73® Amateur Radio Today

Including Ham Radio Fun!

JANUARY 1997
ISSUE #436
USA $3.95
CANADA $4.95

International Edition

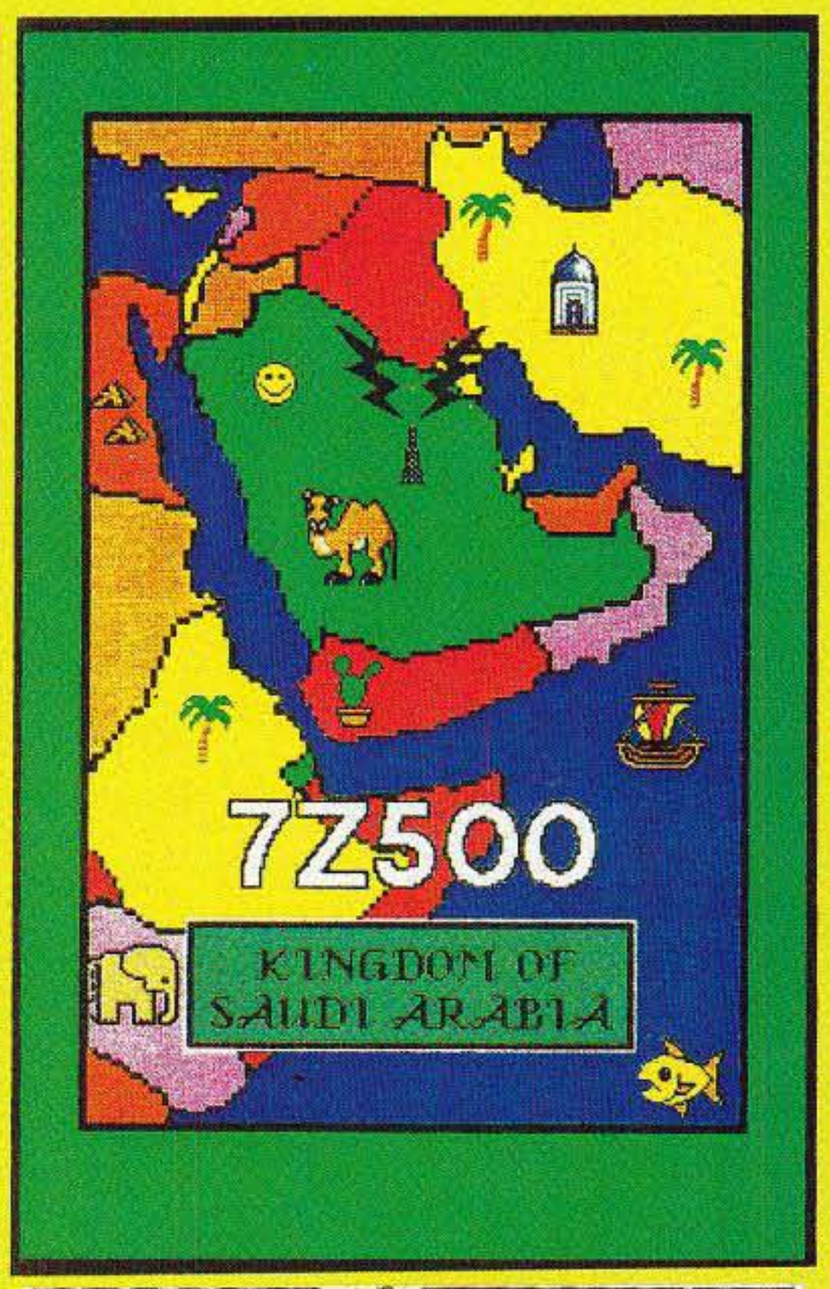
Automatic
Voltage
Controller

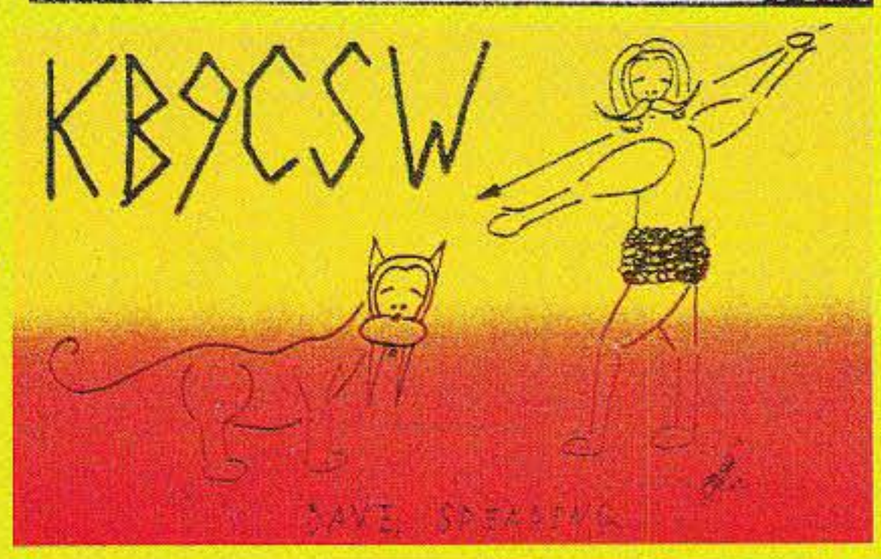
More CW fun
With this keyer

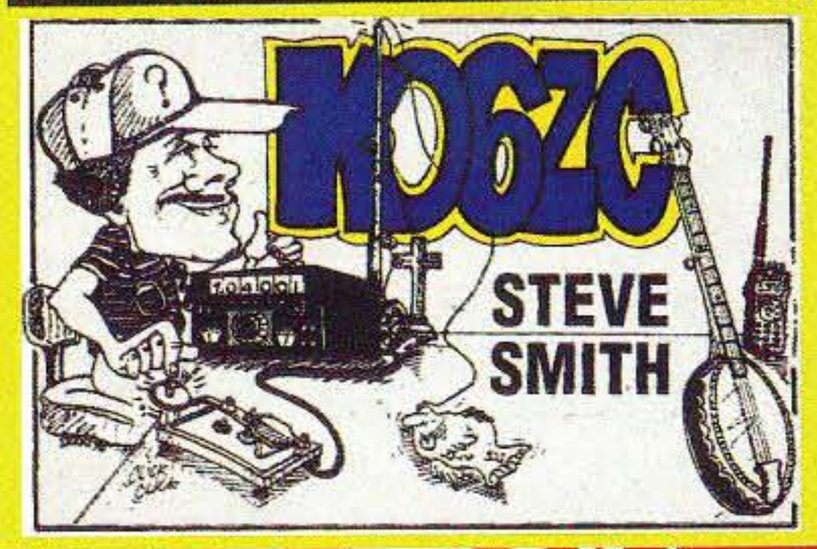
Soup up your Rx
With a preamp

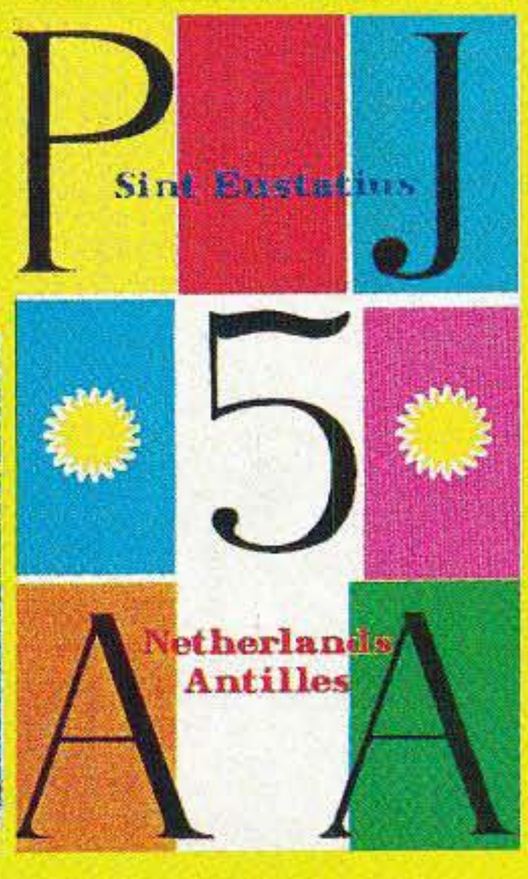
73 Reviews:
WEFAX Demodulator

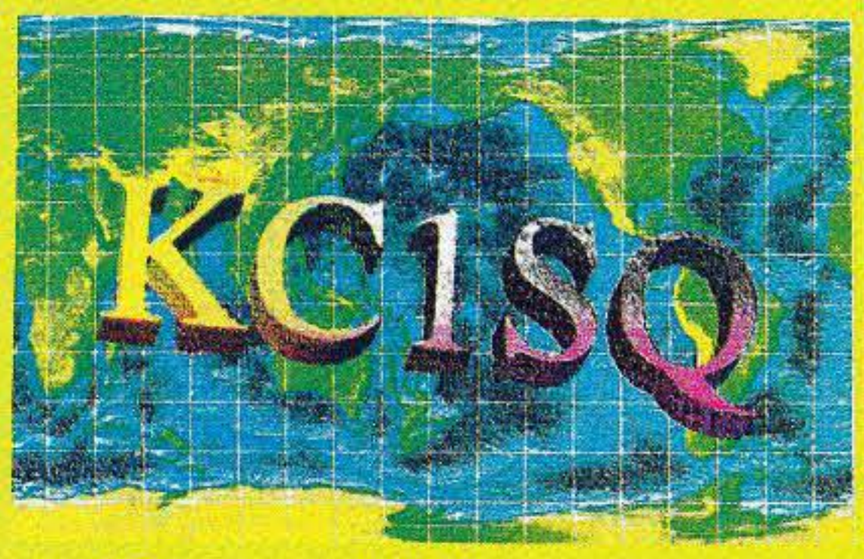
Build a ScopeMixer
The industrial-strength signal cleaner











0 74851 08725 1 01

JRC

JST-245

160-10 Meters PLUS 6 Meter Transceiver

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

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

★ JST-145 COMING SOON ★

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

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

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

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

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

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

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

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

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

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

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

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

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

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

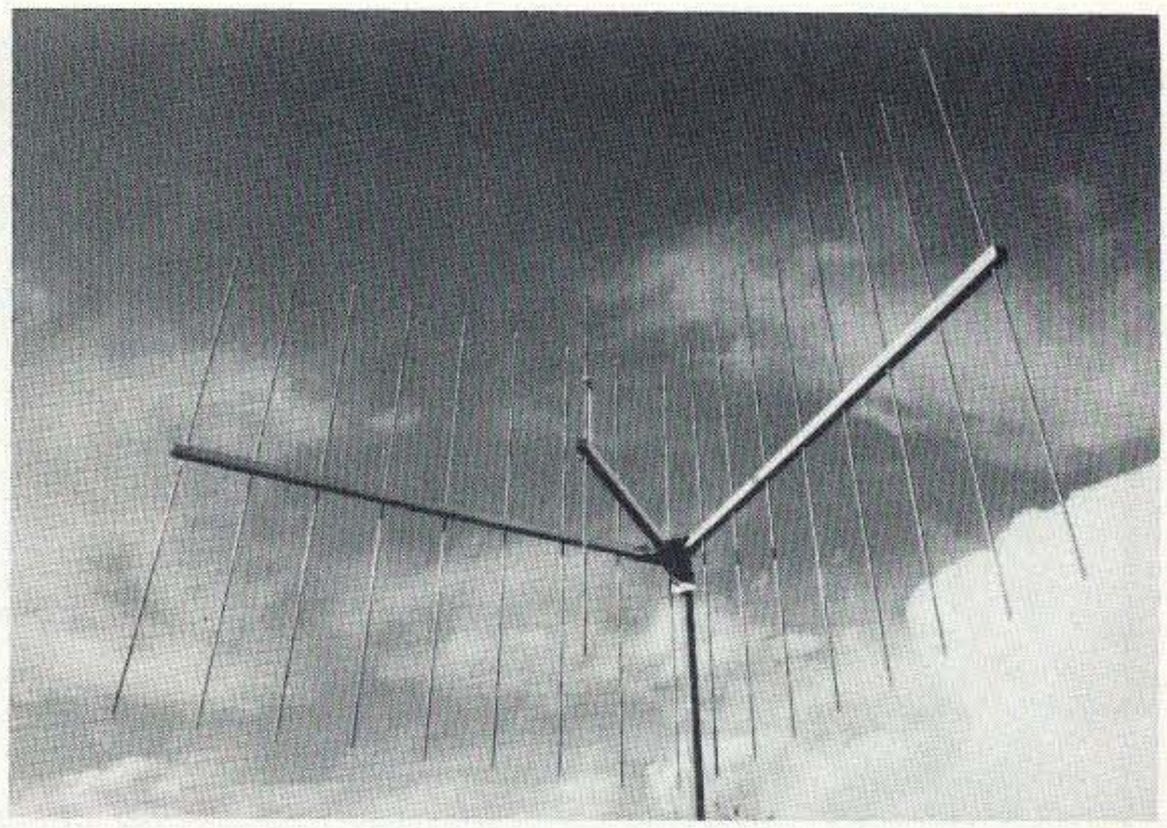
JRC *Japan Radio Co., Ltd.*

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

CIRCLE 159 ON READER SERVICE CARD

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.

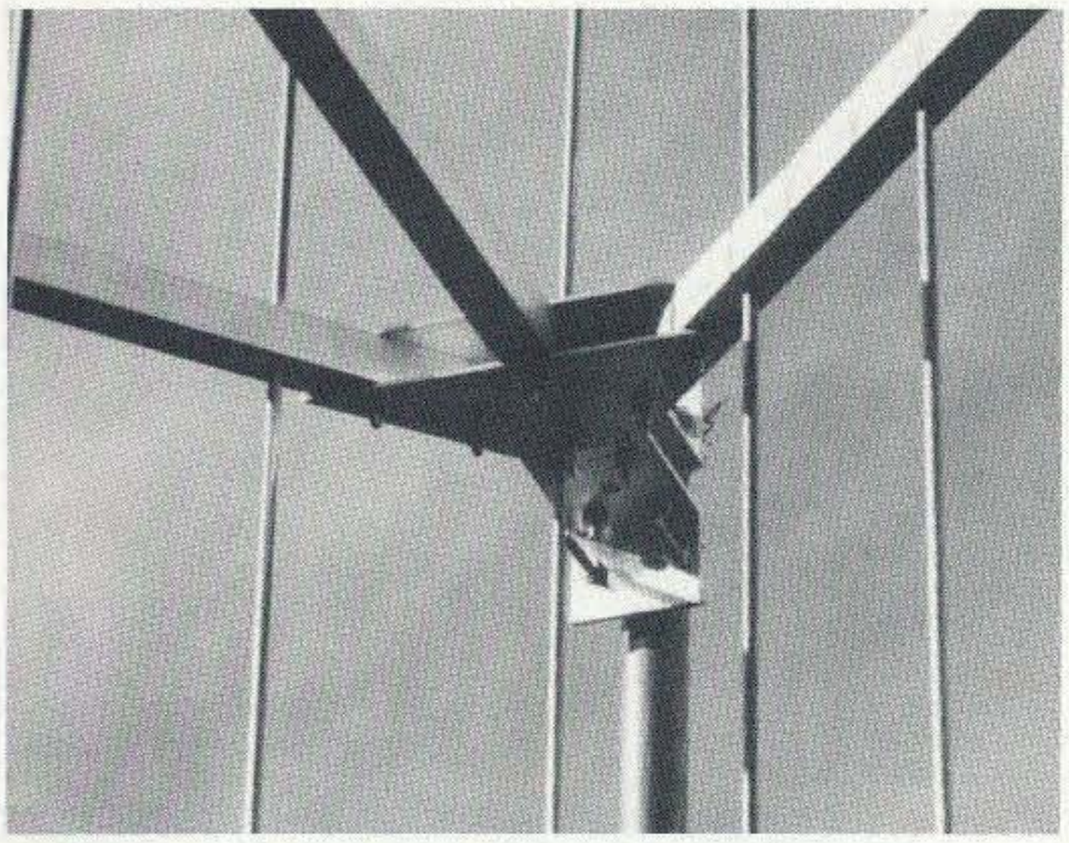
An omnidirectional antenna radiates uniformly in all direction, and it also hears noise and interference from every direction.

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

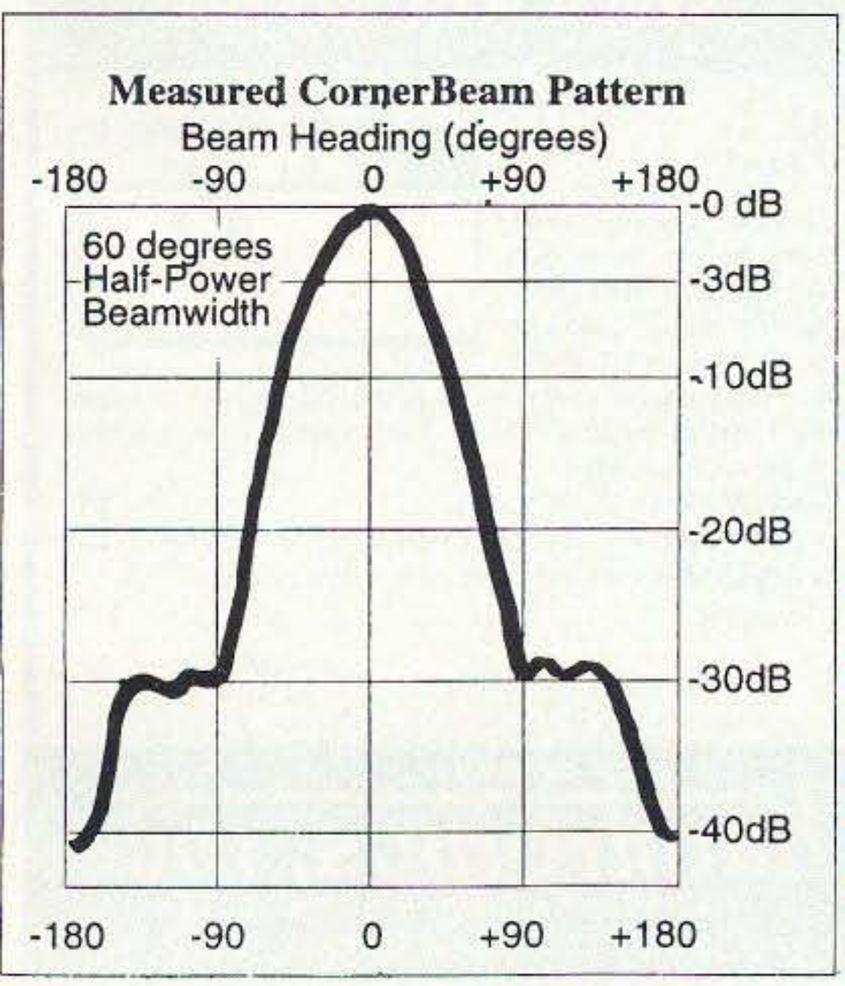
Construction: Aircraft aluminum. Booms are square. Elements are solid rod. Stainless hardware included for tower and mast mounting accepts up to 1.5" dia. mast and may be rotated for vertical or horizontal polarization. Connector is SO-239 for VHF, N female for UHF. Dual-Band antenna has separate driven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

Name_____Amt. Enclosed_____

Call_____ Phone_____

Street_____ Unit_____

City_____ State_____Zip_____

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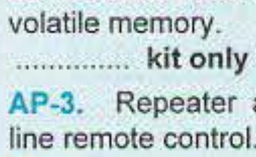
CIRCLE 57 ON READER SERVICE CARD

You'll KICK Yourself
If You Build a Repeater
Without Checking Out Our Catalog First!

Hamtronics has the world's most complete line of repeater controllers, cw and voice id boards, dtmf controllers, autopatches, ctcss boards, exciter, pa, and receiver modules. Here's a sample...

CWID. Traditional diode matrix, permits field changes; use with COR-3. ..... **kit only $59**



CWID-2. Miniature cwid board, eprom-controlled, easy to build. ..... **only $54/kit, $79 w/t.**

DVR-1. Add real speech to your repeater. Records your own voice up to 20 seconds. Use for voice id or to play club announcements. ..... **$59/kit, $99 w/t**

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

COR-4. Complete COR and CWID all on one board. Low power CMOS logic, timers, courtesy beep, 2nd rcvr input, id in eprom. ..... **only $99/kit, $149 w/t**

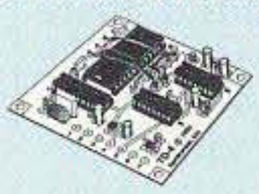
COR-5. Microprocessor controller with all the bells & whistles! Full autopatch, reverse ap, phone remote control, lots of dtmf control functions, all on one board, as used in REP-200 Repeater..... **$379 w/t**

COR-6. COR timers, courtesy beep, voice id. Like COR & DVR-1 on one board! Record your own voice up to 20 seconds. Low power CMOS, non-volatile memory.

..... **kit only $99, w/t only $149.**

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

TD-2. Four-digtit 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.**

TD-3. CTCSS Decoder/Encoder. Prevents repeater access unless tone is present. Can also be used with mobile to access repeaters..... **kit only $29.**

HIGH QUALITY VHF & UHF FM TRANSMITTER AND RECEIVER MODULES

FM EXCITERS: 2W output, continuous duty.

TA51: 6M, 2M, 220MHz. ..... **kit $99, w/t $169.**

TA451: 420-475 MHz. ..... **kit $99, w/t $169.**

TA901: 902-928 MHz, (0.5W out)..... **w/t $169.**

VHF & UHF AMPLIFIERS.

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

FM RECEIVERS:

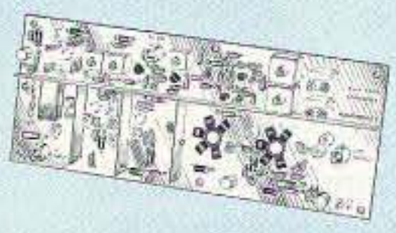
- **R100 VHF FM RECEIVERS** Very sensitive – 0.15uV, superb selectivity – both crystal and ceramic IF filters for >100 dB at ±12kHz (best available anywhere), flutter-proof squelch. For 46-54, 72-76, 140-175, or 216-225 MHz. ..... **kit $129, w/t $189.**
- **R144/R220 RCVRS.** Like R100, with 2M or 220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

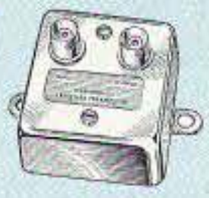


- Xmitting converters (at left) for 2M, 432 MHz.
- Kits only $89 vhf or $99 uhf.
- Power amplifiers up to 50W output.

LOW NOISE RECEIVER PREAMPS

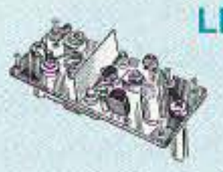
LNG-( ) G_AA_S FET PREAMPS

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.*

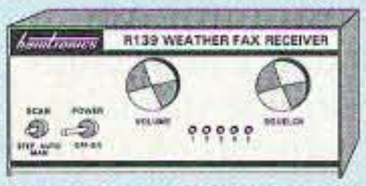
LNW-( ) ECONOMY PREAMPS



ONLY $29 kit, $44 wired/tested

- Miniature MOS FET 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.*

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 Russian Meteor weather fax** images on the 137 MHz band. 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 12Vdc pwr adapter** **$189**
- **R139 Receiver Wired in case with 12Vdc adapter** **$239**
- **Internal PC Demodulator Board and Imaging Software** **$289**
- **Turnstile Antenna** **$119**
- **Weather Satellite Handbook** **$20**

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
w&t still only $1295

50-54, 143-174, 213-233, 420-475 MHz (902-928 MHz slightly higher.)

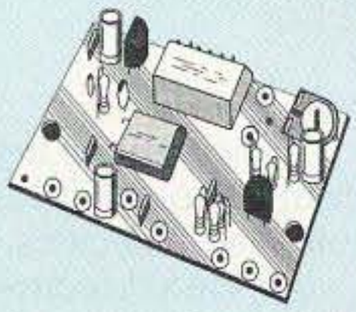
Digital Voice Recorder Option ..... only $100. Great for voice ID or making club announcements.

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

REP-200N Repeater. No controller so you can use your own. ..... **Kit only $695, w&t $995.**

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**

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 weather and emergency broadcasts from NOAA/NWS or Environment Canada.**

Excellent 0.15µV sensitivity provides good reception even at distances of 70 miles or more with suitable antenna. No comparison with ordinary consumer radios or scanners! **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 – any one who needs up-to-date weather info and emergency warnings, even from distant stations.

Small enough for emergency or portable use, it can 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 supply, and built-in speaker. It is also available factory wired and tested.

- **RWX Rcvr** kit, PCB only **$79**
- **RWX Rcvr** kit with cabt, spkr, & 12Vdc adapter **$99**
- **RWX Rcvr** wired/tested in cabt with spkr & adptr **$139**

WWV RECEIVER

NEW Get time & frequency checks without buying multi-band hf rcvr. Hear Geo Alerts for conditions 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** wired/tested in cabt with spkr & adapter **$129**

- **Buy at low, factory-direct net prices and save!**
- **For complete info, call or write for free catalog.** *(See last month's ad for more products.)*
- **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 Including Ham Radio Fun! Amateur Radio Today

JANUARY 1997
ISSUE #436

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REVIEWS

HAM RADIO FUN SECTION

On the cover: Winning entries from *73's* "QSL of the Month" contest, June 1996 through January 1997. Winners for each month have received a free one-year subscription or extension.

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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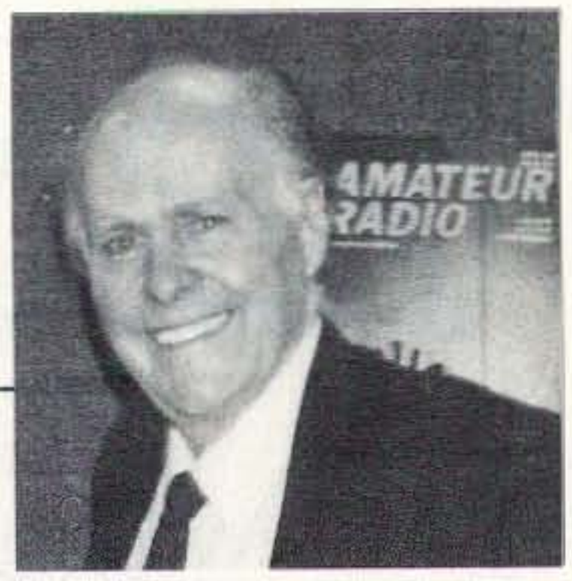
Contract: Have you tried microwaves? How about amateur television? When's the last time you home-brewed a piece of equipment? Reading this contract commits you to trying something new or long-neglected. The *73* advertisers can supply you with whatever you need ... just don't forget to tell 'em *73* sent you.

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1



Resolutions

The beginning of the new year is a good time to make changes. The Christmas holidays wind up the old year, giving us a chance to make a fresh start with the new one. What changes are you going to make?

Yes, of course I have some recommendations. Hey, if you give me an inch, I'll try to revamp your whole life for you. For the better. Are you game to try some changes that will (a) Make you much healthier? (b) Happier? (c) Wealthier? (d) Do a better job with your kids? (e) Bring adventure into your life? (f) Accomplish something you'll be proud to be remembered for?

That's a tall order, but doable, unless your (bad) habit patterns are so thoroughly ingrained that you are no longer even capable of change.

Let's start with adventure, since that's closest to home, hamwise. Pick something you haven't done yet, but which sounds like fun, and get cracking. It could be slow-scan, RTTY, packet, 6m, 10 GHz, the ham satellites, or even 160m. Read, ask questions, start setting up the gear, and learn. I hope you'll keep careful notes so you can help others avoid the pitfalls and blind alleys. Maybe I can even get you to do some articles for *73?* If I can just get you started, I guarantee you'll be in for adventure.

Take 6 meters for instance. When the band was opened after WWII, I didn't think much about it. I was busy having fun up on 10m and 2m. Then one day I turned on my old pre-war Meissner FM tuner. The FM broadcast band, as I recall, used to be at 50-56 MHz, with the 5m ham band from 56-60 MHz. Suddenly I was hearing a whole bunch of S-9 W6s and W7s pouring through. Well, it didn't take long for me to convert an SCR-522 transmitter to 6m and build a converter for my SX-28. As far as I know, I was the first station on 6m in New York City and I had a ball.

In those days everyone was crystal-controlled, so with my surplus frequency meter I could tell who was who locally just by checking the frequency. There was a scattering of hams around Northern New Jersey, Long Island, upstate New York, and Connecticut.

To help other hams find out when the band was open I set my rig up on 50.1 MHz with a code wheel keying it as a beacon. That attracted Perry Ferrell, who had a contract with the Air Force to investigate the propagation characteristics of the band. I got a nice Radio Amateur Scientific Observations (RASO) certificate from the Air Force for my participation.

Later, when Perry became the editor of *CQ*, this helped me get him interested in my RTTY work. And that led to my doing a RTTY column in *CQ*, which led to my getting Perry the job as editor of *Popular Electronics*. And that led to my becoming the editor of *CQ*. And *that* led to my starting *73*.

But then, every new thing I've done in amateur radio has led to some sort of adventure for me, so I hope you won't get fed up with me prodding you to try new modes and bands. I get so discouraged when I listen to 75m nets and 20m round tables, where it is obvious that everyone is just marking time with their lives until the Silent Key guy comes calling. How is that better than watching ball games or sitting in bars? It's like going to a gourmet feast and eating a hamburger.

I've written about health, wealth, and happiness before. Should I keep repeating myself? A good part of happiness is in your family. So how much attention are you paying to romance? While a new rig may really get *your* juices going, your wife will be far more responsive to romance. And don't you forget it.

One of the easiest ways to rekindle romance is with dancing. Yes, I know, you're a klutz and would rather turn off your linear and run barefoot than go dancing. So get one of Sherry's how-to-dance videos and see what happens. You could use the romance and Sherry can use the extra business. Call 800-43-DANCE for a catalog.

What will it take to get you to make the big health change for '97? With daily exercise, a healthy diet, stopping poisoning your body, drinking enough water, and stuff like that? No chance, eh? Well, 1997 is going to be whatever you make it, and the new year is a fine time to make the big changes in your life that will see you living healthier, happier, and wealthier. Or not. You can make my year for me by letting me know that I've helped you decide to make changes. Will I be getting a note from you, or perhaps a handshake and some encouragement at a hamfest?

I haven't been invited to the '97 HamVention yet, but perhaps I'll see you there in '98? A new, trim, slim, grinning you?

I got a letter recently from a reader who thanked me for pushing him many years ago to start his own electronics-oriented business. His company is now one of the top in the field and he's having the time of his life.

The Camel's Nose

As if we don't have enough trouble with the FCC slicing off chunks of our unused ham bands, now Congress is forcing the FCC to hack away at us. Yes, of course our ARRL ham lobby in Washington should have prevented this. But I'm not sure we have even a vestibule there, much less a lobby.

Congress, a collection of politicians (mostly lawyers) you keep re-electing, can smell money through 10 feet of lead. And their main purpose in getting elected seems to be to spend as much of your money as they can, including borrowing as much as possible from the future. So the aroma from the recent FCC spectrum auction made Congress impatient with the FCC's slowness in generating more money for their pork futures.

Just before going home for the holidays, Congress whipped through Public Law 104-208, and it was signed by Clinton Oct. 4th. This little baby slices off two 5 MHz chunks of our 13 cm band to be put up for auction. Slice and dice.

I know you won't forgive me for going back in time 30 years. That's when the ARRL stopped our ham growth dead and almost totally destroyed our American ham industry, wiping out about 90% of our ham dealers as well. But if this catastrophe had not happened—if amateur radio had been permitted to continue growing as it had steadily in the previous 17 years—today we'd have over 5 million hams, and our country would have over 4 million more technicians, engineers and scientists than it does now. And I don't think we'd have either unused microwave ham bands or any problem with Congress and the FCC slowly putting what's left of us out of our miseries.

I don't think we would have lost all of our consumer electronics industries to Japan either.

Where have the kids all gone? They're rushing to the Internet, where you'll find endless teenagers having a ball with chat rooms instead of chasing DX or gabbing on 75m. Or getting on our ham satellites with packet.

If an ARRL director were to come to you, wringing his hands, asking what, oh what, can be done about this, what would you say?

I'll give you a hint. There are two things I can think of that the League could do to start turning this situation around. No,

Continued on page 7

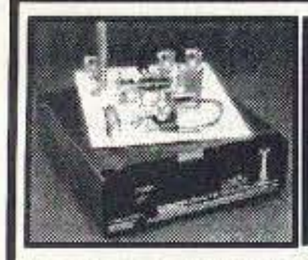
RAMSEY

Synthesized FM Stereo Transmitter

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

FM-25, Synthesized FM Stereo Transmitter Kit $129.95

Tunable FM Stereo Transmitter



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

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

RF Power Booster Amplifier

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

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

Micro FM Wireless Mike

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

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

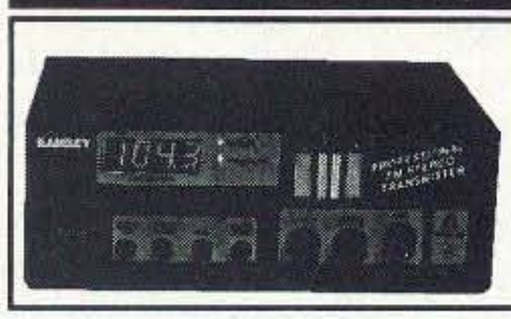
Crystal Controlled Wireless Mike

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

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

Call for our Free Catalog !

Super Pro FM Stereo Radio Transmitter



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

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

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

Speech Descrambler Scrambler

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

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

Tone-Grabber Touch Tone Decoder / Reader

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

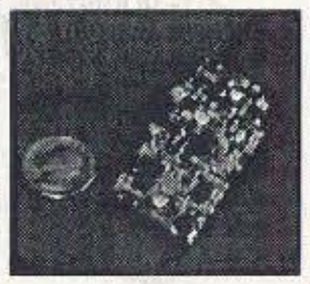
TG-1, Tone Grabber Kit..... $99.95
CTG, Matching Case Set for TG-1 Kit..... $14.95
TG-1WT, Fully Wired Tone Grabber with Case..... $149.95
AC12-5, 12 Volt DC Wall Plug Adapter..... $9.95

Mini-Peeper Micro Video Camera

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

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

MicroStation Synthesized UHF TV Transmitter



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

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

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Victor, NY 14564

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CIRCLE 34 ON READER SERVICE CARD

LETTERS

From the Ham Shack

Neil V. Friend W2AMY. Thank you for printing WA8YKN's article on "free energy" devices which appeared in the September issue. Having read several articles on "zero-point" energy without the term being defined, I found his explanation enlightening.

Concerning the discussion of the "N" machine, however, I submit that the machine follows known laws of electrical power generation by mechanical-magnetic means and draws no power from "N space" or other sources. Any voltage or current generated is strictly the result of relative motion between a conductor and a magnetic field as occurs in any generator or alternator (read your *ARRL Handbook*). I also submit that the magnetic field does rotate as one with the magnetic cylinder, in spite of Tesla's reported conclusion that it remains stationary (a point discussed later).

Anyone determined to construct a copy of DePalma's machine would be well advised to first build an inexpensive small-scale version, as I did, for testing after considering the following discussion.

In this discussion, it is assumed that the copper disc, shaft and magnets shown in **Fig. 3** of WA8YKN's article all rotate as a single unit and the disc is electrically connected to the shaft. Observe that in **Fig. 3** of the article the magnet flux (not shown) surrounds the entire cylinder, while becoming weaker with distance from the cylinder. This is basic magnetic theory.

Again referring to **Fig. 3**, note that the brush (and part of its lead closest to the brush) in contact with the copper disc is bathed in the outer magnetic flux from the cylinder. The brush and its lead are stationary while the magnetic field rotates so that there is relative motion between them, which induces a voltage in the brush and that part of its lead within the field. The induced voltage will depend on the speed of rotation and flux density but, due to the limited exposure to the field, the voltage will be low. *This is the sole source of any power generated by this machine* as evidenced by the observations. If the copper disc is replaced by one of significantly greater diameter, the brush and lead will be isolated from the rotating magnetic field with a consequent reduction or elimination of generated power.

Going back to the smaller copper disc, we can relocate the brush to a slip ring mounted on and insulated from the shaft and well out of the magnetic field. Restore the circuit by soldering a jumper wire between the outer edge of the copper disc and the slip ring. Once again, with this brush and its lead now isolated from the rotating magnetic field, the power generated will be zero.

I have verified the above with the help of a fractional horsepower DC motor, four 1.12" diameter ring magnets and some lathe work. Measured output at 2,300 rpm while using a 1.2" diameter brass disc was 2.75 mV open circuit and 1.6 mA short-circuit current. With a 1.5" diameter brass disc or the slip ring version there was no detectable output.

WA8YKN also notes that rotating the magnet alone produced no voltage in a stationary disc and caused Tesla to conclude that the field did not rotate with the magnet. This conclusion is unreasonable if one considers a cylindrical magnet that has a non-uniform field. It appears to absurd to imagine that the non-uniform field would remain non-uniform and stationary while the source of this field rotated.

WA8YKN cites a DePalma test which produced 1.05 volts at 7,200 amps, but it is not stated whether this was an open circuit voltage and short-circuit (no load resistor) current. Such a high current would be expected in a short circuit fed by the interaction with an intense magnetic field rotating at high rpm. Both current and voltage can be expected to drop dramatically if measured with a suitable load on the output.

I have a copy of a data sheet on another DePalma test which shows 1.872 volts and 3,492 amperes, which they multiplied together to get an output of 6,538 watts. From the data sheet it is obvious that these are open-circuit voltage and short-circuit current readings and the computed output is therefore meaningless (again, read your *ARRL Handbook*).

With this machine all may not be as it at first seems and your efforts may be better expended on some other device.

Spoilsport... Wayne.

Warren Rudolph W4OHM. Wayne, you wondered how many still have the October 1960 37¢ issue. I have every issue from #1 to now, all in binders. I was licensed W4OHM after WWII and have held the same call ever since. I am a chartered member of the Shenandoah Valley Amateur Radio Club and obtained my first class commercial license and radar endorsement. I've also written articles which have been published in several radio magazines. I went on the Winchester police force in 1942 as a dispatcher and retired as Chief of Police in 1980 with the rank of major. I am presently active on 10 and 2 meters and am an active member of the local radio club.

Don Walters WA8FCA. Re your August editorial and keeping our 144, 220, and 420 MHz bands: Perhaps we should pitch to the potential buyers that we need at least a couple of MHz for amateur radio because it provides a "hands-on" training ground for and a place where future technicians and engineers can develop an interest in communications and electronics, something they do not get in trade schools and colleges. And regarding the sale of the spectrum, I believe that it should be leased for a period of time with the lessee paying an initial fee which is the highest bid and then a yearly lease payment based on a percentage of what they paid initially for the term of the lease. This provides a continuing revenue stream to the government for a public resource being used for commercial and private gain. Why? Because the spectrum is a national resource that should be kept publicly held while generating an initial and a continuing revenue stream for the private use of this public resource. *(1)*

I have been a ham since 1962 and have learned much from it that has provided countless hours of fun and learning, as well as provided a training ground for learning some marketable job skills that have enabled me to always find a job. But just as mainframe computer programmers are dinosaurs, nearly having outlived their usefulness, could it be that amateur radio has also outlived its usefulness? I hope not. If not then we must redefine amateur radio and what benefit to our society/country it can/does provide and then let our society and country know!

Detroit radio station WJR is now airing Art Bell's show. It's a little too late at night for me to listen to it, but I might start taping it.

When is *73* going to get an E-mail address for letters and perhaps sending manuscripts for articles? *(2)*

Amateur radio/computer swap and shops do not advertise as much as they used to. I remember the local swap and shops always being crowded and people knowing about them substantially before their date. But not these days. There is just not the same level of advertisement and promotion that there used to be. *(3)*

I have a younger brother whose past lifestyle may now be causing him medical problems. He is not HIV positive, but appears to be sick too often with viral infections and the like. I am seriously thinking of building the Bioelectrifier circuit to see if it will help him. If I do build one I will let you know if the results are promising or not. *(4)*

Keep up the *great* work, rattle those chains, keep pushing us all to do something, keep the editorials interesting and mind expanding. Perhaps it might just get enough, or at least some, people moving!

Hmm. Don, on (1), for some leaping liberal reason you are expecting corporations to actually consider the future. It doesn't happen with people, corporations or politicians. Get real. (2) Now and then I look to see what has accumulated at Design73@AOL.com. (3) Ham radio, as well as our hamfests, has sunk below the public awareness horizon. When will clubs and hamfest organizers get live PR persons? I got a hamfest announcement for a Detroit October hamfest a week after my October 73 came. (4) The bio-e won't hurt and could work wonders for your errant brother. Lemeno... Wayne. 73

NEVER SAY DIE
Continued from page 4

they're not doing either one. Instead they're passing the hat, asking for more money.

But, let's see what you come up with. How's your creativity doing?

ARRL Worried

I've been getting form letters from the League confirming that they are, at long last, starting to worry about the potential loss of ham bands which I've been gloom-and-dooming about in my editorials for a couple of years or so. Naturally they've used this as an excuse to rattle their tin cup, begging for donations. Hey guys, you're a multi-million-dollar publishing enterprise. If you need more money for something, raise the subscription price for *QST*.

As far as donating money for the protection of our frequencies is concerned, it seems to me that I remember money being set aside for that before. $100,000 comes to mind. Of course, I'm getting old now and maybe my memory isn't as good as it used to be, but I seem to remember visiting the lavish League hotel suite in Geneva's most expensive hotel during an ITU conference, and the flying over of directors for parties, all at the members' expense. And hey, wasn't there something about a League president who vacationed away a big bunch of that frequency-saving money with a girlfriend in the Caribbean? Golly, what was his name? I forget if I ever wrote about that or not.

The League letters confirm that there really is a major problem—that our UHF ham bands in particular are in serious jeopardy. As I've been saying. But, you know, I didn't see anything in the letters about what the League would do to stop the incoming tide. The demand for more and more satellite and other UHF channels is going to continue to grow exponentially, and we have the League saying they need more money. To do what, guys? What are you going to do, send baskets of money to Washington to be doled out (no pun intended) to Congress? You can't possibly match the commercial lobby money, so what will you do if we send you a big check? Party some more?

Yes, I have some good ideas on what could be done to help stem our loss of satellite bands. But first I want to know if (a) a significant number of our active hams really give a damn; and (b) what the Tech/Novice hams (now over half of us) think. Do many of them really care? In other words, if the League actually came up with a workable plan, but needed the support of the membership, would they get it? However, as far as I can see, other than begging for money, they have no plan of action.

Why should a 75m op care one whit about what happens to our 3300 MHz band? Or even 1300 MHz, for that matter? I suppose that the 20m DXers, contesters, certificate hunters, rag-chewers, the CW-forever crew, and so on couldn't care less what happens to our unused (and presumably unneeded) bands.

Until nearly 1970 the top half of 2m was a virtual desert. Heck, when *CQ* magazine proposed taking it away and making a new CB out of it there was almost no fuss. Then along came repeaters. Now we're willing to fight to hold onto our precious repeater band. But hey, why bother about our 500 MHz-wide band up at 10 GHz? Or a couple of unused 5 MHz segments of the 2300 MHz band? People in general, and hams in particular, don't think much about the future. If they did they wouldn't smoke or be grossly fat. These are denials of the future consequences of our actions.

So, guys, if we send you money, what will you really do with it? Will it be like sending money to Washington? Will it just go in the pot and be that much more to spend on current enthusiasms?

The Michigan Miracle

Maybe you can remember not long ago when Michigan had one of the highest unemployment rates in the country. When the state was a national disaster, verging on bankruptcy. While I'm not a fan of all the Republican party planks, the

Continued on page 22

QRX . . .

FCC Stops Renewal Reminders

As of October 22, the FCC has ceased issuing Form 610R license expiration notices—reminders to hams that their tickets are going to expire within the next 90 days and that they must request renewal. The last notices sent by FCC covered into February 1997, although the specific date was not available. A Form 610R for renewal must be returned by mail only to the FCC.

The demise of the Form 610R means that hams—whose licenses are issued for 10-year periods—must take the initiative to remember the renewal date of their tickets and file a Form 610. AN FCC spokesman in Gettysburg says the Commission hopes to have a Form 610 available soon on the World Wide Web to permit on-line renewals.

From *The Repeater*, official newsletter of the Alamo Area Radio Organization, San Antonio TX.

Have You Applied for a Vanity Callsign?

The FCC will not start making any grants for first-day filers until all day-one applications have been entered into the FCC's computer. Then applications will be processed randomly from among those in the first-day pool.

The number of hams taking advantage of Gate 2 has been less than anticipated. As of September 25, 1996, the FCC had received 5,297 Gate 2 applications. First-day vanity filers totaled 4,527, a number that even surprised the FCC, which had been expecting a larger flood of Gate 2 filings. The FCC said 4,188 paper applications and 339 electronic applications were received the first day. Another 770 applications, mostly paper, had showed up by Wednesday, September 25. Slightly more than 7% of the applicants used the FCC's newly inaugurated electronic filing system.

Among the major headaches for the folks in Gettysburg are applications that contain illegible information. FCC personnel have been instructed to skip over requested callsigns they cannot decipher. Also, some electronic filers have been sending their payments to the wrong Post Office box in Pittsburgh and using the FCC Form 159 designed for use by those filing on paper. The FCC said that contrary to instructions on the electronic application form, electronic filers should not forward a copy of their license to the FCC by mail. FCC personnel have no way to match up licenses with applications, and they don't need the license copy to process the application.

The FCC said that some applicants apparently have had second thoughts about changing their callsigns and have contacted the FCC to pull their Gate 2 paperwork. The FCC says that cannot be done. Those issued a vanity callsign who decide they like their old callsign better will have to pay another $30 and reapply under Gate 1.

If the FCC is unable to grant any of your vanity callsign requests, your application will be dismissed, and the FCC will notify you to that effect. But the Commission will not return your $30 until you request a refund in writing.

Excerpted from *Harmonics*, October 1996, official newsletter of the South Jersey Radio Association.

Alaskan Hams Sizzle During Forest Fires

It's a sign of how times have changed that ham radio was not even considered as a communications link by Emergency Management, because of the wide use of cellular phones, during the recent disastrous forest fires in the Big Lake area of Alaska. The Amateur Radio Emergency Service Net wasn't part of the scenario. Hams were used for some of the communications during the Miller's Reach fire, but only after going to the Emergency Management people to make their availability known.

Communications ground to a halt when telephone lines and cellular phone frequencies were so overloaded they jammed. So many people were trying to get in touch with loved ones in fire-threatened Southcentral Alaska that the local cellular companies had radio stations begging people not to use their cellular phones; landlines were taking a minute or more just to come up with a dial tone.

Hams to the rescue! "My XYL, who is not a ham, and rarely pays attention to what I am listening to or doing on the radio, was totally impressed with the number of hams who suddenly came from nowhere to be just about everywhere," wrote Bob NL7QP, editor of *Mara News*. "We must continually make our communities aware of the importance of amateur radio during a disaster. We need to make better use of the bands we have, and encourage that use so we can retain those bands."

Condensed from an editorial in *Mara News*, the official newsletter of the Matanuska Amateur Radio Association, Wasilla, AK.

The Boy and the Frog

A boy was crossing a road one day when a frog called out to him, "Kiss me and I'll turn into a beautiful princess."

The boy picked up the frog and put it in his pocket.

The frog said, "If you kiss me, I'll turn into a beautiful princess, and I'll stay with you for a week."

The boy took out the frog, smiled at it, and returned it to the pocket.

The frog cried, "If you kiss me and turn me back into a princess, I'll stay with you forever, and do anything you want!"

Again, the boy took out the frog, smiled at it, and put it back. After a long pause, the frog asked, "What is it? Why won't you kiss me?"

The boy answered, "Look, I'm an amateur radio operator. I don't have time for girlfriends, but a talking frog—hey, that's cool!"

Lifted from *ARNS Bulletin,* October 1996.

Learn More About QRP

Founded in January 1994, CQC brings amateurs interested in low power together, and endeavors to expand their interests and give them a forum in which to discuss problems and accomplishments. Besides its bimonthly meeting for local members, CQC publishes a bimonthly newsletter, *The Low Down. The Low Down* contains technical articles, product reviews, member news, upcoming activities, and an activities calendar. CQC membership is open to anyone interested in QRP.

In eastern Colorado try the Colorado QRP Club net every Monday evening at 8 PM on the 147.225 repeater in Golden, and on the 145.160 machine in Colorado Springs. They also use 146.445 simplex. On HF, call "CQ CQC" at 8 PM on 3710 kHz (the national 80 meter QRP frequency).

For an application form, send an SASE to Mark Meyer, 14153 West First Drive, Golden CO 80401. Membership dues are $10 a year, including a subscription to *The Low Down.*

Excerpted from *ARNS Bulletin.* October 1996. 73

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

RS-L SERIES

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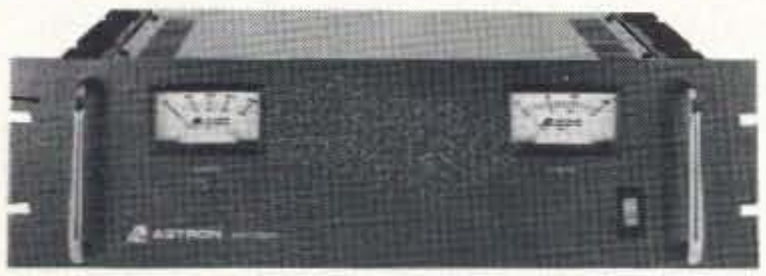
MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-4L	3	4	3½ × 6⅛ × 7¼	6
RS-5L	4	5	3½ × 6⅛ × 7¼	7

RM SERIES



MODEL RM-35M

• 19" RACK MOUNT POWER SUPPLIES

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

RS-A SERIES

MODEL RS-7A

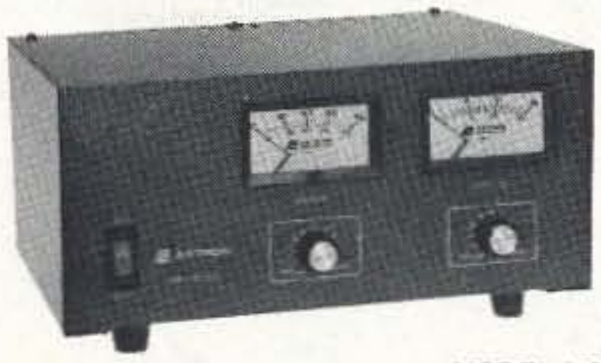
MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-3A		•	2.5	3	3 × 4¾ × 5¾	4
RS-4A	•	•	3	4	3¾ × 6½ × 9	5
RS-5A		•	4	5	3½ × 6⅛ × 7¼	7
RS-7A	•	•	5	7	3¾ × 6½ × 9	9
RS-10A	•	•	7.5	10	4 × 7½ × 10¾	11
RS-12A	•	•	9	12	4½ × 8 × 9	13
RS-12B		•	9	12	4 ×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

RS-M SERIES

MODEL RS-35M

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

VS-M AND VRM-M SERIES



MODEL VS-35M

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

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

RS-S SERIES

MODEL RS-12S

• Built in speaker

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

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

CIRCLE 16 ON READER SERVICE CARD

The ScopeMixer

An adventure in ham radio systems integration.

Dave Evison N6GKC
153 Park Avenue
Palo Alto CA 94306

How would you like to adjust your antenna tuner while your rig is terminated in a dummy load? (Your final amplifier and fellow hams sure would!) Or how about monitoring your SSB signal and checking the peak envelope voltage for clipping and crossover distortion? (Wow, talk about good operating practice!) And wouldn't it be great to check the rise and decay time of your CW envelope and be able to *see* those chirps or clicks? Or how about being able to detect and measure harmonic radiation and other spurious products (just like the big guys)? Well, even if you're sitting on a very thin bill-fold, you can manage all of this—and more—with a ScopeMixer System. While it's primitive by commercial standards, it can provide you with a versatile measurement system at very low cost. The ScopeMixer will empower you (without spectrum analyzers and other professional laboratory instruments) to produce superior, well-tested designs.

The ScopeMixer System is an example of ham radio systems integration: a couple of simple circuits containing only one active component (a 10-cent transistor), an inexpensive 40-year-old kit oscilloscope ($15 at any ham flea market), a secondhand MFJ SWR Analyzer used as a local oscillator (about $40—but you may already have one of these handy little devices). Now that's real ham engineering!

The ScopeMixer is a good example of recycling older technology that is rarely used today: the wave analyzer. The wave analyzer has been supplanted by the spectrum analyzer in most commercial laboratories, but it's still simple, inexpensive, and provides an impressive measurement capability.

The design criteria for the ScopeMixer were to keep the cost and parts count low and use only readily available parts. The result is a straightforward bipolar mixer using a 2N2222A transistor (**Fig. 1**). The RF is applied to the base, the local oscillator to the emitter, and the IF taken from the collector—it really couldn't be simpler—and with 2N2222 transistors selling for less than 10 cents, it couldn't be much cheaper. There is no IF transformer. Instead, an old broadcast "ferrite loopstick" is used. The unit draws less than 10 mA and requires only a 3 volt supply (a couple of AA batteries in series).

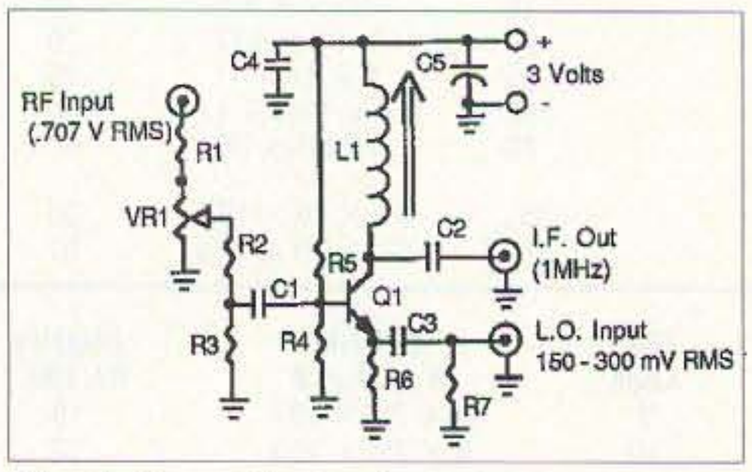


Fig. 1. ScopeMixer schematic.

How it works

The ScopeMixer is a simple application of a heterodyne mixer. It converts the RF input to a 1 MHz intermediate frequency, which is well within the bandpass of the ancient oscilloscopes. While any frequency between about 550 kHz and 1600 kHz can be used for the IF, 1 MHz simplifies setting the local oscillator when measuring harmonic and other spurious products.

The ScopeMixer was designed to use an MFJ (or Autek) SWR Analyzer as a local oscillator working either 1 MHz above or below the RF. Harmonics and other spurious emissions are measured by establishing an IF reference level at the carrier frequency, then tuning the local oscillator up or down from the carrier frequency and observing signals that develop an IF of 1 MHz. For example, if a reference carrier of 7 MHz having a second harmonic component is connected to the ScopeMixer, it will produce an IF of 1 MHz at 6 MHz and 8 MHz (reference frequency) and at 13 MHz and 15 MHz (the second harmonic). The amplitude of the harmonic responses when compared to the amplitude of the reference carrier will determine their relationship in decibels (dB).

To understand the input circuit refer to **Fig. 1**. The values of R1 through R4 were calculated to deliver 25 millivolts rms to the base of the 2N2222 when 707 millivolts (.707 volt) rms is applied at the RF input. While the 2N2222 in this configuration will work with levels significantly greater than 25 mV at its base, it becomes quite nonlinear. Maintaining 22

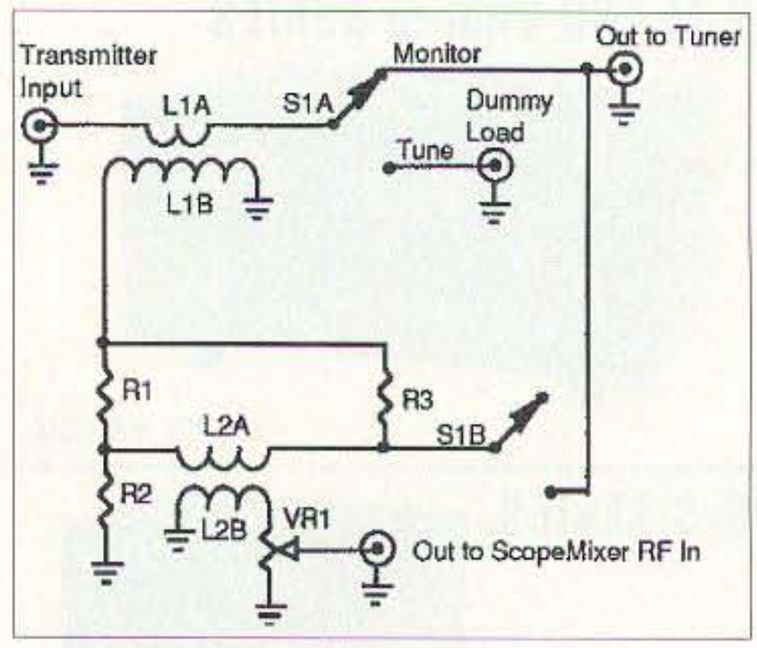


Fig. 2. ScopeMixer Range/SWR Unit.

