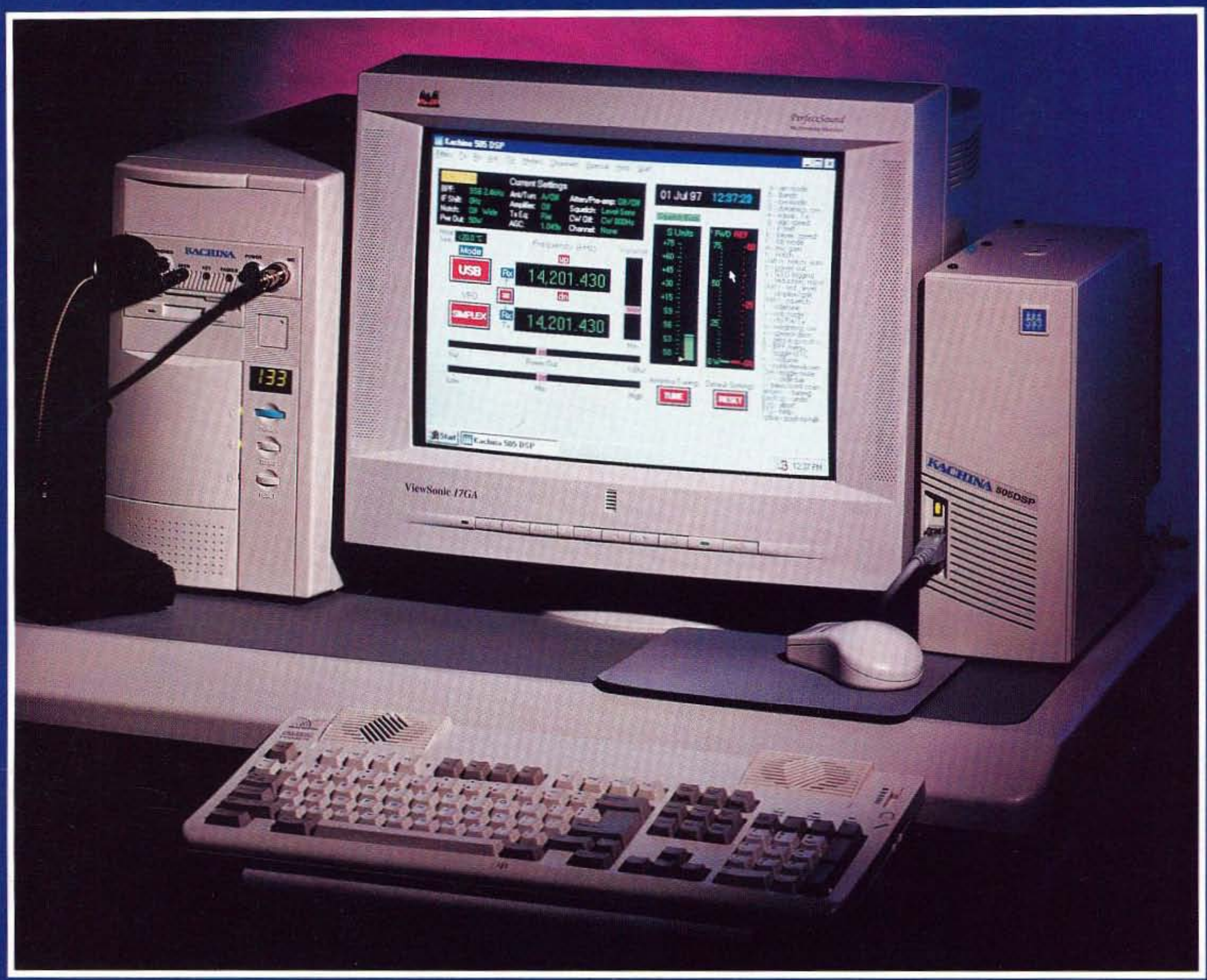
Including Ham Radio Fun!

73® Amateur Radio Today

AUGUST 1998
ISSUE #455
USA $3.95
CANADA $4.95

International Edition



Build an FET Probe

Updating Old Linears

All-Band Antenna Overview

Reviews:

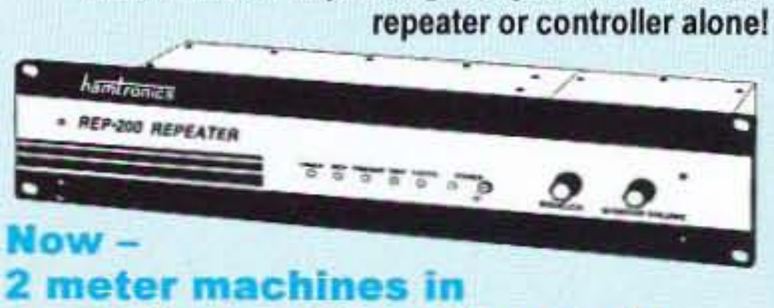
Kachina – The New Genera

Whiterook MK-88 Keyer

Get more features for your dollar with our

REP-200 REPEATER

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



Now – 2 meter machines in stock for next day shipment!

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

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

☛ **FCC type accepted** for commercial service in 150 & 450 MHz bands.

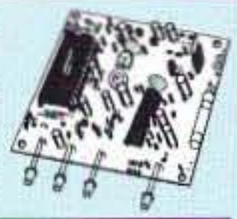
Digital Voice Recorder Option. Allows message up to 20 sec. to be remotely recorded off the air. Play back at user request by DTMF command, or as a periodical voice id, or both. **Great for making club announcements!** .....only $100.

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

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

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

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



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

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

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

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

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

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

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

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

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

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

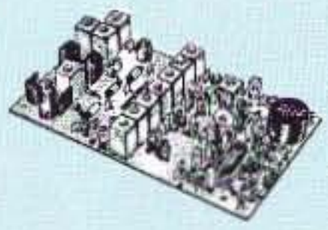
SUBAUDIBLE TONE ENCODER/DECODER

Access all your favorite closed repeaters!

- **Encodes** all standard CTCSS tones with crystal accuracy and convenient DIP switch selection.
- Comprehensive manual also shows how you can set up a front panel switch to select tones for several repeaters.
- **Decoder** can be used to mute receive audio and is optimized for installation in repeaters to provide closed access. High pass filter gets rid of annoying buzz in receiver. **New low prices!**
- **TD-5** CTCSS Encoder/Decoder Kit .....now only **$29**
- **TD-5** CTCSS Encoder/Decoder Wired/tested **$49**

CRYSTAL CONTROLLED VHF & UHF FM EXCITERS & RECEIVERS

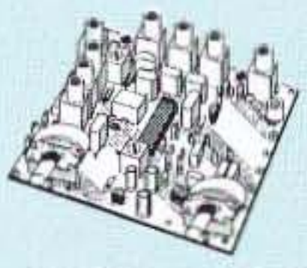
FM EXCITERS: 2W output, continuous duty.



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

VHF & UHF POWER AMPLIFIERS.

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



FM RECEIVERS:

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

WEATHER ALERT RECEIVER

A sensitive and selective professional grade receiver to monitor critical NOAA weather broadcasts. Good reception even at distances of 70 miles or more with suitable antenna. No comparison with ordinary consumer radios!

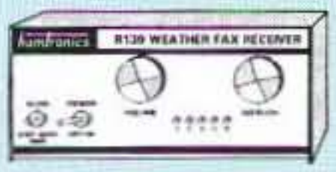
Automatic mode provides storm watch, alerting you by unmuting receiver and providing an output to trip remote equipment when an alert tone is broadcast. Crystal controlled for accuracy; **all 7 channels** (162.40 to 162.55).

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

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

WEATHER FAX RECEIVER

Join the fun. Get striking images directly from the weather satellites!



A very sensitive wideband fm receiver **optimized for NOAA** APT & Russian Meteor **weather fax** on the 137MHz band.

Designed from the start for optimum satellite reception; not just an off-the-shelf scanner with a shorted-out IF filter!

Covers all 5 satellite channels. Scanner circuit & recorder control allow you to automatically capture signals as satellites pass overhead, even while away from home.

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

WWV RECEIVER

Get time & frequency checks without buying multiband hf rcvr. Hear solar activity reports affecting radio propagation. **Very sensitive and selective** crystal controlled superhet, dedicated to listening to WWV on 10 MHz. Performance rivals the most expensive receivers.

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

SYNTHESIZED VHF FM EXCITER & RECEIVER MODULES

No more waiting for crystals!

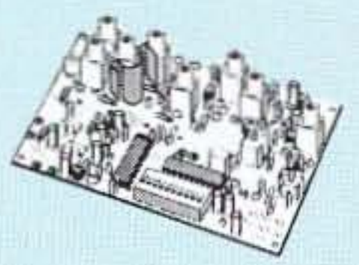
NEW

Hamtronics is pleased to announce a new line of its vhf fm transmitters and receivers, popular for repeaters, voice & data links, control, telemetry, and other demanding applications.

T301 Exciter and R301 Receiver provide high quality nbfm and fsk operation on 144-148 MHz and 220-225 MHz (also 139-174 MHz and 216-226 MHz for export and gov't services). Features include:

- *Dip switch frequency selection.*
- *Exceptional modulation for voice and ctcss.*
- *Very low noise synthesizer for repeater service.*
- *Direct fm for data up to 9600 baud.*
- *Commercial grade tcxo for tight frequency accuracy in wide range of environmental conditions.*
- *In stock for same day shipping.*

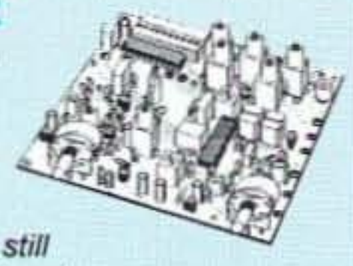
T301 EXCITER



Rated for continuous duty, 2-3W output.

- **Kit** (ham band only) ...$109
- TCXO option ...$40
- **Wired/tested** ...$189 (includes TCXO)

R301 RECEIVER



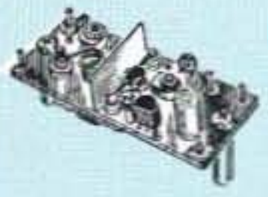
- **Kit** (ham band only) ...only $139
- TCXO option ...$40
- **Wired/tested** ...$209 (includes TCXO)
- Traditional crystal-controlled receivers & *exciters are still available for all vhf and uhf bands.*

LOW NOISE RECEIVER PREAMPS

LNG-( ) GaAs FET PREAMP

STILL ONLY $59, wired/tested

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



LNW-( ) ECONOMY PREAMP

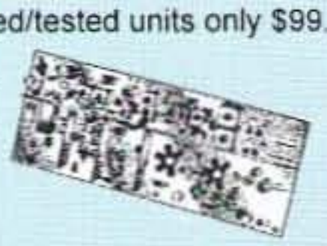
NOW ONLY $24/kit, $44/w&t

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

TRANSMITTING & RECEIVING CONVERTERS

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

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



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

Buy at low, factory-direct net prices and save!
For complete info, call or write for complete catalog.
Order by mail, fax, email, or phone (9-12, 1-5 eastern time).
Min. $6 S&H charge for 1st lb. plus add'l weight & insurance.
Use Visa, MC, Discover, check, or UPS C.O.D.

See SPECIAL OFFERS and view complete catalog on our web site:
www.hamtronics.com
email: jv@hamtronics.com

Our 36th Year

hamtronics, inc.
65-D Moul Rd; Hilton NY 14468-9535
Phone 716-392-9430 (fax -9420)

ASTRON CORPORATION
9 Autry
Irvine, CA 92618
(949) 458-7277 • Fax (949) 458-0826 www.astroncorp.com

SWITCHING POWER SUPPLIES

	CONT.	ICS	WT.(LBS)
SS-10	7	10	3.2
SS-12	10	12	3.4
SS-18	15	18	3.6
SS-25	20	25	4.2
SS-30	25	30	5.0

SS-25M With volt & amp meters
SS-30M With volt & amp meters

ASTRON POWER SUPPLIES

• HEAVY DUTY • HIGH QUALITY • RUGGED • RELIABLE •

SPECIAL FEATURES

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

PERFORMANCE SPECIFICATIONS

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

SL SERIES

• LOW PROFILE POWER SUPPLY

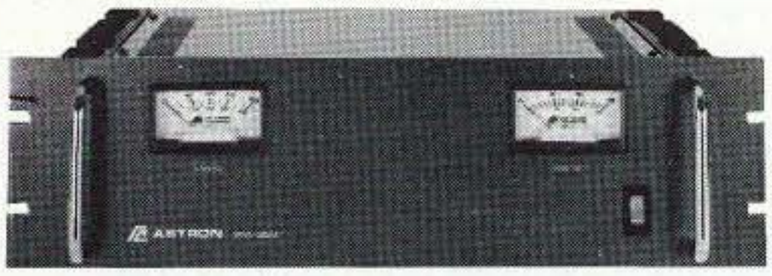
MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
SL-11A	•	•	7	11	2⅝ × 7⅝ × 9¾	12
SL-11R	•	•	7	11	2⅝ × 7 × 9¾	12
SL-11S	•	•	7	11	2⅝ × 7⅝ × 9¾	12
SL-11R-RA		•	7	11	4¾ × 7 × 9¾	13

RS-L SERIES

• POWER SUPPLIES WITH BUILT IN CIGARETTE LIGHTER RECEPTACLE

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

RM SERIES



MODEL RM-35M

• 19" RACK MOUNT POWER SUPPLIES

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

RS-A SERIES

MODEL RS-7A

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

RS-M SERIES

MODEL RS-35M

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

VS-M AND VRM-M SERIES

MODEL VS-35M

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

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

RS-S SERIES

MODEL RS-12S

• Built in speaker

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

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

CIRCLE 16 ON READER SERVICE CARD

RAMSEY

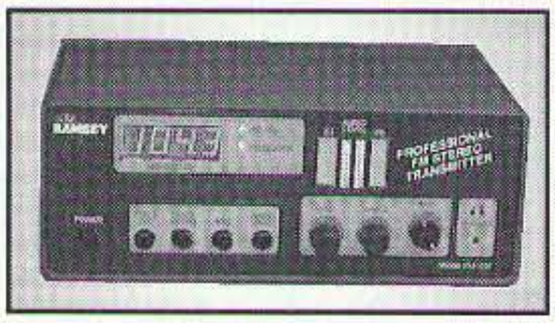
World's Smallest TV Transmitters

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 law enforcement 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. Audio units include sound using a sensitive built-in mike that will hear a whisper 15 feet away! Units run on 9 volts and hook-up to most any CCD camera. Any 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!

C-2000, Basic Video Transmitter Cube.....$89.95
C-3000, Basic Video and Audio Transmitter Cube.....$149.95
C-2001, High Power Video Transmitter Cube.....$179.95
C-3001, High Power Video and Audio Transmitter Cube.....$229.95

Super Pro FM Stereo Radio Transmitter



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

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

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

AM Band Radio Transmitter

Ramsey AM radio transmitters operate in the standard AM broadcast band and are easily set to any clear channel in your area. Our AM-25, 'pro' version, fully synthesized transmitter features easy frequency setting DIP switches for stable, no-drift frequency control, while being jumper setable for higher power output where regulations allow. The entry-level AM-1 uses a tunable transmit oscillator and runs the maximum 100 milliwatts of power. No FCC license is required, expected range is up to 1/4 mile depending upon antenna and conditions. Transmitters accept standard line-level inputs from tape decks, CD players or mike mixers, and run on 12 volts DC. The Pro AM-25 comes complete with AC power adapter, matching case set and bottom loaded wire antenna. Our entry-level AM-1 has an available matching case and knob set for a finished, professional look.

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

CCD Video Cameras

B&W Camera

Color Camera

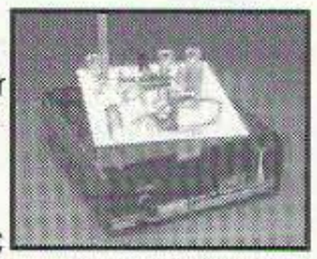
If you're looking for a good quality CCD board camera, stop right here! Our cameras use top quality Japanese Class 'A' CCD arrays with over 440 line line resolution, not the off-spec arrays that are found on many other cameras. You see, the Japanese suppliers grade the CCDs at manufacture and some manufacturers end up with the off-grade chips due to either cost constraints or lack of buying 'clout'. Also, a new strain of CMOS single chip cameras are entering the market, those units have about 1/2 the resolution and draw over twice the current that these cameras do - don't be fooled! Our cameras have nice clean fields and excellent light sensitivity, you'll really see the difference, and if you want to see in the dark, the black & white models are super IR (Infra-Red) sensitive. Our IR-1 Illuminator kit is invisible to the human eye, but lights the scene like a flashlight at night! Color camera has Auto White Balance, Auto Gain, Back Light Compensation and DSP! Available with Wide-angle (80º) or super slim Pin-hole style lens. They run on 9 VDC and produce standard 1 volt p-p video. Add one of our transmitter units for wireless transmission to any TV set, or add our IB-1 Interface board for audio sound pick-up and super easy direct wire hook-up connection to any Video monitor, VCR or TV with video/audio input jacks. Cameras fully assembled, including pre-wired connector.

CCDWA-2, B&W CCD Camera, wide-angle lens.....$99.95
CCDPH-2, B&W CCD Camera, slim fit pin-hole len.....$99.95
CCDPH-2, Color CCD Camera, wide-angle lens.....$149.95
IR-1, IR Illuminator Kit for B&W cameras.....$24.95
IB-1, Interface Board Kit.....$24.95

FM Stereo Radio Transmitters

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

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



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

FM-10A, Tunable FM Stereo Transmitter Kit.....$34.95
CFM, Matching Case and Antenna Set.....$14.95
AC12-5, 12 Volt DC Wall Plug Adapter.....$9.95

RF Power Booster

Add some serious muscle to your signal, boost power up to 1 watt over a frequency range of 100 KHz to over 1000 MHz! Use as a lab amp for signal generators, plus many foreign users employ the LPA-1 to boost the power of their FM Stereo transmitters, providing radio service through an entire town. Runs on 12 VDC. For a neat, professionally finished look, add the optional matching case set.

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

Treasure Finder Kit

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El Supremo & Founder
Wayne Green W2NSD/1

Associate Publisher
F. I. Marion

Associate Technical Editor
Larry Antonuk WB9RRT

Nitty Gritty Stuff
J. Clayton Burnett
Priscilla Gauvin
Joyce Sawtelle

Contributing Culprits
Bill Brown WB8ELK
Mike Bryce WB8VGE
Joseph E. Carr K4IPV
Michael Geier KB1UM
Jim Gray W1XU/7
Jack Heller KB7NO
Chuck Houghton WB6IGP
Dr. Marc Leavey WA3AJR
Andy MacAllister W5ACM
Dave Miller NZ9E
Joe Moell KØOV
Steve Nowak KE8YN/5
Carole Perry WB2MGP

Advertising Sales
Frances Hyvarinen
Roger Smith
603-924-0058
800-274-7373
Fax: 603-924-8613

Circulation
Linda Coughlan

Data Entry & Other Stuff
Christine Aubert
Norman Marion

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AUGUST 1998
ISSUE #455

Including Ham Radio Fun!

73 Amateur Radio Today

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

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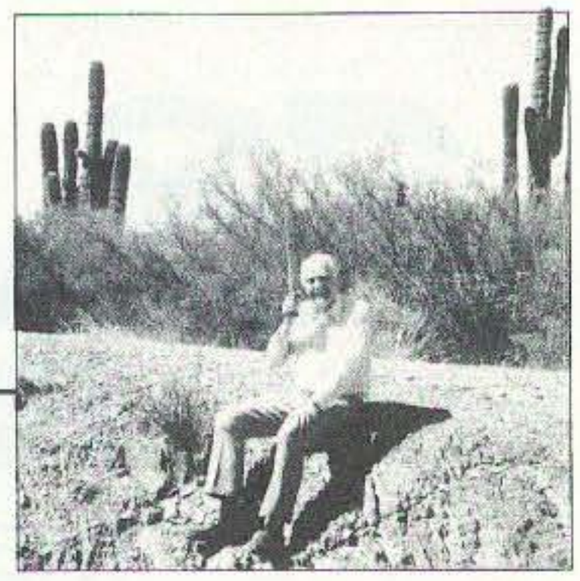
Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1



Barry

Amateur radio lost a treasure when Barry K7UGA died. He was always a solid supporter of ham radio. I met him when he was campaigning in New Hampshire in 1964 and we stayed friends. Now and then, when I'd get to Washington, he seemed never too busy to have lunch with me in his Senate office. We laughed over the *73* cover picture I ran during the campaign — the White House with a yagi on top of it.

Barry was, by far, the most famous American ham we've ever had, and he kept active right up until he was felled a couple of years ago by a stroke. I gather that this wiped out his memory, much like Alzheimer's, so all we really lost this year was his body.

Barry had a whopping station. I stopped off in Phoenix one time on my way to California and visited Barry and his shack. We talked for hours and had a great time. That was when Herbert Hoover Jr. was the president of the ARRL. I explained to Barry how the inner circle at ARRL HQ had been using Herb, unbeknownst to him, for their own purposes. Herb was a good friend of Barry's, so he called him and told him what I'd said. A couple days later the news was out that Herb had resigned as president of the League.

In 1985, when the Mexico City earthquake hit, Barry sent his station from his Senate office over to the Mexican Embassy, including his big yagi antenna, and had someone operate the station 24 hours a day, keeping them in touch with Luis XE1L in Mexico City. Luis later was awarded the Medal of Honor by Mexican President de la Madrid for his help during the disaster.

It's too bad that Barry didn't have a better campaign manager back in 1964. If he'd been elected I believe our country would have taken quite a different path. I believe that we'd have been out of Viet Nam in a hurry and that his basic approach of our having a minimal government would have made the America of 1998 an entirely different country. We might have much better schools, health care, and a freedom from the fear of the IRS, FDA, NSA, CIA, and other assorted alphabet government agencies. We might not even have a $6 trillion debt to pay interest on (and that doesn't count a few trillion more in unfunded government obligations).

We certainly would have been spared the enormously expensive and totally lost "war on poverty." And perhaps the lost "war on drugs." Or the Carter inflation. Or the Nixon fiasco. How different would our country be if we hadn't spent trillions on those three lost wars? It hurts a country to lose wars, both monetarily and psychologically.

Barry was in love with freedom — with liberty. He was a conservative, but he was no fan of the religious right and said that Jerry Falwell deserved "a boot right in the ass" for his proposed agenda.

By the way, I'll bet you didn't know that Barry wasn't born in the United States. Arizona didn't join the union until he was three years old.

I wish I'd taken the time to learn what I've discovered in the last year about how anyone can avoid a stroke, heart trouble, cancer, and so on. It's been a tough job sorting out all the misinformation from both the medical industry (which the media calls our health care industry), and from the alternative health field (which the medical industry calls quacks). Well, it's too late to help Barry enjoy another dozen or more years of active hamming, but maybe I can help others keep those DX pileups boiling. Probably not, since not many people seem interested.

Well, it sure would have been fun if I could have gotten on the air from K7UGA/3 at the White House 30 years ago.

Peoria in September

I'm still stewing over what subjects will be of the most interest to those of you who will be there to catch my performance. I've been wanting to do a couple of tapes that I could either sell or use as subscription premiums, and since I do a lot better with an audience than sitting in my ham shack, this would be a good opportunity.

One tape would be about the day that Khrushchev saved amateur radio. That's right, he did just that, and it's one whale of a story of how that all came about and the incredible serendipity that saved our hash — by the skin of our teeth, so to speak.

Another would be about the greatest disaster in the history of the hobby, how it happened and what the results, which we're still seeing today, have been.

My third choice is the result of some recent writing and research. I've been integrating my three books, *The Secret Guide to Health, The Secret Guide To Wealth,* and *The Secret Guide To Wisdom* into *The Secret Guide To Being Healthy, Wealthy, and Wise*. Yep, there are some shortcuts to all three goals, but they all mean making major changes in your habits and even in your understanding of how you've been brainwashed into a misunderstanding of how the world really works.

Please let me know, if you're going to be there on September 19th, when I play Peoria again, which of the three topics would be of the most interest to you. If you opt for the non-ham subject you should bring your wife and kids too — they'll benefit from it as well.

While I'm on hamfests, I haven't heard word one about how Dayton was this year. How was it? I was grateful that I didn't decide to go this year because Art Bell W6OBB interviewed me again on his radio talk show and I was suddenly up to here in mail asking for my catalog and ordering my booklets. Thousands of letters.

We discussed my growing conviction that NASA had to have faked the Moon landings, the excitement and adventure that amateur radio can provide, God, the Bioelectrifier, and a bunch of other subjects. Four hours of 'em!

My wife Sherry got involved with a video production course at Keene State College and picked as the subject for her video the Moon landing hoax. She did a lot of research, looking at every photo and video she could find on the subject. The result was a short video backing up the reasons why so many people now believe that NASA had to have faked the landings. You can get a copy

from Radio Bookshop for $15 (and $3 s/h).

This galvanized me into semi-action, madly (I was angry) typing away, explaining the two dozen or so reasons why I was converted from a believer to a skeptic. The result is a booklet, *Moondoggle*, which I think you'll enjoy. It's only $5 and it'll enable you to win any arguments from people who still believe, as Art Bell does, that golly, our government wouldn't lie to us about something as huge as that!

Say, have you ever even wondered for a moment how NASA, after a long string of failures of their rockets, suddenly pulled off six (6) successful Apollo missions to the Moon? Have you ever wondered, even a little, about the incredible serendipity that resulted in eleven (11) astronauts being killed in "accidents" a few months before the Moon trips? Did these chaps refuse to go along with the program?

While discussing conspiracies, did you hear the ex-Secret Service agent on the Art Bell show saying that our government knows all about the ETs and UFOs, and has been in communication with them for years?

Get to Peoria in September if you can and say hello before the government decides I'm too much of a troublemaker.

The Worst Poverty of All

A chap called asking for a catalog of my books. He mentioned that he had a bad heart so I suggested he might do well to read my just published book on health since it might help him live an extra 20 years or so. No, he said he didn't have any interest in living much longer. I asked him, isn't there anything you'd like to do that you haven't done? No. Isn't there any place you'd like to visit — like see the pyramids, the Taj Mahal, the lost city of Petra, or maybe climb the Great Wall of China? No, no interest. He'd visited Canada and Mexico and that's all the travel he would ever want to do.

This poverty of spirit is the worst poverty of all.

Most of us, if freed from the restraints of health and a lack of money, have all kinds of places we'd like to see and things we'd like to do. I have a bunch more countries I want to visit and a bunch more things I'd like to do. But mostly I want to do everything I can to make our country what our founders had in mind. I want to help as many people as possible to be healthy and to have more fun in life, and that includes having the money it takes to have the fun.

I had a yacht at one time and I had lots of fun with it. I had a plane and plenty of adventures as a result. I've had several Porsches and the stories that go with having had them. They were fun. But I've done those things and don't want to do them again. There are too many new things I haven't done yet. I've been on a hunting safari in Africa, had my own Arabian horses, flown around the world making 20 m SSB contacts as I went. I've operated from weird small countries and even from a desert island. I've ballooned over the African veldt, making 2 m contacts as I went.

How about you? What would you like to do if you had the time and money to do it? Okay, so what's stopping you? The only thing stopping you is the same thing that's stopping the chap I talked with on the phone — a poverty of spirit. If you think positively, good things will come your way. If you think negatively, your expectations will be rewarded. That's the way it works.

Mozart Wins More

Remarkable increases in IQ for students at the University of California at Irvine after listening to a Mozart sonata have triggered more Mozart research. In Brittany they found that cows give more milk when Mozart is played for them. It's helping Asians speed their learning of English, calming down pedestrian traffic in downtown Edmonton, Alberta, and reducing drug traffic. In Japan it's improving the yeast for making *sake* by about ten times. They measure the quality of the yeast by its density.

I've already written about the amazing difference it makes to both seeds and plants when you play classical music for them vs. rock music — and by not much of a stretch, the difference it makes with kids. Rock music is addictive, like cigarettes, and apparently not much better for people. Have you ever heard of a rock musician who didn't have drug problems? How many classical performers have such problems? I've never heard of any. When are you going to let the Mighty Mo help improve your life?

Guilty!

As I jog across the north pasture of our farm every day I feel guilty. Here I am, with my shirt off, enjoying the warm sun as I exercise, looking at the ever-changing display of wildflowers. A week ago the field was dotted with thousands of beautiful yellow dandelions. Now they're almost all gone and in their place are tens of thousands of buttercups. I can understand why artists want to try and capture such beauty.

Closer to the ground are violets and patches of wild strawberry flowers.

Early in May many of the trees and bushes were completely covered with blossoms. What a fantastic place to live.

As I look down while jogging through the knee-high grass, I see many more kinds of wildflowers. And they're always changing. Soon white and purple clover will be blooming, then violet vetch, and later the field will be filled with orange paintbrush. In the shady woods around the

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Number 6 on your Feedback card

QRX . . .

Hams Volunteer in Emergency... Again

Ham radio operators from across Minnesota provided a link with the outside world last spring after tornadoes struck two towns in the southern part of the state. Tornadoes flattened Comfrey, a farm community of about 500, and badly damaged the city of St. Peter, population 9000, and the home of Gustavus Adolphus College. Electricity and telephone service were knocked out by the storm on March 29. At least two people were killed.

For Minnesota Section Manager Randy "Max" Wendel NØFKU, this was more than a disaster which required the helping hand of ham radio. St. Peter was his home town, and where his parents still lived. Wendel and Minnesota SEC Gary Peterson NØZOD were among dozens of ARES members who responded.

Wendel and Peterson alerted other ARES members to be prepared to assist with communication, then headed for St. Peter. ARES members from Rochester and the nearby Mankato area were among the others who turned out. Wendel himself arrived in St. Peter after nightfall, using his ARES identification to get past state police barricades. Wendel found his parents' home damaged, but they were safe. Others, including their neighbors, found themselves suddenly homeless.

Wendel said hams already had situated themselves at key locations, including the Nicollet County Emergency Operations Center, a shelter for victims, and at a sports arena. The ARES team set up an emergency base station at Gustavus Adolphus College. While most students were out of town for spring break, 28 students remained on campus and had no contact with the outside world.

During the next day or so after the tornado struck, ham radio was the only communication out of the city and the primary means to coordinate supplies into the city from the Red Cross in Mankato to the shelters in St. Peter. The morning after the tornado, the Salvation Army arrived to distribute food. Hams provided logistical support for that effort as well. Other hams shadowed disaster assessment officials who went door to door throughout the city or handled net control duties at the EOC. Still others simply made themselves available as needed to cooperate in the recovery effort.

With typical ham ingenuity, Dave Kleindl KAØBFP scrounged enough materials to construct a temporary dipole to put a local broadcast station back on the air after its towers had been downed in the storm. With help from other hams, Kleindl also got a generator to a water tower that was still standing and reactivated the local VHF/UHF amateur and public safety repeaters.

"This event once again set a clear example of the importance of amateur radio during an emergency," Wendel said. Both he and Peterson stressed the importance of planning. Fortunately, the local government officials and agencies were aware of amateur radio as a resource. "When it comes to the unexpected, there is no time to explain who we are and why and how we can help," he added.

From April 1998's *marcKey*, newsletter of the Manteca (CA) ARC, Mike Saculla WA6FQM, editor.

You might be a real ham radio operator if:

•You know what year your FCC license expires, but you forget when to renew your driver's license.

•You have more money tied up in radios, towers, computers and antennas than you do in your children's college funds.

•You have traded your radios so often that the monthly payment on your MasterCard is about the same as your mortgage payment.

•You have climbed your tower four times this year for antenna maintenance and haven't changed the oil in the car once.

•You would rather look at the pictures in *QST* than the ones in *Playboy*.

•The clerks at Radio Shack smile when you come in.

•You burn 30 gallons of gas going to an electronics flea market to look at all the treasures and you buy a 35¢ resistor.

•Your most pressing social engagements are the contest weekends.

•All your Christmas and birthday presents come from Radio Shack.

•All the presents you buy for your wife and kids come from Radio Shack.

•You spend more time working on your radios than you do using them.

•You won't speak to your wife for two days after you've missed your turn on a DX net.

•You believe that hams who can't or won't use Morse code have a major personality defect.

•You hear a CQ at about 4 p.m. and you consider it an "afternoon delight."

•You judge a man's character not by his behavior or convictions, but rather by his ability to break through a pileup.

•You spend more than one day at HamCom or the Hamvention®.

•You actually *read* all the brochures you brought home from HamCom or the Hamvention®.

•You give your wife perfume called "On the Aire."

•You have a sign on the door of your ham shack reading "The Shack" and you get no objection from your wife.

•About once a year you clean up your shack, but never get around to cleaning your closet.

•Your radio station is cleaner than your garage.

•You got your ham station in a divorce settlement and she wound up with everything else.

•All of your coax lines and feedlines are not only the same RG part number, they are also all the same brand.

•You are talking on the radio all afternoon on Super Bowl Sunday.

•All your T-shirts are promotions for major radio brands.

•The only picture you can find of yourself is one that was taken in your ham shack.

By Bud Johnson WI5G, originally printed in *The Q-Fiver*, June 1998, Susie Scott N8CGM, editor.

GM *vs.* Microsoft

At a recent computer expo (COMDEX), Bill Gates reportedly compared the computer industry with the auto industry and stated, "If GM had kept up with technology like the computer industry has, we would all be driving 25-dollar cars that got 1,000 miles to the gallon." Recently, GM addressed this comment by releasing the statement, "Yes, but would you want your car to crash twice a day?"

If Microsoft built cars:

• Every time they repainted the lines on the road you would need to buy a new car.

• Occasionally your car would die on the freeway for no reason, and you would just accept this, restart and drive on.

• Occasionally, executing a maneuver would cause your car to stop and fail, and you would have to reinstall the engine. For some strange reason, you would accept this too.

• You could only have one person in the car at a time, unless you bought "Car95" or "CarNT." But then you would have to buy more seats.

• Macintosh would make a car that was powered by the sun, was reliable, five times as fast, twice as easy to drive, but would only run on 5% of the roads.

• The Mac car owners would get expensive Microsoft upgrades to their cars, which would make their cars run much slower.

• The oil, gas and alternator warning lights would be replaced by a single "general car default" warning light.

• New seats would force everyone to have the same size butt.

• The airbag system would say "Are you sure?" before going off.

• If you were involved in a crash, you would have no idea what happened.

—Attributed to *USECA Express* via Ann KA8IF, and lifted from a copy of the Traverse City, Michigan, Cherryland ARC newsletter, *Cherry Juice*, by KA8LDS.

Gotta Have One!

Jake the inventor is struggling through a bus station with two huge and obviously heavy suitcases when a stranger walks up to him and asks, "Have you got the time?"

Jake sighs, puts down the suitcases and glances at his wrist. "It's a quarter to six," he says.

"Hey, that's a pretty fancy watch!" exclaims the stranger.

Jake brightens a little. "Yeah, it's not bad. Check this out ..." And he shows him a time zone display—not just for every time zone in the world, but for the 86 largest metropoli. He hits a few buttons and from somewhere in the watch a voice says, "The time is fifteen forty-five," in a very western Texas accent. A few more buttons and the same voice says something in Japanese. Jake continues: "I've put in regional accents for each city." The display is unbelievably high-quality, and the voice quality is simply astounding.

The stranger is struck dumb with admiration.

"That's not all," says Jake. He pushes a few more buttons, and a tiny—but very high-resolution—map of New York City appears on the display. "The flashing dot shows our location by satellite positioning," explains Jake. "View recede ten," he says, and the display changes to show eastern New York State with true and magnetic north, and grid square references.

"I want to buy this watch!" says the stranger.

"Oh, no, it's not ready for sale yet—I'm still working out the bugs," says the inventor. "But look at this," and he demonstrates that the watch is also a very creditable little 10-meter radio transceiver with an autotuner, memory keyer, and DVK, and a sonar device that can measure distances and tower heights up to 125 meters, and a call logger with thermal paper printout for hard copy, and, most impressive of all, has the capacity for voice recordings of up to 300 standard-size books. "But I only have the US/foreign *Callbooks*, QSL bureaus and managers, and all the *Antenna Compendiums* in there so far," Jake apologizes.

"I've got to have this watch!" says the stranger.

"No, you don't understand—it's not ready!"

"I'll give you $1,000 for it!"

"Oh, no, I've already spent more than that!"

"I'll give you $5000 for it!"

"But it's just not ..."

"I'll give you $15,000 for it!" And the stranger pulls out his checkbook.

Jake stops to think. He's spent $8,500 for materials and development, and with $15,000 he could make another one and have it ready to go on the market by Dayton time. Plus, getting the

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LETTERS

From the Ham Shack

Clark Crawford N7EDB. I'm so glad you have had the tenacity and audacity to continually send out the messages, year after year, to deaf ears and unseeing eyes. It is so encouraging to many of us who think and feel the same and channel our energies to the same end in different ways. Our home is a continuous school to those who will come and hear our slant on schools, medicine — or more correctly, healing arts — politics, religion, spirituality, etc., almost always very contrary to the mass media perspective. The gloom-and-doomers have been at it for thousands of years, but they affect only those who believe in them. I keep my path set on innovation, evolution, success, fun and ease. That is where I think mankind is going. You are a major player in that trend. Thanks for speaking for so many of us quieter ones.

Thanks, Clark, I need some encouragement now and then. Sigh ... Wayne.

John Lawson W3ZC. For 25 years I was a regular on our local repeater here in 3-land. That is, until a couple of years ago. Now I rarely get on. All I hear is talk about rain gauges, tomato plants, chipmunks, the attributes of various brands of potato chips, how a troubled rig needs a good smoking to get it working again, and, the most disturbing, how it doesn't matter how it works or why it works, just that it does work. This isn't ham radio. It's something else. Oh well, there always was *73 Magazine*. Until "Never Say Die" in the July issue.

I have been a regular subscriber to *73* for the last 15 years, and a sporadic subscriber before that for as long as *73* has been around. Once in a while, Wayne, you write some pretty interesting editorials. And then there are the other times. The July issue was the worst. Maybe this will bring you back down to Earth, Wayne. *73 Magazine* is an amateur radio publication. You remember ham radio, Wayne. I'm sure that most hams don't give a hoot that you read *Dilbert*. Nor do they care that you are a strong supporter of paper clips and disdain the dreaded staple. Then you run off at the mouth about your heroes Fleischmann and Pons and their fantasy, cold fusion. Do you think we hams really care to read about the attributes of drinking 12 glasses of water a day in a ham magazine? Or that we are enthralled at reading tutorials on the dark inner workings of the pharmaceutical industry, or the marvelous and grandiose solution that you originated for the Social Security "problem?" Do you really think that hams are interested in reading in a ham magazine about Nostradamus, your views on nutrition, Asian economy, or the fact that you were intimately involved with the high-IQ Mensa group? Maybe that explains why you seem to have lost your grasp on ham radio. Then there are comments on *El Niño*, Antarctic rocks, and children's suicide.

I left the *coup de grace* till last. I understand how important it is to maintain harmony in a marriage. But give us a break. Your wife's dissertation on how the world's population was deceived on Moon landings by NASA? You, a former member of Mensa, writing a long harangue on how your wife discovered that NASA never sent anybody to the Moon? All of these topics are interesting and important. But it is NOT ham radio, and *73* is supposed to be a ham magazine. Wayne, you had a lot more sense when you were poor.

Go ahead, Wayne, your turn. Take your best shot. Tell us how all of these topics are really ham radio. This ought to be good!

*So read the rest of the magazine. It's **all** ham radio. I notice that you didn't have one single positive suggestion, which doesn't surprise me. John, I've been trying to promote amateur radio as a communications medium for almost 50 years and, from what you write, there are some hams who are actually using it for that. Which you decry. Doesn't **anything** but ham radio interest you? My editorials have always been about anything I think the readers will be interested in. They were like that when I first started with* Amateur Radio Frontiers, *and then when I was the editor of* CQ *for five years, and in* 73 *since I started it 38 years ago. For a couple of years, when the magazine was being published by IDG, there were no W2NSD/1 editorials, and the magazine's circulation dropped to half. John, I watch the reader reply cards and note that my editorials almost always get a top vote. But one more thing: The hobby has changed since we got started in it — me in the 1930s, and you, presumably, in the 1940s. Before transistors and ICs we could build our own stuff. There were hundreds of parts houses and almost a thousand ham stores. We built using tubes on a metal chassis, mounted on 19-inch steel panels from Bud. I had shelves of resistors, capacitors, variables, switches, tube sockets, tubes, meters, and so on. And when something went wrong, the equipment went onto the workbench and I fixed it. I had a tube tester, oscilloscope, VOMs, a signal tracer, audio and RF generators, and so on. And I knew how to use 'em. Now, when my HT goes sour, what am I going to do? The same as you, John — I'm going to send it to the factory. So what do you want to hear the guys on the repeater talking about? What model rig they bought? How many years can you listen to that mindless drivel without moving on to something more interesting — like the Internet? John, I've been asking the readers for years to write about any new equipment they've bought, hoping someone would come up with something interesting I could print. I've gotten zero response. I'm encouraged that hams are talking about tomatoes, rain gauges and chipmunks ... Wayne.*

Joseph T. Gabus AB5RE. While searching back issues of *73 Amateur Radio Today* for a good Field Day antenna for QRP operation, I found Mr. Tilburg's article, "Half Square DX Antenna," May 1997, and began to gather materials for a 20-meter half-square CW antenna. I found a spool of plastic-covered AWG-14 wire, but not AWG-16, and not having a junk box full of parts, etc. I bought a plastic cutting board, about three-eighths inch thick, and cut and drilled the holes for the wire and coaxial cable. Using the formula for the smaller wire, for 14.040 MHz, I found that my wire lengths were a bit short, since the resonant frequency appeared to be about 14.090 MHz, but the SWR bridge indicated a 1:1 reading all the way down to 14.000 MHz. With the antenna supported at 20 feet, by two two-and-three-quarter-inch PVC masts, I hooked up my MFJ-9020 four-watt transceiver and gave it a try a few weeks before Field Day. I was pleased to make about 10 contacts, in many directions. On Field Day, I set up my 20-foot high PVC masts in a N–S alignment (thinking I had them east-to-west), theoretically favoring the north and south. I lengthened the horizontal antenna element about two inches, and brought the resonant frequency down to

Continued on page 86

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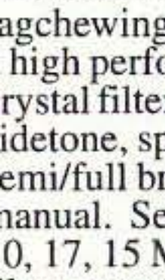

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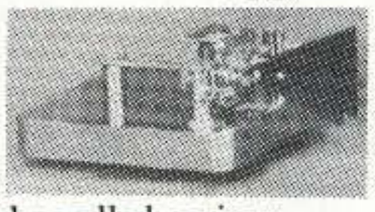

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A Silk Purse ...

Easy upgrades for Heathkit's SB-104 transceiver.

Paul Blum K9ARF
1138 Cardinal Lane
Green Bay WI 54313
[theblums@execpc.com]

As a radio amateur on a budget, I always keep my eyes open for bargains—especially "repairman specials"—that may come my way. I came across such a deal when I was offered the chance to buy Heathkit's SB-104 at a low price. The radio was in excellent shape physically, but needed tender loving care to return it to operation.

The quality of used Heathkit gear is dependent upon the person who assembled it. If that person wasn't skilled in the art of soldering, it can be a nightmare. The seller was nice enough to let me "look under the hood," and I discovered very neat, conscientious assembly work. Sold!

It wasn't long before I dug into the service manuals and had the rig back in working condition. But as I used the radio on the air, I noticed some deficiencies in its performance. The hot rodder/home-brewer in my blood kicked in, and I set about to improve things.

Introduced in the mid-seventies, the SB-104 was Heathkit's first attempt at a fully solid-state HF rig. They made some improvements along the way, which resulted in the SB-104A. The "A" version has several refinements, notably an entirely new receiver front-end board. The "A" front end uses diode doubly-balanced mixers similar to those used today. Heath offered a retro-kit to update original models to the "A" version. They also offered a kit to add crowbar overvoltage protection to the matching station power supply. Many SB-104 owners became painfully aware of the need for this protective circuit, as I have seen the factory repair stickers labeled "overvoltaged" inside.

Microphone mods

The first modification I performed was to replace the microphone jack on the front of the radio. The original is an oddball two-conductor connector which may be difficult to obtain. I replaced it with a more common four-conductor microphone jack, and used an extra conductor to provide bias for an electret mike cartridge (fed through a 12 k resistor to the 11-volt supply). You can put in any mike jack that will fit, to match whatever microphones you have around. The microphone circuit is originally designed for high impedance microphones, so I improved the input to work better with a low impedance mike. Simply replace R204 on circuit Board B with a resistor of approximately 50 k ohms.

11-volt regulator

The SB-104 operates on 13.8 volts DC, and a mobile bracket was available, so one could assume it can be run mobile. Well, it can, with two stipulations: I hope you have lots of room in your car (I don't!), and the engine had better be doing something other than idling. I attempted to operate the radio on emergency power (a car battery in my shack) and discovered it started going crazy if the voltage got lower than 12.8 volts. Looking deeper into the problem, the radio's regulated voltage is 11 volts. The 11-volt regulator couldn't maintain below 12.75 volts input, and would upset the biasing of some of the circuits, notably the various oscillators. The pass transistor couldn't turn on "hard enough" to hold the voltage steady.

I redesigned the 11-volt regulator using a P-channel power MOSFET, which has a very low turn-on resistance. On circuit Board B, remove the following components: C203, C226, C227, D207, R254, R255, and the

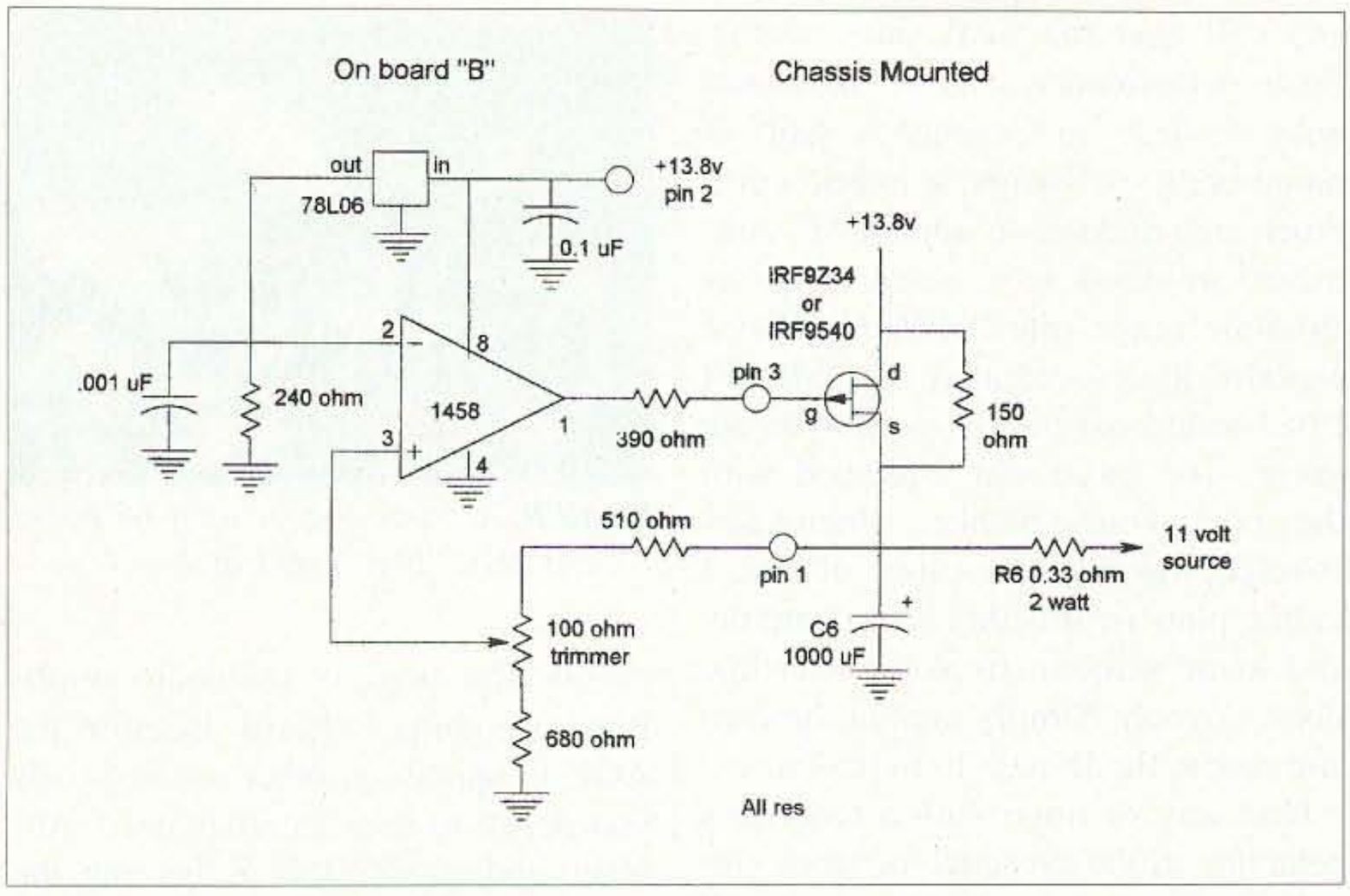

Fig. 1. *11-volt regulator, Heathkit SB-104. All resistors 1/4 W, 5% unless specified.*

power transistor Q2 (mounted on the chassis). The power MOSFET transistor should mount in the same socket Q2 was removed from. Be sure to use insulating washers to prevent a short to the chassis. I constructed the remainder of the regulator circuitry (**Fig. 1**) "dead-bug" style in place of the old circuitry on Board B. The circuit consists of an op-amp referenced to a regulated six volts driving the power transistor. A lower voltage on the output results in turning on the transistor "harder." The small trimmer potentiometer should be adjusted for 11 volts output. After performing this modification, the radio remains stable down to 11.5 volts supplied.

S-meter

In the process of testing the SB-104, I had a calibrated signal generator attached to test the receiver. When I attempted to calibrate the S-meter, I found that it had less than a 20 dB range from S1 to full scale. I tried many different ways of correcting this, and found the best solution to be the simplest. On the receiver IF/audio board (Board F), the S-meter circuit is fed through a zener diode, ZD502, 4.7 V. This voltage drop is too much, delaying the action of the S-meter until well after the AGC starts functioning. Remove ZD502 and replace it with a pair of silicon switching diodes (1N914 or similar) in series. The series-connected diodes provide a 1.4-volt voltage drop, and should be installed with polarity opposite that of the zener diode. Adjust R534 on the top left corner of Board F to calibrate the S-meter. Use either a calibrated signal generator or off-the-air signals to set it to your liking. This modification greatly increases the range of the meter.

AGC "pop"

I found another design flaw I traced to Board F. When using the radio in a normal discussion with the AGC switch set to "slow," the AGC would "pop" when I unkeyed, and this effectively shut down the receiver until the AGC voltage decayed. I would miss the first few words of reply if my friend was quick on his mike. On the receiver IF/audio board (Board F), capacitor C535 controls the AGC decay. I added a few parts to hold off the charging of this capacitor momentarily when the transmitter unkeys. Just add three parts: a 2N3904 transistor, a 15 kΩ resistor, and a 15 µF tantalum capacitor. I added them dead-bug fashion along the top edge of the board adjacent to R544 (refer to **Fig. 2**).

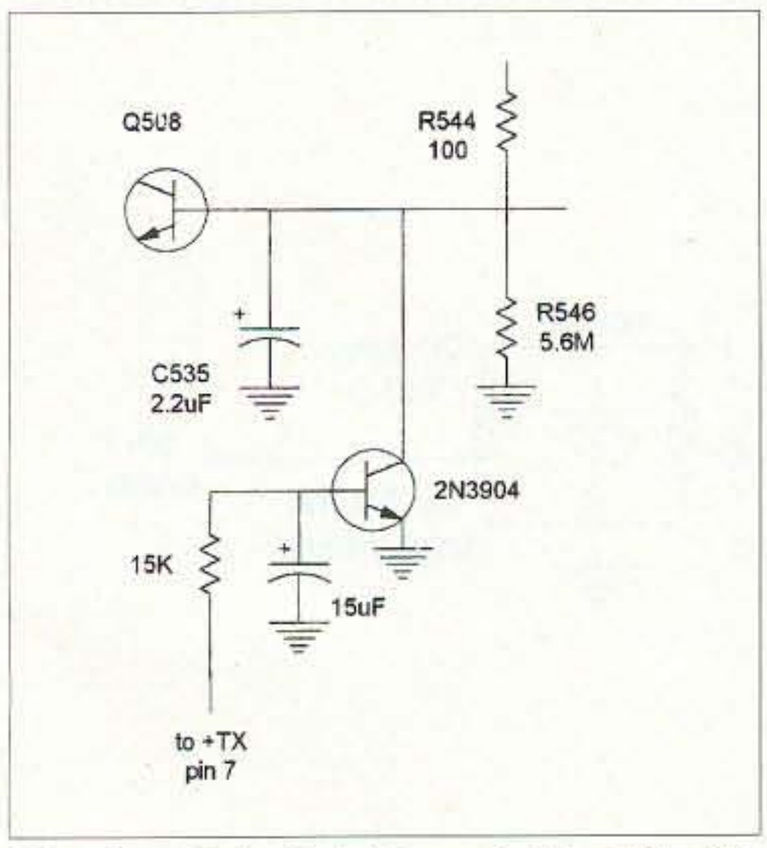

Fig. 2. *"Unkey" AGC mod, Heathkit SB-104 Board F.*

Photo A. *Heathkits such as these once ruled the waves.*

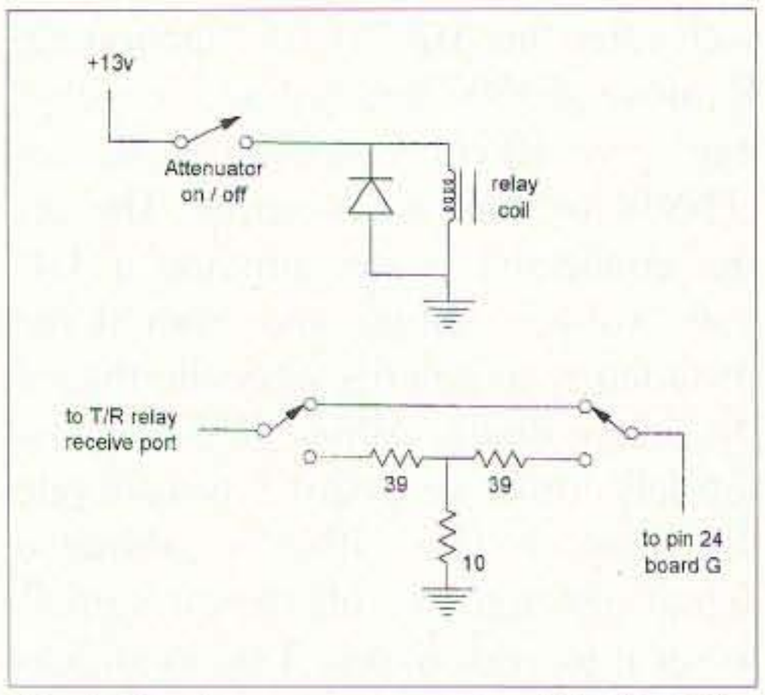

Fig 3. *Receive attenuator, Heathkit SB-104.*

Display ICs

In the process of my improvements, I picked up a second SB-104 (in horrible shape) as a source of parts, cheap. The frequency display on it had a couple of segments that were blank. The display digits are not LEDs, but a type of flat vacuum tube display. They require 180 volts DC for operation, so be careful when poking around behind the display! I determined the display driver IC was bad, but could not find a replacement for the DD700 chip used by Heathkit. Later I got lucky and a factory-repaired board I found had a more common IC in its place. These numbers are still currently available: SN75480N or ECG2028.

Receiver mods

The remaining modifications were done to improve the receiver's poor performance in the presence of strong signals. The true measure of a good receiver is that it can handle large signals and still hear the weak ones nearby. Such performance can be measured with modest equipment: A pair of home-brew oscillators, a hybrid combiner, step attenuator, and an AC voltmeter are used to measure receiver dynamic range (the *ARRL Handbook* explains the procedures). The SB-104 I had tested out poorly as to dynamic range. The radio was equipped with the optional noise blanker, which I discovered was a major cause of this. I didn't plan to use this radio mobile, and found it ineffective on power line noise anyway. Simply unplug the card and rewire the IF path to bypass it.

One way of improving a receiver's behavior in the presence of large signals is to attenuate them. Almost all current HF transceivers include an attenuator switch. I added a 20 dB attenuator and a small 12-volt DPDT relay to the underside of the chassis near the antenna jack (see **Fig. 3**). Put the relay inline between the T/R relay (or the optional RX antenna switch if you have one) and pin 24 of Board G. You can switch it with the now-unused NB switch. When the band is full of "big guns" (like during a contest) you can switch in the attenuator.

One determining factor of dynamic range is the quality of the filtering in the receiver. Without adequate crystal filters, a radio will exhibit "mystery S-meter syndrome" when big signals are on the band. The SB-104 has this big time—the S-meter goes up, but you don't hear anything. The nearby loud signals are getting through the crystal filter, operating the AGC, but end up

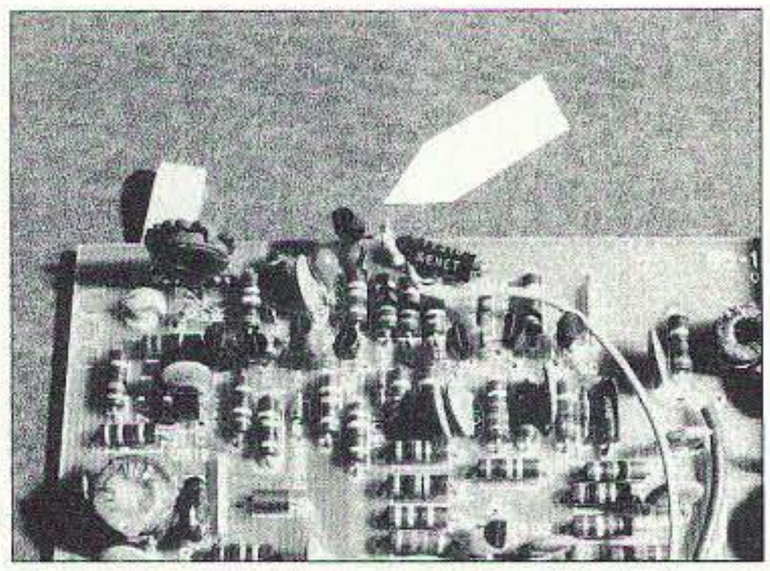

Photo B. *A "dead-bug" cluster on Board F cures AGC "pop" (see* ***Fig. 2****).*

outside the range of the audio amplifier, so nothing is heard. Because the AGC is operating, other weak signals you desire to hear are attenuated. Another undesired effect is hearing the opposite sideband of large signals.

