions for three optional mounting methods—shimming the buttons, mounting them on the foil side of the board, and remoting them.

I installed the completed keyer in a small plastic box (RS270-222), mounting the board and the jacks on the lid of the box. That was the point at which I found that the buttons didn't protrude enough for operation. Since the box is plastic, I found that I could create a single elongated hole surrounding all five buttons, allowing them to be depressed. That seemed easier than removing the buttons from the board and re-installing them on the foil side or shimming them. The box has room for an AA battery holder (RS270-382) and when finished, it's just a little blue box with two tiny jacks and five buttons on the top. You may want to use a metal box to suppress RFI generated by the microprocessor, but it was not a problem in my test environment.

If you hate batteries, it would be a simple matter to add a power jack or pigtail power lead, and, of course, a 5V regulator between any higher voltage supply and the existing +3-5V terminal on the board. A 7805 (RS276-1770) will do just fine.

There is a 10k resistor network, which is a component I hadn't seen before. I mention it because the little bugger is *fragile*. Handle with care, because a replacement won't be easy to find at your local parts store!

Although it isn't strictly necessary, I added a power on/off switch in the positive line from the battery holder. I did this because it is occasionally necessary to clear the keyer's memory, and it's a nuisance to open the box and disconnect the battery. Note that the dynamic memory in the AK-1 is volatile; that is, anything you have stored will vanish when power is disconnected. I don't see this as a problem since it's basically a CQ memory anyhow—it only takes a couple of seconds to re-record your callsign and optional second message.

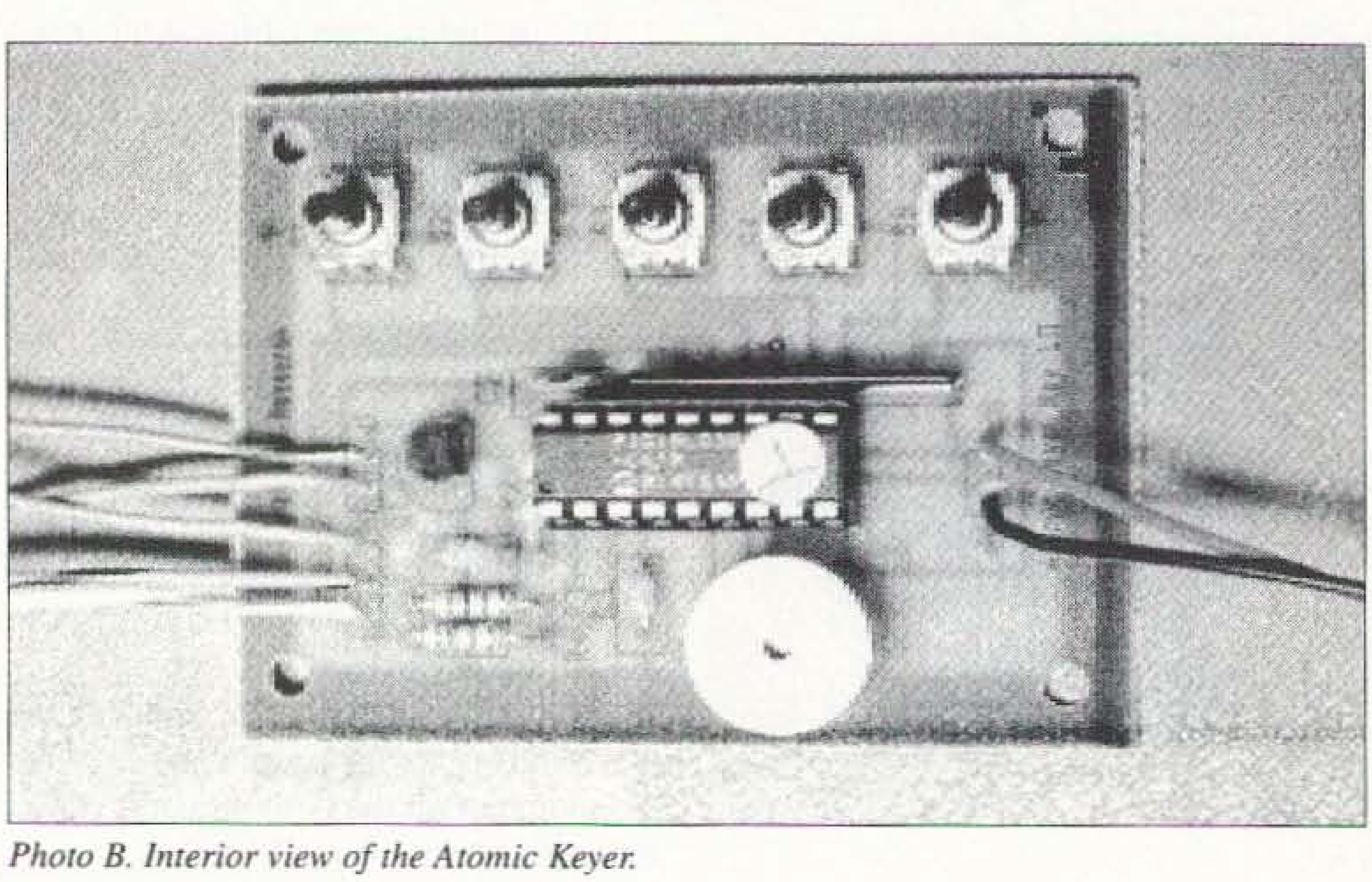


Photo B. Interior view of the Atomic Keyer.

The smoke test

The keyer essentially tests itself! As soon as you connect power to it, you will hear "AK 1" sent through the piezo audio output. There's not much that can go wrong, and if you hear the sign-on characters you are probably in business. If not, take another look at component placement and examine the solder joints. And if you still have trouble, Embedded Research is only an E-mail away.

Operation

Keying is clean and precise. As with all keyers, it will take a bit of practice to get used to the AK-1's "personality" or "feel." The ability to put the keyer into "practice" mode is great when you are first getting used to it.

The five buttons have the following functions:

1 send CQ CQ CQ DE DM1 DM1 DM1 K
2 send DM1 DM2
3 send DM1
4 send DM2
5 Set Speed: dits down, dahs up
1&3 Input DM1... Press 3 to finish
3&5 Input DM2... Press 3 to finish
1&4 TUNE Key output, stop by hitting paddle or button 4
2&4 Toggle On Air / Practice modes

DMn represents the two dynamic memories, in which you can store message text and/or your callsign. Where functions are shown with two button numbers separated by the "&" character, you need to press both buttons simultaneously to enable the function. An undocumented combination, 4&5, makes the keyer report its software version (v1.22 in the unit reviewed).

Memory usage is a bit unusual, in that the AK provides two dynamic message memories (you can load characters into them) and two static memories. The first static memory sends a standard 3 x 3 CQ call and when you send it, the AK will plug in your callsign from the first dynamic memory. The second static message will send the first dynamic message immediately followed by the second dynamic message. Personally, I think it would make more sense to go with dynamic message memories only, because I often use something other than a standard 3 x 3 QSO—I usually end a CQ with AR or AR K rather than just K; of course, once in a great while I like to call CQ DX!

The speed setting is also a bit unusual, and not adequately described in the instructions. Pressing button 5 puts the keyer into speed setting mode, after which speed is increased by holding in the dah paddle, or decreased by holding in the dit paddle. You hold the paddle in until the keyer reaches the desired speed, then release it. If the rate of increase or decrease is too slow for you, you can "bump" it along by tapping the opposite paddle (without releasing the one you are using to change the setting). It seems a little odd at first, but you easily get used to it and of course it obviates the need for a speed control pot.

Conclusion

The Atomic Keyer is an excellent little kit, representing very good value for the money. It's unlikely to replace my CMOS-III for day-to-day use in my shack, but on the other hand, it cost less than half as much and it will be great for field and mobile work. Gary and Brian are very amenable to suggestions, and indications are that the AK-1 will be upgraded as users supply useful feedback. One of the great benefits of programmed keyers and PIC technology, as compared with, say, the 8044, is that an upgrade will be just a matter of popping in a new chip.

Availability

The AK-1 Atomic Keyer kit comprising circuit board and all board-mounted components is available for $29.95 (+$3.95 shipping/handling) from: Embedded Research, P.O. Box 92492, Rochester NY 14692. E-mail: gmdsr@vivanet.com.

*To subscribe to QRP-L, send a message to LISTSERV@lehigh.edu and use the following as the message text: SUBSCRIBE QRP-L your_name your_callsign.

Number 44 on your Feedback card

M★LOG Logbook Program

It doesn't get much easier than this!

Larry Feick NFØZ
3333 W. Wagontrail Dr.
Englewood CO 80110

Call me Ishmael. Oops, wrong story! Call me old fashioned. I believe in CW, I believe in tradition, and I believe that amateur radio operators are ladies and gentlemen. I also believe that the first and only purpose of amateur radio is communication; anything that gets in the way of communication is bad, and anything that facilitates it is good. If that makes me a curmudgeon, call me Wayne Green!

For years I resisted the idea of computerizing my logbook, mostly because the logging programs I ran into were cluttered, clumsy, and had a tendency to force me to change my logging and even operating habits to suit the program. Surely it should be the other way around, I thought—computers are supposed to help people by taking over part of the workload, not add to it!

I was reasonably happy with the system I had; a paper system that worked, and worked well, and I really didn't need a computer to do what I wanted to do. Besides, most of the logging programs that I have seen are either highly specialized for specific interests (like contesting), or are designed by hams who have no idea how to write a good computer program.

So when I was asked to review M★LOG, from Milestone Technologies, I had mixed feelings. I expected the process to be a waste of time and effort, and expected to continue doing things as I have always done them. Well, it *wasn't* a waste of time, and the great news is that this is a computer program that not only allows me to continue doing things the way I have always done them, much more efficiently, but adds a whole new area of possibilities.

From the moment you open the box, you see that M★LOG is different. The manual is comprehensive and well written, and installation is a snap—just put the disk into the drive and type INSTALL. Unlike so many programs lately, this installation program tells you what it is doing and gives you some options, such as where the program will be installed. There are also facilities for updating from earlier versions, and for importing log data from other programs (and for exporting data in several different formats).

As with any computer program, there are three key questions:

(a) What data can be stored (what goes in)?

(b) What can you do with the data once you've got it into the program (what comes out)?

(c) How easy is it to use?

> ***"At the touch of a couple buttons I can see how many countries I've worked, and how many are confirmed."***

Data

QSO records in M★LOG are stored in "tables," which you can think of as being an electronic log book. Just as you can have separate logbooks for different purposes, you can have multiple log tables. I ended up creating a universal "main" log, supported by separate temporary tables for specific purposes, such as the local QRP club's contest. That allowed me to look at the contest log separately and produce a printed log and QSL card labels, but I was also able to copy the contest entries into the main log so that I could have those QSOs included in my index of stations worked, and some statistical studies that I do from time to time. M★LOG allows you to establish an unlimited number of such logs.

The QSO data to be stored is a problem area with many logging programs. There are some aspects of a QSO which you will always want to record: callsign, name, location, date, time, band, mode, and QSL card sent/received. Beyond that, logging requirements depend on how you operate and what your goals are. Some people will be primarily interested in contests, others in awards, and so on. In fact, it's probably fair to say that no two hams will have identical logging requirements. Attempting to cater to everyone's needs requires either a lot of fields, or a lot of flexibility.

M★LOG's approach to this problem is to offer a flexible record structure in which the standard data items are predefined, along with some "nearly standard" things like text comments (recorded in three individual fields, or an associated text file of unlimited size), country (from a prefix table that you can edit and update) and fields to describe your "operating conditions" (rig, power, antenna).

But, this is where this one really shows its power—in addition to the data described above, you can actually define six separate fields for whatever purposes you want. When you first start using the program, two of these six fields are set up for states and counties, but you can redefine them if you want to. I've left those in place and defined a field for grid square, and left the other three for "ad hoc" requirements such as specialized contest exchanges. There are so many things that people track these days! A few examples are Regions, Zones, 10-10 numbers, club member numbers, power levels, IOTA numbers... the list goes on. And if you need more than six of these, no problem: M★LOG will let you create a duplicate table with six more definable fields, and so on.

The thing is, each of these user fields is indexed and reportable, so at the touch of a couple buttons I can see how many counties I've worked, and how many are confirmed!

On the other hand, you don't *have* to use any fields except for the callsign, and according to the manual, unused fields do not occupy any space on your disk!

Also, at the touch of a button, you can consult a CD ROM callbook and plug the relevant information into the QSO record (and also print out a mailing address to a text file). QRZ!© and Amsoft© databases are directly supported, and others can be used with a bit of configuring.

The bottom line is that if you can write it down on a paper log sheet, you can store it in M★LOG.

Getting it back onto paper

There are four basic types of data output you might need from your logging program:

(1) Look up and display a record on the screen.

(2) QSL data in the form of cards, labels, or data for use in another program.

(3) Actual logs, for contest entries and award applications.

(4) Data analysis, including an index of every station you have worked, activity by band and mode, or whatever it is you want to look at.

All of these are well supported, and again the program goes beyond the basic requirements and offers virtually infinite flexibility.

When you want to look up a callsign, you can select from a list ordered by callsign, date/time, or several other ways, or you can input a callsign or partial callsign. Either way, M★LOG looks to be very fast. I installed it on a 386, and with about 2,000 QSO records loaded into the program an individual callsign was found almost instantaneously.

QSL data can be printed in a standard label format, and you can modify the label specs to match whatever stationery you have. You can also output QSL data as a text file, as a delimited data file, or as a WordPerfect© secondary merge file. These formats allow you to pick up the data with another program to do the actual printing. For example, if you have enabled the external callbook facilities, you can output data allowing WordPerfect to print the data block on one side of a QSL card, and an address and other messages on the other side—resulting in a mailable postcard.

An advanced feature of both log and QSL printing is the ability to prepare output from a template that you design. The template is an ASCII file which you prepare with a text editor or word processor. In the template file you can include both literal text to be printed and also specify fields from the QSO record and where they are to be positioned. I found this feature is very handy when preparing contest logs, because it allows you to specify the contents and order of columns in the report.

Probably its most powerful feature is the ability to specify logical constraints for reports and on-screen selection lists. Requests are framed in a language which will be very familiar to users of dBASE and similar programming languages. An example of use would be something I did the other day; I requested a list of all confirmed CW contacts on 40m with DX stations where the other station and I were both operating QRP.

But how do you drive it?

For all its power and flexibility, M★LOG is very easy to use. The program starts with a nice graphics screen, and the characters "ML" are sent, in Morse, from the PC speaker!

All of the various logging, reporting, and utility functions are organized in a rational manner, and the menu selections reflect the tasks in ways that are familiar and easily understood. Screens are nicely laid out, not cluttered with an excessive number of data fields, and you can move around easily with the keyboard or a mouse. Whenever the cursor is in a data field, there is a message at the bottom of the screen explaining what the field is for, and further help is available by pressing Function Key 1.

When you are entering QSO data, you can select from a number of "QSO Profiles" to provide some of the data automatically. I set up a profile for each combination of rig and antenna that I use, so I don't have to type in the information each time. And some fields are carried forward from one record to the next—fields like the band, mode, time and date, which often require only a minor adjustment. You can even set up your function keys to put specific information into specific fields.

The contest mode offers two optional methods, abbreviated and full record. In the abbreviated mode, it automatically generates serial numbers, and puts the current time in (calculated into Zulu from the PC's clock) when you press the Enter key. In the full screen logging mode, you have access to all of the data fields, so you can use your own defined fields for oddball contest exchange information like power level, member number, or first name.

"Dupe" checking is almost instantaneous, and unlike some contest programs you can continue and log a dupe. This feature is handy if you made the contact before you were able to report it as a dupe, or if there are contest rules that say, for example, dupes are OK if a certain time period has elapsed. The important thing is that it shows you all previous contacts with the station and allows *you* to make the decision!

You don't have to be a computer expert to install and use M★LOG: the basic functions are done just the way you would do them on paper, and the manual makes it easy to figure out how to do more elaborate tasks later.

What's missing? Things that I, for one, don't want! It doesn't have a keyer built into it, it doesn't directly control my transmitter, and it doesn't have predefined contest logs that need to be updated every year when the rules change. And only two of the more popular CD ROM callbooks are directly supported. If those features are critical to you, you can either use another program or write to Milestone Technologies and complain about how old-fashioned *they* are!

Wrapping up

I can say without hesitation that this is the best logging program that I have ever used, and it opens up a whole world of possibilities in analyzing my log data going back over 20 years or so. When you factor in the price (lower than most packages I see advertised) it becomes a bargain, too. M★LOG Radio Logkeeping System Requirements: Any DOS PC running DOS 2.10 through Windows 95™. Hard disk recommended.

Milestone Technologies, 3140 S. Peoria St. Unit K-156, Aurora CO 80014; (303) 752-3382. Credit card orders (Visa/MC/Disc/Amex) 800-238-8205. Price: $39.95 + $5.00 s/h in US and Canada.

Number 46 on your Feedback card

A Simple QRP Wattmeter/Dummy Load

OK, how many countries have you *worked with 5W?*

J. Frank Brumbaugh KB4ZGC
Box 30 - c/o Defendini
Salinas PR 00751-0030

Ham QRP operation is a rapidly increasing interest and the number of commercial kit transceivers, transmitters and receivers is increasing proportionately. While many kits are designed for CW operation only, more are being offered which are capable of SSB as well.

The most important thing about QRP operation, and the main reason for its burgeoning popularity, is that it works! A lot of hams with QRO stations, having tried QRP, are amazed that Q5 QSOs are possible worldwide using just 5 watts or less. And they are intrigued by the challenge of chasing awards at QRP levels, awards many have already earned using high power.

A further reason for the enthusiasm for QRP is that many hams live in condominiums, apartments and small-lot subdivisions where high power is guaranteed to interfere with the multitude of nearby consumer electronic equipment. Switching to QRP generally eliminates interference without reducing the enjoyment of operating on the HF bands.

QRP is widely accepted as meaning a maximum of 5 watts PEP or less RF output to the antenna. Therefore, QRP enthusiasts are very interested in *knowing* the level of RF their rigs are putting out. The combined RF wattmeter/dummy load described here (**Fig. 1**) is designed to measure power levels between 1 and 6 watts of RF, to provide an overlap beyond the 5-watt level. In addition, the RF levels below 1 watt are not displayed, enabling the most important 1- to 6-watt range to occupy about 95 percent of the meter scale. This instrument is easily calibrated with a variable DC voltage of about 9 VDC to just over 25 VDC, monitored with a DMM to assure voltage accuracy.

"Switching to QRP eliminates interference without reducing the fun of HF."

The circuit

RF applied to J1 is dissipated by the dummy load resistor Rx. The peak RF voltage developed across the dummy load is rectified by D1, filtered by C1, and applied through meter multiplier resistor R1 to meter M1, which is bypassed for RF by C2. However, zener diode D2, between D1 and R1, prevents the passage of rectified voltage when the input power level is less than about 1 watt. Thus, only rectified voltage from power levels between 1 and 6 watts RF will be indicated on the meter.

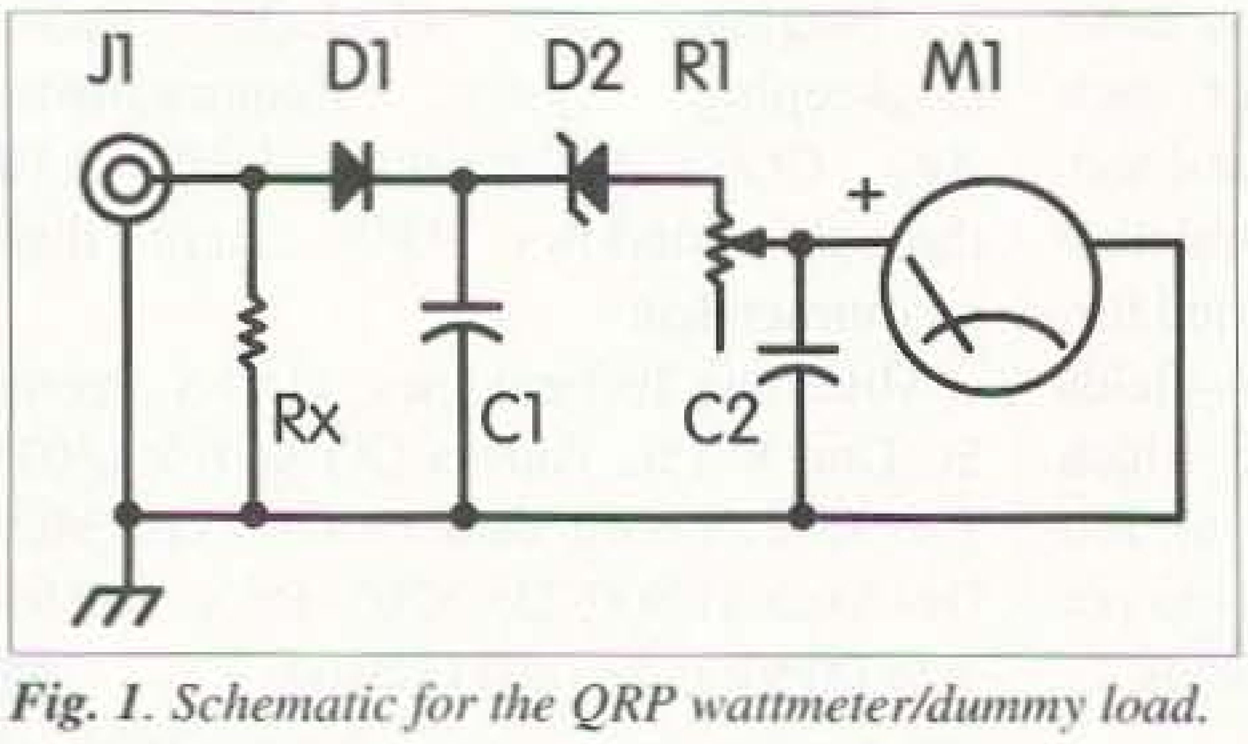


Fig. 1. Schematic for the QRP wattmeter/dummy load.

Because of the relationship between RF power and peak voltage across a known resistive load, the voltage variation is nonlinear, and is much more rapid at very low power than at higher powers. Measured on a meter, the change in rectified voltage from 0 to 10 volts (the equivalent of 1 watt) would take up the lower 40 percent of the meter scale, leaving only the remaining 60 percent for the power span from 1 to 6 watts. Using the zener diode to suppress this unwanted power range results in the 1- to 6-watt range using over 90 percent of the scale.

The calibration mark at 1 watt will be slightly above scale zero on the meter. Full-scale will represent 6 watts. The scale will still be somewhat compressed at the high end, but this is unavoidable.

Calibration

First you calibrate your meter. **Fig. 2** shows the setup for this. A source of filtered 9-25 VDC is needed. A DMM should be used to check the accuracy of the calibration voltages.

To maintain maximum accuracy, the meter must be calibrated using the same parts that will be used in the final instrument. With the parts tacked together and the meter face removed to expose the scale so calibrations can be made with a fine pen, and with R1 set to maximum resistance, gradually apply DC voltage at the input until it reaches 24.49 volts. Then adjust R1 so the meter needle rests at full scale. Mark this point "6."

Then lower the input voltage to 22.36 volts. Mark the point where the needle stops "5." This should be marked in red, if possible, as a reminder not to exceed the QRP maximum RF level of 5 watts.

Continue reducing the input voltage and marking the meter scale as follows: 20 volts, 4W; 17.32 volts, 3W; 14.14 volts, 2W; 10 volts, 1W.

An alternative method of calibration is available if you have access to an accurate low power wattmeter. Simply connect the wattmeter in line with a transmitter and the wattmeter/dummy load. Adjust your transmitter for the same power levels listed in the above paragraph, as measured on the known-good wattmeter, and mark the corresponding level on the face of the wattmeter/dummy load.

This completes the calibration. Replace the meter face, untack the components and proceed with construction.

If you are unfamiliar with the disassembly of meters please see "Use Those Surplus Meters," *73*, January 1992, page 42.

Construction

This instrument must be constructed in a shielded enclosure. An aluminum box or a case made of printed circuit board material is ideal. The meter size will dictate the size enclosure required. One of the small surplus edge or square plastic meters originally made for home entertainment equipment or CB radio, most of which have approximately a 200 µA movement, will allow compact construction. (I built mine in an LMB OOZ aluminum box which measures 2-3/16" x 2-1/8" x 1-3/4". The SO-239 on top almost makes it look top-heavy!)

"Lots of hams are amazed that Q5 QSOs are possible worldwide using 5 watts or less."

The dummy load uses six 300-ohm 2-watt 5% carbon film resistors (Mouser No. ME 262-300), connected in parallel. Ocean State Electronics carries 2% 2-watt film resistors, but not in 300-ohm value. However, a 270-ohm and 330-ohm resistor in parallel is equivalent to two 300-ohm resistors in parallel.

I chose to make my internal dummy load by bundling the six resistors together and soldering them in parallel at each end. I chose 12 watts rated dissipation so the load would just loaf along when dissipating 5 watts or less.

Depending upon the size of the enclosure and the room remaining after mounting the meter, the dummy load resistors can be bundled together tightly, although this reduces the safe maximum dissipation rating. You've got 5 watts of heat you have to dissipate, somehow.

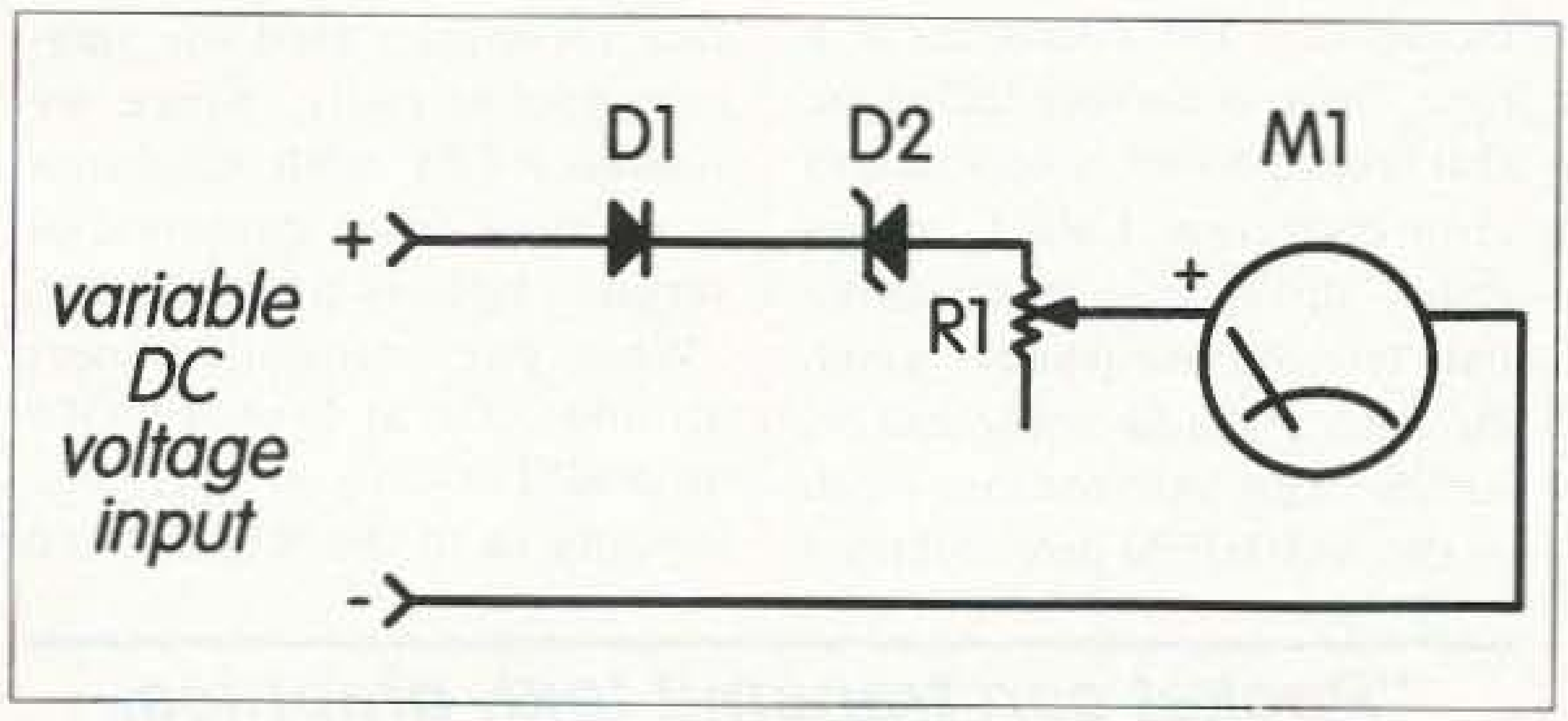


Fig. 2. Calibration setup.

Operation

Because this instrument contains a permanently wired dummy load, it is intended solely to be used either to measure RF output from your QRP transmitter or to allow setting your rig for a specific output power before connecting the rig to your antenna or tuner.

Connect J1 to the antenna connector on your transmitter. The RF output power will be indicated on M1. If you can vary the output power from your rig you can easily set it for any desired power output between 1 and 5 watts.

Parts List

C1, C2	0.01 µF ceramic disc
D1	Germanium diode, 1N34, 1N60, 1N90, 1N270, etc.
D2	9V 400 mW zener diode
J1	RF connector, builder's choice
M1	Microammeter, 200-300 µA (see text)
R1	Meter multiplier trimpot, 150k Ohms
Rx	50 Ohm dummy load, home-brewed, see text

Number 48 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
P. O. Box 473
Stevenson MD 21153

Over the last few months we have been examining some basic concepts of radioteletype. This has been in response to a number of you who have written with the message, "Hey, I just came in. What's all this RTTY stuff about, anyway?" To date, a glossary of terms, fundamentals of character encoding, and methods of digital transmission have been covered. This month the series concludes with techniques for consummation of information intercourse.

Although there are several specialized ways to transmit digital data, this column will take a look at the three major ways of moving information this way, through conventional RTTY, AMTOR, and packet.

Conventional RTTY

Conventional Baudot, or Murray, RTTY allows transmission of data from sender to receiver, one way at a time. This is often termed "half duplex" communication. As we saw last month, the bits are sent sequentially, each character composed of a START pulse, data pulses, and a STOP pulse. In a RTTY transmission, the transmitting station sends data straightaway, nonstop, until the data stream is reversed, sender becoming receiver, receiver becoming sender.

For a classic RTTY station, data rates typically are 45.45 baud (bits per second), each data pulse lasting about 22 ms. Let's forgo some of the intricacies for right now. That means that a noise pulse would have to last a substantial time, perhaps at least seven to 12 milliseconds, to destroy a data pulse. Nonetheless, a nearby signal can take out letters, or groups of letters, with abandon. Unless the receiving operator questions the integrity of the transmission, errors in data exchange will neither be caught nor repaired.

AMTOR

Contrast this with AMTOR, in which seven-level code, a special AMTOR code, is transmitted at 100 baud. Here, each data pulse is only about 10 milliseconds. Consequently, a much briefer burst of noise can "take out" a data pulse, rendering that character so much garbage.

> **"With AMTOR, erroneous groups are not displayed, they are dumped into that great bit bucket in the sky!"**

So on the surface, as it is set up, you might get the impression that AMTOR is a much less reliable medium than Baudot for RTTY transmission. Not so fast, Kemosabe! Recall that Baudot RTTY is transmitted one way at a time, with the sender's brain responsible for filling in missing characters. Thus, if you are looking at a line which says, "TO ALL STJTIONS," your brain has little trouble realizing that the third word should be "STATIONS," particularly if I tell you that the Baudot codes for "A" and "J" differ by one bit. So monitoring a Baudot transmission is no problem. Everyone expects "hits" now and then, and you develop the knack for reading through them.

But with AMTOR, we will ask the system to do this for us. So, each character must meet certain bit matching criteria (let's forgo the details here, too) to be valid. And groups of characters containing an error are as invalid as random noise.

Erroneous groups are not displayed, they are dumped into that great bit bucket in the sky! Thus, if you are just monitoring an AMTOR conversation and receive a group of characters in which the character check does not compute, your receiving setup will toss it away, and you will never see it on the screen. Since you are not in communication with the sender, and thus have no way to re-request transmission of the group in question, it is lost forever. While there are one-way, or broadcast, modes of AMTOR which build in enough redundancy to allow for a certain number of hits, they are not typically used in contact type settings.

Allowed to operate as designed, though, AMTOR allows for virtually flawless transmission. With a noise-free circuit, the rates of data transmission can approach the maximum data rate being sent. With interfering or noisy signals, the receiving station will recognize the errors in transmitted information bundles and re-request transmission of that data. Under such conditions, the many retransmissions can slow information exchange to a crawl; but the data *will* get through, and get through perfectly.

Packet

Where AMTOR operates on a morsel of a few characters at a time, there is another technique that takes a different approach to error correction. Called "packet radio," this scheme organizes the data into discrete packets which have integral addressing and error-checking information, much as the XMODEM protocol used for computer program exchange. Each burst of data, called a "frame," contains:

- •An opening flag byte
- •An address field containing the address of the originating station, ultimate addressee, and any repeaters required in between
- •A control field which identifies the type of data contained in the frame
- •An information field containing up to 256 bytes of data
- •An error-checking field using the Cyclic Redundancy Check
- •An ending flag byte

These packets are sent by FSK or AFSK as fast as systems allow, with some work done on the air at 9,600 baud. In many areas, penetration of packet is such that information of some sort is always flowing through the ether!

While each of these techniques would appear superior in some way, whether simplicity, reliability, or speed, each has its champions, and each is "best" under a given circumstance. I look forward to hearing from readers as to how you all are using these, or other, techniques to move data. I should add that while conventional RTTY is limited to alphanumeric data, packet just moves packets of data. Those packets may assemble into text, graphics, sound files, or graphics, making this transmission technique invaluable to the transfer of complex information in this digital age.

> **"Packet can transmit text, graphics, sound files or graphics, making it invaluable in this digital age."**

In fact, the packet switching network that forms the heart of the Internet and the World Wide Web is only a slightly different form of the transmission technique used for amateur packet radio. Since we started RTTY with machines scavenged from commercial service, I guess we could say, "What goes around, comes around." Or at least LOOPs around! Lots of you have been logging in to the RTTY Loop Home Page, where back columns are available, as well as lists of programs available in the RTTY Loop Software collection, and many, many sites of interest to the radio amateur on the World Wide Web. Check it out yourself, at http://www2.ari.net/ajr/rtty/. Let me know what you think, and what you are interested in seeing in future columns, by snail mail to the post office box, or via E-mail to me at ajr@ari.net, or on America Online at MarcWA3AJR, or on CompuServe at 75036,2501. Above all, let me hear from you! 73

NEVER SAY DIE

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The information on how to care for your body is available, you just aren't going to find it in the medical books. Just as you fight change, whether it be the code test, at your work, getting serious about dieting, etc., doctors tend to stay with what they learned in school. They don't spend much time keeping up. That might louse up their golf days or fun times spent at medical conventions (more golf). Yes, I'm cynical. I'd be less cynical if America wasn't down near the bottom in health among developed nations.

Ignorance Is Bliss

Sure, as long as you can be blissful when you are both poor and sick. A lack of skills and knowledge dooms one to either a career in crime or a non-demanding, low-paying job with little future. Ignorance of maintaining the body means chronic illnesses such as diabetes, arthritis, multiple sclerosis, Lyme disease, back trouble, heart attacks, glaucoma, cancer, AIDS, and so on. That's bliss?

Publishing Technology

Technology sure has changed publishing over the last three decades. When I started *73* in 1960 I would get typewritten copy from the authors. I'd then edit this with a pencil, using standard proofreaders' notation, and send it to the printer to be set in type. I'd picked Morton Press, in downtown Manhattan, a 60-year-old printing company that specialized in magazines.

The type was set on old Mergantheiler Linotype machines using hot lead. They'd ink the trays of type and send me galley proof strips for proofing and to paste up into page format. The photos, schematics, and other illustrations were sent out to be made into halftones and came back as thin copper sheets stuck on wooden blocks the same height as the lines of type. I would then cut the galleys and proofs of the illustrations to fit the pages and send these "pages" back to the printer to have the type and illustration blocks clamped together to print the pages. They would then correct any typesetting errors (often making more errors in the process), put the pages together and send me a proof of the assembled pages.

The last two or three days before press time were hectic, requiring me to be at the printer's plant to make last-minute corrections and then correcting the errors made in making the previous corrections. Printers had special rooms set aside for the editors to do this last-minute work.

Today most articles arrive in disk form and I edit them on my computer. The photos are scanned in by computer. The schematics are drawn by computer instead of by a draftsman. Then the copy and illustrations are put together in the computer and the finished page printed out on film for offset printing.

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NEVER SAY DIE

Continued from page 49

When I was starting *73* I had to buy a stencil addressing system and a mimeograph. The addressing system used paper stencils which had to be softened with water before typing. There was a stencil holder that clamped on the typewriter platen, and typewriters had a stencil position that pushed the ribbon out of the way. The typewriter then cut the softened paper. The stencil printing machine weighed in at around 600 pounds. I'd stick stacks of the stencils into one side and it would slide them under an inked roller and print the address. At magazine mailing time I'd have to sit there for hours feeding magazine wrapper papers under the stencil printing area. Then I'd drive the cartons of wrappers to the printer in Norwalk, Connecticut.