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

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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.

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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
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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.

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"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."

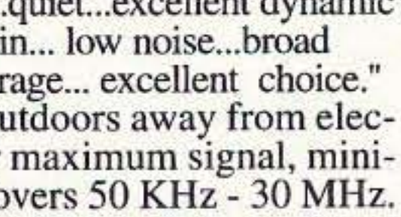
Mount it outdoors away from electrical noise for maximum signal, minimum noise. Covers 50 KHz - 30 MHz.

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.

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$39.95 MFJ-1701

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MFJ-1704, $59.95. 4 position cavity switch with lightning/surge protection. Center ground. 2.5 KW PEP, 1 KW CW. 50 dB isolation at 500 MHz. 50 ohm. 6¼x4¼x1¼ in. *MFJ-1704N, $69.95, N connectors.*

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MFJ-260C, $29.95. VHF/HF. Air cooled, non-inductive 50 ohm resistor. SO-239 connector. 300 Watts for 30 seconds, derating curve. SWR less than 1.3:1 to 30 MHz, 1.5:1 to 650 MHz. 2½x2½x7 in. *MFJ-260CN, $34.95, N connectors.*

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Suppress TVI, RFI, telephone and other interference by reducing unwanted harmonics going to your antenna. 9 poles, MFJ's exclusive *Teflon® Dielectric Technology™* capacitors, hi-Q inductors, ground plane shielding, RF tight cabinet gives excellent TVI/ RFI protection. Full legal power 1.8-30 MHz. Mounting tabs.

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Animate weather maps. Display 10 global pictures simultaneously. Zoom any part of picture or map. Manager lists over 900 FAX stations. Automatic picture capture and save.

MFJ Iambic Paddles

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The best of all CW worlds --a compact MFJ Keyer that fits right on the Bencher iambic paddle!

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Use your rig's 12 VDC power supply to power two HF/VHF rigs and six or more accessories with this MFJ *high current* multiple DC outlet.

2 pairs of 30 amp 5-way binding posts separately fused for rigs. 6 switched, fused pairs for accessories. DC voltmeter, "on" LED, RF bypassed, 6 ft. of 8 guage power cable. See *free* MFJ catalog for more DC outlets.

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to 28 mV at the base will enable the ScopeMixer to display levels as low as -30 dB (referenced to the input level).

The pot will allow fine-tuning to the desired 25 mV when levels slightly greater than 0.707 V rms are applied to the ScopeMixer RF Input. I recommend that the pot be kept full-on and that the input to the mixer be trimmed using the range control pot on the Range/SWR Unit.

The Range/SWR Unit samples the RF source to be monitored. It accommodates RF levels from 180 mW to over 100 W. It also includes an antenna bridge for performing "stealth" antenna tuner adjustments. In **Fig. 2,** you see that the RF signal to be monitored/measured is sampled inductively by L1A/L1B. With S1 in the tune position, the RF source is terminated in an external dummy load, and a small sample of the RF energy is used for antenna bridge excitation. R1, R2, R3, and the antenna system are configured as a simple antenna bridge—and the ScopeMixer is used as the detector. Using the oscilloscope readout of the ScopeMixer provides great sensitivity, smoothness and resolution. L2A/L2B transfer the signal developed by the unbalanced condition of the bridge to VR1 which provides level control to the ScopeMixer. VR1 functions as the RF range control. With S1 in the monitor position, the unbalanced bridge signal is fed to the ScopeMixer through L2A/B and VR1. This signal is used as both the calibration level for SWR measurements and reference level for attenuation measurements.

ScopeMixer construction

I'm a great fan of Wes Hayward and his Ugly Construction, and my ScopeMixer is an excellent candidate. If you're not familiar with ugly construction, check the *ARRL Handbook* (it's actually listed in the index of some issues under "Ugly"). The accompanying photo shows a prototype ScopeMixer mounted in a small metal box (note that ugly construction was retained).

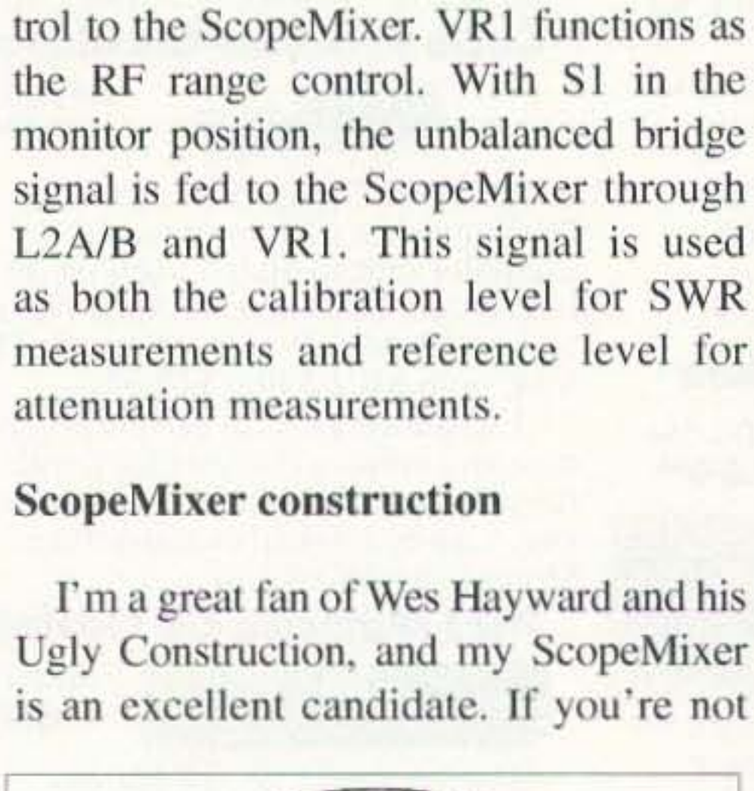

Fig. 3. Calibration overlay grid.

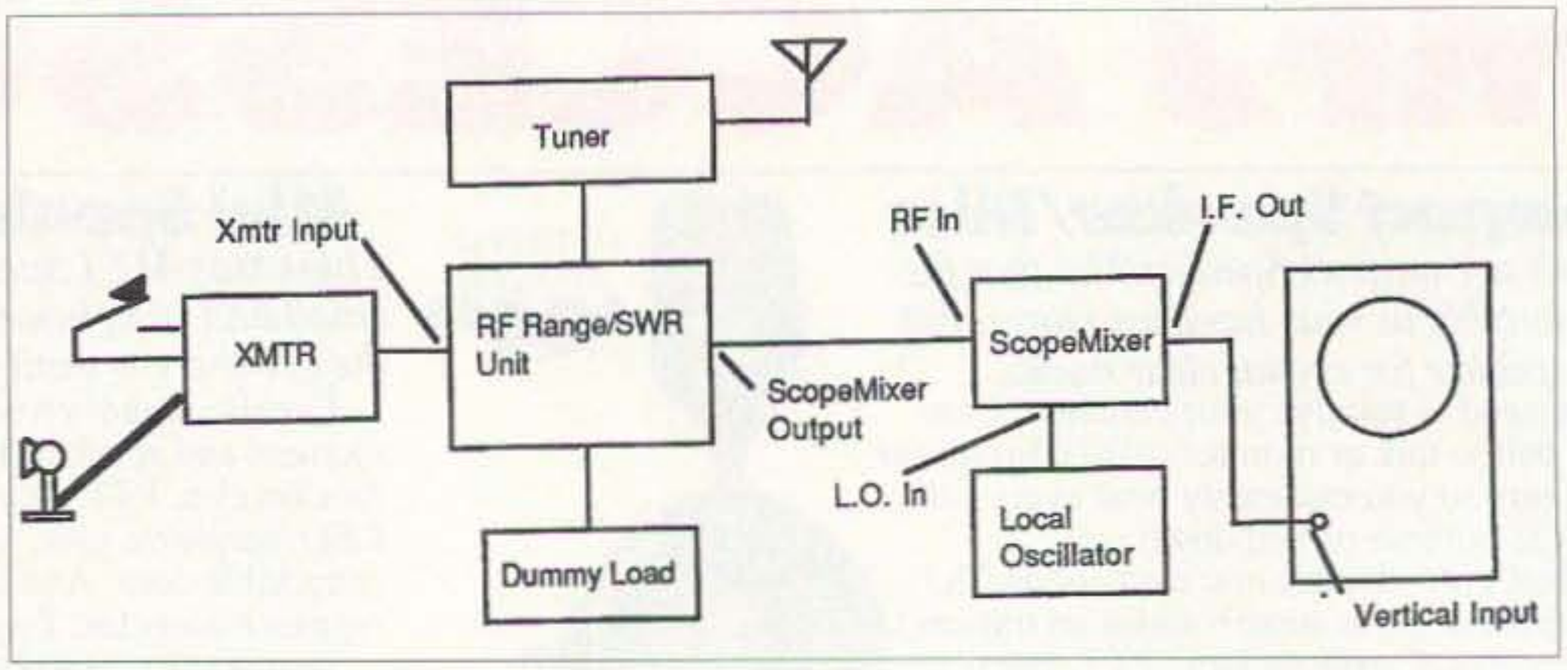

Fig. 4. ScopeMixer Range/SWR Unit system setup.

Range/SWR Unit construction

L1 and L2 are RF transformers made by winding secondaries over off-the-shelf Radio Shack™ 100 µH RF chokes (RS #273-102). Before winding the secondary onto L2 (30 turns #26 enameled), it's a good idea to put a layer of masking tape over the windings of the choke. The primary (L1A) is four turns of stranded, insulated wire (about #20).

The Range/SWR Unit should be enclosed in a suitable chassis box for both shielding and prevention of RF burns. Use a good quality wafer-type switch (do not use a toggle-type switch) and ensure the switch is a break-before-make type.

Making a calibration overlay grid

A pattern for a calibration overlay grid is shown in **Fig. 3.** Using this overlay grid will simplify measurements and increase accuracy.

Make an overlay from the magazine pattern by copying the image onto an overhead transparency sheet. Then cut the overlay out and place it on the face of the cathode ray tube. Align the center horizontal line of the overlay grid with the oscilloscope trace.

Measurements

The ScopeMixer will allow you to make attenuation measurements in decibels (dB). Since dB measurements are relative measurements (compared to an identified reference level) you will be able to rely upon the basic accuracy of the oscilloscope's vertical deflection linearity—which in the case of the older kit scopes works out to be about 5%. Overall accuracy is cumulative and factors such as local oscillator leveling, gain-bandwidth product of the 2N2222, noise, etc., all contribute. But, after all, the ScopeMixer is for ham applications, not rocket science.

To minimize identified noise and gain problems, measurements should be performed on the X1 range and utilize the large CRT deflection (4 to 5 inches). In this manner, deflection accuracy will be limited to the vertical deflection linearity and the gain control will be closer to halfway on.

Using the scope attenuator to provide 20 dB gain (for example, establishing a reference level on X10, then setting the scope to X1 for measuring attenuation—equivalent to 20 dB gain) is not recommended because noise components increase dramatically as the variable gain control is set at or near maximum. A second reason for not using the scope attenuator in the measurement scheme is that above 1 MHz the scope's internal attenuator compensation adjustments greatly influence the actual gain/attenuation between steps, and among the three kit scopes used for this project, all three had severely maladjusted attenuator compensation.

Oscilloscopes with wider bandpass characteristics *do not* work well with the ScopeMixer system as they are sensitive to unwanted signals appearing in the IF output (local oscillator, RF fundamental, etc.). If a wideband scope is used, an IF transformer with a tuned primary and secondary will be required. The low cost of the older oscilloscopes, and their performance

in this application, justify their dedication to the system.

For amateur applications, measurements are generally made while performing adjustments for peaking or nulling. For example, you've just finished a QRP rig and you want to check for, and if necessary attenuate, harmonics and other spurious products. In this case your concern is not the accuracy of the harmonic level, but rather to be able to detect it and reduce it as much as possible. In this case the ScopeMixer will be able to display the spurious signal. You peak the display using the local oscillator, and then make adjustments to the rig, or substitute new components in the circuit, to reduce the level of the spurious signal.

There is nothing particularly critical about setting up the system. Use high quality RG 58U coax cable and BNC connectors, and ensure that excessive RF is not applied to the Range/SWR Unit. The power level should not exceed 100 watts. Interconnect the equip ment as shown in **Fig. 4**, and set the equipment as specified under "Equipment Setup."

In adjusting the loopstick, start with the slug in about halfway. Apply the local oscillator frequency (approximately 1 MHz above or below the RF input signal); set the pot on the ScopeMixer fully clockwise and adjust the Range/SWR Unit pot to the level of RF to be applied.

Key the transmitter and apply a CW signal to the system. Fine-tune the local oscillator to produce maximum vertical deflection and stabilize the display. Adjust the focus control for best trace. Then adjust the variable gain and vertical position controls to set the waveform peaks to the reference levels (**Fig. 6**).

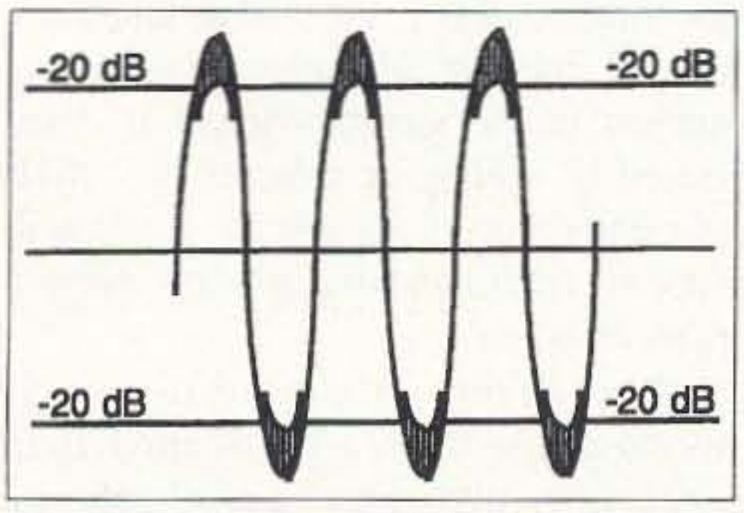

Fig. 5. Although the peak-to-peak amplitude of this waveform measures greater than -20 dB, "subtracting the fuzz" results in a more accurate measurement of -20 dB.

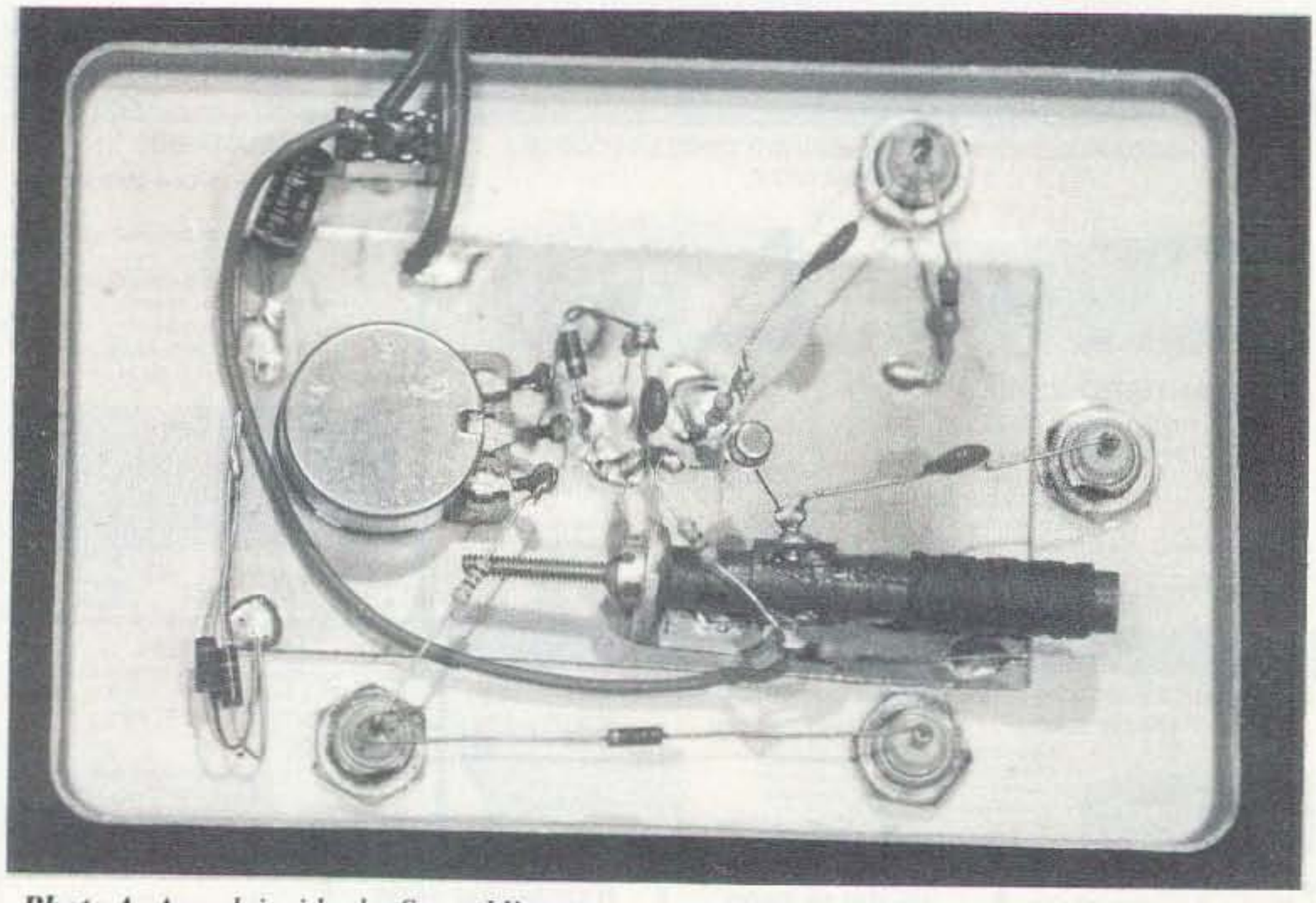

Photo A. *A peek inside the ScopeMixer.*

Note the frequency of the local oscillator and compare it to the frequency of the applied RF. If the frequencies are separated by more than 1 MHz, adjust the slug further into the coil; if separated by less than 1 MHz, adjust the slug out of the coil. Repeat this process until a 1 MHz ±10% IF is achieved.

To check the SWR function of the Range Unit and adjust the tuner for minimum SWR, interconnect the equipment as shown in **Fig. 4**. Set the Range/SWR Unit to the tune position, then remove the antenna tuner from the Range/SWR Unit. Key the transmitter and apply a CW signal. Fine-tune the local oscillator, and peak and synchronize the IF display. Set the waveform peaks at the reference levels (**Fig. 6**). Remove RF power.

Connect a 50Ω non-inductive resistor to the tuner port, then key the transmitter. The peak-to-peak display should be approximately 1/4 inch or less (**Fig. 8**). Remember to subtract the fuzz. Remove RF power from the system. Remove the 50Ω resistor and reconnect the tuner and antenna system. Key the transmitter and adjust the tuner for minimum deflection.

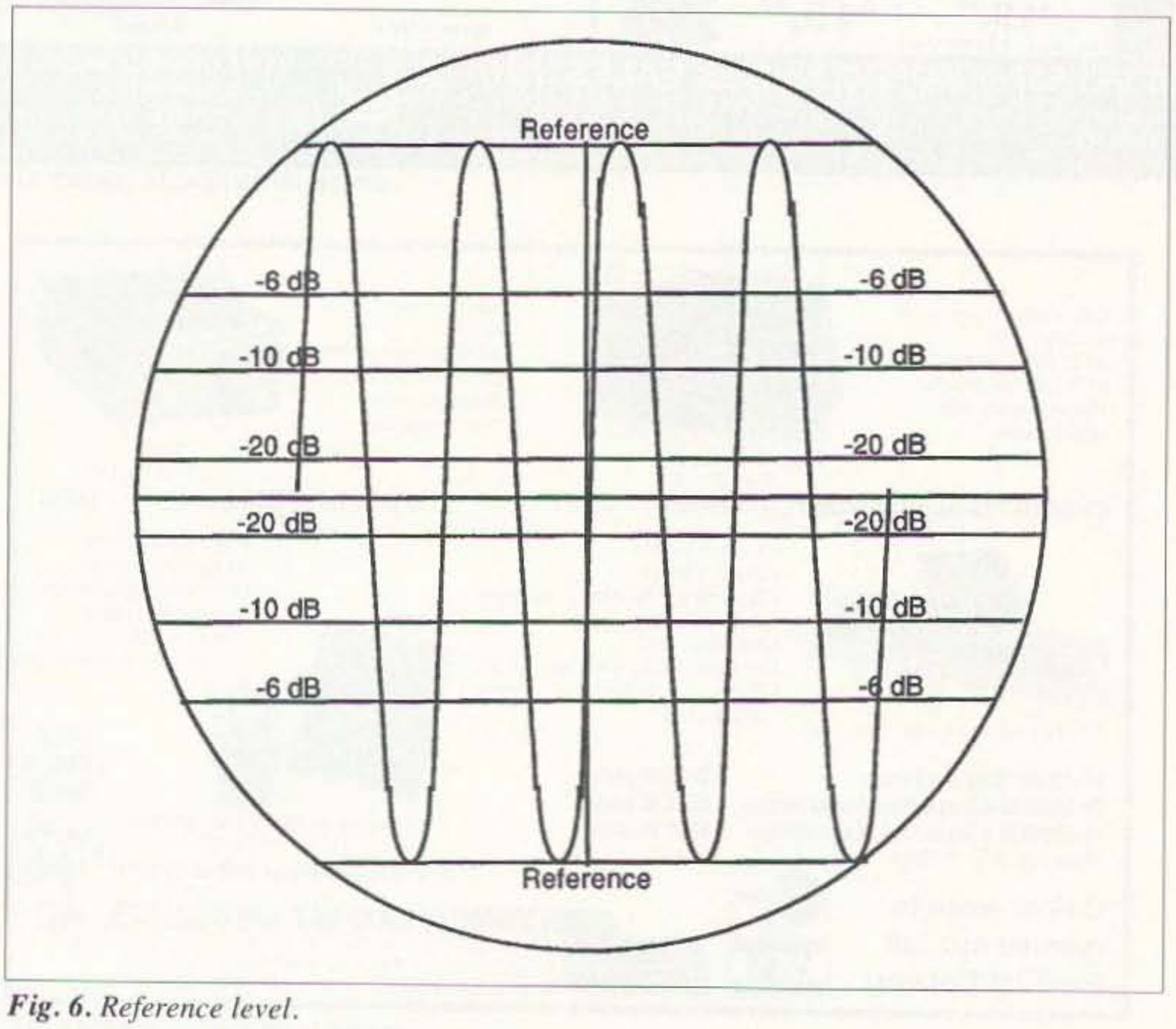

Fig. 6. *Reference level.*

Equipment setup

Oscilloscope front panel control settings:
- Vertical attenuator: X1
- Variable gain: 40
- Horizontal sweep: 100 kHz
- Horizontal vernier: 80
- Horizontal gain: 20
- Sync selector: Int +
- Intensity and focus for best trace.

Local oscillator (LO) (MFJ or Autek SWR Analyzer) settings:
- Frequency: 1 MHz below the RF source to be measured.

ScopeMixer settings:
- RF input pot fully clockwise, power switch on.

RF range/SWR unit settings:
- Set tune-monitor switch to monitor
- Set range pot according to the amount of power to be sampled. If possible limit the RF level for initial settings from 5 to 10 watts.

Measuring harmonics and other spurious products

First, establish a reference level at the fundamental carrier frequency being measured. Once set, the vertical gain control should not be readjusted until all measurements have been made and noted. The local oscillator is then adjusted above and below the carrier while watching the scope for intermediate frequency responses. Harmonics, of course, will be multiples of the carrier frequency, but other spurious responses will not. Once a response is detected, peak the signal using the local oscillator, and read its amplitude (in dB) from the calibration grid. The frequency of the spurious signal is determined by adding or subtracting 1 MHz (depending upon whether the local oscillator is operating above or below the spurious response).

Note: Below -20 dB, noise and the width of the trace significantly limit accuracy. With experience, you can improve such measurements by "subtracting the fuzz" from the measurement (**Fig. 5**).

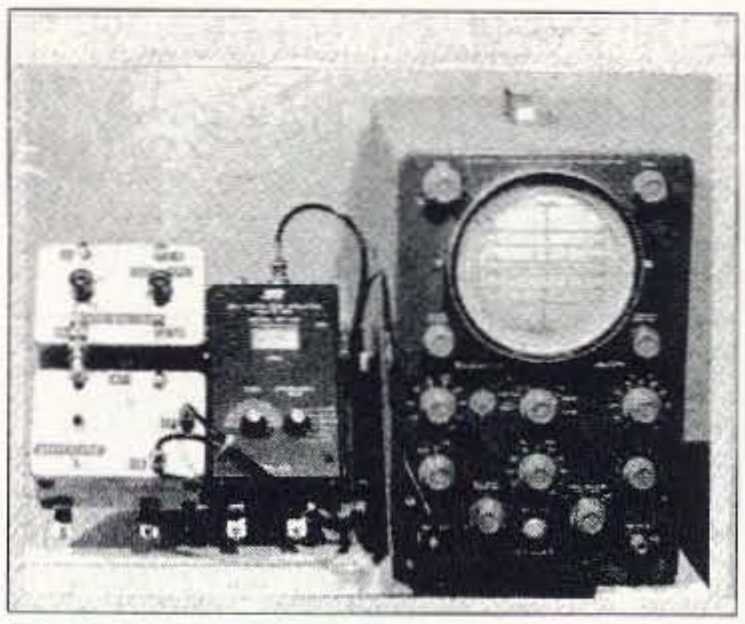

Photo B. ScopeMixer system with scope...

Monitoring modulation

Monitoring modulation is limited to observing the modulation envelope, but a great deal of information can be gathered in this manner—single sideband peak envelope voltage clipping and crossover distortion can be observed. Refer to the *ARRL Handbook* for more information on these parameters.

Examining keyed carrier waveforms

With the transmitter in the CW mode, key the transmitter by sending a series of evenly spaced dits and adjust the horizontal vernier to observe the keyed envelope.

Measuring SWR

Remove the antenna tuner from the Range/SWR Unit, then set the RF Range/SWR Unit to the tune position. With the transmitter in the CW mode, key the transmitter and fine-tune the local oscillator to peak the oscilloscope display. If the rig is SSB-only, set it to tune. Adjust the Range pot until the peak-to-peak signal is set to the reference levels on the calibration overlay grid. The oscilloscope vertical position control may

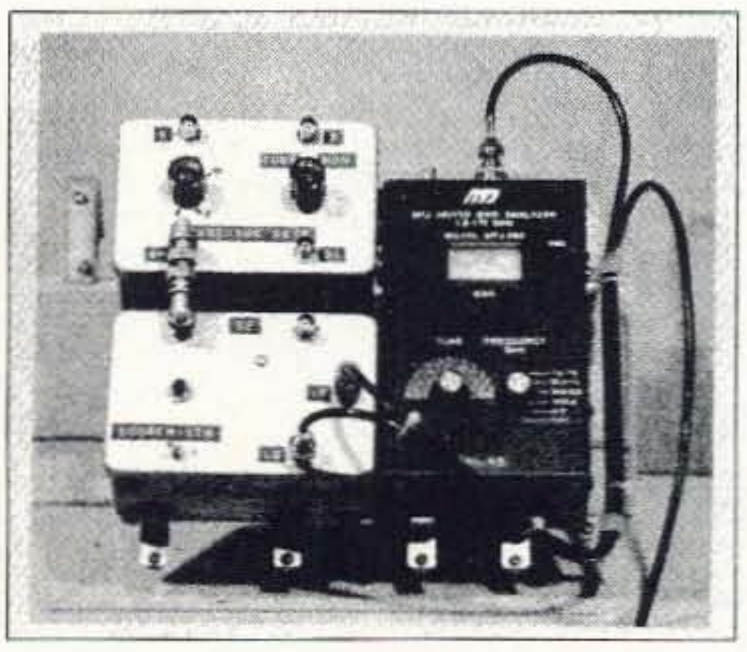

Photo C. ... and without the scope.

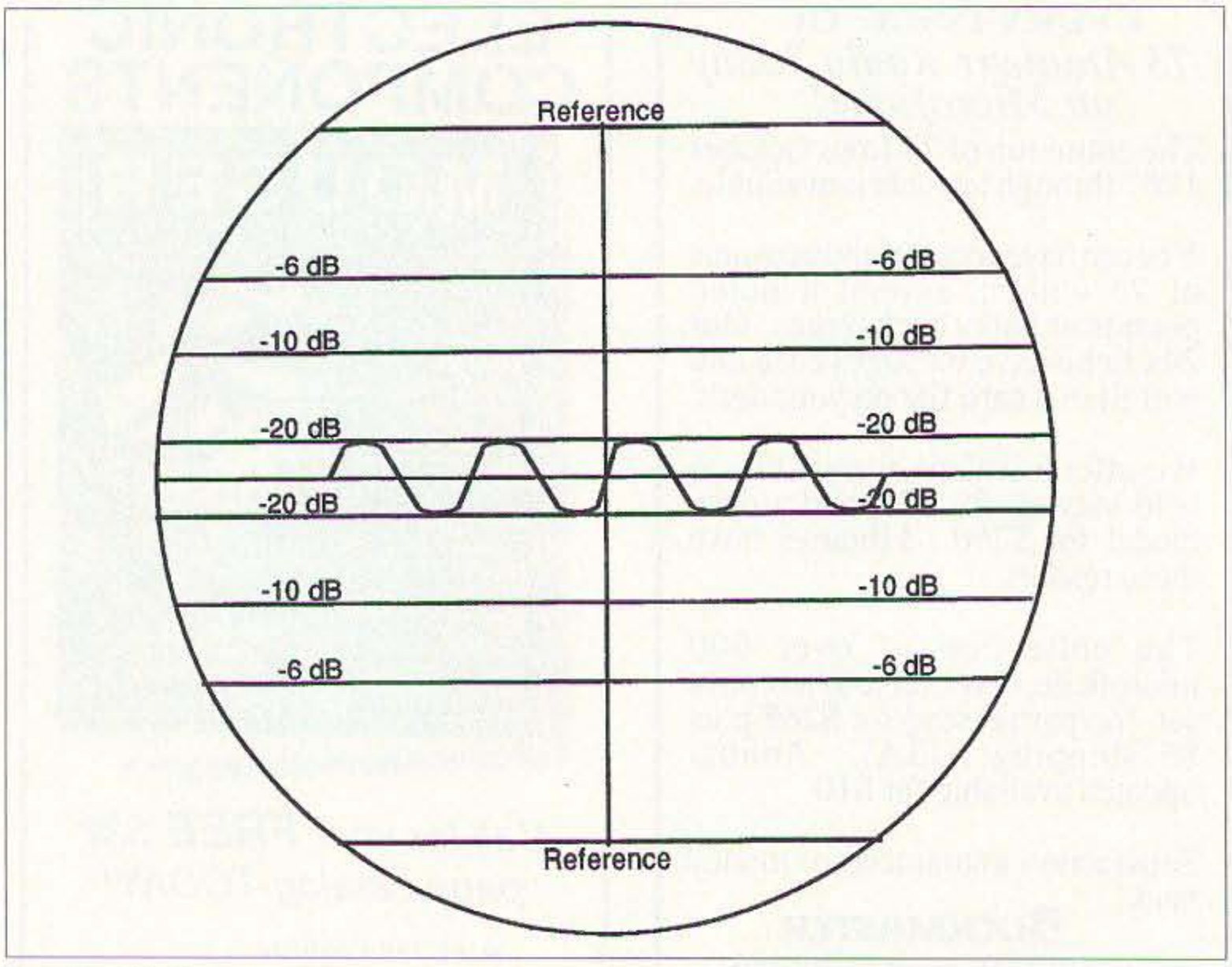

Fig. 7. -20 dB.

also require adjustment to position the waveform on the calibration grid (**Fig. 6**). Once set, remove RF power and connect a 50Ω non-inductive resistor to the tuner port. Key the transmitter. The peak-to-peak display should be approximately 1/4 inch or less (**Fig. 8**). Keep in mind that you need to subtract the fuzz (**Fig. 5**). Remove RF power from the system. Remove the 50Ω resistor and reconnect the tuner and antenna system. Key transmitter and adjust antenna tuner for minimum peak-to-peak display on the oscilloscope. A matched condition will result in a peak-to-peak display of approximately 1/4 inch (Fig. **8**). 73

ScopeMixer Parts List	
R1	75 Ω
R2	910 Ω
R3, R7	51 Ω
R4, R6	1 k
R5	4.7 k
VR1	200 Ω Linear Composition
C1, C2, C3	.001 µF
C4	0.1 µF
C5	10 µF
L1	Broadcast Ferrite Loopstick*
*Antique Electronic Supply Cat. #PC-70-A (or equivalent)	

Range/SWR Unit Parts List	
R1, R2, R3	51 Ω 1/2 W
VR1	600 Ω Linear Composition
S1	DPDT Wafer Switch (break-before-make)
L1B, L2A	100 µF RFC (Radio Shack 273-102)
L1A	4 turns #22 insulated wound over L1B
L2B	30 turns #26 enamel covered wound over L2A (cover L2A with a layer of masking tape before winding L2B)

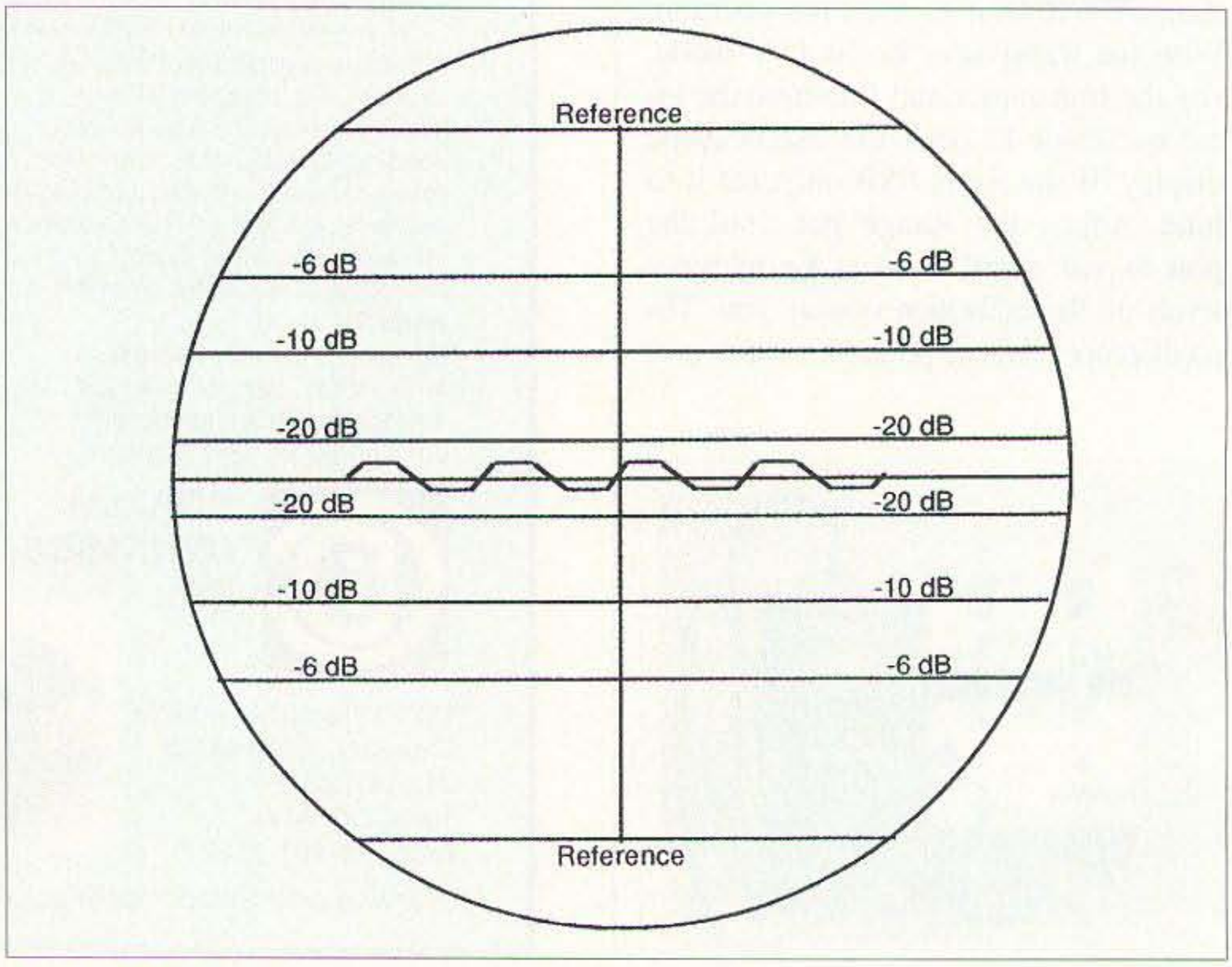

Fig. 8. SWR null.

A Flexible Keyer

A weekend of investment; a lifetime of ease.

Parker R. Cope W2GOM/7
8040 E. Tranquil Blvd.
Prescott Valley AZ 86314

An inexpensive flexible keyer can be built with two 4000 series CMOS ICs to generate independently adjustable self-completing dots and dashes. The keyer can drive an inexpensive MOSFET cathode switch that will key anything from a solid-state QRP rig to a kilowatt tube final. The keyer includes an optional sidetone generator that can be used as a code practice oscillator while you learn to use the keyer.

The keyer described generates a keying waveform whose weight can be adjusted to suit your preference. This weekend project uses no critical parts or unique ICs, so, depending on the state of your junk box, construction costs can be low. Equations are given to allow modification of the design to fit the parts you have.

The keyer generates a keying waveform that drives a MOSFET transistor to cathode-key a tube type transmitter or switch a positive voltage to ground to key a solid-state exciter. Some solid-state transmitters switch a positive voltage in the exciter to ground for keying and refer to it as "cathode keying." That is likely a misnomer because the only cathodes are probably cathodes of semiconductor diodes. Just so we can all sing from the same hymnal, I will refer to switching a positive voltage to ground as "cathode keying."

The keying speed is variable from less than five to about 30 words per minute with a single front panel control. Equations are given for selecting parts to allow higher keying speeds. The weight is adjusted internally and is maintained for all speeds. A front panel toggle switch is provided to produce continuous "key-down" for transmitter tuning. The optional sidetone generator can provide about 100 mW of audio to drive low impedance phones or a speaker. This power is adequate for most situations.

The functional block diagram in **Fig. 1** shows how three monostable multivi-brator pulse generators and logic elements can be used to produce the keying waveforms. One multivibrator generates the dash period, the second generates the space period, and the third generates the dot period. The space-to-dash ratio and dot-to-dash ratio of the keyer are adjusted independently. The selected ratio of dot/dash/space is maintained for keying speeds from 5 WPM to 30 WPM. The monostable

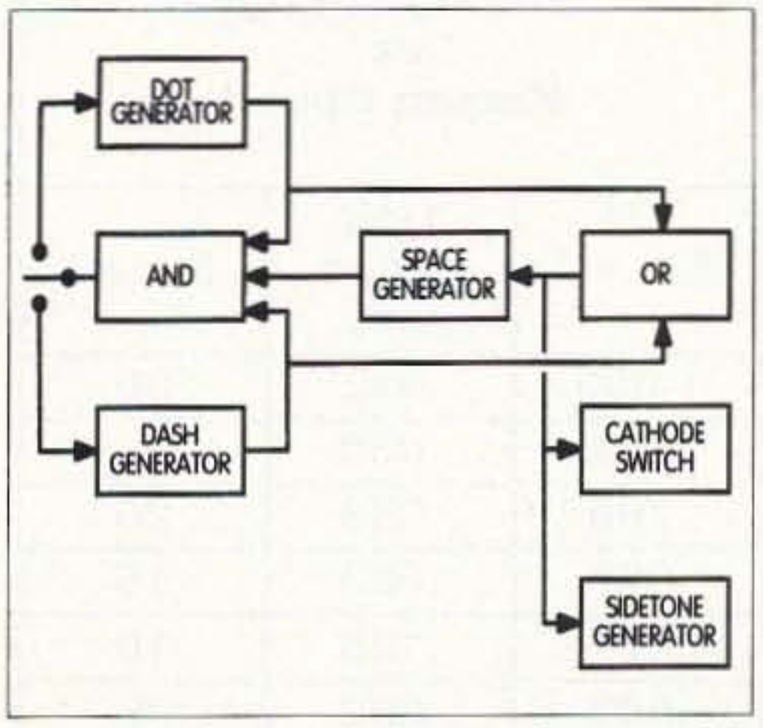

***Fig. 1.** The keyer is built around monostable multivibrators and combinatorial logic.*

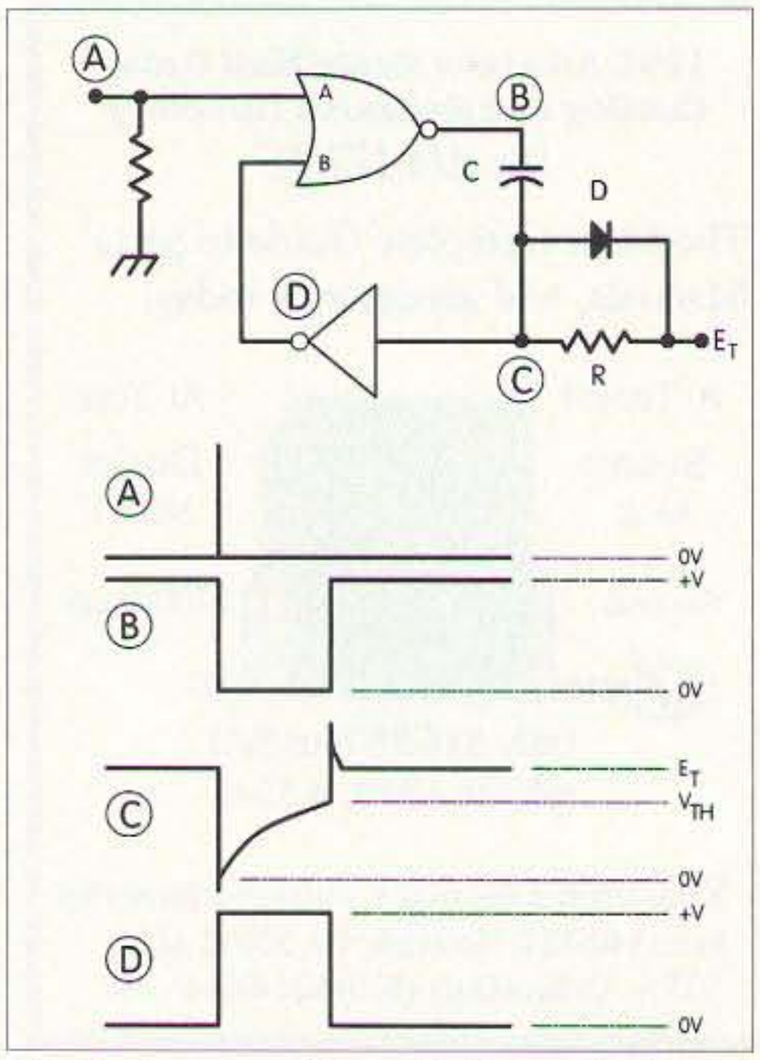

Fig. 2. A monostable multivibrator built with CMOS has these critical waveforms.

multivibrators used are non-retriggerable. Once a pulse is initiated, subsequent triggers during the period of the pulse have no effect on the pulse duration.

A typical monostable multivibrator is shown in **Fig. 2**. The timed period is determined by R x C, V_{TH} (a characteristic of the IC), and E_T, the timing voltage controlled by the "Speed Control." The threshold, V_{TH}, of 4000 series CMOS is between $0.45V_{DD}$ and $0.55V_{DD}$. V_{DD} is the supply voltage +V. While the match of thresholds from one chip to another may vary 20%, the match of units within an IC is very close. Therefore, the inverters are all within one IC to ensure tracking of the periods as E_T is varied. Each of the multivibrators uses one section of the CD4009 hex inverter. The ICs can be either AE or BE versions; use whatever is available.

In a NOR gate, the output is "low" (zero volts) when either input "A" or "B" is more positive than V_{TH}, and is "high" (+V) when both inputs are more negative than V_{TH}. In **Fig. 2**, the resistor at the "A" input of the NOR gate holds that input "low" until a positive trigger drives it above V_{TH}. The "B" input which is connected to the output of the inverter is "low" because the positive voltage, E_T, at the inverter's input is above V_{TH}. When a positive pulse is applied to the "A" input of the NOR, the output goes "low." This negative transition is coupled through C to the input of the inverter and drives the inverter's input below V_{TH}. The inverter's output goes "high" and holds the "B" input of the NOR gate high until C, charging through R toward E_T, reaches V_{TH}. While the inverter's output is "high," the "B" input to the NOR gate holds the output low and triggers to the "A" input have no effect. The stable state of the multivibrator is both inputs of the NOR gate "low" and the input of the inverter held "high." The unstable state, or timing state, has the output of the NOR gate low, C charging toward E_T, and the inverter output high.

The transition of the NOR's output from +V to zero will try to drive the input of the inverter negative (below ground) when E_T is less than +V. The IC's input protection circuit limits the negative voltage to one diode drop below ground. On the positive transition of the NOR's output, the positive swing on the inverter's input is clamped to E_T by the diode across R.

The voltage on the input of the inverter rises toward E_T at a rate controlled by R and C. The instantaneous voltage on the gate is:

$$V_c = E_T \times (1 - e^{-t/RC})$$

This can be rewritten in terms of t and RC:

$$-t/RC = \mathrm{Ln}(1-V_c/E_T)$$
$$t = -RC \times \mathrm{Ln}(1-V_c/E_T)$$

where t = time in seconds
R = ohms
C = farads
Ln = the natural logarithm
V_c = the instantaneous voltage across the capacitor
E_T = the speed control voltage

When the gate voltage V_c reaches V_{TH}, the output of the inverter switches. Since each pulse generator's period ends when $V_c = V_{TH} = 0.5V_{DD}$, the time of the pulse can be written as:

$$t = -RC \times \mathrm{Ln}(1-V_{TH}/E_ET) = -RC \times \mathrm{Ln}(1-0.5V_{DD}/E_T)$$
$$t = RC \times 0.69 \text{ when } E_T \text{ equals } V_{DD}$$

When all three pulse generators have the same V_{TH} and E_T, the pulse generators maintain their ratios as E_T is varied. The minimum pulse period (highest keying speed) occurs when E_T is +V and the slowest speed occurs when E_T is near V_{TH}.

The duration of the unit timing period, which is equal to the time of a dot or space, is determined as follows: The standard word "PARIS," requires 48 unit periods (dot periods). Therefore, at 30 words per minute (half a word per second) there are 24 unit periods per second and the duration of a unit period is about 0.042 seconds. To produce a dot period of 0.042 seconds requires an RC of 0.029 seconds (0.042 x 0.69). A standard 3:1 dash period is 0.126 seconds and the RC is 0.087 seconds. The dot and space are varied with respect to the dash to change the keying weight. The value of E_T/+V for various keying speeds is given in **Table 1**.

The keyer shown in **Fig. 3a** uses two CMOS ICs: a CD4001 quad NOR gate and a CD4009 hex inverter. U1A and U2A generate the dot pulse, U1B and U2B generate the dash pulse, and U1C and U2C generate the space pulse. The dot period is determined by C2 x (R2 + R3) and E_T; the dash period is determined by C3 x R5 and E_T; the space period is determined by C6 x (R9 + R10) and E_T. The dot pulse or dash pulse is triggered with the positive voltage switched through the key. The voltage on the arm of the key is obtained from the AND formed by D5 and D6. The keying waveform for the gate of Q1 is obtained by ORing the dot and dash pulses. The trigger for the space generator is obtained by differentiating the keying waveform with C5 and R8, and inverting the negative transition with U2E. The keying waveform is inverted by U2D to gate the sidetone generator

Timing Voltage vs. Keying Speed

E_T/ +V	Unit period secs.	Speed
1.000	.042	30
.884	.050	25
.769	.063	20
.667	.083	15
.571	.125	10
.507	.250	5

Table 1.

and AND'd with an output from the space pulse generator with D5 and D6 to produce the voltage for the arm of the key; the diodes D5 and D6 clamp the arm of the key low during the key-down and space period. The arm of the key returns to +V only after the end of the dot/dash and space periods. Therefore, only after the dot/dash/space period ends is there a positive voltage available at the key to provide a trigger or re-trigger for either the dot or dash with a key closure. R7 provides the pull-up for the diode AND and in conjunction with C1 and C4, filters out the spike that can occur during the transition from key-down to the space period. The capacitors C1 and C4 also filter any RF that may be picked up on the leads from the key.

The sidetone oscillator, shown in **Fig. 3b** as U1D and U2F, is an astable multivibrator that oscillates at a frequency determined by R14 and C8. The oscillator is gated "on" when the output of U2D applied to U1D (via point A) is zero. The values of C8 and R14 shown in **Fig. 3b** generate a 720Hz square wave during "key-down." To lower the frequency increase R14 or C8. The output current capability of U2F is in the range of 2 mA which is fine for driving CMOS gates or other high impedance loads, but is inadequate for low impedance loads like phones or a speaker. A simple MPF930 source-follower easily provides 100mW of audio power to an 8 ohm speaker or phones.

For example, the typical MPF930 has a threshold of about 3V gate to source and saturates at 0.2A with a gate to source voltage of about 4V. R15 controls the input voltage to Q2. When the input is 3V or less the source voltage is zero and when the drain current is 0.222A the gate to source required is about 4.2V. With 0.222A flowing in 8 ohms, the voltage across the speaker is about 1.8V. Therefore the peak voltage at the gate must be 1.8 + 4.2 or 6 volts. To obtain 100mW of audio into an 8 ohm speaker or phones requires a power supply of at least 6V. A different speaker resistance or power output would require a different supply voltage. The current drawn from the supply is in the range of 0.25A which warrants an AC powered supply. When the supply voltage is more than 6V, a resistor R16 in series with the speaker will limit the maximum current under full volume. With an 8V supply,

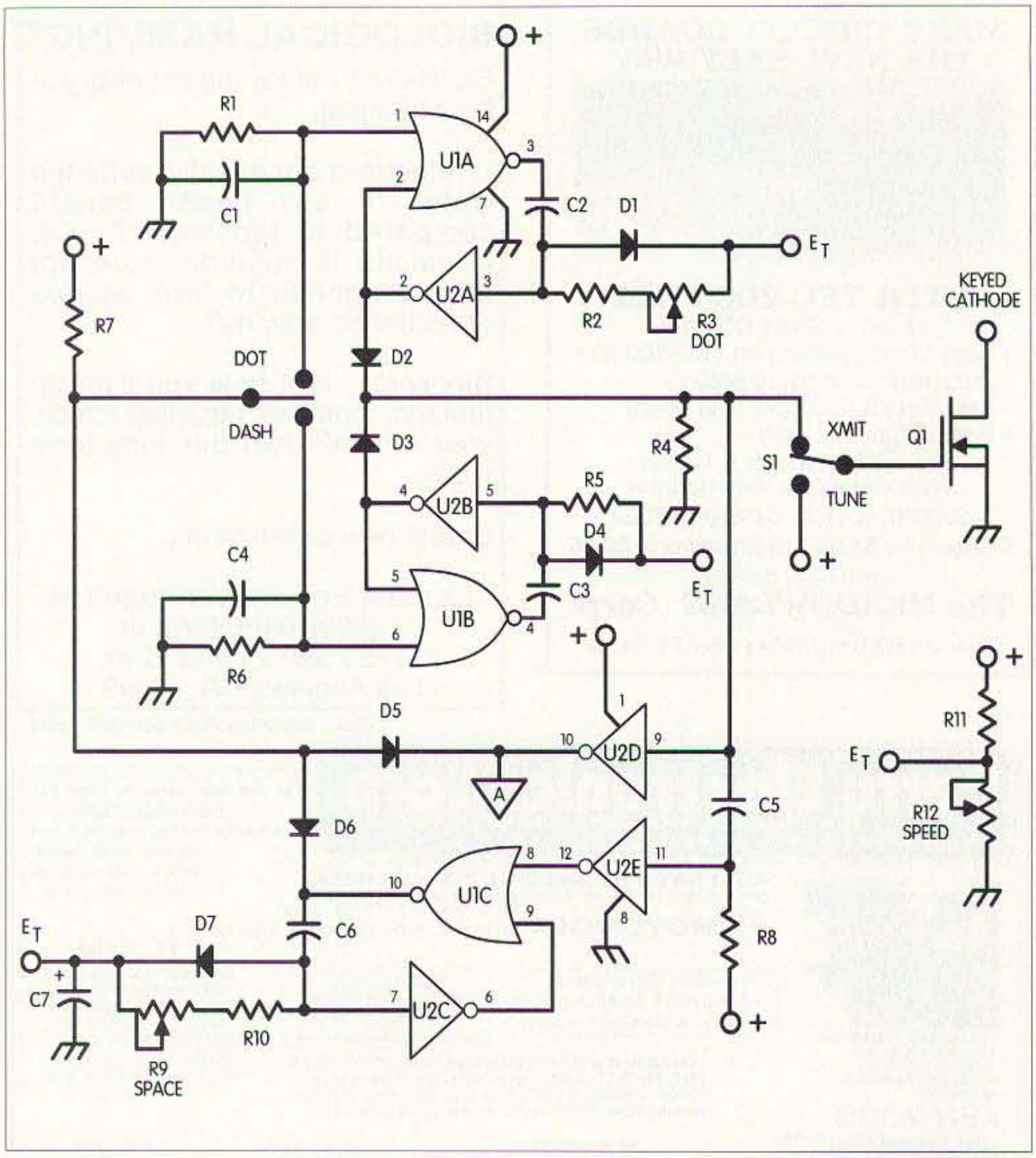

Fig. 3a. The keyer uses garden-variety CMOS ICs.

R16 should be 13 ohms but with a 12V supply, it should be 27 ohms. If the sidetone generator is not desired, delete the parts marked * in **Table 2** and tie the inputs of U1D and U2F to either +V or ground.

The electrical parts list for **Fig. 3a** and **Fig. 3b** is given in **Table 2**. Most of the parts are available from Radio Shack™, and those that are not in the retail catalog will be ordered by most Radio Shack stores from Radio Shack Unlimited. If your cupboard is bare and your local store won't order from Radio Shack Unlimited (RSU), equivalent parts can be obtained from almost any industrial electronics distributor. For example, Digi-Key, PO Box 677, Thief River Falls, MN 56701-0677; toll-free order number is (800) 344-4539.

Keying a solid-state transmitter involves switching a relatively low voltage so the "cathode" switching transistor can be safely located in the keyer. Switching 48 volts or less can be done safely with Q1 in the keyer, but if a vacuum tube final is to be keyed, prudence and safety dictate that Q1 should be located near the cathode of the keyed stage to keep the high voltage out of the keyer and away from the operator.

The choice of Q1 depends on the requirements of the transmitter to be keyed. The MPF930 is a TO-92 N-channel enhancement mode MOSFET that can switch +30 volts. While the drain current is rated as 2A, this specification is not very meaningful because thermal conditions limit the current carrying capacity to something in the range of 0.5A in a 122°F ambient temperature. The MPF960 can switch +60 volts. Either the MPF930 or the 960 will be sufficient to key most solid-state exciters. The drain saturation resistance is about 10 ohms which results in a drain to source voltage of about 0.5V when drain current is 0.5A, and about 0.25V when drain current is 0.25A.

Keying a vacuum tube power amplifier requires the keying transistor to switch voltages sufficient to cut off the tube and be capable of carrying the peak cathode current. A typical kilowatt tube final will be cut-off with +100 volts or so applied to the cathode and cathode peak current will be less than 1A. **Fig. 4** shows how the MOSFET can be used to cathode key a high power amplifier stage. $E_{c/o}$ in **Fig. 4** is a positive voltage sufficient to cut-off the keyed tube for "key-up" conditions, that is, when Q1 is not conducting. Of course, $E_{c/o}$ can be obtained with a resistive divider if need be. The value of the resistor between the cathode and $E_{c/o}$, or Thevenin's equivalent source resistance of the divider, is arbitrary; it must supply the cut-off voltage at zero current during "key-up" and limit the current from $E_{c/o}$ during "key-down."

