FEBRUARY 2001
ISSUE #483
USA $3.95
CANADA $4.95

THE NEW!

73 Amateur Radio Today

Get Kids Involved!
Way Cool Rocket Project

Build:
- Noise Blanker
- Fiendishly Simple Battery Charger
- Xtal Oven Control

Class D Amps

Make Your Own PCBs

Portable Personal Repeater

Plus Much MORE About Our Great Hobby!

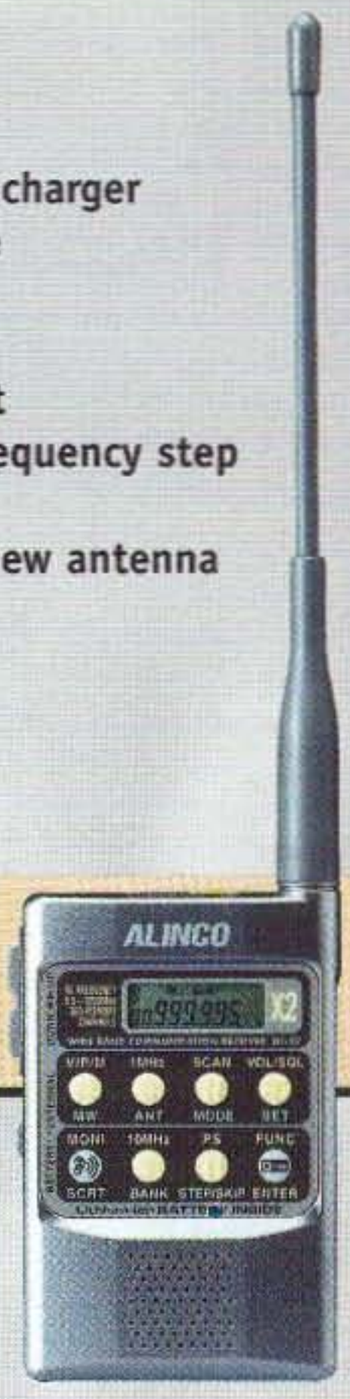
Now There Are Three!

Alinco Wide-Range Receivers with Features You Won't Find Elsewhere!

Listening adventures come alive with this family of Alinco receivers!

New Alinco DJ-X2000 Wide-Range Intelligent Receiver™

- 100 KHz ~ 2.150 GHz coverage*
- 2000 memory channels
- Advanced "on board" help feature
- Computer programmable
- Alphanumeric channel labels
- Flash Tune™ locks onto local signals **
- Transweeper™ searches for "bugs" **
- RF Frequency Counter
- Digital TXCO 1 ppm stability
- AM, NFM, WFM, FM Stereo***, CW, LSB, USB Modes
- Ni-Cd battery & quick charger
- CTCSS search & decode
- Digital Recorder
- Two-stage Attenuator
- Direct Frequency input
- User-programmable frequency step
- ChannelScope™
- Super-wide coverage new antenna
- Much more!



New Alinco DJ-X2 Pocket Communications Receiver

- "Credit Card" size
- 700 memory channels
- Internal Lithium Ion battery
- Snap-on charger and dry cell pack
- RF "sniffer" searches for bugs**
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- Clone Feature
- Three antenna modes
- Preset memory and VFO modes
- Free downloadable software on www.alinco.com

DJ-X10 Wide-Range Communications Receiver

- 100 KHz ~ 2 GHz Range*
- 1200 memory channels
- ChannelScope™ Display
- AM, WFM, NFM, USB, LSB CW modes
- On-board HELP messages
- Superb sensitivity
- "Beginner" and "Expert" modes
- Alphanumeric channel labels
- Automatic Memory Write feature
- Cloning Feature
- Attenuator
- Excellent audio

www.ALINCO.com

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Specifications subject to change without notice or obligation.

* Cellular blocked in USA models. Unblocked versions available for export and authorized use. ** Patent applied for. ***Accessory stereo headphones or speakers required.

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FEBRUARY 2001
ISSUE #483

THE NEW!
73 Amateur Radio Today

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QRX . . .

Trouble in Space

Like you, we thought it was now "safe to go near the water" with some good news about last fall's Ariane launch of Phase 3-D, and so our Andy MacAllister W5ACM presented a rosy picture of things in his characteristically detailed "Hamsats" column this month.

Just prior to press time, though, and well after Andy's column was on its way to press, things started to go haywire. Roy Neal K6DUE picks up the story:

Ham radio's newest satellite is in trouble. Malfunctions in AMSAT Oscar-40's propulsion system have put the satellite into an unplanned orbit. Controllers are working on what they hope will be a recovery plan.

The AMSAT News Service said that the initial attempt to fire the satellite's rocket engine failed, apparently because helium valves did not open on command. Helium pressure is required to open the engine's fuel valves.

Controllers were trying to raise the orbit. After sending up a series of commands, ground controllers were able to get the helium flowing, but not at required levels. In a joint release, AMSAT Germany President Karl Meinzer DJ4ZC, and AMSAT-North America President Robin Haighton VE3FRH, said that enough pressure finally was built up and the spacecraft was programmed to perform an initial engine burn on Monday, December 11th.

The burn began as scheduled, but for unknown reasons continued three minutes too long. They say this put AO-40 into an unplanned orbit with a 60,000-

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SS-10	7	10	1⅛ x 6 x 9	3.2
SS-12	10	12	1⅝ x 6 x 9	3.4
SS-18	15	18	1⅝ x 6 x 9	3.6
SS-25	20	25	2⅞ x 7 x 9⅜	4.2
SS-30	25	30	3¼ x 7 x 9⅝	5.0

MODEL SS-25M

DESKTOP SWITCHING POWER SUPPLIES WITH VOLT AND AMP METERS

MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SS-25M*	20	25	2⅞ x 7 x 9⅜	4.2
SS-30M*	25	30	3¼ x 7 x 9⅝	5.0

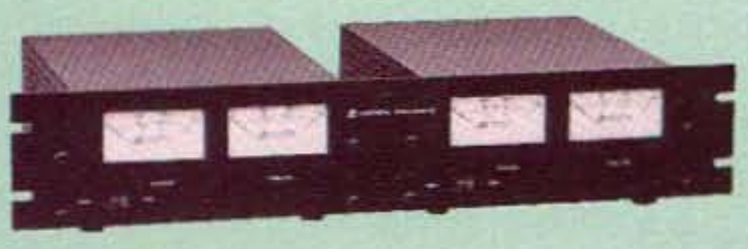
MODEL SRM-30

RACKMOUNT SWITCHING POWER SUPPLIES

MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SRM-25	20	25	3½ x 19 x 9⅜	6.5
SRM-30	25	30	3½ x 19 x 9⅝	7.0

WITH SEPARATE VOLT & AMP METERS

MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SRM-25M	20	25	3½ x 19 x 9⅜	6.5
SRM-30M	25	30	3½ x 19 x 9⅝	7.0



MODEL SRM-30M-2

2 ea SWITCHING POWER SUPPLIES ON ONE RACK PANEL

MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SRM-25-2	20	25	3½ x 19 x 9⅜	10.5
SRM-30-2	25	30	3½ x 19 x 9⅝	11.0

WITH SEPARATE VOLT & AMP METERS

MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SRM-25M-2	20	25	3½ x 19 x 9⅜	10.5
SRM-30M-2	25	30	3½ x 19 x 9⅝	11.0

MODEL SS-12SM/GTX

MODEL SS-10EFJ-98

CUSTOM POWER SUPPLIES FOR RADIOS BELOW

EF JOHNSON AVENGER GX-MC41
EF JOHNSON AVENGER GX-MC42
EF JOHNSON GT-ML81
EF JOHNSON GT-ML83
EF JOHNSON 9800 SERIES
GE MARC SERIES
GE MONOGRAM SERIES & MAXON SM-4000 SERIES
ICOM IC-F11020 & IC-F2020
KENWOOD TK760, 762, 840, 860, 940, 941
KENWOOD TK760H, 762H
MOTOROLA LOW POWER SM50, SM120, & GTX
MOTOROLA HIGH POWER SM50, SM120, & GTX
MOTOROLA RADIUS & GM 300
MOTOROLA RADIUS & GM 300
MOTOROLA RADIUS & GM 300
UNIDEN SMH1525, SMU4525
VERTEX — FTL-1011, FT-1011, FT-2011, FT-7011

NEW SWITCHING MODELS

SS-10GX, SS-12GX
SS-18GX
SS-12EFJ
SS-18EFJ
SS-10-EFJ-98, SS-12-EFJ-98, SS-18-EFJ-98
SS-12MC
SS-10MG, SS-12MG
SS-101F, SS-121F
SS-10TK
SS-12TK OR SS-18TK
SS-10SM/GTX
SS-10SM/GTX, SS-12SM/GTX, SS-18SM/GTX
SS-10RA
SS-12RA
SS-18RA
SS-10SMU, SS-12SMU, SS-18SMU
SS-10V, SS-12V, SS-18V

*ICS – Intermittent Communication Service

RAMSEY

Doppler Direction Finder

Track down jammers and hidden transmitters with ease! This is the famous WA2EBY DF'er featured in April 99 QST. Shows direct bearing to transmitter on compass style LED display, easy to hook up to any FM receiver. The transmitter - the object of your DF'ing - need not be FM, it can be AM, FM or CW. Easily connects to receiver's speaker jack and antenna, unit runs on 12 VDC. We even include 4 handy home-brew "mag mount" antennas and cable for quick set up and operation! Whips can be cut and optimized for any frequency from 130-1000 MHz. Track down that jammer, win that fox hunt, zero in on that downed Cessna - this is an easy to build, reliable kit that compares most favorably to commercial units costing upwards of $1000.00! This is a neat kit!!

DDF-1, Doppler Direction Finder Kit $149.95

1 GHz RF Signal Generator

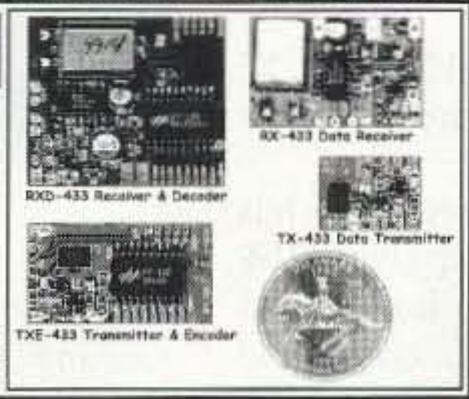
A super price on a full featured RF signal generator! Covers 100 KHz to 999.99999 MHz in 10 Hz steps. Tons of features; calibrated AM and FM modulation, 90 front panel memories, built-in RS-232 interface, +10 to -130 dBm output and more! Fast and easy to use, its big bright vacuum florescent display can be read from anywhere on the bench and the handy 'smart-knob' has great analog feel and is intelligently enabled when entering or changing parameters in any field – a real time saver! All functions can be continuously varied without the need for a shift or second function key. In short, this is the generator you'll want on your bench, you won't find a harder working RF signal generator - and you'll save almost $3,000 over competitive units!

RSG-1000B RF Signal Generator $1995.00

Wireless RF Data Link Modules

RF link boards are perfect for any wireless control application; alarms, data transmission, electronic monitoring...you name it. Very stable SAW resonator transmitter, crystal controlled receiver - no frequency drift! Range up to 600 feet, license free 433 MHz band. Encoder/decoder units have 12 bit Holtek HT-12 series chips allowing multiple units all individually addressable, see web site for full details. Super small size - that's a quarter in the picture! Run on 3-12 VDC. Fully wired and tested, ready to go and easy to use!

RX-433 Data Receiver..... $16.95 TX-433 Data Transmitter..... $14.95
RXD-433 Receiver/Decoder..... $21.95 TXE-433 Transmitter/Encoder..... $19.95



Super Pro FM Stereo Transmitter

Professional synthesized FM Stereo station in 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 freq with Up/Down buttons, big LED display. Input low pass filter gives great sound (no more squeals or swishing from cheap CD inputs!) Limiters for max 'punch' in audio - without over mod, LED meters to easily set audio levels, built-in mixer with mike, line level inputs. Churches, drive-ins, schools, colleges find the FM-100 the answer to their transmitting needs, you will too. Great features, great price! Kit includes cabinet, whip antenna, 120 VAC supply. *We also offer a high power export version of the FM-100 fully assembled with one watt of RF power, for miles of program coverage. The export version can only be shipped if accompanied by a signed statement that the unit will be exported.*

FM-100, Pro FM Stereo Transmitter Kit $249.95
FM-100WT, Fully Wired High Power FM-100. ..... $399.95

World's Smallest TV Transmitters

We call them the 'Cubes'.... Perfect video transmission from a transmitter you can hide under a quarter and only as thick as a stack of four pennies - that's a nickel in the picture! Transmits color or B&W with fantastic quality - almost like a direct wired connection to any TV tuned to cable channel 59. Crystal controlled for no frequency drift with performance that equals models that cost hundreds more! Basic 20 mW model transmits up to 300' while the high power 100 mW unit goes up to 1/4 mile. Their very light weight and size make them ideal for balloon and rocket launches, R/C models, robots - you name it! Units run on 9 volts and hook-up to most any CCD camera or standard video source. In fact, all of our cameras have been tested to mate perfectly with our Cubes and work great. Fully assembled - just hook-up power and you're on the air! One customer even put one on his dog!

C-2000, Basic Video Transmitter.....$89.95 C-2001, High Power Video Transmitter...$179.95

CCD Video Cameras

Top quality Japanese Class 'A' CCD array, over 440 line line resolution, not the off-spec arrays that are found on many other cameras. Don't be fooled by the cheap CMOS single chip cameras which have 1/2 the resolution, 1/4 the light sensitivity and draw over twice the current! The black & white models are also super IR (Infra-Red) sensitive. Add our invisible to the eye, IR-1 illuminator kit to see in the dark! Color camera has Auto gain, white balance, Back Light Compensation and DSP! Available with Wide-angle (80°) or super slim Pin-hole style lens. Run on 9 VDC, standard 1 volt p-p video. Use our transmitters for wireless transmission to TV set, or add our IB-1 Interface board kit for super easy direct wire hook-up to any Video monitor, VCR or TV with A/V input. Fully assembled, with pre-wired connector.

CCDWA-2, B&W CCD Camera, wide-angle lens $69.95
CCDPH-2, B&W CCD Camera, slim fit pin-hole lens.. $69.95
CCDCC-1, Color CCD Camera, wide-angle lens $129.95
IR-1, IR Illuminator Kit for B&W cameras $24.95
IB-1, Interface Board Kit $14.95

AM Radio Transmitter

Operates in standard AM broadcast band. Pro version, AM-25, is synthesized for stable, no-drift frequency and is setable for high power output where regulations allow, typical range of 1-2 miles. Entry-level AM-1 is tunable, runs FCC maximum 100 mW, range 1/4 mile. Both accept line-level inputs from tape decks, CD players or mike mixers, run on 12 volts DC. Pro AM-25 includes AC power adapter, matching case and bottom loaded wire antenna. Entry-level AM-1 has an available matching case and knob set that dresses up the unit. Great sound, easy to build - you can be on the air in an evening!

AM-25, Professional AM Transmitter Kit. $129.95
AM-1, Entry level AM Radio Transmitter Kit... $29.95
CAM, Matching Case Set for AM-1..... $14.95

FM Stereo Radio Transmitters

No drift, microprocessor synthesized! Great audio quality, connect to CD player, tape deck or mike mixer and you're on-the-air. Strapable for high or low power! Runs on 12 VDC or 120 VAC. Kit includes snazzy case, whip antenna, 120 VAC power adapter - easy one evening assembly.

FM-25, Synthesized Stereo Transmitter Kit $129.95

Lower cost alternative to our high performance transmitters. Great value, easily tunable, fun to build. Manual goes into great detail about antennas, range and FCC rules. Handy for sending music thru house and yard, ideal for school projects too - you'll be amazed at the exceptional audio quality! Runs on 9V battery or 5 to 15 VDC. Add matching case and whip antenna set for nice 'pro' look.

FM-10A, Tunable FM Stereo Transmitter Kit. $34.95
CFM, Matching Case and Antenna Set $14.95
FMAC, 12 Volt DC Wall Plug Adapter $9.95

Mini Radio Receivers

Imagine the fun of tuning into aircraft a hundred miles away, the local police/fire department, ham operators, or how about Radio Moscow or the BBC in London? Now imagine doing this on a little radio you built yourself - in just an evening! These popular little receivers are the nuts for catching all the action on the local ham, aircraft, standard FM broadcast radio, shortwave or WWV National Time Standard radio bands. Pick the receiver of your choice, each easy to build, sensitive receiver has plenty of crystal clear audio to drive any speaker or earphone. Easy one evening assembly, run on 9 volt battery, all have squelch except for shortwave and FM broadcast receiver which has subcarrier output for hook-up to our SCA adapter. The SCA-1 will tune in commercial-free music and other 'hidden' special services when connected to FM receiver. Add our snazzy matching case and knob set for that smart finished look!

AR-1, Airband 108-136 MHz Kit..... $29.95
HFRC-1, WWV 10 MHz (crystal controlled) Kit..... $34.95
FR-1, FM Broadcast Band 88-108 MHz Kit $24.95
SR-1, Shortwave 4-11 MHz Band Kit $29.95
SCA-1 SCA Subcarrier Adapter kit for FM radio.... $27.95
FR-6, 6 Meter FM Ham Band Kit $34.95
FR-10, 10 Meter FM Ham Band Kit..... $34.95
FR-146, 2 Meter FM Ham Band Kit..... $34.95
FR-220, 220 MHz FM Ham Band Kit..... $34.95
Matching Case Set (specify for which kit) $14.95

RF Power Booster

Add muscle to your signal, boost power up to 1 watt over a freq 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 transmitters, providing radio service through an entire town. Runs on 12 VDC. For a neat finished look, add the nice matching case set. Outdoor unit attaches right at the antenna for best signal - receiving or transmitting, weatherproof, too!

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
FMBA-1, Outdoor Mast Mount Version of LPA-1 ..... $59.95

PIC-Pro Pic Chip Programmer

Easy to use programmer for the PIC16C84, 16F84, 16F83 microcontrollers by Microchip. All software - editor, assembler, run and program - as well as free updates available on Ramsey download site! This is the popular unit designed by Michael Covington and featured in Electronics Now, September 1998. Connects to your parallel port and includes the great looking matching case, knob set and AC power supply. Start programming those really neat microcontrollers now...order your PICPRO today!

PIC-1, PICPRO PIC Chip Programmer Kit $59.95

FM Station Antennas

For maximum performance, a good antenna is needed. Choose our very popular dipole kit or the Comet, a factory made 5/8 wave colinear model with 3.4 dB gain. Both work great with any FM receiver or transmitter.

TM-100, FM Antenna Kit $39.95
FMA-200, Vertical Antenna $114.95

Order Toll-free: 800-446-2295

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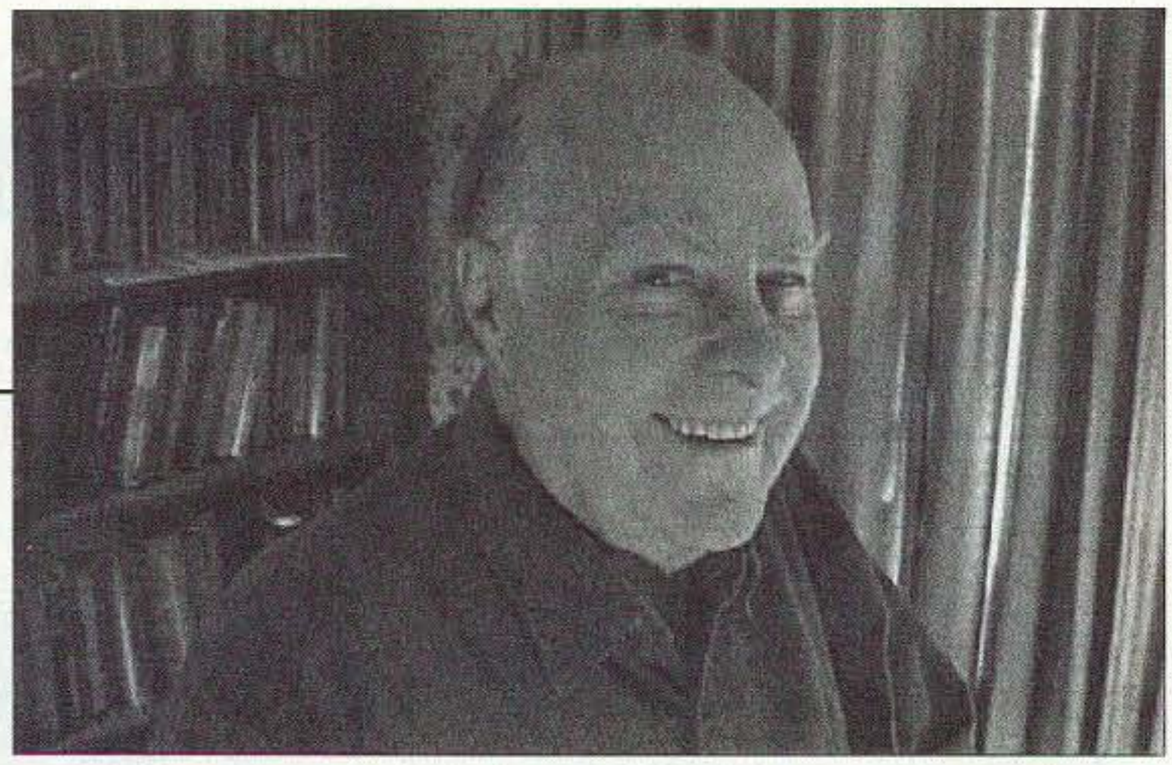

CAFR

How much do you know about your state's Comprehensive Annual Financial Report? According to Walter Burien, who has done extensive research into the situation, this is the financial report that you haven't been seeing, as compared with the usual Annual Service Budget. I realize that you are not going to believe that the states and the federal government have been keeping two sets of books, a cute little maneuver which has been hiding around $45 trillion in assets. That's with a T.

About $32 trillion of that is invested in the stock market—and that's 53% of the stock in *all* publicly traded companies!

Well, I knew that the states had some good scams going for them, but I didn't realize their extent. For instance, up here in New Hampshire the state runs a chain of state liquor stores, plus tolls on the turnpikes. But some of the revenue sources are truly ingenious. Did you know that most of the states put through legislation forcing insurance companies to set aside 33% of their revenues in an escrow fund for the payment of claims? Okay, maybe you knew that. But I'll bet you aren't aware that instead of using the funds from the insurance premiums for the escrow the insurance companies borrow the money from their state at lower than the prime rate and use that money for the escrow fund. They then can invest their premium reserves in the stock market, where they can make a much higher profit on the investment. That accounts for another $8 trillion.

Plus, in a similar deal, $5 trillion in Bond Surety Escrow Accounts.

Meanwhile Congress has driven our taxes up over 50% of our paychecks. It comes to over 70% if you count the taxes on everything we buy, too.

If they'd cut out the double bookkeeping some states could operate tax-free, the national debt could be wiped out, and so on.

Well, we've been suckered into so many other things that this doesn't come as any big surprise.

My next step will be to see if I can find any yearly accounting reports for New Hampshire listing *all* the state's revenue sources. Like property taxes; gasoline; car, boat and skimobile registration; driver's licenses; hunting and fishing licenses; rooms and meals tax; Cannon Mountain tramway and ski revenues; The Flume revenues; Mt. Washington Carriage Road revenues; business profits tax; business inventory tax; turnpike tolls; liquor store profits; and who knows what else. Oops, I almost forgot the state lottery, which is a nice little moneymaker.

Say, when are you going to run for your state legislature and either get your share of the money your state is fleecing people out of or else maybe start making the scam public? Or you could just pocket lobbyist bribes for your retirement.

Reaching That 78%

With only about 22% of our licensees interested enough in the hobby to bother reading any ham rag, that leaves 78% who are unreachable, either to get them excited about expanding their ham horizons or in helping them find out about new gear coming on the market. Considering that subscriptions to the ham rags cost less than most people pay for a lunch for two, this indicates a serious lack of interest in the hobby by the majority of licensees.

There was a time when about 75% of us were reading a ham rag—so what's changed?

Well, one thing is the no-code Tech license, which marooned around 70% of us up on 2m, where someone 50 miles away is DX. So who needs a magazine full of contest and ARRL official club news, packet, RTTY, DXpeditions, ham satellites, and so on? Why would hams who don't even own a soldering iron want to read about construction projects? Even the simple ones? Most of these people memorized the ARRL *Q&A Manual*, got their ticket, and bought their HTs. End of story.

There's a simple way we can upset the hell out of our blindfolded brethren. And that's by making more and more of our repeaters cross-banded to the DX bands so they'll be able to get a taste of making DX contacts without having to get on the Internet to do it. Let's make some windows so they can see that there's a whole world out there. A beautiful, exciting world.

Listening to guys talk about very little or less of much interest on 160m and 75m wasn't what got me to learn the damned code so I could get my ticket—it was listening to the DX rolling in on 20m that did it. Wow! Australia! India! Kenya! Not in my wildest dreams did it occur to me that someday hams I'd worked in India would be taking me to see the Taj Mahal and teaching me to chew betel nut (ugh!). Or that a ham in Kenya would talk me into organizing an all-ham hunting safari in northern Kenya and personally show me the famous Ambouseli game park. Or that a New Caledonia ham would take me up in his plane for an air tour of his country.

It isn't difficult to cross-band a repeater. I set up a repeater at my home station back in 1970 just so I could make 20m contacts with my 2m HT while I was getting my morning walking exercise, and I worked lots of DX that way. And my repeater up on the top of nearby Pack Monadnock Mountain (WR1AAB) was cross-banded to either 6m or 10m at the user's option, allowing any of the users to talk all around the world.

Please stop futzing around, and cross-band your repeater. Then let me know about what happens so we can get more repeater owners to add this function. I'll bet I might even start seeing some articles coming in on ways to make the DXing more flexible. You know, with remotely rotatable beams, remotely tuning the bands, and so on.

Also, let me know what happens as far as your users are concerned.

Continued on page 62

Big Savings on Radio Scanners

Uniden® SCANNERS

NEW!

Bearcat® 780XLT Trunk Tracker III

Mfg. suggested list price $529.99

Less CEI Introductory Instant Rebate -$150.04

Introductory price $379.95

500 Channels • 10 banks • CTCSS/DCS • S Meter

Size: 7^5/8" Wide x 6^15/16" Deep x 2^13/16" High

Frequency Coverage: 25.0000-512.0000 MHz., 806.000-323.9875MHz., 849.0125-868.9875 MHz., 894.0125-1300.000 MHz.

The Bearcat 780XLT has 500 channels and the widest frequency coverage of any Bearcat scanner ever. Packed with features such as Trunktracker III to cover EDACS, Motorola and EF Johnson systems, control channel only mode to allow you to automatically trunk certain systems by simply programming the control channel, S.A.M.E. weather alert, full-frequency display & backlit controls, built-in CTCSS/DCS to assign analog and digital subaudible tone codes to a specific frequency in memory, PC Control with RS232 port, Beep Alert, Record function, VFO control, menu-driven design, total channel control and much more. Our CEI package deal includes telescopic antenna, AC adapter, cigarette ligher cord, DC cord, mobile mounting bracket with screws, owner's manual, trunking frequency guide and one-year limited Uniden factory warranty. For maximum scanning enjoyment, order magnetic mount antenna part number ANTMMBNC for $29.95; The BC780XLT comes with AC adapter, telescopic antenna, owner's manual and one year limited Uniden warranty. Not compatible with AGEIS, ASTRO or ESAS systems. For fastest delivery, order on-line at www.usascan.com

Bearcat® 895XLT Trunk Tracker

Mfg. suggested list price $729.95/**Special $194.95**

300 Channels • 10 banks • Built-in CTCSS • S Meter

Size: 10^1/2" Wide x 7^1/2" Deep x 3^3/8" High

Frequency Coverage: 29.000-54.000 MHz., 108.000-174 MHz., 216.000-512.000 MHz., 806.000-823.995 MHz., 849.0125-868.995 MHz., 894.0125-956.000 MHz.

The Bearcat 895XLT is superb for intercepting trunked communications transmissions with features like TurboScan™ to search VHF channels at 100 steps per second. This base and mobile scanner is also ideal for intelligence professionals because it has a Signal Strength Meter, RS232C Port to allow computer-control of your scanner via optional hardware and 30 trunking channel indicator annunciators to show you real-time trunking activity for an entire trunking system. Other features include Auto Store - Automatically stores all active frequencies within the specified bank(s). Auto Recording - Lets you record channel activity from the scanner onto a tape recorder. CTCSS Tone Board (Continuous Tone Control Squelch System) allows the squelch to be broken during scanning only when a correct CTCSS tone is received. For maximum scanning enjoyment, order the following optional accessories: PS001 Cigarette lighter power cord for temporary operation from your vehicle's cigarette lighter $14.95; PS002 DC power cord - enables permanent operation from your vehicle's fuse box $14.95; MB001 Mobile mounting bracket $14.95; EX711 External speaker with mounting bracket & 10 feet of cable with plug attached $19.95. The BC895XLT comes with AC adapter, telescopic antenna, owner's manual and one year limited Uniden warranty. Not compatible with AGEIS, ASTRO, EDACS, ESAS or LTR systems.

Bearcat® 245XLT Trunk Tracker II

Mfg. suggested list price $429.95/**CEI price $194.95**

300 Channels • 10 banks • Trunk Scan and Scan Lists
Trunk Lockout • Trunk Delay • Cloning Capability
10 Priority Channels • Programmed Service Search
Size: 2^1/2" Wide x 1^3/4" Deep x 6" High

Frequency Coverage:
29.000-54,000 MHz., 108-174 MHz., 406-512 MHz., 806-823.995 MHz., 849.0125-868.995 MHz., 894.0125-956.000 MHz.

Our Bearcat TrunkTracker BC245XLT, is the world's first scanner designed to track Motorola Type I, Type II, Hybrid, SMARTNET, PRIVACY PLUS and EDACS® analog trunking systems on any band. Now, follow UHF High Band, UHF 800/900 MHz trunked public safety and public service systems just as if conventional two-way communications were used. Our scanner offers many new benefits such as Multi-Track - Track more than one trunking system at a time and scan conventional and trunked systems at the same time. 300 Channels - Program one frequency into each channel. 12 Bands, 10 Banks - Includes 12 bands, with Aircraft and 800 MHz. 10 banks with 30 channels each are useful for storing similar frequencies to maintain faster scanning cycles or for storing all the frequencies of a trunked system. Smart Scanner - Automatically program your BC245XLT with all the frequencies and trunking talk groups for your local area by accessing the Bearcat national database with your PC. If you do not have a PC simply use an external modem. Turbo Search - Increases the search speed to 300 steps per second when monitoring frequency bands with 5 KHz. steps. 10 Priority Channels - You can assign one priority channel in each bank. Assigning a priority channel allows you to keep track of activity on your most important channels while monitoring other channels for transmissions. Preprogrammed Service (SVC) Search - Allows you to toggle through preprogrammed police, fire/emergency, railroad, aircraft, marine, and weather frequencies. Unique Data Skip - Allows your scanner to skip unwanted data transmissions and reduces unwanted birdies. Memory Backup - If the battery completely discharges or if power is disconnected, the frequencies programmed in your scanner are retained in memory. Manual Channel Access - Go directly to any channel. LCD Back Light - An LCD light remains on for 15 seconds when the back light key is pressed. Autolight - Automatically turns the backlight on when your scanner stops on a transmission. Battery Save - In manual mode, the BC245XLT automatically reduces its power requirements to extend the battery's charge. Attenuator - Reduces the signal strength to help prevent signal overload. The BC245XLT also works as a conventional scanner. Now it's easy to continuously monitor many radio conversations even though the message is switching frequencies. The BC245XLT comes with AC adapter, one rechargeable long life ni-cad battery pack, belt clip, flexible rubber antenna, earphone, RS232C cable, Trunk Tracker frequency guide, owner's manual and one year limited Uniden warranty. Not compatible with AGEIS, ASTRO, ESAS or LTR systems. Hear more action on your radio scanner today. Order on-line at www.usascan.com for quick delivery.

More Radio Products

Save even more on radio scanners when purchased directly from CEI. Your CEI price after instant rebate is listed below:

Bearcat 895XLT 300 ch. Trunktracker I base/mobile scanner	$194.95
Bearcat 780XLT 500 ch. Trunktracker III base/mobile	$379.95
Bearcat 278CLT 100 ch. AM/FM/SAME WX alert scanner	$159.95
Bearcat 245XLT 300 ch. Trunktracker II handheld scanner	$194.95
Bearcat 248CLT 50 ch. base AM/FM/weather alert scanner	$89.95
Bearcat Sportcat 200 alpha handheld sports scanner	$169.95
Bearcat Sportcat 180B handheld sports scanner	$149.95
Bearcat 80XLT 50 channel handheld scanner	$99.95
Bearcat 60XLT 30 channel handheld scanner	$74.95
Bearcat BCT7 information mobile scanner	$139.95
AOR AR8200 Mark II Wide Band handheld scanner	$539.95
AOR AR16BQ Wide Band scanner with quick charger	$209.95
ICOM ICR8500 wideband communications receiver	$1,469.95
ICOM PCR1000 computer communications receiver	$379.95
ICOM R10 handheld wideband communications receiver	$279.95
Uniden WX100 Weather Alert with S.A.M.E. feature	$49.95

AOR

AOR® AR8200 Mark IIB Radio Scanner

AOR8200 Mark IIB-A wideband handheld scanner/**SPECIAL $539.95**

1,000 Channels • 20 banks • 50 Select Scan Channels
PASS channels: 50 per search bank + 50 for VFO search
Frequency step programmable in multiples of 50 Hz.
Size: 2^1/2" Wide x 1^3/8" Deep x 6^1/8" High

Frequency Coverage:
500 KHz to 823.995 MHz, 849.0125-868.995 MHz, 894.0125-2,040.000 MHz
(Full coverage receivers available for export and FCC approved users.)

The AOR AR8200 Mark IIB is the ideal handheld radio scanner for communications professionals. It features all mode receive: WFM, NFM, SFM (Super Narrow FM), WAM, AM, NAM (wide, standard, narrow AM), USB, LSB & CW. Super narrow FM plus Wide and Narrow AM in addition to the standard modes. The AR8200 also has a versatile multi-function band scope with save trace facility, twin frequency readout with bar signal meter, battery save feature with battery low legend, separate controls for volume and squelch, arrow four way side rocker with separate main tuning dial, configuarable keypad beep/illumination and LCD contrast, write protect and keypad lock, programmable scan and search including LINK, FREE, DELAY, AUDIO, LEVEL, MODE, computer socket fitted for control, clone and record, Flash-ROM no battery required memory, true carrier re-insertion in SSB modes, RF preselection of mid VHF bands, Detachable MW bar aerial. Tuning steps are programmable in multiples of 50 Hz in all modes, 8.33 KHz airband step correctly supported, Step-adjust, frequency offset, AFC, Noise limited & attenuator, Wide and Narrow AM in addition to the standard modes. For maximum scanning pleasure, you can add one of the following optional slot cards to this scanner: CT8200 CTCSS squelch & search decoder $89.95; EM8200 External 4,000 channel backup memory, 160 search banks. $69.95; RU8200 about 20 seconds chip based recording and playback $69.95; TE8200 256 step tone eliminator $59.95. In addition, two leads are available for use with the option socket. CC8200 PC control lead with CD Rom programming software $109.95; CR8200 tape recording lead $59.95. Includes 4 1,000 mAh AA ni-cad batteries, charger, cigar lead, whip aerial, MW bar antenna, belt hook, strap and one year limited AOR warranty. Enter your order now at http://www.usascan.com.

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QRX . . .

continued from page 1

kilometer apogee. Apogee is the satellite's most distant point from Earth.

Meinzer and Haighton said very detailed information on the engine burn was collected and had already given some indications as to what went wrong. They said final analysis could show that the situation might have no impact on the mission goals or that controllers may need to change strategy for achieving a useful final orbit.

But then the other shoe dropped. A report posted on the *CQ Magazine* Web site said that AO-40 may have stopped transmitting. The *CQ* story said that the last report of telemetry being received was at 11:16 UTC on Wednesday, December 13th.

On December 14th, AMSAT released another statement that confirmed the *CQ* report and went a lot further. It said that telemetry transmissions from AO-40 stopped while work on the propulsion system was in progress. Also, that an investigation by the AO-40 development team has begun.

Now, AMSAT says it is waiting for certain onboard software events to occur on Saturday afternoon, December 16th. These are programmed to start a spacecraft emergency routine called "command-assist" which attempts to re-establish communications. AMSAT says that this offers the best chance of recovering evidence of what made the telemetry transmissions stop.

Thanks to Roy Neal K6DUE, via Newsline, *Bill Pasternak WA6ITF, editor.*

Incentive Licensing: QCWA Says QRT

It's time to turn back the hands of time and end the inequity of Incentive Licensing. So says the Quarter Century Wireless Association, as it has filed a petition before the FCC asking the agency to restore privileges withdrawn from Advanced, General Class, and Conditional operators back on November 22, 1968, the day that an ARRL-fostered idea called Incentive Licensing came to ham radio and forever changed it.

The basic idea of Incentive licensing was to try to force higher technical standards in ham radio by compelling all of those then licensed to upgrade. To accomplish this, Advanced, General, and Conditional class licenses lost significant operating privileges. Novice class operators lost the right to use radiotelephone on 2 meters.

To regain the privileges withdrawn, a ham had to upgrade to Amateur Extra Class by passing a 20-words-per-minute Morse test and an engineering-level written examination. Those in the ARRL who had pushed the idea of Incentive Licensing honestly believed that forced upgrading would lead to more technical innovation by hams. Instead, tens of thousands of operators sold off their stations for pennies on the dollar and completely disappeared from ham radio. Others protested by refusing to upgrade. This led to animosity between hams of different license classes, as well as between some hams and the American Radio Relay League."

But the loss was not limited to those no longer on the air. There was a trickle-down effect that in turn hastened the demise of long-established amateur equipment manufacturers like Hammarlund, National, and Hallicrafters. Others, like E.F. Johnson, abandoned the amateur marketplace and looked to other radio services to survive. And after all these years, some people have not been able to let go of their grudge.

According to Gary Harrison KØBC, QCWA president, the way the QCWA envisions bringing everyone back together is by restoring as many of the operating privileges lost by Advanced, General, and Conditional class hams as is possible under today's Part 97 rules.

It is the QCWA view that no useful purpose is being served by continuing to deny the privileges withdrawn from those amateur operators who still suffer from Incentive Licensing. It says that there are still several thousand amateur operators who were negatively affected by Incentive Licensing. QCWA says that the only way to end the inequity is by restoring the privileges lost on November 22, 1968. As we go to print, no rulemaking number has been assigned to this request.

Thanks to QCWA, via Newsline, *Bill Pasternak WA6ITF, editor.*

TAPR Taps Ackermann

At the 19th Annual TAPR/ARRL Digital Communications Conference in September, TAPR (Tucson Amateur Packet Radio) elected John Ackermann N8UR as its new president.

One hundred thirty-five hams, including a dozen from outside the US, attended the annual event, which includes presentation of technical papers, hands-on demonstrations, and beginner's sessions. Over 100 people attended Friday afternoon's APRS seminar, and 70 were present for a technical symposium on programming PIC chips held Sunday morning.

Ackermann succeeds Greg Jones WD5IVD, who had served as president since 1993, with Steve Bible N7HPR, replacing Ackermann as vice president. Bob Hanson N2GDE, will continue to serve as secretary, and Jim Neely WA5LHS remains treasurer. The elections were held at TAPR's annual board meeting, held in conjunction with the DCC.

"Greg Jones led TAPR through a period of growth and innovation," Ackermann said. "On his watch, we brought significant new products to market, including the DSP-93 digital signal processing unit, Totally Accurate Clock, and MIC-E and PIC-E data encoders. Greg also laid the groundwork for our Frequency Hopping Spread Spectrum Radio project. He guided us into the Internet age, along the way creating the TAPR SIG mailing lists that now handle thousands of messages per month. Greg is also responsible for our increased publishing activities. His retirement leaves a void in TAPR that will be hard to fill."

Ackermann said that his primary objective will be to ensure that TAPR remains on the cutting edge of radio technology, with a special emphasis on emerging concepts such as Software-Defined Radios. He will also focus on increasing membership and optimizing the organization's management structure.

Ackermann (ex-AG9V), who lives in Dayton, OH, has served on the TAPR board of directors and as vice president since 1995. He was first licensed in 1974 and has helped build packet radio networks in Ohio and Wisconsin. Ackermann is active on APRS, runs a Linux-based Internet site at his home, and can occasionally be found on CW chasing DX.

Bible lives in Kingsland, GA, and has been a TAPR board member since 1996. He was project manager for TAPR's Totally Accurate Clock (TAC-2), EVM Radio Interface, PIC Encoder, and DGPS Reference Station kits. Bible is leading TAPR's development of a road map to develop Software-Defined Radio technology for amateur use.

In other news from the DCC:

• TAPR announced that it will be offering the "EasyTrak" satellite rotor and radio controller. This PIC-based unit will control azimuth and elevation rotors for satellite use, as well as tune popular radios for Doppler correction.

• PRUG, the Packet Radio Users Group of Japan, demonstrated the possibilities of low-cost Internet-connected sensors and software mobile agent technology. PRUG also introduced the TINI-AMEDES, a Java-based one-board computer with Ethernet interface that supports the Dallas Semiconductor 1-wire interface. They also provided an update on their 2.4 GHz spread spectrum radio, which has been commercialized by Root, Inc.

TAPR is a nonprofit research and development corporation dedicated to advancing amateur radio through digital technology. It focuses on development of hardware and software tools that enable ham radio operators to explore leading-edge technologies. Despite its name, TAPR is an international organization with over 2,000 members worldwide.

For more information, telephone (940) 383-0000, or E-mail [tapr@tapr.org]. Their Web site is at [www.tapr.org].

Thanks to TAPR for this.

Oops!

Our apologies to Ernest "Ernie" Orman, Jr. W5OXA/W5B/KP2 for misspelling his name in last month's interesting QRX item on the Old Biloxi Lighthouse.

MFJ TUNERS

MFJ-989C *Legal Limit* Antenna Tuner

MFJ uses super heavy duty components to make the world's finest legal limit tuner

MFJ uses super heavy duty components -- roller inductor, variable capacitors, antenna switch and balun -- to build the world's most popular high power antenna tuner.

MFJ-989C
$359.95

The rugged world famous MFJ-989C handles 3 KW PEP SSB amplifier input power (1500 Watts PEP SSB output power). Covers 1.8 to 30 MHz, including MARS and WARC bands.

MFJ's *AirCore*™ roller inductor, new *gear-driven* turns counter and weighted spinner knob gives you exact inductance control for absolute minimum SWR.

You can match dipoles, verticals, inverted vees, random wires, beams, mobile whips, shortwave -- nearly any antenna. Use coax, random wire or balanced lines.

You get everything you've ever wanted in a high power, full featured antenna tuner -- widest matching range, lighted Cross-Needle SWR/Wattmeter, massive transmitting variable capacitors, ceramic antenna switch, built-in dummy load, *TrueCurrent*™ Balun, *scratch-proof* Lexan front panel -- all in a sleek compact cabinet (10¾Wx4½Hx15D in).

MFJ AirCore™ Roller Inductor gives high-Q, low loss, high efficiency and high power handling.

MFJ's exclusive *Self-Resonance Killer*™ keeps damaging self-resonances away from your operating frequency.

Large, self-cleaning wiping contact gives good low-resistance connection. Solid 1/4 inch brass shaft, self-align bearings give smooth non-binding rotation.

MFJ *No Matter What*™ Warranty

MFJ will repair or replace your MFJ-989C (at our option) *no matter what* for one year.

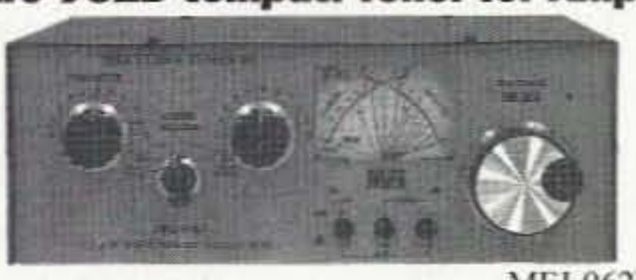
More hams use MFJ tuners than all other tuners in the world!

MFJ-986 Two knob *Differential-T*™

MFJ-986
$329.95

Two knob tuning (differential capacitor and *AirCore*™ roller inductor) makes tuning foolproof and easier than ever. Gives minimum SWR at only one setting. Handles 3 KW PEP SSB amplifier input power (1.5 KW output). Gear-driven turns counter, lighted peak/average Cross-Needle SWR/Wattmeter, antenna switch, balun. 1.8 to 30 MHz. 10¾Wx4½Hx15 in.

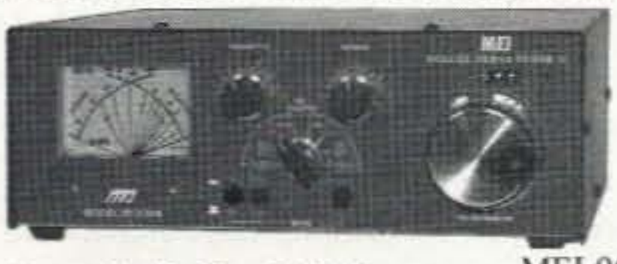
MFJ-962D *compact* Tuner for Amps



MFJ-962D
$269.95

A few more dollars steps you up to a KW tuner for an amp later. Handles 1.5 KW PEP SSB amplifier input power (800W output). Ideal for Ameritron's AL-811H! *AirCore*™ roller inductor, gear-driven turns counter, pk/avg lighted Cross-Needle SWR/Wattmeter, antenna switch, balun, Lexan front, 1.8-30MHz. 10¾x4½x10⅞ in.

MFJ-969 300W *Roller Inductor* Tuner



MFJ-969
$199.95

Superb *AirCore*™ Roller Inductor tuning. Covers *6 Meters* thru 160 Meters! 300 Watts PEP SSB. *Active* true peak reading lighted Cross-Needle SWR Wattmeter, *QRM-Free PreTune*™, antenna switch, dummy load, 4:1 balun, Lexan front panel. 3½Hx10½Wx9½D inches.