How did I get *73* started? Well, I didn't have much money, so I first sent letters to every ham club I knew of, asking for subscriptions. I also wrote to all of the ham radio stores, suggesting they carry the magazine on their counter. By selling my boat, plane, and a Porsche I got just enough money to print 10,000 copies of the first issue. Around 300 stores ordered copies, plus I had around a thousand paid subscriptions. By the third issue my 10,000 print run was too little and I ran out of copies to sell as back issues. Within two years I had over 850 ham stores selling the magazine and the subscriptions were pouring in.

Having edited *CQ* for five years, I knew all of the ham authors, so I asked them to consider my new magazine when they were writing construction articles. Despite all my travels the year before, when I was fired from *CQ* I had five whole issues completed and ready to go. Their new editor, outside of getting bogus ham tickets for the *CQ* staff, had little to do. When it finally came time for him to do some work he couldn't do it and he was fired.

The *CQ* publisher wanted to stop running construction articles and just run columns, so my old authors had no choice but to turn to *73* They, understandably, wanted to get paid something for their work, and *QST* paid nothing except prestige for their articles, so I had the first choice on most construction, theory and product review articles.

Just 13 years ago, when I was forced to sell my whole magazine empire to one of the megapublishers (or else!), I started over. At that time it cost me over $500,000 for the latest in a computer publishing system. Now, for under $1,000 you can do almost as much as we could with that half-million-dollar system. A used Mac PowerBook© and a used laser printer and you're in business. I still do some of my work on a $500 (used) Model 140, though I've graduated to a faster and larger-screened Performa© Mac for most of it. But even the fastest new Mac and the latest in film printers cost less than $50,000 now, down over 90% in 13 years. And prices are going to nothing but continue to go down as faster processors, cheaper RAM and bigger storage devices appear.

There are few businesses that couldn't be helped with a newsletter and an easy way to generate promotions, so we'll be seeing more and more in-house publishing. There's a great opportunity there for people to become experts in this technology and consult for small businesses.

Outraged

I am outraged over the outrageous things people are getting outraged about. I'm up to here with political correctness and with the seemingly endless euphemisms invented to spare people's increasingly delicate sensibilities. Mental institutions, correctional facilities, Department of Defense, physically challenged, senior citizen, chairperson … phooey.

More Bum Dope

A reader from Ohio claims the HamVention speaker chairman told him he didn't ask me to speak this year because I demanded a speaking fee, plus travel and hotel costs. I don't charge a speaking fee for hamfests. I do usually ask that my travel and hotel expenses be covered, though I did not ask this of the HamVention.

Here's exactly what I wrote to Ken Allen KB8KE: "While I was disappointed to again not be invited to be on the program, I can understand the pressures you must be under from the League... I'm their worst nightmare and you certainly can't afford to offend them. I've heard from several sources how they're gloating over being able to keep me off the program.

"My message this year is the most important I've had since I first spoke at Dayton in 1955, where I addressed the banquet. I'm calling for every ham club in the country to do their utmost to get at least one local ham elected to their state legislature. The next step is for this person to get on the educational committee and introduce a bill getting the state's schools to initiate an eight-year course in the fundamentals of electronics, communications and computers for grades 5-12.

"Our country desperately needs high-tech career workers to design, manufacture, sell, operate, and service the high-tech products which will dominate both business and home in the 21st century. This can help us get radio clubs started in every school in the country and revive the high growth we had from 1946 to 1964 (11% per year, steadily for 18 years!). Without something dramatic like this, how many years can we really hope to keep our hobby going, considering the mounting commercial pressures for spectrum and the billions they are willing to pay for it? Ham legislators have an added benefit to us of being able to provide some clout when matters of interference and antenna restrictions come up. We need to infiltrate the state legislatures, so I'm really disappointed that I won't be able to get this message across at the HamVention this year."

No, I didn't get any answer.

Most conferences pay the travel and hotel expenses for the speakers. I spoke at the Tesla Society in Colorado Springs, the Global Sciences Congress in Tampa, and the Edmonton Ham Convention last year on that basis. But it's tough for me to take the time to give talks, so I haven't been pushing it.

Ideas

If you'd follow the instructions in my $5 booklet, *Making Money, A Beginner's Guide*, you wouldn't have to have me think up ideas for ways to get rich. I keep coming up with great ideas for new businesses on at least a weekly basis. There are endless products and services which would sell well, but which aren't on the market yet.

When I was a kid I got a pair of in-line skates, but having just two wheels, they weren't easy to use. By adding a couple more wheels an entrepreneur has racked up hundreds of millions. How come you didn't think of that? Well, there's a wide-open opportunity for someone now to use modern materials and invent a pair of roller skates (the old kind) that are light and can be simply snapped on a pair of (probably special) shoes. What a great answer to getting around our cities! Beats the heck out of walking. But they have to be simple to put on and take off, and easy to carry around. The market? Millions upon millions of pairs for use in every city in the world. Yes, I've written about this before, but you haven't done anything about it yet. I don't want to hear any complaints about your not having money.

How about an idea for a new and badly needed publication? I sure wish I had the time to do this. This has to do with helping food companies introduce new products. Hundreds of new products are being put into our supermarkets every year, and zillions of dollars are being spent to build their sales. How about a magazine to sell at checkout counters which would provide information about these new products? I'd encourage the public to try the new products and then report on how they liked them. A vox pop approach. None of us put much credibility on product endorsements in ads, but where an independent magazine publishes customer reactions, this would be much more believable. And this is something no company could generate through advertising.

Yes, there would be both good and bad reviews. This is what I did when I published *CD Review*. It's the only way to maintain credibility. Sure, the major labels really hated it when we trashed one of their new releases, but since our readers were spending about $25-30 million a *month* on CDs, they had no choice but to advertise in my magazine.

It's different when it comes to high-ticket products like audio equipment. There my policy was to only publish favorable reviews. But we never did a favorable review on anything that didn't deserve it. This is my policy with *73* too. If a product is good, I want to help the manufacturer to sell it. If it isn't very good, we just keep quiet.

With the food business there are so many new products and their cost is low, so the reviews should be brutal where brutality is called for. In the long run that's helpful for the manufacturers too. It shortens the agony for crappy products and the company will lose much less in the long run.

Would supermarkets make room for a new magazine? Anything that helps them bring in more customers and sell more products will get good placement.

Yes, I seem to often think in terms of publications. Well, they're easy to start small and build. With today's desktop computers anyone with $1,000 can get into publishing.

How about a magazine or even a flyer called *Killer Bs*? This would review the B movies on tape, and there are thousands of 'em. Some are darned good, but how can you find out about 'em? You sure can't tell from the package. I might even rent some videos if I had a way to tell what was good.

For that matter, we need a lot better system for reviewing first-run movies. Oh, I tape "Sneak Previews" and Siskel and Ebert to see what they think, but I haven't found them very reliable. My idea is to go to the first showing of a new picture and poll the emerging audience. How did they like it? You could hire a dozen high school students to poll a couple audiences and you'd have information that would support at least a newsletter. I'll bet you could get a radio or TV spot on the news with your results too.

Next thing you'll be reviewing plays, new museum exhibits, and so on, the same way.

One idea I wrote about several years ago and you ignored had to do with organizing a CD for graduating high school and college classes. You'd get together with a local recording studio and make recordings of the bands, choral groups, etc., as a graduation keepsake. It would be like the photos of the graduating class.

There are a lot of schools within driving distance, so you could work up quite a business.

Just keep your eyes open and your imagination on the front burner and you'll be able to think of all sorts of part-time money-making opportunities.

If you have a computer and laser printer you can start doing newsletters for local businesses. They don't have the personnel, the time, or the equipment to do them, but a newsletter is a powerful selling tool. And by the time you're doing a dozen of 'em, you'll be very busy. The next thing you know, you'll be keeping their mailing list for them too.

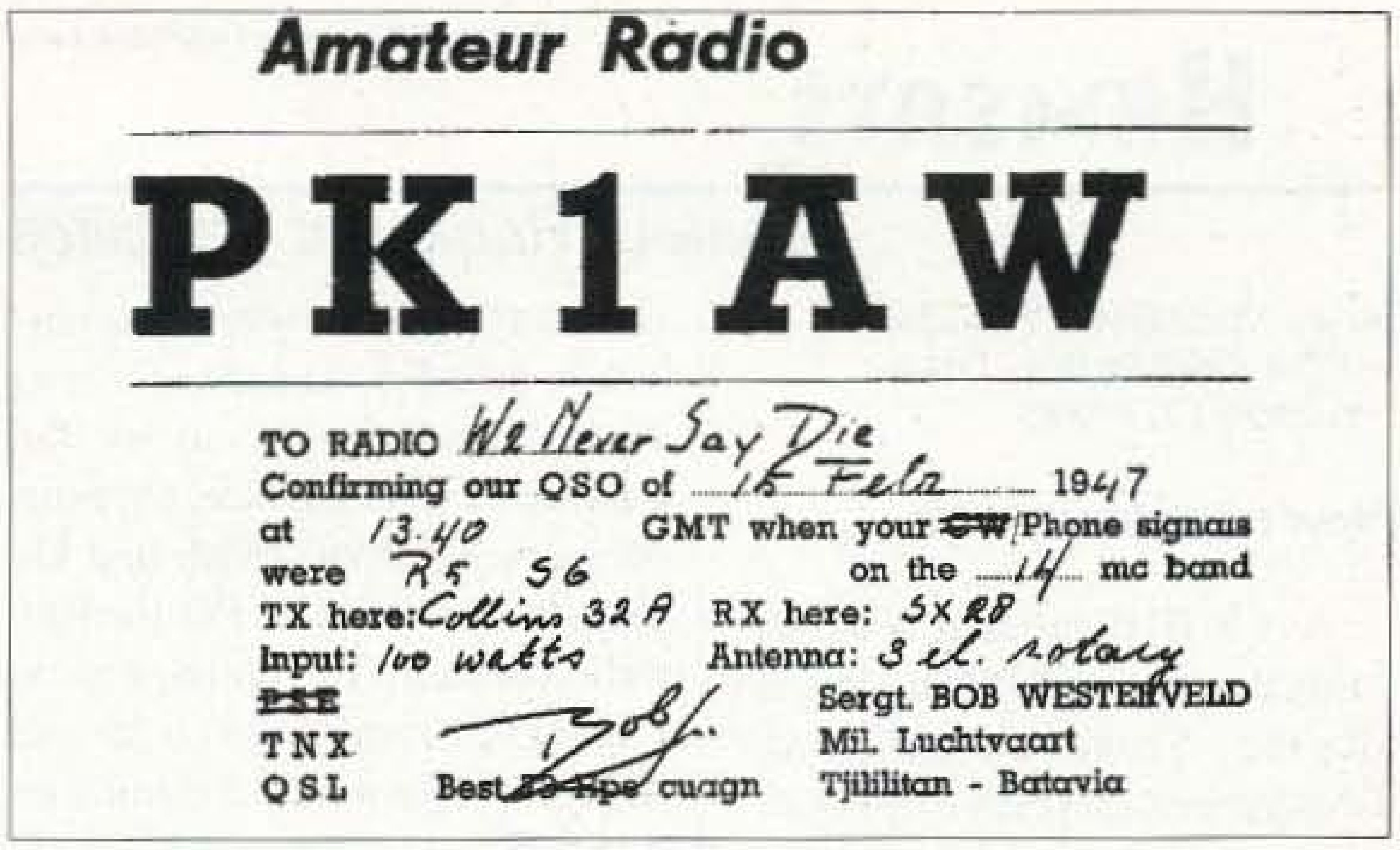
That ought to hold you for a while. If you'd like to read about more of my brainstorms, let me know. There's no shortage.

More Ideas

Money-making ideas, of course. There are all sorts of products and services out there just crying for entrepreneurs to step up and take a swing. Some will provide a fun and profitable life for you. Others will give you the opportunity to make millions—which is okay, as long as you don't get caught up in the pursuit of money as a goal in itself.

One wide-open opportunity is in the organization of hi-fi shows. Back in the 1950s, when I started my first manufacturing business, making loudspeaker enclosures, my main sales tool was demonstrating my product at hi-fi shows around the country: New York, Boston, Washington, Chicago, Los Angeles. These shows were in hotels and were packed solid with people listening and buying. Without those shows my speakers never would have become the best selling speakers in the country within two and a half years of their introduction. But I don't know of anything like that happening around the country now, and I'm too busy to do it, though I know the ropes, having put on a whopping computer show in Boston.

What happened to the shows? The industry, under pressure from Avery Fisher, took control and that was the end of it. Industry groups tend to be slow to meet changes. Look what happened to the IEEE and the NCC shows, once the largest in the country in electronics and computers. Pffft. Showmen can run successful shows, not committees.



Cold Fusion Gets Easier

When Doctors Pons and Fleischmann, two respected chemists, stuck a palladium wire into a lithium and heavy water solution, and then passed a current through it for some days—suddenly the cell started generating far more heat than any chemical reaction could explain.

Other scientists tried to replicate the experiment using palladium wire, sheets, and chunks. Many failed, but some succeeded. Those who failed went to the press to exposé P&F's fiasco. Those who succeeded kept working to refine to process—to make it work faster, more dependably, and generate more heat.

Physicists were adamant that this was not fusion because so little radioactivity was detected. Impossible. So, lacking any theory for why this "anomalous heat" was being generated, researchers went by the seat of their pants (empirical, it's called), trying this and that. Some were even getting heat using nickel and plain water.

The effect was best with metals having a lattice-like molecular construction such as palladium, nickel, rubidium, rhodium, and platinum. These metals acted like sponges, absorbing hydrogen. They found that around the time the lattices were 85% full of hydrogen the anomalous heat started appearing.

Jim Patterson, an inventor, and not a chemist or physicist, figured that since the start of the reaction depended on the metal absorbing hydrogen as quickly as possible, the more surface area of the metal, the faster it would absorb the hydrogen. So he coated some microspheres of polymer with palladium. Sure enough, the reaction started reliably in record time—in a few minutes instead of days. And the amount of heat increased amazingly. By last December he demonstrated a cell at a power company conference which was generating over a thousand watts of heat with only about one watt of drive. A thousand to one!

Hmm, said I, if those microspheres work so well, why not eliminate the spheres and just use cheaper and easier-to-make finely powdered metal. That would have even more surface area. Or go the next step to a chelated metal? Heck, go to even smaller metal particles by making a colloidal suspension of the metal in the electrolyte solution? Talk about surface area!

When I asked Patterson about this, he smiled and said he'd done just that and had some patents in the works. Jim's the chap who got the first cold fusion patent on his cell, and then the first patent claiming more energy out than in. Since that smacks of perpetual motion, which the patent office has always refused to even consider, this may be a historic first. It's real enough so Motorola and Bectel are already said to be licensed to help develop the technology.

Lest you think that colloidal metals are something mysterious and difficult to brew, they're something you can make on the kitchen table yourself. In minutes. No, this cold fusion research field doesn't take a million dollar laboratory to get in on the fun. Indeed, the leading American researcher in the field (before Jim) was Dennis Cravens, a young teacher at a small college in Vernon, Texas. Dennis set up a small lab in his garage and, investing less than $5,000 in his equipment, was a true pioneer. I first met Dennis when he was delivering a lecture on his

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HAMSATS

Amateur Radio Via Satellites

Andy MacAllister WA5ZIB
14714 Knights Way Drive
Houston TX 77083

New repeater in orbit

A new UHF repeater is in orbit using the callsign RRØDL. It's part of the Space AmateurFunk EXperiment (SAFEX) from Germany, and is fully operational from the *Mir* space station. You can work stations across North America via this 70 cm in-band FM repeater in space. Although it helps to use a home station with directional antennas and reasonable power, many stations have had successful contacts through the repeater using only handie-talkies and "rubber-duck" antennas.

What is SAFEX?

On October 30, 1985, the space shuttle *Challenger* was launched carrying the first German Spacelab mission. During the week-long mission a special crossband transceiver from Bosch was used by Dr. Reinhard Furrer DD6CF, Dr. Ernst Messerschmid DG2KM, and Dr. Wubbo Ockeis PE1LFO for ham radio contacts. The uplink was on channels between 437.125 and 437.375 MHz with a downlink on 145.575 MHz. Several hundred calls were heard by the German Spacelab hams and dozens of successful contacts were made. This was the first German amateur radio operation from space. Since then there have been several.

In 1992, the German ham activities went to *Mir* using the callsign DP1MIR. The second German Spacelab mission followed in 1993, once again with the callsign DPØSL. In the next two years the Russian-ESA (European Space Agency) operations continued with the DP3MIR endeavor in 1994 and the DPØMIR project in 1995.

In 1993, discussions and negotiations ensued between NPO Energia and Russian radio amateurs concerning future ham radio gear and operations onboard *Mir*. A new ham radio station for *Mir* was proposed. In 1994 three groups in Germany agreed to fund, design and build a new system to be mounted in the "Priroda" module in *Mir*. The German groups included the *Deutscher Amateur Radio Club (DARC)*, the Ham Radio Group at the German Aerospace Research Establishment *(DLR)* and the *Deutsche Agentur fuer Raumfahrtangelegenheiten (DARA)*. The Russians supported the installation in the "Priroda" module and the operation of the station.

Experience with earlier German and Russian space missions showed that astronauts and cosmonauts are very busy. The SAFEX-II system was developed to allow ham radio activity without constant intervention by orbiting hams. The popularity of the digital packet radio digipeater system used by the Shuttle Amateur Radio EXperiment provided a good model, but did not provide any unattended voice activity that a "flying" repeater can provide.

Mode 1: NBFM UHF Repeater

Downlink: 437.950 MHz
Uplink: 435.750 MHz
CTCSS Tone required for access.

Mode 2: 9600-Baud Packet

Downlink: 437.975 MHz
Uplink: 435.775 MHz
No CTCSS tone required.
Primary operation: digipeater.
Mailbox active with onboard laptop.

Mode 3: QSO Operation with *Mir* Crew

Downlink: 437.925 MHz
Uplink: 435.725 MHz
CTCSS tone required for access.
Digital voice recorder can provide beacon messages.
Packet transmission of digital pictures.

SHF Experiment: 10-MHz-wide linear transponder

Downlink center: 2410 MHz
Uplink center: 1265 MHz
Uses include high-speed data, ATV (FM or AM), etc.

Table 1. SAFEX-II frequencies for RRØDL on Mir.

The gear

The SAFEX system is comprised of two main units with various auxiliary components. The equipment weighs in at around 30 kilograms. Three external antennas are needed, along with significant electrical power. During normal operation, the complete system draws about 50 watts in a 24-hour period from the 28-volt *Mir* power bus, but can draw as much as 300 watts in two hours during high-power transmissions. The SAFEX gear can be commanded for frequency and mode changes by the cosmonauts, or remotely operated by ground stations in Russia (R3K in Moscow) and Germany (DFØVR in Oberpfaffenhofen).

"Many stations have had successful contacts through the FM repeater in space using only handie-talkies and 'rubber-duck' antennas."

A digital voice recorder and digital voice identifier system are included, along with a 9600-baud TNC (Terminal Node Controller) for packet operation. Appropriate filters are incorporated for the repeater and crossband modes. A 2 meter transceiver is not part of the current system, but will be installed for later crossband work.

The primary radio unit is the 430 MHz repeater with a 2.2 MHz offset between input and output frequencies. It can also be used for two-way contacts with those on *Mir*, or as an AX.25 packet digipeater, still with the 2.2 MHz split between uplink and downlink frequencies. A laptop PC can be connected to the SAFEX 70 cm unit for mailbox operation when in the packet mode. The packet system will also be used to send pictures from *Mir* using a special file format compatible with a new software version of JVFAX, currently in development. A digital camera is used to get an image that is subsequently stored in the laptop, and then transferred to the TNC.

During the first days of the SAFEX-II operation, the digital recorder was used to send a voice message on an FM downlink of 437.925 MHz. Early repeater operation required the use of CTCSS (Continuous-Tone, Controlled-Squelch System—also known as "PL" or Private Line) tones to activate the repeater on the uplink frequency. The tone used in July was 141.3 Hz, also known as EIA (Electronic Industries Association) code 4A. While this tone setting can be changed, it may become the standard for future operation. Refer to **Table 1** for uplink and downlink frequency details.

The second radio unit includes a crossband linear transponder with a 1265 MHz input and a 2410 MHz output. While use of the 70 cm system is geared more toward "normal" ham operation, the L/S-band system is an experiment designed to test techniques that may become more prevalent on future manned missions. The microwave transponder is 10 MHz wide and uses an IF (Intermediate Frequency) in the 70 cm band. This bandwidth is capable of passing high-speed data or even television signals. The ATV (Amateur TeleVison) group at the University of Bremen was tasked with the design and construction of many of the L/S-band components. The wide bandwidth of the transponder is sufficient to pass most AM or FM ham TV signals. For narrowband signals, however, the Doppler shift will be a problem. At 2410 MHz, a signal can exhibit over 100 kHz of apparent drift from AOS (Acquisition of Signal) to LOS (Loss of Signal) during an overhead pass. SSB (Single Sideband) or CW (Continuous Wave) operation will be a REAL challenge.

Finding *Mir*

The best way to track the *Mir* space station is to use a tracking program on a computer. Software can usually be purchased or found on various BBSs, via the Internet. A good source of quality programs is through AMSAT, the Radio Amateur Satellite Corporation. You can call for information at (301) 589-6062. Access via the World Wide Web can be found at http://www.amsat.org. A simple

Timeline	Downlink	Offset	Uplink
Start of Pass	437.960	-2.22	435.740
	437.955	-2.21	435.745
Closest Point	437.950	-2.20	435.750
	437.945	-2.19	435.755
End of Pass	437.940	-2.18	435.760

Table. 2. Doppler-correcting Mir repeater frequencies (MHz) for ground use.

alternative is to set a dual-band (2 meter and 70 cm) radio or scanner to listen on 145.55 MHz and 437.95 MHz. The 2 meter simplex frequency has been active for many years, and the 70 cm frequency is the *Mir* SAFEX-II repeater output.

Working the SAFEX-II repeater

At 70 cm frequencies, Doppler shift is a serious consideration for NBFM (Narrow-Band FM) work. The apparent receive frequency at the beginning of a pass will be as much as 10 kHz higher than expected. At the end, it will be 10 kHz lower. To get into the repeater, compensation must also be applied to the uplink signal.

Using the published uplink and downlink frequencies, effective communications can only be achieved through the repeater when the *Mir* space station is at its closest point to the observer. At all other times during the pass, corrections must be made to hear the repeater output and to get into the receiver.

Doppler shift is a result of the relative velocity of a moving object with respect to an observer. For a horizon-grazing *Mir* pass it will be at a minimum. For an overhead pass it will be at a maximum. Most new tracking programs allow the inclusion of a specific frequency for Doppler calculations. Use 437.95 MHz if your program has this option. It will provide data on what to expect when the space station comes over.

While listening at a higher frequency at the beginning of a pass, it will be necessary to transmit lower than expected to get into the repeater. For example, if the repeater signal is heard best on 437.96 MHz (rather than the published 437.95 MHz), the appropriate uplink will be on 435.74 MHz (rather than on 435.75 MHz). This correction will change during the pass. Continuously modifying the repeater offset in the radio during a 10-minute pass can be difficult. If your UHF transceiver has memories that can be programmed with different repeater offsets or input/output frequencies, an easy alternative is possible.

> ***"The SAFEX-II system was developed to allow ham radio activity without constant intervention by orbiting hams."***

In a typical 70 cm HT or mobile rig, with tuning increments of 5 kHz, program five different memory locations with appropriate receive frequencies and repeater offsets. Don't forget to include the 141.3 Hz CTCSS (PL) tone. **Table 2** is a list of five receive frequencies and suitable transmit offsets that will take care of the Doppler corrections needed during any pass. Simply tune for the best audio quality, and the programmed offset will provide the proper uplink frequency to center your signal in the *Mir* repeater receiver.

The SAFEX-II system will provide much more than just a high-flying repeater. With the high-speed packet and ATV-capable microwave transponder many experiments and exciting activities are possible. The German and Russian groups will be exercising the different subsystems in the months to come, and unlike a typical hamsat, there's someone always nearby to hit the reset switch, pull the covers off, or just pack the gear up for shipment back home for any needed repair.

Number 54 on your Feedback card

CARR'S CORNER

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041
E-mail: carrjj@aol.com

Calculating Antenna Bearings

If you're a DXer who uses a directional antenna, especially a yagi or quad beam (which are unidirectional), then it might be nice to know the direction in which to point the darned thing. The trick is to know the *great-circle bearing* between your location and the DX location. That bearing can be calculated with some simple spherical trigonometry using a hand-held calculator or a computer program. Before talking about the math, however, we need to establish a frame of reference that makes the system work.

Latitude and longitude

The need for navigation on the surface of the Earth caused the creation of a grid system to locate specific points on the surface of our globe. **Figs. 1** and **2** show how this system works. *Longitude* lines (**Fig. 1**) run from the North Pole to the South Pole. The reference point (longitude zero), called the *prime meridian*, runs through Greenwich, England. The longitude of the prime meridian is 0 degrees. Longitudes west of the prime meridian are given a plus sign (+), while longitudes east of the prime are given a minus (-) sign. If you continue the prime meridian through the poles to the other side of the Earth it has a longitude of 180 degrees. Thus, the longitude values run from -180

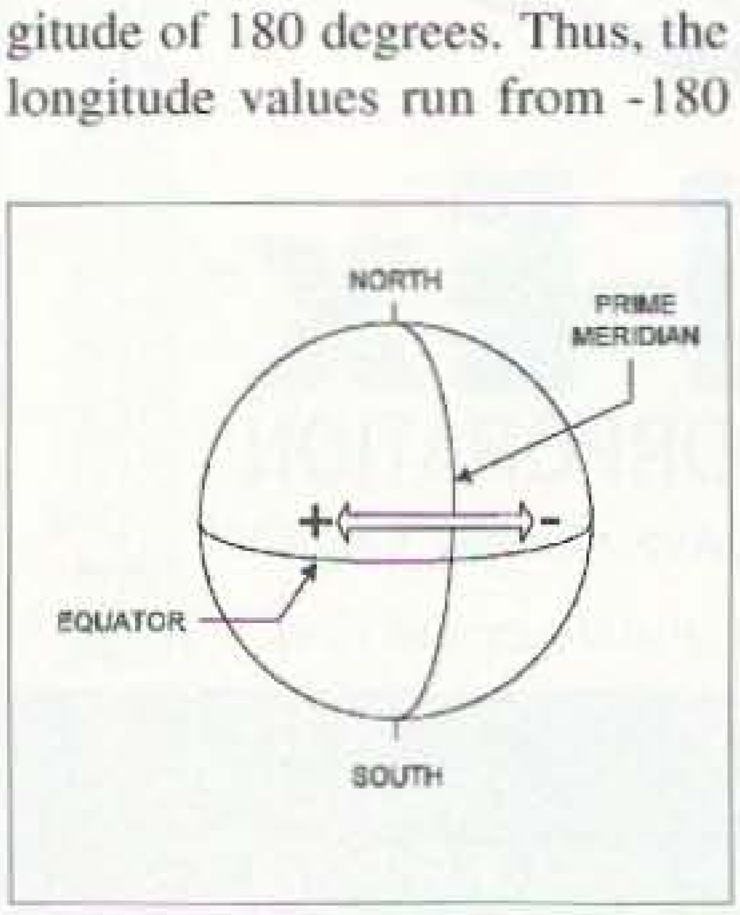

Fig. 1. Measuring longitude.

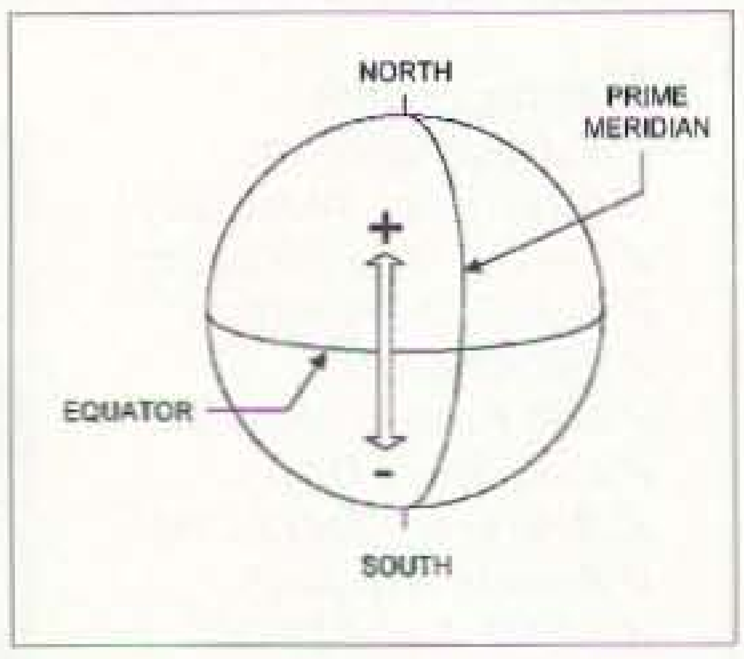

Fig. 2. Measuring latitude.

degrees to +180 degrees, with ±180 degrees being the same line.

The observatory at Greenwich is also the point against which relative time is measured. Every 15-degree change of longitude is equivalent to a one-hour difference from the Greenwich time. To the west, subtract one hour for each 15 degrees, and to the east, add one hour for each 15 degrees. Thus, the time on the east coast of the United States is -5 hours relative to Greenwich time. At one time, we called time along the prime meridian *Greenwich Mean Time* (GMT), also called *Zulu time* to simplify matters for CW operators.

Latitude lines are measured against the equator (**Fig. 2**), with distances north of the equator being taken as positive, and distances south of the equator being negative. The equator is 0° latitude, while the North Pole is +90° latitude and the South Pole is -90° latitude.

Long ago, navigators learned that latitude can be measured by "shooting" the stars and consulting a special atlas to compare the angle of certain stars with tables that translate to latitude numbers. The longitude measurement, however, is a bit different. For centuries sailors could measure latitude, but had to guess at longitude, often with tragic results. In the early 18th century, the British government offered a large cash prize to anyone who could design a chronometer that could be taken to sea. By keeping the chronometer set accurately to Greenwich Mean Time, and comparing GMT against local time (i.e. at a time like high noon, when the position of the sun is easy to judge), the longitude could be calculated. If you'd like to learn more about this subject, most decent libraries have books on celestial navigation.

The great circle

The shortest distance between two points is a straight line, right? Nope, not on a globe. On the surface of a globe, a curved line called a *great-circle path* is the shortest distance between two points. This path can cause some interesting anomalies. For example, I live on a latitude that is close to the latitude of Lisbon, Portugal (in which case, why do *they* get the good weather?). Given that fact, one might assume that I would point my beam due east, at a bearing of 90° from true north. If I did that, I might hear Portuguese voices coming over the receiver, but they would be from the west coast of Africa, close to Angola (a former Portuguese colony).

"The great-circle bearing between your location and a DX location can be calculated with some simple spherical trigonometry, using a hand-held calculator or a computer program."

Fig. 3 shows the basic problem of calculating antenna bearings. Consider two points on a globe: A is your QTH, while B is the other station's QTH. The distance D is the great-circle path between A and B.

The great-circle path length can be expressed in either degrees or distance (as miles, nautical miles or kilometers). To calculate the distance, it is necessary to find the difference in longitude (L) between your longitude (LA) and the other guy's longitude (LB): L = LA - LB. Keep the signs

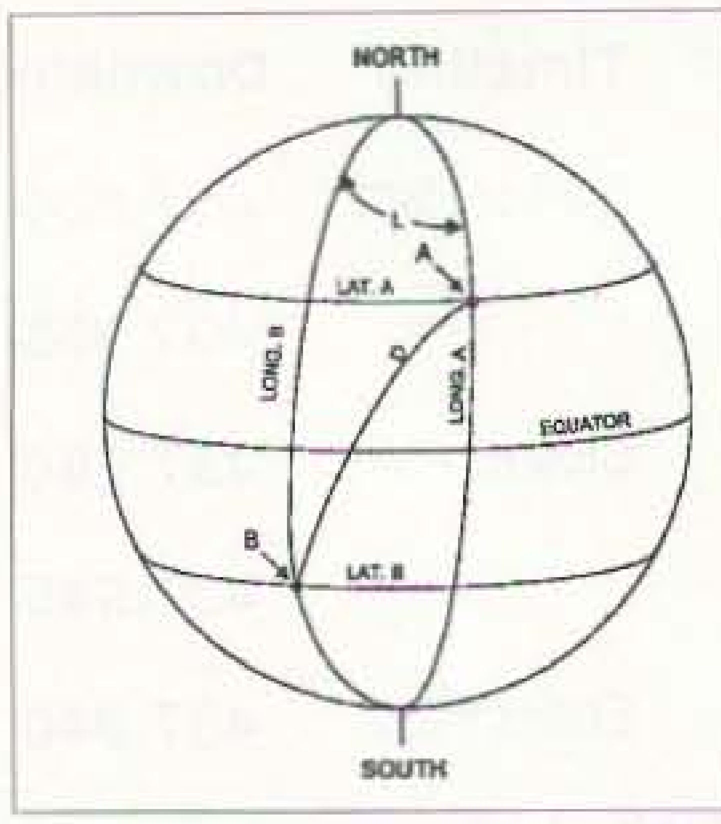

Fig. 3. The great-circle path.

straight. For example, if your longitude (LA) is 40°, and the other guy's longitude (LB) is -120°, then L = 40 - (-120) = 40 + 120 = 160. The equation for distance (D) is:

$$\cos D = (\sin A \times \sin B) + (\cos A \times \cos B \times \cos L)$$

D is the angular great-circle distance;
A is your latitude;
B is the other station's latitude.

To find the actual angle, take the arccos of Equation 1, i.e.:

$$D = \arccos(\cos D)$$

In the next equation you will want to use D in angular measure, but later on you'll want to convert D to miles. To do that neat trick, multiply D in degrees by 69.4. Or, if you prefer metric measures, then D times 111.2 yields kilometers. This is the approximate distance in statute miles between A and B.

To find the bearing from true north, then work the equation below:

$$C = \arccos\left[\frac{\sin B - (\sin A \times \cos D)}{(\cos A \times \sin D)}\right]$$

The problems

Now for the rub: This equation won't always give you the right answer unless you make some corrections.

The first problem is the "same longitude error," i.e. when both stations are on the same longitude line. In this case, L = LA - LB = 0. If LAT A > LAT B, then C = 180°, but if LAT A < LAT B, then C = 0°. If LAT A = LAT B, then what's the point of all these calculations?

The next problem is found when the condition -180° ≤ L ≤ +180° is not met, i.e. when the absolute value of L is greater than 180°, ABS(L) > 180°. In this case, either add or subtract 360 in order to make the value between ±180°:

If L > +180, then L = L - 360
If L < -180, then L = L + 360

One problem seen while calculating these values on a computer is the fact that in BASIC the sin(X) and cos(X) cover different ranges (see **Fig. 4**). The sin(X) function returns values from 0° to 360°, while the cos(X) function returns values only over 0° to 180°. If L is positive, then the result of Equation 3, bearing C, is accurate, but if L is negative then the actual value of C = 360 - C. I ran across this problem when trying to compare the results of calculations from New York, NY (40.43N, 77W), to Japan and points in Australia. I had expected some bearings in the northwesterly direction because of the great-circle map published in older editions of the *ARRL Antenna Book*. Oops! After doing a bit more research, I found the error and added the test below to my program:

```
IF L < 0 then
L = 360 - L
Else L = L
End if
```

Another problem is seen whenever either station is in a high latitude near either pole (±90°), or where both locations are very close together, or where the two locations are antipodal (i.e. on opposite points on the Earth's surface). According to Hall (1973), the best way to handle these problems is to use a different version of Equation 3 that multiplies by the cosecant of D (i.e. csc(D)), rather than dividing by sine of D (i.e. sin(D)).

I have a Visual BASIC 4.00 program for calculating the bearing and distance, but the listing is not suitable for printing here. An executable version will be available soon, so contact me for price and availability if you want a Windows© program for calculating bearings.

Acknowledgment: My thanks to the ARRL Technical Department for aid in locating Hall's article, as well as other material on the problem of bearing calculations.

Connections

I can be reached via snail mail at P.O. Box 1099, Falls Church, VA 22041, or via Internet E-mail at carrjj@aol.com.

Reference:

Jerry Hall, K1PLP (1973). "Bearing and Distance Calculations by Sleight of Hand," *QST*, August 1973, pp. 24-26.

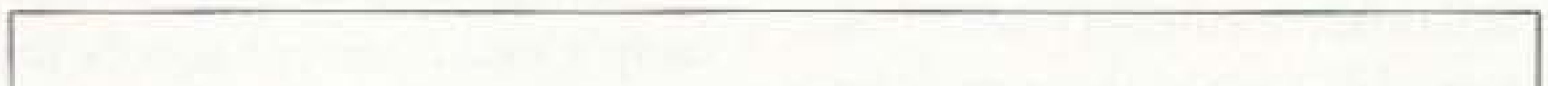

Fig. 4. Sine and cosine ranges.

NEVER SAY DIE

Continued from page 51

work at the 3rd International Conference on Cold Fusion (ICCF-3) in Maui in 1993. Dennis is now working with Jim, helping him to develop his cells.

With most of the world pretty well discovered, today's pioneers are in the high-tech fields, bringing us cellular radio, packet, personal computers, and such.