An N-channel power MOSFET for Q1 is an ideal switch in that drive power is practically nil even though the drive voltage must swing from ground to nearly +10V. The package style essentially determines the power that the device can dissipate without a

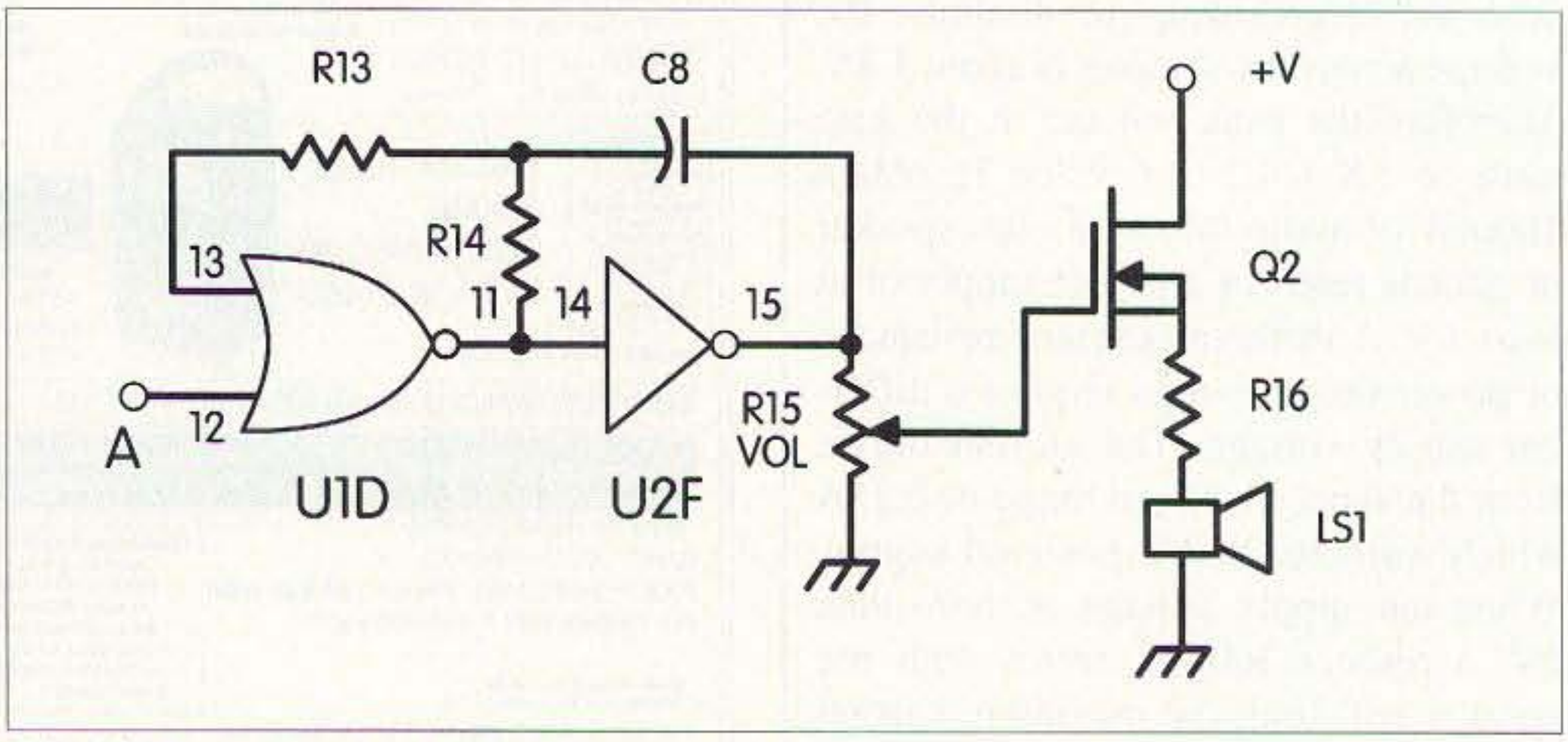

Fig. 3b. The sidetone generator is optional.

Electrical Parts List for Figs. 3a and 3b

Circuit Symbol	Description	Number
C1, 4, 5	100 pF ceramic	272-126
C2, 3, 6	0.1 ± 10% µF film	272-1069
C7	2.2 ± 20% µF electrolytic	272-1435
C8*	0.01 ± 10% µF	272-1065
C8	2.2 µF electrolytic	272-1435
D1, 2, 3, 4, 5, 6, 7	1N4148 switching diode	276-1122
LS1*	8Ω speaker: see text	276-2401
Q1	see text	
Q2	MPF930 N-channel MOSFET	RSU
R1, 2, 4, 6, 8, 10, 11, 13*, 14*	100k ± 5% 1/4W	271-1131
R3, 9	500k ± 5% 0.1W trimmer	RSU
R7	10k ± 5%	271-1335
R5	1.8M ± 5% 1/4W	RSU
R12, 15*	100k ± 20% panel mounted pot	271-092
R16*	see text	
S1	SPDT	275-603
U1	CD4001 AE or BE	276-2401
U2	CD4009/4049 AE or BE	RSU

* Used only with the optional sidetone generator of Fig. 3b

Table 2.

heat sink. For example, a TO-220 package has a junction to ambient thermal resistance R_{JA} of 62.5°C/W and the junction temperature must not be allowed to exceed 150°C. When the device dissipates 2 watts the junction temperature rises 125°C above ambient which limits the ambient to 25°C. The temperature near the tube socket of a tube final can approach 100°C. Under these conditions the power dissipation in the switch would have to be limited to 0.4 watts. A heat sink reduces the thermal resistance from case to ambient and since the device's junction to case thermal resistance, R_{JC}, is only few ohms (in the range of 2°C/W), a moderate heat sink can be effective in reducing the junction's temperature rise.

In general, the die size of a device determines the DC current rating and saturated drain resistance, R_{DS}, other conditions being equal. For example, Motorola's MTP2N20 has an R_{DS} of 1.8 ohms, while the MTP5N20 has an R_{DS} of 1 ohm, and the MTP8N20 has an R_{DS} of 0.4 ohm. For a given drain current, the saturated dissipation is directly related to R_{DS}. Therefore, a larger die has lower power dissipation for a given current. A MTP2N20 dissipates 1.8W when the drain current is 1A, the MTP5N20 dissipates 1W, and the MTP8N20 dissipates 0.4 Watts. The junction temperatures for the three devices would be 112.5°, 62.5°, and 25° respectively. Holding the junction temperatures to under 150° limits the operating ambients to 38°C, 87.5°C and 125°C respectively.

It goes without saying that MOSFETs with higher current ratings have larger dice and cost more than the lower current devices. A moderate heat sink similar to Radio Shack P/N 276-1363 with a thermal resistance of 30 ohms is a cost-effective solution to using lower current devices in higher ambients. For example, the MTP2N20 has R_{JC} of 2.5°C/W and with a 30 ohm heat sink the junction temperature rise, when switching 1A, is (30 + 2.5)°C/W x 1.8W = 58.5°C, which means it can operate in an ambient of 91.5°C. The MTP5N20 has R_{JC} of

1.67°C/W and under the same conditions the dissipation is 1W and junction temperature if (30 + 1.67)°C/W x 1W = 31.67°C. With a heat sink, it could operate in an ambient of 118°C.

However, if the cathode current were 2A, the power dissipated in the devices would be four times greater and the heat sink would be more important. Even with a 30 ohm heat sink the junction temperature of the MTP2N20 is an unacceptable 234°C. The MTP5N20's junction temperature would be 126.7°C. The lower R_{DS} of the MTP8N20 results in a dissipation of 1.6W. Its junction temperature rise is (30 + 1.67)°C/W x 1.6W = 50.7° and it can operate in an ambient of 99.3°C.

Clearly, the MTP8N20 is the transistor of choice if the cathode current to be switched is 2A while the MTP5N20 can be used to switch 0.9A in a 102°C ambient. A very thin coat of thermal grease between tab and heat sink is needed to achieve the lowest thermal resistance from case to heat sink. Low thermal resistance is desired because lower junction temperature leads to longer life.

A little less than 8V of gate drive is needed to drive either the MTP5N20 or MTP8N20 into drain saturation with 2A of drain current. Therefore, the keyer power supply should be greater than 8 volts.

The power supply for the keyer is not critical, except that the MOSFET Q1 dictates a minimum voltage of 8V or greater and the CMOS devices limit the maximum voltage to 18V. The current drawn by the keyer without the sidetone is less than 0.1mA and a 9 volt transistor battery has a life expectancy greater than 1000 hours. The current drawn by the sidetone generator is a function of the audio power output. With 100mW output into 8 ohms, the current is 111mA which is best obtained with an AC powered supply.

Adjusting or tuning the transmitter can be done with a string of dots or dashes if the duty cycle is factored into the meter readings, 50% for dots and 75% for dashes. A "Tune" switch, S1 in **Fig. 3a**, allows the transmitter to be operated continuously for tuning and the transmitter's meters to be read directly.

Initial adjustment of the keyer to produce the standard timing—dot and space equal to one unit of time, and dash equal to three units of time—is straight forward. The only test equipment needed is an average-reading voltmeter, either analog or digital. Be aware that not all DVMs read average on the DC ranges. The procedure is as follows:

1. Connect an average-reading DC voltmeter between the drain of the switch transistor, Q1 , and ground.
2. Note the exact indicated voltage when the "Tune" switch, S1, is in the "XMIT" position, and the key is up. The voltmeter will read +V or $E_{c/o}$.
3. With S1 in "XMIT," close the key to the dash position and adjust the "space" trimmer, R9, to make the meter indicate exactly 25% of the voltage measured in Step 2. The meter's needle will flicker if the "Speed" control is set too slow. Set the "Speed" control to get a steady meter reading.
4. Close the key to the dot position and adjust the "dot" trimmer, R3, to make the meter indicate 50% of the voltage measured in Step 2.

That's all there is to it. The "space" trimmer controls the duration of the space relative to the dash period, and the "dot" trimmer controls the duration of the dot relative to the dash period. The dash period is controlled by the "Speed" control, R12 .

The sidetone generator is a separate option that may be used or not; it has no effect on the keyer. It doesn't monitor transmitter output; it only monitors when the key is down and the transmitter *should* be transmitting. If your transmitter doesn't have a built-in sidetone generator, this one can fill the gap.

The keyer is a fine weekend project for the flat-walleted brasspounder and the non-critical components suit the most limited junk box. With the design considerations given, you can modify the circuit to fit the parts at hand. The keyer can make generating the kind of CW you like easy, without spending a lot of money—and it may help clean a few pieces out of the junk box. 73

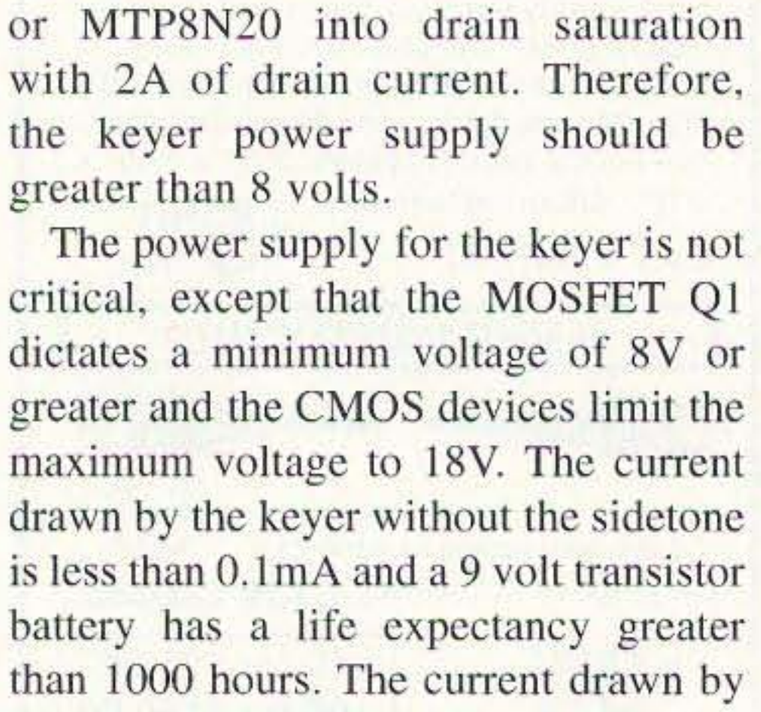

Fig. 4. A power MOSFET can cathode-key a high power RF amplifier.

NEVER SAY DIE

Continued from page 7

Michigan Miracle is almost worth looking at. The Michigan unemployment rate was above the national average for 192 months in a row (1978-1993). It's been below the national average for the last 28 months and Michigan has been turned from a rust belt to a growth belt state.

The Republicans have eliminated the $1.8 billion debt; balanced the state budget for five years in a row; cut taxes 21 times!; downsized the state bureaucracy, while improving state services; and eliminated a bunch of red tape. For three years the state has led the nation in wage increases. Job creation has been at an all-time high. Michigan has proven that tax cuts not only work; they can work wonders! Now, if we could just get Clinton to try a tax cut. Instead he put through the largest tax hike in the history of the country.

They've reformed welfare, with the result that over 90,000 Michigan families are now on the payroll instead of the welfare roll. And one in three of the Aid to Families with Dependent Children (AFDC) is working as compared to one in 12 nationally.

Those Pesky ETs

There goes Wayne, off his rocker again. Well, some recent books I've read have certainly gotten me on a shuttle to Weirdsville. Unfortunately, since a good deal of it makes sense, I'm going to share it with you.

Unless you've been squatting in a cave somewhere, out of touch with the media, you know about Harvard professor John Mack, who decided to look into the stories of people claiming to have been contacted by aliens. His original intent was to show how this contactee stuff was all some sort of mass hysteria baloney. He ended up, after four years of research, publishing a book (*Abduction*) saying that the phenomenon is real, which immediately made him a pariah with his fellow professors.

If you've read Strieber's *Communion*, and his *Breakthrough*, both of which are tediously dragged out stories which can help you enhance your speed-reading skill, you know that tens of thousands of people have been reporting repeated contacts with ETs, and that most of them don't want to talk about it.

A reader sent me a copy of Dr. Arthur

Horn's *Humanity's Extraterrestrial Origins*, subtitled, "ET Influences on Humanity's Biological and Cultural Evolution." Yes, this sure sounds like another woowoo-weirdo book, based on wild speculation (imagination). Instead I found a very carefully researched and thoroughly referenced book. More about that coming.

Another similar book I read recently was also well researched and annotated. This was Temple's *The Sirius Mystery*. I've written about that recently. But, as carefully done as that was, I found Yin's *Pleidian Perspectives on Human Evolution* to be a waste of time. If you're interested in some solid pyramid research you'll want to get the $14 Bauval & Gilbert paperback, *The Orion Mystery*. And also, Tompkins' *The Secrets of the Great Pyramid*, which is $30 and a big (416p) book. The mystery of how these ancient civilizations suddenly sprung up is also discussed by Hancock in his *Fingerprints of the Gods*. All these books tie together in many ways, and lend support to the conclusions in Horn's book that aliens have been around for thousands to hundreds of thousands of years and have been guiding our biological and social development for their own purposes.

Horn points out that the introduction of many languages and religions has served to keep us at war with each other, thus keeping us busy and more easily controlled. Worse, he goes into details on how the major religions started, and then goes back to the most ancient of texts to support his theories.

Horn's theories also help explain why paleontologists have been unable to find any Darwinian predicted chain of evidence for the beginnings of man. Somehow, we magically appeared, with no signs of intermediate life forms having yet been found. Poof, suddenly there was man!

So, between Horn and his voluminous references, the Strieber books, the contactee stories, the millions of UFO reports, and so on, these theories do help tie together a bunch of evidence which mainstream scientists are doing their best to ignore. "Anomalies" is their explanation.

Being a pragmatist, I tend to go with any theory that helps explain the facts. I try not to get emotionally involved (make it a religious matter), and am open to any other explanations which will also fit all of the facts (and not just ignore them). And Horn does do a good job of sorting out the facts and assembling them into a reasonable theory.

I have no problem with the concept of aliens visiting the earth hundreds of thousands of years ago and doing some biological engineering to provide them with a work force. Or in some aliens still being around behind the scenes, keeping track of and influencing events. Even if you accept the big-bang theory (which I no longer do), the universe is plenty old enough for advanced civilizations to have checked out all habitable planets millions of years ago.

Erich von Däniken wrote about this stuff in the '60s and '70s (*Chariots of the Gods*). As I mentioned a few years ago in an editorial, when von Däniken brought up the subject of the Admiral Piri Riis map and cited a ham friend of mine, Father Linehan W1HWK, the head of the Weston Observatory, as an expert on the map, I visited him to see how well von Däniken had done his homework. I found that the map did indeed show Antarctica as it was without the mile or two of ice on it. Further, as a result of the map, Fr. Linehan made soundings in Greenland, where the map showed it to be two islands, and found the map was right. That was the first time this was known. So where did a map showing an Antarctica and Greenland without ice come from? He said it had been copied from other much, much older maps.

Oh yes, the map is centered from above the pyramids of Egypt. Did you know that the position of Egypt's pyramids and their size is a replication of the stars of Orion and that the "ventilator shafts" in the Giza pyramid pointed toward Orion, Sirius, and the Hyades when it was built?

Well, this stuff is more fun to read about than endless stories of the misdeeds and waste of Congress.

Horn has done a monumental job of researching ancient writings and posits an answer for several major historical changes which have baffled archeologists, such as how man suddenly appeared, with no intermediary life forms having yet been found. And how, after a million years or so as hunter-gatherers, suddenly, in just a few years, man seems to have domesticated plants and animals, making farming possible. Then there was the sudden appearance of towns and cities, which call for major developments in organization.

He also has done a remarkable job of researching the early days of the major religions and explained many things about Christ and Christianity that I never heard in church. This is not stuff that any seriously religious person should read. It's better they don't know.

I liked the way Horn's story ties in with what I've read in several other books on Egypt, the Dogon tribe, Graham Hancock's research, and so on. And Pat Flanagan's work too. He's done a lot of pyramid research. There's a new book out on Flanagan and his inventions by Nick Begich, the chap who wrote the HAARP book, *Toward a New Alchemy*.

Yes, all this flies in the face of what we've been taught in school and church, so perhaps we'll do better if we ignore troublemakers like Horn and believe what we've been taught and can see. Any fool can see that the sun is circling the earth, so no wonder Galileo was given a hard time.

Rejuvenation

A while back an old man was struck by lightning—and survived. It was what happened next that was so surprising. He grew a third set of teeth and a head of new dark bushy hair. His inoperable cancers

Continued on page 33

Simple Mods for the Ramsey FX Transceiver Kit

Customize it!

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For those of you not familiar with the FX series kits from Ramsey, they are 12-channel, diode-programmed, FM transceivers with an output in the neighborhood of 5 watts. The series includes rigs for 6 meters, 2 meters, 220 and 440 MHz. The microphone, case and speaker are optional. The theory and assembly manual is all I could hope for. That's where the germ of some of these modification ideas came from.

Mods? For a kit? Why build in the first place? Scratch builders build for several reasons, including the fact that the device they want may not be available at any price. It may be *available* but not exactly the way they want it, or they may want to create something which is uniquely theirs. I suspect that our primitive ancestor who first decided to keep the thighbone s/he had just used for bashing something may have decorated it for the same reason.

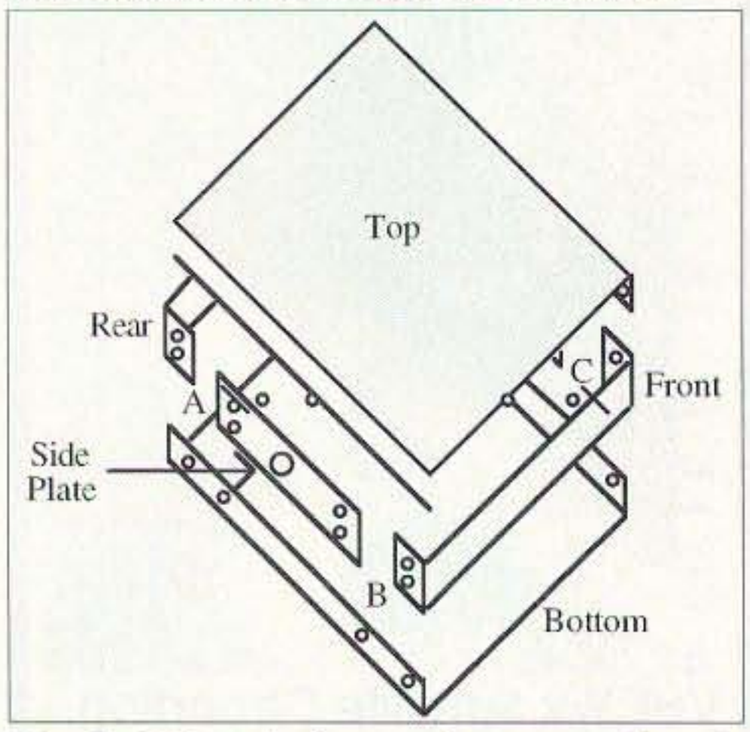

Fig. 1. *Slide switches can be mounted easily at points A, B and C. File notches in the case top to allow free movement of the switch handle. The side plate may need to be shortened slightly.*

Kit building satisfies a large part of that creative urge. Modifying the kit is an even larger step in that direction. Besides, if you built it and it quits working, you have a better chance than almost anyone to make it right again. And it's just plain fun!

On/off indicator

The first change I decided to make to my FX-146 was to install an on/off indicator. I could have wired an LED to the power switch or the wiper of the channel switch but I decided to make it more useful by connecting it to position #1 on the channel selector switch (S2). That's where I've programmed the repeater I monitor 99% of the time. If I see a green light I know that the rig has power and it is tuned to the local repeater. I installed a bi-color LED and connected the other half to position #12, where I've programmed the CAP repeater. Now I have an LED indication that shows if I'm on channel 1 or channel 12. I can count clicks in either direction and know what frequency I'm on—even in the dark, while driving.

A handi-ham suggested that it would be nice if the rig beeped at channel one. I haven't done that to mine yet, but it sounds like a good idea so I might implement that mod in the future.

Reverse polarity protection

The FX kit, as I received it, does include reverse polarity protection. An easy way to provide that protection in a kit or other project is to install a nice hefty power diode backwards between the positive line and ground. When power is connected properly—negative line to ground—the diode will look like a very high impedance—an "open"—and have little or no effect. But, if the leads are reversed at the power source the diode will look like a short and blow the fuse before any damage is done to the rig.

In the December 1994 issue of *73*, Frank Kamp K5DKZ describes another method of reverse polarity protection using a bridge rectifier. If you use his method it doesn't matter how you apply power as the bridge insures correct polarity. Cheap insurance either way.

Non-standard splits

When I bought my FX kit I was assured that it could be programmed for the Civil Air Patrol repeater frequency pair. So when I got to the programming phase of construction I put in 146.52 like the book said. Then I installed the programming diodes for the local ham repeater. So far so good. Then I put in the CAP output frequency of 148.15. Fine. I could hear the repeater. Then I went to the auxiliary line on the matrix and tried to put in the 4.25 MHz split. After considerable study—and hair pulling—I decided that I could get close but not close enough. A couple of phone calls to Ramsey later I'd learned two things. The auxiliary line in the matrix was not set up to be programmed for 4,250 kHz or any other split that could not be divided evenly by eight. And the bits I needed to program that split were there but they were soldered to both sides of the plated-through board at U10, one of the 74HC283s.

A number of alternatives suggested themselves to me but I settled on the cheapest. I used a needle-point jeweler's file to cut pins 6, 2 and 15 loose from the board. They are, respectively, 1, 2 and 4 bits. Then each pin can be tied above ground with a 100k resistor and programming diodes run from each pin to the auxiliary line as needed for your application. It's kind of a combination of the worst aspects of "ugly construction" but mine has been that way for two years and still works fine. If you are absolutely certain that you will never ever want to install a non-standard split just solder U10 to the board. If you think you might, then socket the durned thing so you can get to the pins later.

Access tones

Most Civil Air Patrol repeaters share one frequency pair and require a CTCSS tone for access. I had decided to try using another Ramsey kit, the TD-1 Tone Decoder-Encoder, to generate the access tone for our local CAP repeater.

The TD-1 Tone Decoder-Encoder is a fun little kit all by itself. The board is not much bigger than an Elvis commemorative stamp and only takes a few minutes to assemble, but it comes with a 16-page manual that explains a lot about CTCSS and DTMF tones and gives some ideas about everyday control applications.

All I had to do to get the TD-1 to work for me in the FX transceiver was to add a one-transistor buffer stage and level pot to the basic kit, as explained in the TD-1 manual. Connecting it to the transceiver was a piece of cake since Ramsey plainly marks the points for "PL" input and various points on the transceiver board where I could get the 8 volts to run the tone board.

This gives me one tone which I can turn on and off with a little slide switch. But what if I want more tones? The frequency of the TD-1 is set with a precision pot. How about installing a little sub-board with two or three pots and a front panel switch to select the tones? No, it won't give me access to all the CTCSS tones, but I don't travel much anyway. Ramsey does have a new kit, the QT-1 Subaudible Tone Encoder/Decoder. I've not had a chance to try it out but it is very small and does generate any of the CTCSS tones via switch settings.

You could also hook up a TD-1 as a tone decoder. Then when it is turned on, your receiver would be silenced until someone transmitted that tone. Hmmm. A private line. Wonder what we should call it?

If you are concerned about running out of room on the front panel look around and see if you can find a pair of concentric shaft pots—with an SPST switch. Then you could gang the on/off, volume and squelch controls. That should help make more room for your modifications.

Out-of-band operation

All of the FX rigs are capable of operation outside of the ham bands, where you do not want to transmit without the proper license. A flashing LED installed in the front panel—or wherever you want it—and wired to the appropriate channel-switch position will help you avoid embarrassing little incidents. And visits from the FCC or X-Files. You could make it beep there too.

Channel expansion

When I ordered my FX kit, one of my concerns was that it has "only" 12 channels, so once I had it working, I just had to try expanding it. The method I was looking for had to be cheap—excuse me—thrifty, and fit into the rig with minimum fuss and no external parts. I've seen plans for an interface that allows the user to control the frequency with an external computer and there is a kit available now that moves programming to the front panel, but I wanted thrifty *my way*.

The local club operates a weekly emergency services/test net on the repeater output; if the machine quits we'll know where to meet and what kind of coverage to expect. In fact, once, about 30 seconds into a Skywarn Net the repeater took a lightning hit and went off the air, so I knew I wanted 147.03 simplex, but I did not want to tie up one of my precious 12 channels for it.

Once you have programmed a frequency you have to decide if it is going to be +rpt, -rpt or simplex by installing a diode on the matrix at one of those positions. I installed the diode on the wiper of a double throw switch and ran wires from the contacts of the switch to +rpt and simplex.

I knew before I started that I wanted to program 146.73 and 146.76, and when I looked in the book I saw that both frequencies used the same number of diodes with only one of them being in a different position. I decided that I could use the same switching idea to put two repeater pairs on one channel position. All very elementary to this point, but where do we put this growing number of switches without creating a monster we can't use without accidentally bumping things? The solution turned out to be so simple that I've wondered if Ramsey planned it that way.

If you look at **Fig. 1** you'll see that the Ramsey case is a six-piece clamshell design. In each corner where the pieces come together there is room, with a minimum of metalwork, to install a slide switch. The switches, standard size medium duty DPDT, required a minimum of trimming and filing to fit the case. The mounting ears on the switches are clamped between the case bottom and inner plate and either the front or rear panel mounting ears. This mounting method is very solid and has really stood the test of time here.

You probably won't want to install any accessory switches in the right rear corner near the antenna connector. If you do you might end up feeding RF to some part of the rig that really isn't ready for it and it's hard to predict what the presence of extraneous leads in and around the final will do to your output.

Antenna connector

I'm one of those guys who really doesn't care to use connector adapters. They usually add a bit of attenuation and frequently get lost. So install a BNC connector next to the stock SO239 and wire them in parallel. There is plenty of room and it shouldn't hurt anything.

Conclusion

Naturally, before you install these mods, or any others, it makes sense to make sure the device works the way it's supposed to. If you have absolutely no experience in building there are a number of inexpensive kits that will help you get started. Give it a try.

Both of the kits mentioned above are available from Ramsey Electronics, Inc., 793 Canning Pkwy, Victor NY 14564; phone (716) 924-4560. 73

Build This Receiver Preamplifier

... and use almost anything for an antenna.

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What's happening on the 49 meter band? Is 15 meters open? How about 10? Want to look for beacons on 200 kHz?

If you are like most of us, you don't have antennas for every band. If you are an SWL you probably would like to cover frequencies from 200 kHz to 30 MHz or more, and a half-wave antenna at 200 kHz is almost half a mile long. Don't despair, there is a solution: a high input impedance preamplifier. The preamplifier must have a reasonably high input impedance for random wires, either vertical or horizontal, and a low output impedance to drive today's 50 ohm input impedance receivers, and it must have an adjustable gain from 1 to 20 dB.

Here is a preamplifier that lets you use a short antenna over the range from 100 kHz to well over 55 MHz, with excellent sensitivity. Using a vertical 30-inch piece of number 12 wire, or a few feet of wire laying on the floor, signals which had been barely moving the S-meter were 10 to 20 dB over S9 using the preamplifier, even at 200 kHz.

Construction

This preamplifier can be easily constructed in a few hours, and this will be time well spent. The design utilizes two transistors in a complimentary configuration with feedback to broaden the frequency response and provide the needed, low output impedance.

Fig. 1 illustrates the configuration. Transistor Q1 (NPN) in directly coupled to PNP transistor Q2. Feedback from the collector of Q2 to the emitter of Q1 is accomplished by

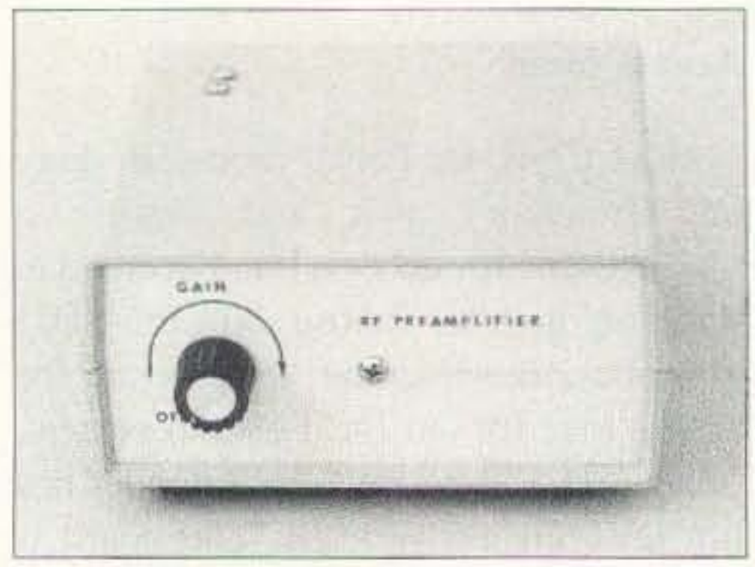

Photo A. *The completed preamplifier unit.*

resistors RF and RA. Because of the high open loop gain of the amplifier the gain of the amplifier is RF/RA, or 20 dB maximum. A 1k potentiometer changes the effective value of RA, resulting in a minimum gain of near unity.

The amplifier is constructed using a Radio Shack™ perfboard, and is relatively simple. Because of the wideband nature of this amplifier care should be exercised to prevent ground loops, which will cause oscillation. This should be checked using a detector on the output with no signal input. There should not be any detector output with no input signal. A detector configuration suitable for this purpose is shown in **Fig. 2**. Input terminals are provided for coax or a wire antenna and the output uses a BNC connector to connect to the receiver.

The amplifier may use almost any complimentary pair of transistors. I used a 2N3904 for Q1 and a 2N3906 for Q2. If wider bandwidth is desired, a 2N918 and a 2N3546 may be used. Another combination is a 2N2222 and a 2N2907. The pinout for the transistors used is shown in **Fig. 3**.

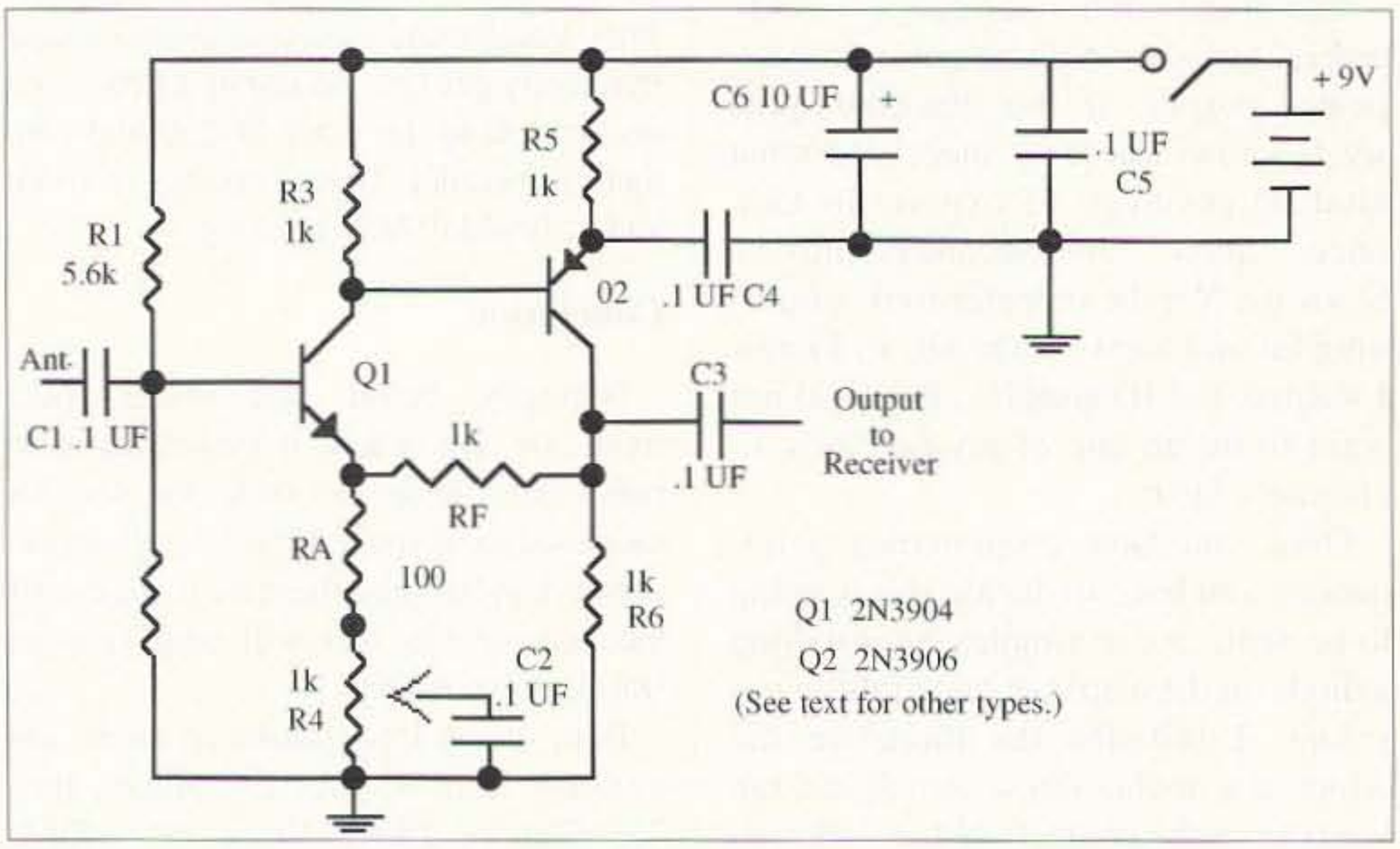

Fig. 1. *Preamplifier schematic.*

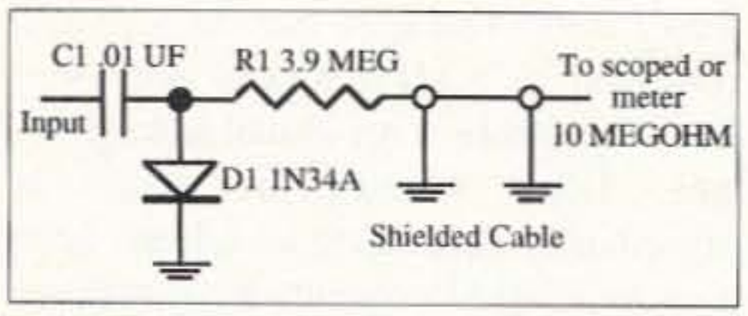

Fig. 2. *Detector for checking if the preamplifier is oscillating.*

The 1k gain control may use Radio Shack's 5k potentiometer shunted by 1,250 ohms made up from a 1k resistor in series with 250 ohms. An on/off switch should be used to disconnect the battery.

The operating voltage may be provided by a 9 volt battery or by an AC power supply consisting of a transformer, rectifier and filter capacitor. Regulation is not necessary. A typical power supply is shown in **Fig. 4**.

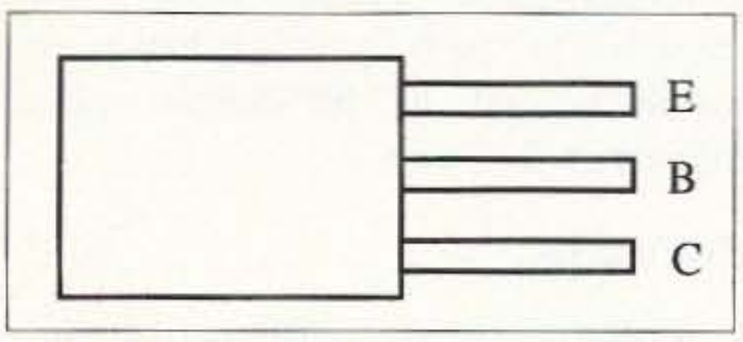

Fig. 3. *Pinout of the 2N3904 and 2N3906 transistors.*

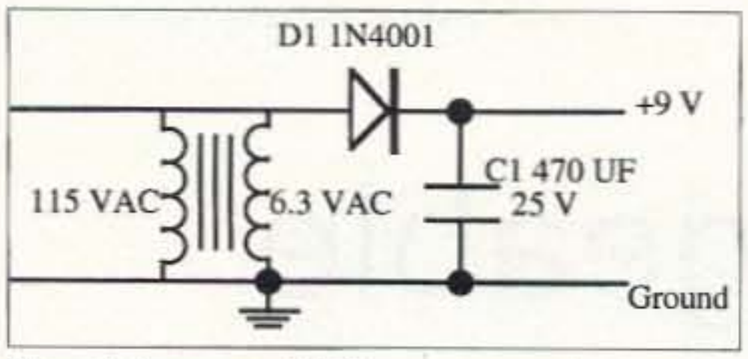

Fig. 4. *Suggested AC power supply.*

Because of the broad bandwidth and the high gain of this preamplifier some receivers may be prone to intermodulation distortion and poor spurious frequency rejection due to signal overload. If you experience such problems, reduce the antenna size or preamplifier gain. If you still experience problems, preamplifier preselection may be necessary. To maintain the high impedance of the preamplifier a simple parallel-tuned network with capacity coupling to the antenna may be used. One such network is shown in **Fig. 5**.

The performance of this preamplifier is impressive because of its low output impedance and high input impedance. This project can be completed in a few hours from the junk box or from parts readily available from Radio Shack.

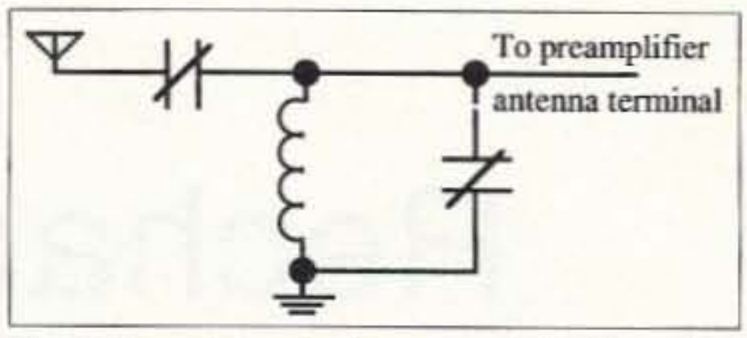

Fig. 5. *Preselector for the preamplifier if spurious response and intermodulation are problems. Parts values vary depending on the band.*

Hook it up to a chunk of wire or whatever you have for an antenna and check it out. 73

Parts List

R1, R2	5.6k
R3, R5, R6, RF	1k
RA	100
R4* (see note)	1k potentiometer, with switch
C1, C2, C3, C4, C5	0.1 µF capacitor
C6	10.0 µF capacitor
Q1	2N3904
Q2	2N3906
9 volt battery	

*Note: A Radio Shack 5k potentiometer may be used, shunted by 1k in series with 250 ohms.

Rechargeable Batteries

The bottom line.

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The rechargeable battery business is booming today. With the wide-ranging market in amateur radio and business-band portable transceivers (HTs), the portable miniature cellular phone explosion, and now portable laptop and notebook computer systems, rechargeable batteries are found in many more areas of life than ever before. Understanding something about these batteries and their technology has also become increasingly important, so here's a brief primer in easy-to-understand terms.

Mr. Wizard stuff

All batteries work on a similar principle: Current flow between a negatively-charged metallic plate and a positively-charged metallic plate is stimulated by a highly ionized electrolyte, such as an acid. Even a lemon, with its naturally acidic juice, will act as a battery when two plates of dissimilar metallic composition are placed within it. Do you suppose that's where the term "juice" comes from?

Back in the old days

For decades, the only practical rechargeable battery was the lead-acid battery, primarily used in automobiles, boats and airplanes as a storage medium for electrical power. The vehicle's engine, when running, can drive a generator or alternator for recharging the lead-acid battery. Then, about 30 years ago, nickel-cadmium rechargeables came onto the scene and took up some of the market share for portable electronic devices of the time (larger "wet" NiCds were also used in stationary battery back-up applications, but were costly). Lead-acid batteries soon challenged NiCds' dominance in the portable electronics field with a "gelled electrolyte" version. Both battery technologies have had their successes and drawbacks in portable electronics since that time. At present, we also have two newer battery technologies struggling for our attention: nickel-metal-hydride (NiMH) and a rechargeable lithium formulation. Let's take a brief look at all four competing formulations.

Boring definitions

First, a couple of definitions. A "cell" is the basic unit. A number of cells are connected in series so that their combined contributions add together. So a battery's cell is just one unit, and the battery itself is a number of those cells connected in series-additive form. Even though we ordinarily call a flashlight cell a battery, that's not technically correct—you need two or more cells in series to make up a "battery" of cells.

Lead-acid cells

Let's look first at the lead-acid cell formulation. The biggest advantage of lead-acid cells is cost; they're relatively inexpensive to manufacture. Lead-acid cells also can be easily kept up to snuff, charge-wise, with a constant voltage charger, with no ill effects. In fact, they rather prefer that kind of treatment. On the disadvantage side of the coin, however, lead-acid cells are heavy. They have the poorest weight-to-energy ratio of all the battery formulations; lead is heavy stuff! The acid used in lead-acid cells (sulfuric acid) is noxious and corrosive if spilled or if accidental leakage occurs. Other formulations aren't as immediately destructive as sulfuric acid; it can be nasty! Eventually the lead plates in a lead-acid battery become clogged or nonporous (technically called "sulfated") and the cell is no longer rechargeable. Lead-acid cells are usually rated for 500 or more recharges before this happens, but it's also predictable on a time-from-manufacture basis. The "spongy lead" in lead-acid batteries has to be beefed up with the addition of antimony (a brittle, white-colored base metal). Antimony reacts with the acid and eventually contaminates the "spongy lead," so lead-acid cells have a built-in clock once the acid is introduced. When that clock runs out, the cell is unsalvageable. A Happy Motoring Tip: Best not to "push" your car battery too much beyond its life-in-years rating printed on the case.

NiCd cells

Nickel-cadmium cells, on the other hand, have a much better weight-to-energy output ratio than do lead-acid cells. This can be very important to users of today's miniature electronic devices, but these batteries are also more expensive to make. NiCds maintain a relatively constant output voltage as they discharge, whereas lead-acid cells drop off (voltage-wise) more linearly. But NiCds also have a "memory effect" attributed to them. One manifestation of this "memory effect" is when NiCd cells are kept on constant charge: They tend not to deliver their full potential charge unless they're first fully discharged. The way this oddity in NiCds shows up goes something like this: When a NiCd cell is fully charged, its open terminal voltage is about 1.4 volts. As the battery's reserve is drawn upon by the load, that figure drops fairly quickly to 1.3 volts, then to 1.2 volts. The NiCd cell maintains that 1.2 volt level right up to the end of its useful discharge curve, at which point it drops quickly down to 1.1 volts, and then lower... all the way to zero. When that 1.1 volt point is reached the load should be removed, because further discharge can harm the pack. In any pack of six, eight or 10 cells, one or two cells will always hit bottom first, and if the load is

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still connected to the pack, current in the reverse direction will be forced through the bottomed-out cells, causing them to reverse polarity. They're usually not salvageable after that happens. Since the drop from 1.1 volts per cell is rapid, "smart" devices will automatically shut down at the point of 1.1 volts per cell, saving the pack from potential harm. The memory quirk mentioned before, however, causes the fast drop-down to occur at a somewhat higher terminal potential than 1.1 volts per cell, so it can be a fooler. The pack (battery of cells) becomes "trained" to expect recharging at a higher point in its discharge curve, and therefore won't deliver as much energy to the load before it "wants" recharging. It's shaken back into reality by one or two deep discharges, carefully monitored so that cell reversal doesn't accidentally occur. So remember that NiCds can become "spoiled" by over-feeding, but it's usually a correctable mistake, even though it's somewhat inconvenient.

It's best to charge NiCds slowly, over 16 to 18 hours, but rapid charging is possible if the cells are built to take the extra punishment. Heat is the enemy of NiCds, and rapid charging causes heat buildup within the cell—it's a sign that the chemical reaction of recharging is taking place too quickly for the cell to handle properly. Rapid charging generally reduces the pack's useful life by 50% or so, about the same as that of a lead-acid battery. It's often an acceptable price for the convenience of rapidly recharging when that option is valuable to the user. When the pack reaches full charge after being rapid charged, a slight discharge can be detected and the rapid-charging turned down to a trickle charge (hopefully).

NiMH cells

A newer alternative to NiCd chemistry is NiMH, or nickel-metal-hydride. NiMH cells have about the same energy-to-weight ratio as do NiCds, but NiMH cells have a much greater energy-to-volume (physical size) ratio—about 25% more. This means that a NiMH cell can be the same physical size (even though somewhat heavier) as a NiCd, and will deliver 25% more energy per charge. NiMH is also more "environmentally friendly" and is sometimes called the "green rechargeable cell." NiMH cells can be charged more quickly than NiCds without loss of potential recharge cycles. They can stand more heat buildup, and, in fact, normally get hotter during recharge than their NiCd counterparts—but that's normal for the NiMH chemistry. They also don't exhibit as much "memory effect" as NiCds do, but there is still some memory retention. The "normal" output voltage per cell is 1.2 volts, just like a NiCd cell. The number of charge/discharge cycles for the NiMH chemistry is about the same as for lead-acid and rapidly-charged NiCds; about 500. They're a bit more expensive to produce than NiCds right now, but the price will no doubt drop as more companies gear up for their production and the NiMH market-share increases.

Rechargeable lithium cells

The highest energy-to-weight power density of all of the formulations is found in the fourth and final formulation, the rechargeable lithium cell. Lithium rechargeables can pack double the energy (in terms of both volume and weight) of NiCds. The specially formulated lithium compound used in lithium rechargeables produces an open terminal voltage of about 3.5 volts per cell. Lithium rechargeables are quite new, and therefore the most expensive to produce, for the moment. Manufacturers are also having problems producing rechargeable lithiums in multi-cell packages, but that also may be a temporary drawback. Lithiums are the most "environmentally friendly" of the lot and they have no "memory effect" at all. Rechargeable lithiums seem to be the technology to watch in the next few years for rechargeable-battery-operated gear.

Non-rechargeable alkaline cells

Just as a comparison: The non-rechargeable alkaline cells that we're all familiar with produce 1.5 volts per cell. Their energy-to-weight ratio is roughly double that of the heaviest of the rechargeables, the lead-acid cell, and about the same as that of a NiCd. Their energy-to-volume ratio (energy to physical size), however, is about the same as lead-acid chemistry, so they're much worse in that respect than NiCds, NiMHs or lithiums (just an interesting aside). 73

A Positive and Negative Power Supply

A simple one-evening project.

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Many circuits using operational amplifiers (op amps) require both positive and negative voltages to operate correctly. This is quite common, especially in many direct conversion receivers, active audio filters, function generator circuits, etc. Most commercial power supplies produce only positive voltages, usually just +13.8 VDC, so you're going to need a simple power supply to solve this problem.

Some hams solve it by connecting two 9 volt batteries in series with the connection between them becoming the common, usually ground, terminal. While this does produce ±9 volts, these batteries are not only expensive, but have to be replaced periodically. When something stops working right how long will it take you to find it's a pooped-out battery?

The simple power supply described here produces not one, but two different positive and negative voltages, and requires only eight inexpensive components in addition to the small power transformer. The total cost should be no more that what you would pay for one or two pairs of 9 volt alkaline batteries, and can probably be constructed entirely from the contents of your junk box.

Because most circuits requiring split positive and negative voltages draw very little current, and usually do not require specific voltage levels as long as the voltages supplied are within device specifications, simple rectifier/filter circuits providing unregulated output voltages can normally be used satisfactorily. However, where specific voltages are required, such as +12 and -5 volts, small 100 mA three-terminal regulators can easily be added to the basic circuit.

The circuit

The basic circuit for this dual, split-voltage power supply is illustrated in **Fig. 1**. The addition of regulators, if required, is illustrated in **Fig. 2**.

A small power transformer with a center-tapped secondary is required if two sets of output voltages are required. If only a single pair of positive and negative voltages are needed, no center-tapped secondary is needed. If you use a center-tapped transformer, you can use either half, both halves

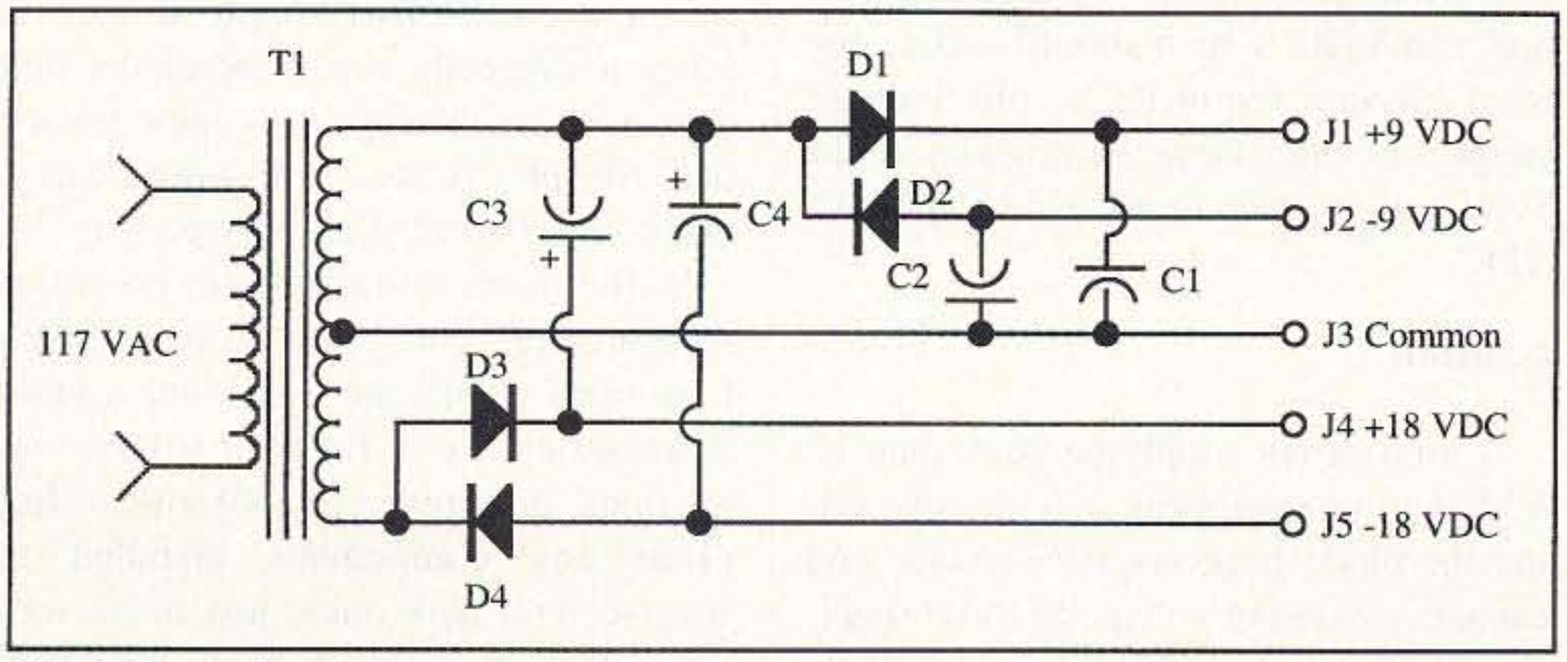

Fig. 1. *Unregulated power supply schematic. All capacitors are 1000 µF, 25 WVDC. All diodes are 1N4001 or equivalent.*

separately, or the full secondary, depending upon the needs of the circuits to be powered.

The basic circuit uses four half-wave diode rectifiers and four filter capacitors, and will produce two sets of positive and negative voltages. One, using the full secondary, is twice that of the other, which uses only half the secondary. This provides considerable leeway in selecting a suitable voltage pair. It also allows regulating either or both voltage pairs, using the small 78LOxx and 79LOxx regulators.

Terminal J3 is common to both voltage pairs, and although normally connected to ground, it can be left floating if you want. However, it must be connected to the "common" in the circuit being powered.

The voltages given in **Fig. 1** are nominal voltages derived from using a 12 VAC center-tapped secondary of transformer T1. J1 (positive) and J2 (negative) provide ±9 VDC referenced to J3, common. Likewise, J4 (positive) and J5 (negative) provide ±18 VDC referenced to J3.

"It's almost impossible to wire this circuit wrong—but Murphy's always lurking nearby."

These voltage are nominal, with no load current being applied, and with 115 VAC applied to the primary of T1. There may be slight variations from these nominal values measured from your supply.

Construction

There is nothing critical in lead lengths nor component placement. It can be constructed in any type enclosure, or even on a breadboard, but watch out for the AC input terminals. You can build it into the equipment in which it will be used. You may also eliminate T1 by building it into your station power supply, using its power transformer for a source of low voltage AC to the rectifier/filter circuits. However, if the station power supply incorporates a bridge rectifier this may not be possible because of potential voltage differences between power supply negative, and common in this circuit.

Be absolutely certain you observe the polarities of diodes and filter capacitors, and double-check these before applying power to T1. A filter capacitor connected backwards can destroy its associated diode, and can also explode! An incorrectly installed diode will apply reverse voltage to its associated filter capacitor, with similar fireworks.