To help correct this problem, I purchased a higher-performance "Fox Tango" crystal filter to replace the stock SSB filter. These are available from International Radio, phone (541) 459-5623, or [http://www.qth.com/INRAD]. This made some improvement, but not nearly enough. This filter is the only narrow bandwidth selective element in the receiver, while most modern HF radios use two sets of filters or more.

An idea came to me as I was cleaning the workbench and found the recently removed Heath crystal filter lying there. Why couldn't I use two crystal filters like the modern radios? I designed a way to add the second filter, adding a small FET amplifier to overcome filter loss. I also used a relay to switch it inline or out. The circuit performs so well I never take it offline.

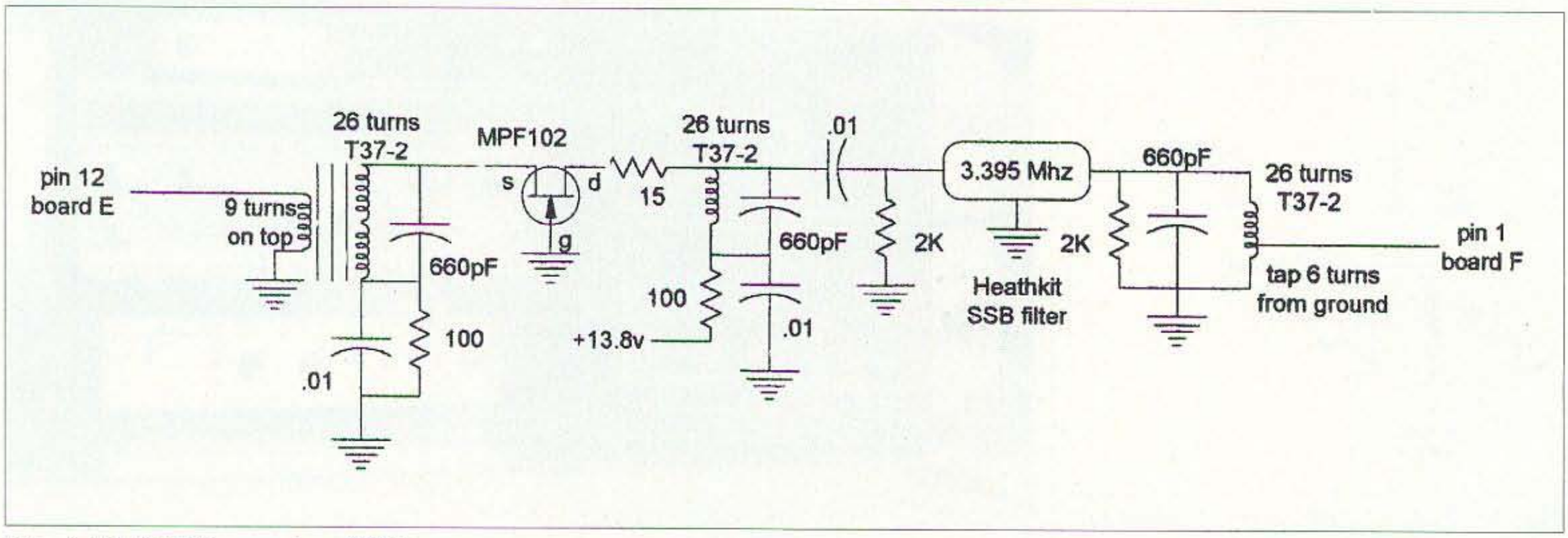

Fig. 4. *SB-104PB secondary IF filter.*

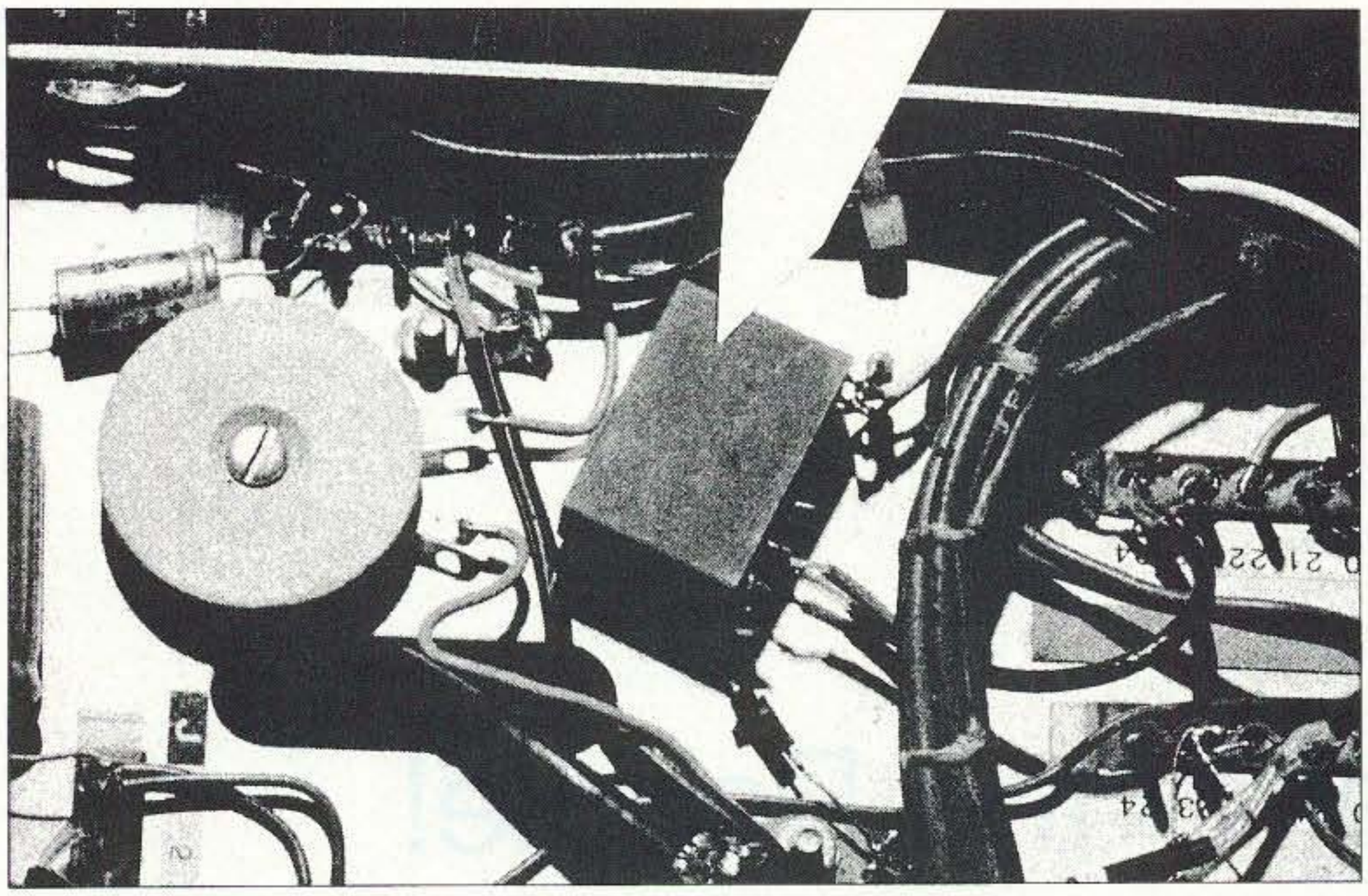

Photo C. The receive attenuator goes under the chassis (see ***Fig. 3****).*

No more "mystery S-meter syndrome." I mounted a small piece of circuit board to the filter, and constructed the amplifier and matching circuit right on it (see **Fig. 4**). The whole assembly then mounts to the chassis above the place the noise blanker used to be. Run some small coax (RG-174) down through the chassis to the IF boards. The input to the second filter comes from Board E pin 12, and the output goes to Board F pin 1. This modification eliminates "filter blow-by" completely.

I really enjoy operating my SB-104A, and I have relabeled it the "SB-104PB" now that I have personally improved it. The radio is easy to work on, with its modular construction, and they seem to be available for low cost at hamfests and flea markets. There are other improvements to be made, and it's an easy radio to experiment with. I recommend another article about this rig by David Palmer W6PHF (*QST*, March 1982) for those who want to experiment further. 73

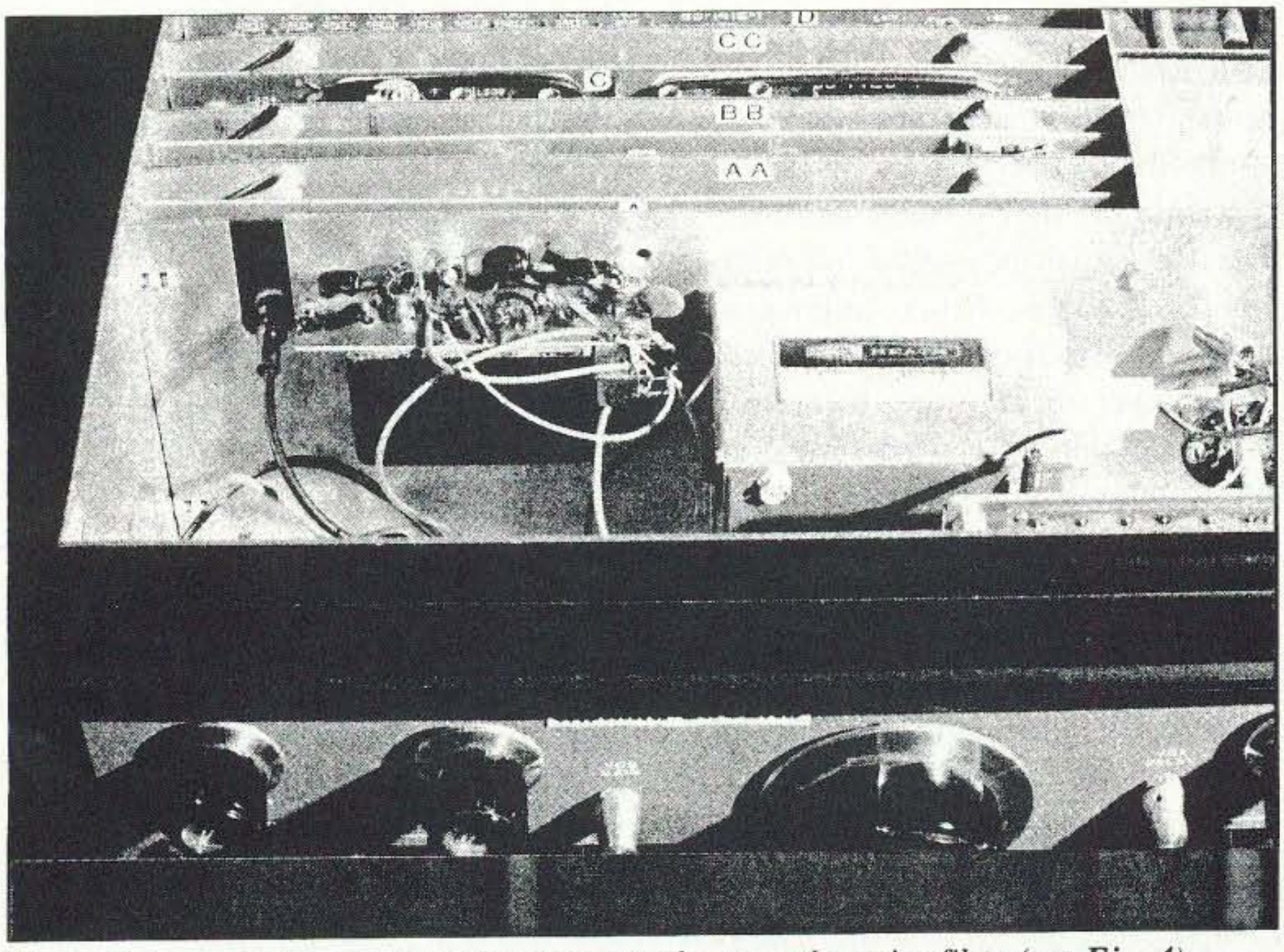

Photo D. A small piece of circuit board hosts the second receive filter (see ***Fig. 4****).*

Power to the People!

To hams who build this tuned input network, that is ...

Ronald Lumachi W2CQM
73 Bay 26th Street
Brooklyn NY 11214-3905
[W2CQM@juno.com]

The salvaging and rebuilding of vintage amplifiers by a knowledgeable and highly motivated group of radio amateurs continues full steam ahead for reasons that remain best known to this select home-brew crowd. Their reasoning is not top secret, nor is it restricted to their eyes only; however, they are reluctant to broadcast to the world what they consider to be an ongoing good deal. It appears they would prefer to enjoy this perk for as long as possible. In a sense, their attitude can be considered a harmless conspiracy to limit the number of participants chasing a finite number of amplifier discards. What they know to be a solid fact is that the older linear decks were typically overbuilt, and that to duplicate the quality of the components today remains elusive except in the most outrageously expensive commercial products. They are equally aware that many early amplifiers currently available with reasonable prices have fallen from grace either because they are considered *old-fashioned*, because a minor component may have been smoked, or because they can't produce the super level of power perceived necessary to compete in the DX pileups.

Perhaps even more compelling is the lure of the newer generation bells-and-whistles amplifiers with their never-ending array of features, strategically unveiled over a period of time in order to create demand by making the older gear appear obsolete. These linears are continually being modified and bundled together with features that are, in fact, far in excess of practical needs. This public relations marketing strategy, coupled with Madison Avenue-type glitz, appears to be the strongest factor in separating the amateur from his savings. It's a force that's often difficult to overcome, especially when you're struggling with your better judgment to keep your hands out of your wallet.

Whatever the reasons hams use to justify the purchase of new-generation amplifiers is fine. I'll buy their old rigs all day long and do what little has to be done to bring them up to speed. It's a money-in-the-bank project even if you plan only to complete the mods and then peddle the upgraded amp for a profit. No one can fault you for turning a buck because you made a good deal.

Many hams, in order to soften the sticker shock of purchasing a new amplifier, will relegate older rigs to pasture at attractive prices. Perfectly serviceable amps are being cast aside and sold at super bargain levels.

Here's where the eagle-eyed home-brewer makes out like a bandit.

In order to learn what these astute hams already know, and to involve yourself in a fun project, take a look at the many articles describing tube retrofit projects. Power supply and RF deck upgrading are commonplace, and well-written treatises featuring Svetlana® and Eimac® tubes are yours for the asking from these sources. To catch up, simply follow the step-by-step construction directions of the tube manufacturers. Before you know it you'll be on the air with a big gun signal with that born-again ugly-duckling amplifier that nobody wanted—at minimal cost!

So what's the problem?

Many circa 1960–1980 amplifier manufacturers did not include a tuned input circuit in the typical grounded grid amplifier. Perhaps the thinking was that the losses were an acceptable tradeoff in light of the manufacturing costs and space requirements for this accessory item. The manufacturers

Photo A. *A view of the tuned input module resting comfortably atop a three-hole 813 B&W LPA-1 amplifier deck cranking out 1000 + watts into the antenna. Output has been substantially improved with the input module installed. All photos by author.*

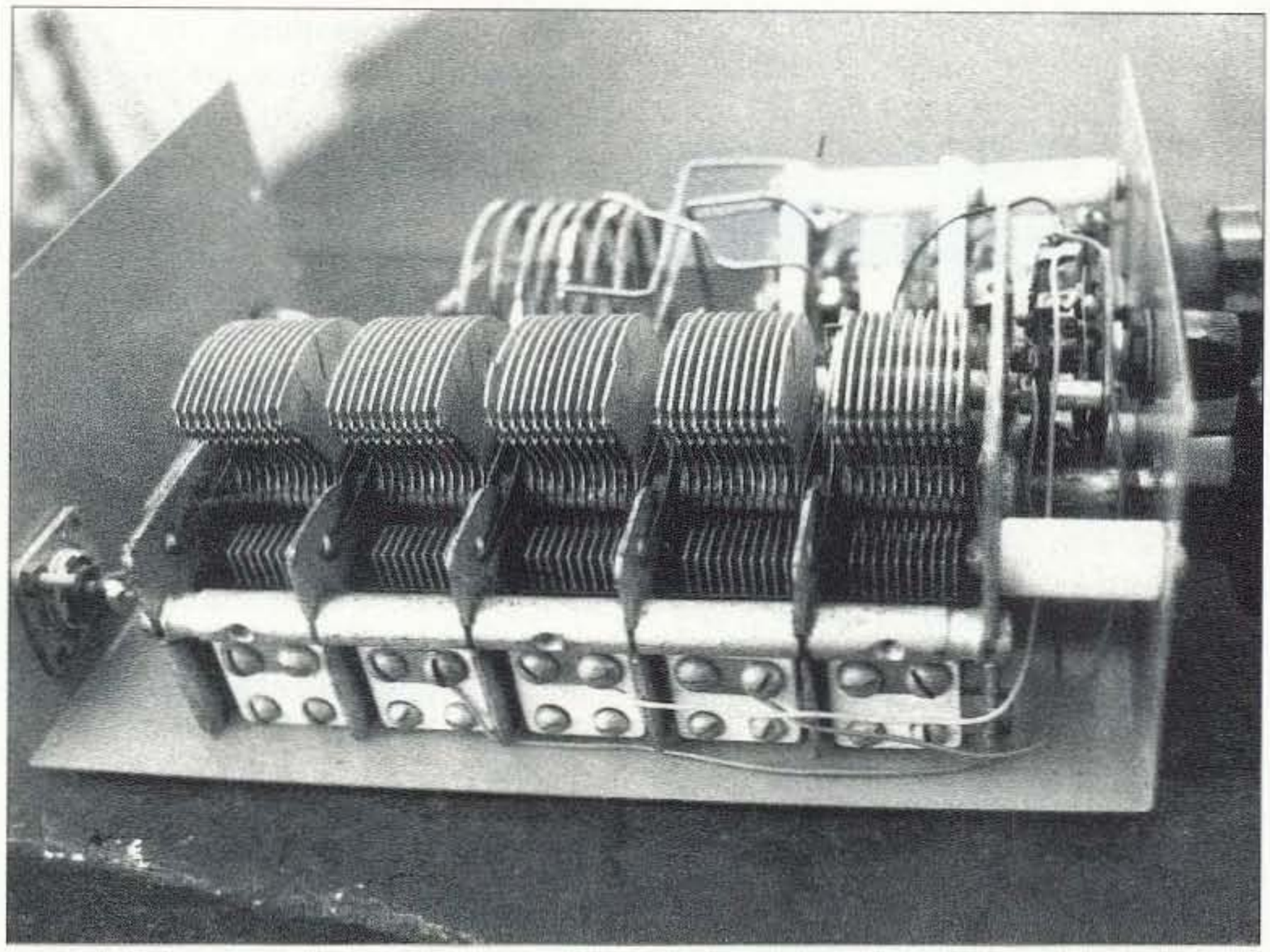

Photo B. *A view of the far side of the tuned input module. Sections one and five of the air variable have been wired permanently into the circuit. The wires reaching out to sections two through four terminate at the rotary switch and have the capability of switching those sections in and out of the circuit as needed. The SO-239 is positioned on the rear wall. A short length of 58U connects this fitting to one side of the "T" adapter on the amplifier RF input.*

were aware of the need for the matching input circuit, but they knew that many early transmitters had provisions to tune for an antenna mismatch. The majority of exciters had power to spare in order to drive the glow-in-the-dark finals at less than ideal conditions.

Obviously, times have changed! Linear amplifier power levels are up, tube amplification factors are out of sight, and excessive grid current, especially in the newer generation ceramic tubes, is critical and unforgiving. More important, exciter/amplifier matching must be more precise with the new-generation solid state transceiver. These digital-readout engineering gems have been programmed to reduce power automatically or will simply shut down when the impedance values are not to their liking.

Consequently, to get the best signal you can on the air, the tuned input circuit is no longer a luxury. The general feeling among amplifier designers is that the input circuit is a must. I haven't read a single amplifier construction or retrofit article that doesn't strongly recommend a tuned input circuit to ensure that the exciter signal linearity is preserved and maximum output is achieved from the new-generation, very expensive, legal-limit-plus amplifier tubes.

The problem is that retrofit circuits and components take up valuable space that's often not available in the typical amplifier deck refurbishing

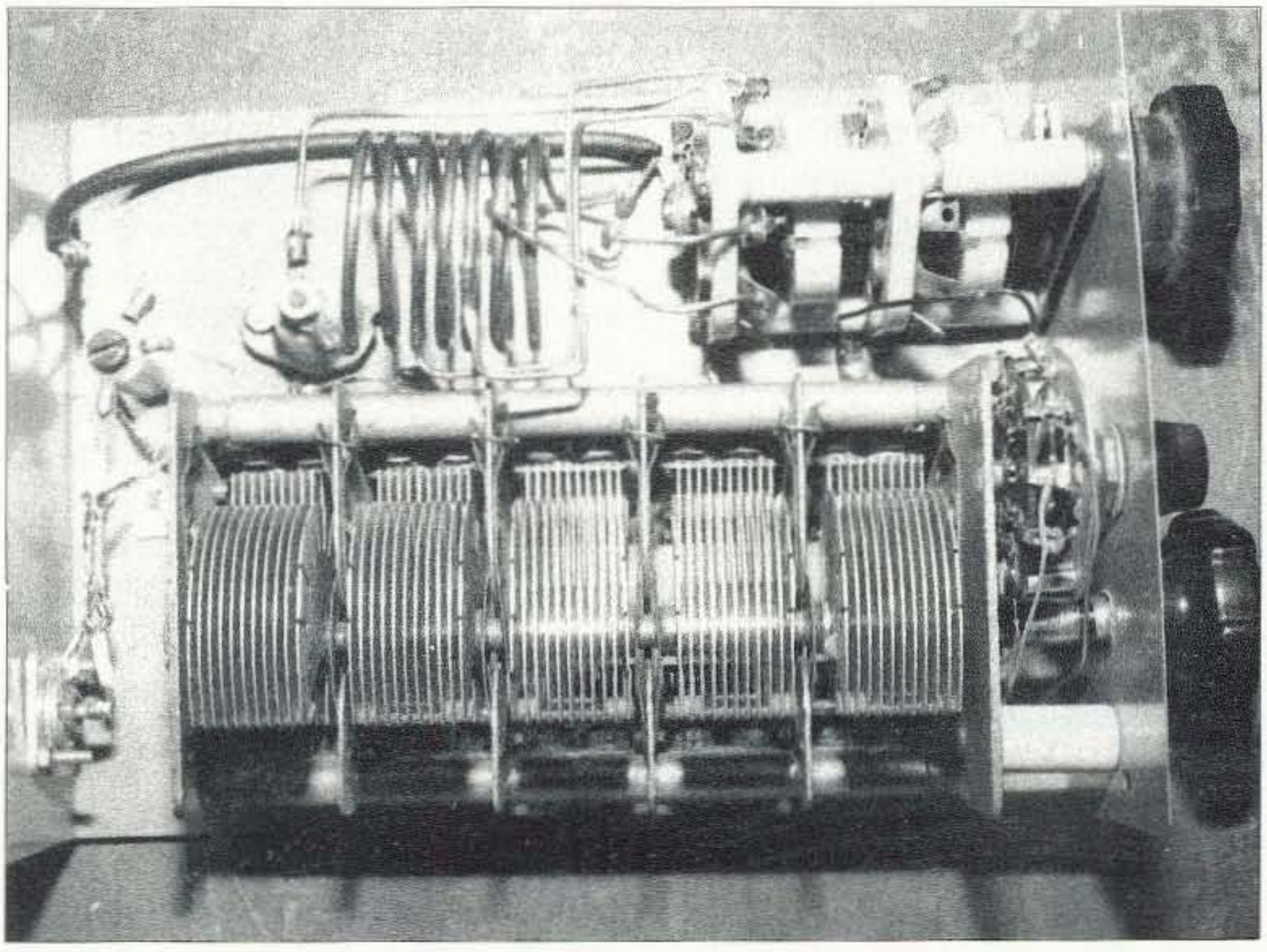

Photo C. *An aerial view of the components mounted within the metal enclosure. Note how the use of the standoffs provided space to mount the three-position rotary switch. The 10, 15, and 40 m taps are visible from this perspective. The 20 m tap is soldered to the bottom end of the coil and not clearly seen. Note that all lengths of 58U have been grounded at both ends with the copper braiding.*

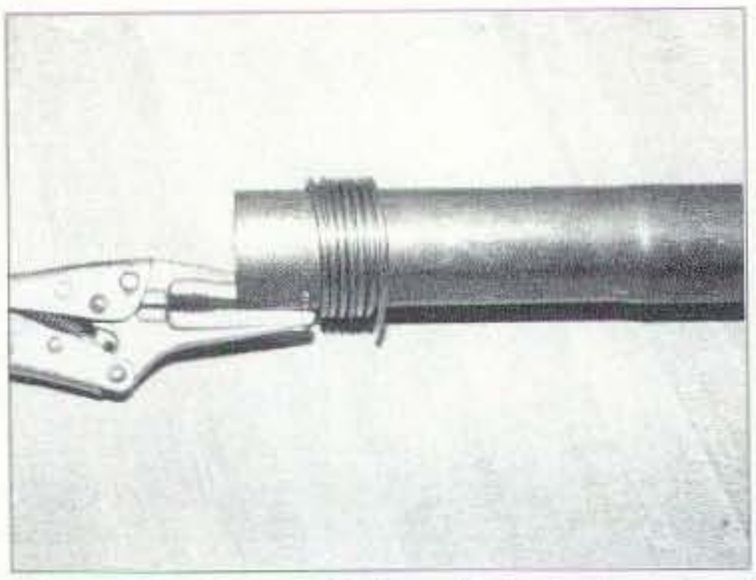

Photo D. *Close-wind a 40-inch length of #10 solid copper wire on a 1-1/2-inch OD form. I used a tailpiece from a kitchen sink drain line that measured exactly to size. The locking pliers secured one end during the winding process.*

project. Even if you were able to shoehorn in the components, linking the bandswitching with the input controls is generally impossible to accomplish without a major rebuild and extensive front panel drilling.

I faced the problem when dealing with a B&W LPA-1 amplifier rebuild (three 813s and vacuum relays). Fortunately, I managed to overcome the dilemma with a simple tuned input project (see **Photo A**) that appears to offer the best of all worlds. All the components of the matching network were mounted outboard in a self-contained enclosure I could move from amplifier to amplifier with no internal modifications. A coaxial "T" adapter and an additional short length of 58U cable were all that was needed for the hookup.

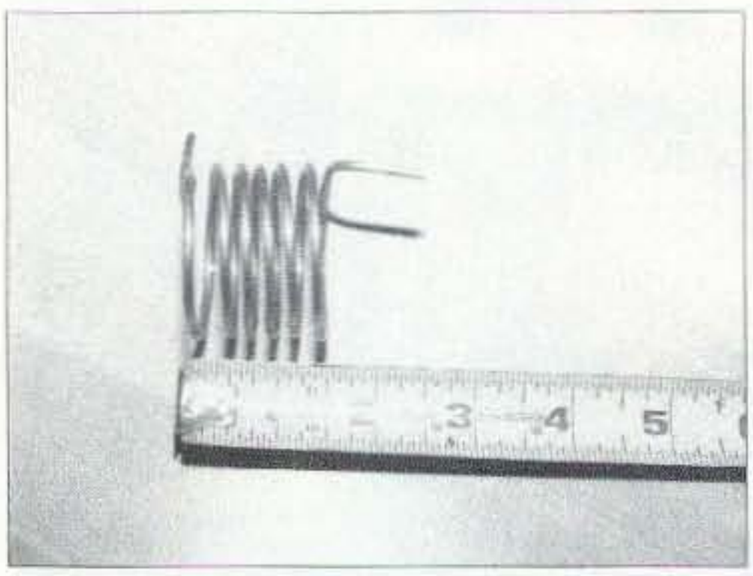

Photo E. *Uncoil the wire evenly to a length of 1-1/2 inches. Cut off any excess length but make certain to leave enough to attach solder lugs. It might be easier at his point to prepare the wire for soldering by burnishing the areas to be tapped. Keep in mind that all taps are counted from the grounded end.*

The circuit requires no power source, nor does it demand any extensive modifications to the exciter or RF deck. If that sounds like a good deal to you, check out the project details below. Then build it up, bolt it on, and broadcast away—with a signal that will do you proud. The components are easy to locate, the cost is minimal, the construction is straightforward, and the results are worth it.

The chicken or the egg?

It probably makes better sense to locate the components prior to purchasing the enclosure. There are no advantages to an overly large cabinet, so select a size that allows you to install the components in an orderly manner in the smallest space possible.

My enclosure measured 3-1/16 inches by 8-1/4 inches by 6-1/8 inches (Radio Shack #270-274) and was sufficiently large to ease the point-to-point wiring (see **Photo C**). Ideally, you'll need a broadcast-type five-section air variable totaling about 2500 pF. (A three-section with additional capacitance grafted on will work OK—Antique Radio Supply #CV264.) Locate an SP5T (nonshorting) porcelain bandswitch and an SP3T (shorting) switch (Radio Shack #275-1385) to move capacitance in and out of the circuit (depending on the band selected).

Lay out the parts and drill shaft holes to secure these components to the front panel. Don't forget to bolt the air variable to the base of the enclosure at several points for a good ground return. Using a 40-inch length of #10 AWG solid copper wire, wind a six-turn coil on a 1-1/2-inch OD form (see *Eimac Amateur Service Newsletter* #AS-10, reprint of *QST* article dated July, 1963). A short length of 1-1/4-inch brass, iron, or PVC pipe, or a closet rod will do. Trim off any excess wire and stretch it out evenly to a length of 1-1/2 inches.

Ensure an even spacing between turns (see **Photo E**). Solder ground lugs on each end of the coil. Ground the coil end closest to the bandswitch. Use a porcelain standoff to secure the far end of the coil (see **Photo F**). Tap the coil at 1-1/4 turns (10 m), 1-7/8

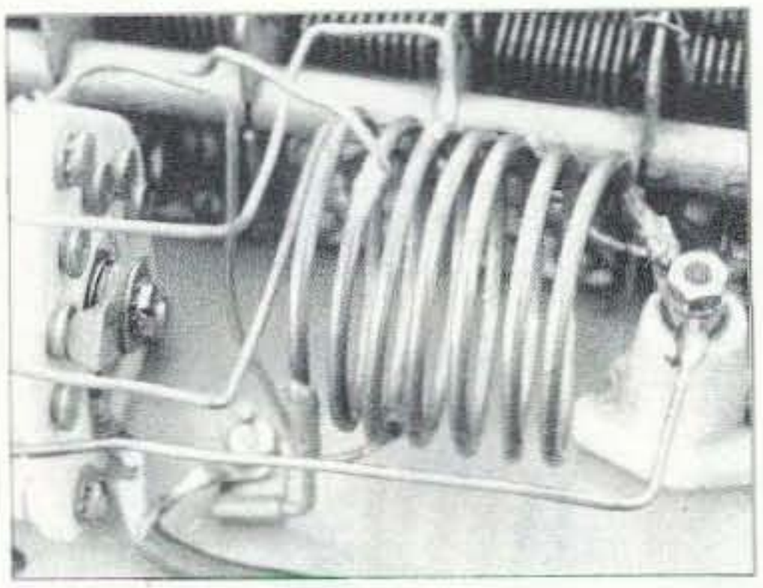

Photo F. *A close-up of the coil tapped for 10–80 m operation. Note that the 58U braid from the bandswitch is securely grounded at the coil end. The 80 m tap is taken off the porcelain standoff to the right and soldered to position five on the bandswitch.*

turns (15 m), 2-1/2 turns (20 m), and 4-1/2 turns (40 m) from the grounded end of the coil to the bandswitch using #14–16 AWG solid copper wire.

Remember that the full coil length will tune 80 m, so run a wire from the standoff to the fifth position on the switch (see **Photo G**). Two air variable sections were paralleled and permanently wired into the circuit (see **Fig. 1**). I used a small rotary shorting switch to move additional capacitance into the circuit as needed. If you prefer, replace the rotary switch with

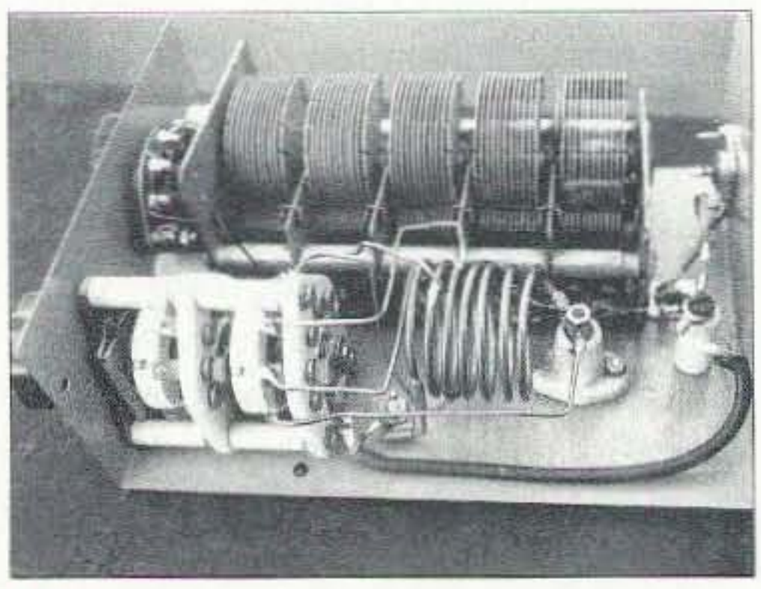

Photo G. *An overview of the parts layout. Only one pole of the porcelain junk box bandswitch is being used (Mouser #10YX025). Note that the far end of the coil is supported by the standoff insulator. The rotary selector switch adds or subtracts capacitance and is nested in front of the air variable. Two porcelain spacers were used to move the air variable back to allow room for the switch mounting. All coil taps are measured from the grounded end. The coil grounding lug is mounted a short distance from the back of the bandswitch.*

three individual SPST/SPDT toggles (RS #275-322) to accomplish the same result.

Before soldering, it may be a good idea to grid-dip the tuned circuits for resonance in order to ballpark control settings. Make certain to record the number of switches (controlling capacitance) in the circuit as well as the position of the variable capacitor knob for each band. Install an SO-239 coaxial connector to the rear of the enclosure and complete the remainder of the wiring with 58U cable. Make certain to ground both ends of the coax. To ensure a zero resistance connection between the input circuit enclosure and the RF deck, use a short length of copper braid between the circuits of both metal cabinets.

What's next?

There's not much left to do except to install the input device. Connect a coaxial "T" adapter (RS #278-198) to the RF input on the rear of the amplifier deck. Run a short length of cable from the exciter to one leg of the "T" and a second length of cable from this fitting to the input tune module. Set up your equipment (including bandswitch positions) and tune all the controls plus the air variable on the input module for maximum wattmeter output.

That's about it, except for an experiment you might find interesting. Tune for maximum amplifier output without the module in the circuit, and then repeat the process with the unit installed. You'll know immediately if the additional input tune device was worth your expenditure of time. Don't hesitate to let me know how you made out.

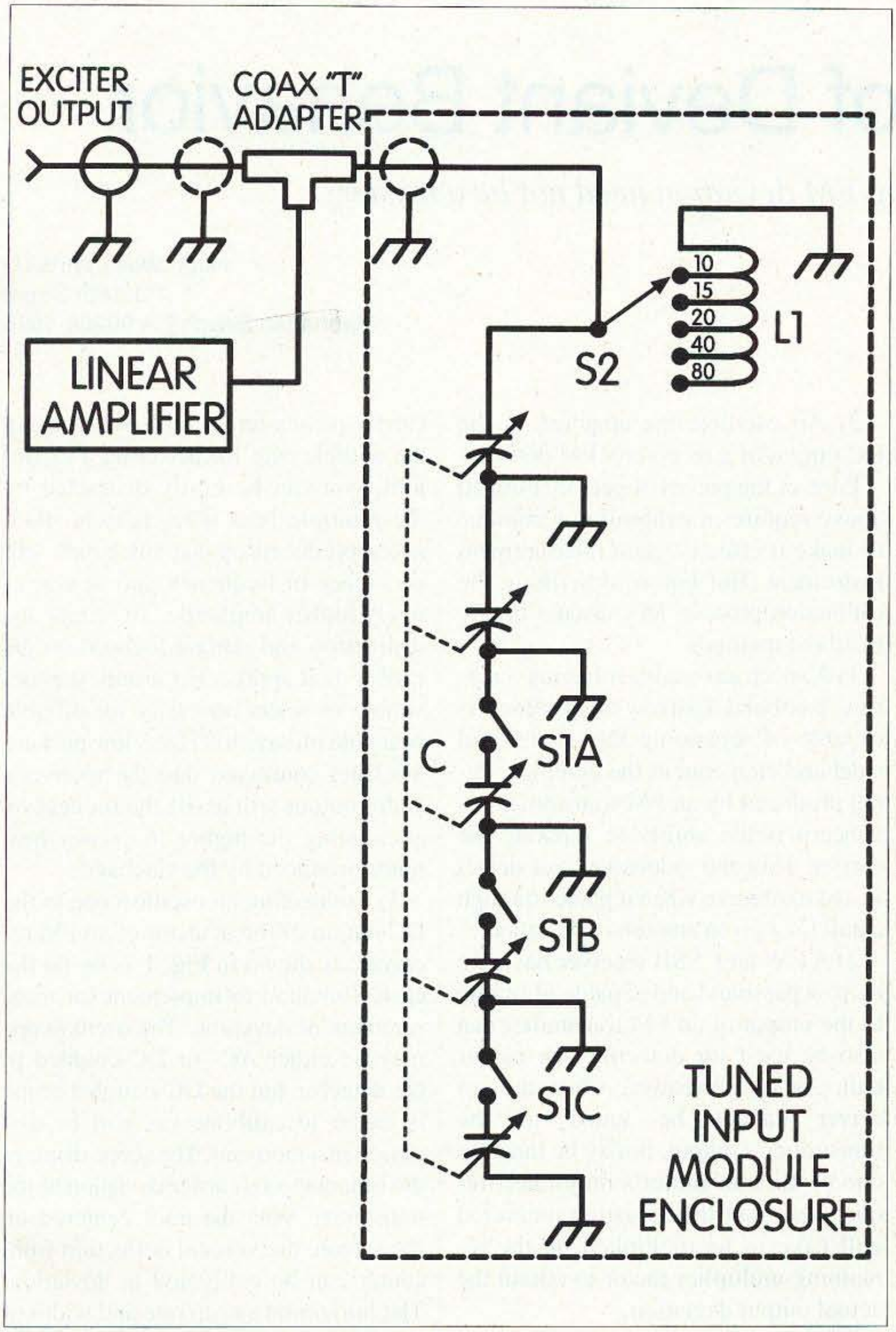

Fig. 1. Tuned input module enclosure. C1: 5-section air variable. L1: 6 turns of #10 wire 1-1/2 inches long (wound on 1-1/2-inch OD form), tapped from ground end at 1-1/4, 1-7/8, 2-1/2, 4-1/8, and 6 turns. S1: SP3T (shorting). S2: SP5T (nonshorting).

Sources of supply

Mouser Electronics
2401 Highway 287 N.
Mansfield TX 76063-4827
(800) 346-6873

Antique Electronic Supply
6221 S. Maple Avenue
Tempe AZ 85283
(800) 706-6789

Secrets of Deviant Behavior

Measuring FM deviation need not be a mystery.

Hugh Wells W6WTU
411 18th Street
Manhattan Beach CA 90266-4025

For the average ham using FM equipment, deviation is just another mystery of communications. Although instruments that measure deviation are available in repair shops, they are not readily available to the majority of ham operators. Nonetheless, making deviation measurements *is* within the reach of a ham who has access to an FM radio or scanner.

Measuring the deviation of an FM transmitter is simply a matter of determining how far the RF carrier shifts during modulation peaks and displaying the results. There have been many techniques or methods developed for measuring deviation. Perhaps the three simplest methods use:

1) A narrow bandwidth spectrum analyzer;

2) A narrow passband CW or SSB receiver;

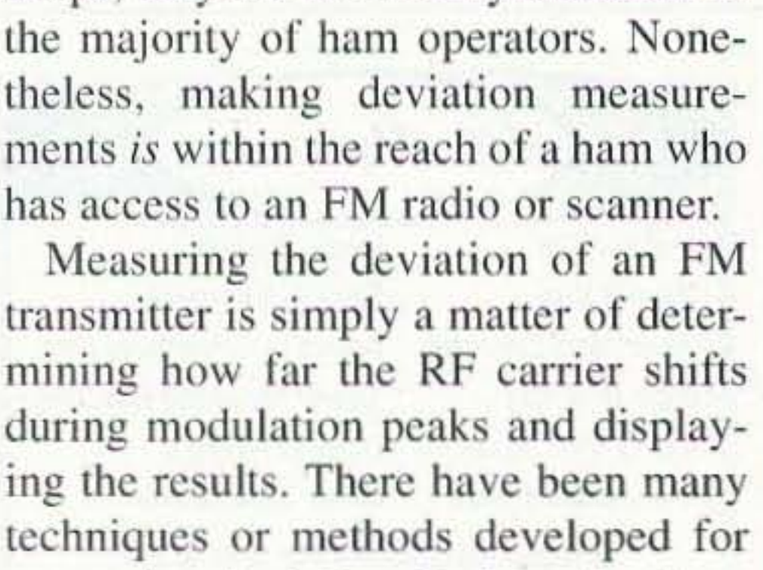

Fig. 1. Connecting a deviation indicator to a receiver's FM detector.

3) An oscilloscope attached to the DC output of a receiver's FM detector.

Each of the pieces of gear mentioned above requires a calibration technique to make it effective as a measurement instrument. But before describing the calibration process, let's discuss briefly the three methods.

1) A spectrum analyzer having a narrow passband (narrow dispersion) is capable of separating the carrier and sideband elements in the complex signal produced by an FM transmitter. Of concern is the ability to separate the carrier from the sidebands and detect it, and to observe when it passes through a null for a given amount of deviation.

2) A CW and SSB receiver having a narrow passband and capable of tuning to the output of an FM transmitter can also be used for detecting the carrier null. As an alternative, when the receiver cannot be tuned to the transmitter's output, it may be tuned to one of the transmitter's multiplier frequencies—but the deviation measured will have to be multiplied by the remaining multiplier factor to obtain the actual output deviation.

To detect the carrier null, allow the FM carrier to beat against the receiver's BFO and note the signal loss as the carrier passes into a null. When using the audible beat for detecting a carrier null, you can be easily distracted by the multiple beat notes present. Beat notes produced by the sidebands will be higher in frequency and at a relatively higher amplitude. To reduce the distraction and remain focused on the carrier as it approaches a null, it is desirable to select an easily identifiable beat note of, say, 400 Hz. A low pass audio filter connected into the receiver's audio output will assist the process by attenuating the higher frequency beat notes produced by the sidebands.

3) Connecting an oscilloscope to the DC output of the detector of an FM receiver, as shown in **Fig. 1**, is by far the easiest method to implement for measurement of deviation. The oscilloscope may be either AC- or DC-coupled to the detector, but the DC-coupled scope is easier to calibrate (as will be discussed in a moment). The scope displays the instantaneous carrier deviation of the transmitter. With the trace centered on the screen, the vertical deflection from center can be calibrated in deviation. The horizontal sweep rate and width of the scope is adjusted for comfortable viewing as only the vertical component is of concern.

Calibration of the scope can be performed by two methods. For both the AC- and DC-coupled scope, the carrier null technique may be used to establish scale calibration points for various deviation amounts. However, when a DC-coupled scope is connected, the following calibration method is used.

With the advent of synthesized radios, dial-up frequency shift calibration became very easy. Calibration is obtained by setting up a separate synthesized transmitter operating on the same frequency as the receiver to be calibrated and offsetting the transmitter (or receiver) by ±5 kHz. Deviation is indicated by marking off the scope's screen at +5 kHz and -5 kHz. Assuming a linear detection curve, the scale may be divided down to 1 kHz or 2 kHz increments. Linearity of the detection curve will be obvious by comparing the + and - offset difference in scale deflection. Nonsymmetrical deviation from a transmitter will be readily apparent once the scale is calibrated.

Carrier null calibration technique

Perhaps the oldest and most used method, because of its accuracy and repeatability for determining deviation, is the carrier null technique. Detecting the carrier null involves observing when the FM carrier passes through a null or zero point using either method 1 or 2 as described above. The carrier will predictably pass through

Audio Frequency Values

Deviation (in kHz)	1st null (in Hz)	2nd null (in Hz)
1	415.8	181.2
2	831.6	362.3
3	1247.4	543.5
4	1663.2	724.6
5	2079.0	905.8
6	2494.8	1086.9
7	2910.6	1268.1

Table 1. Audio frequency values required to create a specific deviation using either the first or second null.

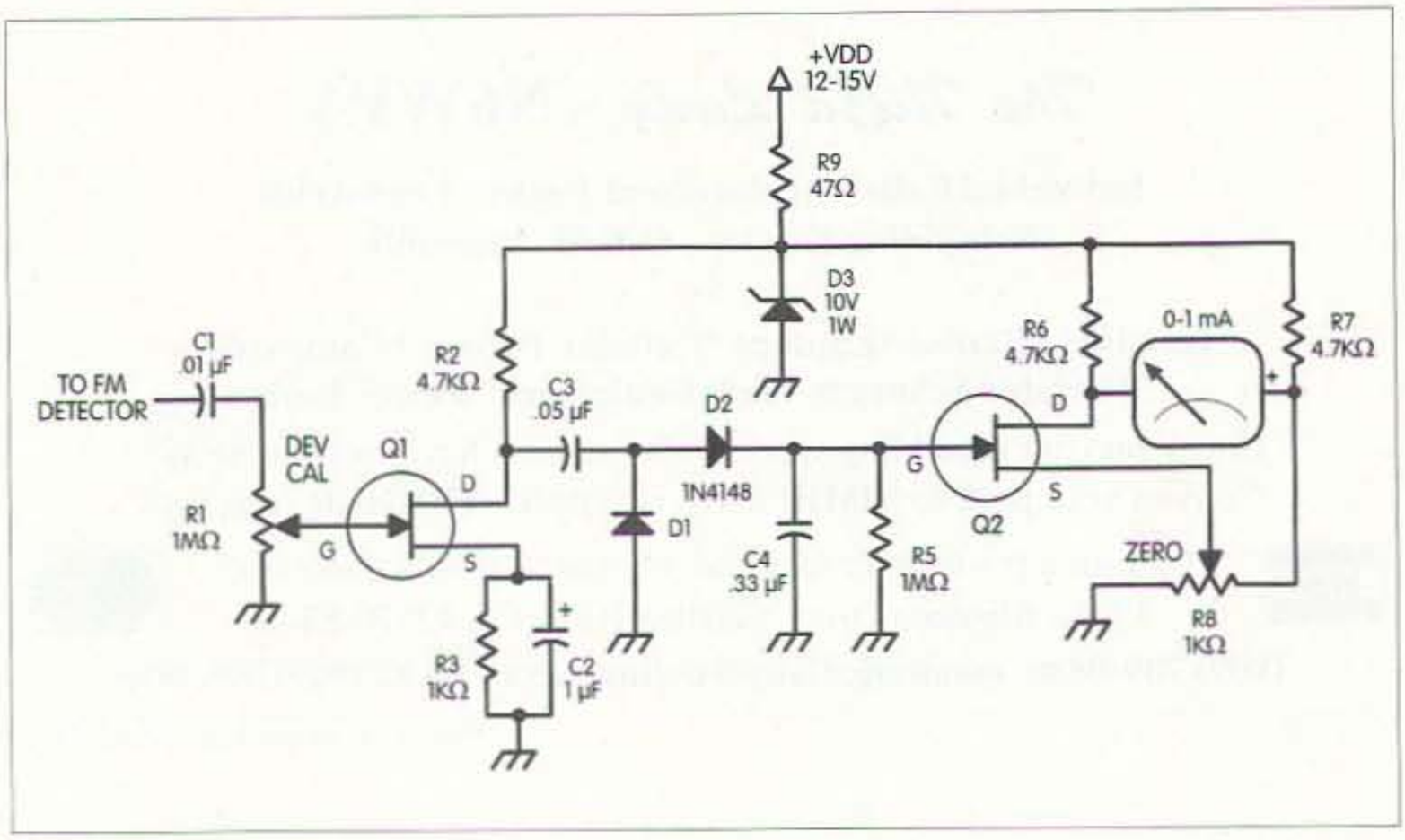

Fig. 2. Peak-reading voltmeter used for monitoring FM deviation.

a null at several modulation index (M) points such as M = 2.405 and 5.52.

Calibration of deviation involves applying a single sine wave audio voltage of known frequency to the transmitter and increasing the audio amplitude until the carrier reaches a null. The null is detected as a loss of beat note in the CW or SSB receiver, or as a carrier loss by a spectrum analyzer. If the modulating audio frequency used is 1 kHz, then at the first null the deviation would be 2.405 kHz and at the second, 5.52 kHz. It is usually easier to detect the first null than the second when listening to beat notes.

For calibration purposes, it is preferable to identify specific or whole number deviation points instead of using a number like 2.405 kHz. Therefore, specific frequencies can be calculated using the following equations:

$$Fdev = AF \times M(at\ null)$$

$$AF = \frac{Fdev}{M(at\ null)}$$

The first equation finds the frequency of deviation when the audio frequency is known and the second finds the audio frequency when the deviation is known. In the equations, the M value is selected to match the desired null, e.g., 2.405, 5.52. To simplify things, **Table 1** provides a listing of various audio frequencies for specific values of deviation as a function of the first and second null. Generally speaking, for most ham applications, calibrating a single deviation point is usually sufficient. That single point would be the maximum deviation value desired for that application—perhaps 5 kHz.

An FM receiver used as a deviation meter

Most all FM receivers, including some scanners, can be utilized to display deviation; it is simply a matter of connecting a metering circuit, as shown in **Fig. 1**, to the DC output of the FM detector ahead of the de-emphasis network. The metering circuit can be a peak-reading AC voltmeter or an oscilloscope. If the scope has a DC input, the deviation can be determined simply by offsetting a received carrier by ±5 kHz and marking the screen accordingly. For rough calibration and casual deviation comparisons, the receiver with its meter or scope attached may be tuned to either a ham or commercial repeater. Deviation calibration of repeaters is usually performed using calibrated test equipment and can be assumed to be close to 5 kHz.

As a calibration transfer standard, a DC scope and an FM receiver can be calibrated by the ±5 kHz offset method and then used to adjust the deviation of a transmitter to 5 kHz which is being modulated by a single tone. The calibrated transmitter can then be used to calibrate a peak-reading voltmeter, circumventing the carrier null calibration technique.

Peak-reading AC voltmeter

The circuit shown in **Fig. 2** will detect and display the peak deviation on a meter. The instantaneous pointer movement follows the modulation with the deviation value indicated at the peak pointer excursion. However, a more accurate peak can be determined when the transmitter is modulated with a constant amplitude single frequency tone rather than with voice peaks.

To maintain simplicity, the meter circuit was designed to operate from a single polarity voltage source with as few parts as possible. Meter response linearity was given up as a trade-off for simplicity, as only the peak deviation point is needed. It is interesting to note that the circuit exhibits reasonable linearity in the upper 90% of the scale.

When voice is received, the meter will function as a pseudo-VU meter, with the pointer flying back and forth. The rate of pointer swing is dampened by the time constant as determined by capacitor C4 and resistor R5. The dampened swing, however, does not deter calibration from a single tone, but does prevent accurate calibration from voice peaks.

Because most FM receiver detectors provide more than a one-volt output when the IF limiter is saturated, the voltmeter input sensitivity was considered adequate at approximately 500 mV for full-scale deflection. A pot was included for setting the desired maximum deviation point on the scale. The input sensitivity of the circuit is affected by the value of the supply voltage, and regulation of V_{dd} is necessary. Input signal value—voltage versus meter scale—was plotted for various values of V_{dd} to determine the best circuit linearity. A V_{dd} value ranging between 9.7 and 10.2 volts was ideal, with a 10-volt zener being preferred. A one-watt zener was chosen to gain V_{dd} stability.

The voltage detector, which is a fairly high impedance circuit, consists of

Continued on page 78

Only One Antenna

All about multibands.

Bill Clarke W2BLC
764 Alta-Voor Road
Altamont NY 12009
[W2BLC@bigfoot.com]

The antenna dilemma for many hams is very real. Not everyone has the physical space or unlimited resources to install multiple HF antennas and towers. It is also safe to say that many hams live where at least some restrictions apply to antenna structures—and not every ham *wants* to put up towers and beams and separate antennas for each band. The reasons may vary from esthetics to finances.

All that a ham station really requires for communications is an efficient antenna for the chosen band(s) of operation and a rig to put a signal into the antenna(s). For most HF operators, this means an antenna capable of working all the bands, usually 80 through 10 meters. However, the antenna can include 160 meters if there is the physical space available.

The single-wire multiband antenna answer

There are several choices of single-wire antennas available that will operate on more than one band. The term single-wire means that only one wire is used in the antenna's construction (a dipole is a single-wire antenna). Each of the following antennas is a well-designed multiband antenna, constructed of a single-wire element antenna. Some examples can provide gain over a simple dipole on the higher bands.

Single-wire antennas are not obtrusive, are easily installed, and are as close to "sure-fire" as you can get. Cost covers the range from a few dollars for a home-brew wire antenna built with "junk-box" parts to a little over a hundred dollars for a factory-built trap antenna. The single drawback for using these antennas is the need for a tuner, particularly on the lower bands.

An adequate antenna tuner that is capable of handling the output power of any modern HF transceiver can be purchased new for under $100. For kilowatt power levels, the prices start at a little over $250. My personal favorite is the MFJ Differential-T tuner, which is capable of handling my linear amplifier and any antenna I have ever connected to it.

Many of the newer solid state HF transceivers have built-in antenna tuners that do the antenna matching automatically. Should you be fortunate enough to own such a rig, you only need to connect the feedline from a multiband antenna to work the world.

The Carolina Windoms

The original Windom antenna was designed by W8GZ in 1928 as a half-wave antenna, off-center fed with a single wire (this was BC: before coax). Today's Carolina Windom retains the half-wave off-center fed primary element; however, it is now fed with coax and incorporates a vertical radiating element (which is part of the feedline). They are well-constructed antennas designed to be installed and used for many years with no further attention.

The Carolina Windoms are available in three sizes (for various band combinations):

1. Carolina Windom 160 (160–10 meters), 252 feet long.
2. Carolina Windom 80 (80–10 meters), 133 feet long.
3. Carolina Windom /2 (40–10 meters), 66 feet long.

Installation can be either horizontal or as an inverted vee (see **Fig. 1**).

Due to the half-wavelength size of the horizontal element, the Carolina Windom antenna gives gain over a dipole on all bands above the primary

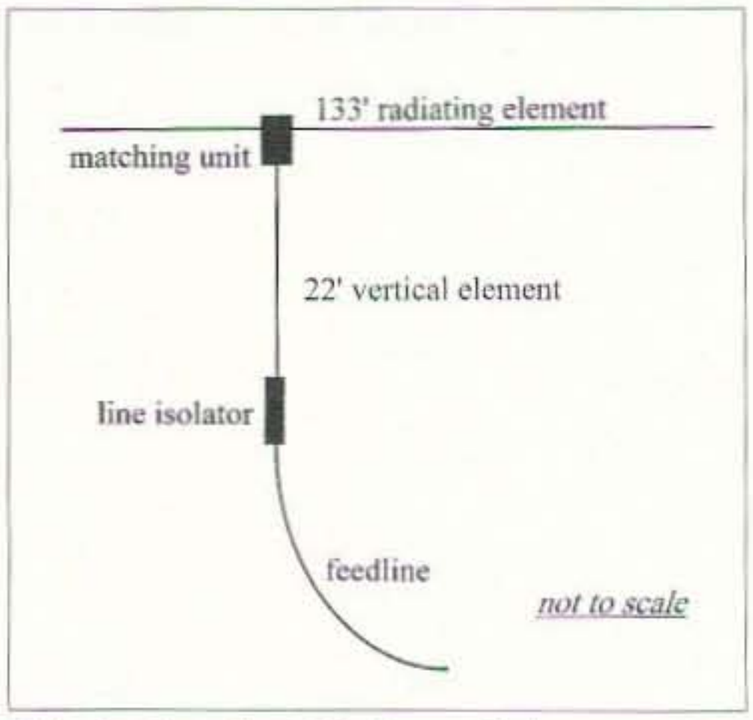

Fig. 1. *Carolina Windom. All figures not to scale.*

design band. The primary design band is the lowest operating band (40, 80, or 160 meters). The antenna should be mounted 30 or more feet above the ground.

An offshoot of the Carolina Windom is the Carolina beam, which is essentially a bent version of a Carolina Windom taking only 82 feet of horizontal space for installation. The Carolina beam is designed for improved performance in the DX bands, but performs well on the 80 and 40 meter bands (see **Fig. 2**).

Carolina series antennas are available from The Radio Works.

The G5RV antenna

The G5RV antenna is a small single-wire antenna, fed with coax line, and only 102 feet from end to end. It works on the 80–10 meter bands. The antenna is centerfed with a 31-foot section of 450-ohm ladderline, which is used as a matching section, and is terminated with a coax feedline. The feedline runs from the matching section to the transmitter (any length). The antenna must be mounted 35 or more feet above the ground, due to the ladderline matching section (see **Fig. 3**).