Getting back to colloids. I ran into these first with my reading in the health area. It seems that colloidal silver is a miracle remedy for many problems. It's very easy to make. You merely put a couple pure silver wires in distilled water, add a little pure salt to make it conductive, and then pass a small current through it. In minutes you have a silver colloid solution. How much voltage does it take? 28 volts is fine (four 9V batteries).

I'm reading all I can on the use of silver colloids for health purposes and, when I get some time, I'll have a booklet available for anyone interested.

What's a colloid? It's particles of metal so small that they remain suspended in a solution and don't sift out when left undisturbed. We're talking very small particles, just a few molecules each. That's why there is such an enormous surface area for the cold fusion reaction.

Will it be Jim and Dennis demonstrating a cell generating 10,000 watts next year with one watt of drive, or you? How's your pioneering spirit? Have you ever had a desire to go where few have gone before? The threshold of the unknown isn't as far away as you think. I've been privileged to be good friends with several of our ham pioneers—Sam Harris W1FZJ who did pioneering moonbounce work and invented the parametric amplifier was a very good friend. As was John Williams W2BFD, the pioneer of radioteletype, Jack Babkes W2GDG with narrowband FM, and Wes Schum W9DYV with sideband.

The frontiers today are no farther away than they were a century ago. But instead of Africa, Tibet and reaching the poles, they're in digital voice, spread spectrum, cold fusion, and the

Continued on page 59

Number 56 on your Feedback card

HAM TO HAM

Your Input Welcome Here

Dave Miller NZ9E
7462 Lawler Avenue
Niles IL 60714-3108

As *73's* "Ham to Ham" column begins its second year with this issue, I'd like to take just a moment to express my thanks for all of those contributors who've sent in their tips, suggestions, and ideas ... the meat and potatoes that keeps the column going and growing. I'm always looking for more, so don't hesitate to offer your own ideas to the list. There's a lot of information this time, so let's get right to it.

Lighten up

From George Vaughn WA4VWR: "I've found a local source for the bulbs that illuminate the Kenwood TS-940's sub-display. When one of them went bad in my TS-940S, I removed both and measured the voltage applied to and the current drawn by the single working bulb ... 12 volts at 75 milliamperes. A trip to the local Radio Shack™ store resulted in my discovering standard RS replacement bulbs of the exact size and shape (RS Cat. #272-1092), but the RS bulbs draw 15 mA less, or 60 mA—and they lack the little green 'bootie' that the original Kenwood bulbs have. The 'bootie' can be carefully removed from the old bulb (provided it hasn't been cooked into place), and, with the aid of a touch of clear silicone grease, can be installed on the RS replacement bulb quite easily.

"The 15 milliamp difference in current (and light output) is about the same as if one were to put a 47 ohm, 1/2 watt 'bulb-life-extending resistor' in series with the Kenwood bulb, so to me it's perfectly acceptable. The biggest difference is in the price: $1.49 for two of the RS bulbs vs. $4.19 for each of the Kenwood replacements ($8.38 total) plus $6.00 shipping. That's $7.19 per bulb from Kenwood, 75 cents per bulb from Radio Shack. Guess which ones I'm using in the future.

"What about the TS-940S's 'S-meter' bulbs ... does Radio Shack carry a replacement for them? Yes, but this time the difference is more pronounced. The bulbs in the S-meter are 12V at 75 mA; the Radio Shack replacement with wire leads (Cat. #272-1141) is rated at 12V but this time at only 25 mA. It's noticeably dimmer than the stock Kenwood bulb, but it may be acceptable to many; you'd have to try it and see. Personally, I chose to use Radio Shack's Cat. #272-1143, a 12V, 75 mA bulb, but with a screw-in type of base. If you use the same bulb as I did, it's advisable that you not solder the 12 volt feed wire directly to the screw-type base, but rather wrap a couple of turns of non-stranded, fairly stiff wire around the screw-threads instead. Also, be sure to connect the 'ground' 12 volt feed wire to the screw-base, not the 'hot' wire. If the screw-base on this bulb were to ever cut through the insulating grommet, you might damage your set if the hot 12 volt lead were connected to it and then shorted the supply bus to ground. You can easily determine which feed wire is 'hot' and which is ground by measuring each with a voltmeter when the set is turned on. The 'hot' wire will have 12 volts on it and, of course, the ground wire won't. Again, make sure that the ground wire connects to the screw-base shell of the replacement bulb. The tip of the replacement bulb should be reasonably safe to solder the 'hot' 12 volt lead to, using the existing 'solder-blob' as a connection point ... do it quickly.

"One other small caveat: The #272-1143 bulb is just a tad too large to fit into the existing holes in the back of the TS-940S's meter, but a few seconds with a tapered reamer will result in the right hole size for a nice fit; take your time and don't get carried away! If done properly, the original Kenwood bulbs can still be used later on if desired. By the way, it is necessary to remove the metal meter mounting bracket to perform this particular step, but again, the cost savings are well worth the small extra effort."

Moderator's note: We've all noticed how difficult it's become to change the pilot lamps inside most of today's radios. In the old days, when both radios and lamps were a lot bigger, changing a pilot lamp was a pretty straightforward, easily accomplished job . The lamp was always mounted in a socket, and usually a twist of the wrist popped it right out. Not so today; most are now on small wires, soldered in place and buried deep within the wiring of the front panel. It usually requires some internal "surgery," so many hams either don't bother changing them at all when they burn out, or they leave the job for when the set has to be disassembled for some other troubleshooting reason. George has offered some well-thought-out advice in his tips from above; here's some more for you to consider.

More on lamps

What follows won't make the task of bulb changing any easier, but it just might double or triple the time between pilot lamp failures. When a lamp does burn out, many probably think first of going back to the manufacturer for a replacement. There's nothing wrong with that idea, especially if it's a very specialized type of bulb. But, as George pointed out, it's probably the most expensive and time consuming route to take, especially when there may be a much more cost effective approach. Since Radio Shacks stock a number of small, low voltage lamps, many of which will either fit directly or can be adapted to fit, a bit of "ham innovation" is sometimes needed, as exhibited in George's piece.

Take a look into what Radio Shack calls their 12V micro-lamp, Cat. #272-1092. It may well work as a replacement bulb for LCD displays and other situations where a very small size lamp is in order. Hobby stores also carry what they call "grain-of-wheat" lamps, which are very similar, but be sure to ask about their voltage and current ratings. By the way, using a lamp rated at a higher voltage is fine, as long as it will provide enough brightness once it's installed; in fact, it will last a lot longer than one rated at the nominal voltage. Additionally, if you lower the voltage to a 12V lamp, even by just a couple of volts, you'll increase its life dramatically. I've seen test curves that prove that the life expectancy of a lamp zooms upward as the voltage across it goes down, and vice versa of course. Putting a resistor in series with each lamp you replace will often give you two to three times the life expectancy from a given bulb, everything else being equal.

There are three things to consider before doing this: what value resistor will be needed; what its wattage rating should be; and how much loss of light is acceptable. Lowering the voltage to the lamp will decrease its brightness—and shift its color toward the red region—so you'll have to judge visually whether you can accept these consequences.

You can install the lamp, clip-leading a resistor in series with it, then looking at the meter or display under normal room lighting, to see if it's OK for your own particular situation. To arrive at the right resistor values, simply use Ohm's Law, plugging in the correct numbers for your own transceiver's lamp supply:

- Voltage drop desired divided by the lamp's rated current equals the resistance needed.
- Voltage drop desired times the lamp's rated current equals the resistor's wattage.

By way of an example, let's take the Radio Shack #272-1092 lamp that I mentioned before, which has a current rating of 60 mA or .06 amps. Let's say we'd like to drop the 12 volts feeding the lamp down to 10 volts, or a 2 volt total drop. We plug in the numbers:

2 (volts) divided by .06 (amp) equals 33 ohms;

2 (volts) times .06 (amp) equals .12 watt.

Now we know that we'll need a 33 ohm, 1/4 to 1/2 watt resistor in series with each lamp in order to drop the 12 volt lamp supply down to 10 volts. A 1/2 watt resistor will provide a four-times-safety margin for heat dissipation (dissipation ratings for resistors generally assume their full lead length in free air, so it's safest to over-rate them by two to four times for shorter lead lengths and operation within confined enclosures).

By the way, try to avoid using bulbs intended for flashlight service; they're often high brightness, low life expectancy. There are charts available showing life expectancy at rated voltages for various lamp type numbers. The lamp's manufacturer can provide this information and it's also sometimes included in the more complete electronic supply house catalogs. It's surprising how much different lamps do vary in their average life expectations.

Don't "nit-pick" on Alinco!

Last month I gave you some tips on how to improve the Alinco DR-1200T's static discharge resistance with improved grounding. There are usually ways to improve upon just about any radio made. I'm not trying to nit-pick on Alinco, it's simply that I've become fairly familiar with this rig and feel comfortable attempting some "improvements."

This month I'll show you how you can make the internal CPU "reset" push-button accessible from the front panel. I'd be very interested in seeing submissions from readers on modifications that they've made to this and other popular radios; please just make sure that your tip is reproducible and that it doesn't create any "hidden" problems of its own. Obviously, I can't test all tips submitted to me for the column, since I don't have access to every rig on the market ... wish I did!

The Alinco DR-110T and DR-1200T/TH (and perhaps others in this line) have a hardware CPU reset push-button switch located just to the right (when viewed from the front) of the "Call/Call W" switch, but it can only be accessed from inside the radio, when the front plastic cover is removed. There's also a software reset (described in the owner's manual) that involves holding in both the "F" and "VFO/M" keys at the same time and turning the "POWER" switch on and off. But what if that doesn't correct your problem? The hardware reset switch actually momentarily grounds the reset pin on the CPU and should clear any conceivable programming error—at least anything that's curable by restarting the microprocessor.

It's an easy matter to add access to this hardware reset switch the next time you have the radio on your workbench. Simply drill a small hole (1/8" or so should do it) between the "Call/Call W" switch and the microphone connector. The hole should be carefully drilled from the inside to the outside (in fact, there exists a small "starter" hole inside the plastic front panel, as if they intended to make the switch accessible, then changed their minds). The finished hole is barely noticeable against the black background of the front panel itself, but it will give you access to the momentary hardware reset switch. Just use a thin, insulated probe to access the switch, should the CPU ever go bonkers and require a complete, non-maskable reset. Resetting the CPU will erase all memories and other user-defined data from the radio, but at least it will get you quickly back to "ground zero" again for reprogramming (you have a written copy of all of your programmed entries, right?).

Here's another quick tip for the same model of transceiver, in the spirit of the lamp tips mentioned earlier. If you don't want to go directly to Alinco for replacement display bulbs, I've successfully used Radio Shack's #272-1092, 12 volt, 60 mA "microlamps" as replacements. Chances are, they'll fit in other brands of transceivers as well for easily obtained replacement purposes, but always check for excessive heat buildup and too much current drain anytime you decide to substitute for a manufacturer's original part.

Short fuse

From John Ayers AA1IC: "It's often recommended by transceiver manufacturers (and others) that a mobile amateur transceiver's 13.8 VDC supply come directly from the vehicle's battery terminals, with a fuse or circuit breaker as close to the battery itself as possible (as opposed to simply picking up a feed from a convenient 'existing' battery voltage point somewhere under the dash). This practice will often cut down on the amount of noise introduced by the vehicle's electrical system into the ham rig, as well as minimizing RF interference from the ham gear getting back into the vehicle's computer or other RF sensitive electronics.

"Though the practice is strongly recommended, the hardware needed to accomplish it isn't always easy to obtain. For several years now I've been keeping my eyes open for the 'ideal' hardware to accomplish this job—something with adequate current capability and feed wire size, ease of physical mounting, and also suitably enclosed to prevent premature environmental-exposure failure. I've run across an automotive automatic circuit breaker at a local NAPA auto parts store that I feel meets these criteria. It's small, is rated at 20 amps DC, comes equipped with 10-32MS connecting studs, has husky mounting ears, and is fully enclosed against the elements (something we have to think about in our Vermont winters!). The one I chose is part #CB6317 and sells for under $6 including tax. If physical mounting within the engine compartment isn't practical in your installation, there is also an in-line model (without the mounting ears) that could be slipped inside a short length of PVC pipe (or other insulated covering) for added protection."

Moderator's note: If you're not able to find the circuit breaker that John mentioned locally, try obtaining a catalog from Parts Express, 340 E First Street, Dayton, OH 45402-1257 (513-222-0173 or 1-800-338-0531 for orders). They stock a variety of circuit breakers, fuse blocks, high-quality battery clamps, side mount posts, and other accessories needed for mobile audio and radio installations. They also carry the heavy primary wire (as large as No. 4 gauge), in any footage quantity desired, for extending your transceiver's cabling *right up to the battery itself. As John pointed out, you can often automatically avoid many mobile noise/interference headaches simply by using a "dedicated" radio 13.8V battery run ... or even a dedicated separate battery. A "clean" battery feed source (without random noises generated by other devices) is always the first step in any mobile installation noise elimination "foxhunt."*

(Ed. note: Remember that the breaker must be mounted as close to the battery as possible for maximum protection.)

Net topics

From William Thim N1QVQ: "On some of our area repeaters, we have both general check-in nets and newcomer nets these days. But a group of us, N1TDW, N1SPJ, KD1ZV, and myself, came up with the following idea a while back. Why not have a local 'expert' net night when possible? We discussed it with the repeater owner, and he went for it enthusiastically and without hesitation.

"Basically, we encourage hams in the area with expertise on some particular aspect of ham radio to give an informal 20- to 30-minute talk on a subject in which he or she is experienced, followed by an appropriately timed question and answer session. Examples of subjects might be packet, satellite communications, the ins and outs of amateur TV, antenna construction and installation, weather nets, HF data modes, etc. The list is nearly endless since ham radio has so many interesting facets. The topics don't even have to be purely amateur radio; someone in broadcasting or emergency rescue could also keep a group riveted with a description of their profession and some of their interesting or off-beat experiences on the job.

"Start by suggesting one 'expert night' per month, then have the other area nets announce it on their own net night, repeaters and PBBSs and see if it doesn't increase your list of check-ins and 'future-ham SWL' listeners alike."

Power astray

From Jack VanGilder N3MPS: "My VHF packet station consists of a Kantronics KPC-3 TNC, in conjunction with a Kenwood TM-241A 2 meter FM transceiver. Both are powered by a 13.8 VDC external supply ... not an uncommon current-day setup. One day, however, my TM-241 wouldn't release from the transmit mode, was emitting a low-pitch tone, and the KPC-3 TNC became very hot to the touch.

"I immediately shut everything down and began to investigate. I discovered that the small coaxial power plug that supplies the 13.8 VDC to my KPC-3 had worked its way loose, pulling out just far enough to allow the 'normally closed' contact on the sleeve of the power jack to 'make' before the tip of the plug had broken its contact. I had installed the alkaline back-up batteries in the KPC-3, so the full 13.8 volts was placed across them by this unfortunate set of circumstances. The batteries apparently built up substantial internal heat and pressure, rupturing their seals and allowing their corrosive electrolyte to leak out into the TNC itself.

"What to do? I first applied some baking soda and warm water to the area affected, allowed it to neutralize any acids present, then cleaned the circuit board as best I could with a sponge and more fresh warm water. After permitting it to dry thoroughly, I was elated to find that everything was now working again. However, not wanting a repeat performance, I then made sure that the tip of the external power plug would disengage before the sleeve's normally closed contact had the chance to switch back as the power plug was slowly removed. It's probably also a good idea to remove the batteries whenever the unit is operated from an external power supply, as well as to insulate the battery terminal connector so that it can't come into contact with anything that it shouldn't inside the TNC.

"The lesson learned? Beware of those little coaxial power connectors (and others) that permit 'automatic' power transfer switching. Make sure that they 'break' before the other connection 'makes.'"

Moderator's note: Jack brings up a good point, and one that has the potential of creating problems in many other pieces of equipment. Any power connector that allows the "normally closed" contact to close before the external tip connection is completely broken is a candidate for the type of problem that Jack describes. This could be any item, from your daughter's portable stereo to your own telephone answering machine. Better put it on your list of things to check out; I know I have. Depending upon the actual circuitry of the device, you might be able to install a diode in series with the internal battery feed, with the diode's anode toward the positive battery output. This would permit current to flow only from (not to) the battery pack (you'll lose about 0.6 volts across a silicon diode, but that may not be consequential—you'll just have to give it a try and see).

Simply floored!

From Bob Boehm N8EXF: "Operating mobile, whether HF, VHF, or UHF, can be very challenging today with the smaller automobile interiors and plastic dashboards!

"I ran into a problem of where to mount my Kenwood TS-440S/AT in my Dodge 4x4 ... either the gear shift was in the way, or I couldn't reach the radio's controls! I solved the installation problem by building my own custom floor-mounted bracket out of Stanley™ brand preformed channel pieces from my local home improvement center. They come in various lengths and in 90-degree angles, allowing you to fabricate just about any kind of custom-fitted mobile floor mount that you might need.

"In the case of my own TS-440S, I used one 18" channel, cut it in half, and bolted a 90-degree 'T' section to each half. This formed the 'base' that was then bolted to the floor. Next, with two pieces, each 10" long, the vertical uprights were formed, onto which the mobile mounting bracket for my TS-440S was attached. The completed installation resembles an upside down 'T' when viewed from the side (see **Fig. 1**).

"It's withstood life in a 4x4 very nicely and the controls of the radio are within easy reach of the driver, without cramping anyone in the passenger's seat—the perfect solution in my own case. Perhaps this same idea can

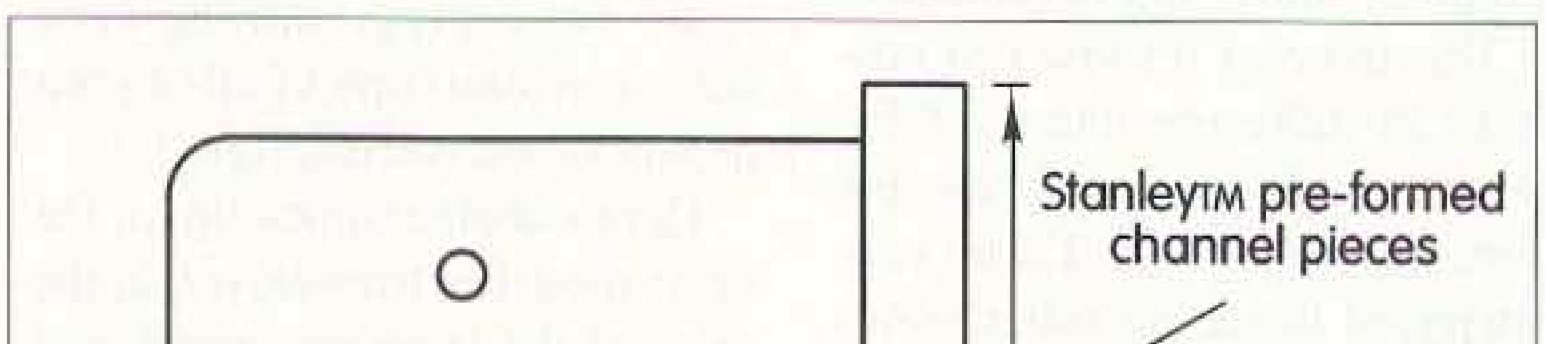

Fig. 1. Side view of N8EXF's idea for a home-brew floor mount to better position his Kenwood TS-440S HF transceiver in his Dodge 4x4. Two identical sections are needed, spaced to accommodate the standard Kenwood mounting bracket for this radio.

be adapted to solve your mobile installation woes as well."

Cable tie rip-off

In order to keep long lengths of coax cable, audio cable, power cable, etc. from tangling up when coiled, many hams use electrical tape around the cable coils when storing or transporting them. Tape works, of course, but it usually ends up leaving an unwanted gooey residue on the cable as well. Tape has a limited number of uses before it no longer adheres to itself , and, naturally, it's often lost when the cable itself is uncoiled for use. Fortunately, there is a much better solution, thanks to modern "fastener science."

The half-inch-wide sew-on Velcro™ material—not the self-adhesive variety—makes an excellent, permanently re-usable cable tie if the simple dimensions shown in **Fig. 2** are followed. Various lengths of Velcro are usually available in craft or fabric stores; just ask your XYL for her suggestions. As everyone knows, Velcro has two parts, a "fuzzy" soft-surfaced loop strip, and a "pinchy" harder-surfaced hook-strip. I'll just call them "fuzzy" and "pinchy" for easier identification purposes.

To make a single cable tie, cut about 6" of "fuzzy" Velcro and about 1" of its "pinchy" counterpart, place a few drops of household "super" glue (of the type containing cyanoacrylate ester) on the backside of the smaller "pinchy" piece, then place the two pieces back-to-back and squeeze them together securely between a couple of pieces of scrap aluminum, using a long-nose pliers, hemostats, or a vise, letting the glue cure.

Next, punch one or two small holes (a leather belt punch works nicely for this) into the free end of the "fuzzy" strip, large enough to pass a small, thin plastic cable tie-wrap (I use the 1/8" wide by 4" long #T18R plastic tie-wraps). These are the type of plastic tie-wraps sold in most electronic stores for permanently tying bundles of cables together, but in this case, it will be used to permanently fasten your new "Velcro tie" to the cable you're working with ... roughly 6" back from the cable's connector is generally about right (doubled-over waxed cable lacing twine also works nicely in place of the plastic tie).

Once the Velcro tie is fastened to the cable at the right point, with the plastic tie-wrap or lacing twine, just coil the cable up as you normally would. Once it's completely coiled, wrap the new Velcro tie—"fuzzy" side up—around the coil and press down on the "pinchy" strip to lock. Pull on the "pinchy" strip to unlock the tie. You now have a permanent, re-usable, always-close-at-hand cable tie system. A small "starter line" painted across the very end of the "pinchy" strip will tell you at a glance where to rip it open.

Make up as many ties as you'll need for all of your cables (including those on your power tools) and you'll thank yourself each time you use them ... it's a great rainy day or cold weather indoor construction project. Different colors of the Velcro material can be used to make up different colored "Velcro ties" for easy identification of different cable lengths or connector types.

Feel free to vary the dimensions shown in **Fig. 2** to accommodate smaller or larger cable coils. The dimensions shown seem to work well for "average" coils, so it's best to start by using them (at least until you're more familiar with the idea), then you can "customize" to your heart's content. By the way, don't steal your XYL's Velcro supply; I know the consequences of *that* mistake!

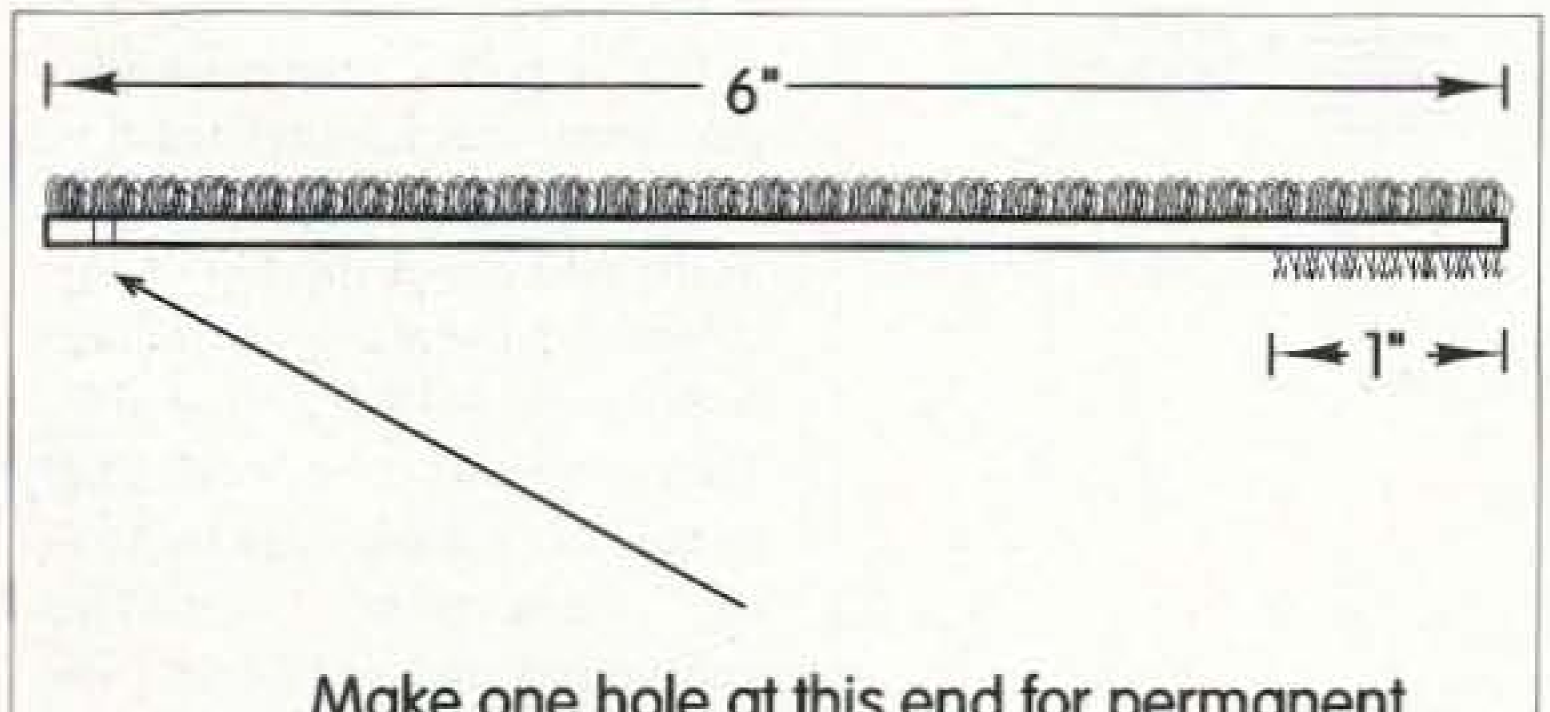

Fig. 2. Side view of NZ9E's home-brew Velcro™ cable tie.

To UTC or not to UTC?

From Ken Guge K9KPM: "Many hams prefer to keep their station logs in UTC time, as opposed to local area time. It often makes QSLing much easier, since the DX station will probably use UTC time in his or her log (the use of UTC time seems to be much more popular with hams in other countries than with those of us here in the U.S.).

"One of the problems in using UTC time is the change-of-date that occurs at UTC Midnight. Here in North America that happens several hours before our local date-change; we sometimes forget about that fact. If you're going to be consistent in your log-keeping, the UTC date change must also occur at the correct point in time, yet none of the UTC clocks I've seen take that factor into account.

"My Timex Indiglo™ watch, however, does. It has two time display options: one for local time and date, another for an optional time and date. If UTC time is programmed into the optional display, the date will also be correct (on that display) following UTC Midnight—so the correct time and date for UTC are always just a 'touch of a button' away. You might want to take a look at these watches (and perhaps others with the same option) the next time the kids ask what you'd like for your birthday. Dads who are hams are easy to buy for!"

Two different worlds

In today's two worlds of electronics, analog and digital signals

NEVER SAY DIE

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investigation of other anomalies of science. They're in rediscovering lost or buried past developments in health and other fields, such as the work of Royal Rife, which should be reopened. Ditto Wilhelm Reich. There are some amazing things happening with magnets. Just reading some of the books on my list of books you're crazy if you don't read will open all sorts of pioneering opportunities to anyone with imagination and curiosity. Whole continents of science are still there to be discovered. Which will you be prouder of 10 and 20 years from now, having watched Murphy Brown or some ball games, or having helped pioneer a new technology? This stuff doesn't take formal education—indeed, that seems to be a drawback when it comes to original thinking. It doesn't take a lot of brains either. What it takes is the same thing success at anything takes: persistence. That's what sets life's winners apart from the rest of us.

Beware The NSA

A reader sent me a copy of a couple articles from *Health Freedom News* that got my attention. The first was a reprise of the work Dr. Robert Becker reported in his fascinating book, *Cross Currents*. I've reviewed that book in a past editorial, but I didn't get you to read it. I'd hoped to get at least a few readers fired up enough to start experimenting with ways to regrow missing body parts through the use of low voltages.

The second part had to do with a friend of the author who had built a chamber which shielded a person totally from all electromagnetic fields. He put in antennas to detect the very low levels of frequencies given off by living creatures, then built a wideband amplifier to amplify the body emissions and then feed them back at a high level to get positive feedback. He found that animals could tolerate the treatment for about 30 seconds. He found the results to be amazing. The animal's genes and cells which are programmed for aging and death seemed to be reset backwards.

He found that three treatments a week apart was able to rejuvenate old and maimed cats and dogs. The next-door neighbor's dog, for instance, had been hit

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must coexist, often side-by-side, on the same circuit boards in our receivers, transceivers and data controllers, yet the two varieties of signals are often mutually incompatible. Steep-wave-fronted digital data signals are often the most troublesome culprits in this coexistence battle, impressing "digital noise" of various kinds onto the more "peace-loving" analog signals. It's a problem that electronic circuit designers are continually fighting (and overcoming for the most part). Here are some of the proven techniques that they use.

Obviously, keeping digital and analog circuit components as far apart physically as possible is the first step, though not always entirely practical in today's crowded circuit board environment. But where it is possible, it's best to follow that axiom. Keeping parallel-running circuit traces or harness wiring with digital pulses and analog signals away from each other is also important. "Noise induction" is often the cause of crossover between those two worlds. Shielded cabling can help, even for circuitry that doesn't normally call for shielded wires. Multi-layering of boards, with digital and analog signals one above the other, is another source of cross-induction problems; sometimes shielding in the form of aluminum sheet-stock between the two can help in this area. Just make sure that any shield-planes are grounded only to their respective ground buses. This implies that digital and analog grounds and ground planes should also be separated from each other on the PC board(s), and they should be as large as possible to provide the least amount of resistive voltage drop (since that's where problems can sometimes begin). The use of separate positive power supply traces for the digital and analog portions of the circuit is also almost a must; make sure that all digital chips are powered only from the digital power bus and all analog chips or transistors are fed only from the analog feed point. A common power supply for the digital and analog circuits is usually possible, but separate plus power and ground leads to each separate power bus on the board itself is considered to be good practice. Using separate output regulator chips from a common power supply can also offer some noise crossover protection. Working to avoid ground loops, where the resistive loss in the loop can act as a development point for crossover noise, should be taken into consideration. If it's possible to ground coax cables on one end only, many potential problematical ground loops can be forestalled before they develop. Lastly, but certainly not leastly, generous numbers of bypassing capacitors, on both the analog and particularly the digital, power buses can save countless hours of troubleshooting and head-scratching later on. Bypass caps are inexpensive; use them freely.

Hopefully some of these tips may prove useful to both amateur digital circuit builders and circuit troubleshooters alike, since they can usually apply to both ends of that scale. It's often a mistake to assume that every precaution has been carefully observed in every manufactured item of ham equipment ... there's often lots of room for improvement. Just ask any dyed-in-the-wool equipment modification aficionado!

In closing

One closing note: Many thanks to Tom Miller WA8YKN (314 S. 9th. St., Richmond IN 47374) for allowing me to "beta test" his new "micro-sized" Bioelectrifier, the original circuit of which was first described in *73*, May 1996 issue, beginning on page 10. Tom did a beautiful job of reducing the circuitry, board size and battery compliment to their smallest common denominators. His revised schematic diagram is shown in **Fig. 3**. Tom also informed me that FAR Circuits (18N640 Field Court, Dundee IL 60118) is offering his board (only the PC board), and that Tom himself is offering a kit of parts and completely wired and tested units (less the enclosure). Contact FAR Circuits for the basic circuit board and Tom for the semi-kits (at the addresses above) ... asking for a current price list. Also always include a self-addressed and stamped envelope (SASE) when corresponding with those who have been thoughtful enough to offer us these boards and kits ... their margins are often too low to allow them to pay for the postage to answer our questions! Also, remember that the Bioelectrifier is for experimental purposes only, for enhanced plant-growth studies, and that it has no governmental approval for any other experimental use (does water have governmental approval for human consumption? I'm not sure).

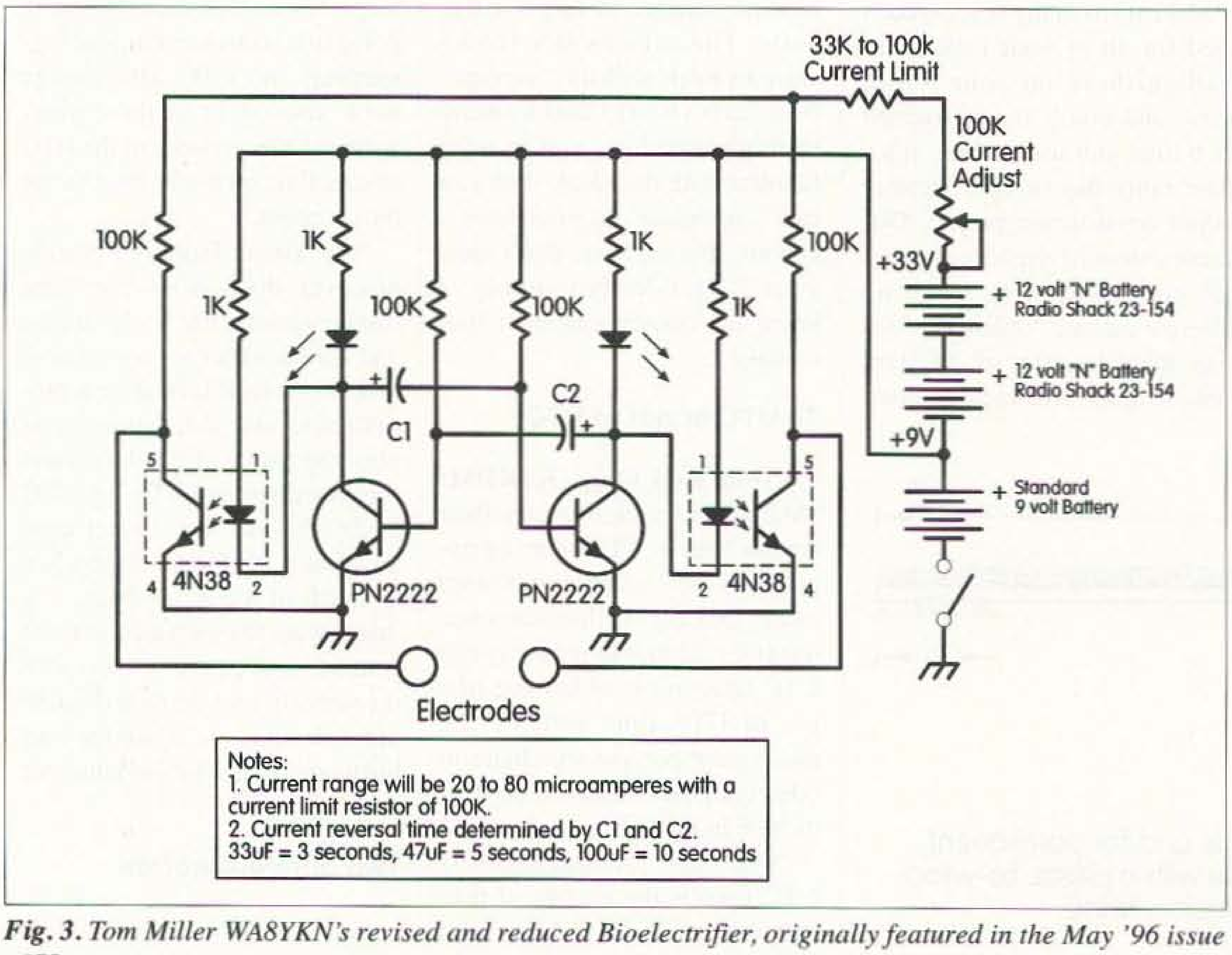

***Fig. 3.** Tom Miller WA8YKN's revised and reduced Bioelectrifier, originally featured in the May '96 issue of* 73.

This ends another month of "Ham to Ham." As mentioned in the beginning, we're now into our second year of the column and hope to go on much, much longer. Many thanks to the folks at *73* for making "Ham to Ham" possible. A special thanks to my principal proofreader and general guru of the often impractical English language, Sue Miller KA9UCK, and to Joyce Sawtelle of the *73* staff for her helpful support.

I still need your continued input to keep the column interesting. Send your ham-related tips, ideas, suggestions, and shortcuts to the address at the top of this column and share your findings with the rest of the *73* readership. They don't have to be "earth-shattering" or "cutting-edge technology" brainstorms ... just ideas you've found to be practical and helpful to you in your everyday amateur radio experience. Hope to hear from you soon. 73, de Dave, NZ9E.

• Murphy's Corollary: "All matter will be damaged in direct proportion to its importance to the end-user."

Many thanks to this month's contributing readers...specifically:

George Vaughn WA4VWR
545 Arlington Avenue
Jackson TN 38301-4701
packet adr: WA4VWR @ KB4YTM.#WESTN.TN .USA.NOAM
E-mail adr: grv8626@jackson .feenet.org

William Thim, Jr. N1QVQ
50 Miller Road
Broad Brook CT 06016-9676

John Ayers AA1IC
Automation Services
RR2, Box 160
Lyndonville VT 05851
E-mail adr: ayers@plainfield .bypass.com

Jack VanGilder N3MPS
159 Chappelear Drive
Charlotte Hall MD 20622-3206

Bob Boehm N8EXF
6821 Le Conte Ave.
Cincinnati OH 45230-2935

Ken Guge K9KPM
1107 E. Woodrow Avenue
Lombard IL 60148-3126
packet adr: K9KPMW9ZMR .EN52VA.IL.USA.NOAM

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*.