MFJ-949E *deluxe* 300 Watt Tuner

MFJ-949E
$149.95

***More** hams use MFJ-949s than any other antenna tuner in the world!* Handles 300 Watts. Full 1.8 to 30 MHz coverage, 48 position *Precision48*™ inductor, 1000 Volt tuning capacitors, *full size* peak/average lighted Cross-Needle SWR/Wattmeter, 8 position antenna switch, dummy load, *QRM-Free PreTune*™, scratch proof Lexan front panel. 3½Hx10⅝Wx7D inches. **MFJ-948, $129.95.** Economy version of MFJ-949E, less dummy load, Lexan front panel.

MFJ-941E *super value* Tuner

MFJ-941E
$129.95

***The** most for your money!* Handles 300 Watts PEP, covers 1.8-30 MHz, *lighted* Cross-Needle SWR/Wattmeter, 8 position antenna switch, 4:1 balun, 1000 volt capacitors, Lexan front panel. Sleek 10½Wx2½Hx7D in.

MFJ-945E HF+6 Meter *mobile* Tuner

MFJ-945E
$119.95

Extends your mobile antenna bandwidth so you don't have to stop, go outside and adjust your antenna. Tiny 8x2x6 in. *Lighted* Cross-Needle SWR/Wattmeter. Lamp and bypass switches. Covers 1.8-30 MHz *and* 6 Meters. 300 Watts PEP. **MFJ-20, $4.95,** mobile mount.

MFJ-971 *portable/QRP* Tuner

MFJ-971
$99.95

Tunes coax, balanced lines, random wire 1.8-30 MHz. Cross-Needle Meter. SWR, 30/300 or 6 Watt QRP ranges. Matches popular MFJ transceivers. Tiny 6x6½x2½ inches.

MFJ-901B *smallest* Versa Tuner

MFJ-901B
$79.95

MFJ's smallest (5x2x6 in.) and most affordable wide range 200 Watt PEP Versa tuner. Covers 1.8 to 30 MHz. Great for matching solid state rigs to linear amps.

MFJ-16010 *random* wire Tuner

MFJ-16010
$49.95

Operate all bands anywhere with MFJ's reversible L-network. Turns random wire into powerful transmitting antenna. 1.8-30 MHz. 200 Watts PEP. Tiny 2x3x4 in.

MFJ-906/903 *6 Meter* Tuners

MFJ-906
$79.95

MFJ-906 has lighted Cross-Needle SWR/Wattmeter, bypass switch. Handles 100 W FM, 200W SSB. **MFJ-903, $49.95**, Like MFJ-906, less SWR/Wattmeter, bypass switch.

MFJ-921/924 *VHF/UHF* Tuners

MFJ-921 or MFJ-924
$69.95

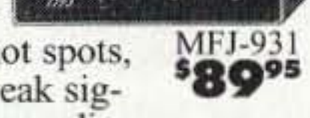
MFJ-921 covers 2 Meters/220 MHz. **MFJ-924** covers 440 MHz. SWR/Wattmeter. 8x2½x3 inches. Simple 2-knob tuning for mobile or base.

MFJ-922 *144/440 MHz* Tuner

MFJ-922
$79.95

Ultra tiny 4x2½x1¼ inch tuner covers VHF 136-175 MHz and UHF 420-460 MHz. SWR/Wattmeter reads 60/150 Watts.

MFJ-931 *artificial* RF Ground



MFJ-931
$89.95

Creates artificial RF ground. Also electrically places a far away RF ground directly at your rig by tuning out reactance of connecting wire. Eliminates RF hot spots, RF feedback, TVI/RFI, weak signals caused by poor RF grounding. **MFJ-934, $169.95**, Artificial ground/300 Watt Tuner/Cross-Needle SWR/Wattmeter.

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LETTERS

From the Ham Shack

John Baxter N3FPZ [jbaxter@voicenet.com]. I am really enjoying getting to know you, Wayne. We're kindred spirits, but I have not been so incredibly successful at realizing my dreams. I am working on this, and now you're helping me with your thoughts ... thanks!

Story of my life in three sentences: I'm N3FPZ, licensed for about 13 years, and my work is as a test engineer with Motorola. I love music — the Love of My Life is a piano teacher and composer, and we are just getting going in her studio with digital recording. I love invention and ideas, so, needless to say, your materials are wonderfully useful and fascinating to me.

For now, I just wanted to pass along a suggestion — and please forgive me if somebody has already thought of this. I listened with a lot of interest to your talk from 1995 about the possibility of revitalizing ham radio by encouraging young people, with the side benefit of revitalizing America's ability to innovate technically. This would be, as the kids might say, "awesome."

Might we create a "chain reaction" effect if we started a movement to get individual hams to spend a very small amount to provide their local school libraries, and selected kids, with:

1) Subscription to *73* magazine.

2) Copy of *ARRL Handbook* (if ready).

3) Simple receiver to monitor 2 meter repeater traffic.

4) Simple receiver to monitor world band broadcasts.

5) Very simple BFO circuit to allow world band receiver to copy SSB and CW.

6) Package of information about ham resources available on the Web.

7) Other cool stuff that kids would love.

Total cost of selected items is a few bucks to a couple hundred. Multiplied by the number of hams willing to do this ...

What brought this to mind was remembering key people who gave me an *ARRL Handbook* early along, and friends who otherwise encouraged me.

Thanks for all you do, Wayne! By the way, I just met Charles Martin here at Motorola Broadband Communications Sector in Horsham PA. He used to work for you ... small world! Charles is AB4Y.

Good thought! The first thing I did when I got interested in amateur radio was head for the school library, where I found copies of QST. *— Wayne. [And please say hello to Charles, "The Pride of Bowling Green," for us all. He has been a friend of 73 for almost 25 years, contributing reports and ideas from the world over, stateside to Mozambique. — J.B.]*

Scott Dennis AL7EM. I have long remembered your mention about researchers who were compressing speech digitally by using phonemes. I just ran across an article about how JPL researchers are doing something similar, and wanted to pass it along. I would love to see this developed for ham radio! Here are the links:

• [http://www.jpl.nasa.gov/releases/2000/digitalperson.html]

• [http://www-b.jpl.nasa.gov/releases/2000/digitalperson.html]

• [http://www-b.jpl.nasa.gov/pictures/tech/digitalpersonnel/].

OK, guys, let's get busy with this. — Wayne.

Gary KG4JPP. I just wanted to let you know I just got my Technician license as a result of a show you did with Art Bell on ham radio about a year ago.

Congratulations! — Wayne.

Bill Haddad WD9HXH. During WWII, I participated in action against the enemy at the battles of Tarawa, Saipan, Tinian, and Okinawa. Through the years, I have read many accounts and details of these and other battles. In my opinion, few of these writings really portray what it is like to be involved in the chaos of war. I am more than somewhat convinced that two people witnessing an event cannot agree as to what took place. Most writers of history weren't involved in the action, and the ones who were can only portray a small part of that history. This does not apply to one of the most interesting accounts of WWII I have read about. You guessed it! Your life as a submariner in WWII. After reading your book, I laid it down. About a month later, I read it again. Wayne, I don't have to tell you what you already know. To wit, "This is one account people are crazy if they don't read!" I thoroughly enjoyed reading it the second time, and before the year is over, I intend to read it again.

Thanks, Bill. I wrote the book mainly for my old crewmates to read, so you know it has to be accurate. That's the way it really was ... and it sure was hairy at times! — Wayne.

Albert "Sonny" Solis KD5GBI. Wayne, I have been a ham radio operator for about 2 years now. I am 49 years old but have been interested in ham radio since I was 13. I got my license and bought an old TS-430 and I was on the air! My first contact was on 10 meters SSB to a station in California. I now work 15 meters or 40 meters CW. I have not updated to General and I wonder if it is worth it. With the new CW requirements, many hams thought it would be the end of ham radio. In my opinion, it died a long time ago. Let me share my very limited experiences with you. I wanted my daughter Amanda to get interested. We listened to 75 meters (3.950) and we heard the worst disgusting language! My daughter said that ham radio was just a collection of old, foul-mouthed men and she didn't want any part of it! You know, she's right. When I was young, the idea of talking to someone in another part of the world was exciting. The reality of what I hear is 10 to 20 second QSOs to DX stations. Well, so much for using ham radio to foster international understanding. Contests make 10 meters a joke. I then went to CW on 15 and 40 meters. Here I could "talk" to other hams. Wayne, I don't know what the answer is, but ham radio is dying. Getting youngsters involved is a step in the right direction but the old, foul-mouthed hams on 75 meters will certainly kill the hobby. I subscribe to your magazine, *CQ*, and *QST*. I subscribe to all in an effort to support the magazines. I don't QSO too often because of my work. I guess that I am just rambling now. Thought I would pass along my experiences. Thanks for reading this.

Being solution-oriented, here's a suggestion on how we can clean up the garbage-mouthed old farts. The next time you hear some old-timer trashing us, tape him. Step two is to use a telephone ROM and get the names and addresses of his neighbors. Step three would be to anonymously send them a note and a copy of the tape, asking them to ask their neighbor to clean up his act. — Wayne. 73

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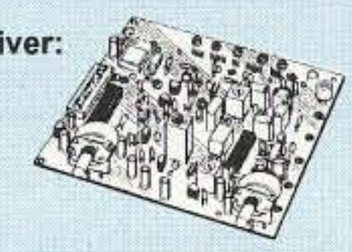

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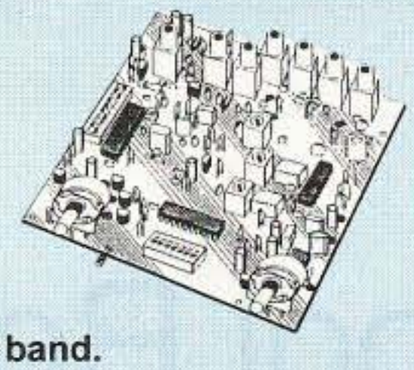

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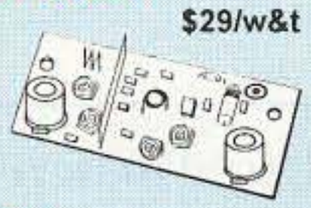

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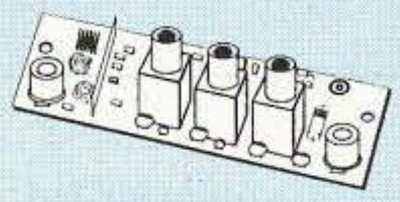

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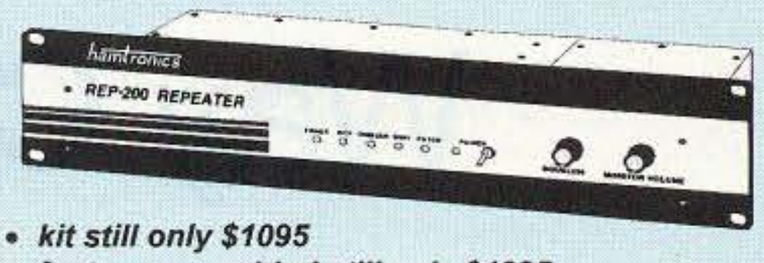

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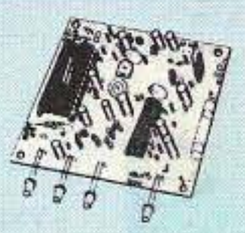

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Way Cool Rocket Project, Part 1

This 70cm rocketborne radio telemetry system is strictly for kids — NOT!

This is the first in a series of three articles that will describe the construction and flight operation of a basic single-channel 70cm (433 MHz) rocketborne radio telemetry system, or rocketsonde.

The transmitter portion of this system is mounted in a small sounding rocket and used to telemeter air temperature of an atmospheric air column to 2,000 meters (about 6,000 feet). The ground-mounted receiver portion of the system is used with a fully steerable antenna array consisting of two stacked Ramsey Electronics four-element 433 MHz yagi antennas. Receiver output is supplied to a strip chart recorder.

This telemetry system is currently being utilized as an instructional tool in a volunteer-led, after hours, high school science enrichment program called "Sounding Rocket 101." The primary purpose of the program is to provide a hands-on science activity to high school science clubs that will provide additional learning opportunities in the areas of: electronics, communications, atmospheric science, and applied physics. The Sounding Rocket 101 program is presented in a way that ignites student interest (no pun intended!).

One of the primary design goals for the telemetry electronics was to produce an easy-to-build, low-cost, single-channel radio telemetry system that could be easily duplicated by an electronically inclined high school student. The purpose of this series of articles is to encourage other radio amateurs to duplicate the system and become involved with providing additional advanced learning opportunities for high school students.

In keeping with the low-cost design objective, the core elements in the radio telemetry system are 433 MHz AM transmitter and receiver modules

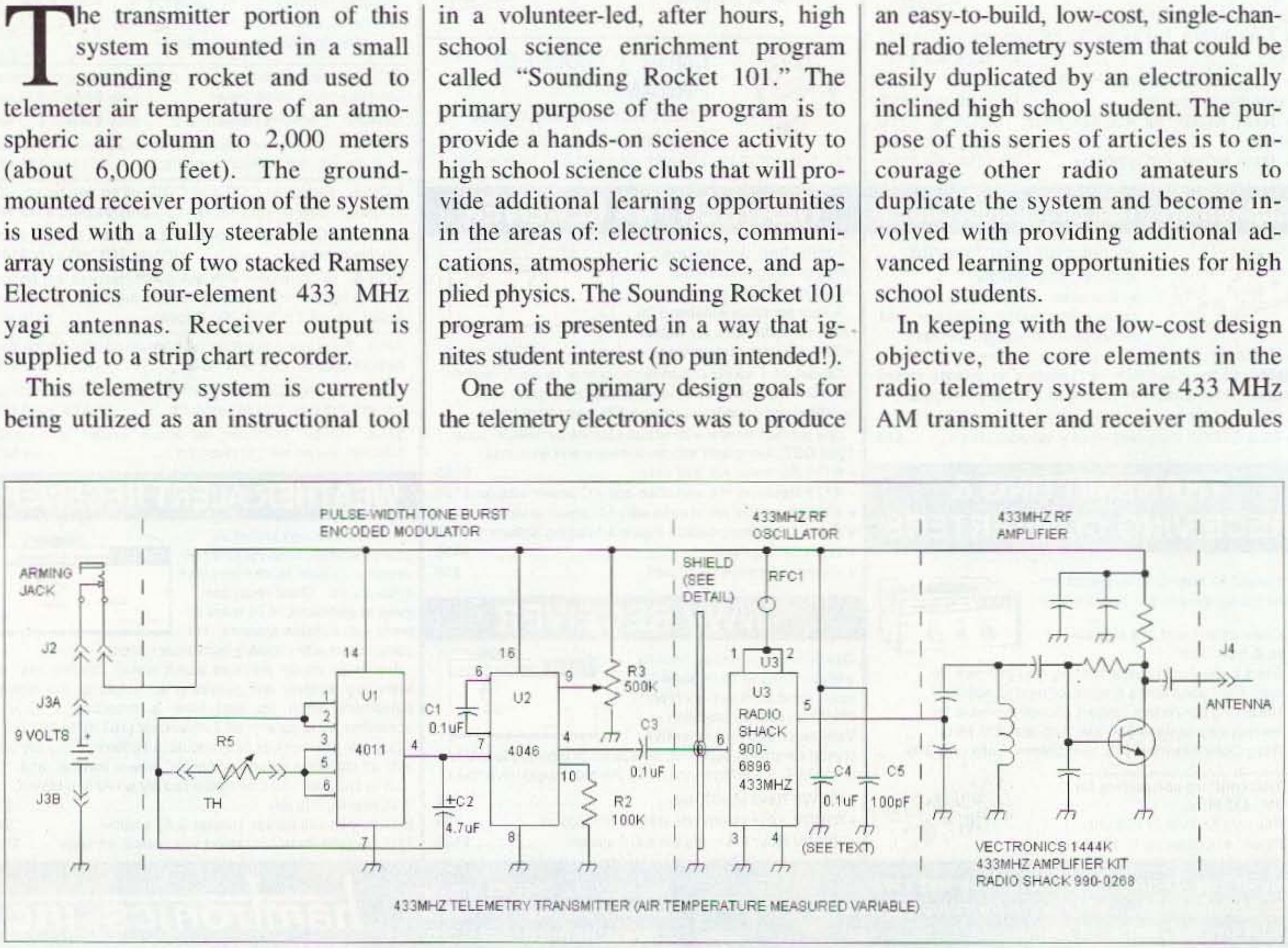

Fig. 1. *Transmitter schematic (see also Fig. 8).*

available from Radio Shack. Although the Radio Shack UHF modules are designed for short-range (several hundred feet) remote control use, through the use of external circuitry their effective communication range can be extended to a little over a mile. The total cost for both modules is less than twenty dollars. To further minimize cost, off-the-shelf circuit assemblies are used were possible. Total cost for all three of the electronic modules used in this project is less than fifty dollars.

The transmitter

Figure 1 — Transmitter schematic. A Radio Shack 8 milliwatt RF output, SAW-device-controlled, 433 MHz AM transmitter module (Radio Shack #900-6896) is used as the core element for the telemetry transmitter. A 4011 quad 2-input NAND gate is used as a variable pulsewidth oscillator. The resistance of the thermistor, R1, determines the width of the output pulse. Output from the 4011 is supplied to the input of a 4046 phase locked loop integrated circuit. Here, the pulse provided by the 4011 is converted to a tone pulse. Potentiometer R3 is adjusted for a tone frequency of about 2 kHz. This 2 kHz tone pulse is capacitively coupled to pin 6 of the transmitter module ("Code in" or modulation input).

RF output from the transmitter is taken from pin 5 of the transmitter module and supplied to the input of a Vectronics 1444K 433 MHz RF amplifier. Although this amplifier is primarily designed as a preamplifier for receivers, in low power applications it also works very well as an RF power amplifier.

Using the RF amplifier, output from the transmitter module is increased from 8 milliwatts to about 80 milliwatts. Using an impedance matching network at the output of the amplifier was experimentally determined to be unnecessary at the power levels being considered in this application. This RF output level is sufficient to ensure reliable data collection from the design altitude of 2,000 meters. Power for the transmitter is provided by a standard Duracell 6LR61 alkaline 9-volt battery. A closed circuit two conductor jack, J1, is used as an on/off switch when the transmitter package is installed in the rocket airframe. A blank plug is inserted in the jack to remove power from the transmitter.

The receiver

Figure 2 — Receiver schematic. A Radio Shack 433 MHz AM receiver module (Radio Shack #900-6895) is used as the core element for the telemetry receiver. Radio Shack does not provide a schematic of the receiver. However, from an examination of the component layout on the miniature circuit board, the receiver appears to be of the super-regen type. A 7805 five-volt regulator is used to provide power to the receiver. The same Vectronics kit used as an RF power amplifier for the transmitter is also used with the receiver as an RF amplifier at the front end of the receiver. A Rainbow Kits AA1 audio amplifier kit (Radio Shack #900-6895) is used on the back end of the receiver. A two-conductor open circuit phone jack is placed in parallel with the speaker to supply audio to a small tape recorder.

The telemetry decoder

Figure 3 — Decoder schematic. An LM555 timer IC is connected as a frequency-to-voltage converter. The values of resistance and capacitance used with the IC are selected for a pulse tone frequency of about 2 kHz. Voltage output from the decoder varies from 0 volts with no pulse input to about +5 volts with a 2 kHz tone input. A 5 megohm potentiometer is used to attenuate output of the decoder for use with a strip chart recorder.

An SPDT switch (SW2) is used to bypass the 5 meg pot for output to a computer or other recording device. Before the telemetry system is used to gather data in flight, the entire rocketsonde transmitter payload package is enclosed in a sealed chamber and exposed to a range of temperatures. Output from the received and decoded signals are recorded and used as calibration data. The participating students use the calibration data to

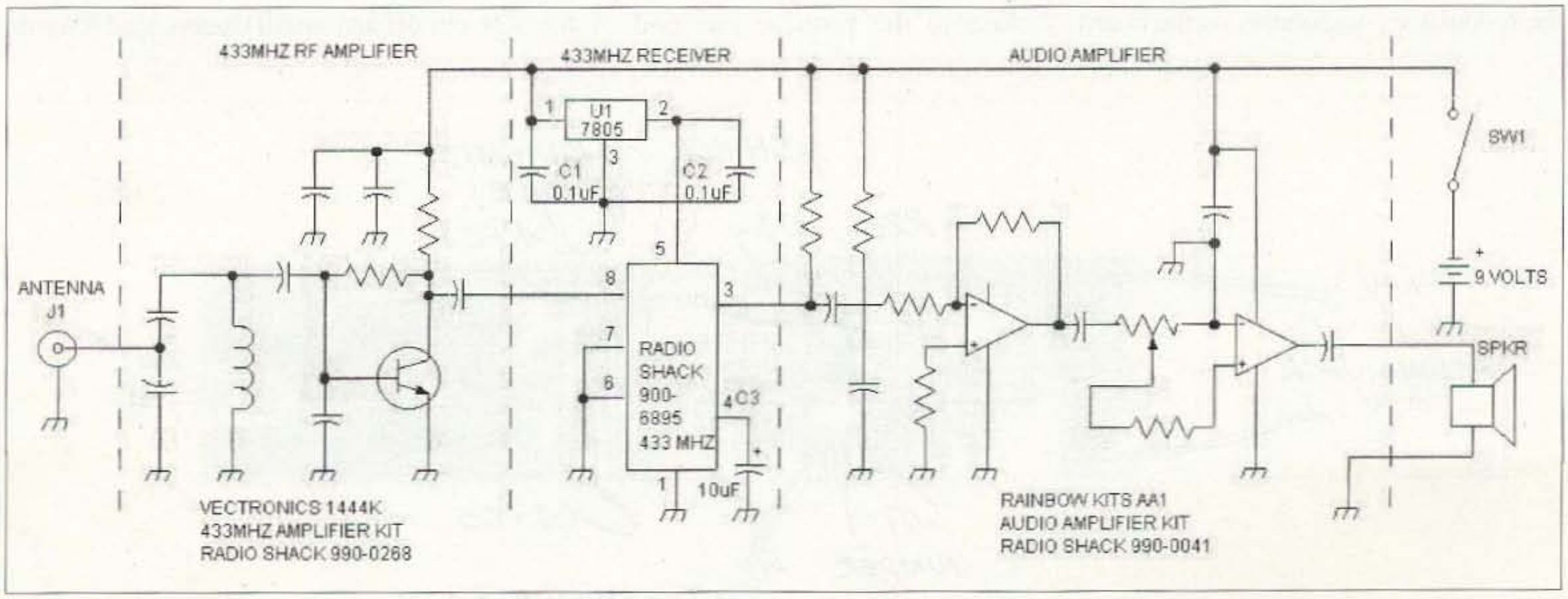

Fig. 2. Receiver schematic.

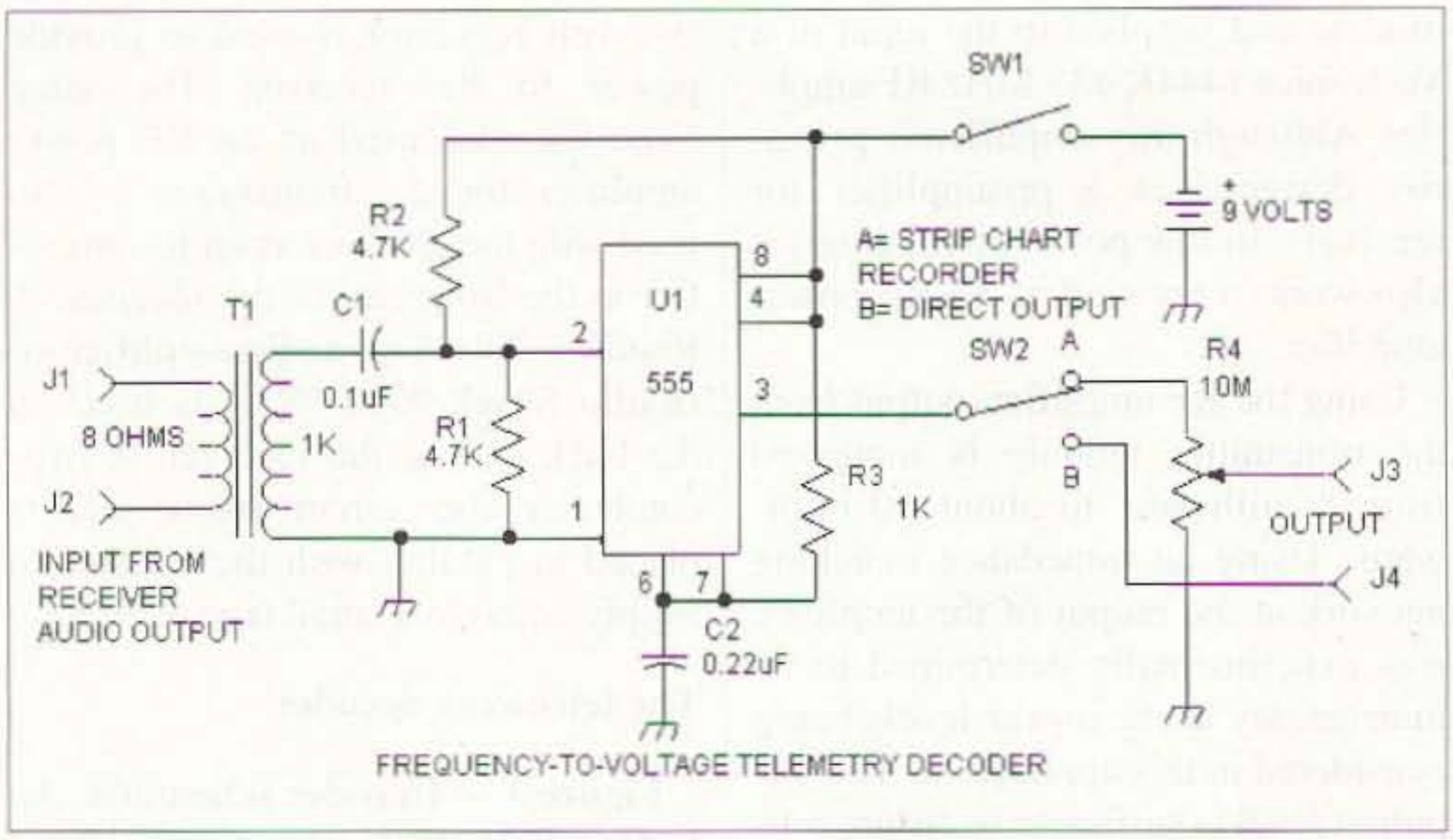

Fig. 3. Decoder schematic.

construct pulsewidth vs. temperature templates. After the flight telemetry data is recorded, the students then use the templates to "reduce" the telemetry data by converting pulsewidth to temperature. During the flight of the rocketsonde, some of the students use theodolites to shoot angles on the rocket in flight. Later, the students use trigonometry to calculate the altitude of the rocketsonde vs. time. The students then combine the two sets of data to construct a graph of air temperature vs. altitude.

Construction of the transmitter

An approximately six-inch by one-inch printed circuit board is used for the transmitter. A full-size reproduction of the circuit board foil pattern is shown in **Fig. 5**. The first steps are to assemble all the modulator components on the board.

Figure 4 — Component placement diagram (transmitter). Make sure to save all of the component lead cuttings, as you will need some of them a bit later. Note that the leads of capacitor C2 (4.7 µF electrolytic) are left a bit long so that it can be bent over the integrated circuit U2. This is necessary to allow the assembled unit to fit into the rocket payload housing.

A short piece of hookup wire is connected to the free lead of capacitor C3 (0.1 µF disc ceramic), and the other end of the wire is soldered to the PC board as shown in the component location diagram. Take one of the longer component lead cuttings and slip the ferrite bead over the wire. Shape as shown in the component location diagram, and solder in place. It is important that the ferrite bead be placed close to the positive bus end of the wire, and the remaining wire is dressed close to the surface of the board.

The next step is to install the transmitter module. This module must be installed with the large round can on the board facing away from the modulator section. This will ensure the correct pin sequence on the board. Make sure that the bare power lead with the ferrite bead does not contact any part of the transmitter module.

Turn the PC board over to the foil side. Solder capacitors C4 and C5 (0.1 µF and 100 pF disc ceramic) between the positive power pad and the ground bus. It is important that you use zero lead length when soldering the capacitors in place. The next step is to fabricate the RF shield. Cut a 17mm by 19mm rectangle from a sheet of .005 brass. Solder three of the scrap component leads to the brass plate as shown in the shield detail. Mount the shield to the board and solder in place. Ensure that the plate does not contact the transmitter module.

The Vectronics 1444K RF amplifier kit is assembled per the instructions supplied with the kit. When winding the three-turn coil, make sure to keep the turns close together. Once the Vectronics kit is assembled, scrap component leads will be soldered to the Vectronics kit to convert it to a module that can be mounted on the transmitter PC board. You will need five lengths of scrap lead material.

Solder the leads in place so that most of the lead projects below the foil side of the Vectronics PC board. Make sure to cut off any small excess lead lengths

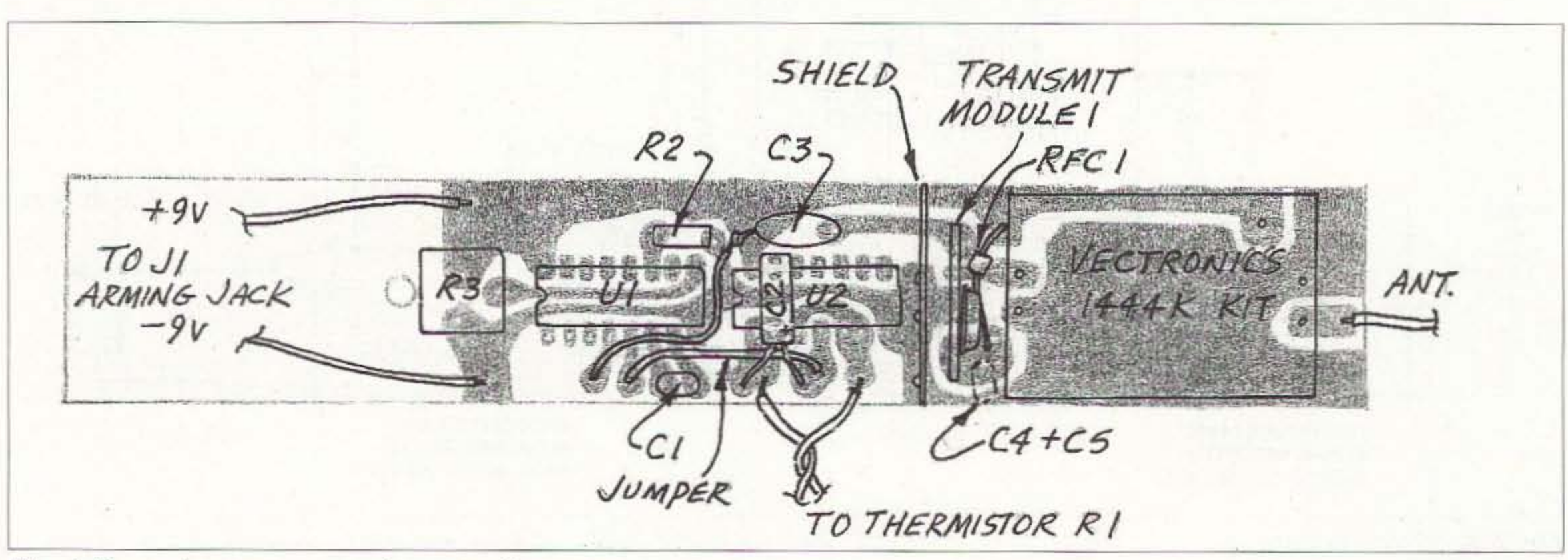

Fig. 4. Transmitter component placement diagram.

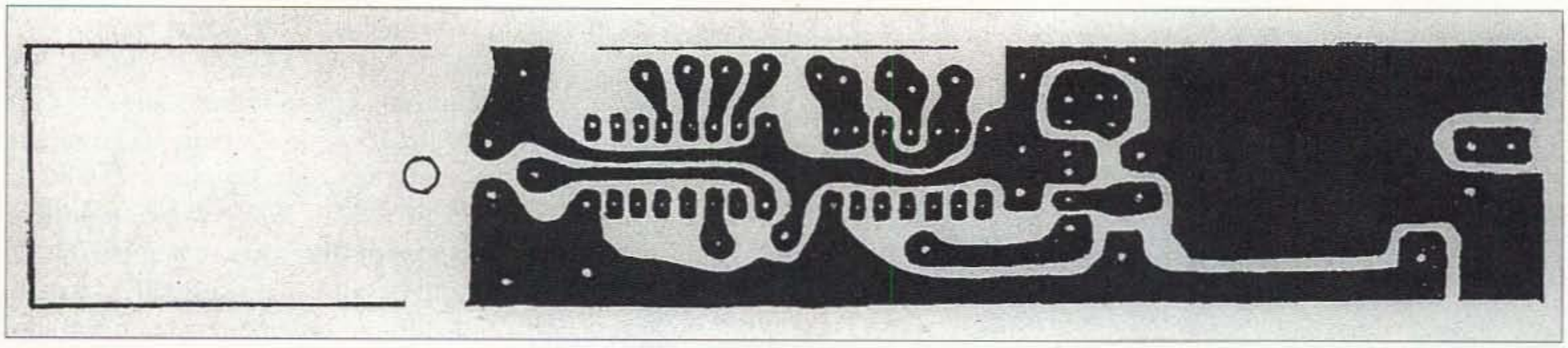

Fig. 5. Transmitter board, foil side.

that project above the component side of the board. Position the Vectronics board in place, inserting all the prefabricated leads in the holes in the transmitter board. Make sure that the Vectronics PC board is as close to the top surface of the transmitter PC board as possible.

Solder all the leads in place and cut off all excess lead length on the foil side of the transmitter board.

Prepare a three-inch length of hookup wire. Solder one end to the RF amplifier output pad on the transmitter PC board. Solder the free end to both pins of a two-pin connector. This is the transmitter antenna connection. As shown on the transmitter board component layout diagram, solder the black wire from the battery snap connector to the negative power bus on the transmitter PC board.

Prepare three-inch and six-inch lengths of red hookup wire. Slip a short length of heat shrink tubing over the shorter length of red hookup wire. Splice one end of the three-inch length of red wire to the red wire from the battery snap connector. Slide the heat shrink tubing over the solder joint and, using the barrel of the soldering iron, heat shrink in place. Solder the free end of the three-inch red wire to one terminal of the arming jack. Solder one end of the six-inch red wire to the switched terminal on the arming jack. If you are not sure which is the switched terminal, use an ohmmeter to check for continuity. When the plug is inserted in the jack, the switched terminal will be open; it will be closed when the plug is removed.

As shown on the transmitter PC board layout diagram, solder the free end of the red wire to the positive power bus on the transmitter PC board. If you wish, you can cut the two red wires from the arming jack and install a two-pin connector. This will make for easier installation of the transmitter package into the payload airframe.

Prepare two seven-inch lengths of green hookup wire. Twist the two wires together to form a "twisted pair" about six inches long. As shown on the transmitter board layout diagram, solder the two wires on one end of the "twisted pair" to the points indicated on the transmitter board layout diagram.

Solder the two free ends of the "twisted pair" to a two-pin connector. This is the connection point for the thermistor temperature sensor. The thermistor will be mounted to the outside of the payload airframe and is connected when the transmitter package is installed in the payload airframe section. This completes assembly of

Continued on page 14

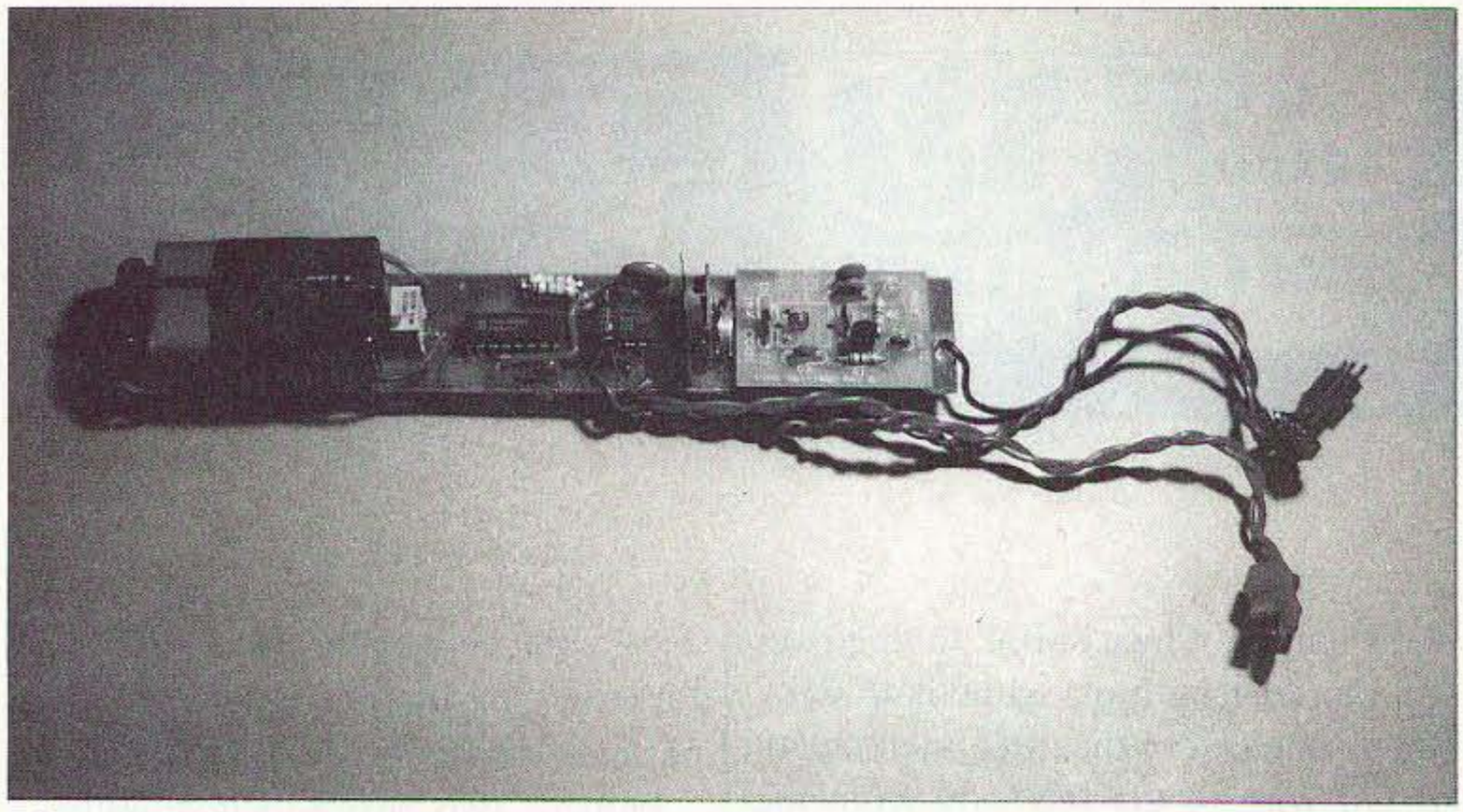

Photo A. *Telemetry transmitter.*

Way Cool Rocket Project, Part 1

continued from page 13

the telemetry transmitter. **Photo A** shows the telemetry transmitter.

Construction of the Receiver

Like the transmitter, the telemetry receiver is assembled on a printed circuit board. A full-size printed circuit foil pattern for the receiver PC board is given in **Fig. 7.** The first step is assembly of the Vectronics 1444K RF amplifier kit and the Rainbow Kits AA-1 audio amplifier kit. Make sure to save all the scrap component leads.

Figure 6 — Receiver component placement diagram. Assemble the RF amplifier and audio amplifier as detailed in the instructions included with each kit. NOTE: When winding the three-turn coil for the RF amplifier, keep the turns close together.

Using some of the scrap component leads, solder a wire lead to the input, output, and power points on both the RF and audio amplifiers. Make sure that most of the wire lead projects out from the foil side of the PC board. Cut off the exposed end of each lead from the component side of the board. Check to see that the soldered leads match with the holes in the receiver PC board. Install both the RF amplifier

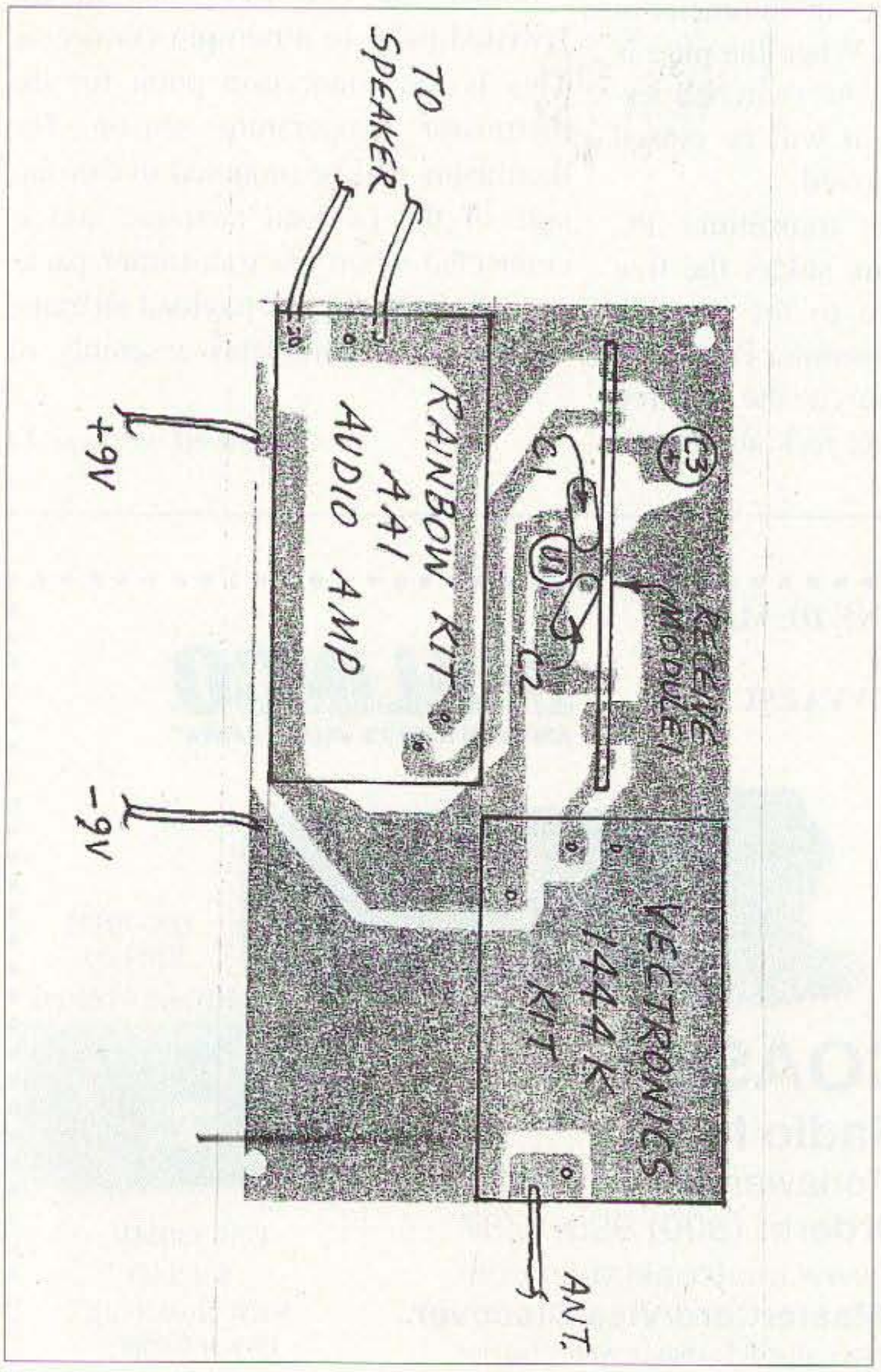

Fig. 6. *Receiver component placement diagram.*

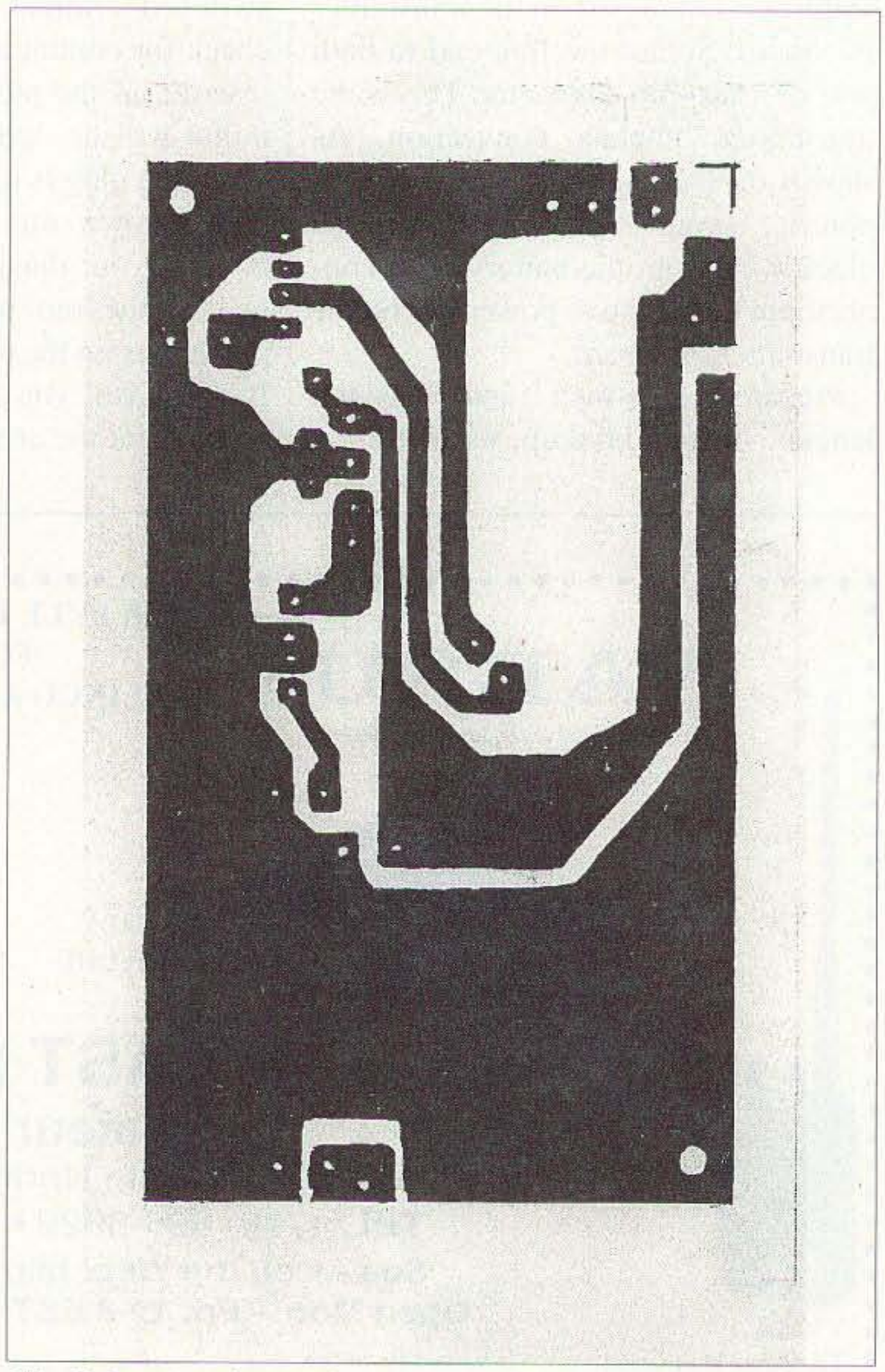

Fig. 7. *Receiver board, foil side.*

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25 Amp
$149.95
plus s&h

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No RF Hash!