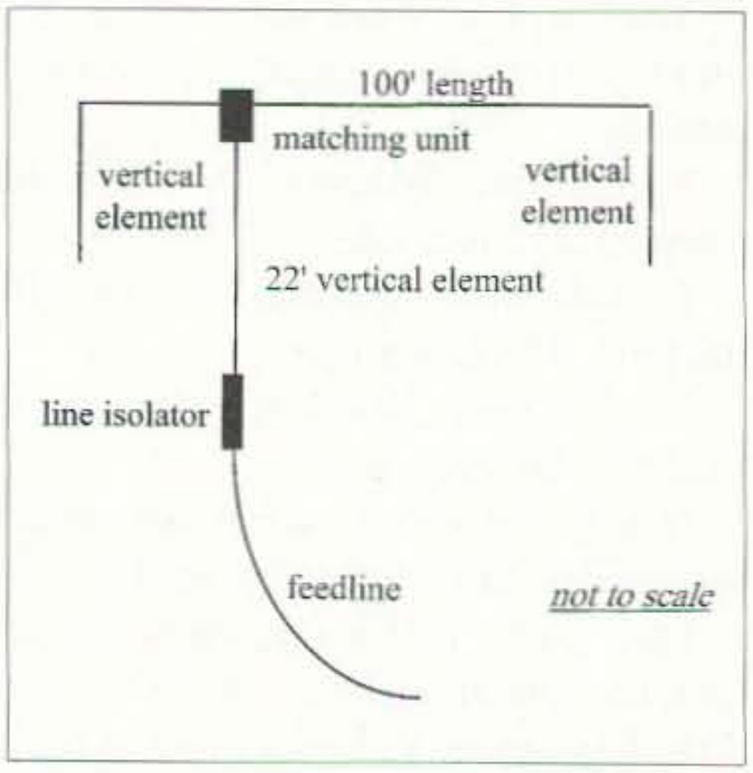

Fig. 2. *Carolina beam.*

The G5RV antenna provides gain over a dipole on all bands above 80 meters and functions well with the auto tuners found on many of the newer HF rigs. It can be installed as a horizontal or inverted vee antenna.

Constructed G5RV antennas by Van Gorden Engineering are available through many amateur radio equipment outlets. The Radio Works also produces a G5RV antenna. As a homebrew project, the G5RV is a popular antenna, with parts readily available from ham stores and the suppliers listed at the end of this article.

Trap antennas

Trap multiband antennas have been around for many years. Due to the weight of the traps used, they tend to be somewhat heavier than the wire-only antennas previously mentioned. Trap-based antennas function as dipoles for each band and provide no gain as the operating frequency increases.

The theory of a trap antenna is the simple isolation of the used portion of the radiating element, based upon frequency, from the overall antenna. In other words, each band's traps isolate part of the antenna into a simple dipole for a single band (see **Fig. 4**).

Some trap antennas use a single pair of traps for all-band coverage, while others use several traps. All trap antennas are physically shorter than a full-size antenna for a comparable single band. It is normal to need a tuner on the lower bands for full frequency coverage. Trap antennas can be installed as horizontal or inverted vee antennas.

Manufactured trap antennas are available from SPI-RO Manufacturing, Inc. Individual sets of traps are available from many ham radio stores for those wanting to build their own trap antennas.

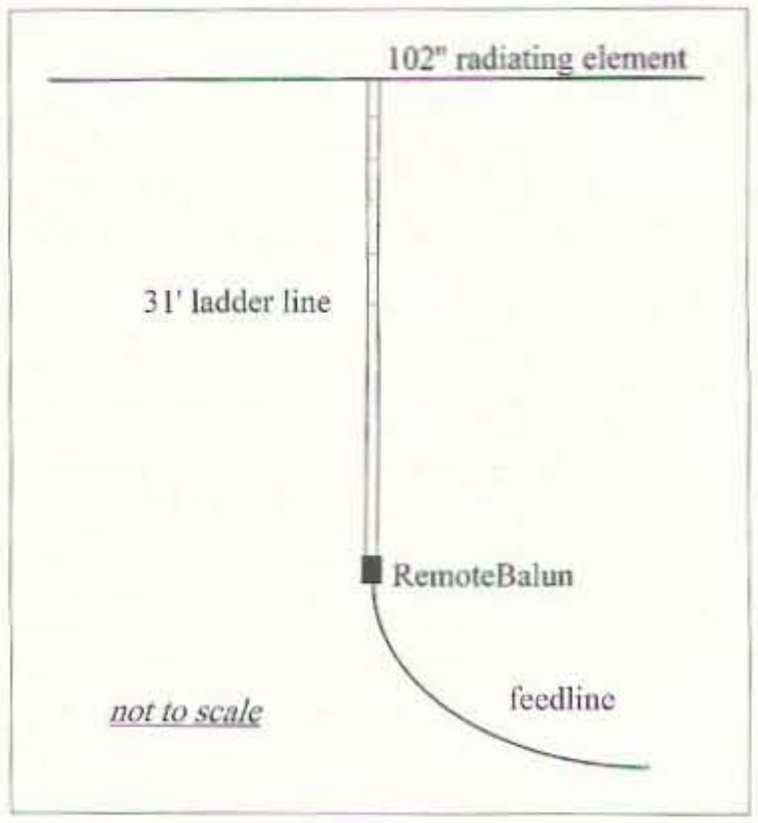

Fig. 3. *G5RV.*

Multiband center feed

A very easy antenna to install, this one provides gain on bands above 80 meters and is perfect for the homebrewer. It's a simple half-wave dipole (cut for the lowest frequency of planned use) fed at the center point with 450-ohm ladderline. Generally, the antenna is about 135 feet in overall length (see **Fig. 5**). The antenna can be designed for 40 meters and up by using an overall length of 67 feet.

Many hams are scared away by the ladderline. However, there is a very simple solution to the "ladderline problem"—use a RemoteBalun™ from The Radio Works. This device acts as an interface between ladderline and coax, allowing easy antenna cable entry into the shack and simple tuner usage.

This simple antenna has been a standard for hams all over the world. Like the Carolina Windom, G5RV,

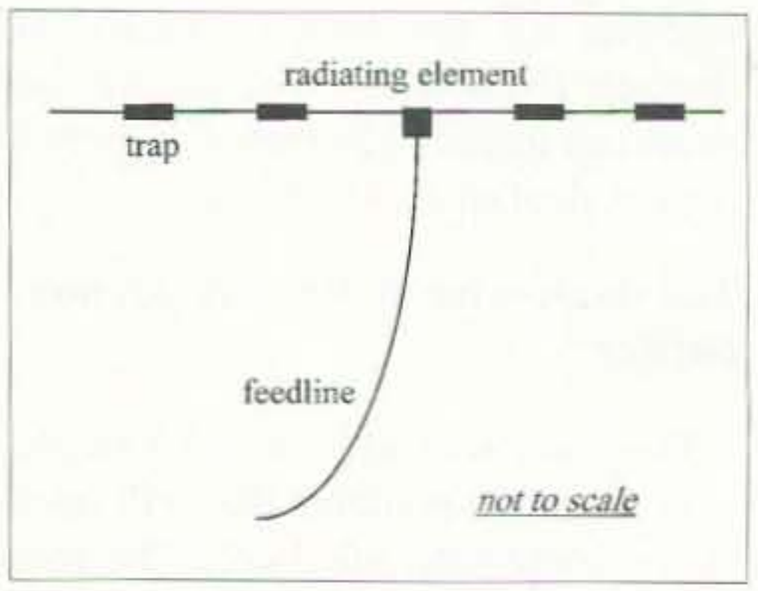

Fig. 4. *Trap dipole. Trap antenna length is a product of the number and types of traps used and the bands designed for.*

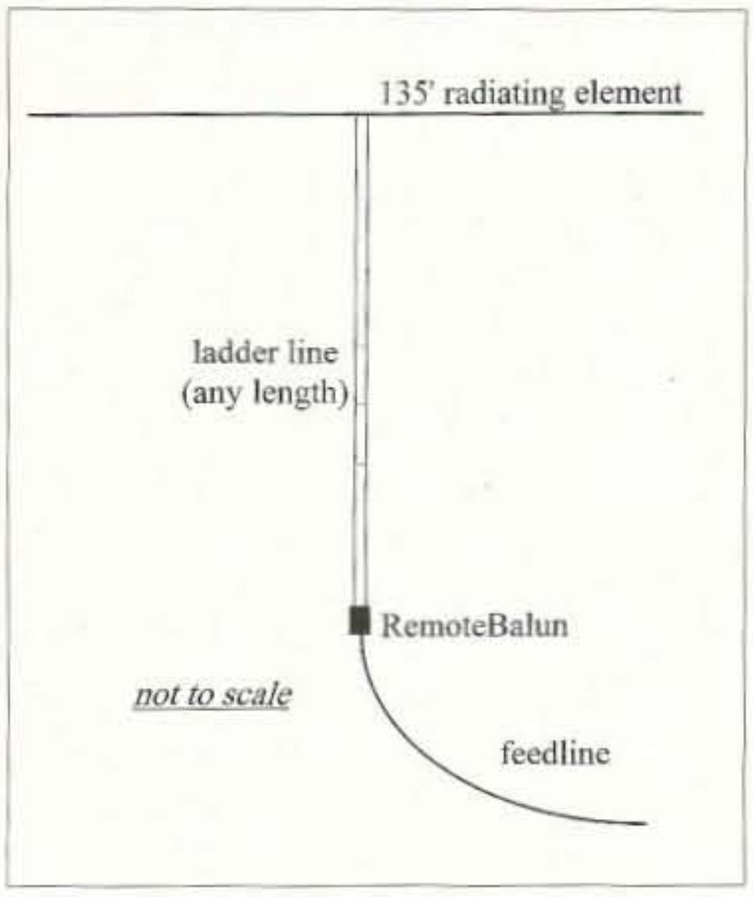

Fig. 5. Multiband dipole.

and trap antenna, it can be installed as a horizontal or inverted vee.

Double extended zepp

Similar in appearance to the previous antenna is the double extended zepp (see **Fig. 6**). Its advantage is a nearly 3 dB gain over a simple half-wave antenna on the band of design—and that improves as you move up through the bands. The antenna's major drawback is its sheer size. It is an excellent candidate for home-brew.

The double extended zepp is 1.28 wavelengths long at the design frequency. The original versions called for parallel feeders from the center of the antenna to the shack. The modern version uses a 4:1 balun at the end of a measured length of ladderline and coax to the shack.

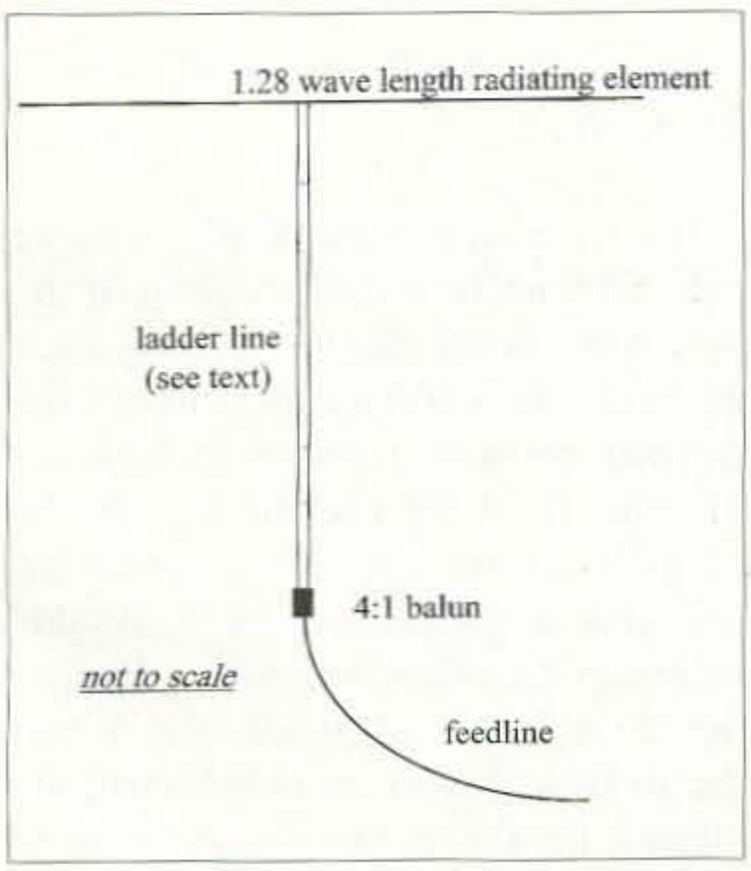

Fig. 6. Double extended zepp.

An 80-meter version would be 343 feet long overall, with the ladderline 29.5 feet long before the 4:1 balun. A 40-meter version would be 171 feet and 14.7 feet, respectively. There is no reason that ladderline could not be used from the feed point to the shack, as with the multiband centerfed antenna.

The double extended zepp can be installed horizontally or as an inverted vee.

Endfed zepp

An often overlooked home-brew multiband antenna is the endfed zepp (see **Fig. 7**). Based on an antenna originally used on the zeppelin airships, it is a capable half-wave design providing multiband use and gain on frequencies above that of design. Careful planning must be used with this antenna to prevent RF from entering the shack via the feedline.

The feedline must be one-quarter wavelength and the main element a half wavelength long. Although the diagram shows the feedline leaving the main element at right angles, this is not a requirement. The feedline can be brought into the shack and connected directly to a tuner, or a RemoteBalun™ could be used.

The endfed zepp can be used on bands above that of design and provides gain over simple dipoles. End feed may allow easier antenna installation in some instances. This antenna is a home-brew project.

The dimensions for an 80-meter endfed zepp call for 450-ohm ladderline to be 67 feet long and the main element to be 134 feet long. A 40-meter version would be 67 feet and 33.5 feet, respectively.

Safety note

When installing any antenna, be aware of your surroundings. *Do not* install an antenna in such a manner that it could fall onto a power line or another's property, or onto persons. Follow good engineering practice, such as outlined in the various publications of the ARRL and required by the National Electric Code (and your local electrical safety code).

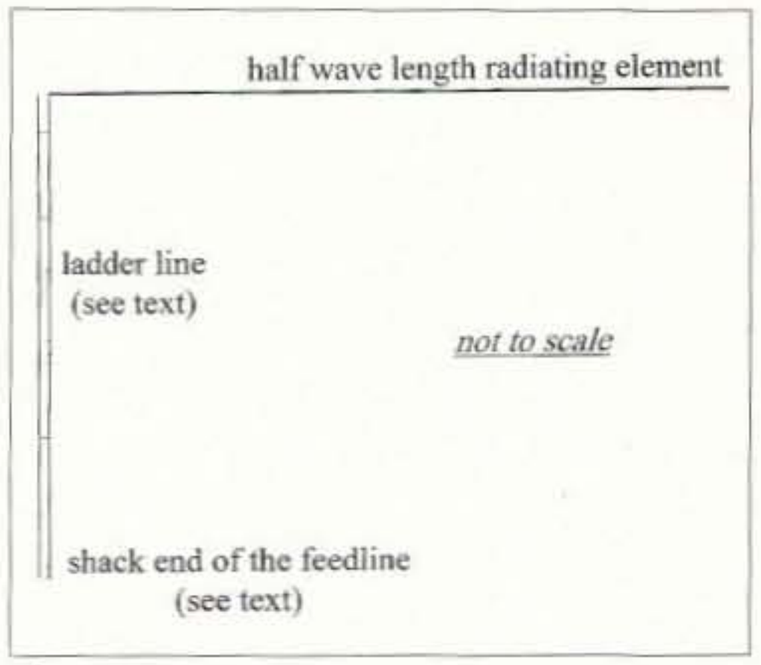

Fig. 7. Endfed zepp.

Suppliers

The following antenna suppliers sell products as indicated:

Antennas West
Box 50062
Provo UT 84605
(801) 373-8425
Constructed antennas

Davis RF Co.
P.O. Box 730
Carlisle MA 01741
(800) 328-4773
[www.davisrf.com]
Wire, feedlines, rope, insulators

The Radio Works
P.O. Box 6159
Portsmouth VA 23703
(800) 280-8327
[www.radioworks.com]
Constructed antennas, wire, feedlines, rope, insulators, RemoteBalun™

SPI-RO Manufacturing, Inc.
P.O. Box 2800
Hendersonville NC 28793
(800) 728-7594
Constructed antennas

Van Gorden Engineering
P.O. Box 21305
South Euclid OH 44121
Constructed antennas, traps, insulators

The Wireman, Inc.
261 Pittman Road
Landrum SC 29356
(800) 727-9473
[www.thewireman.com]
Wire, feedlines, rope, insulators 73

Cool It!

Cold facts about the hot topic of heat transfer.

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

Cool it! can be good advice when a lid tunes up on the signal you're trying to copy. It's also good advice if you want your transistors to live a long and useful life. This article won't be much help for the first problem, but it will help you understand how to cool a transistor. Come to think of it, keeping your transistors alive for a while may keep you from blowing your cool.

There are several ways of having cooler transistors besides using cooler watts or making transistors with that rare-earth unobtainium. Seriously, though, cooling a transistor is a matter of getting the heat out of the junction. Heat can only be moved from a warmer place to a cooler place. You can't add cool; you can only remove heat, which is practically the same thing. In a transistor the hot place is the junction, and the cooler place is usually the ambient air. In between the hot junction and the cool ambient is the transistor's case and maybe a heat sink.

Thermal resistance R_θ impedes the flow of heat and is analogous to electrical resistance impeding the flow of current. R_θ is given in terms of degrees per watt, °C/W. The thermal resistance from junction to case is $R_{\theta JC}$, the thermal resistance from junction to ambient is $R_{\theta JA}$, and the thermal resistance from heat sink to ambient is $R_{\theta SA}$. The thermal resistance through which the heat must flow is:

$$R_\theta = R_{\theta JC} + R_{\theta CA} + R_{\theta SA}$$

In many specifications, thermal resistances are not specified. Instead, the maximum power dissipation at some case temperature, usually 25° C, is given and a derating factor that relates allowable power dissipation at other case temperatures. These two methods of specifying allowable dissipation can be reconciled, though.

The $R_{\theta CA}$ is determined by the case style; all TO-92s have the same $R_{\theta CA}$, all TO-220s have the same $R_{\theta CA}$, and all TO-3s (TO-204s) have the same $R_{\theta CA}$. The thermal resistance between the junction and case $R_{\theta JC}$ is determined primarily by the die size and internal mounting. Larger dies have a larger contact area between the die and the case and have lower $R_{\theta JC}$. Larger die also permit higher currents. For example, the IRF630 has I_D of 9 A and $R_{\theta JC}$ of 1.67° C/W, while the IRF612 has I_D of 2 A and $R_{\theta JC}$ of 6.4° C/W. Both have $R_{\theta JA}$ specified as 62.5° C/W, which implies that the $R_{\theta JC}$ is much smaller than $R_{\theta CA}$. A TO-3 (TO-204) case has an $R_{\theta JA}$ of about 30° C/W. Therefore, a particular die in a TO-204 case can dissipate about twice the power of the same die in a TO-220 case.

A moderate heat sink one inch long by one inch wide with half-inch fins has an $R_{\theta SA}$ of about 30° C/W in still air. The thermal resistance $R_{\theta JA}$ of the IRF630 in such a heat sink then is:

$$R_{\theta JA} = R_{\theta JC} + R_{\theta SA} = 1.67 + 30 \approx 32° \text{ C/W}$$

The thermal resistance $R_{\theta SA}$ can be reduced with forced-air cooling of the heat sink. When the air velocity over the heat sink is 100 feet per minute, the thermal resistance drops to between 11° and 12° C/W and the $R_{\theta JA}$ of the IRF630 on such a forced-air-cooled heat sink drops to about 14° C/W; this increases the allowable power dissipation by a factor of about five. When the air flow is increased to 400 feet per minute, the thermal resistance drops to about 6° C/W.

Forced-air cooling works by replacing the hot air next to the heat sink with cooler ambient air. The faster the air moves over the heat sink, the more quickly the heat can be carried away, and the cooler the heat sink.

The heat sink to ambient thermal resistance $R_{\theta SA}$ is dependent on its surface area as well as its thermal conductivity. Larger and heavier heat sinks have lower $R_{\theta SA}$. A copper heat sink is more effective than an aluminum one with the same dimensions.

While the surface area of the heat sink exposed to the air is the major determinant of thermal resistance, the shape of the heat sink plays a part as well. The obstruction to convection air currents flowing over the heat sink determines how quickly or easily the heated air can move away from the hot surface of the heat sink. Consequently, a heat sink would ideally be oriented with the fins vertical so the air can rise up over the fins. Also, a heat sink should be mounted in an area that doesn't trap air, that has free air movement. A heat sink mounted on a circuit board pushed against the cover will not be as effective as one with room around the board. Keep in mind that the air temperature inside a cabinet will be higher than the outside air. A 20° C rise inside a cabinet is not unusual. If the cabinet is in a 35° C (95° F) room, the internal temperature of the cabinet can easily be 55° C (131° F).

The temperature of power transistors is usually considered because you know they have the potential to get hot, but many times the temperature rise of a small transistor is overlooked, which leads to "Oh, shucks" or some such expression when you burn your fingers. Which translates into "Dummy, you should have thought about that!" Those little buggers can get hot!

Reducing the temperature rise of the case for a TO-92 is just as important as it is for a TO-220. The choice of heat sinks for the TO-92 transistors is not as broad as it is for the power transistors with TO-220 or TO-3 cases, but keeping the temperature rise within safe limits is just as important. AAVID Engineering makes a clip-on heat sink (model number 575400) for the TO-92 transistor case that has a thermal resistance $R_{\theta SA}$ of about 40° C/W. Mouser Electronics [958 N. Main, Mansfield TX 76063; (800) 346-6873] carries a broad range of AAVID heat sinks, including those for large and small transistors.

Sometimes the thermal characteristics of the small transistors in the TO-5 or TO-18 metal can or TO-92 plastic package are given in degrees Centigrade per watt and a case temperature derating factor instead of $R_{\theta JA}$. For example, the 2N3904 is specified in both terms. The thermal resistance from junction to ambient is specified as 200° C/W. Total device dissipation is also specified as 625 mW, with a case temperature of 25° C, with the dissipation derated 5 mW/°C above 25° C. Most TO-92 silicon transistors have a maximum junction operating or storage temperature of 150° C. Therefore, the maximum permitted case temperature rise above 25° C is 125° C. **Fig. 1** shows the derating curve for the 2N3904 and similar transistors. The transistor can dissipate 100% of the rated power at 25° C and zero power at 150° C. With the maximum junction temperature and power dissipation given, the thermal resistance case to ambient can be inferred:

$$R_{\theta JA} = \Delta T_c / P_D = 125° \text{ C}/0.625 \text{ W} = 200° \text{ C/W}$$

where T_c is case temperature and P_D is the rated power dissipation at 25° C.

Once a heat sink has been selected, mounting the transistor to it is not the no-brainer it might appear to be. Of course, the transistor should be clamped to the heat sink to ensure intimate contact—but not too tightly. Excessive clamping pressure can distort the case of the transistor and crack the semiconductor die or break an internal connection. Mounting a TO-220 is not a difficult problem, but minimize distortion of the mounting flange. Be careful not to let the screwdriver used to drive the mounting screw touch the plastic body during the tightening operation. Such contact can result in damage to the plastic body and internal device connections.

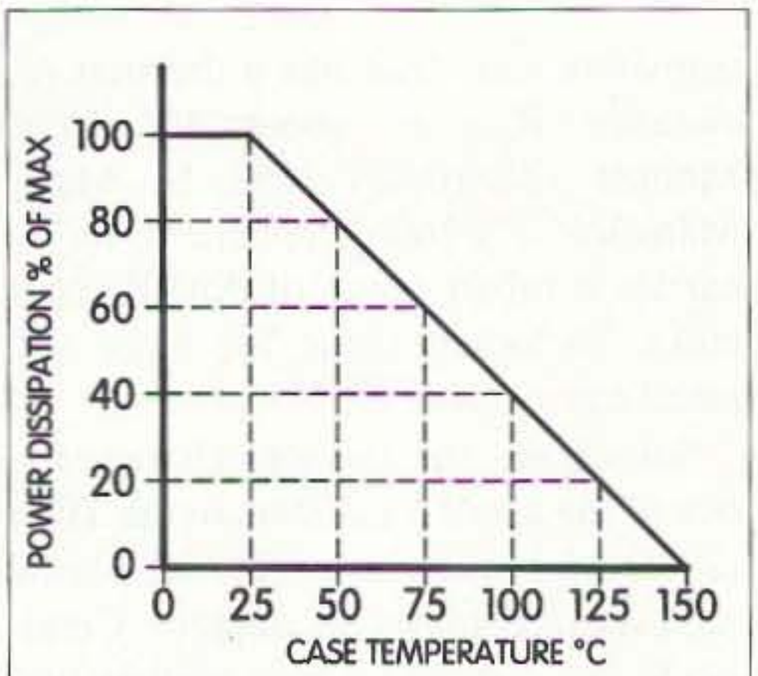

Fig. 1. Power dissipation derated for temperature, for 2N3904 and similar transistors.

Mounting the TO-225 Thermopad package presents a more obvious problem, because the mounting hardware goes through the body of the case. It is apparent that excessive mounting torque can distort the case, which may damage the internals. A compression washer under the screw head and a flat washer between the lock washer and the transistor will limit the pressure applied to the transistor. A split lock washer should be compressed but not flattened. When it's flattened it's just like a flat washer, and it loses its locking ability.

Stud-mounted devices can be over-torqued and warp the hex base as well, which may crack the semi-conductor die. A flat washer and lock washer will limit the force applied to the stud.

A piece of equipment designed for intermittent duty can often be increased to continuous duty with the addition of an appropriate heat sink. A heat sink does little or nothing for the pulse ratings of the transistor, because the thermal time constant is so short. A heat sink can limit the case rise to something close to the internal temperature of the cabinet. The heat sink may allow the extra margin, and the temperature rise of the output stage can be brought down from hot to warm.

In the discussion above, the thermal resistance between the transistor case and the heat sink was assumed to be zero. Imperfections in the mating surfaces of either the transistor or the sink produce small air spaces that result in a non-zero thermal path. The thermal resistance can be as high as two or three degrees C/W. Thermal grease or low-durometer-reading thermally conductive pads can be used to fill those spaces and reduce the thermal resistance by 50% to 75%. Thermal grease is the most common interface between transistor and heat sink used in home projects. The grease should be applied sparingly—just enough to fill the minute air gaps at the case-to-sink interface. A little is better than a lot. If you can see the grease, it's probably too thick. The thermal resistance of properly applied grease is in the order of 1° C/W. When mica or other hard insulators are used between the transistor and heat sink, the grease should be applied to both sides of the insulator.

Thermal grease has another application at the workbench other than providing the interface between transistors and heat sinks: It is an excellent thermal interface as well as a lubricant or release for soldering iron tips. Petroleum lubricants will burn away in time and make a bad situation worse.

The calculations of temperature rise aren't difficult or laborious, but finding the thermal characteristics of a transistor or heat sink may require a little digging. A heat sink can save money in the long run and maybe even in the short run. With the right heat sink you can turn on the power with confidence. It's been said that transistors must work on smoke—because they don't work very well after you let the smoke out of them.

Keeping the transistors cool while you're debugging a circuit or until you're sure of the power dissipation is an interesting challenge. One lab had a workbench with a built-in heat sink cooled with chilled antifreeze coolant. Such a heavy-duty setup is extreme, but an extruded heat sink upside down in a baking dish of ice water is an excellent short-term substitute.

Remember: However you do it, a cool transistor is a happy transistor! 73

Number 27 on your Feedback card

Look, Ma — No Knobs!

Exploring the revolutionary new Kachina 505DSP computer-controlled HF transceiver.

Richard Lubash N1VXW
P.O. Box 311
Dublin NH 03444
[rlubash@poco.mv.com]

A few months back, when I received a call from *73 Magazine* asking me if I would be interested in reviewing Kachina Communications' first foray into the HF amateur marketplace, I jumped at the opportunity. I had heard about this revolutionary new concept in amateur communication equipment design at Dayton, and ever since, I had been dying to get my hands on one. So interested was I that I had even downloaded a demo software package from Kachina's Web site months before the rig was released.

The 505DSP, in case you haven't heard, is the first big step in the next generation of HF rigs. It not only incorporates Digital Signal Processing technology that meets or surpasses anything available today for ham equipment, but also provides front-end control of the transceiver via a computer-based software interface. Now, I'm not talking an HF rig bristling with knobs and buttons and an RS-232 port on the back with an available CAT program as an alternative to knob twisting. I'm talking a fully-featured state-of-the-art transceiver with just one button for on/off. Now *this* is different!

The beauty of this radio is that you have complete control of all transceiver functions via software. From an operating point of view, the 505DSP is a lot less cluttered and complicated than a 100+ knob radio, but has the capability of reaching any level of control depth the operator wishes.

Needless to say, when the big box labeled Kachina Communications arrived, I was excited. As fate would have it, I was one day away from leaving for a trip, but that didn't stop me from dropping everything and spending the next few hours engrossed in being a radio pioneer. The 505DSP comes well-packaged in a double box that contains everything needed to set the radio up. In my case, I would be operating the radio using a laptop, so it was necessary for

Photo A. *The revolutionary new 505DSP looks more like a computer than an HF rig.*

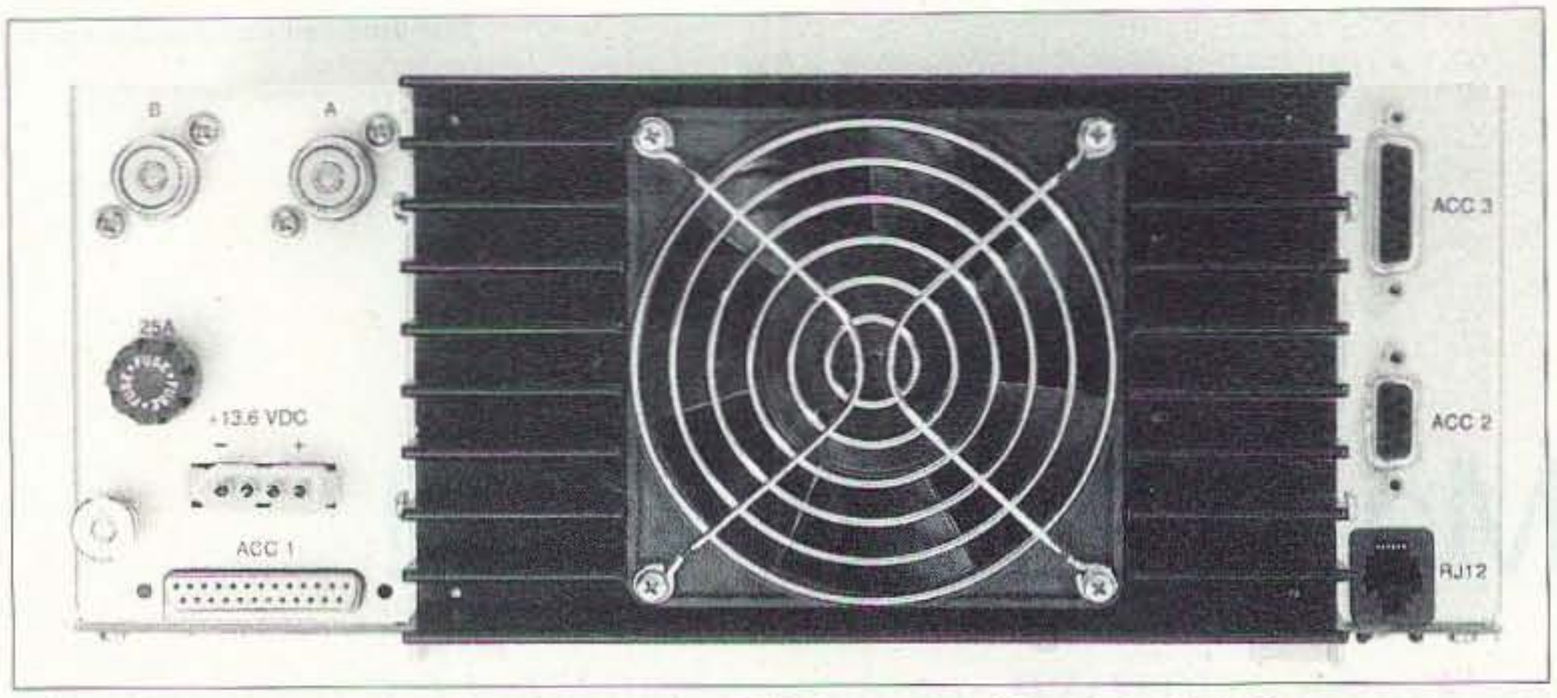

Photo B. *Accessory input/output on the 505 is accomplished via Sub-D computer-type connectors. The large fan runs all the time but is extremely quiet.*

Kachina to supply an additional box that accommodated the control head cover and extra cabling. The basic transceiver comes with a hand microphone and all cabling and parts necessary for the control head to mount in a spare hard drive bay in your computer. If your computer also has a sound card and speakers, an external speaker is not necessary. The 505 also requires an external 13.8 volt DC supply capable of supplying 25 amps continuous power. A high speed antenna tuner is also available for the 505DSP, and was included in the model sent to *73*.

Computer requirements for the 505 are on the light side considering the functionality of the supplied Windows™-based software. For my operation, I used a 586 laptop with 8 Mb of RAM running Windows95™. The control software is compatible with Windows 3.1, 95, or NT and only requires a 386DX or higher processor and 4 Mb of RAM (8 Mb RAM recommended for Windows95). Other computer resources required are a spare serial port and 2 Mb of hard disk space.

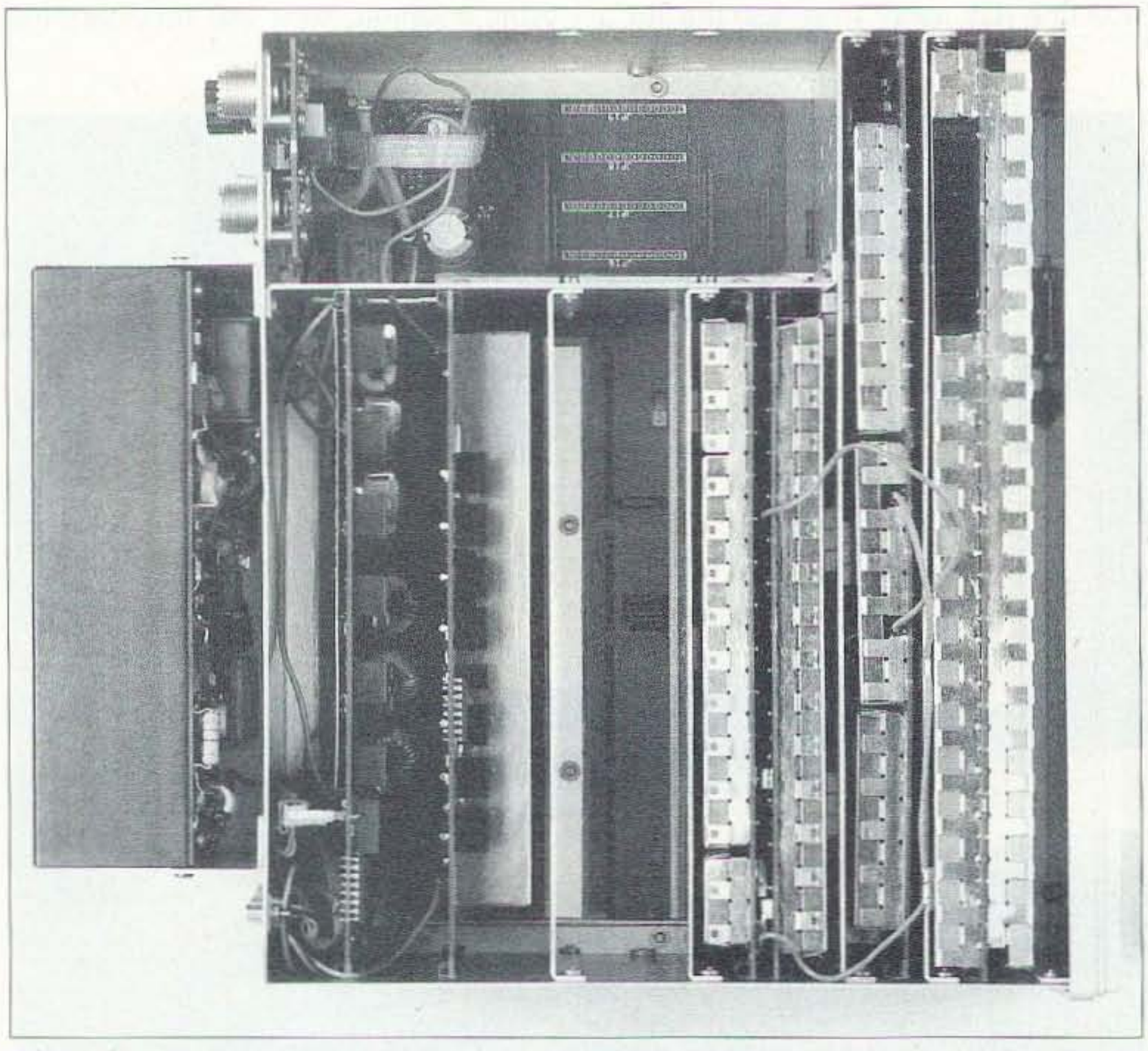

Photo C. *The inside of the 505 is neat and uncluttered as a result of modular plug-in cards.*

Getting the Kachina 505 up and running was a breeze. It took all of 15 minutes to hook up the rig to the power supply and computer and load in the software with the aid of the well-written installation manual. (I was a little worried at the mere 16-page thickness of the installation and operation guide until I discovered that the main manual is virtual and contained just a mouse-click away in the operating software.)

The software interface was very intuitive, so I decided to take the rig for a spin with just a few glances into the manual. I tuned up to 10 meters using a 10-element log periodic. I was able to get a weak copy on OH8JSZ through the Arctic flutter and then turn around, and via the miracle of DSP noise reduction, get a readable copy on ZK1DI coming in from Cook Island on 12 meters.

The sound of the 505DSP running into a three-inch external speaker was pleasant, with excellent clarity. Weak stations were very readable, and the fidelity on strong stations down on 20 meters made copy comfortable without that traditional communications mid-range sound. Tuning is accomplished using the up/down arrows on the keyboard, with the left/right arrows choosing the tuning resolution from 1 Hz to 10 MHz.

The virtual control panel is uncluttered and easy to read, a departure from some of the newer high density front panels of the new generation of HF rigs. The main window consists of a current settings status box that gives a readout of most of the main transceiver operating parameters, including filters, IF shift, notch, power, antenna port, tuner status, AGC time, Tx Eq, input attenuation, squelch, CW offset, and RIT. Below that is Tx and Rx frequency, mode, receive volume, and two "soft" faders that are used to select settings for any of the transceiver's adjustable parameters. The "soft" faders can be selected through hot keys, menu selection, or clicking on the individual items in the Settings box. On the right of the control window is a date/time readout, two-meter modules,

Inside the 505DSP (excerpt from Kachina's Web page)

The 505DSP's first mixer is a high-level diode ring, followed by high-level, low-distortion amplifiers, and 20 kHz-wide 75 MHz roofing filters. The gain of the 75 MHz stages is sufficient only to overcome the mixer and filter losses, and gain-controlled to prevent overload of the second mixer and the following 40 kHz IF stages. Most of the receiver gain takes place in the 40 kHz IF amplifiers which, to prevent ringing, use minimal LC selectivity. The output of the 40 kHz IF amplifier is then fed to the DSP portion of the radio, where the digital selectivity and processing take place. In the case of the 505DSP, the center IF frequency is a 40 kHz signal. The receiver IF strip has a bandwidth of 15 kHz at the maximum attenuation points, which means that signals ranging from 32.5–47.5 kHz are presented to the A/D converter. If we now choose a sampling frequency of 31.25 kHz, the center frequency will be translated down to 8.75 kHz (40–31.25). The string of signals is analyzed and processed at the 31.25 kHz rate, which is lower than the 40 kHz signal frequency. But as SSB signals require only about a 3 kHz bandwidth, we can bandpass filter again and again, reducing the sampling rate to as low as twice the bandwidth. By reducing the passband width, so we can reduce the sampling rate. As a result, digital filters may be narrowed down to previously unheard-of bandwidths without the ringing associated with crystal and mechanical filters—as low as 100 Hz, in fact, as in the 505DSP.

Two synthesizers provide low phase noise injection voltages to the mixers, which translate signals to and from the 75 MHz and 40 kHz IF amplifiers. The first local oscillator is a state-of-the-art DDS/PLL hybrid with a basic tuning step of less than 0.5 Hz. Control software, however, limits the user to 1 Hz steps. The second local oscillator is a VCXO. It supplies fixed-frequency injection to the second mixer. Both local oscillators are phase-locked to a common, precision, reference oscillator.

The reference oscillator is microprocessor-compensated against temperature. A DC voltage supplied by the DSP part of the circuit allows the reference oscillator to be calibrated against a reference signal (WWV, for example).

Product detectors and balanced modulators are mixers (IF and BFO signals mixed to produce an audio signal; microphone and BFO signals mixed to produce an IF signal). These are further mixers in a chain of mixers. DSP uses the phasing method to produce SSB. One sideband of a double sideband signal is phase-canceled, the other reinforced—the method used in the old phasing rigs, except that in DSP, the phase shift is constant with frequency. No mechanical carrier balancing is involved. The opposite process takes place in the receive mode.

General specifications

Frequency coverage, Tx: 1.8–2.0, 3.5–4.0, 7.0–7.3, 10.1–10.15, 14.0–14.35, 18.068–18.168, 21.0–21.45, 24.895–24.995, 28.0–29.7 MHz
Frequency coverage, Rx: 0.1–30 MHz
Frequency stability, short term: Can be automatically calibrated to within ±10 Hz of WWV or other external standard
Modes: USB, LSB, AM, CW
Power requirements: +13.8 V DC nominal; 25 A maximum (Tx), 2 A maximum (Rx)
Operating temperature range: -10° to +50° C
Transceiver dimensions/weight: Length, 32 cm. Height, 29.5 cm. Width, 1.5 cm. Weight, 5.27 kg. (12.5 x 11.5 x 4.5 inches, 11.6 lbs.)
Control head dimensions/weight: Length, 17.5 cm. Height, 4.5 cm. Width, 5.0 cm. Weight, 0.58 kg. (6.8 x 1.75 x 5.85 inches, 0.26 lbs.)

Receiver

SSB sensitivity: 0.18 µV (2.4 kHz filter, 10 dB SINAD, preamp on), 0.35 µV typical (2.4 kHz filter, 10 dB SINAD, preamp off)
AM sensitivity: 0.6 µV (preamp on), 1.0 µV typical (preamp off)
Audio power (5 µV input): >2 W into 8 Ω, >4 W into 4 Ω
Spurious rejection: >80 dB
Image rejection: >80 dB
IF rejection: >80 dB
3rd-order intercept point: +18 dBm typical @ 20 kHz (preamp off)
3rd-order IMD dynamic range: 96 dB typical (preamp off)
2nd-order intercept point: +49 dBm typical
Blocking dynamic range: 115 dB typical @ 20 kHz (preamp off); 118 dB typical @ 50 kHz
Audio THD: <5% @ 2 W into 4 Ω
Manual notch depth: >-50 dB

Continued on page 30

continued from page 29

Transmitter

Output power: SSB, 100 W ±dB into 50 Ω; AM: 25 W carrier nominal
Spurious harmonics: <60 dBc @ q00 W into 50 Ω
Carrier, opposite sideband suppression: SSB: <-55 dBc
CW keyer speed: 5–80 wpm, adjustable

and a full list of keyboard shortcuts that can be turned on or off.

That's all there is to it. The whole rig can be controlled from this simple, easy-to-read control panel. To upgrade the control panel to the newest, most advanced version, all you need to do is download it from Kachina's Web site on the Internet.

The software that is used at present to control the Kachina 505DSP is 16-bit Win 3.xx-compatible. The reason for this is that Kachina wants the software to run on any machine down to a 386 with 4 Mb of memory. They are working with other developers, and it should not be difficult to have OS and hardware-optimized software for the 505. Kachina is also planning to work with third-party developers to create software linking with Logging and HF Data software to produce an integrated station software concept.

Firmware upgrades are fully accomplished by inserting PCMCIA type-2 cards into the two slots on the processor board. Kachina will provide these as part of their upgrade policy, which means you will be able to completely upgrade firmware for the cost of the

Photo D. *For the hard-core knob twisters, Kachina offers an optional main tuning control.*

card. They chose this method to provide ease and control of upgrade installation, and ensure speed compatibility with the 21 MHz processor in the CPU. In addition, because the 505DSP is constructed more like a computer with its plug-in card bays than a traditional HF rig, even major replacements and repairs can be accomplished by swapping cards, instead of sending in the radio. Another aspect of the rig that brings to mind computers is the rear panel. All connectors other than the two antenna PL-259 connectors are either subminiature D-type computer or modular phone-type connectors. The ACC1 connector provides for TNC, phone patch, PTT, and related audio connections. ACC2 allows for an external automatic antenna tuner, and ACC3 provides for interface with a power amplifier. In addition, an RJ12 modular connector can be used to operate the rig with the computer and rig separated by up to 75 feet.

The 505DSP uses a double conversion receiver with IF stages at 75 MHz and 40 kHz. The DSP operates at 40 kHz before the AGC and is the highest frequency IF-based DSP on an amateur transceiver. The transmitter also uses DSP for phase-canceled sideband suppression. All filtering is DSP-based, thus eliminating the need for expensive optional crystal filters. Kachina does not supply a schematic with the radio, but a free one can be obtained by sending a request to the manufacturer. An explanation of the rig's operation can be seen in the sidebar "Inside the 505DSP."

Since the front panel of the 505DSP is your computer keyboard and screen, a short tour of the software is necessary to get the hang of things. The Help menu is adequate in getting you started. The only thing I missed was the ability to print out all or part of the menu, so I would not have to bounce back and forth between help windows. I have included an in-depth look at the supplied software (version 2.21) in the sidebar "On the Menu." I found the software easy to use, but was only able to operate the rig with the speed of a nonvirtual radio after I had taken the time to learn the keyboard commands.

Using the 505 to full potential takes a bit of learning. The curve is not high, but to get the speed and agility necessary for contests or jumping into a DX pileup, it is necessary to know what keys to press without having to refer to the help or shortcut menu. I found after I had mastered these skills, I was able to perform DSP, tuning, and split functions with a few key clicks that made operation actually faster than reaching out and twisting knobs or going into the arcane menu systems of conventional rigs.

The only operation that I found a little difficult to get used to was tuning without a knob. After years of having that large flywheel control to rock back and forth when trying to dig that elusive DX out of the noise, up/down arrows proved a bit difficult. The bottom line is, even old hams can learn new tricks, and by the time I sent the rig back I was up/down tuning on the Kachina with the best of them. Kachina, in recognition of the ham/tuning knob fetish, has developed an accessory tuning knob that sits on your operating desk and connects to a spare Com port on your computer. This accessory should be shipping by the time you read this review.

Operation of the 505DSP proved to be a joy. Though I was expecting a high-quality rig, I was still pleasantly surprised by how well the receiver performed. I was able to use the rig in the

On the Menu
(a look at the 505DSP control software)

Since the front end of the Kachina is your computer—instead of an array of knobs, buttons, and switches—to provide an effective discussion of the radio's functions it is necessary to include a software review to make this article complete.

Here are the basic Menu Bar functions (almost every Menu Bar function has an equivalent "hot key," so it is not necessary to go into the menus with the mouse to control the radio).

Filters menu

The Filters menu provides access to DSP bandpass filtering at 3.5 kHz, 2.7 kHz, 2.4 kHz, 2.1 kHz, and 1.7 kHz for SSB; and 1 kHz, 500 Hz, 200 Hz, and 100 Hz for CW. This, plus two data filters, eliminates the need for costly crystal filters. IF shift, manual, and automatic notch with three variable notch widths are also available in the filter menu.

Tx menu

The Tx menu allows you to vary transmit frequency, mike gain, power out, speech monitor, audio monitor, vox controls, amplifier on/off, and transmit equalization.

Rx menu

The Rx menu includes direct frequency entry, a bandswitch, AGC speed, attenuator, squelch, noise reduction controls, and RIT.

Ant menu

Ant menu allows you to retrieve and display your antenna impedance data in the form of a Smith Chart for each of the HF bands, engage the automatic antenna tuner, and select the antenna you wish to use for each band (antenna port A or B).

CW menu

The CW menu gives operator access to the CW keyer functions of QSK or semi break-in, speed, dynamics, weight, and sidetone level. CW functions, including CW filter default, left/right/straight key options, nine transmit message buffers, and a "live type" CW feature which allows direct keyboard-to-CW entry.

Meters

Meter selection of the two digital meters includes receive meter calibrated in S-units, volts, or dBm; and transmit meters calibrated in forward power, reflected power, ALC, and SWR.

Channels

The Channels menu provides interface to the memory functions of the 505. The recall command will open a window with 100 memories capable of storing Tx/Rx frequency, mode, AGC setting, and filter settings. These memories are divided into five groups, and can be scanned using varying dwell time and squelch hold. Memories can be saved, printed, and cleared through menu choices, and a specified frequency range can be scanned in user-defined frequency increments.

Special

The Special menu is the largest of the pulldown menus and allows access to a multitude of the 505's software features. The user can access the internal logging program and lock controls; change tuning and slider rates; set the clock; monitor heat sink temperature; calibrate the receiver; and do a selective frequency sweep. The last two functions are quite interesting. The frequency calibration allows the user to input a standard frequency (I used WWV) and then let the radio tune to that frequency and perform an internal calibration against the reference frequency. The frequency sweep allows the user to select a frequency and ± deviation and then do a signal or continuous sweep, creating a graph of band activity. The resultant graph can then be clicked on to move the receive frequency to any source of band activity.

Help

The Help menu "is" the manual. It provides a complete on-line description of all radio functions and menus as well as a searchable index. The Help menu also allows for the continuous display of all shortcut keys, which makes learning

Continued on page 32

keyboard commands a lot easier. Help selections are broken down into subcategories which include: tuning, buttons, slide bars, shortcut keys, main menu, function keys, user's guide, and Com port setup instructions. The function keys provide 16 user-definable settings.

Quit

Quit exits the 505 control program.

ARRL International DX SSB Contest, and was very impressed by the DSP filtering. The Kachina, with filters set to 1.7 kHz and tuning steps set at 100 Hz, allowed me to tune up and down the crowded 15- and 20-meter bands as if I were working a channelized rig. By using a combination of DSP filtering, IF shift, notch, widely variable AGC, and noise reduction, I was able to tune and work weak stations in the midst of the SSB chaos that occurs in a contest. I was very impressed with the rig's computer-based contest potential. The only thing lacking at this time to make the 505 a viable contest alternative is the need for third-party software to be integrated with the control software to automate contest data entry.

Day-to-day operation of the 505, away from the hubbub of a crowded contest weekend, proved to be pure joy. I made many QSOs with the rig and received excellent reports on audio and signal clarity. I spent a few Sunday mornings on my regular sked with Bob Moss W3GJQ (who is quite a bit more into SSB audio than your average ham) and worked to optimize the audio sound of the Kachina. Out of the box, with the supplied hand microphone and factory audio settings, the rig sounded good, but with a little fiddling, and constructive feedback from Bob, I was able to get the rig sounding *great*. We were only able to speculate about how the rig might have sounded with a high-end microphone driving it. I did, during the time I had the radio, speak to other Kachina operators, including Doug Smith KF6DX at the Kachina Club Station in Arizona, and was singularly impressed with the audio quality of the radio. My only complaint at the time of this writing is with the speech processor. Although the processor does perform its appointed function of increasing the apparent signal for working weak-signal stations or pileups, I found the audio quality with

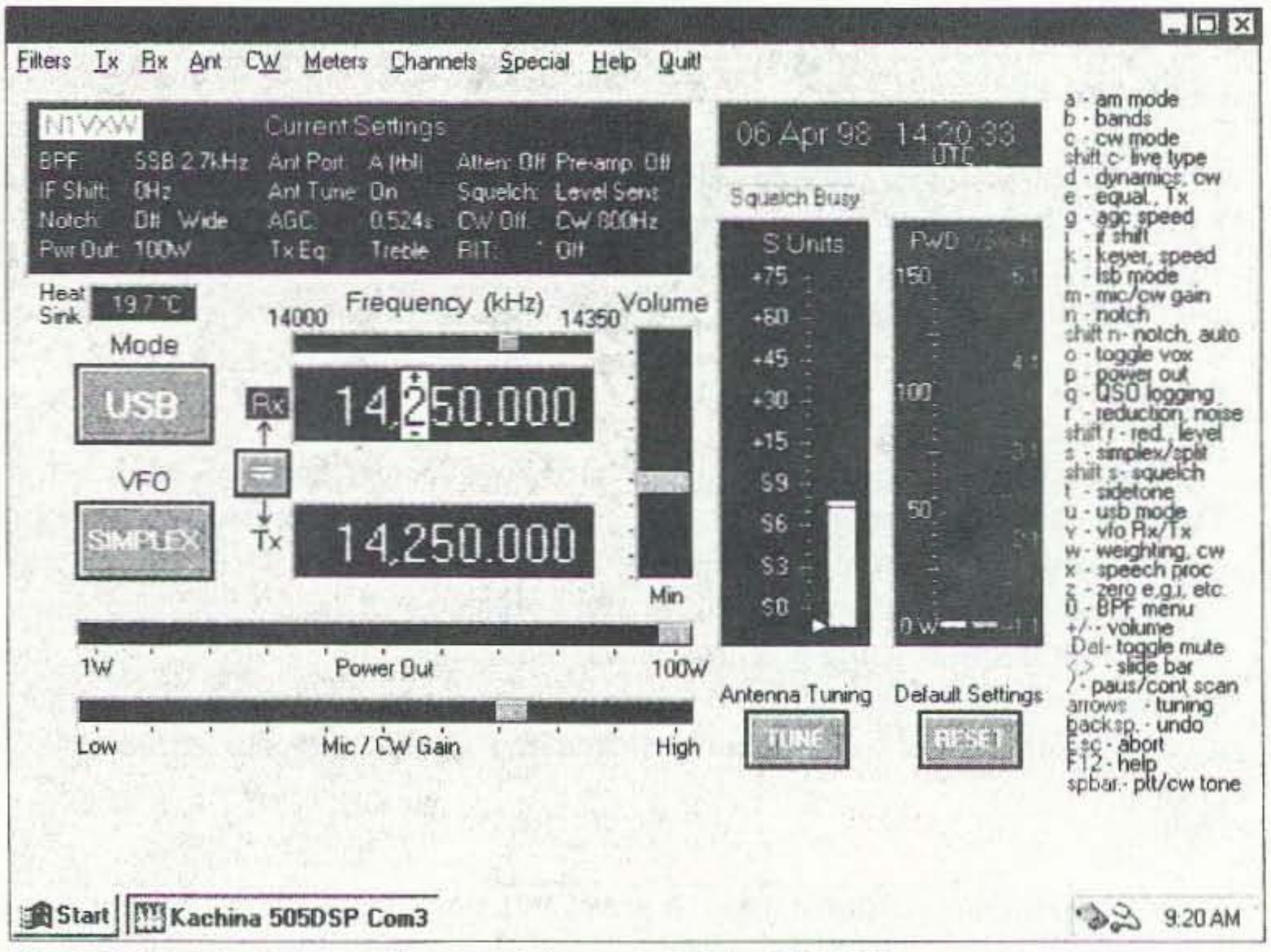

Photo E. *This is the versatile virtual front end of the 505DSP.*

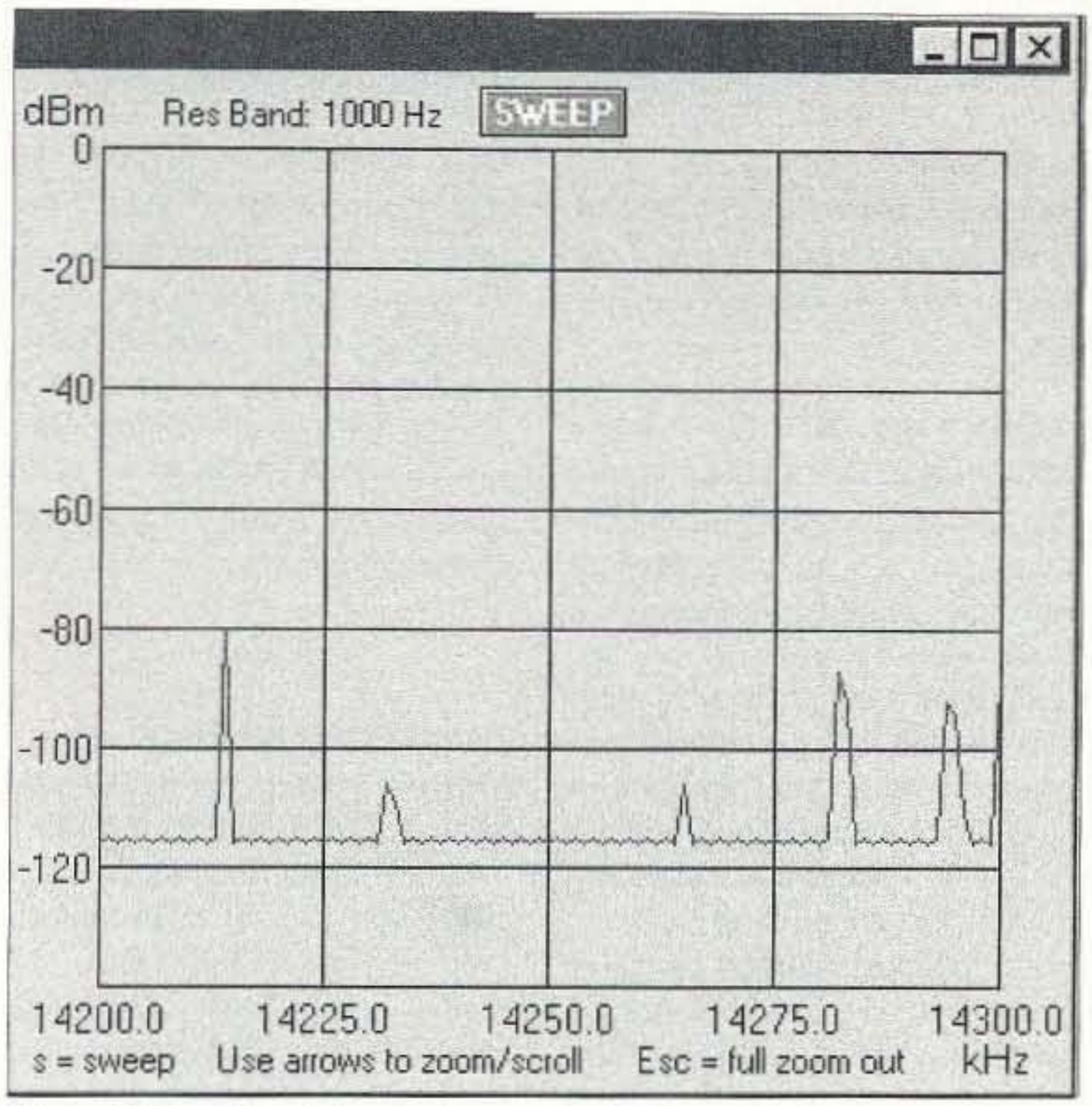

Photo F. *Band activity is shown on the Sweep screen.*

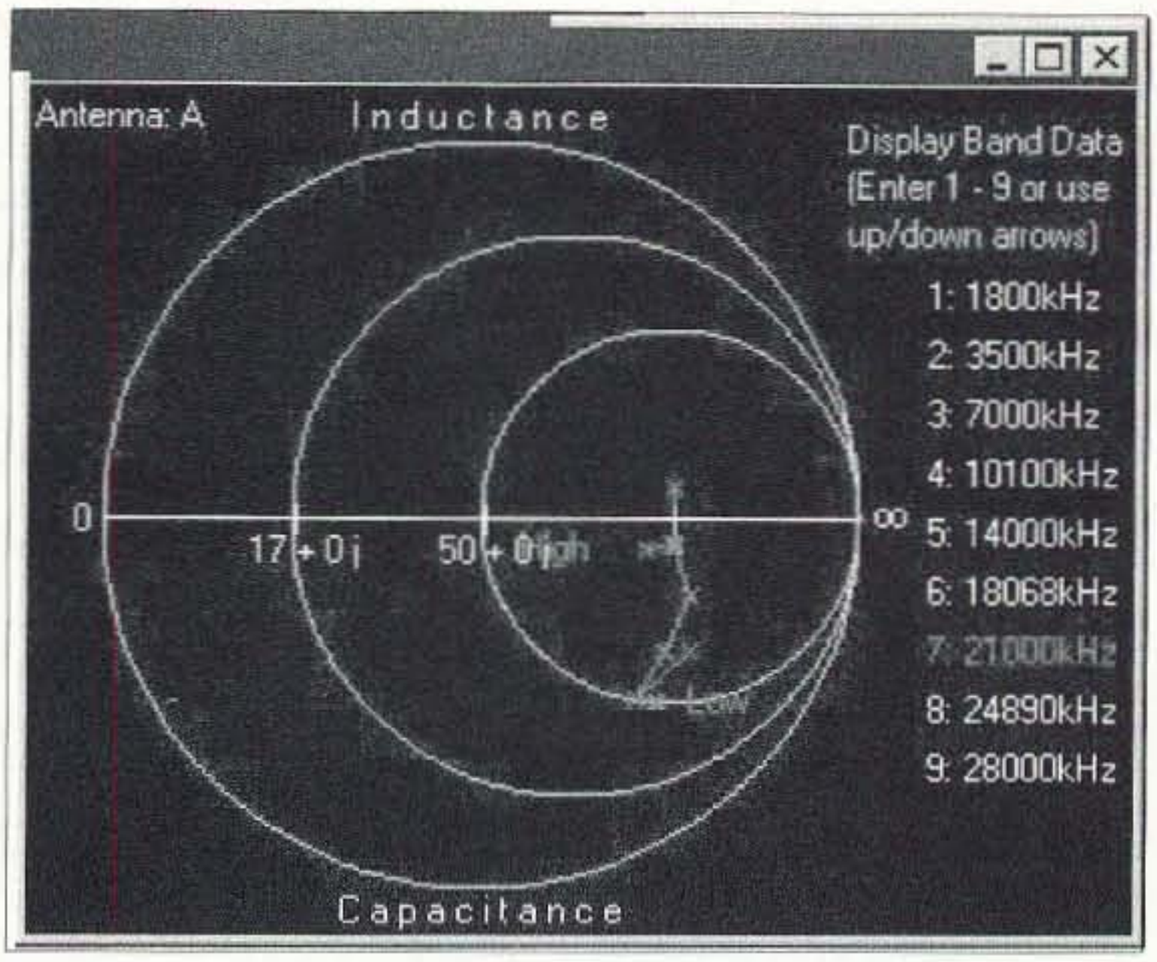

Photo G. *Antenna LC data is displayed on a band-specific Smith Chart.*

the processor on to be a little rough, and left it off except when needed. Kachina informed me that they were working on this, and a modification was forthcoming.