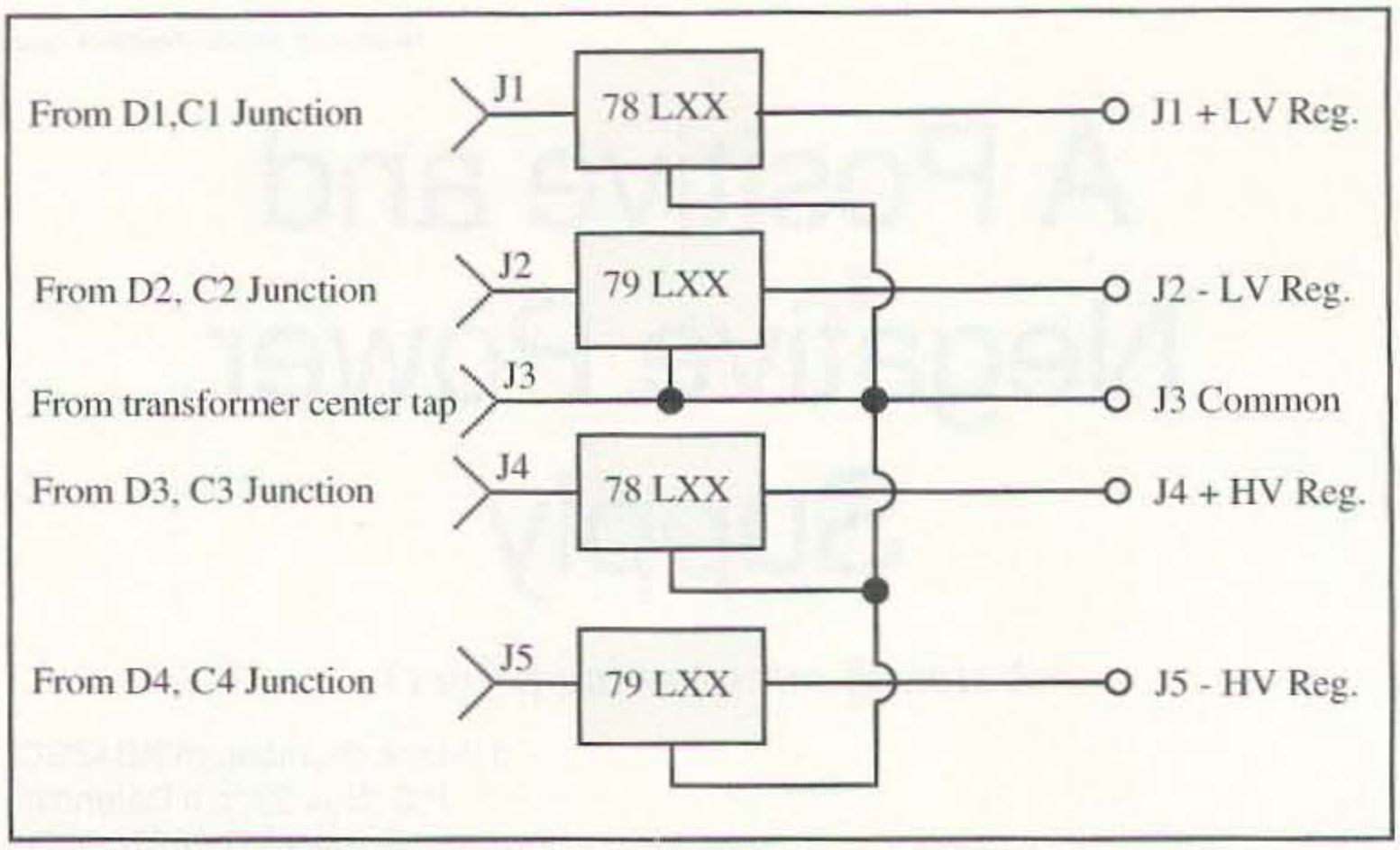

Fig. 2. *Adding three-terminal regulators to the basic supply circuit.*

Also note the connections to the 78LOxx and 79LOxx regulators, which are different from each other, if these are needed in your application.

Although not shown in **Fig. 2**, you may wish to bypass inputs and outputs of each regulator to enhance stability and to eliminate any hash impressed on the DC voltage rails by the circuits being powered, which could interfere with proper regulation. In this application, 0.1 µF bypass capacitors should be sufficient.

Remember to return J3 common, to which the bypass capacitors are returned, to the common in the externally powered circuit. Usually this will be the DC ground, in which case the bypass capacitors should be returned to the nearby chassis ground, as would J3.

Although the example illustrated in this article provides a nominal ±9 VDC and ±18 VDC, which should suffice for most circuits requiring a split voltage supply, a center-tapped secondary of 24 VAC will produce nominal ±18 and ±36 VDC.

Caution

A transformer supplying more than 12 VAC will produce peak voltages exceeding the diode peak inverse voltages and capacitor working voltage of those specified. In this case, substitute components which will withstand higher voltages.

Because circuits requiring split voltages for proper operation draw only a few milliamperes normally, a very small and inexpensive power transformer can be used for T1. A transformer with a 12 VAC center-tapped secondary rated at 100 mA or more should be sufficient. Just be sure the secondary is center-tapped if you want two sets of split voltages.

Here is a rule of thumb which, if applied in every case, will save a lot of problems in the future: Every time a supply voltage enters or exits an enclosure, bypass inside the enclosure, using a 0.001 µF, 0.1 µF and 10 µF electrolytic capacitor in parallel. These capacitors, acting in concert, will strip the DC lines of any hash generated within or external to each enclosure.

Operation

Check the voltages between J3 and all output terminals before using the supply to power other circuits. Although it is almost impossible to make a wiring error in a circuit this simple if care is taken to correctly orient the diodes and capacitors with respect to their polarities, Murphy is always lurking nearby. So be *sure* before you apply power.

If the four voltages and polarities measured are not similar to those given here, turn it off and see what you've done wrong. Look for poor solder connections and reversed polarities. Replace any components installed in reverse with new ones, just to be sure since they may have been damaged. Feel the diodes, if they are warm look

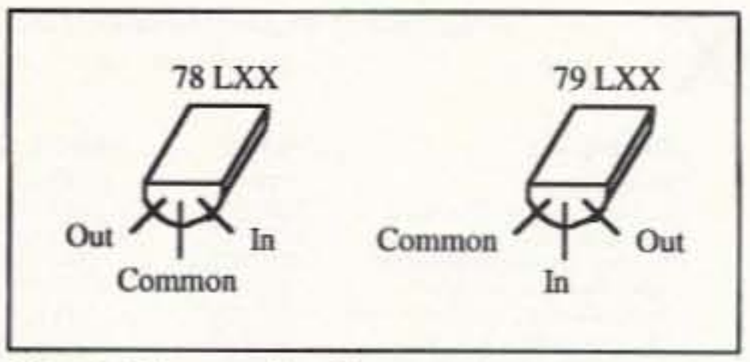

***Fig. 3**. Pinouts for the common positive and negative low current regulators.*

for possible shorts. The associated filter capacitor might be leaky and need to be replaced. Check also for any shorts to common.

If you do not regulate the output voltages, you may notice that there is a slight difference between the voltage levels in the pair being used. This is normal and reflects the different current requirements of the circuit being powered. If the circuit functions correctly don't worry about the voltage differential, which is usually of no consequence. But if it really bothers your sense of perfection, add regulators.

When adding regulators, remember that they require head space—higher input voltages than the desired output voltages. The 9 VDC rails can be regulated to 6 volts or less, and the 18 VDC rails can be regulated at 12 volts or less, and possibly even at 15 volts in most supplies.

You may be tempted to use zener diodes as regulators. I don't recommended this because they will cause additional current drain, and the diode and its dropping resistor have to be matched to the current required by the external circuit. This limits the universality of uses for which this power supply was designed. 73

Parts List

C1-4	1,000 µF 25W VDC (minimum) electrolytic capacitor
D1-4	Rectifier diodes; 1N4001 or equivalent
J1-4	Terminals, your choice
T1	Transformer, 120 VAC to 12 VAC center-tapped, 10 mA or greater

NEVER SAY DIE

Continued from page 23

disappeared. He no longer needed his glasses or cane and was completely healthy and looked years younger, much to the bewilderment of the doctors who followed and documented his progress.

It may be that the doctors at the Albert Einstein College of Medicine in New York have accidentally tapped into this fountain of youth in their AIDS research. They've patented the process, as have several other hospitals, but there's no word in the medical literature (or the press) of these hospitals using this blood purification system to cure AIDS. One might wonder why the silence. Well, that would be someone who has not done his homework and read about a long string of other remarkable discoveries which have been given a similar treatment by the medical industry.

Are the growing number of miracle cure reports from people using the Miller Bioelectrifier or the Beck "plant growth stimulator" true? Is this simple, inexpensive, and fairly fast process really curing virtually every cancer case it's been tried on? Is it curing AIDS? Lupus, Lyme Disease, and a host of other illnesses? Is it really causing people to lose weight and grow new hair? Is it giving them industrial-strength immune systems which are able to fight off colds, flu, and anything else "going around?" That's what the medical review board reports are showing. How soon will we be able to see some research hospitals fight off the pressures from the AMA and give this approach a rigorous test on Alzheimer's, cancer, osteoporosis, arthritis, diabetes, and so on? Is the Department of Health totally anesthetized?

For that matter, considering the potential, have you heard one single politician say word one about this medical discovery? They don't dare without jeopardizing their lobbying money from the AMA, the doctors and nurses organizations, the hospitals, drug manufacturers, and the insurance industry. The higher our medical costs, the bigger the insurance company buildings and hospitals will grow.

Why am I not surprised, considering the corruption in every industry I've gotten to know personally or read much about? The amazing thing would be if the $1.5 trillion medical industry weren't corrupt.

Cesspool

Gee, I hate to bother you about this, but our 20m cesspool on 14,313 is alive and stinking. Yes, I wasted some time listening to one of our biggest public advertisements for the elimination of our hobby. There was one old man on there with a strong signal, prattling on endlessly about showing Saddam Hussein a lesson. He was cursing freely and showed no indication that thought had contributed anything to his opinions. Other strong voices were breaking

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73 Review

HFx from Pacific Sierra Research Corporation

New propagation forecasting software.

Richard Lubash N1VXW
rlubash@poco.mv.com

As I start writing this review it has been 36 days without a single spot being sighted on the face of the sun. The last time old Sol had such a long period without blemishes was 1944, two years before I was born. We are indeed in the midst of the solar doldrums. At a time like this, a little magic or a crystal ball sure would come in handy—just that extra edge so you could find that lone DX station up on 20 meters that hasn't shown up on the cluster. With so many bands and so little time, it sure would be nice to know where to look. Or maybe you have a buddy in Shiprock, New Mexico, and would like to set up a sked on 17 meters but due to low flux levels haven't been very successful. Well, what you need is some good propagation software for that computer sitting on your bench waiting to log a contact.

Pacific Sierra Research Corporation, out of Santa Monica, California, thinks they may have the answer for you with their new propagation forecasting software, HFx. I know, you think "propagation software" and your mind pictures arcane DOS programs that governments use to find out just when to flood an unsuspecting country with shortwave broadcasts or get that super-secret message through. There are a number of these programs floating around and the key phrase for them is *not* intuitive. Well, HFx is a Windows-based application that is designed around the concept of point-and-click. Out of the box I found myself being able to play around with HFx, though it's true power can't be unleashed until you read the well-written manual.

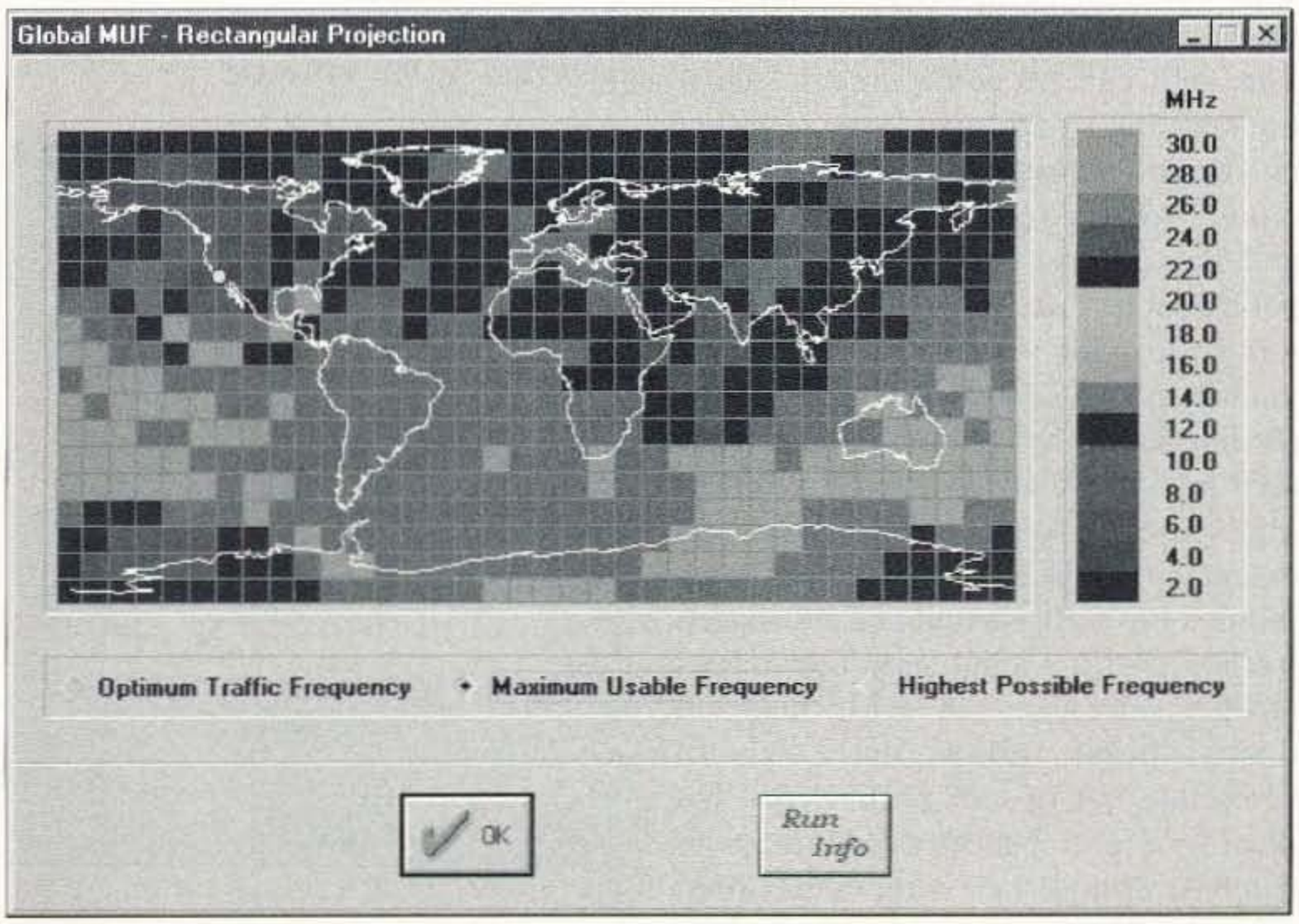

Fig. 1a. *World view showing Maximum Usable Frequencies for transmitter location, date and time.*

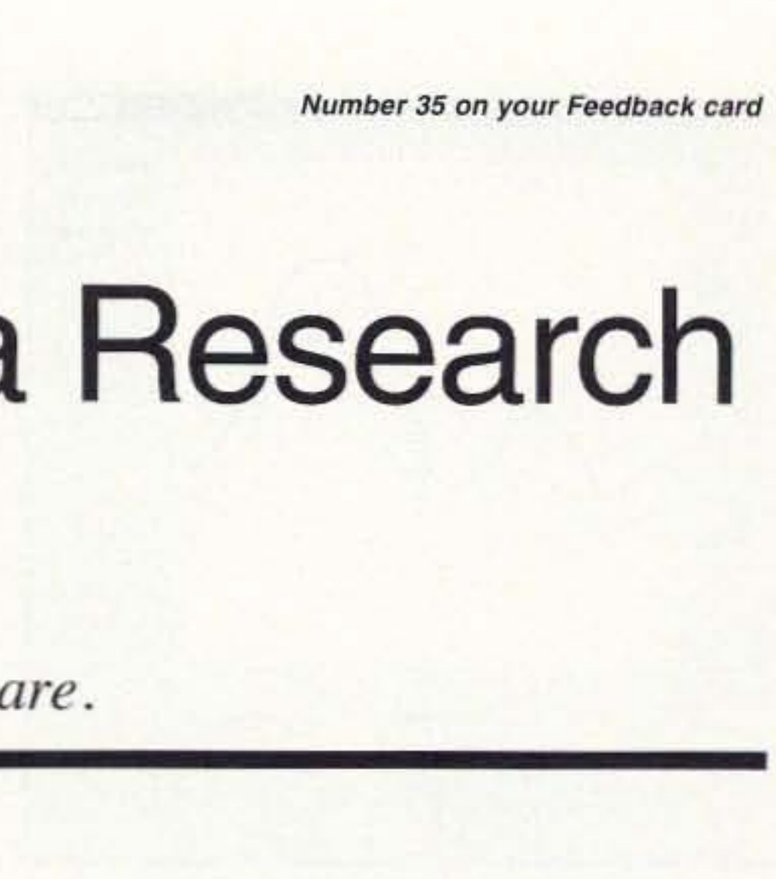

Fig. 1b. *Spherical global view of Maximum Usable Frequencies for transmitter location, date and time. This view can be rotated on either axis.*

What is HFx?

HFx is a powerful HF propagation tool that calculates ionospheric skywave signal strength from 2 to 30 MHz. HFx uses a very intuitive graphical user interface that heavily supports point-and-click and bases its operation on virtual-raytrace algorithms developed by ITS and CCIR over the last 30 years. The software creates three distinct output models designed around user input of:

- The geographic position of both transmitter and receiver
- Emission power and antenna characteristics
- Date and time
- Propagation path (long or short)
- Solar flux or sunspot number and K index

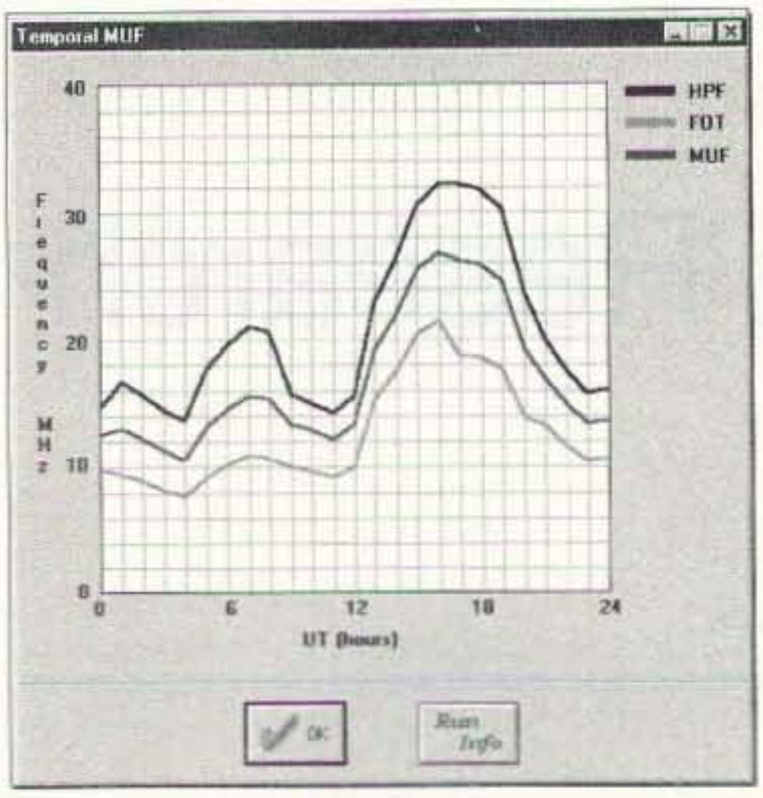

Fig. 2. Highest Possible Frequency, Maximum Usable Frequency and Optimum Traffic Frequency plotted between transmitter and receiver for a 24-hour period.

After you input the above information via dialog boxes or by point and click on a world map, HFx will give you the following models:

•Global MUF, which is displayed by user choice on a flat or spherical world map that can be configured for Highest Possible Frequency, Maximum Usable Frequency or Optimum Traffic Frequency. (See **Figs. 1a** and **1b.**)

•Temporal MUF, which consists of a 24-hour graph plotted for a path between the transmitting station and receiving station with frequency versus UTC time for Highest Possible Frequency, Maximum Usable Frequency or Optimum Traffic Frequency. (See **Fig. 2.**)

•Hop Mode, which provides both a graphic representation of the hop path between transmitter and receiver, and

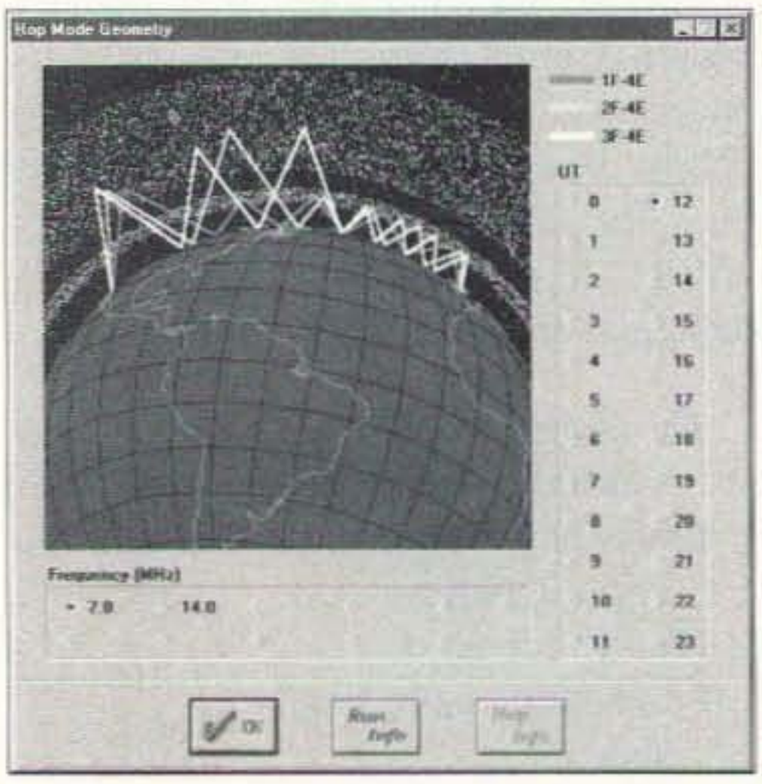

Fig. 3. Hop path for transmitter and receiver on 40 meters at 1200 UTC.

a plot of availability and signal-to-noise ratio for the HF amateur bands 80-10 meters during a 24-hour period. (See **Figs. 3, 4** and **5**.)

HFx system requirements are a little more robust than the typical hamfest junker PC, but with many hams upgrading their systems running it should not prove too great a challenge. Minimum configuration is:

386-based PC
Windows 3.1 or higher, including Windows 95
Hard drive with 6 megabytes of free space
3.5" floppy drive
4 megabytes of free RAM
Mouse
SVGA monitor set to 256 colors at 640 x 480

"HFx is a powerful HF propagation tool that calculates ionospheric skywave signal strength from 2 to 30 MHz."

Operation

The main operational window consists of a world map and two tool bars which provide access to all of the features incorporated in HFx (see **Fig. 6**). The map can be configured to show transmitting and receiving station placement, solar position, major world cities, great circle path between Tx and Rx, auroral boundaries based on geomagnetic activity and day/night terminator. The window can be resized via the mouse and the world view will automatically resize to the new window position with no need for scrolling. The system comes with an extensive online help system that mimics the well-written and illustrated manual. Political and state boundaries are not shown on the world map but dialog boxes allow entry via a scrollable list of call prefixes so that placing the transmitter and receiver can be accomplished without the aid of a world atlas.

After playing with HFx for a few

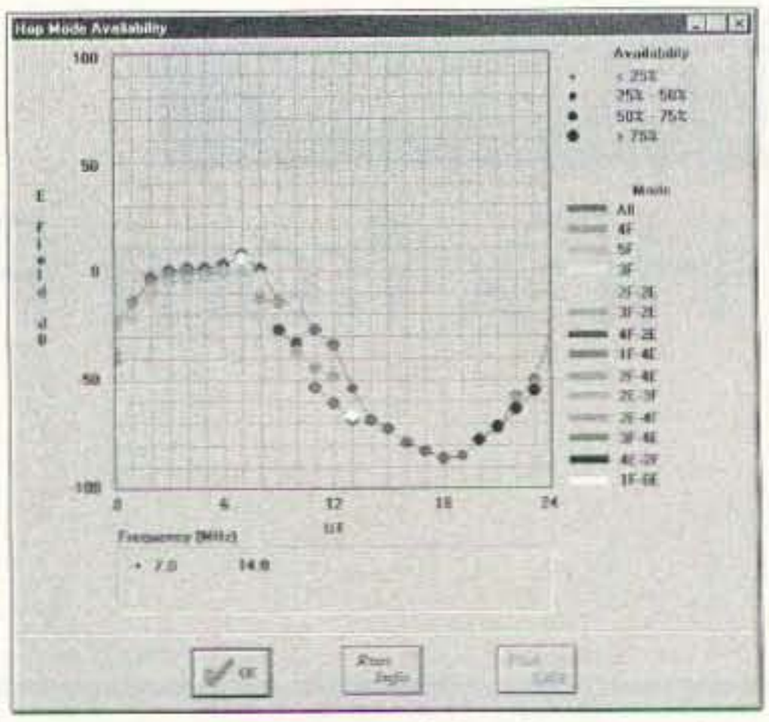

Fig. 4. Hop mode availability for transmitter and receiver on 40 meters over a 24-hour period.

hours you can enter data and get results in a matter of seconds, and it becomes fun to see what the software says about the possibilities for the QSO you are currently having. I decided to give HFx a shakedown by comparing its predictions with the actual contacts being made during the '96 CQWW RTTY and CQWW SSB contests. I decided to not only test it against stations that I heard from my QTH but also against station sightings that came in on the DX cluster during the contest. I was able to set up the transmit locations on cluster spots using the latitude and longitude information from a callsign CD ROM, and used the scrollable list of callsign prefixes on HFx for the DX station location. In addition, I used HFx to set up a number of skeds with stations here in the US based on optimal times predicted by the software.

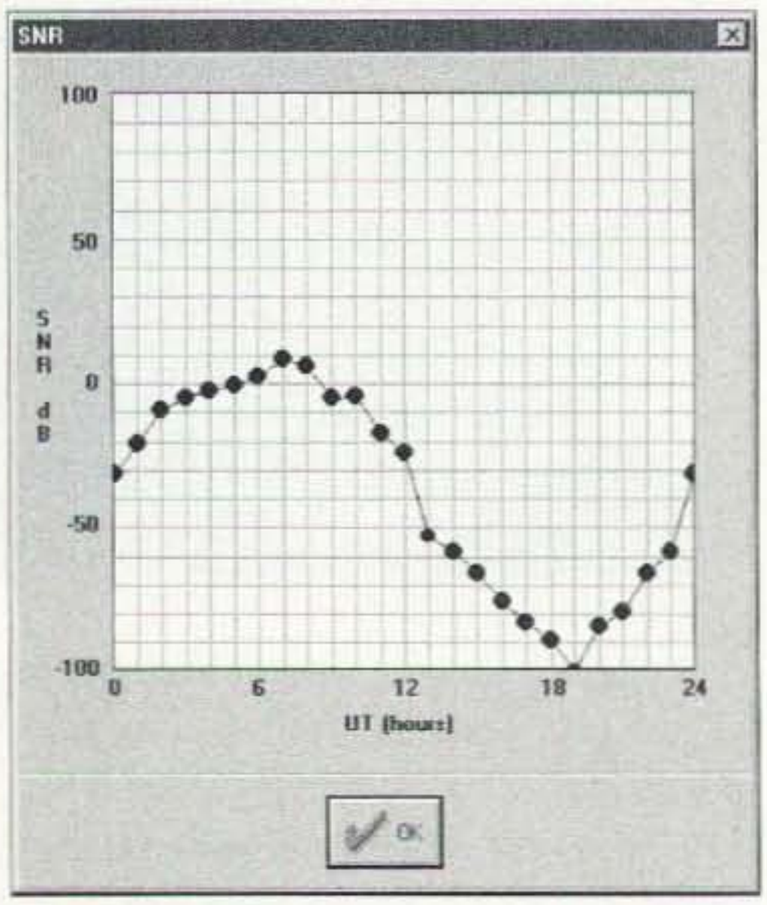

Fig. 5. Signal-to-noise ratio for transmitter and receiver on 40 meters over a 24-hour period.

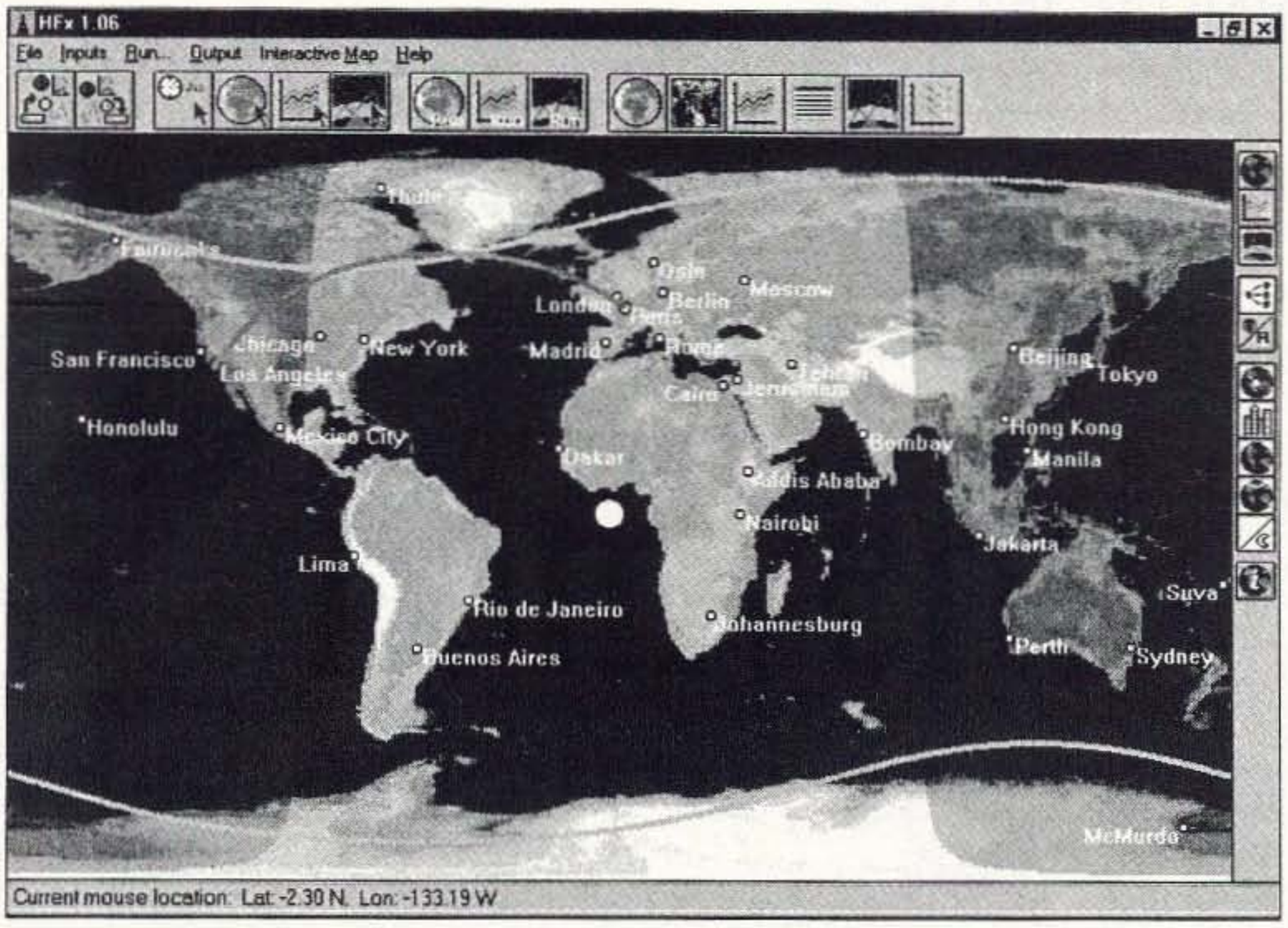

Fig. 6. Main screen, showing transmitting and receiving station placement, solar position, major world cities, great circle path between Tx and Rx, auroral boundaries based on geomagnetic activity and day/night terminator. These items may be turned on or off at user's discretion.

Conclusions

The results of my unofficial field testing were quite amazing. HFx was able to predict that communication should have been possible for recorded DX spots the vast majority of the time. In many cases, HFx showed a small window of opportunity at the Maximum Usable Frequency and, sure enough, spots would start showing up on the cluster. I also checked HFx against my station log randomly over a period of about six months and the vast majority of contacts fell within the plotted window of opportunity. I found the hop mode to be quite educational in that it gave a graphic representation of the signal path, availability and signal-to-noise ratio.

"I do like technology and, like most hams, I love toys; HFx fits both requirements."

I enjoyed using HFx. I don't have a "big gun" station and probably never will, but I do like technology and, like most hams, I love toys. HFx fits both requirements. I would like to see the next release of the software include a display of Lowest Possible Frequency and possibly dynamic real-time entry of the time at the transmit location, but for now I think the folks at Pacific Sierra Research Corporation have a winner.

Although it would take a serious amount of research with both transmit and receive stations available at different times, places, times of the year, and solar conditions to thoroughly test out any propagation software, I found the results that HFx produced for both my contesting experiment and setting up skeds to be quite impressive. One should understand that any propagation program just collates past statistical data in the hope of applying it to the future, which is never entirely predictable. Using propagation software does, however, give one a place to start when turning on the rig and wondering where that DX might be lurking or when the best time is to call that friend on the other side of the country. The little bit of magic that a program like HFx can perform sure can't hurt, and, after all, doesn't amateur radio involve just a little bit of magic?

Availability

HFx is priced at $129. If you are on the Internet you can get product information, order HFx or download a demo copy of HFx at: <http://www.psrv.com/hfx/>. Or, contact the company directly: Pacific Sierra Research Corporation, 2901 28th St., Santa Monica CA 90405-2938; (800) 820-4PSR, (310) 314-2300 outside US and Canada. 73

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73 Review

MultiFAX® AM/FM WEFAX Demodulator

Fine-tuning a satellite tracking system.

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I had spent the last several weekends working on my overall weather satellite Automatic Picture Transmission (APT) receiving system. My Hamtronics R139 was built and working well. The Woodhouse Communications Turnstile antenna was assembled and mounted on a tripod on the roof, along with my LNG-137 preamp. I was receiving weather satellite transmissions left and right. Unfortunately, most of the passes I received were coming in totally randomly. I was simply recording everything that came in, and laboriously sorting through the pile later. This worked, but it took several minutes to watch each image paint itself on the screen—only to find out, in some cases, that it was a totally uninteresting shot of some clouds out over the ocean. Since I was primarily interested in the weather occurring in my own general vicinity I found that I was wasting an awful lot of time. It was time to do some homework on my new demodulator.

I purchased my demodulator based on recommendations from a couple of knowledgeable friends, rather than on my own understanding. Once I had my weather receiver up and running well enough to hear anything, I fired up the demodulator and learned enough about it to demodulate pictures. Then I went back to improving my antenna installation. Now that the antenna was installed I had time to fine-tune the final part of the system.

My demodulator was the external demodulator unit from MultiFAX®. This demodulator works in conjunction with MultiFAX's MFMAP Version 7 software, providing a means to decode several types of weather satellite images. I was new to the satellite image business, and wasn't sure exactly what I might be wanting to decode—either right now, or in a year or two. The MultiFAX unit supported NOAA, Meteor, GOES, Meteorsat and HF WEFAX. I had also chosen the MultiFAX because it comes in an external version—I didn't have to tear my PC apart to install a card, and I could easily use the external unit with my laptop. (Of course, the MultiFAX does come in a PC card model for the diehards.) The MultiFAX hooked up via the PC's printer port for full parallel data operation. I knew that some units only used the serial port, which limited their overall data throughput. (I had certainly learned this with my experiences with the home-brew, shareware-supported demodulators.) Another necessity was the ability to record satellites unattended—I certainly couldn't be home to fire the software up in the middle of the day.

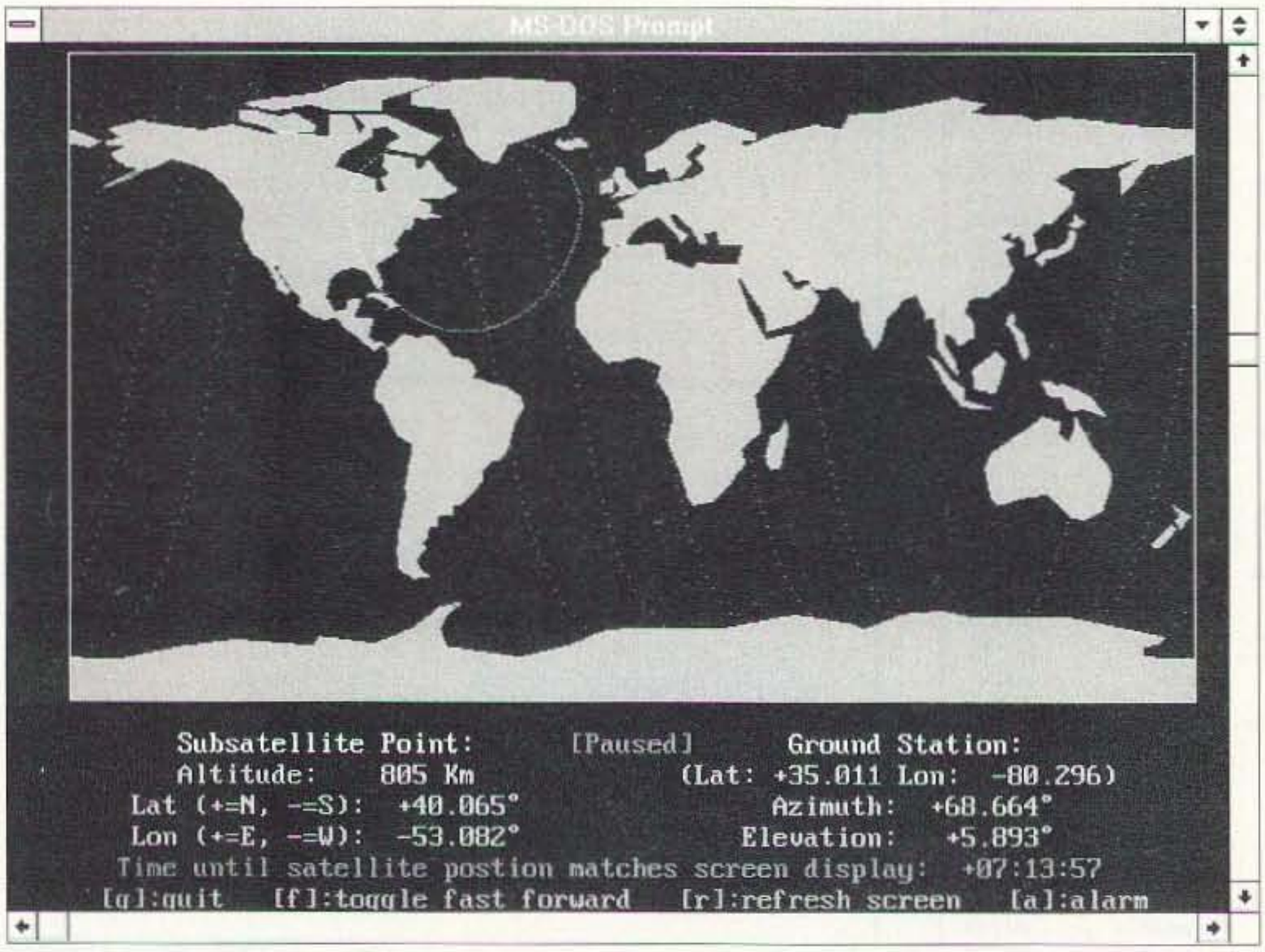

***Photo A.** MFMAP7 provides a real-time graphical display as it plots satellite locations.*

What little knowledge I accumulated had easily taken me to the point where I could decode and display images. The installation of the unit itself and the MFMAP7 software was a cinch—just plug the box into your computer with the supplied cable, copy the files from the disk, and hit the road. MFMAP7 takes up about 800 kilobytes on your hard drive, but you'll need about 4 MB total available space. A complete satellite pass gets "recorded" to the hard drive in real time, and takes as much as 3.5 M per image! About the time I decided I needed to learn more about the MultiFAX unit I also found out I needed to do something about the couple of dozen 3.5 MB files on my hard disk—things were getting pretty crowded!

Using it? Simple!

At this point I decided to read the manual, which, in retrospect, was not a

bad move and perhaps should have been attempted earlier on in the game. To begin with, I found that there was no reason to save all of those fat files on my hard drive. The MultiFAX software uses three main types of files. The first type is a Picture file. This file is a complete data recording of the entire satellite pass, and is the 3.5 MB file discussed earlier. This file is recorded from the pass, or the tape recording of the pass, and stored to disk. Once stored, the image is called up using the Display menu of the program. The display menu lets you zoom in and out, invert the image, change the brightness and contrast, and perform various types of image enhancement. Once the image is modified to provide the best picture, you can save it as a View file. A View file is saved in binary format, and consists only of the interesting information cropped from a Picture file. This lets you save just the valuable information from each image, and not use up disk space with useless images. The third file format is the common .GIF format. Either the View or Picture screen lets you output the image to a .GIF file that can be easily used in desktop publishing programs or printed out.

Once I determined that there was no need to be hoarding those huge Picture files, the process became much simpler. To record a file, you simply select the Record option from the Main Menu. This lets you give a filename to the image you are about to record. At this point MFMAP7 displays a graphic signal level meter. This would more accurately be called an on-screen oscilloscope. The meter is a display that shows the relative "brightness" level of the received signal for its entire trace across the screen. A too dark signal will be seen as compressed near the bottom of the display, while an overly white image will be seen crowded near the top of the display. It's a simple matter to adjust the output control of the MultiFAX unit to correct the image, providing a proper range of contrast for the image—before you even start recording. Once the contrast is adjusted you simply hit any key, and the MultiFAX goes into AutoStart mode. This mode synchronizes on the left edge of the image, so the recording will start at the proper time to create the image properly aligned with the screen. (Of course, if for some reason the signal is lost and the image starts recording with the edge going down the middle of screen, the situation is easily corrected once in the Display menu.) As the unit records, the image is traced out to the screen a line at a time, over the next several minutes. A keystroke stops the recording, saving as much of the image as has been recorded up to that point.

The recorded image is then called back up in the Display menu. This menu allows zooming in and out, inversion of the image, changing of the brightness and contrast, false colorization, and a variety of other functions. A section of a Picture is saved as a View, which takes up only a few hundred kilobytes of disk space.

Scheduling the recording

After the novelty of satellite imaging wears off, you'll find yourself not necessarily wanting to record every single bird that passes within earshot. You'll probably want to tailor your recordings to capture just passes that go right over your location, or perhaps you want to capture all the images you can—but just in the three hours before Saturday's ball game. In this case, the Record menu offers a timed function that will start recording a single image at a specific time, based on your computer's clock. In addition to this "wait until recording" mode, MFMAP7 also includes a utility that allows use of a separate schedule file, and will call the Record module at specific times. Using the feature you can record up to 200 passes automatically—as long as you have about 700 MB of space available on your hard drive!

But how do you know when the satellites will be coming over so you can set the timer properly? Luckily, MFMAP7 has a built-in satellite tracking function. This uses a graphical display that shows a world map, and traces the path and footprint of each of the satellites. This display works in both real and accelerated time, so it is very easy to see what will be visible from your location for the rest of the day. The software even tells you the number of hours to wait until the next pass of the selected satellite. Of course, as with all tracking programs, you'll need to download the Keplerian elements on a regular basis so the program can fine-tune itself. These are available from the MultiFAX BBS or via the Internet. The satellite tracking feature of MFMAP7 supports the Kansas City Tracker system, meaning you can have the software automatically adjust your antennas for you as the satellite passes over.

Once you have the proper images recorded, the MultiFAX software supports grid and map functions that allow the user to overlay latitude and longitude lines, as well as map information. More advanced "frosting on the cake" features include the ability to create pseudo three-dimensional images, colorization based on temperatures, infra-red optimization to allow temperature data to be read directly from an image, and even animation. (Yes, you can produce your own moving cloud images just like on the six-o'clock news!)

The MultiFAX WEFAX Demodulator, combined with the Hamtronics R139 receiver, and the Woodhouse Turnstile antenna, has proved to be a very satisfactory weather monitoring station. However, even with all the resources available, including one's own "eye-in-the-sky," I still find myself occasionally getting outsmarted by the weather. I suppose this is simply Nature proving that she's superior to technology, and may never change. Until it does, I still keep an umbrella in the trunk. For more details contact: MultiFAX®, 321 Mason Road, Fairport NY 14450; Telephone (716) 425-8759; FAX (716) 223-6198; BBS (716) 425-8759. 73

An Enhanced Automatic Voltage Controller

Make this project even more useful.

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I try to read all the projects published in the amateur radio literature, especially those in *73* and *QST*. There are many neat ideas in these articles and sometimes if I find a project I can use in my shack, I'll build it. Even if I don't build the project, it is fun to see the different solutions people offer to solve a problem. I have learned a lot about electronics just trying to understand how the different designs work, and I like to design projects myself, so I am always looking at a project to see if I can think of a different (and possibly better) way.

I recently read "Automatic Voltage Controller" (*73*, August 1996). It seemed like a great project and was one I wanted to build. I have had firsthand experience with voltage

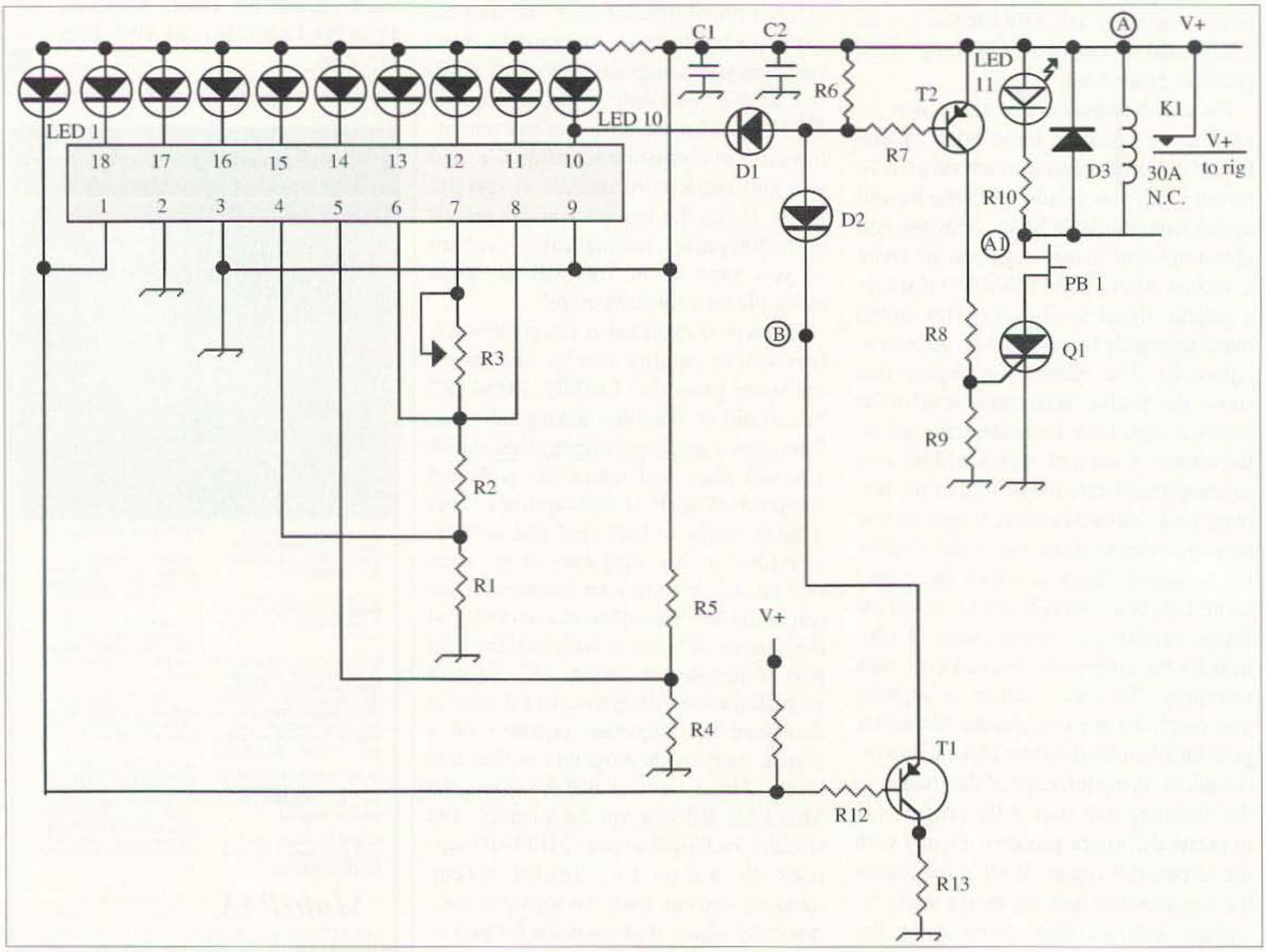

Fig. 1. *Schematic for the modified Tiny Tic-Tac Tester (left) with the enhanced voltage controller (right).*

Photo A. *Enhanced Automatic Voltage Controller with remaining 40 amp relay.*

out-of-range problems. I use an IC-735 on my sailboat when I cruise, and like all sailors, I never seem to keep my batteries fully charged. One day when transmitting, the rig just shut itself down. Eventually I got it re-started but it was not the same. Evidently the low voltage had ruined one of the ICs in it. That turned out to be a $100 learning experience. Is it any wonder I was interested in this project?

Enhancements to the AVC

After thinking about the project for a few days, I decided I wanted to enhance it. The project shown uses zener diodes to set the upper and lower voltage control levels, which works fine but doesn't let you see what the actual voltage is during operation. You may recall I wrote a project article for *73* in March 1996 ("The Tiny Tic-Tac Tester") that was based on an LM3914, which accurately displays voltages. I wanted to add this feature and use it to control the relays as well.

Another feature I thought might be useful was latching relays. Low voltage often occurs when you are transmitting. When you stop transmitting, the load decreases and the voltage increases. With the original design, the AVC would turn on again; indeed, it seems possible that the relays would chatter on and off. I wanted to have those relays trip and stay tripped until I was able to correct the problem.

Finally, I wanted to eliminate as many of those mechanical relays as possible and use electronic relays. My enhancement eliminates two of the three relays.

The design

Fig. 1 shows my enhanced controller schematic. I have drawn it in two parts. The left-hand side is the same circuit used in "The Tiny Tic-Tac Tester," with R1, R2 and R3 set for a voltage range of 11.4 to 15.0 volts. A

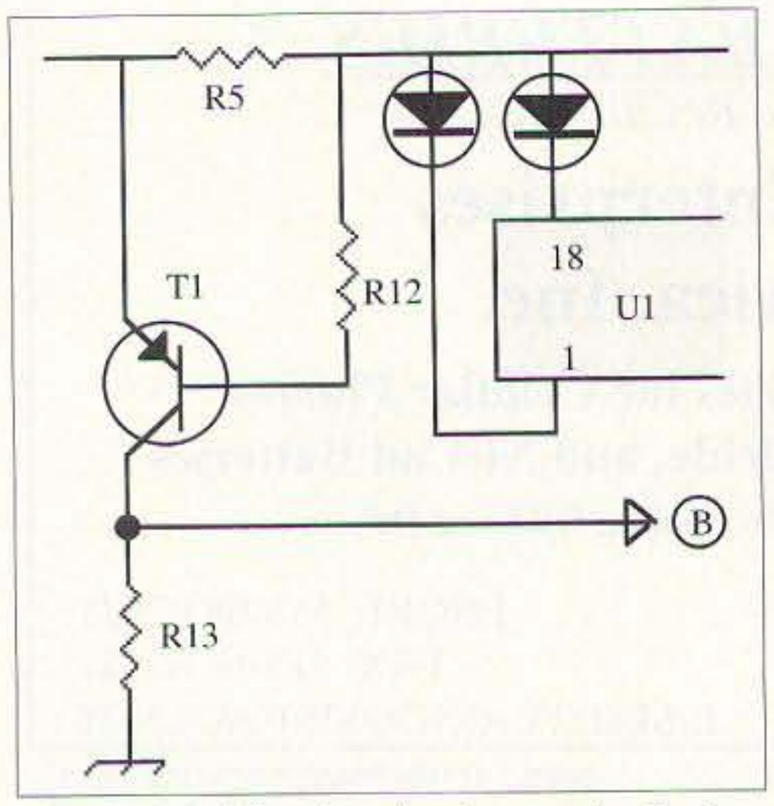

Fig. 2. *Modification for dot mode display. Connect T1 as shown. Note: R11 is not used.*

complete description of this circuit is given in the original article. Briefly, the supply voltage is divided down by R4 and R5 and fed to pin 5 of the LM3914. R1, R2 and R3 are used with the onboard voltage reference to set the low voltage limit at pin 4 and high voltage limit at pin 6. I tied pin 9 to V+ to get a bar mode display for this project. When the supply voltage is less than 11.4 volts, all LEDs are off. As the voltage rises from 11.4 to 15 volts LEDs turn on from left to right. The higher the voltage the more LEDs are on until at 15 volts all the LEDs are on. With 1% resistors for R1 and R2, this is an accurate expanded scale voltmeter. I set R3 for an LED current of about 4 mA to limit the power that LM3914 would have to dissipate. It would, of course, be possible to use the dot mode instead of the bar mode, requiring only a small design change for the low voltage input (see "Alternative Circuits" below).

While an LED voltmeter may seem obsolete when fancy digital voltmeters are readily available on the surplus market, the LM3914 offers a feature no digital meter can. It can be an active part of the circuit, allowing it to control the circuit, as well as displaying the voltage in a passive fashion. To see how this works, note that I have attached a wire from the cathode of LED #10 (the one that turns on when the voltage reaches 15.0 volts) to the base of transistor T2. When the supply voltage reaches 15.0 volts, the LM3914 turns on LED #10 by allowing current to flow from its cathode to ground. When it is off, the LM3914 does not let current flow. Because T2 is connected to the cathode of LED #10, current will also flow from its base to ground so T2 turns on when the LED turns on. So with just one additional wire the LM3914 can turn on a control transistor when the voltage reaches 15.0 volts.

The other control point is when the voltage falls below 11.4 volts and LED #1 turns off. This is done the same way except that I wanted to turn on T2 when LED #1 turns OFF rather than when it turns ON. T1 is used to invert the effect of LED #1. When LED #1 is on, current is flowing from its cathode to ground, and because T1 is connected to its cathode, T1 is also turned on. This puts V+ across R13, and therefore on the base of T2, preventing current flow from the base of T2. When LED #1 shuts off, T1 shuts off and the voltage across R13 goes to zero, which lets current flow from the base of T2 to ground, turning it on.

The diodes D1 and D2 prevent interaction between LED #1 and LED #10 and make control of T2 an "OR" operation. If LED #1 is off *or* if LED #10 is on, T2 turns on.

With the LM3914 voltmeter now turning on T2 at the limits I set, I needed T2 to trip a latching relay. Q1 is that relay. Q1 is an silicon-controlled rectifier (SCR). One characteristic of an SCR is that when it is turned on (conducting) it will continue to conduct until the current through it stops. In other words, it is latched on. The gate of Q1 is used to turn the SCR on. When T2 is off, no current flows through R9 so Q1's gate is at ground and Q1 does not conduct. When T2 turns on, the gate is pulled high and current flows through Q1, energizing relay K1 and opening it. The only way to close the relay is to stop the current through Q1. Push-button PB1 does this reset job. LED #11 indicates that the circuit has tripped.

That's all there is to it! The circuit draws about 25 mA when it is in standby (depending on how many LEDs are on) and 200 mA when it trips the relay. Not much power—and *that* can be reduced by using the dot mode display if you desire. See below.