They are fully protected with Over Voltage and Over Current protection circuits.

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MFJ *MightyLites*™ can be used anywhere in the world! They have switchable AC input voltage and work from 85 to 135 VAC or 170 to 260 VAC. Replaceable fuse.

***MightyLites*™ . . . Mighty Features**

Front-panel control lets you vary output from 9 to 15 Volts DC.

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MFJ-4245MV, $199.95. 45 Amps maximum or 40 Amps continuous. Weighs 5.5 pounds. Measures 7½Wx4¾Hx9D in.

***NEW!* 25 Amp *MightyLite*™**

Super light, super compact switching power supply delivers 25 Amps maximum/ 22 Amps continuous at 13.8 Volts DC. Low ripple, highly regulated. ***No RF Hash!*** Five-way binding posts for high current. Quick connects for accessories. Over voltage/current protection. 110 or 220 VAC operation. Meets FCC Class B regs. 3.5 lbs. 5½Wx2½Hx10¾D in.

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MFJ 35/30 Amp Adjustable Regulated DC Power Supply

Massive 19.2 pound transformer . . . No RF hash . . . Adjustable 1 to 14 VDC . . .

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plus s&h

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It's highly regulated with load regulation better than 1%. Ripple voltage is less than 30 mV. *No RF hash* -- it's super clean!

Fully protected -- has over voltage protection, fold back short circuit protection and over-temperature protection.

You get front panel adjustable voltage from 1 to 14 VDC with a convenient detent set at 13.8 VDC. A pair of front-panel meters let you monitor voltage and current.

Three sets of output terminals include a pair of heavy duty five-way binding posts for HF/VHF radios, two pairs of quick-connects for accessories and a covered cigarette lighter socket for mobile accessories.

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Power two HF/VHF transceivers and six or more accessories from your 12 VDC power supply

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$74.95
plus s&h

MFJ-1116
$49.95
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New!
MFJ-1117
$54.95
plus s&h

MFJ-1118, $74.95. This is MFJ's most versatile and highest current *Deluxe Multiple DC Power Outlet*. Lets you power two HF and/or VHF transceivers and six or more accessories from your transceiver's main 12 VDC supply.

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MFJ-1112, $34.95. Similar to MFJ-1116. No on/off switch, LED, meter, fuse.

NEW! MFJ-1117, $54.95. For powering four HF /VHF radios (two at 35 Amps each and two at 35 Amps combined) simultaneously. Tiny 8x2x3 inches.

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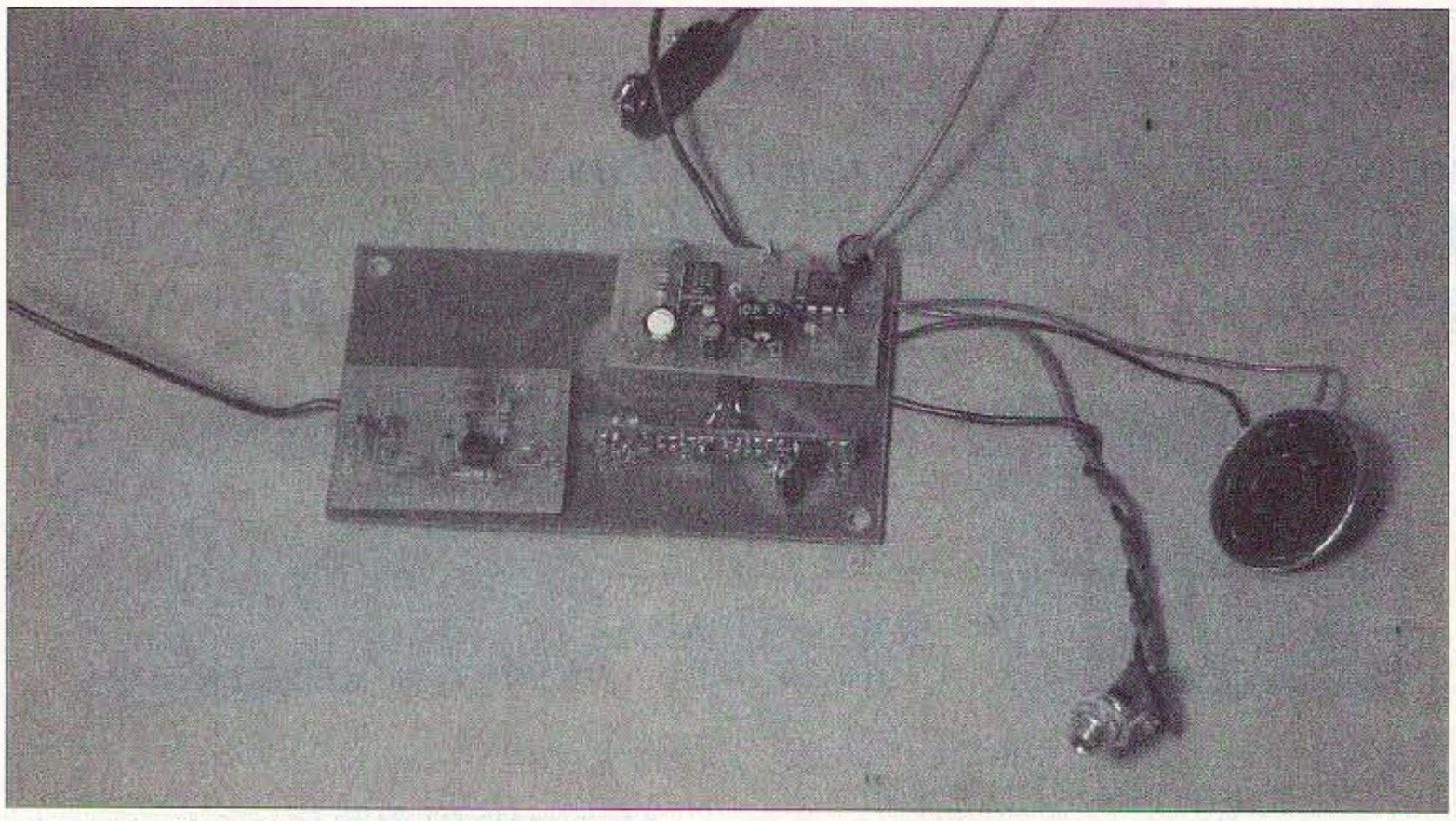

Photo B. Completed receiver board.

and the audio amplifier to the receiver PC board. Seat each of the circuit boards as close as possible to the component side of the receiver PC board and solder in place.

Install the receiver module so that the coil faces the audio amplifier. Position the module so that you have minimum lead length and solder in place. Next, install capacitor C3 (10 µF electrolytic). Make sure to observe proper capacitor polarity. Solder C3 in place. Install U1, the LM7805 voltage regulator IC. Make sure that the flat surface on the IC case faces the receiver module. Leave the leads a bit long so that the component can be bent away from the coil on the receiver board. Solder U1 in place. Install capacitors C1 and C2 in place next to U1. Try to use the minimum lead length on these components and solder in place.

Use hookup wire to connect the speaker and output jack J2 to the audio amplifier output. Solder an SPST switch (SW1) in series with the positive lead from a 9-volt battery snap connector. Solder the battery leads to the appropriate points on the receiver PC board.

Photo B — Completed receiver PC board. I housed the receiver in a 2-inch x 4-inch x 5-inch Bud aluminum minibox. The receiver PC board is mounted on 1/4-inch aluminum standoffs and is positioned as close as possible to the antenna connector. **Photo C** shows the receiver mounted in the enclosure.

Construction of the decoder

The decoder is a simple enough circuit to be easily wired on 1/2 of a Radio Shack #276-159 "Dual General Purpose IC PC Board." Lead length and component placement are not critical in this circuit. The type of attenuator you use will depend on the input requirements of the recording device you are using. I used banana type jacks for the decoder input and output connections. **Photo D** shows the decoder mounted in its housing.

Testing and tuning

Attach a short antenna to the receiver and solder a twelve-inch length of wire to the transmitter RF amplifier output connector. Temporarily connect the thermistor to the transmitter. Plug in a blank plug into jack J1 on the transmitter. This will ensure that power is removed from the transmitter. Temporarily break the positive power lead to the transmitter and install a milliammeter in series with the positive power lead. Install a 9 volt battery to the transmitter battery snap connector. Connect a 9 volt battery to the receiver. Apply power to the receiver. You should hear a rush of static coming from the speaker.

Next, remove the plug from transmitter J1. This will apply power to the transmitter. You should see about 10 milliamps of current to the transmitter. At the same time, you should hear tone pulses in the speaker. Use the point of a wooden toothpick to gently separate the turns on transmitter power amplifier coil. Go easy here, as the adjustment required is small.

Adjust for maximum signal strength from the speaker. Use the same technique to adjust turn spacing on the receiver RF amplifier coil. Again, adjust for maximum signal strength. Power down the transmitter and receiver and reconnect the positive power lead in the transmitter.

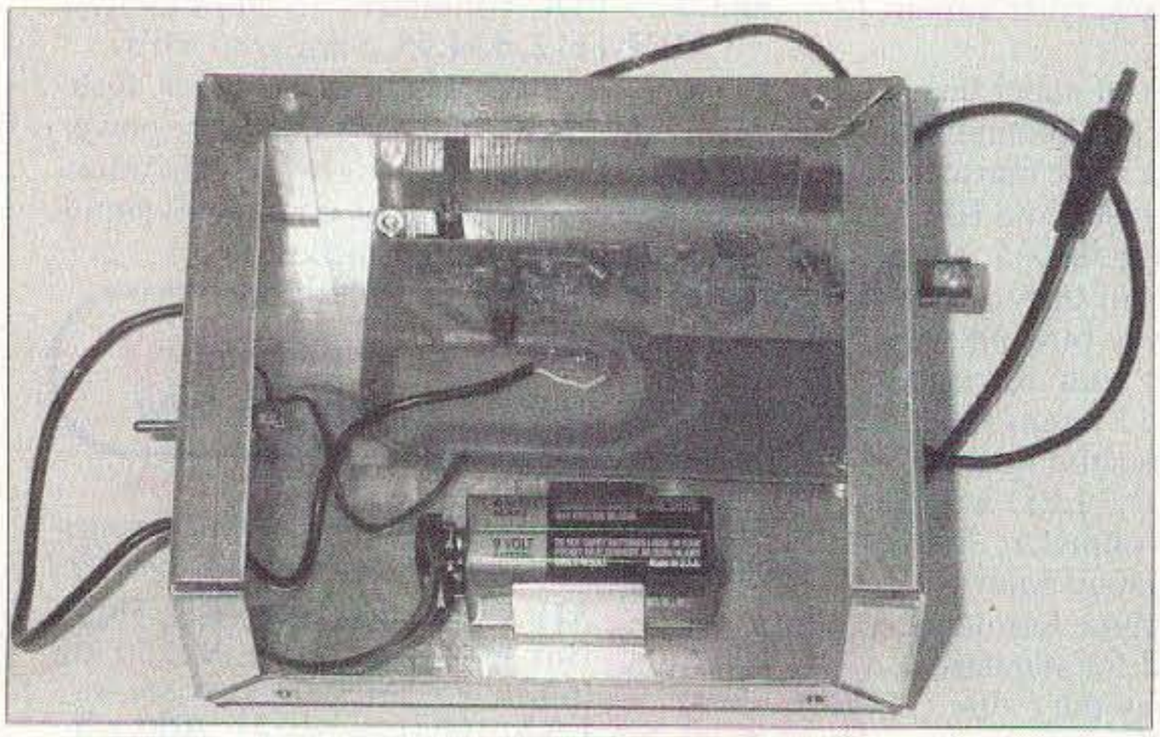

Photo C. Receiver mounted in the enclosure.

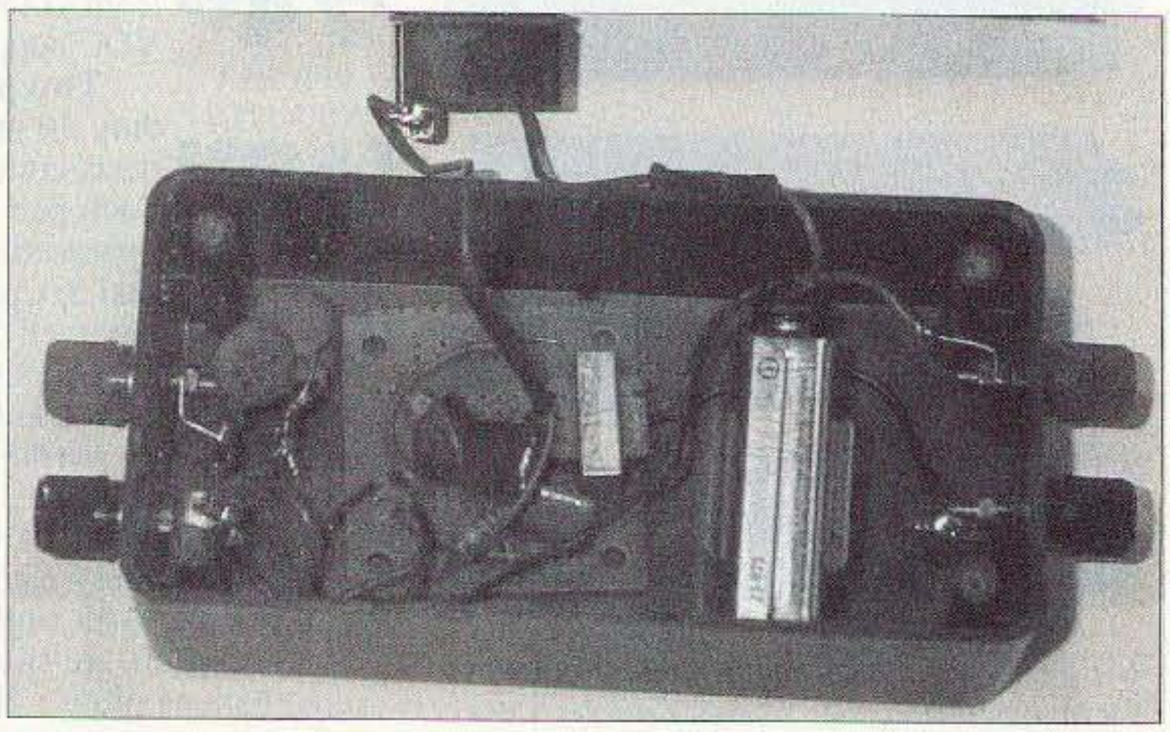

Photo D. Decoder mounted in its housing.

NAME	DESCRIPTION
Transmitter Parts List	
C1, C3, C4	0.1 µF disc ceramic cap, RS #272-135
C2	4.7 µF electro cap, RS #272-1024
C5	100 pF disc ceramic cap, RS #272-123
R1	Thermistor, RS #271-110
R2	100k 1/4 W resistor, RS #271-1347
R3	500k pot, Mouser #72-T70YP-500k
J1	1/8-in. open frame closed circuit jack, RS #274-246
J2, J4	Thermistor connector, 2-pin Deans ultraplug, Deans #1300 (available from R/C suppliers)
J3	9 V battery snap connector, RS #270-324
Module 1	433 MHz AM transmitter module, RS #900-6896
Vectronics 1444K RF amp kit	433 MHz, RS #990-0268
U1	4011B CMOS quad NAND gate, Digi-Key #CD4011BCN-ND
U2	4046 micropower PLL, Digi-Key #CD4046BCN-ND
RFC-1	Ferrite bead, Mouser #542-FB64-110
Misc. components: 0.005-in, sheet brass; PC board	
Receiver Parts List	
C1, C2	0.1 µF PC-mount cap, RS #272-1069
C3	10 µF electro cap, RS #RSU11296852
U1	7805 IC +5 V regulator, RS #276-1770
Module 1	433 MHz AM receiver module, RS #900-6895
Vectronics 1444K RF amp kit	433 MHz, RS #990-0268
Rainbow Kits AA1 audio amp kit	RS #990-0041
SW1	SPST mini toggle switch, RS #275-624
J1	BNC chassis-mount jack, RS #278-105
J2	2-conductor open frame jack, RS #174-251
Spkr	1.1-in. mylar mini speaker, Mouser #253-5011
Misc. components: 9 V battery snap (RS #270-324); 9 V battery holder (RS #270-326); aluminum minibox; PC board	
Decoder Parts List	
C1	0.1 µF cap, RS #272-1069
C2	0.22 µF cap, RS #272-1070
R1, R2	4.7k 1/4 W resistor, RS #271-1330
R3	1k 1/4 W resistor, RS #271-1321
R4	5 meg pot, linear taper, Mouser #31VC605
T1	Audio transformer, RS #273-1380
U1	LM555N IC timer, RS #276-1723
SW1	SPST toggle switch, RS #275-624
SW2	SPDT toggle switch, RS #275-625
J1, J2, J3, J4	Banana jacks, RS #274-661
Misc. components: 9 V battery snap (RS #270-324); 9 V battery holder (RS #270-326); small plastic box; PC board (RS #276-159)	

Component Suppliers	
NAME	**URL**
Radio Shack	www.RadioShack.com
Digi-Key	www.digikey.com
Mouser Electronics	www.mouser.com

Part 2 of this three-part series will discuss integration of the transmitter electronics package into the sounding rocket payload section and construction of the telemetry tracking antenna. Have fun! 73

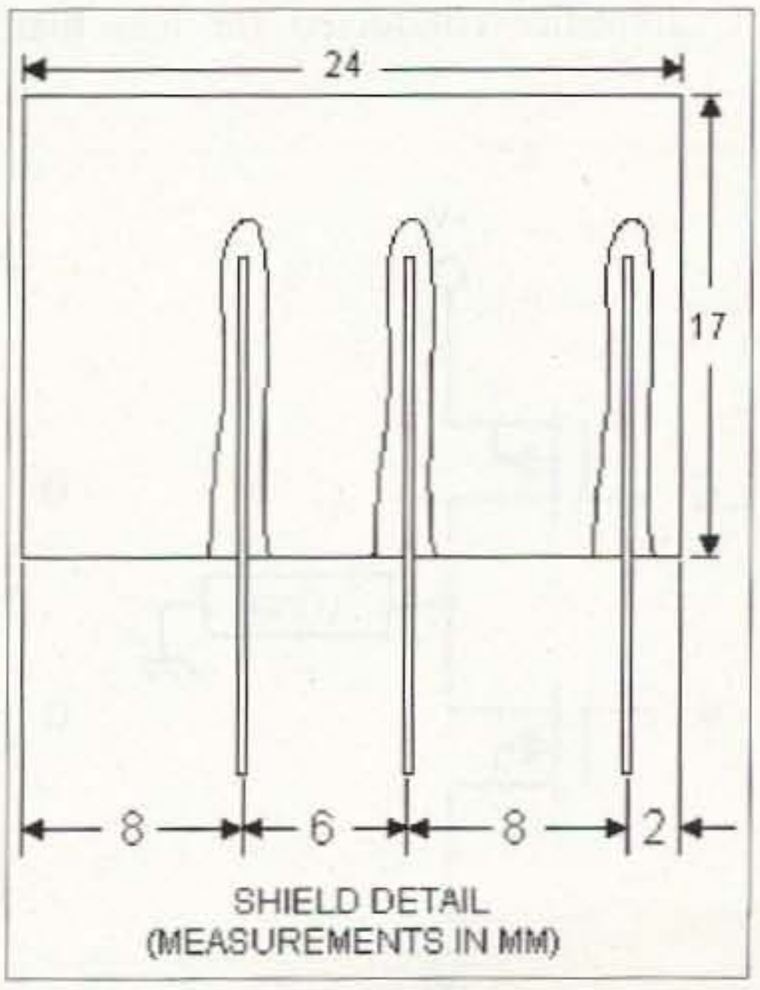

Fig. 8. Shield detail from Fig. 1.

Table 1. Parts lists.

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

All About Class D Amplifiers

What you do know can't hurt you.

A class D amplifier is a high efficiency amplifier whose efficiencies can be greater than 90%. Some authors restrict class D amplifiers to amplifiers with constant duty cycle, and reserve class S for pulsewidth-modulated (PWM) amplifiers. By whatever name, the amplifiers have very high efficiencies. Just to put us on the same page, I'll call them all class D.

When vacuum tubes were the only active devices, amplifiers were classified as A, B, or C, depending on their conduction angles. For example, a class A amplifier conducted for 360 degrees of the input signal and efficiency could never exceed 50%. A class B amplifier conducted for about 180 degrees and had a maximum efficiency of 78.5%. A class C amplifier conducted for less than 180 degrees and had an efficiency of about 65% to 85%. While other modes of operation were known to the academics, the limitations of tubes restricted their practical application to these three classes.

An in-between class of operation that is appropriate for vacuum tubes is class AB. In class AB the push-pull connection eliminates even harmonics, and makes it possible to extend operation until the instantaneous plate current is reduced to zero for a small portion of each cycle without causing excessive distortion in the output. Class AB amplifiers have efficiencies in the order of 40 or 50%.

Because tubes can have short term dissipation exceeding the rated plate dissipation, class AB was used to squeeze a little more power out of a tube. As an aside, a further distinction of amplifiers was denoted by the subscript 1 or 2 which indicated whether grid current flowed. The subscript 1 meant no grid current and is assumed unless otherwise noted. The subscript 2 meant there was *some* grid current. Class A_2 or AB_2 indicated that grid current flowed (with an attendant increase in distortion). Because the cost of a tube was significant, every effort was made to reduce the tube count and get the most from every stage. Today the cost of the passive components in a circuit outweigh the cost of the semiconductor and no great effort is expended in reducing the transistor count.

Class G amplifiers are a high efficiency class of amplifier that has a maximum efficiency of 84.2%. A complementary class G amplifier requires two power supplies and uses

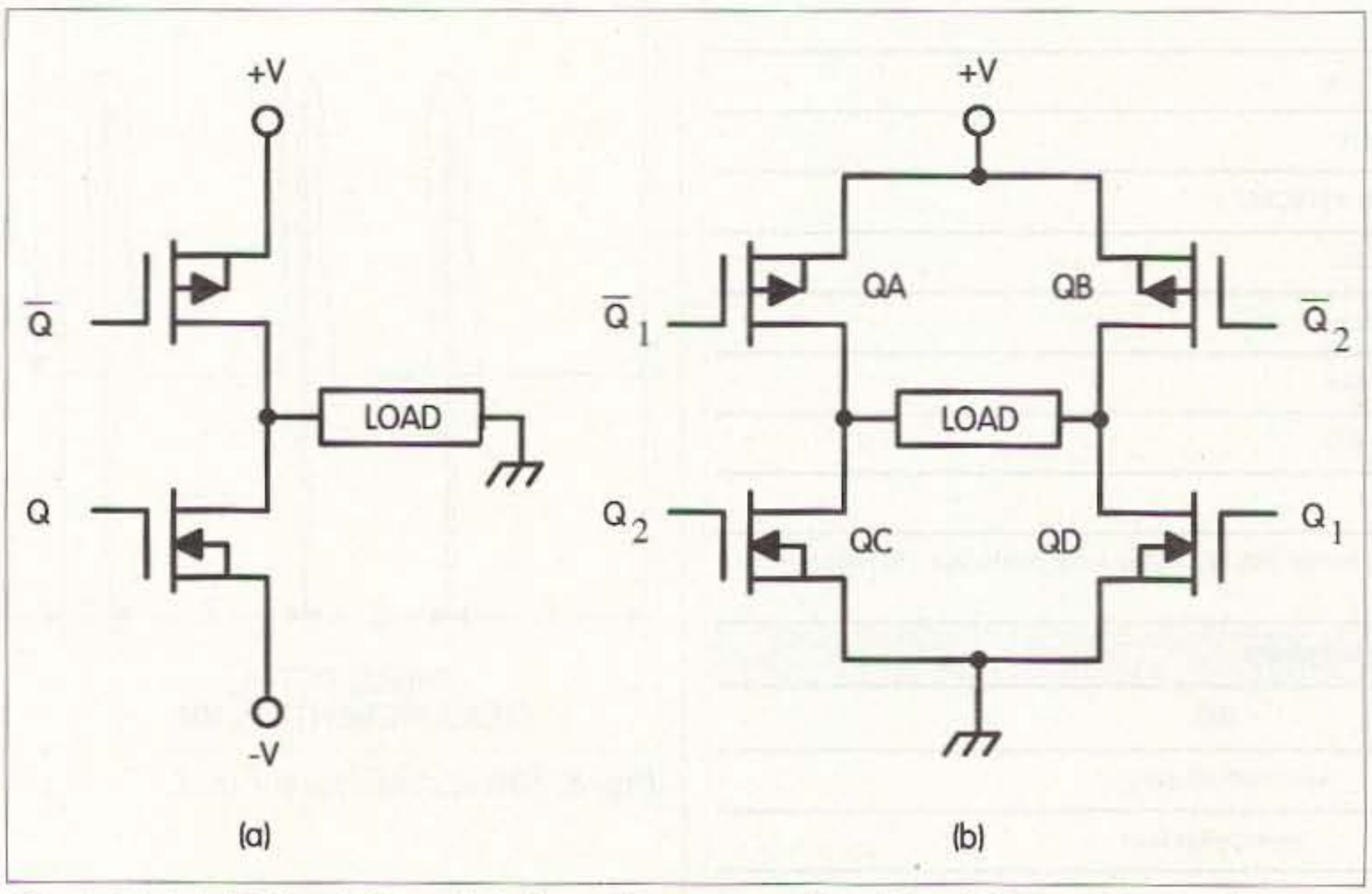

***Fig. 1.** (a) A half-H switch needs balanced power supplies. (b) A full-H needs a single supply.*

four transistors, instead of the two used in class B. One pair of transistors operates from a lower supply voltage (e.g. $\pm 1/2\ V_{cc}$). The first pair of transistors work for low level signals and the second air operates when the input signal exceeds what the first pair can handle. The scheme was described by L. Feldman in "Class G High Efficiency Hi-Fi Amplifiers," in *Radio Electronics,* August 1976. The scheme has enjoyed little success.

The class of operation of an amplifier cannot be divined by just looking at the schematic — it depends on the operating point. For example, the schematic of a class B amplifier looks very much like the schematic of a push-pull class A amplifier, but a class D amplifier is unique.

Power semiconductors have opened many of the formerly esoteric amplifiers to practical uses. Class D amplifiers are an example of a high efficiency class of amplification made practical by semiconductors. Class D amplifiers are basically switches that are either open or closed. When off, the semiconductors conduct no current and dissipate no power. When on, the drop is less than a volt even when conducting amps, and they dissipate little power. On the other hand, vacuum tubes need a plate voltage in the order of a hundred volts to conduct even a moderate current. In short, tubes don't make good switches.

Since the transistors in a class D amplifier are either on or off, they aren't suitable for linear applications as such. But, the average of a PWM signal can be proportional to a varying audio input, and the PWM signal can control efficient power semiconductor switches. Class D amplifiers routinely have efficiencies approaching 95%.

Pulsewidth modulation is widely used in switch mode power supplies (SMPS) to produce a regulated unipolar voltage. The output DC voltage is compared to a reference voltage to produce a PWM signal and the pulsewidth changes to correct the output voltage.

While either MOSFETs or BJTs can act as the switch, the MOSFET is preferred because of its higher switching speed and lower drive requirements. High switching speed is desired because

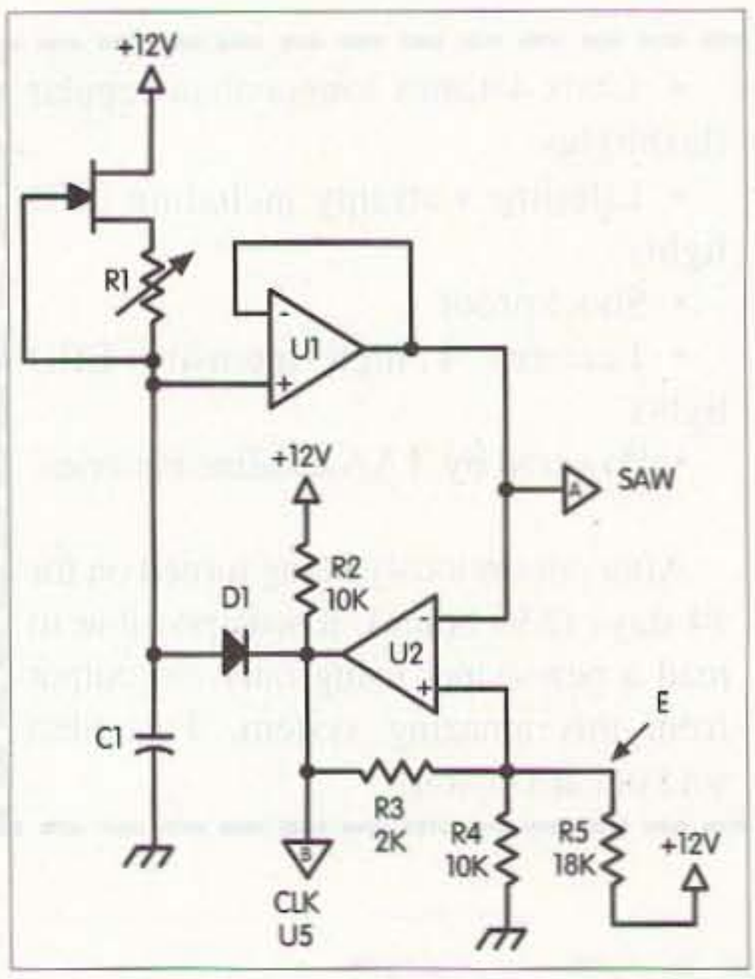

Fig. 2. PWM uses a linear sawtooth.

a high switching frequency reduces the inherent distortion in the recovered signal. A switching frequency ten times the highest audio frequency is sufficient for distortions below 40 dB. Therefore a 20 kHz audio signal requires a switching frequency of 200 kHz or greater. 3 kHz communications audio only requires a switching frequency of 30 kHz.

The efficiency of the switch is ultimately determined by the internal resistance of the switch transistor(s) and the load resistance. When R_S is the switch resistance, the efficiency η is:

$\eta = P_L/(P_L+P_s) = R_L/(R_L+R_S)$

where R_l is the resistance of the load and R_S is the saturation resistance of the transistor(s). For high efficiencies, R_S must be low compared to the load. The internal resistance of a MOSFET is R_{DSon} and the internal resistance of a BJT can be calculated from V_{CESAT} and the collector current I_C, $R_S = V_{CESAT}/I_C$.

An internal resistance of even 0.1 Ω and a 4 Ω load has the potential of achieving an efficiency of about 95%. Recent MOSFET introductions have R_{DSon} of a few milliohms. Since the power dissipated in the transistor is only I^2_{RDSon}, heat sinking of the transistors is seldom needed.

The BJT has a lower collector/emitter saturated voltage and dissipation than the R_{DS} and dissipation of a MOSFET. But this advantage is usually overridden by higher base drive current and delays when turning off the saturated BJT. It's not a simple trade-off.

A price is extracted for using a high switching frequency: The gate drive current for the MOSFET switch becomes a serious consideration for any fast or high frequency application.

Even though the MOSFET is a voltage-controlled device it takes time to charge the input capacitance and affect a switch. The rate of change of voltage with respect to time across the a capacitance may be expressed as:

$dV/dt = I/C$

where I is the charging current in amps and C is the capacity being charged in Farads, t is in seconds. The effective input C of a FET is not obvious.

The input capacity of an FET is more than just the static gate/source capacity, C_{gs}, plus the gate/drain capacitance, C_{gd}. The input capacitance is increased by that old bug-a-boo: "Miller effect." Miller effect is the phenomenon by which the feedback path between input and output provided by the interelectrode capacitance C_{gd} increases the apparent input capacitance.

The input capacitance of an amplifier can be expressed as:

$C_{in} = C_{gs}+C_{gd}(1+ACos\phi)$

where ϕ is the phase angle of the drain load. When the drain load is a resistor, ϕ is 0° and $Cos\phi = 1$. Therefore, when the load is resistive, $C_{in} = C_{gs}+C_{gd}(1+A)$.

Another uncertainty of the input capacitance of a transistor is the variable nature of C_{gd}. C_{gd} of a transistor is not a constant value like a tube's plate-to-grid capacity. The grid/plate capacitance of a tube depends on the physical construction of the tube which is constant, while the gate/drain capacitance of a transistor is dependent on the voltage across the gate/drain junction. As the reverse junction voltage increases, the static junction capacitance decreases. This change in capacitance with voltage is referred to as the varactor effect or the parametric capacitance. The parametric capacitance introduces a complication in determining the capacitance to be charged.

Most power MOSFET manufacturers specify a "total gate charge," Q_T, needed to raise the gate voltage sufficiently to just saturate the drain for the particular drain voltage and rated drain current:

$Q_T = i_g t$

Where i_g is the gate input current in amperes and t is time in seconds needed to charge the gate capacitance. 25 mA into a Q_T of 10 nC (nano-Coulombs)

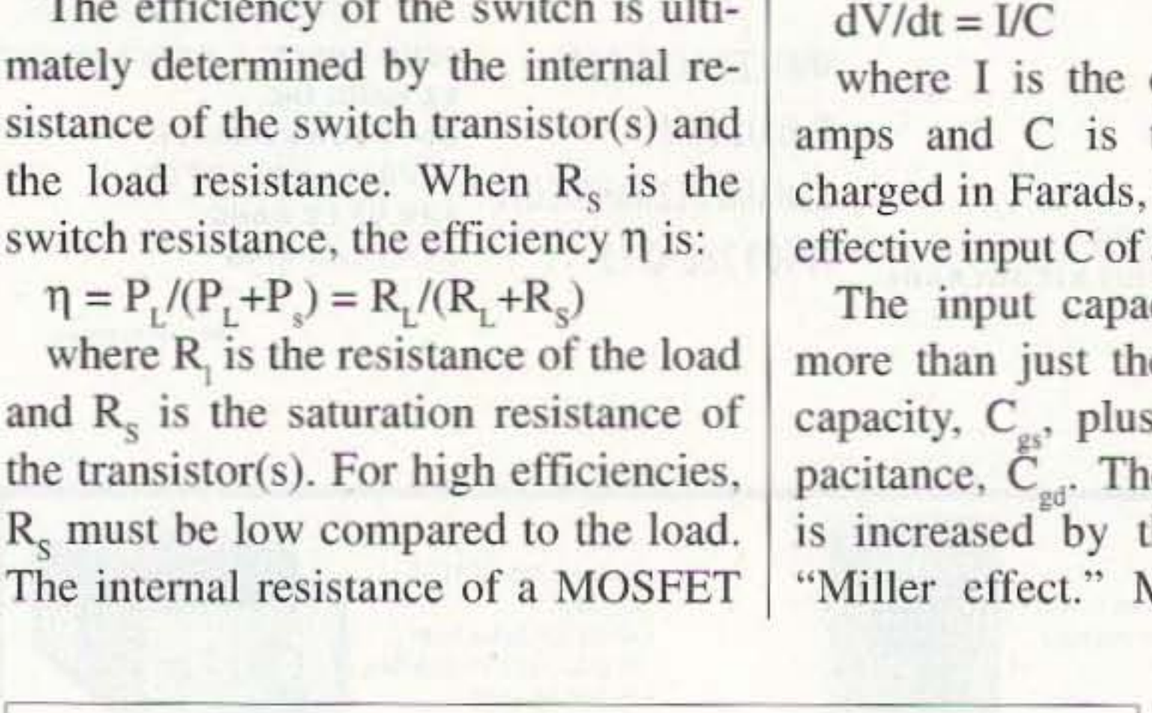

Fig. 3. The variable pulsewidth is obtained by comparing the sawtooth with the audio.

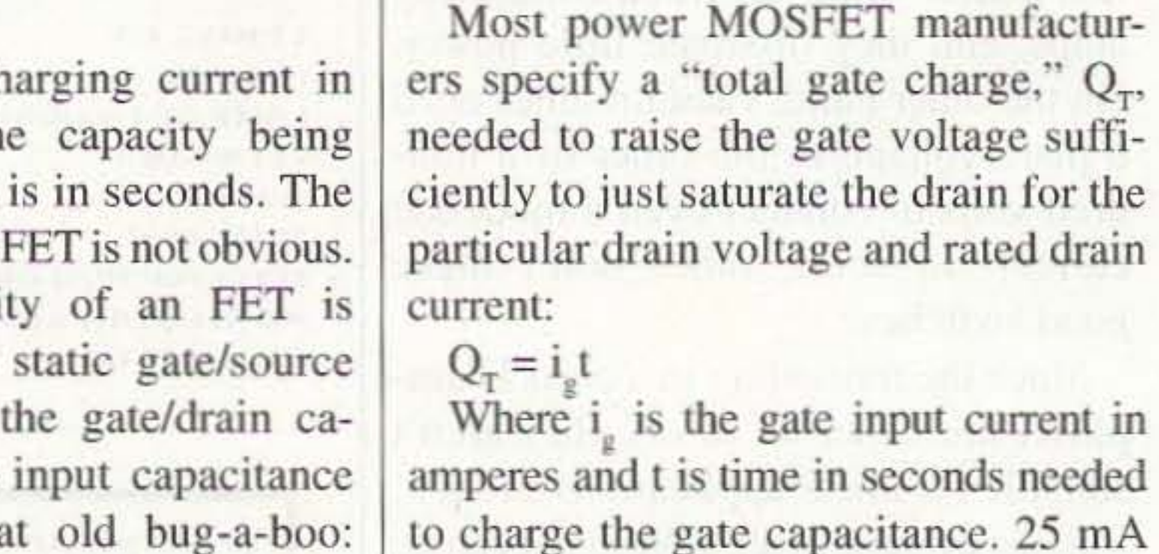

Fig. 4. The drive to high voltage MOSFETs is capacitively coupled.

will change the gate 2.5 V in 1 µsec. The gate drive current is a spike of current that exponentially trails off to zero as the input capacitance becomes charged.

Since the total gate charge is that charge which is required to just switch the device, prudence indicates that overcharge capability be provided. A safety factor in the charging current of two to one is not unreasonable. The compliance of the gate drive current must also be greater than the gate voltage required to saturate the drain current. Most power MOSFETs require a gate voltage in the range of 5 to 10 V to saturate the drain current, but some devices switch with voltages as low as 2.5 V. The charging current then must come from a voltage of 2.5 V to maybe 10 V.

The time needed to charge the gate capacity is important because during the rise and fall of gate voltage, the drain voltage and current are nonzero and power is dissipated in the drain. As a result, the gate drive current influences the efficiency for a particular frequency. A rise/fall time that is 10% of the total period increases the dissipation by a tolerable amount. For example, a 10% rise and fall time decreases an efficiency of 95% to about 94%.

The configuration of the power switch is usually a full-H as shown in **Fig. 1(a)**. When transistors QA and QD are on, current flows in the load in one direction. When QB and QC are on, load current flows in the other direction. For the sake of argument, let's say current flows in QA and QD represent the positive half of the output cycle and QC and QB represent the negative half cycle.

A full-H has the advantage of producing a peak-to-peak output voltage that is nearly twice the single supply voltage. However, a full-H requires complementary MOSFETs and complimentary gate drives. A negative pulse on QA's gate and a positive pulse on QD's gate allows current to flow in one direction in the load. Load current reverses when QB and QC conduct.

A full-H with a 12 V supply has a peak-to-peak load voltage of almost 24 V_{pp}, and the maximum power output to a 4 Ω load will be about $V_{rms}^2/4$ or 18 W_{rms}. A half-H shown in **Fig. 1(b)** requires balanced positive and negative supplies and produces an output of $(V_+ + V_-)2/2R_{load}$.

When the transistors have an R_{DSon} of 0.1 Ω, transistor dissipation ($I_{rms}^2 R_{DSon}$) will be about 0.15 W. Obviously, heat sinking is not a major consideration.

If the P-channel transistors QA and QB in **Fig. 1(a)** need a drive of 5 V, they are turned on by a gate voltage of +5 V and off by 0 V. The voltage across the load essentially swings from the positive rail to ground in one direction for a positive input and in the other direction for the negative input.

While the power in the load may be high, transistor dissipation is low. For example, the current in the load and transistor is approximately E_{supply}/R_{load}. If R_{DSon} is specified as 0.1 ohm and the load is 4 ohms, the total resistance in series with the load is 0.2 ohms and 95% of the supply voltage appears across the load. If the load were 16 ohms the efficiency would be over 98% with zero transition time. If the transition time is 10%, the dissipation will increase and efficiency will drop about 1%. Heat sinking is still not much of a factor.

The PWM generator is the critical part of the class D amplifier. PWM controllers intended for power supplies or motor controllers are available from several companies and a few are intended for audio applications. But they all have the same basic internals, though they may be implemented differently.

Fig. 2 shows a generic method of generating linear PWM with discrete components: A constant current charging C1 produces a linear ramp of voltage. U1 is a unity gain buffer that isolates C1 from any loading presented by the following circuits. When the voltage across C1 equals the reference voltage on comparator U2, U2's output goes to near zero and discharges C1 through D1. When U2's input is less than the reference, U2's output goes to +12 V and allows C1 to charge and the cycle repeats. The positive transition of U2's output sets the flip-flops U5A and U5B in **Fig. 3**.

The sawtooth is compared with the audio in comparators U3 and U4,

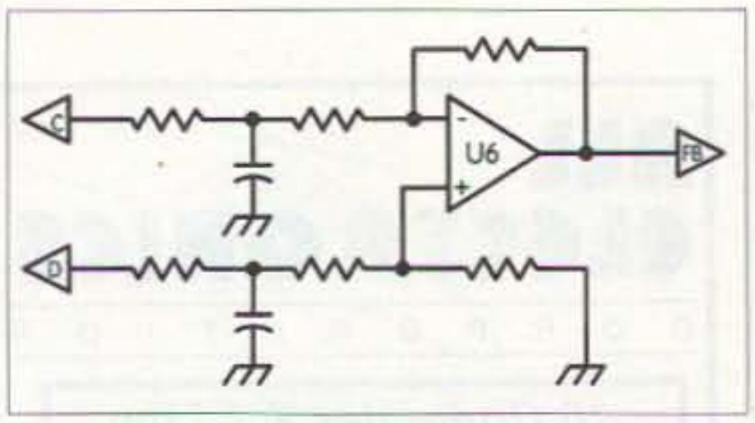

Fig. 5. A differential amplifier converts the floating output to single-ended.

shown in **Fig. 3**, to produce a pulse whose width is proportional to the audio amplitude. U7 provides the gain needed to raise the audio input to about 6 volts peak for use by U3 and U4. U7 also sums the input with the output fed back from U6 for comparison with the input.

The constant current charging C1 is produced by the JFET Q1. R1 in the source of Q1 controls the charging current and consequently the rate of rise of the voltage across C1. The hysteresis of comparator U2 controls the amplitude of the sawtooth. After the amplitude is established by U2, R1 can be adjusted to produce the required frequency. The hysteresis in U2 controls the amplitude of the sawtooth; the current in Q1 controls the rate of rise of the voltage across C1.

For the values shown in **Fig. 3**, the noninverting input of U2 swings from a low, E_{lo}, of about +1 V to a high, E_{hi}, of about +7 V. A swing of about 6 volts. Therefore, the output of U2 switches at inverting inputs of +1 V and +7 V. When the ramp of voltage applied to the inverting input rises to the voltage on the noninverting input, +7 V, the output of U2 goes to zero, and C1 is discharged to near zero through D1. When the voltage on C1 falls to 1 V, the output of U2 switches to +12 V, D1 becomes reverse-biased, and the voltage on C1 rises from about +1 V to about +7 V and the cycle repeats. The positive rise of the output of U2 also resets the flip-flops U5A and U5B.

The hysteresis of U2 and the ramp amplitude can be changed by choosing different values for R2, R3, and R4 and the voltage E at the inverting input can be calculated. When the output of U2 is low, essentially zero, the noninverting input is:

$$E_{lo} = 12x(R3^{-1}+R4^{-1})^{-1}/(R4^{-1}+R3^{-1})^{-1}+R5.$$

When the output of U2 is high, the noninverting input is:

$$E_{hi} = 12x[R5^{-1}+(R2+R3)^{-1})]^{-1}/ \{R4+[R5^{-1}+(R2+R3)^{-1}]^{-1}\}.$$

The comparators U3 and U4 compare the voltage ramp to the audio. When the offset audio exceeds the ramp voltage, the comparator switches and produces a pulse whose width is proportional to the audio amplitude. The audio is capacitively coupled to U3 and U4 to remove any DC that may exist on the audio.

The audio input to U3 is offset to +1 V and the positive half of the audio raises the input to U3 above 1 V, and the output switches to +12 V. The audio input to U4 is offset to +7 V and when the negative half of the audio input makes the input less than the sawtooth, U4's output switches.

The positive transition of U3 and U4 triggers U5. The outputs of U5B drive the QB and QC sections of the switch, and the outputs of U5A drive the QA and QD sections of the switch. The flip-flops are reset by the positive transition of U2 when the sawtooth starts its rise. The outputs of U5 drive the switches.