CW operation on the Kachina proved to be a very pleasant experience. Menu selection lets you set up your paddle for left- or right-hand operation, speed, weight, and dynamics. All controls are accomplished from the two soft faders and allow the operator to tailor his CW signal to individual tastes. Sidetone frequency and level can be set from the menu, which I find a real plus (owning an 80-pound rig that requires picking up and the use of a screwdriver simply to adjust sidetone level). In addition, the software supplied with the 505 lets the operator type directly into the rig to produce CW. This feature is fun and also allows messages of up to 59 characters to be stored in nine memory buffers.

Other features of the Kachina include a band scope that will sweep a predefined portion of the spectrum for signal activity. Though the sweep requires a momentary muting of the receiver audio, the resultant graph allows the operator to jump from signal to signal by simply clicking the mouse on the graph. Refresh rates and sweep parameters are controlled by software; all in all it is the best software-based band scope I have seen to date for amateur equipment.

Another software plus is the Smith Chart feature. The antenna tune function on the radio not only remembers the tune setting for previous frequencies, but also applies the data to a band-specific Smith Chart that can be used to analyze the characteristics of any antenna connected to the 505. The antenna tuner is quick, quiet, and fast. Kachina rates it as being able to tune any antenna up to a 3:1 SWR, and that proved to be true with the antennas I connected to the 505. One of my favorite features was the Snapshot Keys. By pressing a combination of F1 through F8, shift and control, you are able to take 16 different memory snapshots of current receiver settings and assign them to "F" keys. This beyond-quick memory function has uses that are only limited by the imagination of the operator. Another plus is the backspace key. Imagine being able to undo the last 10 changes you made to the parameters of your radio!

When all is said and done, the Kachina 505DSP proves to be a very capable first effort from a company that has been supplying commercial and military communications equipment for a long time. The radio, in my opinion, provides a high value per dollar when compared to similarly priced radios, in that the front panel controls are in your computer, letting the manufacturer invest the cost difference in technology. The ability to upgrade control software or use or write custom software, combined with low-cost PCMCIA card firmware upgrades, makes this a rig that can grow and last into the future without being obsolete out of the box.

For more information, check out the Kachina Web site at [www.kachina-az.com]. The Kachina 505DSP HF transceiver is manufactured by Kachina Communications, Inc., P.O. Box 1949, Cottonwood AZ 86326. Telephone (520) 634-7828; FAX (520) 634-8053; E-mail [KACHINA@sedona.net]. Price, $1995. With antenna tuner, $2234. 73

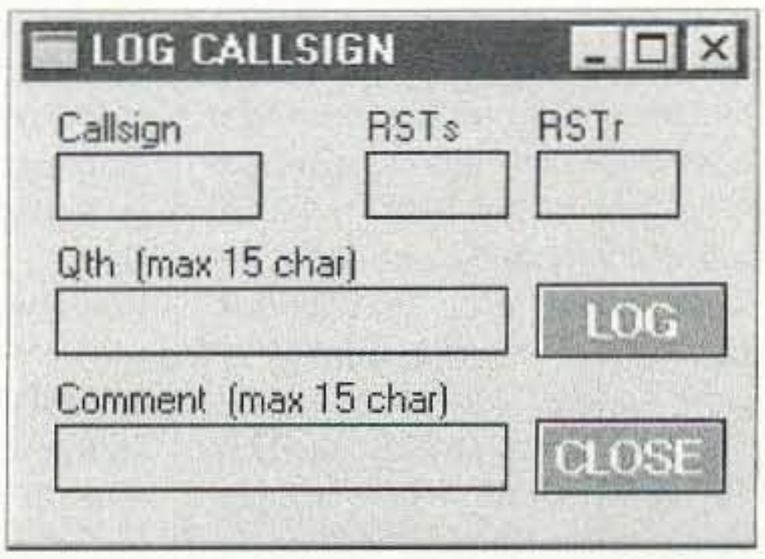

Photo H. *The 505DSP software includes a basic logging program.*

SPECIAL EVENTS

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the November issue, we should receive it by Aug. 31. Provide a clear, concise summary of the essential details about your Special Event.

AUG 1–2

JACKSONVILLE, FL The 25th annual Greater Jacksonville Amateur Radio & Computer Show will be held August 1st and 2nd at the Osborn Convention Center in downtown Jacksonville. The site is conveniently located one mile north of the I-95/I-10 junction. Take the Forsyth St. exit off I-95. Activities include forums and group meetings, a huge indoor swap area, and commercial exhibitor booths. Testing for all grades of ham license will be at 9 a.m. Sunday in the lobby area. Walk-ins are welcome. Hours are 9 a.m.–5 p.m. Saturday, and 9 a.m.–3 p.m. on Sunday. Exhibitor and swap area setup is Friday July 31st, 1 p.m.–6 p.m., with drive-in access for easy unloading. Admission is $8 at the door. Swap tables are $25 each for the weekend. Tables may be ordered from *Karl Hassler N4DHG, 2767 Scott Circle, Jacksonville FL 32223. Tel. (904) 268-2302.* Commercial booths are available via *Menard Norton KE4IOR at (904) 384-6750 or E-mail via [ke4ior@juno.com].* Headquarters hotel is the Jacksonville Omni with a special rate of $69 to those mentioning the hamfest. Phone *(904) 355-6664 or 1-800-843-6664* for reservations. Free parking is available in the main convention center parking lot and the entire hamfest is air-conditioned. Many alternative activities are available in the area. Talk-in is on the 146.76 rptr, or for more details, check the Web site at *[http://www.pobox.com/~w4ue/hamfest.html];* or write *Greater Jacksonville Hamfest, P.O. Box 27033, Jacksonville FL 32207.* The 1997 Greater Jacksonville Hamfest was designated the ARRL National Convention and the eight participating clubs plan an even bigger show this year. All proceeds go to upgrading amateur radio projects and activities in northeast Florida.

AUG 2

ANGOLA, IN Land of Lakes ARC will sponsor a Hamfest Sunday, August 2nd, 7 a.m.–2 p.m. at Steuben County 4-H Fairgrounds, corner of 200 W. and 200 N., Exit 150 off I-69. Free parking, camping, chicken BBQ, swimming, amusement park and outlet shopping nearby. Indoor tables $8, trunk sales $2. Vendors setup Saturday, August 1st, 3 p.m.–10 p.m., Sunday, August 2nd, 4 a.m.–7 a.m. Not responsible for theft or accidents. Advance tickets $3, gate tickets $4. Advance sales end July 22nd. For more info, contact *Theresa J. Limestahl KB9NNR, P.O. Box 346, Fremont IN 46737. Tel. (219) 495-5403; FAX (219) 495-1675. Packet [KB9NNR@N9LCF].* Talk-in on 147.180 pl 131.8, 444.350, packet 145.510.

BERRYVILLE, VA The Shenandoah Valley ARC, of Winchester VA, will present the 48th Berryville VA Hamfest at Clarke County Ruritan Fairgrounds, 6 a.m.–3 p.m. Talk-in 146.830. Admission $5. Tailgaters $7 (indoor spaces available by reservation). VE exams by the Mountain ARC Teams. Contact *Tom Martin KF4TNX, (540) 323-0074. E-mail [hamfest@Vvalley.com], or write to Shenandoah Valley Amateur Radio Club, P.O. Box 139, Winchester VA 22604.*

MARSHFIELD, WI The Marshfield Area ARS will hold their 7th annual "Hamnic" (a potluck dinner/swapfest) on Sunday, August 2nd, at Wildwood Park Shelter in Marshfield WI. Gather around 11 a.m. Talk-in on 147.180 or contact *Guy Boucher KF9XX, 107 West Third Street, Marshfield WI 54449. Tel. (715) 384-4323. E-mail [guyboucher@tznet.com]. Packet [KF9XXX@W9IHW.E5. AI.WI.USA.NA].* All are welcome!

RANDOLPH, OH The Portage ARC "Hamfair '98 For Radio Amateurs and Computer Enthusiasts" will be presented at Portage County Fairgrounds in Randolph (between Akron and Youngstown, on St. Rt. 44, 4 miles south of I-76). The event will take place from 8 a.m. to 4 p.m. Unlimited free parking. There will be indoor vendors and a huge flea market. Setup begins at 6 a.m. An on-grounds restaurant will serve breakfast and lunch. Advance tickets (available until July 15th) are $4; $5 at the gate. Other features include Worked-All-States card checking and ARRL officials to answer your questions and bring you up to date with what is happening. Indoor tables with electricity are $10 each. Flea market spaces $3 each. For reservations or info and tickets, contact *Joanne Solak KJ3O at (330) 274-8240.* Mail registration with a check/m.o. for the total amount, payable to *Portage Amateur Radio Club, 9971 Diagonal Rd., Mantua OH 44255.* Talk-in on 145.39 (-600 MHz). Get a look at the Web site at *[http://parc.portage.oh.us].*

AUG 8

HUNTINGTON, WV The Tri-State Amateur Radio Assn. (TARA) will hold their hamfest at the Huntington Memorial Fieldhouse at 2590 5th Ave. For more information call *Bernie Mays at (304) 743-5459, or E-mail to [wb8zer@juno.com].*

LEWISTOWN, PA Juniata Valley ARC will hold a Hamfest August 8th, 8 a.m.–1 p.m. at Decatur Township Fire Company grounds. Follow US Rt. 522 North to the site, which is eight miles east of Lewistown. Admission $1. Tailgating $5. Indoor tables $10. Talk-in on 146.91. For info call *Rich Yingling WB3COB at (717) 242-1882.*

OSCODA, MI The 1998 I.C.A.R.E. Hamfest will be held at Oscoda Airport in the Yankee Air Force Museum, Oscoda MI, 8 a.m.–2 p.m. Setup at 6 a.m. $3 trunk sales, tickets $4 in advance, $5 at the door. Tables $7 each. Free overnight RV parking available. VE exams with 9 a.m. check-in. Mail ticket orders with an SASE payable to *I.C.A.R.E., P.O. Box 271, Oscoda MI 48750.* For more info, call *(517) 739-2896,* or *(517) 739-3129. E-mail [ka8aip@centuryinter.net].*

AUG 9

FRANKFORT, KY The Bluegrass ARS will hold its annual Central Kentucky ARRL Hamfest 8 a.m.–4 p.m., August 9th, at Western Hills High School in Frankfort. From I-64 exit 53 take Route 127 north 0.7 mile. Turn left at the third stop light and follow the signs. Admission is $5 in advance, $6 at the door. For VE exams contact *Bill Fuqua WA4LAV* by July 31st at *(606) 272-9523; or E-mail [wlfuqu00@pop.uky.edu].* Indoor and outdoor flea market, commercial vendors, forums, free parking, and refreshments. Handicapped accessible. Vendor setup starts at 6 a.m. Tables are $15 before August 1st, $25 after August 1st. Tailgating is free with admission. Talk-in on 145.390(-) (Frankfort) and 146.760(-) (Lexington). For info and reservations contact *John Barnes KS4GL at (606) 253-1178 evenings; E-mail [KS4GL@juno.com];* or SASE *John Barnes KS4GL, 216 Hillsboro Ave., Lexington KY 40511-2105.*

ST. CLOUD, MN The St. Cloud Radio Club will hold its 50th annual Hamfest on August 9th at Whitney Senior Center, St. Cloud MN. VE exams begin at noon. Talk-in on 146.94 and 147.015. For info and tickets contact *WØSV, 401 Great Northern Dr., Waite Park MN 56387. Tel. (320) 255-1410. E-mail [jmaus@cloudnet.com].* Check the Web site at *[WWW.WØSV.ORG].*

AUG 15

BURFORD, ONTARIO, CANADA The Brantford ARC will host "Hamfest '98" at the Burford Fairgrounds on Hwy 53, 15 km west of Brantford, Saturday, August 15th. Free parking. Doors open to the public at 9 a.m.

Admission $5, children under 12 free. Tables are $8 each, plus admission. Tailgaters $4 plus admission. Vendors' gate opens at 7:30 a.m. Prepaid tables are guaranteed. Refunds only if canceled by August 5th. Tables not prepaid will only be held until 9 a.m. Reserve early if you have special requests such as wall tables, hydro access, etc. Special requests *must* be prepaid. For table reservations, contact *Richard La Rose VE3RLX, 153 Dunsdon St., Brantford ON N3R 6N3, Canada. Tel. (519) 752-2437; E-mail [rlarose@bfree.on.ca];* or *Brantford ARC, P.O. Box 25036, Brantford ON N3T 6K5, Canada; E-mail [ve3ba@bfree.on.ca].*

LONGVIEW, WA The Lower Columbia ARA, W7DG, will sponsor its 7th Annual Ham Radio, Computer, and Electronic Equip. Swap Meet 9 a.m.–3 p.m. at the Cowlitz County Fairgrounds in Longview. Take exit 26 or 39 off Interstate 5 and follow the signs west for the county fairgrounds. Mt. St. Helens and the Oregon coast are nearby. Admission is $3. Swap tables are $12 before August 1st, $15 after. Commercial tables $15. Free parking. Overnight RV parking on the fairgrounds for $10, elec. available. No VE exams. Vendor setup on Friday 5 p.m.–9 p.m., Saturday 6 a.m.–8:45 a.m. Talk-in on 147.26(+) pl 114.8. For more info write to *LCARA Swap Meet, P.O. Box 906, Longview WA 98632; or call Bob KB7ADO at (360) 425-6076 eves. E-mail to [KB7ADO@ aol.com].*

WASECA, MN The Viking ARS will hold a Hamfest and Craft Fair at Waseca County Fairgrounds, 8 a.m.–2 p.m. 8' x 8' inside spaces will be available to vendors for $15, or if booked and paid for by June 15th the fee will be only $10. Outdoor tailgating available for $8, or $5 if booked and paid by June 15th. General admission is $1, $3 for hams. Hams are eligible for door prizes and must have a license to qualify. For info or to book space, contact *Lloyd L. Schlaak, (507) 465-8619; E-mail [nØvfv@smig.net].* Talk-in on the 146.940 MHz WAØCJU rptr.

AUG 16

CAMBRIDGE, MA A tailgate electronics, computer and amateur radio Flea Market will be held rain or shine, Sunday, August 16th, 9 a.m.–2 p.m., at Albany and Main St., Cambridge MA. Admission $4. Free off-street parking. Fully handicapped accessible. Tailgate room for 600 sellers. Sellers $10 per space at the gate, $9 in advance—includes one admission; setup at 7 a.m. For space reservations or further info call *(617) 253-3776.* Mail advance reservations before Aug. 5th to *W1GSL, P.O. Box 397082 MIT BR., Cambridge MA 02139-7082.* Talk-in on 146.52 and 449.725/444.725 pl 2A W1XM rptr. Sponsored by the MIT Radio Society and the Harvard Wireless Club.

AUG 18

ANGELS CAMP, CA The Calaveras ARS will hold an Amateur Radio Flea Market Saturday, July 18th, 7 a.m.–2 p.m. at Utica Park in Angels Camp. Buyers free! Sellers $5. Talk-in on 145.170(-) pl 100. For more details call *Steve at (209) 878-3829 or Susan at (209) 795-0618.*

AUG 22

AUSTIN, MANITOBA, CANADA The Manitoba Amateur Radio Museum (MARM) is hosting its 4th Annual Hamfest on the grounds of The Manitoba Agricultural Museum at Austin, 1-1/2 miles south of Hwy. #1 on Hwy. #34. Admission is $5, indoor tables $5. The dance on Saturday at 8 p.m. is $8. Banquet $8. Camping $12 with elec., $10 without elec. Talk-in on 146.91(-). For further info, contact *Dave Snydal VE4XN, (204) 728-2463.*

BRIDGEWATER, NJ The Somerset County ARS, Inc., will hold their Annual Hamfest at the Somerset County 4H Center on Milltown Rd., just off Route 202, 8 a.m.–1 p.m. Setup is at 6 a.m. Call *Pat N2CQM, (732) 873-3394; FAX (732) 873-0052;* or write to *SCARS, P.O. Box 742, Manville NJ 08835. E-mail [scars@qsl.net].* The Web site is at *[http://www.qsl.net/scars].* Talk-in on 448.175(-5) pl 141.3, and 147.135(+6) pl 151.4.

WARSAW, IN The 2nd Annual Kosciusko Co. Hamfest and Computer Show will be held August 22nd, 8 a.m.–2 p.m. at Kosciusko County Fairground, Bronson & Smith St., Warsaw. General admission is $3. Inside vendor area (includes one 8-foot table) $5. Free flea market setup outside. VE exams at 2 p.m. Sponsored by Hoosier Lakes Radio Club of Warsaw IN. For more details call *Loren Melton WB9OST, (219) 858-9374 eves after 6 p.m. CDT. E-mail [WB9OST@WAVEONE.NET]. Talk-in on 146.985(-).*

AUG 23

CHEEKTOWAGA, NY The Lancaster ARC is the sponsor of the Greater Buffalo Hamfest and Computer Show which will be held August 23rd, 8 a.m.–3 p.m., at Hearthstone Manor, 333 Dick Rd., Cheektowaga NY. For more information check the Web site at *[http://hamgate1.sunyerie.edu/~larc/greaterbuffalohamfest.html];* or contact *Luke at (716) 634-4667; E-mail [lcalianno@aol.com].*

YONKERS, NY The Yonkers ARC Hamfest/Computerfest will be held at the Yonkers Municipal Parking Garage on Main St. in Yonkers. There will be no VE exams. Sellers, pre-registration is $10 per space, $14 per space at the door. AC power is available with pre-registration. Buyers: $5; XYL, YL, kids under 12 admitted free. For more info call *John at (914) 963-1021; or Jim at (914) 969-5182.* To pre-register, make checks payable to *The Yonkers Amateur Radio Club,* and mail to *Y.A.R.C., P.O. Box 378, Centuck Sta., Yonkers NY 10710-0378.* Include, name, call, date, address, city, state, zip, and number of spaces you are paying for. Talk-in on 146.865 and 440.150 rptrs., also on 146.520 simplex.

AUG 29

LA PORTE, IN The La Porte

County Electronics Assn's annual Summer Hamfest will be held 7 a.m.–2 p.m. Saturday, August 29th, at the La Porte County Fairgrounds, located 50 miles east of Chicago. Plenty of paved area for selling, and an air-conditioned building with eight-foot tables for vendors inside. Open at 6 a.m. for vendor setup. Tickets are $5, tables are $5, from *Rich Dugger WD9ARW, 4977 W. 150 N., La Porte IN 46350. Tel. (219) 326-6672. E-mail [lpcea@hotmail. com].*

AUG 29–30

BOXBOROUGH, MA The 1998 New England ARRL Convention at Boxborough MA will be held at the Holiday Inn Boxborough Woods Hotel and Conference Center, Route I-495. For information regarding exhibits, contact, day or evening, *Anthony Penta W1ABC, General Chairman, 88 Hill St., Topsfield MA 01983. Tel./FAX (978) 887-8887. E-mail [tony@shore.net].* For room reservations, contact *Mel Cole WZ1Q, Reservations Chairman, P.O. Box 8, Prides Crossing MA 01965. Tel. (978) 927-1953. E-mail [mel@shore.net].* For exhibit and advertising info, contact *Richard Cosma KD1BF, Exhibits Chairman, 95 Higgins Road, Framingham MA 01701-4311. Tel. (508) 877-8241; FAX (617) 248-6939; or E-mail [kd1bf@amsat.org].*

WOODLAND PARK, CO The Mountain ARC Campfest-Swapfest will be held Saturday, Aug. 29th and Sunday, Aug. 30th, at Colorado Lions Club Camp, four miles north of Woodland Park, on Hwy. 67 North. Free admission for buyers. $10 daily to camp and/or sell. Campers may set up camp Friday, August 28th after 2 p.m. Advance reservations requested. Contact *Judy KBØWGN at (719) 836-0217; E-mail [dsrtflwr32@aol.com];* or mail reservations to *MARC, P.O. Box 1012, Woodland Park CO 80866.*

AUG 30

DUBUQUE, IA The Great River ARC, Iowa Antique RC and Historical Society, and the Tri-State Computer Users Group are getting together to sponsor the 5th Annual Hamfest Radiofest Computer Expo from 8 a.m.–2 p.m. at the Dubuque County Fairgrounds on Old Highway Rd., west of Dubuque. Features include free parking, camping (elect. available), dealers, flea market, tailgating, with VE exams at 10 a.m. Admission is $4 in advance and $5 at the door; 12 and under admitted free. Eight-foot tables are $8 each. Talk-in on 147.84/.24. Contact *Jerry Ehlers WØSAT, (319) 583-1016; Loren Heber NØYHZ, (319) 556-5755; or Jerry Lange KBØVIK, (319) 556-3050.* Write to *G.R.A.R.C., P.O. Box 546, Dubuque IA 52004-0546. E-mail [kbØlcj@mwci.net].* Visit the Web site at *[http://grarc.mwci.net/].*

WOODSTOCK, IL The Tri-County Radio Group, Inc., will hold its 8th Annual Hamfest and Computer Extravaganza at the McHenry County Fairgrounds located just north of Route 14 on Route 47, beginning at 6:30 a.m. for the flea market and 8 a.m. for the exhibitors. (Setup available on Saturday, by appointment, or 6:30 a.m. on Sunday.) Talk-in on 146.52 (simplex). Reservation deadline is August 11th. For more info or reservations, contact *Bob Grosse N9KXG, (708) 944-0500. E-mail [TCRG@quality-enterprises.com].* Mail: *T.C.R.G., P.O. Box 3107, Skokie IL 6007-6107;* or visit the Web site at *[http://quality-enterprises.com/TCRG].*

YONKERS, NY The Westchester Emergency Communications Assn., Inc., will hold its Summer Radio and Electronics Hamfest, 8 a.m.–2 p.m. August 30th, at the Yonkers Raceway. This outdoor tailgating event will feature all types of new and used ham radio equipment, computers, CB, shortwave, scanners and other varieties of electronic equip., and parts. Free unlimited parking, handicap accessible. Admission is $6, children under 14 free with adult admission. Talk-in available on WECA's rptr. at 147.060 MHz, pl 114.8. For more info, please call the *WECA info-line at (914) 741-6606;* or visit the Web site at *[WWW.WECA.ORG].* WECA is an all-volunteer amateur radio organization whose members are dedicated to providing public service and emergency two-way radio communications in Westchester County and the surrounding areas.

SEPT 5

CARP, ONTARIO, CANADA The Ottawa ARC (OARC), Inc., is pleased to announce its 2nd Annual Hamfest. The event will be held Saturday, Sept. 5th, 10 a.m.–1 p.m. on the Carp Agricultural Fair Grounds (at Falldown Lane) in Carp. Take Highway 417 to the Carp Road exit, north to the fairground. Tables are $10 each, plus admission, tailgate spaces $5 each plus admission. General admission is $3. For info contact *Jim Cummings VE3XJ, (613) 446-1225; E-mail [fleamarket@oarc.net].* Take a peek at *[http://oarc.net/fleamarket]* on the Web. The OARC Hamfest is held at the Carp Agricultural Fair Grounds at the same time as the Carp Farmer's Market, so an additional bonus is that guests can also enjoy stocking up on farm-fresh produce, and crafts from local artisans.

UNIONTOWN, PA Saturday, Sept. 5th, the Uniontown ARC will hold its 49th annual Gabfest at the club grounds located on Old Pittsburgh Rd., just north of the intersection of Rts. 51 and 119. Free parking and free tailgate space with registration. The event starts at 8 a.m. Talk-in is on 147.045(+) and 147.255(+). Table space available. For more info contact *Carl WA3HQK or Joyce KA3CUT Chuprinko, Rte. 6 Box 231-CC Morgantown WV 26505. Tel. (304) 594-3779.*

SPECIAL EVENT STATIONS

JULY 26–AUG 8

KINCARDINE, ONTARIO, CANADA The Kincardine DX Group will operate XK3K to celebrate the 150th Anniversary of the Town of Kincardine. This special callsign will be used between 0000 UTC July 26th and 2359 UTC August 8th. Operation will be on all bands 80–10 meters, SSB and CW. Please send an SASE for QSL to *Bill Hardie VE3EFX, 755 Johnston Crescent, Kincardine Ontario N2Z 1S5, Canada.*

JULY 31–AUG 2

OSHKOSH, WI The Fox Cities ARC of Appleton WI will operate W9ZL from the Experimental Aircraft Assn. Fly-In and Convention (EAA AirVenture '98) at Wittman Regional Airport in Oshkosh. SSB-HF operation will begin on Friday, July 31st and continue through Sunday, August 2nd, in the General portions of the phone bands. RTTY operation will be mostly on 7085 and 14085. Operators of the club will man the station from 8 a.m.–4 p.m. daily. A special 8 x 10 certificate is offered for contacts with proper QSLs. QSL to *Wayne Pennings WD9FLJ, 913 N. Mason, Appleton WI 54914 USA.*

AUG 1–8

NEWARK, NOTTINGHAMSHIRE, ENGLAND Nottinghamshire Scouts and Guides will operate Station GB98RH from the Sherwood 98 International Camp at Walesby Forest Scout Activity Centre, a 250-acre site located in the Sherwood Forest area of Nottinghamshire. The site will be the home for a week to over 7,000 Scouts and Guides, representing over 26 countries and five continents. Depending on conditions and the availability of operators, the station expects to be QRV between 0800 and 2400 UTC on 80 m, 40 m, 20 m, 18 m or 12 m, 15 m or 10 m, and 6 m, 2 m, or 70 cm. Outside of these times band occupancy will be more restricted. Modes will be mainly SSB and CW with perhaps some RTTY and Packet.

AUG 5–8

ELGIN, IL The Antique Radio Club of Illinois (ARCI) will, for the first time, have a vintage amateur station *transmitting* on August 5th–8th, at Radiofest XVII, from the Holiday Inn in Elgin. Radiofest XVII is one of the nation's largest gatherings of antique radio collectors held each year. N9CQX will be the host and will be assisting individuals, who must bring current copies of their

licenses, to broadcast over a variety of vintage tube radio equipment. The station will operate AM phone and SSB on 80, 40, 20, 15, and 10 meters. Contact (or receive) station N9CQX on either of these days and send a reception report along with a LSASE to ARCI for a QSL certificate. For more info about this rare opportunity, or for more info about Radiofest XVII, E-mail *[arci31280@aol.com]*. Visit the Web site at *[http://members.aol.com/arci31280/arci.htm]*.

AUG 8–9

OSCODA, MI Station K8Y, working at the Yankee Air Force Museum (formerly Wurtsmith Air Force Base), will operate 1300 UTC Aug. 8th—2100 UTC Aug. 9th. Freq.: 3.700, 14.050, 14.270, and 3.885. Send SASE for a certificate to *Ray Knuth KB8ZYY, P.O. Box 271, Oscoda MI 48750 USA.*

AUG 13-16

SYCAMORE, IL The Kishwaukee ARC will operate W9S to commemorate the 42nd anniversary of the Northern Illinois Steam Power Show, from 1300Z August 13th to 1900Z August 16th. The four main frequencies are: 14.030 (CW), 14.250, 7.235, and 28.350. Stations contacted may request a certificate by sending a 9" x 12" SASE to *Bob Yurs W9ICU, P.O. Box 341, Sycamore IL 60178 USA.*

AUG 15

WILMINGTON, NC The Azalea Coast ARC will operate AC4RC 1500Z–2100Z, from the original radio room of the Battleship *USS North Carolina BB 55*. Freqs.: 7.250, 14.250, 21.35, 28.400. QSL to *AC4RC, P.O. Box 4044, Wilmington NC 28406 USA.*

AUG 15–16

WASECA, MN The Viking Amateur Radio Society will host their 3rd annual Special Event Station (WAØCJU/9ALD), honoring Edgar F. Johnson for his contributions to amateur radio. 9ALD was Edgar Johnson's call before Minnesota became part of the Ø call district. The station will operate in conjunction with the 3rd annual Hamfest/Swapmeet and a craft fair. There will be vintage E.F. Johnson AM, SSB, and CW equip. set up for hams to operate. A special certificate will be issued to all guest operators. A special QSL card will be issued to all hams who work the station. Vintage E.F. Johnson transmitters will operate on both SSB, AM, and possibly CW. HF operation will be between 0800 CDT–2100 CDT. Freqs. planned for use on AM are 3885, 7290, 14286, 21400 and 29000 kHz. SSB operation will be on 3900, 7260, 14250, 21350 and 28400 kHz. CW operation will be on 3700, 7125, 14050, 21150, and 28050 kHz.

AUG 15–17

ENGLEWOOD, NJ The Englewood ARA, Inc., invites all amateurs the world over to take part in the 39th Annual New Jersey QSO Party. For further details, contact (as soon as possible) *Englewood Amateur Radio Association, Inc., P.O. Box 528, Englewood NJ 07631-0528 USA*. Send a #10-size SASE for a reply. The contest will be held from 2000 UTC Saturday, August 15th to 0700 UTC Sunday, August 16th, and from 1300 UTC Sunday, August 16th to 0200 UTC Monday, August 17th. Phone and CW are considered the same contest. General call is "CQ New Jersey" or "CQ NJ." New Jersey stations identify themselves by signing "DE NJ" on CW, and "New Jersey calling" on phone. Frequencies: 1810, 3535, 3950, 7035, 7135, 7235, 14035, 14285, 21100, 21355, 28100, 28400, 50–50.5, and 144–146. The Englewood ARA suggests phone activity on the even hours; 15/10 meters on the odd hours (1500–2100 UTC); and 160 meters at 0500 UTC. Logs must show the UTC date and time, QSO exchange, band and emission, and be received not later than Sept. 12th, 1998.

AUG 22

NORTHPORT, LONG ISLAND, NY K2ARC, American Red Cross Emergency Communication Service will celebrate the 200th Anniversary of the Eaton's Neck Lighthouse, Northport, L.I., NY, in conjunction with participation in "Lighthouses on the Air." Operation will be on 7.280, 14.280, 21.380, and 28.380. For a special QSL, SASE to *CABNY-ARCECS DX Assoc., P.O. Box 1479, Huntington NY 11743.*

OXNARD, CA The Ventura County ARC will celebrate their 60th Anniversary of ARRL affiliation by operating Station K6MEP 0000 UTC–2400 UTC August 22nd. Operation will be on 28.340, 21.400 and 7.100. QSL to *K6MEP, P.O. Box 2103, Oxnard CA 93034 USA.*

SEPT 5

NOTRE DAME, IN Notre Dame ARC will operate ND1U 1600Z–2359Z Sept. 5th, to commemorate the 100th Anniversary of the First North American Wireless Transmission. SSB: 7.250 and 14.250. CW: 7.035 and 14.035. To obtain a commemorative QSL, send an SASE to *Notre Dame Amateur Radio Club, 226 COBA, University of Notre Dame, Notre Dame IN 46556.*

SEPT 12–13

VERVIERS, BELGIUM The G.D.V. "Gang de Verviers" of Verviers, Belgium, will again operate ON4USA, 1100 UTC–1700 UTC, Sept. 12–13. The operation will originate from the Henri-Chapelle Cemetery, Belgium, and all radio operators are encouraged to participate. Station ON4USA was formed in 1988 by Mr. Christian Keldenich in gratitude for their freedom which was gained more than 50 years ago. The station continues to operate on a yearly basis and many of the participating hams are bilingual, so language will not be a major problem. This event is conducted to honor the memory of those who gave their lives between 1939 and 1945 for the freedom of Europe, and to celebrate the liberation of the area around Verviers, Aubel, Welkenraedt, Hombourg and Henri-Chapelle, Sept. 9–12, 1944. CW: 7.040, 14.040, and 21.040. SSB: 14.225, 21.275, and 28.475. 73

NEVER SAY DIE

continued from page 5

field I see the reclusive lady slippers, a type of orchid.

A bird flies up from her nest in the field, scolding me. And I surprise some pheasants having an early lunch. In a whoosh they're away to the field across the dirt road. I jog over a little rise and there's a young fawn looking at me. When I get closer she turns and casually walks into the nearby forest.

Then I remember the thousands of days on the crowded New York subway, going to school and to work. I remember the car exhaust as I walked the sidewalks and the endless people, none smiling. The porno theaters and stores around Times Square.

School Daze

You're probably getting bored with me bitching about how our schools are doing such a rotten job of educating our kids — of how our youngsters are scoring right at the bottom of the developed world, with even the kids in Albania running rings around 'em. Well, golly, perhaps the NEA (the teacher's union) is right and we just need to spend more money. We need to raise teachers' salaries and thus get better teachers. Ya-da-ya-da.

Well, we're already spending far more per pupil than any other country, and our test scores are still dropping. I do like the solution to this problem: Lower the bar so more kids appear to have higher scores.

A look at the costs per pupil for K–12 shows that it has been going up fairly steadily for the last 45 years at a little over $1000 per decade ($108 per year), which has taken us from about $1600 per year in 1953 to $6500 this year. The fact that many parochial schools and schools like the Sudbury Valley School are doing a far better job of educating kids at less than half that isn't being mentioned.

A recent study showed that one third of the eighth graders in our public schools were unable to demonstrate a basic

Continued on page 71

Intro to Superhets

Part 1: History and overview.

Hugh Wells W6WTU
1411 18th Street
Manhattan Beach CA 90266-4025

Early in the development of radio, a piece of wire bent in the shape of a hoop became a receiver. As such, it was placed in a strong magnetic field produced by a transmitter. The received signal produced a small spark between the ends of the wire hoop. A distance of a few feet between the transmitter and receiver was considered good.

To increase the distance, a more sensitive receiver was developed by using a rectifying junction. Materials such as oxides and carbon were tried. Each produced a sensitivity that was reasonable but still not good enough. Later, a mineral called galena was found to produce an even better sensitivity. This was the age of the crystal set, and because of the better sensitivity, the distance between the transmitter and receiver could be increased.

Crystal sets were expensive and only a few people could afford them. At the time, it was common for people to gather around the set and share headphones so that they might hear a program. The choice of program listened to was determined by which one could be heard. A selection was not possible at the time.

Later on, when more stations began operating, an interference situation developed. The need to select a desired station began to grow. Tuned circuits were developed, and helped to a degree. However, at that time impedance matching was either unknown or not understood because the impedance of the crystal detector was seldom matched to the impedance of the tuned circuit. Poor sensitivity and very broad bandwidth were the result. With the advent of the vacuum tube, impedance matching became easier. This was especially true after the development of the triode tube.

Better receivers were sought, and by using the triode tube, many detector circuits were developed. At first the tube only replaced the crystal as a rectifier and produced only a negligible increase in performance. However, the triode, when used in detector circuits such as the grid leak, infinite impedance, plate, regenerative, and many others, produced results which delighted everyone. At first it was thought that sensitivity and selectivity had reached their peak. This idea was short-lived, because as the number of transmitters increased, so did the number of remote listeners and interference problems.

Tuned radio frequency (TRF) amplifier stages were added to the receiver, shown in **Fig. 1**, ahead of the detector to improve both the sensitivity and selectivity. As each tuned circuit was added, so was a knob on the front panel to tune it. To tune in a station on one of these receivers, which had five or six RF stages, it was necessary to be an octopus. If all the circuits were not tuned to the same frequency at the same time, the sensitivity would drop off so rapidly that a station could be bypassed without knowing it.

Great strides were made in the radio business when companies like Atwater-Kent ganged the tuning capacitors together with steel bands or wire to synchronize the tuning of each circuit with a single knob. This was called gang tuning and was hailed as a major development.

To better this arrangement, companies like Majestic mounted many tuning capacitors on a single shaft, which eliminated haywire and steel bands—for a while, that is. Wire and string returned to receivers, not to gang capacitors together, but to synchronize a big dial to the tuning capacitor. The price of receivers was then determined by the number of tubes and the size of the tuning dial.

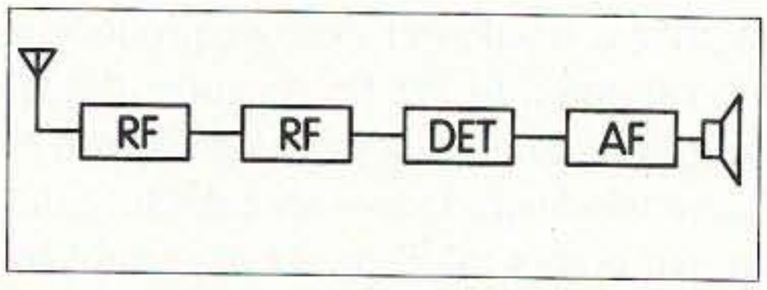

Fig. 1. A TRF receiver with a detector preceded by two RF stages.

Even though receivers became fancier and higher-priced, the problem of interference still continued to mount. In 1932, Edwin Armstrong developed the superheterodyne receiver. This receiver was the answer to most all of the existing receiver problems, and even today, the superhet receiver is still used. However, the circuitry has been refined and updated through technology. A single conversion superhet following Armstrong's original design is shown in **Fig. 2.**

The word superheterodyne seems to be a coined word for the era of its development. However, the word heterodyne describes the principle of operation. When two signals, whether audio or radio frequency, are mixed together, beat notes are produced. These beat notes are the sum and difference combinations of the principal input signals. Musicians use the heterodyne principle when tuning a stringed instrument. By plucking two strings simultaneously and then a third string, beat notes are produced. The third string can be tightened or loosened to produce the desired beat note.

Because the bandwidth of a tuned circuit becomes narrower as its tuned frequency is reduced, the ability of the circuit to select a particular signal is improved. The disadvantage for the TRF and crystal set was that there was very little control over the receiver's bandwidth except through the use of multiple tuned stages.

To get around this problem, heterodyning was introduced, allowing the input signal to be at one frequency and the frequency selective circuits within the receiver to be at another fixed frequency. As shown in **Fig. 3**, a signal arriving at the antenna of the receiver at 2 MHz can be converted to a frequency of either 1 MHz or 5 MHz by beating it against a signal at 3 MHz. If selectivity improvement is desired, then the heterodyned frequency of 1 MHz would be chosen. The 5 MHz signal is higher than the original 2 MHz signal and, therefore, the tuned circuits would exhibit a wider bandwidth. The 3 MHz signal is called a local oscillator (LO) signal because it is produced within the receiver for the purpose of heterodyning it with an incoming signal. Because the result of this heterodyning produces a new signal (1 MHz), this new signal is called an intermediate frequency (IF) signal. An IF amplifier is fixed tuned to the desired frequency.

Of course, there are other important circuits in a receiver to improve both the sensitivity and selectivity. It is also necessary to consider noise reduction from the many sources that surround a receiver. Let's now examine and discuss each stage of a receiver to provide some insight into its function.

Front end

The receiver front end consists of those stages existing between the antenna terminals and the input to the IF amplifier. Front end stages are the RF, mixer, and oscillator. It is generally assumed that a circuit must be an amplifier to be called a stage. In actuality,

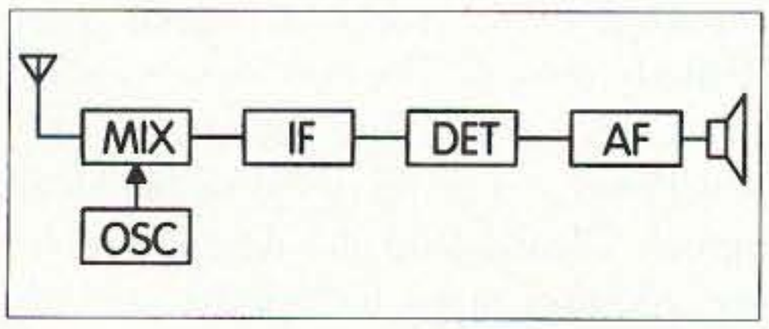

Fig. 2. Single conversion superheterodyne receiver.

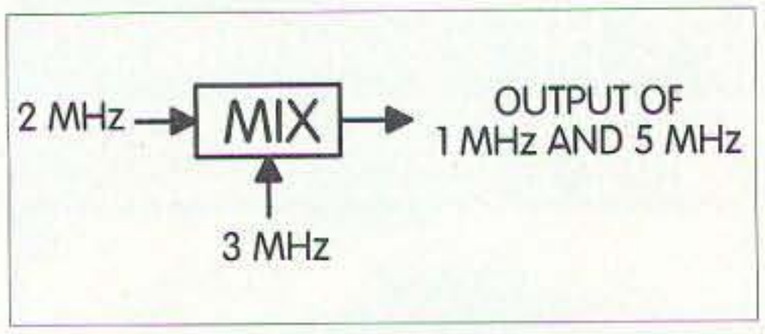

Fig. 3. Two fundamental signals being mixed, producing sum and difference beat frequencies.

the oscillator is not considered a stage, but only an oscillator section. For instance, a power supply is not an amplifier and it is rarely, if ever, called a stage. These circuits are usually referred to as sections, such as the power supply section, oscillator section, noise limiter section, and so forth. However, the term "stage" is used rather loosely at times and has become acceptable in most circles.

Front end circuitry becomes the real heart of the receiver and is the determining factor in its success as a listening device. Some factors involved are sensitivity, selectivity, noise figure, and image rejection. Noise figure is frequently a measure of sensitivity as a signal level compared to a received noise floor. Unfortunately, there is no formula which will satisfy all of these factors at the same time. A compromise at times, however, will satisfy most situations. To a degree, all of these factors tend toward the same requirements in circuit design and may be considered a "formula."

For a receiver to be sensitive, it must be able to respond to weak signals. How weak must the signal be to be called weak? The term sensitivity then is relative and is tied to the state of the art receiver sensitivities. At present, a sensitivity of 0.1 microvolt for 10 dB of quieting is about average for VHF and UHF receivers. Low-band receivers in the 400 kHz to 50 MHz region perhaps require only two microvolts for 10 dB of quieting. The difference in the frequency range versus the sensitivity is determined by the amount of atmospheric noise present at the antenna terminals of the receiver.

Maximum atmospheric noise seems to be centered on 25 MHz. Fortunately, atmospheric noise decreases at the rate of 3 dB per octave for increasing frequencies. Therefore, VHF and UHF frequencies are less bothered by atmospheric noise. Of course, atmospheric noise is not the only noise which must be overcome in a receiver. Noise caused by the thermal agitation of electrons as they bump into things becomes quite predominant at times. Vacuum tubes and early semiconductor devices produce a wonderful amount of noise. Today we use noisy diodes as a noise source for testing receivers.

When a tremendous amount of amplification takes place following a noisy stage, all of the noise produced by that stage will be amplified along with any signal which is present. If the signal is weak, the noise may mask it. Also, when the signal is strong, it may mask the noise. When an engineer designs a receiver, he must consider every factor carefully so that a receiver will be produced which will provide the best capabilities possible at minimum cost. Considerations must be made for the front end stages to provide a suitable signal-to-noise ratio, ample adjacent channel signal rejection, etc.

So far, sensitivity has been the major point in the discussion, although bandwidth has been mentioned. Generally speaking, the wider the bandwidth of the front end, the greater the amount of noise that will enter. Therefore, narrow bandwidths are desirable. In addition, narrow front end bandwidths tend to reduce crosstalk (modulation of the incoming carrier by a strong adjacent channel signal) and images. However, the major contributor to crosstalk is any nonlinear device within the receiver existing in the early part of the signal path.

An image signal is caused by heterodyning action. Since superhet receivers use heterodyning for frequency conversion, image rejection becomes a problem. All superhets are plagued with this condition. However, better receivers reduce the problem by using many high-Q tuned circuits in the RF stage and by frequency conversion techniques. An image signal is usually an interfering signal, which enters the receiver front end outside of the normal passband of the input circuit. It is usually just the right frequency to beat with the local oscillator to produce a signal equal to the IF. As such, the IF amplifies and passes the signal as if it were the desired input signal. Once the signal enters the receiver, it cannot be rejected. It must be kept out in the beginning. We will include a further discussion of images when we talk about mixers and oscillators.

RF stage

The RF stage design is generally chosen for the receiver's application. For instance, if the receiver is to be used for FM music or local signals which are generally very strong, the RF stage requirements are reduced to perhaps none. It may also be designed as a passive (nontunable) stage with a passband wide enough to cover the desired band. However, when the receiver is designed for communication in the VHF and UHF region, the front end design becomes critical as the typical signal is very weak and easily masked by noise and adjacent channel interference.

The gain of the RF stage is of secondary importance when compared to signal-to-noise ratio, which is a measure of sensitivity. The purpose of the RF stage is to provide only enough gain to present a signal to the mixer at a level above the noise level generated within the mixer. Although a high gain sounds desirable, it comes at the cost of increased noise generation as a function of gain. Typically, the RF stage provides only slightly more gain than required to overcome the insertion losses of the tuned circuits preceding the stage.

When transceivers are used in a duplex mode (transmitter and receiver operating simultaneously), the receiver is subjected to having a high level of RF energy being present at its antenna. Even though it isn't at the same frequency, the high RF level can cause a masking of the received signal, particularly if weak. The condition is called "desense," where the receiver is desensitized as a result of the strong local signal. Clearing up the desense problem requires many techniques, including filtering, a nonsaturating RF stage, and signal separation (narrow pass-

band). Duplexers, high-Q cavities, and helical resonators are common in base station and mobile equipment where the transmitted signal level must exceed the received signal level by 60 dB because some desense is still noticeable at 60 dB.

Mixers

The second most important stage in the receiver is a mixer. During the frequency conversion process, noise is generated. The level of noise must be kept to a minimum. The mixing process is usually the noisiest within a receiver and that noise level must be overridden by the incoming signal from the RF stage. Therefore, the RF stage must have a noise figure less than that of the mixer, yet have just enough gain to provide a signal level exceeding the noise level of the mixer.

The mixer stage of a receiver is not generally required to exhibit gain, since the achievement of gain embraces the generation of noise and is to be avoided when possible. Many mixer designs have been developed over the years, starting with diodes being the first in a series of nonlinear devices. Because of the inherent noise generation within a mixer, many designs have been used with low-noise vacuum tubes, transistors, JFETs, and now balanced mixers. Balanced mixers may be made using active and/or nonactive (passive) devices. The objective of using a balanced mixer is to reduce intermodulation distortion, and modern passive balanced mixers have a large dynamic range which prevents them from creating signal distortion during the presence of strong signals whether local or adjacent channel.

The purpose of a mixer is to act as a nonlinear device to distort the waveform of the incoming signal. Consider what a halfwave rectifier in a power supply does to the sinewave input from the power line. It distorts the signal by conducting on only one halfcycle of the waveform. The mixer does essentially the same thing to its input signals. Because of the distortion, combinations of the various input signals are produced and only the desired combination is selected for use. Without this distortion generator (mixer), frequency conversion would be difficult.

Images

Because of heterodyning action, images occur. What is an image? As a result of mixing a local oscillator signal with all of the signals appearing in the antenna circuit, there will be two product signals that will be adjacent to the oscillator and separated by a frequency equal to the IF. One of these signals will be oscillator frequency plus the IF, and the other will be the oscillator minus the IF. As **Fig. 4** shows, the difference between the two input signals is twice the IF. One of the two signals will be the desired signal and the other is the unwanted signal, or image. It is called an image in comparison to the desired signal, which places it in a mirror-image position relative to the oscillator.

As an example, if the oscillator is at 10 MHz and the IF is 2 MHz, then the #1 signal will be 2 MHz less than 10 MHz, or 8 MHz. At the same time, #2 is 10 MHz plus 2 MHz, or 12 MHz. A signal arriving at the antenna terminals at either or both 8 and 12 MHz will be mixed with the oscillator and converted to 2 MHz. Either of the two signals may be designated as the desired one, and the other is then called the image.

To reduce the strength of the image, tuned circuits resonant at the desired frequency must be used between the antenna terminals and the mixer. The greater the number of resonant circuits or circuits exhibiting a high Q, the more the image will be attenuated.

Another way of attenuating the image even further is to increase the frequency separation between signal #1 and signal #2. This is done by increasing the frequency of the IF. The greater the separation, the easier a low-Q circuit will reject/attenuate the image. Two techniques typically used to reduce the image are increasing the number of tuned circuits or Q of the tuned circuits between the antenna and the mixer, and utilizing multiple frequency conversion.

Next time: oscillators, IF amplifiers, detectors. 73

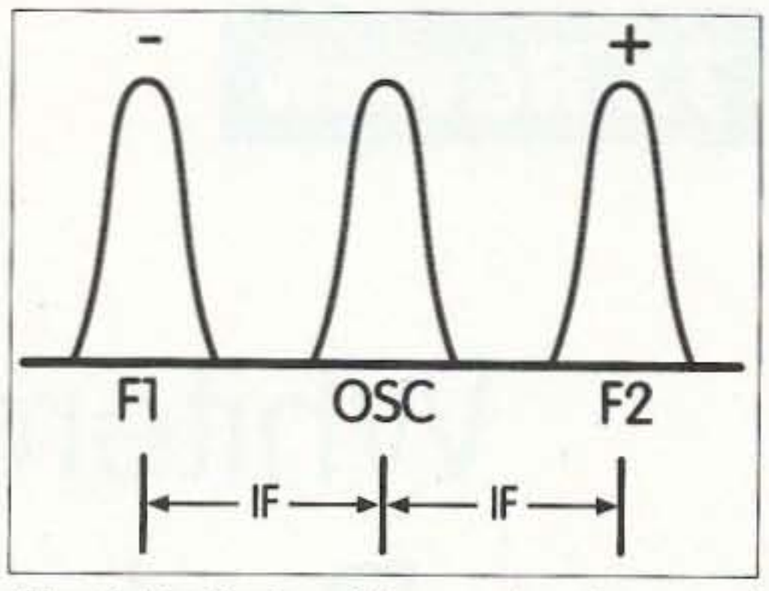

Fig. 4. *Desired and image signals created through heterodyning. Desired and image signals are separated by two times the IF.*

Number 42 on your Feedback card

Whiterook's Model MK-88 Pocket Electronic Keyer

If CW is for you, check out this keyer.

Thomas M. Hart AD1B
54 Hermaine Ave.
Dedham MA 02026

Morse code is the oldest amateur mode and is composed of unmodulated RF. The first Morse code transmitters sent noisy electronic pulses with signal strengths that changed during transmission. The "damped wave" of early designs was replaced in due course by the constant output levels of tubes. The term "continuous wave" (CW) refers to the generation of RF on a single frequency at a continuous strength.

The actual code is named after Samuel F.B. Morse, an American artist and inventor, born in Massachusetts in 1791. Morse was a prominent painter and sculptor who graduated from Yale and became a professor at New York University by 1832. He had other interests, including communications. In 1837, Morse invented a system for message transmission over a single wire using an electrically pulsed code. Early systems used electromechanically-controlled pencils to mark paper strips driven by clockworks and were effective at distances up to 20 miles; relay stations ultimately increased system range. Operators soon realized that they could copy "by ear" and that the recorders were unnecessary. In time, other investigators, including Thomas Edison, improved the technology so that multiple signals could be sent on a single wire. By using alternating current on different frequencies, many signals could be in process at any given time. Filters were then used to send messages to specific receivers for decoding.

About two years ago, I discovered the RS-12 satellite and began to use it for communications. Both SSB and CW modes are available on modes K and A on this particular satellite. It had been quite a while since I had used a straight key or keyer. My computer and terminal unit have done most of my CW in recent years, and then, mostly during contests. My venerable Ten-Tec™ keyer had long since stopped working and I was on the search for something new.

I started with no idea what might be available or how much I could expect to spend. In fact, the costs of most units were appalling. I wanted to make a few satellite contacts, not invest in a blue-chip keyer. It seemed that mechanical keyers had largely disappeared from the scene, with the notable exception of the Vibroplex™ Classic—a beautiful unit, but one that did not come close to fitting into my cost/benefit curve.

Then, I saw an advertisement for Whiterook Products, a company owned and operated by John Roblin WA6KYO. I sent for a catalog. Whiterook offers a variety of keys and keyers, the latter in single- and double-lever versions. I now have two MK-88 keyers and am very pleased with both.

What is an iambic keyer?

The term "iambic" denotes a two-syllable metrical foot, where the first syllable is unaccented and the second accented. In short, a term with the emphasis in a "di-*dah*" fashion. In practical terms, iambic keyers feature two levers that are used in a "squeeze" fashion to facilitate use. Iambic keying operates in two main fashions, mode A or B. The latter is far more common, and is designed to allow the user to insert dits or dots while keying a string of the opposite element. Sounds confusing, but it works great. The current Whiterook MK-88 is exclusively mode B.

Iambic keyers allow the user to press one lever for a series of dots and the other for dashes. The special feature of the system is that when both levers are pressed, the keyer alternates between dots and dashes, very convenient for generating CW. There are memories in the chip design that hold the inserted dit or dot and then send it at the right time. Keyers are especially useful in generating the so-called

"iambic seven" characters: C-F-K-L-Q-R-Y. Use of alternate paddles makes keying quite effortless, although there is a learning curve to overcome. Iambic keyers are much more user-friendly than the older single-paddle "sideswipers."

Integrated circuits: the keyer brain

Older versions of the MK-88 (and many other keyers, too) used the Curtis 8044ABM integrated circuit, which is no longer in production. An exact substitute is the Island Keyer chip, a 20-pin "keyer on a chip" that has a 50 µA resting current and good RF immunity. An external 50 to 500 µA meter can be used to monitor code speed during operation. Contact debounce is minimized, characters are self-completing and weight control is available. Dot and dash memory is part of the chip design as well.

Model MK-88

The Whiterook keyer is capable of speeds of up to 40 wpm, but most of us will never approach speeds that high (maximum wpm is 20 to 30 in most cases). The case is black ABS plastic and the entire unit is small and light. There is no provision for external power, but there is enough space inside to change that. As shipped, the keyer uses a single three-volt lithium battery (included); replacements are available from Radio Shack™ and other electronics stores. The output goes to a 3.5 mm jack mono connector that is designed for positive-keyed (i.e., switched to ground) solid state rigs. The unit was targeted at the QRP market, but I have used it with power up to 160 watts from 80 to two meters.