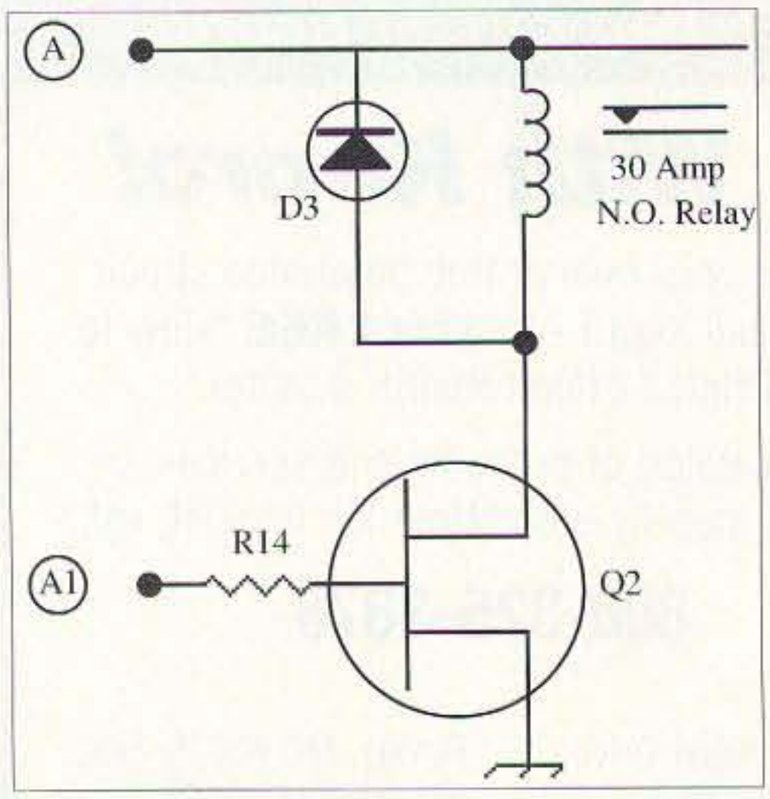

Fig.3. *Modification to use NO relay. Replace NC relay between points* ***A*** *and* ***A1*** *in* ***Fig. 1****, with circuit shown.*

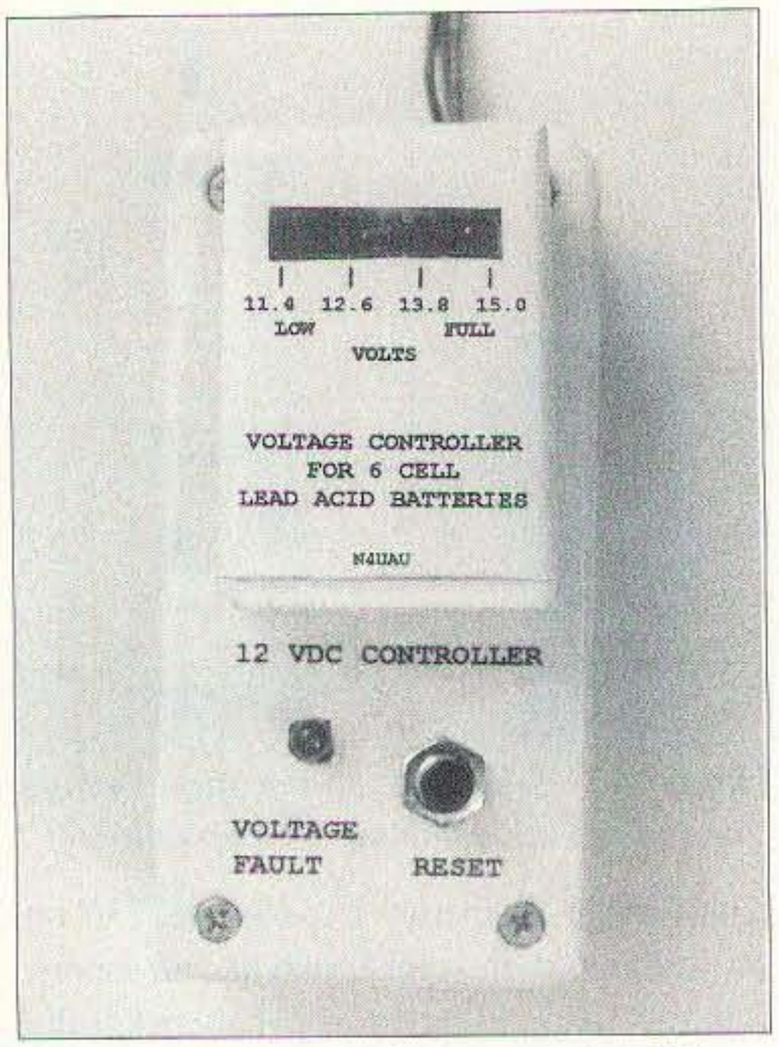

Photo B. *Enhanced Automatic Voltage Controller in its "elegant" case.*

Alternative circuits: Using the dot mode for voltage display

While the circuit does not draw much power, it is possible to reduce the current to around 12 mA by operating the LM3914 in the dot mode. This will also reduce the power dissipated in the LM3914. If you wish to run the LM3914 in the dot mode, LED #1 will not work as a control point because it has too high a leakage current in the dot mode (this is a basic LM3914 design fact). The circuit is easily modified, as shown in **Fig. 2**. R15 will cause T1 to be on whenever *any* LED is on. When the voltage falls below 11.4 volts all the LEDs turn off and no current flows through R15 (except leakage current). Setting R3 at about 360 ohms (for 4.0 mA of LED current) gives a voltage drop of about 1.4 volt across R14 when any LED is on which turns on T1.

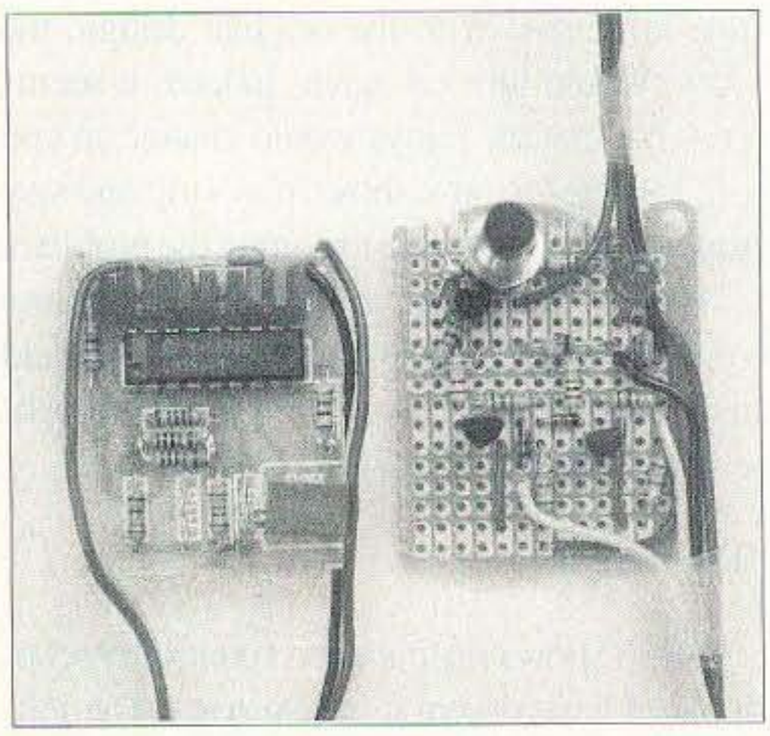

Photo C. *"Guts" of the Enhanced Automatic Voltage Controller. Note the simple parts layout on the Radio Shack PC board.*

Using a normally open relay

If you want to build this project but don't want to have to locate a high-current NC relay, you might do what I first did, and use the Radio Shack™ NO relay (275-226). To use the NO relay it is necessary to modify the circuit a bit. See **Fig. 3**. Q2 is a MOSFET which is turned on when Q1 is not conducting because its gate is high. This holds the relay closed. When Q1 conducts, Q2 shuts off and the relay opens. You might wonder why Q2 is a MOSFET and not an NPN transistor. Q1 is basically a diode so when it conducts the drop across it is about 0.7 volts. This will not turn off a transistor but will turn off a MOSFET which needs about 2 volts on its gate to conduct. This circuit will draw around 200 mA because the relay coil is energized all the time. The addition of a simple SPST switch between the coil of K1 and V+ will let you de-energize the coil when you are not using the rig. You still get the voltage display from the LM3914 and current draw is only 25 mA.

Parts List	
(All resistors 1.4 watt 5%, unless otherwise noted.)	
R1	7.68k 1%
R2	3.83k 1%
R3	3.2k (1.2k fixed and 2.0k pot)
R4	10.0k 1%
R5	5.0k 1%
R6	24k
R7	15k
R8	100k
R9	15k
R10	1k
R11	24k
R12	15k
R13	10k
R14	33k
R15	360 ohms
C1,C2	1.0 µF
T1	PN2907
T2	PN2907
Q1	2N5061
Q2	IRFD020
D1,D2	1N4148
D3	1N4001
LED#1-11	LEDs
PB1	NC push-button

Obtaining the parts and building the project

I built the AVC part of the circuit in a small Radio Shack box and glued my modified TT-T Tester (still in its original Tic-Tac-box case) to it. It may not look elegant but it was quick and easy to build and it works fine. After all, I wanted to improve the circuit, not the package!

Parts are available at the usual parts suppliers. I still have parts (including a PC board and 1% resistors, for the 11.4 to 15 volt range) and can supply the parts for the rest of the project, except for a PC board. As **Photo C** shows, the rest of the circuit is simple enough that it can be easily made on a Radio Shack universal board (#276-150).

Tiny Tic Tac Tester: All parts, PC board, instructions—$15.

Voltage Values Displayed by LM3914	
LED# Turns On	**When Voltage Reaches**
LED#1	11.4 volts
LED#2	11.8
LED#3	12.2
LED#4	12.6
LED#5	13.0
LED#6	13.4
LED#7	13.8
LED#8	14.2
LED#9	14.6
LED#10	15.0

All parts for the Enhanced Voltage Controller (includes the Tic Tac Tester parts, plus all parts and instructions for the controller except a PC board; includes a 40 amp NC relay—$25. 73

Ask Kaboom

Your Tech Answer Man

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Still More Stress

For the last few months, we've been discussing electrical, mechanical and thermal stress, examining how each affects various components. Let's continue:

More caps

When we left off, we were looking at capacitors. The problem with caps is that there are so many different kinds, it makes it hard to generalize about them! So, let's look at still a few more types of caps.

Plastic capacitors, typically made of polypropylene or polystyrene, are used where low drift and accurate capacitance are required. Many plastic caps come in small, green, dipped packages and are somewhat rectangular, often with rounded corners. Inside the hard-dipped shell is a foil and plastic arrangement that's wound in layers, at least in the larger values. The stability of plastic caps comes from the inherent stability of the plastic itself, which changes its dimensions and density very little with temperature.

Plastic caps are very rugged. You won't break them if you drop the rig. (Of course, if you sit on it, that's another story.) Their voltage ratings vary from around 50 volts to considerably higher voltages. As with any cap, you can blow holes in the insulating layer with too much voltage.

No plastic cap should get hot in normal operation. I've never seen a leaky one but, of course, it could happen. As with any leaky cap, the resulting current flow would heat up the part.

External heat doesn't seem to be much of a problem with these caps, either. The plastic insulating layer inside could melt if things got *really* blistering, but that would be an extreme circumstance. I have seen a couple of open plastic caps near big heat sinks, but not for many years. I suspect their reliability has increased over the last 10 or 15 years.

Variable caps

Most variable caps use either air or plastic for their insulating layers. Air caps are nothing more than plates with space between them! They are fairly rugged, but the plates can be bent pretty easily, making them subject to mechanical stress. If the plates get too close to each other, the cap will be more susceptible to overvoltage arcing. And, of course, if the plates actually touch those from the opposite side of the circuit, the cap will become a conductor, and cease being a capacitor at all!

Plastic variables are less prone to plate bending because the plates are pushed up against the plastic, rather than hanging free in space. They are pretty hard to break, unless you turn one so hard you tear the plastic. It's not easy to do.

While receiver circuits use such low voltages that they don't stress variable caps, the voltage ratings of the parts must be carefully observed when the caps are used in transmitters. A high SWR, or a transmitter pushed to produce more power than it was built for, can raise the RF voltage high enough to punch through plastic caps, or to arc over air caps. Plastic caps will be ruined if the plastic has holes zapped through it, but air caps may survive. An arced air cap, though, will have burn marks on it, and those areas will not work as well as the normal metal, resulting in a less-efficient cap. Also, a hot enough arc may actually melt the metal plates, destroying the capacitor. I've seen plenty of arced air variables in antenna tuners, though, and that still seemed to work fine.

Important note: The voltage ratings for caps are normally stated in volts DC. At radio frequencies, the number must be derated (made smaller) by a factor that depends on the frequency of operation—so don't assume a 100-volt capacitor will withstand 100 volts of RF at 146 MHz! At such a high frequency, the part may break down with perhaps only 30 volts across it. Cap manufacturers usually offer derating charts that show permissible voltages at various frequencies.

"If things get hot enough to melt metal plates you have more to worry about than capacitors!"

Like all caps, variables shouldn't get hot. Plastic ones can be leaky, but it's rare, especially since they pretty much never have serious power applied to them. Air variables only leak if they become very grimy or oily, opening a new path from one side to the other. Of course, if you arc an air variable, it isn't going to stay cool!

External heating can kill a plastic variable, but generally not an air variable. If things get hot enough to melt metal plates, you have more to worry about than capacitors!

Inductors

Coils and transformers are subject to stress, too. Many are tightly wound and have shellac or something like it coated on the wire for insulation, rather than the plastic jacket used on normal hookup wire. It's often important for the insulation to be thin because the tight windings provide maximum magnetic energy transfer, thus maximum efficiency—but that thin insulation can break down from excess voltage.

Essentially, the adjacent windings act like capacitors because the two wires can, at any given moment, be at different voltages as the energy moves back and forth within the coil. Two conductors at different voltages, separated by an insulator (here, the wires' insulation) equal a capacitor, right? So, the rules for caps apply here, as well as others relating to wire itself (like melting!).

Typically, coils and transformers break down in two ways. Adjacent windings short to each other, especially in high-voltage transformers, such as the "fly back" transformers in TV sets and computer monitors. Or, windings melt, causing an open circuit. That, of course, is caused by excessive current heating the wire enough to melt it. It happens more often than you might imagine. In fact, it's probably the primary cause of transformer failure.

Although external heating is unlikely to kill inductors, internal heating is their nemesis. Like resistors, though, most inductor failures are caused by some other circuit's pulling too much current through the wire. And, oddly, the damage may be on the other side of the magnetic circuit! Many power transformer primaries open after something shorts out the output of the secondaries! The secondaries themselves are often unharmed.

Switches and relays

Contacts have several failure modes. Overvoltage can cause them to arc, just as in the plates of an air variable capacitor, which is essentially what a switch is when it's off. As you turn it on, the contacts get closer and closer together, until the voltage can break through the air between them and arc over.

Overcurrent can actually weld contacts together! I used to have a linear amplifier whose power switch did that all the time. The inrush current to the power transformer was so huge that, if the switch contacts happened to touch right around the moment the AC power input's wave was at maximum, the switch would weld itself in the "on" position, requiring me to pull the switch out and break the contacts apart with a screwdriver (after unplugging the amp, of course)! It used to happen only about once in 20 times, but it was a pain in the neck.

Relay contacts are just switch contacts, so they suffer the same problems. Contacts should never get hot. If they do, check them for blackening or loss of plating. As long as the resistance is nice and low, significant heat is not going to happen.

Many people file contacts, but it is a cure somewhat worse than the disease. It will work for a little while, but the loss of the plating which occurs with filing usually leaves pure copper, and copper makes soft, easily damaged switch contacts—that's why they plate the darned things in the first place. Filed contacts usually go bad again in very short order.

Connectors

There are so many kinds that it's hard to classify them. Normally, connectors are hardy, unless you arc them over with way too much voltage. Some insulating materials used in RF connectors, though, can heat up if lots of power is applied, especially at very high frequencies. After all, a connector is a capacitor, too, what with its having two conductors separated by an insulator. It really pays to observe power and frequency limits for the various kinds of connectors, and to always use connectors appropriate for the purpose.

Well, I think we've covered the stress issue pretty well. Next time, something different! Until then, 73 from KB1UM. 73

HAMS WITH CLASS

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The Keys To Success

As a follow-up to previous columns which described various telegraph keys that my ham radio classes have had fun making, I'll describe one that many students used for this year's Science Fair at our school. Most of the materials are easy to obtain so we didn't run into that as a problem.

"All the kids had a chance to participate in contributing something to the display."

Construction

For this key you will need: 10 feet of insulated wire (commonly called bell wire), a dry cell, a three-inch by four-inch piece of aluminum foil, three brass paper fasteners, a large nail, a paper clip, and a milk carton.

First, cut away the top of the carton. Then cut a piece one inch wide by three inches long from the center of one side of the carton. Next, cut the opposite side.

Cut a six-inch piece of wire (to be used later). Then wrap the remainder of the wire around the nail to make an electromagnet. Leave six-inch ends to the wire. Remove the last inch of insulation from each end, and also from the ends of the six-inch piece. Wrap the aluminum foil around the strip you cut from the side of the carton. Then fasten it at the top of the milk carton, using a brass paper fastener. At the same time attach one end of the wire from the electromagnet to the fastener. At this time also attach the short piece of wire to its fastener.

Now slip the dry cell inside the milk carton. Attach the other end of the short wire to one pole of the dry cell, and the wire from the electromagnet to the other pole.

Attach the paper clip and a brass fastener to the cut strips at the side. Stick a small piece of cellophane tape over the paper clip. Put the electromagnet in place with the end about one-quarter inch above the paper clip.

Displaying the keys

Now the kids in your class will be ready to put all the telegraph keys on display or to put their own telegraph company into business. Sometimes there's a problem getting the milk-carton telegraph key to click. If you don't get a click, move the electromagnet down a tiny bit at a time until you do.

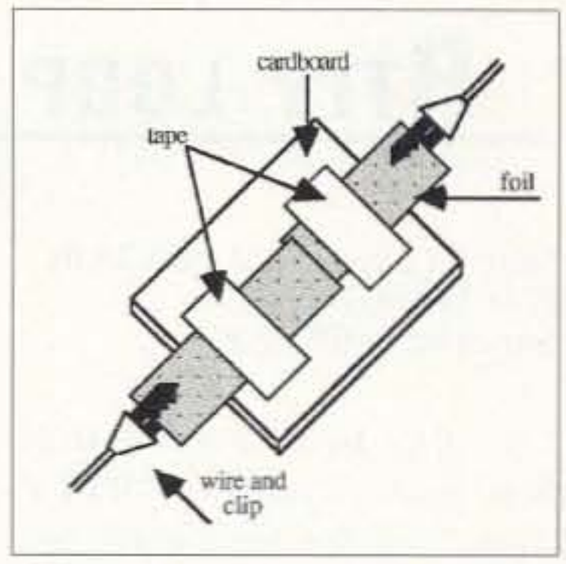

Fig. 1. The milk-carton telegraph key.

For this display of telegraph keys that one of my classes was working on, the kids came up with a great idea. They not only showed all the different types of homemade telegraph keys that were fun to make, but they did some research, built older models, and included photographs of some classics.

In a future column I'll show photos of the actual displays the children organized. It was a wonderful project and it gave all the kids a chance to participate in contributing something to the display. 73

***Photo A.** Alicia Kube (left) and Diana Dasalla, 7th grade ham radio students, doing a presentation on telegraph keys and batteries.*

RTTY LOOP

Amateur Radio Teletype

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As has been my custom these past 20 years of "RTTY Loop," let me be among the first to wish each and every one of you a Happy New Year! May this year be one of health, success, and peace for us all.

We have been discussing, of late, all of the latest computer programs available for radio teletype, packet, and other digital forms of communication. One question often asked is where these programs may be found. This month, here's a look at two massive online sources.

CompuServe

The granddaddy of online services, CompuServe, has recently revamped its interface and, with CompuServe 3.0.1 as an access program, the service has a new face, if not new content. The amateur radio segment of CompuServe can be reached by the GO HAMNET command. **Fig. 1** shows the opening screen of this venerable resource.

Fig. 2 shows the variety of topics covered in the message section, ranging from scanners to packet to company-specific information. Within each section are a few to dozens of messages dealing with a wide range of information. This is a good place to post that question or puzzle that interests you. It is likely the answer will be there the next time you check in.

A similar range of topics is covered by the file libraries, shown in **Fig. 3**. With 23 sections of information and hundreds of files available, this is often the first place to find the latest release or update of ham radio software.

Over the years, I have always found a wide variety of material on the CompuServe system, with a breadth that is hard to beat. You don't need the latest access program to use the service—the content is the same no matter which door you come in.

America Online

Although quite a bit younger, America Online has made quite a name for itself, and has quite a nice amateur radio section, as well. **Fig. 4** shows the entrance screen for their Ham Radio Club, reached with the keyword Ham Radio. There are quite a few features, as can be seen, although the ARRL section is a tad dated, with information many months old online.

Just as with CompuServe, a message section is available, as shown in **Fig. 5**, with a variety of topics and room for thousands of messages. Unlike CompuServe, where messages scroll off the system after a while, AOL seems to hold them online for much longer, making searches of topics and threads a bit easier.

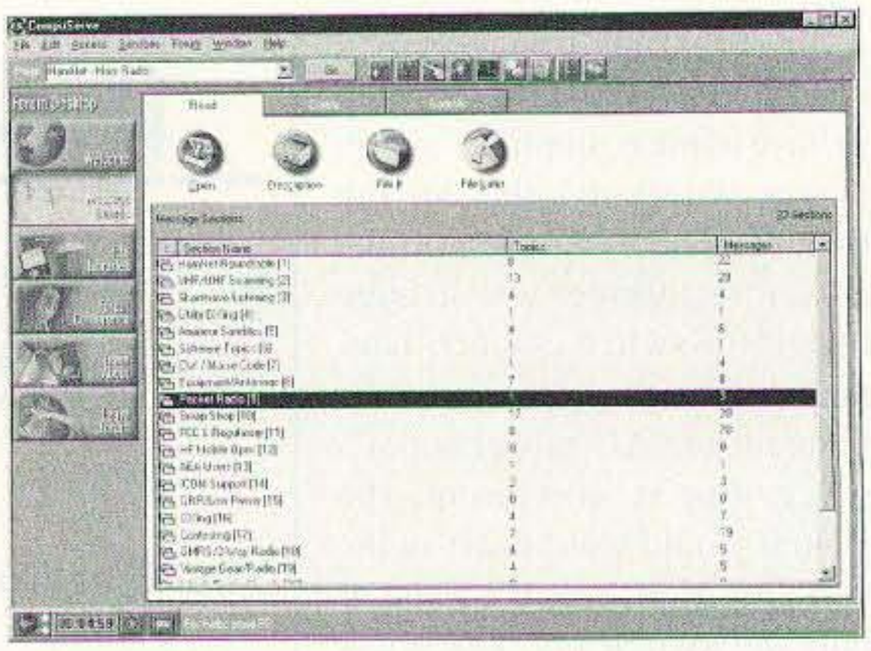

Fig. 2.

Their Software Exchange, shown in **Fig. 6**, supports file libraries for a variety of systems. Even the Macintosh, which seems poorly represented on some systems, has a section; **Fig. 7** shows what is currently available. There is also a live conference area, which sponsors online chats, giant cyberworld QSOs, on various ham radio topics.

> ***"Recently-introduced economy and flat rate pricing structures have made using CIS and AOL much more attractive."***

Although these online services were once quite expensive, recently introduced economy and flat rate pricing structures have made using CIS and AOL much more attractive. If you are on one of these services, why not take a look at the ham radio boards, if you have not already. For some users, these represent an attractive alternate to other types of online providers.

An example

While online, I received a message on CompuServe from S. Neil Xenias N4CTB, who posed the following question: "I have recently purchased a Dovetron Terminal Unit, and I'm wondering if it is worth adding to the digital portion of my ham station. It appears to be operational, and I noticed the digital (RS-232) output port on the rear panel, thinking perhaps it might work with a computer-based station. I have contacted Dovetron for advice, and was hung up on (twice) when I mentioned requesting technical assistance. So with hurt feelings, I thought of asking you for advice. Should I keep this thing or cannibalize it?? Thanks in advance, Doctor, and my best 73!!"

Well, Neil, the Dovetron terminal units have been quite popular for many years, and I would be surprised if it would not do you well. I understand the need for documentation, though, even if the folks at Dovetron do not. So, I turn to the readership of this column. Anybody? If so, drop me a note, or direct the information to Neil directly. I know you won't let me down.

Of course, when it comes to online sources, you can't go wrong surfing on over via the Internet to the RTTY Loop Home Page. I have been doing some upgrades and am trying to put some of the programs you have

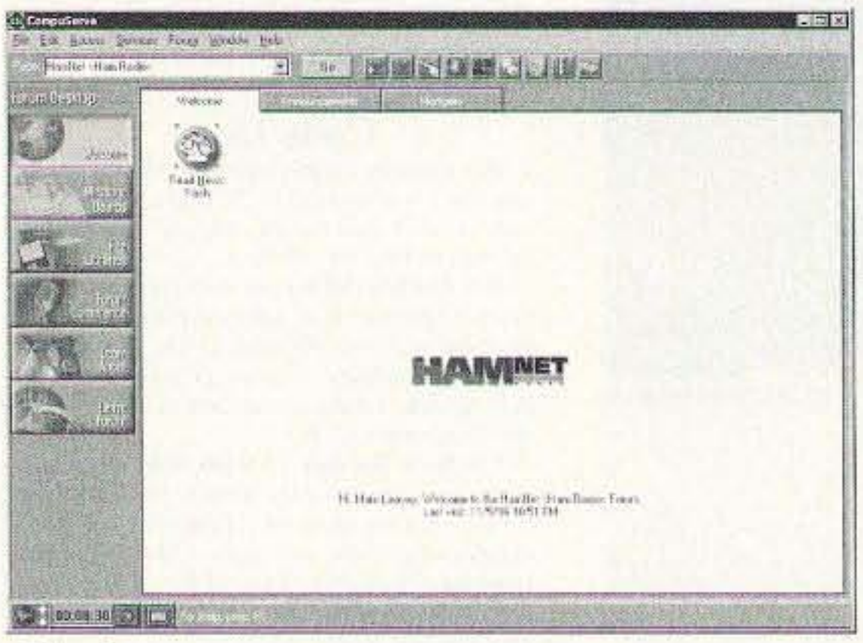

Fig. 1.

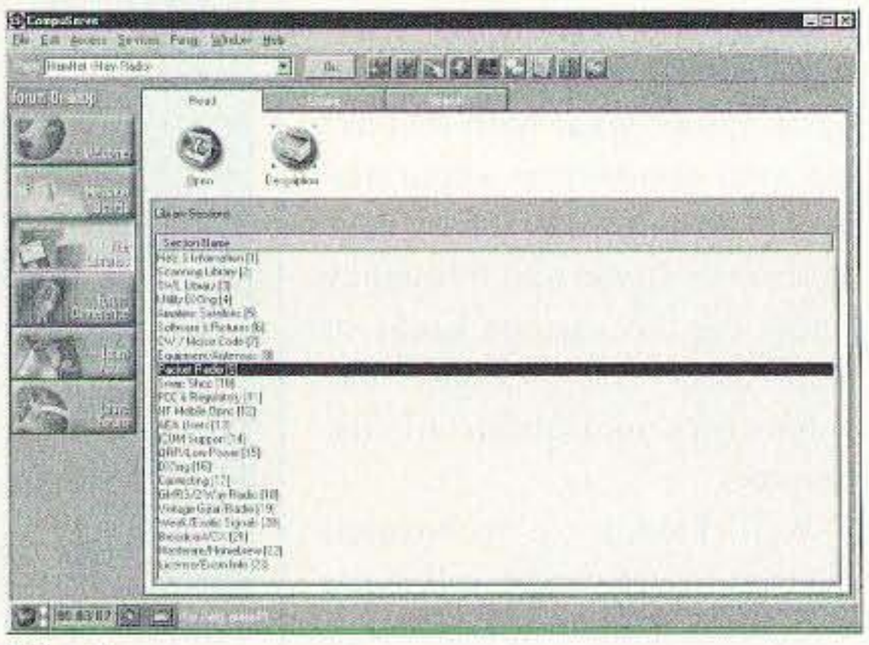

Fig. 3.

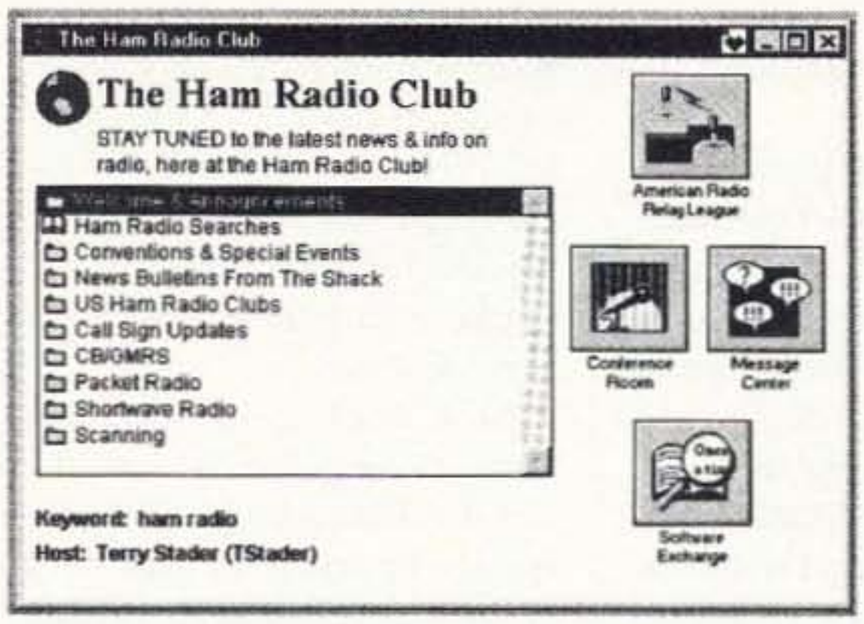

Fig. 4.

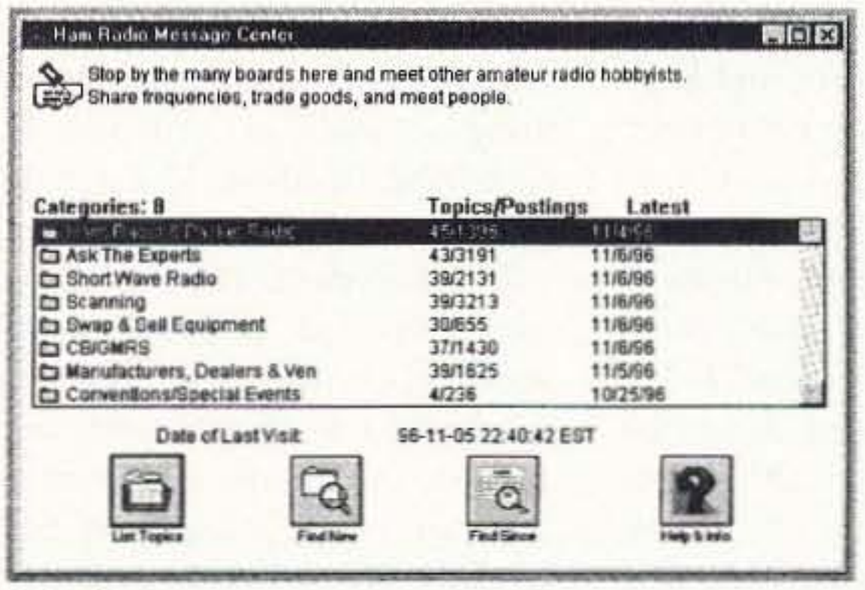

Fig. 5.

asked about up for downloading, as well as links to many ham radio sites on the World Wide Web, and there are many, many ham sites! Stop by the page at http://www 2.ari.net/ajr/rtty/ and see if you can't find something interesting. If you have, or know of, an amateur radio related site, drop me a line and let me know, so that we can establish a crosslink. Speaking of links and webs, I plan some antenna work this fall and winter, when the trees are bereft of their foliage. Stay tuned—those of you who remember my exploits with a bow and arrow a few years back won't want to miss this one!

So, let me hear from you, via mail, or via E-mail at ajr @ari.net, or Marc WA3AJR on AOL, or 75036,2501 on Compu- Serve. You are all part of this column, and I do love hearing from each of you. 73

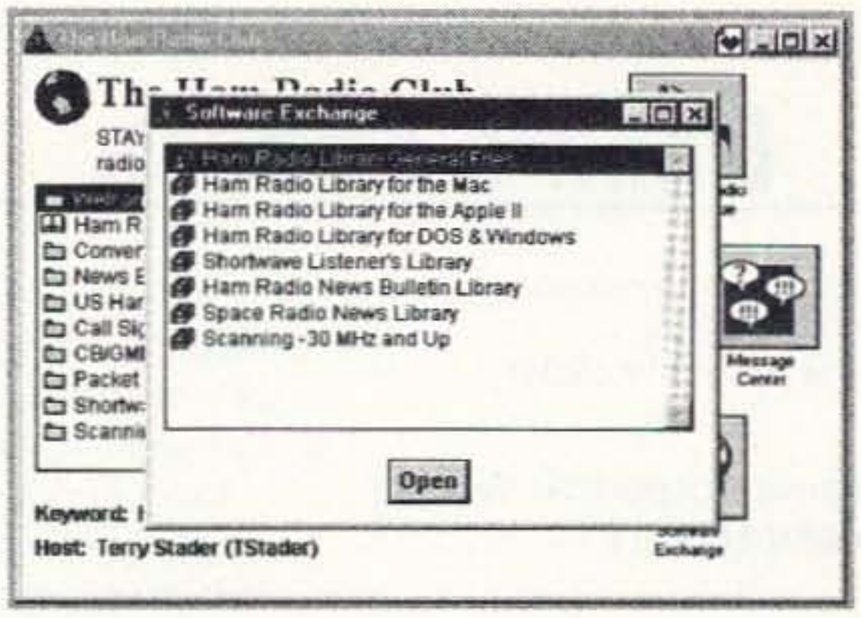

Fig. 6

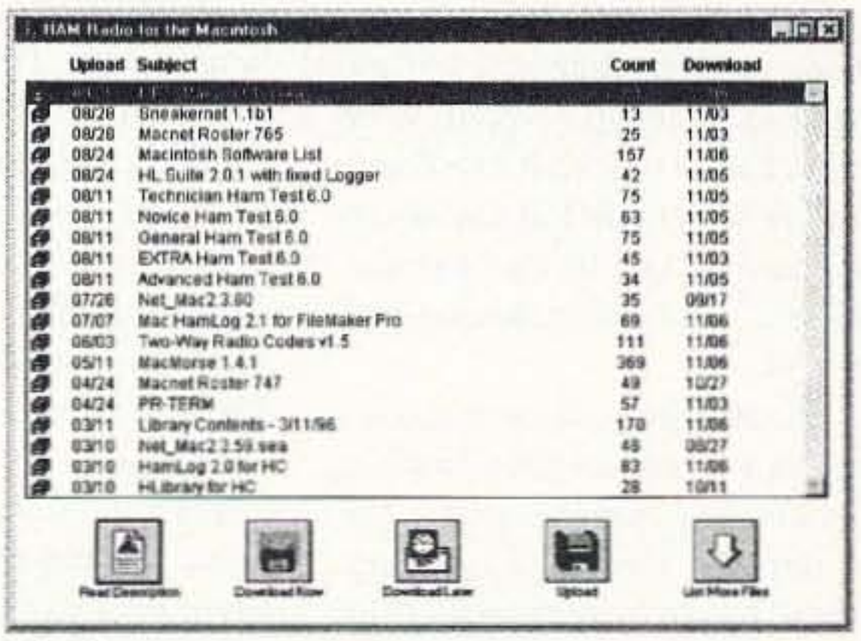

Fig. 7.

CARR'S CORNER

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041

Some Potpourri: Wanna Make History?

Wanna help make history and do some VHF hamming in the bargain? Or how about honoring history, making some history and doing some neat hamming? All are possible, although it's going to be pretty hard. The Irish Radio Transmitters Society (IRTS) announced a contest last year for the first transatlantic ham communication on 2 meters.

The winners will each receive one of two crystal glass trophies generously provided by the Waterford Crystal Company, whose products are known worldwide. In fact, if you've bought any of that stuff you'll know that a custom piece of Waterford is a fine and expensive prize indeed! Waterford Crystal, after all, is one of the finest producers of crystal glassware in the world (and an Irish icon).

"The winners will each receive one of two crystal glass trophies generously provided by the Waterford Crystal Company."

The crystal trophies are called the Brendan Trophies, after the legendary Irish folk hero, Saint Brendan. Among the Irish, he is probably second only to Saint Patrick, and is often referred to as "Brendan the Bold." And why was Saint Brendan so bold? Well, if his travels, chronicled in *Navigatio Brendani* (*The Voyages of Brendan*), are actually history instead of folk tales and storytelling, then he may well have sailed to the east coast of North America—transatlantic—in the end of the fifth, or beginning of the sixth, century A.D. ... in a leather boat! There is about as much time between Brendan and Leif Ericson, who also apparently made the journey, as there is between the first English settlements in North America and Wayne Green's birthday. In other words, ol' Brendan was a pretty early traveler to North America, if the stories are true.

Internal evidence of the legend suggests that he probably reached Iceland or Greenland, and possibly Nova Scotia, nearly half a millennium before Leif Ericson. The stories date to that time, and have verifiable facts, or at least suggestions of facts. That Brendan's feat is at least possible was proved in 1976 by Tim Severin, who repeated the journey in a leather boat of traditional design. If you are one to bend an elbow in honor of the bold (or the foolish), then St. Brendan's feast day is May 16th each year.

For radio signals, the North Atlantic path has always been something of a challenge because it crosses magnetic lines of force at high latitudes, and is bombarded with assorted troubles such as the aurora, particles and radiation from space. Indeed, "something of a challenge" often means downright difficult.

The short-term radio propagation condition predictions are usually made for the North Atlantic path because it describes nearly-worst-case conditions. An ionosonde device tests the path between the continents, and that data is published on radio stations such as WWV.

Marconi was the first to cross the Atlantic on a radio "boat" ... about a millennium and a half after Brendan and a millennium after Leif (by the way, I know a Norwegian lady who celebrates October 12th not as Columbus Day, but as Leif Ericson Day). Marconi probably used LF frequencies, which were more practical than the shortwaves in those days, to transmit the Morse code letter "S" from the west coast of England to a receiving site near St. Johns, Newfoundland, in December 1903.

It took another 20 years for the shortwave radio to cross the Atlantic. On the night of 27 November, 1923, the contact was established by ham radio operators ... and it startled the world! Today, anyone with a few watts loaded into a wet string antenna can work transatlantic contacts with ease. I recall one old fellow who gave ham club speeches on early radio, having been one of the first post-war, i.e. post-World War I, hams to be licensed. In about 1960, he came to the Potomac Valley Radio Club, of which I was a member, and gave us a talk. (Personal note: Former ARRL President Vic Clark W4KFC picked me up for meetings; because I am an epileptic I could not medically qualify for a driver's license until I was 23.) He told us how they were using frequencies as close to 200 meters wavelength (around 1,500 kHz in the AM BCB to our present-day 160 meter ham band) as possible. The HF frequencies were considered useless (which is what prompted the famous "... 200 meters and down" statement that is enshrined in Clinton B. DeSoto's book of the same title). The antenna was strung out across his father's Piedmont Virginia farm, and was one of those three-wire flat-tops that ran about 600 to 1,000 feet down the meadow. "DX" was any station two states away.

In 1924, he went away to the University of Virginia to study engineering, and left the ham station to his younger brother. When he returned for Thanksgiving, he noted that the flat-top antenna was gone, and was replaced with a couple of puny little things between 60 and 120 feet long. His brother sheepishly told him "we are using the shortwaves now." Skeptical, the fellow decided to send a message to his roommate, who lived in Ohio. So, hearing a station with an "8xx" callsign (they didn't use national designators in those days, so one-by-two callsigns such as "1AW"—Hiram Percy Maxim's callsign before it became "W1AW"—were used) he asked the guy to relay the message to Canton, OH. "Sure, OM, I'll be glad to, but you are probably in a better position to relay it yourself than me because I am FRENCH 8xx." He darn near fell off his chair! His first DX was over the supposedly intractable Atlantic Ocean, with little more than 15 watts of power.

Now, back to the Brendan Award. Some people claim that the 2 meter Transatlantic Challenge sponsored by IRTS will be a greater technical achievement than Marconi's 1903 work ... so here's your chance for immortality. The award will go to the first two amateur radio stations who establish two-way contact on 2 meters, across the Atlantic ocean, without using a satellite or earth-moon-earth (EME) methods. That would be cheating!

Both stations must be physically located on land, or on non-tidal waterways, within the boundaries established by the continental shelves of Europe and North America. Each operator must be properly licensed as an amateur radio operator by his or her national government, and be operating within the provisions of that license (especially power and frequency limits). IRTS reserves the right to have its representatives inspect both claimants' stations to ensure that things are on the up-and-up.

The normal rules for an established ham QSO apply to the 2 meter Transatlantic Challenge. Both stations must receive the callsign of the other in full; signal reports must be exchanged (any recognized system—RS, RST, meteor scatter—can be used, but it must include at least two characters); each station must receive confirmation (Morse "QSL," "R" or voice "Roger") from the other. The data must be exchanged within a single four-hour period. If the four-hour period expires, then a new contact-pair (another four-hour period) must be established.

In something of a "shades of Marconi" effort, the Radio Society of Great Britain (Lambda House, Cranborne Road, Potters Bar, Herts., EN6 3JE, England) is setting up a special account for donations to its RSGB Propagation Studies Committee to allow the establishment of permanent beacons

on 2 meters. One beacon will be located near Lands End, England, and the other near St. Johns, Newfoundland. That project could result in some substantial propagation studies, and could lead to the information that will cause someone—or more than one someone—to win the St. Brendan Trophy.

For a good source of technical information on the problems of 2 meter transatlantic propagation, check out "How To Win The Brendan Trophies" by Dr. Geoffrey H. Grayer in the June 1995 issue of *Radio Communications* (*RadCom* is the journal of the RSGB, and thus enjoys a position similar to the ARRL's *QST* among British ham operators). The address for RadCom is the same as for the RSGB above).

The Brendan challenge is not impossible, but it would be very difficult. One of my earliest ham writing tasks was the monthly report of the Northern Virginia Radio Club (club station W4PAY) to the Foundation for Amateur Radio's *Autocall* newsletter. As a result of that task, I received an invitation to the 1960 Edison Award (sponsored by General Electric) banquet in Washington, DC. The two fellows who won the award that year had established two-way ham contact on 2 meters between California and Hawaii. Not exactly the North Atlantic path, but about as far (although I would prefer being in KH6-land than in any location in the North Atlantic ... save only EI-land and G/GM-land, for which I have a special fondness).

"Hams With Class"

One of my favorite ham columns has been "Hams With Class" in *73*, partially because I have a soft spot for people who work with kids and introduce them to radio in general and ham radio in particular. Every year I judge several science fairs, and am impressed with the ability of kids to do science and technology. A lot of them are little more than re-doing classroom demonstrations, or worse, but another big bunch is doing some real science (unfortunately, I won't be able to judge too many science fairs this year because I am teaching a Northern Virginia Community College class in Visual BASIC on Saturday mornings).

The point of this digression is that we hams have an opportunity to hook kids into the hobby at an early age through education. There are a couple of ways to go about this (besides reading "Hams With Class"). First, you can mentor (or is that "Elmer"?) youngsters who show interest in radio. That's how I got started (Mac Parker W4II was mine), and I suspect it's how many of you-all got started as well). Another way is to work with high school and junior high school science fairs, or volunteer to work with the science departments.

"Here's your chance for immortality."

In some schools, they permit college-degreed members of the community to teach science classes, although under the supervision of a licensed teacher. That's a possibility for both community involvement and (in some cases) a little (very little, sadly) extra income. In other cases, even non-degreed people with industrial arts experience are allowed to teach shop classes (again, under a licensed teacher's supervision). An auto mechanic I know teaches a two-hour shop class every day at the local voc-tech school (a high school with an industrial arts flavor).

You can also set up demonstrations of ham radio for the school, or serve as a community advisor or mentor to a student ham radio club (I've seen both done).

Still another tactic would be to become familiar with radioscience observing, and integrate ham radio into it. This activity includes looking for natural radio signals such as whistlers (1 to 10 kHz), sudden ionospheric disturbances (SIDs) caused by solar flares (these are found by monitoring 15 to 30 kHz VLF stations for sudden increases in signal level), and propagation studies (especially during solar eclipses or other solar events). Ham radio can be "snuck into" such activities.

Still another way is to find and encourage schoolteachers who want to get into ham radio themselves. Mentor them, get them licensed, and help them set up a station. You do that with newbies anyway, so why not concentrate some advertising for your club's Novice class on the local schools? I recall a seminary professor who taught at a school that had a large contingent of Third World students on scholarship. He said the reason was that it cost $25,000 a year to keep a missionary in those countries, but only $10,000 a year to educate a national ... who would go back home and remain in place teaching for many, many decades (at no additional cost or effort). The same principle applies for hams: Teach a teacher how to "fish" and you won't have to feed his or her students yourself. Teachers, after all, are largely dedicated to their profession, and will perform admirably to mentor young hams-wannabees and help them get licensed. Putting a little effort into junior and senior high schools, not to mention the upper end of the elementary grades, will pay rich dividends for the hobby.

How important is getting more lifetime hams into the hobby? Radio spectrum is precious, and there is a simple rule in effect: Use it or lose it. Remember, the 11 meter Citizen's Band was a ham band pre-1957. We lost it to the Class D CB service because the FCC could see that very few people were using it ... the 1956 or 1957 "Save 11" contest at the last minute notwithstanding.

Connections ...

I can be reached via snail mail at P.O. Box 1099, Falls Church, VA 22041, or via Internet E-mail at carrjj@aol.com. 73

HAMSATS

Amateur Radio Via Satellites

Andy MacAllister WA5ZIB
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Houston TX 77083

Good News—Bad News

We start the new year without AMSAT-OSCAR-13. This high-orbit, long-life satellite was launched in June 1988. Since then it provided hamsat enthusiasts quality high-tech communications for over eight years before succumbing to the gravitational effects of bodies beyond the earth. Most satellites in elliptical orbits with a perigee, or low point, of thousands of miles will stay in orbit for hundreds, if not thousands, of years. Due to the orientation of A-O-13's orbit, this was not the case. The forces of nature took over and its premature end was inevitable as its perigee was pulled closer to the earth by the sun and moon.

On the positive side, A-O-13 performed extremely well while in orbit. AMSAT-OSCAR-10, while not as functional as A-O-13 was before reentry, still provides high-orbit, Mode "B" (70 cm uplink and 2 meter downlink) operation almost 13 years after launch. Before launch, A-O-10 was known as Phase 3-B. It was the second Phase 3 hamsat. Its predecessor, Phase 3-A, never made it into orbit due to a rocket malfunction in early 1980. Excellent long-distance contacts are still possible through A-O-10 when conditions are right. The on-board computer no longer works, but the Mode "B" radios and the solar cells are doing well. When the satellite is properly illuminated, signals are good.

Phase 3-D coming soon

Amateur radio's next major satellite is scheduled for launch in April 1997. Named "Phase 3-D," this satellite is the largest, most complex and most expensive ham-radio satellite ever built. Volunteers in over a dozen countries on five continents have been working for years to bring this project to fruition.

The launch is to be the second ever for the new Ariane 5 rocket. The first Ariane 5 failed in June 1996. Corrections have been made, tests have been run, and optimism is high for the second flight. Phase 3-D will be sent up with a pair of technological measurement packages for validation of the launch vehicle's ability to place two satellites into a geostationary transfer orbit.

After launch, Phase 3-D will become an OSCAR (Orbiting Satellite Carrying Amateur Radio) and will begin a period of testing and orbital adjustment that may last months.

In the meantime...

Waiting for the new high-orbit satellite needn't be dull. We have over a dozen operational LEO (low earth orbit) hamsats in orbit available for use four to six times a day each, anywhere on earth. Frequencies used on these satellites range all the way from the 21 MHz uplink of RS-12 to the 2400 MHz downlink beacon of Dove-OSCAR-17. There is a good mix of digital and analog (voice/CW) satellites available. We have new satellites like Fuji-OSCAR-29, launched only a few months ago, to older satellites including UoSAT-OSCAR-11 launched in March 1984.

Uplinks	Channel A	145.815 MHz - 1200 baud AX.25 FSK
	Channel B	145.835 MHz - 1200 baud AX.25 FSK
	Channel C	145.855 MHz - 1200 baud AX.25 FSK
	Channel D	145.875 MHz - 1200 baud AX.25 FSK
Downlinks	UHF TX1	437.206 MHz - 1200 baud AX.25 BPSK
	UHF TX2	437.138 MHz - 1200 baud AX.25 BPSK

Table 1. *Band plan for Mexico-OSCAR-30.*

The South Africa AMSAT Award

In a cooperative effort with Southern Africa AMSAT, the Radio Amateur Satellite Corporation (AMSAT-North America) is promoting the South Africa AMSAT Satellite Communication Achievement Award. This award is the perfect entry-level award for satellite enthusiasts. The requirements are simple. Send 25 QSLs (or good front and back photocopies) for Phase-2 (low earth orbit) satellite contacts to the AMSAT Awards Manager. The fee is $3.50 for AMSAT members and $5.00 for non-members. Additional funds are requested for the return of QSL cards if photocopies are not submitted. Send to: AMSAT Awards Manager, Mike Scarcella WA5TWT, 310 Lombardy, Sugar Land, TX 77478. Mike has been authorized to issue the South African award without the long delays previously encountered with overseas submission. The low-orbit hamsats can be a lot of fun.

A New Year's event

For many years the ARRL has sponsored Straight Key Night (SKN) on New Year's Day. Ray Soifer W2RS invites interested satellite operators to participate in the 25th annual SKN via OSCAR. He reports that there are no rules, no scoring, and no need to send in a log. Just call CQ SKN in the CW passband segment of an OSCAR between 0000 and 2359 UTC on January 1, 1997, or answer a CQ SKN call from another station. Contacts via the moon also count. Ray refers to the moon as OSCAR-0. Nominations for the best "fist" can be sent via the Internet to w2rs@amsat.org.

An end before a beginning?

Less than a month after the successful launch of Fuji-OSCAR-29, Mexico-OSCAR-30 (M-O-30) was successfully placed in orbit from the Russian Plesetsk facility on September 5, 1996. The satellite's polar orbit is just under 1,000 kilometers (600 miles) high. Signals from the satellite were received shortly after launch, but there is a problem. The signals disappeared after several days and attempts to command the satellite failed. Work continues in an attempt to bring M-O-30 back to life, but catastrophic failure in the command receiver is feared.

Prior to launch, the new satellite was called UNAMSAT-B. This was not the first UNAMSAT, but rather the replacement for UNAMSAT-1 which never achieved orbit. The UNAMSAT-1 launch attempt on a converted Soviet SS-25 (TOPOL) missile met a fiery end when an upper-stage motor failed on March 28, 1995. Following the disaster, the UNAMSAT crew was dejected but not without hope. Two sets of spacecraft modules were originally built.

While UNAMSAT-1 lay in a mass of rocket debris somewhere in eastern Russia or on the bottom of the Sea of Okhotsk, the back-up modules were waiting safely back in the lab in Mexico City. It took a lot of work over a one-year period to get the second UNAMSAT ready—to buy new solar panels and get another ticket to orbit. Project Director David Liberman XE1TU provided the needed drive. UNAMSAT-B represents the never-say-die attitude of true space pioneers.

UNAMSAT-B

Built at the Universidad Nacional Autonoma de Mexico by the PUIDE (Programa Universitario de Investigacion y Desarrollo Espacial, or University Program of Space Research and Development) group, UNAMSAT-B is the most recent

microsat "clone." The first microsats were launched six years ago from French Guiana. They are small cubes, 25 cm on a side, weighing about 10 kg each, with five internal stacked modules. Four of the modules contain standard systems common to all AMSAT microsats; a five-channel 2 meter receiver, battery charge regulator unit, computer and 70 cm transmitter. The fifth module in the stack is called the TSFR, or "This Space For Rent." The TSFR in M-O-30 contains an intriguing experiment to identify meteors that have velocities greater than 72 km/sec.

The five-channel, 2 meter receiver was designed for digital (1200 baud FSK AX.25) uplinks from users on four simultaneous channels: 145.815, 145.835, 145.855 and 145.875 MHz. The fifth channel is the unpublished uplink for ground-based control stations. It is used to send software up to the satellite and change onboard operational parameters. A failure in the command receiver is one of the possible reasons for M-O-30's silence.

The BCR module, or battery charge regulator, contains not only the power control circuitry, but also the nickel-cadmium batteries that allow the satellite to operate during eclipse periods.

The computer module uses a radiation-hardened NEC V40 microprocessor. There is also a 256 Kbyte bank of EDAC memory and an additional 4 Mbyte bank of SRAM. Total computer-system power consumption is under 1 watt.

The transmitter module contains two separate UHF transmitters for telemetry and communications downlink. Both use BPSK (bi-phase shift keying) modulation at 1200 baud, AX.25 protocol. The primary transmitter is on 437.206 MHz, and the secondary transmitter is set to 437.138 MHz. Only one transmitter at a time is activated, but either can be used for all telemetry and data communication purposes.

The body of the satellite is surrounded by high-efficiency gallium-arsenide solar cells and a thin quartz crystal coating. The 2 meter antenna is on the top, while the 70 cm antennas are arranged around the bottom. The 41 MHz antenna is a canted dipole.

The TSFR module

Packed into the fifth module is a 70 watt (RMS) radar transmitter on 40.997 MHz, a sensitive receiver and a computer. The transmitter sends short pulses (1 to 16 ms) every one to 16 seconds. The 41 MHz transmitter is licensed by Mexico according to the ITU (International Telecommunications Union) frequency allocation listings. The receiver then listens for echoes from ionization trails caused by meteors as they burn up in the atmosphere. The returning echoes are digitized, analyzed by the computer and then downlinked as data files on 70 cm for study.

In order to provide the temporary but high current needs of the radar transmitter, special buffering on the 10 volt satellite power bus was required. A special switching power supply was designed to charge a bank of 16 tantalum capacitors to 40 volts between pulse transmissions. The system does not overload the main power bus and has a DC-to-RF efficiency of 92 percent.

The 41 MHz receiver is a single-conversion design with both lower and upper sideband detectors. Total bandwidth is about 20 kHz, enough to handle the maximum Doppler shift expected from returning meteor-trail echoes.

For meteors, 72 km/sec is the solar system escape velocity. Meteors traveling faster are from outside our system. The TSFR computer (68HC805 microcontroller) records the received echo from the receiver and then sends it to the main satellite computer module as a 64 byte block for further analysis and subsequent transmission via the downlink transmitter. The analysis includes a Digital Fast Fourier Transform (DFFT) and a special buffer system to check for Doppler shift between subsequent received signals. If Doppler shift is detected between the samples (indicating relative meteor speed), the radar transmitter will be set for a faster pulse repetition rate for a period of time. Data that represents meteors traveling above the 72 km/sec speed limit will be logged and stored in files.

Communications

The frequencies shown in **Table 1** define the Mode "J" communications capabilities of M-O-30. The following data was received by Norbert Notthoff DF5DP a few days after launch on the 70 cm downlink before the satellite went silent:

```
UNMSAT-1>STATUS:?12S f<-
UNMSAT-1>PUIDE:

AFTER ALL IT STILL
MOVES.....
Y A PESAR DE TODO SE
MUEVE....

UNAMMEXICO.
UNMSAT-1>BCRXMT:%?12
UNMSAT-1>TIME-1:PHT:
uptime is 005/10:32:41.
Time is Sat Sep 07 18:17:29
1996
```

More information

Additional information about the M-O-30 and efforts to bring it back to life can be easily found on the Internet. The best source is from the AMSAT World Wide Web site. The URL (Universal Resource Locator) is: http://www.amsat.org. M-O-30 bulletins and updates, along with orbital elements for tracking programs, can be found and downloaded. The AMSAT site provides a link to the UNAMSAT web pages, or you can address them directly at: http://serpiente.dgsca.unam.mx/unamsat/unameng.htm. M-O-30 held much promise both as a fun satellite and as an exciting experiment. If efforts to bring it back fail, let's hope that the UNAMSAT team will try again. 73

Number 54 on your Feedback card

HAM TO HAM

Your Input Welcome Here

Dave Miller NZ9E
7462 Lawler Avenue
Niles IL 60714-3108

With the first issue of the new year comes a nice variety of "Ham To Ham" tips. Many thanks to those who've taken the time to send in their ideas (often several) during 1996, as well as to the names that we're seeing for the first time. I'm always looking for more tips, ideas, suggestions and shortcuts to keep the column going and growing, so please don't hesitate. The address is above.

Adjustable antenna tip

From William Thim Jr. N1QVQ: Bill has been very supportive, with a number of good tips. "I own a portable antenna that covers several VHF/UHF ham bands, but it must be physically adjusted for each different band. After losing the adjustment instructions once, I decided not to let that happen again, so I got the tuning instructions from a friend, then transferred them to the antenna's base using a customizable rubber stamp kit like the ones sold in many office supply stores. A coat of clear lacquer spray over the stamping sealed it. To make sure that I always had a tape measure with the antenna for those critical adjustments, I made a trip to the XYL's favorite sewing supply store and purchased one of those 'cloth-tape yardsticks,' attached it to the antenna using a 'twist-tie,' and now I know I'll have everything needed for adjusting the antenna. You can 'customize' this basic idea to fit your own antenna-element needs, depending upon the particular model of adjustable antenna that you have."

Moderator's note: Good idea, Bill; also, don't forget to "twist-tie" that special Allen wrench or an inexpensive small screwdriver to the package if loosening and tightening set-screws is involved in the adjustment. A small, plastic "zip-lock" bag with a hole punched into one corner can hold these odds and ends. The bag itself can then be secured to the antenna package with a "twist-tie" or short length of cable-lacing twine.

Not written in stone

From David Hyman KBØONF: A way to cut down on paper costs in your ham shack: "I've been able to drastically cut down on the amount of scratch paper that I use by assigning the note-taking task to a scrap piece of 1/4" thick, 8 1/2" x 11" chunk of white Plexiglas™ instead. Smooth white Plexiglas is available from surplus outlets around the country at very reasonable prices ... often sold by the pound (look in your Yellow Pages under 'surplus-retail'). It can be easily cut with a bandsaw, or simply scored with a utility knife, then cracked over the sharp edge of a table—the ragged edge can then be either filed or lightly 'fire-polished' with a propane torch (go easy, it doesn't take much heat).

"The white Plexiglas is then the 'perfect' writing surface for either dry marker pens or the water soluble pens sold in art stores and office supply outlets. I prefer the 'dry markers' myself, one of which is the Expo Markaway 3™ , No. 83000, by Sanford. Black is probably the best color and a chisel-shaped tip works nicely for me.