When U5 is a CD4013, the output current is limited so that some current gain must be provided to drive MOSFETs with high Q_T. A 2N3906 PNP emitter follower can be used to drive the P-channel MOSFET and a 2N3905 NPN can be used to drive the N-channel MOSFET. These transistors have h_{fe} of about 60 at 1mA of base current and can supply significant peak currents to drive rather large MOSFETs.

The voltage across the load essentially floats; one side is grounded for positive signals while the other side is grounded for negative signals. This balanced signal is converted to single ended in U6 for feedback to the input of U7 as shown in **Fig. 5**. U6 can also scale the voltage to a range suitable for U7.

The voltage across the load is a series of pulses that must be filtered to remove the switching components before it can be compared to the audio input. The filter is not terribly critical but it can introduce phase shifts in the recovered audio that can lead to instability when fedback. The amplifier will oscillate if the overall phase shift approaches 180° before the gain has fallen to less than one. Therefore, the low-pass filter should cut-off below the switching frequency but well above the highest audio frequency. Ideally, the phase shift should be no more than about 150° at the highest audio frequency.

Kilowatt amplifiers require power supplies in the range of a couple of hundred volts and several amps. The drive required is still only ten volts or so, and the peak gate current will seldom need to be greater than 100 mA. A drive current of 70 mA can switch a MOSFET with a total gate charge of 70 nC in 1 µs.

Shifting the drive to the 200 volt gate voltage of the P-channel MOSFET requires capacitive coupling. **Fig. 4** shows how this can be accomplished. The diodes clamp the gate drive to the high voltage. The coupling capacitors should be large compared to the gate input capacity. But remember, it is the switching frequency being coupled, not the audio frequencies. 0.1 µF capacitors with appropriate voltage ratings should do the job.

Class D amplifier ICs are available that perform the PWM and drive speaker resistances. The Linfinity Microelectronics' LX1720 is a stereo unit that produces 20 W per channel. The data sheet says THD + noise is less than 1% over the 20 Hz to 20 kHz frequency range. Linfinity has a monophonic unit, the LX1710, with power capability of 50 watts that should be available by the summer of 2000. TI also has a monophonic class D IC amplifier, the TPA032D01, that has an output of about 10 W. The IC was designed to drive MOSFETs with Q_T of 10 nC so they have rather limited output current capabilities. For high power, high voltage applications, capacitive coupling and some current gain is in order. The emitter followers are appropriate here as well. While the

Continued on page 59

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Portable Personal Repeater

Handy, inexpensive, and fun!

I know all of us dedicated hams just love to stay in contact wherever we go. A true ham never even thinks about going anywhere without his/her HT (handie-talkie). Here in the Bay Area, there are so many repeaters that you can always find a group that fits your fancy. Not only is it fun, but an HT is a jewel when an emergency occurs. They come in very handy on camping trips, snow trips, or in the mountains.

If you're lucky, there will be a repeater always within range. In most big vacation resorts, that may be the case. But if you go deep into the woods in the middle of nowhere, then you may not be within range of a repeater. What's the solution? There are many, but my solution had to be portable, lightweight, low-cost, and easy to build, with good performance. How about a fully self-contained portable crossband repeater for almost no cost? Sound impossible? Read on.

How are all these requirements met? First of all, most full-blown repeaters cost in the range of several thousand dollars. They involve a high-quality receiver, transmitter, controller, and an expensive duplexer. A duplexer is basically a very high-Q resonant cavity which isolates the transmitter from the receiver. This is necessary since the difference in transmit and receive frequencies for repeaters is only 600 kHz on VHF.

In addition, a VHF duplexer is bulky and heavy. A UHF repeater would be slightly smaller, but still impractical both in terms of cost and size. My main objective was to keep in touch with other repeaters when I visited remote sites which were not HT-accessible. Thus I needed it to be synthesized so that I could change frequencies on the fly without retuning a duplexer. The answer was a fully self-contained crossband repeater. I had to be creative, since with a family of four, I could not justify to the YL that I should spend a $1,000 on a box I would just use twice a year.

So what exactly is a crossband repeater? It is exactly that: A crossband repeater repeats not on the same band as in a conventional repeater, but on another band. In this case, VHF to UHF and vice versa. This is great, because it eliminates the need for an expensive duplexer since the two frequencies are so far apart that standard LC components in the radio are more than adequate for isolation. Most

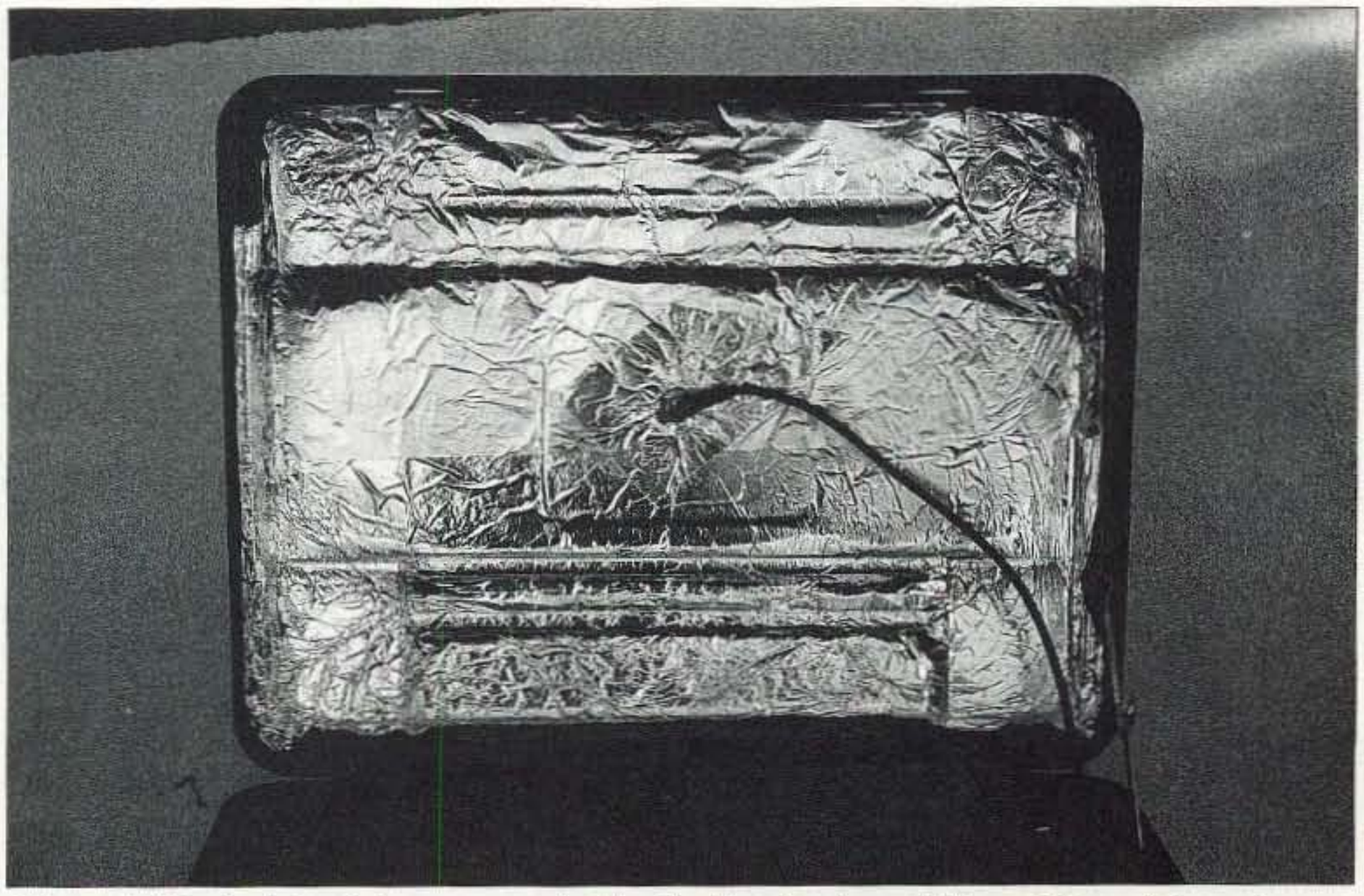

Photo A. *The inside of the repeater is lined with aluminum foil, and Scotch brand spray adhesive is used to secure the foil. The foil serves as the ground for the repeater antenna.*

Photo B. *The crossband repeater is shown with the battery, the Alinco 580 which is used as the repeater, the two Yaesu FT-470s which are the remote radios, a power supply used for charging the battery, and a solar panel.*

dual-band HTs have this feature. Simply read the manual for your respective radio to see how it is activated. If I want to access a VHF repeater, I must use UHF on my HT and vice versa.

The first challenge was to find a cheap container to house the repeater. It had to be rugged, lightweight, and low-cost. After all, I wasn't going to spend an arm and a leg for something I would use once or twice a year. The solution: an old camcorder case. Remember how big those camcorders were just 10 years ago? These are available at surplus stores, flea markets, maybe even in your attic. Well, the camera may be obsolete, but the case is still useful. You can refoam the inside or just use the old stuff.

How about the radio? Well, I just used my Alinco 580. It doesn't have to be permanently installed — only when I need to use it as a repeater. I have several HTs, so using one as a repeater was no problem. Besides, an Alinco 580 can be bought used for under $200. I have seen these go for under $150 at flea markets.

What about a good long-life battery? I ended up buying a brand-new 6 volt 10 amp-hours gel-cell for $15. To attach the gel-cell to the HT, I suggest purchasing the AA dry battery pack and bringing the power lines out. That adds an extra $15 if you don't already have one of these adapters. This way, everything just snaps right in place when you need to use the repeater.

Personally, I don't trust used gel-cells, so if you are serious about building a good repeater, buy a new one. I have found that many of the gel-cells sold at flea markers are batteries which are taken out of service from alarm systems after a few years of operation. Seldom do they have full capacity. It's well worth the $15 for a new battery, unless you absolutely know you have a good one to begin with.

With a 10 amp-hr battery, the Alinco 580 will transmit continuously for 12.5 hours. (I wouldn't recommend this, though, since the radio will probably burn up with continuous transmit.) The receive current is only a measly 20 mA average. Yes, only 20 mA. With a 10 amp-hr gel-cell, the receiver can operate continuously for 500 hours. That's 20 days on standby receive. With a 10% transmit cycle, or about 2.4 hours per day, you get about four days of continuous operation. Just right for a good weekend of fun.

In the same camcorder case, I even managed to fit a small solar panel that can supply about 100 mA in good sunlight. But a caution on this. Yes, it will make the battery last a little longer, but you would need at least four of these panels shown in the picture to maintain the battery indefinitely. Even then, on overcast days, it may have problems. The only exception is if the repeater is used sparingly.

What about a cheap high-performance antenna? Well, good performance, rugged, dual-band antennas are not cheap. But think again. How about using a mobile antenna? Most of us already have mobile antennas. I had a Larsen 2/70 dual-band with 3 dB on VHF and

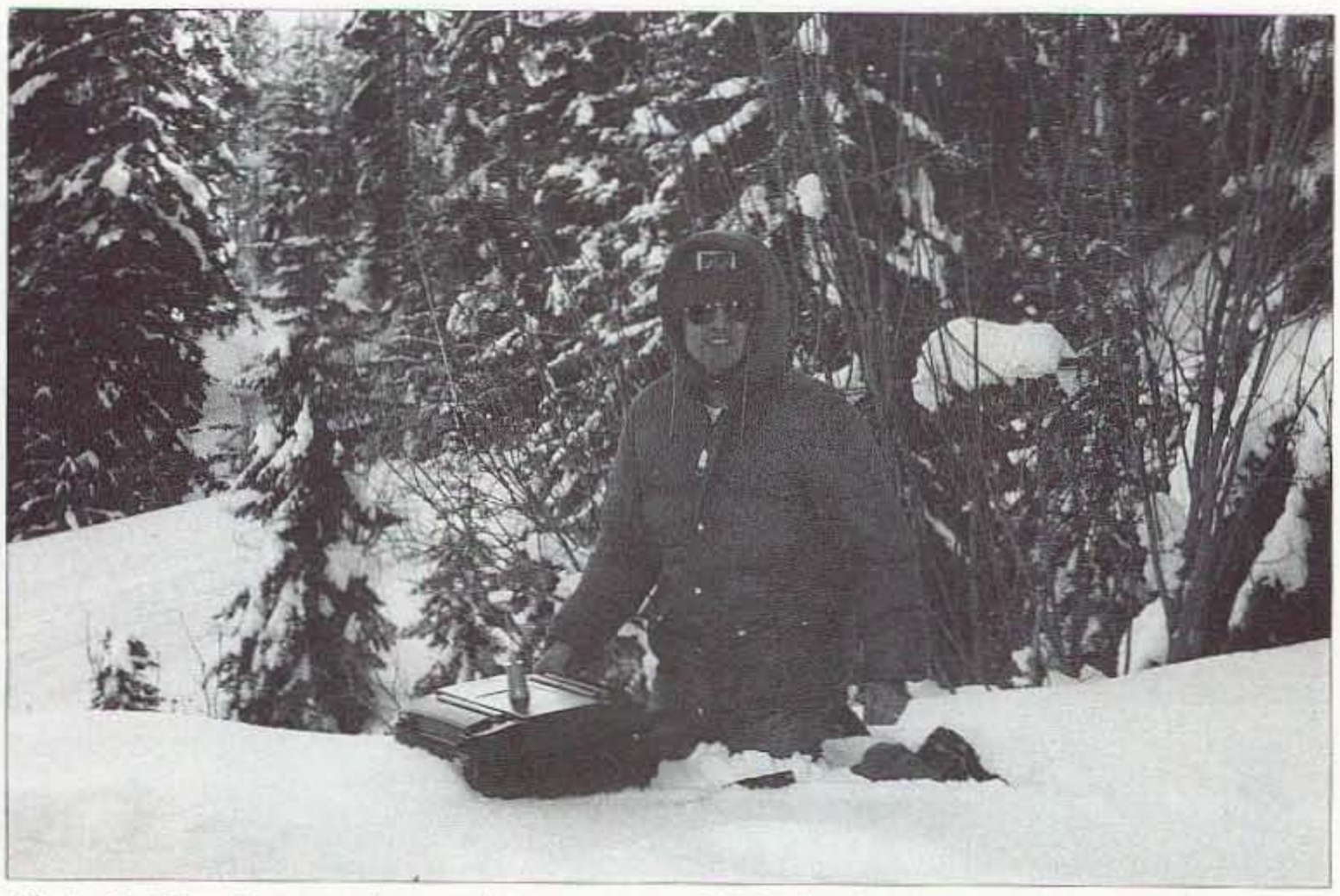

Photo C. *Here I am setting up the repeater at 5,000 ft. Place it next to a good landmark since an overnight snow storm will easily cover up the radio.*

Continued on page 59

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Inside Digital TV/VCR Tuners

Part 6: Making your own PC boards.

This is the next-to-last part in the series in the discussion of digital tuners. In this part, a simple and reliable method will be described to allow the making of printed circuit boards. Of course, some of you may already be well in front of us, having used the board layouts as provided in parts two and three of the series and gone ahead to make your own. But it is never too late for a refresher course in PCB making — or a new look at it for beginners.

Both the top and bottom sides of the data transmitter and receiver boards used in the project are shown again in **Figs. 1** and **2**. **Figs. 3** and **4** are provided to show the location of jumper and "Z"-wires used on the respective boards.

Over the years, many techniques and methods have been developed for making boards. Most of those methods are just out of reach of the ham experimenter. In answer to a ham's need, I'll present a process that produces boards that are very effective, reliable, and repeatable. Although the process is time consuming and perhaps archaic in some respects, it is still within the reach of most experimenters. The process produces one board at a time, but generally, that's all a ham needs to build a project. Duplicate boards can be made by repeating the process as many times as is needed. Both single and double-sided boards can be made using the process.

In the process, white bond paper (18–20 lb.) is used as a circuit transfer medium and paper mask. Fingernail polish is used as an etch resist. Once the fingernail polish has dried, the paper mask is removed and the board is then etched, drilled, and stuffed with parts. A summary of the procedure is shown in one sidebar, while another provides a listing of tools and material used in the process. **Photo A** shows a picture of the major items.

Preparing the mask

Bond paper used for photocopying is my choice of mask paper because it is the easiest with which to work in this process. The first step in the process is to make a 1:1 copy of the desired

Procedure Summary

1. Prepare a 1:1 ratio copy of the circuit trace/pattern.
2. Clean the copper on the board.
3. Coat both the paper mask and the copper with rubber cement.
4. Align the paper with the board, press down, and rub from the center to the edges.
5. Indent the hole locations for drilling using a scribe.
6. Cut along the trace lines with a knife held at a very shallow angle.
7. Remove the paper in the area of the trace. Repeat steps 6 and 7 until all of the copper trace is exposed.
8. Inspect the exposed copper.
9. Paint the copper with fingernail polish or lacquer. Attempt to keep the paint inside of the trace area.
10. Allow the paint to dry.
11. Remove the remaining paper mask.
12. Inspect and repair the trace pattern.
13. Etch the copper.
14. Remove the paint/resist.
15. Drill and clean the board.
16. (optional) Solder-coat the board.
17. Install the components.

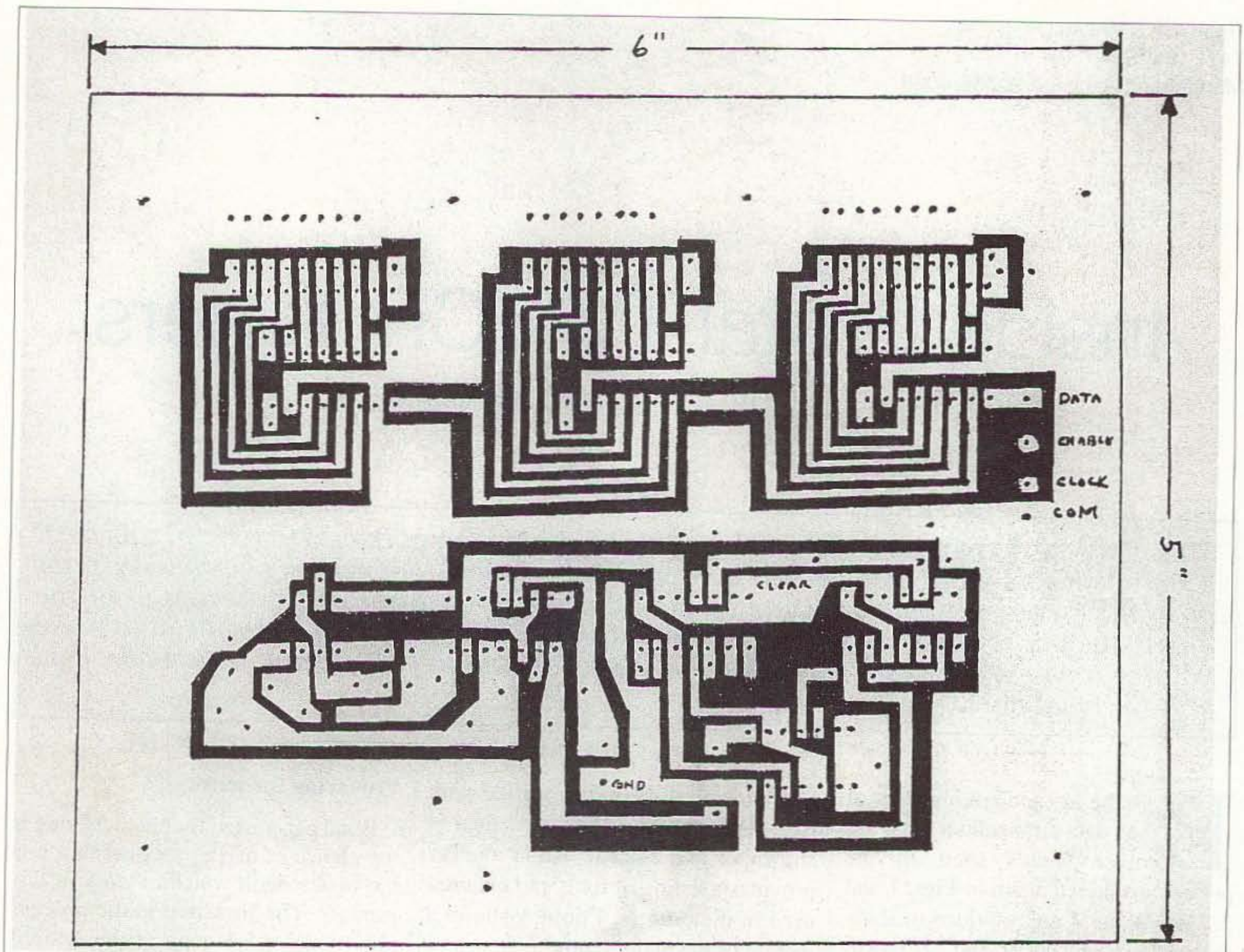

Fig. 1(a). *Bottom trace view of the Data Transmitter board. The white area represents the copper, and the black area is where the copper has been removed.*

circuit pattern, using any copying method that's available. By that I mean that a circuit can be hand drawn onto the paper using a pencil or can be copied using a copy machine. The circuit line edges must be distinguishable, but the density of the line is not important for this process to work.

If the circuit is being laid out for the first time, then a parts placement diagram should be made along with the circuit trace pattern. When making the circuit traces for the bottom side of the board, it is important to remember that all parts must be "viewed" from the bottom and through the board as if it was transparent. Forgetting that step causes the board to be made such that parts would have to be placed on the bottom of the board for proper orientation.

During the trace layout, as much copper as possible should be left on the board. Leaving the copper on the board has several advantages, but the two most important are that the etchant lasts longer when less copper is removed, and more copper on the board supports a lower circuit impedance. Perhaps another is that once copper is removed from the board, it cannot be replaced. It's better to have the copper and not need it than to need it and not have it.

If an original layout has been done, it should be photocopied so that it can be retained should a second board be desired. Following the trace layout, the component placement diagram should be verified as matching the trace pattern. When making the placement diagram, the board should be viewed

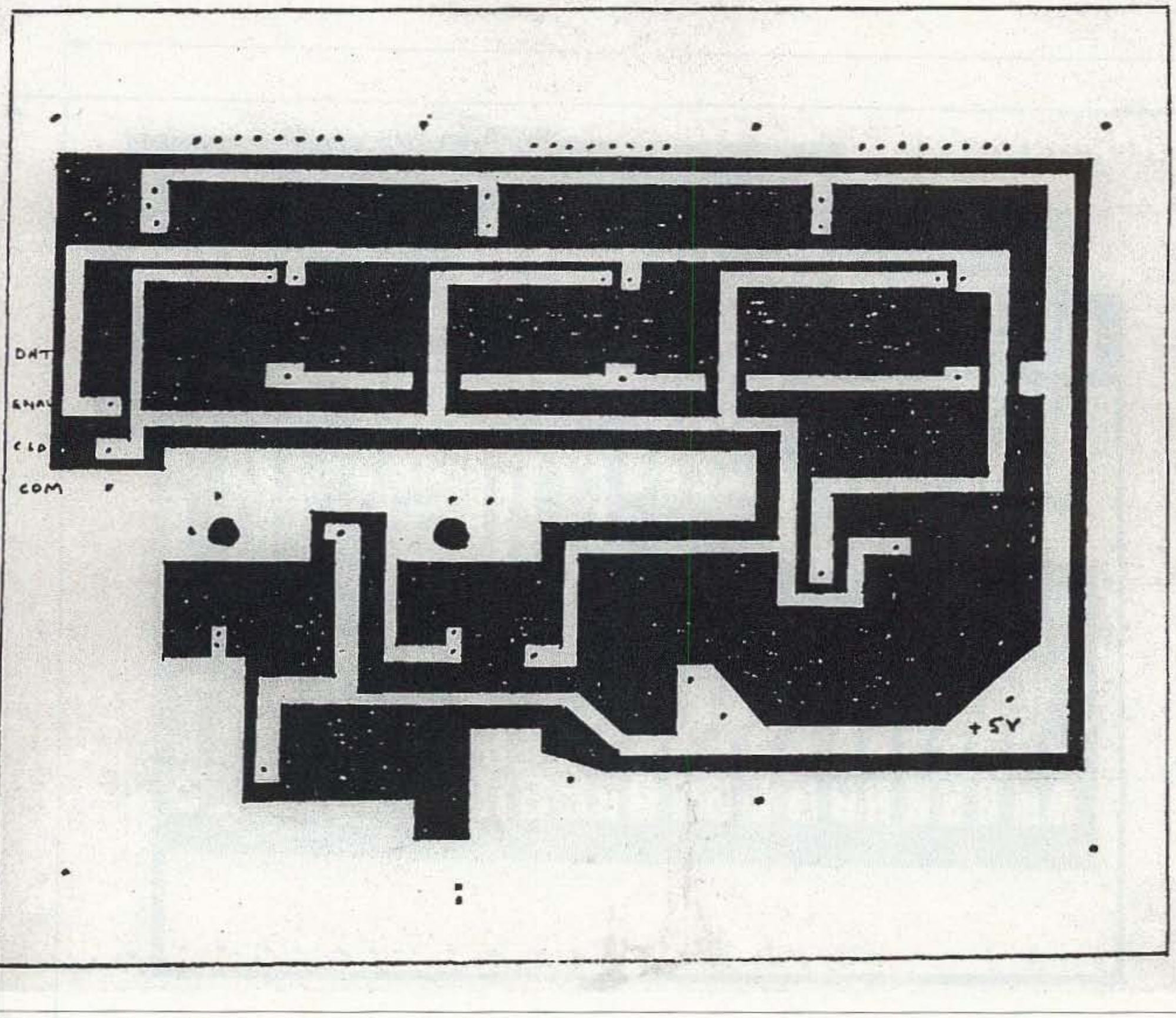

Fig. 1(b). Top trace view of the Data Transmitter board.

from the top side because that's the stuffing side. It is usually during this step that circuit errors are picked up when an original design is being done.

Preparing the board

Using the trace layout as a guide, select a board size just slightly larger than the trace pattern desired, because some misalignment usually occurs when the trace pattern is applied. Cutting the board, particularly with a saw, results in sharp, sliverlike pieces remaining along the cut edge. These slivers can cut the skin if care isn't taken when handling the board material. The board edges and burrs can be cleaned up with a file, sandpaper, or stone.

After the board is cut, clean the copper, using either a non-oil-based cleanser or fine steel wool. The objective is to remove the heavy oxides and dirt from the surface of the copper, leaving it fairly bright. Clean the board surface with alcohol, lacquer thinner, or acetone

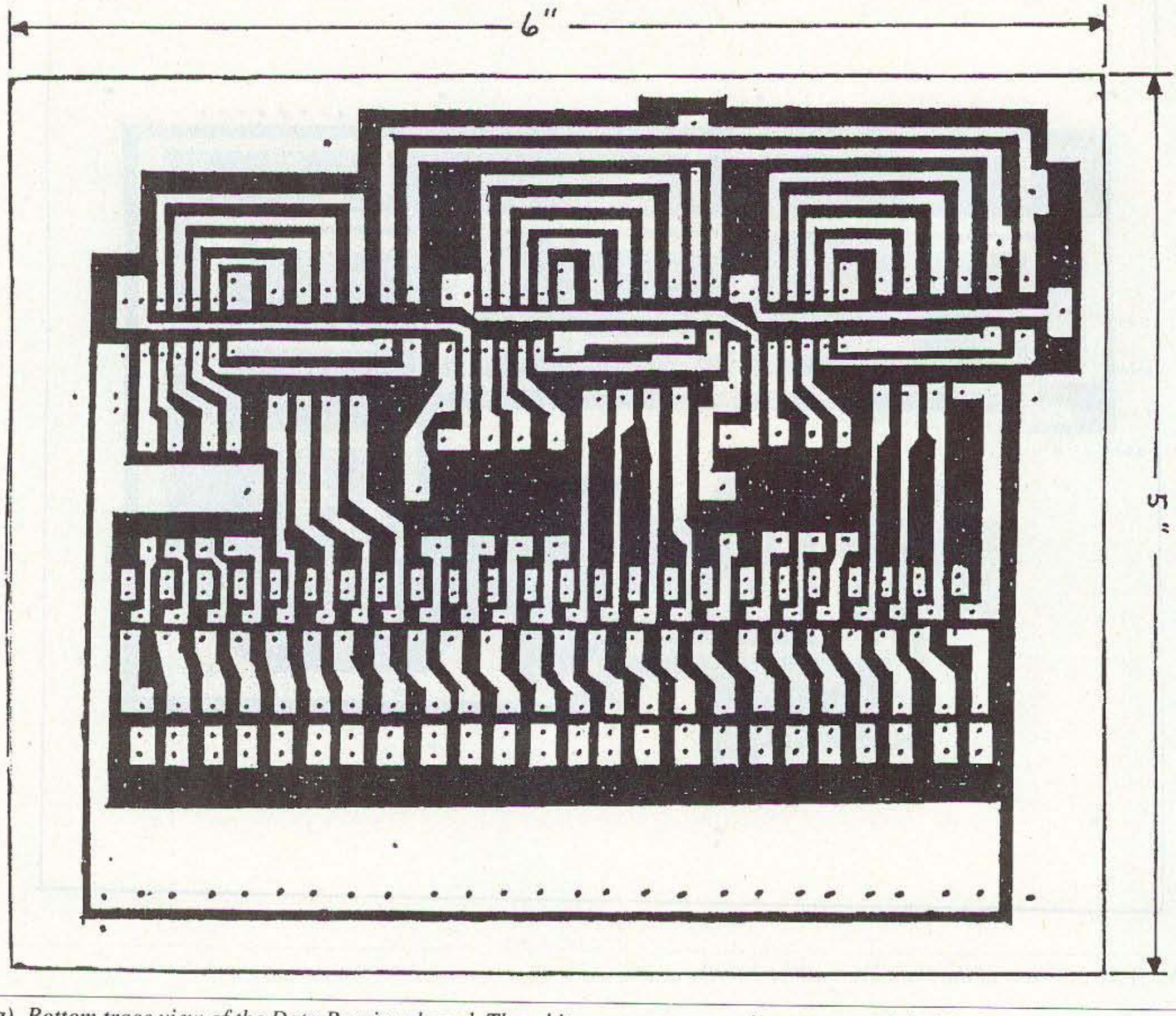

Fig. 2(a). Bottom trace view of the Data Receiver board. The white area represents the copper, and the black area is where the copper has been removed.

to remove any oil and debris that might remain. Be careful to not touch the surface with your fingers as that can deposit oil onto the copper.

Transferring the pattern

Transferring the pattern requires that the paper mask be rubber cemented to the surface of the copper and allowed to dry. Then, carefully cut out the trace pattern, using a very sharp blade.

The steps involved begin with applying rubber cement to both the copper surface and to the back side of the paper mask, leaving the trace pattern exposed. **Photo B** shows the application of cement that must cover the copper's entire surface. Before the rubber cement dries very much, align the paper mask with the board and lower the paper onto the board. **Photo C** demonstrates how the paper mask is laid down after all of the copper has been coated with cement. If wrinkles occur, the decision to remove the mask or "use it as is" must be made. If the mask can be lifted, it will be necessary to flow more rubber cement under the mask before putting it back down. If the wrinkle is not affecting any critical trace pattern or dimension, then it probably isn't going to hurt the process and can be left alone.

While maintaining the alignment of the mask, press down in the center of the paper with your fingers and rub from the center outward, removing air bubbles and lumps. Some rubber cement may be pressed out, and that's all right as the process removes excess

cement along with the air bubbles. All of the cement lumps should be removed or flattened, if any exist, leaving the paper mask flat and tight against the board.

With the mask in place, time must be allowed for the rubber cement to dry. The amount of time is dependent upon a number of factors, but waiting from 30 minutes to an hour is typical.

After the cement is dry, the spots marking where the holes are to be drilled can be lightly punched with a sharp tool. The objective here is to very lightly dimple the copper so that you can "see" where to drill the holes later on in the process. A sharpened nail, scribe, or ice pick may be used for marking the holes. Copper dimples easily so that very little effort is required. Practicing the dimpling operation on a scrap piece of board is recommended, so the amount of effort

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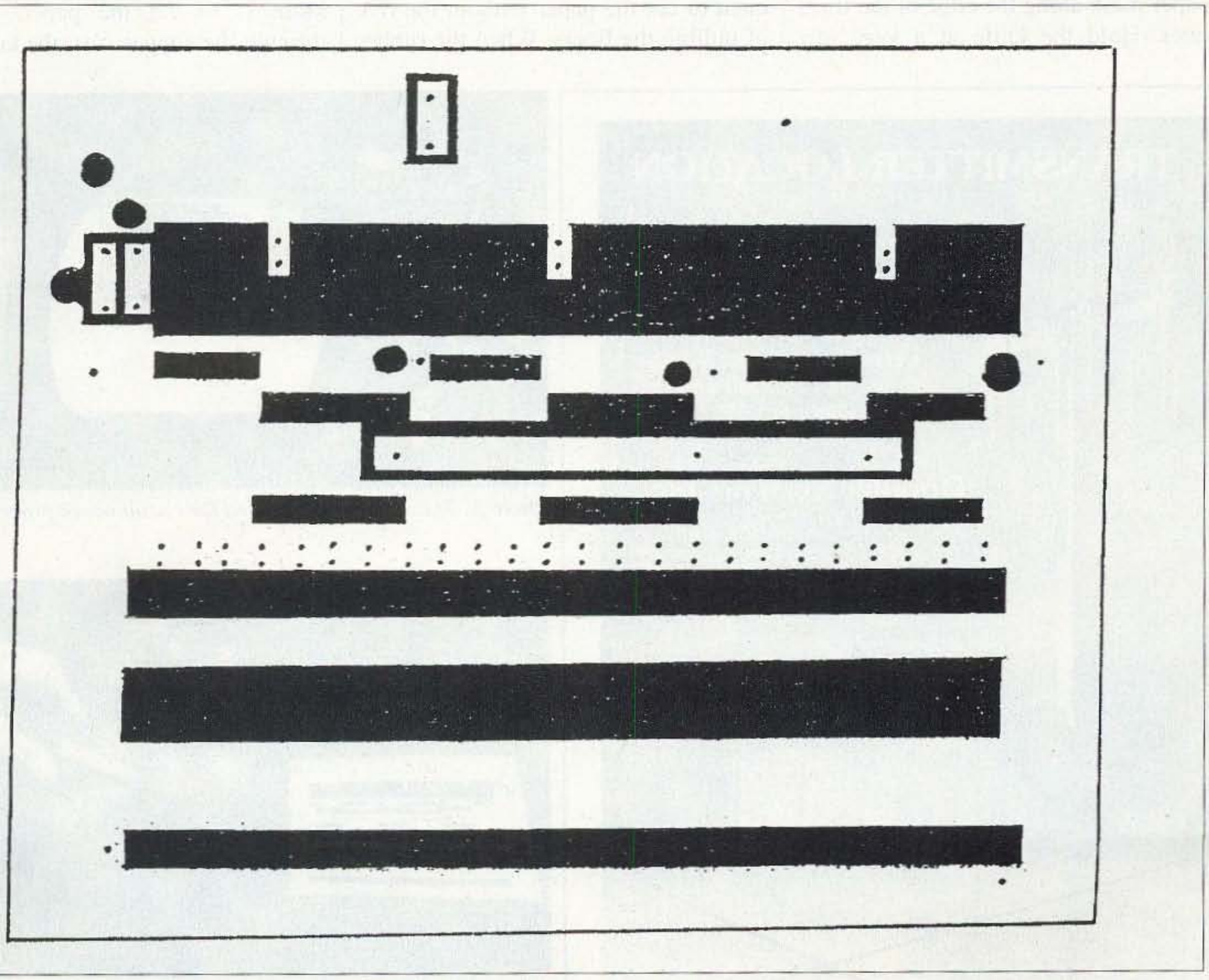

Fig. 2(b). *Top trace view of the Data Receiver board.*

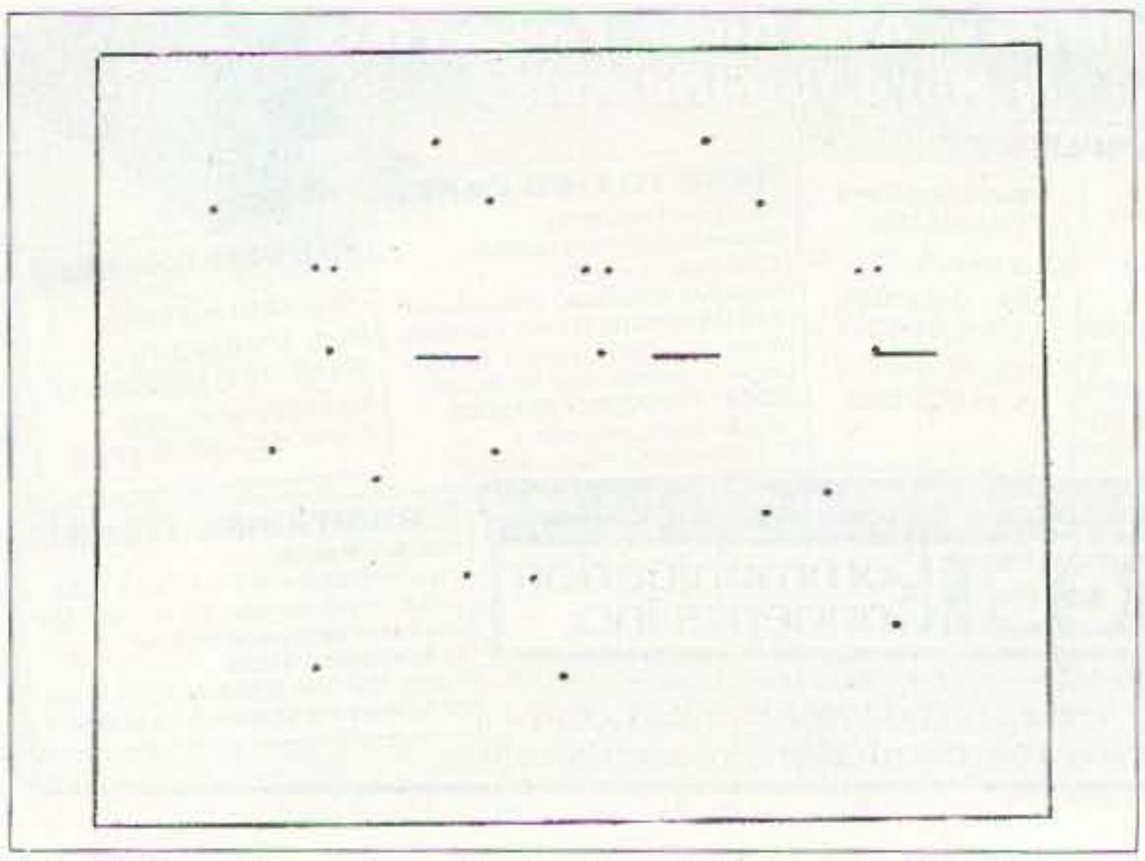

Fig. 3. Data Transmitter: Z-wire locations indicated by dots, and the lines show where wire jumpers are placed (shown at 50%).

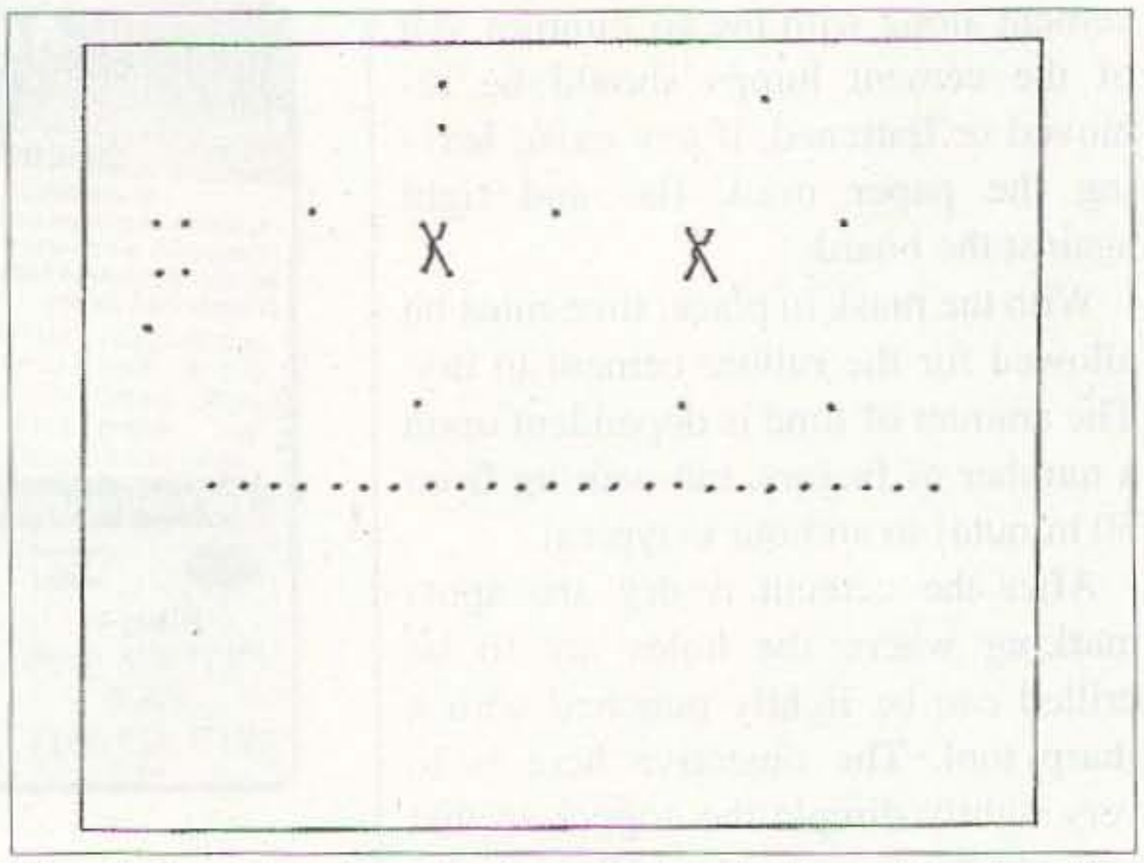

Fig. 4. Data Receiver: Z-wire locations indicated by dots. The lines show where wire jumpers are placed (shown at 50%).

and pressure can be determined before applying the dimpling operation to the circuit board. Dimpling means to "mark the copper," not "punch holes into it."

Using a sharp knife blade, cut the paper mask along the edge of the trace lines. Hold the knife at a very low angle so that the blade cuts the paper rather than pulls against the paper, bunching up the fibers as shown in **Photo D**. In tight areas, placing the blade edge on the trace line and then pressing it down hard is usually sufficient to cut the paper without the risk of pulling the fibers. When the rubber cement is firmly holding the paper, there is little risk of fiber pulling when a low blade angle is used while drawing the blade along the trace line.

During the paper cutting operation, it is important to remember that the knife is to cut the paper, not cut through the copper. Yes, the knife will

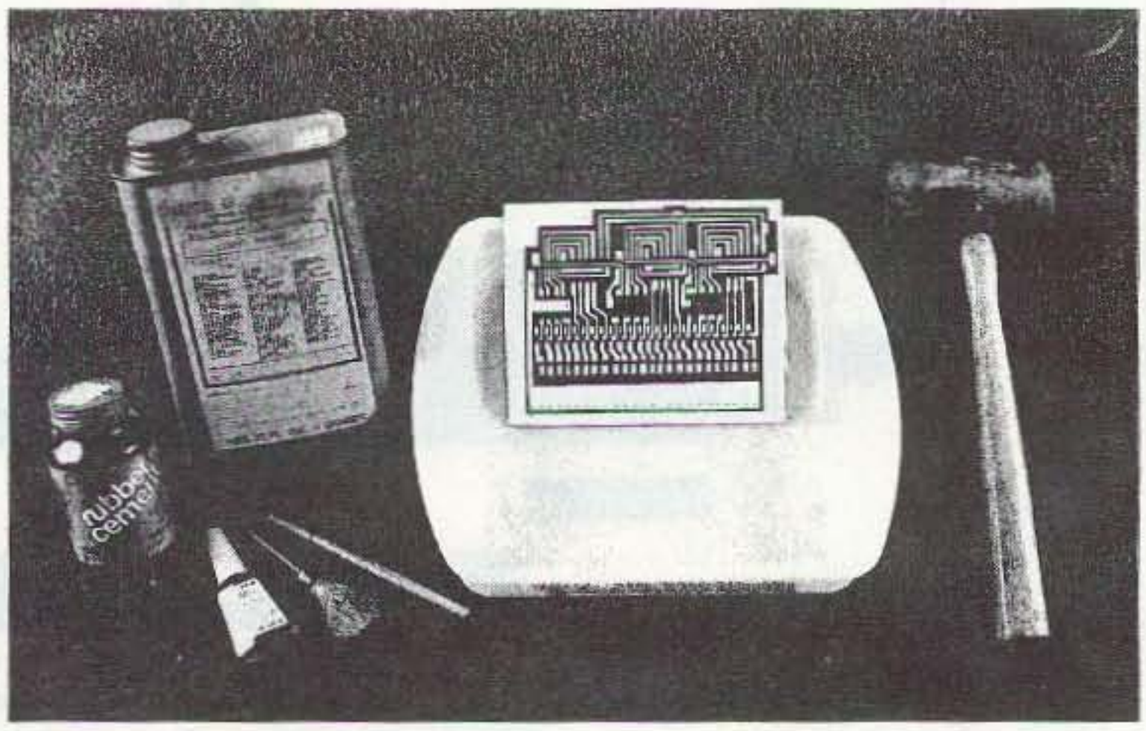

Photo A. The major items needed for circuit board processing.

Photo B. The application of rubber cement to the copper surface.