Whiterook cautions that high power transmitters may interfere with the keyer because the case is not shielded. I have not experienced problems while operating at medium power levels (up to 160 watts) except on the 160 meter band. For some reason, I have enough RF in the shack to lock up the keyer when running 100 watts on 1.8 MHz.

The mechanical system is plastic and is not as rugged as metal counterparts offered by Kent, Bencher, Vibroplex, MFJ and others. However, careful use should eliminate any short term system failure due to materials. There is no way to adjust the gap, an absence that may not be desirable to some operators. When used as a single lever system, the dot and dash levers are "sideswiped" as needed. The only problem that I have noticed here is that if one lever is not completely released, or accidentally brushed, strange combinations of dots and dashes may result. The non-iambic operator has to develop a feel for the keyer; a soft touch is required.

It is very interesting to operate the keyer and find that it is absolutely silent. There are no relays or other gadgets that let you know what you are sending. A sidetone in the rig is necessary. One change from earlier versions of the MK-88 is the addition of two red dots; one on the thumbwheel that acts as on/off switch and speed control, and one on the case. The dots remind you that the key is off when they are lined up next to each other.

I feel that the Whiterook MK-88 is a fine product that will meet the needs of many CW operators. Hard-core Morse coders will probably want something more upscale, but portable, QRP, and occasional operators will appreciate

Photo A. *Whiterook's MK-88 Keyer.*

the price and features. The unit is very light and must be treated carefully. Do not plan on putting a brick on top to hold it in place while you operate.

Whiterook offers the MK-88 for $59.95 plus $2.00 shipping and handling. Order it by mail from:

Whiterook Products Company
309 S. Brookshire Ave.
Ventura CA 93003-4413.

You can also order by phone/FAX at (805) 339-0702, or by E-mail at [wpc@west.net]. Don't forget to check the Web site at [http://www.west.net/~wpc]. 73

Experimenter's Power Panel

Reduce the hassle (and the risks) of haywiring—and encourage exploration in electronics.

Marion D. Kitchens K4GOK
2709 Colt Run Road
Oakton VA 22124
[jkitchen@erols.com]

Hams who enjoy experimenting with electronics projects are in constant need of various voltage supplies that are readily and easily accessible. Most common needs include five volts at a few amps for TTL and similar circuits, nine volts at less than one amp, and a 13.8-volt high current supply. The power panel described here provides those voltages right at the workbench.

This power panel is one that has evolved over a number of years, and therefore includes those features that have proven most useful for me. They include a digital voltmeter for monitoring the regulated panel voltages, as well as for measuring external voltages such as circuits under test. External voltage measurements from 200 millivolts full scale up to 200 volts full scale are accommodated, with 10 megohm input impedance.

All regulated voltages have front panel On/Off switches and heavy-duty binding posts suitable for banana plugs or direct wiring. Green, yellow, and red LED indicators make it easy to tell at a glance which voltages are active and which are not. The five-volt supply delivers up to three amps, and the nine-volt supply can deliver considerably more than needed for most needs—up to about 10 amps.

There are no critical or fussy circuits. All parts are readily available from several sources, including many hamfests.

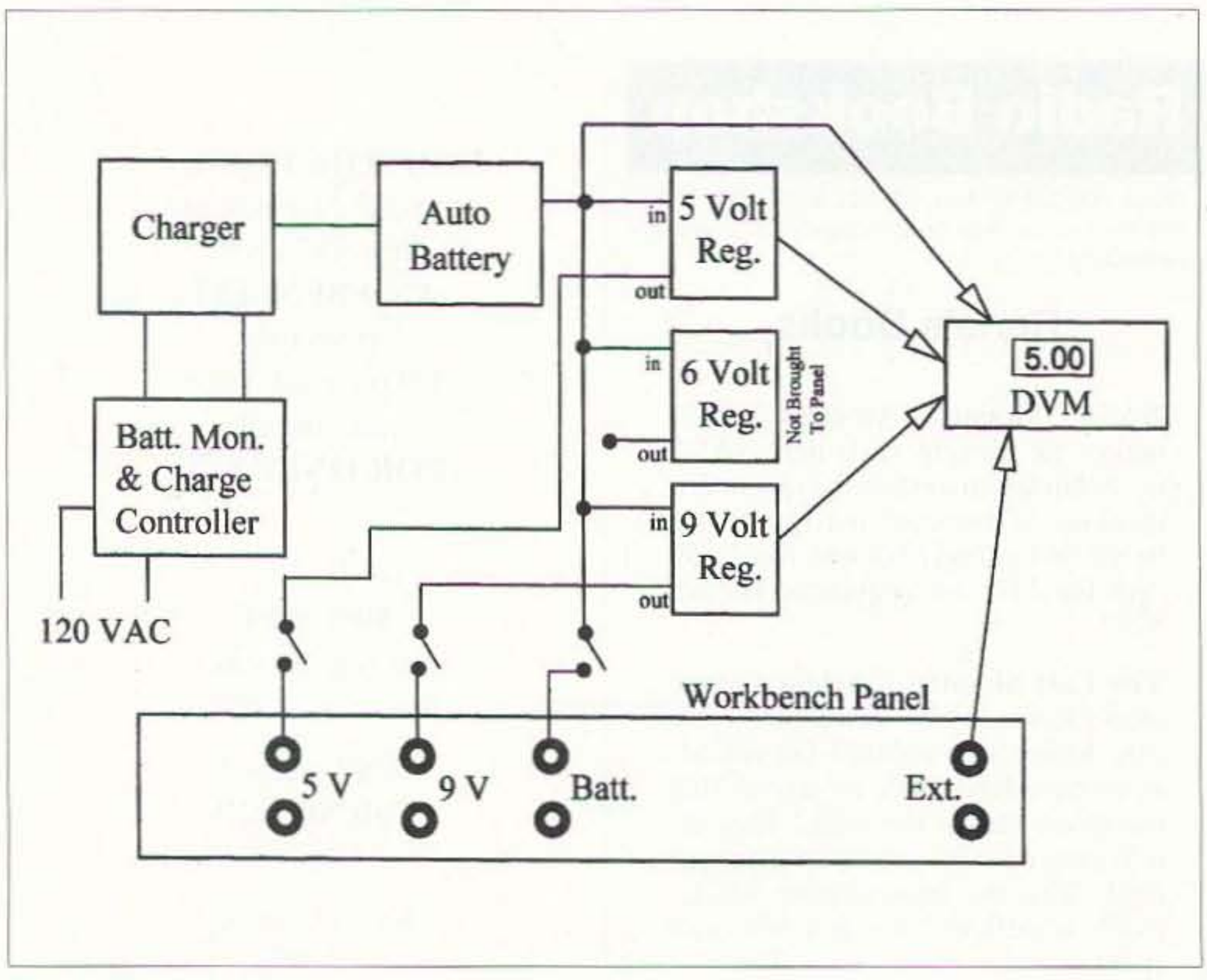

Fig. 1. Block diagram.

Circuit description

Fig. 1 shows the basic elements composing the power supply and panel.

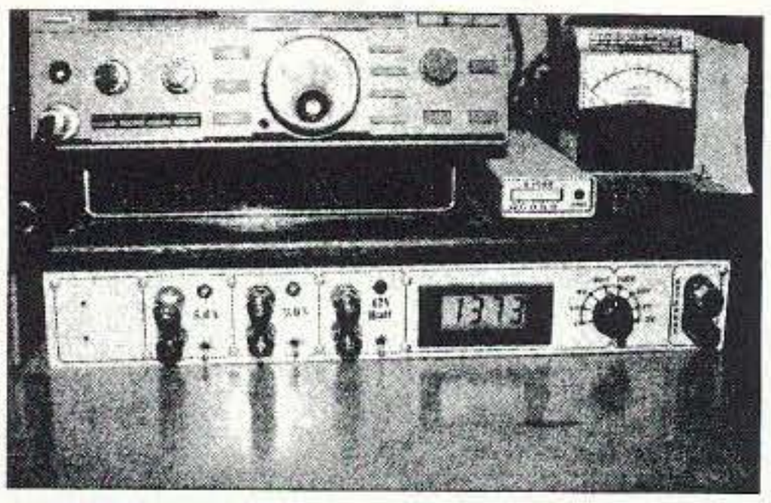

Photo A. *Power panel in its operating location.*

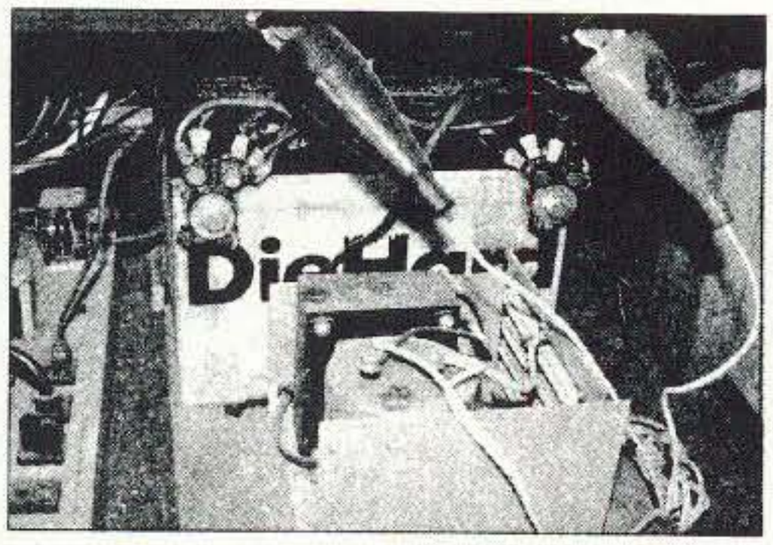

Photo B. *Power panel battery and charger.*

Note that it starts with an automotive battery under the workbench. The battery is kept charged by the Battery Monitor and Charge Controller described in the June 1995 issue of *73 Magazine*. **Photo A** shows the Battery Monitor and Charge Controller on the shelf just above the power panel.

Photo B shows the battery and its simple charger. The charger schematic is shown in **Fig. 2**. It uses a common full wave rectifier circuit from a 30 VAC, center-tapped transformer. The 1 Ω resistor limits the output current to prevent overloading the transformer and diodes when charging a low battery. Note that a voltmeter across the 1 Ω resistor can be used to indicate the current—one volt equals one amp of current.

The 13.8-volt supply is simply the auto battery, whose voltage varies depending on the battery's charge state.

Fig. 3 shows the schematics for the nine-volt and five-volt regulators as constructed. Note that the five-volt regulator gets its input from the nine-volt supply. That arrangement reduces the power (heat) dissipation required of the five-volt regulator since it operates from only nine volts instead of the full 13.8 volts of the battery. This arrangement also requires the nine-volt supply to deliver the full three amps delivered by the five-volt regulator, plus any current drawn from the nine-volt supply directly. The LM317 is limited to a maximum current of 1.5 amps; hence the current-boost 2N3055 transistor in the nine-volt supply. The 190 Ω and 82 Ω resistors help stabilize the output voltage of the nine-volt supply. Their values are not critical, so any value close to those shown should work equally well. The particular LM223 five-volt regulator on hand

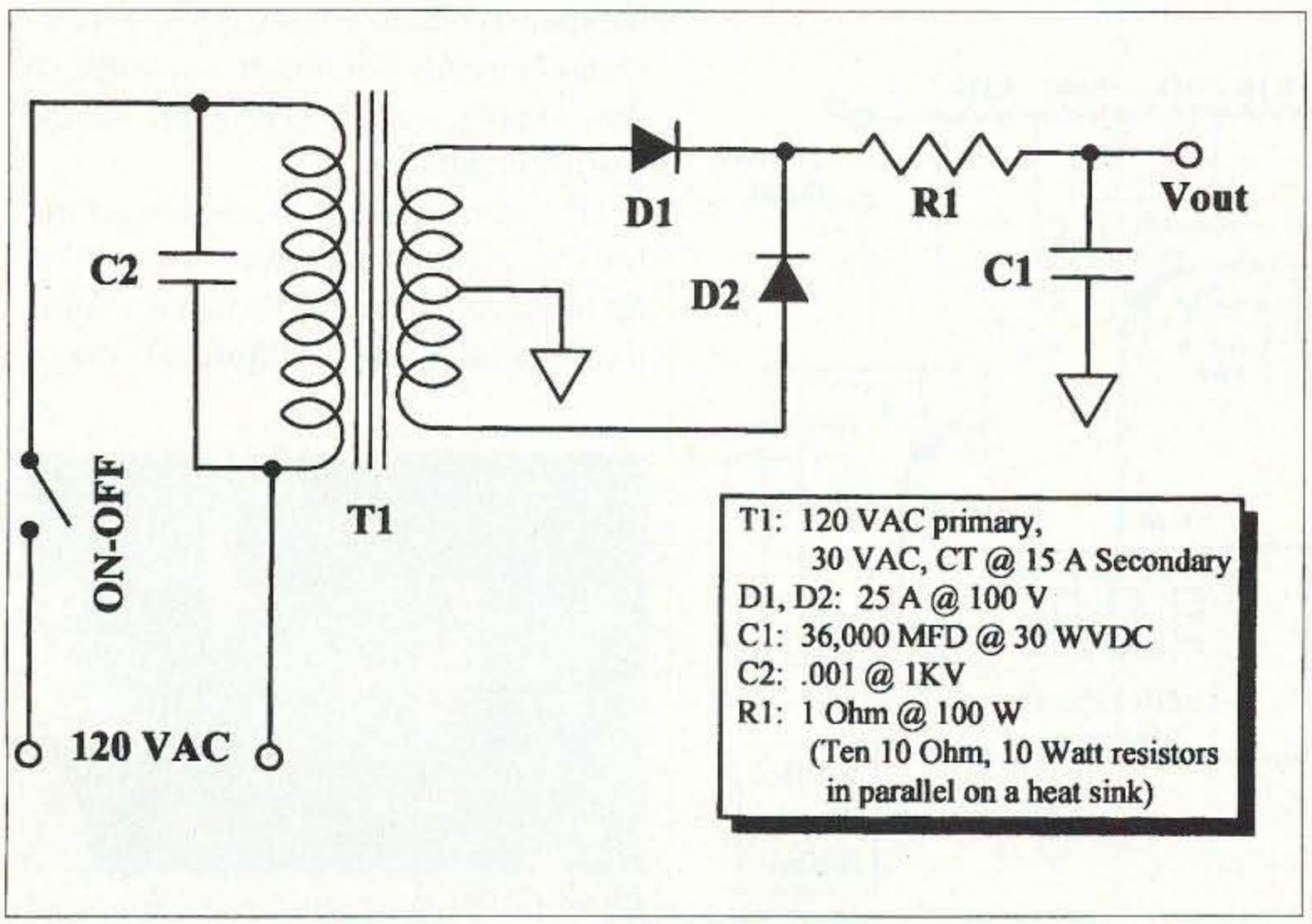

Fig. 2. *Battery charger schematic.*

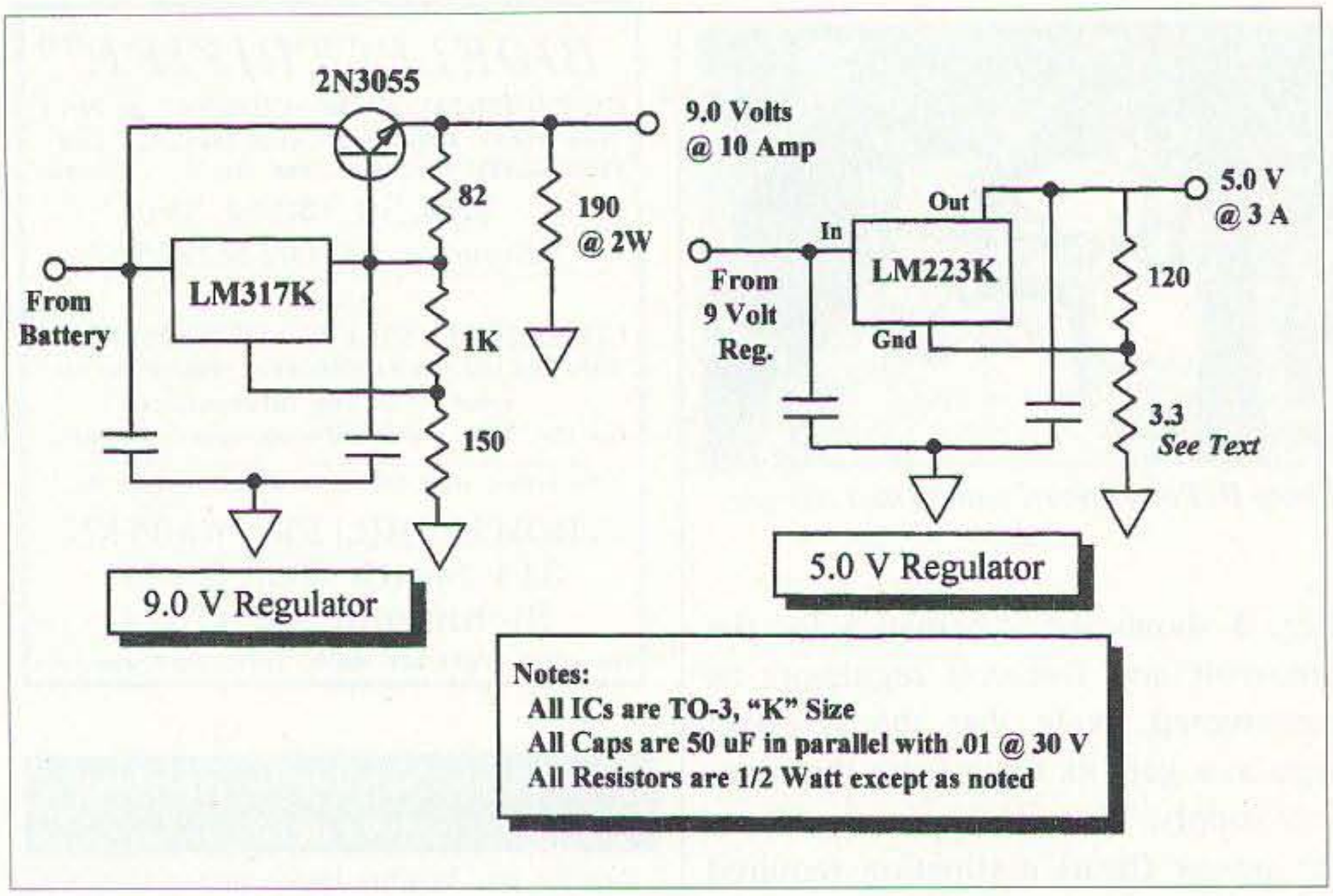

Fig. 3. Nine- and five-volt regulators.

had an output voltage that was lower than desired, so it was "trimmed" to be closer to five volts by use of the 3.3 Ω resistor and 120 Ω resistor shown in the schematic. If your LM223 output is sufficiently close to 5.00 V, put a short across the 3.3 Ω resistor, or replace it with a piece of wire.

The digital meter module is one of those "can't measure its own voltage" types available from many mail order houses. It is powered by a separate "wall wart" nine-volt DC transformer.

Fig. 4 shows the digital voltmeter switching, resistor dividers, and associated components. The three 200k calibration pots should be adjusted by (1) measuring the regulator output voltages with a known accurate DMM, and (2) adjusting each pot so that the panel meter reads correctly. Note from **Fig. 4** that the battery voltage to the panel meter is not switched on and off as are the five-volt and nine-volt regulator outputs. That way, the panel meter monitors the battery voltage any time its selector switch is in the "Batt" position.

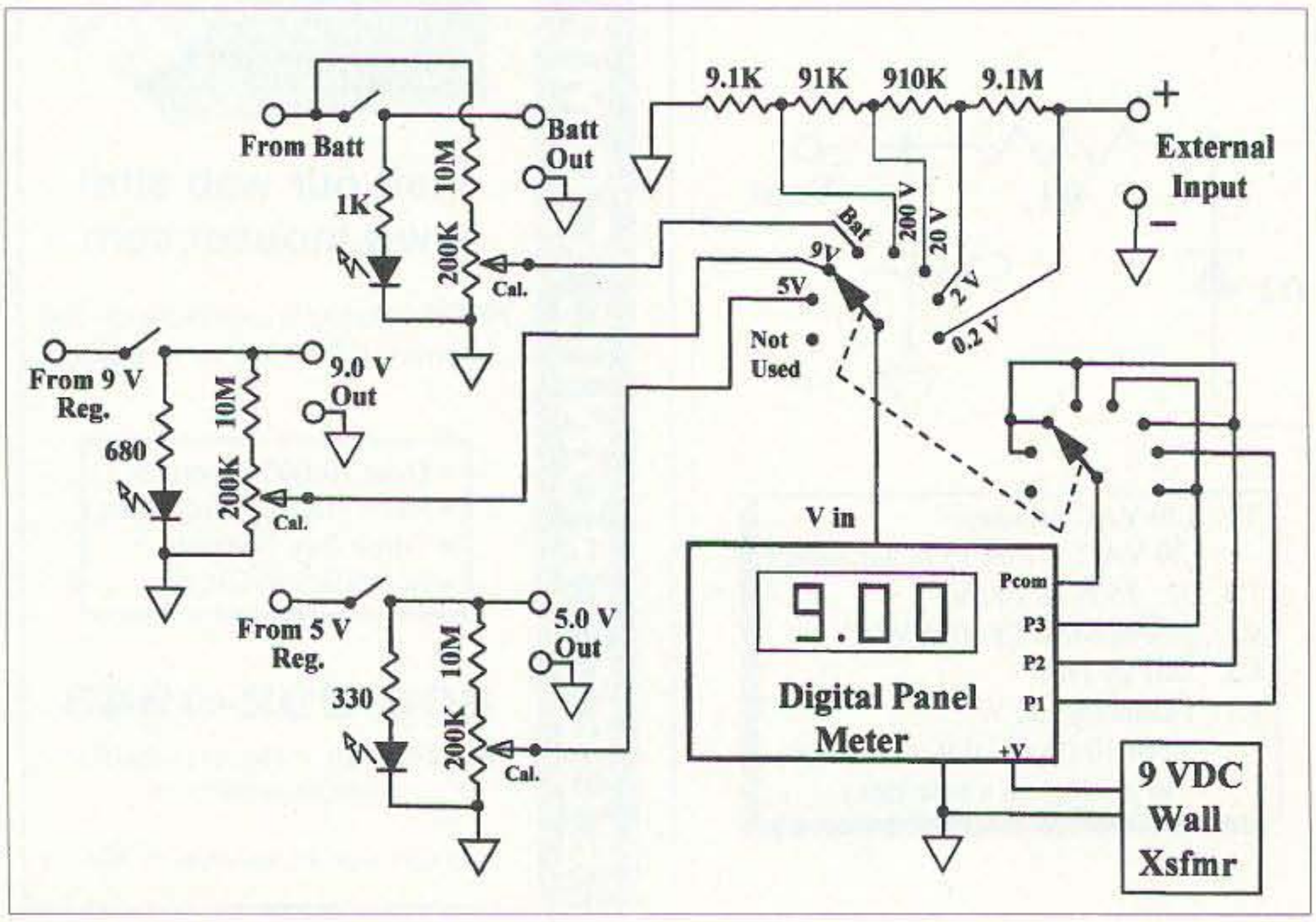

Fig. 4. Switching and voltage divider wiring diagram.

Construction

The front panel is made from 1/8-inch-thick PCB material. Painting and labeling are as shown in the photos. The panel is mounted to the workbench via small 90° angle aluminum brackets.

The charger construction is rather straightforward, with one exception. That exception is the 100-watt, 1 Ω resistor, which is made up of ten 10 Ω, 10 W resistors all wired in parallel and epoxied to a five-inch by six-inch piece of 1/8-inch-thick aluminum for heat dissipation. Point-to-point wiring is used throughout the power panel construction, as well as the battery charger.

Regulators are set in large heat sinks and then mounted as individual units underneath the workbench, as shown in **Photo C**. All the electronics associated with each regulator unit are mounted directly at the regulator ICs. The five-volt and nine-volt regulators are shown in the foreground of the photo. The third heat sink and regulator in the background is for a six-volt supply. This six-volt supply has proven useful in powering older equipment such as six-volt relays and coaxial switches designed for older automotive use—these are often very inexpensive at hamfests. Most experimental circuits do not use six volts, so that supply was not brought to the workbench panel.

The voltage dividers and switching for the digital meter were assembled on a small perfboard installed behind the benchtop panel. **Photo D** shows

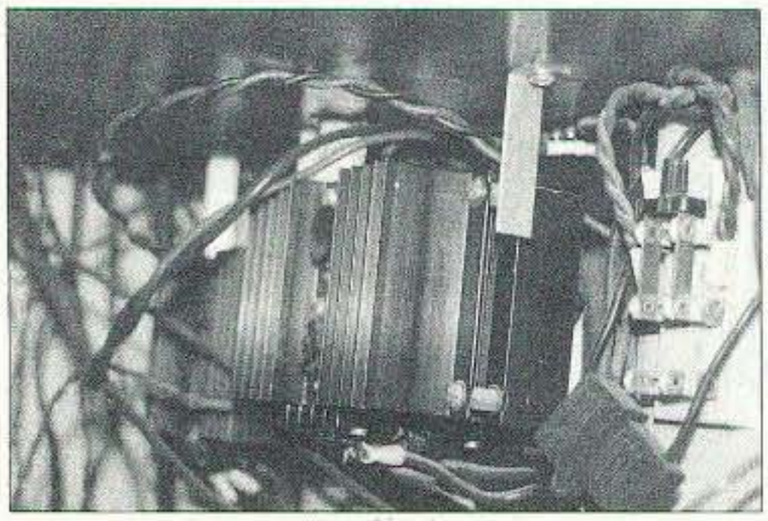

***Photo C.** Regulators and heat sinks under the workbench.*

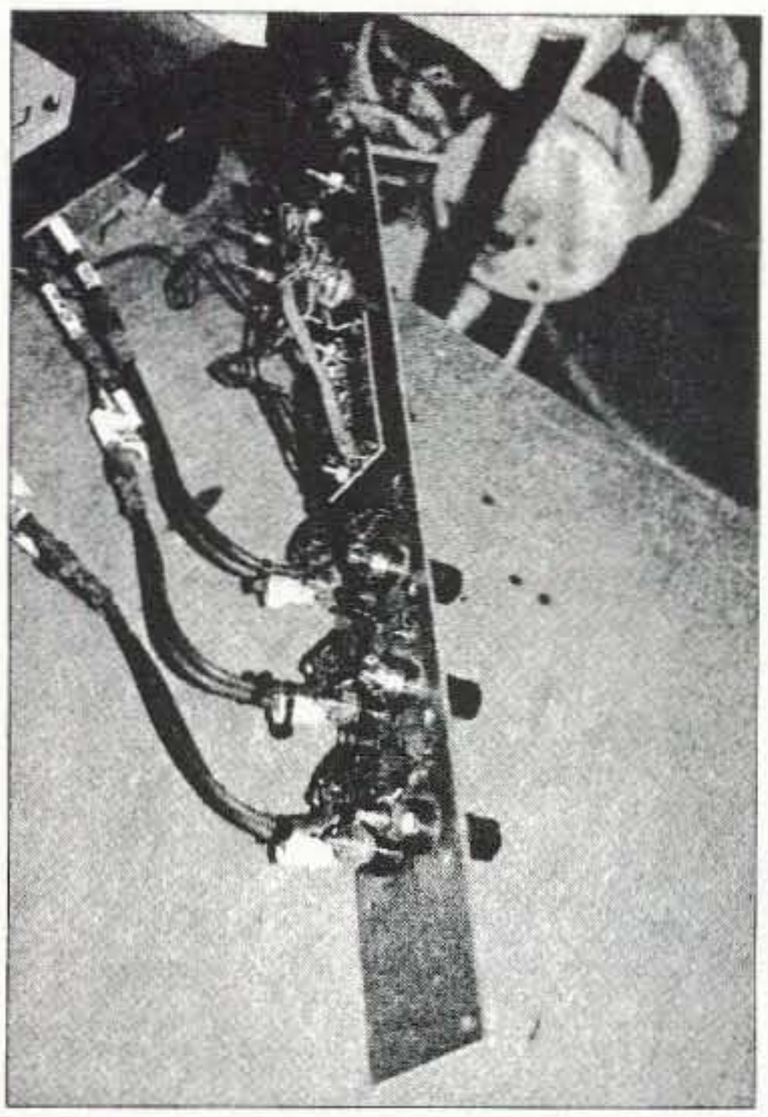

***Photo D.** Wiring behind the front panel.*

the perf mounted on the back of the rotary switch. Note the heavy #10 wiring used to bring the power to the workbench panel. This heavy wiring from the regulators reduces voltage drops when a few amps of current are drawn.

Other output voltages

Fig. 5 shows the necessary information for designing regulators for any desired output voltage. When using **Fig. 5**, follow the equations from left to right, through "A" to "B" to "C" for your particular needs. Be sure to check the required power dissipation of the components used in your regulated supplies, and provide adequate heat sinks. A first approximation of the power to be dissipated in a regulator IC is:

Power = (Supply Voltage - Regulated Output Voltage) x Output Current.

Keep in mind that most TO-3 regulators are limited to about 20 watts, and that assumes they are in adequate heat sinks.

My schematics were based on the components on hand at the time of construction. The components determined the specific circuit designs. Other regulator circuit designs are frequently used, and are described in publications such as the *Voltage Regulator Handbook* (National Semiconductor, 1975). I encourage you to use components you already have or can find readily at hamfests.

Future additions

Note the unused space on the left side of the power panel. That space is reserved for future installation of the next-most-needed supply—a variable voltage source. For some analog circuits (op amps and the like), a dual-ended supply (plus and minus voltages) is often needed. So that reserved space just might be used for a variable voltage, dual tracking regulator. But that's forecasting the future, which is beyond the intended scope of this article. 73

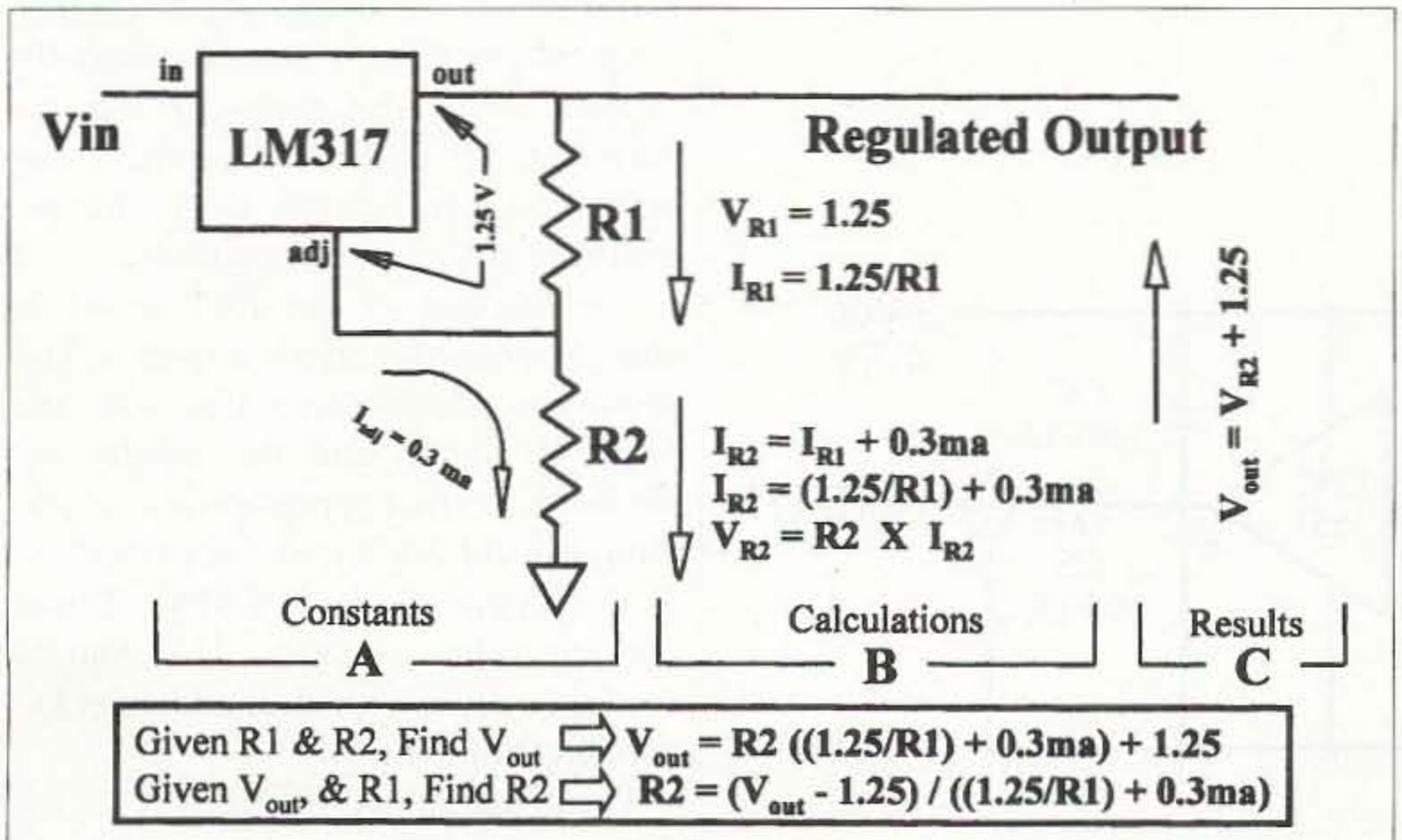

***Fig. 5.** Designing other regulators.*

An FET Probe to MMIC

How about some (well, relatively) new technology for your test bench?

Hugh Wells W6WTU
1411 18th Street
Manhattan Beach CA 90266-4025

If you experiment as much as I do, you will have occasion to need a high-impedance probe having some gain for use ahead of an oscilloscope, counter, or high-frequency voltmeter. It may also be used as an RF sniffer for detecting the presence of RF on resonant circuits. The probe has a frequency range from about 20 kHz to 500 MHz, and an output impedance of 50 ohms—which makes it usable over most of the ham bands. The general specifications for the probe when using an NEC UPC1651 MMIC and MPF-102 JFET are:

E_{in} = 15 V_{p-p} max
Z_{in} = >100 k
Z_{out} = 50 ohms
V_{cc} = 3–5 V
F = 20 kHz to 500 MHz
gain = >10 dB.

Here is the story about how the FET probe came into being. A while back I ran across an NEC UPC1651 MMIC (monolithic amplifier) and at first had difficulty in using it. But as a true experimenter, I began designing circuits around it to see what it would do. Failures seemed to prevail over successes until I realized that the input and output impedances were 50 ohms.

From that point on, things improved. The projects ranged from the FET probe to stripline amplifiers. So far, the FET probe has proven to be the most useful application because it has provided an increased input sensitivity to the supporting equipment. The equipment is "pushed" to respond to lower signal levels and slightly higher frequencies than it would normally support. What this means to the experimenter is that his equipment can be extended sufficiently to provide indications not previously possible.

Construction of the FET probe is straightforward with no surprises. The prototype was implemented with the NEC UPC1651 and the results are shown in the first paragraph above. Although I did not try one personally, a Mini-Circuits MAR-1 or MAR-2 (and perhaps other versions, too) should work equally well and should meet the specifications shown.

There are minor differences in the device configurations which are shown in **Figs. 1** and **4.** Both the circuit and

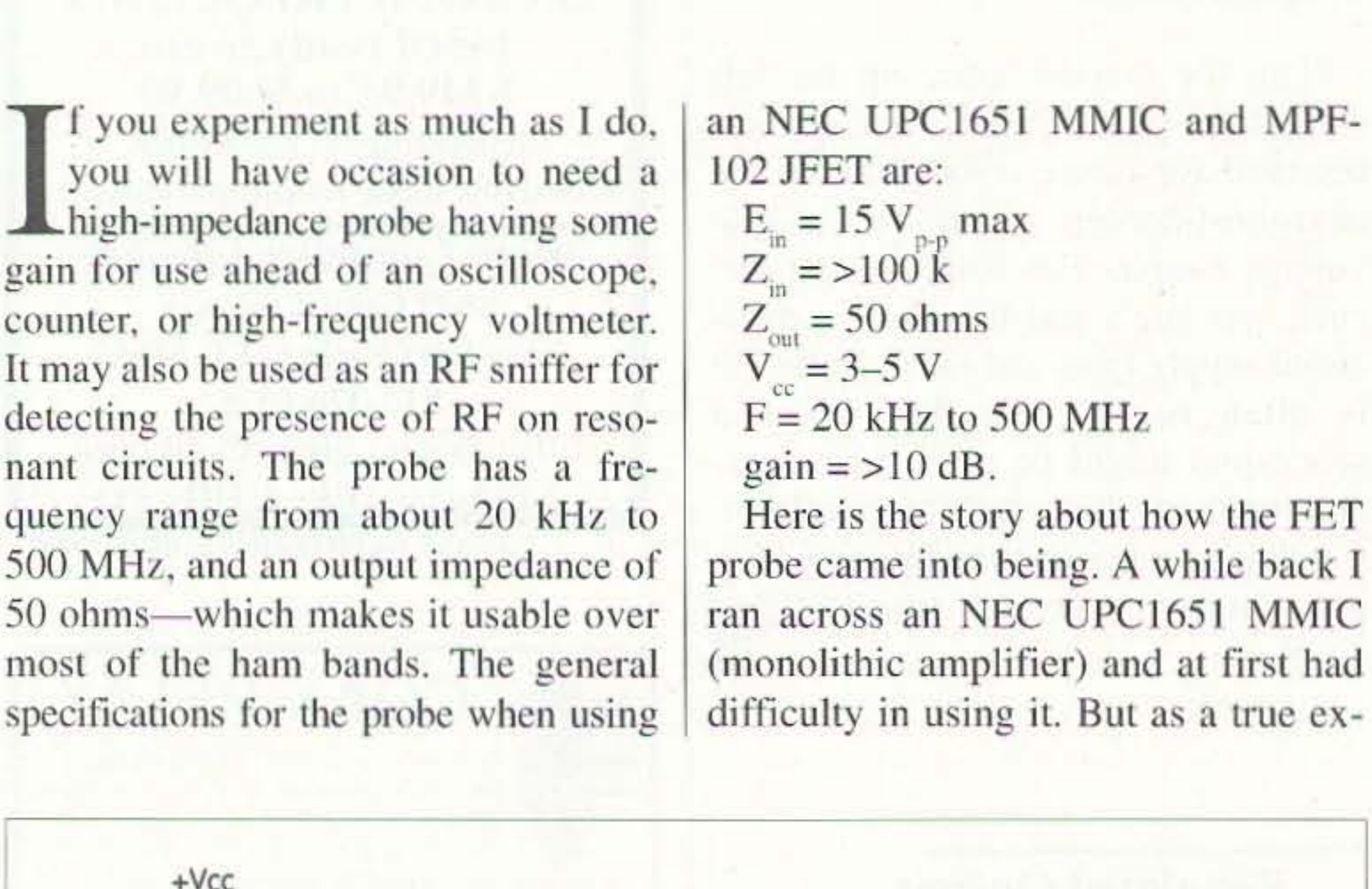

Fig. 1. Schematic of FET probe using an NEC UPC1651 MMIC.

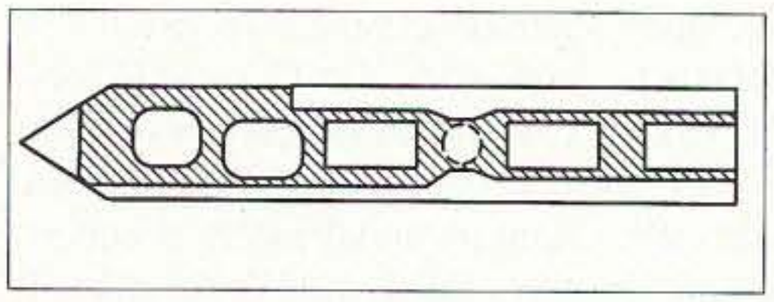

Fig. 2. Single-sided printed circuit board layout for the NEC UPC1651 FET probe.

the board layout for each MMIC are shown, to provide you with construction options. The UPC1651 has one long lead which designates the output. Internal biasing is obtained through another terminal. The input and output terminals are on opposite sides of the device and require only coupling capacitors to the adjoining circuits.

When using a MAR device, the output terminal must be biased externally. Typically, a series-connected inductor and resistor are used with the MAR device. However, in the FET probe application it might be best to use only a 75-ohm resistor. It has been found that 1/4-watt carbon resistors in the 50–100 ohm range tend to be non-inductive and work well in RF circuits. An inductor, if used, would tend to peak the response at some frequency when a flat probe response is preferred.

To obtain a high input impedance, a JFET connected as a source follower was used as an input stage. Although little or no experimentation was done in selecting the 560-ohm source resistor, suitable probe results were obtained. However, the source resistor value may be adjusted as required to improve the match between the FET and the MMIC to achieve a better or different response. In other words, the design lends itself to experimentation and improvement to meet the user's needs.

Again, and although my FET probe was implemented with an MPF-102, other JFETs, such as 2N5245-48, 2N4416, etc., should perform well as

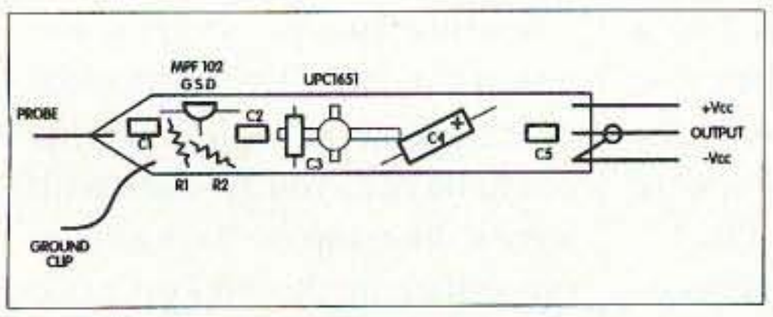

Fig. 3. Parts layout for FET probe using the NEC UPC1651.

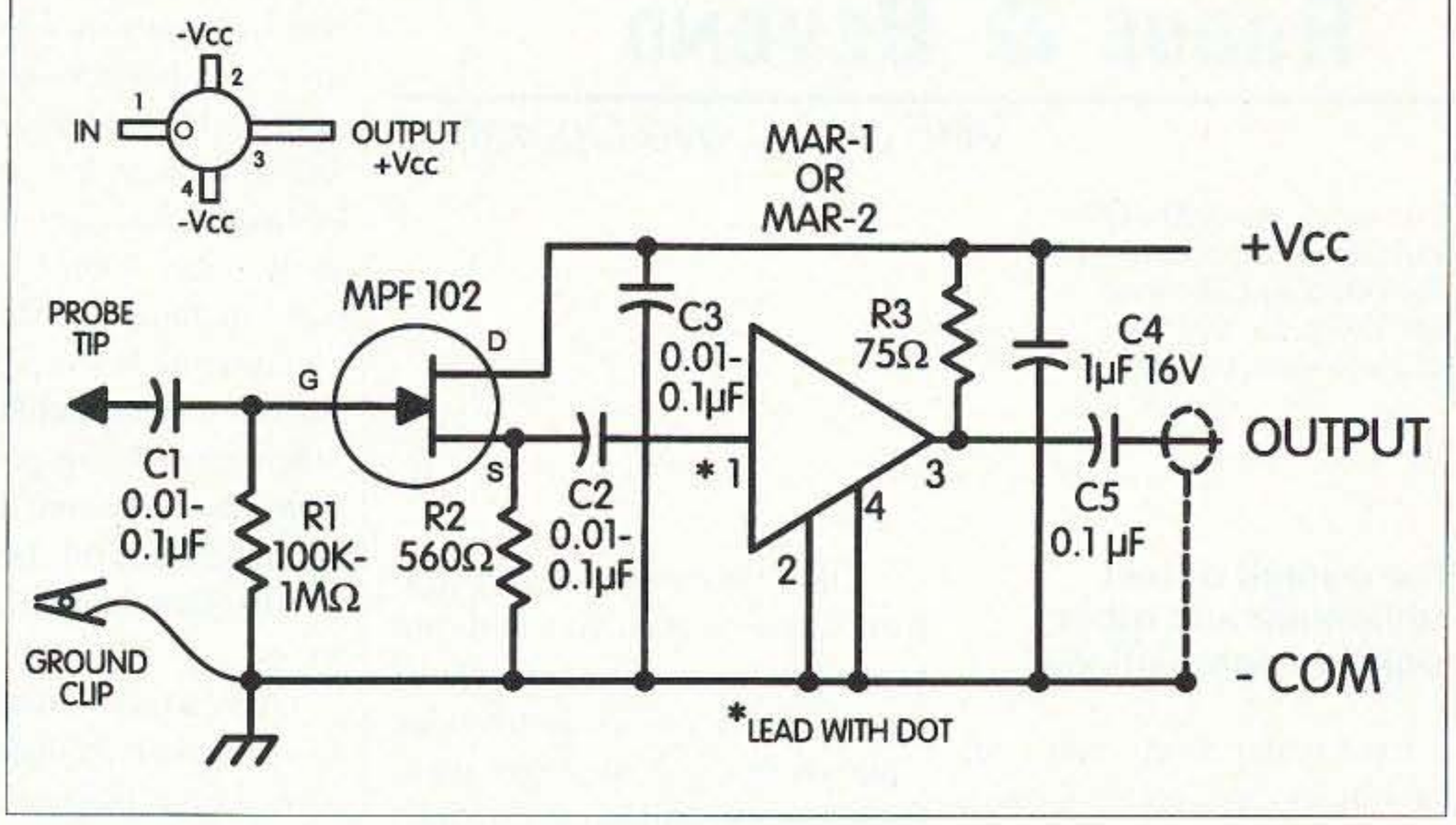

Fig. 4. Schematic of FET probe using a Mini-Circuits MAR-1 or MAR-2 MMIC.

they were designed to operate in the 400–500 MHz region. Since the MMICs are designed to operate up to about 1000 MHz, the FET will be the frequency-limiting factor.

I built my probe on a strip of single-sided 1/32-inch glass circuit board which is narrow enough to fit inside the shell of a Sharpie® marking pen, but the probe works well without a cover should you choose to operate it that way. The parts are mounted on the copper side of the board to keep lead lengths to a minimum and not require any holes—except, that is, for a 3/16-inch one to provide clearance for the MMIC body so that the terminal leads will lie flat against the board. If it is necessary to cut the MMIC leads, care must be taken to retain the lead orientation, particularly on the UPC1651.

Component leads were formed to lie flat and are soldered to the copper traces. Chip capacitors were used for coupling and small axial lead caps were used for the 1 µF and 0.01–0.1 µF V_{cc} bypass caps. The two axial-lead capacitors are skewed to fit inside the envelope of the pen shell.

One-eighth-watt resistors may be used in the 100 k to 1 meg and 560-ohm resistor locations, but the 75-ohm used with the MAR device must remain as a 1/4-watt carbon to achieve the flat frequency response. The circuit board layouts shown in **Figs. 2–3** and **5–6**

Continued on page 78

Number 50 on your Feedback card

Above & Beyond

VHF and Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave.
San Diego CA 92119
[clhough@pacbell.net]

The pursuit of test equipment and other junkyard acquisitions

Even better, this month's column should be labeled, "Confessions of an Electronics Junkie." It might provide some revealing confessions and realizations on what insight is involved in purchasing and picking out equipment to put in our ham shacks.

Let's open the doors to reality and look at a variety of deals made to pick up test equipment. Sure, we all would like to have the very best in frequency counters, signal generators, o-scopes, and such for use when the need arises. That's why we are junkyard *aficionados*. We try to get the best deal we can on a limited budget. The want list does not stop at just simple items, but can get quite involved when the lack of logic and reason hinders our judgment. Deep pockets and lust for a particular item need to be balanced by a swig of Kool-Aid™ and a bit of self-realignment and evaluation.

Actually, if your purchases resemble mine, you too have become quite a collector of various pieces of test equipment which you've picked up as bargains during a hot flash of "pickupitis," only to find out later that your bargain turned out to be something less desirable on closer (and cooler) evaluation. That's why we want to advise you about our experiences—so that you can avoid diving into a new money pit. In other words, picking up something that someone just passed to you which has a problem they could not fix—or did not want to—and so they made a get-rid-of as-is sale.

I don't want to say every deal out there is bad, but here are some pointers from my experience. There *are* some bargains out there—just evaluate them without the "hot blood flowing" if you can. That's the point of the column this month—to describe some of the bad decisions I have made in purchasing "bargain" test equipment—things I paid good money for, and which, I can now admit, make great doorstops.

Don't get me wrong. Collecting parts and pieces towards a well-stocked junk box is admirable and has saved quite a bit of money for all of us. It's just that when we need a D9 Caterpillar™ bulldozer to *move* the junk box, it's time for another approach. It's great to save old parts, but I have become very aware that holding on to old AC power transformers from TV sets and bags of parts removed from PC boards can be detrimental to movement about the shack.

I might be getting a little fussy about parts and all the impressions that go with holding on to a large quantity thereof, waiting to acquire that certain piece of unobtainium to start a certain project. If you are as assiduous at collecting material for your junk box as I am, you too might benefit from reviewing priorities and storage space before spring—or summer—cleaning becomes a necessity.

Sometimes I lose my focus and start collecting material at a rate that makes it seem that my goal is to be one of the major electronics suppliers—when most of the material I have assembled should be heading off towards a museum for proper use. For example, why did I pick up a rusty Hallicrafters S19 Sky Buddy HF receiver? I don't know for sure, but possibly it's because I had one in my very early years. Don't be discouraged at these words of disenchantment. Just read between the lines: We should be specific when assembling parts collections and make sure that they're something useful. Don't amass a collection that will not be put to use.

I have to admit that to be able to write these columns for quite a bit of time, lots of material had to be obtained and put to use so that I could focus more clearly on the subject. But sooner or later the pile in front of the workbench gets too high and impairs vision. It's not getting rid of good usable items, but instead taking a look at how much dust has collected on top of things and taking appropriate action.

I have been witness to other collections that have filled many old dresser drawers stacked one on top of another to hold parts, and I've wondered how anything could be found in the clutter. The same holds true for stacks of cardboard boxes in the garage, and I have to admit that it's also true for other personal storage areas. Something had to be done to refocus on parts that actually would be used and to get rid of my museum—either that, or charge admission.

Since annual cleaning has started taking place at my shack, I have disposed of about three pickup truckloads of material that was hard to give away. I guess the reevaluation of this material by someone who would take it off my hands prompted a rebirth in my thought processes on what is valuable and should be retained. This has led to a retention rule that is quite close to the truth. If it hasn't been used in a year or two you probably *won't* use it, so get rid of it.

I have been in the process of upgrading my test equipment for many years and have even picked up hangar queens of test equipment that I have made operational on the test bench. What is a "hangar queen"? Well, it's a nonfunctional piece of equipment that is used as a source of repair parts to facilitate repairs to your operational equipment when it crashes.

The premise of buying hangar queens is that this equipment is quite cheap because it does not function. It might have parts missing. The cost of a hangar queen, in most cases, is quite inexpensive when compared with the price suggested by the original manufacturer of the equipment. You probably will be shocked at the cost of new parts to repair old test equipment. What you have to do is determine for yourself what you can tolerate to store for "that day" when something breaks on your prime 15- to 20-year-old test sweeper or o-scope.

I have come to see that having repair parts is great if you have room to store them. In some cases, it might be better to obtain another test set. Of course, this depends on your area of the country and what has been available to use as a guide for future needs. In some parts of the country, test equipment is at quite a premium and all recommendations are quite void. The primary rule to follow, then, is that if it's reasonable and you can use it, pick it up even if it's a spare.

In looking for new and interesting material to write about, I've also run into many different electronic bargains that I did not need. If this piece of equipment is of the rare type that would be appreciated in a friend's shack and improve his test equipment, I usually purchase it on speculation that it will not be turned down by someone in our microwave group for cost. Don't go too far out on a limb, though. If it turns out to be bad, you're stuck with a great doorstop, so have a cushion either in the pickup price (usually with no guarantee) or take a phone number and let the

interested parties work something out, especially if it's pricey. The moral of this story is to bring a pencil and notepad to the swapmeet, at minimum.

Nearing the top of the list for things to bring to swapmeets is a small pouch of simple tools to test and evaluate some of the bargains you would like to examine to determine the likelihood of operability. Just a simple screwdriver to remove a top panel could have saved me the price and hauling home of a great piece of test equipment by revealing that the power transformer was cut off right at the windings' entrance to the core—making the unit worthless. Add AC power cords with both blade and round HP-type plugs to the tool kit for simple power-up checks.

I have even obtained some units that had all their internal circuitry removed—even though they looked just fine from the outside. Then there can be the other side of the coin, but this doesn't happen too often. I was offered two different items on different occasions. The first was a spectrum analyzer plug-in unit that had been on the shelf for many months, at a price that would dazzle you.

It seems that a third party had evaluated the unit and reported to the store owner that a big chunk of circuitry was missing from the inside of the unit. Because this was a valued customer, the information was accepted as gospel. A half hour or so later, in I walked. I was confronted by the plug-in on the display shelf. When I questioned the owner, he told me the tale and offered me the unit for a pittance of the original price. I picked up this "hangar queen" for almost nothing.

The upshot of this was that several months later when I finally obtained a mainframe into which to plug the unit to see what was missing, I was quite surprised—not only did it power up, but it functioned. Opening up the unit showed everything in place. Sometimes you win, sometimes you lose, but that day I won *my* version of the lottery.

The point here is to be careful in examining any piece of test equipment, even if it comes from good sources. A good rule of thumb is to turn it on, if the opportunity presents itself, and try it out. That's the sure method of testing. I cannot envision a reasonable seller who won't let you turn on and inspect anything he is selling, to show you it functions. It's protection for both you and the seller. The buyer knows what he is paying for, and the seller knows that his responsibility ends at the end of the driveway.

Both parties are served here in that the item for sale is not misrepresented. Most bargains are an as-is sale and can be tested in a simple test check. This is the best way of purchasing any item. Only big outlet merchandise or new equipment carries guarantees that can protect the buyer, but the price tags of new equipment are quite a bit higher than those for the used material that we are talking about here.

The other bit of advice that I wish to offer is this: Don't let your reason and emotions be overwhelmed by a deal that appears too good to be true. Yes, this can happen, but try to evaluate the situation and piece of equipment by looking at them from different angles. I remember that I just could not pass up a dual-voltage regulated current controlled bench power supply and could not figure out why everyone was passing it up. A deal (for me) made in heaven. I purchased it on outward appearances and was glad to do so at the time.

On arrival home, I looked at the AC plug and noticed that it was set up for European 220 AC power. Not a problem. I would cut the plug off and restrap the transformer to 110 AC. Ha! Was I in for a surprise! Not only did the transformer only have a single 220 winding, but it was sealed and I could not even probe it. The power supply was eventually used but at the price of using a large 1:1 transformer that happened to have a dual 110 primary. I connected the output 110 winding to the AC power (reversed from normal) and connected what was the dual primary into a 220 output tap.

It worked fine, and is in use to this day on my bench. Every time I look at that transformer on the extension power cord it reminds me of a snake that has just eaten a large rodent. Sure, it came out OK, but only with the external AC transformer. Watch your emotions, as well as what you purchase; it's not all a wonder world out there. There are lots of honest folks who have picked up something that needs a whatchacallit and haven't located one and are just trying to offer you a chance to find one to make that bargain piece of equipment function.

Future projects

N6IZW has started to try his hand at solving one of the common microwave test equipment challenges—a simple solution to the need for a microwave workbench power meter. Not everyone can afford or locate a suitable power meter to make measurements at our microwave frequencies. So this project is one that can be put to use in most amateurs' shacks using a computer for a readout. The plan is to make program calibrations on the curve of response allowing your home-constructed unit to be normalized by the computer. This, instead of comparing meter readings to constructed calibration charts. The project is still in the thinking stage, but it will be well founded on fact and prior experience.

Another project we would like to undertake is to come up with a simple SSB transceiver for use as an IF system for use with microwave converters. We are open to suggestions on this ambitious project and hope it can be pulled off to help those who cannot find a used two-meter multimode rig.

The two-meter rig is used as an IF amplifier in a microwave transverter. The multimode rig seems to be a stumbling block preventing many from getting into the microwave realm. New multimode rigs are quite expensive today and a used one can be hard to locate.

The last and final project is one that should be off the ground soon. I have received many requests to republish the plans and make available boards for a 30 MHz IF system for use with Gunn diode wideband FM transceivers for 10 GHz use. I might have to revisit the old PC board if I can locate a supply of TDA-7000 chips used in the IF amplifier. If there is time, I have a design for a compact amplifier using the same circuit but much smaller. The system would be quite a bit smaller, as the board size I am looking at is about two inches square. External to the main board would be the power supply modulator, which is essentially a voltage regulator and a single op amp used to voice FM modulate the adjust terminal of the voltage regulator.

I will try to get part of the system in an upcoming column. The whole project is dependent on getting PC board artwork ready to evaluate to see if there are any major errors. I always try to do my best in evaluation, as it seems that no matter how many times I look at a simple PC board there always will be an error or two that tries to get left in.

Well, that's it for this month. I hope to make some progress on the 10 GHz Gunn transceiver for next month. At least we will try to get the power supply modulator published, since this is such a simple part that it can be wired on a piece of perfboard. 73, Chuck WB6IGP. 73

Number 52 on your Feedback card

CARR'S CORNER

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041-0099
[carrjj@aol.com]

Some thoughts

This month, I want to take a look at a number of different topics, so the column may seem a little disjointed ... but not rambling (I hope).

Things to do

The fall season is close upon us, so there are some things you might want to consider doing. First, if you live in the northern tier of states, you should consider winterizing the ol' antenna system before the first blasts of winter set in. There isn't a lot to do regarding winterizing, but it's time to look at the electrical connections, tighten bolts and screws, check the tuning, and inspect any insulation or weatherproofing that you use. The reason for doing these little chores is that they become big, big chores when the ice forms on the landscape! Believe me ... I know about that one!