"Cleaning the white Plexiglas surface after use is easy too. A dry erase spray cleaner is sold specifically for this purpose, but I've found that lacquer thinner, poured into a defunct glass window cleaner spray bottle, works just as well and at a fraction of the cost. The lacquer thinner doesn't seem to attack or soften the white Plexiglas that I'm using in any way."

Moderator's note: I've used a similar idea in my own ham shack using a "note jotter," consisting of a washable pen and plastic-coated tablet, made for wall hanging near a kitchen telephone. In this case, a damp cloth will erase everything. Remember those little marker slates with a clear plastic on top, followed by a translucent sheet and ending with a black waxy surface? You simply lifted the two top sheets to erase the whole tablet ... great fun to use as I remember.

Considerable cable considerations

From Phil Salas AD5X: "I'd suggest that you consider using 9913 coax cable, instead of the more popular RG-213, for your VHF/UHF antenna feedlines. 9913 has about a third less loss than RG-213 at a given frequency, and is much easier to 'connectorize' with the standard PL-259 UHF connectors. The inner insulation is easier to strip since it is mostly air! The shield is easier to solder to the PL-259 since the inner dielectric doesn't conduct the heat away as it does in the RG-213 type of cables. Cable X-perts (orders 1-800-828-3340, tech inf. 1-847-520-3003) sells 9913 for 42 cents per foot, which is only about six cents per foot more than RG-213. The disadvantages: You must take extra care to properly waterproof your outside connectors (since any internal water will flow easily through its mostly air-filled innards) but you should carefully waterproof all outside connectors anyway. Also, 9913 is not quite as flexible as RG-213, since the center conductor is a solid copper conductor. A stranded center conductor form of 9913 is available, but it's a bit more expensive ... the choice is strictly up to you.

"For waterproofing those outdoor connections and connectors, I've had very good luck with a product called Plast-Dip™. It's a fast-curing liquid plastic material that's intended primarily for coating tool handles. A can of the thick liquid costs about $7 at Home Depot™ and other hardware and home centers, but it should last you a good long while. I usually put two coats of it on all of my outdoor connections. For wire connections, such as separating a coax shield and center conductor for feeding a dipole antenna, I immobilize the point where the shield and center conductor separate, using hot glue (hot glue guns are great for lots of things). Then I attach solder lugs to the ends of the shield and center conductor—where attachment to the antenna will take place. Finally, I dip the entire end (including the solder lugs) into the Plast-Dip and let it cure. After curing, I use a sharp hobby knife to trim off the excess Plast-Dip insulation that covers the ends of the solder lugs. Neat, easy and very waterproof!"

Moderator's note: Good suggestions, Phil. Waterproofing outdoor coax fittings can't be overstressed; any moisture in even the solid insulation coax is disastrous. The shield of a coax must appear as a solid conductor to RF; that is, each overlapping strand of braid must touch as many of its neighboring strands as possible, seeming to be a solid outer pipe. Water of any sort inside the coax jacket spoils this shielding quality (and you can't tell it by DC resistance checks alone—it must be tested with true RF testing, looking for loss or leakage). Even a small nick in the outdoor cable's jacket must be re-sealed. Phil's suggestions on the best (lowest loss) cable are also well taken. Even if your entire cable run can't be of a low-loss variety,

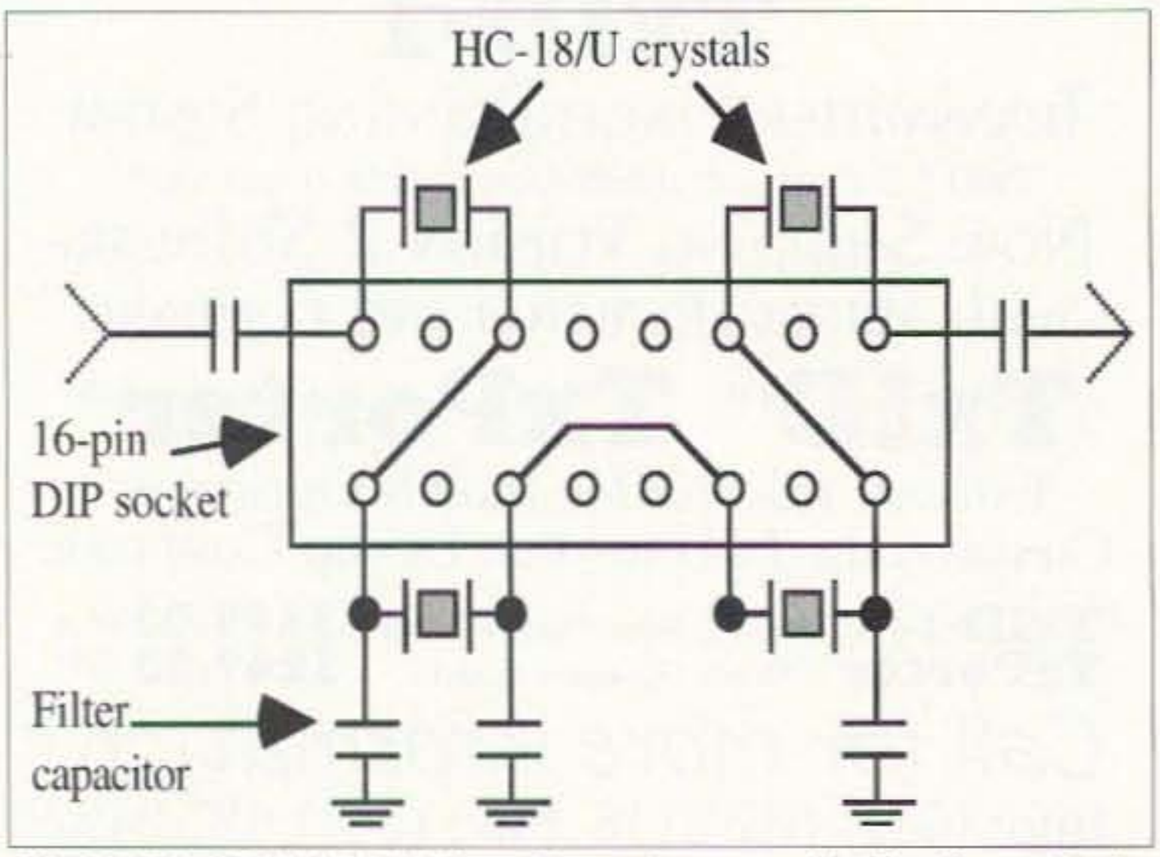

Fig. 1. KB4ZGC/W4LJD'S idea of how a four-crystal ladder filter might be laid out using a standard 16-pin DIP IC socket for mounting the crystals.

every foot that you can manage will be that much better.

Crystal DIP

From J. Frank Brumbaugh KB4ZGC/W4LJD: "When constructing crystal ladder IF filters, you can save PC board space, simplify the layout time and make the crystals much easier to check or replace by simply using a standard 16-pin DIP socket to hold the four crystals needed. Interestingly, the HC-18/U style of crystal with wire leads will plug in directly across three pins of a standard DIP IC socket. A quick look at **Fig. 1** will illustrate how a four-crystal filter would be wired using this scheme. Just clip the HC-18/U's leads to about 1/4", then plug in the crystals after all of the heat-producing soldering has been done. If you need more than four crystals, just add another DIP socket!"

Moderator's note: Clever idea, Frank. By the way, Frank's right, a wire-lead HC-18/U fits perfectly across three pins of a normal DIP socket. I'd recommend using the best DIP sockets you can afford for this application. The ones with round "machined" pins hold the crystal nice and tightly.

Murphy's Corollary: When working out a problem on a specific piece of equipment, try sleeping on it... it's sure to make an impression!

Many thanks to this month's contributors. Without your continued input, I'd soon run out of ideas. Please keep them coming.

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in with catcalls, carriers, and jamming, but without signing calls.

If I were an advisor for any company wanting to get the use of a ham band for their products, I'd record and edit a few days of this kind of crapola as proof that there clearly are much better public uses for the billions of dollars worth of ham spectrum we've inherited and are laying to waste. Since we claim to be self-regulating, we have no valid excuse for allowing this kind of sickness to go on.

So why are cesspools like that poisoning our hobby? It seems to me this is largely the result of a lack of credible leadership from our one (and really only) national organization. The pathetic weakness of our ARRL leadership has left amateur radio in a similar situation to a leaderless country like Somalia. This weakness starts right at the top: the ARRL board of directors, which you continue to re-elect. My bumper sticker Never Re-elect Anyone (the NRA for the '90s) should be not just applied to Congress, to help flush out

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that mess, but also to your ARRL board of director rubber-stamp voting every other year. Keep flushing until we get some young people in there and see signs of leadership beginning to show.

How will you know? When you see signs that the League is attacking messes like 14,313, K1MAN's endless ego gratification, the lack of youngsters coming into the hobby, our overall lack of growth (except for no-coders), the disinterest of the no-coders in upgrading, and stuff like that.

Amateur radio got grandfathered into most of our present ham bands as a result of the pioneering work hams did in the earliest days of radio. Then we held on to most of our bands by providing clearly visible public services. Amateur radio was often the only means of communicating in emergencies. And, as I keep mentioning, 80% of the licensed hams went into the military for WWII, providing a priceless contribution to our winning the war, in which radio, radar and sonar were critically important.

But today, due to an almost total lack of leadership, we are no longer the pioneering group we once were. We no longer are of any value whatever to the military in case of a war. Even our vaunted emergency communications are disorganized and being made irrelevant as other communications services are passing us by. The only hope I can see for our survival is as a way to help get kids interested in high-tech careers, the way we did before the ARRL virtually stopped youngsters from entering the hobby 33 years ago. We *have* to provide some sort of visible public service if we're going to hold our ham bands, which are worth tens to hundreds of billions today. But without leadership it's only a matter of time, and I doubt that we have much of that.

But how about the FCC—won't they protect us? Why should they? These days we are nothing but a royal pain in the butt and an additional difficult-to-justify expense for an outfit whose budget is being cut back, year after year. Instead of putting the pressure on the ARRL to solve our problems we write to the FCC, demanding help. When nothing comes of that we write to our Senator or Congressman, asking him to put pressure on the FCC to help. And he then sends a copy to the FCC, pushing for action. And since there is little the FCC can do, they just want to stop the pain.

What would you do if you were a politically appointed FCC commissioner? You know little about the history of amateur radio. All you know is that there is a disorganized bunch of old (very old and largely lower middle class) white men who are enjoying billions of dollars worth of the spectrum which they inherited when it was of no value and are these days contributing little in return. All you get is complaints—about interference, bad language, repeater coordination, and so on. Try sitting in a commissioner's chair for a minute and see how that feels.

If you feel that I'm dumping on the ARRL about all this, then please let me know who you recommend to help solve our problems? If you really don't believe our leaders have no responsibility to lead, then what alternative do you suggest? If you don't have an answer, ask your director and then let me know what he proposes.

Or should I start work on a book, *Ham Radio — In Memoriam*?

Professors and Beards

Have you ever noticed how many professors wear beards? Maybe there's a good psychological reason for this. Try on my reasoning and see how it fits.

What has teaching college got going for it? Short hours, lots of prestige, tenure (you can't get fired), paid sabbaticals, and generous retirement benefits. No, you'll never make a lot of money, but the security is a trade-off. And the prestige. They sure play *that* game. Doctor. Professor. Distinguished Professor.

Now, if you were a person with low self-esteem, also known as an inferiority complex, you would tend to look for work where prestige is flaunted. Low self-esteem people can't help but do everything they can to make others think they are important.

But they also tend to want to hide their faces. I went to a costume party when I was a kid. My mother made a Shadow costume for me, complete with a black veil. That was the first time I'd ever been at a party where my face was hidden, and wow, did that feel different. Suddenly I was very outgoing and the life of the party. A veil or mask gives one a sense of security. And so does a beard to hide behind. Think over the bearded people you know and see if you think I'm right.

The only bearded guy I can think of that this doesn't fit was Sam Harris W8UKS/W1FZJ/W1BU, but then he wore his in the '40s and '50s, back when that was an outrageous thing to do—which was why he did it. He didn't just wear it, he flaunted it.

Vegetizing

Unless you've chosen to be uneducated in the food department (aka ignorant), you know that you really should be including a hefty bunch of veggies to your diet. At least if you want to make it with any grace through your 50s and not join the strictly steak and potatoes group in their $2,000-a-day hospital wards. Yes, I know, you and Bush are not broccoli fans. I happen to like it, but I can almost empathize with those who don't. When I was a kid I hated cauliflower and didn't think I'd ever like it. Now I love it.

Anyway, I've found a great way to not just make these veggies delicious, but to do it in their healthiest (for you) form: raw. Here's the deal. I hope you have a blender. I throw in a cup each of raw broccoli and cauliflower, and a half cup of raw carrots. Zizz 'em together until they're in pieces slightly smaller than Grape Nuts.

You're going to need some salad dressing for this. I'm using a couple of tablespoons of my old coleslaw recipe. It has two parts extra virgin olive oil, two parts apple cider vinegar, one part honey, one part mayonnaise, six parts plain yogurt, a teaspoon or two of celery seeds, salt and pepper to taste. Then whip it all together. This makes a fabulous sweet-sour dressing that's great for slaw and as a veggie dip. It's reasonably low cal and easy to

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HOMING IN

Radio Direction Finding

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A Foxhunting Jamboree

When did you first hear about radio direction finding (RDF)? Since it has become a tool for finding downed aircraft and stolen cars, today's school kids probably get a vague notion of it early on. Sadly, they aren't told that it can also be great fun for them.

A recent E-mail exchange with Tom Stewart K3TS brought back memories of my introduction to RDF. Tom wrote a classic article about 2 meter hidden transmitter hunting in New Jersey for the September 1957 issue of *QST*. I was 10 years old at the time and studying for my ham ticket, faithfully trying to copy W1AW code practice every night on my drifty Hallicrafters S-38D receiver. That *QST* issue was one of my first ham radio magazines. Tom's tales of T-hunt trickery got me eager to try the sport.

When my Novice license arrived the following spring, I agitated at the radio club in our town of 11,000 souls to get the group to hold some hidden transmitter hunts. Even though Novices had 2 meter phone privileges at the time, we were a hundred miles from the nearest 2 meter activity and there were no repeaters to bridge the gap.

Finally, the club scheduled a hunt on 75 meter AM, where most mobile operating was done in those days. I somehow managed to lash together a two-tube 75 meter converter with vibrator power supply and connect it to the broadcast receiver in the family's gas-guzzler convertible. Of course I had to talk Dad into driving. Bemused by the whole thing, he agreed.

For an RDF antenna, I used the multi-turn flat loop from the back cover of an old table model broadcast set. I hadn't learned enough RF theory to do a good job of resonating and coupling it, so it wasn't very sensitive or directional. Dad and I did a lot of riding around just trying to hear a signal over the ignition noise. Fortunately, the hunt boundaries were small and gas was cheap.

Hundreds of T-hunts later, I still think it is the most fun you can have in ham radio. I wish every youngster could experience it. But how many kids nowadays have supportive radio clubs and patient fathers to Elmer them into it? How can we bring kids and RDF together? I think "Homing In" readers Greg and Gabriella Owens (WA6HKM and KE6JQS) have found an answer.

This campground welcomes foxes

Greg and Gabriella's letter arrived shortly after Labor Day. They were in charge of a committee from the Simi Settlers Radio Club that would be hosting a Scout Jamboree-on-the-Air (JOTA) campout. They wanted to know how to put on a demonstration of foxhunting (also called radio-orienteering and ARDF) as part of their JOTA activities. What an opportunity!

JOTA is a worldwide ham event, held annually in mid-October for almost 40 years. Having never been in Scouts, I knew very little about it. I had no idea if foxhunting had ever been done there before. (Actually, I'm still not sure.) Either way, I knew that this opportunity couldn't be passed up, so I called them immediately.

JOTA celebrations run for a 48-hour period beginning Friday afternoon. They range from simple to elaborate. In some towns, a ham invites a troop or two for a ham shack visit, letting Scouts participate in contacts with other JOTA groups. In other places, it's a full-blown Camporee with many stations and activities. That's what the Settlers were planning.

"We hope to have stations on every active HF and VHF band," Gabriella told me. "We'll demonstrate both voice and CW modes on the air. Local ATVers will set up two stations so the Scouts can have television QSOs back and forth. We will also have code oscillator kits for them to solder together."

Photo A. *April WA6OPS helped explain RDF to eager Scouts before they went out to hunt. Looking on is longtime Scouting supporter Darryl Widman KF6DI. (Photo by Joe Moell KØOV.)*

The Simi Settlers' JOTA site would be Lake Casitas Recreation Area near scenic Ojai, California. Scouts from Ventura, Los Angeles and Santa Barbara counties were invited. Several hundred could be accommodated. The event would officially begin at noon Saturday and continue for 24 hours. Many Scouts would camp over Saturday night, while others would be at the lake shore for just a few hours on one day. Foxhunting at night would be unsafe, so we had to make it possible for many Scouts to hunt at the same time during our limited available hours.

Lake Casitas is a drive of over 100 miles for T-hunters in my area, but it is only about 40 miles from Santa Barbara, where there is a growing group of radio-orienteering enthusiasts. I own plenty of fox transmitters, but not enough RDF gear for dozens of Scouts to use. What's more, April and I would need knowledgeable helpers for one-on-one training of the Scouts. I zipped off E-mail to Marvin Johnston KE6HTS of the Santa Barbara Amateur Radio Club and he immediately agreed to help.

Having no experience with foxhunting demonstrations for pre-teens, I could only try to envision how it would go. I imagined that we would take the Scouts in packs or troops of a dozen or two and give them a quick show-and-tell on RDFing and map plotting. Then we would hand out some gear and send them into the woods to try to find five foxes transmitting for a minute each in sequence, just like they do in a formal international-rules competition (see "Homing In" for August and September 1996).

Greg surveyed topographical maps of the site and suggested a hilly area of about one square mile across the park road from the camping area. He even agreed to make lots of copies of that map for the Scouts. "Don't worry," he told me, "they are prepared for being in the woods and will bring compasses with them." Good, all I would need for orienteering would be a batch of protractors.

For a week before the event, I spent each evening tuning up my RDF sets and borrowing more. On Friday afternoon, April and I went to the site to check it out. I quickly realized that my imagination had not served me well. The hilly area was fenced off. No access! Oh well, it wasn't very shady. In truth, it looked like a barren home for rattlesnakes. Besides, it was too far away from the campsite.

We decided to hide the foxes within the large wooded JOTA campground, not far from our van where we were showing a video of international radio-orienteering competitions (see **Photo A**). Scouts would not have a long hike. We could easily watch and help. As a side benefit, the sight of them combing the grounds with sniffing gear would attract much more attention to our demonstration.

The two hundred or so Scouts that came to Lake Casitas were mostly in elementary school. They may be champs at the latest video games, but they had to start at square one when it came to RDF. No way could we simply slap gear into their hands and send them out. It worked best to guide them along in groups of two or

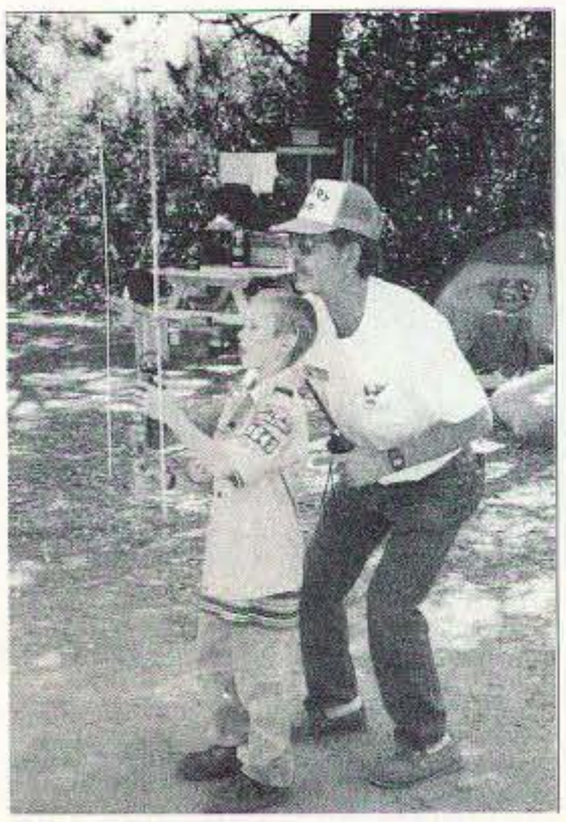

Photo B. *Reg Reginato KE6ZQY of Santa Barbara shows a Scout how to use his dual-dipole TDOA RDF set in the JOTA-96 campground. (Photo by April Moell WA6OPS.)*

three as they learned. One Scout at a time used the RDF set while the others watched. It would then be their turn to find the next foxes.

Five cycling intermittent transmitters proved to be too confusing during the learning process. We changed two of them to be continuous emitters on separate frequencies below 146 MHz, just for first-timers. One was in a surplus ammunition box while the other was the cleverly camouflaged "stud T" (see "Homing In" for October 1996). That one always got looks of amazement when the Scouts flushed it out. As time and equipment permitted, those who did well on continuous foxes could try to bag the intermittent ones on 146.565 MHz.

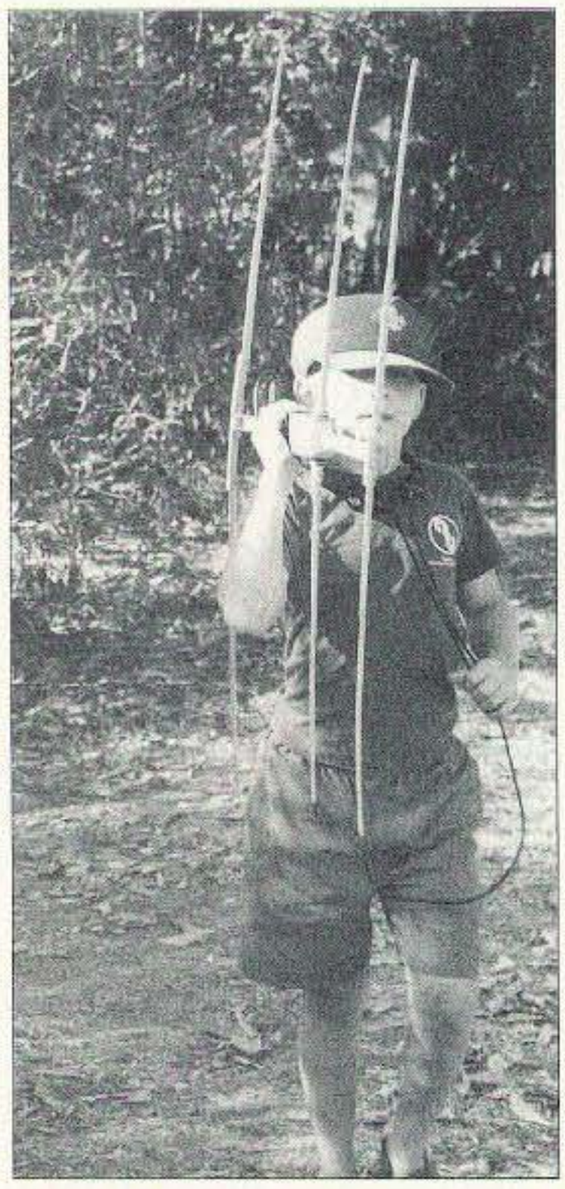

Photo C. *To this Cub Scout, RDF gear seems a bit heavy after a few minutes of fox tracking. Next time, I'll add a mast so this Russian-made set can be held high more easily. (Photo by Joe Moell KØOV.)*

Better tools needed

To regular users of VHF-FM, it's easy to gauge the strength of incoming signals by the amount of background hiss, or lack of it (quieting). But to a Cub Scout who has never held a handie-talkie before, it's not obvious. After some practice, a few of them did well at getting bearings with an HT, beam and active attenuator. Others couldn't seem to get the hang of it, especially if the HT didn't have an S-meter.

Other types of RDF sets were much easier for kids to learn. The Santa Barbara group brought several dual-dipole homing sets (TDOA type) with left-right indication (meter or LEDs). Although TDOAs are more prone to multipath bearing errors and they lack signal strength indication, the kids found them easy to learn and had good results (see **Photo B**).

In Europe and Asia, where radio-orienteering is a popular sport in schools, everyone uses special amplitude-based RDF sets for 2 meters. There are many variations, but they all incorporate a yagi or phased array antenna and a built-in receiver with wide-range RF gain control. Signal strength is indicated by a panel meter, tone pitch, or tone loudness.

I had only two of these foreign-made sets along, but I think they were easiest for Scouts to learn to use. All they had to do was turn the antenna for strongest signal indication and walk that way. Their excitement grew as signal strength rose and they had to lower the RF gain; it meant they were closing in. Bearings were nearly always accurate.

Weight was the biggest disadvantage of the integrated receiver/antennas. It surprised me how difficult it was for some grade-schoolers to hold a three-element 2 meter yagi overhead long enough to hunt down a hidden

Photo D. *Who says Morse is dead? Another hit of JOTA-96 was this code oscillator kit project. (Photo by April Moell WA6OPS.)*

fox. Their arms would become fatigued in about three minutes and the beam would slip down to shoulder height (see **Photo C**). Of course that adversely affected the beam's sensitivity and directivity. In the future, I want to have lighter antennas with masts, so they can easily be held overhead.

Competitive foxhunters prefer using earphones to hear fox modulation and strength tones in noisy surroundings. That's why most foreign-made integrated receiver/antennas don't have speakers. But phones aren't ideal for one-on-one training. My solution was to have the trainee wear them around the neck instead of over the ears. With gain turned up, they put out enough audio for the trainer, the trainee, and observers to hear. As a bonus, this eliminated the chance of an audio blast directly into the ears if the RF gain control was improperly set when the fox came on the air.

More "fox people" needed

ARDF and kit building were smash hits at our JOTA operation. Lots of Scouts were beeping away on their newly-built code oscillators as they came up to the foxhunting display (see **Photo D**). Some older Scouts said they'd had lots of HF QSOs in previous years, so they were glad to have some new activities this time.

Most Scouts had an opportunity to track at least one fox Saturday afternoon. Darkness fell around 6 p.m. and it was time for a big spaghetti dinner around the campfire. Then we left them for the night, promising to charge up the fox batteries for more hunts the next day.

If there was any doubt that foxhunting enthralled the Scouts, it was dispelled Sunday morning. As we pulled into the campground, we were greeted with young voices shouting, "The fox people are here!" Before we could get the RDF gear out, were mobbed. Scouts who had hunted on Saturday wanted to try again, because the foxes were all in new locations. We gave first priority to those who had not gotten a chance to hunt Saturday; then we let the rest have at it again.

Hats off to the Simi Settlers Radio Club for going beyond the call of duty in providing a special JOTA experience for the Scouts. Special kudos to Greg and Gabriella for paving the way for ARDF events. Also thanks to foxhunting enthusiasts from the Santa Barbara Amateur Radio Club for helping. In addition to Marvin, they were Stephen Nelson KD6VEX, Nerella Reginato, Reg Reginato KE6ZQY, Brian Peddicord KF6DZN, Mike Peddicord KE6OTM, Scott Phillips KF6EDD, Hubert Stamps KC6NAH, Bib Ummels KE6WYA, and President Darryl Widman KF6DI.

Many Scout officials at JOTA-96 expressed interest in future foxhunting demos and activities for their dens, troops, and packs. Given enough inexpensive equipment and trained leadership, radio-orienteering could become a mainstream Scouting activity. I have lots of ideas for gear. But will Scouting organizations across the country be able to find enough T-hunters to get this program off the ground?

Are you "Homing In" readers willing to build and stockpile some kid-proof ARDF gear, seek out your local Scout leaders, and put on training sessions? I want to hear constructive opinions and ideas from both T-hunters and Scout leaders about this concept. Let's prove that we mean it when we say we want more young people involved in ham radio activities. Send E-mail to Homingin@aol.com or write to the address at the beginning of this column. 73

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make. If you use a half cup measuring unit you'll use one quart of yogurt and end up with about two quarts of dressing.

The olive oil is good for you, as are the apple cider vinegar, honey, and yogurt. The best part is that this helps you live longer so you can watch while your enemies die of heart attacks, cancer, and other eating diseases. Heh, heh.

The combo of the raw zizzed veggies and slaw dressing makes eating health food easy. Hey, give it a try. It might help keep you from becoming a veggie.

Government Control

The religious fervor over abortion, pro and con, seems to have blinded both sides to the realization that once they get the government involved in religion, they have started on the slippery slope toward the government domination and control of religion. Is that really what they want? The old camel's nose in the tent syndrome?

The pro-lifers want to use the government to force their beliefs on everyone, backed by our so-called "correctional system." The pro-choicers want to force *their* beliefs on everyone, via government control. If either side wins, we all lose.

The same holds for school prayer. The damned judges should stop trying to get involved with religion vs. the government. Heck, I sat through school prayers for years without being impacted one whit. It was one of those rituals which we did without thinking, like saluting the flag, which we used to do every day. You know, that "One

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ABOVE & BEYOND

VHF and Above Operation

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A 1296 MHz Amplifier/ Mixer for Converter Use

With the coming of the new year and the holidays behind us, it's time to start getting our microwave and other projects off the back burner and start putting them together. Winter affects us in varying ways, with our many states and their vastly different geographical settings. For us here on the West Coast it means putting on a heavy shirt or light jacket for the chilly mornings, or getting prepared for our rainy season.

For other parts of the country with much harsher weather conditions this is truly the time for evening workbench projects. Last month we covered several older 2 meter multimode rigs, showing their use in SSB and narrowband FM operation as a lower-frequency IF system. This IF system is the heart of this RF converter, needing only a mixer, filter and local oscillator as additions for construction of a 1296 MHz converter.

Construction

This rig was quite easy to construct. While it is a peanut whistle (low power: +10 dBm), it is a complete rig needing only a local oscillator for operation. The beauty of this approach was that all the amplifiers are part of existing circuitry that is readily available. This circuitry requires only assembly into a shielded box to house the mixer, amplifier PC boards and relay switching circuitry.

This project was started when I tried to put together PC boards using MMIC amplifiers like the MAR series. This meant that I would have to come up with a PC board layout and select amplifiers to perform the receive and transmit functions of a low power RF controller. It was also intended to drive the transverter with a 2 meter multimode rig as the IF system in this project.

After several cuts at breadboarding this project I discovered that I did not need to construct amplifier chains as they were already at hand. The amplifiers came from Qualcomm surplus IF amplifier PC boards that I had available. They were originally a receive IF amplifier and a transmit IF amplifier using multistage MMIC amplifiers. Their small size, high gain and output power capability (+10 dBm on transmit) made them a very good candidate. The first breadboard test circuit was built using these IF PC boards, with a few other parts tossed in. These were simple RF relays, switching a mixer for converting frequency and a simple power supply regulator. Having all the material at hand and in modest quantity, allowing for others to use it, made this approach a natural for repeatability. First I had to construct a working model to prove that miniature inexpensive relays would function at 1296 MHz, thus eliminating expensive coaxial relays for low power switching.

I wanted used small surplus miniature SPDT relays removed from junk PC boards to switch the DC control voltages and the input and output RF switching as well. I was hoping that the RF losses would not

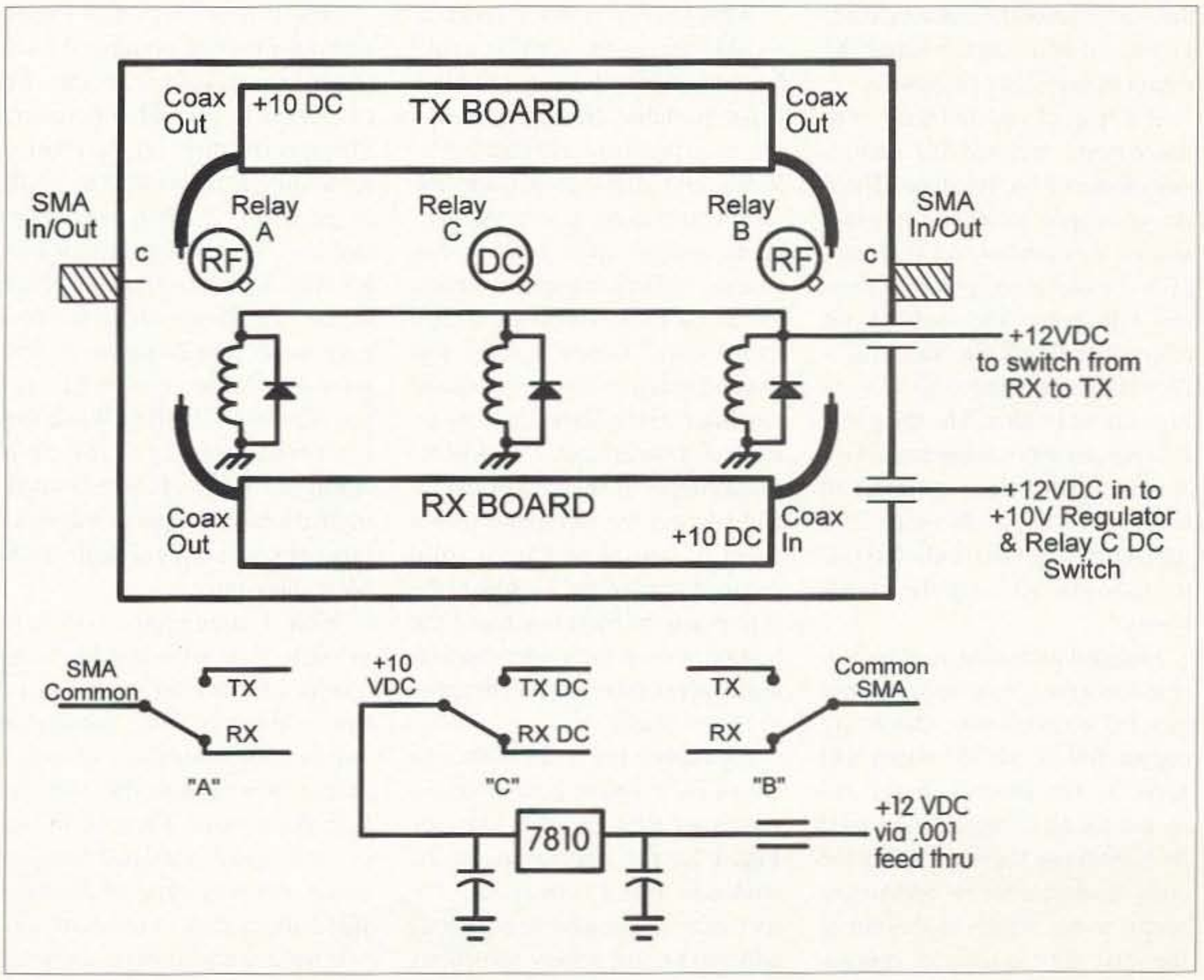

Fig. 1. *Layout diagram of the amplifier converter unit.*

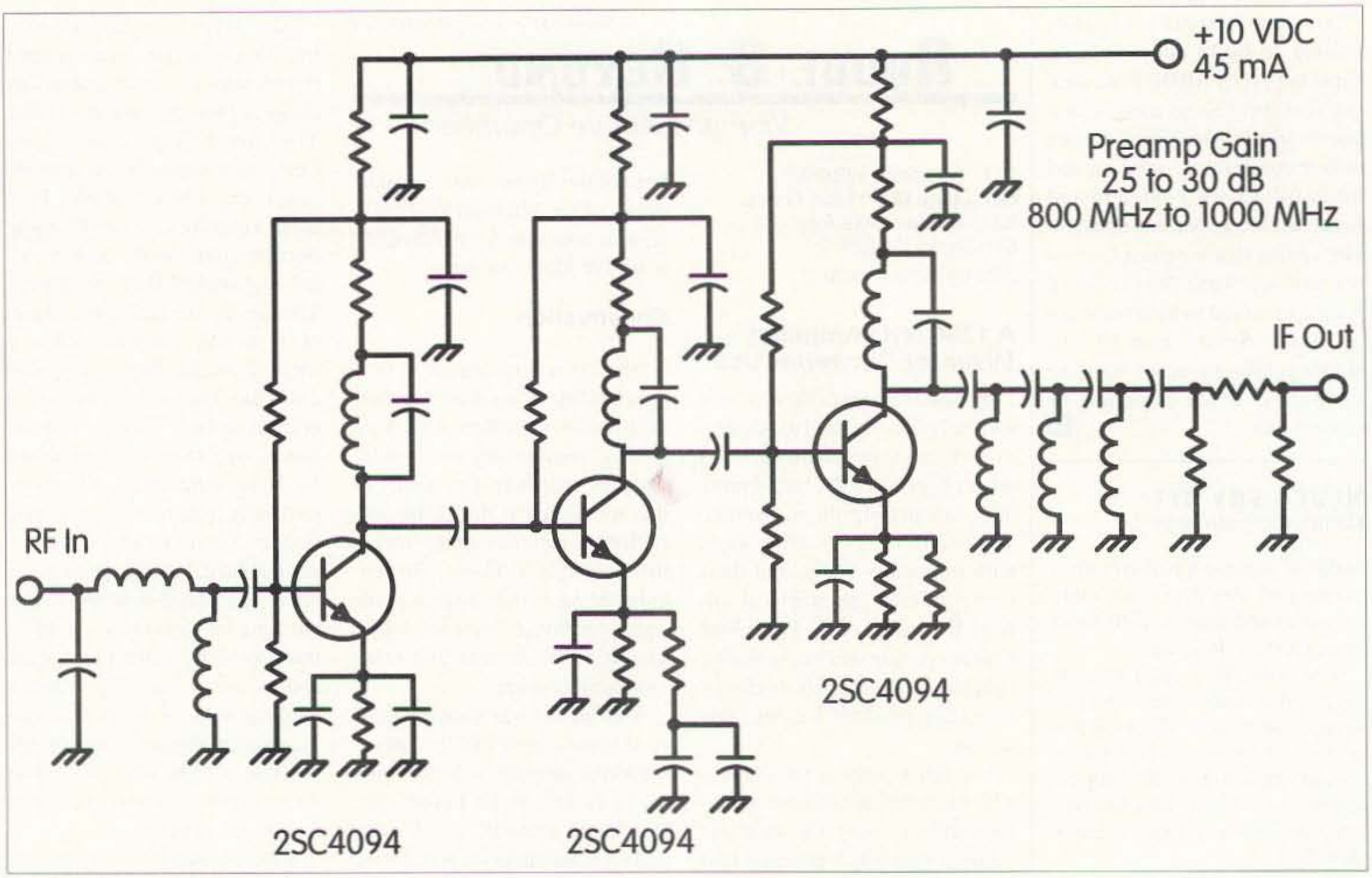

Fig. 2. Schematic diagram of the receive amplifier.

be excessive in these relays for 1296 MHz. The only way to prove this was to leave the theoretical environment and actually build the circuit as originally proposed.

The relays I selected were miniature metal-enclosed TO-5 relays manufactured by Teledyne. These relays are quite small and the exact size of a modest power transistor (TO- 5 metal-cased power transistor). I did not try the small 12 volt relays offered by Radio Shack (275-241) but I believe they should work in a similar fashion. The thing that is important about using any device at these frequencies is to make all leads as short as possible, especially the common ground leads. It is OK to make the RF amplifier leads longer.

I suggest mounting the relay upside down on a piece of copper circuit PC board blank. The entire copper foil of the PC board will serve as the ground shield and mount for all components. I used the position on the side wall for the coax connector in/out SMA connector to be exactly at the pin of the relay for the transfer contact. This gave minimum lead length to the relay by mounting it directly at the coax connector location.

What I have constructed is a reasonable layout that can be easily reproduced with the materials I will make available. However you are free to experiment and change the layout and application using the same components to suit your particular design requirements. In this case the old axiom applies: "If you change the recipe you might change the product." Give it a try if you like and watch for circuit layout and amplifier instabilities. Use similar PC board material of .062 double-sided copper to shield your circuit and connect the side plate with a seam of solder making a solid grounded enclosure. I soldered the side plates to each other and the bottom plate on the inside, connecting all copper foil surfaces together to form a shield.

Similarly a top cover is also cut out of PC board material to complete your RF-tight enclosure. See **Fig. 1** for the dimensions of the enclosure that I constructed. Dimensions do not have to be strictly adhered to; just follow something similar if you plan to use the IF amplifier boards that I will make available for this project.

The IF amplifiers that I used were surplus units removed from Qualcomm transceivers that we converted to 10 GHz operation. The specification on the receive RF amplifier is about 28 to 30 dB of gain and 2 dB noise figure making a very sensitive high gain RF front end. The transmit IF, or in our case RF amplifier, has less gain measuring 24 dB but it will provide a higher power RF output of nearly +10 dBm. While this is a peanut whistle (12 mW) it is still quite effective. External switching and a power amplifier will make this converter a formidable 1296 MHz transverter.

What I attempted to do is to provide you with the building blocks of circuitry to construct this converter. The thing that makes these amplifiers attractive is that they fit into this application like a glove. Their small size (1" x 3"), high gain and ready to place and play type of circuitry make them easy to use with +12 volt battery applications for home or portable rigs.

As I stated earlier, I will provide a mini kit of both the Rx and Tx PC boards with a 2000 MHz PC surface mount mixer and a short section of waveguide to construct an evanescent mode filter (see the end of this column for details). The only thing you will have to add is a local oscillator at 1152 MHz to complete the transceiver. That is if you also choose to use a 144 MHz transceiver for your IF system. The LO frequency would change if you change the IF frequency you use. If you used 432 MHz as the IF system frequency then the LO required would be 864 MHz.

Considering the 1152 there are several options on the LO, including a 96 MHz crystal oscillator followed by a times-three multiplier and double to 576 MHz, followed by a single doubler to 1152 MHz. An alternative would be to phase-lock up an old CATV front end on 1152 MHz for a very economical local oscillator. I have covered these for ATV projects and assume that with some modification they could adapt to this use as well. I used a different tack with a synthesizer that I had on hand.

This surplus synthesizer from Qualcomm is in small quantity and not easily available at present in the model that will generate 1152 MHz. We do have models that will lock up to 2304 MHz and, allowing for the onboard divide-by-two's reducing the LO to 1152 MHz, we might be able to tap off that line and use it in this application. I will have to try to find some time to try this modification and see if it is practical; more on this later. The actual synthesizer that I used is in the test bed area of my shack and I am in the process of documenting it. While it is an excellent choice, we do have a quantity of them and have not fully developed details for others to follow our conversion at this time. Also, this unit will prove to be costly because it comes equipped with a high quality 10 MHz TCXO on the PC board, this in addition to the 3036 synthesizer circuitry.

In the prototype conversion we were able to not only generate the required 1152 MHz for the converter's use at 1296 MHz transverter use, but also to use an additional oscillator port to drive a 3.7 to 4.2 satellite LNA by broadbanding its strip line circuitry to serve a harmonic amplifier. This LNA feeds a simple PC board antenna feed of triband proportions, making harmonics available for 2304 MHz, and 3456 MHz and higher harmonics available for calibration at other amateur frequencies. These frequencies are direct multiples of 1152 MHz.

I have tried both the CATV tuner's local oscillators and had some trouble increasing frequency higher to make it run at 1152 MHz. Normally the CATV tuner's upper frequency limits are near 1050 MHz and require modification to go higher. While the 3036-based synthesizer is much more complex, it is also the best local oscillator I have tried. However, it's somewhat expensive considering it comes with a 10 MHz high stability TCXO reference. Whatever local oscillator you select, this RF amplifier/mixer arrangement should prove quite easy to set up for a simple 1296 MHz converter.

The IF amplifiers provide gain over a 800 to 1700 MHz range. The receiver IF amplifier provides some 30 dB gain and exhibits a 2 dB noise figure, making a very good front end for a receiver converter. The transmit IF amplifier is also well suited for low power applications, or as a first driving amplifier. As it stands it provides +10 dB output power when driven from the mixer. Normally it has 25 dB gain but will only provide +10 maximum saturated out power in transmit. As both units run from a regulated +10 volts they are easy to use as they only require an input and output RF connection in addition to the +10 volts and ground.

In my application I mounted the amplifiers on the PC board with the receive amp facing forward or left to right, and the transmitting amp reversed with the receive amp. In this way I could use only one input and output RF connector and mount them on the side wall, which is about 3/4" high and constructed out of PC board material cut to length. All four sides are 3/4" high and soldered together. Another scrap of PC board material will serve at the top cover plate.

I mounted the two miniature TO-5 miniature relays as close to the coaxial connector for minimum lead length. I also soldered the relay coil with minimum lead length to ground. Place a rectifier diode across the relay coil for DC suppression. Position the other contacts as best you can to the input and output of the amplifier at their respective ends of the compartment. See **Fig. 1** for my particular layout. Exact replication of my layout is not necessary as long as your lead length is as minimum as you can make it. Remember that you are working at 1296 MHz and short leads are necessary.

The amplifiers both have input and output pads, making easy connection to their PC board circuitry. No adjustment or modification is necessary to their circuits; they can be used as they come. I soldered the PC board ground foil to the bottom circuit, making the amplifiers' PC board ground common and direct to the mounting bottom circuit board foil. I also mounted a third relay to switch the +10 volt DC line to either the Rx or Tx amplifier. Main DC input to the unit is 12 volts nominal and I used a 7810 voltage regulator mounted inside the case for the regulated DC supply.

This relay coil for the DC switch distribution is fed to an external key lead, making both the input and output coax (miniature TO-5 relays) switch when the DC control relay is also switched from this common key lead. In the nonkey condition DC power is supplied to the receive amplifier. When the key lead is energized the receive amp goes open and DC power is supplied to the transmitting amp and switching relay coils to energize them into operation.

This keying sequence can be changed to ground depending on your particular switching conditions. You don't have to follow my conditions; if yours are different make internal changes—don't modify your other equipment. If your keying conditions supply ground, tie the switching relay to +12 volts and run the open end to the switching lead. Bypass this lead with a feedthrough capacitor and ground to the transmit switch on this lead.

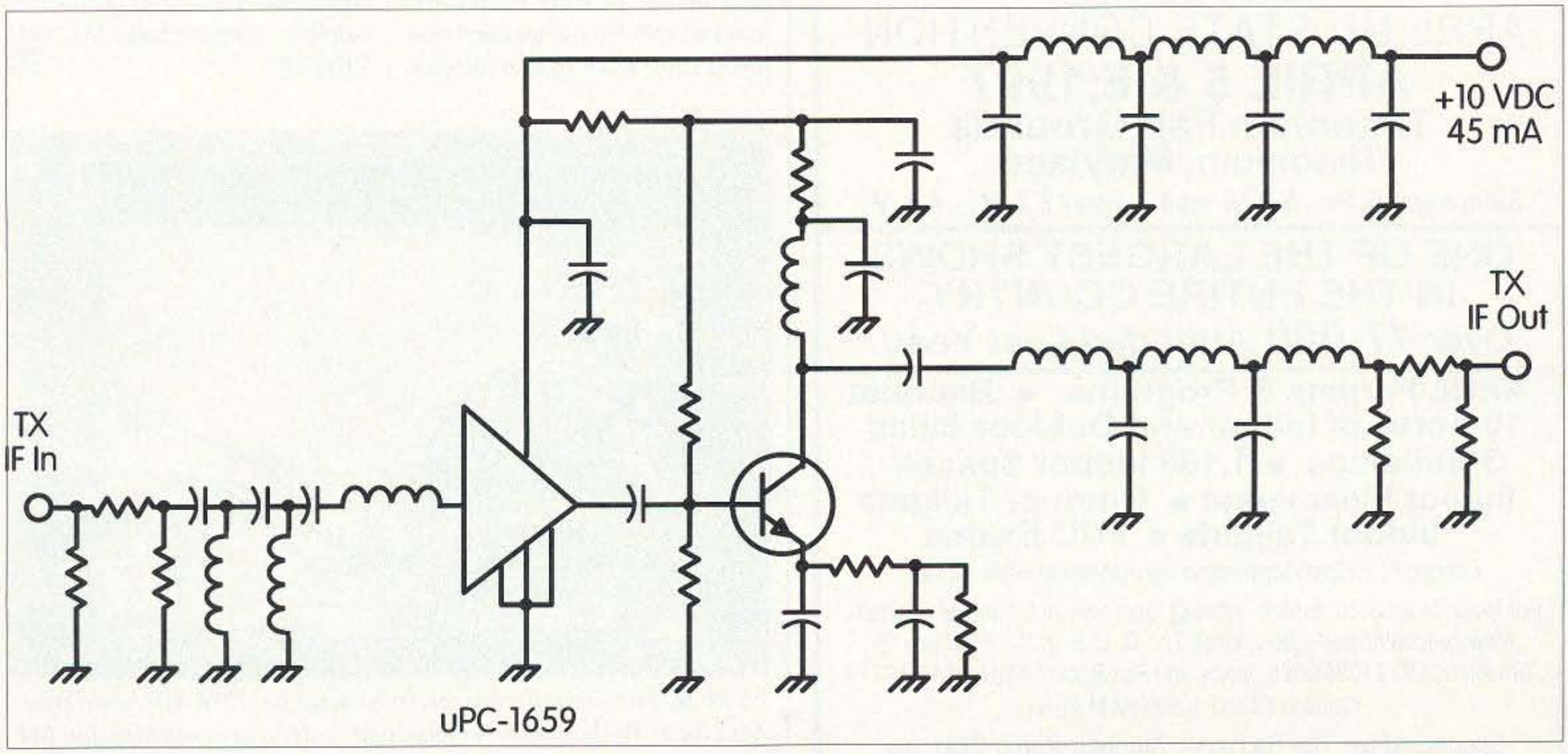

Fig. 3. Schematic diagram of the transmit amplifier.

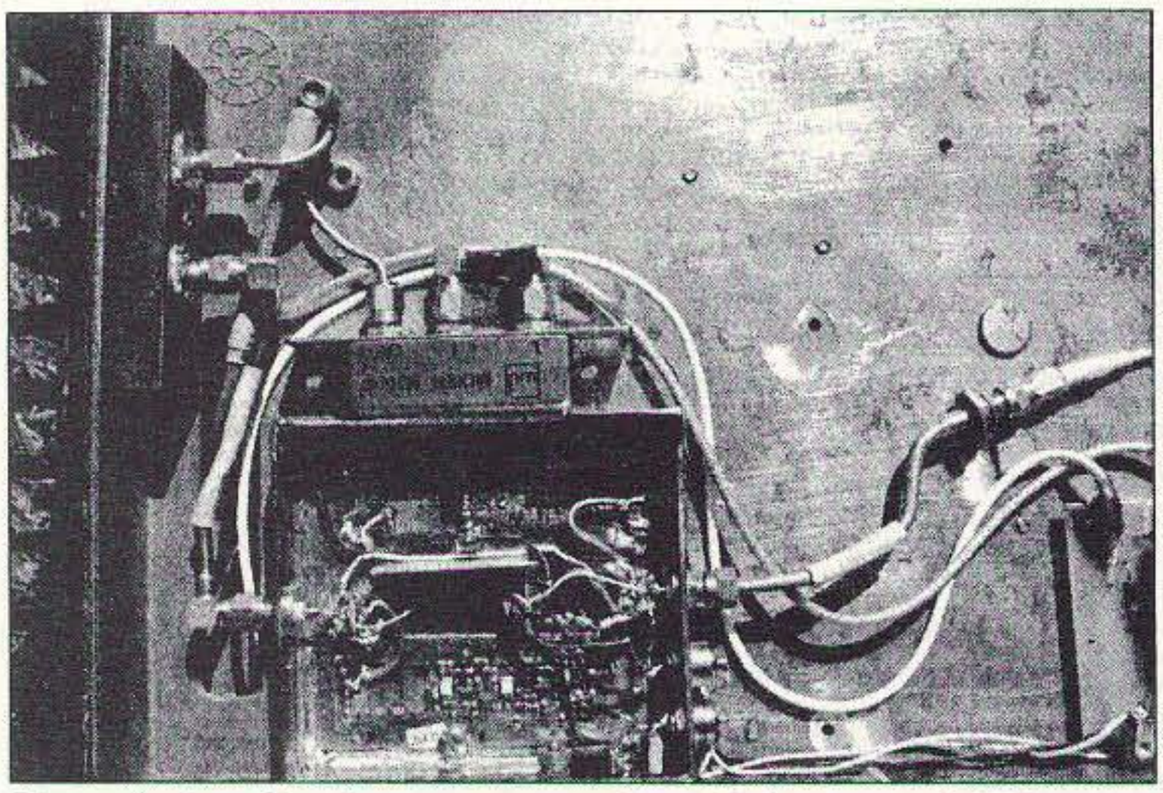

***Photo A.** Completed converter unit, lower left corner of RF housing. Mixer mounted to upper part of converter case and waveguide filter (for 1296 MHz complete low level transverter system) to rear left of photo (requires LO at 1152 for complete package).*

Preventing trouble

The only important part of construction on this RF amplifier is to run leads to the input and output switching miniature relays in as short as possible a path to reduce loss and prevent unwanted stray effects like lead crosstalking, which is undesirable. What is lead crosstalking? Well, another term for this is the venerable alligator effect known as oscillation. The only difference between an oscillator and an amplifier is that a good functional amplifier will not oscillate. However, if you give this amplifier a chance by coupling between the input and output circuits it will take off and fly as a oscillator.

The best answer to preventing this effect is to bypass the power and switching leads with a feedthrough capacitor. Use small relays for coaxial switching, make ground connections as short as possible and use as direct wiring as possible. In some stubborn cases it might be necessary to construct some small case-high internal shields constructed out of small PC board scrap pieces and solder them to the common bottom ground surface to serve a grounded separator.

The cover plate can also be a source of trouble when it is attached. Let's suppose that you have just finished the amplifier/mixer unit and all tested out OK. It sounds just fine and you are satisfied with this amplifier and have tested switching and all is still OK. However, when you put the cover on the noise in your receiver increases or some other effect is in apparent, like the presence of "birdies in your receiver." What's up?

Well, chances are the container is acting like a short section of waveguide with an input and output connector serving as the connectors to a waveguide to coaxial transition, and we have resurfaced the old alligator trick again (when the cover is placed on the amplifier)! The solution is to remove the cover plate and place some black conductive foam and glue it to the inside of the cover plate. Other material can be used, even some iron particles from a smashed iron toroid core. What type of material to use? Well, it doesn't matter much as both the iron core particles and the black conductive foam present a very high impedance or resistance to RF from coupling between the input and output of the amplifier.

If you use broken ferrite core material, glue the small broken pieces to the underneath side of the cover plate. This also will help to place a lossy substance in the path of the oscillation, thereby reducing the case's susceptibility to aiding oscillation. If you can figure out where an amplifier is getting its coupling from input to output you can stop the oscillation using one of these tricks I just mentioned. It's not hard but it does take some small amount of time to make a very stable amplifier system when placed into metal containers. They all act like waveguide and couple so be careful and test each and every one you build to prevent unwanted oscillations.

Next month I will get into several dish antenna feeds that can be constructed, and cover several that were obtained from surplus.

Concerning the 800 to 1700 MHz amplifiers used in this month's project: I will make them available in a kit containing both the Rx and Tx amplifiers with a 2000 MHz surface-mount mixer and a short section of waveguide 17 to construct the evanescent mode filter, for $20 postpaid.