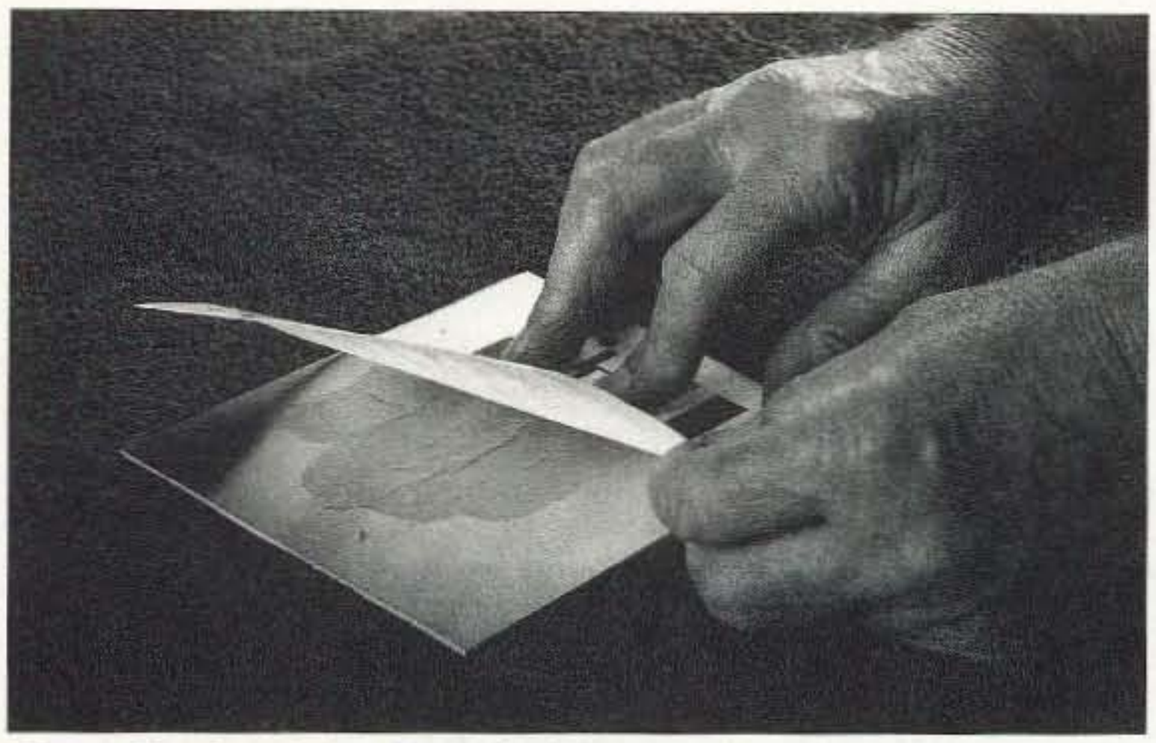

Photo C. *This shows how the paper mask is laid down onto the copper.*

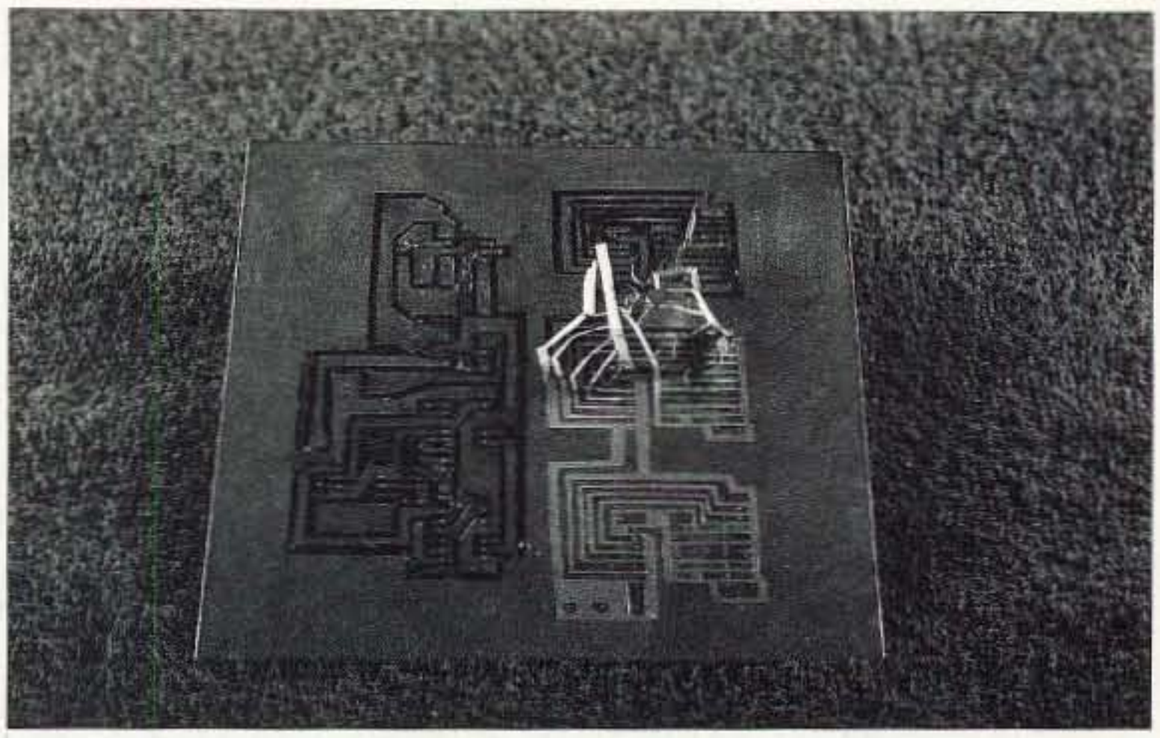

Photo F. *Fingernail polish covers all of the copper that is to be retained. The paper mask is being removed, exposing the copper to be etched away.*

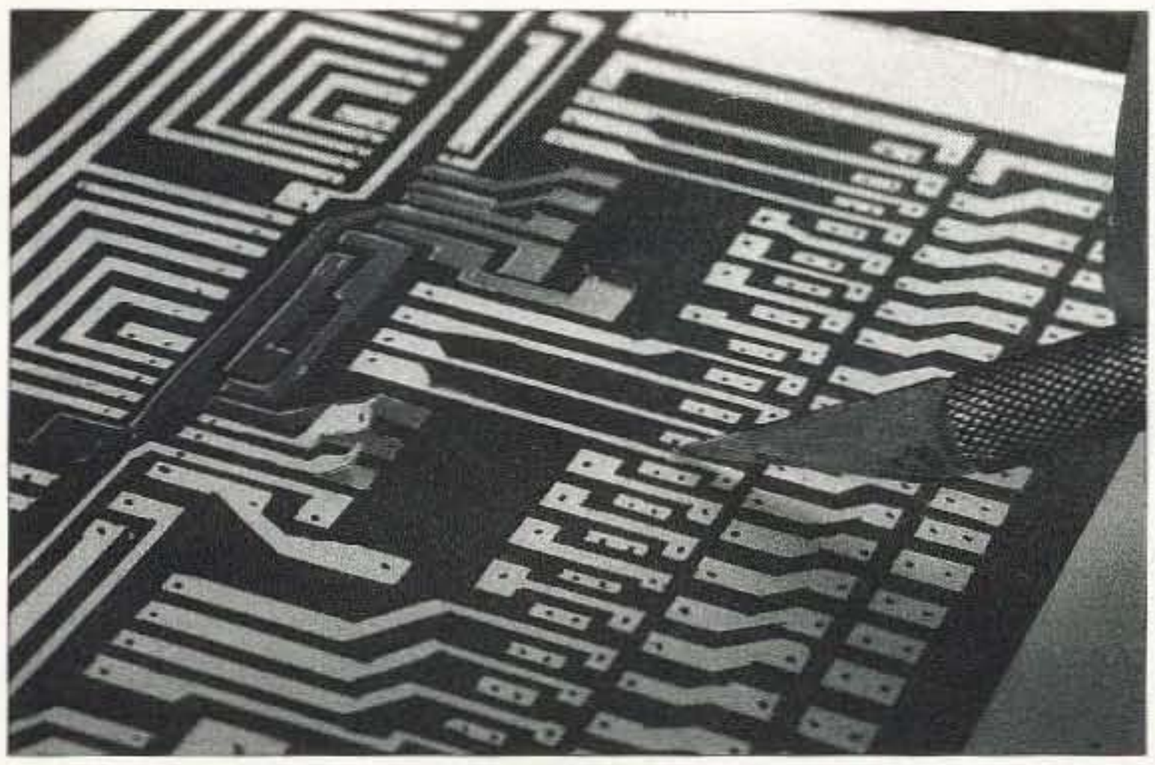

Photo D. *The circuit trace is cut with a shallow blade angle.*

Materials Needed for PC Board Processing

- Copy of the circuit trace pattern (actual size).
- Fingernail polish or lacquer paint (any color other than clear).
- X-acto knife or equivalent with a sharp blade.
- Rubber cement for paper use only.
- Printed circuit board material cut to size (single or double-sided, as required).
- Sharp scribe or pointed nail.
- Solvent (lacquer thinner, acetone, and/or alcohol).
- PC board drills #57 and #62, as needed.
- Copper etchant (ferric chloride or equivalent).

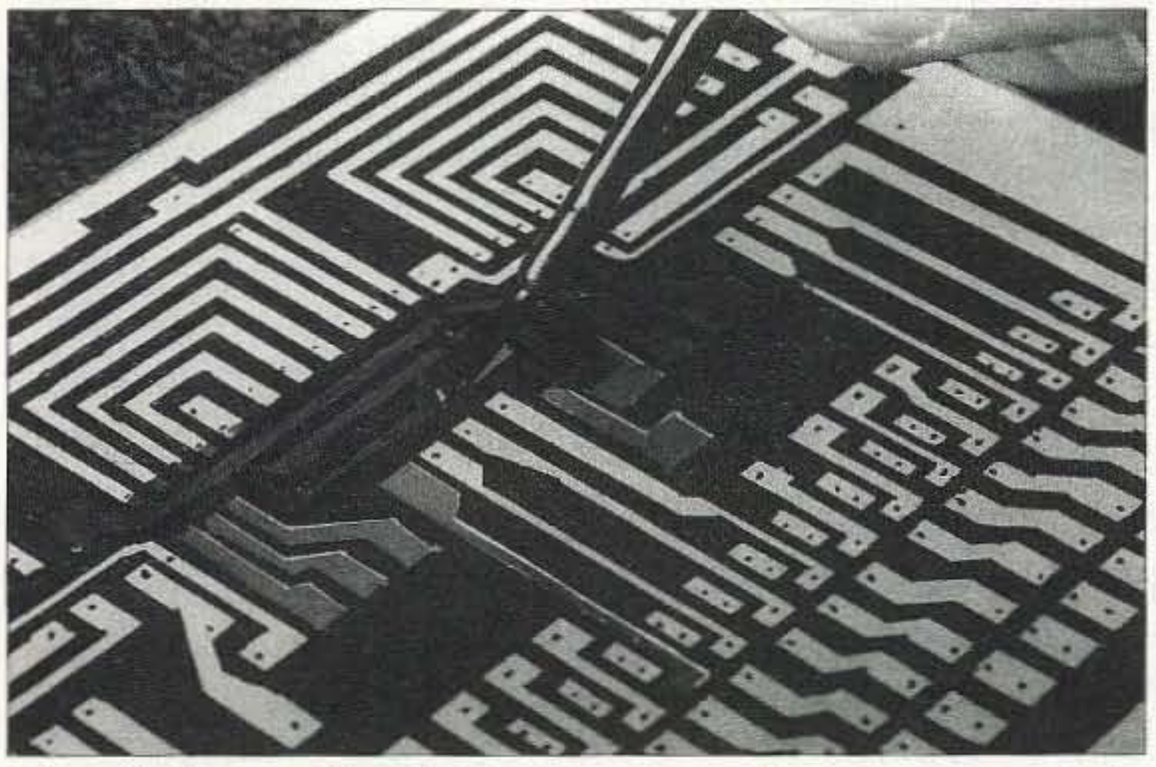

Photo E. *Fingernail polish is painted onto the copper through the paper mask.*

clearly mark the copper as it is drawn across the surface, but the intent is to cut the paper, not necessarily to cut into the copper. It takes a little practice to gain the right "feel" for the process to work smoothly.

When cutting a trace line, try to cut along the entire trace line without lifting the blade until you come back to the starting point. Lifting the blade and resuming the cutting operation may create a paper burr at the junction of the stop and start position. Should that occur, the knife blade should be pressed down against the burr to cut it completely.

After the trace has been cut completely, begin lifting out the paper piece representing the copper trace to be retained. Watch for any uncut paper fibers and sever them with the knife blade to free the paper trace as it is lifted. Inspect the exposed copper for any remaining rubber cement and remove any residual. The exposed copper is the trace pattern that is to be retained for the circuit.

Look for any cutting errors in the trace pattern, and if there are none, then brush some fingernail polish onto the exposed copper as shown in **Photo E**. Give the polish a few minutes to cure before working on adjacent trace patterns. Trace patterns away from the one just filled with polish may be

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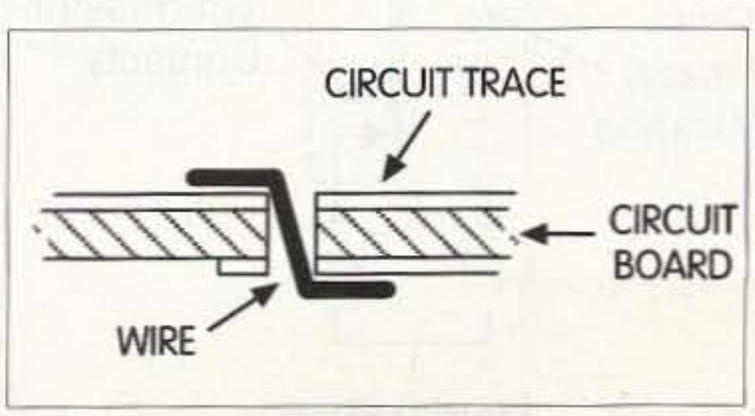

Fig. 5. *Details of using a Z-wire to connect together the top and bottom side circuit traces of the board.*

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Crystal Oven Controller

Build this solid state regulator for your oscillator oven assembly …
OK, it's not for everybody!

There are two main ways to keep the output frequency of a crystal oscillator stable; use a temperature sensor and feedback to correct the frequency, as with a TCXO, or operate the crystal in an oven set to the crystal's turning point. Of the two, the oven is the easiest for a radio amateur to implement.

Crystal ovens can be classed as one of two types according to the method used to regulate or control the temperature: thermostatic or proportional. Thermostatic ovens use a simple bi-metal–controlled set of contacts which open and close at the operating temperature, much the same as a common house furnace thermostat. Proportional ovens regulate the amount of heat generated until a balance is reached at the desired temperature.

Of the two types, proportional ovens are typically the more expensive and the more stable. However, thermostatic ovens are less expensive, and if there is significant insulation between the heater and the crystal, they can be as stable as proportional ovens. But, such well insulated ovens are typically larger than most popular ovens. The chief drawback to a thermostatic oven is the wear and tear on the thermostat contacts. This article presents my solution to the pitting and wear on the contacts of a particular crystal oven, but is applicable to most thermostatically controlled crystal ovens.

I had been looking for a good, inexpensive, precision frequency standard for doing some oddball astronomical timing and photography when I happened upon a module from a military surplus SRT-14A. What I had found was the RFO, Unit 1 (Z-2001), 100 kHz reference oscillator — see the photographs. This oscillator generates a very stable 100 kHz that it supplies to the various synthesizer modules. The oscillator module is compact as far as hollow-state boat anchor units go and uses a 5654 (6AK5) oscillator and two 5814 (12AU7) cathode follower output tubes. The output frequency is stable to better than one part per million over weeks and the aging of the crystal is very low if for no other reason than its age. Changes in crystal frequency attributable to aging decrease with the operational age of the crystal.

Originally, the module was operated from a regulated 250 VDC supply, but I found that it would work at voltages as low as 30 VDC. I opted to run mine from a regulated 150 VDC supply. The most prominent component, the oven, is a model TC922 made by Bliley Electric Company, measuring about 4.5 inches tall by 3.75 inches in diameter. It has a seven-pin base connector

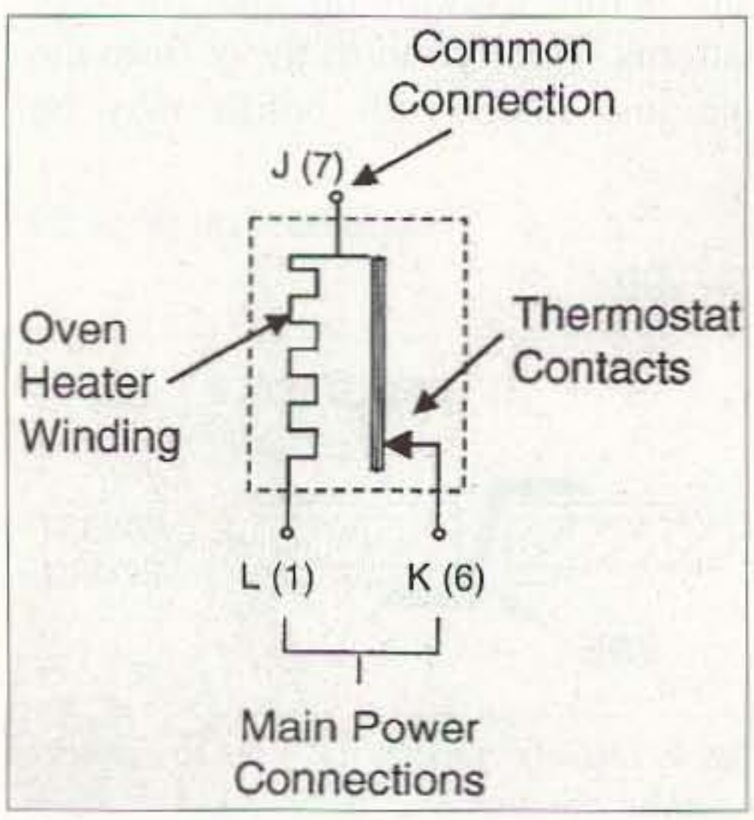

Fig. 1(a). Typical oven wiring.

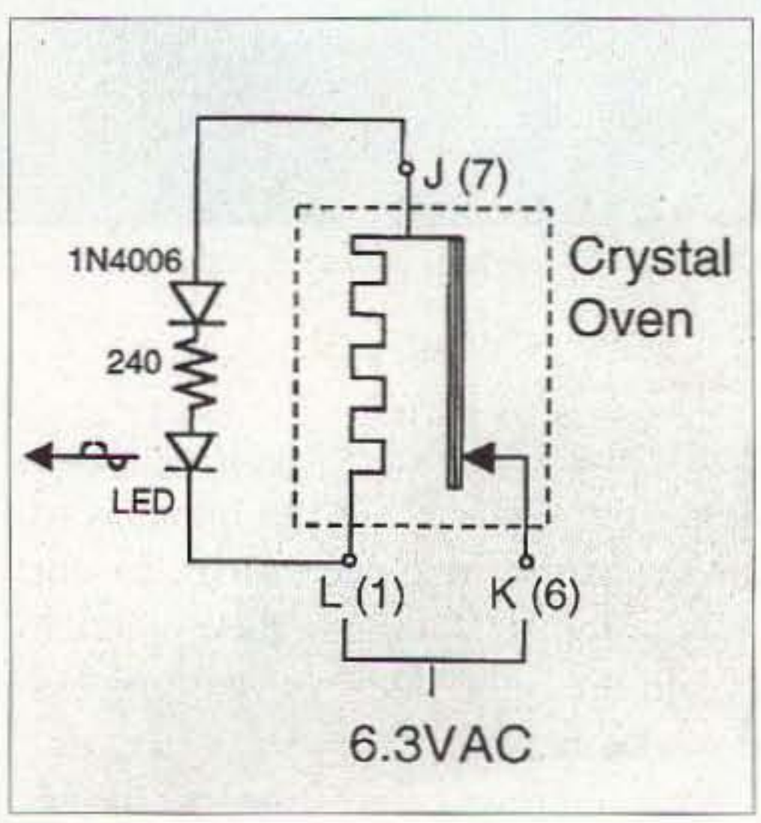

Fig. 1(b). Oven with LED indicator.

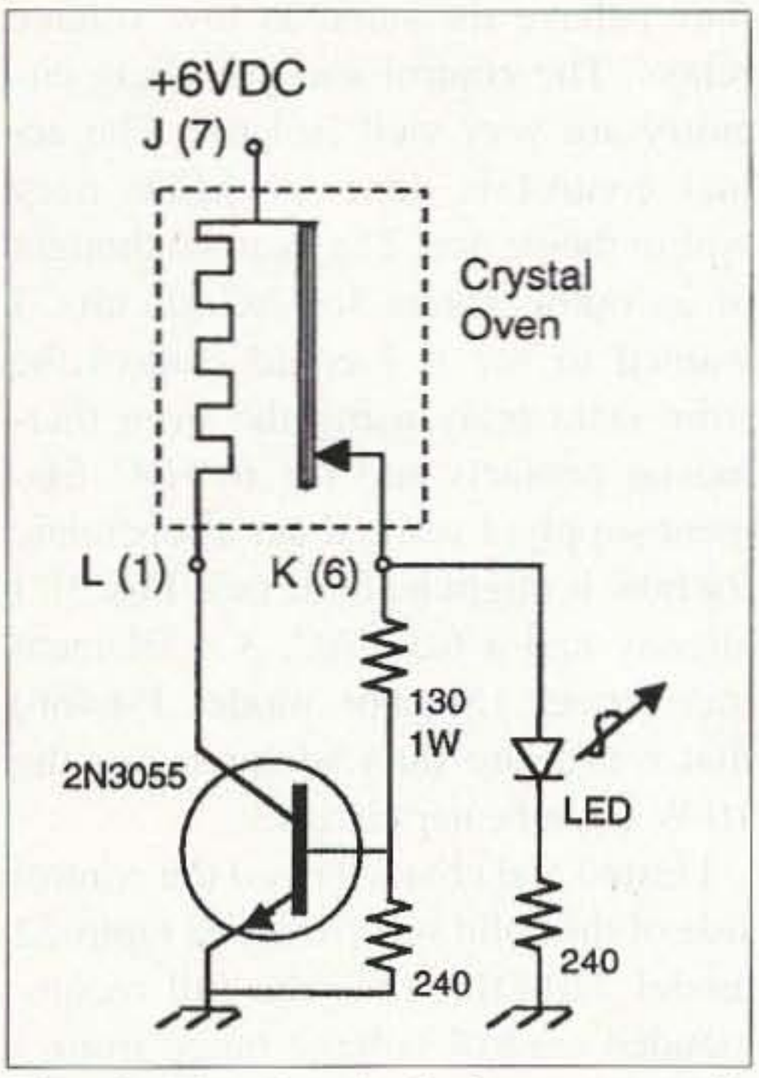

Fig. 2. Transistorized thermostat with LED indicator.

and is mechanically clamped in place. The oven was designed to operate at the upper temperature turning point of the 100 kHz crystal, 70° C. The TC922 oven was designed to draw a maximum power of ten watts, or 1.58 A at 6.3 VAC.

Actually, I eventually found two complete oscillator modules. But, the thermostat contacts in the second module oven were pitted and worn. Burnishing the contacts brought temporary relief, but it was soon obvious that the thermostat was beyond repair.

An E-mail to the Bliley Electric Company confirmed my fears — they no longer stocked the original oven or replacement thermostats. Months later, at a hamfest, I found a matching oven complete with crystal. It was missing a large portion of the Bakelite upper cap, but the asking price was very reasonable. Combining parts, I now had a complete second oven and oscillator module. Not wanting to lose either of my working units to further contact pitting and wear, I needed to find a way to reduce the contact current.

I considered converting the ovens to full proportional control, but I did not want to change any of the module wiring (so that boat anchor fanatics/purists would not hunt me down). I did want to reduce the thermostat contact current to extend the life of units already over forty-five years old. Seriously, amateur radio operators, me included, have been too eager to tear into surplus equipment and make modifications rather than work with and use the original design. When someone examines a piece of surplus equipment at a hamfest and notes the presence of a new control or hole, the first word that comes to their mind is "butchered," not "enhanced." All modifications in this article are external to the original oscillator module.

Every thermostatically controlled oven I have run across connects the thermostat contacts in series with the resistive heater windings or element as shown in **Fig. 1(a)**. The small letters in the figure correspond to the SRT-14A oscillator module connector pins. The numbers in parentheses correspond to the oven pin numbers. Most, if not all, oven designs bring the common connection out to serve as a part of an indicator circuit for contact closure or oven cycling. The easy access to the common connection is what allowed me to treat the thermostat contacts and the oven heater windings separately.

First, I tested each oven by adding an LED with a rectifier diode and a current limiting resistor in parallel with the heater windings to indicate when the oven was heating [see **Fig. 1(b)**]. This works whether the oven is operated from DC or from the original AC.

Once I knew the two ovens were operational and cycled normally, I decided

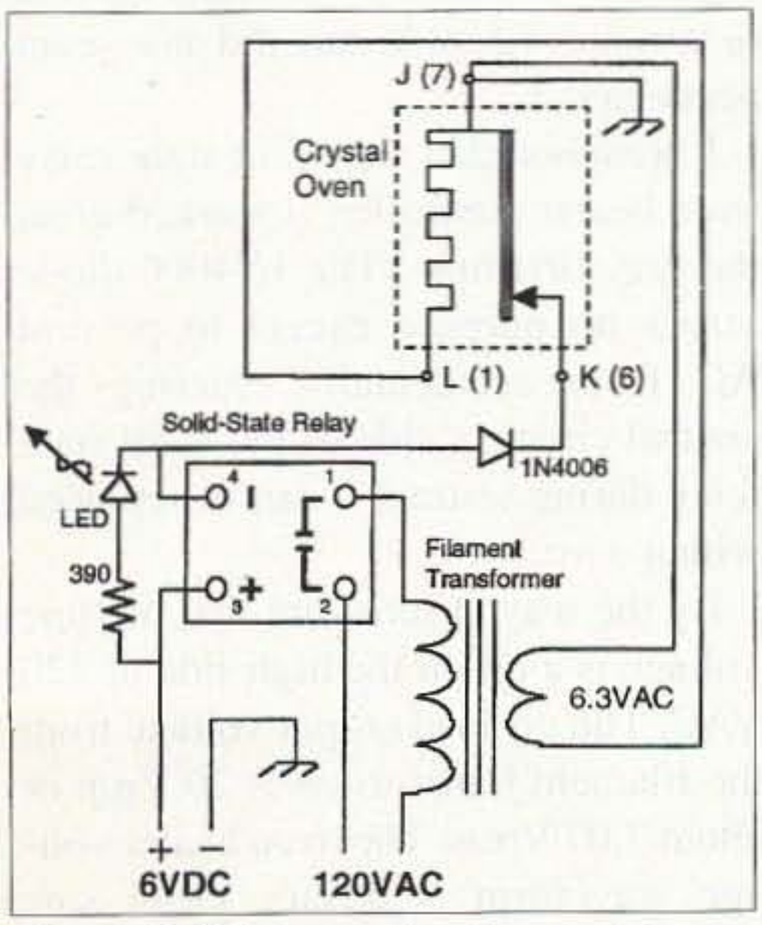

Fig. 3. Solid state relay thermostat controller with LED indicator.

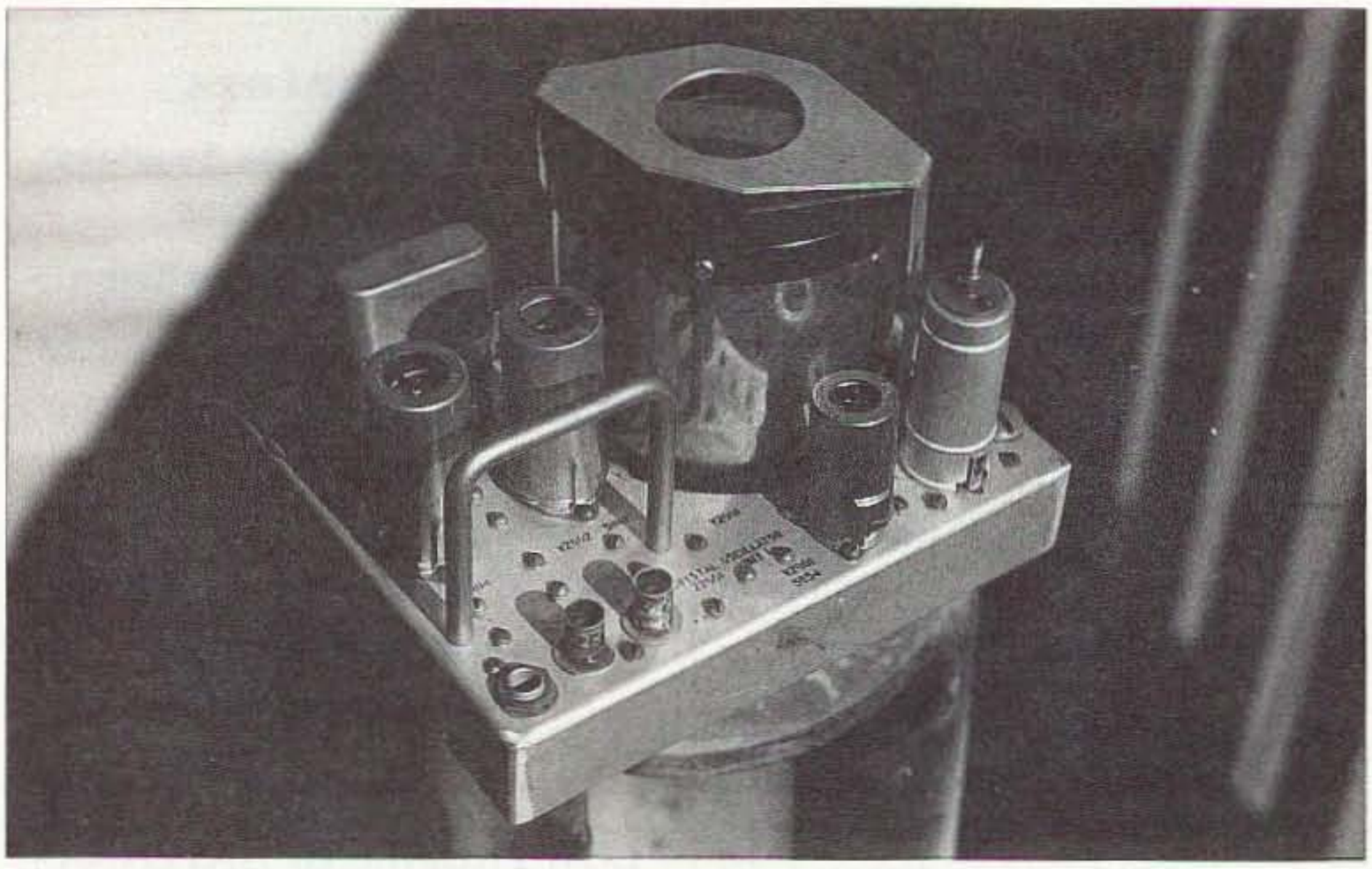

Photo A. View of the complete SRT-14 reference oscillator.

to use a transistor to reduce the current through the oven thermostat contacts. I had already decided to operate the three vacuum tubes from a regulated 6 VDC filament power supply. This would extend the life of the tubes and remove any concerns about line voltage fluctuations. I used a simple 2N3055 circuit, complete with an LED oven heating indicator as shown in **Fig. 2**. The LED circuit is no longer connected across the oven heater windings but is instead connected to the thermostat.

The 2N3055 needed only a couple of square inches of heat sink, so a simple aluminum "L" mounting bracket worked very well. However, it seemed as if the oven would never cycle off. I believe the problem was that the voltage drop across the 2N3055 was too high and the supply voltage too low. For a constant heater resistance, the heating is proportional to the heater voltage squared — hence a small voltage drop has a magnified effect. This problem could have been overcome by increasing the oven supply voltage to compensate, requiring me to build another power supply just for the oven — something I did not want to tackle.

I decided to take a different approach. I borrowed a solid state relay to use in experiments with the SRT-14A oscillator oven. Solid state relays are remarkable devices. For AC loads, they behave the same as low voltage relays. The control and switching circuitry are very well isolated. The actual control is done by LEDs deep within the device. They can be thought of as optoisolators for AC circuits. I wanted to see if I could control the solid state relay using the oven thermostat contacts and the 6 VDC filament supply. I worked out a schematic for how it might be done (see **Fig. 3**). I already had a 6.3 VAC, 3 A filament transformer (Stancor model P-6466) that was more than adequate for the 10 W oven heater circuit.

I tested and characterized the control side of the solid state relay, an Opto-22 model 240-D10, over the full recommended control voltage range from 3 to 25 VDC. This particular solid state relay is rated for 10 A resistive loads and is certainly overkill, but it was available, easy to mount, physically compact, and has convenient screw terminal connections.

It turns out that the control side circuitry of the solid state relay could be modeled as a fixed 1.5 V drop (the internal LED) in series with a 1 k resistor. With a 6 VDC supply, the control current is only (6 – 1.5)/1 k = 4.5 mA. Allowing another 12 mA for the oven indicator LED, the oven thermostat contact current would only be 16.5 mA, versus 1.6 A under the original configuration (about a 100x reduction). Putting the LED indicator back in parallel with the oven heater windings would reduce the contact current to a mere 4.5 mA, but did not seem necessary.

I breadboarded the solid-state relay oven heater controller. It worked great the very first time! The 1N4006 diode serves no purpose except to prevent AC from accidentally entering the control circuitry side of the solid state relay during testing; it can be replaced with a wire.

By the way, it turns out that my line voltage is a bit on the high side of 120 VAC. The no-load output voltage from the filament transformer is 20 Vp-p or about 7.07 Vrms. The oven heater voltage waveform is a nice clean sine

Photo B. Bliley crystal oven removed from SRT-14.

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Craig Kendrick Sellen
c/o Mallard Meadows RHC
476 Belmont St., Room 405
Waymart PA 18472

Need a Noise Blanker?

This impulse noise suppressor can be added to any SWL, ham, or CB receiver.

Automobile ignition and electrical impulse noise are serious problems for the ham station operator or SWL who lives near a busy street. Most commercial receivers have noise clipping provisions, but the circuit used is not effective for SSB or CW operation. Some receivers have no noise limiter of any kind. If your receiver is deficient in this respect and if you are bothered by ignition noise or other noise created by electrical impulses, this audio noise blanker is what you need.

The noise blanker works equally well with SSB, AM, and CW signals. It accepts a signal that is nearly indistinguishable because of impulse noise and makes it 90% readable. It is not necessary to modify your receiver; the noise blanker is connected between the low-impedance output of the receiver (3.2 to 16 ohms) speaker. The noise blanker itself requires no external power supply. An audio amplifier, which is used to raise the low level output of the blanker to a comfortable speaker level, does require a power supply. This will be explained later. Refer to **Fig. 4**.

Circuit operation

Refer to **Fig. 2**. Assume that a high level noise pulse, whose amplitude greatly exceeds the blanking level, enters the system. After passing through transformer T1, where it is split into two identical signals 180 degrees out of phase with each other, the signal takes two different paths, as shown in the diagram.

In the lower path, the signal (waveform A) passes through a peak clipper consisting of diodes D1 and D2, which are connected in opposite polarity and are in parallel with the signal path and ground. When the noise-pulse amplitude reaches the voltage level equal to the reverse bias on the diodes, both diodes conduct and shunt everything above this level to ground. The truncated signal (waveform B) is then passed to balance potentiometer R6. This type of circuit is called a peak clipper, and similar circuits are found in many receivers.

The other input signal, waveform C, is fed to a base clipper consisting of a pair of diodes, D3 and D4, connected in opposite polarity and in series with the signal path. The arrangement does not allow the signal to pass until its amplitude exceeds the blanking level. The portion of the signal that exceeds the level (waveform D) is passed to a peak clipper consisting of reverse-biased diodes D5 and D6 which are connected in opposite polarity between signal and ground. Operation is the same as in the D1, D2 peak clipper.

The two clipped output signals, waveforms B and E, are applied to opposite ends of balance potentiometer R6. If the wiper of this potentiometer is adjusted to receive signals of equal amplitude, the composite signal appearing as the audio output then looks like waveform F. Note that this signal contains far less power than the original input waveform, and even less power than a peak-clipped waveform.

The result is that, regardless of how great the noise is compared with the desired signal, any noise pulse that exceeds the blanking level will not only

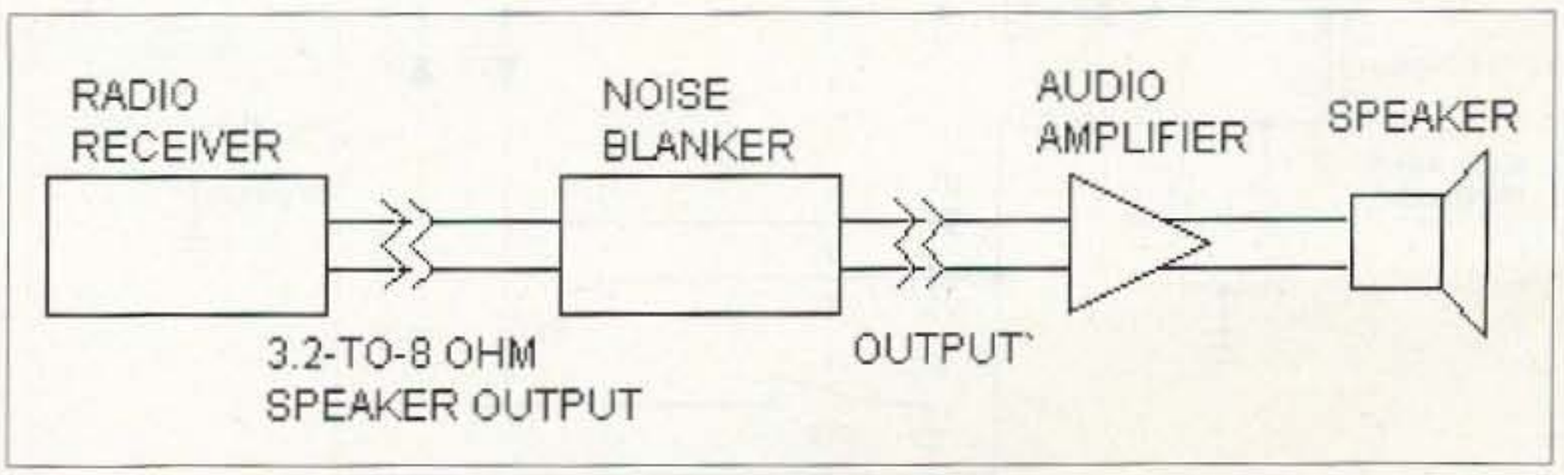

Fig. 1. *The noise blanker connects between the receiver loudspeaker output and external audio amplifier.*

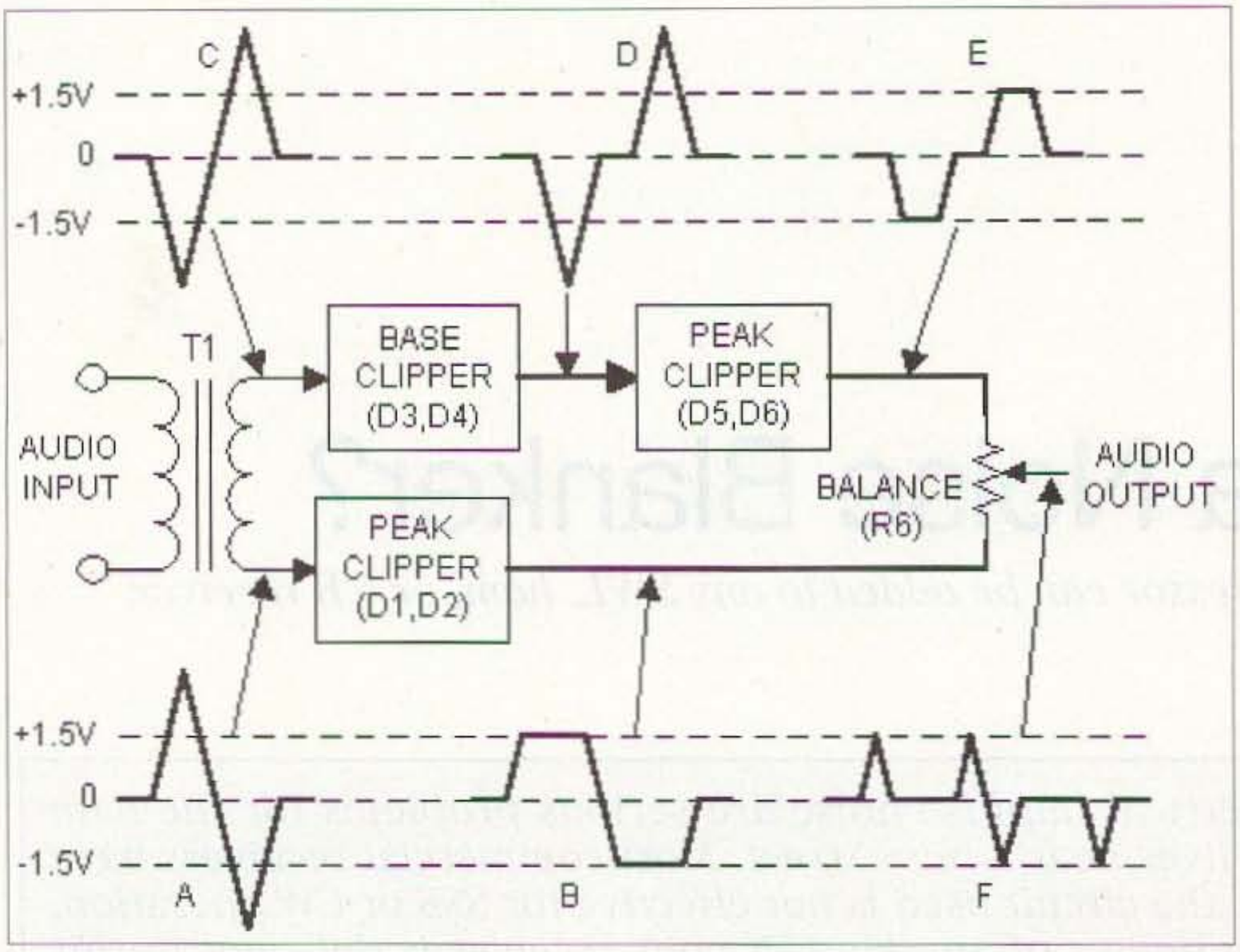

Fig. 2. Waveform diagram.

be greatly reduced, but will in fact have an audio power less than that of the desired signal. Thus the noise can hardly be heard.

Construction

The circuit of the noise blanker is shown in **Fig. 3**. It is used in conjunction with **Fig. 4** and can be assembled on a printed circuit board, on perfboard, or with point-to-point wiring on tie strips. My version uses perfboard. The amplifier described here can work and any type of IC circuit can be used, such as LM380 or LM4862, etc. Remember, you must supply power for this audio amplifier. An LM386 was readily available and easy to use. Transformer T1 is a 50L6 audio output transformer, used because it was in my junk box — but any other type can be used if it has a low-impedance speaker winding and a 2000–5000 ohm primary winding. A good source for the transformer is Antique Electronic Supply, 6221 South Maple Ave., Tempe AZ 85285. Diodes D1 through D6 can be any general-purpose germanium signal units such as 1N34A. Be sure to observe the polarities on the diodes and, when soldering, use a heat sink on the leads.

Adjustment

The balance potentiometer R6 can be adjusted by ear, or for more exact results, with an oscilloscope. Connect the low impedance output of the receiver speaker to the blanker input (see **Fig. 1**). Turn on the receiver and the noise blanker and place noise blanker switch S1 in the OFF position. Set the receiver volume control to its normal position and turn the audio amplifier gain up so that you can hear a signal. Adjust the noise blanker amplifier gain R7 to a comfortable listening level and turn S1 ON. Turn up the receiver volume control until the speaker output is very distorted. Adjust the balance control R6 until the audio output is at a minimum. This will be close to the mid-position of R6. Once R6 is adjusted, it will remain correct for a long period of time unless components age or are replaced.

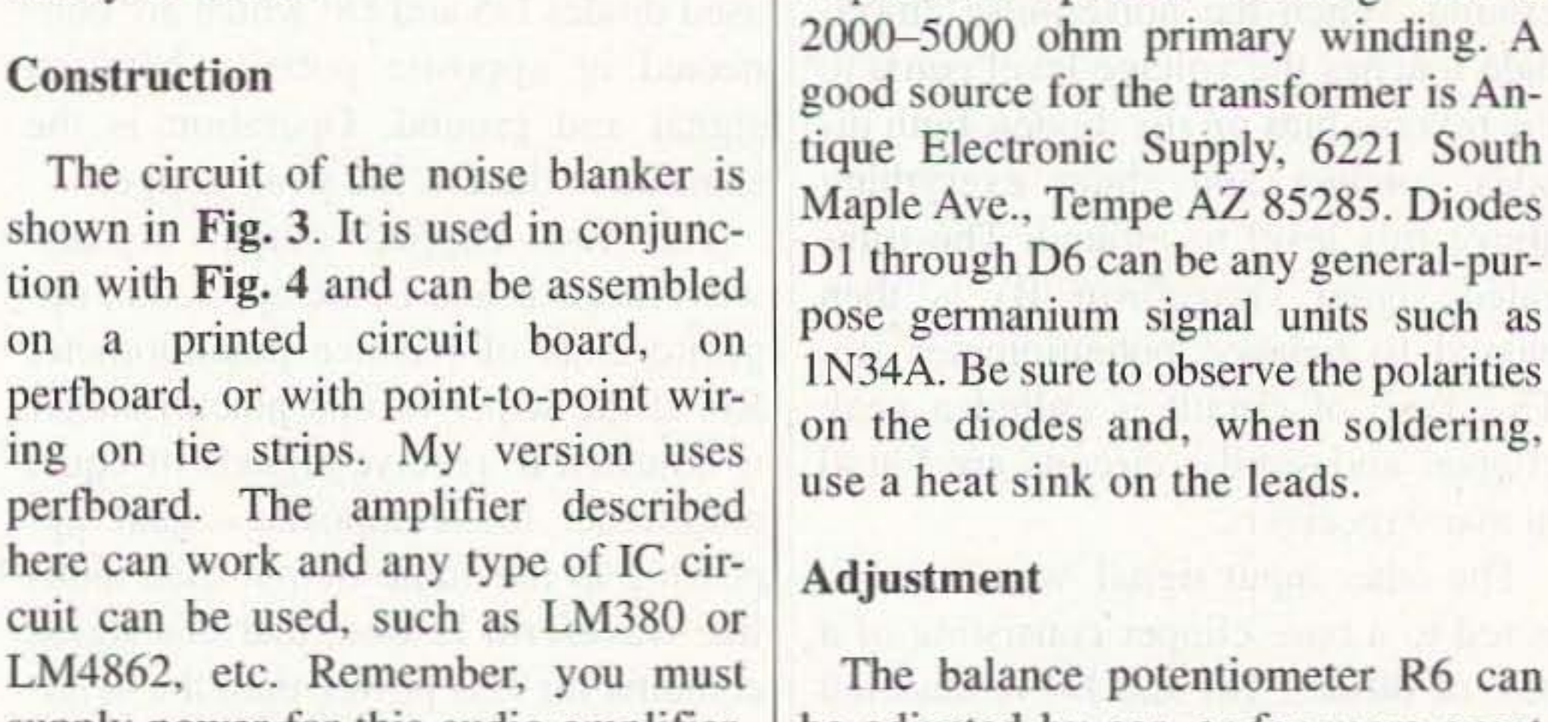

Fig 3. The blanker circuit.