NEVER SAY DIE

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by a car some years before and a hind leg crushed so it had to be amputated. And there was spinal cord injury. The dog's hair was graying and falling out, it was overweight and had trouble breathing. Three months later the hind leg had regrown, the spinal damage healed, the dog's hair had grown back (now black) it had lost the excess weight, and was breathing normally. It was young again.

The physicist returned home a few days later to find the National Security Agency (NSA) cleaning out his papers and laboratory. They explained that he had no say in the matter. A few days later his house and lab were burned to the ground.

The NSA is twice the size of the CIA and operates both in and out of the US. It monitors phone and radio communications worldwide. All long distance phone calls and faxes are subject to monitoring by the NSA.

Now, if the above isn't total baloney, and I have no reason to suspect it is, maybe it's about time you started working on a shielded room and sending me articles on building wideband amplifiers. Considering the progress Becker made, the above isn't completely implausible.

I'm going to track down the author and see if I can get more details.

The article also mentioned a chap who has been working with magnetic fields. He immerses people in a strong field and body regeneration has occurred. One man had a tumor which blocked 90% of his spinal cord, making him a quadriplegic. 104 hours of treatment totally healed the tumor and the paralysis. Another, blind from degeneration of his optic nerve, regained full sight after six hours in the magnetic field.

I've got a good friend who is deeply involved with magnets and magnetism therapy. I'll see what he knows about all this.

Meanwhile, is any of that enough to get you to cut back on your TV and rag-chewing and do some experimenting? Sigh, I thought not. But if you do decide to experiment, keep quiet about it so you or your lab don't suddenly disappear. Well, not 100% quiet. I expect some confidential reports which I'll memorize and burn.

Insurance protection

Skip this section if you have no interest in your or your family's health.

Do HMOs or your company health insurance help keep you healthy? Sure, just as much as fire insurance keeps your building from burning and accident insurance keeps you from having accidents. Well, perhaps that's not an apt comparison since sometimes fire insurance tends to encourage "business fires."

How about doctors and hospitals? They mainly deal with relieving the symptoms caused by illness, and not with helping you avoid illness. No, that's up to you. And, as I've mentioned, your doctor is not one of the first people you want to turn to for advice. An AMA report showed that doctors live an average of 58 years, while the rest of us manage to live an average of 75 years.

Now, would you rather read my grumblings about the ARRL and the FCC, or pass along what I've been learning about how to live longer and healthier? At 74, and with one more average year to live, for some reason I'm paying more attention to maintaining and even maybe improving my body's health. I've got enough projects lined up so I'd like to counterbalance those doctors who died in their 40s by living into my 100s.

Well, I've already outlived "Bud" Budlong W1BUD, the League General Manager for many years. Knew him well. I knew Mort Kahn W2KR well too. He was the architect of the League's so-called "Incentive Licensing" proposal. As the Hudson Division Director he got together with some other directors and pulled a palace coup, where they threw Budlong out (he died soon after) and Kahn replaced him with a puppet, with Kahn pulling the strings from his yacht in Florida.

But you don't want to hear about all that dirty laundry when I could be explaining what I've discovered via one heck of a lot of research about recovering your robust health and preventing any of the normal illnesses such as cancer, heart trouble, arthritis, diabetes, and so on. I'm convinced that all that stuff is completely avoidable. Or, if you've already done the damage through ignorance, repairable.

Identity

There's a strong tendency among our revered "health care givers" to categorize us. Back in the days when I was a licensed professional mental repair technician, I quickly learned never to jump to any conclusions as to what was causing my patients' troubles based on seemingly similar cases I'd worked on with similar problems. The fact is that we're all different mentally as well as physically. And that difference goes right down to some basic levels.

This came to mind as I was reading a fascinating book, *The Pulse Test*, by Dr. Arthur Coca. The book was originally published 40 years ago, and is available in a pocket book 1996 edition. It's 186p, $5, and has ISBN 0-312-95699-1. Yes, it'll be in my next update of my list of books you're crazy if you don't read.

It points out that we're all allergic to different things—foods, dust, pollens, and so on. It also points out that we are probably unaware of our sensitivity to

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HAMS WITH CLASS

Carole Perry WB2MGP
Media Mentors Inc.
P.O. Box 131646
Staten Island NY 10313-0006

Dayton '96 Youth Forum

There were lots of young adults in the audience at the Dayton Youth Forum this year; therefore, it was a success. The youngsters who interview to be presenters and who spend lots of time preparing their presentations enjoy a responsive, large audience of their peers.

The forum opened up with Maria Lopez, Clifford Uyeda, and the nice folks at Kenwood giving a little pep talk about youth in amateur radio. They also gave away several watches and Kenwood sports bags. It's my rule at the Youth Forum that prizes may be won only by people under the age of 18. This forum is for them!

The speakers

My first speaker was Beth Harris KJ7FC from Cheyenne, Wyoming. She is 15 years old, has an Extra Class license, and is last year's recipient of the ARRL's Hiram Percy Maxim Award. Beth's teacher exposed her to amateur radio in the seventh grade. She showed us a video that she and her teacher put together showing the elaborate satellite tracking station, moonbounce, and AMSAT equipment at the school's radio station. Beth spoke about how knowledge gained from being a ham has helped her in her various school studies.

Ken Fritz N3WAX is a 13-year-old Tech Plus from Glen Mills, Pennsylvania. Ken is active on RTTY and CW and enjoys operating special events stations like the Miss America Pageant and different Boy Scout events. He showed a series of slides from various club activities like Field Day, which he feels provides incentives for children to get involved and to upgrade their licenses. He stressed the importance of local clubs in helping to give newcomers a good start.

Sam Garrett AAØCR is 18 years old and is from Florissant, Missouri. He is the 1991 recipient of the Westlink Report Young Ham of the Year Award. Sam has spoken at several Youth Forums with me across the country in the past few years. He is a most accomplished young man. His speech was about how to use amateur radio to get scholarships for college. The scholarships are available to people of any age who want to pursue post-secondary education. Sam spoke about FAR, Foundation for Amateur Radio, which is a clearing house for administering scholarships for different groups. DARA, the Dayton Amateur Radio Association, has eight awards for $2,000 per year to aid college-bound students. The ARRL Foundation is a large resource for lots of scholarships. Through a single application process, you can gain access to many sources of funds. He also mentioned Chavarim of Philadelphia, which awards money to qualified hams of the Jewish faith. The Radio Club of America has permanent grants in place at several universities and technical colleges across the country. Interested applicants can contact FAR for more details.

Sam also made another good point: Add amateur radio activities to college résumés to show involvement in community activities.

My next guest from industry was Richard Stubbs KC5NSZ, who is the customer service manager for MFJ. Martin Jue, who is the founder of MFJ, deserves a tremendous amount of credit for always being so supportive of educational efforts in amateur radio. He has been good enough to send Richard to several of my youth forums and to make wonderful presentations of radio gear to winning children. The young man who won the MFJ 9420X 20 meter travel radio was in attendance at the Youth Forum in the hope of getting inspiration to become a ham. What better "inspiration" could there be?

Photo A. Carole Perry WB2MGP gets Dayton Youth Forum participants ready ahead of time.

***Photo B.** Left to right, front row: Sam Garrett AAØCR, Beth Harris KJ7FC, Sarah Wisutzkey, Kirk Severson KBØLNM, Ken Fritz N3WAX, Jeremy Graham N9OWS. Back row: Carole Perry WB2MGP, Ben Fenster KBØOVM, Mike Ballbach NØZTQ. Photo by Mrs. Ballbach.*

Jeremy Graham N9OWS, age 14, was next to speak. He talked about the close relationship between various Boy Scouting activities and amateur radio. Different merit badges, like Orienteering, utilize map and compass skills. He told about how valuable he was on a campout when he and some other Scouts were separated from the group. Having the radio with him helped make things a lot easier. Jeremy got a pleasant surprise after speaking—he was called back up to the podium 10 minutes later to receive the prize of an ICOM W31A 2m/440 dual-band radio, presented by Chris Lougee. Chris has given away ICOM rigs at almost every Youth Forum I've run. Let's all remember to support those manufacturers who are supportive of young people in the hobby.

Cathy Lentz KBØFDU is 19 years old and has spoken at my forums before. From Hiawatha, Kansas, she has the distinction of being my first married youth forum speaker. The fact that she's also a busy young mom made her appearance that much more special. Cathy has a starring role in the amateur radio promotional video "Always On The Air" being produced by Bill Pasternak and others. She showed us the first few minutes of the tape. It looks like a winner. Cathy spends time going into local schools to do radio demos for the children. She suggests that many schools require community service of their students, and that teenaged hams might want to look into doing demonstrations as a way of earning this credit.

The last presentation was worth waiting for. Under the guidance of Ellie and Rip Van Winkle from the Boulder Amateur Radio Club in Colorado, the BARC Jr. "Dayton Team" did a round-table discussion, along with a wonderful talk about why their club is so successful with youngsters. The team consisted of chairman Mike Ballbach NØZTQ, 16, with an Advanced license; Ben Fenster KBØOVM, 13, with a Tech Plus license; and Kirk Severson KBØLNM, 13, with a Tech Plus license. Sarah Wisutzkey, a fourth-grader, was the alternate who attended all the meetings with the boys. The team gave the audience at Dayton some valuable information about fund-raising ideas like raffles, donations, loaner radios, and many more creative approaches needed to raise the money for the trip to Dayton for the team. For the last few years Ellie NØQCX has provided me with excellent young speakers for the Dayton Youth Forum. BARC Jr. is lucky to have such dedicated elmers and elmiras to help them out and to encourage them in their amateur radio activities.

> **"Sam AAØCR made a good point: Add amateur radio activities to college résumés to show involvement in community activities."**

The interest of young people going to the Internet is something for all of us to consider. That's one reason these youth forums are so important. We, as adults, the parents and the teachers, have to listen to what the youngsters are saying about what motivates them and what interests them.

Hope to see lots and lots more children at Dayton in '97!

QRP

Low Power Operation

Michael Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

This is a special 10th-year column. Yup, 10 years of "QRP." It's hard to believe that it's been that long since I started this column for *73*. A lot has happened to both ham radio and QRP in the last decade. Let's look back and then put our sights on the next 10 years.

Personal

When I started this column, there was the ever-popular "Hate Mike Bryce Club." The two primary members were my wife Lynnette and friend Terry. Well, the club folded in 1988. Lynnette left me for Terry and I joined the singles' ranks. And the Hate Mike Bryce Club folded. Two years later, I met a very attractive woman with a passion for the old and unusual. I fit right in so we were married on Field Day of June 1990. Donna and I spent our honeymoon chasing W6s on 40 meters.

While Donna had no interest in radio, and still does not, she delights in the hamfests. Always looking for old radios to repair, I became rather proficient at fixing old tube-type receivers. Between antique clocks, old radios and teddy bears, we have an interesting home! And personally, I wouldn't change a thing.

Clubs

In 1986 when I started this column, there were perhaps three QRP clubs of international fame. They were the QRP ARCI, The Michigan QRP club, and the G-QRP club. Today, all three are alive and well, and all three have shown outstanding growth in their ranks.

Perhaps more important has been the growth of smaller local-based clubs. There are now local clubs in nearly every corner of the union. Here is a short list of some of the clubs that have emerged: The New England QRP Club, NorCal, The NorthWest QRP Club, The St. Louis QRP Club, and The Colorado QRP Club. There's more to the list than I have included; if nothing else, this shows that activity in low power ham radio is growing.

Perhaps the most popular topic I've covered in this column has been building equipment. I've tried to cover the spectrum from easy-to-build to out-and-out stupid! There are several projects that still leave a warm spot in my soul. Here is a quick look at some of my personal favorites.

The Two-Fer

The Two-Fer was a simple VXO-based transmitter that was easy to build. You could assemble it in less than half an hour. With a whopping 1 watt output, the Two-Fer could easily work the world. While most of us assembled the Two-Fer transmitter, there was a matching direct conversion receiver that didn't work worth a hoot.

I don't know how many Two-Fer transmitters were built. I'd guess well over a thousand. To this day, I still get requests for parts kits and PC boards for this project.

As popular as the Two-Fer was (and is today!), there came several improved versions of the basic circuit. Of course, those new and improved Two-Fers were given plenty of space here in the column.

The 6L6 Special

I started this project as something to do on the weekends while Donna worked. It was also the birthday for the 6L6. I built a few tube-based transmitters when I got my Novice ticket way back when, so out came the Greenlee chassis punches and a trip to Perry's QTH. Perry W8AU has the world's largest walk-in junk box!

With its single 6L6 and a 5U4 in the power supply, the 6L6 Special would produce about 10 to 14 watts of RF—if you wanted to be mean. Operation was crystal-controlled on 80 and 40 meters. If you poked, beat and kicked the poor guy, you could manage 20 meters as well. Also, if you pumped the plate voltage up and bolted the little 6L6 down, you could zap out 50+ watts, for a short time.

The mail produced by the 6L6 Special was huge. I got letters from old-timers who'd renewed their interest in ham radio all because of the 6L6 Special. Oh, and then there were the letters from the new hams confused about the dipping and peaking of the 6L6!

"QRP does not mean using decades-old circuits; you'll find plenty of microprocessors in our QRP gear."

I have no idea how many versions were built, but I'm sure the 6L6 Special generated a lot of warm fuzzies for many a ham.

The T/R Switch

One of the first projects to appear in the column, this was very popular with builders. The switch allowed painless interfacing between a QRP transmitter and receiver. It also generated a sidetone and provided a key interface.

On the downside, right after the T/R Switch was published, Radio Shack™ discontinued several key parts. That made the PC board outdated. As popular as the T/R Switch was, I'm planning an updated version. Look for it in the coming months.

The Pulse Charger

This guy started out on a whim. I never expected it to take off like it did. So popular was the Pulse Charger that I redid the original article and produced a PC board. I received requests for boards from all over the world—I even had a small company ask about building the Pulse Charger for commercial use.

There are probably a dozen more projects that were just as popular, but the ones described above seemed to generate the most mail.

Hate mail, farts and fizzles

The column titled "The Oscillator From Hell" generated more hate mail than you can imagine! I guess it was aptly named! To this day, I still get nasty letters about that column.

Continued on page 79

Number 64 on your Feedback card

Ham Radio Fun

Communications Simplified, Part 10

Peter A. Stark K2OAW
PO Box 209
Mt. Kisco NY 10549

Now that we understand the fundamentals of AM and FM, it is time to look at a typical radio receiver.

Fig. 1 shows the same crystal radio we introduced in Part 6 (*73*, June 1996). We pointed out that it consists of just a few parts:

1. An outside wire antenna, which captures all the various radio signals coming our way.

2. An antenna coil and variable capacitor, which do two jobs. The antenna coil is wired as a transformer, coupling the antenna signal to the radio. The secondary of the coil along with the variable capacitor also form a tuned circuit which selects the station we want, while rejecting stations we do not want.

3. A diode which rectifies the AM signal.

4. A 0.001 µF capacitor which filters out the high-frequency carrier and sidebands, and keeps only the envelope—the audio signal.

5. A pair of headphones which convert the audio signal to sound.

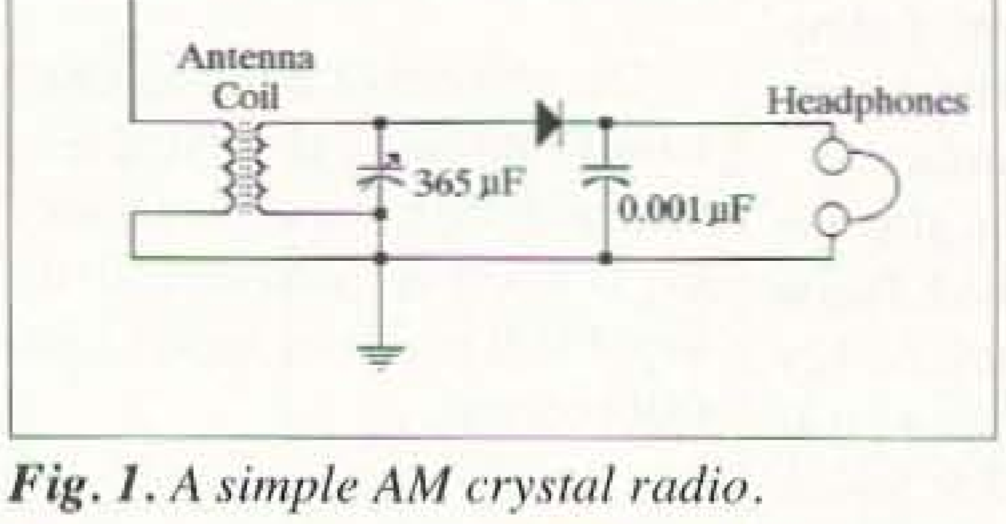

Fig. 1. A simple AM crystal radio.

Variations of this radio circuit date back to the early days of radio. The big advantage, of course, is that it is simple and requires no batteries, but that simplicity carries a price—the radio doesn't work very well. It has poor sensitivity and poor selectivity.

Sensitivity

The term *sensitivity* describes the ability of a radio to pick up weak signals. Our crystal radio has low sensitivity; it can pick up only really strong stations.

Sensitivity has to be judged in relation to noise. Just picking up a station is not enough if the station is so noisy that it is not pleasant to listen to. Spec sheets and advertising literature usually specify receiver sensitivity by measuring how much voltage from the antenna (usually measured in microvolts) is required to make the desired signal (usually the sound out of the speaker) 10 times or 100 times stronger than the noise. This ratio of signal to noise is then called the *signal-to-noise ratio*; a decent radio might provide a 10-to-1 or 100-to-1 signal-to-noise ratio with an antenna signal of under 1 microvolt.

This definition of sensitivity is useful for most radio receivers, but not for a crystal radio. Typical receivers have amplifiers which produce noise when tuned to a weak station, or to no station, so measuring the signal-to-noise ratio is possible. With a crystal set, however, there is really no noise to be heard from the headphones, so measuring the ratio is tough. Still, you need several hundred thousand microvolts of antenna signal to hear anything at all, so sensitivity is clearly bad. The signal-to-noise ratio (and many other quantities as well) is usually measured in decibels, so let us pursue this a bit more.

When we compare two voltages or two currents, the decibel formula is:

$$dB = 20 \log_{10} \frac{\text{(voltage or current after)}}{\text{(voltage or current before)}}$$

Let's look at a simple example to see how that applies to measuring sensitivity.

Suppose you turn on a receiver, disconnect the antenna (so there is no input signal), and adjust the volume control to get some measurable amount of noise from the speaker. Measure the speaker voltage and call that the "before" voltage. (For our example, suppose it is .7 volts.)

Now connect the receiver's antenna leads to a signal generator, properly adjust its frequency so the radio can receive it, and set the generator output until the receiver's speaker voltage is 7 volts (10 times more than before.) Call this the "after" voltage; it is the voltage needed to provide a signal 10 times stronger than the noise.

Now insert the "before" and "after" values into the formula for decibels:

$$dB = 20 \log \frac{\text{(after)}}{\text{(before)}} = 20 \log \frac{(7)}{(0.7)}$$

$$= 20 \log 10 = 20 \times 1$$

(since 10 to the 1st power is 10, log 10 is 1). And so the answer is 20 dB.

Now go back to measure the amount of signal coming from the generator into the receiver antenna connection. This value (in microvolts) is the sensitivity to produce a 20 dB signal-to-noise ratio in the receiver output.

Strictly speaking, this is not entirely correct, because the "after" measurement is not just the signal, but also includes a bit of noise. Hence, many people will call our 20 dB value the *signal-plus-noise-to-noise* ratio, rather than just the signal-to-noise ratio. They may also write it as (S+N)/N, meaning that the signal-plus-noise is divided by the noise output.

Selectivity

Selectivity describes the ability of a receiver to select the station you want, and keep out other stations that you don't want. Our crystal radio has poor selectivity because it has trouble separating nearby stations.

As we've discussed in previous parts, a radio signal consists of a carrier and sidebands, and has a certain bandwidth which depends on the type and amount of modulation. Resonant circuits in the receiver tune in the station you want. Ideally, they should pass all the frequencies in the carrier and sidebands equally well, and completely reject all other frequencies below and above; in reality, however, that is not possible.

DETOUR

At this point, we need to review resonant circuits. **Fig. 2** shows a parallel-tuned resonant circuit of the type most often used in radio receivers. The basic tuned circuit consists of the inductor L and capacitor C, in parallel with each other. An AC input voltage is applied through the resistor R_{in}, and the output connects to a load resistance R_{load}.

If we were to disconnect the L and C, then the input signal would go straight to the output load. Of course, there would be a loss because of current in the two resistors (which make up a voltage divider), so that the output voltage would be smaller than the input voltage. Let's ignore this, though, and just consider the present voltage to be 100%, or the maximum of what it can be, considering the two resistors.

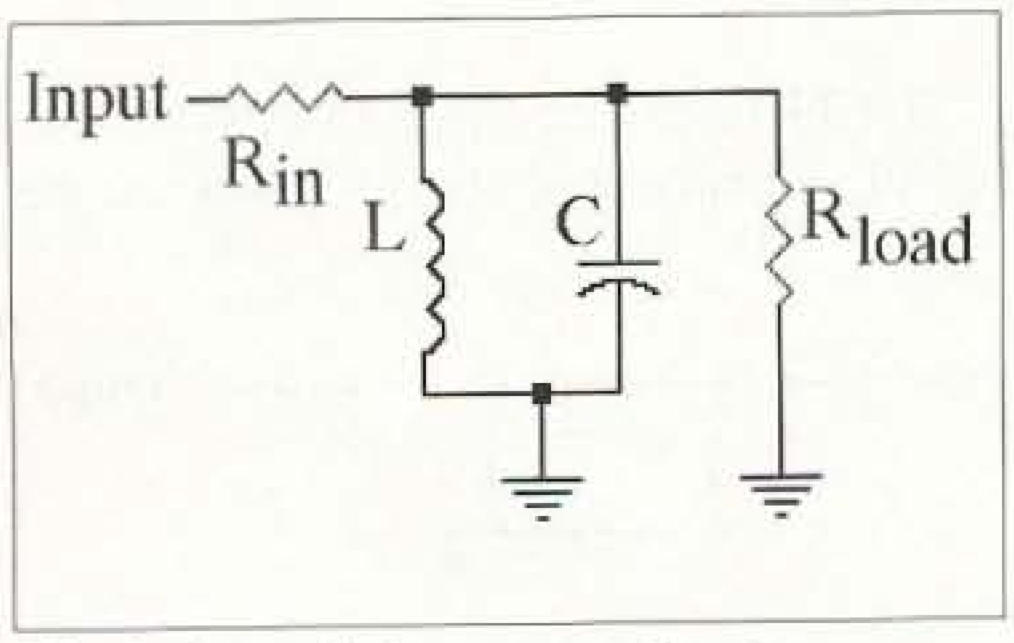

Fig. 2. A parallel-resonant circuit.

When we now connect L and C, there is some current through the inductor L, and also current through the capacitor C; as a result, the output voltage will generally drop. If the voltage drops to 50% of what it was before, we will say that the response of the circuit is 50% or, rather than use percents, we will simply call it 0.5; similarly, if the voltage drops to 80%, we will say that the response is 0.8.

So the response depends on the currents through L and C. There is an important frequency, called the *resonant* frequency, at which the currents through L and C are exactly equal, but opposite in direction—when one current goes up, the other goes down. In this case, the two currents exactly cancel each other out, and it is as if L and C were not there. In other words, at the resonant frequency we get the maximum 100% output voltage; we then say that the response is 1.

"If the superheterodyne receiver had never been invented, communications as we know it would probably not exist."

The resonant frequency is the one at which the reactance of C and the reactance of L are equal; that is,

$$X_C = X_L$$

$$\frac{1}{(2 \pi f C))} = 2 \pi f L$$

Solving this last equation for f gives us:

$$f = \frac{1}{(2\pi \sqrt{L C})}$$

This is the resonant frequency of this circuit. At this frequency, the output from the circuit is the highest (limited, of course, by the values of the resistors).

As soon as the frequency goes either above or below the resonant frequency, the two currents no longer cancel, and the output voltage drops. The left curve in **Fig. 3** shows the response of this circuit as the frequency changes. We see a peak at the resonant frequency, with a drop above and below that frequency.

Fig. 3 shows the actual frequency response of a tuned circuit at the left, and the ideal response we would like to have for a radio at the right. The ideal response would be a rectangle, where *all* the signals within the bandwidth of the radio signal (carrier and sidebands) get through equally well (the response is 1 or 100%), while *nothing* gets through above or below that range (the response is 0 or 0%).

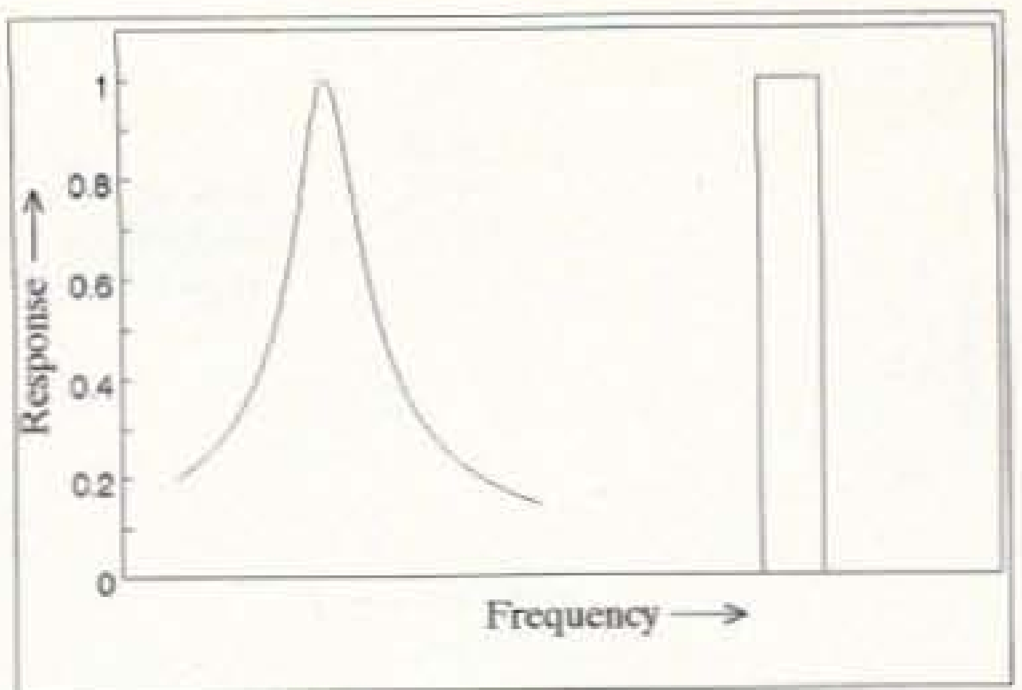

Fig. 3. Actual and ideal resonant response.

You can see there is a big difference between what we want and what we get. The ideal rectangular response at the right has:

1. A flat top. This lets the carrier and all sidebands get through the tuned circuit equally well.

2. Steep skirts. The skirt is the vertical part at the left and right. Steep skirts make sure that the response drops very fast, so that no adjacent stations get through.

3. A definite bandwidth. Ideally, this should be just as wide as the bandwidth of the signal we are trying to receive—no more, and no less.

The actual tuned circuit response shown on the left in **Fig. 3** has none of these. The top isn't flat, so the carrier can get through, but the farther out a sideband is, the less of it gets through. The sides aren't steep enough to keep out adjacent stations, since even pretty far away from the peak the curve still has fairly high response. Finally, there is no definite bandwidth to the circuit.

We can flatten out the top a bit by widening the whole curve. The relative width of the curve is determined by a number called the *Quality Factor,* or *Q* , of the circuit.

The Q describes how wide or narrow the response curve is. For instance, **Fig. 4** shows several different response curves with different Q. The higher the Q, the narrower the response is; the lower the Q, the wider it is. You can see

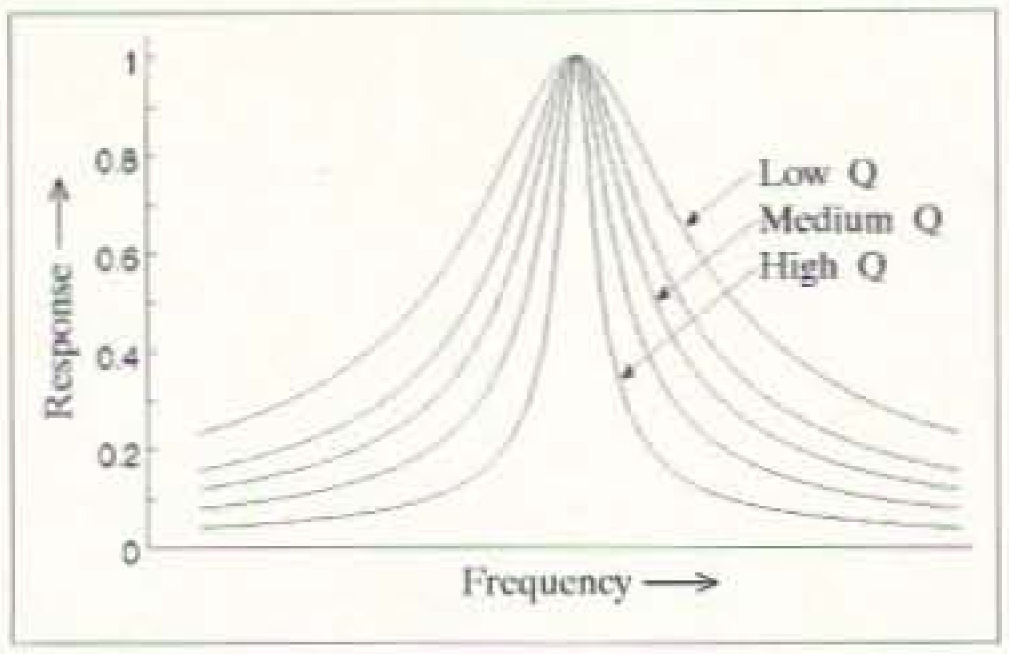

Fig. 4. How Q affects the shape of the response.

that a lower Q would even out the top—but it also widens the bandpass and makes the skirts even less steep.

Fig. 5 shows how the Q is measured. To find the Q, you need two measurements—the resonant frequency and the *3-dB bandwidth*, also often called the *half-power bandwidth*. The resonant frequency is simply the frequency at which the response is a maximum. In other words, it is the frequency of the peak.

The 3-dB or half-power bandwidth is a bit harder to measure. This bandwidth is defined as the difference between the two frequencies where the response drops by 3 dB from its peak value. This also happens to be the point where the output power drops to half of the power at the peak. This needs a bit of explanation.

Look at **Fig. 5**. At the peak, the response has a value of 1. Going down 3 dB from the peak gets us to a response of 0.707 (or $\sqrt{2}/2$, to be exact.) If we insert these values into the formula for voltage decibels, we get:

$$20 \log \frac{0.707}{1} = 20 \times (-0.15) = -3 \text{ dB}$$

In other words, when the response drops to 0.707 of its value at the peak, it has dropped 3 dB from the peak.

This point also happens to be the half-power point. Suppose the output voltage from the circuit is 10 volts at

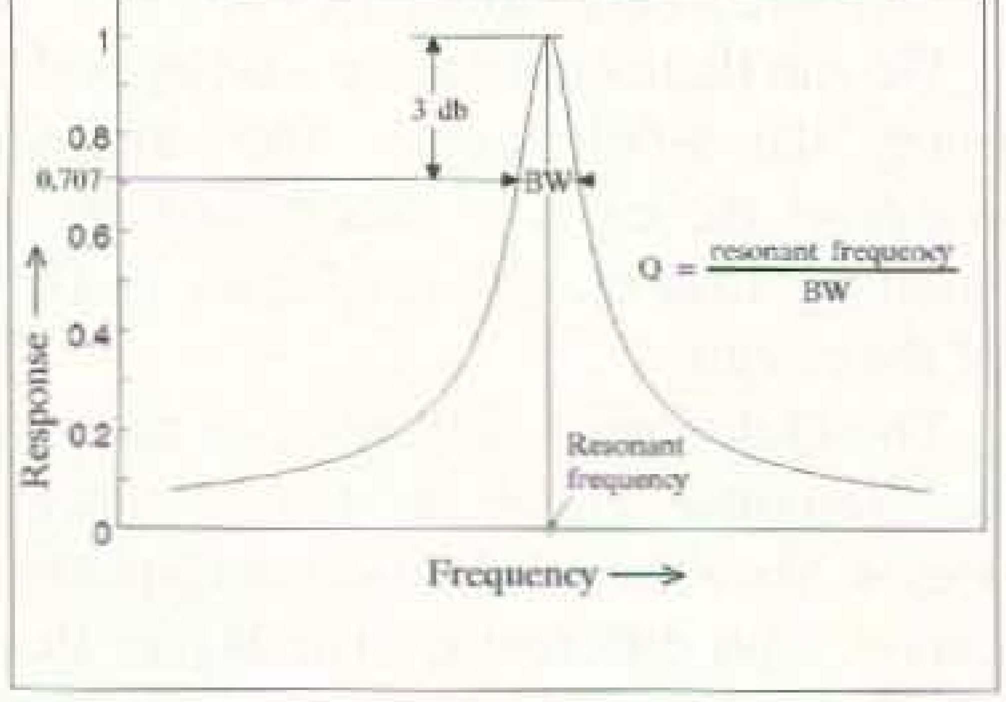

Fig. 5. How to measure the Q of a resonant circuit.

the resonant frequency, and it goes into, say, 100 ohms. Then the power output would be:

$$P = \frac{V^2}{R} = \frac{10^2}{100} = 1 \text{ watt}$$

At the 3-dB point, however, the output voltage drops to 0.707 of its value at the peak, or just 7.07 volts, so the power is now:

$$P = \frac{V^2}{R} = \frac{7.07^2}{100} = \frac{50}{100} = 0.5 \text{ watt}$$

We can use the equation for power decibels to check that 0.5 watt is 3 dB less than 1 watt:

$$10 \log \frac{0.5}{1} = 10 \times (-0.3) = -3 \text{ dB}$$

So back to **Fig. 5**. What we do is to go to the curve, find the two frequencies (one lower than the resonant frequency, and the other higher) where the output drops to 0.707 of its value at the peak, and find the difference between them. This is labeled BW in **Fig. 5**. The Quality factor Q is then defined as:

$$Q = \frac{\text{resonant frequency}}{\text{BW, the 3-dB bandwidth}}$$

The Q is affected by the resistances in the circuit. In **Fig. 2**, the input resistor and the load resistor both affect the Q—the lower the resistors are, the lower the Q. (The resistance of the coil also affects it a bit, but the two resistors have the greatest effect.)

END OF DETOUR

Now that we know some more about resonant circuits, compare **Fig. 1** with **Fig. 2**. The antenna and the primary of the coil in **Fig. 1** feed the signal into the tuned circuit, so their resistance affects the Q. The headphones are the load on the circuit, so their resistance also affects the Q, and, because all of these have fairly low resistance, the Q is terrible! In a typical crystal radio, the response of the tuned circuit is so wide, and the skirts so broad, that it is almost impossible to separate stations from each other. Unless you are lucky to live very close to one radio station and far from all others, don't expect to get very good performance from a crystal radio.

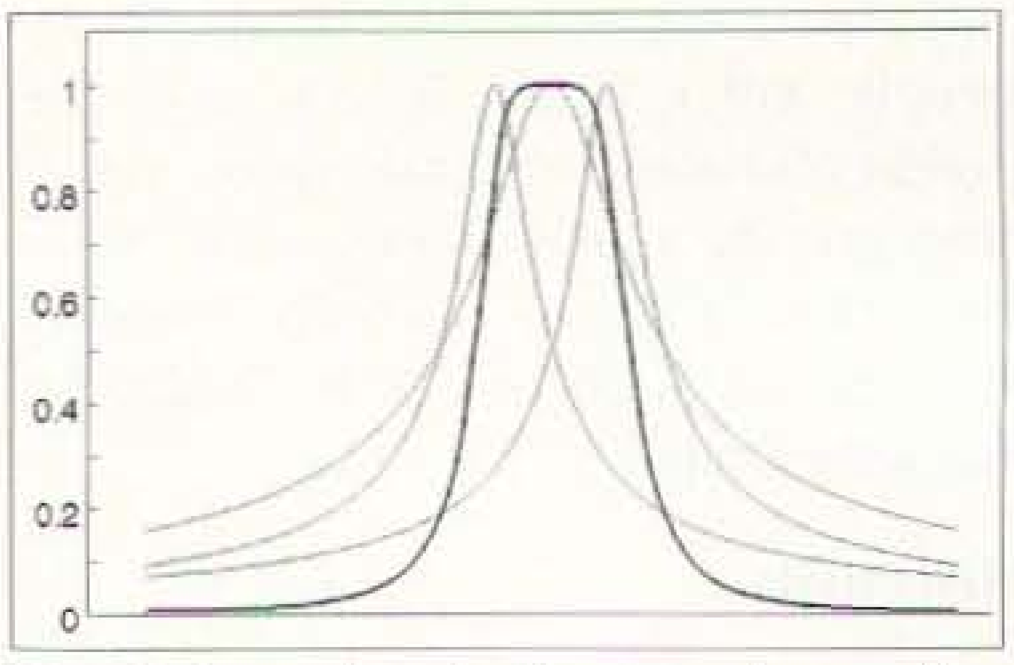

Fig. 6. Improving the bandpass by combining tuned circuits.