Well, that's it for this month. Next month I will cover microwave stripline tuning methods. 73 Chuck WB6IGP. 73

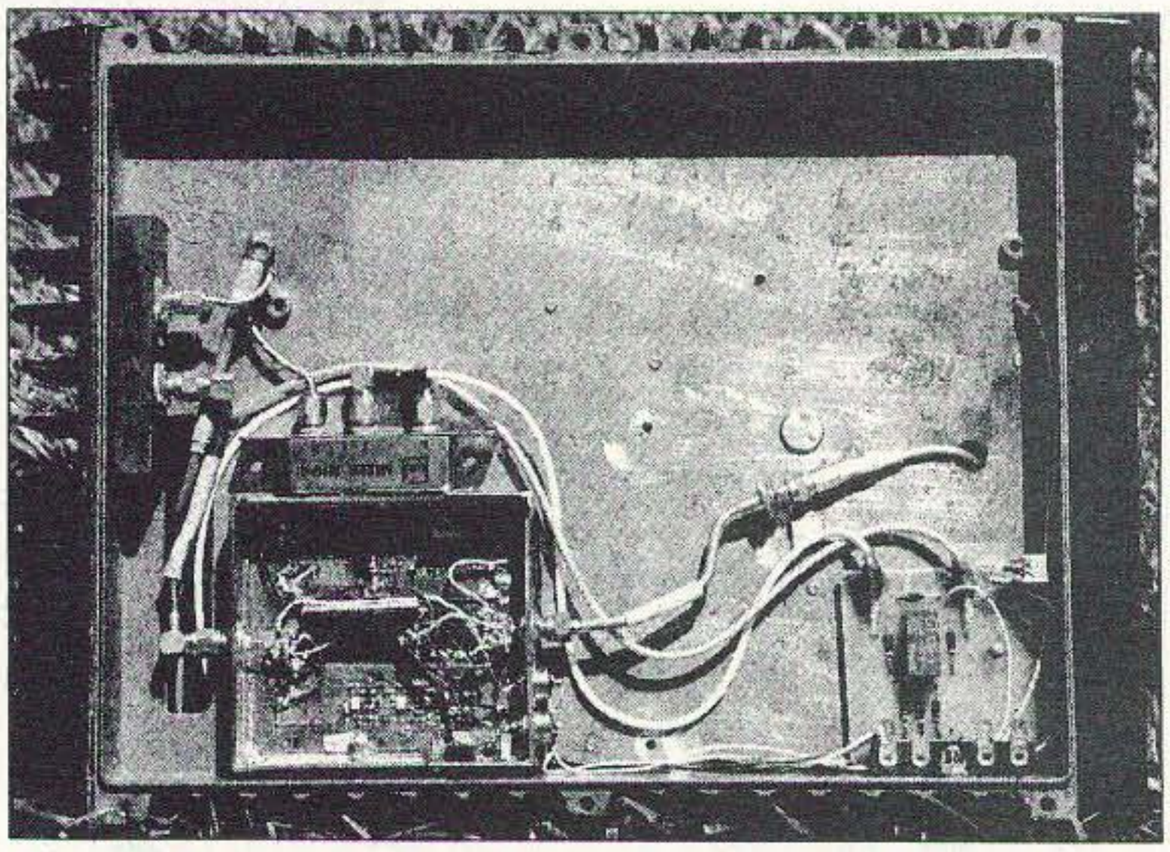

***Photo B.** Full view of transverter package for 1296 MHz converter. Additional PC board on bottom right is RF relay switching for 144 MHz IF changeover.*

QRP

Number 63 on your Feedback card

Low Power Operation

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The days in January are always gray and cold in Ohio, so let's begin the new year with three construction projects. The projects are simple to build and they are useful, too. They're electronic keyers.

To make it easier for you to build these keyers, all the artwork has been laid out in Circad™ format. You can get a copy of Circad from any of the larger telcom suppliers. I know CompuServe has the latest version. AOL more than likely does as well. The demo version is usable, but some features are locked out. You can edit and print out these files with the demo version.

I will post all of the files for this column, except for Circad, in the HAMNET forum. Inside HAMNET, the files will be in the QRP library section. All three projects will be in the library, and one file will have all three projects together. So, you can download one, two or three files by themselves, or one file with all three projects. All files will be in ZIPPED format. You'll need PKUNZIP or another unzipping program to view the files.

Because I wanted as many hams as possible to give these keyers a try, subminiature parts and super-small PC boards were not used. Instead, the layouts are large enough so even a novice in home-brewing can have a very good chance of building a working project.

Two of the keyers were laid out by Jay Graswell WBØVNE. I worked on the last one, the DYI Plus keyer. One of the keyers is built on single-sided PC board; two require a double-sided PC board.

The Curtis keyer

The first keyer is a classic. Based on the Curtis keyer on a chip IC, the original project was done by Paul Page N1FB and Bob Shriner WAØUZO. The work appeared in the December 1983 issue of *QST* magazine.

Although many versions of the Curtis keyer have appeared, this version has most of the features, without making an overly complex project. Also, this version does not require a double-sided PC board.

Assembly is very basic. There's nothing really special to worry about. I would suggest, however, that you use a socket for the Curtis chip. The chip is a bit pricey.

As you can see in the overlay for the PC board, many of the controls for speed, sidetone volume and so on are mounted directly to the PC board. I would mount the speed control off from the board so you can easily change its setting. Aside from the speed control, leave the others as shown.

Your local Radio Shack™ should be able to supply you with almost everything you will need. Radio Shack also carries a nice selection of project boxes to put the keyer in. The PC board is a bit large to fit inside some of the QRP rigs out today. This keyer would be a excellent choice for a benchtop unit.

Radio Shack won't have the trimmers nor the Curtis keyer chip. You can get the trimmers and the Curtis keyer chip from Mouser Electronics, 1-800-992-9943. Point your browser at their World Wide Web address at www.mouser.com.

You can also obtain the Curtis chip from Jade Products at 1-800-523-3776. Their web site is: www.hampstead.k12.nh.us/~djade/index.html. Jade Products also sells a Curtis keyer kit at $46.20 PP. It is *not* the same one presented here, however.

Right now, I'm not sure PC boards will be available. It's possible I may be able to talk FAR Circuits into making some of the single-sided boards. I will let you know if any of the boards will be made.

The DYI Plus keyer

This is an old favorite of mine. This time around, I've changed the layout and put the circuit on a double-sided PC board. This makes the keyer much smaller than the original version on its single-sided PC board. And, there was enough room to add an extra transistor and a reed relay. This relay allows the keyer to key transmitters using emitter keying. If your QRP transmitter requires the emitter of the oscillator transistor to be pulled to ground, a transistor switch may not do the job adequately. The results are usually a bag of unwanted chirps and tweets.

Because the CMOS chips will operate on a wide range of power supplies, I did not use any inline regulators. I would steal power from a regulated source from your rig. The CMOS will be happy with anything between 5 and 16 volts. Current demand for either of the keyers in this trio is just about zip. Only the relay demands a stiff amount of current.

The relay I used in the DYI Plus is an off-the-wall item at Radio Shack. It comes in two different voltages: 5 volts and 12 volts. If you run your DYI Plus from a 12 volt source, guess what relay you should use? The relays have the following Radio Shack numbers: for 5 volts, 275-232; for 12 volts, 275-233. Mouser electronics also sells these relays.

When I did this version of the keyer, I added a header to the circuit board on .100 centers. My idea is to use those cute shorting jumpers and a header to select between relay keying and solid-state keying. There is no reason why you can't use a clipped resistor lead instead of the shorting jumpers. And, there is enough current from the 4027 to drive both transistors. This way, you could have two outputs, although why is beyond me.

Speaking of headers, I also laid out the board to accept .100" headers for the speed pot and all the I/Os. I just hate seeing a project with a zillion wires soldered in place. The use of the plug-in headers makes for a much cleaner installation. If you can train yourself to use a standard header, you could switch out one keyer project for another.

G3BIK's keyer

The last keyer in our trio is by G3BIK, and comes from the Oct. 1994 issue of *Radio Communication*.

The circuit is very similar to that of the DYI keyer. The difference lies mainly in the choice of ICs used. Instead of the 4011, a 4093 is used. A 4013 replaces the 4027 used in the DYI keyer. Also, this keyer has an onboard 1 kHz keying monitor. It will drive one of those piezo units. I'm not sure I would like to use one of those for sidetone monitoring!

Note that this keyer is laid out so it is very narrow and only one inch wide. It would fit along the backside of just about any QRP rig. The relay TX output will ensure total keying compatibility.

Assembly

No rocket science stuff here. If you have assembled a few kits now and then, you should be able to get all three of these to work.

The only cautions are to handle the CMOS chips carefully; they're subject to damage caused by static. The ICs must also be installed correctly. Reverse one and it's almost a sure bet it's toast. I'd use IC sockets, especially on the double-sided PC boards. The prototypes I made had plated through holes. If you decide to make your own double-sided boards, be sure to solder the connections on both sides of the board.

I'd use a 9 volt battery to test out these keyers. There's no need for large high-capacity gelled batteries. In fact, just in case you have something out of whack, you'll do little damage with the 9 volt battery. On the other hand, you can easily burn off copper traces with a gel cell.

I've built the DYI Plus keyer and the Curtis keyer board. They work just fine. I have not assembled the G3BIK keyer.

Again, I'll have all the files uploaded to the QRP section on CompuServe. And, of course, the QRP section is hiding inside HAMNET. If I come up with any changes to either the boards or the schematics, I'll have the updates in those libraries.

If there is enough interest, perhaps a small run of double-sided PC boards with plated through holes will be made for the DYI Plus keyer.

Next month I'll have some more odds and ends for various circuits you can use for your latest QRP projects. 73

Communications Simplified, Part 13

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Mt. Kisco NY 10549

It's time to look at the transmission lines that connect the antenna to a receiver or transmitter.

Characteristic impedance

Let's review what we said about characteristic impedance earlier in this series. Think for a moment about how an ohmmeter works. Inside every ohmmeter is a small battery. When you connect the ohmmeter across a resistor, the meter connects that battery across the resistor. Current starts to flow through the resistor, the meter measures how much current there is, and computes the resistance from Ohm's law:

$$\text{resistance} = \frac{\text{voltage across resistor}}{\text{current through it}}$$

Now, imagine that you have an infinitely long length of some cable, such as the flat twin-lead cable used for TV antennas, and you connect the ohmmeter between the two wires at your end. What will you measure?

Connecting the ohmmeter to the end of your cable connects its battery across the two wires. The ohmmeter, of course, doesn't know whether there is an inch, a foot, or a mile of wire there, so it sends some current out its test leads, hoping eventually to reach a resistor at the end. Normally, the current would reach a resistor after going through just a few feet of wire, and settle down to whatever current Ohm's law wants. In this case, however, that test current just keeps going forever (at almost the speed of light), searching for a resistor that isn't there. The ohmmeter doesn't know that this test current never reached a resistor; it happily measures the current and voltage, and displays a value of resistance anyway.

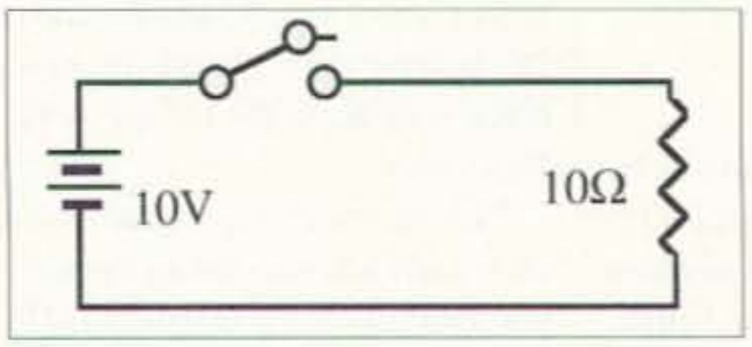

Fig. 1. A simple series circuit.

The amount of current that flows depends on the kind of cable. Actually, its resistance has fairly little to do with it; it's the capacitance between the two wires and the inductance of the wires that mainly determine how much current flows down the cable. The resistance the meter measures therefore depends on the type of cable; we call it Z_0, or the *characteristic impedance* of the cable.

Different cables have different characteristic impedances—the TV twin-lead is 300 ohms, the coaxial cable used for TV antennas is 75 ohms, while the coax generally used for transmitting antennas is 50 ohms. And the twisted-pair cable generally used for audio and telephone circuits would measure 600 ohms.

Reflections

Now look at **Fig. 1.** Here we see a simple circuit, consisting of a 10-volt battery, a switch, and a 10-ohm resistor, all connected in series. Right now, the switch is shown open, and so there is no current. Once we close the switch, current starts to flow. The value is given by Ohm's law as V = I/R; this works out to 10 volts/10 ohms, or 1 ampere.

But let's complicate the issue a bit by making the wires between the switch and the resistor 186,000 miles long. To simplify things a bit, let's assume that the wire has no resistance, but it does have a characteristic impedance Z_0 of perhaps 100 ohms. What is the current just after we close the switch?

Since it takes light one second to travel the distance from the resistor to the switch and battery, even if the battery had a high-power telescope so it could "see" the resistor at the far end, it could still not know precisely what is at the end of the wire at the instant the switch closes—it could only see what was there one second earlier. So, as before, the current it sends out depends not on the resistor, but on the characteristic impedance of the line. The current is therefore:

$$I = \frac{10 \text{ volts}}{100 \text{ ohms}} = 0.1 \text{ ampere}$$

So, if we had a voltmeter and ammeter connected at the switch, we could see 10 volts and 0.1 ampere entering the line as soon as the switch closes. A half-second later, that voltage and current reach the middle of the line; one second later they finally reach the resistor.

The problem is that 10 volts and 0.1 ampere are all wrong for a 10-ohm resistor. By Ohm's law, if there is 10 volts, there should be 1 ampere; if there is only 0.1 ampere, then there should be only 1 volt. The resistor therefore looks at the voltage and current reaching it, and says "No, no, no—something is wrong—there is either too little current, or too much voltage—or perhaps both!"

The resistor therefore short circuits some of the applied voltage to bring it closer in line with what should be there, considering the amount of current. This temporary short circuit causes an additional current to flow through the resistor as well.

This situation, however, leads to a contradiction. At the resistor, the voltage is now lower than 10 volts while the current is slightly higher than the original 0.1 ampere. However, a short distance back from the resistor the line voltage and current are still 10 volts and 0.1 amperes. But this can't be! In a parallel circuit, the voltage must be the same everywhere, while in a series circuit the current should be the same as well. And so the drop in voltage and increase of current must start to travel back along the line, eventually making the voltage and current the same everywhere.

One way to look at this is to think of an outgoing signal (10 volts and 0.1 amperes) traveling from the battery to the resistor, and a second, returning signal, traveling back from the resistor toward the battery. The returning signal adds to (or subtracts from) the outgoing signal, changing the total voltage and current along the wire. In technical terms, we say that the returning signal is a *reflection* —part of the outgoing voltage and current have been reflected from the load, and travel back along the line.

The reflection will eventually reach the battery, which will look at the lower voltage, and do everything it can to boost it back to the required 10 volts. In the process, it will send out a burst of more voltage and current (but still the wrong values). These will go back to the resistor, cause yet another reflection, and so on. Eventually, the voltage and current will stabilize at the 10 volts and 1 ampere that DC circuit theory says we should have.

We can calculate how much voltage is reflected from the *reflection coefficient*, represented by the capital Greek letter gamma:

$$\Gamma = \frac{Z_L - Z_0}{Z_L + Z_0}$$

where Z_L is the value of the load resistor (100 ohms in this case), while Z_0 is the characteristic impedance (which is 10 ohms in our example). So in this case, the reflection coefficient is:

$$\Gamma = \frac{Z_L - Z_0}{Z_L + Z_0} =$$

$$\frac{100 - 10}{100 + 10} = \frac{90}{110} = 0.818$$

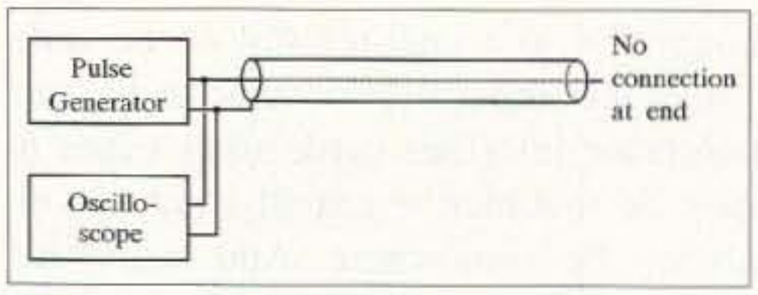

Fig. 2. *Time-domain reflectometry.*

What this means is that 81.8% (a fraction of 0.818, or 8.18 volts) of the outgoing 10 volts will reflect off the 1-ohm resistor. The voltage across the resistor will then be 10 - 8.18 = 1.82 volts. Knowing how much voltage will actually reflect is nice, of course, but it's more interesting to look at three special cases.

Case 1: There is no load resistor at the end of the cable at all—the output is open. In this case, Z_L is infinity, and the equation becomes:

$$\Gamma = \frac{\infty - Z_0}{\infty + Z_0} = \frac{\infty - 10}{\infty + 10} = \frac{\infty}{\infty} = +1$$

That's because the infinity on the top and bottom are so big that we might as well ignore the Z_0. So, with the output open, the reflection coefficient is +1, and 100% of the outgoing signal is reflected.

Case 2: If, on the other hand, the end of the cable is shorted, then Z_L is zero, and the equation becomes:

$$\Gamma = \frac{0 - Z_0}{0 + Z_0} = \frac{0 - 10}{0 + 10} = \frac{-10}{+10} = -1$$

In this case, the reflection coefficient is -1, and so -100% of the outgoing voltage is reflected. That is, it is all reflected, but the polarity changes (that's what the minus sign means). That makes sense, since the voltage at a short circuit must be zero; the only way to get this is if the outgoing voltage and the returning voltage exactly cancel each other out.

Case 3: Suppose, on the other hand, that the load resistance Z_L is exactly equal to Z_0? In that case, the numerator of the equation becomes $Z_0 - Z_0$, which is zero. The reflection coefficient is therefore zero, and nothing is reflected at all.

So we see that the only way to get no reflection is to load the end of the line with a resistance exactly equal to the characteristic impedance of the line itself.

Let's see how reflections in cables can cause problems.

Reflections in digital circuits

Fig. 2 shows a simple test circuit which we can rig up in the lab. At the left we have a pulse generator; the pulse generator acts sort of like a battery and switch, except that it closes the switch only for a very short time (sometimes as short as just a few billionths of a second). In other words, it connects a voltage to the line for a tiny instant, and then immediately disconnects it again. The pulse generator feeds a length of transmission line (we use 100 feet of RG-58 coax cable in our lab experiment), whose far end is shown open. A fast oscilloscope is connected across the pulse generator to show us the signal.

Fig. 3 shows the result. The fairly sharp pulse at the left is the signal coming out of the pulse generator. It appears as a narrow pulse, on for just a very short time. The slightly smaller pulse at the right is what comes back from the end of the line—this is the reflection. It is slightly smaller, because there is about a 10% loss of voltage in going down the cable and back (this is, after all, a practical cable, not a theoretical, loss-free one). Note also that the returning pulse is slightly wider and not nearly as nice and square. This is caused by the various parts of the pulse traveling down the cable at slightly different speeds, which results in the pulse spreading slightly.

From this picture, we could calculate the signal loss in the cable; much more interesting, though, is to calculate how fast the signal travels. In this picture, the scope sweep was set to 0.05 microseconds per division; since the spacing between the two pulses is about six divisions, the delay between the outgoing and returning pulses is about 0.3 microseconds. In that time, the pulse traveled 200 feet (100 feet from the generator to the end, and another 100 feet to return). The signal velocity is therefore:

$$\text{velocity} = \frac{\text{distance}}{\text{time}} = \frac{200 \text{ feet}}{0.3 \text{ µsec}} =$$

$$6.67 \times 10^8 \text{ feet/sec}$$

Since there are 5,280 feet in a mile, this works out to about 126,000 miles per second. Note that this is slower than the speed of light, which is usually given as 186,000 miles per second; this latter figure is only true for light in a vacuum anyway, not for light in air, glass, or other materials.

In our electrical case, the speed of the signal in the cable is only about 67% of the speed of light; we call this number the *velocity factor* of the cable, and usually write it as 0.67 rather than 67%. (Remember that our measurement is only an approximation; the actual published velocity factor for RG-58 cable is slightly less, but the delay time is hard for us to read from the scope, and so 0.67 is about as close as we're going to get.)

The velocity factor is thus:

$$\text{velocity factor} = \frac{\text{actual speed}}{\text{speed of light}}$$

Now imagine that the pulse in **Fig. 3** is just one of many pulses being sent in a cable, perhaps as part of a computer local area network. If the end of the cable is open, then the pulses reflected from the end will get mixed in with the outgoing pulses and cause major errors in the system. So reflections can be a big problem.

Fig. 3 dealt with a line whose far end was open. If the far end had been shorted, there would still be a reflection, but the reflected signal would be negative instead of positive.

From our previous discussion, we can now see that the only way to prevent reflections is to make sure that the end of the cable is properly terminated—we must place a resistor at the end of the line, and make sure that its resistance is equal to the characteristic impedance of the line. If the resistance is slightly off, there will be a reflection, but it might not be large enough to matter. In general, a resistance larger than the characteristic impedance will provide a positive reflection; a resistance smaller than the characteristic impedance will provide a negative reflection. Thus the cables in local area networks are always connected to a load resistor at the end; sometimes the resistor will be inside the computer interface card, other times it may be mounted externally, but it will always be somewhere. And since the signals in these cables can travel in either direction, there will be a termination resistor at each end of every cable.

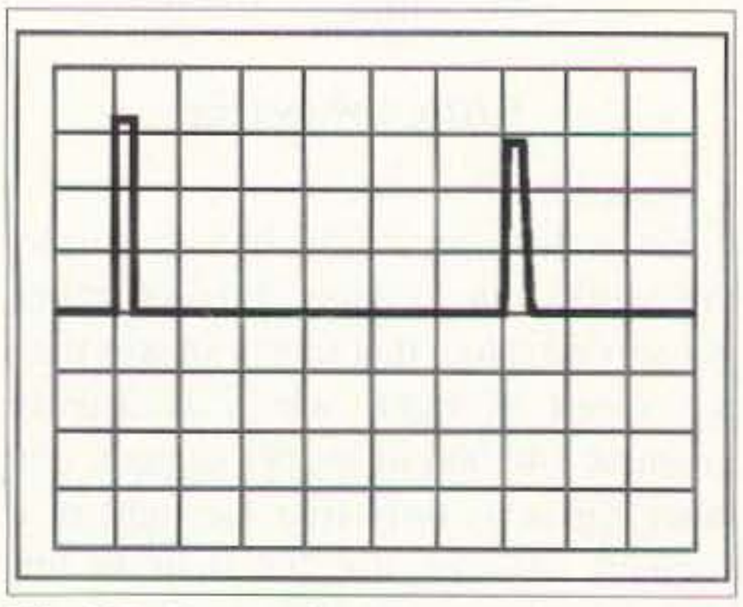

Fig. 3 Reflection from an open circuit.

Incidentally, putting a proper load resistor at the end of the cable is not enough—*how* you connect it is important too. If that resistor is right at the end of the cable, with short leads, all is fine. But **Fig. 4** shows what happens if that resistor is connected with foot-long clip-leads. There is still a small reflection; in fact, there are now *two* small reflections. At point A is a small positive reflection, caused by the clip-leads. The two clip-leads make a small transmission line, but its characteristic impedance is higher than that of the coax cable. So we get a positive reflection at this point. A foot later, the termination resistor has a lower resistance than the clip-lead impedance, and so we get a small negative reflection at point B. This points out that this type of test, called *time-domain reflectometry* (or TDR) because it measures the reflections and the time they occur, lets us analyze the locations of shorts and opens, as well as the locations of bad connections. Commercial TDR instruments are thus very useful for finding problems in buried or hidden cables.

Reflections in analog circuits

Analog signals can be reflected from the ends of cables just as digital ones can. For example, consider the antenna lead from a TV antenna to the TV set. To prevent reflections, the characteristic impedance of the cable usually matches the impedance of the antenna, and the impedance of the TV set's antenna input. Since there are two kinds of common antenna leads in use—the flat "twin-lead" cable which has a Z_0 of 300 ohms, and TV coax with a Z_0 of 75 ohms—many TV sets have two separate inputs as well. TV antennas usually have a 300-ohm connection, but we often use a 75- to 300-ohm transformer to match it to coax cable. (There's a second reason, too—the 300-ohm twin-lead is a balanced lead, whereas the coax is unbalanced, so slightly different connections are needed.)

Why the careful impedance matching? Because reflections can cause delays. If some of a received TV signal went directly to the TV set, while a small portion of it was reflected from the set back to the antenna, and then reflected a second time from the antenna back to the set, the TV set would get a weak signal shortly after the main, strong one. This would cause a ghost image to appear to the right of the main image. (If you get ghosts in your TV image, don't immediately blame the antenna installation. Ghosts are also often caused by reflections from nearby buildings, hills, or other large objects.)

But there is a second way to look at reflections of analog signals. Let's suppose that the signal entering the coax line in **Fig. 5** is not a pulse, but a sine wave. The reflection will then also be a sine wave, rather than a pulse. Depending on the length of the line, that reflection could arrive at the beginning of the line at various times. So let's examine a few special cases.

Case 1: Suppose that the line is exactly one-quarter of a wavelength long, and its far end is open-circuited. We earlier defined a wavelength as the distance a signal travels in the time of one cycle. The equation for the wavelength lambda was:

$$\lambda = \frac{\text{velocity}}{\text{frequency}}$$

For the velocity, of course, we now have to take the velocity in the cable, and we have already learned that this velocity is smaller than the speed of light in a vacuum; it is the speed of light times the velocity factor for the particular cable.

Let's put some numbers on this. Suppose we use an RG-58 cable with a velocity factor of about 0.65, and a

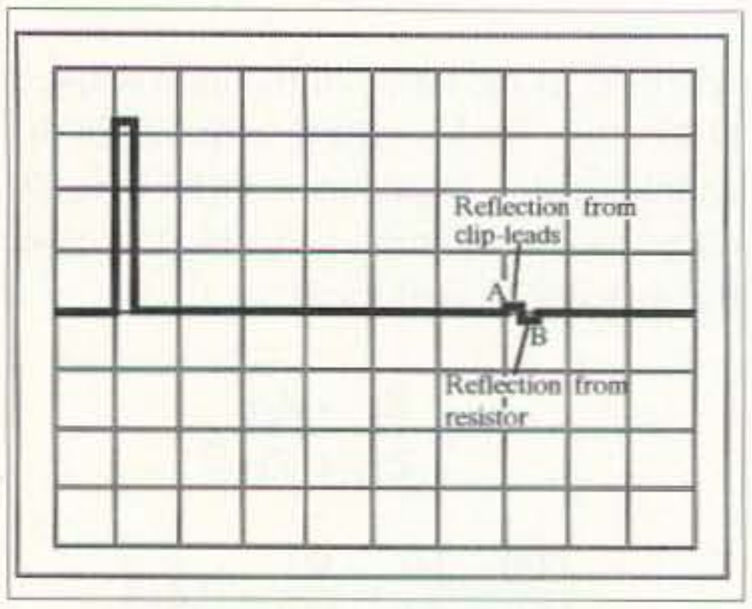

Fig. 4. Reflection from a bad load.

frequency of 1.6 MHz. One wavelength is then:

$$\lambda = \frac{186{,}000 \text{ miles per second} \times 0.65}{1{,}600{,}000 \text{ Hz}}$$

$$= 0.0756 \text{ mile}$$

which is about 399 feet. A quarter-wavelength is then about 100 feet.

So let's take 100 feet of RG-58 cable, leave the far end open-circuited, and send a 1.6 MHz signal into it. The signal will take exactly one quarter of a cycle to travel down to the end. Since the end is open, the reflection coefficient Γ is +1, and so the signal is completely reflected. It now takes a quarter of a cycle to travel back to the beginning of the line, arriving exactly one-half of a cycle after it started. Assuming a low-loss line, the signal coming back will be almost exactly the same size as the outgoing signal.

The only problem is that the returning signal is now exactly one-half of a cycle behind the outgoing signal. In other words, the positive half-cycle of the sine wave arrives just as the signal generator is producing the negative half-cycle. And so the positive and negative half-cycles exactly cancel, producing 0 volts at the input into the line. The oscilloscope will see nothing.

Let's think about this for a moment. The signal generator in **Fig. 5** is generating a voltage (we didn't specify how big) but the actual voltage measured by the scope at the input into the line is 0 volts. How can that be? The only possible explanation is that the transmission line behaves like a short circuit. There is current, but no voltage.

We can summarize this as follows: *A quarter-wavelength transmission line which is open-circuited at the far end behaves like a short circuit at its input.* It may be a bit hard to believe, but it is true.

One more thing: The generator, thinking it is feeding a short circuit, is outputting more than its normal current, trying to overcome that short. So the input to the line is a point of zero voltage, but higher than normal current.

Case 2: Let's now take a similar case, but instead of leaving the far end of the line open-circuited, let's short it and see what happens as the positive half-cycle part of a sine wave leaves the signal generator.

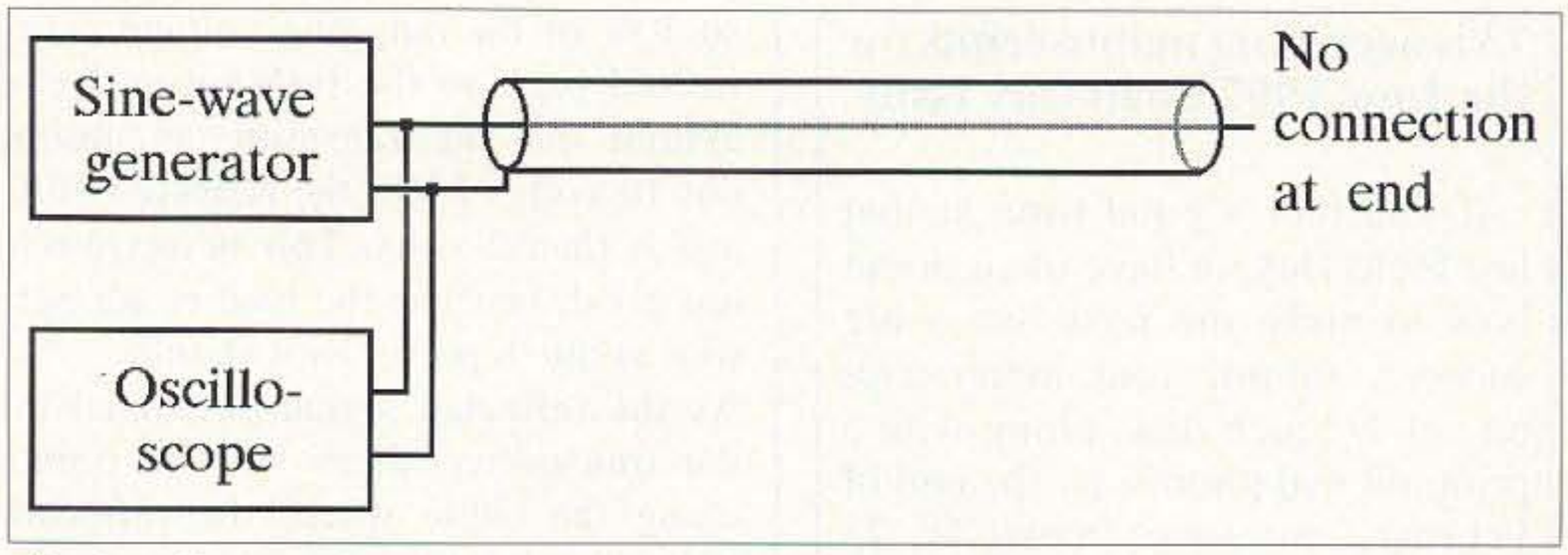

Fig. 5. Reflection of a sine wave.

The signal takes a quarter of a cycle to reach the short. Because the reflection coefficient Γ at a short is equal to -1, the positive half of the sine wave is completely reflected, but the minus sign means that it becomes negative rather than remaining positive. This signal now takes another quarter of a cycle to arrive back at the signal generator, arriving exactly a half of a cycle after it left.

Let's stand back and think about this for a moment. The positive half of a cycle left the generator, was inverted at the reflection, and returns just as the generator is outputting the following negative half of the cycle. The generator is now trying to output a negative voltage, but there is already a negative voltage on the line. So the generator doesn't really have to do anything to make the voltage negative. Hence it does not output any current. How can that be? The only possible explanation is that the transmission line behaves like an open circuit. There is a voltage, but no current.

We can summarize this as follows: *A quarter-wavelength transmission line which is short-circuited at the far end behaves like an open circuit at its input.* This, too, may be a bit hard to believe, but it is true. Given the right test equipment, you can prove it for yourself.

We can extend this idea to other lengths of cables. For example, the cable in **Fig. 6** is 3/4-wavelength long. What do we see if we look into the input?

Let's imagine that the line is split into the three parts labeled **A**, **B**, and **C** in **Fig. 6**, each part a quarter of a wavelength. Since the right end of part **C** is open, the left end of it looks like a short. Part **B** is therefore shorted at the right, so its left end looks open. Finally, part **A** sees an open at its right end, so its left end looks like a short. So a 3/4-wavelength line which is open at the far end looks like a short at its input.

We can extend this reasoning to any line whose length is some multiple of a quarter-wavelength, and which is either shorted or open at its end. But what about other lines?

More complicated cases

In most cases, transmission lines will not be an exact multiple of a quarter-wavelength, and they will not have an exact short or open at their end. What then?

The mathematical analysis of such cases is fairly difficult, and most professionals will use a special kind of graph called a Smith Chart to figure out what happens. But even without the Smith Chart, we can still get a general idea of what is going on. So let's consider the case in **Fig. 7**, where we see a transmitter feeding a 75-ohm load (most likely an antenna) through a 50-ohm transmission line that is 1.68 wavelengths long.

Because the load resistance is not equal to the line's characteristic impedance, there will be a reflection. The reflection coefficient is:

$$\Gamma = \frac{Z_L - Z_0}{Z_L + Z_0} = \frac{75 - 50}{75 + 50} = \frac{25}{125} = 0.2$$

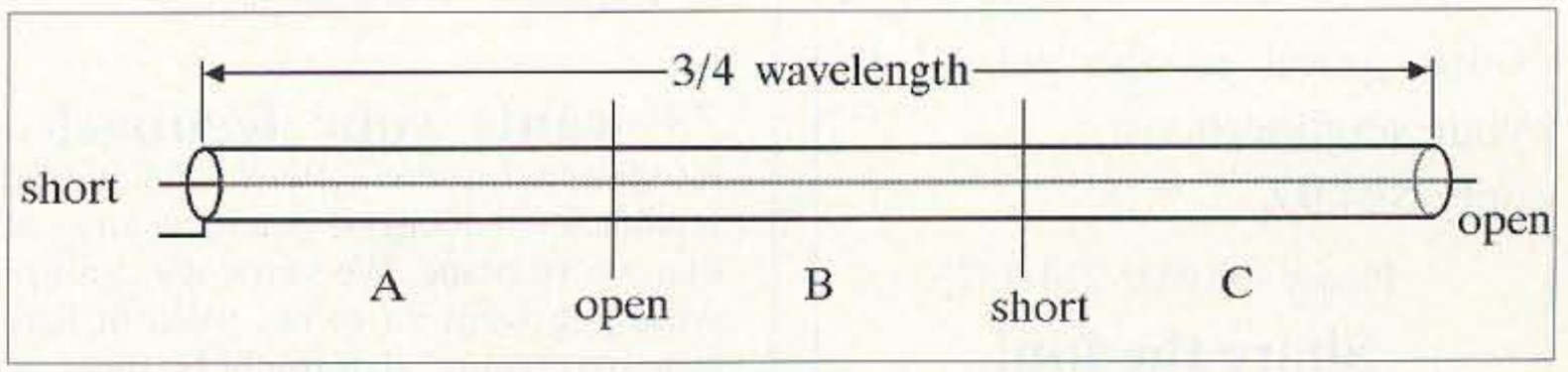

Fig. 6. A 3/4-wavelength line.

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so 20% of the outgoing voltage is reflected back to the transmitter. Let's assume that the transmitter is putting out 10 volts of RF; the reflected voltage is then 2 volts. This is obviously not good, because the load is not getting as much power as it should.

As the reflected signal goes back to the transmitter, there will be points along the cable where the reflected voltage will add to the outgoing voltage, giving us more than 10 volts. This voltage is called V_{max}, and is equal to:

$$V_{max} = V_{forward} + V_{reflected}$$

In our example, this voltage is 10 + 2 = 12 volts.

At the same time, there will be other places along the line where the two voltages are opposite, and so they subtract to give:

$$V_{min} = V_{forward} + V_{reflected}$$

In our example, this voltage is 10 - 2 = 8 volts.

Ideally, if the load was perfectly matched to the line, there would be no reflected voltage, and so V_{max} and V_{min} would be equal—the voltage would be the same 10 volts everywhere, and there would be no maximum or minimum. But that seldom happens exactly.

The presence of maxima and minima means that we can take measurements along the line, and find these points of maximum and minimum. This is not particularly practical with coax cable, but it can be done with open-wire balanced lines, where you can easily get to the wires to take voltage readings between them It is also sometimes done with microwaves; microwave signals (i.e., signals with a very high frequency on the order of gigahertz) are usually carried in waveguides (more on these later). It's possible to cut a slot into a waveguide and insert a small probe to take voltage readings inside it. This can be used to measure the VSWR, but it can also be used to find the frequency. Because the distance from a maximum to a minimum point is a quarter-wavelength (and the distance between two minima is therefore a half-wavelength), this can be used to measure the wavelength of a signal. If you know the speed of the signal in the waveguide, you can then calculate the frequency.

We say that these minima and maxima indicate the presence of *standing waves* along the line, and then define a *standing wave ratio* (also called a *voltage standing wave ratio* because we measure the voltage), abbreviated as SWR or VSWR:

$$VSWR = \frac{V_{max}}{V_{min}} = \frac{V_{forward} + V_{reflected}}{V_{forward} - V_{reflected}}$$

In our case, this is 12/8 or 1.5.

In the best case, if V_{max} and V_{min} were equal, the VSWR would be 1; many people read this as "1 to 1" or 1:1.

In the worst case, when *everything* is reflected, $V_{forward} - V_{reflected} = 0$ and the denominator is zero, so the VSWR is infinite. So measuring the VSWR is a common way of checking whether an antenna is well matched to the transmitter and its feedline. (It is not a perfect measure, because a resistor load equal to the transmission line's characteristic impedance would produce no reflections, yet obviously radiate no signal into the air!) 73

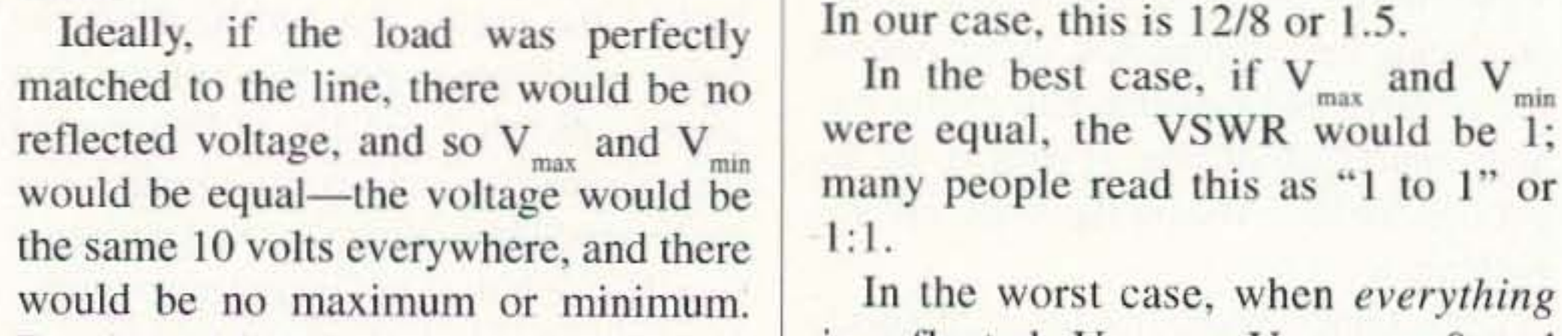

Fig. 7. *A more typical example.*

***73* wants your feedback...** we've been improving *73* for the past months with more articles, easier reading type, etc. And honestly, we *need* your feedback (in detail) if you have any critique either for or against the subtle changes that we've made. We know we can't please everyone every time, but if you tell us what you want *73* to be, we'll at least try to head in the direction for further "improvements" that might be most appealing to you. Thanks.

Build a Well-Regulated Power Adapter

Add some stability to your plug-in wall transformer.

James Tarchinski N8PTG
3135 Primrose Drive
Rochester Hills MI 48307

As you flip through the pages of *73*, or any other source of electronics circuit information, you'll find that many of the circuits either incorporate or need to be powered externally by a positive 5-volt DC power supply. Five-volt supplies are by far the most common supply value used for today's electronics. Knowing this, one would assume that there must be dozens of 5-volt regulated DC power adapters on the market, right?

Wrong. The free enterprise system has missed the mark on this one—regulated 5-volt adapters are nearly nonexistent, so electronics hobbyists often end up incorporating supplies into their project designs. In fact, they tend to design and build these supplies over, and over, and over again. But you don't have to keep repeating yourself—there is a better way.

Wall adapters can provide a convenient way of powering your electronics projects; you just need to modify them so they have the correct output characteristics for just about any regulated voltage that you will ever need! Because everyone has a different application with different design criteria, however, we do not go through one particular design. Rather we will discuss how to modify wall adapters in general, concentrating particularly on how to modify an adapter electrically without reworking the basic packaging of the unit's electronics.

A bit of history

The consumer electronics industry as we know it today would not exist if it were not for "industry standards." Industry standards are essentially gentlemen's agreements among companies stating that they will all produce products that utilize a standard format for something. This type of arrangement allows companies to save money by jointly developing a new technology, but yet they can each make money by selling their own unique products.

For example, before any company sold a compact disc (CD) player, all the major audio manufacturers of the world agreed on the specifications for the disc format. From the

#	Labeled Voltage	True Voltage	% Error
1	+5	5.10	2.0%
2	+5	9.65	93%
3	+6	7.94	32%
4	+6	8.42	40%
5	+9	10.34	15%
6	+12	12.38	3.2%

Table 1. *"Don't believe everything you read." The true output voltage can differ from the rated voltage in a random sampling of DC adapters. Adapter #2 was the worst unit tested, with an output nearly double the voltage listed on its case.*

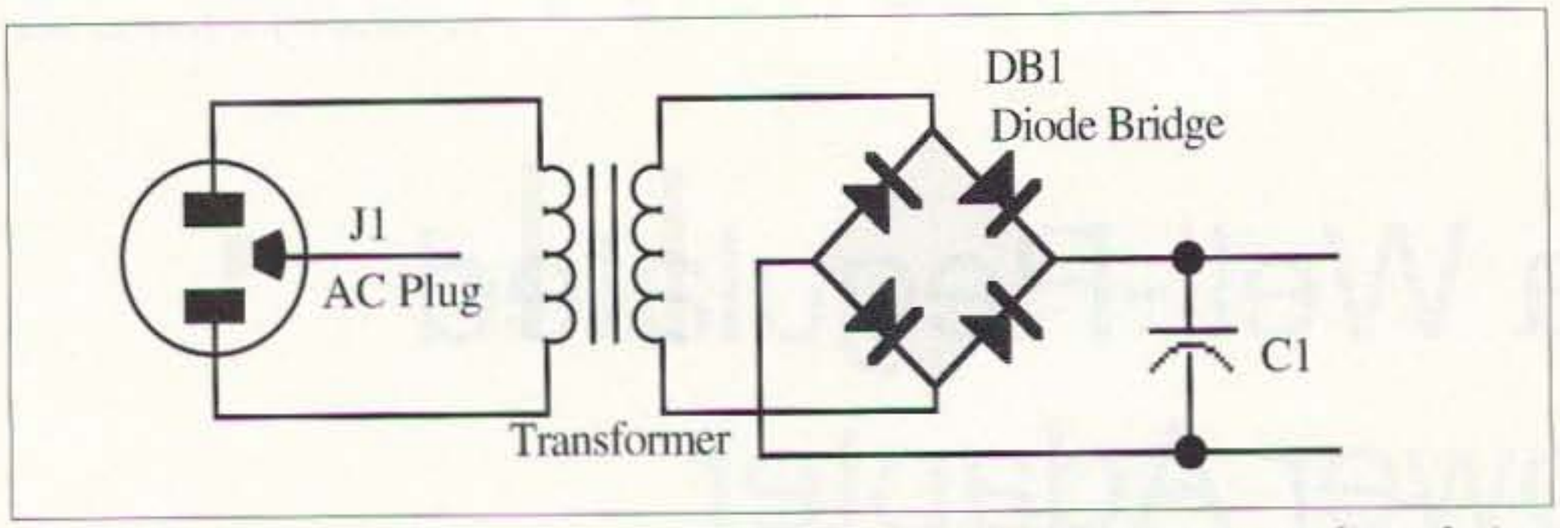

Fig. 1. The basic type of power adapter. The lack of any semiconductor regulator devices helps to keep the adapter's cost down, but it also keeps the unit's usefulness down.

consumer's point of view the end result was that you can now listen to the same CD on equipment made by RCA, Sony, Tandy, or any other of several dozen different manufacturers. When you bought your equipment you didn't have to choose between a RCA player and disc format or a Sony player and disc format. We were not so lucky when it came to other areas of home electronics.

Of course, VCRs come to mind. When these devices first hit the market they came in two flavors: VHS and Beta. After years of battling, VHS finally won and the Beta format went the way of eight-track players. Those people who backed the Beta format were the big losers, as they ended up with machines that no longer have tapes available for them.

Another area that still suffers from a serious lack of standardization is that of the AC-to-DC power supplies that are used with consumer electronics equipment. These supplies can be found in any voltage that is a multiple of 1.5 volts, from 1.5 to 13.5 volts. Furthermore, there are numerous different styles and even sizes of plugs currently used with these devices. And finally, there are plugs on the market that are wired with either polarity—with the tip being positive and the ring being negative, or vice versa.

Another problem with plug-in AC-to-DC supplies is that they don't always output the voltage indicated on their cases! To illustrate this point, I surveyed six different supplies, each made by a different manufacturer. While in the best case the actual output voltage was within 2% of the rated voltage, the worst-case supply was off by a whopping 93% (see **Table 1**).

There are a number of reasons why the actual output voltages of supplies are so different from their specified values, but by far the most common is cost. In order to make the supply as cheap as possible, most do not have solid-state regulators incorporated in their design, so their output varies directly with the line voltage supplied by the power company. Also as a cost-cutting measure, very liberal tolerances are used in the manufacture of these devices, and there is generally a lot of unit-to-unit variability in performance.

The load being driven by the supply is also an important factor in determining its net output voltage. For the data presented in **Table 1**, all the supplies were tested in their open-circuit configuration. But when an adapter is supplying its rated current the output voltage will almost always drop below its open-circuit voltage. Other than by testing the adapter under different loading conditions, there is no way to predict how far the output voltage will fall.

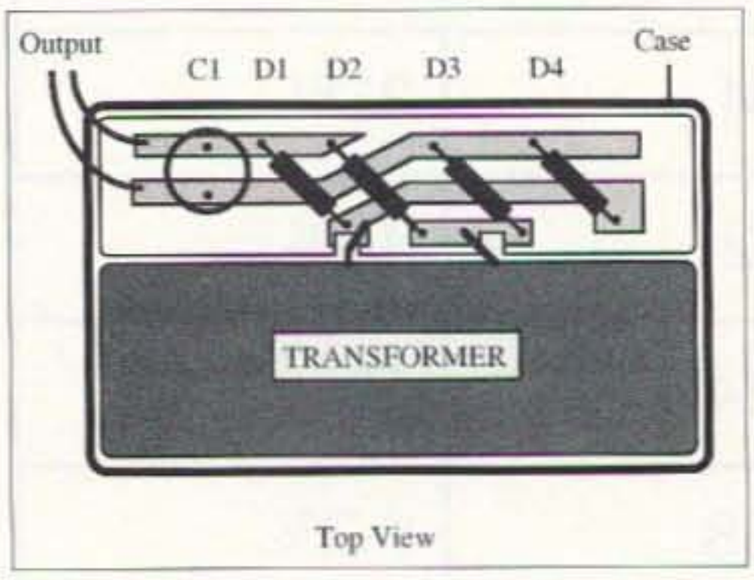

Fig. 2. In spite of the limited number of components stuffed into the enclosure of an off-the-shelf power adapter, there is not generally much space available for expansion.

The variability of a power adapter's output is the main obstacle to using it to run circuits containing integrated circuits. One of the simplest ways of overcoming this obstacle is to install a voltage regulator on the DC output side of the adapter.

The electrical design

Fig. 1 is the schematic for a very simple AC-to-DC converter, while **Fig. 2** is the associated board layout. As you can see, the circuit contains nothing more than a standard full-wave diode bridge rectifier and a single filter capacitor. While this design is cheap, the voltage output is not very stable and therefore probably not suitable for any of your projects that use integrated circuits.

The circuit can be easily modified to incorporate a regulator, however. It is the job of the regulator to stabilize the adapter's DC voltage over a wide range of input voltages and output currents.

One of the most commonly used types of voltage regulators is the 78xx series. Low cost and the availability of several regulation voltages are among the reasons for the popularity of this line. **Table 2** is a list of regulators included in the 78xx series.

Fig. 3 is the pinout of a 78xx regulator in a TO-220 case. When viewed from the front, the leftmost pin (pin 1) is the input voltage line, which must be supplied with an input voltage that is at least 3 volts greater than the device's specified output voltage. Pin 2 of the device

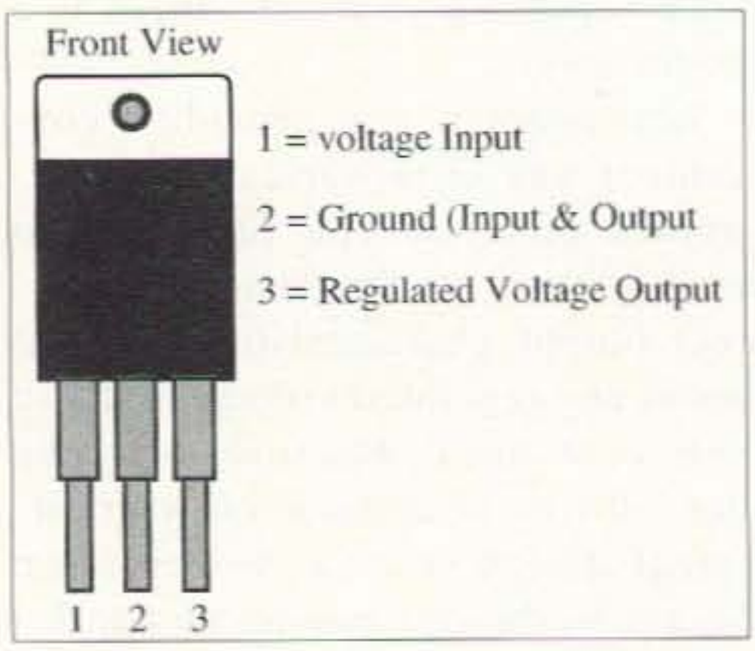

Fig. 3. Pinout of the 78xx series of voltage regulators.

is the common (ground) line shared between the input and output pins. Finally, pin 3 is the output line, which distributes the regulated voltage.

It is a simple matter to incorporate a 78xx series regulator into the basic power adapter design just described, creating a wall adapter with a well-regulated output. **Fig. 4** shows how this is done.

The power adapter you start with will need to have an output voltage, before modification, of about 3 to 5 volts higher than the regulated voltage you'd like to achieve. This requirement is imposed by the 78-series regulators, which need to see the higher voltage in order to regulate properly. If you refer again to **Table 1** you'll see that this should not be a problem, as most adapters output a higher voltage than specified on their labels.

Besides the regulator itself, only a few additional capacitors are needed to filter both the input and output voltages. The large caps are used to "smooth out" the voltage produced by the full-wave rectifier, storing energy for when the input AC signal changes direction. The smaller caps are used to filter out high-frequency noise, since they tend to look like short to ground to high-frequency signals.

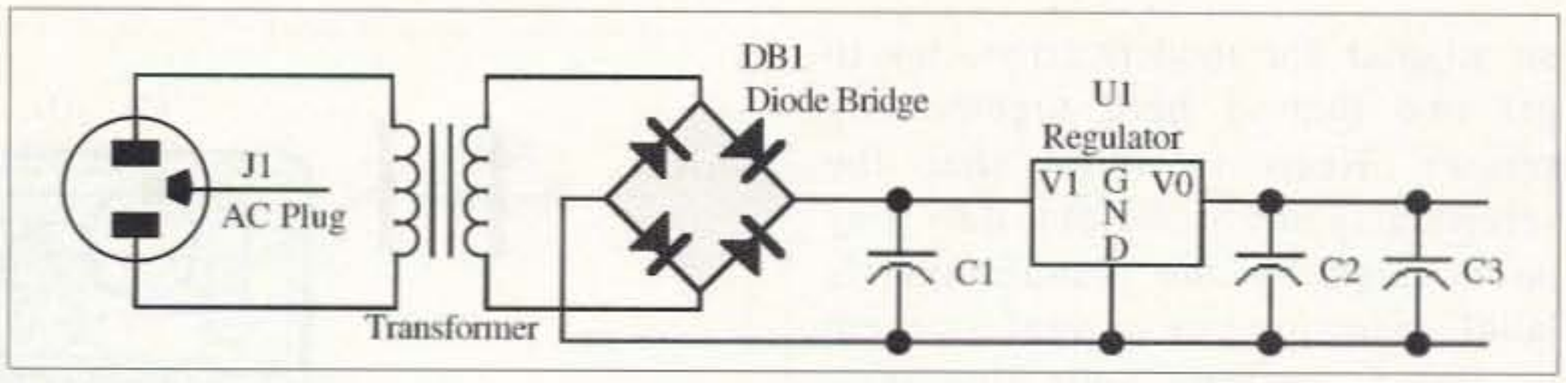

Fig. 4. The most straightforward method of integrating a voltage regulator into a basic power adapter circuit.

Don't lose your cool!

While it is easy to design a 78xx device into an adapter circuit, here's a strong word of caution about the amount of current these regulators can supply: The current values listed in **Table 2** represent the maximum amount of current that can be supplied when they are mounted so that they have adequate cooling. In order to obtain "adequate cooling," you must generally use some form of heat sink to help dissipate the heat generated by the regulator.

In most cases you will have to forgo any type of heat sink on the regulator if you choose to return the adapter to its original enclosure. Because of this, the maximum current available from a 78xx device in this application should be considered to be only about 25% to 50% of the device's maximum rated current. This is a price you pay for having a wall adapter with a well-regulated output voltage.

Don't blow a fuse!

Besides the regulator and extra caps, you might consider placing another item inside the power adapter's enclosure—a fuse. By fusing the input side of the regulator you will protect the regulator, as well as your project, from an overcurrent situation. Keep in mind, however, that this fuse will most likely be placed inside the adapter's enclosure, so to change the fuse you'll need to take the enclosure apart. This might not be an easy task.

The packaging design: Option #1

Packaging additional electronics into an existing power adapter is the key to a well-regulated supply that still looks professional. This is often an uphill battle, because manufacturers save money by minimizing the amount of wasted (i.e. available) space inside enclosures.

However, opening the power adapter without damaging the enclosure is generally the hardest part of any modification project. To open most adapters you'll need to use a sharp, thin knife or razor blade to cut along the seam between the face plate (the part with the terminals that plug into the outlet) and the rest of the enclosure (the square bowl). If you have yet to purchase

Output Voltage	Output Current	Part Number	Package Style
+5	100mA	78L05	TO-92
+5	1A	7805	TO-220
+6	1A	7806	TO-220
+8	100mA	78L08	TO-92
+8	1A	7808	TO-220
+12	100mA	78L12	TO-92
+12	1A	7812	TO-220
+15	100mA	78L15	TO-92
+15	1A	7815	TO-220
+18	1A	7818	TO-220
+24	1A	7824	TO-220

Table 2. Common values of the 78-series of voltage regulators. The "Output Current" column lists the maximum current for a device mounted on a sufficiently sized heat sink. Usable current for the application described in the text is significantly less.

an adapter for modification, try to get one that is held together by screws. Keep in mind that the screws may not be visible; they may be covered by the manufacturer's label, requiring you to hunt for them by lightly running your fingernail over the label.

Packing a regulator and additional components into an enclosure is more of an art than a science, so there is no single recipe for success, but here are some suggestions: For the additional components you need to add into a circuit, try to place as many as possible directly on the adapter's printed circuit board (PCB). This form of mounting tends to increase the circuit's reliability.

In some cases, space permitting, you may be able to mount some components on the bottom of the PCB. This is especially true of smaller items, like filter caps.

Sometimes there are small metal plates mounted inside adapters for various reasons. You can often use this metal plate as a heat sink for the voltage regulator. This will increase the amount of current you can safely draw from the device. Make sure the plate is not electrically connected to other parts of the circuit.

Be sure to use heat-shrink tubing or tightly-wrapped tape around any component leads inside the enclosure. The leads may not be in danger of shorting together now, but components might shift around considerably the first time the unit is dropped onto a hard floor.