Part	Value	Description
B1–B4	1.5 V	AA penlight battery
C1	10 µF 15 V	Electrolytic capacitor
D1–D6	1N34A	Germanium signal diode
R1, R2	1.8k 1 W	Resistor
R3–R5	10k 1/4 W	Resistor
R6	50k	Miniature trimpot
S1	DPST	Switch
T1	50L6	Transformer (see text)
Misc.: Suitable perfboard, PCB, or other wiring method; battery holders, chassis box, solder, hookup wire, etc.		

Table 1. Blanker parts list.

Part	Value	Description
C2	0.22 µF	Mylar capacitor
C3	10 µF 15 WVDC	Electrolytic capacitor
C4	0.047 µF	Disc capacitor
C5	220 µF 15 WVDC	Electrolytic capacitor
C6	100 µF 15 WVDC	Electrolytic capacitor
R7	50k	Panel-mount pot
R8	10 Ω 1/4 W	Resistor
ICI	LM386-N	Audio amp

Table 2. Amplifier parts list.

Operation

Tune in a signal, set the audio amplifier gain for a comfortable listening level, and advance the receiver volume control until some audio distortion is noticed. At this point, back off the receiver volume control slightly until the audio is clear. This means that the noise blanker is operating properly; the receiver volume control is now the blanking-level control, and the audio output level is controlled by the gain control on the noise blanker amplifier.

When you tune in very weak or very strong signals, the receiver volume control may need to be readjusted, depending on the effectiveness of the receiver AGC system. If the receiver volume control is set too low, the noise blanker will not be as effective as desired; if the receiver audio control is too high, the desired audio will be distorted.

The noise blanker does not begin to work until the amplitude of the impulse noise is greater than that of the signal — it works best when the noise amplitude is several times that of the signal. Therefore, it is important that the noise pulse not be limited or suppressed by the receiver. In some cases, turning off the receiver AGC may improve the noise suppression characteristics of the system.

The noise blanker has been used very successfully with a mobile SW

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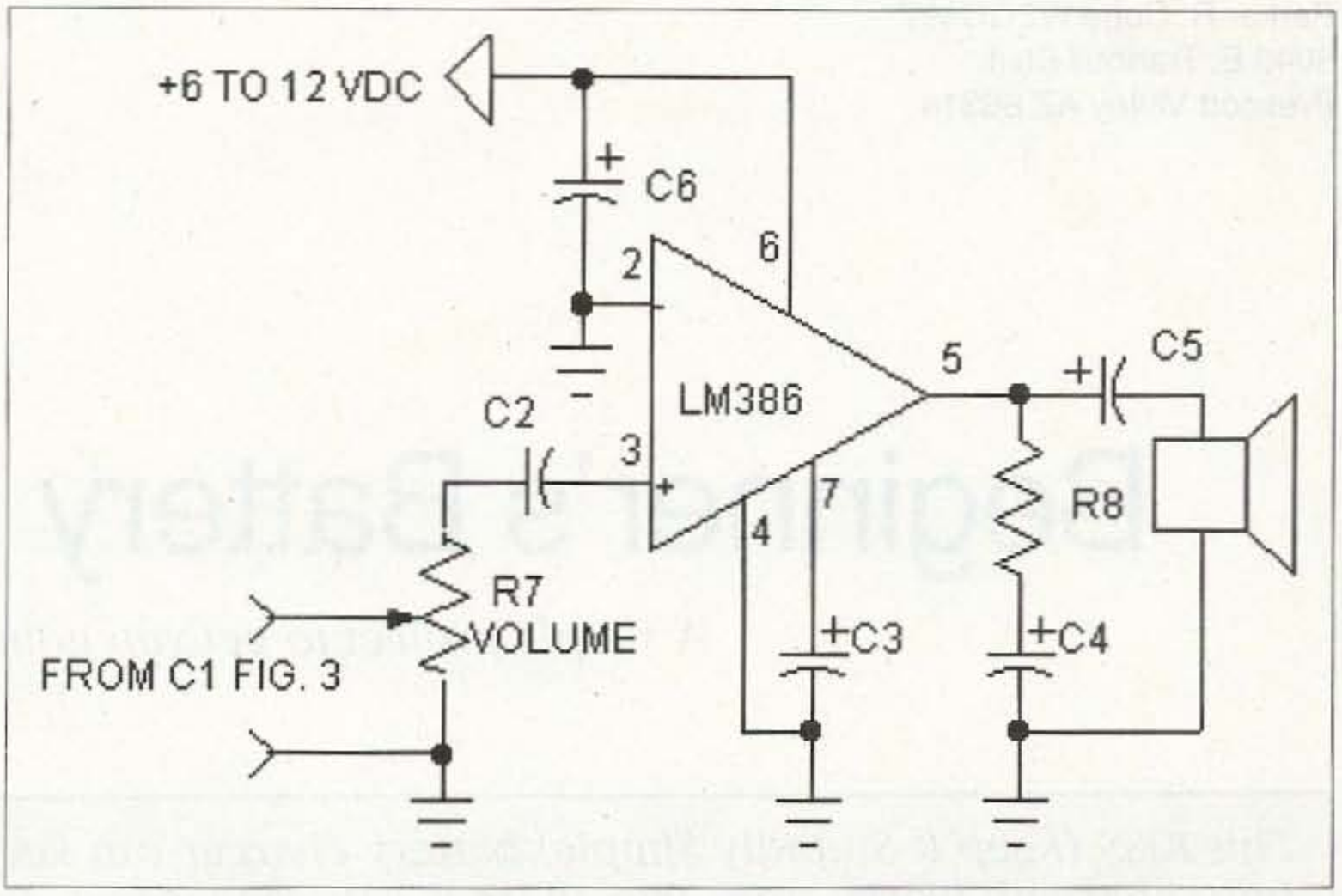

Fig. 4. *The audio amplifier.*

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

Beginner's Battery Charger

A simple project to get you going.

This KISS (Keep It Stupidly Simple) battery charger can keep your rechargeable batteries fully charged, worry-free. The charger can recharge 1.2 volt NiCds, 12 volt lead acid batteries, or any rechargeable battery. The battery voltage isn't important. Just plug it in to keep your batteries charged and ready when you are. However, be aware that the charger can represent a shock hazard under some conditions and should be treated as a live 120 V wire. If it is plugged into a ground fault interrupter (GFI), you can't get stung.

How does a GFI protect you from a shock? If the hot side of the line is connected to the automobile's frame (the negative side of the battery) and the neutral line is open, the circuit is completed from the line to the car's frame and from frame to you and ground. Ouch! The GFI senses current in the earth (you) and disconnects the power.

The National Electric Code requires GFIs in the kitchen, the bathroom, the laundry, and garage, but not in other wiring branches in the building. The requirement for GFIs is relatively new, and some houses are wired without a green or "bonding wire." The bare wire in the non-metallic cable (Romex cable) is the bonding wire. It is the green wire in appliances and the green screw in the wiring receptacle. Metal wiring conduit can take the place of a bonding wire. The green wire carries current only in the case of a fault in the ground wire.

The (GFI) may already be in the house, or if the house was wired before the National Electric Code required GFIs, you may have to add one. When you install a GFI, connect the GFI wiring with black to black, white to white and green to earth ground. If your house is wired with only two wires, black and white, white is grounded by the electric company — if you trust the electrician that did your wiring. If you don't trust him or her, measure the voltage from wire to earth. It had better be zero, if not, corrective action is required; change the wiring in the receptacle. The black wire should go to the brass screw and white to the chrome screw. But, if the electrician swapped the lines somewhere, white may not be neutral.

If you plug into a properly wired GFI, you won't get stung when the ground wire is open and you become part of the circuit.

The charger shown in **Fig. 1** is the utmost in simplicity. It can probably be built out of your junk box, but if your junk box is empty, the parts can be bought from your local hardware store and Radio Shack. The light bulb, socket, and plug are from the hardware store, and the rectifier diode and battery clips from Radio Shack. Of course, if you want to charge a "D"-size cell, then a battery holder will have to be used, but you won't need battery clips.

Any rectifier with a PIV greater than 200 V, such as 1N4004,5,6,7, can be used. The 1N4003 has a PIV of 200 V and costs maybe a dime less than the 400 volt 1N4004. The 1N4000 series of diodes has a 1 A current rating, and 1 A is the maximum charging current that the charger can supply. That's enough for most uses.

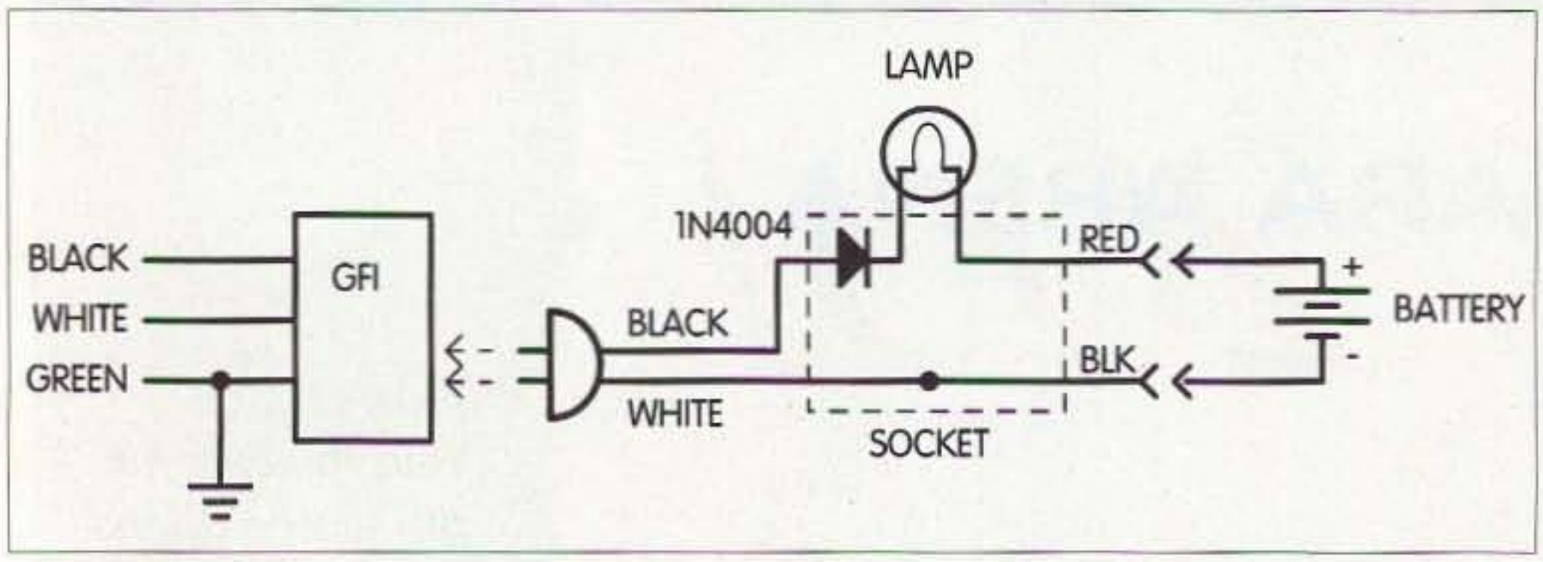

Fig. 1. A simple current-limited battery charger uses half-wave rectification.

The peak inverse voltage on the diode is the peak line voltage plus battery voltage. Therefore, a 120 volt line (169 V peak) and a 12 V battery applies a PIV of 183 volts to the diode. A 12 volt lead acid battery has a voltage of 13.8 volts when charging. In the case of a fully charged battery, the PIV on the diode is 169 V+14 V = 183 V. Compare this to a half-wave rectifier operating from 120 volts with a capacitive input filter. The capacitor is charged to the peak, 169 V, and on the reverse half cycle the maximum voltage is the negative peak, so voltage across the diode is $2E_{pk}$.

The rectifier converts the 120 volt line current into half-wave rectified current, with the lamp limiting the current. The lamp can be anything up to 200 W. The higher the wattage, the higher the charging DC current. The diode can be put into the lamp socket with room to spare.

The resistance of the lamp limits the charging current and provides a constant charging current to the battery. The current in a lamp with half-wave current is not easy to calculate exactly, because an incandescent lamp has a very nonlinear resistance characteristic that is dependent on the current. But a first-cut estimate can be made that assumes a linear resistance vs. current.

The full-wave current in a lamp is I = P/E, where E is the rated voltage for the lamp and P is the watts. The average full-wave (DC) current calculates to be 0.9 x I_{RMS}. The half-wave current is half that, or 0.45I_{RMS}. The measured currents for a number of bulbs are given in **Table 1**.

The resistance of a lamp with half-wave current is found to be lower than the first-cut estimate. The calculated half-wave current for a 200W bulb is 0.75 but the measured current is 1 A_{DC}. In any event a 200 W lamp will recharge a "dead" car battery in a day or so.

Ideally, a trickle charge just replaces the charge lost through the battery's internal self-discharge mechanism. Prudence says to provide a little more current than the minimum, but not enough to boil away the electrolyte. A 15 W night light is appropriate for trickle charging most lead acid car batteries, but a 40 W bulb is also sufficient.

While the batteries are assumed to be 12 V lead acid car batteries (SLI, Starting, Lighting, and Ignition, batteries), NiCds or any rechargeable battery can be charged when an appropriate lamp or resistor is used to limit the current. A resistor instead of the lamp is appropriate for small, low-amp-hour batteries like NiCds.

Most car batteries have an amp hour rating of about 60 Ah, motorcycle batteries about 15 Ah, and NiCds in the order of 450 mAh. The physical size of a lead acid battery is good indication of its amp hour capacity. The watts per cubic inch of lead acid batteries are very similar across all manufacturers.

The current required to charge the battery depends on its amp hour rating, not its cranking amps. A charging rate equal to the amp hour rating is a good fast charge rate, and a "hot shot" would be about five times that. Of course, the KISS charger can only provide 1 A. The trickle charge rate is 10% or less of the amp hour rate, but that depends on the condition of the battery and how it has been used or abused. I've found that a trickle charge of about 0.1% into a two-year-old battery in a garden tractor will maintain a full charge. That is 60 mA into a 60 Ah battery.

When fast charging a battery, care must be taken not to overcharge. The capacity after overcharging is actually less than maximum. Overcharging quickly shortens life, and can boil away the electrolyte. That's sure not good for the battery. In a word, overcharging a battery doesn't do it any good. In the days when a car's voltage regulator was essentially calibrated relays, overcharging was the primary

Lamp Watts	DC Current (A)
200	1
100	0.42
60	0.26
40	0.17
25	0.1
15	0.065

Table 1. Bulb currents.

cause for the relatively short battery lives. With today's electronic regulators, battery life can extend to ten years.

Since the charging current is the important item, finding the desired current-limiting resistor becomes critical. Calculating the fixed current-limiting resistance is more certain: The average (DC) half-wave current is:

$$I_{av} = 0.318 \times I_{pk} = 0.318 \times \sqrt{2} \times E / R$$

or 0.45 x I_{RMS}.

Therefore, a 12 kΩ 1/2W resistor instead of a 120 volt light bulb would be needed to provide a 4.5 mA trickle charge current for a 450 mAh NiCd, while a 15 W light bulb would supply about 60 mA to a car battery. A 15 W lamp will keep a trolling motor battery or garden tractor battery fully charged over the winter to be ready to go when spring comes around.

There is some merit to the conventional wisdom that says keep the battery off the garage floor. At least off a cold floor. The plastic case doesn't care where it sits. Some say that when the battery sits on the cold garage floor, the temperature difference between the floor and the top of the battery causes the electrolyte to circulate and speed up the self-discharge. I won't get into that argument. It makes sense to set the battery on a couple of pieces of two by four even in a warm shack. The boards will protect the floor and keep the battery and XYL happy.

A battery can be charged with either a voltage source or a current source. Charging from a voltage source requires close control of the voltage and usually some upper current limit control as well as sensing the condition of charge. With current charging the charging is slower but independent of battery voltage and is a better "set and forget" approach.

The KISS charger is essentially a current source with the charging current limited by the light bulb or a fixed resistor. The current is essentially the same whether the battery is fully charged or completely discharged.

A charging current equal to the amp-hour rating of the battery is a fast charge while a current of less than 10% of the amp-hour rating is considered a trickle charge. A trickle charger will probably recharge a discharged battery but it will take just short of forever. I've found a trickle current of 0.1% times the amp-hour rating to be adequate for a garden tractor battery.

A typical 60 Ah car battery can be charged with 60 A in a little over an hour, but that rate can seriously overcharge the battery if you forget it. A 6 A charge for 10 hours is safe enough, but it too can overcharge the battery if it's left on too long. 0.06 A (a 15 W lamp) can trickle charge the battery for months without problems. Essentially set it and forget it.

The efficiency of the charger is very low. An amp from a 120 volt line to put an amp into a 12V battery is really pretty poor efficiency, but that's the price paid for simplicity.

The measured charging current versus lamp wattage is given in **Table 1**.

These measured currents are for a completely dead, zero volts, battery and the actual resistance of the lamp not known with certainty. Nevertheless, it's better than a WAG. The currents can be extrapolated for other lamp wattages. For example, a 7 W lamp will have a current that is a little more than 0.11 times that of a 60 W lamp. Using lamps with the same bases makes it convenient to change the charging current. You can change from a 1 amp rate to a 60 mA rate just by changing the light bulb.

The modern "maintenance-free" batteries are really just "low maintenance" batteries. They still should be checked occasionally by prying off the covers to make sure the electrolyte covers the plates. Add distilled water to bring the electrolyte a quarter inch above the plates if required. It won't be a catastrophe if you have to add plain tap water, but it's not the best thing for the long battery life.

For the typical automotive lead acid battery, the charging voltage is a reasonable indication of the state of the battery's charge. A typical 12 volt lead acid car battery has a charging voltage of about 13.8 volts, while the voltage under a light load is 12 volts. The specific gravity is the usual measure of the state of charge of a battery, but with sealed batteries, that's a bit inconvenient. So the terminal voltages, with all of their uncertainties, are used to indicate the state of charge.

While the main thrust here is toward lead acid car batteries, NiCds or other rechargeables can be recharged equally well. Just keep in mind the lower current ratings of these small cells. For low charging current, even a 15 W lamp will probably produce too much current and the lamp will have to be replaced with a resistor. To check the maximum charging current for a particular resistance or lamp, connect a DC current meter in place of the battery, then plug the charger into the 120 V mains. The indicated current is the charging current.

A rundown car battery can be recharged over the weekend with a 200 W lamp limiting the current. It's worth mentioning that if you expect to need a little extra help on a cold morning, put the lamp under the hood near the battery to keep things warm for the next morning's start. But don't forget to take off the charger before you crank the engine. The fan belts can chew things up in a hurry, and probably blow the line fuse as well.

A word to the wise: the voltage at the battery clips is 120 volts while the battery is disconnected. Unplug the charger while you're making the connection.

A simple charger can keep your shack's auxiliary battery up to snuff without constant attention. The charging current has to be a little more than the average discharge current. It doesn't take much of a charger to keep a battery charged. 73

Calendar events

Listings are free of charge as space permits. Please send us your Calendar 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 February 28. Provide a clear, concise summary of the essential details about your Calendar Event.

FEB 4

LORAIN, OH Winterfest 2001 will be held at Gargus Hall, 1965 N. Ridge Rd., 8 a.m.–1 p.m. Talk-in on NOARS repeaters 146.700(-) and 444.800(+). Ample all indoor commercial space, reservations required. There will be a hamfest and pancake breakfast. Tickets are $5 each at the door, and include admission for one to the hamfest and the breakfast. 6 ft. tables are $10 each. All workers require an admission ticket. Setup for vendors begins at 6 a.m. This event is being sponsored by the Northern Ohio ARS. For info, contact *John Schaaf K8JWS at (216) 696-5709; or write NOARS via E-mail at [noars@qsl.net]; or snail mail to NOARS Winterfest, P.O. Box 432, Elyria OH 44036-0432.*

FEB 5

SUN CITY, AZ An Amateur Radio Equipment Auction will be conducted at 7 p.m. by the West Valley ARC at St. Clement of Rome Catholic Church Social Hall, 15800 Del Webb Blvd., Sun City AZ, (1/2 mi. S of Bell Rd.). Free admission. The club keeps 10% on equipment sales. Talk-in on 147.30(+). Contact *Ron K6OP, (623) 546-5710; E-mail [ronk6op@juno.com].*

FEB 9–11

ORLANDO, FL The Orlando Hamcation Show and ARRL North Florida Section Convention will be held Friday, February 9th, noon to 8 p.m.; Saturday, February 10th, 9 a.m. to 5 p.m.; and Sunday, February 11th, 9 a.m. to 3 p.m. The Orlando ARC will sponsor this event at the Central Florida Fairgrounds, Rt. 50 Colonial Dr., 3 miles west of I-4. Special features include Guest Speaker Ed Petzolt K1LNC, the 1999 ARRL International Humanitarian Award winner. Forums: DX, satellite demos, Phase 3D, PSK-31, APRS. 150 commercial booths, 400 swap tables, the largest tailgate in the southeast, and RV camping with elect. and water, $16 per night. VE exams, must register in advance; call *Gil Lineberry at (407) 843-4122.* Register for the Foxhunt by 4 p.m. at the info booth. Admission $7 in advance or $9 at the gate. Talk-in on 146.760. Check the Web site for up to date info, [www.oarc.org/hamcat.html]. Contact *Ken Christenson, 5548 C Cinderlane Pky., Orlando FL 32808; (407) 291-2465; or [af4zi@juno.com].*

FEB 18

FARMINGTON HILLS, MI The Livonia ARC will present its 31st Annual Swap 'n Shop on Sunday, Feb. 18th, 8 a.m.–12:30 p.m., at The William M. Costick Activities Center, 28600 Eleven Mile Road (between Middlebelt and Inkster Roads). Talk-in on 144.75/5.35. For info send 4x9 SASE c/o *Neil Coffin WA8GWL, Livonia ARC, P.O. Box 51532, Livonia MI 48151-5532; or call the club hotline at (734) 261-5486.* Visit the Web page at *[www.larc.mi.org]; or E-mail to [swap@larc.mi.org].*

FEB 24

HORSEHEADS, NY The Amateur Radio Assn. of the Southern Tier, of Elmira NY, will sponsor its 20th Annual Winterfest on Saturday, Feb. 24th, 8 a.m.–3 p.m., at the NYS National Guard Armory on Colonial Drive in Horseheads NY. Talk-in on 146.70(-), with 147.36(+) as a backup. Admission is $5 in advance, $6 at the door. Children 10 and under admitted free. VE exams start at 9 a.m. Dealers will feature new and used equipment for sale. For more info, send an E-mail message to the auto-responder at *[winterfest@arast.org].* You can also visit the Web site at *[http://www.arast.org]* and click on the Winterfest link.

LA PORTE, IN The LPARC Cabin Fever Hamfest will be held Saturday, February 24th, at La Porte Civic Auditorium, 1001 Ridge St., La Porte IN, 7 a.m.–1 p.m. Chicago time. Admission $5, tables $10 ea. Talk-in on 146.52 and 146.61(-) PL 131.8. For info, contact *Neil Straub WZ9N, P.O. Box 30, La Porte IN 46352; tel. (219) 324-7525; E-mail [nstraub@niia.net].* Visit the Web page at *[www.geocities.com/k9jsi/].*

MILTON, VT The Radio Amateurs of Northern Vermont will sponsor the Northern Vermont Winter Hamfest and ARRL Vermont State Convention on Feb. 24th, 8 a.m.–1 p.m., at Milton High School, Route 7 in Milton, 5 miles north of I-89 Exit 17. Features include flea market, dealers, book sales, forums and demonstrations. VE exams will be given at 9 a.m. and 1 p.m. Commercial exams at 1 p.m. Admission is $3, free for under 18 years. Tables are free while they last. Call for large setups. Check the Web site for forum schedule and vendor setup info. Talk-in on 145.15 rptr., bulletins on 146.67. Contact *W1SJ at (802)*

879-6589; or E-mail [w1sj@arrl.net]. Web site at [http://www.ranv.together.com].

FEB 25

HICKSVILLE, NY The LIMARC Winterfest 2001 Electronics Hamfair and Flea Market will open at 9 a.m. for buyers, with doors opening at 8 a.m. for vendors. The event will be held at Levittown Hall, 201 Levittown Parkway, Hicksville NY. Tables are by advance reservation only; $20 if received by February 14th, $25 after. *Payable to LIMARC, P.O. Box 392, Levittown NY 11756.* Each reservation includes one 6 ft. table and admission for one person. General admission is $6, children under 12 admitted free if accompanied by a paying parent. For more info visit the LIMARC Web site at *[http://www.limarc.org],* or call the 24 hour info line at *(516) 520-9311.* Talk-in is on the 146.850 rptr., PL 136.5.

CUYAHOGA FALLS, OH The Cuyahoga Falls ARC, Inc. will host their 47th Hamfest, Electronic and Computer Show on Sunday, Feb. 25th, 8 a.m.–2 p.m. at Emidio's Party Center, 48 E. Bath Rd., at the corner of State Road, in Cuyahoga Falls OH. North Coast Amateur Radio Inc., from North Tonawanda NY, will be featured at this event. Tickets are $4 in advance, $5 at the door. 8 ft. tables are $14 for the first table (includes one ticket), $10 for each additional table. Contact *Carl Hervol, Hamfest Chairman, 2292 Lake Center St., Uniontown OH 44685. Tel. (330) 497-7047; or E-mail [carlh@voyager.net].*

MARCH 10

SCOTTSDALE, AZ The Scottsdale ARC hamfest will be held starting at 6 a.m. at Scottsdale Community College, 101 North - Exit Chaparral Rd., 9000 E. Chaparral Rd, Scottsdale AZ. Parking $2. Tables $10. RV parking. VE exams. For more info, contact *Roger Cahoon KB7ZWI, 8501 E. Edward, Scottsdale AZ 85250. Tel. (480) 948-1824. Mobile (602) 725-7256; Fax (602) 943-7651. Send E-mail to [rgcahoon@msn.com].*

MARCH 18

MAUMEE, OH The 46th Annual Hamfest/ Computer Fair of the Toledo Mobile Radio Assn. will be held 8 a.m.–2 p.m. at the Lucas County Rec. Center, 2901 Key St., in Maumee. For details, send an SASE to *Paul Hanslik N8XDB, P.O. Box 273, Toledo OH 43697-0273. Tel. (419) 385-5056; Web page [www.tmrahamradio.org].*

MARCH 31

WATERFORD, CT The Radio Amateur Society of Norwich CT will hold their 31st Ham Radio Auction at the Waterford Senior Center on Rt. 85, starting at 10 a.m. Setup at 9 a.m. From Hartford, take Rt. 2 South to Rt. 11 to Rt 85 South. From the Shoreline, take Rt. 95 to Rt. 85 North. Talk-in on 146.730(-). Bring your gear to sell (10% commission to RASON). Free admission, free parking. Contact *Mark KE1IU at (860) 536-9633; or see the RASON Web page at [www.rason.org].*

SPECIAL EVENTS, ETC.

NOW THROUGH END OF FEB

SAN JOSE, CA Some members of "The Crystal Set Radio Club" [http://clubs.yahoo.com/clubs/thecrystalsetradioclub], a very active Yahoo! clubs on-line discussion group forum, are sponsoring a Crystal Radio Building Contest. This contest is now underway, and runs through February, 2001. The contest objective is to demonstrate innovation and craftsmanship in the design and construction of home-made crystal radios. The contest is open to everyone world-wide. There are two classes of entries, Master and General, and three categories of design: General, 100% Homebrew, and Free Style. A contest Web site has been set up where you can find the detailed rules and information at *[http://w3.one.net/~charlie/contest/].* A distinguished panel of judges has been assembled to judge the contest entries. Short biographical sketches are posted at the contest site. Each judge has had extensive experience in several areas of vintage radio and crystal set design and construction. Prizes, which have been donated by various individuals, include an unbuilt MRL-2 Crystal Radio kit, and a pair of vintage headphones. A FAQ page linked with the Building Contest site should answer most questions that might come up. It is updated as new questions come in. Hard copy information is available for those who do not have Internet access, but who are interested in the contest. Send an SASE to: *Crystal Radio Building Contest, c/o Lawrence A. Pizzella WR6K, 856 Ironwood Drive, San Jose CA 95125-2814 USA.*

FEB 16–FEB 25

ST. SIMON ISLAND, GA The Third Annual International "Elmer Memorial" Crystal Radio DX Contest will take place from 1200 UTC on Friday 16 February 2001 to 1200 UTC on Sunday 25 February, 2001. Rules for this contest can be found at [http://www.thebest.net/wuggy/]. These contests have been coordinated to allow those who build a Crystal Radio to enter in the Building Contest, to use their creation in the DX contest and report on its performance in the DX contest. For those without Internet access, a hard copy of the rules for the DX contest can be obtained by sending an SASE to: *Crystal Radio DX Contest, c/o O. Pool WB4LFH, 216 Hermitage Way, St. Simon Island GA 31522 USA.* You can hear lots of DX on the Broadcast band with the right kind of Crystal Set, Antenna, Ground and Phones. During the first two contests 1000+ mile DX was routinely logged. These were not just the 50kW clear channel stations, but many 1kW and 5kW stations. Those who want to learn how to make a high performance Crystal Set, or are just curious about what is involved, are invited to visit *[http://clubs.yahoo.com/clubs/thecrystalsetradioclub],* read the archived posts, look at the pictures of some crystal sets built by the members, and get to know this interesting group of "ultimate QRPers."

MARCH 17

MACON, GA The Macon ARC will operate W4BKM 1500–2200 UTC on Saturday, March 17th, at the 19th annual Cherry Blossom Festival in Macon. Phone 14.240, 21.335, and 28.390. For a certificate, send QSL and a 9 x 12 SASE to *Macon ARC, P.O. Box 4862, Macon GA 31208 USA.* 73

Andy MacAllister W5ACM
14714 Knights Way Drive
Houston TX 77083-5640

Aloft at Last

"It was a textbook launch, from the first minute of flight, until P3D separated from the Ariane 5 launch vehicle. All received telemetry indicates the launch went perfectly, and our satellite appears to be in very good health."

This was a quote from AMSAT-DL Executive Vice President and P3D Mission Director Peter Guelzow DB2OS, following the launch and deployment of Phase 3D on November 16, 2000, at 0107 UTC, from the European Spaceport in Kourou, French Guiana. It was later discovered that the 70cm transmitter did not come on as programmed, but signals were easy to receive and decode from the two-meter transmitter when it was activated.

P3D Becomes an OSCAR

It's been a long haul. The Phase 3D project began over 10 years ago. No one ever expected it would take so long or become so complex. It was worth the wait. The new name for AMSAT's largest and most advanced satellite is AMSAT-OSCAR-40. OSCAR stands for Orbiting Satellite Carrying Amateur Radio. The successful launch of this satellite that carries radio gear covering frequencies from 21 MHz through 21 GHz (or even higher if you include the onboard laser downlink) represents the beginning of a new era in amateur-radio communications. This is truly a "DC-to-light" hamsat.

The design life of AO-40 is 10 years. The satellite weighs about 1,400 pounds, 500 of which is propellant (monomethyl hydrazine, nitrogen tetroxide, and ammonia) to adjust the orbit. Phase 3D was mounted inside a conical adapter assembly that supported the main payload. The wingspan with solar panels unfurled will be about 20 feet. Stabilization is controlled by a unique 3-axis momentum-wheel system. Complete satellite details appeared in the October, 2000 Special Satellite Issue of *73*. You can also find frequency charts and other specifications via the AMSAT Web site: [http://www.amsat.org].

The Rocket

The Ariane-5 launcher is the latest and most massive rocket in use by Arianespace and the European Space Agency. The complete rocket stands about 150 feet and weighs just under 1.5 million pounds at lift off. The main engine is cryogenic, but the two strap-on solid rockets generate the majority of the thrust. However, they only burn about a fourth of the time during first-stage flight.

The upper stage engine is quite small by comparison, weighing only 21,800 pounds. It provides 100 seconds of powered flight before release of the main payload.

The Ariane-5 design goal is 98.6 percent reliability. The program uses proven avionics, redundant control systems, a cryogenic engine that is ignited and controlled prior to take-off, only four motors (two solid and two cryogenic), and a simplified system architecture.

The Other Passengers

Phase 3D was not the only passenger on Ariane flight V135. The main payload (mounted above P3D inside the payload fairing), weighing in at over 10,000 pounds, was PAS-1R from PanAmSat. It was built by Boeing Satellite Systems, Inc. as a long-life (15 years) replacement for PAS-1. The satellite, when fully deployed, has a wingspan of 134 feet, carries 36 Ku-band transponders and 36 C-band transponders, and

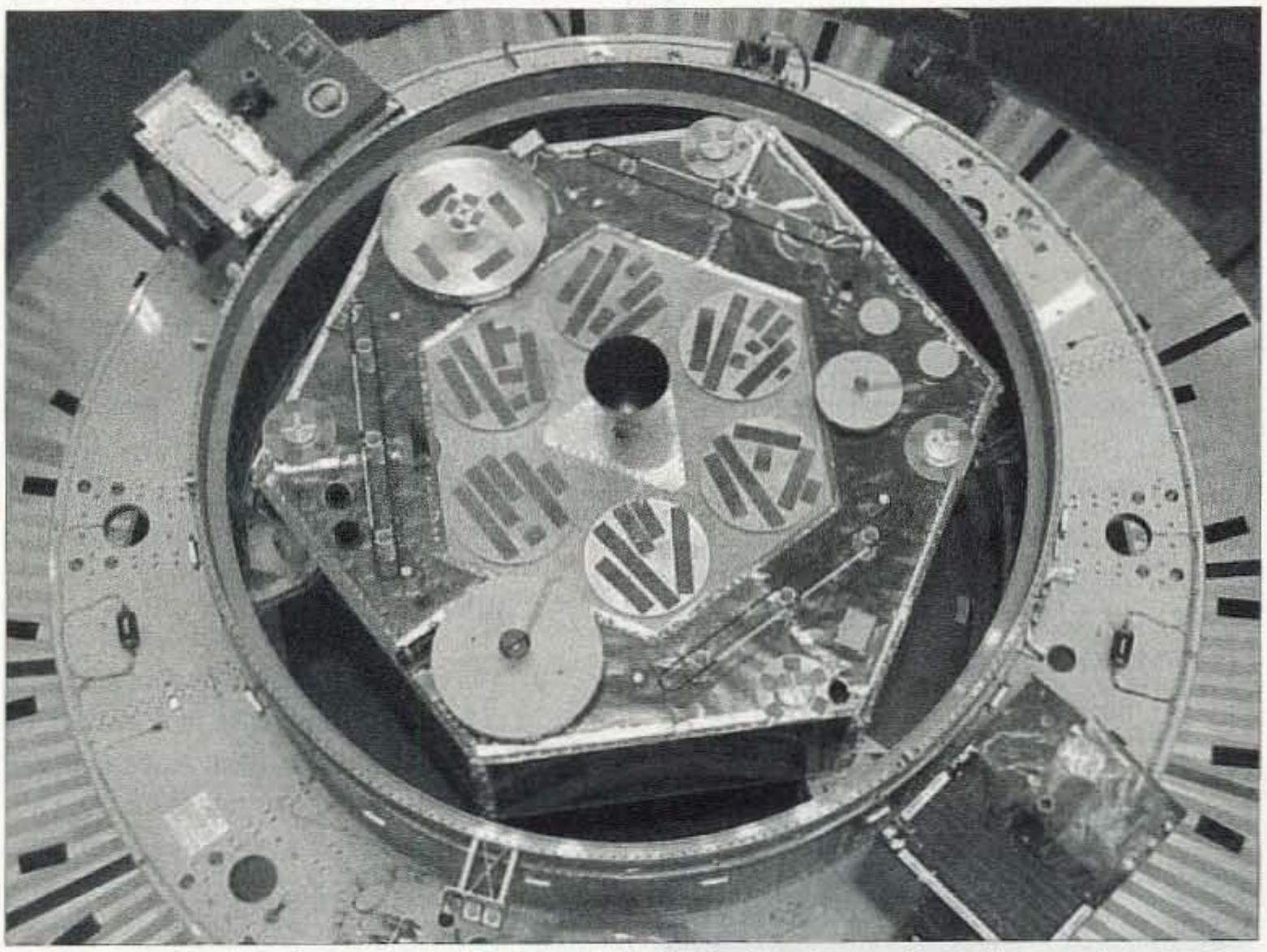

Photo A. *A final look at Phase 3D (now AO-40) inside the conical adapter ring waiting for launch. (AMSAT-DL photo)*

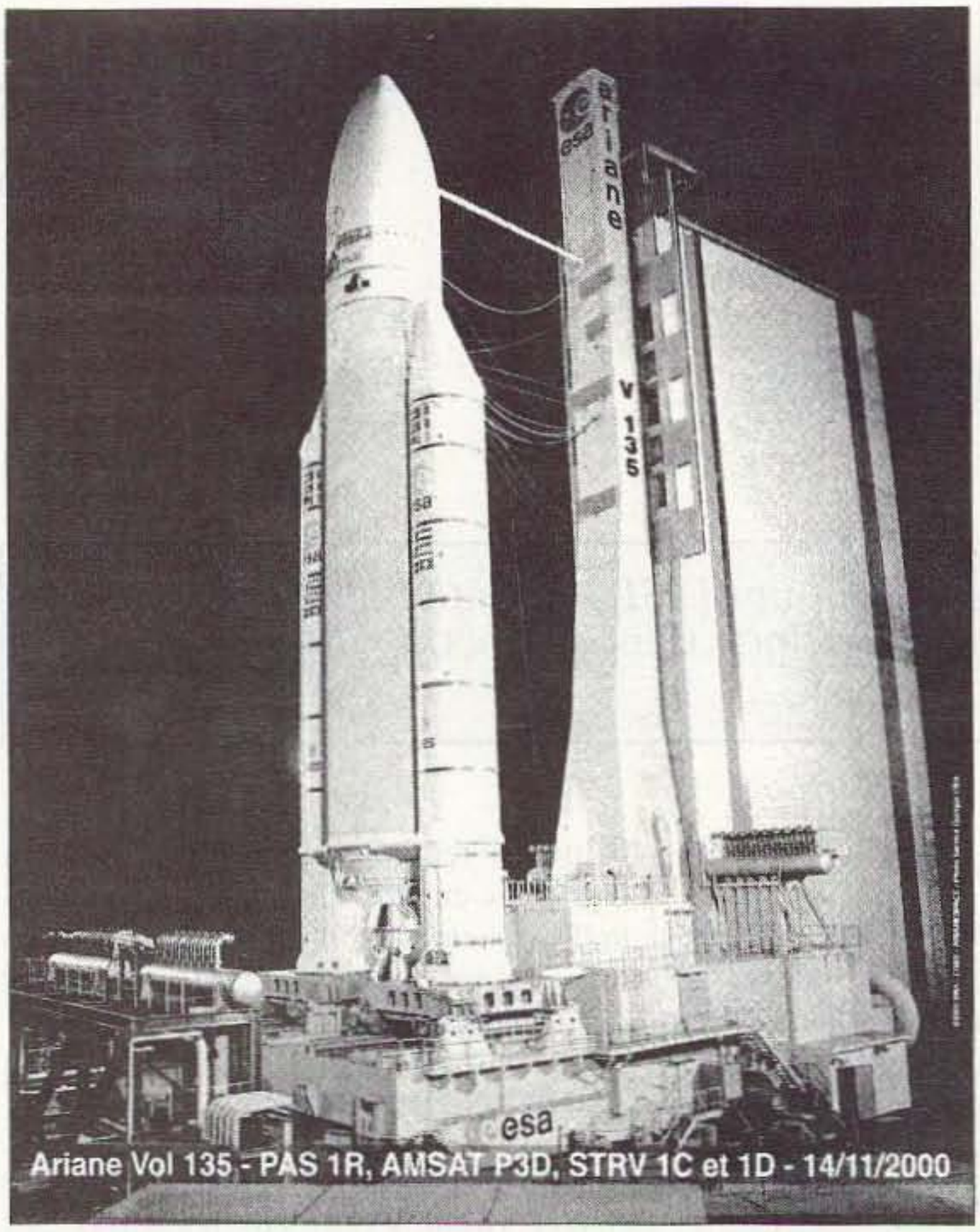

Photo B. *The Ariane 5 launcher just before launch from Kourou, French Guiana. (Arianespace photo)*

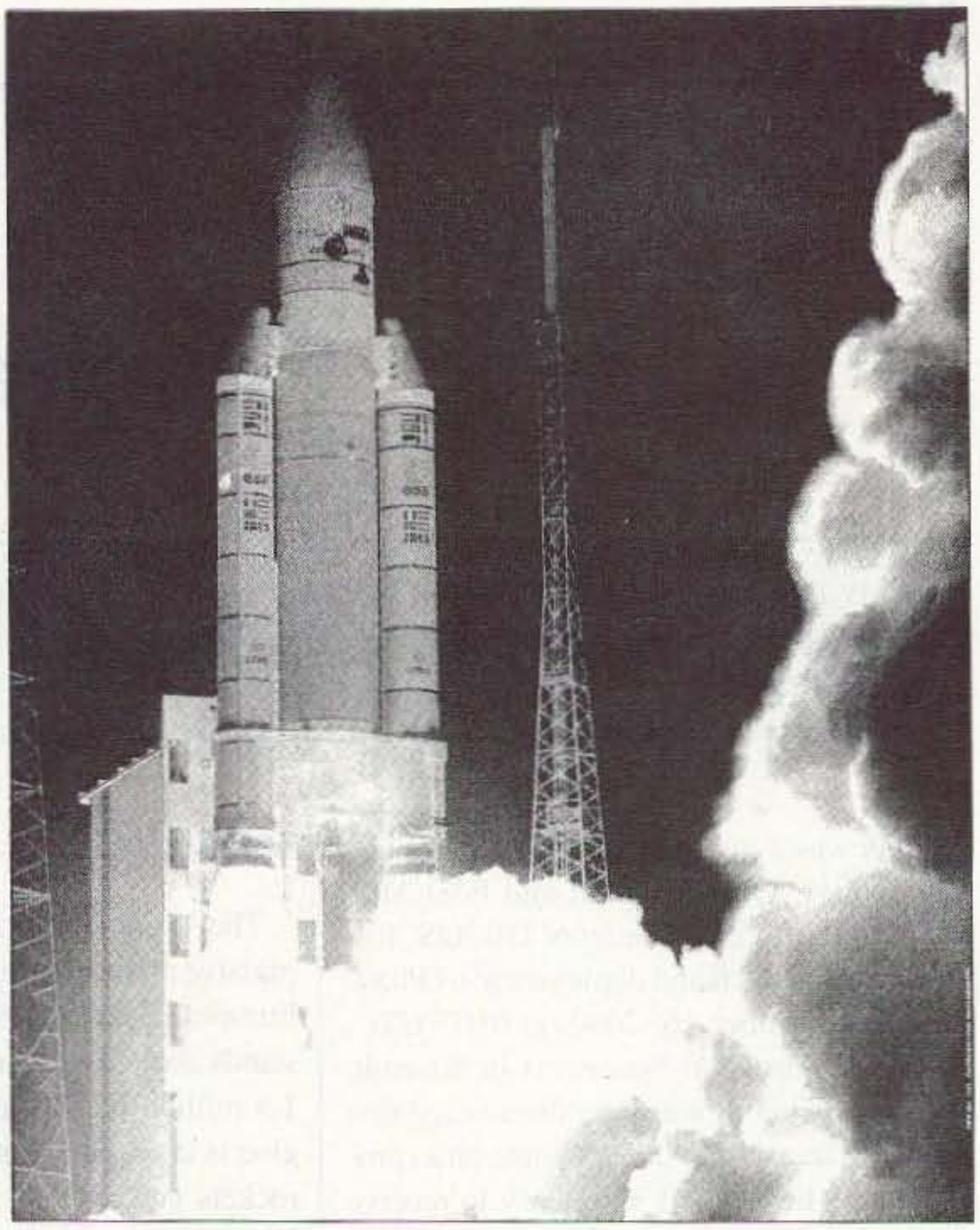

Photo C. *Liftoff of Ariane mission V135 with AMSAT's newest satellite on November 16, 2000. (Arianespace photo)*

has an onboard power of 15 kW. It is positioned at 45 degrees west above the north coast of Brazil in geostationary orbit. PAS-1R's coverage area includes Africa, the Americas, and Europe.

The other two passengers were relatively small (220 pounds each) British military micro satellites, STRV-1c and STRV-1d. They both carry research experiments for digital data communications and were attached to the ASAP (Ariane Structure for Auxiliary Payloads) ring at the base of the payload structure. These British satellites are cubes less than three feet on a side, have a design life of two years, and do not carry any propulsion systems to adjust their orbits. The ASAP ring is designed to carry several small satellites along with the main payload, but for this flight, there were only two.

The Flight

This was the seventh launch of an Ariane 5 vehicle. The first flight, just a few years ago, was a catastrophic failure, but since then the Ariane-5 program has progressed well. This flight carried nearly 14,000 pounds of payload to a geostationary transfer orbit. The perigee, or low point, was 590 km. The apogee, or high point, was 39,000 km, with an inclination to the equator of 6.5 degrees.

While the flight was originally scheduled for a day earlier, there was a communications problem that caused a 24-hour delay. AMSAT members and other hamsat enthusiasts took the wait stoically. What's one more day after years of anticipation?