How do we improve sensitivity and selectivity?

Improving sensitivity seems fairly simple—just add some amplifiers. Well, it's not quite that simple, because you have to do it just right, as we shall see in a moment, but it *can* be done. Improving selectivity, on the other hand, is somewhat more complicated. There are some modern components, such as crystal or ceramic filters, which can provide a fairly sharp bandpass. The more traditional method, however, is to just add more tuned circuits. For example, the dark curve in **Fig. 6** shows how using three resonant circuits, each tuned to a slightly different frequency and having different Qs, can improve the overall response. There are several ways of getting this same result, and, obviously, the circuit must be carefully designed and set up, or else the resulting bandpass may be lopsided or have lumps in the top.

The problem is that you can't just parallel a bunch of tuned circuits together, as in **Fig. 7**. Even though this looks like three separate tuned circuits, if you parallel the three inductors into one, and the three capacitors into one, you see that there is really only one tuned circuit here. To use more than one tuned circuit in the radio you must somehow separate them so they are not all in parallel with each other. The secret is to separate them with amplifiers.

The TRF or tuned radio frequency receiver

The TRF, or tuned radio frequency receiver, became popular as soon as the

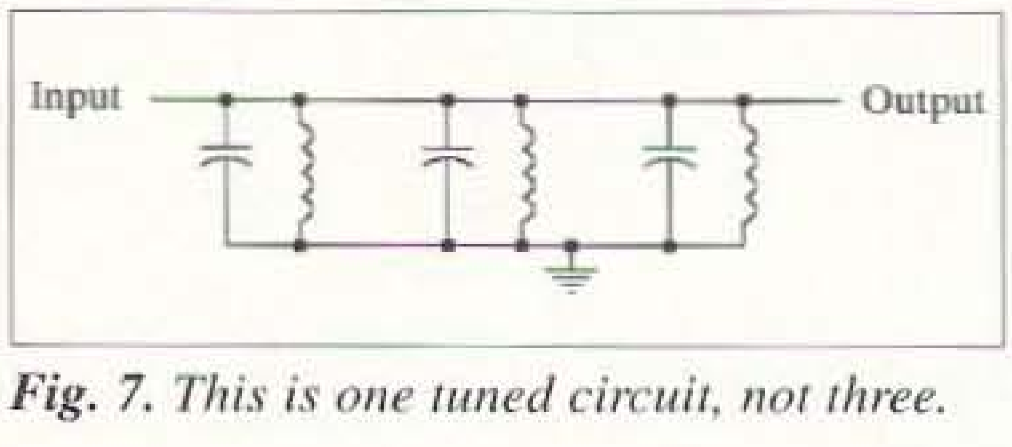

Fig. 7. This is one tuned circuit, not three.

electronics industry got to the point where it was possible to build amplifiers cheaply enough. **Fig. 8** shows the block diagram.

The circuit started with an antenna, usually a longwire strung outdoors. Then came two or more RF tuned circuits, separated by RF amplifiers. These were called RF because they all amplified the actual radio frequency (RF) signal. Eventually came a detector, which was simply a rectifier diode and capacitor, that worked just like those in the crystal radio shown in **Fig. 1**. This was followed by an AF amplifier, called AF because it now amplified the audio frequency signal, not the radio frequency signal. The audio signal then went to a speaker. You'll note how RF amplifiers separated the tuned circuits, so they would act separately instead of becoming one single tuned circuit, as in **Fig. 7**.

The TRF receiver worked quite well for its time, but it had some major problems. One difficulty was that each time you wanted to change stations you had to retune all the tuned circuits. Although **Fig. 8** shows only three, some more expensive radios had four or even more. But as **Fig. 6** shows, even three tuned circuits have to be carefully adjusted if you want to get an overall response with a fairly flat top and steep skirts. It was almost impossible for the average owner to get it right.

A second problem had to do with the actual physical construction of the radio. If two tuned circuits were too close to each other, the two inductors would act as a transformer. Some of the amplified signal from one of the later stages would get back into an earlier stage, only to be amplified again and again—this positive feedback made the radio into a perfect oscillator! The more tuned circuits there were, or the more gain the amplifiers had, the worse the problem became. It was really difficult to build a receiver that had both high sensitivity and high selectivity.

Superhet to the rescue!

The solution was the superheterodyne (superhet for short) receiver, invented around 1930. This idea revolutionized radio; all modern receivers use it.

Fig. 9 shows the block diagram. The amplification in the circuit is provided in three separate sections: the RF section,

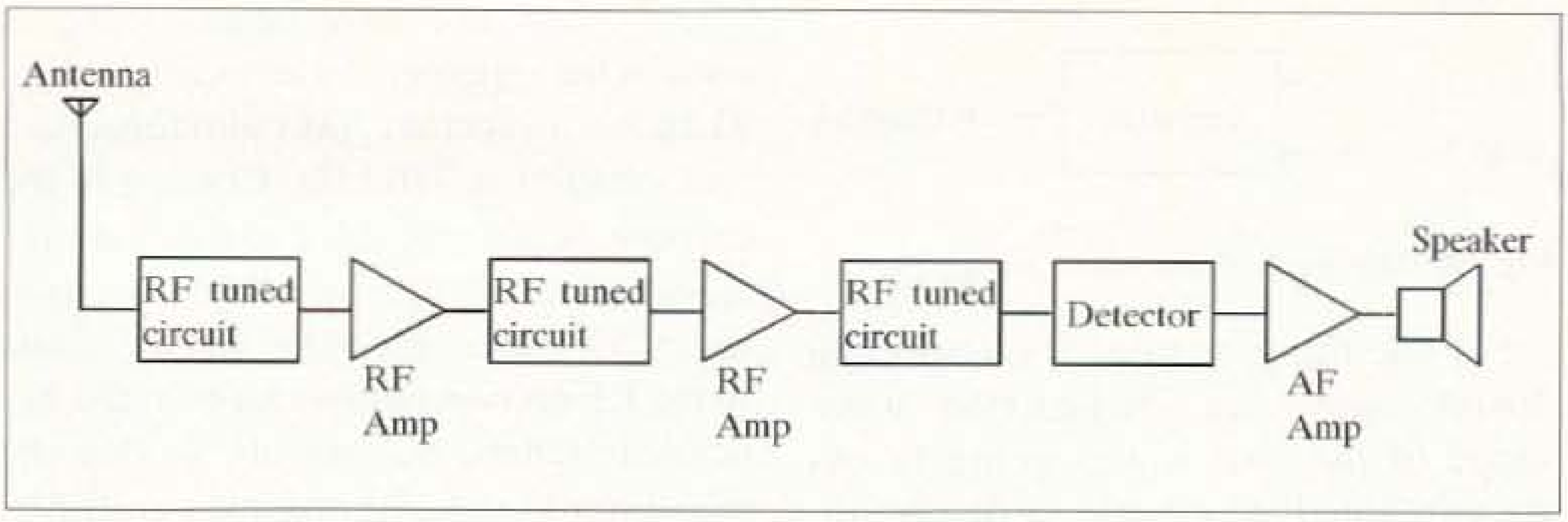

Fig. 8. The tuned radio frequency (TRF) receiver.

which extends from the antenna to the mixer; the IF section, which goes from the mixer to the detector (and is the main feature of the superhet); and the AF section, which extends from the detector to the speaker.

As before, the RF section contains some RF tuned circuits and amplifiers, which amplify the radio frequency signal. Similarly, the AF section contains some audio amplifiers, and amplifies the audio signal. Between them is the IF or *intermediate frequency* section, which amplifies the signal, but also provides all of the selectivity for the entire radio.

The superhet solves both problems of the TRF design. First, the IF section operates at a different frequency from the RF section; moreover, the IF section stays tuned to the same frequency regardless of which station we listen to. So the tuned circuits in the IF section can be properly aligned in the factory to give the best bandpass curve, and they don't get retuned by the user.

Further, because the overall radio gain is split into three sections, each section's gain is smaller. With less gain, feedback from the output back to the input is less of a problem, and because each of the three sections—the RF, the IF, and the AF—operates at a different frequency, it doesn't matter if a signal from one section sneaks into another, since it just gets rejected.

So the superhet's great feature is that the signal in the IF portion of the radio stays at a constant frequency regardless of what station you tune to. This is done by *heterodyning* or *beating* two signals.

DETOUR

Heterodyning is so important to radio that we have to look at it some more. Consider the circuit shown in **Fig. 10**. We have a box containing some circuitry, and two inputs into the box: one a 100 Hz sine wave, the other a 1000 Hz sine wave. What comes out?

Assuming there is *something* inside the box (not just empty air!), the two input signals will usually, somehow, combine into the output. Electrical engineers will now explain that there are two main possibilities.

If the circuitry in the box contains only resistors, inductors, and capacitors, it is called a *linear* circuit. In linear circuits, the output is proportional to the inputs; there is nothing in the output which didn't come from the input. This is just a fancy way of saying that if 100 Hz and 1000 Hz go in, then only 100 Hz and 1000 Hz can come out.

If the circuitry in the box also contains some diodes, transistors, tubes, or other *nonlinear* components, then this becomes a whole new ball game—things can come out that didn't go in.

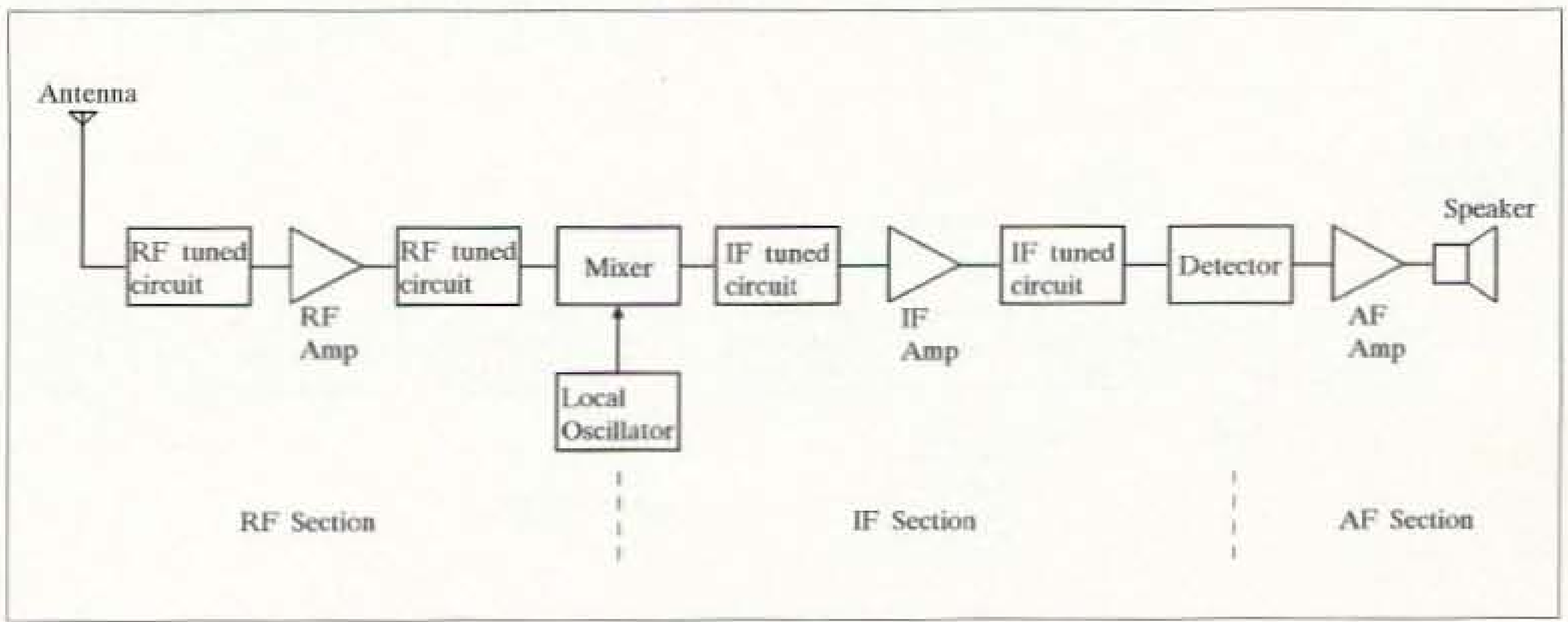

Fig. 9. The superheterodyne receiver block diagram.

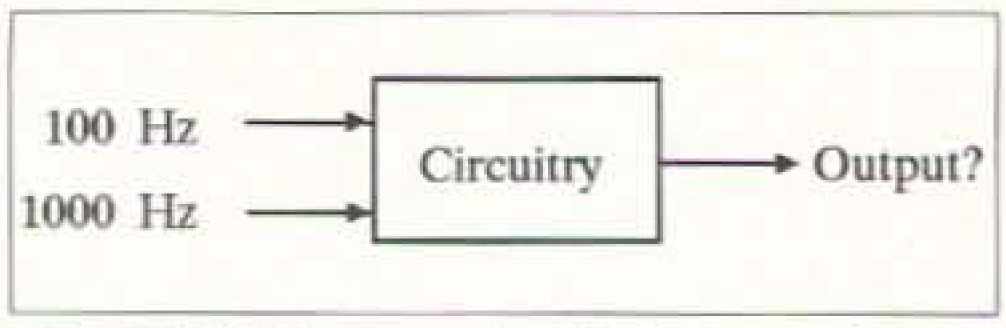

Fig. 10. Mixing two signals in some circuit.

For one thing, nonlinear circuits can distort; they can change the wave shape of the sine waves going in. As we explained way back at the beginning, this introduces harmonics. So the 100 Hz signal could now produce harmonics of 200, 300, 400, or more Hz, while the 1000 Hz signal could now have harmonics at 2000, 3000, etc. Hz.

Much more important for us, though, is that the two input signals can interact with each other. This process is called *heterodyning* or *beating*. When two signals interact like this, they produce new signals whose frequencies are the *sum* and *difference* of the original two signals. In our case, the sum would be 1100 Hz (1000 plus 100), and the difference would be 900 Hz (1000 minus 100). These new frequencies would be called *heterodynes*.

As usual, things are just a bit more complicated. The distortion harmonics also produce sums and differences. For example, the 200 Hz harmonic of the 100 Hz signal could heterodyne with the 3000 Hz harmonic of the 1000 Hz signal to produce 2800 and 3,200 Hz, and so on. Fortunately, the harmonics are usually smaller than the fundamentals, and so these heterodynes are also smaller than the main ones at 1100 and 900 Hz.

At a first glance, you may think this heterodyning is a terrible complication but remember that, without heterodyning, the superheterodyne receiver would be impossible, and radio and TV reception would be a lot worse today.

END OF DETOUR

Let's now see how heterodyning is used in the superhet. As an example, **Fig. 11** shows a superhet AM radio tuned to a radio station at 880 kHz. Coming in the antenna is not just this station, but also signals from all sorts of other stations—radio, TV, radar, etc. The tuned circuits in the RF section remove most of the undesired signals, but not all, so that the signal coming into the mixer is mostly 880 kHz, but still has many other signals.

The mixer is a nonlinear circuit; it receives this combined signal, but it also gets a 1335 kHz signal from the oscillator below it. Since it is nonlinear, it heterodynes these signals. There are a lot of different signals going in so it produces a lot of heterodynes, but the most important ones are the sum and difference of the desired station at 880 kHz, and the oscillator signal at 1335 kHz. This gives us 2215 kHz, the sum, and 455 kHz, the difference.

Note that the tuned circuits in the IF section are all tuned to 455 kHz, so they keep the 455 kHz signal and reject the others. By the time the signal gets to the detector, the filtering has been pretty much completed, and the signal is almost purely 455 kHz (plus the nearby sidebands).

Now, suppose we retune the radio to a different station, say one at 770 kHz. We retune the RF tuned circuits, but these only do a rough job of removing faraway signals; they aren't the main tuned circuits in the radio, so it isn't important to get them just right. But—and here is the important thing to note—we also retune the oscillator to 1225 kHz. The difference between 1225 kHz and 770 kHz is again 455 kHz! So the IF section amplifies the resulting signal, without having to be retuned itself.

The trick when changing stations is to retune the RF circuits (but a slight error here isn't critical), and the oscillator (this is important!) so the difference in frequency between the station you want and the oscillator stays at 455 kHz. Since the RF tuning adjustment isn't that critical, it is possible to use a single knob to adjust all the tuned circuits at the same time, without having to worry about whether all of them are right on target.

In case you wonder why we chose 455 kHz for the IF frequency... well, other values are possible, but this just happens to be a popular one in AM broadcast receivers. FM broadcast receivers usually use 10.7 MHz IF, and other IF frequencies are also used in other kinds of receivers.

If we let $f_{station}$ be the frequency of the station we want, and f_{IF} be the IF frequency, then the oscillator frequency f_{osc} should be:

$$f_{osc} = f_{station} + f_{IF}.$$

But it's also possible to let

$$f_{osc} = f_{station} - f_{IF}.$$

Either way, the difference between $f_{station}$ and f_{osc} is equal to the IF frequency f_{IF} so either will work.

The converter

Many radios combine the mixer and the oscillator into one circuit called the *converter*. This is a popular technique for lowering the radio's cost, because several components in the circuit do many jobs at the same time. **Fig. 12** shows the converter used in many popular AM broadcast radios; there are several useful techniques that are worth mentioning.

L1 and C1 are the RF tuned circuit, with C1 being the tuning capacitor, but L1 does several different jobs. The top part of the winding (above the ground connection) is the part that actually resonates with the capacitor; the bottom part (connecting to C2) acts as the secondary of a transformer, to bring the signal from L1 to the transistor without loading down the tuned circuit (which would reduce the Q).

At the same time, L1 is also the antenna. As we will see later, coils or loops of wire can act as antennas; in this case, L1 is wound on a ferrite core (a ceramic core which contains ferrous metal particles); the core helps to pick up the energy from the radio signal, and concentrate it in the coil.

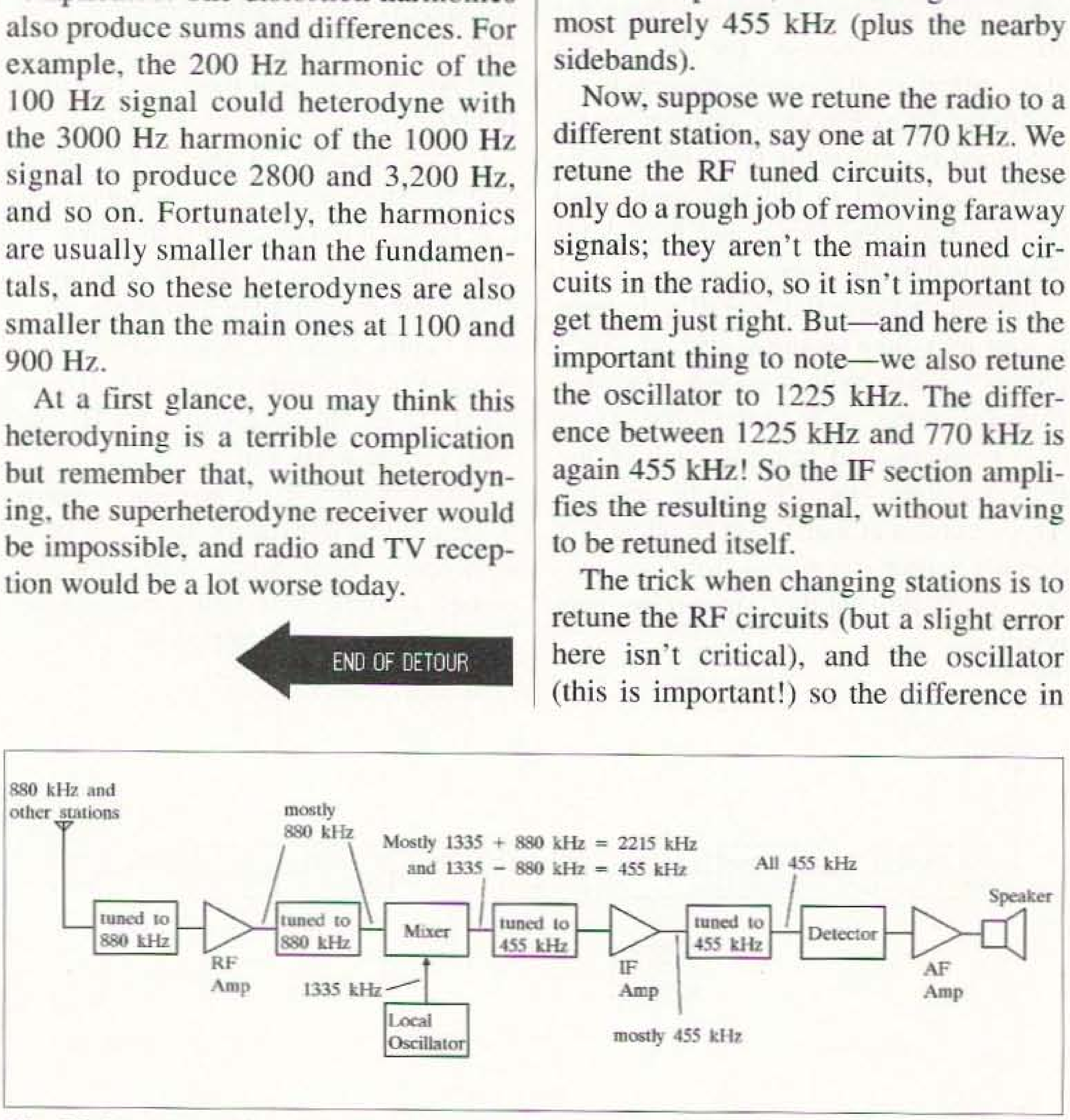

Fig. 11. Superhet with a 455 kHz IF, tuned to 880 kHz.

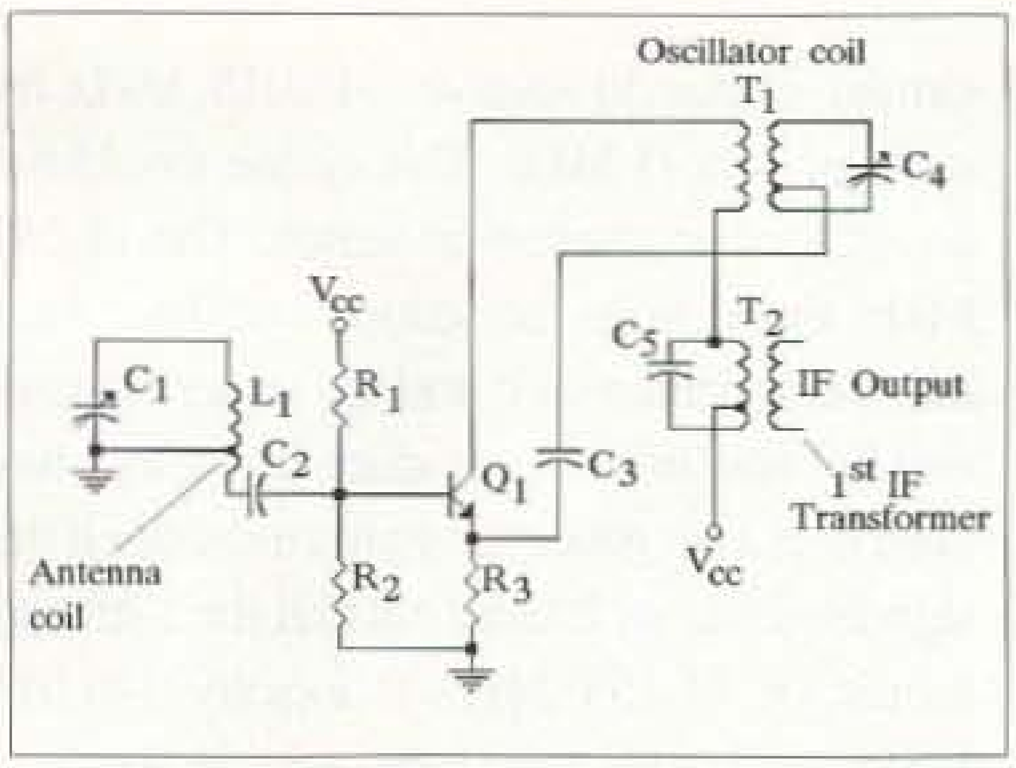

Fig. 12. Typical converter in an AM receiver.

The transistor also does two jobs. First, it oscillates at a frequency 455 kHz above the signal you want to pick up. To do this, we need an amplifier with positive feedback. The transistor is the amplifier, with its output coming out of the collector, going through oscillator coil T1, and back through C3 into the emitter of the transistor. Capacitor C4 resonates with the secondary of this coil to control the oscillator frequency.

At the same time, however, the transistor amplifies the RF signal coming from the antenna coil, and mixes it with the oscillator signal. Because the transistor is nonlinear, it also produces the sum and difference heterodyne frequencies. The primary of IF transformer T2 and capacitor C5 resonate at 455 kHz, and send the 455 kHz difference frequency on to the IF amplifier.

Note how T1 and T2 both use taps on one winding (the tap is a third connection part way into the winding). This reduces the loading on the resonant circuit, and keeps the Q from being lowered.

Variations on a theme

Although **Fig. 9** showed one RF amplifier (with two RF tuned circuits), and one IF amplifier (also with two IF tuned circuits), there is nothing sacred about these numbers. Many cheap radios use only one RF tuned circuit, and no RF amplifier; the converter shown in **Fig. 2** is a good example.

On the other hand, more expensive radios might have more RF amplifiers and/or more IF amplifiers. In fact, quite a few radios use *double conversion*. In this scheme, there are two mixers and oscillators (or two converters), and two different IF amplifier sections. We'll see the reason for this in a moment.

Superheterodyne sensitivity and selectivity

By splitting the amplification into separate sections, a superhet can provide more gain in each section without the danger of signals feeding back and causing oscillation. Further, because the IF amplifier does not need to be retuned each time you change stations, it can be optimized and carefully adjusted at the factory to provide the best possible bandpass characteristics—steep skirts and a flat top. But, there is more to it than that.

Recall our definition of the Quality factor Q of a resonant circuit:

$$Q = \frac{\text{resonant frequency}}{\text{BW, the 3-dB bandwidth}}$$

The 3-dB bandwidth doesn't really specify how well the circuit will reject adjacent stations; in order to reject such interference, the response of the tuned circuit has to be 30, 40, or even more dB down from the top of the curve at the frequencies of any adjacent stations. Still, it provides a useful yardstick for comparison.

"Just picking up a station is not enough if the station is so noisy that it is not pleasant to listen to."

We can rewrite the above equation as:

$$\text{3-dB bandwidth BW} = \frac{\text{resonant frequency}}{Q}$$

To get a small bandwidth, you have to either make the resonant frequency small, or make the Q big, but in most resonant circuits, there is a limit to how big Q can get. It is affected by the resistance of the rest of the circuit, and is seldom more than 20 or 30. So making Q big is not a feasible approach to making the bandwidth small. To get a small bandwidth, it would help if you could make the resonant frequency small.

In a TRF receiver, though, you must tune the resonant circuits to the frequency of the station you want to receive, so you really can't make the resonant frequency small to get a good bandwidth. To further complicate the design, the bandwidth will change as you tune to different stations.

In a superhet, on the other hand, all the selectivity is obtained in the IF stages, and their frequency stays the same for all stations. Moreover, the IF frequency is lower than *any* of the stations you want to receive, so you can get the same narrow bandwidth for every station you listen to. In theory, at least, you could get the bandwidth as narrow as you want, simply by going to a lower IF frequency. (Note how AM broadcast radios, which need a lower bandwidth than FM broadcast radios, also have a lower IF frequency of 455 kHz instead of 10.7 MHz.) But there is a fly in the ointment, as they say—the image.

The image

Let's return to the radio diagrammed in **Fig. 11**. It is tuned to 880 kHz, has a 455 kHz IF, and an oscillator frequency of 1335 kHz. Here we see that 1335 kHz - 880 kHz = 455 kHz.

So far, so good, but suppose there was a station at 1790 kHz. Look at the following calculation:

1790 kHz - 1335 kHz = 455 kHz

In other words, the difference between the new station at 1790 kHz and the 1335 kHz oscillator frequency is *also* 455 kHz. This new radio station could also now be heard, though not as well as the one at 880 kHz because the RF tuned circuits largely remove it. If it were strong enough, though, it would come through anyway. The 1790 kHz frequency is called the *image frequency*.

Note how the image frequency is calculated:

Desired station	880 kHz
+ IF frequency	+445 kHz
Oscillator frequency	1335 kHz
+ IF frequency	+455 kHz
Image frequency	1790 kHz

That is, the image frequency f_{image} is

$$f_{image} = f_{desired\ station} \pm 2 f_{IF}$$

(We used the ± sign in the equation because in some radios the oscillator could also be below the desired station frequency; in that case, the image frequency would be below the oscillator frequency, and we would need the minus sign.)

This brings us to a problem. Just a few paragraphs ago, we said "In theory, at least, you could get the bandwidth as narrow as you want, simply be going to a lower IF frequency," but if you do that, then the image frequency gets closer to the desired frequency, and then the RF tuned circuits may not be able to get rid of it. So you have two conflicting requirements:

To get better selectivity—lower bandwidth—you want to *lower* the IF frequency.

To get better rejection of the image frequency, you want to *raise* the IF frequency.

This is particularly a problem with high-frequency receivers intended to receive narrowband signals. For example, consider an amateur FM receiver for 146.94 MHz. Since the bandwidth of FM signals on this frequency is typically only 10 or 15 kHz, a low IF frequency (such as 455 kHz or even less) would be ideal. But then the image would be at:

$$146.94\ \text{MHz} + (2 \times 455\ \text{kHz}) = 147.85\ \text{MHz}$$

which is not even 1% away from the desired frequency. There is no way that a typical RF tuned circuit could keep the image out—you'd need a tremendous Q to do it.

Typical receivers solve the problem in one of two ways. A few use a much higher IF frequency (around 10 MHz), but with special crystal or ceramic filters which can get the narrow bandwidth even at this higher IF frequency.

A much more common alternative is to use two separate IF sections and double conversion. **Fig. 13** shows the block diagram of a double-conversion superhet to receive 146.94 MHz. Since 10.7 MHz and 455 kHz IF transformers are fairly inexpensive (they are manufactured by the zillions for use in standard AM and FM broadcast receivers), many communications radios use them as well, and we show them here.

To receive 146.94 MHz, the first oscillator runs at 146.94 minus 10.7 MHz, or 136.24 MHz (the oscillator could be either 10.7 MHz *above* the desired signal, or 10.7 MHz *below*; in this case, we chose to use the lower frequency). The second oscillator and mixer convert the 10.7 MHz first IF signal to 455 kHz by using an oscillator at 10.7 MHz + 0.455 MHz, or 11.155 MHz.

By using two IF frequencies, the double-conversion receiver solves our two problems. The high first IF frequency does not provide much selectivity, but it helps to eliminate the image. Since the image frequency is at:

$$f_{image} = f_{desired\ station} - 2f_{IF}$$

(Note that we use a minus sign since the oscillator is below the desired signal, so the image must be even below that.) The image frequency is now:

$$146.94\ \text{MHz} - (2 \times 10.7\ \text{MHz}) = 125.54\ \text{MHz}$$

which is far enough away from 146.94 that the RF tuned circuits can remove it (or at least significantly reduce it).

The second IF frequency of 455 kHz, on the other hand, is low enough so that even transformers with reasonable Q can provide a narrow bandwidth.

Incidentally, suppose we wanted to use a similar circuit to receive 145.015 MHz instead of 146.94 MHz. This circuit would not do, and for an interesting reason: The 11.155 MHz signal from the second oscillator goes into the second mixer, and the mixer is intentionally nonlinear (to produce a heterodyne). Hence, it also generates harmonics of all the signals going in. It turns out that the 13th harmonic of 11.155 MHz is exactly 145.015 MHz. Although this harmonic is weak, a small amount of it will still sneak back into the RF stage and fool the receiver into thinking there is a weak, unmodulated signal at that frequency. Unless your desired signal is substantially stronger than this false signal (called a *birdie*), it will not be heard.

The solution in this case is to change the second oscillator frequency from 10.7 *plus* 455 kHz to 10.7 *minus* 455 kHz, or 10.245 MHz. This new oscillator frequency has harmonics at different places. While this removes the birdie at 145.015 MHz, it introduces birdies elsewhere, such as 143.43 (which is the 14th harmonic of 10.245 MHz). Designing wideband receivers (receivers designed to receive a wide range of frequencies) is always a problem; there are always some birdies somewhere, and the designer has to carefully choose his oscillator and IF frequencies to try to place the birdies at places where they will not interfere with normal operation.

Summary

If the superheterodyne receiver had never been invented, communications as we know it would probably not exist. The combination of features we have described allows radio receivers to have selectivity and sensitivity, letting millions of transmitters around the world coexist with each other while making it possible for us to select and listen to even extremely weak signals from far away.

We have touched on some of the important concepts, yet have had to skip many others. In the next installment, we will try to cover some more concepts having to do with the transmitters and receivers which we run into daily. 73

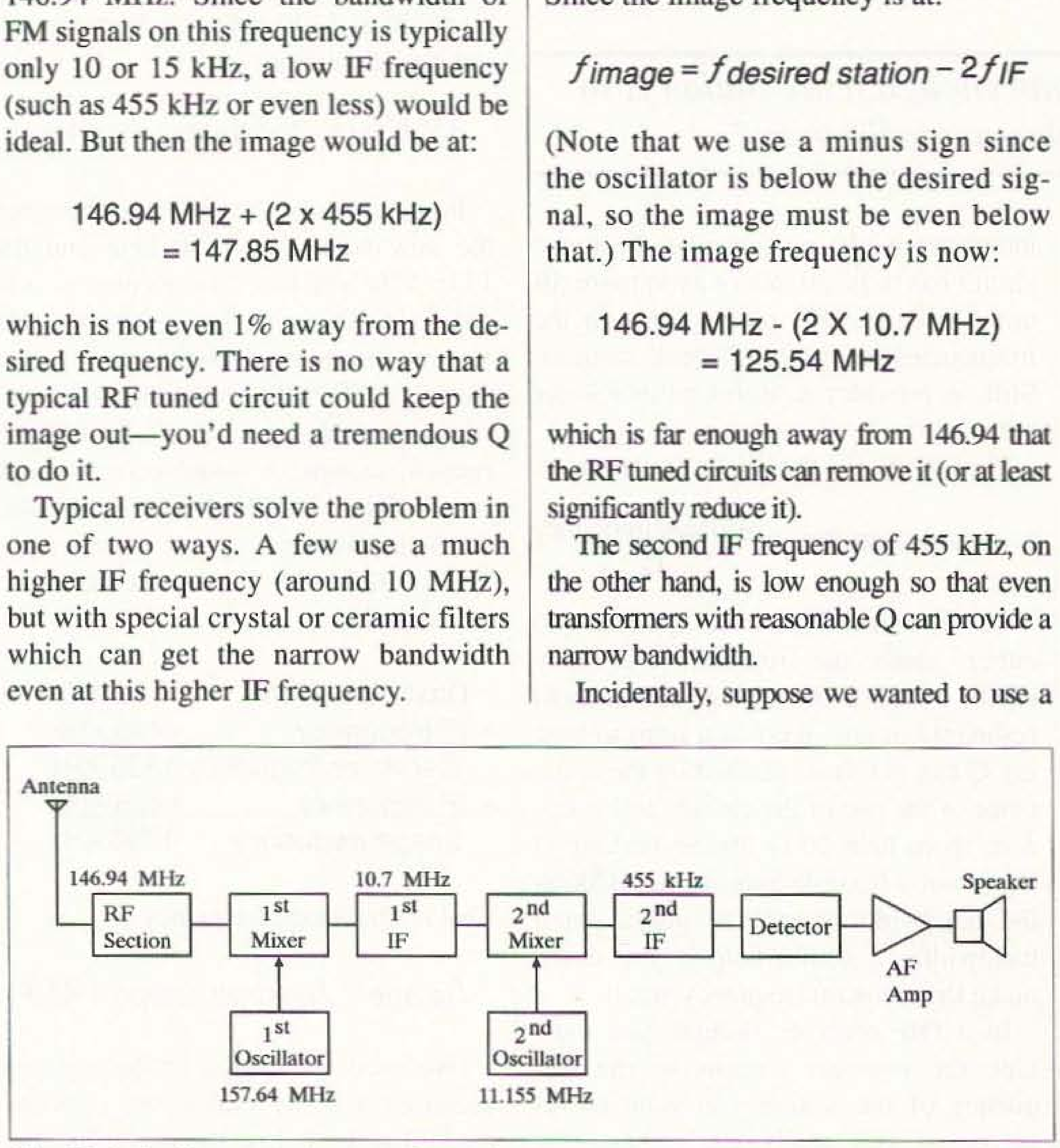

Fig. 13. A double-conversion superheterodyne.