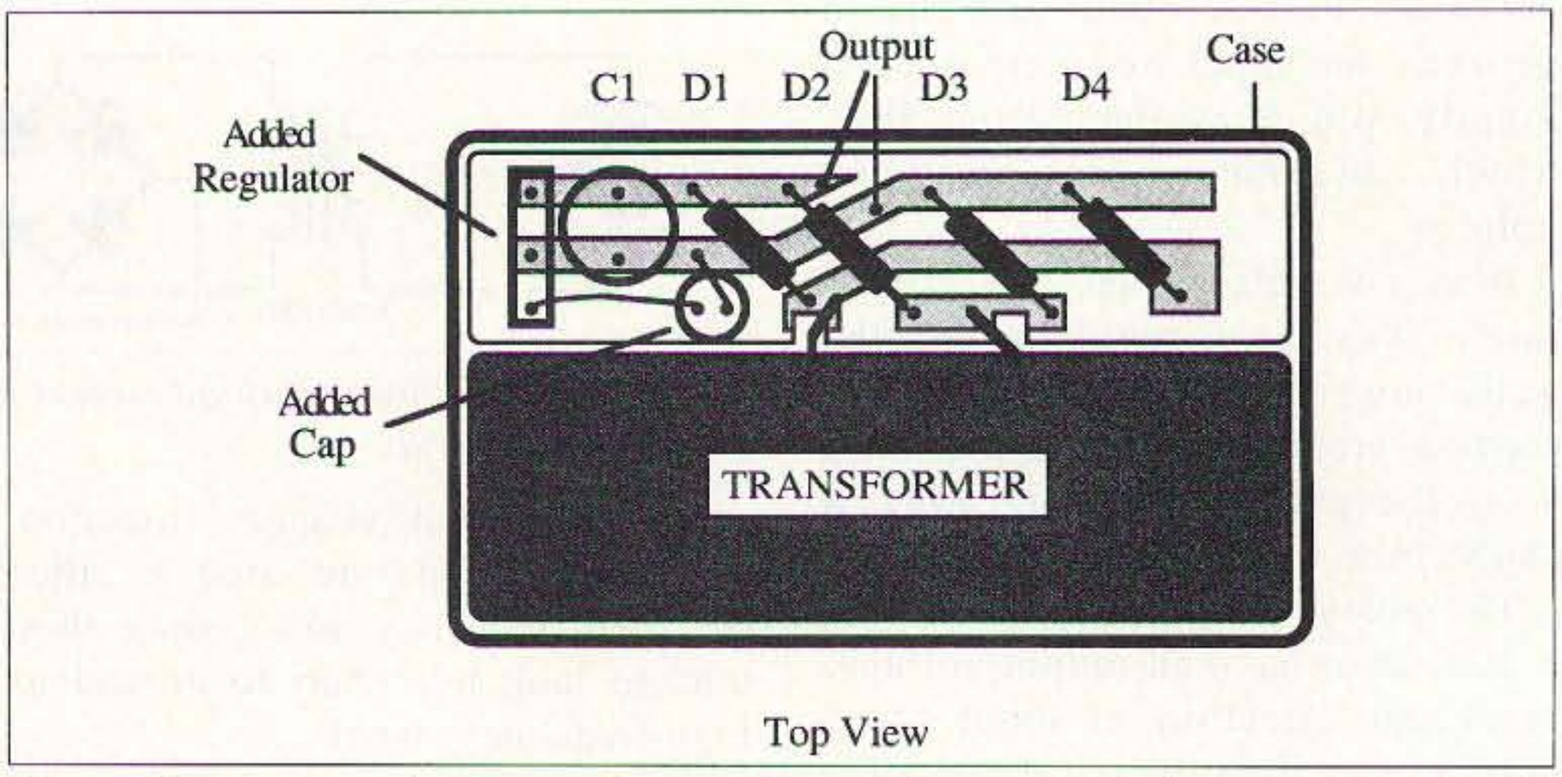

Fig. 5. One way to package a regulator and extra filter capacitors into a power adapter's enclosure.

Once you modify an adapter, run it for a while with the enclosure just taped together, not permanently sealed. Every 15 to 20 minutes of operation under full load, open the enclosure just to make certain you don't have the overheating problem mentioned above.

When you've finished your modifications and tests, reseal the enclosure using Super Glue™ or some other form of adhesive that works well on plastics.

Never modify an adapter rated for outdoor use, even if you plan to use it only indoors. It's too hard to reseal the enclosure in a way that is guaranteed to keep moisture out. Besides, if anyone else were to use the adapter they might see that it's labeled for outdoor applications, and use it as such.

The packaging design: Option #2

There is another packaging option if you are unable to modify an existing adapter case as described above—you can purchase a new case. Many electronics supply companies sell appropriate small enclosures. Some even sell dedicated "wall transformer enclosures." These are small cases with electrical terminals protruding through them that can plug into any standard 120V wall outlet. On the inside of the enclosure, you can generally solder to the terminals, making connection to this project's PC board easy.

If you are interested in this option, check your mail-order parts supplier for different enclosure designs and sizes before you begin the project. Most such cases are very inexpensive, and you might find them a bargain if you find it difficult to open an existing wall transformer case. 73

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A Hamfest Computer Shopping Guide

You can computerize your ham shack for pennies on the dollar if you know how to shop the hamfests.

Alex Piechocki N3JSU
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Towanda PA 18848

With hamfests and computerfests merging, they're getting to be great places to shop for computers. Today there is so much quality computing equipment available at such cheap prices that no one has the excuse not to have several computers in the shack. Indeed, today's hamfests often have more computer than ham equipment exhibitors.

IBM and compatibles with up to a 286 processor are available for under $100, complete and working. And that's with a color monitor, keyboard, disk drives, and up to a 20Mb hard drive. There is a tremendous supply of these machines, and little demand, so they're cheap. They make great packet stations, and will run satellite tracking software and do word processing; they're a great learning tool. Businesses sell their old computers for almost nothing to avoid hazardous waste disposal fees, as demanded by the EPA. Some of them are kaput, but many are just older, slower models which have had to be replaced.

What to look for

First, you want a monitor without a burned-in screen. Next, look at the cooling fan. If it is burned out or wadded up with filth, stay away! Keyboards should also be clean, right down to between the keys. A quick cleanup to cover up years of abuse won't usually get between the keys. Also, the case itself should be reasonably clean. Look for telltale signs of neglect from damp, unheated storage—like rust!

Open up the case and take a look inside. The motherboard (the largest printed circuit board you can see) should be clean, with no dirt buildup or corrosion. Check the battery. If it has leaked and corroded the surrounding chips and wire traces, you don't want the misery.

Check the cards plugged into the motherboard. The connectors should conform to the ISA (Industry Standard Architecture). That means you should have a 62-pin connector next to the back of the computer for connecting to the 8-bit bus.

"The dealer has already made his profit, so any money he gets from the sale of these used drives is pure gravy."

Next to the 62-pin connector should be a 36-pin connector. This connector, along with the 62-pin one, are used to attach cards to the 16-bit bus. Some manufacturers used custom connectors so their customers would have to buy *their* custom cards. Avoid these computers.

The AT&T-6300 has the 16-bit bus on the other side of the motherboard! IBM PS/2 models 50 and higher have a custom bus referred to as MCA, or microchannel. Parts for these guys are few and far between, and thus are expensive relative to standard ISA boards. The IBM PC Junior is in a class by itself, as are all Apples. The installed cards tell you a lot about what you are getting. Typically on these low-end machines you will have a minimum of three cards. One for the monitor, one for the disk drives, and one for input and output. If there are more, you might be getting a memory upgrade or a turbo processor. All of the chips have their date of manufacture on them, typically the year and week. This can indicate if some of the cards were added later or if everything is original.

Memory is important. The PC and XT computers, with the 8080/8086 microprocessors, could only handle 640K of memory. The 286 machines could address up to 16Mb. It is very easy to tell how much memory you have by checking the chips on the motherboard. Find a section of identical chips; the older machines had two banks of eight chips each of the 256K (total of 512K) and two banks of 64K chips (128K). After the manufacturers identification number there will be a 64, 256 or 1028, followed by a dash and then the speed that these chips can handle. All you need to do to the speed number is to add a zero and you have the speed in nanoseconds. For example, a -15 is 150 ns; a-7 is 70 ns. Speed is important because the faster the motherboard clock's speed, the faster the memory needs to be. If you are running an 8086 at a typical 4.77 MHz, your memory needs to be at least 200 ns. For a 50 MHz system the speed of the memory increases to 40 ns. You also will see that the 64K and 256K chips have 16 pins on them, the 1Mb (1024K) will have 18.

The 286 machines started to use memory called SIPs (Single In-line Package). This memory had the chips soldered on a small printed circuit board that had 30 small in-line pins. The chips used on these

memory boards can be easily removed with some solder wick and a small soldering iron. They can then be transformed into SIMMs (Single In-line Memory Module), which most new computers use today. A vendor might be selling motherboards for $3 each, untested with memory chips still installed; these boards are worth buying just for the memory! I once bought 486 motherboards for $10 each just for the parts. On each board was 256K in cache memory in sockets, which made it easy to remove them. Cache memory, and video memory, are different animals than regular computer memory.

The computer's main memory is referred to a DRAM, dynamic random access. This memory is nothing more than transistor and capacitor pairs. They are dynamic in the sense that the capacitor always wants to discharge, so the computer has to ensure they get charged back up millions of times per second. SRAM (static RAM) or VRAM (video RAM) or SCRAM (static cache RAM) are all the same idea. They are set to digital ones and zeros and stay at this value until externally changed. They are very fast, largely due to more transistors inside for the megabytes they contain, and more expensive, hence you will not see many computers using these for main memory.

Software and documentation are an important part of the deal. "No software" can mean having a computer that can't do anything. All computers have a small software program built into them. The program executes whenever you turn on your computer. It is referred to as the POST (Power On Self Test). This self diagnostic will indicate any number of problems, from a stuck key on the keyboard to bad memory. But after this the most important software to have is the DOS (Disk Operating System). Fortunately, if your computer is really bare bones, down the isle is probably someone who will sell you an obsolete copy for a couple of dollars. PC DOS or MS DOS are the same software—one was written for IBM, and the other was written for IBM compatibles. Both were written by Microsoft. The program has undergone several revisions, with the current one up to version 6.2. The older computers cannot even use the newest version, so the copy of version 3.2 for one or two dollars isn't too bad a deal. Version 5.0, which is very close to the latest and greatest for newer machines, can be had for $5 a copy! Unfortunately, to make good use of the version 5.0, you need a lot of memory and at least a 386 processor.

Documentation is helpful when it comes to setting some of the motherboard's jumpers. If you are planning on doing a lot of tinkering and would like to modify the motherboard, there is hope. Some of the larger libraries have, in their technical section, a book copy or even a CD-ROM of *The Micro House Encyclopedia of Main Boards*. This reference book details all of the switches and jumpers on most of the motherboards you will find.

Upgrades and parts for your PC

Because used computers bring such low prices, many dealers run chop-shop operations. They disassemble hundreds of PCs and bring the parts to flea markets in hopes of making a larger profit. You can get an idea of pricing by checking the classifieds in some of the computer magazines.

The first monitors were black and white (or orange or green) and used an internal MDA (Monochrome Display Adapter) card. They were only good for text. The next monitors were called CGAs, after the internal plug-in card (Color Graphics Adapter). This improved somewhat with the next generation called EGA (Enhanced). the color monitors truly made an important transition when they went to VGA (Video Graphic Array). Hospitals and some industries keep up on the latest technologies; as soon as Super VGA became available, the installed VGA monitors became obsolete. Also, many companies lease computers, and at the end of the lease there is a lot of outdated equipment to be dumped. Refurbished VGA monitors can be bought for around $100 and come in several sizes. I've seen a 12" go for under $75, and the 15" go for $130. Try to purchase brands that you will be able to repair. Schematics on some monitors are harder than others to find. Some schematics are included with the deal, while others might cost you over $50! With any monitor you need a compatible interface card to run it. CGA and EGA cards can be bought for under $15. VGAs, on the other hand, start where the less expensive cards leave off. There's a lot of snob appeal in these cards, so brand names like Orchid and Cirrus tend to increase the asking price as well as the

quality of documentation and the quantity of memory. Since VGA cards can still be bought new for under $50, it pays to keep up with the latest ads. The latest and the greatest is to be able to plug your video card into the high-speed computer bus. This only exists on 486 and newer computers. It is referred to as the Local Bus, VESA local bus, and PCI bus. This is what you eventually would want to graduate to if you have the latest fast-action video games to play. If you like a lot of color resolution, select a video card with at least 1 megabyte of video RAM. The one really neat thing about all of these cards is that they are all downward compatible; in other words, the software that runs on your MDA system will display correctly on CGA, EGA and VGA systems!

Disk drives come in several flavors. The floppy drive on the PC was only capable of storing 360K worth of data. The XT had a version with two floppies; one was a 360K and the other a 1.2Mb. The crazy thing about these was that the magnetic media on the disks were different for each of the disks. That made for easy mistakes in using them in the wrong drive. Therefore you could end up with read or write errors, even though the disk drive was working fine. These large 5.25" drives gave way to the 3.5" 720Ks, which are basically useless today. The standard 3.5", which is on all new machines, provides 1.44Mb. The small 360K drives are available new for $1, so you don't repair these, you just throw them out whenever they fail! The large 1.2Mbs are available for $20 used, and the small 1.44Mbs you can buy for under $30. Most floppy drives plug in via a flat cable to the same driver card as the hard drive. The number one wire is painted red, so make sure it plugs into the number one pin on the drive. If you are running only one drive, the end of the line plug is used. It is the one with the twisted piece of cable next to the connector. This "end" piece is the A drive when you have two floppy drives installed.

Hard drives are a lot of fun. There are many wacky ones out there waiting for you! The earlier ones included on the PC were of the MFM (Modified Frequency Modulation) type. Following these were the RLL and the ESDI, both improvements to the MFM technique. These drives require special formatting to use so removing an MFM drive from a PC and installing it into an AT requires a complete new format! We're talking machine code here, which is not a pleasant task for a novice. Stay away from these old outdated formats unless the drive is exactly the same as the one you have and you've grown attached to its quirks.

The latest and greatest today is SCSI (Small Computer System Interface) and IDE (Integrated Disk Electronics). They both are about the same speed. One sends its data in parallel and can support up to seven devices (SCSI), while the other (IDE) sends its data in serial and can support two devices with the same interface card. I recommend going with IDEs; they install more easily than MFMs and RLLs. They plug into the IDE interface card, which is also plentiful and cheap—typically one or two dollars. New ones can be bought for under $20. IDE drives of

"A vendor might be selling motherboards for $3 each, untested, with memory chips still installed; these boards are worth buying just for the memory!"

40Mb can be bought for $20 from dealers who upgrade computers. The dealer has already made his profit, so any money he gets from the sale of these used drives is pure gravy. Hard drives are hermetically sealed and designed for 50,000 or more hours of use before failure; however, shock, vibration and heat can lower that. But there should still be many hours left for you to play with.

Accessories such as CD ROMs, sound cards and such are available as people upgrade. Single-speed CD ROMs with 8-bit plug-in cards are available new for $25. There's no demand for these when the state of the art is already selling CD ROMs at 8X speeds. People are conditioned to think that single-spin is too slow. Believe me—a single-spin CD player will still locate that callsign for you faster than using the book, and you have the added benefit of playing your favorite musical CDs too. Sound cards are available as people upgrade to the latest and greatest in multiple voice polyphony. After years of listening to single sideband, an 8-bit sound card will sound heavenly. But don't stop here—16 bits is the standard, and again, if you shop around you can find these at bargain basement prices.

Building your own computer

Over $10 billion in hardware is out there getting obsolete. Some of it will find its way to your local hamfests for pennies on the dollar. What a temptation to build a system that is really unique, teaches you a new skill, and does something useful for you around the house or shack.

Remember, with computers running in the RF range you need good grounding. If your enclosure has sturdy grounding fingers, along with liberal amounts of stainless steel wool on the edges, then when you transmit your RF will not get into the computer and confuse it or shut it down. This will also keep the computer from messing up your receivers.

The best way to build your own is to start out with a cheap system. The 286 computers came with good power supplies. Be very wary of the high volume computers such as IBM, Dell, Compaq, and AT&T, since only large companies can afford to build nonstandard, one-of-a-kind parts. Almost all of the other computers use generic parts.

Most power supplies are identical. They are all switching supplies, and even the connectors to the motherboard are the same. Just remember to put the four black ground wires in the middle if your supply has two plugs.

The one thing to pay attention to is watts. The very early computers were small; only 85 watts. Try for something up in the 250-watt or more range. Accessories take lots of power. Once you have a computer with a good power supply, case and disk drives, all you need is to replace the motherboard and you can say you built your own. Motherboards are relatively inexpensive, even if you buy a new one. New motherboards are tested and warrantied, and go for $50 or less for a 486 type. You can buy these boards minus the processor chip, which is the big money. Look around at the 'fests for processors. Since many people upgrade, you can find 486-SX 25 MHz processors for

$20 to $30. That is the bargain way to start. You can always upgrade with the faster DX-2s, 3s and 4s later.

First, you should be aware of how these processor chips are different. All Intel 486 chips are made the same. It is in the testing that they are given their labels. The SX label is for 486s that had defective math coprocessors, which are for floating point math. The only programs that use it are engineering work stations, computer assisted design (CAD), and some spreadsheet programs. Most games don't use this processor since they don't need the precision or the resulting slower execution speed. To upgrade the SX with a math coprocessor you have to buy a 487 chip. This chip is a DX chip with an extra pin on it to disable the SX chip (pretty sneaky, eh?). The 486s are warmed up and run at a high clock speed at the factory; the ones that pass error-free get the highest ratings. The ones that fail are re-tested at a slower speed. Thus you have your DX-50 MHz, DX-33 MHz, DX-25 MHz, etc. The same holds for SX too.

Some motherboards let you change their clock speed with little jumpers, some with software, and some need to have the on-board clock chip replaced. Make sure your motherboard can run at the speed of your chip. If you only run your computer for a short time, or slap a big heat sink and fan on the chip, you can juice up the clock speed and run faster than the numbers painted on the chip. I've run my 25 MHz chips at 33 MHz with no errors. Just put your finger on the chip under load ... if it feels hot you will shorten its life, but if it is cool to the touch you shouldn't have any problems. The DX/2 series plug into the same socket as the other 486s. It is worth it to pay a few dollars extra for a ZIF (Zero Insertion Force) socket. Then you can change your processor with no effort in seconds. Just remember, there is an alignment dot that needs to be followed. Sometimes it is a squared off corner, so follow it to ensure you put the processor in the right way.

The DX/2 and /3 and /4 all have frequency doubling, tripling, or quadrupling circuits in them. The reason it makes your system faster is that when an instruction is sent to the processor, the processor can take many clock cycles to decode and act on the command. But it only takes one cycle to bring in instructions from the motherboard. So, to set the frequency on the motherboard for these chips, divide the chip frequency by its multiplying number. The DX/4-100 is run at 25 MHz; the DX/2-66 at 33 MHz. After everything is put together it is amazing how these systems start right up.

Digital electronics does not have all of the tweaking that analog does, but there will be some small details to attend to before you will be on your way. All motherboards have some form of setup. The earlier boards used jumpers. This evolved to software disks, to the point now where the setup is part of the system's BIOS (Basic Input Output System). Remember those POST error signals (beeps sort of like Morse code, or an on-screen message to tell you your error)?

When you start up you have the opportunity to go into the computer's CMOS setup. This is a couple of chips that use very little power and have the on-board battery feeding them when you turn off the computer. When you go into the setup you tell the computer what you have attached to it. You type in the size disk drives that you installed, the amount of memory on the board, what functions you want the motherboard to use, such as clock speed, cache controller, etc. You can usually wing it, but having some documentation on what and how sure make you feel more comfortable as you are typing.

Sometimes your system may appear to be dead on startup. The boards you installed might be set to the same address or interrupt (IRQ). Simply remove all of the cards, with the exception of the video one, and gradually start putting them back until you find the conflict. This type of problem doesn't usually happen until you put the CD-ROM, sound card, mouse driver card, game port, and fax modem cards in. There is a good chance that the computer is trying to talk to two or more cards at once. Computers may be fast, but they still need to communicate to the input and output one at a time.

This has been a whirlwind tour of computers, by no means complete. Even if you are planning to purchase new, going to the dealer with some basic knowledge of computers and the prices of the various components can help you drive a better bargain. I hope I will be seeing you at the flea markets, having as much fun as I do, recycling computers and keeping hazardous waste out of our landfills. 73

A Retiree's HF Mobile Installation

This style of hamming ain't exactly hard to take.

Bert Simon K2FZ
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Coconut Creek FL 33066

After having lived on boats for 15 years, the concept of a mobile HF installation was so embedded in my failing brain that when the time came to give up boats and become a landlubber, I knew that the dreaded ham virus would force me to acquire a good HF mobile station. Selling my boat put me in a position to choose, within reason (my wife said it was OK), the vehicle, the radio and the antenna.

The vehicle

I envisioned a vehicle that would contain a small desk for writing, reading and hamming. A comfortable place to recline would be kind of nice, for resting the eyes when the need arose (which happens rather frequently as one nears the QCWA second cluster category). I chose a "high-top conversion" type van which came complete with four captain's chairs and a bench seat that folds down to become a bed at the flip of a switch. A sturdy desk was installed behind the driver's position and *voila!* A very comfortable vehicle where every day can be a "Field Day." Three additional batteries, of the gel cell persuasion, were installed, along with battery safety/disconnect circuit breakers. A digital voltmeter is being constructed to provide close voltage measurements, important in making a battery's life long and prosperous. Additionally, a through-the-ceiling fan was installed and is generally in operation when the van is parked. I haven't found it necessary to charge the batteries after three hours of hamming and ventilating, but then again, so far I haven't operated more than three hours at a stretch.

"The marine channels might come in handy if I'm ever marooned by a rising tide."

Photo A. *Inside the van.*

The radio

The latest breakthrough in HF communications appears to be DSP (digital signal processing) in which, due to the wonders of science, the gershmeckda signals go through an amorphous transition into a digital conglomeration completely alien to humans. It is then magically transformed back into supposedly intelligible signals. Considering that this radio might be my last big ham purchase before being recalled from this planet, I decided I might be remiss if I didn't become a DSPer. Other considerations involved money as well as the weight of the radio (some of the very sophisticated radios weigh in at 30-plus pounds and get into the three-plus kilobuck category). I decided it would be best to keep the "radio footprint" to a minimum and so decided on a remotely-operated rig.

The radio which met my criteria was the SG 2000 with Powertalk head (DSP, that is), made by SGC of Bellevue, Washington. The price was under three kilobucks and the radio weighed 12 pounds, which didn't make any difference since the remote head, which was the device to be table-mounted, was only about two pounds. This radio has

nice features, such as over 600 marine channels programmed into its memory. I figured this might come in handy if I'm ever marooned by a rising tide—I can always call the Coast Guard. The radio also comes with over 60 ham frequencies programmed, which mainly represents the band edges as well as other convenient frequencies used for ham mobile/marine operations. Additionally, 60 other frequencies may be programmed in according to individual requirements. But heed these words of caution: This radio is not for every ham and there are those who may find some of the operating features are less than ideal for typical amateur operation—if one allows four seconds to go by without using the main frequency dial it is then necessary to press the "FREQ" button, sometimes more than twice. When this button is pressed, the radio beeps to announce that the button has been pressed and the tuning knob is now operational; it's not exactly a "contest" radio. As for CW, I have found it unusable due to the delay of the AGC response. I have discussed this problem with SGC and am awaiting their recommendations. For now, I am able to use the radio on CW by providing an MFJ keyer with an audio tone, and then feeding the tone signal plus an additional pair of leads to a big old-fashioned switch. Both sets of leads are wired to a separate microphone connector. The other item which takes a bit of getting used to is the CW DSP operation. The apparent bandwidth in this mode is very sharp and in order to be able to switch the DSPer from the broad mode to the sharp mode it is important to receive the CW tone at approximately 1000 cps. I find that I'm not always able to select the tone accurately enough to fall within the passband of the filter. Again, it's not exactly a contest radio.

There are approximately 30 push-button functions to this radio and the DSP version has an additional eight push-buttons plus some added knobs. I admit it would take a better man than I to operate this radio and still survive bebopping down the road at 65 miles per hour. In fact, in my degenerative condition I find it somewhat exasperating to locate the necessary buttons (let alone execute them) before the telltale sound of the beeper announces that the four-second period is up and I must start over again. (Perhaps a neuron transducer can be added to activate my sole operating brain neuron, which might enable it to move fast enough to avoid the dreaded four-second announcement.)

"If I didn't require a stool to stand on, I could probably install the antenna in less than a minute."

Now, with all my criticism regarding the SGC 2000, one might think that I don't like it. *Au contraire, mon ami.* The radio, in spite of its faults, does have its charm, although I do believe that it, along with SGC's QMS mobile antenna and its "20 dB advantage," would be best suited for a non-technical/non-ham paramilitary-type operator.

The antenna

I have found Don Johnson's book on HF mobile installations to be a wealth of information. Additionally, valuable mobile antenna comparisons are contained in *QST* and *Worldradio* issues. The "HF Mobile Shoot-Out" described by *Worldradio* compares the relative radiation of 17 HF antennas ranging from those having center-loading coils with and without top hats to the SGC-QMS (20 dB advantage) bottom-loaded antenna. The high Q center-loaded type won hands down, with those having top hat devices showing a 2 or 3 dB advantage over the less grotesque center loaders. The worst antenna was the one which was advertised as "the 20 dB advantage." It measured about 10 dB *less* than the typical center-loader. Quoting Gilbert and Sullivan: "Things are seldom as they seem." My advice: Beware of extravagant claims.

I had decided that an antenna that could be remotely tuned to continuously cover the entire 80 through 10 meter spectrum and have a high Q center-loaded coil would be my choice. I investigated two of the several companies producing such antennas: T.J. Antenna Co. of Hermiston, Oregon, and High

tenna Co. of Hermiston, Oregon, and High Sierra Antennas of Nevada City, California. They appeared to have similar products, all based on the Don Johnson design. I chose High Sierra because they had available a type of mount which allowed the antenna to be readily removed. In fact, I can remove and/or install the antenna in less than three minutes, but if I were as tall as a basketball player and didn't require a stool to stand on, I probably could do it in less than a minute.

High Sierra makes several types of mounts and they can also manufacture just about any mount to suit individual requirements. Their mounts are of heavy-gauge steel construction and are attractively painted black, which closely matches the type of rectangular aluminum extrusions used in condo "screened-in constructions." I decided to use High Sierra's mount and join it to a two- by three-inch aluminum extrusion (readily available at large hardware stores). I joined the aluminum extrusion and the "Universal Mount" from High Sierra with #14 SS self-tapping screws and star washers which provided rigidity and good electrical bonding.

I was able to mount the antenna without drilling any holes in the van by using U-bolts to fasten the aluminum structure to the spare tire supports. I recommend using proper HF practice and making certain that there are good grounds between the supporting structure and the vehicle, but then again, just follow Don Johnson's advice and you'll have a good installation. Truthfully, I am not absolutely certain how my signal would be affected without the proper grounds, but I'll put it in the same category as the test for pearls: "Place the pearl in a container of vinegar and if it dissolves it was real." The only holes I drilled in the van were the ones to provide the DC voltage and the coax feed to the antenna; I thought it looked better than having wires dangling in the wind whenever the antenna was not in place.

One other advantage of this radio and antenna combination is its ability to tune in all kinds of other HF activities—SWL broadcasts, marine stuff, etc. Having a continuously tunable high Q antenna covering all the frequencies from 80 through 10 meters really makes for excellent reception.

The end result

I am thrilled with the entire mobile operation. I compare it to my base station, which is an ICOM 735 using an ICOM AH-2 remotely-operated antenna tuner. This particular setup is my condo HF station and employs about 17 feet of wire as the antenna plus about five radials, installed under the carpet of the ham shack, which range from five to 10 feet—not a very good installation but at least it's hidden from the eyes of the condo commandos. I find that I am able to receive more signals and more DX from my mobile when parked right next to the condo, as compared to the condo base station. A good indication of the mobile's performance is the amount of returns I get from calls made; it's much better than that of my base station. The antenna tuning is remotely controlled by an up/down switch conveniently installed near the radio and the built-in SWR indication of the SG 2000 works well, although it does require the pressing of two buttons to activate the SWR function. The "SHFT FUNC" button must be pressed before you can press the "FWD-SWR" button. I wouldn't recommend tuning the antenna while driving—however, the usable bandwidth on 20 meters is quite adequate, about 200 kHz without requiring retuning. I attribute the success of my mobile installation mainly to the quality of the High Sierra Antenna and the sage advice in Don Johnson's book. I must also give credit to SGC because I have frequently been told that I have excellent audio quality.

Life is good. 73

Photo B. K2FZ's van, with the antenna attached.

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nation, under God" stuff. Hmm, now that I think about it, that "Under God" part got added later. Our pledge of allegiance when I went to school never mentioned any deity.

For that matter, the pledge never meant anything either. If the United States was viewed as good we'd support it. Considering the problems we face today, it is getting more and more difficult to feel anything strong about our country. The main thing it has going for it is that, as terrible as things are, they seem to be worse most other places. But that's not something I'd willingly lay my life down for. If you don't chew gum, spit on the street, spray-paint cars, or pee in elevators, Singapore has a lot going for it.

During WWII I had no problem in volunteering for the most dangerous duty there was because I really didn't care much whether I lived or died. Recent research has shown, as I've mentioned, that this was the result of the childhood beatings by my father. This is one of the major causes for teen suicides. Luckily I underwent some brain repairs when I was 28 which got rid of all that crud and changed my life.

Please, let's stop zealots from trying to use the government (and our federal judges) to further their religious goals. I'd also like to get the government out of social engineering too. Not one program has worked, but that's not enough to stop the under-informed from pushing to spend more of our money for their pet projects.

Oxygen

The largest organ in our bodies is our lungs, and they're there to bring oxygen into our systems. We burn oxygen for fuel. Plus, more oxygen in our blood helps kill off microbes and viruses. Now do you suppose that there's any connection between the dropping percentage of oxygen in our air and the recent increase in all kinds of illnesses? It might even tie in with the increase in gutlessness and lack of creativity shown by our younger generation since oxygen is critical to the brain's operation.

How much oxygen have we lost so far? A couple hundred years ago our air had 38% oxygen. In the 1950s it was down to 21%, and now it's down to just over 19%! Worse, in the cities it's as low as 9%, due to the extensive heating of buildings by burning fossil fuels, the thousands of cars and trucks, and even millions of people breathing.

One of the benefits of jogging is that it forces us to breathe more heavily and bring in more oxygen. Dr. Douglass, of *Second Opinion*, has a great book out on how to prevent aging. In it he recommends breathing pure oxygen every day while exercising as a way to reverse the aging process. Adding

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oxygen to our bodies seems to help beef up our immune systems, which in turn can help reverse arthritis, cancers, and other annoying breakdowns of the body.

It seems to me that if you can even remember every now and then to hyperventilate, that's going to being more oxygen into your system. But I know how difficult it is to remember to breathe.

When we get tense our tendency is to hold our breath, making it even worse. There are few headaches that can't be cleared up by hyperventilating—getting more oxygen into your system, where it first goes to your brain, and then to the rest of your body. The brain uses a surprising amount of oxygen, so when we cut down the brain is one of the first parts to malfunction.

The decreasing oxygen percentage in the air means a higher percentage of nitrogen (and a much higher percentage of CO_2), leading to an increase in nitrogen narcosis, the "rapture of the deep" it's called when you're diving. It's a gradual loss of reality, but one which is not noticeable by the individual involved. Maybe you've noticed a lot of that going around.

If you've read anything about breathing you know that just as we gradually lose the flexibility of our eyes from focusing them at one distance or direction so much of the time—reading, computering, TV watching—we also lose a great deal of our lungs' capacity to bring oxygen into our bodies by shallow breathing. Every so often exhale completely and then suck in as much air as you can into your lungs and hold it for a few seconds. Then completely exhale again. Use more of your lung capacity whenever you think of it. And hyperventilate to make up for all that oxygen that's no longer in your air.

I see where in Beijing there is a flourishing business in selling oxygen. They have booths where you can breathe 50% oxygen for $6 an hour. That's something which could do well in our more polluted cities such as L.A., Denver, and New York.

The Value of College

A recently released study showed that the $40,000 investment for a college education results, on the average, in an increase in lifetime earnings of $300,000. Hey, that's almost a 10-times gain on your investment! No wonder parents are so anxious to get their kids into college. Yeah, except for one little tiny thing. If you take that same $40,000 and invest it in something safe that returns 6% you'll end up with $550,000.

Big corporations put a good deal of stock in your college degree when they're hiring, but few small companies give a hoot. They want to know what you can do for them, not where you went to school. And working for a large company is one way to pretty well assure that you are never going to make any serious money. I keep mentioning the *Inc*. magazine survey which showed that virtually all of our more successful entrepreneurs either skipped college entirely or dropped out in frustration after a year or two. College does help the unmotivated to make more in dead end jobs, but seems to be a waste of time and money for anyone with the determination to succeed. So much for the election oratory about how everyone should be able to go to college. For what? Just to keep them out of the labor market for four more years at public expense and further dumb them down and demotivate them?

I tried hiring RPI graduates for my company and was appalled at their lack of skills or even any interest in acquiring skills. I went to the university and interviewed graduates, looking for the most promising. Most were incredible duds and not worth even trying. The few I ended up giving a try were unmotivatable.

When I started *73* I used to hire college dropout hams and teach them the publishing business, and they were eager to learn. Some have gone on to excellent careers as a result, doing very well for themselves.

Just as anyone with the right help can learn to read and write in a hundred hours (according to the top prize-winning New York State and New York City teacher John Gatto), anything of value one can learn from going to college can be learned in a tiny fraction of the time by reading books by the world's top experts (who beat the heck out of the professors most colleges provide). Our colleges, like our grammar and high schools, are a mess.

Schools

Just in case your only reading matter is the ham rags and your TV set is broken, I'm going to rub

your nose in what a mess you've let our schools get in. It's bad enough that you're screwing up your life with that garbage you've been eating and sewage you've been drinking, but in addition to teaching your children to eat and drink the same destructive stuff, you've also allowed our school system to disintegrate so they are being mentally poisoned and stunted. Hey, don't look around for someone else to blame. And none of this gee, what can little me do about big problems like that?

Now let's look at some facts of what you've sheepily let happen, and most of it has been done with the money our beloved government has taken out of your pocket and spent for you. You can't name one single job the government is doing that can't be done far better and at less than half the cost.

The government loans for students have helped zoom college costs. $24 billion today, and headed for $36 billion in five years. All not just a total waste, but a poisoning of the educational well. I won't repeat again my simple plan which would completely eliminate college tuition and at the same time enormously improve what students are learning, making it infinitely more practical and useful in the *real* world.

In the past 15 years, while the Consumer Price Index has risen 74%, college tuition has risen an average of 234%. In 1979 the cost of a college education (already inflated) equaled 21% of the average family's income. It's now 39%. Tenured professors earn an average of $60,000 annually for 18 hours a week of work, 30 weeks a year.

From 1975 to 1985, while student enrollment grew 10%, the non-teaching staff (like deans) grew by 60%. And in the last 30 years the academic year shrank from 191 days to 156.

At a majority of the top 50 colleges listed in *US News and World Report* students can graduate without taking a single course in math, science, English, history or literature. The Hudson Institute reports that American schools are now awarding more degrees in home economics than math and more in protective services than in all of the physical sciences.

A federal study showed that 56.3% of the graduates of four-year colleges couldn't calculate the change they'd get back from $3 after buying a 60¢ bowl of soup and a $1.95 sandwich. Parents are spending fortunes on four years of expensive baby-sitting, and we're all forced by law to support this mess. Or else go to prison.

American students rank #1 in the world in how good they feel about their math skills, but a 1992 international study by the Educational Testing Service showed us ranking last in math achievement (well behind Slovenia). In 1972 28% of college-bound seniors had an A or B high school average. By 1993, 83% had an A or B average, while at the same time their SAT scores were plummeting. Now the educational establishment, to cover its dirty tracks, is planning to "re-norm" the SATs, since they've gone down permanently.

The students with the lowest SAT scores become education majors. Students who earn education degrees have lower scores on all the accepted tests than any other major than social work. They don't read, and few can write a coherent letter. On the average, our teachers read one book a year, and that's a fiction book.

More money isn't going to cure this mess. Paying dumbed-down teachers more isn't going to make them better. Creating even more administrative layers isn't going to help our kids.

Why did you have a kid anyway? Your kids are probably the *only* mark you're going to leave on the world to record your having been here. Why are you teaching them to eat garbage and drink sewage? Why are you putting them into our cesspool public schools?

Maybe you've read that parochial schools cost about a third as much as our public schools per student, and teach them far more. Probably not.

So what can you do about this mess? Start at the heart of it: your government. Get out there and vote, making sure that you Never Re-elect Anyone (NRA). And get your family and friends out there to do likewise. Let's flush that Congressional toilet we've allowed to stop up and stink. Step two is to get some ham friends to run for your state legislature and re-elect the heck out of them. Let's infiltrate the system and start hacking back

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Number 84 on your Feedback card

New Products

More Fun Than Rabbits

If you've played with the FCC part 15 "rabbits" you'll find that this new ATV transmitter from PC Electronics will allow much greater scope and reliability. The new TX33-1b 33cm band (902-928 MHz) 1 watt transmitter is sturdy, accepts video from most camcorders, cameras or VCRs, and has an 11-mile snow-free line of sight DX. A video monitor jack lets you set up focus and lighting before you transmit, then shows you your video so you can fine-tune.

It's compact, rugged, and surprisingly inexpensive, at $329 (including shipping in the contiguous USA). If you're a licensed ham, contact PC Electronics by phone, snailmail or E-mail for details at 2522 Paxson Ln., Arcadia CA 91007. Phone (818) 447-4565; E-mail tomsmb@aol.com.

I'll Take One of Each...

The new Contact East catalog supplement is 48 gorgeous full-color pages of test equipment, tools and supplies for engineers, hobbyists, managers and technicians. All the brands you trust, all products fully guaranteed, and Contact East promises same-day shipping on orders placed by 4PM. To get your free copy, call (508) 682-2000; FAX (508) 688-7829; write Contact East, Inc., 335 Willow Street, North Andover MA 01845.

New Multiband Dipole Antenna

Dynamic Electronics Inc. announces their new multiband antenna for HF and VHF. The DP-1 covers 80, 75, 40, 30, 20, 17, 15, 12, 11, 10, 6, and 2 meters. It's 125 feet long and has a maximum width of 2 feet. This 8-dipole element trapless antenna has wide bandwidth on each band and can handle maximum power, and it is $129 plus $6 shipping and handling (US and Canada). Also available is the DP-2, which covers 40, 30, 20, 17, 15, 12, 11, 10, 6, and 2 meters. The DP-2 is only 65 feet long (maximum width 2 feet), and is priced at $110 plus shipping and handling. For more information, contact Dynamic Electronics, Inc., P.O. Box 896, Hartselle AL 35640; (205) 773-2758; FAX (205) 773-7295 or check it out at HTTP://www.hsv.tis.net/~dei.

Alinco Responds to Ham Needs

The new DX-70TH was created for hams who've enjoyed the features of Alinco's popular line of amateur equipment, but have wanted more. Well, here's more! The new model maintains all the features of the DX-70T mobile/portable/base unit but increases the output on 6 meters to 100 watts (the DX-70T has a 6 meter output of 10 watts).

Priced at $1,074, the DX-70TH can be used as an all-mode (SSB, CW, FM, AM, and Data) radio in mobile/base/portable environments. A mobile mounting bracket is included, and many other accessories are available. See your dealer for more information or write Alinco, 438 Amapola Ave., Ste. 130, Torrance CA 90501. Phone (310) 618-8616 or FAX (310) 618-8758.

Field Strength Meter

Palomar Engineers announces a new field strength meter, Model PFS-1, for serious antenna work. It features a detector linear over nearly a 30 dB range, an accurate step attenuator with 30 dB range, a 25 dB RF amplifier, high Q tuned circuits to suppress out-of-band local signals and a panel meter readable to .1 dB.

The meter covers 1.8 to 150 MHz and is powered by 9- or 12-volt batteries. Antenna connection is an SO-239 jack on the rear of the aluminum cabinet. All this, and the PFS-1 is priced at only $195! For further information, contact Palomar Engineers, P.O. Box 462222, Escondido CA 92046; Phone (619) 747-3343; FAX (619) 747-3346; E-mail 75353.2175@compuserve.com.

In Synch

Need to synchronize your station to absolute time? TrueTime has an affordable solution: The TimeLink 3 (TL-3) is a precision real-time clock that receives three channels of WWV radio-transmitted time signals simultaneously. Transmissions are synchronized to the National Institute of Standards and Technology Atomic Time Standard. The TL-3 outputs time on a Display, RS-232 I/O port, IRIG B serial time code, audio speaker and a 1 PPS. Computer software drivers are available for DOS, Windows, Windows NT and Novell Netware—and all this, including the antenna, is only $549! For more information contact: TrueTime, Inc., 2835 Duke Court, Santa Rosa CA 95404. Phone (707) 528-1230; FAX (707) 527-6640.

Manufacturers:

Your new products could be announced here...call Joyce at 603 924 0058.

Need Answers?

Here you go! The 1997 edition of *Answers*, the new RadioShack™ catalog, is available now. It's 280 pages of what you'll find at more than 6,800 dealers across the country—plus the hundreds of products available through RadioShack Unlimited, a special order program that gives customers access to more than 100,000 unique and hard-to-find personal electronics products, parts and components. *Answers* is an easy-to-read reference tool that helps take the mystery out of electronics, for only $2.95.

It's Free!

If you've been looking for a club involving radio here's a new guidebook that may be just what you need, especially if your QTH is in the Southeastern United States. The *Radio Hobby Clubs Pocket Guide* lists more than 50 clubs, including ham radio clubs, scanner clubs, CB clubs, and a radio-related computer bulletin board. Radio hobbyists will find club addresses, contact phone numbers, meeting places and times, and radio frequencies for the West Central Florida area.

Anyone interested in radio can get this handy little (5-1/2 x 4-1/4 inches) guide by sending name, address, and two first class stamps to: RADIO CLUB GUIDE, P.O. Box 103, Largo FL 33779-0103.

Handbook on CD-ROM

The ARRL Handbook CD ($49.95) will simplify searching for information in this PC version (Windows/DOS) of their massive yearly handbook. It includes sounds bites to illustrate various modes and activities. For some uses the paper edition ($38) is better, but with the CD edition you get many active programs for calculating antennas, feedlines, etc.

Get both.

QST on CD!

The back issues of *QST* are now available on CD, from 1970 through 1994. Each four-year group costs $39.95, putting 24 years of the magazines into one small CD wallet for you. Yes, they're working on ROMing the earlier issues. What a great way to search for articles! This is like an encyclopedia of amateur radio. Yes, the columns are there too.

More Antennas

The ARRL has announced Volume 5 of their Antenna Compendium series. It includes 41 articles and a disk (IBM format) with data for use with antenna plotting and modeling programs. $20.

NEVER SAY DIE

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the forest of rotten laws we've allowed Congress to use to steal our money and spend it on stuff that is ruining what could be one heck of a country.

If you just nod and sit there, nothing is going to change for the better, but we know from history that it is going to keep getting worse, and our kids are so poorly educated and stripped of creativity and guts by our schools that they're going to accept whatever comes along, the same way you have.

Sermon over. Oh yes, thanks to Walter Williams and Don Feder for the statistics I stole from their columns.

Magnetic Healing?

I've read a good deal about the power of magnets to help the body heal. I've even reviewed a couple of books on the subject, and I have a good friend I met at the Global Sciences Conference in Tampa earlier this year who is an expert on the subject. So I wasn't completely surprised when I got a letter from a reader who was active in the early linear accelerator days.

He explained that the researchers for General Atomic, working on the linear accelerator for Lawrence Livermore in San Francisco, were surprised when their magnetic doughnut-shaped coils collapsed the copper tubes the coils were wound around when the capacitors were discharged into the coils. They didn't know that nonmagnetic materials such as copper, brass and aluminum could be formed by a high energy impulse magnetic wave. Once they discovered this they sold units to several companies for forming parts.

In the early days of testing the equipment one technician didn't want to bother setting up a special jig, so he just held the part to be formed in his hand and let loose the magnetic blast. His hand got a severe burn that should have taken at least six months to heal. A few days later it was healed. They tried to interest people in the medical field, but got nowhere.

One of their people got his ankle shattered while skiing in Nevada. Gangrene set in so he was flown to a hospital in San Francisco, where they wanted to amputate. Friends brought him to the magnetic unit and two days later the gangrene was fading away. When the doctors went to operate the ankle had healed. The medical community refused to look at what they'd found.

If you've read any of the books I've recommended on the medical industry this will not surprise you.

Bioelectrification

Reader Baluch in Ohio wrote to say that he had taken a shortcut with the bioelectrifier. He used two dimes, a 27V battery (three 9Vs) and a microammeter and didn't bother switching polarity. He just tapped the current on and off. He said that he started losing weight immediately and is now down to his normal weight, his memory has improved (he's 72), and he's looking for some hair to start regrowing next.

Well, Bob Beck grew a new head of hair, so who knows? And then there's that chap who was struck by lightning and grew new hair *and* a new set of teeth. 73

UPDATES

Frank speaks

... a far, far *brighter* thing I do ...

This comes from J. Frank Brumbaugh concerning his November '96 article, "A Low Current Light":

"After my article descended into the depths of the magazine's computer system, I discovered a source of brighter yellow LEDs: All Electronics, PO. Box 567, Van Nuys CA 91408-0567; Cat. #LED-29; four for $1.00. These are T 1-3/4 yellow LEDs, water clear, 2.1 volt at 20 mA. Each produces 550 mcd light level, much brighter than the diodes specified in the article. Use five LED-29s in series with a 120-ohm 1/4W resistor for a far brighter light source." ... J. Frank Brumbaugh

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SPECIAL EVENTS

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the April issue, we should receive it by January 31. Provide a clear, concise summary of the essential details about your Special Event.

JAN 11

LOVELAND, CO The Northern Colorado ARC will host their Winter Superfest 9 AM–3 PM at the Larimer County Fairgrounds, 700 Railroad Ave. VE Exams, commercial exhibits, computer and radio goodies, more. Reserve tables from *Jeanene Gage NØYHY (970) 351-7327.* For general info, call *(970) 352-5304.* Talk-in on 145.115(-) 100 Hz.

PHOENIX, AZ The ThunderBird ARC will host the WestFesT-West Valley Hamfest at Glendale Community College, North Lot, 6000 W. Olive (Dunlap & 59th Ave.), starting at 6 AM. The event is being sponsored by the Amateur Radio Council of Arizona. Free admission, parking $2, tailgaters $5. Talk-in on 154.43- 146.52. Contact *Mark KC7BXS, (602) 931-1204;* or *Ralph WØDNO, (602) 582-8208.*

JAN 18

ST. JOSEPH, MO The Missouri Valley ARC, Green-Hills ARC and Ray-Clay ARC will sponsor the 7th annual Northwest Missouri Winter Hamfest, 9 AM–4 PM at the Ramada Inn. The motel is located at I-29 and Frederick Ave. (exit 47 on I-29), and is offering special rates for hamfest participants. Major exhibitors and flea market all indoors. Free parking. Admission by pre-reg. is $2 each or 3 for $5; at the door, $3 each or 2 for $5. Pre-reg. requests received after Jan. 8th will be held at the door. Swap tables $9 each for the first two tables. Commercial exhibitors welcome; write for details to *Northwest Missouri Winter Hamfest, c/o Gaylen Pearson WBØW, 1210 Midyett Rd., St. Joseph MO 64506.*

JAN 19

BROADWAY, OH A Winter Ham Radio Fair will be sponsored by the Union County ARC 8 AM–3 PM, on State Hwy. 347 three tenths of a mile west of State Route 31. Free parking. Tickets $2 at the door; no advance sales. Age 16 and under free. 8-foot tables $10 for full length, $5 for half. Reservations are encouraged. Please forward payment with an SASE to *Union County ARC, c/o Gene Moore N8YRF, 24461 Claibourne Rd., Marysville OH 43040. Tel. (937) 246-5943.*

RICHMOND, VA The Richmond Amateur Telecommunications. Soc. will hold "Frostfest 97" at the Showplace, 3000 Mechanicsville Tpke. I-95, exit 75 to I-64 East, then exit 192 (Rt. 360 East), go 1/2 mi. on left. Hours 8:30 AM–3:30 PM. Indoor dealers' flea market, forums. Wheelchair accessible. Talk-in 146.88/28. Admission $5. Dealers' tables $35, flea market tables $15 (must RSVP by Jan. 4th). *Contact Craig Spain, (804) 526-9838 eves., or write Richmond Frostfest '97, P.O. Box 932, Chester VA 23831.* For general info, call *(804) 739-2269, ext. FEST. Internet at http://frostfest.rats.net.*

YONKERS, NY A Giant Electronic Flea Market will be held by the Metro 70cm Network 9 AM–3 PM at Lincoln H.S., Kneeland Ave., Tel. (914) 969-1053. Doors open 7 AM for vendors, 9 AM for buyers. New and used equipment for CB, amateur radio, commercial two-way, computers, stereo buffs, electronics parts and kits, plus much more, will be on sale. Donation $6, kids under 12 free. Table setup at 7 AM. VE Exams 9 AM–11 AM. Contact *Otto Supliski WB2SLQ, (914) 969-1053.* Talk-in on 449.425 PL 156.7; 223.760 PL 67.0, 146.910 Hz, and 443.350 MHz PL 156.7. Mail reservations to *Metro 70 CM Network, 53 Hayward St., Yonkers NY 10704.*

JAN 26

DOVER, OH The Tusco ARC Hamfest will be held at the Ohio Nat'l. Guard Armory, 2800 N. Wooster Ave., starting at 8 AM. Setup starts at 6 AM. Admission $2 donation at the door. Tables are $8 each. For info and tables, contact *Tusco ARC, c/o Howard Blind KD8KF, 6288 Echo Lake Rd. NE, New Philadelphia OH 44663.* Please bring your own extension cords. 120 volts is available. Send reservation orders by Jan. 12th to *Tusco ARC, c/o Howard Blind KD8KF.* Talk-in on 146.730(-)

JAN 28

ODENTON, MD A Post Holiday Swapfest and Flea Market will be held by the Maryland Mobileers ARC 8 AM–2 PM at The Odenton Vol. Fire Dept. Hall, 1425 Annapolis Rd. (Route 175). Free VE exams, pre-reg. with *Jerry Gavin NU3D, (410) 761-1423.* Talk-in on 146.205/.805. Donation $3. Tables in advance $7 (table and one operator). Contact *Bill Ziegler KA6TYY, 1307 Ashburton Dr., Millersville MD 21108. Tel. (410) 987- 2384 eves.*

FEB 14

ORLANDO, FL The Orlando HamCation Show and Computer Show, ARRL North Florida Convention will be held at Central Florida Fairgrounds, Rt. 50, 3 mi. west of I-4. Sponsored by OARC of Orlando. Setup Fri. 9 AM–5 PM. Open to the public Fri. 5 PM–9 PM, swap tables only. Sat. 9 AM–5 PM; Sun. 9 AM–4 PM. Largest tailgate area in Florida. RV overnite parking $16. Advance tickets $6, $9 at the gate. Free parking. Swap tables $25/Tailgate $15 all 3 days. Forums: NASA Astronaut, Slide/Photo Exhibit of Lightning Storms, ARRL, APRS Demo by Bob Bruninga, WX Downloads, WX Equip. for the Home, Shortwave Listening by Bob Grove, Publ. *Monitoring Times,* Build a VHF SWR Meter, Grounding for Lightning, Antenna Workshop, Radio Testing, DX Speaker Al Hernandez and Ladies' Programs. For info and adv. tickets, contact *Orlando HamCation, P.O. Box 547811, Orlando FL 32854. E-mail: kd4jqr@aol.com. Web Page www.cycat.con/users/oarc.*

PROPAGATION

Jim Gray W1XU
210 Chateau Circle
Payson AZ 85541

Seasonal lows in solar flux values, combined with the consistently low flux values (60s and low 70s) at the end of Cycle 22 and the beginning of Cycle 23 will *not* bring smiles to the faces of DXers this month. Conditions are expected to be Fair (F) or trending around Fair for many days of the month, but there will be *few* Good (G) days and *many* Poor (P) or Very Poor (VP) days... unfortunately, on weekends also. Geophysical upsets may be expected between the 5th and 7th as well.

10–12 meters

A few possible daytime F2 layer openings to South and Central America on the Good (G) days.

15–17 meters

Fair DX openings on Good (G) days between noon and sunset, and short-skip openings during the daylight hours. The band dies at sunset.

JANUARY 1997						
SUN	MON	TUE	WED	THU	FRI	SAT
			1 F	2 F	3 F-P	4 P
5 P-VP	6 VP-P	7 P-F	8 F	9 F	10 F	11 F
12 F	13 F-G	14 G	15 G-F	16 F	17 F-P	18 P-VP
19 VP-P	20 P-F	21 F	22 F	23 F	24 F-G	25 G-F
26 F	27 F	28 F	29 F	30 F-G	31 G	

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA	20	40	40	40	80	80				20	15	15
AUSTRALIA	20		20		40	40	20	20			15	15
CANAL ZONE	15	20	20	40	40		20	20	15	15	15	15
ENGLAND	20	40	80	40	40		20	20	20	20	20	20
HAWAII	20		20		40	40	80	20			15	15
INDIA	20					20	40	20				15
JAPAN	20						20	20				20
MEXICO	15	20	20	40	40		20	20	15	15	15	15
PHILIPPINES							20					
PUERTO RICO	15	20	20	40	40		20	20	15	15	15	15
SOUTH AFRICA			40	40				15	15	15	20	20
U.S.S.R.	40	80	80	40			20	20	20			40
WEST COAST		80	80	40	40	40	20	20	20			

CENTRAL UNITED STATES TO:

ALASKA						80	40	20				
ARGENTINA	20		40	40	40						15	15
AUSTRALIA	15					40	20	20	20			15
CANAL ZONE	20	80	40	40	40	40	20	20	15	15	15	20
ENGLAND	40	40	40	80				20	15	20		40
HAWAII	15	20			40	40	40				15	15
INDIA	15	20	20				40	20	20			
JAPAN						80	40	20				
MEXICO	20	80	40	40	40	40	20	20	15	15	15	20
PHILIPPINES								20				
PUERTO RICO	20	80	40	40	40	40	20	20	15	15	15	20
SOUTH AFRICA	20	40							15	15	20	20
U.S.S.R	40		40	40				20	20			

WESTERN UNITED STATES TO:

ALASKA	15	20			40	40	40	40	40			20
ARGENTINA	15	20		40	40	40	40	40		15	15	15
AUSTRALIA	15	20	20				40	80	40	15	15	15
CANAL ZONE	20	20		40	40	40			20	15	15	15
ENGLAND			80	40					20	20		
HAWAII	15	15			20	20	20	20				15
INDIA		20										
JAPAN	15	20			40	40	40	40	40			20
MEXICO	20	20		40	40	40			20	15	15	15
PHILIPPINES	15	20					40	40		20		20
PUERTO RICO	20	20		40	40	40			20	15	15	15
SOUTH AFRICA	20	40	40							15	15	20
U.S.S.R.		40	40	40	40				20	20		
EAST COAST		80	80	40	40	40	20	20	20			

20 meters

DX to most areas of the world during daylight hours, peaking a few hours after sunrise and again during the early afternoon. Although the band usually closes soon after sunset, you may find occasional openings to South America and Antarctica until midnight. Daylight short skip from several hundred to 2,000 miles or so possible on most Good (G) or Fair (F) days.

30 meters

DX toward Europe in the late afternoon and evening on Good (G) days until midnight, and then toward the Orient in the early sunrise hours. Possible long-path DX in the morning and also short skip most days out to a thousand miles or more, and farther in the evening.

40 meters

DX toward Europe and Africa in late afternoon hours, toward South and Central America around sunset, and good openings to the West and South Pacific peaking around sunrise on Good (G) days. Expect daytime short skip to 1,000 miles, and 2,000 miles at night.

80–160 meters

Both are excellent bands for DX during hours of darkness, peaking at midnight and just before dawn. Daytime skip on 160 is nonexistent, but on 80 it can be up to 500 miles, and over 2,000 miles at night. On 160, short skip can reach from 1,000–2,500 miles at night. Experts prefer vertical polarization for transmitting antennas (low-angle signal take-off) and horizontal polarization for receiving antennas (less noise) on 160 meters.

When using the "Time, Band, Country" chart: Where 10 meters is shown, also check 12 meters; where 15 meters is shown, also check 12 meters; where 20 meters is shown, also check 17 meters; where 40 meters is shown, also check 30 meters. The ionosphere is *not* consistent at all times and locations; hence the bands shown are also inconsistent. 73

UPDATES

Continued from page 85

Yagi update

If a parts list seems a bit too small, it just may be.

Here is the list that was omitted from the October issue's "440 Yagi Link Antennas":

Parts List

For each antenna:

1	18" to 20" piece of 1" square aluminum boom stock
1	13-5/8" piece of 3/8" aluminum tubing (reflector)
1	13" piece of 3/8" aluminum tubing (driven element)
1	12-5/8" piece of 3/8" aluminum tubing (first director)
1	12-3/8" piece of 3/8" aluminum tubing (second director)
1	2-1/4" piece of 3/8" OD aluminum tubing
1	3/8" by 3-1/2" piece of thin aluminum sheet stock (for gamma match tube)
1	7/8" by 2-1/2" piece of thin aluminum sheet stock (for SO-239 mount)
6	#6 by 1" self-tapping stainless steel screws (for mounting all parts so far)
2	#4 by 3/8" machine bolts with nuts and washers (for gamma strap)
1	3-1/2" piece of RG-8 coax with outer cover and shield removed (gamma)
1	U clamp (for mounting boom to mast)

73

Number 88 on your Feedback card

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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 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 March 1997 classified ad section is January 12th, 1997.

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