Second, the propagation patterns in the high frequency (HF) bands change during the winter. For the most part, skip lengthens and the available DX changes. If you want to erect an antenna to take advantage of those changes, then now is the time to do it. I believe that fall and spring are the times to decide on such changes or additions because of the impending propagation changes that occur in each of the following seasons. You might, for example, want to consider a low angle of radiation antenna to take advantage of winter DX.

Third, I believe it's the responsibility of amateur radio operators to replicate themselves. That is, to become Elmers and "propagate the faith." Now that school is starting up again, you might be able to help some youngster enter the hobby. If you have a technical bent, then contact the science department of your local high school and offer to volunteer.

Two roles are likely available in most areas. First, you can be a science fair judge. Second, you can be an advisor to students and teachers on electronics- or radio-oriented projects.

In other cases, you might find other local opportunities. I exchanged E-mail (see my E-mail address above) with a ham who assisted a local high school in setting up a ham station. Another fellow helped them set up a radio astronomy receiver (which was made with a surplus TVRO satellite dish, a VHF communications receiver used as a variable IF, and a low-noise amplifier and mixer front end). Although from a technical point of view this setup was really quite simple, it also was beyond the abilities of the physics teacher and students who wanted to use it.

There are a number of different things that amateurs can help with in the area of science, especially radioscience. In my book *RadioScience Observing* (Howard W. Sams/PROMPT), which is available from Amazon Books [http://www.amazon.com], there are a huge number of ideas that can be used to help high schools and their students.

If you want to study a lot of different successful efforts, then you might want to use your World Wide Web browser and look up documents on the Search for Extraterrestrial Intelligence (SETI), radio astronomy, and related subjects. The SETI League operates a Web site on the subject. Also, if your student advisees want to do some whistler and spheric hunting (which can be done with equipment no more complicated than an audio amplifier with a front-end filter!), then check out the Project Inspire Web site (below).

Whistlers and spherics are naturally-occurring radio signals found in the 1 to 10 kHz portion of the spectrum. The receivers are basically audio amplifiers with filters that cut off frequencies below 1,000 Hz and above (usually) about 8,000 Hz. Whistler hunters generally connect a whistler receiver and WWV shortwave receiver to a stereo cassette tape recorder, and then log observations.

Bill Pine, director of Project Inspire, produced an article titled "How to Set up a Successful Listening Program in Your School." A copy can be downloaded from the NASA Web site where the Project Inspire Web page is found (see below). Bill breaks his recommendations into four phases:

1. Receiver assembly.
2. On-campus drill.
3. Evening field observations ("sunset runs").
4. Early morning observations ("dawn patrol").

Even if you are not a science teacher, you will still prove useful in the first phase: receiver assembly.

The lessons laid out by Bill Pine (material below from the NASA Web site) include:

Hour 1: Reading resistor codes, identifying capacitors, soldering technique, practice soldering on surplus components. Each student attaches at least one component to the board.

Hour 2: Attaching wires to switches, attaching wires to jacks. Each session wires one complete switch and one jack.

Hour 3: Identifying semiconductor components, attaching the IC socket to the board, pinout configurations, attaching the semiconductors to the board.

Hour 4: Attaching the switch and jack wires to the board, circuit checkout and testing.

In addition, the following activities might be areas where you can help:

1. Setting up the receivers and connecting the ground wires and cassette tape recorders.
2. Setting receiver and recorder levels.
3. WWV time marks.

Notice anything in common with amateur radio? These activities are similar to the kinds of things we do all the time in our hobby, especially if we are technically oriented!

Radioscience resources on the Web

C. Crane Company
558 - 10th Street
Fortuna CA 95540-2350
E-mail: [ccrane@aol.com]
Web: [http://ccrane.com]

Grove Enterprises
P.O. Box 98
7540 Highway 64 West
Brasstown NC 28902
Web: [http://www.grove.net]

S.P. McGreevy Productions, Inc.
P.O. Box 928
Lone Pine CA 93545-0928
E-mail: [vlfradio@triax.com]
Web: [http://www.triax.com/vlfradio/]

Project Inspire
c/o Bill Pine
Chaffey High School
1245 N. Euclid Avenue
Ontario CA 91762
E-mail: [pine@nssdca.gsfc.nasa.gov]
Web: [http://ssdoo.gsfc.nasa.gov/education/inspire/]

SETI League
Dr. Paul Shuch, N6TX, Executive Director
P.O. Box 555
Little Ferry NJ 07643
E-mail: [N6TX@setileague.org]
E-mail: [Info@setileague.org]
Web: [http://seti1.setileague.org]

National Science Teachers Association
1840 Wilson Blvd.
Arlington VA 22201-3000
Web: [http://www.nsta.org]

Will's Natural Radio
E-mail: [N4YWK@amsat.org]
Web: [http://www.altair.org]

One of the reasons for the existence of amateur radio as a hobby is that we provide some public service. Traditionally, this has meant using our ham rigs to provide communications for others, especially in time of emergency or for special events. That role seems to be diminishing as cellular telephones and personal radio service transceivers become easily available. Perhaps it's time that we look at other areas of public service to help justify our continued use of valuable segments of radio spectrum. I recommend involving ourselves in educational activities in our community.

One of the Web sites above had a neat quotation, which I paraphrase: Learning something every day is half the solution to the problem of ignorance. The other half is teaching someone something every day.

Using your rig in a hospital

Some years ago (1970s), while I was in college, I worked as a biomedical equipment technician in a medical center hospital. During that time we found a number of problems with electromagnetic interference (EMI). Medical and scientific instruments tend to be quite sensitive to EMI at close proximity to transmitters.

At that time I wrote an article on using ham gear in hospitals, and why it isn't permitted. Most people who wrote to me about the topic were surprised, but understood. A few really arrogant jerks wrote and told me they would operate their two-meter handhelds (or whatever) if they were a patient in a hospital, and no "(expletive deleted) idiot like you (meaning me) is gonna tell me otherwise!" One comment was something akin to those bumper stickers about gun control: "No one is going to take my ham rig away from me until they pry it from my cold, dead hands." Puh-leeze!

We hams are supposed to be responsible citizens. If our operation interferes with life-saving patient monitoring and related equipment, then we can do without QSOs for a short period, now, can't we? By the way, for those who don't "get it," if you feel like responding to this column like some people did to the earlier one, please spare me your ire. I won't receive it, but will reflect it back, for I have little patience with self-centered fools.

You will note that hams are not singled out. The last time I went to an emergency room (last November) was as a patient. While lying on a stretcher in an ER hallway (one tends to do that a lot in ERs), a man tried to use a cellular telephone. A security guard pointed to a sign on the wall that not only forbade the use of cell phones inside the hospital, but also required that they be turned off entirely! In other words, you cannot even have the cellular telephone in receive mode.

Why are they so sensitive to cell phones? One possible reason is that hospitals use radio telemetry for electrocardiography (ECG) in certain units. A typical ECG radio is a 1 to 10 mW VHF or UHF transmitter that picks up the ECG waveform, and then uses it to frequency modulate the transmitter. A series of antennas around the coronary care unit (or a lesser "step-down" unit) picks up the signal, and sends it to receivers at a nurses' station or special monitoring station. In some systems, the antennas directly feed a 60 dB wideband amplifier before it is sent to the receiver. Even a relatively low power signal from your ham rig or cellular telephone can drive the receiver or amplifier into nonlinearity, and produce intermodulation distortion (IMD). And that can cause problems.

I recall one problem of IMD from when I was working in the hospital. A nurse called me at 0300 or so, and told me that one patient's signal was coming in on two channels of their eight-channel system. It turned out that the problem was an FM broadcast band receiver at the nurses' station. The night nurse tuned in a station and kept it on low volume to while away the nighttime hours.

The antenna of the FM BCB receiver was located only inches from a 17-inch whip antenna protruding from the false ceiling tiles. The whip was for the ECG telemetry receivers, and was feeding a 60 dB amplifier only inches away. The local oscillator of the FM BCB receiver was radiating into the antenna and amplifier, driving it into a nonlinear operating region. Because of the specific station that the nurse was listening to, the combination of one telemetry frequency and the FM BCB LO frequency produced a second-order product that was on the operating channel of another telemetry unit. Sighhhh.

After a lot of head scratching, I located the problem on a hunch by turning off the radio. The two ECGs were in their respective channels, allowing the nurses to properly monitor both heart patients.

If you think it's difficult to get some hams to give up their rigs in a hospital, or take away the cellular telephones of visitors, try telling a night nurse to give up her FM radio! That was not an easy chore (AM BCB radios were tolerable, however). I suspect the only reason the nurses didn't disembowel me and curse my soul was that my wife was one of their colleagues (she was a coronary care unit nurse at that hospital when this occurred).

Having a bit of cardiac trouble myself, you might say this topic is near and dear to my heart (sorry, bad puns sometimes fit!).

The problem of electromagnetic interference in hospitals has gotten serious enough to attract the attention of the Food and Drug Administration. Check out their Web site for information on the problems of electromagnetic interference to medical devices. It is at URL [http://www.cdrh.fda.gov].

RF exposure and hams

There are some new regulations from the FCC regarding RF radiation exposure from our rigs. Some hams must file paperwork with the FCC. In any event, you will want to be aware of the problems so that you can guard against affecting your own health. One or more of Wayne's editorials in the past have dealt with this subject. I talked with Stu Cowan on this topic some years ago, so the issue has been around for quite a while.

If you are concerned with this potential problem, and how the problem can be cured, then I recommend that you obtain a copy of a new book published by the ARRL. It is called *RF Exposure and You* (ISDN 0-87259-662-1) by Ed Hare W1RFI. The price is $15, which is certainly cheap for a book of that size (especially one that contains information that may help you retain your health). It is available from ham radio stores, or direct from the ARRL at [http://www.arrl.org]. I also found it listed by Amazon Books, so check out [http://www.amazon.com]. 73

If you're a No-Code Tech, and you're having fun operating, tell us about it! Other No-Code Techs will enjoy reading about your adventures in ham radio—and we'll pay you for your articles. Yes, lots of nice clear photos, please. Call Joyce Sawtelle at 800-274-7373 to get a copy of "How to Write for 73 Magazine."

Number 54 on your Feedback card

HAM TO HAM

Your Input Welcome Here

Dave Miller NZ9E
7462 Lawler Avenue
Niles IL 60714-3108
[dmiller14@juno.com]

Moderator's note: Roger and Ron Block of PolyPhaser Corporation have put together a well-written series of tips and suggestions on how we can effectively protect our ham radio stations from the effects of a lightning strike. Last month, we went over the need for adequate lightning protection on utility lines entering our homes and ham shacks. Now picture this ...

Lightning protection—what your mother never told you, part 8

As the ground system rises in voltage from a lightning strike, the protectors will take the ground system energy and place it on the power, telephone, and cable lines, while keeping the voltages between earth and the active lines within the limits of equipment survival. As mentioned previously, the utility ground rod for the house should be interconnected to the husky radial ground system described in previous columns. If this is not the case, the energy from the tower strike will traverse the house safety ground wires to this rod, causing problems throughout the system. Interconnecting them in the ground (using bare copper strap conductors) will reduce the inductance of the interconnecting path. House wires are a parallel path. If the interconnect path is better (lower inductance and resistance), the majority of the current will bypass the house wiring. An alternative is to provide a copper strap path through the house (difficult to fly past the XYL!). But this may not be a sufficiently low inductance path anyway (due to the length needed), and it will likely radiate to other wires and equipment inside the house, to boot.

The power and telephone feeds to a house can be either aerial or underground. Most hams believe that an underground connection is superior, because it provides better protection from a potential lightning strike. Although a feed buried underground will not sustain a direct hit, the amount of energy generated if a nearby tree is struck, coupled through the conductive ground medium, can be equal to a direct hit! By being underground, the wires can actually be at greater risk. The depth at which the wires are buried is also immaterial, when compared to the depth to which low-frequency strike energy can penetrate.

Just a word for those who feel that they are safe from lightning because they always disconnect the coax from their equipment when it's not in use. When asked what they do with the disconnected line(s), they'll usually respond that they're simply placed on the floor. Stop and think about the last few thousand feet that the lightning has just jumped ... you can see the fallacy in this reasoning. In fact, they may make the situation worse, since arcing also involves ignition-temperature plasmas inside your house. While it's true that the radio may make it through the initial lightning strike, will it survive the ensuing fire inside your home? Tossing the coax out the window isn't without its problems too, especially if the coax has already entered the house from the antenna and then loops back out the window, or if the antenna is roof-mounted, and without an adequate low-inductance ground path of its own.

Grounded coax switches won't last long with direct hits either—unless other low-inductance earth-to-ground paths are provided. Remember that grounding the center conductor of the coax, and not disconnecting its shield, can still allow large amounts of strike energy to be shared with your equipment. The coax shield connects to your equipment's chassis, and if a single-point ground is not present (along with power and telephone protectors), equipment will be damaged. Here's the point: When dealing with the amounts of energy present in a lightning bolt, thinking in terms of voltage and current levels that are normally present isn't sufficient. We have to set our thinking toward very, very large amounts of energy ... energy that's looking for a way to earth-ground. Our only effective protection is to provide that path, with as few obstructions as possible. That's been the thrust of the series. Try *not* to think in terms of compromise.

Ground system materials

Solid copper (wire or strap) or copperclad steel (rod) makes copper the most commonly used earthing material. A below-grade ground system should be made utilizing the same base material. Mixing materials, like galvanized rods with bare copper radials, will create a battery action in which the zinc of the galvanized rods will dissolve into the soil. This will cause bare steel to rust, which will not provide an optimum connection to the earth. Using stainless rods to prevent corrosion will not produce the best conductivity; since stainless steel wire would be required to interconnect the rods (remember, we don't want to mix metals), the overall resistance of the system would be increased. An all-aluminum ground system should only be considered in very acidic soil conditions, and even then, the soil should be chemically tested for other aluminum-attacking soil compounds. Joints between copper radials and copperclad rods should be made by exothermic welds (see below) or by using appropriate joint compounds in high-compression clamps. Soldered connections, such as torched silver solder, will not last as long as an exothermic weld.

An exothermic weld is created with a graphite mold (for the desired connection) into which copper oxide and aluminum powders are placed. An additional starter powder ignites the exothermic process. The resultant molten copper is deposited into the lower mold cavity where it burns away any oxides and creates a larger fused connection. This larger cross-sectional bond decreases resistance and increases the surface area, which reduces the inductance of the joint. Since the materials are similar, the connection lasts as long as the remaining grounding material.

High-pressure clamps can produce a good bond between copper and copper because the material is malleable (soft and workable). However, average ground rods are only copperclad, with the majority of the rod being plain steel. The differences in the coefficient of expansion and contraction (with temperature changes) of the two materials will loosen a mechanical connection over time. The use of joint compounds helps, and further enhances the weather-tightness of the bond. The requisite high pressure must come from a material stronger than copper.

Strata problems

Rock layering within the subsoil can make ground rod insertion extremely difficult. If layering makes it impossible to continue the insertion of a ground rod, simply cut off the rod and connect it into the system as is (even one short rod is better than none). A rock layer

will hold water and salts, which means the conductivity will be good. Making more connections to areas of higher conductivity will reduce the overall impedance of the ground system.

A ground system has a finite resistance and an inductance value. The amount and location of the inductance can reduce the overall effectiveness of radials. When a radial is placed in a poorly conductive soil, the radial inductance is quite high. Conversely, when the radial runs in highly conductive moist soil, the inductance of the wire is mostly shunted by the soil's conductivity. Because copper strap has lower inductance than wire, it's been recommended throughout this series for all radial runs. The strap's extra surface area reduces inductance and the sharp edges allow for a high E-field concentration (which in turn allows arcing to occur in poor or no soil conditions). We don't really care how the charge spreads out and away from our equipment, as long as it does just that!

That's Roger and Ron's presentation for this month. If you'd like to see the original, unabridged version of this series, you can contact PolyPhaser Corporation, Customer Service Department, 2225 Park Place, P.O. Box 9000, Minden NV 89423-9000 and ask for their Special Bulletin, Protection to Keep You Communicating (©1995). You can also pay a visit to PolyPhaser's home page on the World Wide Web at: [http://www.polyphaser.com/]. PolyPhaser's Web site also supports text downloads of the original material that's going to be condensed here, plus other related texts on the subject. The PolyPhaser Tech Line telephone BBS at (702) 782-6728 is also available to interested readers. The communications parameters are: Data bits—8, Parity—None, Stop bits—1, Baud rate—300 to 14400. If you are dialing in for the first time, the Tech Line requests your name, address and telephone number. You will also need to create a password. Once you've logged on, just follow the menus to navigate around the bulletin board. The "Ham To Ham" column will continue this series on protecting your ham station from the destructive effects of a lightning strike, with part 9 coming up next month.

Switch that switch!

From Ken Guge K9KPM: "I think that we've all run into the problem of rotary switches becoming 'noisy' (i.e., making poor contact) when left in one single position over a period of time. It's never been completely clear to me why this happens; theoretically, it could be due to a couple of factors. In very low-current circuits, it may be due to a minuscule degree of arcing that could be occurring on a molecular level, which, with time, eventually develops into a high-resistance contact being formed. It could also be due to the contacts on the rotary switch 'taking a set' (i.e., losing some of their tension from being slightly spread apart). Whatever the actual reason, I believe that I've found a reasonable solution to the problem.

"I own an older Yaesu FT-101E ham-band transceiver that I have in my auxiliary station upstairs in my study. I use it when it's too cool in my basement to operate comfortably from my main ham station installation. After a time resting in one position, however, the bandswitch on my FT-101E would sometimes not make good contact when I first turned the radio on to operate. Exercising the switch (running it back and forth a few times) would usually cure the problem, but taking off the transceiver's bottom cover and spraying the switch sections with contact cleaner seemed to be a more reliable fix ... until now. Lately, I've simply been placing the FT-101E's bandswitch in the 11-meter position (since I don't operate on that band position) when I'm done using the transceiver, and then switching it back to the desired ham band when operation next takes place, some time later. Since taking up this routine, I've not had to further exercise or spray the bandswitch once, leading me to consider this practice a more or less permanent solution. Whether it's simply the self-cleaning action of rotating the switch at the beginning and end of an operating period, or the fact that tension on the switch's contacts is released during periods of non-operation is probably immaterial; and more just a matter of curiosity. That this solution works for me is the important point, and so far it's been working like a charm. Now I just have to remember to do it!"

Moderator's note: Thanks, Ken. Potentiometers (controls) and antenna switches that are rarely (if ever) changed may also benefit from Ken's suggestion. Why not give it a try?

Two for one

From Stephen Reynolds NØPOU: "In case you haven't seen them, there's a new type of bass woofer speaker on the market now, one with completely isolated dual-voice coils. Since the lower audio frequencies (in the bass range) don't really need to be directionalized (i.e., the average person can't discern which direction bass is coming from), limited-space stereo systems can usually get by with just one bass woofer or subwoofer, located midway between the left and right higher frequency speakers. Given that, the best way to combine the bass frequencies from the two stereo channels is in a totally isolated, dual-voice coil-design single woofer (see **Fig. 1**). This keeps the higher frequencies completely separate, while combining just the bass frequencies. These bass woofers are usually intended to operate in the 40 to

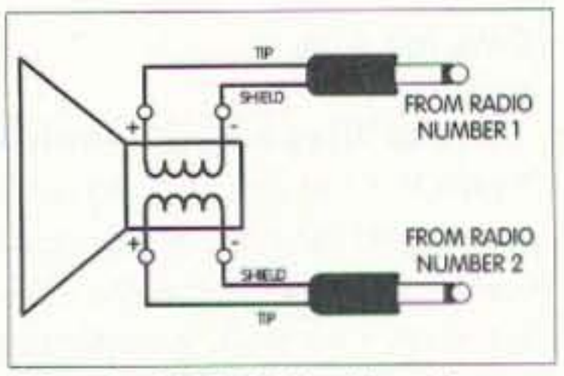

Fig. 1. *NØPOU's idea for using a dual-voice coil speaker to reproduce the audio from two radios, in just one speaker, when space is at a premium.*

3,000 Hz range, so they're nicely tailored for ham radio applications (a little like a built-in high-frequency noise filter!). You can find dual voice coil woofers at Radio Shack® as well as in stores that cater to the automobile sound equipment market. For the typical ham radio application, take a look at Radio Shack's six and a half-inch #40-1373, at about $25.

"Why bother with a dual-voice coil speaker in the first place? Because it allows you to feed two radios into just one speaker, with total isolation between them, yet it will reproduce both audio sources even if they're active at the same time. If you don't have a lot of extra room in your ham shack or mobile ham installation for speakers, this method may be just what you've been looking for."

Moderator's note: Great suggestion, Stephen. I can think of at least a couple places for a dual-voice coil speaker in my own installations.

Murphy's Corollary: You can't win; most times you can't even break even, but worst of all, you generally can't quit!

Thanks to those who've contributed to this month's column, especially:

Roger Block, President
PolyPhaser Corporation
2225 Park Place
P.O. Box 9000
Minden NV 89423-9000

Ken Guge K9KPM
1107 E. Woodrow Avenue
Lombard IL 60148

Stephen Reynolds NØPOU
510 S. 130th Street
Omaha NE 68154

If you're missing any past columns, you can probably find them at *73*'s "Ham To Ham" column home page (with special thanks to Mark Bohnhoff WB9UOM), on the World Wide Web, at: [http://www.rrsta.com/hth].

Note: The ideas and suggestions contributed to this column by its readers have not necessarily been tested by the column's moderator nor by the staff of *73 Magazine*, and thus no guarantee of operational success is implied. Always use your own best judgment before modifying any electronic item from the original equipment manufacturer's specifications. No responsibility is implied by the moderator or *73 Magazine* for any equipment damage or malfunction resulting from information supplied in this column.

Please send any ideas that you would like to see included in this column to Moderator NZ9E at the address at the top of the column. We will make every attempt to respond to all legitimate ideas in a timely manner, but please send any specific questions, on any particular tip, to the originator of the idea, not to this column's moderator nor to *73 Magazine*. 73

HAMSATS

Amateur Radio Via Satellites

Andy MacAllister W5ACM
14714 Knights Way Drive
Houston TX 77083

The European Space Agency

Since the attempted launch of the first amateur-radio, high-elliptical-orbit satellite, *Phase 3A*, in May 1980, AMSAT (the Radio Amateur Satellite Corporation) organizations around the world have relied heavily on European rockets for a ride into space. *Phase 3B*, now known as *AMSAT-OSCAR-10*, successfully reached orbit on June 16, 1983. It was launched on an *Ariane-2* rocket from Kourou in French Guiana.

Fifteen years later, *AO-10* is still in orbit and providing a communications system using its still functional Mode B transponder (70-cm uplink and two-meter downlink), when the solar panels are properly illuminated. The onboard computer failed in late 1986 due to radiation damage in the memory circuits, but the default operating mode has provided over a decade of additional use for hamsat enthusiasts. Eventually the batteries, solar panels, and radio components will fail, but in the meantime it's the only serious DX hamsat in the sky.

The European Space Agency (ESA) continues to support satellite efforts from AMSAT and educational institutions around the world. The agency has its roots in the European Launcher Development Organization (ELDO), created in 1962 by Belgium, France, Germany, Italy, the Netherlands, and the United Kingdom. That same year, the European Space Research Organization (ESRO) began operations with the five nations of the ELDO plus Denmark, Spain, Sweden, and Switzerland. Ten years later, the two groups merged to form the European Space Agency. By 1980, the agency had been joined by Austria, Ireland, Norway, and Finland. Canada is also a partner in specific ESA programs and has a seat on the ESA Council.

The primary task of the ESA is to provide a cooperative European space research program with a long-term policy to become and remain competitive in space technology. Since the first launch of an *Ariane* rocket in December 1979, they have successfully adhered to their goals.

Arianespace

The programs of the ESA require launchers to get payloads to orbit. Since the beginning, Arianespace has provided the necessary hardware and services to do the job. Arianespace is a privately-held commercial company. It was created in 1980 to do three main duties: Arianespace markets satellite launch services, is the prime contractor for the industrial production and financing of *Ariane* rockets, and conducts launch operations from the *Ariane* launch site in Kourou, French Guiana. The primary shareholder is France, with over 55 percent. Germany is a distant second at 19 percent, while the other participating countries split the rest.

Arianespace is the first commercial space transportation company with more than 50% of the market. They have launched over 137 satellites since their inception. In the past nine years, they have sent more than two-thirds of the western

world's telecommunications satellites into orbit.

The *Ariane 5* and *Phase 3D*

Most hams who have been following the *Phase 3D* project know that amateur radio's most ambitious satellite is designed to be launched into orbit by the latest *Ariane* rocket, the *Ariane 5*. Delays and launcher problems have kept *Phase 3D* on the ground, but it is hoped that agreements will be reached and problems resolved, so that AMSAT's newest satellite will get a ride to space on an *Ariane 5*.

In January 1985, the members of the ESA and *Ariane* met in Rome to begin the *Ariane 5* project. The new launcher was to be a rocket for the future, capable of taking 15,000 pounds of payload to geostationary transfer orbit (GTO), or 44,000 pounds to low earth orbit (LEO). The *Ariane 4* could only take 10,000 pounds to GTO. The new *Ariane 5* was also to be capable of taking human passengers to orbit via the *Hermes* capsule, and to transport space station modules into space for the *Columbus* program. While the space station plans and manned space activities are currently on the shelf, the work continues to make the *Ariane 5* the new heavy lifter of Arianespace.

June 5, 1996, marked the maiden flight of the *Ariane 5*. Mission 501 was unfortunately a very short ride. Software errors in the main stage control systems caused the rocket to veer off course, tear apart and explode. Debris, rocket fragments, and fuel rained down upon the French Guiana jungle. Fortunately, *Phase 3D* was not onboard, but the inevitable delays before a second attempt could be made were long and tedious.

Sixteen months after the disastrous flight of *Ariane 501*, the second mission (502) successfully took off from the jungles of South America. The flight was not perfect, but it was very close. The payloads *MaqSat H* and *TeamSat* both achieved orbit. The problems of flight 501 were resolved, but AMSAT's *Phase 3D* was not onboard.

Following the 501 mission, it was discovered that the vibration stresses imposed on payloads by the *Ariane 5* launcher were greater than expected. AMSAT was notified of the new vibration specifications after a study of the 501 launch was released by the ESA. In order to survive on an *Ariane 5*, the *Phase 3D* spacecraft needed significant structural work. If *Phase 3D* were a car, this would mean stripping the vehicle to the frame, and then designing, fabricating and installing panels and support pieces wherever stress problems might occur. It was hoped that the modifications could be performed in time for mission 502, but it was not to be. If the mechanical modifications had not been required, *Phase 3D* might have been ready in time, but the combination of new mechanical changes and ongoing payload design and integration was too much.

Phase 3D is now ready for launch, but does it have a ride? AMSAT Germany's President Karl Meinzer DJ5ZC is constantly in negotiations with the ESA working to get *Phase 3D* into orbit. While *Phase 3D* could not be easily sent to space on launchers from other countries, it can be retrofitted for a flight on an *Ariane 4* vehicle. Time will tell, and the work goes on. *Phase 3D* is loaded with all the experiments and communications transponders that it can hold. The systems have been tested, and they work.

To find out more about the *Phase 3D* program, you can start on the Internet with AMSAT's home page at the Universal Resource Locator (URL) [http://www.amsat.org]. Be prepared for quite a ride through cyberspace. Many fascinating links are available to other AMSAT groups around the world and educational institutions working on small satellites carrying amateur-radio payloads. Membership in AMSAT is open to all individuals, not just hams. A one-year membership includes six issues of *The AMSAT Journal*. Each issue includes numerous articles about amateur satellite operations, construction articles, and news about current and future spacecraft. Call AMSAT at (301) 589-6062 for more details. 73

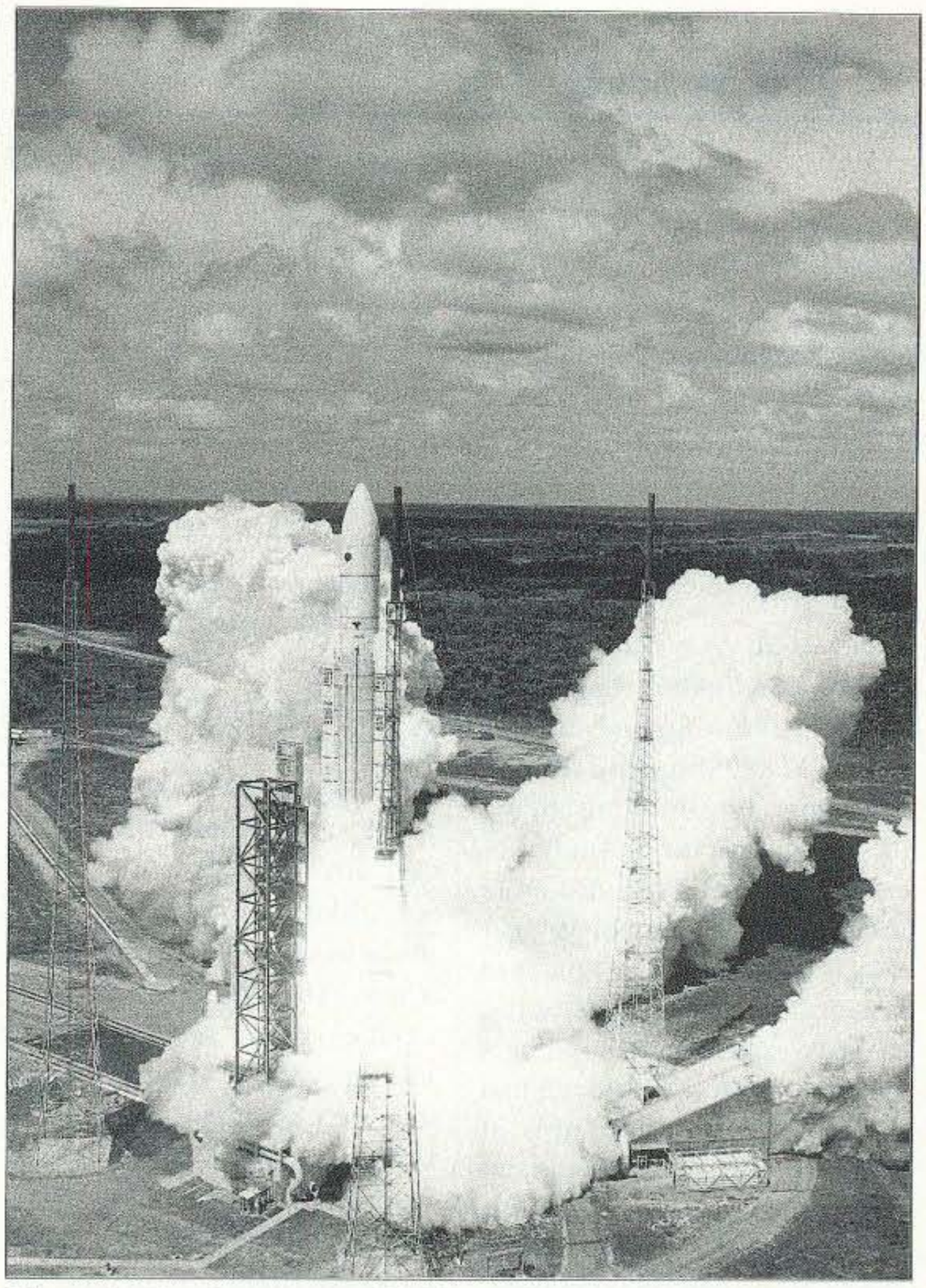

Photo A. *The first successful flight of an* Ariane 5 *launcher took place on October 30, 1997, in Kourou, French Guiana. Photo courtesy of Arianespace.*

Number 58 on your Feedback card

HOMING IN

Radio Direction Finding

Joe Moell P.E. KØOV
P. O. Box 2508
Fullerton CA 92837
[Homingin@aol.com]
[http://members.aol.com/homingin/]

Tracking owls, cranes, and foxes

We've all seen nature shows on TV that feature biologists locating radio-tagged critters with portable direction finding gear. Migrating birds are among the most difficult to study because they travel long distances in short periods, even in weather that is bad enough to prevent researchers from following them by aircraft. Researchers are beginning to discover that the hundreds of thousands of amateur radio enthusiasts on our continent can aid their efforts. For instance, *Amateur Radio Newsline* reported that the Wildlife Conservation Corps recently sought volunteers to help study the movements of endangered whooping cranes.

Another important species being studied is the burrowing owl. In winter months, these unusual creatures can be found in the southern US, from California's Imperial Valley to Texas. They also make homes in Florida from Orlando to the keys. However, their habitat is diminishing. As a result, they are considered endangered in some places and "of special concern" in others.

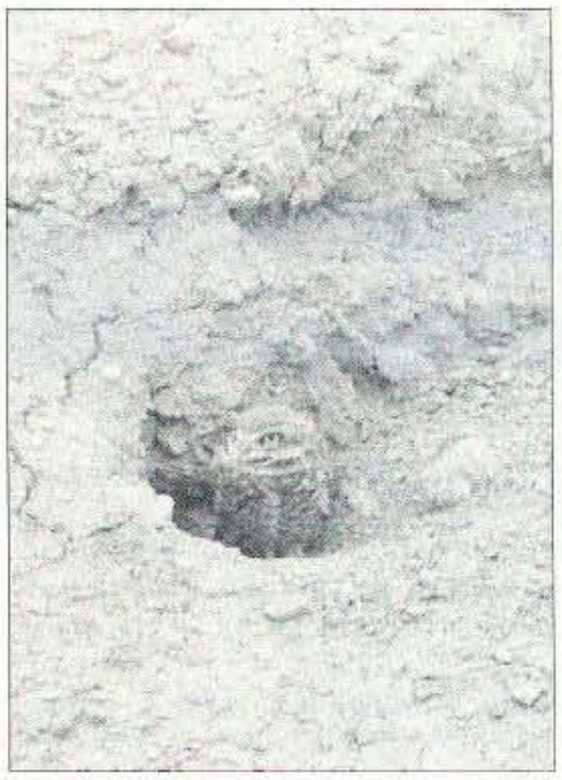

Photo A. *Burrowing owls blend in well with their surroundings. I discovered this one standing guard along the banks of an irrigation canal near El Centro, California.*

Unlike other owls, it's unusual to see a burrowing owl in a tree. They prefer to roost in cavities on the ground in treeless grasslands (**Photo A**). By day, they stand at a burrow entrance, ready to duck inside when necessary to avoid predators such as hawks. At night, they take flight to feed on small snakes, lizards, and rodents. They fly in an undulating pattern and sometimes hover in the air to catch grasshoppers, beetles and other insects.

"Homing In" readers help

Early in March, E-mail arrived from Helen Trefry, a wildlife technician with the Canadian Wildlife Service, who is working on a project about burrowing owls. "We know so little about their movement," she wrote. "We have no idea how long they take to migrate or if they make long stops along the way. It may be that weather is a large factor in determining the rate of movement."

Owls banded during the summer in Saskatchewan had previously been recovered in southeastern Colorado and the panhandle of Texas, lending support to the theory that they migrate south through the plains east of the Rockies to spend winter months in southern Texas and nearby regions of northern Mexico. To get more data, twelve Saskatchewan burrowing owls had been fitted with necklace-style VHF transmitters before their southward migration last fall.

Ms. Trefry and her associates used the tags to learn that the birds traveled from 68 to 202 miles nightly, during the hours of darkness. In the daytime, they borrowed badger burrows to use as avian motels. Bad weather grounded the researchers' small plane (but not the owls!) after a few days. The tag signals were lost in southwestern North Dakota, near Dickinson. They were not heard again until December, when one was picked up by another aircraft 56 miles southwest of San Antonio, Texas. The remains of a banded Saskatchewan owl were discovered by a southern Texas wildlife refuge manager in December.

I agreed to attempt to find some hams along the flight path to monitor for tag signals during the anticipated northward flight period. It was too late to get the announcement into *73 Magazine*, but I put out the word via *Amateur Radio Newsline*, the *ARRL Letter*, the *Homing In* Web site and Internet mailing lists for transmitter hunters. Dozens responded, representing most of the states in the expected migration path. Hundreds viewed the burrowing owl page of my site, which gave the tag frequencies and monitoring tips. I have no way of knowing how many ham-hours of monitoring were done, but I know that the response was heartwarming to me and to the researchers. Thank you all!

Somehow, the surviving owls returned to Saskatchewan in late April and early May without being detected by hams or researchers along the way. Perhaps if more advance notice had been available and more hams had been monitoring, some valuable insights about migration rates and patterns could have been obtained. Helen wants to try again during the owls' southward flights this fall, so I'm putting out the word now.

Another biologist from the ornithology laboratory at a prominent eastern university has contacted me about the possibility of ham operators and scanner enthusiasts participating as citizen volunteers in his institution's long-term wildlife research projects. The studies could take place anywhere in North America, so we're starting the project by asking all interested "Homing In" readers to contact me. I will compile a database of potential volunteers and their geographic distribution.

Professional researchers use very sensitive narrowband VHF receivers, but scanners or two-meter ham transceivers with extended receiver range are also suitable if used properly. Multimode receivers such as the Trident TR2400 and Sony ICF-PRO80 in the SSB or CW mode will copy weak pulsed signals better than FM-only sets (**Photo B**). Tag frequencies are often grouped very closely, which may be a problem with typical 5-kHz channel spacing of scanners and ham sets.

Signal pulses from tags are very short, to conserve battery life. They occur only about once per second, so you can't just use the SCAN mode in a typical scanner to search for them. You must slowly step through the frequencies with the squelch open, listening through the noise for the "blip ... blip ... blip" (momentary quieting) of the pulses.

If you have a sensitive receiver capable of tuning from 148 to 174 MHz and wish to devote some time to protecting wildlife, please send E-mail or postal mail to me. Volunteers in rural areas are particularly needed. Let me know your location, equipment and antennas for monitoring and/or direction finding. Include your phone number if you are willing to be called. If enough hams respond from appropriate locations, we'll be able to write proposals for one or more formal research projects within a few months.

Frequency-agile foxboxes

"Homing In" for March featured a detailed description of low-cost ammunition-can foxboxes for international-style transmitter hunts. For that project, I used surplus circuit boards from crystal-controlled VHF business-band transceivers, retuning them for the southern California coordinated transmitter hunt frequency, 146.565 MHz.

There is no coordinated transmitter hunt frequency in the Pacific Northwest at this time. That's why Dale Hunt WB6BYU of Yamhill, Oregon, needed synthesized transmitters to put in the foxes he is building for events in the Portland area, and elsewhere in Oregon and Washington. He chose a new synthesized two-meter transmitter kit from Hamtronics, Incorporated, 65 Moul Road, Hilton NY 14468-9535; (716) 392-9430.

In the past, I have built several Hamtronics kits for club repeaters and for my own use. They have always been easy to assemble and tune-up problems have been minimal. The T301-2Y follows this tradition, with a plated circuit board and components of high quality. It is rated for two to three watts continuous output from 144.0 to 154.235 MHz. Models that cover ranges up to 174.635 MHz, and 216.0 to 226.235 MHz are also available.

The circuit (**Photo C**) has two main sections: a synthesizer and a three-stage amplifier chain. The synthesizer logic includes a microcontroller and a serially programmed phase-locked loop IC. It has its own voltage regulation and draws about 30 milliamperes. On power-up, the microprocessor boots and programs the synthesizer, which takes about half a second.

For repeater use, the power-up delay is unacceptable. By breaking one trace on the circuit board, the synthesizer can be operated continuously and the output stages keyed separately. But Dale found that running the synthesizer continuously in his foxboxes was causing problems. Besides the continuous battery drain, there was enough leakage of the two-meter synthesizer output into the output coax to provide some telltale signals to nearby fox hunters, even when the output stages were keyed off. So he changed his control circuits to key the synthesizer, accepting the delay at startup.

Most fox controllers are designed to key handie-talkies or mobile transceivers with a small NPN pull-down transistor. To switch the full T301-2Y supply current, which is about a half ampere, add a PNP power transistor or MOSFET. Be sure to provide sufficient base or gate drive to minimize voltage drop across the switching device.

Separating DC input voltages for the synthesizer and output stages makes it easy to control RF output power by varying the supply voltage to one or more of the amplifiers. The simple way to do this is with an LM317 variable voltage regulator. In my tests, RF power could be smoothly adjusted from 350 milliwatts to full output.

An RCA-type receptacle is provided for RF power output. "Plugs with a long center pin can short to the case under the board," Dale reports. "Hamtronics sells RF-grade RCA plugs with a shorter center pin, which I would consider a good investment. The manual warns that operating the transmitter without a 50-ohm load can destroy the transistor, and there is no SWR protection circuitry. However, specifications for the BLX-65 final transistor state that it will survive 50:1 SWR at 2.5 watts output. At one watt output, I expect it to be very robust. At three watts output, the final and driver transistors run warm to the touch, but they are room temperature at one watt.

"Transmit frequency is set with a 10-position DIP switch, using binary encoding," WB6BYU continues. "Subtract 144 MHz from the desired frequency, round off to tens of kHz, and convert to binary. The last switch is five kHz. For example,

Photo B. *This researcher uses a Sony multimode receiver and attenuator to track pulsed signals from tags on desert tortoises in California.*

using the southern California T-hunt frequency, 146.565 - 144 = 2.565. That is the 256 switch plus the 5-kHz switch, quite easy to remember. Flip up those four switches and you are on frequency. If you have more than one favorite frequency, you can use a multipole switch or diode matrix to select the binary codes. The manual recommends realignment when changing a few hundred kHz, but I changed the frequency from 145 to 148 MHz without any noticeable difference in output power.

"Assembly was straightforward. It took about four hours to install all parts on the board. Adjustment was fairly easy, also, requiring only a voltmeter, wattmeter and dummy load. Be sure to order the special square alignment tool for the coil slugs. On the version I purchased, there is a trimmer capacitor for exact frequency adjustment. For wide temperature ranges or high frequency accuracy, a temperature-compensated oscillator option is available for $40 more. The voltage-controlled oscillator stage is a little microphonic, so you'll hear it in the transmitted audio if it bangs around loose in the box."

I checked Dale's T301-2Y on a spectrum analyzer and was favorably impressed. At all

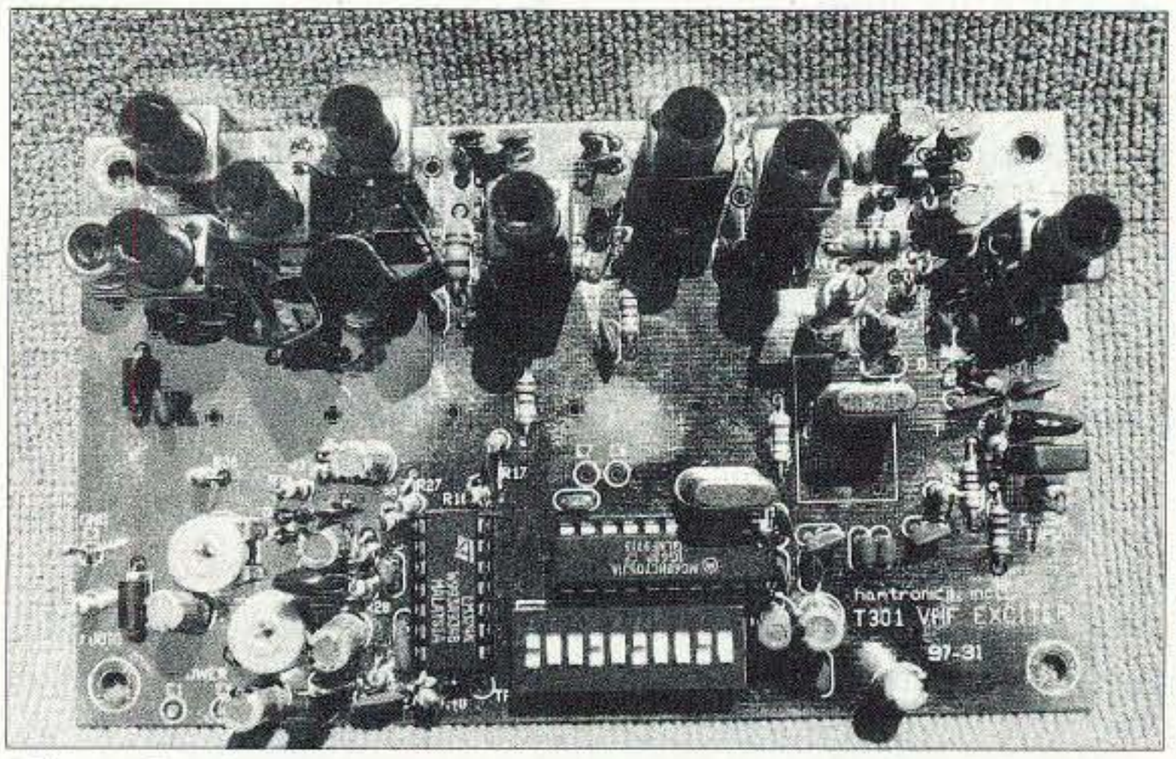

Photo C. *The Hamtronics T301 synthesized VHF transmitter board measures 3 x 5 inches.*

Number 60 on your Feedback card

On the Go

Mobile, Portable and Emergency Operation

Steve Nowak KE8YN/4
1011 Peacock Ave., NE
Palm Bay FL 32907-1371
[ke8yn@juno.com]

In marketing, a key concept is to find a need the customer has and provide a product or service to meet that need. In many cases, however, companies reverse this concept so that they find what product or service they have and then expend all their efforts in order to convince customers that they must have that particular offering. This part of the marketing process is called promotion.

In some cases, promotion works well. In others, it may not, and companies find themselves in the "Where Are They Now?" sections of the Sunday paper. No matter how good a buggy whip you have to offer, very few will be sold.

Although amateur radio is a noncommercial service by definition, it *is* a service, and it is in our best interests to market ourselves and our service. Why should the general public allow us to have exclusive or nearly exclusive access to vast portions of the electromagnetic spectrum? Because we can meet some needs of the general public better than any other service.

People have a critical need for reliable communications, today more than any time in our history. Once we were content to receive news weeks or even months after an event occurred, but today we expect to have information current right up to the minute. Most of the time this is furnished by commercial providers, and most people assume that those services will always be available under all circumstances. Better than 99% of the time this is true, but the other 1% is when we may be called upon to provide such service.

Having a market potential of less than 1% might sound pretty small, but it is not as bleak as it might seem. There are many products or services which are rarely utilized. When was the last time you used your fire extinguisher? How about your carbon monoxide detector? Your home or life insurance policies? Nevertheless, rational people invest in each of these because they know that there is a small but very real chance that they might need one or more of these items. Our services, like these other examples, might not be used often, but they will be used. What is it that makes our services so special and sets us apart from our commercial counterparts?

1) We provide a technical service with no equipment, maintenance, or operating cost to the customer. Cellular telephone users expect to pay for their telephones and be charged for the use of the cellular telephone systems. When those systems fail, we are able to provide communications service and we do so without these costs; in fact, we are prohibited from being paid. For a ham radio operator providing emergency communications, a doughnut and a cup of coffee are the only profit he'll see.

2) We provide our services wherever they're needed. Sometimes the locations where we are needed are indeed off the beaten path. If a shelter is established at a school to provide for storm victims, or if weather spotters are needed out in the cornfield country, or a checkpoint is needed at a roadside rest miles from civilization, we'll set up and operate wherever we're needed. If necessary, we'll not only provide our communication equipment but also a generator, tent, and other facilities to support our own operations.

3) We can provide a range of services. Usually we think of heading out with a two-meter handie-talkie or mobile rig when we think of emergency communications. However, for data transfer we may choose packet. For weather spotting or search and rescue, APRS may be the preferred support. For health and welfare traffic to and from remote locations, there are the low bands and the traffic handling networks. In some cases, amateur television is gaining popularity for supporting public service efforts. We are able to select a frequency and a mode to meet most situations.

What does all this cost the general public? Very little. There is no direct cost and no additional cost recognized. All we ask is to keep the frequencies we've been able to use in the past. In today's market this means that the government as representative of the general public must forgo the opportunity to

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levels from 350 milliwatts to full power, its harmonics and spurious emissions were better than 60 dB below the main carrier. At full power, they were -68 dBc.

In-band spectral purity of the synthesizer is also excellent. At 600 kHz away from the carrier, noise sidebands were -105 dBc in my tests, compared to values from -82 to -95 dBc on three crystal-controlled rigs that I checked at the same time. This is an important consideration if you are designing a repeater system, because high transmitter noise sidebands can cause the repetitive "kerchunk, kerchunk, kerchunk" of desense when weak signals are being received.

I belong to a club that has been fighting repeater desense problems for some time. The system has a high-power crystal-controlled transmitter/amplifier lineup and marginally-effective duplexer cavities. We temporarily replaced the two-watt exciter with Dale's T301-2Y and the desense problem disappeared! So our trustee is ordering a T301-2T (the high stability version) for a permanent replacement.

The manual is very thorough, including theory of operation, lots of troubleshooting tips, plus information about using the unit for voice, repeater and data applications. Charts of typical voltages at test points, transistors and IC terminals are also provided. "At $109, the T301-2Y is not the cheapest option for a fox transmitter," WB6BYU summarizes, "but it provides frequency agility and simple power control, and it safely provides continuous duty if needed."

Mobile sprint in San Diego

Ambitious hidden-transmitter hunts with excellent prizes are a long-time tradition at Southwestern Division conventions of the ARRL. This year's event (Hamcon-98) is no exception. T-hunt Chairman Doc O'Connor K6DOC promises a memorable San Diego-style mobile hunt. That means the first finder wins, so prepare for a rapid pace.

I anticipate multiple transmitters and short transmissions, so I suggest having lots of helpers in your vehicle—a map reader, navigator, beam-turner, and transmission-timer. This allows the driver to concentrate on efficient progress through the streets and freeways. The convention is August 14-16 at the Town and Country Hotel in San Diego, and the mobile T-hunt will be on Sunday afternoon.

Will there be other transmitters to find during Hamcon-98? Who knows? ... So better bring your sniffing gear just to be sure ... 73

QRP

Number 60 on your Feedback card

Low Power Operation

Michael Bryce WB8VGE
SunLight Energy Systems
955 Manchester Ave. SW
North Lawrence OH 44666
[prosolar@sssnet.com]

Once again, the Dayton Hamvention® has come and gone. This year the QRP gang was once again out in full force. Blessed with really fine hamfest weather all three days, the flea market was a shopper's paradise!

In the last several years, we have seen a glut of NE602-based QRP monobanders. At the hospitality suite, there were two new rigs introduced. Both were multiband transceivers, and both were multimode as well. Best of all, they both start off life as kits!

The M1 from S&S Engineering

The first one we'll look at comes from our friends at S&S Engineering. It's called the M1, a multiband, multimode (USB, LSB & CW) QRP rig. With a continuous frequency range of 1.8 to 30 MHz, the M1 also sports an honest-to-goodness AM detector. There's an adjustable audio filter with 100 Hz to 3 kHz bandwidth. You have your choice of either manual or automatic gain control.

You can cruise the ham bands with 1 Hz to 10 MHz tuning rates. You can also input an operating frequency directly from the keyboard if you desire. If you choose to transmit, the M1 will produce five watts of RF into a 50-ohm load.

Of course, you'll get all the bells and whistles you've come to expect with today's modern microprocessor. There are RIT, SPLIT and band stacking registers in the M1, and a built-in keyer with digital speed and weight settings.

Optional features you can add to the M1 are a Collins 2.5 kHz SSB filter; a backlit display with adjustable brightness and optically coupled shaft encoder; and a digital power and VSWR meter may be added as well.

Looking into the prototype Dick had on display, the M1 looks like a simple kit to assemble, thanks largely to the microprocessor. There are a lot of surface-mounted components inside the M1. Several of the larger surface-mounted ICs will come presoldered to the PC board. The M1 is seven inches by nine inches by two and a half inches.

It has a lot of options. You can more or less custom-build your own by adding on the options you need at the time of assembly.

The price of the M1 has not yet been carved in stone. According to Dick, the price will be between $600 and $700 for the kit. The M1 looks like a winner—and if it works as well as the other products from S&S Engineering, they *will* have a winner!

The Elecraft K2 transceiver

A new company to appear in the QRP marketplace is Elecraft. They introduced the new K2 all-band SSB/CW transceiver kit. The K2 covers 160 through 10 meters. As it comes, the K2 will operate CW. You can add on the SSB module, 160 meters and a high-power PA. The K2, with the high-power module, will kick out 50 watts of RF. Although far from the QRP power levels most of us use, this opens up an entirely different market for the K2. A 100-watt internal PA is also under consideration.

The K2 is just under three inches high by nearly eight inches wide and a little more than eight inches deep. It weighs about three pounds without any of the internal options added. Out of the box, it covers 80 through 10 meters (160-meter band is an option). A built-in keyer is also standard.

You get two VFOs for split operation. RIT and XIT are standard, too, as are direct keypad entry of frequencies and memory channels, memory channels store mode, VFO A/B, split, and RX filter and RX sideband. The main tuning knob has three turning rates: 1, 10 and 100 kHz per knob revolution. You get 10 Hz tuning resolution.

The K2 has some interesting features. I really like the low power demand of the receiver. It requires only 100–150 mA of current in the battery save mode. This makes it possible for long-term operation with just a small battery back.

Inside the K2 that was on display at the Hamvention, I noticed the lack of internal wiring. There was some, but most of the interconnections between the main board and the display

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sell our frequencies to commercial interests. With everything so fiscally driven in this day and age, it is very tempting for our officials to want to sell off this seemingly little-used resource and apply the revenues to other purposes. However, if we continue to have access to these frequencies, we'll continue to provide our service. Even though *we* know we're an answer to the public's needs, how do we make sure that the *public* knows and has confidence in us?

First, we need to make certain that we deliver what we promise. If we have an obligation to provide a service to the community, we need to be physically, mentally, and technically prepared. Do you keep a radio handy at all times? Is your "grab bag" ready to go if you are called upon to serve? There's nothing more pathetic than a ham reporting to a remote site with only a handie-talkie, a rubber duck, and a single battery pack. Do our customers, whether the city or county, the Red Cross or the Salvation Army, know how to get the area hams mobilized? Can we provide services for an extended period? How about reciprocal support agreements with nearby communities? Murphy's Law tells us that we will be needed at the most inopportune time and under the worst conditions possible.

Second, we need to ensure that our efforts are recognized. Do the local weather reporters acknowledge SkyWarn's contribution when reporting on bad weather? How about a banner that reads "Communications Provided by Amateur Radio" to display whenever we set up a public service station? Have you invited members of the city council to Field Day? If you have trouble getting noticed by the local evening television news, how about a neighborhood newspaper or even a neighborhood association newsletter? Depending upon your timing, it may be easier to get publicity than you think. As this column is being written, the headlines have mainly focused on the last episode of "Seinfeld," the delay of release of Windows 98™, the death of Frank Sinatra, and the hype surrounding the new "Godzilla" movie. I hope these are indications of slow news days, rather than a reflection of what has become of key importance to us.

How has your club sought out recognition? What special projects is it undertaking? Send me a quick note and I'll include the best ideas here. The E-mail and snail-mail addresses are at the top of the column. Who knows? You may be able to get better local publicity if you include a copy of an article or column from this magazine! 73

board are made by plug-in connections. This wireless design will certainly ease construction of the K2. Oh yes, I almost forgot—the K2 is a kit!

As far as I could tell, there are no surface-mounted components used in the K2. I do know you have to wind the various toroids inside the rig. However, in talking with the people from Elecraft, they may offer an option of having all the coils prewound. That will be an extra-cost option, however.

Another slick design feature of the K2 is the use of built-in test gear. The K2 includes a voltmeter, frequency counter, RF power meter and microprocessor-based self-alignment firmware to speed the alignment of your K2. You don't need a bench full of expensive test gear to get the K2 up to perfect specs!

There's a boatload of options for the K2. Among them are the SSB option, 160 meters, and a noise blanker with variable threshold and buffered IF output to the rear panel. You can also get an automatic internal antenna tuner and an internal gel-cell battery.

As I mentioned earlier, you can add on a 50-watt PA, and if you're into computer-controlled rigs, you can add the host computer remote control via RS232.

Also available are the SWR/power and A/B antenna switch. There are additional RX crystals filters and a low-noise analog audio CW filter with multiple bandwidths. Whoa! The K2 sounds like a QRP operator's dream rig!

Price is set at $549 for the basic unit. Add $79 for the SSB option. The 160-meter option is $29, and it's $29 for the noise blanker.

Factory-assembled QRP transceivers were also introduced. There were two units on display at Hara Arena. They both were working prototypes, with stock available later this year.

The SGC-2020

Without a doubt, the SGC-2020 drew the largest crowds this year. They were really promoting their new QRP rig—although it's a bit of a stretch to call it a QRP rig. The 2020 produces up to 20 watts of RF. You can set the output power from zip to 20 watts, with five watts the best for long battery life (using the PortaPak™ pack).

Covering all modes, the 2020 also covers all the ham bands. Modes of operation are SSB and CW. You can receive AM, but the 2020 does not support an AM detector.

The 2020 has a backlighted LCD display that provides most if not all of the operating specs. You can turn the backlight off to conserve power. The 2020 also includes a built-in keyer for CW. You can also operate many of the digital modes, as the 2020 switchover time is about 10 ms.

The 2020 is two and three-quarters inches high by six inches wide by seven and one-quarter inches long. It weighs two and a half pounds and has a list price of $625.

The 2020 also has the full support of a microprocessor deep down inside its slim case. You get all the bells and whistles we have come to expect. You get a slew of memories, split operation and RIT/XIT.

The PortaPak for the SGC-2020

The SG-2020 PortaPak is a portable carrying case and power system. Inside, there is room for a CW key and other accessories. The overall size of the PortaPak system is about three by sixteen and a half inches. The PortaPak has an adjustable nylon strap, and can be easily carried over the shoulder or in the hand. The full PortaPak system is a sturdy, compact package, well protected for all climatic conditions—but a cautionary word: The present portable package is *not* waterproof.