Above & Beyond

VHF and Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave
San Diego CA 92119
Internet: clhough@aol.com

Pursuit of 2304 MHz: local oscillator and filter

Last month I discussed using a Qualcomm 3036 phase-locked loop (PLL) synthesizer as the backbone for construction in the microwave arena. This synthesizer has enabled our microwave group to construct several converters for different microwave bands, using surplus material, for local oscillator generation. A synthesizer is not perfect, as we stated last month, but it is perfectly acceptable when it's inexpensive and performs well. After all, that's the basic premise for most amateur-related projects: low cost and suitability. After that can come the pursuit of excellence, and gold-plating.

I know that the subject of synthesizers can be a little intimidating but I will try to remove some of the mystique, showing that they can be easily modified. Additionally, the waveguide below cutoff filters that we constructed and used in our transverters will be covered for use at 1296, 2304 and 3456 MHz. I will describe the transceivers that our club members constructed. This was a rush-to-completion project so we didn't use all the bells and whistles. One quick item that was put to use to demonstrate this operation was the filter construction. These filters are not the ultimate, but they are easy and inexpensive to construct and are tolerant of mistakes. This makes a very simple package to assemble with other components to facilitate a microwave converter. Let's cover the synthesizer first.

The synthesizer

The Qualcomm 3036 synthesizer chip is the heart of this circuit. This little chip can directly control a voltage-controlled oscillator (VCO) up to 1.6 GHz by itself, with minimal external circuitry. Equipping it with an additional divide-by-two frequency divider chip (on the PC board) will extend the VCO towards the 3 GHz range. This is the reason the synthesizer that we make available is capable of working directly at 2556 MHz and other frequencies above the 1.6 GHz frequency range of the synthesizer chip.

Other circuitry on the synthesizer board includes the loop filter and clock reference circuitry. The clock used in this application is a very high stability 10 MHz temperature-compensated crystal oscillator, or TCXO for short. The oscillators we use are capable of stability of .1 hertz at 10 MHz or better over temperature.

The 3036 synthesizer chip can be programmed by an IBM 8-bit computer bus, or it can be pin-for-pin programmed in a fixed mode of operation. While the IBM bus mode might be attractive to some serious experimenters wanting to push for other developments, most applications will fall on the basic pin-for-pin manual programming methods that we have developed for single-frequency amateur frequency generation. It is in this fixed mode that all of the amateur frequencies were generated for use at the 2 to 2.7 GHz frequencies for local oscillator use. Multiplication schemes were employed for use at 3456 MHz, 5760 and 10368 MHz. All these schemes used manual pin-for-pin programming.

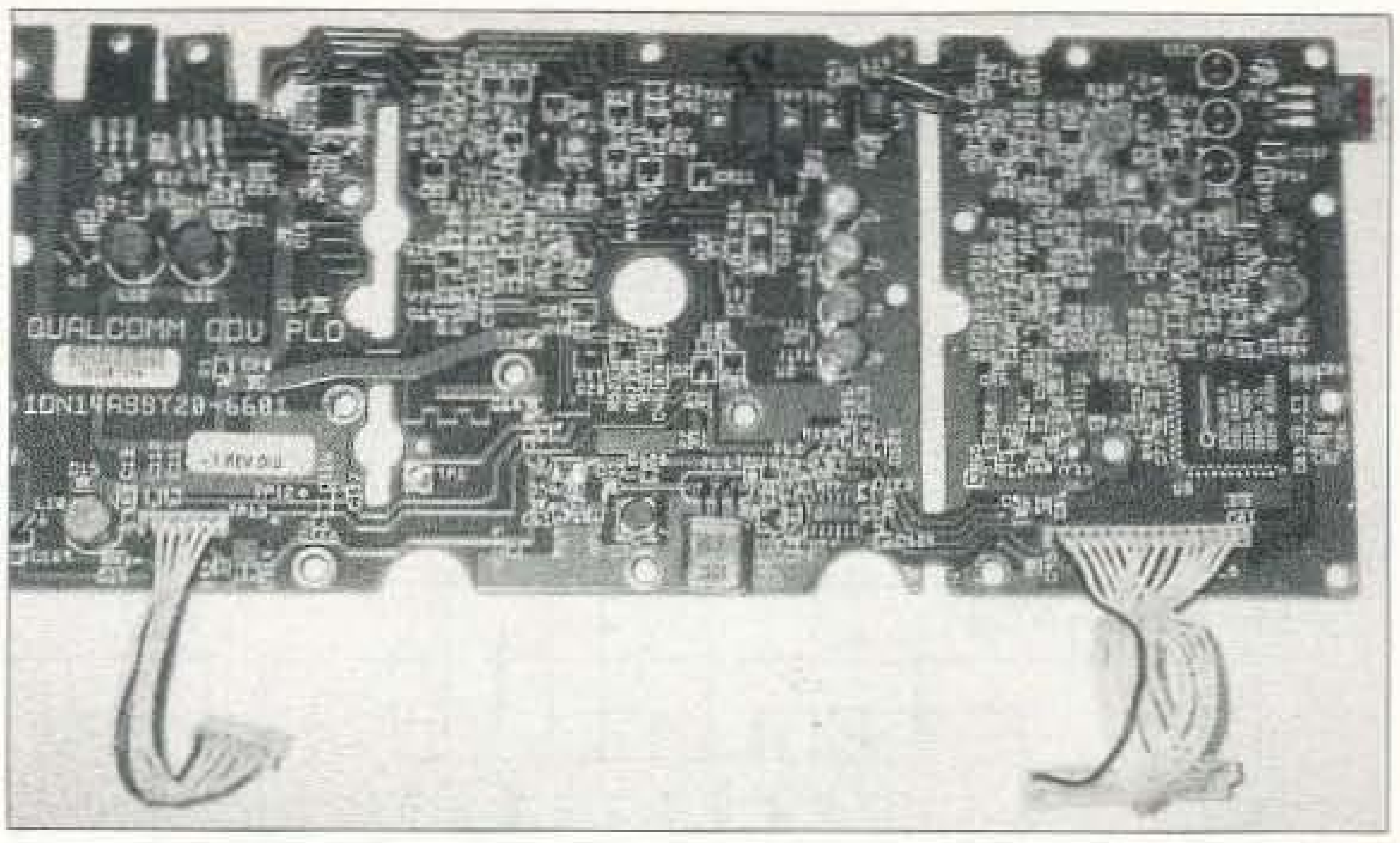

Photo B. Qualcomm power supply synthesizer board before conversion. The left and middle parts of the PC board have been removed, leaving a cigarette pack-size PC board containing all the synthesizer circuitry.

Photo A. 2304 MHz transverter from Down East Microwave, built by Pete W6SAJ.

The IF frequency we have chosen to use is 2 meters, making a local oscillator frequency of 2160 required for 2304 MHz. That is, 2160 MHz plus 144 MHz equals 2304 MHz, the operating frequency. Other IF frequencies are possible. The synthesizer as originally used in commercial operation required a frequency of nearly 2.6 GHz and was controlled by an on-board processor (the IBM single-chip 8-bit controller). Pin 22 is the mode select pin of the 3036 chip and is grounded for bus mode and tied to +5 volts for pin-for-pin programming.

Modifying the 3036

Gently cut pin 22 at the board solder trace with a sharp Exacto™ knife and lift the pin from the PC board solder pad nearly horizontal for wiring to +5 volts. In this same manner lift the other pins with the knife to provide for pin-to-pin reprogramming. It might sound difficult, but the conversion is easy; it just requires a delicate smooth operation. A heavy-handed method of operation here will break the pin and render the chip useless.

If you take care and lift the pin with easy slow movements and do not apply force, the pin can be lifted without breaking it. Lift it just enough to allow soldering to the new programming control, which is either ground or +5 volts, as determined by the frequency reprogramming chart shown in **Table 1**. If you are heavy-handed with the knife when lifting the chip pins they will break off and the chip will be gone. Gentle lifting of the pin works well. Do not try to move the pin more than once as it might weaken and break off. Also, don't try to make the pins uniform or "pretty them up," as excessive movement could also break the IC pin off flush with the IC.

Let's discuss the internal structure of the 3036 chip so you can get some idea of just what is going on inside. The Qualcomm 3036 PLL has three counters internal to the chip: the 7-bit "M" and 4-bit "A" pulse swallow counters, and a 4-bit reference counter. All of these programming pins must be configured to our new programming information, along with four control pins (some of the pins are already tied to the correct ground or +5 volt connections and do not have to be changed). **Fig. 1** shows a schematic of the complete assembly.

To modify the synthesizer, you will need a grounded static-free work station equipped with a temperature-controlled soldering iron, an Exacto knife, and a small

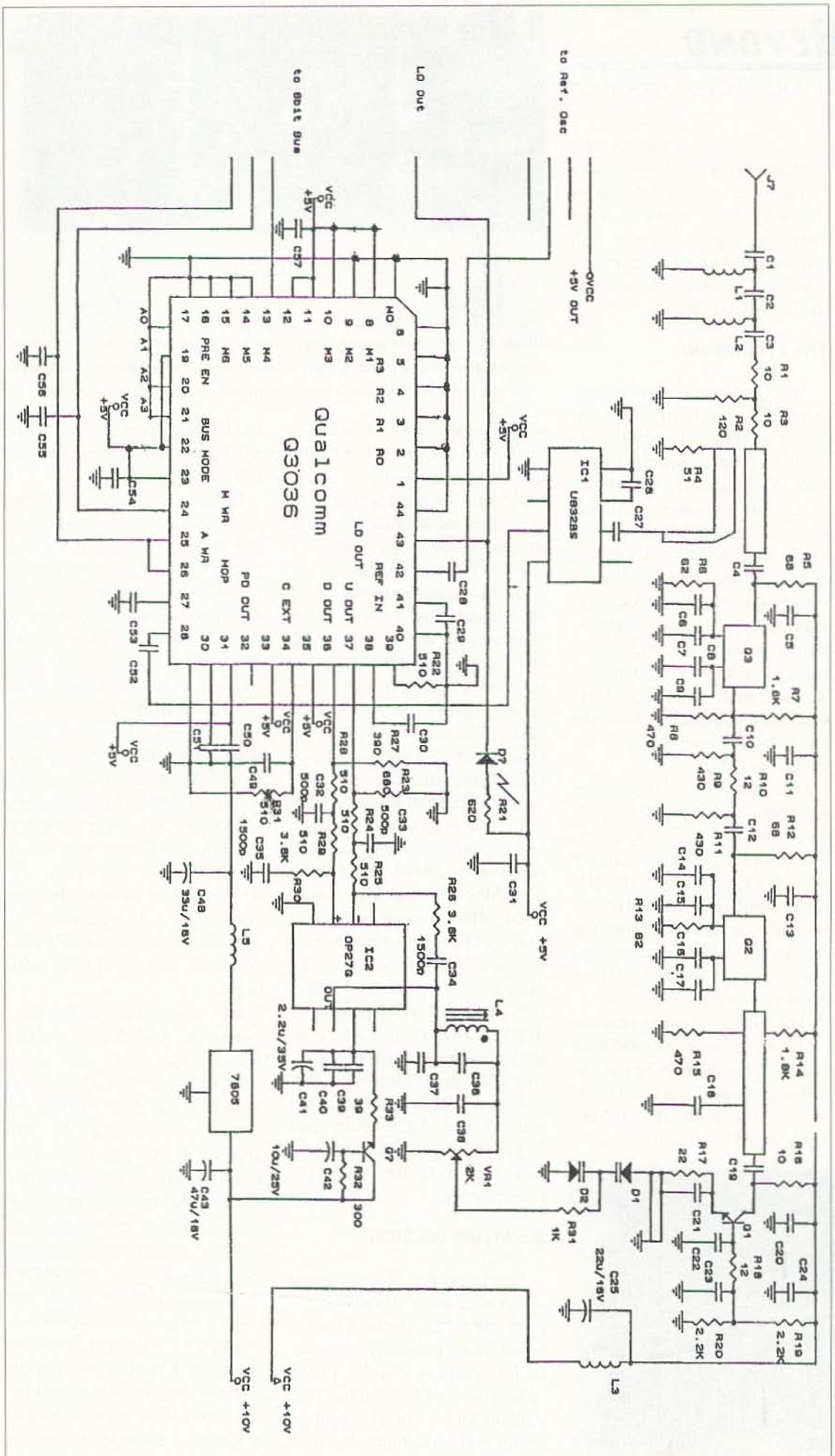

Fig. 1. The Qualcomm 3036 synthesizer chip and its schematic diagram. This was reverse engineered by Kiyotsugi Tanemura JG1QGF.

magnifying lens to examine your progress. The circuitry is quite tolerant to soldering and handling abuse. Don't get me wrong here—I don't recommend mishandling the synthesizer, as it is a high density PC board using very small surface-mount components. It has proven to be quite abuse-resistant, but don't push your luck by mishandling it. Use a temperature-controlled soldering iron that is grounded, and work in a static-free setting. This will prevent static and other voltage-induced problems from damaging chips on the PC board. Do not use a high-heat soldering iron as the excessive heat can lift the PC board copper foil by breaking the bond between the copper trace and the PC board.

To reprogram the 3036 synthesizer chip we used an Exacto knife with a sharp blade and carefully cut the pins of the 3036 (at the PC board) that needed to be lifted to suit our particular reprogramming information. The stock PC board as received was set up for programming by a CPU located on another PC board and connected by the board connector located just above the 3036 chip. (The boards that I make available are pretested by connecting a processor using the stock programming frequency of 2620 MHz.)

In the PC boards that I make available there may be parts of the PC boards that are jumpered around, such as power supply, and other troubles. These "other troubles" have no bearing on the synthesizer operation as most of these trouble spots occur where some of the circuitry has been removed in the modification to amateur frequencies. The cable that connects to the processor is removed along with the processor. This leaves many of the pins of the 3036 open. There are other pins that are tied to ground on the PC board, and some of these need to be lifted and tied to +5 volts. See **Fig. 1** for the pinouts of the 3036 synthesizer chip. **Table 1** shows pin programming for several frequencies commonly used.

The remainder of the conversion consists of reducing the size of the PC board, removing the power and control circuitry that

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Q 3036 Pin Assignment/Description

Pin #	Name	I/O Type	Description
1	V_{CC1}	+5V input	Power supply connection
2	R0 IN	TTL/CMOS input	R counter input bit 0 (LSB)
3	R1 IN	TTL/CMOS input	R counter input bit 1
4	R2 IN	TTL/CMOS input	R counter input bit 2
5	R3 IN	TTL/CMOS input	R counter input bit 3 (MSB)
6	GND	GND	Ground connection
7	M0 IN (DBUS0)	TTL/CMOS input	M counter input bit 0 (LSB), data bus bit 0 (LSB)
8	M1 IN (DBUS1)	TTL/CMOS input	M counter input bit 1, data bus bit 1
9	M2 IN (DBUS2)	TTL/CMOS input	M counter input bit 2, data bus bit 2
10	M3 IN (DBUS3)	TTL/CMOS input	M counter input bit 3, data bus bit 3
11	V_{CC2}	+5V input	Power supply connection
12	V_{CC3}	+5V input	Power supply connection
13	M4 IN (DBUS4)	TTL/CMOS input	M counter input bit 4, data bus bit 4
14	M5 IN (DBUS5)	TTL/CMOS input	M counter input bit 5, data bus bit 5
15	M6 IN (DBUS6)	TTL/CMOS input	M counter input bit 6(MSB), data bus bit 6
16	PRE EN/(DBUS7)	TTL/CMOS input	Prescaler enable input (0=DMP enabled; 1=DMP bypassed), data bus bit 7 (MSB)
17	GND	GND	Ground connection
18	A0 IN	TTL/CMOS input	A counter input bit 0 (LSB)
19	A1 IN	TTL/CMOS input	A counter input bit 1
20	A2 IN	TTL/CMOS input	A counter input bit 2
21	A3 IN	TTL/CMOS input	A counter input bit 3 (MSB)
22	BUS MODE/	TTL/CMOS input	Bus interface control input (0=8-bit data bus, 1=16-bit parallel)
23	V_{CC4}	+5V input	Power supply connection
24	MWR	TTL/CMOS input	Register 1 write input (rising edge active)
25	AWR	TTL/CMOS input	Register 2 write input (rising edge active)
26	HOP CLK	TTL/CMOS input	Hop clock input (rising edge active)
27	VCO IN	Diff ECL input	1600 MHz VCO input
28	VCO IN/	Diff ECL input	Bias decoupling for VCO input
29	GND	GND	Ground connection
30	VCO DIV OUT	ECL output	VCO divider output
31	V_{CCO1}	+5V input	ECL output power supply
32	PD OUT/	ECL output	Phase detector output
33	V_{CC5}	+5V input	Power supply connection
34	CEXT	Analog	External capacitor connection
35	V_{CC6}	+5V input	Power supply connection
36	PD D OUT/	ECL output	Phase detector D/ output
37	PD U OUT	ECL output	Phase detector U/ output
38	V_{CCO2}	+5V input	ECL output power supply
39	REF DIV OUT	ECL output	Reference divider output
40	GND	GND	Ground connection
41	REF IN/	Diff ECL input	Bias decoupling for REF input
42	REF IN	Diff ECL input	Up to 100 MHz REF input
43	LD OUT	TTL output	Open collector lock detector (O.C.=in lock)
44	GND	GND	Ground connection

Table 1. Pin programming for changing the frequency of the Qualcomm 3036 synthesizer chip.

is not required. You can prepare the circuit board with modifications first, then cut off portions of the board that are not required.

There is a C2610 +10 volt regulator (TO-220 package) that is part of the power supply circuitry. It can be removed and used to power the modified synthesizer. There are two traces on the bottom of the synthesizer board: a small one and a large wide trace. The wide trace is the +10 volt input to the +5 volt regulator for the 3036 chip. The small trace is the +10 volts for the oscillator amplifier buffer string. Short these two traces together and tie to regulated +10 volts from the C2610 device. On top of the board there are four traces going over the top portion of the board's cutout. Leave this circuitry in place, along with the crystal and chip circuit to the right. On the far right of the 10 MHz crystal filter there is an attenuator pad "T" configuration. This is the 10 MHz reference input. All circuitry to the right and below the 10 MHz filter can be removed.

If you have trouble finding the 10 MHz input pad, start at the far-right part of the PC board before cutting it. There you will find two off-board connections. The bottom one is the +12 volt main input to the power distribution and regulator circuit. The top one is the 10 MHz input and connects directly to this pad to use when you reduce the size of the synthesizer PC board. You might select to leave the PC board intact; that's OK—it's your option whether to have a smaller PC board or keep it at the original size.

General Equations

N = PLL input Freq/Phase Detector frequency

PLL input Freq = VCO Freq/2

N = 10(M+1) +A

M = int(N/10)-1

A = N-10(M+1)

R = Reference Frequency (10 MHz)/Phase Detector Freq - 1

IF Freq	Lo Freq	Phase Detector Freq	VCO Freq	PLL Input Freq (VCO/2)	N	M	A	R
144	10224	2	2556	1278	639	62 (111110)	9 (1001)	4 (100)
448	9920	2	2480	1240	620	61 (111101)	0 (0000)	4 (100)
432	9936	2	2484	1242	621	61 (111101)	1 (0001)	4 (100)

Table 2A*. Pin-for-pin programming of the 3036-based PLL synthesizer. As shown in these three examples, the general equations are used to determine the M, A, and R values for a desired IF frequency. These values (in binary form) are hard-wired to the appropriate pins on the IC (see* ***Table 2B****).*

1	+VCC	
2	R0	0
3	R1	0
4	R2	1
5	R3	0
6	GND	
7	M0	0
8	M1	1
9	M2	1
10	M3	1
13	M4	1
14	M5	1
15	M6	0
18	A0	1
19	A1	0
20	A2	0
21	A3	1

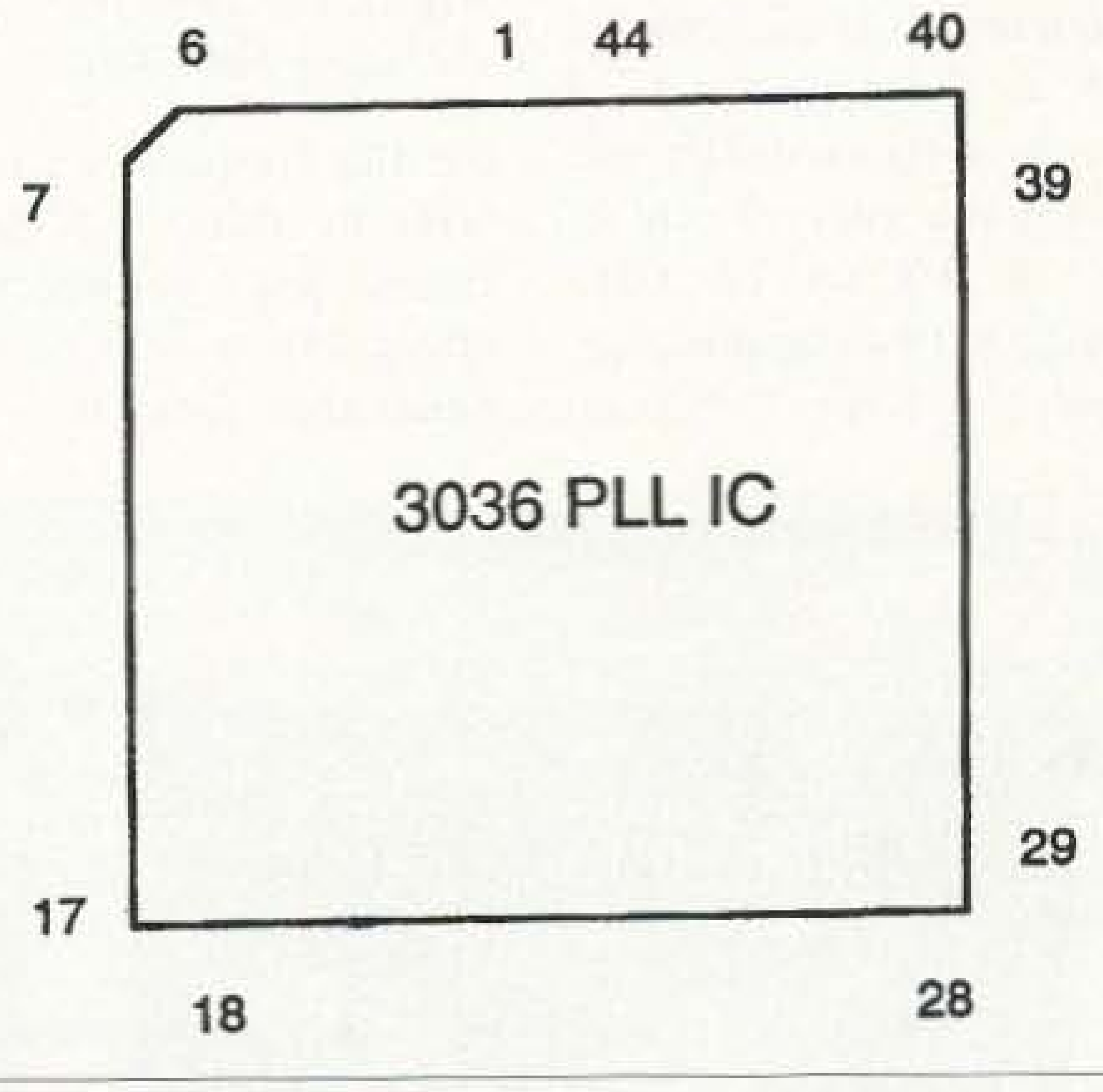


Table 2B*. 3036 PLL IC Pinout (top view of chip). The table lists pin designations along with the proper wiring for 144 MHz IF/2556 MHz VCO operation.*

The board can be cut near the bottom cutout where we tied the two traces together, and just above the four capacitors to the right of the top cutout. Cut near the ground foil beneath the PC board traces. You can retain part of the PC board if you desire. This will retain a very good -5 volt bias circuit using a 7660 chip. The other control circuitry is not of interest to an amateur conversion of the synthesizer power supply control board as it was originally built. This conversion removes the essential oscillator synthesizer, reducing of the board real estate to a smaller package. See the accompanying photos for details on the conversion.

Consult **Table 2A** for pin programming information covering a few standard frequencies. Many frequency combinations are possible in the 2.16 to 2.6 or so GHz range using the stock VCO on the board. The board is set up to work with a reference divided frequency of 1.25 MHz. Note that other reference frequencies are possible, such as 2 MHz. All that is required is to reset the "A" reference counter. Before lifting the 3036 pins I suggest you make a paper drawing of your attack plan on how and which pins to lift. (See **Table 2B**.) A little planning in this area will help to familiarize you with the methods of conversion to prevent errors.

When you have lifted all required pins, test each pin for proper DC resistance between either ground or the +5 volt line, as required according to the frequency modification chart, with a VOM. Set the VOM to the X10 scale to verify all pins before and after modification and before applying power. This should bulletproof the modification procedure for errors. When you are satisfied that all is well, connect a source of 10 MHz (1 volt P/P) to the input of the attenuator pad by the 10 MHz filter and apply power. There is an LED phase-lock indicator on the PC board. If all is well it should blink on then off, indicating proper phase lock.

Once you have verified phase lock and output power you can verify output frequency and power. Normally we see about +8 to +10 dBm power output.

Originally we made a modification to the circuitry in the phase detect balance circuit but we found that the circuit is best left alone. Rather, what needs to be done is to modify the output loop filter for the proper values required for the new division divide-by frequency. This loop filter consists of a parallel LC filter shunted to ground with two capacitors. This network is normally set to 1.25 MHz.

The loop filter is converted by changing the filter capacitor component values. To convert it to our new reference frequency add a .001 µF capacitor across the LC filter and add .003 to .004 µF as additional shunt capacitance. The best way to change these values is to piggyback additional capacitors across the existing lower-than-required values. This filter is tied directly to pin 6 of the OP-27 op amp output.

Microwave filter construction

The filter that we constructed for these three bands is an evanescent mode filter, or just call it a waveguide filter below cut-off frequency. It is constructed out of a short section of waveguide of no particular size except for the general rule of thumb: A 10 to 12 GHz waveguide with an opening approximately 1/2"-by-1" is good

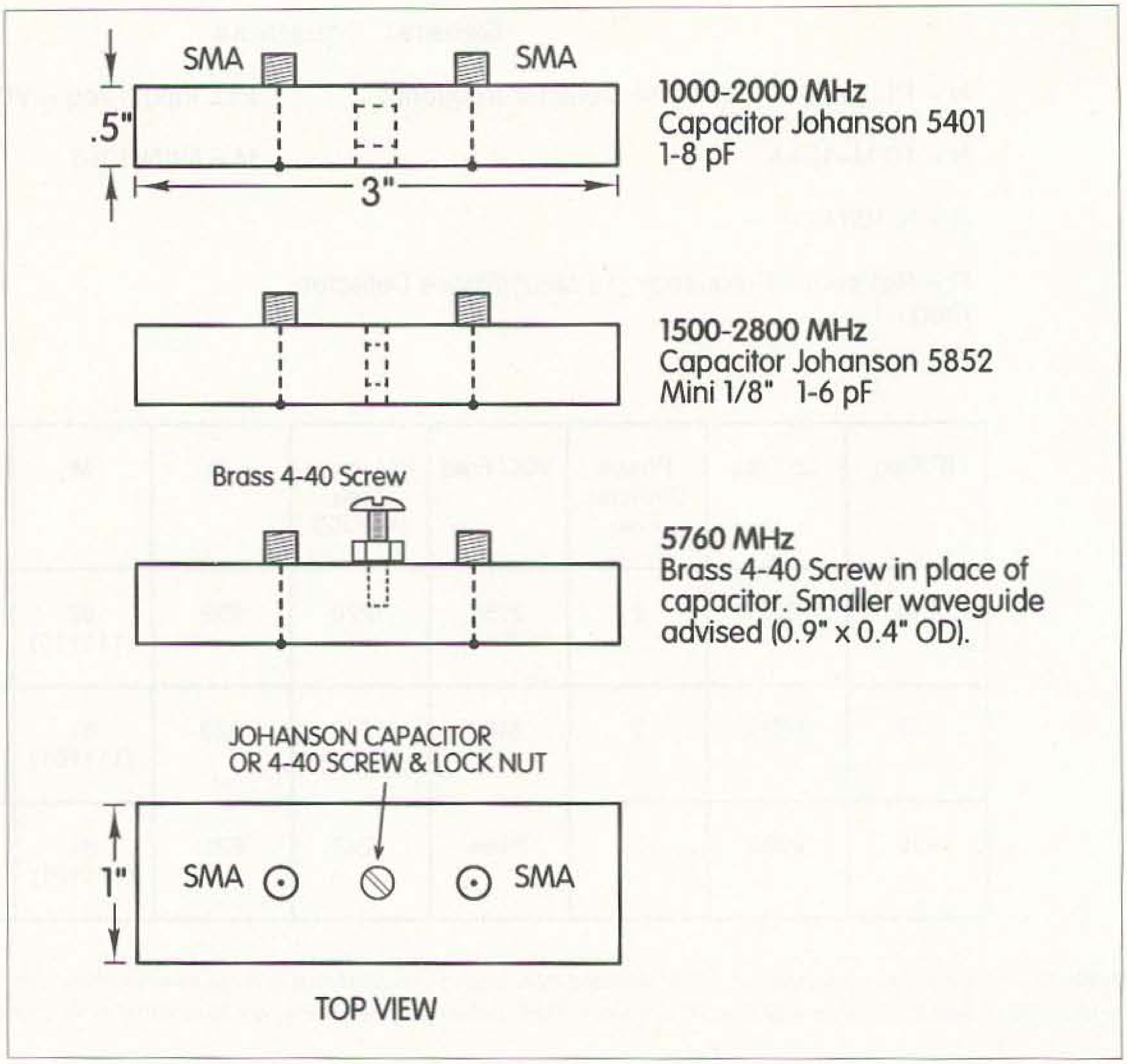


Fig. 2. The 2304 filter using WG-16 1" x 1/2" OD waveguide, and details for other frequencies up to and including 5760 MHz.

for the frequency range of 1 GHz to about 3.5 GHz. The filters that I constructed were attempted by selecting components that seemed to suit the frequency of interest knowing the results of my first construction attempt.

My first attempt was to use a Johanson 5481 1-to-8 pF variable and soldering it between the top and bottom of the waveguide. Coax connectors were spaced 1/2 inch on either side of the capacitor to serve as the input and output ports of the filter. It was no trouble to resonate this filter at 1296 MHz, but the upper frequency was limited to about 2 GHz. Constructing a similar filter but replacing the capacitor with a smaller width (1/8 inch) version of the Johanson capacitor vs. the 5481, which is 1/4 inch wide, made resonance at 2304 and 3456 feasible. Moving on to 5760 was impossible with even the smallest variable I had so we tried a small 4/40 bolt in place of the capacitor. This, while very critical, worked well.

Use a lock nut on the 4/40 bolt (brass nut and bolt) and when it is tuned, lock it with the nut. See **Fig. 2** for the mechanical details. Waveguide rule of thumb: For frequencies in the 1 to 2 GHz range, a waveguide with a 1 inch by 1/2 inch outside diameter is acceptable. For higher frequencies, use the next size smaller waveguide, with dimensions near .9 inch by .4 inch wide.

Well, that's it for this month. I hope that this column is not rushed too much as I am working seven days a week and have little time off for any activities. Pacific Bell, the company I work for, is the prime provider for video operations for the Republican Convention in San Diego and it has me very busy. On another note, I am held up on sending out 30 MHz kits as the supply of TDA-7000 chips is depleted and the new order has not arrived. Please be patient as the orders *will* be filled. Best 73 always, Chuck WB6IGP.

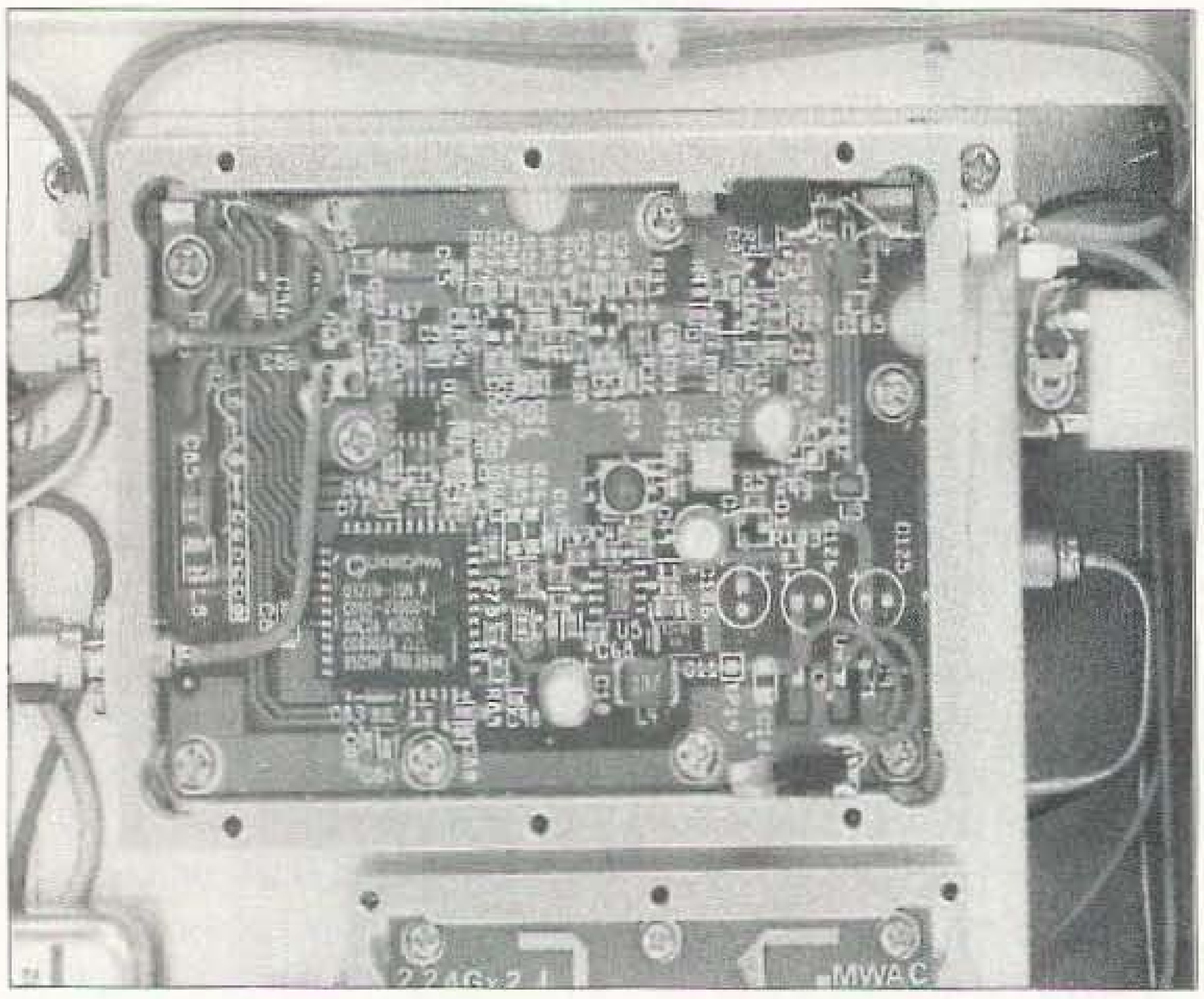


Photo C. *Completed Qualcomm synthesizer, packaged in a milled-out aluminum case. Unit constructed by Kiyotsugi Tanemura JG1QGF in Japan. This is a premium high-quality conversion that anyone would be proud to have constructed.*

BARTER 'N' BUY

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The *73* Flea Market, Barter 'n' Buy, costs you peanuts (almost)–comes to 35 cents a word for individual (noncommercial) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad. This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make 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 December 1996 classified ad section is October 12, 1996.