Nine hours before launch, the final countdown began. All of the electrical systems were checked, the main cryogenic tanks were filled, and at T minus 6 minutes, 30 seconds, the synchronized sequence started. Six minutes later, the automated ignition sequence began. The countdown during the last 10 seconds was in French, but no translation was needed. The "count finale" proceeded to it's inevitable conclusion with the Ariane 5 rising majestically off the pad.

This was a nighttime launch. The sky above Kourou lit up like day as the massive launcher took off. Commentators at the site were awed by the scene and the accompanying sound and vibrations. Camera views of the take-off were shown from various angles and the jettisoning of the solid boosters was clearly visible at 2 minutes, 25 seconds, into the flight. The launch video was available to North America live via C-band satellite. It was on Galaxy 4R at 99 degrees west.

At 29 minutes, the main payload, PAS-1R, was released. Then, at 34 minutes, the

pair of micro satellites, STRV-1c and STRV-1d, separated from the ASAP ring. At 41 minutes into the flight, the ASAP was released. The Y.A.C.E. (Yet Another Camera Experiment) on Phase 3D recorded this event for later download. Finally, at nearly 42 minutes after launch, Phase 3D became an OSCAR. When telemetry indicated a successful separation of the newest hamsat, applause and relief filled the Jupiter control room in Kourou.

Here We Go!

During the last few years I have heard a lot of hams say that they would get into satellite work or join AMSAT when Phase 3D (now AO-40) was up. The wait is over. It's time to check out gear that has been lying around waiting for this day, or to investigate the new radios and antennas that will work with AO-40. It's also a good time to join AMSAT or renew your membership. You can check out the AMSAT Web site [http://www.amsat.org] or call Martha at (301) 589-6062.

It will be a while before AO-40 is fully commissioned. Orbital maneuvers using the main engine and the ammonia arcjet motor will take several months before the target orbit is achieved. The geostationary transfer orbit provided by the Ariane 5 does not provide the ground track and coverage that the satellite designers desire. Through the use of multiple main engine firings and two long periods of arcjet usage at one to two hours per orbit at perigee, the apogee will be raised to almost 48,000 km (30,000 miles), the perigee to 4,000 km (2,500 miles), and the inclination to 63 degrees with respect to the equator. All of these changes may take most of 2001 to complete. When they are done, the solar panels will be deployed and the high-power systems and transmitters can be activated.

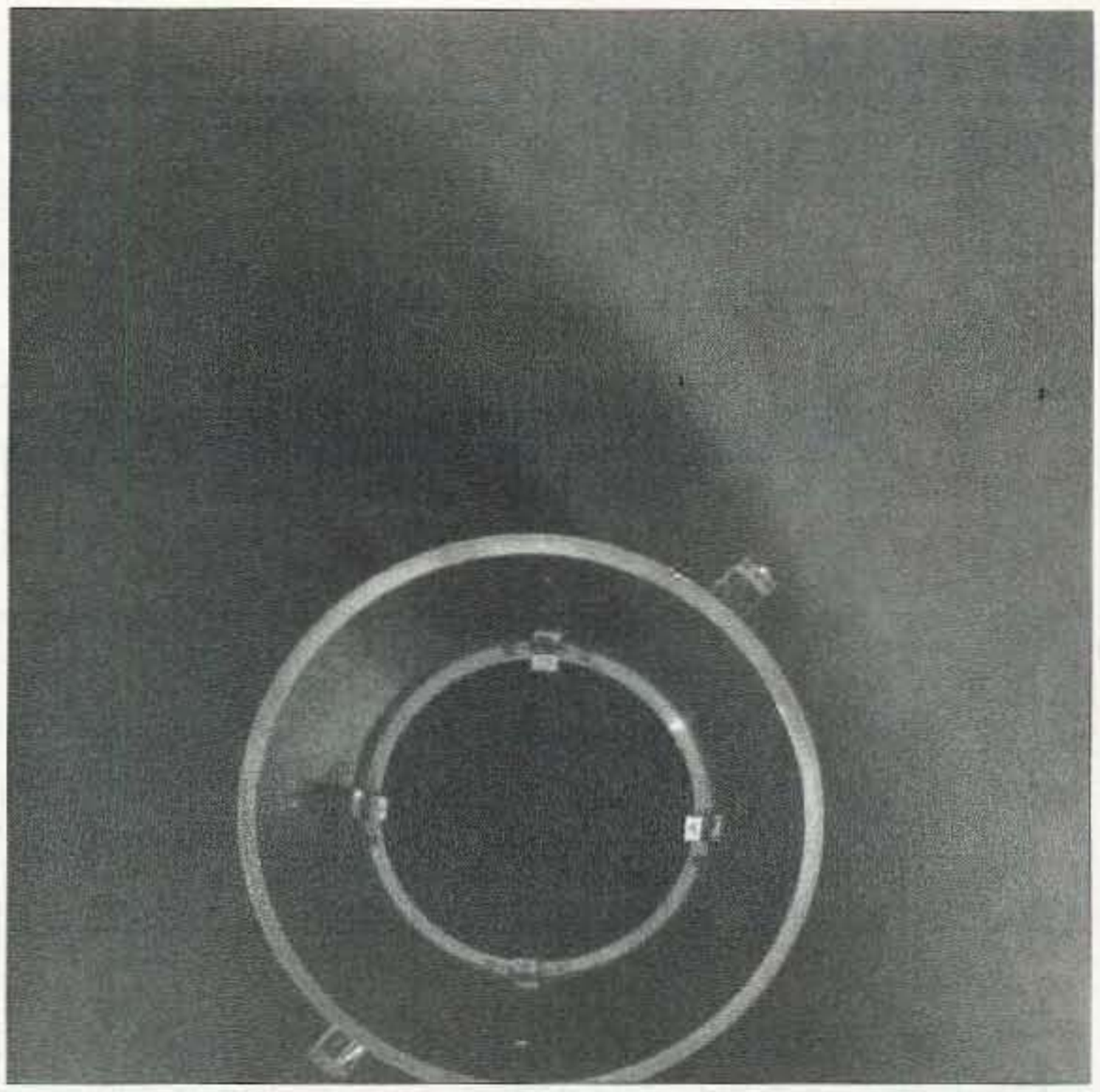

***Photo D.** Y.A.C.E. image from AO-40 of the conical adapter ring separation just before deployment of our newest hamsat. (G3RUH and AMSAT-DL photo)*

In the meantime, there will be periods when the satellite will be made available for amateur-radio communications. This will give hams a chance to check out their ground stations and make some contacts via AO-40. It will also be a good time to learn more about telemetry and orbital mechanics. 2001 will be an exciting year! 73

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[http://members.aol.com/homingin/]

Albuquerque Invites the World to Foxhunt

Last fall, I began researching sites for the first USA championships of international-style foxhunting, which is also called radio-orienteering, foxtailing, and ARDF. "Homing In" for October 2000 explained the requirements for hunt venues, accommodations, hospitality, and so forth. Response was excellent, many discussions were held, E-mails flew back and forth, and now the result can be announced.

The 2001 USA ARDF Championships will take place July 31st through August 4th in Albuquerque, New Mexico. They will be open to all ARDF enthusiasts, including visitors from any member country of the International Amateur Radio Union (IARU). The Albuquerque Amateur Radio Club (AARC) will host.

Headquarters will be on the campus of the University of New Mexico. That's where dorm rooms and cafeterias will house and feed the participants, and training sessions will take place. The formal competitions, one each on 2 meters and 80 meters, will be at nearby well-mapped sites in the beautiful Sandia Mountains.

The AARC, under President Mike Eaton K5MJE, is promoting all types of hidden transmitter hunts in central New Mexico, both on foot and in vehicles (**Photo A**). Chair of the Organizing Committee for the USA Championships is Jerry Boyd WB8WFK (**Photo B**). Readers of *73 Amateur Radio Today* will recognize Jerry as author of the 80-meter ARDF receiver project in the November 2000 issue.

Mike, Jerry, and the rest of AARC want participation from all over the USA and the world. They especially seek entries from Canada, Mexico, and other Western Hemisphere countries. If a team of ARDFers from any other North, Central, or South American country registers, the Albuquerque event could be designated as the Second IARU Region 2 ARDF Championships.

The USA ARDF Championships are for anyone, with or without a ham license, at any ARDF skill level, beginner to expert. Competitors will be divided into appropriate age and gender divisions. Depending on the number of participants and their hometowns, there may also be some stateside geographical divisions to encourage friendly rivalries. Perhaps it will be North versus South, or East versus West.

Photo A. *Albuquerque, New Mexico, has had regular mobile hidden transmitter hunts like this one for about a decade. Now AARC members are adding on-foot hunts to their club activities.*

Victoria Seeks Foxhunters, Too

There's another opportunity to display RDF excellence this coming August. The Seventh Friendship Radiosports Games (FRG-01) take place in Victoria, British Columbia, from August 7th through 10th. As described in this column many times (most recently in October 1999), the Games are a biennial tradition of Friendship Amateur Radio Society (FARS) chapters in USA, Canada, Japan, and Asiatic Russia. FRGs include CW sending, receiving, and pileup competitions, HF QSO contesting, and a two-meter on-foot foxhunt.

The four participating FARS countries will select their team members in coming months. You can apply for a position if you're an experienced radiosports fan living in one of them. Team sizes are limited. Contact Kevin Hunt WA7VTD of FARS-USA to apply for the USA's team, or Perry Creighton VA7PC of FARS-Victoria for the Canadian team. Electronic and postal addresses are under Resources below.

If you just can't get enough ARDF fun, it's possible to attend both these events. The time between them is just right for a scenic drive (and ferry) from Albuquerque to

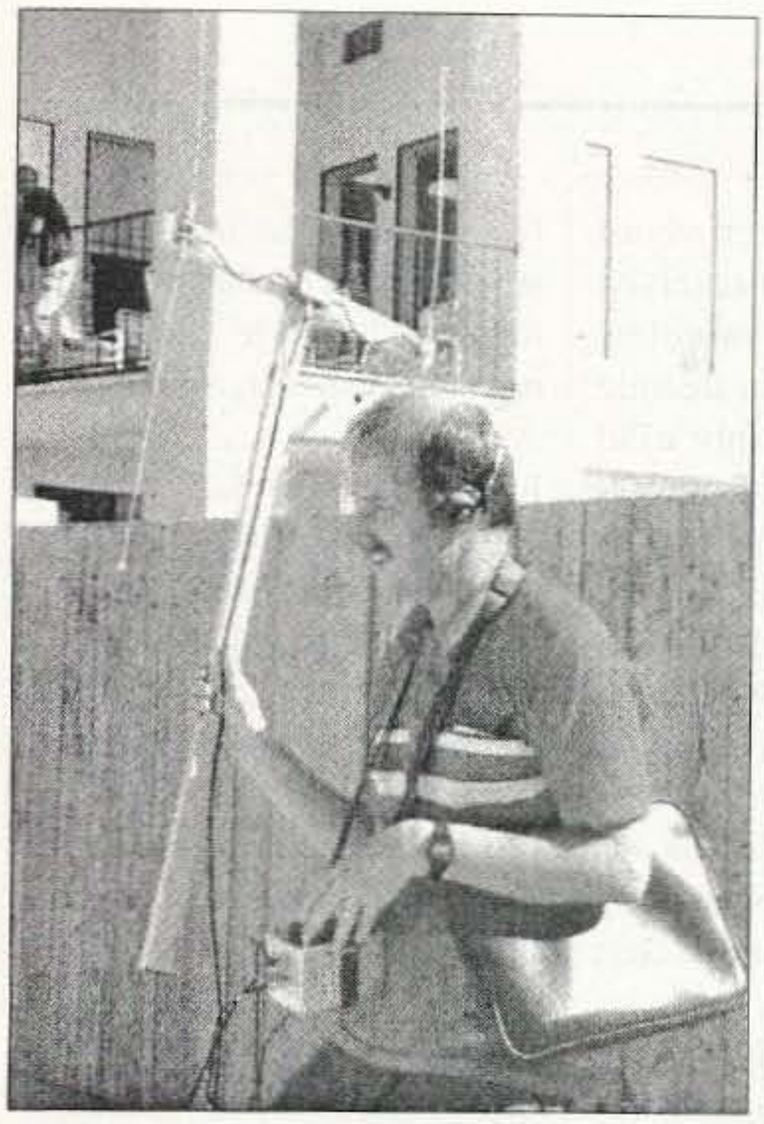


Photo B. *Jerry Boyd WB8WFK, who led the effort to bring the 2001 USA ARDF Championships to Albuquerque, enjoys designing and constructing his own RDF equipment. He built this dual-antenna RDF add-on unit several years ago.*

Photo C. *Three ARDF Team USA members, just back from the World Championships in China, were honored in Placentia, California, on October 28. Left to right, they are Marvin Johnston KE6HTS, Jay Thompson W6JAY, and Richard Thompson WA6NOL.*

Victoria by way of Four Corners, Salt Lake City, Boise, and Seattle. With a little preplanning, you could have time to stop and see Canyon De Chelley National Monument, Natural Bridges National Monument, and Capitol Reef National Park. Maybe we'll have a mobile convoy!

Even if there's snow on the ground where you are right now, it's not too early to start making plans for your Y2K+1 ARDF adventures. Get your portable direction-finding gear built and tested so you'll be ready to start training when the weather warms up. Details and registration information for both events are available by mail and on the Web, as listed in Resources. You'll also find links and updates for these and other upcoming ARDF adventures at the "Homing In" Web site.

Feed 'Em and Fox 'Em

I can tell that interest in ARDF is growing by the increasing number of letters and E-mails asking about local events. Our "world class" radio-orienteers are scattered throughout the country, so they often have to travel long distances to attend events and get experience. Almost all of them are working to develop local interest in the sport, if for no other reason than to give them more practice opportunities. They are excellent teachers and are eager to help new foxtailers learn the rules, choose their equipment, and develop their technique.

Of particular note are efforts of Marvin Johnston KE6HTS in Santa Barbara, Bob Frey WA6EZV and Dick Arnett WB4SUV in Cincinnati, Sam Smith N4MAP in Atlanta, and Jerry Boyd WB8WFK in Albuquerque. They each put on several training events in the past year. Dale Hunt WB6BYU of Portland (OR), Charles Scharlau NZ0I in the North Carolina Piedmont, and others are stepping up their efforts.

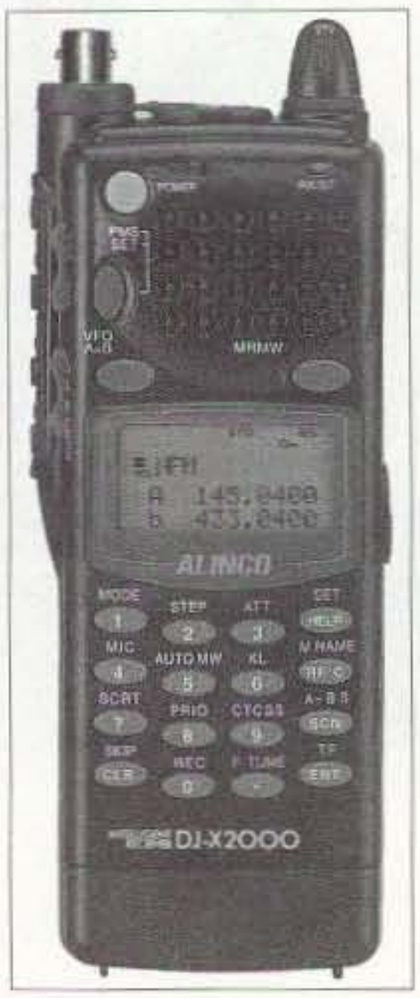
If you are close to any of them, get involved! If not, the task of developing ARDF locally is yours. With the help of other hams in your town, it can be relatively easy and fun. This may be just the activity to shake the doldrums out of your club. Start planning now!

An excellent way to increase the interest and participation in radio-orienteering is to make it a social event. That's how the SuperSystem UHF repeater network of southern California welcomed two of its members home from the ARDF World Championships in China last October. They fired up the grill at Tri-City Park in Placentia for a cookout of hamburgers, hot dogs, and Korean barbecued ribs, followed by a bevy of desserts that included the official Welcome Home cake (**Photo C**).

Then it was time to hunt transmitters.

Continued on page 50

New Products



Alinco Announces New DJ-X2000 Hand-Held Wide-Range Scanning Receiver

Alinco USA has announced the release of the DJ-X2000, a "new generation" wide-range receiver expected to be available in the North American marketplace this month. With continuous coverage from 100 kHz to 2150 MHz (cellular band excluded), the DJ-X2000 offers a broad package of functions and features not found in other scanning receivers. The new unit receives most common modes, including CW (Morse Code), wide FM, narrow FM, AM, upper sideband, lower sideband, and FM stereo broadcasts.

"Alinco designed this receiver to meet the needs of the listening enthusiast and for professionals in public safety and news gathering operations," said Katsumi Nakata KE6RD, Branch Manager for Alinco USA. "With 2000 memories, on-board 'help' navigator, hidden transmitter detection, and more, we are confident in saying there is nothing quite like it in the marketplace. It is such a fresh design, we have applied for two patents on new circuits included in this unit."

The DJ-X2000 features alphanumeric channel naming, is computer programmable, receives FM stereo broadcasts, has an instant "Flash Tune™" feature that can lock onto nearby signals, a frequency counter for checking radios in the field, and a digital recorder that can record a user voice memo or received audio for over two minutes. The receiver can also decode CTCSS tones commonly used by FM transmitters and can associate a tone associated with a given memory channel.

A Ni-Cd battery (EBP-37N) and quick charger (EDC-88) are included, and the receiver accepts battery packs used in several other Alinco radios. In addition, it can be powered by 12 V external DC, found in base or mobile operations.

Some technical highlights include a Digital Temperature-Compensated Crystal Oscillator (DTCXO) for frequency stability that is accurate to 1 ppm and technically superior to older TCXO designs. The dot matrix LCD display conveys an amazing amount of information, depending on the function the user has selected. From the relative field strength meter to graphic displays of band activity, it keeps the operator informed of its operations. The on-board "Help" navigator guides the user through most functions and features and can instantly instruct the user to change settings for the function in question. A new antenna design boasts increased sensitivity, improved low-end performance and a conventional BNC antenna terminal that allows easy connection to external antenna systems. A two-level attenuator reduces strong or interfering signals 6 or 20 dB.

Alinco expects a strong demand for the DJ-X2000, saying it may take some time for production to catch up with demand. The DJ-X2000 is the latest wide-coverage receiver to come from Alinco, which manufactures other receivers and a wide variety of transceivers for the amateur radio marketplace in North America. MSRP for the DJ-X2000 is expected to be US $650, but dealers frequently discount from manufacturer's price guides.

For further information, contact Alinco USA, 438 Amapola Ave., Ste. 130, Torrance CA 90501; tel. (310) 618-8616; fax (310) 618-8758; site [www.alinco.com].

Hamcalc Software

Hamcalc version 48, released last November, has many new programs and upgrades of existing ones. Over 250 painless math and design programs for radio amateurs and professionals, used worldwide as a design, reference, and learning tool since its introduction in 1993. Most programs can be run in either metric or imperial/US units of measure. Contains much information not readily found in current amateur handbooks and literature, but easy to use even for nontechnical hobbyists.

For a free Hamcalc CD-ROM, please send US $7.00 in check or money order (no stamps or IRCs, please), to cover cost of materials and airmail to anywhere in the world, to George Murphy VE3ERP, 77 McKenzie St., Orillia ON L3V 6A6, Canada. E-mail: [ve3erp@encode.com].

Mini-News from MFJ

• MFJ heavy-duty conventional regulated power supplies are super clean — no RF hash! Excellent for HF or 2m, 440 MHz transceivers and accessories. The MFJ-4322 delivers 22A surge and 20A continuous at 13.8 VDC. Its massive transformer, heat sink, and heavy-duty construction add up to over 19 lbs., and measure 8Wx4-3/4Hx11-3/4D inches.

• The MFJ-4312 delivers 12A surge and 10A continuous at 13.8 VDC, and weighs over 13-1/2 lbs. 8Wx4-3/4Hx10-1/4D inches. Like the 4322, it is highly regulated, with load regulation better than 1.5%. Extremely low ripple voltage — less than 40 mV.

• MFJ's 1717PL Back-of-Radio Antenna plugs into your 2m/440 MHz mobile or base rig in the shack. Fold antenna vertically, and you're ready to operate — no more coax tangles, finding a place to put a magnet mount, or putting up an outside antenna. This is a foldover dual-band flexi-duck with a quality PL-259 connector. 16-1/2 inches long. 2.15 dBi gain on 440 MHz; full-size quarter wave on 2m. Factory-tuned for minimum SWR. $24.95.

For further information, please contact MFJ Enterprises, Inc., PO Box 494, Mississippi State MS 39762; tel. (800) 647-1800; fax (662) 323-6551; E-mail [mfj@mfjenterprises.com]; site [www.mfjenterprises.com].

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Photo D. *Ryan Millard had his dad (Bob KE6JI) teach him to use RDF gear as they found the six easy two-meter transmitters at Tri-City Park. Then Ryan went out by himself to find the hard ones. Is he a future ARDF champion?*

Homing In

continued from page 47

David Corsiglia WA6TWF and John Luthy KF6QCQ of the SuperSystem took groups of people out into the park to learn how to hunt three 440 MHz foxes. On 2 meters, I had a total of 11 transmitters to be found. Six of them were in easy-to-spot ammunition cans on separate frequencies for beginners. Each was on the air for about 7 seconds, then off for 30 seconds, then on again, and so forth.

For the would-be experts, I had an undisclosed number of micro-T's. (There were five, but they didn't know that for sure.) All were QRMing each other on 146.565 MHz, the southern California T-hunt frequency. One transmitter was in the rafters of a gazebo with its antenna in the clear. It was intended to jam the others, which were under the bleachers of the ball field, buried under some ivy, and so forth (**Photo D**). Who would find them all in the shortest time?

For those that finished that task quickly, a hidden 80-meter transmitter awaited, with hunting gear to find it available for loan. You may not be ready for such an elaborate event right away, but don't let that stop you from adding a simple transmitter hunt to a springtime cookout for your ham club. Maybe you'll discover a future ARDF champion!

How to Divide?

Even if you're too young to drive (or too old), you can participate in on-foot foxhunting. Team USA members competing in China last year ranged in age from 15 to 59. As in most long-distance events (such as 5k and 10k runs), there are IARU ARDF age and gender divisions at formal ARDF events so that teenagers aren't competing directly against senior citizens.

When foxhunting championships began in Europe about 20 years ago, the age range of competitors was rather narrow. Juniors were boys under 19 and Seniors were men 19 and up. As competitors aged and more older hams joined in, a division for Old-Timers (males 40 and up) was added.

In 1996, as the average age of foxtailers continued to increase, the Europeans added a separate division for males 55 and up, called Veterans. All this time, there has been only one division for females, regardless of age. That's hardly fair when you consider that the only woman on Team USA 2000 in China would have been a Veteran if she had been male. She was up against all ages in her gender division.

To date, formal ARDF events here in IARU Region 2 (North and South America) have usually followed the European/Asian age/gender categories. For next year's USA (and possibly IARU regional) Championships, it's time to decide if that will continue, or if we should go our own way.

In 1997, a committee was formed in Europe to propose revisions to the IARU ARDF rules. Of all the topics being debated, the one of most interest to us in the Western Hemisphere has been realignment of the age/gender divisions. The latest proposal (Version 2.4b, issued last August) calls for five male divisions and four female divisions. Age breaks for men would be at 19, 40, 50, and 60. For women, the dividing ages would be 19, 35, and 50.

As in the present rules, a person of any age could choose to compete in the prime-age division (19–35 for women, 19–40 for men), where they are required to search for all five hidden transmitters. All other divisions must search for four of the five, except for the highest age division (women over 50, men over 60), which would search for only three in this proposal. They can't choose for themselves which three or four to find, as that is determined and announced ahead of time for each division.

The new European rules are still undergoing some fine-tuning. Some parts, such as improved starting procedures for very large events, are already being tested. They are expected to be finalized in about eight months, then approved by the IARU Region 1 General Conference in 2002.

Should we adopt these new divisions here in Region 2? Or should we consider a similar plan that would leave male age divisions

Continued on page 61

Photo E. *At local radio-orienteering events like this one in Thousand Oaks, California, foxtailers of all ages can compete for the same prizes. For regional, national, and world championships, age and gender divisions are essential.*

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SSTV 2001

You don't need to spend a lot of money to have fun with pictures. Not anymore, anyway. With the advent of so many soundcard programs, many hams already have the setup in place to get right into SSTV and have a ball.

You will find it is really easy and the cash outlay can be minimal or none depending on your approach. Ideally, we would all like to have a digital camera to put images into our computer as soon as we snap a great shot. And many folks do. I haven't arrived there yet and life is still good in the image-on-disk arena. I do have a scanner, but they are reasonable these days if you want to go that way.

If you wish, there are other avenues. Most folks in the digital radio mode have Internet access. There are many great opportunities to lift excellent images from there. In any event, you will want a method of editing your images. In my case, I find it necessary to do a little tweaking with a low cost graphics program after scanning. I am using Paint Shop Pro 6. The price tag on that was about $100 and it does most anything I need. I am not a stickler for perfection and cannot justify the high end programs that cost 5 or 6 times as much.

So, what am I saying? If you are set up to do, for instance, PSK31 and want to get a few image files together on disk so you will have something to send over the air, you can get into Slow Scan Television for a trial run with a free demo download and a little learning time (usually very little, it is easy and the programs are intuitive).

I did this a few years ago and then got caught up in all these other digital programs and set the SSTV on the back burner. I decided it was time to revisit this area and I am glad I did.

Here is what I did to get going. I checked into the ChromaPIX Web site (**Table 1**) and downloaded the latest version of the SSTV software. I also downloaded and printed the manual, which is in Adobe Acrobat format. There is a real advantage to that format. First the software to open and print the file is free and secondly, the illustrations come out just like the day they were recorded.

The manual is about 30 pages and very informative with many screenshots and explanations of every button and control you will see on your monitor. I wouldn't tackle this project without that kind of assistance.

To make matters even simpler, the installation was a snap. I had an earlier version of ChromaPIX on the hard drive and the instructions were to remove that one which I dutifully did. The installation then progressed without a hitch.

I had brought up the old program a week or so ago and was not able to make a recognizable copy of any SSTV signals, so I thought I was going to have to do some adjusting with the new software before I could get started. There are plenty of instructions should this be necessary, and I wasn't terribly concerned.

So, as it happened there was no tweaking necessary. I tuned in the popular 14.230 MHz and waited a short time to hear an image being transmitted, clicked receive on the monitor, and — Presto! — there came an image that was perfectly defined. Well, except for the small problems caused by interference that crops up often in a 1,000-mile path.

I was pleased. The copy on the monitor was acceptable in keeping with the noise I could hear on frequency. Next, it was time to assemble a few images in a file. You will find most hams who work with SSTV have a huge file of digital images. I haven't "arrived" at the time of this writing.

I started with a scanned image that I put a few words into just for fun. Then I got a little antsy to get going and lifted a couple of colorful images from news sources I came across on the Internet. These weren't exactly entertaining, but gave a simple basis for some testing ground.

The next process was to gain some attention via SSB so someone would be ready to receive. First chance I had in midafternoon, the path from here to where the activity was, wasn't doing me much of a job. No one responded for about the first hour to my break-in calls. I was beginning to feel doomed or neglected, at least.

Suddenly a louder signal popped up that was a bit closer and we exchanged a few images. I got to watching the meters as the images were transmitting and realized I was transmitting the pictures at slightly below 25 watts.

That would explain some of the poor copy on the other end. The reason for the problem was easy to explain. I had been using relatively low power on the other digital modes and the soundcard driver was adjusted for decent performance with PSK31.

While the second image was on its way out the coax, I brought up the Windows control panel and boosted the drive. The response at the other end told me I was doing right. The meter showed the transmitted signal was now 50 watts. Much better.

I was now receiving reports that the images were just about perfect at the other end. Some of the improvement wasn't strictly power. As it happened, at least one of the stations I had barely copied from across the continent an hour or so previously came on, and the reception was now excellent.

There are a few other tricks that are necessary when working digital modes. One of the major concerns is that when the PTT automatically opens the mic circuit when you are ready to transmit, most transceivers broadcast every noise in your shack, via the mic input, along with the modulated SSB signal. It gets confusing at the receiving end, among other complications.

It is fairly easy to overcome this problem when using one of the PSK31 programs or

Fig. 1. ChromaPIX screenshot — *This is what you see on your monitor. This was an off-the-air shot. The image is one I scanned in using the CSCAN module that comes with the package. I scanned using the option "clipboard." Then pasted to my graphics program and separated the several pics from the album page, then to the image file to be brought up as you see here. On the left are some slider adjusters which I tweaked a little to get the best resolution before this screenshot. The lighthouse in the upper right is still a bit hazy, but that may have been so in real life. The tabs above the sliders open other editing options. At the bottom left is a histogram for the image-keepers who are "pure-in-heart." Directly below the image are options for arranging borders and shading and inserting insets in the image. Below these controls is a well thought out file management system. The right panel is for controlling the interface with the radio, mode selection and tuning indicators. For a full description of all you see here, go to the Web site and download the manual. Won't cost you a dime to give it a look-see. Plus the full-working program can be downloaded for free while you are there. It will run for 30-minute intervals without registration. See The Chart for the URL.*

MMTTY or any of the other great digital communications programs, because all that is really necessary is to unplug your microphone. What it can't hear, it can't send. However, with the SSTV mode, you will need the microphone in between sending images so you can communicate with the other stations.

Fortunately, my new Icom rig was designed to eliminate the problem. It has a SSB digital option that can be chosen from the front panel. It is quick and sure, just hold down the SSB button for two seconds and the mic is dead even with the accessory port PTT actuated.

There are other options available for the average rig. A simple solution is to cut the mic feedline and install a switch. I have talked to folks who are using this method. It works every bit as well as the push-button on the Icom.

There are other easy fixes. I believe several of the store-bought interfaces provide a switch in the box that allows the same function. All it took was a few thousand hams with the same complaint and along came the answers. Most likely other late model rigs are coming with a similar option and I am just not aware of it. As a matter of fact, I wouldn't have realized it was available on the Icom except in reading some aftermarket material. The info is probably cleverly hidden in the owner's manual and I missed it.

I can't criticize documentation too much. I was just recalling how I read the ChromaPIX manual and saw so many useful sounding features then quickly forgot them. I am now discovering them all anew and thinking, "Where did I read about that?"

You will probably do the same thing. This software is filled to the brim with bells and whistles. One that comes to mind is clicking — or is it double-clicking? — on the image and it automatically enlarges to several times its "normal" monitor size. Very nice when the sending station starts asking what you see in the image.

You will find a lot of options to choose from as you go through the setup process. One that I wasn't sure if I had chosen (may be default) is when you have the program in the "Auto-Receive" mode, it not only recognizes a transmitted image but will select the correct mode to receive. I learned this from watching as a different transmitted mode came in, the SSTV mode in ChromaPIX immediately changed to match. A very nice feature, especially if you miss what the other operator states as the SSTV mode.

You will soon find SSTV is just as addictive as any of the other digital modes. And you will also find the folks who are already into the mode are extremely helpful. You won't fail. I was discussing some of this with another ham who was just trying out the ChromaPIX. He was remarking about the encouragement he was receiving as well as constructive advice. My thought is that most of the hams who are involved have seen the oft repeated problems and recognize them right away. And here is a place where a picture is truly worth a thousand words. The explanation of the symptoms are right there on the monitor.

I mentioned about building image files which organizes your efforts to recall stored images after a few days. ChromaPIX is all set to help you with this file management. You can instruct the program where to save the images you receive over the air with an Autosave function and, if you don't mess with the process, the files will be numbered for help in recall later.

You will find editing capabilities to aid in customizing the image as well as adjusting the colors. I find that often the color needs help after scanning an image into the system. I also have a separate graphics program for the heavy duty resizing, file conversions, etc., but for the most part, there is enough to add whatever special effects you want within ChromaPIX.

There are two other "extras" included in the package. One is a module to import directly from your scanner to ChromaPIX or to the Windows clipboard. This can be a step-saver. Plus, there is a module to import from your video camera. I am having a difficulty with my scanner which requires a few extra steps to establish communication with Windows. I found the ChromaPIX scanner module reacted the same way which meant no new learning curve and it worked as promised.

You will discover a nifty feature that is allowed between ChromaPIX users. When

you are receiving an image from another user and he has the "caller ID" function enabled, his callsign will be displayed below the image and will remain encoded in the image so you will know later where the image originated when you view it from your file.

There simply isn't room enough here to comment on all the bells and whistles in the software package. I don't think they covered it 100% in the 30+ page manual. The program is truly sophisticated. They have done a great job and it works. The manual does have many detailed images to guide you by example with setup and use.

You will never really understand what is there until you try it. And the demo is uncrippled and free for the download. The only real encouragement (read: nagging) the software gives you to register is it will simply quit and shut down every 30 minutes until you register (pay money). And believe me, when you are into this program, 30 minutes simply flies by, but you will be able to evaluate quite well within a few 30-minute sessions if this is what you want to do with this mode in ham radio. It IS fun.

A few weeks ago, I had an interesting experience — thrilling by some standards. I was working a bit of PSK31 from my high power system at about 50 watts and signed with the station when I noticed a not quite complete appearing call on the screen — "down in the mud" as we tend to say.

I gave it a reply, though I wasn't sure if it really was for me or was just my imagination. The station came back from New Jersey and, to both operators' surprise, turned into a decent QSO. It turns out he was using one of the little QRP rigs that come as kits and was running 2 watts into a vertical or some other single element radiator. My memory fades a little on that detail.

The point is, here we were at a busy time on the band, plenty of competition for the frequency and he was maintaining very good communication on this narrow mode with minimal radiated power. It speaks very well for the capabilities of PSK31. Hams are doing great things with this mode. There is no need for expensive amplifiers and it is beginning to look like expensive rigs aren't required either.

I was thinking how, about a half century ago, I would snag some DX across the country on 40 meter CW with about 4 watts, but would have to stay up half the night until everything was "just right." Here was a successful QSO on PSK31 at the busy time of day. I was impressed — still am.

Speaking of these things, there is another mode that is doing quite well, and I mentioned it last month. Look around 14.080 and listen for an "out-of-place" SSTV-sounding warble. It is MFSK16. That mode keeps getting busier all the time. Nino IZ8BLY, has a real winner on his hands this time. The software, Stream, is free for the download and listed in The Chart (**Table 1**).

I received an E-mail recently from a ham who was a bit intimidated by the info in this column. It seemed to him I wasn't addressing the needs of the "wannabe" digital enthusiast. I apologized for that, and do so to any who feel this way as well. The reason I started this column a few years back was to develop interest in the digital modes and, in the process, improve my comprehension.

Well, as I explained to the inquiring ham, when I became proficient, the simplicity must have dropped a notch or two. Then I went on to address his specific questions and discovered I was referring him to specific sites I have listed in the chart for further reading to fill in the chinks on the basics. What occurred to me then was I am depending on people to do just that but some of the verbiage I write doesn't point to those Web sites as telling the story. So ... the truth is just about everything I tell you is found on the Web sites I direct you to in The Chart. You scarcely need me for anything but a cheering section <smile>.

If you have questions or comments about this column, E-mail me [jheller@sierra.net]. I will gladly share what I know or find a resource for you. For now, 73, Jack KB7NO. 73

Source for:	Web address (URL):
Mix W Soundcard program for PSK31, RTTY, new modes, MTTY, FSK31, more	http://tav.kiev.ua/~nick/my_ham_soft.htm http://users.nais.com/~jaffejim/mixwpage.htm
MMTTY New RTTY soundcard freeware plus links to other software	http://www.geocities.com/mmtty_rtty/
TrueTTY — Sound card RTTY w/ PSK31	www.dxsoft.com/mitrtty.htm
Pasokon SSTV programs & hardware	www.ultranet.com/~sstv/lite.html
PSK31 — Free — and much PSK info	http://aintel.bi.ehu.es/psk31.html
Interface for digital - rigs to computers	www.westmountainradio.com/RIGblaster.htm
Interface info for DIY digital hams	www.qsl.net/wm2u/interface.html
WinWarbler info and free download	www.qsl.net/winwarbler/
Site with links to PSK31 and Logger 7, also Zakanaka	www.geocities.com/kc4elo/
PSKGNR — Front end for PSK31	www.al-williams.com/wd5gnr/pskgnr.htm
Digipan — PSK31 — easy to use — new version 1.2	http://members.home.com/hteller/digipan/
TAPR — Lots of info	www.tapr.org
TNC to radio wiring help	http://freeweb.pdq.net/medcalf/ztx/
ChromaPIX and ChromaSound DSP software	www.siliconpixels.com
Timewave DSP & AEA (prev.) products	www.timewave.com
Auto tuner and other kits	www.ldgelectronics.com
XPWare — TNC software with sample DL	www.goodnet.com/~gjohnson/
RCKRtty Windows program with free DL	http://www.rckrtty.de/
HF serial modem plans & RTTY & Pactor	http://home.att.net/~k7szl/
SV2AGW free Win95 programs	www.raag.org/index1.htm
Source for BayPac BP-2M & APRS	www.tigertronics.com/
BayCom — German site	www.baycom.de/
BayCom 1.5 and Manual.zip in English	www.cs.wvu.edu/~acm/gopher/Software/baycom/
Int'l Visual Communication Assn. — nonprofit org. dedicated to SSTV	www.mindspring.com/~sstv/
Creative Services Software	www.cssincorp.com
Hellschreiber & MT63 & Stream & scope	www.freeweb.org/varie/ninopo/iz8bly/index.htm

Table 1. *The Infamous Chart ... updated monthly.*

QRP

Low Power Operation

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On to the HW-9

With most of the smaller projects out of the way, as promised, I'll now dive into the Heathkit HW-9 QRP transceiver.

The HW-9 was produced from 1984 to 1991. It was the last of the QRP transceivers Heathkit offered. In fact, the HW-9 was sold right up to the end of kit production by Heathkit. The barebones HW-9 sold for $249.95 without the band pack. It was one of the first kits Heath produced that appeared in the light brown color scheme.

The HW-9, a complete redesign of the HW-8 Heathkit, started out with a clean sheet of paper. The only thing they kept in the old design was the shape and size of the cabinet.

Out of the box, the HW-9 covers the first 250 kHz of 80, 40, 20, 15, and 10 meters. You could add on the optional band kit to get the WARC bands as well.

Unlike with the HW-8, there is no front-end amplifier used in the HW-9. Instead, the HW-9 uses a balanced mixer and a broadband design. There's no front-end peak control to mess with as in the HW-7 and HW-8, thanks to the broadband front end. Selectivity is provided by a 4-pole crystal filter and an active audio filter as well. Selectivity is 1 kHz at 6 dB down and 250 kHz (narrow setting) at 6 dB down. Sensitivity is rated at 0.2 µV.

The transmitter is quite robust in the HW-9. Running at least 4 watts output on all bands except for 10 meters, most HW-9s routinely produce over 7 watts of output. The RF output is continuously variable.

The HW-9 does not include an internal power supply, and requires 12.6 volts at one amp. It will work from 11 to 16 volts.

Also included in the HW-9 was full break-in CW. This worked OK until you got up around 20 wpm — then the keying got a bit sluggish and started to run the characters together.

Heath also included an S-meter that worked on receive, too. Just bells and whistles, but nonetheless it is an S-meter.

Building the HW-9

The HW-9, like any other Heathkit, needed to be assembled. For the HW-9, all you needed was a VTVM and frequency counter. Instead of counting parts and checking them off, this time Heathkit had the parts mounted on tape. You then cut out the part and inserted it into its proper location on the PC board. You repeated the step until the tape segment was used up. I built an HW-9 using this method, and although it is a lot easier than looking for a part in a pile of parts, it's not much fun! Clearly, many could see the changes coming down the road for Heathkit.

There are two PC boards inside the HW-9. On the top half of the HW-9, you find the oscillator board. And just as the name implies, all the oscillators used by the HW-9 are located on this PC board, including the VFO. On the bottom half of the HW-9, you'll find the T/R circuit board. Here the filters for the front end and band switches are located. Also, the final amplifier transistors are located in a cramped corner of this board.

Operating the HW-9

If you've worked with an HW-8, the HW-9 superhet receiver will surprise you. No longer do you have to be sure you're on the correct sideband to make a contact. The audio filter works great, and there's plenty of audio to drive a speaker if you desire. The QSK, while a bit sluggish at higher speeds, does work quite nicely. And overall, stability is typically less than 500 Hz after a 30-minute warm-up. The rig will settle down to 150 Hz per 30 minutes after a 90-minute warm-up.

Some Common Problems

You can't mention the HW-9 without talking about the VFO drive. They have a history of drive troubles. Mainly, the VFO slips as you try to tune the radio. Luckily for us,

Photo A. *Here's the QRP station of Mike Kassay VE3MKX. Top row, left to right: HW-7, HW-8. Bottom row: HW-9 with speaker, and wattmeter/antenna tuner.*

Heathkit quickly became aware of the problem and issued a fix. Here is the official Heathkit fix for the VFO drive problem. One caution: The parts listed in the fix are obviously no longer available from Heathkit, so some "field forming" may be necessary.

May 29, 1987
HW-9 QRP CW Transceiver
Bulletin No.: HW-9-8
VFO Dial Slips or Binds

Since the introduction of the HW-9 transceiver, it has had a history of VFO dial slipping or binding problems. These problems are caused by different parts of the VFO assembly. Here are some of the areas of the VFO assembly which cause the slipping or binding problems and some fixes to correct them. Also given is the new method of mounting the VFO capacitor. If all else fails, make the changes given in the "New VFO Capacitor Mounting Procedure."

The vernier drive assembly (P/N 100-1839) in the first production run of HW-9s didn't meet torque ratio specs. This caused the dial to slip. To identify this vernier drive assembly, see if it uses #6 setscrews. If so, it's an earlier drive assembly. Replace it with a vernier drive assembly that has #4 setscrews installed. These drive assemblies meet torque ratio specs. The drive assembly with #4 setscrews are in second production and later HW-9s, and also in Heath Part Replacement stock.

In some cases, the dial will slip or bind only after installing the VFO shield (P/N 206-2692) over the drive bracket (P/N 204-2692). Engineering corrected this problem by changing the thickness of the drive bracket from 0.041" to 0.030". Because of the small change, it's difficult to tell which drive bracket is installed. If the dial slips only when you install the shield, move the lockwasher on the vernier drive from the inside of the drive bracket to the outside of the bracket. This will allow the VFO shield to slide easily over the drive bracket, removing tension on the drive.

Misalignment of the shafts of the variable capacitor and the vernier drive assembly will also cause dial slippage. If the capacitor frame is not bent at a right angle at either corner, the shaft will be misaligned and the dial will slip. To correct this, install a #6 flat washer (P/N 230-60) between the rear of the capacitor frame and the drive bracket at the two locations shown in Fig. 1. This drawing *[not in this 73 — ed.]* shows the 6-32 x 1/8 screw into the drive bracket, and then the flat washer placed on the screw before it is attached to the capacitor frame.

Photo B. *The Heathkit QRP trio.*

New VFO Capacitor Mounting Procedure

The following method is used to mount the VFO capacitor in the HW-9 transceiver to minimize dial slippage and binding. This change will be installed in the next production run of HW-9s.

Parts required (one each; Heath P/N in parentheses): drive bracket (204-2909); 4-40 x 15/16" screw (250-480); 4-40 nut (252-2); #4 lockwasher (254-9); rubber grommet (73-53).

Procedure:

• Install the rubber grommet at hole GA of the new drive bracket.

• Push the 4-40 x 15/16" screw through the grommet at GA. On the inside of the bracket, place the 4-40 nut and the #4 lockwasher on the screw. Turn the nut about 1/4" onto the screw.

• Set the capacitor/drive assembly into the bracket. Turn the 4-40 x 15/16" screw into the indicated hole of the variable capacitor until the screw end is flush with the inside edge of the capacitor frame. Tighten the 4-40 nut against the capacitor frame.

• Tighten the control nut and rotate the shaft to make sure it turns smoothly. *[End of bulletin. — ed.]*

Next time, I'll take a closer look at the insides of the HW-9, with a few fixes. Also, I'll show you more official Heathkit fixes for the radio, as well as a few modifications. 73

Photo C. *Again, Mike's station, but this time he has added the HW-99 (left), an HW-9 on steroids.*

THE DX FORUM

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Flash! N6NR blows it big time!!

Were you looking for a January DX Forum and couldn't find it? Be assured that your eyesight is totally intact. I had a total flameout on last month's issue. I told everybody it was because I was sick in bed with the flu, which was true. But what really brought me to parade rest was the fact that the whole article was devoted to the latest version of MMTTY. I hope you read Jack KB7NO's review in the DECEMBER issue instead.

Back around September (or was it August?) I wrote a piece on the 25th Anniversary of the founding of the Central Arizona DX Association, and the celebration that was planned. I admit that I had a tiny bit of self-interest in that story, as I am one of those charter members.

As it turns out, I was not able to get down there for the celebration, which was a big disappointment for me. However, a few days ago I received a "care package" from Bob K7BHM, the club historian. In it was some pictures of a few of the attendees. But there was booty as well.

Keep in mind that as I write this, there is snow falling outside, and it is a few weeks before Christmas (darn the production delays associated with printed media). Well, thanks to the CADXA, Christmas has already arrived. What I received was a beautiful coffee mug (no cheap knockoff, this one is really nice), and a mouse pad — both monogrammed with the CADXA logo, and some words commemorating its 25th anniversary year. But that's not all. I also received a very nice blue pen with my name and call engraved in gold lettering. Totally way cool!! I also had a camera flameout this month, so maybe one of the future issues of the DX Forum will contain a shot or two of my newly acquired DX memorabilia.

The reason why I mentioned this has nothing to do with me, but rather to illustrate just what a superb group of DXers the Central Arizona DX Association is, and always has been for that matter. To invest that amount of time and money to honor those who "kicked the flywheel" of this fine organization into motion, speaks volumes about the quality of the people that comprise it. My hat is off to the CADXA, and here's to another 25 years of DXellence!

Hamshack tours

I was supposed to start this feature last month, but oh never mind. Every few months or so, we will take a snapshot of some of the DXers who roam the bands, some great, and some small. In the early installments, most of the material will come from personal Web pages on the Internet. It is hoped, however, that you will take delight in sending some photos and station descriptions, bios, etc., via snail mail.