Professional high-quality stainless steel latches provide reliable, secure connection of the battery pack and front panel cover. The cover provides protection for the front of the radio and storage for the microphone. Ten D-cell flashlight batteries will operate the unit for several days, depending on usage and power output. Special D-cell batteries can be purchased and will provide up to 12 Ah operation; D-cell NiCd batteries can be used and will provide up to 4 Ah operation. The battery container is designed for 10 batteries and will provide 15.5 volts for D-cell alkaline, or 12.4 volts for NiCd batteries.

The Patcomm PC-9000 QRP HF transceiver

The PC-9000 is a compact HF transceiver that covers all nine HF amateur bands. SSB and CW modes are standard and there is the option to add the same built-in RTTY and Morse decode capability that has made its big brother, the PC-16000, outstanding. Six meters is included, and an FM module is also available separately. The unit's compact size (eight inches wide by two and three-quarters inches high by seven and a half inches deep), standard noise blanker, and 12 VDC power requirement make the PC-9000 the ideal rig for mobile or portable use. The built-in keyer and keyboard interface make it a joy for the CW enthusiast. Dual output levels (5 W and 40 W) and an amplifier control jack allow operation from QRP to QRO. The receiver is a single-conversion design using dual DDS synthesizers for improved phase noise (no PLLs are used). Excellent selectivity is achieved with a 2.4 kHz bandwidth crystal filter in the (10.7 MHz) IF stage. Additional filtering is obtained with a continuously variable SCAF filter (400 Hz to 2500 Hz) in the audio stage. Three tuning rates are provided: 1 kHz for CW or fine-tuning, 12 kHz for SSB, 120 kHz per knob revolution for quick scans across the band. A lock button to disable the tuning knob is also provided to prevent unintended frequency excursions during mobile/rough operation. RIT and SPLIT operating modes are supported, and SLOW/FAST AGC selection is provided. The standard configuration of the PC-9000 includes a connector for an external IBM-type keyboard and software for sending CW. The optional RTTY/Memory upgrade software/hardware package will add Morse and RTTY decode (and RTTY send) functions, as well as Direct Frequency Entry (from the external keyboard) and memory storage.

The PC-9000 has a list price of $799. Street price will be lower, but I don't know by how much. I have a feeling you're looking at around $600 for a basic PC-9000.

All of the new rigs I've talked about this month are kind of expensive. However, you must take into account the fact that they all are multiband and sport both SSB and CW. Several even allow you to receive AM for some shortwave listening if you desire. All in all, I think the QRP family will really latch onto the new rigs.

Whether you like to roll your own, or just want to open up a box and play, there's really a selection out there this year.

I especially like the ability to add the internal/external battery packs. It's now possible to operate all-mode multiband QRP just about anyplace on the planet.

Sources

S&S Engineering
14102 Brown Road
Smithsburg MD 21783
(301) 416-0661
[n3sad@aol.com]
[www.xmetric.com/sseng]

Elecraft
P.O. Box 69
Aptos CA 95001
(408) 662-8345
[radio@elecraft.com]
[www.elecraft.com]

Any SGC dealer or
[www.sgcworld.com]

Patcomm
7 Flowerfield M100
St. James NY 11780
(516) 862-6511

Number 63 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
P. O. Box 473
Stevenson MD 21153
[ajr@ari.net]

It's summertime, and hot here in the mid-Atlantic. Let's just stay inside in the air-conditioning and answer some of your questions.

Bill Karl W2BY passes along the following:

"I am new to RTTY. I am using Hamcomm 3.1, a TS-440s and an SB 200 linear. I run at about 200 watts out to a TA 33jr and this is satisfactory. I like to run the TS-440s at no more than 30 watts output to conserve the finals, though I've been told that I can run as much as 50 watts out without damage. I was intrigued by your recent column on QRP RTTY. I have been wondering what kind of power levels are typical for RTTY operation. I assumed that almost all operators used an amplifier, especially with band conditions as they are now, but apparently some hams operate RTTY barefoot. Prior to joining the RTTY gang I was operating PACTOR. Since this is a bursty mode, I could safely run the TS-440s at full output. I would be interested in your comments."

You are correct, Bill, that band conditions play a large role in power requirements, but a lot of RTTY operators use a lot less power than you might think. With the semi-redundant nature of an FSK signal, a good demodulator can often pull a signal out of static that practically obscures it to the ear. So, I say, go for it! Will you work everyone on the air? Of course not. But you can certainly have a great time, and make any number of RTTY contacts, without blowing your finals or your wallet on an amplifier. Keep in touch and let us know how you do.

Rudy Ault N2JZK writes:

"I have been reading your column in *73* off and on for some time now, and I've decided to get back into the RTTY mode.

"Before the dawn of time, there was a program which would convert the Radio Shack Tandy Color Computer II into a RTTY transceiver. I used one for a long time, with wonderful results. Do you have any idea where I could obtain this program these days?"

Years ago, Rudy, this program was available, I know, on the Delphi on-line service. Now, I have not been on Delphi in quite some time, and I am not even sure whether or not the service still exists. I did a search of several databases and was unable to find a current listing for the programs. Unfortunately, my CoCo system bit the dust a few years ago. If anyone has a system on line, and can send me a copy of the program by E-mail, I will post it on the "RTTY Loop" Home Page for downloading.

Terry Burkholder NP3G is "in search of ..." and I think we have the answer. He writes:

"I am looking for a list of frequencies for commercial RTTY news and weather info that we can copy from the Caribbean. Trying to get set up for the hurricane season, so that if we lose the Internet will have somewhere to go to get weather info."

The solution comes from our friend overseas, Joerg Klingenfuss, who puts out an extensive line of books and CDs with frequency information.

This summer, they announce the publication of four new products:

- *Radio Data Code Manual*
- Set 2, Compact Disc Recordings of Modulation Types
- *1998/1999 Guide to Worldwide Weather Services*
- *Shortwave Communication Receivers 1942–1997*

The new *Radio Data Code Manual* has been expanded to nearly 800 pages, and now includes more than 230 graphics and screen shots, plus the revolutionary Unicode tables for all major scripts and languages worldwide. New aeronautical telecommunications technology such as ACARS, ATN, CIDIN, CNS, and INMARSAT and recent amendments to certain meteorological code forms are covered, as well as thousands of new meteorological station index numbers, aeronautical location indicators, and aircraft and airline designators.

Set 2 of the Compact Disc Recordings of Modulation Types covers more than 120 new recordings on two CDs: ACARS, ADPCM, ALF, ALFA, ALIS-2, ARS-Guard, ASCII Slovak, ATC-RADAR, ATIS, AWACS-NATO, BR-6028, BUL-ASCII, CALLSEL, CIS (various), Clover, Clover-2000, Coquelet-13, Coquelet-80, CVSD, DATATRAK, DECCA, DECTRA, DGPS, Dialup (V22, V22bis, V32) and Leased Line standards (V21, V23, V26, V26bis, V27bis, V27ter, V29, V33), DME/ILS/VOR, DTMF, DUP-FEC-2, EFR, ERMES, Eurosignal, FAF-FAX, FEBECO, FMS-BOS, G-TOR, GAF-FEC, GN-FEC, HARP, HARRIS RF-5710, HELL, HYPERFIX, JOINT-STARS, LORAN-C, Manchester, Micro-PCM, MPTI 1327/1343, NDB, NMT900, Packet Radio, PACTOR, PACTOR-2, Pager, PSK31, RELP, RIPLE-Control, SELCAL (various), SSTV (all modes), TMS-430, TT2300, Vocoder, and much more.

The new *1998/1999 Guide to Worldwide Weather Services*, just the answer to Terry's question, covers the latest Internet, Navtex, radiofax and radiotelex meteorological data sources worldwide. It includes hundreds of sample charts, home pages, images, and messages recently monitored.

For customers outside of North America, they now offer Fred Osterman's brand new third edition of his bestseller *Shortwave Communication Receivers 1942–1997*. It now covers no fewer than 770 communication receivers, with dramatically improved coverage of Australian and European manufacturers.

For detailed descriptions and sample pages and color screen shots, surf to their Web site at [http://ourworld.compuserve.com/homepages/Klingenfuss/].

From books to software, the questions keep coming in. Amrum KB9DD says:

"I was active on RTTY many years ago (pre-computer days) and now want to get active again. I have both Mac PPC and PC (Intel 200MMX) platforms. Can you suggest what you think would be the best software (either commercial or shareware) to use? I would prefer split screen to basic comm programs like Zterm."

Thanks for the chance to plug my site, Amrum. The "RTTY Loop" Home Page has an extensive listing of software available, for a nominal cost, that is sure to fill your needs. Just check it out at [http://www2.ari.net/ajr/rtty/] and scan the list of programs available from the Software Collection. Readers not on line may obtain a copy of the list by sending a self-addressed, stamped envelope with a request for the Software Collection directory to the address at the top of this column.

This is not the only place to have your RTTY questions answered. Mark Gustoff WO7T asks:

"Are you aware of any user groups I can post a RTTY question to? I'm struggling with hookup of my FT-920 to my PK232MBX. I suspect most of

Continued on page 74

Determining Antenna Feedpoint Impedance

Even you *can learn from this tutorial.*

Hugh Wells W6WTU
1411 18th Street
Manhattan Beach CA 90266-4025

How do you find the feedpoint impedance of a resonant antenna? Have you ever attempted to match a transmission line to an antenna? What method did you use for determining when the feedline impedance was matched?

Of course, measuring the feedpoint impedance and measuring the resulting VSWR will lead you toward a proper match. But what do you use when an impedance bridge and a VSWR indicator are not available? Certainly, you can guess and/or make a judgment.

A method is described here for determining the mechanical dimension that relates to an approximate impedance value and provides a judgment guide to impedance matching. Once the transmission line is attached, it is only necessary to fine-tune the adjustment to achieve a proper match.

Before continuing with determining the antenna impedance value, a short review of transmission lines must occur. Everyone is familiar with coaxial cable and TV twinlead. Both are transmission lines suitable for use in communication systems. But what do you know about these two types of transmission lines? Perhaps the first important fact is that twinlead is a balanced line and coax is unbalanced. What is the difference between balanced and unbalanced? The two words themselves describe the differences.

Let's consider the twinlead first. It is two identical wires running parallel. Being balanced, the two wires exhibit the same characteristics. The easiest way to understand the balanced concept is to consider yourself as being a bird and to sit on one of the wires while looking at the other. Then hop over to the other wire and look back at the first one. What do you see and conclude? Of course, the two wires look exactly alike, and that means that they are balanced.

What about coax? It also has two conductors that run parallel, as does twinlead. However, when you try the bird's-eye view again, what do you see? One wire completely surrounds the other and they are not alike. Therefore, coax is an unbalanced line.

The characteristic impedance of a transmission line is usually known. Therefore, a discussion is unnecessary here as to how the impedance of a line is determined.

Transformer impedance theory

With that in mind, let's continue with finding the impedance of a resonant circuit, which may be a coil and capacitor connected in parallel, or perhaps a dipole antenna. The impedance correlation between the two is identical, and transformer theory/calculation can be used to find the impedance at various turns of the coil or at mechanical points along the dipole.

For this process to work, it is necessary to make an impedance assumption for the calculations to provide useful data. If one end of the coil is grounded, then the impedance at the ground end is considered to be zero ohms, and the top end of the coil is 1000 ohms. Where does the 1000 ohm figure come from? In free space, the impedance would be infinity, but when the circuit is loaded by the surrounding environment and a realistic circuit "Q," the impedance is lower than infinity. But how low? Some believe the

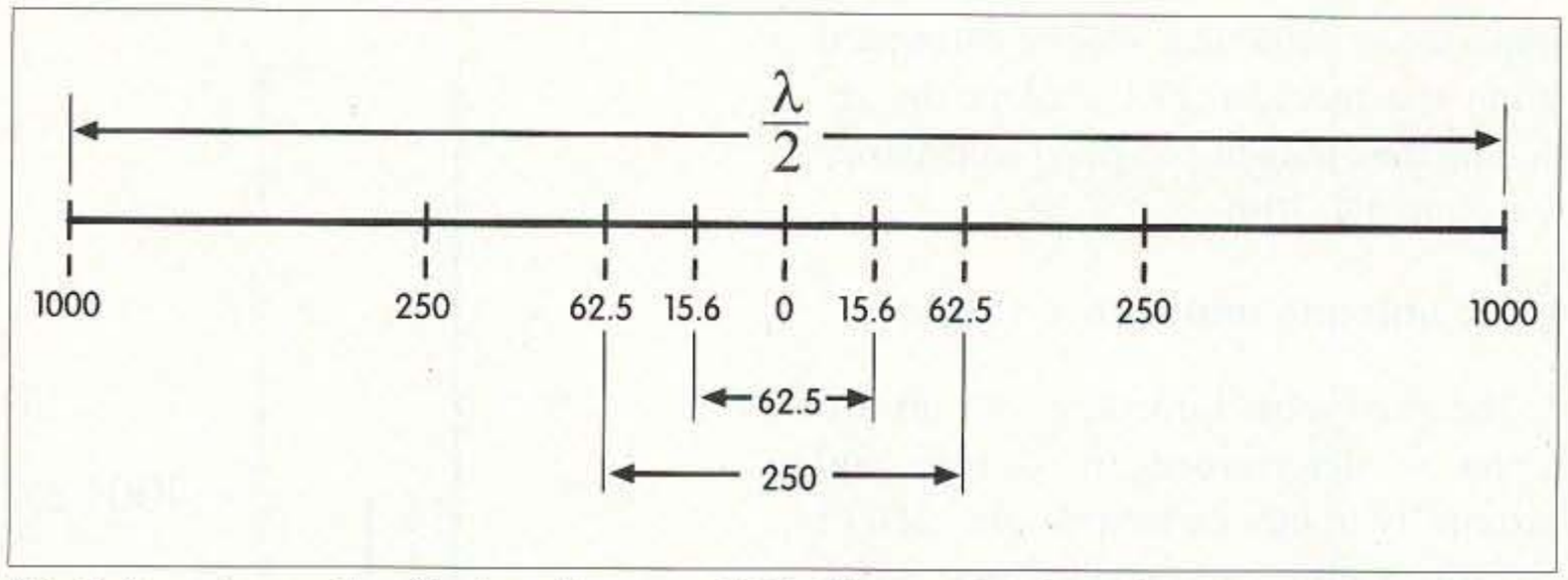


Fig 1. *Impedance distribution along a solid half-wave dipole in free space, assuming the end impedance to be 1000 ohms. Balanced feedpoints shown.*

top of the coil impedance is 2000 ohms; others believe it is around 1000 ohms. Take your choice of value, as the results of using the mechanical method of impedance determination will end up being reasonably close.

For the examples discussed here, 1000 ohms will be used. Following transformer impedance theory, the impedance varies as a function of the square root of the turns ratio, which means that one-fourth of the inductor's total impedance will be found at its center tap. Using this theory, let's find the impedance at the center of a coil whose impedance is zero ohms at the ground end and 1000 ohms at the top. The center tap on the coil will yield an impedance of 250 ohms, which is one-fourth of the total impedance. Now that was easy, wasn't it? Next, what is the impedance at one-quarter of the coil up from ground? Simple! If the impedance at the center point is 250 ohms, then at the one-quarter point, which is halfway between the center tap and ground, the impedance will be 250/4 = 62.5 ohms.

Finding element impedance mechanically

The impedance along the surface of a dipole antenna can be determined in exactly the same way as taps on the coil. **Fig. 1** shows impedance values at various mechanical points along a half-wave dipole whose center impedance is zero ohms, and whose impedance at each end is 1000 ohms. Half the distance between one end and the center of the dipole yields an impedance of one-fourth of the end impedance, or 250 ohms. Half of the remaining distance is one-fourth of 250 ohms, or 62.5 ohms. Again, half the distance between the 62.5 ohm point and zero is 15.6 ohms. Really simple, isn't it?

So what does all of this mean? It means that you can now predict with reasonable accuracy the impedance at various mechanical distances along the antenna element as long as the element is a solid conductor from end to end. When the center of the element is broken, the feedpoint impedance will be in the 66–72 ohm region. It will be balanced. The mechanical technique described for determining the impedance for a solid element does not apply to an element with a broken center.

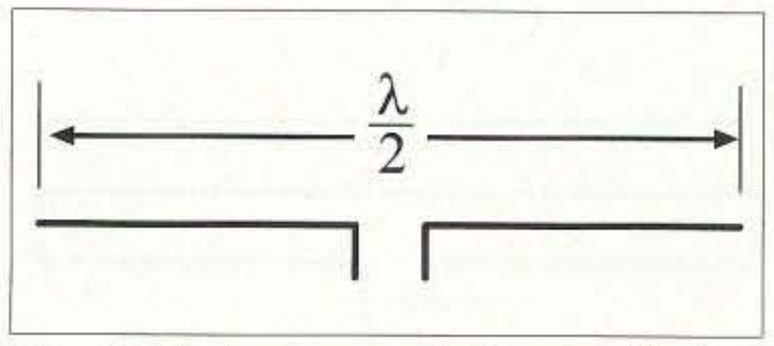


Fig. 3. *Broken center half-wave dipole—feedpoint impedance is 66–72 ohms balanced.*

Once the element feedpoint impedance distribution is known, it is time to select a transmission line and connect it to the antenna element. Starting with 300 ohm twinlead, as an example, where should it be connected to the half-wave dipole? Did I hear you say just beyond the two 250 ohm points? No! From zero to a distance just beyond one of the 250 ohm points? No again! Well, then, where can we connect the twinlead?

First, 300 ohm twinlead is a balanced line and must be connected at balanced feedpoints on the antenna element. Observe the mechanical length from zero to the 250 ohm point. Find the same length centered over the zero point and you will find the points to be at 62.5 ohms. Yes, we want 300 ohms; therefore, divide 300/4 = 75 ohms. Locate the 75 ohm points, one on either side of the zero, and attach the twinlead for a near-perfect match.

Coax is an unbalanced transmission line. Should we select 52 ohm coax, where would it be connected to a half-wave dipole? Using **Fig. 2**, connect the outer conductor (shield) to the zero point on the antenna, and the coax center conductor to the 52 ohm point on either side of the zero points on the element. It doesn't matter which side, as the antenna remains balanced because an unbalanced transmission line is matched to an unbalanced feedpoint on the element. Will this mechanical matching technique work with a quarter-wave dipole? Yes, as shown in **Fig. 2**, as long as the dipole is grounded at the zero point to a suitable ground plane.

One caveat to this application is that the mechanical space between the zero point and 52 ohms may exceed the dimension between the coax's shield and

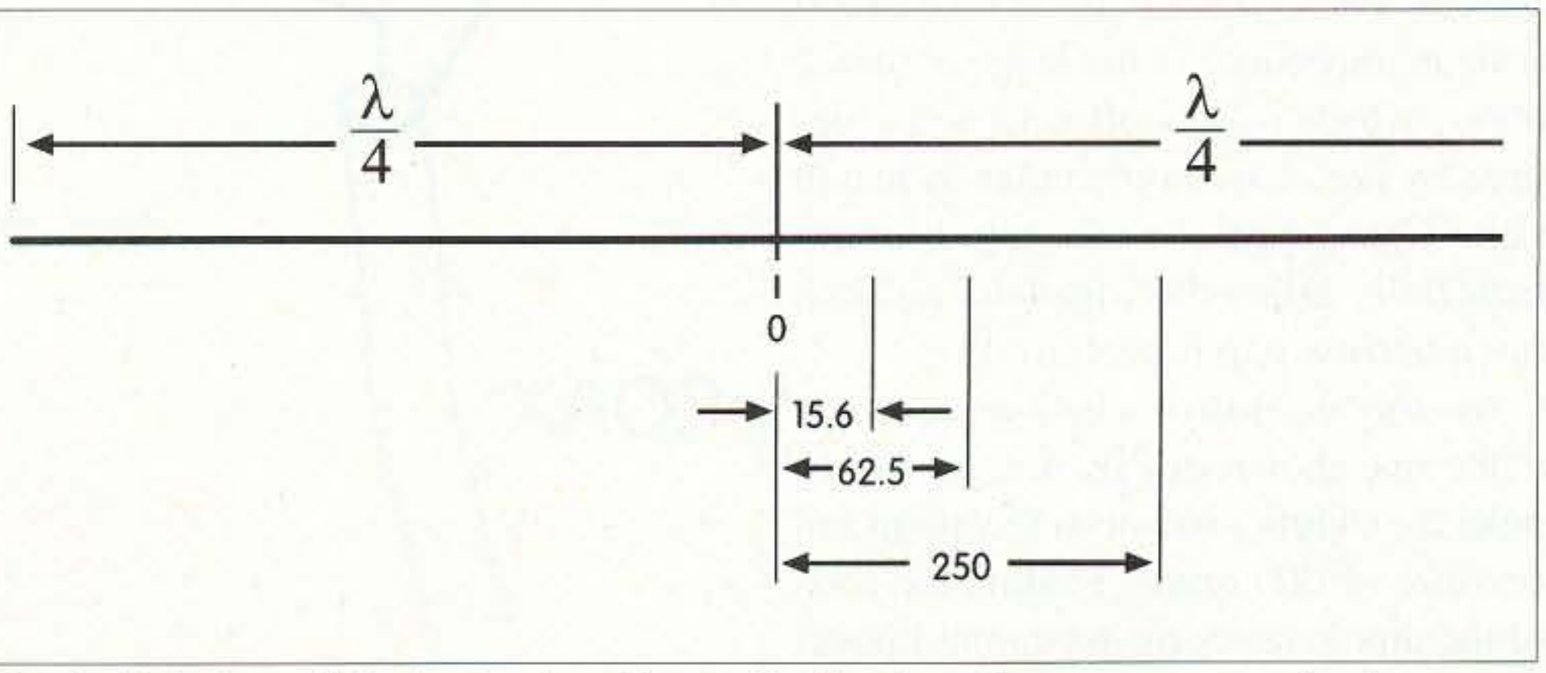


Fig. 2. *Unbalanced feedpoint impedance distribution along a counterpoised quarter-wave element. Counterpoise may be a ground plane or another quarter-wave element.*

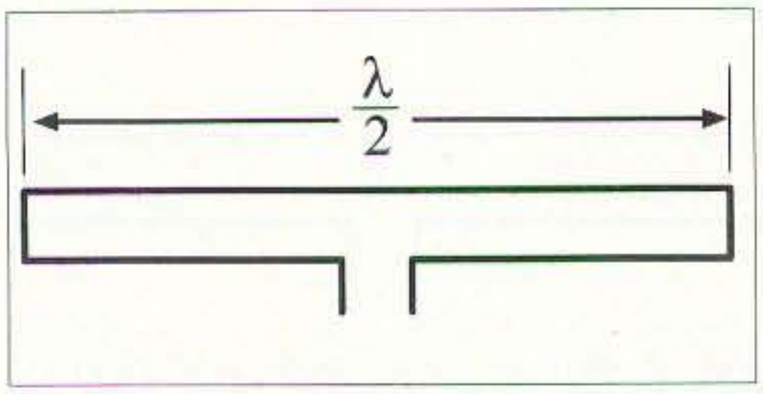


Fig. 4. *Broken center folded half-wave dipole, feedpoint impedance is 300 ohms balanced.*

center conductor and should not be connected directly to the element because a discontinuity would occur. To solve the problem, a gamma match is used to translate the spacing difference and still provide a proper impedance match.

Please note that many antennas currently in use have an unbalanced transmission line connected to a balanced feedpoint on an antenna. Yes, the impedance value is matched and the system may function well, but the balanced/unbalanced condition is not satisfied and a discontinuity will exist. The discontinuity results in a VSWR of about 1.5:1 which cannot be reduced simply by moving the feedpoint tap back and forth. A *balun*, which is a balanced-to-unbalanced transformer, is frequently used to solve the discontinuity problem.

As a reminder, the impedance of a dipole, whether quarter-wave or half-wave, can be determined as indicated when the antenna is operated in free space. And when enclosed in proximity with other elements as in a yagi configuration, the impedance will decrease. Yet, the approximate feedpoint impedance value can still be estimated using the mechanical technique by reducing the element end point impedance by about 10–20%.

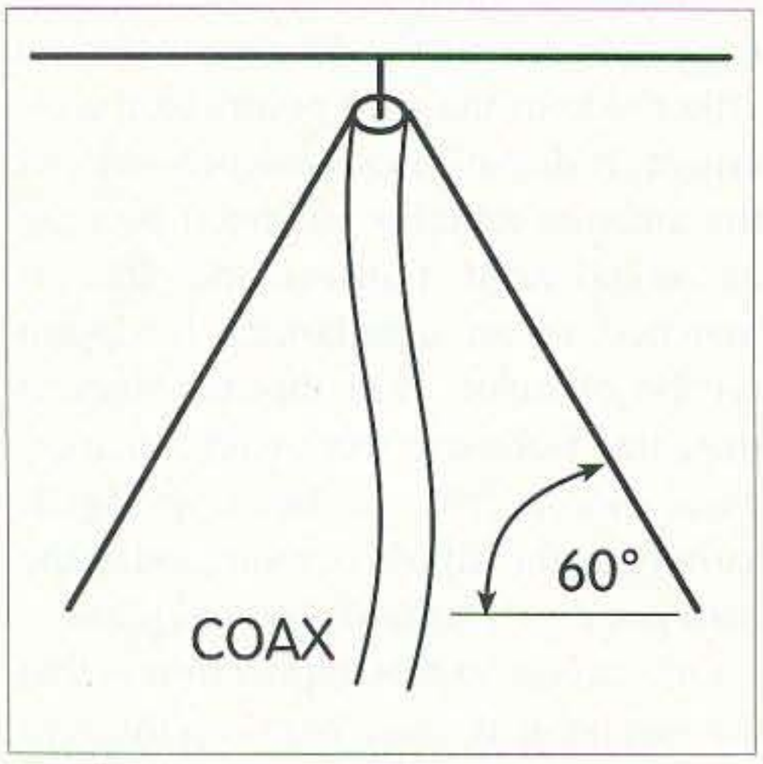


Fig. 5. *Discone antenna, feedpoint is 52 ohms unbalanced.*

Basic antenna impedance values

The feedpoint impedance of an antenna is determined by design and proximity to other elements. In each of the illustrations shown in **Figs. 3–10**, note the mechanical configuration of the element and whether it presents a balanced or unbalanced feedpoint to the transmission line. Some of the impedance values obtained by a design may not match the standard impedance value of transmission lines. Therefore, the closest transmission line impedance is usually selected for use and the resulting VSWR is either tolerated or some impedance adjustments are performed. When there is a known impedance difference the resulting VSWR can be estimated by dividing the higher impedance value by the lower. VSWR values below 2:1 rarely interfere with the ability to communicate via radio, but it is desirable to reduce the VSWR value as much as possible. The VSWR detector in most solid state transmitters have a threshold set for about 1.5:1, making it mandatory to have a VSWR value lower than 1.5:1.

Basic antenna types

Each of the antenna types shown in **Figs. 3–10** represents a basic antenna type with the figure providing an indication of the feedpoint impedance for each. The dipole antenna shown in **Fig. 3** is a half-wave element with a broken center. The feedpoint is balanced with an impedance in the range of 66–72 ohms, which is controlled to some degree by the element diameter-to-length ratio. Changing the center gap does not materially affect the impedance value, but a narrow gap is preferred.

Another version of a half-wave dipole is the one shown in **Fig. 4**, a folded dipole. It exhibits a balanced feedpoint impedance of 300 ohms. Folding the ends of the dipole raises the feedpoint impedance as compared with **Fig. 3**. A small change in the feedpoint impedance

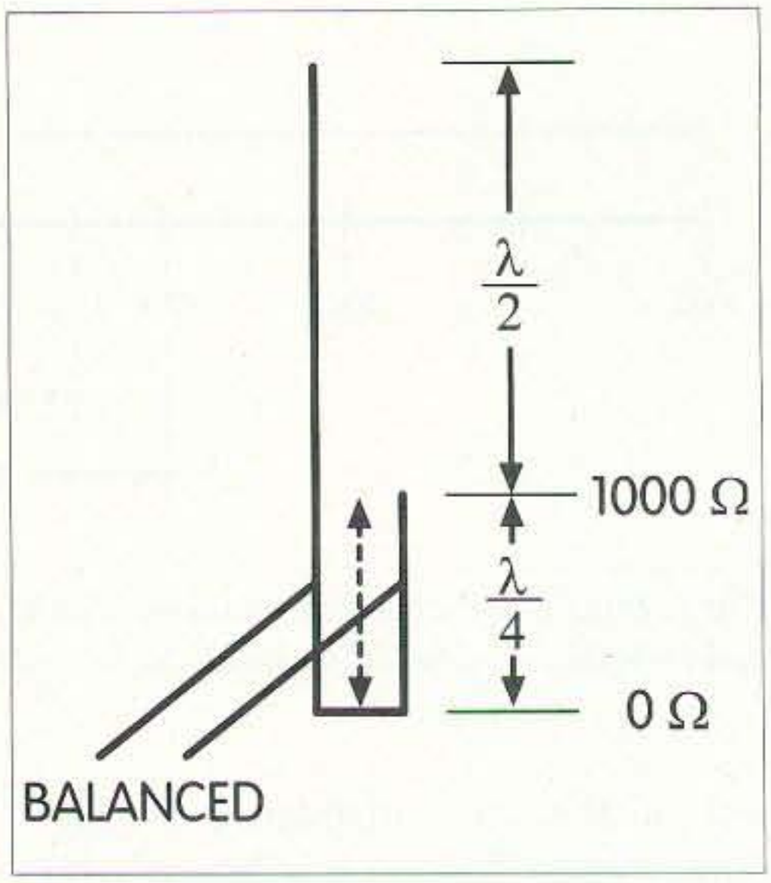


Fig. 6. *"J" antenna showing a balanced feedpoint that is variable from 0–1000 ohms.*

may be accomplished by changing the diameter ratio between the two parallel elements.

The antenna shown in **Fig. 5** is a discone which covers a wide frequency range while maintaining a constant unbalanced feedpoint impedance of 52 ohms. The gap between the disk and the top of the cone must be kept small.

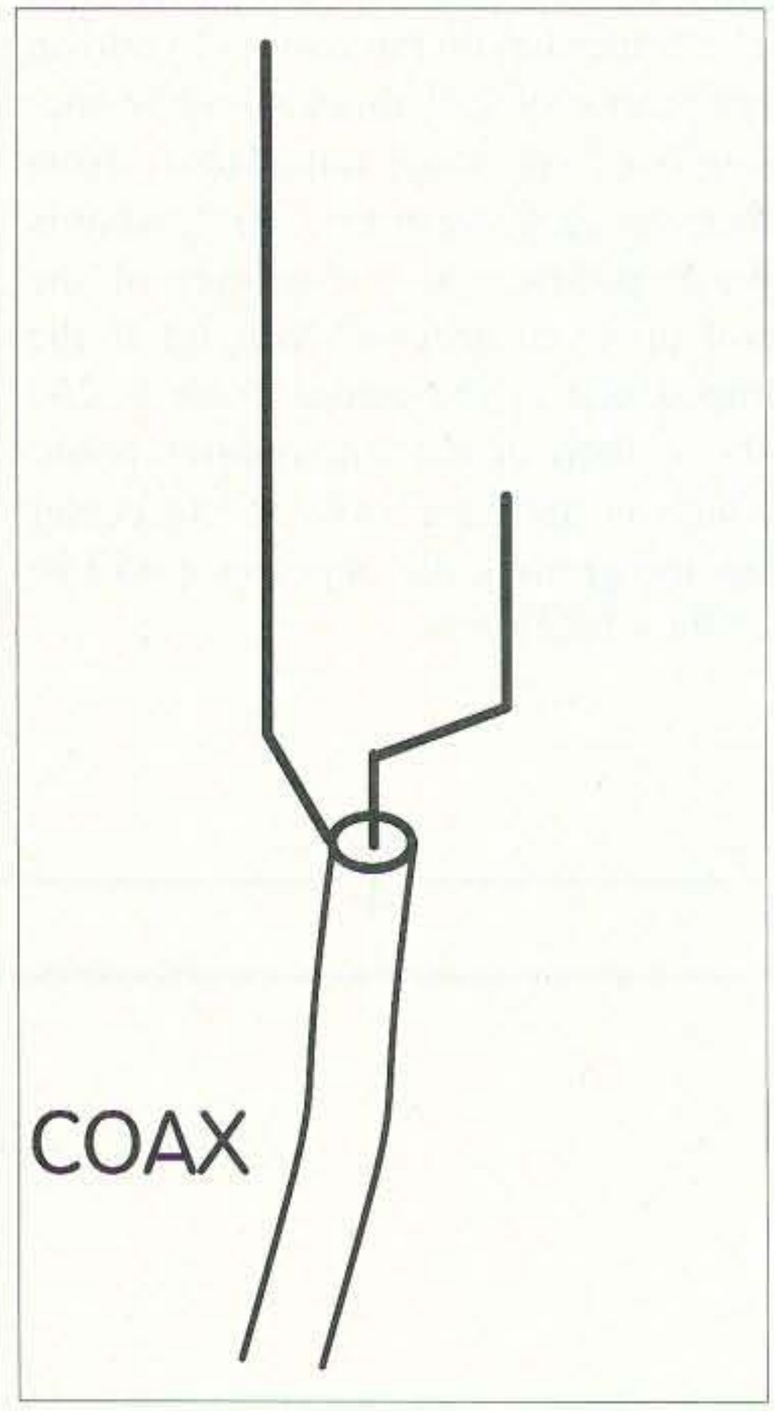


Fig. 7. *"J" antenna showing an unbalanced feedpoint of 52 ohms.*

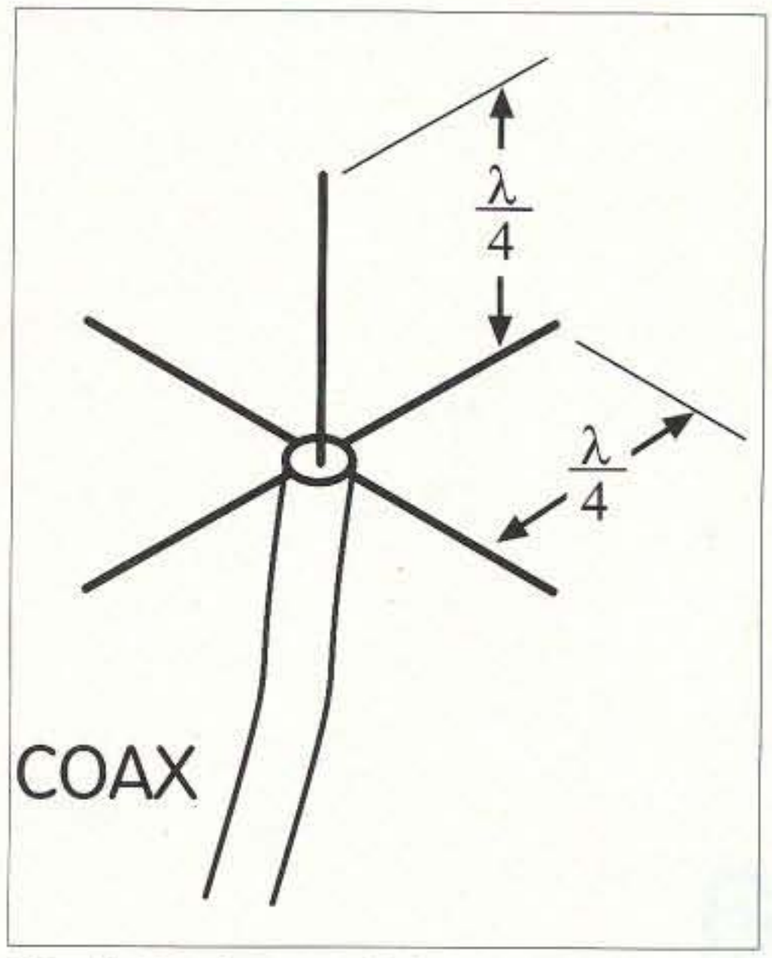


Fig. 8. Simple ground plane antenna. Feedpoint impedance is 23 ohms unbalanced.

A "J" antenna is shown in **Figs. 6** and **7**, with each having a different feedpoint. A "J" antenna utilizes a quarter-wave matching transformer mounted on one end of a one-half-wave element. The half-wave element is endfed at a high impedance from the transformer section. The transformer section operates as a resonant matching stub, permitting a balanced variable matching impedance for a transmission line from zero to approximately 1000 ohms. The impedance distribution along the transformer section may be determined by using the mechanical technique described previously. As shown in **Fig. 7**, the bottom of the transformer section has been broken, creating an unbalanced feedpoint exhibiting an impedance of 52 ohms.

Figs. 8 and **9** show a ground plane antenna in two configurations. **Fig. 8** is the basic form in which the ground elements are 90 degrees to the antenna element. In this configuration, the feedpoint impedance is approximately 23 ohms. Because of the low value, the impedance must be raised in order to match the 52 ohm impedance of available coax. The impedance at the feedpoint may be raised as shown in **Fig. 9** by lowering the ground elements. At a down angle of approximately 45 degrees, the feedpoint impedance will be raised to 52 ohms.

The antenna shown in **Fig. 10** is a coaxial antenna and near cousin to the ground plane shown in **Fig. 9** where the ground elements are lowered to become parallel with the plane of the vertical element. Even though the elements are one-half-wave in overall length, the lower element is usually a tube that surrounds the coaxial feedline, which makes the two element sections electrically similar but mechanically different. As a result, the feedpoint becomes unbalanced and exhibits an impedance of 66–72 ohms, similar to a broken half-wave dipole.

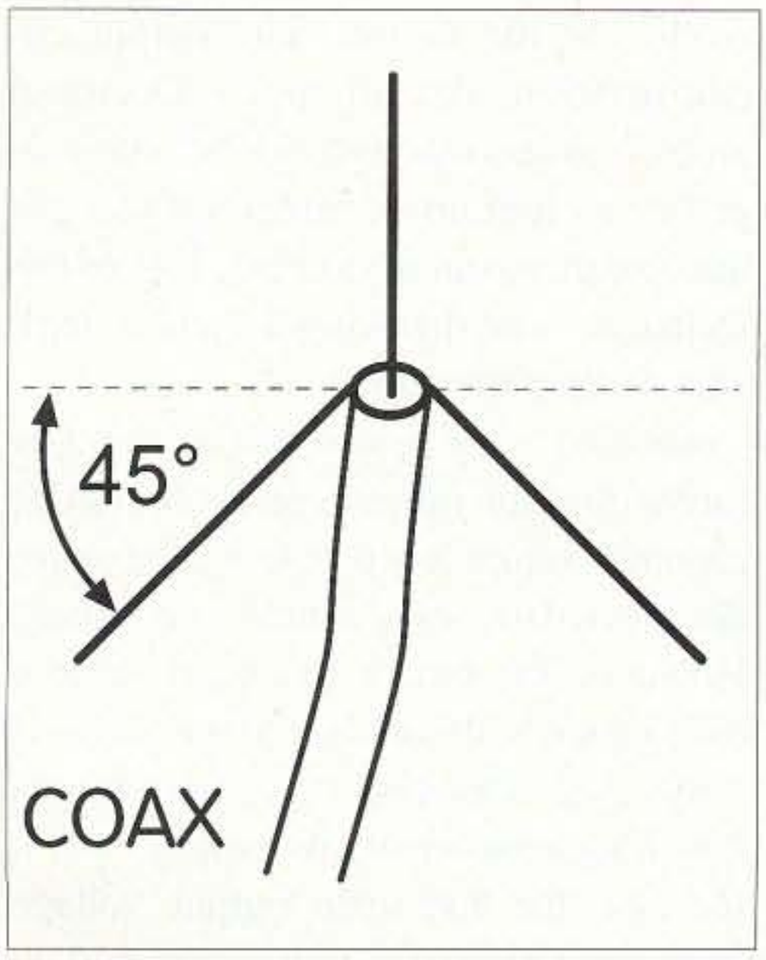


Fig. 9. Modified ground plane antenna with ground elements bent down 45 degrees below horizontal. Feedpoint impedance is 52 ohms unbalanced.

Conclusion

The impedance distribution along a resonant antenna element may be determined mechanically. The usefulness of knowing the distribution aids in the construction of the antenna and selection of a suitable feedline. The *caveat* to the mechanical-impedance determination is that the actual element impedance is directly affected by the proximity of other elements surrounding the antenna, requiring some mechanical compensation in the measurement, but understanding the approximate location of various impedance values along an antenna element helps the builder make construction decisions. 73

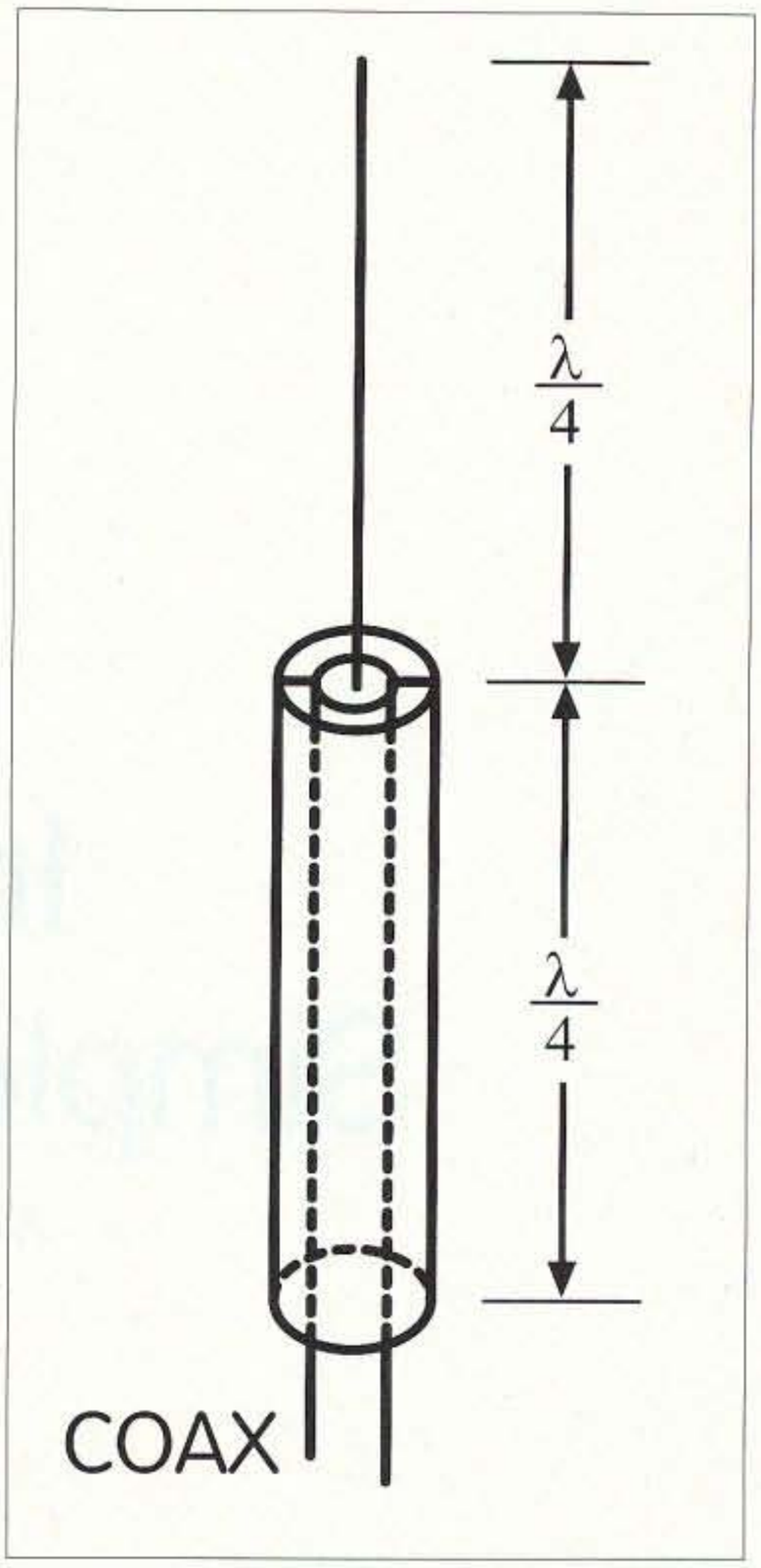


Fig. 10. Coaxial antenna. The lower quarter-wave element surrounds the feedline. The feedpoint impedance is 66–72 ohms unbalanced.

In Search of a Simple Capacitor Tester

A midsummer night's dream project.

Robert B Landon KD6ORG
6860 Eddinghill Drive
Rancho Palos Verdes CA 90275
[rlandon@flash.net]

If you're like me, you have accumulated in your junk box many little things that look like capacitors. If only you had the Rosetta stone, you could figure out the meanings of all the weird colored dots and microscopic printing on these junk box parts. Then, you might even be able to find a use for them someday. Alas, except for a few random successes wrought by studying numerous handbooks, for me the dots have remained just dots and the parts, unusable junk.

After becoming frustrated by having to purchase a new capacitor just to be certain of its value, I decided to find a way of measuring the existing capacitors in my junk box. A quick review of the catalogs showed that there are lots of capacitor testers on the market. Most of these are included with digital multimeters. Also quickly noted were the prices of these little jewels! I was not interested in making a career out of measuring capacitors and already had a multimeter. Also, I didn't need to measure the big capacitors where you can read the values on the body of the capacitor. Armed with these ground rules, I began my search for a simple capacitor tester (a.k.a. cheap!).

The method described in this article was selected after many false starts and failed concepts. It has proven to be quite forgiving of construction techniques, battery voltage changes, and varying voltmeter impedance. In addition to these features, it only uses one low-cost chip, so it certainly qualifies as being inexpensive.

General design concept

The basic method uses the time it takes to charge the unknown capacitor to a particular voltage. This procedure results in converting the unknown capacity value to a time value. The larger the capacitor's value, the larger the time value. This time value is then used to establish the pulsewidth of a recurring waveform and thus control the recurring waveform's average DC value. Thus the time value is converted to a voltage value, which can then be measured by any voltmeter. A highly asymmetrical multivibrator running at approximately 250 Hz controls the recurring waveform's basic time frame.

The chip used is a 339 quad comparator chip. This chip features very low current drain, input power supply levels up to +36 volts, large input current capability for quickly discharging the capacitor under test, and the ability to use "wired AND" on the output. The output circuit performs like an open collector of an NPN transistor and can be wired together so that any comparator can pull the collective output to zero. Use of this technique saved having to add a logic chip for that function.

Another very nice result of this feature is that the output can be shorted to ground without any problem. The circuit described here uses a nine-volt battery. However, the circuit has been successfully tested with supply voltages up to 18 volts. The only change caused by this 100% increase in supply voltage was to increase the full-scale output voltage. This change was easily corrected by adjustment of the scale control.

This tester can measure capacitance values from the picofarad range to the

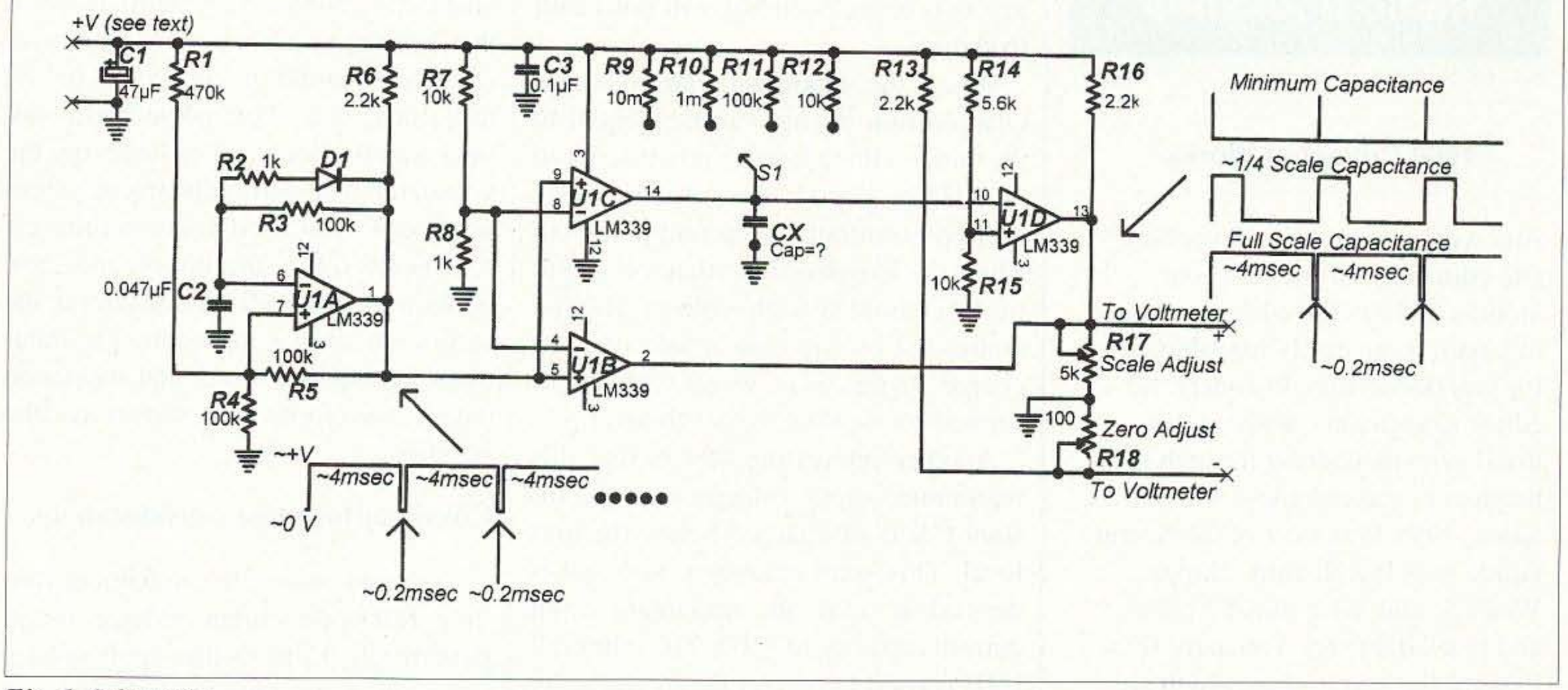


Fig. 1. *Schematic.*

high sub-microfarad range. The low end is limited by stray capacitance (although the measurement effects can be minimized with the offset adjustment) as well as the extremely high resistance values required. The high end is limited by the length of time required to discharge the capacitance value within the small reset time provided.

In the tester described below, the range is from approximately 100 pF per volt to 0.1 µF per volt. Increasing the high capacitance range is possible by increasing the off time allotted to discharging the unknown capacitor by increasing the value of R2 in the schematic. If this is done, however, the maximum output voltage will be decreased unless the on time is similarly increased by increasing R3. Because measuring high-value capacitors was not a goal of this tester, it was decided just to "live with" this restriction.

Circuit description

These basic concepts are shown in **Fig. 1**. Comparator U1A on the left part of the schematic performs the multivibrator function. Its operation can best be explained by first assuming the output at pin 1 of U1A to be open with a voltage close to the positive supply voltage (being pulled up by R6) and that capacitor C2 is at a low voltage. In this condition, capacitor C2 will be charging towards the positive supply voltage through R3 and R6.

When C2 reaches the positive voltage at pin 7 of U1A established by R1, R4, and R5, it will cause the output of U1A to go low (near zero volts). The time C2 took to reach this switching condition is primarily set by the 100 k resistor R3 and the 0.047 µF capacitor C2. When U1A goes low, C2 will discharge very rapidly through the 1 k resistor R2 and diode D1.

When C2 is nearly discharged, diode D1 ceases to conduct and the remaining discharge toward the low voltage of pin 1 of U1A is through the much higher resistance of R3. The function of resistor R1 is to ensure that pin 7 of U1A is more positive than pin 1 when pin 1 is near zero volts. When the discharge of C2 causes its voltage to fall below the voltage at pin 7 of U1A, the output at pin 1 again switches to its high level near the positive supply voltage level and the sequence repeats.

This repetitive sequence results in the highly asymmetrical multivibrator waveform shown on the schematic at pin 1 of U1A. This waveform is fed to the plus (noninverting) inputs of comparators U1B and U1C while a small positive voltage derived from R7 and R8 is fed to their negative (inverting) inputs to ensure noise immunity. When the input waveform goes above the small positive bias, both U1B and U1C become the equivalent of an open circuit to positive voltages (like an open collector of an NPN transistor). When the input waveform is below this bias level, the outputs of U1B and U1C are essentially at ground potential.

U1C is used to set the charge and discharge times of unknown capacitor CX, and U1B is used as a buffer for use as a "wired AND" with the output of comparator U1D as described below.

During the short interval that the waveform from the multivibrator is low, U1C is discharging unknown capacitor CX. During the longer interval, CX is charging towards the positive supply voltage through the selected resistor (R9, R10, R11, or R12). These resistors determine the charging rate of the capacitor and set the basic sensitivity of the capacity tester.

The voltage on CX is monitored by comparator U1D on the negative input of pin 10. When the voltage on CX is lower than the positive bias level established by R14 and R15 on pin 11 of U1D, the output of U1D will be open and its voltage set by R16 and the full-scale adjustment potentiometer of R17. With the values selected for R16 and R17, the highest output voltage will be about 0.7 times the supply voltage. If used with very low impedance

voltmeters, this maximum output voltage will be reduced but will not result in errors.

When the unknown capacitor has charged to a positive voltage equal to the bias voltage on the positive input of U1D on pin 11, the output of U1D will go essentially to ground potential. Thus, the length of time that the output of U1D is at a high voltage will be controlled by the time it takes CX to charge to this bias level, with larger capacitors yielding longer times.

Another interesting fact is that this maximum output voltage starts the instant CX is discharged below the bias level. This is an unknown time that is dependent upon the maximum input current capacity of U1D. The output of U1B is used to correct this problem by ensuring that the output of U1D cannot go high until the discharge cycle is over by using the "wired AND" capability of the 339 comparator. Thus, by connecting the output of U1B to the output of U1D, the output is forced to remain low until the short discharge period of the waveform is over.

An infinite capacitance or short circuit at CX, for example, will never charge up to the bias level and will, therefore, leave the output permanently at its maximum voltage except during the discharge period. This is the saturation level of the tester. The choice of R14 and R15 sets this bias level to approximately 0.64 times the positive supply voltage. This is very close to the value of 0.632 times the supply voltage obtained when time is equal to the RC time constant.

Because CX will be discharged every time the input waveform goes low (about every four milliseconds), RC time constants larger than that will exceed the full-scale capability of the tester. For example, if the one megohm resistor R10 is being used, a capacitor of 0.004 µF times one megohm equals the full-scale time of four milliseconds. It is important to understand this limit to ensure that it does not result in a measurement error.

Another issue is the residual capacity caused by the circuit as well as the test leads. At the highest sensitivity setting, when using the 10 megohm resistor R9, even this small capacitance can cause a very short pulse at the beginning of each measurement cycle with nothing connected to the test leads. This short pulse will result in a small measured voltage on the voltmeter. The zero adjustment potentiometer R18 is used to correct this error. Both full-scale limits and zero correction will be discussed later in the section on setup adjustments. The minimum, one-quarter-scale, and maximum output waveforms are shown on the schematic.

Circuit adjustment considerations

As stated earlier, the maximum limiting full-scale output voltage is approximately 0.7 times the supply voltage (~6 volts for a slightly old nine-volt battery, less a small zero adjustment).

Although there are many ways to adjust the capacitor tester depending on how you want to use it, the following approach seems to be the simplest and assumes the use of a nine-volt battery. My old analog voltmeter has low voltage scales of 0.6, 3.0, and 15 volts. I decided to use the three-volt scale and adjust the circuit for a scale factor of 100 pF/volt on the most sensitive scale (i.e., using the 10 megohm resistor R9).

Because the maximum limiting capacitance is approximately 400 pF, any reading within the three-volt scale (i.e., three volts at 300 pF) will be well within that limit. The adjustment for scale factor uses a "trusted capacitor" somewhere in the range to set the scale factor potentiometer. For example, I had a clearly labeled 220 pF 5% capacitor in my junk box and set the scale factor with that. The zero adjustment and scale adjustment are interactive, so you may have to iterate a few times. To achieve maximum accuracy, each scale should be checked (and readjusted as necessary) using known-value capacitors. For example, the adjustment on the next most sensitive scale using the one megohm resistor R10 would use a 0.003 µF capacitor or less to check/set the scale factor and zero adjustment.

This tester has been successfully used on the 0.6-volt scale for testing very small capacitors down to less

Parts List	
D1	Diode (RS 276-1122)
R1	470 k (RS 271-312, 271-1354)
R2, R8	1 k (RS 271-312, 271-1321)
R3, R4, R5, R11	100 k (RS 271-312, 271-1347)
R6, R13, R16	2.2 k (RS 271-312, 271-1325)
R7, R12, R15	10 k (RS 271-312, 271-1335)
R9	10 megs (RS 271-312, 271-1365)
R10	1 meg (RS 271-312, 271-1356)
R14	5.6 k (RS 271-312)
R17	5 k pot (RS 271-1714)
R18	100 Ω pot (DK 36C12-ND)
C1	47 µF (RS 272-1015)
C2	0.047 µF (RS 272-134)
C3	0.1 µF (RS 272-109)
CX	junk box cap
U1	LM339 (RS 276-1712)
S1	Multi-pole switch (RS 275-1386)

Misc. Parts: 14-pin IC socket; 2"x3" perfboard; 4"x3"x1.5" enclosure; terminal posts; clips for CX

RS = Radio Shack (800) THE-SHACK
DK = Digi-Key (800) DIG-IKEY

Table 1. *Parts list.*

than 5 pF (where many of the mysteriously labeled junk box capacitors can be found). With a basic 100 pF/volt scale factor, the analog meter reading is full-scale at 60 pF. On this scale, it is quite sensitive to distributed capacity and several iterations will be necessary to set scale factor and zero adjustments.

Construction

The original version of this tester was built on a small piece of perfboard and had a single 10 megohm sensitivity resistor for small-value capacitors only. Other than the unsightly condition of the tester, it proved just fine for the limited purpose of checking low-value junk box capacitors. The latest "deluxe" version uses a switch to select the sensitivity resistors (R9 through R12), has terminals to connect the voltmeter, and is in a reasonably attractive plastic enclosure. The only known construction concern is to minimize the distributed capacitance associated with CX (i.e., U1C pin 1, U1D pin 10, S1, and the sensitivity resistors R9 through R12 as well as the leads to CX itself). 73

Never say die

continued from page 37

level of reading proficiency. Even our top students are doing poorly, placing *last* in a recent study of students in 13 countries in math and science.