Unique hand-crafted call sign plaques. Rustic pine board hand painted by artist with 20 years experience. Send SASE for free brochure with design descriptions; **Hamprints**, P.O. Box 23, Mark IL 61340. BNB5002

HEATH COMPANY is selling photocopies of most Heathkit manuals. Only authorized source for copyright manuals. **Phone** (616) 925-5899, 8-4 ET. BNB964

IT'S BACK! The return of the HW-8 Handbook! Second printing. Modifications for the Heath QRP rigs. First class mail $11. DX add $4 for air mail shipping. **Mike Bryce WB8VGE,** 2225 Mayflower NW, Massillon OH 44647. BNB404

MAHLON LOOMIS, INVENTOR OF RADIO by Thomas Appleby, (Copyright 1967). Second printing available from **JOHAN K.V. SVANHOLM N3RF**, SVANHOLM RESEARCH LABORATORIES, P.O.Box 81, Washington DC 20044. Please send $25.00 donation with $5.00 for S&H. BNB420

WANTED: HAM EQUIPMENT AND RELATED ITEMS. Donate your excess gear, new-old-in-any-condition to the Radio Club of Junior High School 22, the Nation's only full-time nonprofit organization working to get Ham Radio into schools around the country as a teaching tool using our EDUCOM - Education Thru Communication - program. Send your radio to school. Your donated material will be picked up ANYWHERE or shipping arranged, and this means a tax deduction to the full extent of the law for you as we are an IRS 501(c)(3) charity in our 16th year of service. It is always easier to donate and usually more financially rewarding, BUT MOST IMPORTANT your gift will mean a whole new world of educational opportunity for children nationwide. Radios you can write off, kids you can't. Make 1996 the year to help a child and yourself. Write, phone or Fax the WB2JKJ "22 Crew" today: **The RC of JHS 22,** POB 1052, New York, NY 10002. **24 hours call (516) 674-4072** or Fax (516) 674-9600. Join us on the WB2JKJ CLASSROOM NET, 7.238 MHz 1100-1230 UTC daily and 21.395 MHz from 1300 to 1900 UTC. Meet us at the ARRL National in Peoria. BNB762

RF TRANSISTORS TUBES 2SC2879, 2SC1971, 2SC1972, MRF247, MRF455, MB8719, 2SC1307, 2SC2029, MRF454, 2SC3133, 4CX250B, 12DQ6, 6KG6A, ETC. **WESTGATE** 1-800-213-4563. BNB6000

TIRED OF IRONING? PCB service. No $ setup, free scanning available. **FIRST PROTO**, 4201 University Drive, #102, Durham NC 27707. (919) 403-8243. BNB5005

WANTED: Western Electric Audio Equipment. Amplifiers, pre-amps, tubes, speakers, parts, mixing boards, etc. **1-800-251-5454**. BNB1050

Morse Code Computer Interfaces $49.95, with CW Filter $79.95, Free Shareware and Ham Catalog. **Dynamic Electronics**, Box 896, Hartselle AL 35640, (205) 773-2758, FAX (205) 773-7295. BNB1034

SUPERFAST MORSE CODE SUPEREASY. Subliminal cassette. $12. **LEARN MORSE CODE IN 1 HOUR.** Amazing supereasy technique. $12. Both $20. Moneyback guarantee. Free catalog: **SASE. Bahr-T5**, 150 Greenfield, Bloomingdale IL 60108. BNB1025

Surplus electronic test equipment for sale at deep discounts. Write, phone, or fax to request the current list. **Jim Stevenson,** 3401 Sunny Slope Road, Bridgewater NJ 08807. Phone: (908) 722-6157, Fax: (908) 722-6391. BNB2084

ASTRON power supply, brand-new w/warranty, RS2OM $99, RS35M $145, RS5OM $209. Call for other models. **(818) 286-0118.** BNB411

HOME AUTOMATION. Become a dealer in this fast-growing field, **1-800-838-4051**. BNB2032

BREAK THE CODE BARRIER: Psychologist & Extra Class operator has developed an amazing hypnosis tape that allows you to master any code speed easily and quickly. To order send $14.95 + $3.00 S&H to **Dr. Hal Goodman,** P.O. Box 184, Eastport ME 04631. For more info. send SASE. BNB2031

DSS BIBLE. New Book Includes: Software, Schematics, Chip Programmer Plans, Reviews & More! $49.95 VISA/MC **TELECODE** 1-520-726-2833. BNB1024

PRINTED CIRCUIT BOARDS for amateur radio and hobby projects. hhh://www.cl.ais.net/farcir or SASE **FAR Circuits**, 18N640 Field Ct., Dundee IL 60118, (847) 836-9148. BNB5013

BRIGHTEN UP YOUR SHACK! Eleven-page Compendium filled with ideas, tips, and instructions for building Illuminated Maps. Send $5.00 (TX res. add $0.41 tax) to **Pineapple Paradise Radio Co.**, P.O. Box 370692, El Paso TX 79937-0692. BNB6005

For Sale: YAESU NC-15 CHARGER/POWER SUPPLY, EICO 717 ELECTRONIC KEYER, KNIGHT KIT VTVM, RCA VCR VJT-275 needs new head, all have manuals. **(219)-277-1786.** BNB5000

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 January issue, we should receive it by October 30. Provide a clear, concise summary of the essential details about your Special Event.

SEP 22

MT. HOLLY, NJ The 80th Anniversary of the South Jersey Radio Assn. will be celebrated at Mt. Holly Armory, Rt. 38. The 48th annual Hamfest Computer Show will be held rain or shine, 8 AM–3 PM. Vendor setup 5:30 AM. VE Exams, tailgate sales, seminars. Make checks payable to South Jersey Radio Assn. Inc., and mail with SASE to *Paul E. Hayden KF2YX, 519 North Elmwood Rd., Marlton, NJ 08053.*

OCT 11–13

MESA, AZ The Scottsdale ARC will host the ARRL Southwestern Div. Convention at the Sheraton Mesa Hotel and the Mesa Conference Center. For details, contact *Barbara A. Myers KB7UKD, Exhibit Chairperson, P.O. Box 17108, Fountain Hills AZ 85269-7108. Tel. (602) 837-6492, or FAX (602) 837-6872.*

OCT 12

ALPENA, MI Hincks Elementary School, 7 mi. north of Alpena, on US-23N, will be the site for the Thunder Bay ARC Hamfest, Computer Fair, and North Color Tour. VE Exams at 1 PM, walk-ins okay. Talk-in on 146.76 or 145.49. SASE to *P.O. Box 764, Alpena MI 49707.* For VE info or details, call *Tom K8CHS, (517) 354-2469.*

EVANS, GA The Augusta Hamfest will be held at Evans Middle School. Setup Fri., 6 PM–9 PM; Sat., 6 AM–9 AM. VE Exams start at noon on the 12th. Contact *Richard KR4XN at (706) 860-3828;* or *Rhonda KE4DIM at (706) 560-9600;* or write to *P.O. Box 3072, Augusta GA 30914.*

OCT 12–13

GERMANTOWN, TN MemFest 1996 Greater Memphis Amateur Radio and Computer Show will be held at Shelby Farms Show Place Arena, 105 Germantown Pkwy, Sat., 8:30 AM–4 PM; and Sun., 8:30 AM–2 PM. RV camping on site. Forums and Non-Ham activities. VE Exams Sat. and Sun. 9 AM–11 AM. Gordon West WB6NOA will be Guest Speaker. Sponsored by the Greater Memphis Amateurs. Exhibitors contact *Mary Moore AC4GF, (901) 758-0661* or *Fax (901) 751-6717.* For Flea Market info contact *Lee Bowers KA4KVW at (901) 867-3461, after 6 PM.* Talk-in on 144.61/145.21 and M9. 17514M. 175.

OCT 13

CHICAGO, IL The Chicago ARC will hold a Hamfest in Oakbrook Terrace IL, 8 AM–3 PM. Setup at 6 AM. Entrance at Park View Dr., north from Cermak Rd. Talk-in on 147.255(+), and 444.825(+). Contact *George, (312) 545-3622; Dean, (708) 331-7764;* or *Cora, (312) 486-6823;* or write to *CARC, 5631 W. Irving Park Rd., Chicago IL 60634.*

LIMA, OH The Lima Hamfest and Computer Show will be held by the Northwest Ohio ARC, 8 AM–3 PM at Allen County Fairgrounds. Setup at 6 AM. Talk-in on 52/52, 146.07/.67, 146.34/.94, and 147.63/.03. To pre-reg. for VE Exams, send complete FCC Form 610, a copy of your old license, a check for $6.05 made payable to *NOARC,* and SASE to *License, c/o NOARC, P.O. Box 211, Lima OH 45802.* For tickets and table reservations, call *(419) 647-6321.* Mail SASE and payment to *NOARC, P.O. Box 211, Lima OH 45802.*

MASON, MI The Lansing Civil Defense Rptr. Assn. and the Central Michigan ARC will co-sponsor a Hamfair, 8 AM–1 PM, at Ingham County Fairgrounds in Mason, MI. Overnight camping available. Trunk Sales space, DX Forum. Vendor setup at 6 AM. Talk-in on 145.390. Contact *Jeff Oberg KB8SXK, (517) 393-4713;* or write to *LCDRA, P.O. Box 80106, Lansing MI 48908.*

QUEENS, NY The Hall of Science ARC Hamfest will be held at the New York Hall of Science parking lot, Flushing Meadow Park, 47-01 111th St., Queens NY. Setup at 7:30 AM, buyers admitted at 9 AM. Talk-in on 444.200 WB2ZZO Rptr., 146.52 simplex. For more info call at night only, *Arnie Schiffman WB2YXB, (718) 343-0172.*

OCT 18–20

CONCORD, CA The Mt. Diablo ARC is host for this year's "Pacificon." The event will be held at the Concord Hilton, 1970 Diamond Blvd. An Antenna Seminar will be held Fri. 8 AM–4:30 PM, pre-reg. required. A Swap Meet will be held Sat. and Sun. 6 AM–11 AM, with seller setup at 5 AM. The seller fee is $10 for both days. There will be Forums, walk-in VE Exams, vendor displays, a Boy Scout Special Events Station, T-hunt, and more, all day Sat. and on Sun. morning. Cynthia Wall KA7ITT will be Guest Speaker at the Sat. evening Banquet. An ARRL Forum will be presented Sun. afternoon. Talk-in on 147.060 + 100. For info, call *(510) 932-6123;* or write to *Pacificon '96, P.O. Box 272613, Concord CA 94527-6125. E-mail: PACIFICON@DESIGNLINK.COM.*

OCT 19

SENECA, PA The Venango Mike and Key Club will hold a HamAuction 8 AM–3 PM at Christian Life Academy in Seneca. Setup at 6 AM. VE Exams at 9 AM. Talk-in on 145.230(-). For reservations contact *Mary Housholder N3QCR, 121 N. Front St., Franklin PA 16323. Tel. (814) 437-2036. Packet: N3QCR@WA3ZCA.#NWPA. E-mail: mahoushold@aol.com.*

OCT 20

CENTRALIA, IL The Centralia Wireless Assn. will host its annual Hamfest at the Salem Community Activity Center, East Oglesby St., Salem IL, starting at 8 AM. Talk-in on 147.27/.87 MHz. Setup for Exhibits and Flea Market will be at 6 AM. For table space and reservations, contact *Daisy King AA9EK, (618) 532-6606.* Mail ticket orders with an SASE to *Centralia Wireless Assn., Inc., Hamfest Tickets, P.O. Box 1166, Centralia IL 62801.*

GOLDEN, CO The 1996 Rocky Mountain Radio League Hamfest will be held 8 AM–2 PM at the Jefferson County Fairgrounds, 15200 W. 6th Ave. Talk-in on 144.62/145.22. The event will feature VE Exams and an ARRL Forum. For info, call *Joe Dickinson WTØC, (303) 771-9577.*

KALAMAZOO, MI The Kalamazoo Hamfest Assn. will present the 14th annual Kalamazoo Hamfest at the County Fairgrounds. Doors open at 8 AM. Trunk sales. Vendor setup at 6 AM. Camping available on site. For more details, call the info hot line at *(616) 657-4482.*

MILLER PLACE, NY "HAMEXPO 96–ARRL Hudson Div. Convention" will be held at the Huntington Hilton Hotel, 595 Broad Hollow Rd., Melville NY. Call *(516) 845-1000* for reservations. The Ham Expo will be open to the public 9 AM–4 PM. Vendor setup at 7 AM. There will be VE Exams and an ARRL Forum. Write to *Radio Central ARC, P.O. Box 680, Miller Place NY 11764. Tel. (516) 399-1877 (Joann N2IME), or E-mail N2MDQ@LI.NET.*

SELLERSVILLE, PA A Hamfest hosted by the RH Hill ARC will be held at Sellersville Fire House, Rt. 152, 3 mi. south of Quakertown and 8 mi. north of Montgomeryville. VE Exams start at 9 AM for all classes. Bring documents. Talk-in on 145.31. Contact *Linda Erdman, P.O. Box 29, Colmar PA 18915. Tel. (215) 679-5764.*

OCT 26

PORT ST. LUCIE, FL The Port St. Lucie ARA "Hamfest–96" will be held 8 AM–3 PM at Port St. Lucie Yacht Club, 500 Prima Vista Blvd. Talk-in on PSLARA Rptr. 146.955 or 146.520 simplex. For table rentals call *Rick Clair (407) 335-1738.* For general Hamfest info, call *Don Metzler (407) 879-4914.*

SALEM, OR The 2nd "Swap-Toberfest ARES/Races Convention," sponsored by the Mid-Valley ARES, will be held at the Polk County Fairgrounds in Rickreall OR. Setup will be 6 AM–9 PM Oct. 25th, and 7 AM Oct. 26th. Doors will be open for the convention 9 AM–3:30 PM. VE Exams, pre-reg. required; call *Sandy Berry N7TQQ at (503) 585-5924.* Registrations received Oct. 20 or later will be held for pick-up at the door. Emergency Comm. vehicles will be on display from the Oregon State Police, Marion and Polk County Emergency Management, the Civil Air Patrol, and the American Red Cross. For more info, contact *Evan Burroughs N7IFJ, (503) 585-5924.* To download a copy of the flyer and pre-reg. form, surf the net for *http://www.teleport.com/~n7ifj.*

ST. LOUIS, MO The Gateway to Ham Radio Club, and the St. Louis ARC will sponsor the 5th annual Halloween Hamfest at West County Tech. School. Vendors' doors open 4 PM–9 PM Oct. 25th, and 6:30 AM Oct. 26th. The event is open to the public 8:30 AM–2 PM. Flea Market, forums, VE Exams. Wheelchair accessible. For advance tickets, SASE to *Dave NØDN, 8370 Latty Ave., Hazelwood MO 63042.* For tables, contact *Keith NØKFE, 8427 Mathilda Ave., St. Louis MO 63123.* Talk-in on 146.34/.94.

ST. PAUL, MN The 12th Anniversary celebration of Hamfest Minnesota and Computer Expo will take place in the main arena at the St. Paul Civic Center, Kellogg & West 7th Sts., St. Paul MN. The event will be sponsored by the Twin Cities FM Club, and will have a huge Flea Market, VE Exams, educational and fun seminars, exhibits, and more. VE Exams and Flea Market setup will take place on Fri. night. Talk-in will be on the 146.16/.76 Rptr. For info and advance reg., contact *Hamfest Minnesota & Computer Expo, P.O. Box 5598, Hopkins MN 55343;* or call *Hamfest Minnesota Info Line at (612) 535-0637.*

SUMTER, SC The Sumter ARA's 10th annual Hamfest and Computer Fair will be held at Sumter County Exhibition Center, 700 W. Liberty St. Contact *Steve Bregger KD4HTS, P.O. Box 52302, Shaw AFB SC 29152-0302;* or *Mike Dunlap KC4HUT, 2763 Tindal Rd., Sumter SC 29150-8830. Tel. (803) 481-4611.*

OCT 27

WESTMINSTER, MD The 7th annual Mason-Dixon Computer & Hamfest will be held at the Carroll County Ag. Center in Westminster, beginning at 8 AM. Setup at 6 PM for vendors and tailgating. VE Exams start at 8 AM, pre-reg. requested; call *Bill Wolfgang NZ3J, (717) 359-7095.* Talk-in on 145.41(-). For inside tables and info, contact *George Johns N3JKY, (717) 632-1621.*

NOV 2

MILWAUKEE, WI The 12th annual "6.91 Friendlyfest" Ham Radio, Computer and Electronics Show will be held 8 AM–1 PM at Waukesha County Expo Center Forum, N1 W24848 Northview Rd., in Waukesha WI. Vendor setup 5:30 AM–8 AM. Wheelchair-accessible. VE Exams onsite. Bring an original and 2 photocopies of your license and/or CSCE (if any) and 2 IDs, one must be a photo ID. Talk-in on 146.31/.91 Rptr. and 146.52 simplex. Contact *Burt N9VBI, (414) 328-0535* for further details.

TAVARES, FL The Lake ARA, Inc. will hold their Hamfest & Electronic Expo 8 AM–4 PM at the East Lake Chamber of Commerce in Sorrento FL. VE Exams at 10 AM, walk-ins okay. Vendor setup Nov. 1st, 3 PM–6 PM; Nov. 2nd, 6 AM–8 AM. Contact *Tony Summerlin KE4NLG, 9210 Fernery Rd., Leesburg FL 34788. Tel. (352) 360-1380.*

NOV 2–3

ODESSA, TX The 13th annual Odessa Hamfest will be held by the West Texas ARC Sat., 8 AM–5 PM and Sun., 9 AM– 2 PM, at Ector County Coliseum, Exhibit Bldg. C, 42nd and Andrews Hwy. Setup Fri., 4 PM–10 PM, and Sat. at 7 AM. Talk-in on 145.470. Contact *Robert Jordan N5RKN, (915) 335-7980; E-mail N5RKN@aol.com.*

SPECIAL EVENT STATIONS

SEP 21

BADIN, NC The Stanly County ARC will operate K4OGB during the "Best of Badin Festival." Operation will be in the lower General 40m–15m bands and 28.365, all phone. For a certificate, send a 9" x 12" SASE to *K4OBG, P.O. Box 581, Badin NC 28009 USA.*

OCT 1

Walt Disney World, Disneyland, Euro Disney, Tokyo Disneyland, and Capital Cities ABC New York. The parks will be operating on 20m, 40m, 75m, and 2m repeaters from 2230-1700 UTC. Look for them on these frequencies: Disneyland repeaters\146.94, 446, 1282.4—simplex 245.09, 144.3 as W6LPJ; Walt Disney World on a 2m repeater, channel not specified; ABC repeater 147.2 and 144.97 packet; Tokyo Disneyland on 2m repeater; Euro Disney on 440 repeater. Send SASE and QSL for collectable Disney Card.

OCT 12–13

MUSKOGEE, OK The Fort Smith ARC will operate KE5TC 1400–2130 Oct. 12th, and 1600–2130 Oct. 13th, in honor of the "USS Batfish" WWII Submarine. Operation will be on 14.250 and 7.240 phone. Send QSL and an SASE to *Royce Rainwater KE5TC, P.O. Box 236, Keota OK 74941 USA.*

OCT 12–14

GREAT LAKES, IL The Great Lakes ARC will operate WV7T from the U.S. Naval Training Center, in celebration of the U.S. Navy's 221st Birthday. Operation will be 0000Z Oct. 12th–2359Z Oct. 14th. You can find them on the 80–10m band CW, SSB and RTTY. Please include the provided contact number on your QSL. For a certificate, send QSL and SASE/IRCs to *Great Lakes ARC, 2072-A Langley St., Great Lakes IL 60088 USA.*

OCT 19

DUNCANVILLE, TX Station KC5SJX will be operated by the South West Dallas County ARC, in conjunction with the Duncanville Harvestfest, 1300Z–2300Z. Operation will be in the Novice 10m phone and CW subband. For a QSL card, send QSL and SASE to *SWDCARC, P.O. Box 381023, Duncanville TX 75116 USA.*

OCT 19–20

EDWARDS AIR FORCE BASE, CA The MARS Base Support Team will operate N6SFV on amateur frequencies, 1400 UTC Oct. 19th–0200 UTC Oct. 20th, in conjunction with the Edwards AFB Open House and Air Show. Freq.: 7.265, 14.265, 21.365 ± QRM, and 6m and 2m SSB. QSL with SASE to *WA6NKL, P.O. Box 874, Acton CA 93510.*

BROWARD COUNTY, FL The Hollywood ARC will operate WB4TON from the Broward County Historical Commission Pioneer Days, in celebration of the 100th Anniversary of the Florida East Coast Railway in Broward County. The station will operate 1300Z–2100Z each day in the 40m, 20m, 15m General phone and 28.400 MHz in the Novice/Tech band. For a certificate, SASE to *HARC, 720 N. 71st Ave., Hollywood FL 33024 USA.*

OCT 31–NOV 1

BREVARD, NC The Transylvania County ARC will operate station KE4ZIS from Transylvania County NC on Halloween. Hours of operation will be 1900Z Oct. 31st–0100Z Nov. 1st. Freq.: 7.237, 14.295, 21.365, 28.335 SSB, and 146.52 FM simplex. For a certificate, send a business-size or 9"x 12" SASE to *T.C.A.R.C., P.O. Box 643, Brevard NC 28712 USA.* Weather permitting, operation will be from the Devil's Courthouse on the Blue Ridge Pkwy.

QRP

Continued from page 63

I did one version of the Two-Fer that everyone just hated. I really don't know why—the circuit worked as it should—but that project was a fizzle.

If you've been following this column for the last 10 years you may have noticed a dearth of receivers. I'm no RF engineer, so most of the receivers I've designed sucked! I'm working on it, so perhaps you'll see a simple superhet receiver one of these days.

Antenna tuners have been a problem. I can't find a solid source of inexpensive parts for a tuner. You can get one ready-made by MFJ cheaper than I could build one. It's one of those projects still on the back burner.

To me, it seemed kinda silly to build an amplifier in a column about low power communications. But there again, who knows? Perhaps I'll come up with an amplifier that's simple to build and set up.

Most, if not all, of the PC boards used in this column can still be obtained from FAR Circuits (18N 640 Field Court, Dundee IL 60118). Write to them and ask for a product listing. An SASE will speed up your request.

The coming new century

Low power ham radio is enjoying steady interest. It's easy to just plunk down your plastic and walk home with a complete radio system. In one small box, you get built-in antenna tuners, DSP, and a zillion other goodies. In some cases, if the operator needs to have a microphone connector installed, he or she must find someone else to install it.

QRP means low power ham radio. It does not mean using decades-old circuits. In fact, you'll find plenty of microprocessors in our QRP gear. The QRP+ from Index Labs is a good example of what you'll come up against in the QRP field today.

During the next 10 years, we'll keep you informed as the latest and greatest equipment comes along. Right now, I'm busy trying to teach myself 68HC11 assembly programming. Who knows? In a year or so, you may see a home-brewed micro-based QRP rig presented in this column. In the meantime, let's just have fun!

What's All This QRP Stuff?

Home-brew a QRP rig.

Ken Gledhill AA7PE
19503 Via de Arboles
Queen Creek AZ 85242

It was shortly after midnight when I finally soldered the last connection to my home-brew multiband QRP rig. The project had consumed many of my evenings and weekends for most of the past year. The receiving portion of the project had been working for several weeks; now was the moment of truth—time to try the transmitter.

The oscilloscope showed that my voice was running 30 volts peak-to-peak across the 50-ohm dummy load. That figured to be just a bit over 2 watts of peak envelope power (PEP) on 10 meters. It was late, so I suspected that the higher bands would be shut down, and a few minutes of scanning up and down 10 meters confirmed my suspicion. So I telephoned and woke N7RSR, a nearby ham friend. I knew he'd understand—he's as crazy as I am about such things. We agreed to meet on 28.500 MHz. After a couple of short calls I received a sleepy response: "Your frequency is pretty close for an analog rig."

The next day was Saturday. There were a number of stations up and down the band, including one from the Fiji Islands. There was a big pileup of stateside stations trying to get through. I figured that it was a long shot with only 5 watts on SSB, but I called anyway. I missed him. He came back to a big station from California. I waited and tried again just as they signed off with each other. This time I heard "Go ahead AA7PE." I couldn't believe it! With only 5 watts, my SSB signals had reached Fiji with a respectable 5 by 5.

"With only 5 watts, my SSB signals had reached Fiji with a respectable 5 by 5."

Usually CW transmitters with output power of 5 watts or less are classified as QRP rigs. However, SSB voice transmissions may be up to 10 watts PEP and still be considered QRP. There are really no absolutes with these definitions, but these values seem to be widely accepted among QRP enthusiasts. These power levels are a maximum for QRP, and it's not uncommon to find QRP transmitters that operate at considerably lower power.

So why is 10 watts considered QRP for SSB rigs when the QRP limit for CW is only 5 watts? Consider first a CW transmitter. Assume that the key is up for approximately half of the time and down for the other half. Under these circumstances, a 5 watt CW transmitter will have an average output power of 2-1/2 watts. The average output of an SSB transmitter depends on your speech patterns, but the average output power of a 10 watt SSB transmitter is usually fairly close to the same 2-1/2 watt value.

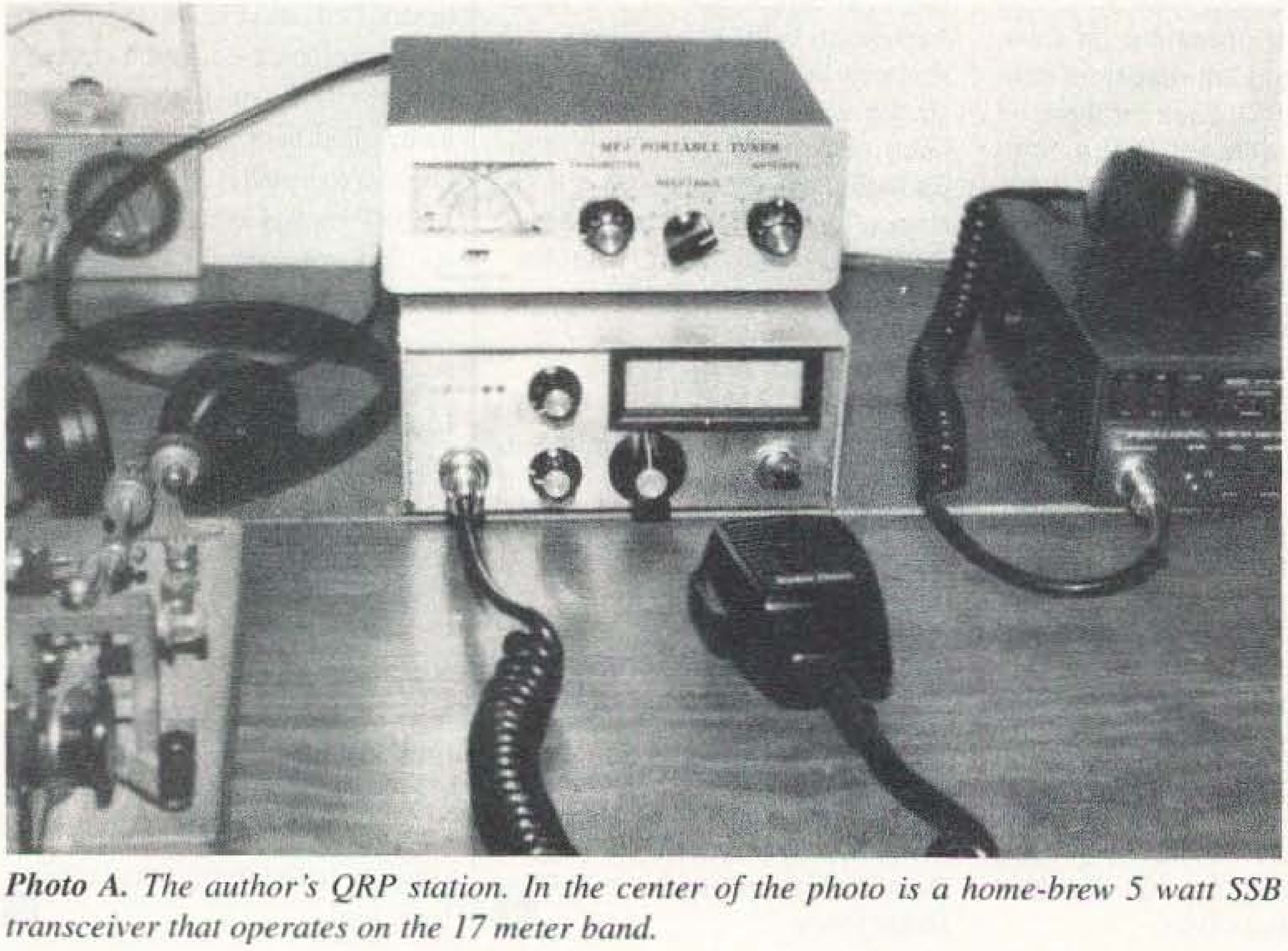


Photo A. The author's QRP station. In the center of the photo is a home-brew 5 watt SSB transceiver that operates on the 17 meter band.

Signals vs. noise

Although the power radiated from a 5 watt CW transmitter is comparable to that coming from a 10 watt SSB rig, the ability of the receiving operator to interpret the signal at the receiver is not the same. The difference in intelligibility is due to a couple of factors. The first is the signal-to-noise ratio (SNR), which is a measure of the degree to which a signal stands out above the background noise. If a signal is received with a high SNR, there is very little interfering background noise and the message is readily understood. Conversely, signals received with a low SNR are buried in noise and difficult to interpret.

There are a number of factors that affect the SNR of a received signal. One is the bandwidth of the receiver. Some receivers use the same bandwidth for both SSB and CW signals so there will be little difference between the received signal-to-noise ratio of a CW signal and that of an equally strong SSB signal. However, if the receiver has a narrow filter, a considerable improvement in the CW signals results. For example, a 2100 hertz SSB filter allows five times as much noise power to pass through it as does a 400 hertz CW filter. With the lower noise power admitted into the receiver, the ratio of the signal power to the noise power is improved. Looking at the situation another way, a receiver using a narrow CW filter can distinguish a 5 watt code signal with the same degree of clarity as a 25 watt signal passing through a wider SSB filter. This feature underscores one of the key reasons that CW is the mode of preference when operating QRP.

CW has a second intelligibility advantage over SSB transmissions, even when received with a similar SNR. For a voice message to be properly understood, it must stand out above the background noise enough for the listener to distinguish the spoken syllables and link them into meaningful words. To distinguish among similar-sounding spoken letters such as P, B, E and D, a phonetic alphabet has been developed.

In contrast to spoken messages, CW doesn't require the listener to distinguish among subtle differences. The signal is either on or it's off; it's much easier for the human ear to copy the message in a noisy environment.

S-meters

Most receivers are designed so that each S-unit represents a fourfold difference in the received signal power. That means that the received power from a signal registering S8 on a particular receiver's S-meter is approximately four times that of one received with an S7 reading. Therefore, if the signal from a 100 watt transmitter registers S9 on a particular receiver's S-meter, by reducing the output power to 10 watts the S-meter reading would only drop to a little over S7.

One evening I was involved in a pleasant SSB contact on 17 meters with a ham located a few hundred miles away. When I mentioned I was only running 5 watts he was surprised by how well my signal was doing (S7) and asked me to check his signal for a test. His 100 watts tipped my meter up to S9 during audio peaks. When he reduced his transmitter power to 50 watts I could see no change in his S-meter reading. He then reduced power twice more, finally ending up at 10 watts. His signal was still a solid S7 on my meter.

ionospheric skip seems to occur more frequently. Noise and absorption are noticeably less on this band than on the lower frequency bands.

20 meters is a very popular band. It often works well for QRP, as it did for me when I connected with the Fiji station.

"Put your money and your time up in the air."

When operating QRP you'll meet all kinds. Shortly after making the Fiji contact I hooked up on 10 meters with a ham about 500 miles away. He said I was pushing his S-meter to a little over S9—but after I explained that my rig was only running at 2 watts, he revised my signal report to an S4. I often get better signal reports if I don't mention my power.

When the ionosphere is cooperating, QRP rigs work just fine. But when the sunspot numbers are low it is not uncommon to tune the entire 10 meter band without hearing a single station. In this condition not even a kilowatt will work.

Your antenna is critical

The better the antenna, the better your signal, since a good antenna improves both the received and transmitted signals. Put your money and time up in the air.

Operation on the lower frequencies is usually most effective when vertically polarized antennas are used. Higher frequency signals do better when horizontally polarized. A beam antenna can add as much as two S-units to your signal strength.

Which band is best?

If you're looking for reliable short-range QRP contacts, then 80 meters is a good choice. Clubs should find this band ideal for local on-the-air round-table discussions. Atmospheric noise can be a significant challenge on this band. The daytime range for an 80 meter QRP SSB rig is usually up to 25 miles. At night contacts can be made over longer distances, with contacts up to 120 miles not uncommon.

Long distance QRP contacts are more likely on 40 meters—especially in the evenings. This is my favorite CW band.

Voice is not allowed on 30 meters, so this is an excellent band for CW. Long-range propagation on 30 meters is similar to that on 40 meters except that However, the popularity of this band often creates pileup conditions that favor the high-power rigs. Successful QRP on this band hinges on your skill and patience.

The higher HF bands of 17, 15, 12 and 10 meters are great for QRP. I've had many successful long-distance QRP contacts on these bands.

Clean signals win

Although there are subbands reserved for QRP operation, most reduced-power contacts are made with stations that are not operating QRP rigs. Indeed, many hams don't really enjoy trying to pull a weak signal out of the noise. However, you can increase your success by making sure your signal is clean, with no clicks or chirps. Listen to a recording of your signal so you can hear what your "fist" sounds like. On SSB, while audio compression provides a bit more average output power, I have found that my QRP signals seem to be more intelligible to the receiving operator when they are unprocessed.

The excitement of hearing your callsign breaking through the background noise as it returns from some distant point on the globe is hard to explain to the uninitiated. By learning to be an effective QRP operator you can beat the odds more often, enhancing your enjoyment in ham radio's most satisfying challenge. 73

Number 82 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

Stress!

It's a concept with which we've all become too familiar, as we attempt to cope with it in our daily lives. Did you ever stop to consider, though, that your electronic equipment is also subject to stress? Just as you can stand only so much before you finally break down, your radio gear will also quit if the stress gets too high. In fact, many equipment failures are due to stress. This month, let's take a look at the types of electronic stress and how it affects various components.

Electronic parts and assemblies are adversely affected by three primary kinds of stress: mechanical, electrical and thermal.

Mechanical stress

Most mechanical stress occurs when sudden force is applied to the unit. In other words, if you drop it. Or, perhaps, a mobile radio could get broken after your car goes over a particularly violent bump. Maybe you carry your HT in your back pocket, and you forget and sit on it.

Dropping rigs usually results in serious damage. The parts most affected are the PC boards and anything made of glass, such as LCD panels. The point of impact will be hit especially hard, but other spots can get wrecked, too. In particular, the corners of PC boards frequently crack or break off. With simple, single-sided or double-sided boards, you can often fix them with wire jumpers. With multilayer boards, you're most likely out of luck. Fortunately, very little ham gear uses multilayer boards, but expect that to change as radios get smaller and smaller. The modern, 1.5-pound camcorder makes extensive use of boards up to six layers deep (!!), and future HTs undoubtedly will, too.

Board cracks often occur in the area of larger, heavier components, such as transformers, big electrolytic caps and power transistors, because their greater mass exerts more force on the board when the unit hits the ground. Sometimes the cracks will be quite obvious, while other times you may need a magnifying glass to see them. Now and then, the component will break the foil but not the board itself, making it even harder to find the trouble. Such breaks tend to look like cold solder joints, and almost always occur on large connections. I've never seen them happen on little transistors, but I've run into plenty of them on power transistors and transformers. When in doubt, resolder.

Double-sided and multilayer boards use what are called "plated through" holes. Essentially, the walls of the holes have copper linings. This technique makes for solid, trustworthy connections between layers, but it has a few drawbacks. The best-known one is that plated through holes make it very difficult to remove parts. Because solder sticks to the plating, you can count on the holes' being filled with solder, and you have to get them really hot in order to melt it all at one time. If you're not successful at that, you'll damage the board, either by lifting and tearing the plating on one side (usually the component side, which is farthest from the iron), or by pulling the plating right out of the hole! I've seen that happen more than once. Although it can be disastrous with multilayer boards, double-sided boards usually survive this problem; you just have to be extra careful to solder the component lead on both sides of the board.

> **"When in doubt, resolder."**

The result of sitting on an HT is pretty much the same: The board and display get cracked, often so badly you can't fix the radio. This time, though, the larger components aren't the issue, as the force has not been transmitted to the board through them. Cracks may be distributed fairly randomly over the PC board, which is a big part of the reason the radio may be ruined. At least with cracks resulting from drops, there's usually a pattern.

Vibration-induced damage is somewhat different. Although the board can, indeed, be cracked, it often isn't. More likely, the solder joints themselves are affected, and you can easily resolder them (if you can find them!).

Mechanical stress affects more than PC boards, though. Switches, controls and jacks are particularly subject to it. Pots get scratchy and intermittent from being constantly turned back and forth, and switches may start making unreliable connections for the same reason. Sometimes contact cleaner helps, sometimes it doesn't.

Electrical stress

Within the category of electrical stress, there are two kinds: over-voltage and over-power. Over-voltage stress induces failure in all kinds of parts by punching microscopic holes in them! Electrons being the energetic little critters they are, they'll try and force their way through any kind of barrier. Raise the voltage, or electromotive force (EMF), of those electrons enough and they can go right through the substrates and molecule-thin barriers designed to keep them where they belong. The result is a short circuit inside a part.

Prime candidates for over-voltage stress failure are electrolytic capacitors, transistors, FETs, CMOS parts, and integrated circuits in general. But what causes the over-voltage condition in the first place?

Voltage regulator failures can cause the supply to put too much voltage into the wrong part of the radio. This happens more often than you might think, particularly when a secondary 5-volt regulator shorts out, sending the main 12-volt supply to a bunch of TTL gates or a microprocessor. *Poof* go the parts. If you change them without checking that regulator, the new parts suffer the same fate almost as fast as you apply power.

Depending on where you live, static electricity can be a serious problem. Northern winters can get extremely dry, and static can build up without your even realizing it. You touch your radio, and you feel ... nothing. The radio, though, receives a huge jolt and stops working. Of course, if the static charge is big enough, you'll feel it, but it sometimes takes much less voltage discharge than you can feel to do significant damage to electronic equipment. That's why it really pays to touch something grounded before handling your gear in winter.

Thunderstorms can have the same effect. I've seen computers fail to boot up the day after a storm, even though no obvious lightning damage occurred. Sometimes the machines will start working again, without intervention. Apparently, a static charge has built up somewhere, and it eventually discharges. Of course, sometimes there is actual damage, too.

Over-power stress is just what it sounds like: Too much power is passed through a component, heating it up and blowing it. In a sense, it's a kind of thermal stress, the difference being that the heating is internal, rather than from an external heat source.