This month I thought I would feature a ham who is representative of the many newcomers to the joy of DXing. By newcomers, I mean within the last decade. Featured here is Charles Johnston AB7SL, who lives in Prescott AZ. Here is some data about Charles in his own words:

"I was born on December 27, 1950. I'll soon be 50 years of age! I spent the first 27 years of my life in Kansas City KS, minus a stint onboard the nuclear fast attack submarine *USS Aspro* SSN 648 during the Vietnam crisis. Once as a child my dad had me listen on the AM broadcast band late one

Photo A. *Here are the charter members of the CADXA at the Silver Anniversary meeting. From left to right are N7CW, W7IUV, K7SA, N7US, W7XA, K7BHM, K7NN, AA7A, W7RV, N7RK, K6AIA, K7SP, N7MW, N7RT, NE7X, NN6R (no, not a typo).*

night to stations coming in from cities all over the USA. That really was my first experience with my love for radio.

"I moved to Arizona in 1977 and continued working as an electronics technician, primarily on microwave devices and subsystems. I became disabled in 1992 and shortly thereafter got my first ham radio license as a No-Code Tech in May of 1995. By November of the same year I had advanced to the top license (Extra Class), which I enjoy to this day.

"I enjoy working DX (foreign stations) and chatting with my regular friends on the ham bands. Since March of 1996 I have made contact with over 280 different DX countries. I hold several awards such as [http://www.arrl.org/awards/was/], Worked All States; [http://www.arrl.org/awards/wac/], Worked All Continents; [http://www.arrl.org/awards/dxcc/], DX Century Club; and [http://www.cq-amateur-radio.com/wazrules. html], Worked All Zones.

"My lovely wife, Jan, is also an amateur radio operator. We stay in touch over 2m (144 MHz) split frequency whenever either of us are away from home. She has been the best thing that has ever happened to me. To have her makes me one lucky and very grateful guy.

"Obviously computing is another hobby of mine. My typical day is comprised of amateur radio and computing — not too bad, I'd say — my own goal is to make DXCC Honor Roll. My station is modest, I only work single sideband. My antennas are simple dipoles. My battle cry is 'Honor Roll on a Dipole!'"

Charles's station includes the following:

Transceivers:

Kenwood TS450S/AT HF Transceiver 10-160M All Mode 100W.

Two - HTX 212 2m Radio Shack transceivers 45W - one base - one mobile.

HTX 202 - 2m Radio Shack transceiver 7W - used for Packet Station.

Linear Amplifier:

Ameritron AL811-H Linear Amplifier - 800W PEP.

Antennas:

W9INN 5-Band (10-15-20-40-80m) inverted "Vee" antenna 50 ft. above ground.

Home-brew 17m inverted "Vee" antenna 50 ft. above ground.

Ringo Ranger II 2m Base Antenna at 55 ft. above ground.

Comet B-10M 2m/70cm Dual Band Mobile antenna.

Three-element 2m Yagi for DX Packet Cluster at 30 ft. above ground.

Microphones:

Astatic "Limited Edition" Diamond Eagle D-104 on amplified stand.

Astatic 10-DA "Super Sideband" mic on amplified stand.

Astatic "Silver Eagle" D-104 on amplified stand.

Computer System:

Dell Dimension L566cx desktop computer. 566 MHz Celeron CPU. 128M RAM.

56k-v90 modem. 48x CD-ROM drive. 17-inch Dell monior. 7.5G hard drive.

Microsoft Windows Millennium (WinMe) operating system.

American Power Conversion - Back UPS Pro 420 - Uninterruptible Power Supply.

Charles has done a nice job with his Web site. You can view some close-ups of his equipment, as well as some very nice high-resolution photos that are quite pleasing to the eye. You can also catch a glimpse of who he has been working lately. I noticed that he recently worked 9H1EL, and 7X4AN. Not bad. Keep goin'!

I highly recommend that you stop by his Web site, and have a peek for yourself. His URL is [http://www.ab7sl.com]. That should be an easy one to remember.

Vox populi

The December issue saw the inauguration of this section of the DX Forum, and it was very well received. I got hate mail, and great mail as well. Remember that the intention here is to provide a forum for DXers to express their opinions. The only editing these comments might receive is the elimination of tasteless language, which, by the way, has not been necessary.

There has been a certain amount of discussion lately concerning the juxtaposition of high-power and low-power stations in the pursuit of rare DX. Coupled with this discussion is the question as to whether the DXCC Honor Roll is unattainable for those who don't grow aluminum on a 40-acre spread. I don't recall who originally raised the question here, but as it turns out, it is one that has been asked many times over

Photo B. *And here is a smaller group at a reception held at the home of Bob K7BHM. Standing are K7SP, N7MW, K7BHM, W8AEF. Seated are NN6R (again, no typo), N7US, NE7X, K7SA, and W7XA. I can't believe it. The only guy that looks close to what he did 25 years ago is Mike N7MW.*

the years. Here are some comments that are reprinted from the NJ DX reflector (with permission from the respective authors). The thread is entitled: Big Dogs and Little Dogs.

"I'm certainly no big gun with my TS570D and vertical antenna. Sometimes there is a 3-500z active between the two, but with a pair of $2.00 headphones, I've been able to work 318. If the 7O1YGF turned out good, it would be 319. I work them when and how I can, and I've learned to find where the operator is listening in the pileup, which direction his finger is heading, and to guess well where he might be next. I have no spare money to spend on this stuff; one of my kid's health problems takes care of any spare change I might have had, so I chase the DX on a budget. No, I didn't work K5K the first night they came on even though I tried. By the second night though they were in the log. Ultimately I worked them on every band and mode I heard them on. I'm no big gun by any stretch. I have learned the value of patience. — Gary AB5RM."

"I don't agree [that the Honor Role is out of reach for the average DXer]. While I have a $2000 radio and a $2000 kW, I have worked 310 countries since October 1997, only missing a couple to the real BIG DOGS (FR/Glorioso comes to mind). I could just have easily worked all those with my backup TS-930 (around $500 on the used market) and MLA-2500 (also about the same). All with a G5RV dipole strung between two trees about 35 feet off the ground.

"All it takes is vigilance, diligence and patience. 73. — Jim AD1C."

"I worked the millennium award with my 1966 Hallicrafters Hurricane. Final contact was with FOØAAA on 10 meters, split.

"As administrator of the Vintage Radio DX100 Award, I receive applications listing contacts with some rather choice and somewhat rare DX stations done with 'Vintage' gear, some at 40 watts or less.

"Yes, I have some of the most recent ICOM transceivers but the proof is in the pudding; the old gear still does the job and fairly inexpensively.

"As far as HUGE antennas go I worked the K5K group with one (I am waiting for the logs to be posted, but I will stick my neck out) using11 band modes. Unfortunately (for me) the starter capacitor for my rotator that drives the monobanders went out about 2 weeks before they were QRV. Adding to that high winds bound the mast on my other tower (TH6DX at 45 feet) both, as Murphy would have it, ended up locked to the north! That happened midway through their operation leaving the station with verticals and wire. I must admit I did run power on most bands; an IC2KL at about 400 watts.

"Give credit to the ops at the other end. They are there to make QSOs! Listen to their operating habits; study a bit of propagation; forget being numero uno QSO. — Dave Paperman W5WP 7BDXCC(SSB), DXCC (CW), etc., etc., etc."

"I know it is NOT necessary to be a big gun to make the DXCC Honor Roll because I made it. My antenna is a TH-5 at 26 feet on a roof tower. That makes me a 'big gun'? RIGHT!

"There is not now, nor has there ever been, any guarantee to work any given station while you are running high or low power, using a big or little antenna. A lot of QRP operators have made honor roll. Some people think skills are developed over time that help in this endeavor.

"I first made DXCC running 100 watts to a vertical. I spent many, many hours calling in pileups to no avail. But I really felt good when I finally did work them. If you learn to operate, you will make honor roll, but maybe not by tomorrow afternoon. Took me many, many years. — de Vic AE5DX."

"NO NO NO!!! When I made the Honor Roll, the best rig I ever had was a Ten-Tec OMNI D and a Clipperton-L amp that can barely squeeze out 750 watts and a tribander that was never over 50 feet high. I am modestly convinced that my DXCC success is 10% station and 90% operator! — Bill W5EC."

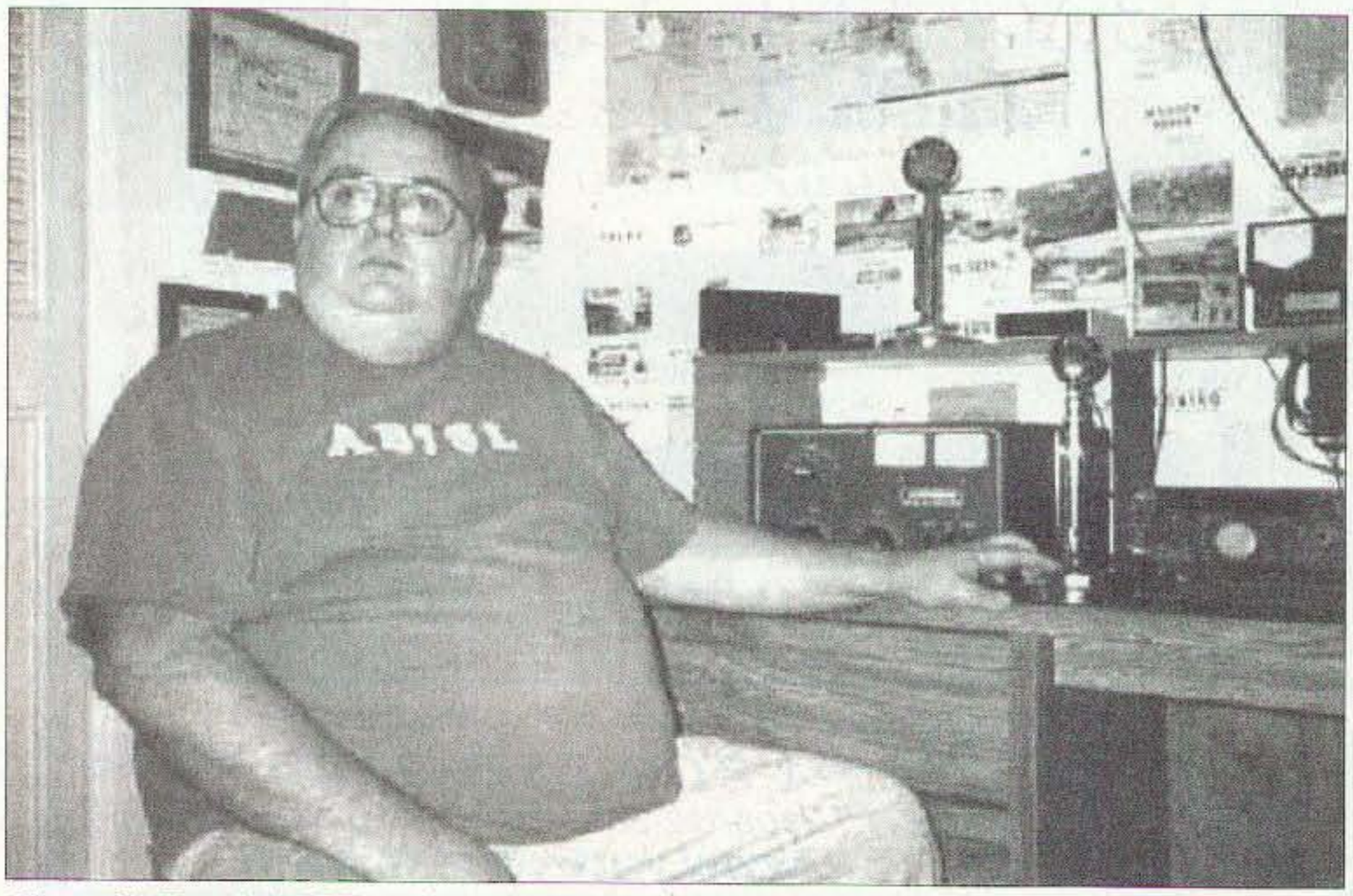

Photo C. *Here is AB7SL at home in the business end of his home.*

Based on the comments above, you may assume that the consensus is that being a little pistol is not necessarily going to exclude you from the lofty goal of ascending to the rarified air of the Honor Roll. In fact, my friend Dave N7KZN and I were just talking about this recently, and he reminded me that he worked over 300 countries with 100 watts and a dipole from his home near Bremerton WA (almost exclusively on CW, I might add). It CAN be done.

After reading through the responses in this thread, I called a couple of my big dog buddies to get their opinions (for their safety, I promised to keep their identities a secret). They both said that they try to come and go quickly, and with their high effective radiated power, they can pretty much "pounce and run" on the first, or second call, and be out of everyone's hair. What I didn't expect to hear was their polemic directed at fellow big dogs who, when they hear a rare one, will obliterate those who are trying to work that station for the first time, and then proceed to carry on a ragchew until favorable propagation has faded away.

So what do you think? Send me an E-mail or a note to the address listed in the header of this column. I promise that your correspondence will be well received, regardless of whether you agree or not.

Pulling the big switch

So much for this month's offering. I hope the opinions expressed in Vox Populi didn't cause you to take offense. It wasn't intended to, at least not by me. Until next month.

73 and good DX! 73

All About Class D Amplifiers

continued from page 22

THD + noise isn't anything to brag about, it is pretty good.

Big brutes of audio amplifiers, kilowatts, can be built with little or no heat sinks. High efficiency audio amplifiers are no longer just academic curiosities. They are here and now. High power class D amplifiers are certainly in the realm of possibility without being a boat anchor. 73

Portable Personal Repeater

continued from page 24

6 dB on UHF with an NMO connector. So why not just use that?

I lined the inside of the camcorder case with aluminum foil so that it will serve as a ground plane as shown in Photo **A**. Obviously, if you use one of those high-end camcorder cases that is constructed of aluminum, the case itself will be the ground plane. These are not as common surplus and are more expensive. To glue the aluminum foil to the inside of the case, I used spray Scotch brand photomount glue. This stuff works great since it spreads well evenly. After mounting the foil, I drilled the hole for the NMO connector and mounted it. When the foam is replaced, the aluminum foil is completely hidden.

Photo B shows the case open as it is ready to be put into service. The insides consist of a power supply for charging the gel-cell, the Alinco 580 which is used as the cross band repeater, and two Yaesu FT-470 dual-band HTs which are used as the radios. Shown also is the optional solar panel. The panel shown only provides about 100 mA in sunlight. It cannot sustain the battery continuously if the transmit duty cycle is high. **Photo C** shows how the repeater was placed at about 5500 feet with the use of snowmobiles.

The repeater worked great. I operated it in McCall ID, and was able to stay in contact with a repeater in Emmett, about 60 miles away. We were at about 2,500 feet on the side of the mountain. The crossband repeater also operated flawlessly from HT to HT, one operating at VHF and the other operating at UHF. It covered the entire line-of-sight area in McCall. I was able to travel easily 15 miles into town and still hit the repeater with a full quieting signal.

So, the next time you plan to travel to some remote ski resort or campsite, consider using a crossband repeater and placing it on the local hill. Just don't forget where you placed it since it can snow heavily during the night and cover up the repeater. You'll be pleasantly surprised how much a 2 watt repeater will extend your range. Also, don't forget to ID that you are transmitting through a crossband repeater. 73

Inside Digital TV/VCR Tuners

continued from page 31

worked following the same process described. As a caution, when cutting the paper mask for IC pins and other closely spaced pad areas, use the knife blade press technique to prevent pulling on the paper. Also, after cutting adjacent pads, brush each with nail polish and allow it to dry. The polish will help hold the paper mask in place during the cutting operation.

When the entire desired trace pattern is covered with nail polish, allow the polish to dry completely — about 30 minutes is sufficient. Then carefully remove the remaining paper mask, exposing all of the copper that is to be removed during the etching process as shown in **Photo F**.

At this time, the board pattern must be inspected thoroughly for trace bridging, errors in the polish placement, etc. Corrections are easily made at this point using a knife blade to remove unwanted polish. Running the tip of the knife blade between IC pads will ensure that the copper is exposed for removal during etching.

If nail polish is missing, or if the trace area needs to be repaired, polish can be brushed onto the copper in those areas. After the polish dries, it may be shaped as desired using the knife blade.

The last part in this series will complete the process of making boards for the data transmitter and receiver. 73

Crystal Oven Controller

continued from page 34

wave. When the controller is switched off, there is still a low level (0.7 Vp-p) voltage on the transformer secondary. This residual voltage produces only about 15 milliwatts of heat. With the new control circuit, after a one-hour warm up, the oven heater cycles on for 4-1/2 minutes, off for 3-1/2 minutes. The average power is only 5.6 watts. For this low power application, the solid state relay stays cool to the touch and requires no additional heat sink.

Continued on page 61

PROPAGATION

Jim Gray II
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Juneau AK 99802

Special Forecast

It looks like solar activity in February will again range from very high to intense. I had been looking for a slight decrease and an associated improvement in conditions, but that is not to be.

Expect poor conditions to persist throughout the month, with only a slight improvement during the last few days. The worst period will be from the 9th through the 15th with a geomagnetic storm being quite likely.

The lower bands and morning gray-line propagation will provide the most interesting opportunities. Stations located in the southern U.S. will definitely have the advantage over northern ones, but night owls and early risers everywhere should fare the best.

Hang in there! — Jim [akdhc2pilot@yahoo.com].

Band-by-Band Summary

10 and 12 Meters

Opens to the east in the morning hours and follows the sun, finally closing in Asia during the late afternoon. No openings are expected at night and daytime performance will deteriorate with the approach of Spring. Short skip usually ranges from 1,000 to 2,500 miles.

15 and 17 Meters

Will provide better daytime opportunities than 10 and 12, especially into the southern hemisphere. Signals peak toward the east before noon, to the south around midday, and to the west in the afternoon. Short-skip can be expected to be about 1,000 miles.

20 Meters

This should begin to improve at night, but is the best overall band for daytime operation. Openings begin at sunrise and last into the evening hours. Short skip will average between 500 and 2,500 miles.

February 2001						
SUN	MON	TUE	WED	THU	FRI	SAT
				1 P	2 F-P	3 F-P
4 F-P	5 F-P	6 P	7 F-P	8 F-P	9 VP	10 P
11 P	12 P	13 P	14 P	15 F-P	16 F	17 P
18 F-P	19 P	20 P	21 F-P	22 F	23 F	24 F
25 F-G	26 F-G	27 F-G	28 F			

30 and 40 Meters

Best at night. Africa, the Middle East, and Asia ought to provide the most opportunities. These bands should be relatively quiet this month with the most atmospheric noise occurring

EASTERN UNITED STATES TO:												
GMT	00	02	04	06	08	10	12	14	16	18	20	22
Central America	15 (40)	20 (40)	20 (40)	(40)	(40)	(20-40)	(15) 20	10-20	10 (20)	10-17	10 (20)	(10) 20
South America	(15) 20	20 (40)	20 (40)	20 (40)	x	x	(15-20)	x	(10)	10 (15)	10 (20)	(10) 20
Western Europe	40	40	40	40	(40)	x	(10-20)	10 (20)	(10) 20	(15-20)	(20)	(20-40)
Southern Africa	(20-40)	(40)	x	x	x	x	x	(10-12)	10 (17)	(12) 17	(15-20)	20
Eastern Europe	(40)	(40)	x	x	(20)	x	(10-20)	(10) 20	(20)	x	x	x
Middle East	(40)	(40)	x	x	x	x	(10)	(10-15)	15 (20)	20	(20)	(20)
India/ Pakistan	x	x	x	x	x	x	x	(15-20)	x	x	x	(20)
Far East/ Japan	(15) 20	20	(20)	(20)	x	x	(20)	x	x	x	x	(10-20)
Southeast Asia	(15-20)	x	x	x	x	x	x	(10-20)	(10-15)	x	x	x
Australia	(10-17)	(15-20)	x	x	(20)	(30-40)	(20-40)	(10) 20	(10-20)	x	(20)	(10-15)
Alaska	15-17	20-30	x	x	x	20-30	20-30	15-17	15-17	x	x	15-17
Hawaii	(10) 15	(20)	20	(20)	20 (40)	40	(20-40)	(20)	(15-20)	x	(10)	10 (15)
Western USA	(10) 40	(15) 40	20-40	(20) 40	40	40	40	(20-40)	(10-20)	10-20	10-20	10-20
CENTRAL UNITED STATES TO:												
Central America	(15) 20	20 (40)	(20) 40	(20) 40	(20) 40	40	(40)	(10) 20	10-20	10-15	10 (20)	15-20
South America	(15) 20	20	20 (40)	20 (40)	(20)	x	x	x	(10)	10	10 (20)	(10) 20
Western Europe	(40)	40	40	(40)	x	x	(20)	(15) 20	(10) 15	(15) 20	(20)	x
Southern Africa	20	(20)	x	x	x	x	x	x	(10-15)	(10) 15	15 (20)	20
Eastern Europe	x	(40)	x	x	x	x	x	(10) 20	(10-20)	x	x	x
Middle East	x	(40)	(20)	(20)	x	x	x	(10-15)	(10-15)	(20)	20	(20)
India/ Pakistan	x	(15)	x	x	x	x	(20)	x	(15)	x	x	x
Far East/ Japan	x	x	(20)	20	(20-40)	(40)	(20)	20	(15-20)	x	15	(15)
Southeast Asia	x	x	x	x	(20)	(20)	20	(15-20)	(15)	x	(15)	x
Australia	(10) 15	15	(15-20)	20	20 (40)	20-40	20 (40)	(20)	x	x	x	(10-15)
Alaska	15-17	15-17	x	x	x	(40)	(40)	20	20	x	x	x
Hawaii	(10) 15	(15-20)	20	20	(40)	(20-40)	20 (40)	x	(15)	(15)	(15)	(10) 15
WESTERN UNITED STATES TO:												
Central America	(20-40)	40	40	40	(40)	x	(20)	(10) 20	10 (20)	10 (20)	(10) 20	(15) 20
South America	17 (40)	(20)	x	x	x	x	x	(15)	12 (20)	10-20	10-20	12 (40)
Western Europe	x	x	(40)	(20)	(20)	x	(20)	(10-20)	(10) 20	(20)	x	x
Southern Africa	(20)	x	x	x	x	x	x	x	(10)	(15)	15 (20)	(15) 20
Eastern Europe	x	x	x	x	x	x	x	x	x	x	x	x
Middle East	(20)	(40)	(20)	20	20	(20)	x	(15)	(10) 15	(10-15)	(20)	(20)
India/ Pakistan	(15-20)	x	x	x	x	x	x	(20)	x	x	x	x
Far East/ Japan	(10) 20	(15-20)	x	x	(40)	40	(40)	x	x	x	(10-20)	10-20
Southeast Asia	(15)	(20)	x	x	x	x	x	(20)	(15) 20	(20)	(10-15)	10-15
Australia	(10-15)	(15-20)	x	x	x	(20-40)	(20-40)	20	(15-20)	15	(10-15)	10
Alaska	10-15	x	x	20-30	20-30	20-30	20-40	x	20	15	x	15-17
Hawaii	(15) 20	(15) 20	20	(20)	(40)	40	(20-40)	(15) 20	15 (20)	(10-15)	10 (15)	(10) 15
Eastern USA	(10) 40	(15) 40	20-40	(20) 40	40	40	(20-40)	(10-20)	10-20	10-20	10-20	10-20

Table 1. *Dual numbers indicate that the intervening bands should also be usable. When one number appears in parentheses, that end of the range will probably be open on Good (G) days only.*

across the tropics. Short skip is under 700 miles during the day but extends beyond 1,000 miles at night.

80 and 160 Meters

Expect some nice surprises again if atmospheric static isn't too strong. Short skip on 80 is over 2,000 miles at night but only around 300–400 miles during the day. 160 meters will provide limited nighttime opportunities with skip averaging between 1,000 and 2,000 miles. 73

Crystal Oven Controller

continued from page 59

With the help of a few solid state components, a very well designed and reliable vacuum tube circuit continues to live and serve a useful purpose. Overall, I am very pleased with the circuit and plan to use it in the final system for a very long time. I might even incorporate the oven controller design into several other pieces of equipment having thermostatically controlled ovens. 73

Need a Noise Blanker?

continued from page 37

receiver in an automobile having no ignition noise suppression. In this case, reception without the noise blanker was nearly impossible unless the signal was exceptionally strong. With the noise blanker, even the weakest signals are not bothered by the ignition noise.

Batteries B1 through B4 will last approximately as long as their shelf life, since the current drawn by the reverse-biased diodes is only a few microamperes (μA). Fresh batteries will last for about a year of normal usage before showing signs of leakage — an indication that they must be replaced. 73

Homing In

continued from page 50

unchanged and add corresponding age divisions for females? Maybe we should leave everything just as it is until more females join the sport here. I want your opinions.

As the number of divisions goes up, a problem at smaller ARDF events will be too few competitors in some divisions (**Photo E**). The European rules committee is considering adding provisions for combining divisions at events whenever the total number of persons in two adjacent age divisions is less than those in other divisions.

Even a large number of divisions won't completely eliminate inequities. For instance, 54-year-old Marvin Johnston KE6HTS had to compete against 40-year-olds in the Old-Timer Division in China last year. Next World Championships, unless the rules change, most of the members of his new division (Veterans) will be older than he will be.

A mathematical technique has been developed to deal with these situations. It's employed in some countries at marathons and other running events, but hasn't received much consideration by marathoners stateside or ARDFers anywhere. "Age-Graded Scoring" uses statistical tables to compare performances of athletes of different ages and genders. An individual's finish time is weighed against the "ideal" time for a person of the same age and gender, giving a percentage score. Even if your finish time worsens over the years as you advance in age, your increasing skill may be reflected by a better age-graded score.

Is age-graded scoring something to consider for ARDF? Implementation will require that tables of ideal times for ARDF be developed. That may be impossible, because radio-orienteering courses have substantial variations in difficulty — much more than marathon courses, which are always the same length and don't involve off-trail running. Again, I welcome your comments and suggestions. My electronic and postal addresses are at the beginning of this article.

RESOURCES

USA ARDF Championships
July 31–August 4, 2001

Postal Mail: Albuquerque Amateur Radio Club, P.O. Box 11853, Albuquerque NM 87192.

E-mail: [aarcardf@egroups.com] for private inquiries; [abqardf-subscribe@egroups.com] to join mailing list.

Web (AARC): [http://www.qsl.net/albuquerquearc/ardf/ardf.html].

Friendship Radiosport Games
August 7–10, 2001

Postal Mail (USA team): Friendship Amateur Radio Society, P.O. Box 13344, Portland OR 97213.

Postal Mail (Canadian team): Friendship Amateur Radio Society, 3018 Spring Bay Road, Victoria BC V8N1Z3, Canada.

E-mail: [farsusa@aol.com] for USA team; [va7pc@rac.ca] for Victoria organizers.

Web (FARS-USA): [http://home.pacifier.com/~fars/]. 73

NEVER SAY DIE

continued from page 4

Look, I'm depending on you because I feel that the whole future of the hobby is in your hands. I'm concerned that the ARRL isn't going to do anything to keep amateur radio from disappearing, and the ham industry is so disorganized that it can't do anything. Please don't wait for someone else to step up to cross-band your local repeaters. Maybe one cross-banded to 20m, one to 75m, and one for 15m? I used to have a fantastic time cross-banding 20m DX stations into my 75m roundtable contacts. Well, I had separate 20m and 75m kW stations, so it was easy to do—and it sure was exciting for everyone involved.

DNA Damage

Did you see the report from the *Journal of the National Cancer Institute* about young smokers triggering changes in their DNA which put them at a higher risk for cancer later in life? Another study showed that 4% of the 4th graders, 7% of the 5th graders, and 15% of the 6th graders had already smoked. Plus over 3 million teenagers who are already addicted to nicotine.

Well, it makes sense. Youngsters' bodies are growing at a high rate compared with adults', so even small amounts of poisons will tend to affect them more, interfering with their cells' ability to make exact DNA duplicates.

We know that mothers who smoke during pregnancy produce children with an average of 8–10 points lower IQ. And that dads who smoke before conception also contribute to an IQ loss. Well, 80 years ago, cigarettes were called coffin nails.

Never Say Die

I particularly like what Kemmons Wilson, the founder of Holiday Inn, had to say in *Imprimus*, the Hillsdale College newsletter (it's free, so subscribe — Hillsdale College, Hillsdale MI 49242). Wilson was discussing entrepreneurialism and said, "Coming up with an idea should be like sitting on a pin— it should make you jump up and do something. I've had a great many ideas over the years. Some were good, some were great, and some I would prefer to forget about. The important thing is to take your best ideas and see them through. Not all of them are going to be winners, but just remember, a person who wins success may have been counted out many times before. He wins because he refuses to give up."

And that's the same thing Ray Kroc, the guy who gave us McDonald's preached. Ray said success doesn't take brains. It doesn't take education. All it takes is perseverance. Never Say Die.

My Failure

While most of the *73* mail is complimentary about my editorials, now and then I get complaints about my not writing about ham radio exclusively. What makes all of the brickbats bearable are letters such as this one from George Daviskul of Jackson MI:

"I discovered you via Art Bell and I discovered me via you. Your information and insight on life is invaluable, and your book suggestions are treasures. You should be aware of the impact you have on people. It's all very positive. Your book suggestions will last me for years to come. I am very excited to be able to share truth. There's never enough of that. Once again, thank you."

What frustrates me is that when I send out a hundred catalogs of my books I'll get back maybe ten book orders. Rather than being happy that I've had an opportunity to touch ten lives, I can't help being disappointed that I've failed to reach the other 90.

Contests

Yes, I know how much some hams hate contests. They grumble and complain about the bands being loused up for a whole weekend or two as the ARRL runs their Sweepstakes, a DX contest, or Field Day.

Hey, guys, the reason the bands are so loused up is because thousands of hams are having fun. If you weren't such an old pill you, too, could be having a ball.

Sure, if you want to win a contest for your section you're going to have to have a pretty good station, a lot of operating savvy, and lots of stamina.

Not that it takes anything outrageous to run up a big score. I had a reasonably good signal on 20m with a kilowatt and a three-element beam. Standard stuff. The day before the contest started I hung a 75m sloping dipole from my tower so I could make some contacts on that band when 20m closed down at night.

So what happened? I ended up with one of the highest scores in the country! My 75m dipole gave me a walloping signal, complete with contacts in Alaska and Hawaii.

Heck, back in 1941 I won the Sweepstakes contest for my section just operating on 160m! I've still got the medal the League sent me pinned on my hamfest hat.

I've had a ball in DX contests. I managed to work 100 countries in one weekend on 20m SSB during one contest. Whew! I got number 100 in the closing seconds of the contest. Was it fun? I'm still bragging about it, ain't I?

If you'll look back in *QST* you'll see that I've won the VHF contest for my section, too.

Getting on the air from a good hot DX location is another kind of contest. The idea is to give as many stations a signal report as you can during the few days you're there, and that takes some damned good operating. The hard part is picking the call letters out of the mess. I worked out a system that no one yet has beat. I guarantee that if you go on a DXpedition somewhere you will never forget a minute of the experience for the rest of your life.

The DXpeditions where I had the most fun were to Navassa Island, in the Caribbean. I went there twice, and both times were fantastic adventures. But I've had memorable fun working the pileups from

Continued on page 64

Wise Up!

Here are some of my books which can change your life (if you'll let 'em). If the idea of being healthy, wealthy and wise interests you, start reading. Yes, you can be all that, but only when you know the secrets which I've spent a lifetime uncovering.

.....Wayne

The Bioelectrifier Handbook: This explains how to build or buy ($155) a little electrical gadget that can help clean the blood of any virus, microbe, parasite, fungus or yeast. The process was discovered by scientists at the Albert Einstein College of Medicine, quickly patented, and hushed up. It's curing AIDS, hepatitis C, and a bunch of other serious illnesses. The circuit can be built for under $20 from the instructions in the book. $10 (01)

The Secret Guide to Wisdom: This is a review of around a hundred books that will help you change your life. No, I don't sell these books. They're on a wide range of subjects and will help to make you a very interesting person. Wait'll you see some of the gems you've missed reading. $5 (02)

The Secret Guide to Wealth: Just as with health, you'll find that you have been brainwashed by "the system" into a pattern of life that will keep you from ever making much money and having the freedom to travel and do what you want. I explain how anyone can get a dream job with no college, no résumé, and even without any experience. I explain how you can get someone to happily pay you to learn what you need to know to start your own business. $5 (03)

The Secret Guide to Health: Yes, there really is a secret to regaining your health and adding 30 to 60 years of healthy living to your life. The answer is simple, but it means making some difficult lifestyle changes. Will you be skiing the slopes of Aspen with me when you're 90 or doddering around a nursing home? Or pushing up daisies? No, I'm not selling any health products. $5 (04)

My WWII Submarine Adventures: Yes, I spent from 1943-1945 on a submarine, right in the middle of the war with Japan. We almost got sunk several times, and twice I was in the right place at the right time to save the boat. What's it really like to be depth charged? And what's the daily life aboard a submarine like? How about the Amelia Earhart inside story?If you're near Mobile, please visit the Drum. $5 (10)

Wayne's Caribbean Adventures: My super budget travel stories – where I visit the hams and scuba dive most of the islands of the Caribbean. You'll love the special Liat fare which let me visit 11 countries in 21 days, diving all but one of the islands, Guadeloupe, where the hams kept me too busy with parties. $5 (12)

Cold Fusion Overview: This is both a brief history of cold fusion, which I predict will be one of the largest industries in the world in the 21st century, plus a simple explanation of how and why it works. This new field is going to generate a whole new bunch of billionaires, just as the personal computer industry did. $5 (20)

Cold Fusion Journal: They laughed when I predicted the PC industry growth in 1975. PCs are now the third largest industry in the world. The cold fusion ground floor is still wide open, but then that might mean giving up watching ball games. Sample: $10 (22).

Julian Schwinger: A Nobel laureate's talk about cold fusion—confirming its validity. $2 (24)

Improving State Government: Here are 24 ways that state governments can cut expenses enormously, while providing far better service. I explain how any government bureau or department can be gotten to cut it's expenses by at least 50% in three years and do it cooperatively and enthusiastically. I explain how, by applying a new technology, the state can make it possible to provide all needed services without having to levy *any* taxes at all! Read the book, run for your legislature, and let's get busy making this country work like its founders wanted it to. Don't leave this for "someone else" to do. $5 (30)

Mankind's Extinction Predictions: If any one of the experts who has written books predicting a soon-to-come catastrophe which will virtually wipe us all out is right, we're in trouble. In this book I explain about the various disaster scenarios, from Nostradamus, who says the poles will soon shift, wiping out 97% of mankind, to Sai Baba, who has recently warned his followers to get out of Japan and Australia before December 6th this year. The worst part of these predictions is the accuracy record of some of the experts. Will it be a pole shift, a new ice age, a massive solar flare, a comet or asteroid, a bioterrorist attack, or even Y2K? I'm getting ready, how about you? $5 (31)

Moondoggle: After reading René's book, *NASA Mooned America*, I read everything I could find on our Moon landings. I watched the videos, looked carefully at the photos, read the astronaut's biographies, and talked with some of my readers who worked for NASA. This book cites 25 good reasons I believe the whole Apollo program had to have been faked. $5 (32)

Classical Music Guide: A list of 100 CDs which will provide you with an outstanding collection of the finest classical music ever written. This is what you need to help you reduce stress. Classical music also raises youngster's IQs, helps plants grow faster, and will make you healthier. Just wait'll you hear some of Gotschalk's fabulous music! $5 (33)

The Radar Coverup: Is police radar dangerous? Ross Adey K6UI, a world authority, confirms the dangers of radio and magnetic fields. $3 (34)

Three Gatto Talks: A prize-winning teacher explains what's wrong with American schools and why our kids are not being educated. Why are Swedish youngsters, who start school at 7 years of age, leaving our kids in the dust? Our kids are intentionally being dumbed down by our school system — the least effective and most expensive in the world. $5 (35)

Aspartame: a.k.a. NutraSweet, the stuff in diet drinks, etc., can cause all kinds of serious health problems. Multiple sclerosis, for one. Read all about it, two pamphlets for a buck. (38)

One Hour CW: Using this sneaky booklet even *you* can learn the Morse Code in one hour and pass that dumb 5wpm Tech-Plus ham test. $5 (40)

Code Tape (T5): This tape will teach you the letters, numbers and punctuation you need to know if you are going on to learn the code at 13 or 20 wpm. $5 (41)

Code Tape (T13): Once you know the code for the letters (41) you can go immediately to copying 13 wpm code (using my system). This should only take two or three days. $5 (42)

Code Tape (T20): Start right out at 20 wpm and master it in a weekend. $5 (43)

Wayne Talks Not at Dayton: This is a 90-minute tape of the talk I'd have given at the Dayton, if invited. $5 (50)

Wayne Talks at Tampa: This is the talk I gave at the Tampa Global Sciences conference. I cover cold fusion, amateur radio, health, books you should read, and so on. $5 (51)

$1 Million Sales Video: The secret of how you can generate an extra million in sales using PR. This will be one of the best investments you or your business will ever make. $43 (52)

Reprints of My Editorials from *73*.

Grist I: 50 of my best non-ham oriented editorials from before 1997. $5 (71)

Grist II: 50 more choice non-ham editorials from before 1997.$5 (72)

1997 Editorials: 148 pages. 216 editorials discussing health, ideas for new businesses, exciting new books I've discovered, ways to cure our country's more serious problems, flight 800, the Oklahoma City bombing, more Moon madness, and so on. $10 (74)

1998 Editorials: 168 pages that'll give you lots of controversial things to talk about on the air. $10 (75)

1999 Editorials: 132 pages of ideas, book reviews, health, education, and anything else I think you ought to know about. $10 (76)

2000 Editorials: In the works.

Silver Wire: With two 3" pieces of heavy pure silver wire + three 9V batteries you can make a thousand dollars worth of silver colloid. What do you do with it? It does what the antibiotics do, but germs can't adapt to it. Use it to get rid of germs on food, for skin fungus, warts, and even to drink. Read some books on the uses of silver colloid, it's like magic. $15 (80)

Wayne's Bell Saver Kit. The cable and instructions enabling you to inexpensively tape Art Bell W6OBB's nightly 5-hr radio talk show. $5 (83)

NH Reform Party Keynote Speech. It wow'd 'em when I laid out plans for NH in 2020, with outstanding and lower cost schools, no state taxes at all, far better health care, a more responsive state government, etc. $1 (85)

<u>Stuff I didn't write, but you need:</u>

NASA Mooned America: René makes an air-tight case that NASA faked the Moon landings. This book will convince even you. $25 (90)

Last Skeptic of Science: This is René's book where he debunks a bunch of accepted scientific beliefs – such as the ice ages, the Earth being a magnet, the Moon causing the tides, and etc. $25 (91)

Dark Moon: 568 pages of carefully researched proof that the Apollo Moon landings were a hoax. This is a capping blow for René's skeptics. $35 (92)

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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.

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This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham newcomer or retired old timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to: *73 Magazine*, Barter 'n' Buy, 70 Hancock Rd., Peterborough NH 03458 and get set for the phone calls. The deadline for the April 2001 classified ad section is February 10, 2001.

President Clinton probably doesn't have a copy of *Tormet's Electronics Bench Reference* but you should. Check it out at **[www.ohio.net/~rtormet/index.htm]**—over 100 pages of circuits, tables, RF design information, sources, etc. BNB530

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NEVER SAY DIE

continued from page 62

places like Nepal, Lesotho, Swaziland, Afghanistan, Sabah, Jordan, and so on. Every place I've operated from was a contest and tremendous fun, so don't grumble to me about contests lousing up the bands for a weekend. Take off your curmudgeon hat and join in the fun. Let's see how good your station is. Let's see how good an operator you are. Hey, and no lying about your power, either. I once published an article about W1FZJ Sam Harris' 100-watt contest finals, complete with a photo. He had separate 250-TH finals for every band and humongous antennas. It took a solid copper bar across his final plate meters to bring the indicated power down to the 100-watt level so he could get that multiplier.

So, what are you going to do instead of joining a contest? Rag chew? About what? When is the last time you've had a really interesting rag chew? Sorry, Charlie, but most rag chews are about as interesting as chewing a real rag. 73

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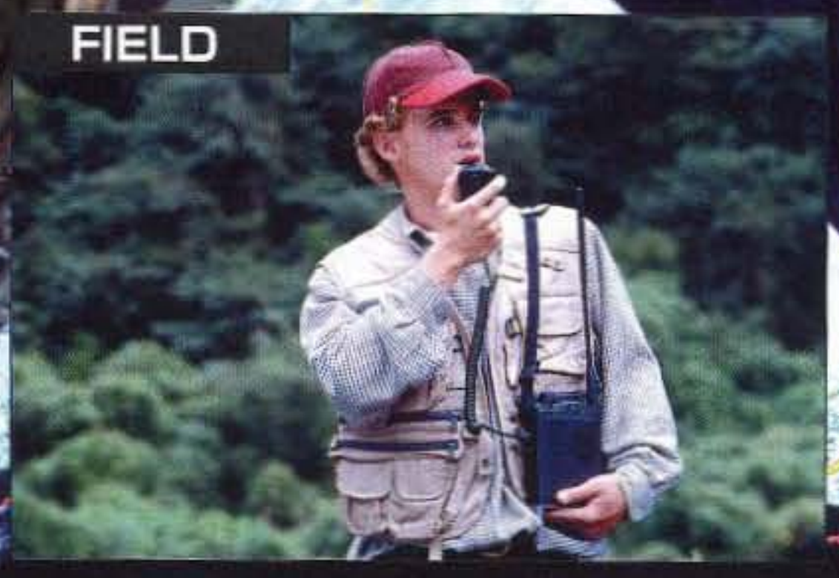

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●5 WATTS POWER OUTPUT: Using a new-technology all-band MOS FET power amplifier, the FT-817 provides 5 Watts of power output when using a 13.8 Volt DC source. When using Alkaline batteries or the optional FNB-72 Ni-Cd Battery Pack, power is automatically set to 2.5 Watts; via Menu, this can be changed to 0.5 Watt, 1 Watt, or up to 5 Watts.

●WIDE CHOICE OF POWER SOURCES: The FT-817 is equipped with an alkaline "AA" cell battery case, and a 13.8 volt DC cable is also supplied. Available as an option is the FNB-72 Ni-Cd Battery Pack (9.6 V, 1000 mAh), which can be recharged using a 13.8 Volt power supply while the radio is being operated.

●TWO ANTENNA PORTS: A "BNC" connector is provided on the front panel, and a type "M" connector on the rear panel, with Menu selection of which connector will be assigned for operation on HF, 50 MHz, 144 MHz, and 430 MHz.

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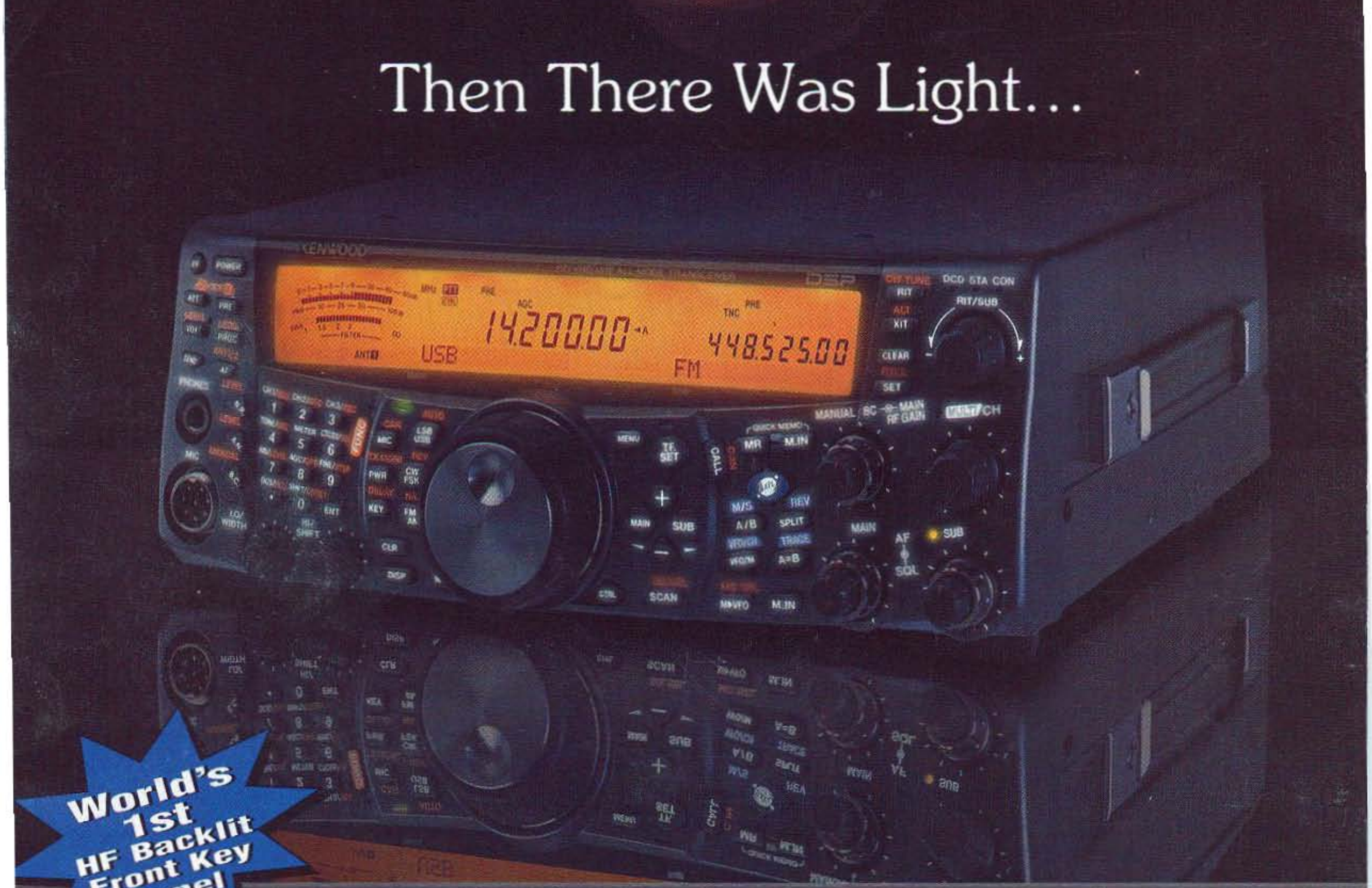

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