The usual cause of over-power stress is a shorted component pulling too much current through another one. I call this "over-power" rather than "over-current" because current doesn't tell the whole story; it's the amount of current at a particular voltage that does the damage. So, over-power stress is best thought of in watts, not amps. That's why resistors, for example, are rated in watts. A 1/2-watt resistor could easily stand 5 volts at 50 mA (.05 amps), but 10 volts at the same current would put it at its absolute limit, and you could expect it to fail in a short period of time.

Another cause of overcurrent failure is bad design. We like to think our equipment is well-designed and will last a long time if nothing unusual occurs. Typically, that's true, but not always. Sometimes what looks right on paper just doesn't cut it in the real world. It's not unusual for a specific model to have a recurrent problem, due to the design's not being thoroughly tested. I remember one VCR model, back in my service tech days, that blew the same transistor over and over again. Every time one would come in, we'd just go right to the same part and replace it. It worked every time, because it was always the same problem! When manufacturers figure out they've got a problem, they usually try to correct it through an engineering change order, or ECO, that changes parts or procedures. That's what service bulletins are for, and many pieces of gear have them. Some have whole books of them!

of RF power, you're going to have to dissipate anywhere from 20 to 70 watts or so of heat, too.

Heat-producing parts, such as power transistors and RF final amplifier modules, are heatsinked to a big piece of metal, which is often the chassis of the radio itself. If the rig is properly designed, most of the heat will flow into the metal and away from the semiconductor producing it. As long as the whole set stays under a certain temperature, everything's fine, as no part gets hot enough to sustain damage. But if the fan fails, or you mount the set in direct sunlight, watch out for trouble. Some designs aren't so well done, and the radios tend to overheat anyway. Tiny HTs get ridiculously hot when you transmit for long periods at 5 watts output or more. If the thing is too hot to hold, just imagine what's going on inside! The heat may not cause immediate destruction of the rig, but its lifetime is sure to be seriously reduced.

Now that we've covered the basic stress guidelines, we'll take a look at individual components and examine the kinds of stress to which they're susceptible ... next time. Until then, 73 de KB1UM.

"It worked every time, because it was always the same problem!"

Thermal stress

Thermal stress is overheating from some external source. The source can be anything from a hot component a millimeter away, to the sun in a hot car. Any way you slice it, heat is the enemy of electronics—period. Of course, some parts have to get hot in normal operation. Unlike in the tube days, though, the heat is pretty much never a desirable or necessary condition. Still, nothing's one hundred percent efficient, and some heat will always be generated. If you try and make 50 watts

Number 84 on your Feedback card

HOMING IN

Radio Direction Finding

Joe Moell P.E. KØOV
PO Box 2508
Fullerton, CA 92837

Dirty Tricks = Valuable Training

When April WA6OPS and I discovered two miles of power line maintenance road running through the hills behind new houses in east Yorba Linda, we knew our search was over. We were checking out the area because it was our turn to be hiders for the monthly Fullerton Radio Club (FRC) hidden transmitter hunt, along with Tom and David Curlee WB6UZZ and KE6IPY. We call these events "T-hunts" here in southern California; in some other places they are called "foxhunts."

The site we chose was ten miles due east of the hilltop where the hunters would gather to start. Over the years, FRC T-hunters have gotten so good at radio direction finding (RDF) that it could be a short hunt, unless we added a few twists.

First we put up a 4-element yagi, coax, transmitter box and battery on the roadside fence. It would have been a functioning hidden T, except there was no fuse in the 12-volt power cord. Next to this decoy was a sheet for the hunters to sign in and record their odometer readings.

The real signal on 146.565 MHz at 8 PM on hunt night came from a quarter-watt handie-talkie in a surplus military ammunition can that we concealed in the brush about 60 feet away from the fake T. In accordance with the hunt rules, any passenger car could be driven to the site by going a few miles east of it into a new housing development, then back west on the wilderness road. We parked our car on a street three quarters of a mile west of the site, expecting to see hunters trying to get there by that route.

Time is not a factor on the FRC hunt. The team with lowest mileage traveled wins. Nevertheless, all of the seven hunting teams were close after a few minutes. Three followed the signal to our observation post and tried going out a dirt road there, only to encounter a locked gate a half mile west of the T. Others parked at another locked gate south of the site and hiked several hundred feet north up a steep hill. Only one team (WB6DCC, WB6DCB, KD6HWD, and KD6MCM) drove to it via the power line road, which gave them high mileage at that point.

Every team stopped upon spotting the decoy, signed in on the sheet, and called us on the frequency posted there. We told them that if they believed that they had found transmitter #1, they should next try to find a second transmitter we had hidden on a different frequency. The FRC hunt normally has only one transmitter to find, but all teams had signed in within an hour and forty-five minutes, so it wasn't hard to convince them to do some more T-hunting.

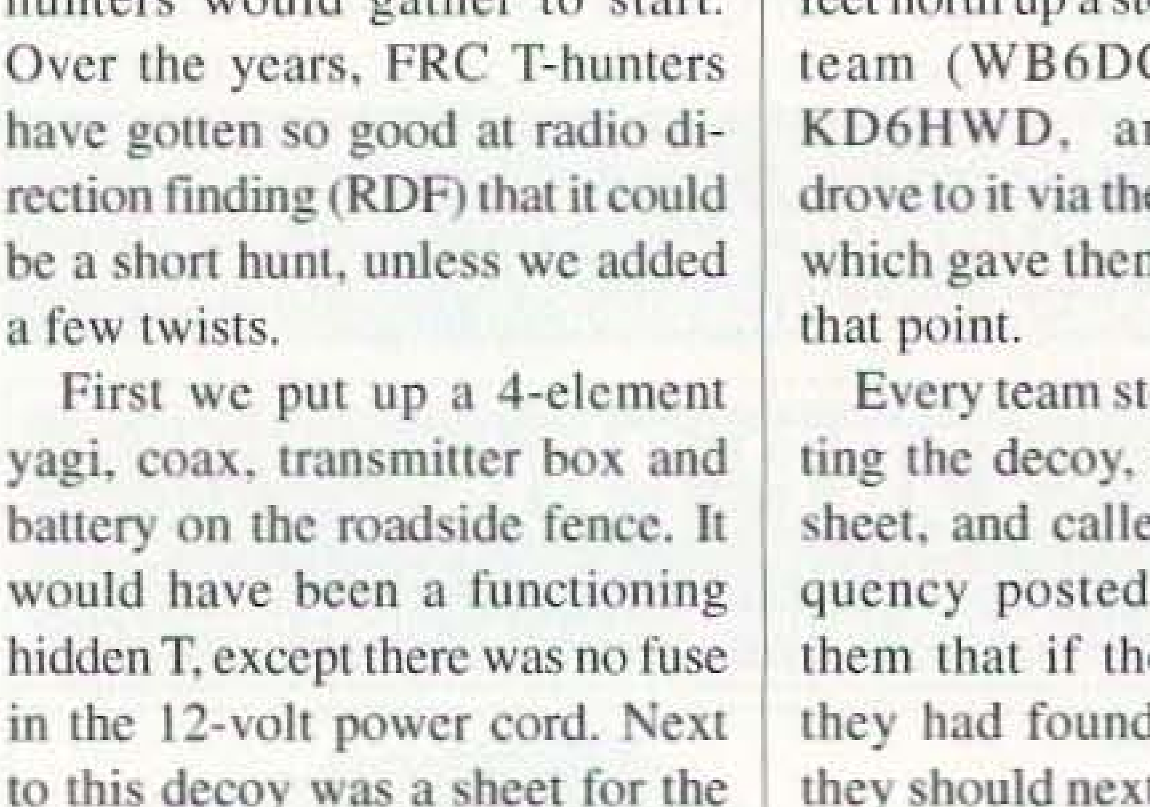


Photo A. The "Stud T" looked just like all the other two-by-fours in the pile. In fact, it had been in precisely that same spot a week earlier when I picked it up.

The Stud T

Transmitter #2 was only 1.6 miles away atop a hill, but it was no ordinary hidden T. In a pile of scrap lengths of two-by-four lumber, one piece was different (**Photo A**). A micro-transmitter, batteries and dipole wires were actually inside the two-by-four. The wood shop magic was courtesy of WB6UZZ. He sliced it like a bagel and hollowed out the insides. Then I fastened the electronics in place with hot glue (**Photo B**).

Instead of a tone generator, this T had a very sensitive mike. From our parking spot, we could easily hear the hunters approach it. We were not secretly "bugging" them, because they realized what was happening within 50 feet of the T when their receivers started squealing with audio feedback. They were able to zero in by turning down their receiver audio as they approached and then banging on the two-by-fours until they found the right one. Five teams grabbed it more or less simultaneously and called us on the frequency on a little label next to the tiny mike holes in the board.

At that point, we announced that no team had as yet tracked down the *real* transmitter that they had started out to find. In a stampede, almost all the teams headed off to try again. Apparently, they all drove back to the points from which they had started walking the first time. The WB6DCC team, having discovered the eastern route earlier, added much less mileage than the others. As a result, they ended up as winners. Most teams pounced on the real T #1 and checked in within 15 minutes, so there was still plenty of time left for food, talk, and a close examination of the "Stud T" at a nearby restaurant.

Most T-hunters like intrigue and cunning, so they were good sports about the deception. Don Lewis KF6GQ wrote on E-mail the day after, "We knew that you had pulled something tricky, but when I tried to sniff it out with the rubber duck, all I got was a stronger signal on the other side of the fence. When we came back (the third time for us), I took the 3-element beam and DFed it down myself, instead of watching the others and checking in at the decoy as I'd done the first time. Never, never, never trust what you see others do! It was a very, very good hunt because it was both fun and frustrating."

Tom and I certainly were not the first to camouflage a hidden T or even to encase it in wood. The Internet RDF mailing list has had transmitter-in-a-log stories from Seattle, Washington, and Melbourne, Australia, in the past year. There is no limit to clever disguises, so experienced hunters have learned to always carry along good on-foot RDF gear.

Decoys are unusual also, but they are not new to our hunts. Ken Diekman WA6JQN was probably the first to use them here fifteen years ago. They serve a valuable purpose because they remind hunters to pay attention to their equipment. T-hunting is an RDF exercise, not an eye test. If hams are going to convince the FCC that we are good enough at it to provide evidence for jammer prosecution, we had better always find the real transmitting turkey and never falsely accuse an innocent ham with a big beam next door.

Helping hams in the heartland

The fun and camaraderie of hidden transmitter hunting pays off doubly when the RDF skills it develops are used for public service. Examples of this can be found in Omaha, Nebraska. According to television engineer John Gebuhr WBØCMC, the Ak-Sar-Ben Amateur Radio Club has encouraged T-hunting for many years.

"On our monthly foxhunts, we just go out and have a good time," John says. "Usually they are held on the Sunday afternoon following the monthly club meeting, but we have also had them in the evening hours. Sometimes we have a picnic afterwards. The fox uses the radio club's call and results are published in the club paper, but they are kind of a loose informal event.

"Most hiders use the club's fox transmitter," WBØCMC continues. "It's in a weatherproof container, battery powered, and will run for six hours at one or 10 watts. It comes on for one minute and then shuts up for three. We start the hunts from the University of Nebraska parking lot. The fox has been in dumpsters, up in trees—you name it. We've done a few mileage hunts, but usually the first team to locate it wins and gets to hide the fox the next month.

"I drive a T-top and use a 3-element beam on a wood pole that sticks up into the air. We had one guy some years ago who had a Doppler and was pretty good with it, but most of the guys now are using handie-talkies and beams. In fact, some of them just use handie-talkies and body shielding. The boundary is pretty broad, including most of Douglas County and over to Pottawattamie County in Iowa. Sometimes the hider will put the fox along the Missouri riverbank, and the big trick becomes trying to figure out which side of the river the thing is on."

Nebraska's ARRL Section Manager Bill McCollum KEØXQ is another regular hunter. He and WBØCMC have used their T-hunting skills several times over the years to track repeater jammers and bootleggers. "Some of the bootleggers that we've tracked down eventually turned into good hams," Bill says.

"We keep on top of it," John adds. "When turkeys pop up, we find them, they know they have been identified and we just don't have the problem again. For example, about a year and a half ago in the dead of winter, somebody would come on at 2 AM every morning and get on the autopatch, dial up numbers and never give a callsign. Bill and I nailed him and the problem went away."

Of course, not all interference is deliberate. Sometimes it's the result of a technical problem. According to John, "One day we started hearing military voices over one of our repeaters. I quickly determined that the signal on our input was coming from Offutt Air Force Base and called Communications out there. I told them, 'Your generals are being heard all over Omaha.' In an hour the interference was gone."

The Amateur Auxiliary to the FCC has been a success story in eastern Nebraska. John says, "Before the FCC's monitoring station at Grand Island closed, I would sometimes get a call from Rebecca out there asking the hams to check something out. We found all kinds of technical problems, spurious transmitters and such. Usually when we find somebody with a bad transmitter, it's fixed within a week. There was only one such incident that we really had problems resolving, and that was a major industrial company and its RF heating equipment at 13 MHz. The transmitter had a free-running oscillator with no frequency control except one tuned circuit.

"The little antenna they were using to couple 10 kilowatts into the work happened to be 19 inches long. So guess where the worst harmonics were! They were getting into every repeater in the Omaha area and even into Fremont, 32 miles away. They were getting into our 222 and 440 MHz frequencies, too, but not as bad. Because they had a harmonic in the aircraft band, we were able to get pressure from the government to get it fixed."

RDF services by Omaha hams are not limited to Amateur Radio bands. They have helped other local agencies as well. "Seven or so years ago, I got a call from Douglas County Civil Defense (CD), which uses a frequency near 155 MHz," says WBØCMC. "That agency is responsible for setting off sirens for tornado warnings and such. Somebody had been giving false calls on the CD frequency. It had gone on for two nights and they figured there was a good chance he'd be out that night, too.

"We got five teams out. Sure enough, he came on and we tracked him to the Douglas County Annex building. It turned out to be a security guard who had picked up a CD handie-talkie from the charger. I called the CD chief and they sent the Sheriff out there. It didn't happen again."

Always gets his man

"John is really good at RDF," says KEØXQ. "There hasn't been anything yet that he hasn't been able to find." The most recent and most serious mission came on April 3, 1996. As Bill and John were talking on the phone, Bill noticed that Omaha Police Department radio calls were coming through the 146.94 repeater. "At first we thought somebody had a stuck 2 meter radio with the mike on top of a scanner," Bill says. "Later we found out that police cruiser radios were picking up hams talking on their channel at the same time."

Photo B. *WB6UZZ used a router to make room for the hidden T parts. The two-meter transmitter is manufactured by Agrelo Engineering, 1145 Catalyn Street, Schenectady NY 12303 (518) 381-1057.*

The two T-hunters drove around Omaha for about a half hour without hearing the police on the 2 meter repeater input. Then, on a hilltop west of Boys Town, John began to pick up a faint signal. He decided to go to Elkhorn, about six miles northwest of the city, where there is an Air Force antenna farm.

"'Your generals are being heard all over Omaha.'"

It wasn't there, but the signal was about 20 dB stronger and still to the northwest. "I think it's in Fremont," John told Bill.

By this time Bill was in Bellevue, on the other side of Omaha. John continued westward. "Trying to drive and hold a three-element beam in a 60 mile-an-hour headwind doesn't lend itself well to precision RDF, but I could tell that the bearing continued to point right toward Fremont," he says. "I was in kind of strange territory, so I decided to get a local ham to go with me. I called Mac McCabe WBØIBV in Fremont. He said he would love to help. I also called the Dodge County Sheriff's office to see if they had a deputy to go along for safety's sake. These days, one never knows what he may run into when knocking on doors.

"The deputy got there before Mac and pulled up alongside my car. He looked at the car, looked at the beam sticking out of the roof and then started to chuckle. I explained who I was and what was going on. Mac showed up and off we went."

A few minutes later, they pulled into a parking lot where the signals were super-strong. They asked the workers there if anyone had left a 2 meter radio on. One went over to his car, got in, and the interference stopped abruptly.

To link ham and police frequencies together, the perpetrator had to set up his dual-band radio in the repeat mode with the right frequencies, offsets and subaudible tones on both UHF and VHF. "It became obvious that this was deliberate," says WBØCMC. "Most people who do something like this inadvertently are apologetic when confronted. Not so here. This fellow was very tight-lipped, wouldn't look anybody in the eye, and gave the impression that he hadn't thought he'd get caught. We identified him, turned our information over to the authorities and haven't had a recurrence.

"We made some real good friends with the Omaha 911 people as a result of this. The following Saturday, several of us met with the 911 Chief of Communications and the Assistant Douglas County Civil Defense Director. We got lots of thanks and an opportunity to give them a briefing on the Amateur Auxiliary program."

Let's go browsing

The new "Homing In" site on the World Wide Web is a good way to learn how to get your club started in hidden transmitter hunting. Besides answers to the most frequently asked questions about RDF, you will find Web links and E-mail contacts to hunt groups in cities and towns all across the country. Point your browser to http://members.aol.com/homingin/ to check it out and then let me know about T-hunts in your town. You can send E-mail to Homingin@aol.com or snail-mail to the address at the beginning of this column. 73

NEVER SAY DIE

Continued from page 61

most of these things, and that the results can be all kinds of lingering illnesses.

On the bright side, the book explains how simple it is to find out what you are allergic to so you can avoid that allergen. It's merely a matter of counting your pulse rate after eating or exposure to different substances. With foods, you can isolate which are treated as hostile by your body just by checking your pulse several times after eating. Well, get the book.

Yes, I'm selling my list of recommended books for $5. If I were selling the books, it would be a free catalog. But the list is the result of a lifetime of reading and the revenue from it goes for photocopying, folding, assembling, addressing and mailing it, plus money to buy more books. So far this month I've bought 17 more books, most of them on the recommendation of readers as books *I* really ought to read.

Getting back to allergies, a recent TV documentary introduced me to Dr. Doris Rapp, who explained that many of the behavior problems kids have stem from allergies. Like hyperactivity, attention deficit disorder, dyslexia, poor grades, fatigue, personality changes, poor concentration, depression, and so on. I probably should put her book, *The Impossible Child*, 161p, $11, ISBN 0-9616318-1-3, on my list, particularly for parents—though people of all ages can have these same reactions to allergens.

My hay fever hit not long after childhood immunization shots. I had the usual scratch tests, where I was found allergic to dogs and cats, a few foods such as cheese, trees, grasses, and most pollens. Dr. Coca's book explains that the scratch test misses many allergens and that the pulse test is much more reliable. It's also one heck of a lot easier and cheaper. Which probably explains why few doctors are aware of the test, even though it's been around for over 40 years.

Apropos that, I've already mentioned the inexpensive cure for epilepsy which one determined doctor has kept going at Johns Hopkins Hospital, but which otherwise would have been lost. I keep finding out about more and more buried medical treasures like these. But then the medical industry is in the hands of a few pharmaceutical companies, the music industry is totally under control of seven international music companies, and so it goes, with us paying the tab while we sit here watching ball games and drinking beer.

"An AMA report showed that doctors live an average of 58 years, while the rest of us manage to live an average of 75 years."

Those Pesky UFOs

I see where the Pentagon has managed to produce a five-pound book whitewashing the "Roswell incident" of almost 50 years ago. News flash: It *still* was a weather balloon. Sure. But if you've read anything about it or seen any of the several exposé TV shows on the subject you'll know the Pentagon is again handing out baloney.

Oh, I agree there are a lot of crackpots involved with UFOs. But then, there are a lot of crackpots involved with anything arguable. In general, crackpots are people who have not bothered to do their homework, but have not let that interfere with them having strongly held opinions. Or, on a more practical level, a crackpot is someone who strongly disagrees with you on some subject, whether you have any real basis for your beliefs or not.

Is Strieber, who wrote *Communion*, and more recently, *Breakthrough*, a crackpot? His story of his many contacts with the alien visitors is fascinating and makes sense. Are the millions of people who have reported seeing UFOs all crackpots? How about the thousands of contactees with stories similar to Strieber's?

A reader says he's been able to photograph UFOs reliably by using a building or something to block out the sun so he could take pictures of the sun's corona. He says the UFOs are coming and going from the direction of the sun and thus aren't easily seen. He described 15 different types of UFOs he spotted in just a two-day vigil.

So if there are aliens visiting us, why aren't they open about saying hello? I suspect it's because they are on scientific expeditions, not military, and they've been doing this for a long time—possibly for thousands of years. I don't think you'll disagree with me that we have not progressed socially to the point that it's safe to mess with us. The hints of their technology tell us that our visitors are far ahead of us, so what possible benefit would it be for them to do more than unobtrusively observe us? If we could go back and visit Earth the way it was a million years ago, would we land and say, "Take me to your leader?"

Well, you're interested in communication. Our visitors aren't using radio, which makes sense to me, so how are they communicating?

I Haven't Got Time

A friend called. When he mentioned having been sick, I naturally suggested he get some books on health and take some responsibility for his body. He said he didn't have any time to read. I don't either, but knowing how important it is to my goals in life (like living as long as I can so I can accomplish my other goals), I *make* the time.

Books, such as those that are on my $5 "books you're crazy if you don't read" list, can help extend your life on to 100 or so. For me that's another 25 years to learn and teach.

Like most other people, I was inculcated by our school system to believed that school and college were the main ways to learn. Experience has taught me the long, hard, expensive way, that you can learn more with a good book in a few hours than you can in college in a few weeks. You don't have to go to a class to learn about radio and electronics, all you need to do is read some books and you'll soon know more than most of the teachers. We're so brainwashed that few people ever even think to question the value of college. My folks never did. Heck, my father came along at WWI time and missed college. He went to New York Military Academy and from there into the Army as an officer. That got him into aviation with the Army Air Corps. But he always felt the lack of a college degree, even when he was busy starting new airlines. He started three of 'em, including the first trans-Atlantic airline.

In just a few weeks of reading you can become an expert on almost any aspect of electronics. But, like exercise to build strength, you do have to tackle the job conscientiously.

I keep bringing up health because you're not going to be able to do much if you're heading for a heart attack or cancer, like over half of your friends. That road is for the ignorant. Ditto all of the chronic illnesses, including diabetes, arthritis, and so on.

You can give me a hand with this. Every time you buy an electronics or radio book, please read it carefully and then send me a book report for possible publication in *73*. If it's a bad book, the review will help spur the publishers to do better. If it's a good review, I want to know so I can read the book, and so do the other *73* readers. It'll also help sell a bunch of books, and that too will encourage the publishers to do better and stop publishing junk and textbook-type boring stuff.

Amateur radio can once again be worth its salt if I can get you to take advantage of the many opportunities for pioneering. But to do that you have to start by learning all you can. Will it be a ham who develops and pioneers digital communications? We did that with FM, NFM, slow-scan, and sideband. But so far we're sadly behind when it comes to digital voice systems using data compacting algorithms.

"Reading books, such as those that are on my 'books you're crazy if you don't read' list, can help extend your life on to 100 or so."

I'm reading every club newsletter I get, looking for any signs of hams doing anything more than having fun with a hobby. I see no signs. That's why I get so nervous and critical when I read about the ARRL getting pushy with the FCC over one thing after the other. It just doesn't pay to give the boss a hotfoot.

PROPAGATION

Jim Gray W1XU
210 Chateau Circle
Payson AZ 85541

Special Forecast

Cycle 21 bottomed out in December 1986, and it now looks like Cycle 22 will bottom out around December 1996 ... just 10 years later. Yes, I had predicted an earlier (May) sunspot minimum, but Old Sol is hanging in there with depressingly low flux values (around 70) which refuse to climb out of the basement. The pundits are now saying that the reported spot of the new cycle was just a fluke ... a Chimera ... an apparition. Frankly, I don't think so. It was real enough and was, in fact, the harbinger of Cycle 23, I believe.

As propagation goes, October could be an *awful* month; either wonderfully awful or awfully wonderful. I predict that the days surrounding the 10th and the 23rd will show some remarkable and extensive geophysical disturbances: possible hurricanes, volcanic eruptions, and earthquakes.

OCTOBER 1996

SUN	MON	TUE	WED	THU	FRI	SAT
		1 G	2 G	3 G-F	4 F	5 F
6 F-P	7 F-P	8 P	9 P	10 VP	11 P	12 P-F
13 F-P	14 P	15 P	16 P-F	17 F	18 F-G	19 G-F
20 F	21 F-P	22 P-VP	23 VP-P	24 P	25 P-F	26 F
27 F	28 F-P	29 F-P	30 P	31 P		

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	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:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
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:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
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		

Heaven knows, there might even be an active ionosphere! It sure is about time! Whatever happens, it won't be docile and calm. Maybe there will be a stock market crash ... it's the right month.

When solar flux is very low, as it has been for months, an ionosphere storm could be a boon and kick the flux up where we'd like to see it ... at least for a few days. When flux is high, as at the peak of a cycle, an ionosphere storm often results in too high a flux value and poor conditions. Therefore, I'll suggest that the days marked P or VP on the chart could, in fact, be very *good* days for propagation, so keep those receivers tuned to the higher HF bands and hope. Also, keep your emergency gear ready for anything!

10-12 meters

Generally Poor, except for occasional transequatorial propagation with F2 openings on the best days—most likely South and Central America.

15-17 meters

DX to Africa and Latin America on the Good days possible, with short-skip out to about 1,000 miles or so in the U.S.

20 meters

Your best band for DX openings around the world from dawn to dark, and openings to the Southern Hemisphere after dark in evening hours. You can expect excellent short-skip during the daytime to 2,500 miles or so.

30-40 meters

These bands ought to be open for DX from just before sunset to just after sunrise. Signals from the east should peak until midnight, and after midnight to other areas. Daylight short-skip of about 500 miles will be possible, and nighttime short-skip to 1,500 miles or more will be available.

80 meters

Occasional DX to various areas of the world should be possible between sunset and sunrise when QRN levels permit on Good (G) days (see calendar), and also short-skip during hours of darkness to 1,500 miles or more.

160 meters

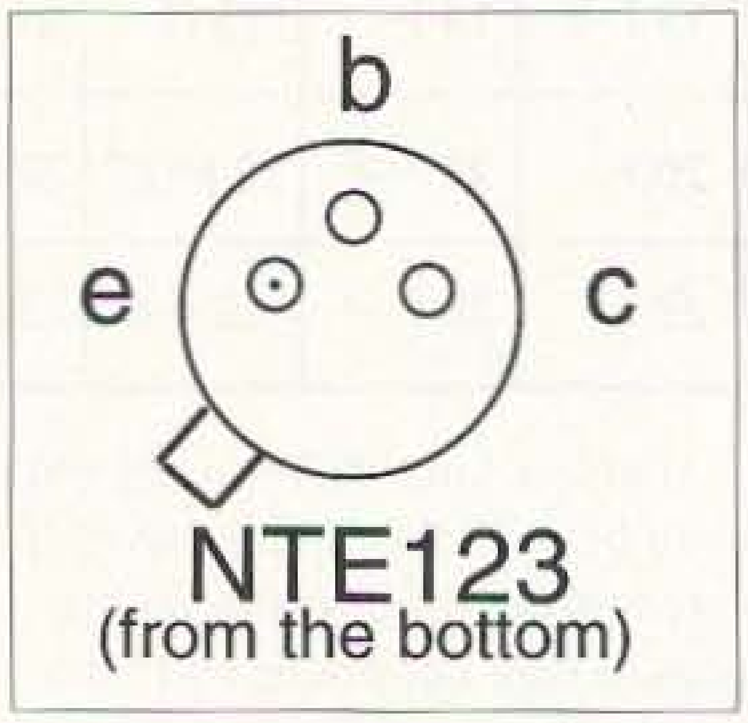
Following the usual summertime slump, this band ought to begin to come alive again during the hours of darkness when QRN permits. Try the days marked (G) on the calendar for best results. DX toward the east until midnight, and to other areas afterwards until dawn. Short-skip to 1,500 miles will prevail when the band is quiet. W1XU. 73

Number 88 on your Feedback card

UPDATES

You say you're having trouble with that preamp...

Before you spend another weekend trying to find out what went wrong with that preamp circuit that you constructed according to Roland Burgan KB8XI's article (August *73*), take a look at the pinout diagram that was inadvertently omitted from the schematic:



BEAR-ly There

The June table of contents erroneously credited Pete Kemp KZ1Z's article "The BEARS Hunt the Fox" to Mike Bryce WB8VGE.

The Book List by Wayne Green. This is a list of 83 books that I say you are absolutely crazy if you don't read. And none of this "I don't have time to read" crapola. These books are the best books I've found in a whole bunch of fields. Many were recommended by readers as being top notch. It's time to become educated on health matters, our school system, our corrupt government, history, science, communicating with plants and animals, child development, the occult, and so on. Order **BL** $5 from Radio Bookshop.

It could happen to anybody...

In KB4ZCG's August article, "Simple Crystal Activity Tester," the R5 Øk ohm potentiometer in the parts list should read, **"R5 10k ohm potentiometer**."

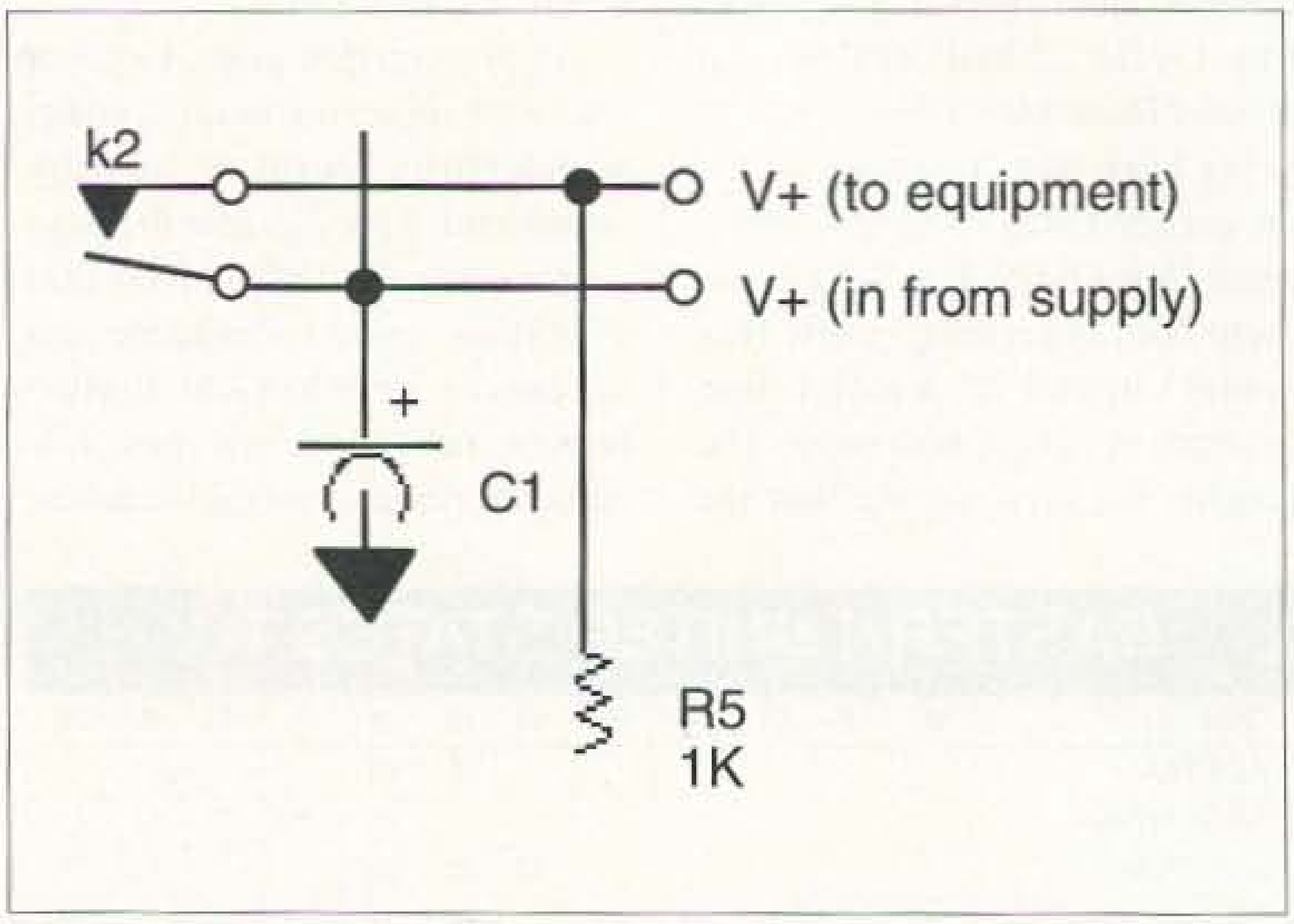
NASA Mooned America by René. The proposition that the Apollo flights were all faked and NASA never got anyone to the moon is patently ridiculous. I'm still waiting to hear from anyone who has read this book and still believes the moon landings weren't the biggest hoax in history. René has done his homework thoroughly and cites 30 darned good reasons why he thinks we've all been lied to. 176p, 8½ x 11. Order **NA** $25 from Radio Bookshop.

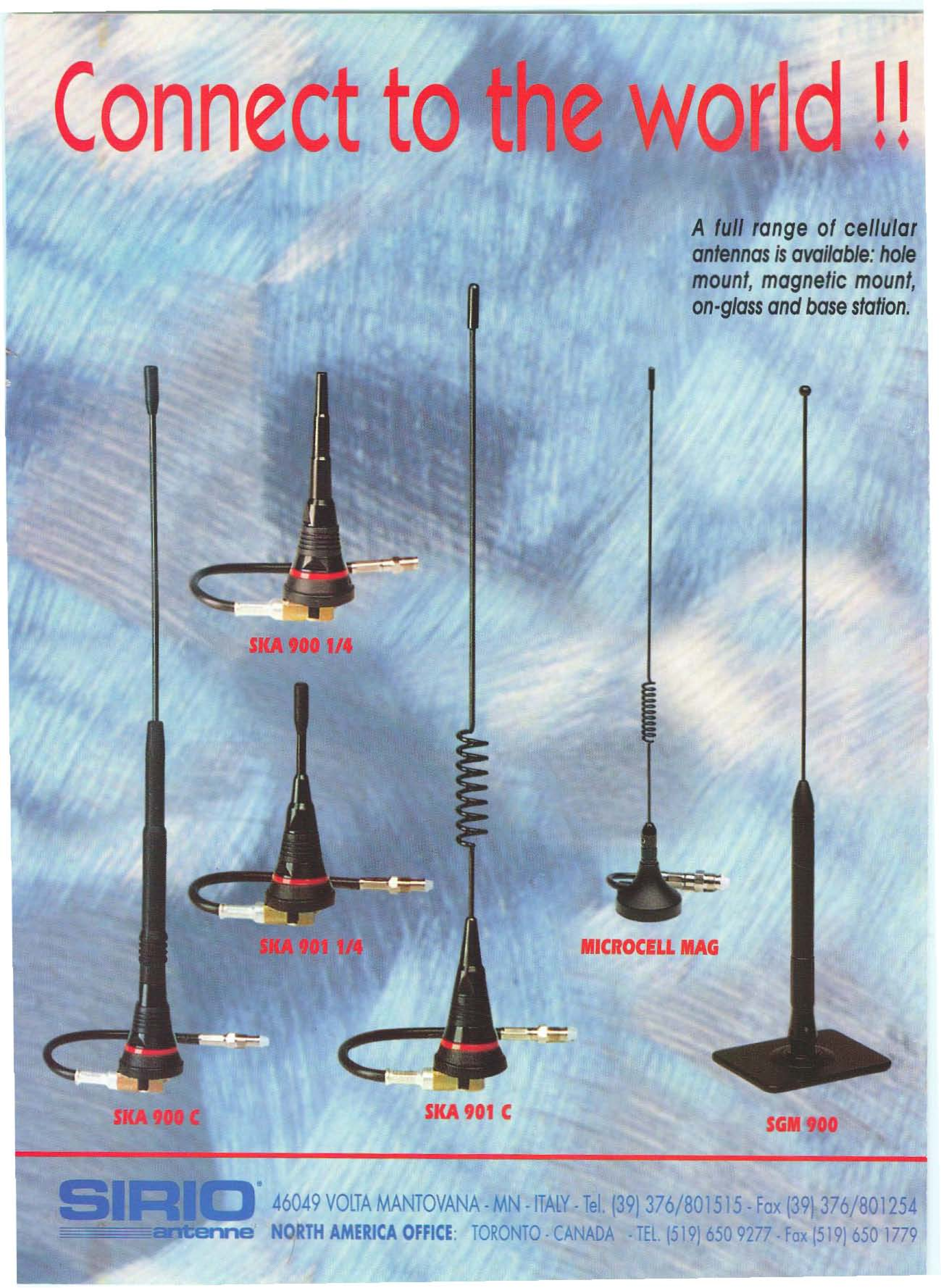
YA GOT IT ALL WRONG, FRED--YOU CAN MAKE A 2 METER GROUND PLANE OUT OF WIRE COAT HANGERS, BUT NOT A 20 METER BEAM!

"R2... see if you can lock down that stabilizer."

In Frank Brumbaugh's "Automatic Voltage Controller" August *73*, look at the first line of the third column of page 46. The R5 that's there should be an R2.

The schematic on page 46 was missing the visual for C1. Here it is:

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