I loved the front-page article in the *NY Times* about the city spending $185,000 in an effort to fire a teacher who was in prison for dealing cocaine.

If you've the interest to read some books exposing the corruption in our school system you may get as upset as I am over what we've let happen to our kids and our money through our inattention. I've written before about the school maintenance men who make over $80,000 a year and work three or four days a week. You and your kids are being screwed and you haven't even whimpered yet, so it's going to get worse.

Our kids are not even being taught to read and write. I wish you could see some of the pathetic letters I get from obviously almost illiterate people. A recent study showed that 47% of Americans have low levels of literacy. I believe it!

A Barnes & Noble study showed that about one book in ten that they sell actually gets read. And a study of our teachers showed that they read an average of one book a year. Fiction, of course.

In Kansas City they doubled the property taxes and poured $1.3 billion into the schools. Computers for two out of three students, pay raises for every school worker, including janitors, a $5 million swimming pool, and $1 million a year to promote the schools on local television. The results of this spending spree? The student scores haven't changed much. The dropout rate still is around 60%. The black enrollment when the spree started was at 69%. Ten years later it had zoomed to 70%, even though some students were now being taken to school by taxis.

Kindergarten for all cost a bundle, but it hasn't raised test scores later on. Well, it's a wonderful baby-sitting system, so the mothers benefit.

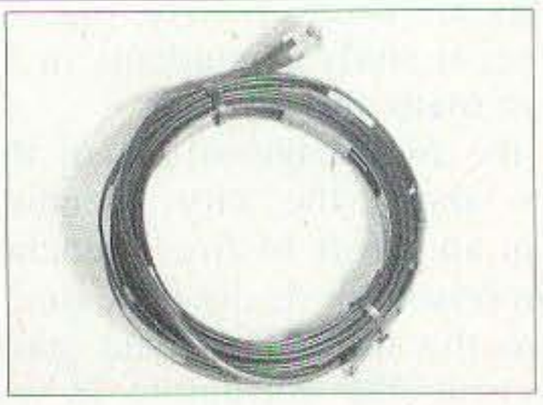
Richer

Both democracy and capitalism have serious downsides which we prefer not to think about. Well, like we say about our country, it has some terrible flaws, but even so it's better than any of the alternatives. So, mindful of that, I keep researching the reasons for our country's larger and more easily identifiable flaws and proposing ways to eliminate them. But eventually we're going to have to come to grips with the major problems

Continued on page 80

Number 72 on your Feedback card

New Products



TAKE ME ALONG!

When you go on vacation, on a business trip, or even to the in-laws' place for dinner, be sure you go prepared—with the new MFJ-1736 six-meter J-pole antenna. Get base station performance anywhere; hang up the 156 inches of 450 Ω ladderline to get great QSOs; when you've had your fill of DXing or exploring exotic sporadic E, just roll it up and toss it in a corner of your briefcase. It works great with the MFJ-9406 (which you've got, of course!) or other six-meter transceiver, and naturally, it comes with MFJ's famous "No Matter What" warranty. To order, or for the name of your nearest dealer, call (800) 647-1800; FAX (601) 323-6551; E-mail [mfj@mfjenterprises.com]; or check out dealer and ordering information at MFJ's Web site: [http://www.mfjenterprises.com].

SEE — AND AVOID — INVISIBLE FIELDS!

The matchbox-sized Micro Alert alarm from AlphaLab, Inc., will let you find out exactly what's emitting radio or microwaves, whether visible or in hidden locations. At highest sensitivity (from 100 MHz to 5 GHz), it will detect a cell phone tower half a mile away, a cell phone 40 feet away, a digital phone 20 feet away — and strong sources of radio and microwaves that you might never suspect, like some wall outlets. An enhanced-sensitivity version (below 100 MHz) is also available for surveillance detection, if you're concerned about that.

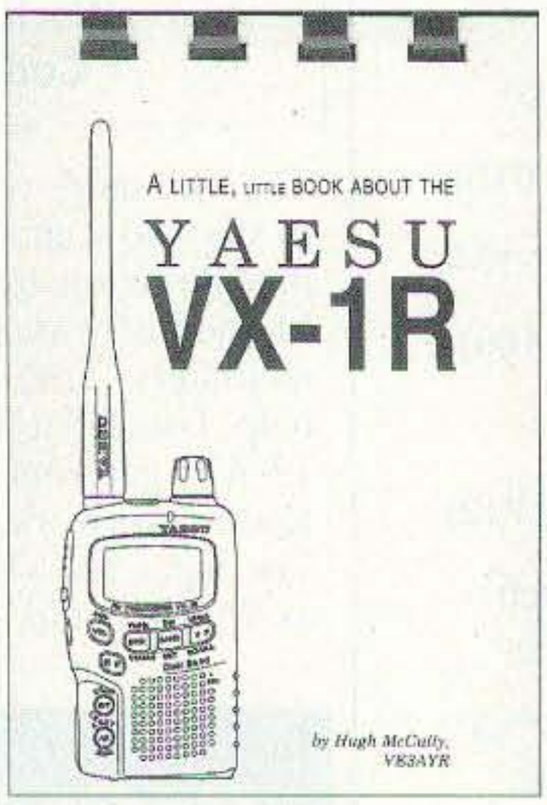
The unit comes with a three-year battery and a one-year warranty, in three colors: black, gray, and off-white. It's priced at $81.50 plus shipping and handling. For ordering information, E-mail [emfmeter@webtv.net].

SPECIALTY NUTDRIVERS

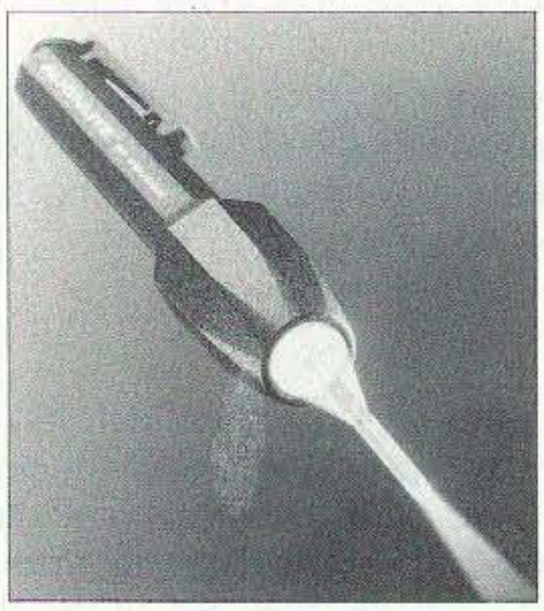
Got a Jensen Tools catalog handy? If your copy is dog-eared, maybe it's time to update. One recent addition to the catalog is the line of Crescent® insulated nutdrivers, with each unit individually tested for 1000 volts. These hollow-shaft tools are precision machined with case-hardened sockets and rubber cushion grips. They feature double insulation, red over yellow, so you can spot faulty insulation. The eight sizes of nutdriver (3/16-inch to 9/16-inch) comply with IEC900/ASTMF1505-94.

For information on Jensen Tools or a free catalog, contact Jensen Tools, 7815 S. 46th Street, Phoenix AZ 85044-9974. Phone (800) 426-1194 or FAX (800) 366-9662.

HE'S NOT KIDDING ABOUT THE TITLE



Yes, it's *A LITTLE, LITTLE BOOK ABOUT THE YAESU VX-1R* by Hugh McCully VE3AYR, a comb-bound pocket reference the size of a deck of playing cards. It contains virtually anything you'd ever want to know about the VX-1R in its 68 pages, and is handily organized from its table of contents to its index to answer all your questions instantly. Get your copy from Janus Computer Services, 610 Barons Court, Burlington ON L7R 4E4, Canada. The price we saw was $4.95, but since we don't know if that's US or Canadian dollars, or if it includes shipping, we suggest you either call (905) 333-0826, or E-mail [janus@bigwave.ca].

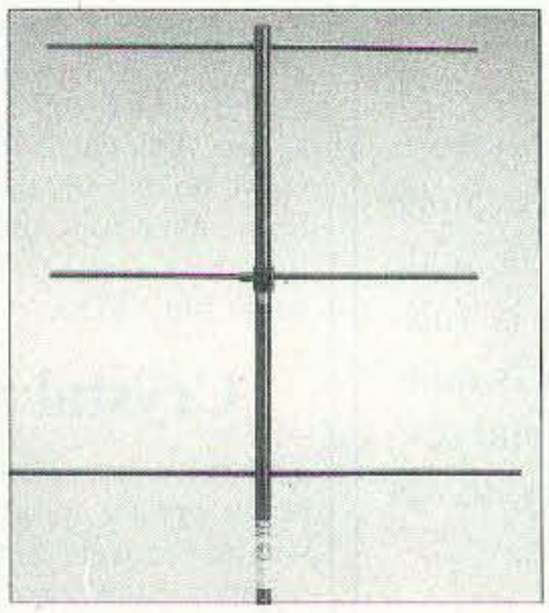


HEY! WHO TURNED OUT THE ...

Well, you won't have to worry about it. Here's Pelican Products' cool new Alignlite™—the world's first alignment tool with a light. The Alignlite's 6000 candlepower xenon beam (600% brighter than an ordinary flashlight!) illuminates even the darkest corners. It's submersible to 500 feet, and when the alignment tool is detached, you can use it as a pocket light.

It just keeps getting better! This little winner comes with two vision aid lenses (red and blue/green) *and* the batteries are included.

Contact Pelican Products, 23215 Early Avenue, Torrance CA 90505 and ask them about catalog number 1975. Call (310) 326-4700; FAX (310) 326-3311; or visit the Web site at [www.pelican.com].



NEW YAGI

Larsen Electronics introduces the new YA3220 line of yagi directional antennas. The compact three-element design offers a full 6 dBd (8 dBi) gain.

The new yagi is factory-tuned to cover the 220–225 MHz band at a maximum of 1.5:1 VSWR.

As with all Larsen products, the YA3220 is backed by a Three Year No-Nonsense™ warranty. For more information, see your dealer or contact Larsen Electronics, Inc., 3611 NE 112th Ave., Vancouver WA 98682. Call (360) 944-7551 or FAX (360) 944-7556.

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Number 74 on your Feedback card

The Digital Port

Jack Heller KB7NO
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A classy approach to SSTV (and you get a free trial!)

A few months ago, an all-new SSTV program emerged using only the sound card in the IBM-compatible as an interface. Further back, in the January column, I mentioned success with W95SSTV. This was a predecessor to ChromaPIX, which is the topic of today's discussion.

These programs have the same authors and can be found on their Web sites. (See **Table 1**.) They are shareware that deserve a close look if you have even the slightest interest in slow scan TV (SSTV). I never did until this last year, when I found that the only interface I needed between my computer and the radio was either a pair of cables to a sound card (cost: $10 to $15) or a serial modem for maybe twice the cost. I have had great success with both.

I have been experimenting with digital signal processing (DSP) in the shack and the ChromaPIX authors claim DSP in their program.

Next month's column will center on DSP, but this program does a whale of a job of digging good, readable images out of the muck that piles up in the narrow slot on 20 meters (14.230 and 14.233) devoted to SSTV.

The presence of this program had been running around in the back of my mind. I just happened to run across a copy of it on CompuServe's Hamnet. Since it is a bit large at 5+ megabytes, I decided I would download it from there because I have a direct connection to a local node which is faster than from a Web page. Even that connection choked and took an extra 10 or so minutes, but now I had the real thing for a trial run.

Use the sound system on your laptop?

However, I didn't get around to it for several weeks. More busyness than I care to explain. The fun started when I decided to try it on the IBM laptop with its sound capabilities. There isn't a lot of info that comes with today's computers. The manufacturers have determined that none of us read the darn stuff, and those who do call to ask what the documentation means, anyway. The rest of us manage to stumble through and get these things working or go over the edge and make real smoke.

Anyway, the side of the little computer has jacks that have international symbols relating to "line in" and "line out," which is what I was looking for. I ran my cable from the speaker jack on the Icom 735 to the line-in and a cable from the line-out to the appropriate accessory jack on the back of the radio. I took a look and, sure enough, the spectral display was responding to the audio signal from the radio. This looked like a piece of cake.

Smoke ...?

You who have read this column before are waiting for the inevitable ... well ... it happened. No, there was no smoke. Everything appeared to work except that the received images were unreadable. All the buttons and menus responded and the included images would display and the editor controls would skew the colors and contrast into hideous proportions. I even tried a short transmit test and the program modulated the outgoing signal from the radio.

I wonder sometimes why I try things others wouldn't even think of doing. Must be something to do with mountain climbing, but that is a physical endeavor and it is different. Don't get me wrong. I never got into mountain climbing "just because it was there," and I don't have ill feelings toward those who do. My forays into the unknown are nearly always mechanical or electrical by nature. The local store is waiting for the day when I bring the charred and broken laptop back with a coax connector hanging out the side. (They told me just that a year or so ago.)

Since then, I have been in touch with Jim Barber N7CXI, and he sent a file explaining that some (many?) laptops are fine for handling regular audio. However, the demands of this program are a bit much. Jim did give a pointer that may help overcome the problem. Incidentally, where credit is due, the

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RTTY Loop

continued from page 63

my trouble stems from some of the CPU/Menu settings on the FT-920 versus anything wrong with the PK232MBX."

Sure! Mentioned here a few months back, the GreenKeys reflector list may be just the ticket. Just send your question to [greenkeys@qth.net], and it will be sent on to hundreds of RTTY enthusiasts, both on and off the air. It is likely that one of them will be able to solve your problems.

Let's conclude this month's column with a story. Captain Paul Wolboldt, CAP, passes along the following tale:

"I have been reading your column for a couple years now—I think, since I arrived here from Hawaii in February 1996. You have a great column. *[Thanks ... MIL.]* I had been a crypto equipment repairman in the Air Force for many years before my discharge from the service. In July of 1994 I signed on with the Hawaii Army National Guard in a combat support battalion. This tour lasted until I left there in February 1996. The interesting thing that had happened to me was that I had been assigned to repair teletype equipment/terminals. About two months before I left, the unit was inventorying all of their equipment because they were changing missions and wanted to turn in all of their old equipment. We pulled out two big travel boxes that were labeled "teletype." Having worked around the teletype guys in the USAF I thought they might be some sort of Model 28 type of gear. Nope. Inside each box was a brand new Kleinschmidt—in perfect condition, not a scratch to be found. They even *smelled* factory-new. The ribbons had never been used. Good thing no one asked me to work on them. I didn't have any books or tools for it. I doubt the company has them since it has been two years. I guess old stuff will turn up in the strangest of places for a long time to come."

Yes, Paul, I agree; you never know where something will turn up. This summer, I have been going through my basement, and I have found stuff that has been lost for years—which is not to say my wife let me *keep* it, just that I could say, "Oh, that's where it's been," before throwing it out!

Check that "RTTY Loop" Home Page, for pointers to all the stuff I've been talking about. You never know what you might find! 73

Current Web Addresses	
Source for:	**Web address (URL)**
HF serial modem plans + software	http://www.accessone.com/~tmayhan/index.htm
PCFlexnet communications free programs	http://d10td.afthd.th-darmstadt.de/~flexnet/index.html
Tom Sailer's info on PCFlexnet	http://www.ife.ee.ethz.ch/~sailer/pcf/
SV2AGW free Win95 programs	http://www.forthnet.gr/sv2agw/
BayCom – German site	http://www.baycom.de/
Pasokon SSTV programs & hardware	http://www.ultranet.com/~sstv/lite.html
Winpack shareware for Windows	http://www.duckles.demon.co.uk/ham/wp.htm
Baycom 1.5 and Manual.zip in English	http://www.cs.wvu.edu/~acm/gopher/Software/baycom/
Tucson Amateur Packet Radio—where packet started—new modes on the way	http://www.tapr.org
TNC to radio wiring help	http://prairie.lakes.com/~medcalf/ztx/wire/
ChromaPIX & W95SSTV	http://www.siliconpixels.com/
VHF packet serial modem kit	http://www.ldgelectronics.com

Table 1. *Current Web addresses. All of the above were cut and pasted directly from the Web page to avoid the inevitable errors when copying. If you encounter a problem with a European address, the network is often at fault. Try again later.*

co-author of the program is William Montgomery VE3EC.

Good stuff on the Web site

Back to the story: I read all the info I had gathered on this laptop installation and there was nothing that said it couldn't be done. The next stop was the Web site, which contains recently updated material including a new manual and a frequently asked questions (FAQ) file.

The FAQ file was interesting because it answered a question I received from Jay WA3IFY. He had wondered about getting his W95SSTV program to key his transmitter automatically when he clicked the "Transmit" button on the screen. In this file is a keying interface to accomplish just that. My lazy-man's way was simply to put the transceiver in transmit mode manually, then click the program to send the image. That works, but most would like a little more sophistication in our equipment.

There was also an updated version of the ChromaPIX software with a patch file to update the previous beta version. I downloaded and printed all this valuable information. It is very well written. A word of advice, though. In my first printing of the manual in black and white, the images printed poorly.

Next time I printed in color, which definitely improves comprehension. If you have color capability, use it. The manual is in the *Acrobat* pdf format. It is a classy way to produce a very nice document that reads the way it was designed. The *Acrobat Reader* program is available at no cost and there is a link from the Web site if you don't already have a copy.

After reading the material and installing the update patch to the program, the incoming images were not improved. It was time to put the workhorse desktop to the task. Installation went well. For some reason, the screen fit the monitor better. On the laptop, I was not able to get the screen to maximize.

A quick check of the incoming signals showed that they were getting weaker as the evening progressed, but the spectral display said they were there. One small problem … the received signals weren't decoding at all … there was no image display.

Heed those warnings

Then came a warning display window from First Aid 98™ telling me my resources were low. Interestingly, after going to the recommended First Aid 98 window and picking a lower percentage threshold for the warning signal, pictures began to appear!

All was well. I was surprised to see the activity on SSTV so late in the evening. I had assumed everyone folded their tents about dusk. I stand cor-

Fig. 1. *Scanned from the manual, this is what the program looks like on your monitor. At lower right are tuning aids. Above those are the mode choice menu, and then the transmit and receive buttons. At middle bottom is file handling, and to the left are controls for editing the image. Clicking tabs gives access to more features, including received image filtering and more editing choices. I tried a live screen save to the clipboard, but the quality was very poor, so I couldn't display actual received images. Nonetheless, incoming images are excellent.*

Mode	Sound	Where to Listen (MHz)
SSTV	Steady warble (more like a small tree full of birds)	3.845; 3.857; 7.171; 14.230; 14.233; 21.340; 28.680; 145.5
RTTY	Two-tone, often varying but steady at occasional idle when no info being sent	3.605–3.645; 7.08–7.1; 10.14–10.15; 14.07–14.1; 18.1–18.11; 21.07; 21.1; 24.92–24.93; 28.07–28.1
PacTOR	Pulsating single tone warble approximately every second when linked	3.625–3.63; 7.07–7.85; 14.065–14.08; 21.07–21.09; 28.07–28.09
* FEC	Similar to RTTY; used in AMTOR and PacTOR modes	Detect while in "Listen" modes on above PacTOR frequencies
AMTOR	Rapid pulsating two-tone for send/error–check when linked	Not heard much since PacTOR came along and is using the same frequency ranges

Table 2. *Here are places to look and sounds to listen for. It is difficult to describe sounds that I can't quite make with my mouth. In some cases, it would take two people whistling simultaneously to approximate what you will hear, but this is information that seems to be left out of the reference books. GTOR is similar to PacTOR in sound and frequency. WEFAX? I have copied some once upon a time, but I can't recall the sound. There are frequencies usually listed with the software. *FEC (Forward Error Correction) is used to call CQ. However, when a link can't be maintained, it provides an alternative mode of communication that may require repeated messages.*

rected. The outstanding image of the evening came from an Italian ham who was having an image-only QSO with a ham on the east coast. That was the best image I had seen thus far, at any time of the day, from Europe.

This was also a first time for me to observe a contact being made without voice monitoring between transmission of images each way. That seems like a natural way to go and I am sure others do it. Maybe they are labeled "purists."

The installation is straightforward. If you follow the written instructions, the program installation takes care of itself like a good Windows 95™ should. You will find the beta version is not crippled except for one thing. It will only run for 30 minutes at a time until you register it. A few sessions will give you a good idea about whether this is the program for you. So the trial run is cheap: the price of two cables. And if you have a few plugs, you can use any decent audio cable. I had some extra cable when I first hooked up the sound board, so it was relatively painless.

As far as cable connections go, the instructions on the Web site will tell you all you need to get up and running. Some digital connections will work just fine from the accessory port on the back of the Icom 735. The serial modem and the PK232 both function well with the incoming audio at a low, nonadjustable level, but the audio to line-in on the sound card requires speaker output. The line-out goes to the pin that goes to the modulator stage, plus a ground of course. (Consult your radio manual.)

You will find that the 18-page manual is an easy read that points you toward the various controls for filtering, editing, and repairing images. It is really an impressive array of controls that makes SSTV easy, fun, and inexpensive, especially when compared to systems available a few years back.

In **Table 2** I mention the 20 meter band frequencies at 14.230 and 14.233. There are others, though not so popular, where you will also find activity. A few weeks ago, I was tuning across 10 meters and came upon an SSTV warble at 28.680. I listened a few minutes and heard something that sounded a bit like Spanish, so I hooked up the modem and got an image featuring a map of Brazil in the background! It was Portuguese they were speaking!

The frequencies where you are most apt to find SSTV are listed in **Table 2** along with some other info. The reason for this chart was a request from a ham recently because he had purchased a great multi-mode TNC and didn't have a clue where to find the signals nor what they might sound like.

He was suggesting that I publish this information in the column, and I thought that was a very good idea. There is a time in everyone's life when we are BRODS (Before Recognition Of Digital Signals—didn't we need one more acronym?), and if we want someone to listen and talk to us, we had better let them know where we are. Sounds simple.

This has been a good month. The SSTV program was a lot of fun to experiment with. In his note, Jim expressed his desire to warn those who try the program that it is a beta version and is still "in process." Read the system requirements listed on the Web site to see if your computer can handle the load.

I appreciate the E-mail contacts for information and suggestions. It helps me to know what you want and how close on track I am. Plus, every now and then, someone points out one of my many missteps. That is good for me—it keeps my ego in control. Talk to you next month.

If you have questions or comments about this column, E-mail me at [jheller@sierra.net] and/or CompuServe [72130,1352]. I will gladly share what I know or find a resource for you. On packet, when you get a chance, drop me a line [KB7NO @ N7NPB.#NONEV.NV.USA.NOAM]. For now, 73, Jack KB7NO. 73

Number 77 on your Feedback card

HAMS WITH CLASS

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

Teachers' Workshop at Dayton

The Teachers' Workshop at the Dayton Hamvention® was filled with a wonderful exchange of really good creative ideas for instructors and teachers. My good friend Gordon West WB6NOA stopped by to remind the audience how important it is to have a ham radio teacher who is lively and enthusiastic. This is especially important when working with youngsters. With all the competition out there today for the children's time, it's important that we motivate and sustain their interest in radio.

Gordon and I plan to resume our "CQ All Schools Net" in September on 28.303 MHz on Tuesdays and Thursdays at 12:30 p.m. eastern time. We invite all to join us and get on to speak with the school kids.

Next, Dave Bell W6AQ gave a little talk about his work as Chairman of the ARRL Public Relations committee. He held the audience spellbound when he showed a videotape about DXpeditions which included recent footage from Heard Island. He gave suggestions about how to incorporate videos like this and other exciting ham radio contacts into classroom lessons. A copy of this video may be gotten free by writing to: Northern California DX Foundation, P.O. Box 2368, Stamford CA 94309-2368. I heartily recommend using it as a motivational and informative lesson in a classroom.

Richard Sandell WK6R, who has among his numerous accomplishments the fact that he was a college professor for many years, was my next speaker. During those years he personally brought more than 3,000 new hams into the hobby. He stresses how important it is to always have the mindset of a recruiter. "Ask," he says, "would you like to join us?"

Richard feels, like many of us, that the Internet cannot replace what we as ham radio operators have. The thoughts and emotions that we exchange easily with each other are not so easily traded on the Internet. In his own family, Richard told us that bribery worked very well with his three daughters and his wife. Whatever works! Richard continues to be a tremendous asset to ham radio by keeping the Hudson Division hams and others well informed through his publishing of the *Hudson Loop*. This service is available by free Internet subscription. To subscribe, send an Internet E-mail message to [subscribe@hudson-loop.org] and type "Subscribe Hudson Loop" on the subject line.

Rosalie White WA1STO is the head of the Education Activities Department at the ARRL. Rosalie offered the services of her department to those who are teachers or instructors. She displayed several of the League publications, highlighting those that deal with recruiting ideas and classroom techniques.

One of the teaching ideas she shared with us is the use of wooden blocks to show kids the progression of a block diagram or the building of a circuit. Rosalie informs us that *QST* magazine runs a series of articles about teaching ideas. Be sure to consult with her office or go to ARRL on the World Wide Web at [http://www.arrl.org/] if you are a teacher looking for ideas.

My next speaker was the dynamic Bob Heil K9EID. Bob is always a great motivational speaker for an audience of teachers—he has so much respect for teachers and the profound influence they have on their students. He is a proponent of the exciting, lively lesson and demonstration technique in the classroom.

Bob is a multi-talented individual with a tremendous list of accomplishments to his credit. He traced for us how his involvement with ham radio was responsible for the many wonderful opportunities he has had in his life.

Bob came up with several interesting suggestions about promoting your ham radio classes. One of them is to contact local TV talk shows. A visit to your classroom where children are involved with wholesome and unusual activities may be just what the local TV show producers may be interested in presenting.

On Staten Island, where I teach, there is a local cable company that has a community programming division. My ham radio classes have been featured several times over the years. You should make your class situation known to these local stations. There may be a need for a "filler" one day, and the station may call you to give you a chance. It's definitely worth a try.

My last guest speaker was Bill Pasternak WA6ITF. Bill is a tireless worker for recruitment of young hams. He is the number-one spokesman for the "Young Ham of the Year" award. Bill invited everyone to be on the lookout for enthusiastic youngsters who are actively involved in the hobby. Nominees for this award should not be children who have gotten licensed just to appease a parent or a teacher. There are so many talented young people out there. Let's all be supportive of them when we meet them on the air—and keep Bill in mind when this award gets publicized in a few months.

You might also want to keep *me* in mind by referring these children to me for an interview for the next Dayton Hamvention Youth Forum. My column next month will feature the wonderful young people who participated in the Youth Forum this past May. CU then. 73

Secrets of Deviant Behavior

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diodes D1 and D2 charging capacitor C4 to a peak voltage value. Two FETs are used to isolate this detector from adjacent low impedance circuits, with transistor Q1 providing a very light load on the receiver's FM detector. Transistor Q2 is operating in one leg of a bridge circuit and functions as a meter driver. Pot R8 is used to zero the meter when the gate of transistor Q1 is momentarily grounded. The circuit was implemented using 2N5245 transistors, but it is believed that others such as the 2N3819 and 2N4416 will work as well.

In conclusion, an FM receiver or scanner may be used for measuring or monitoring frequency deviation of an FM transmitter. Implementation is accomplished by connecting a scope or peak-reading AC voltmeter to the DC output of the receiver's FM detector. 73

An FET Probe to MMIC

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are not to scale and must be fitted to the user's desired packaging envelope. Copper trace widths may be adjusted to obtain any desired board profile.

Mounting the FET probe in a Sharpie pen case worked out well with the probe tip pushed into the cap (which is slightly wider than the pen body). Narrowing the board as much as possible will allow the board and large components to slide into the pen body. A hole is drilled in the center of the pen cap to allow the probe tip to pass. The closed end of the pen body is drilled with a hole large enough for the power lead, ground lead, and RG-174 coax to pass.

Because of the high-frequency attenuation factor exhibited by the RG-174,

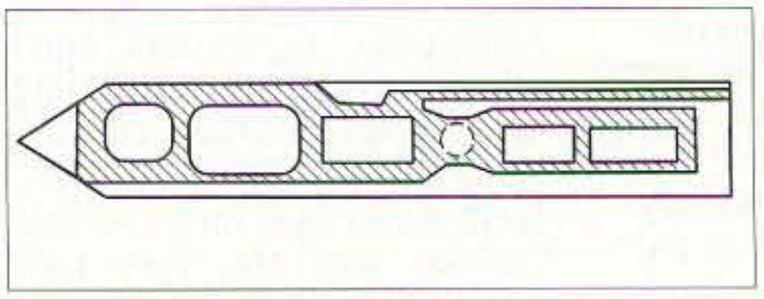

Fig. 5. Single-sided printed circuit board layout for the FET probe with Mini-Circuits MAR-1 or MAR-2 MMIC.

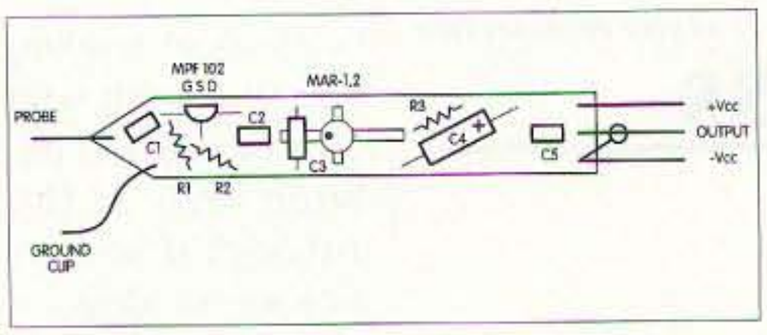

Fig. 6. Parts layout for FET probe using a Mini-Circuits MAR-1 or MAR-2 MMIC.

its length should be kept as short as possible. Also, to reduce reflections and to achieve the best signal transfer between the probe and the equipment in use, the equipment end of the coax may require an impedance termination.

A coax tee with a non-inductive resistor on one port is usually sufficient to achieve the desired match. The value of the resistor would typically be 50 ohms to match the probe and coax impedance. But in the case of the FET probe, the resistor value should be determined experimentally since the equipment's input impedance is a factor in achieving the proper match. In some of my experiments, it was proved better to have no matching resistor attached—which, again, provides room for user experimentation.

In operation, I found that my FET probe using the UPC1651 operated best at 4.5 V in order to achieve the best wideband performance. I recommend a trial test run in which the V_{cc} is varied from about 3–5 volts in order to find the best point of operation for your project. Some versions of MAR devices other than the MAR-1 and MAR-2 require a slightly lower supply voltage than does the UPC1651, which needs five volts.

The FET probe is easy to build and can be an asset to your test equipment and the experiments you perform. Give it a try! Both the circuit and the board layout for each is shown to provide you with construction options. 73

QRX

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10-meter high power capability would be the easiest thing by the next *CQ* 10 Meters Contest. And the extra money might allow him to add computer contest logging ...

The stranger frantically finishes writing the check and waves it in front of Jake. "Here it is, ready to hand to you right here and now. $15,000. Take it or leave it."

Jake abruptly makes his decision. "OK," he says, and peels off the watch.

They make the exchange, and the stranger starts happily away.

"Hey, wait a minute," calls Jake after the stranger. The stranger stops and turns as Jake points to the two suitcases he'd been trying to wrestle through the bus station. "DON'T FORGET YOUR BATTERIES!"

TNX to *The Propagator,* West Palm Beach ARC, Inc., June 1998, Sam Falco KD4VBI, editor.

Heart Problems

If you think you have RFI problems, a Dallas, Texas, television station has you beaten by a city mile. When it turned on its new high-definition transmitter, it caused the wireless heart monitoring system at the Baylor Medical Center to lose all patient contact. According to news reports, no patients were injured during the system outage. The station involved, WFAA, did agree to suspend operations of the new transmitter until the hospital monitoring system was moved to a new set of frequencies not prone to digital television interference. But the shutdown of wireless heart monitors following launch of DTV service in Dallas is almost certainly a harbinger of similar problems elsewhere.

According to *Communications Daily,* the problem centers on the fact that many hospitals have wireless systems which relay patient heart activity data to nursing stations. This lets the patients roam about. Unfortunately, many of these systems rely on previously unused television channels which just now are being occupied by new digital television signals. Moving all the heart monitoring systems will be an expensive proposition for the nation's hospitals, and the heart monitors are not alone. Many other types of wireless systems are believed to use currently unused DTV channels as well.

From *AARC/OVER,* newsletter of Austin ARC, April 1998, Lloyd Crawford N5GDB, editor.

Radar Love

If you're single, you can use radio technology to help find a partner—as long as you're in Japan. "Lovegety" is a small unlicensed radio transceiver attached to a keychain. The $25 gizmo acts as a personal beacon to attract someone to

chat with, a karaoke singing partner, or a mate, depending on switch settings. Hundreds of thousands of units have been sold.

The Lovegety (or "Love-G") has an egglike enclosure with a bottom section that indicates its gender (blue for boys, pink for girls). A Lovegety will beep and flash when it detects another Lovegety, as long as the units are switched on, within close range (about 15 feet), and of the opposite gender. (Some advertising for Lovegety poked fun at a man who wore lipstick and carried a ladies' Love-G.)

The manufacturer, Erfolg, is said to be developing additional models, some with longer range, voice capability, and even a display of personal information.

The company intends to market Lovegety in Britain and Hong Kong. So far, we haven't heard any plans to market the device in the US. If Erfolg does set its sights on the US, we recommend that it employ some better advertising copywriters. Here is a sample of the company's English-language promotional material:

"When a man has LOVEGETY, when a woman having LOVEGETY approaches the man, each LOVEGETY reacts, and a sound sounds. It is the product which can inform opponent of a feeling of oneself even if you do not speak this. If you are the person who is not readily invited to a woman, it is the most suitable product. Or it is the product which is most suitable when you demand an encounter with a woman different from usual. Therefore I use it, and you can be excited by a feeling of the time! There is residual various kinds of usage. Find it pleasantly hard together!"

More about Lovegety at [http://www.kishina.com/lovegety2/].

From the *W5YI Report*, June 15, 1998, Fred Maia W5YI, editor.

Another Science Lesson

When I got my two-meter HT, I also bought an extra battery so I could be charging one up while I was running the other down. Over a period of time, both batteries have been used about an equal amount of time, used under similar conditions, and recharged about the same number of times. With this in mind, I found it hard to understand why one battery would hold a charge for an extended period while the other battery seemed to drain off in nothing flat. I have pondered this situation for some time now and have come up with a theory. It goes something like this:

Most people don't realize that electrons come in two kinds—male and female. My one battery, the one that holds a charge, had both male and female electrons placed in it at the factory. When the radio is turned on, the electrons become excited and actually produce more electrons. With these additional electrons available, the battery will hold a charge longer. Eventually, however, the interbreeding of the electrons produces a lower-grade electron and a complete recharging finally becomes necessary.

The second battery, the one that won't hold a charge, had only male electrons placed in it, as a result of an error at the factory when the battery was built. With this battery, when the radio is turned on, the male electrons get excited but with no females around soon abandon the battery, leaving it dead. These male electrons usually fall to the floor, where evidence of their existence can be found when we walk across the carpet and pick up static electricity.

Adapted from a piece by Ken Jones WD9IBJ in *Bandbits*, newsletter of the Peoria Area ARC, Vol. 12., No. 4, James F. Williams N9HHU, editor.

1.2 GHz Threat

The ARRL has learned that the second civilian frequency for the global positioning system (GPS) could wind up within amateur radio's secondary allocation at 1.2 GHz. A decision on whether the new, second frequency will be 1205 or 1250 MHz is expected to be made in August. An allocation at 1250 MHz could mean the end of amateur radio in the band 1240 to 1260 MHz. The amateur radio 23 cm band runs from 1240 to 1300 MHz.

In February 1997, the Department of Transportation and the Department of Defense announced an agreement assuring civilian GPS users of a second frequency—referred to as L5 and considered essential for critical civilian GPS uses. According to a DOD news release, the White House Commission on Aviation Safety and Security, chaired by Vice President Al Gore, "called for the establishment of a second civil frequency as part of a broader program to maintain US leadership in aviation and satellite technology."

From *The ARRL Letter*, Vol. 17, No. 15; April 10, 1998, via Spring 1998 *Packet Status Register*, Bob Hansen N2GDE, editor.

Top 10 Signs You've Over-Modified Your Scanning Receiver

1. Houston Mission Control drowns out the local repeaters.
2. Your radios glow in the dark. Even when they're not plugged in.
3. The NSA calls to get copies of transmissions they missed.
4. Commercial airline pilots use your antenna array as a landmark.
5. Your wife says "Either that thing goes or I go. Over ..."
6. Your rooftop, car trunk, and back yard are collectively referred to as the "antenna farm."
7. SETI calls you to confirm signals from Orion.
8. You dial in frequencies that Stephen Hawking says don't exist this side of a black hole.
9. You hear voices talking about invading the "third planet from the star."
10. Your "LOW BATTERY" indicator glows constantly, even when you're operating on AC.

By Bill WB1BRE, from *ARNS Bulletin*, May 1998, Steve Auyer N2TKX, editor; originally printed in *Key Klicks*, newsletter of the Green Mountain Wireless Society, Deborah Clark NN1C, editor.

Air Safety Pirate Walks Plank

The FCC has closed down another unlicensed radio station, after the agency received complaints that its signal was interfering with commercial

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NEVER SAY DIE

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our fundamental systems have — or suffer the consequences.

If you'll put down that flag you've been waving for a minute I'll explain what's wrong with democracy. No, I'm not pushing any of the alternatives I'm aware of. Socialism and its sisters communism and fascism have all been tried and found to be horrible failures. Feudalism didn't work either.

Democracy, at least, is in tune with Darwin's survival of the fittest concept in that the will of the people is determined by a vote. And that means that 51% are able to dominate 49% of any differing opinion. Dominate and gradually eliminate. As our politicians have discovered, the way you get that 51% is to be better at manipulating the people. They use the media and your money to do that to you.

The bottom line, which we don't want to think about, is that democracy is a system which tends to make the rich richer and the poor poorer — since the media are firmly in the hands of the richer.

Capitalism tends to compound this problem.

Big companies, driven by the need to constantly expand, grow by gobbling up smaller companies. Rockefeller exploited this, as has Microsoft. We see it in the megamergers and the growth of international megacorporations. We see it in banking, and every other industry.

Many years ago a chap who worked for me had built a small grocery chain in Connecticut. Then a larger chain put in stores near his, one by one. Each time they'd sell groceries at below cost for as long as it took to put his store out of business, then they'd raise their prices above what his had been charging. One by one they wiped him out.

When a WalMart™ store goes in it quickly wipes out a dozen or more smaller merchants, usually killing the downtown part of towns. When I was a kid there were mom-and-pop groceries everywhere. Now they're all gone, replaced by a few supermarkets, and the old groceries are now boarded-up storefronts.

Rockefeller grew by his Standard Oil's systematically gobbling up smaller oil companies.

But what about the government's trust-busting activities, you ask. My answer is to ask you: Who do you think is running the government? And you know the answer as well as I do — money runs the government. Money runs the presidency. Money runs Congress. Money from those who have it in large quantities and

buy the support of our politicians, who need that money to keep their jobs through very expensive re-election campaigns.

The rich in our country have been getting richer and the poor poorer, if you've been reading the surveys. And this is only going to get worse.

The thousands of small car companies of 90 years ago shrank to about four. Then, as international transportation and communications costs came down, the number of car companies grew — for a while. Now we're seeing international car company megamergers with Jaguar and Mercedes Benz joining Ford and General Motors. We'll be seeing more, getting us back to four. Then three. Then, eventually, one.

Twenty years ago there were thousands of small personal computer companies. By 1982 there were over 2000 small companies supplying add-on hard and software for the Radio Shack™ computers. I was running over 300 pages of ads for these products every month in my *80-Micro* magazine. Then IBM came along and wiped out the Radio Shack computer and all those companies either changed to supporting the IBM PC or went out of business.

And so it goes in every industry. Capitalism works great for smaller businesses, but once they get big they tend only to get bigger by gobbling up the small guys, often using despicable methods. Call it the industrial food chain.

RCA got big by subcontracting out small jobs. Then they'd make the next order bigger. Finally they'd place a huge order and then, just before delivery, cancel it. Then they'd be able to buy the company cheap when this bankrupted it.

I once explained in an editorial how Radio Shack managed to get so many company-owned stores so inexpensively, and the president never forgave me.

Democracy is a pretty good system. Beats a king or dictator. But it's still a system that doesn't give much of a voice to minorities — unless they really raise hell.

The Pepsi Generation

There's been a lot of tsk-tsking about what's gone wrong with kids these days. Golly, they're taking guns to school and killing each other. What, oh what, has gone wrong with our society, ask the hand-wringers. Is it the plethora of violence on TV and in the movies? Is it the lack of parental guidance, with both parents having to work to make ends meet?

Sure, those are contributing factors, but I suspect the more basic root of what's gone wrong with not just our kids, but with our society in general, is both well hidden and politically untouchable by the media and our government nannies. Just look at how long it's taken for Congress to even consider doing something about the death toll from smoking! That cigarettes are killing us has been no secret for the last 40 years. Heck, over 30 years ago I was handing out book matches which said "*73 Magazine* Cancer-Free Matches." One of the largest makers of book matches, D.D. Bean, over in the next town, made 'em for me specially so they couldn't light. Ted Hommel W7LFL, who'd worked for me when he dropped out of college, was working for Bean and organized the special project.

Getting back to what I suspect is the strongest factor in influencing our kids' rotten behavior, which you won't want to believe — at least until I can get you to do your homework on the subject so you'll see that, no matter how much you hate the idea, that I'm dead right on this one. It's refined sugar.

I first read about this almost 50 years ago, but my addiction to sugar was so strong by that time that I didn't do anything about it. Oh, my mother did a great

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NEVER SAY DIE

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job of starting me off right. We never had any white bread or jam on the table. I had hot cereal or eggs for breakfast most of the time, with pancakes, scrapple, fried mush, or corn fritters and syrup on rare occasions. It wasn't until I went away to St. Paul's choir summer camp that I got introduced to jam, jelly, and white bread. Thanks a lot. And this continued later at the frat house in college.

So what's wrong with sugar? Oy, what a list! Please stop being cheap and invest $6 in *Lick The Sugar Habit* by Nancy Appleton, Avery Publishing ISBN 0-89529-695-0, 1996, 256 pages. If your local bookstore doesn't have it, you can get it from Radio Bookstore #5745, 800-243-1438 (tell 'em Wayne sent you and that if they know what's good for them they should have Laura Lee interview me again). That's not my Radio Bookshop, by the way. I should sue 'em for coming too close to my mail-order book company name. I started Radio Bookshop in 1958 and it's still going.

Now, about what sugar does. It suppresses your immune system, thereby making you more susceptible to any illness going around, plus cancer, and so on. It upsets your body's mineral balance, leading to osteoporosis, arthritis, and a bunch more horrible illnesses. It often causes hyperactivity, crankiness, anxiety, and loss of concentration in children. It can also cause drowsiness and decreased activity in children. It affects children's grades. It can cause kidney damage. It can lead to cancer of the breast, ovaries, prostate, and rectum. It can weaken eyesight. It can narrow blood vessels, causing hypertension. It can cause hypoglycemia. It can speed the aging process, causing wrinkles and gray hair. It certainly promotes tooth decay. It sure contributes to weight gain and obesity. It can cause asthma, yeast infections, gallstones, kidney stones, heart disease, appendicitis, hemorrhoids, varicose veins, diabetes, food allergies, toxemia during pregnancy, cataracts, cardiovascular disease, emphysema, loss of skin elasticity, damage to the liver and pancreas, constipation, nearsightedness, tendon brittleness, headaches (including migraines), and depression. It can even alter the brain's ability to think.

If you think I'm exaggerating, check out the medical references backing up every one of those claims in the book.

Sugar is a serious poison, made all the worse because the effects are delayed. This is what it took to finally get me to swear off sugar and I've been off it since the first of January this year.

That's right (sob), no more Haägen-Dasz coffee ice cream (whimper). No more apple pie or other desserts. No more Lindt absolutely fabulous chocolate.

If you are so seriously addicted to sugar that reading the above book doesn't stop you, then invest another $6 in William Duffy's *Sugar Blues*, Warner Books, ISBN 0-446-34312-9, 256 pages, 1975. Duffy adds to the list of things sugar does to us, such as contributing seriously to alcoholism and drug addiction. He also shows that sugar is a basic contributor to schizophrenia. I once knew a woman who'd been brought up having coffee, white toast and grape jelly for breakfast every day for years. She was a real mess, with long depressions and suicide attempts that several hundred thousand dollars of psychoanalysis didn't help. She alienated her parents, sister and even her daughter. Well, I said she was a mess. Worse, she eventually married a total loser, who I think was more interested in the money she stole from her first husband than in her.

If you'll look at the list of ingredients on packaged foods you'll find that sugar seems to be everywhere. Sugar, dextrose, and other similar disguises. It's very difficult, if you eat the usual supermarket food, to avoid sugar. Most of your cold cereals have sugar in them, and that's not counting the sugar-frosted babies.

What have I been eating? For breakfast I have a bowl of hot cereal (with a little cream), a banana, and an orange. I also chug down a half cup of V8™ juice with a heaping teaspoon of cayenne pepper and another of minced garlic. They're both supposed to be good for you, and followed by some cereal, the cayenne only burns for a moment.

People who drink Coke™ or Pepsi™ are getting big slugs of sugar and they're getting sick and tired. That's our Pepsi Generation for you, thank you.

The next time you feed your kids cold cereal, ice cream, a milk shake, soda pop, or cookies, just remember that you are pushing them on the road to diabetes, brain loss, and a host of potential chronic illnesses. You can trigger asthma, allergies, and so on. If you absolutely can't help going to a fast food place, at least make it a Wendy's™ with a salad bar.

Nuclear War

Now that the USSR is split up and the Russian government is busy trying (and failing) to cope with their new *Mafiya* and so many people not paying taxes, they're certainly not going to be attacking the US with nukes, right? We know there's no problem because President Clinton told us that our children are now growing up free of the threat of a nuclear holocaust. I know you are probably not going to believe me if I say that Clinton was not telling the truth. Our president wouldn't lie to us, would he?

A special report in the *New England Journal of Medicine* in April this year estimated that an accidental launch of nuclear weapons from Russia would kill 6.8 million Americans instantly and expose millions more to a lingering death from lethal radiation. The report said that the likelihood of such an accident is increasing with time, not diminishing.

The Russians have about 2,500 nuclear warheads ready to be launched. The US has even more aimed at them, and all of these can be targeted in seconds. The Russian nukes are programmed so that if they are accidentally fired without a new target being set they will automatically go to their Cold War targets. Well, there goes an American city, right? Or six, considering their use of multiple warheads.

It's worse than that since neither their nor our missiles have any self-destruct system built in, so that once they are on their way, that's it. If that isn't enough for you, both countries have their missile systems programmed to "launch-on-warning." This means that neither country is going to wait for any suspected incoming missiles to hit before retaliating. Heck, by then it might be too late, if the missiles' targets include our missile sites (which they do). The launch-on-warning allows just a few minutes for top-level decisionmakers to abort the retaliation. Both nations have nuclear-armed submarines within 15 minutes of their targets, so the decisionmaking time is short.

In January 1995 Russian radar operators spotted a rocket rising off the coast of Norway. President Yeltsin was alerted and quickly activated his "nuclear response suitcase," the unit which would allow him to launch a counterstrike. With less than four minutes to spare the Russian officials found that the rocket's path would take it out over the Atlantic Ocean, so the crisis passed. It turned out to be a scientific probe and that the Norwegians *had* notified the Russian authorities weeks before of the planned launch, but the message hadn't gotten through the Russian bureaucracy.

An article in *Scientific American* (Nov. 1997) pointed out that the controls of the Russian nuclear missile systems are failing and that there have been several occasions when the computers have switched to combat mode for

no known reason. Worse, as you've probably read, many of the Russian military haven't been paid in months and the CIA says that there have been conspiracies within nuclear armed units to commit nuclear blackmail.

The CIA also reported that morale has broken down even among the elite submariners and that some sub crews may be able to launch nuclear missiles without getting the special codes from their superiors.

The Russian defense minister recently warned that "if the shortage of funds persists ... Russia may soon approach the threshold beyond which its missiles and nuclear systems become uncontrollable."

Then there are the military personnel in charge of the missile systems. One third of the Russian military are alcohol-dependent, and this is particularly prevalent with the officers. A survey of the US military in Italy and Germany found that 43% of *our* Army personnel were using drugs and 49% of the Navy. 28% of the Army personnel were found to be drinking while on duty and 21% of the Navy. And these are the hands that we have on the Big Red Switches.

Many of the Russian early warning radar systems are now in their former republics and are failing, making Russia partially blind. Two of their early-warning satellites have failed. This tends to make things much more dangerous, encouraging their overreaction.

Will we be able to survive the worsening missile crisis? Or the volcano crisis? The pole shift crisis? Etc. Tune in next year and I'll let you know. Hey, by then I'll have a few more even *worse* crises to worry you about.

Volcanoes

A recent report on the Art Bell show from Mexico City by a volcano expert said that their nearby volcano, Popocatepetl, which is 17,887 feet high and has a crater almost a half mile across, and was thought to be dormant, has been getting more and more active, but that its vents have been clogged so that it seems to be building up to a major explosion. The expert said he believed this could turn out to be the biggest volcano explosion in history.

If the volcano does let loose it could wipe out a big chunk of Mexico and blacken the atmosphere over the whole world, bringing on a sudden winter and stopping crops from growing for who knows how long.

Well, I thought you might not have enough to worry about.

Mexico has one other export of interest — smoke from a thousand or so of the field and forest fires that are raging out of control is rolling into Texas and other parts of our Southwest. The burning pesticides from the affected Mexican farm fields are now being reported to be making thousands of Texans sick.

The activation of Popocatepetl fits the pattern of awakening volcanoes around the world. There's the volcano on Montserrat, which has been dormant for centuries, Mt. Etna in Italy, and so on. Hundreds of volcanoes are newly active under the Pacific Ocean, and Mt. Fuji in Japan is starting to be active and has melted the snow from its peak for the first time since 1728. Two big volcanoes are newly active in Indonesia.

How come?

Well, I have a theory. The *El Niño* warming of the Pacific has increased the moisture in the atmosphere. This has brought heavy rains to the West Coast and tornadoes to the rest of the country. It's also increased the snowfall on Antarctica substantially. This, in turn, since that continent is off center from the South Pole, has induced some wobble which has been jostling the tectonic plates, reactivating old volcanoes.

Are the prophets right that the Earth's crust can actually slip, moving the poles? Nostradamus has predicted that this is exactly what is going to happen, and soon! René, Graham Hancock, Richard Noone, and Chet Snow, in their books, are all predicting essentially the same thing.

I've reviewed all of the books I have been able to find on the Millennium Catastrophes and put the information and my views into a new $5 book on the subject, complete with some ideas on how you and your family may be able to survive. If any of these prophets are right, and many of them have a history of accurate prophecy, the least you can do is make sure that you have a 12-volt ham rig available and maybe some solar cells to recharge it once the power grid is down and there's no more gas for generators.

Of course, if you're living in a city, never mind — just tell yourself that old crazy Wayne is at it again. But, say, have I ever been wrong in my editorial predictions?

Con Job

A letter from a Massachusetts reader pushed me to write again, harping on the same subject. Allen says: "I'm 24 years old and I run a part-time mail order business. I spent a year at Rensselaer Polytechnic Institute (RPI) and for $24,000 I can't remember one thing that I learned there, except that it was a waste of my time and money. My friends are urging me to give this business up and return to school, but I see no point in doing so. Reading your book *Making Money* has given me a lot of encouragement for my decision. I'm enjoying it and your sales video immensely."

Virtually all of us have been suckered into the idea that if we're going to amount to anything we really *must* go to college. My father believed it. I believed it. All of my school friends believed it. I don't recall ever seeing anyone write or talk about any serious alternatives to college.

My father got aced out of college by World War I and went to New York Military Academy, then into the Army Flying Corps. But he was so convinced of the importance of college that he always felt uncomfortable about not having gone to college. So, when I got out of high school it never occurred to me to do anything but go on to college. My dad paid for the first two years. Then World War II came along and I spent four years in the Navy and Uncle Sam paid for my next two years of college. I think it was PL-15, the program for disabled vets.

It never occurred to my dad that not one employer he ever had cared anything about his lack of a college degree. When Philadelphia needed an airport they came to him. He designed, built and operated Central Airport. Then he left there to be the passenger manager for Luddington Airlines (Amelia Earhart was a half-owner), the precursor of Eastern Air Transport (EAT), which became Eastern Airlines.

When Luddington sold out to Eastern he got American Export Steamship Lines, the largest American shipping line, to invest in the first trans-Atlantic airline, American Export Airlines. They started just before World War II and operated all through the war, flying from New York to London.

When the head of Pan-American Airlines convinced President Roosevelt to issue a presidential order making it illegal for a steamship line to own an airline, American Export was forced to sell the airline and it ended up owned by Pan-American.

Ooops, I got off on a tangent. Golly, that hardly ever happens, right?

Yes, a college degree is important if a person is going to work for a large corporation, for the government, or to teach. But, think about it, all three of these career paths have one thing in common: 99.999% of the people pursuing them are never going to make much money or to have much freedom. These jobs are for suckers.

Money and freedom are

mainly possible for entrepreneurs, and college has virtually nothing to offer as far as an education which will be of the slightest benefit when it comes to starting and owning your own business. My book *Making Money, A Beginner's Guide* explains how anyone of almost any age can learn the entrepreneurial ropes with someone else happily paying for their education.

College is a wonderful way to blow about $100,000 and four of the best years of your life. What a bargain. Better yet, this will set you up so that you'll never make much money or have a lot of freedom until you retire and are too old to enjoy it.

Am I exaggerating? I sure wish I was. Well, it's probably too late for you to benefit from what I've learned, but maybe your children or grandchildren can get off the well-beaten path to nowhere with a little shove from you. Actually, anyone from 17 to 70 can get off the track and learn entrepreneuring, but that requires the guts to make the change, and one thing that our schools have done very well is make most of us gutless. Few people have the determination to change, or the perseverance to stick by their decision.

A few years ago I tried to get RPI to change and put in some entrepreneurial courses. As a member of the RPI Council I got the Council to endorse the idea and pressure the faculty and president of the school to start providing entrepreneurial courses. The RPI president solved that problem by dissolving the Council and nothing changed. As a member of the Board of Overseers of the RPI School of Management I got the dean of the school to try and put in some entrepreneurial courses. The president got rid of him and dissolved the Board of Overseers.

I tried hiring some of the RPI School of Management graduates, but they were so out of their element in an entrepreneurial company that I finally had to give up on ever getting them to learn.

Oh yes, at one RPI Council meeting I explained to the group how wasteful it was for me to have endless classes where we had to memorize stuff for tests. Little of all that ever lasted in my memory. You have to *use* information to keep it available. Then the president of the Student Council got up and told the group that as far as he could see, nothing had changed in the 50 years since I'd been there.

I'm probably preaching to readers who have mostly been made deaf and blind by the hypnosis induced by our culture. Sigh.

Recycling PCs

There are tons of old PCs and printers out there available at scrap prices. Has anyone figured out anything to do with 'em yet?

The PCs are made up of a floppy drive, a monitor, power supply, keyboard, and the computer board. Most of the old PCs were taken out of service when just one of their elements failed, so by putting the working parts of two or three computers together you should be able to at least provide one working system, even though it may be using an older 386 or 486 chip.

Sure, these are slower, but they'll make very adequate and inexpensive word processors, and can be adapted for any number of applications.

A school or other nonprofit organization could attract an endless supply of these old machines from company storage rooms if the companies could get tax credits for their donations. That's a whole lot better for them than their dumpsters.

How difficult is it to update the old motherboards with newer chips? Or perhaps make a new board which could be patched in to update old systems? Hardware hackers should get their ingenuity working and get us some articles. There are millions of old PCs out there, so let's see what we can come up with.

Just look at what happened when the FCC forced taxicab companies to change to narrowband FM systems. We hams bought up their old rigs for pennies on the dollar and that started our repeater revolution. That's why our first repeaters were spaced 60 kHz apart. Of course it didn't take long before we had so many repeaters that we had to go to narrowband, spacing them 30 kHz apart. Then to our present 15 and 20 kHz. But it was those tons of old GE and Motorola taxi radio systems that triggered our revolution.

Don't just sit there — get your brain working!

Advertising Basics

If you're in business you have to advertise. If you're *not* in business, what's the matter with you? Are you so gutless that you're going to be a wage slave all your life? Yep, that's insulting, but how else can I get your attention if you don't have your own business yet? The Civil War obviously did not free all of the slaves.

One of the first things I discovered when I started my first major business was that none of the ad agencies I could find knew beans about my kind of product (a loudspeaker). That meant that I had to write my own ads. Believe me, seeing millions of ads during your life no more equips you to write ads than driving a car equips you to design an engine. I found myself in a whole new world.

OK, I decided, if I couldn't find competent help, I would have to learn the ropes myself. So I enrolled in a course in advertising put on by the Advertising Club of New York. And that was one of the best moves I've ever made. Priceless.

For instance, I learned that even some subtle differences in ads can make a whopping difference in their effectiveness. A small change in an ad can double or triple the resulting sales.

Now, let's look at ads aiming to sell ham products from the advertiser's point of view. Remember that your potential customer is most probably in his 50s–70s, so don't get swept away with gorgeous New Age yuppie graphics. Keep artists the heck away from your ad design. Also, no matter how tempting, keep engineers away too. They're going to start loading your ad with the amazing features your product has.

But let's start on an even more fundamental level — the style of type you'll use. Artists are in love with sans-serif type. Any book on type readability will tell you that serif type beats sans-serif around five to one. Since sans-serif type is more difficult to read, many people just won't bother. Worse, the more difficult type is to read, the less retention there is of your message. Serifs? These are those little platforms on the letters. This is sans-serif type. Avoid it like the plague.

If you really want to make an ad almost completely unreadable, use white type on a black background. This is called reverse type and artists love it. It's beautiful and eye-grabbing. There's a slight drawback, though — almost no one will bother to read it.

Then there's the increasing use of ragged-right lines of type vs. justified. If you don't mind cutting your readership in half, use ragged-right copy.

And this makes sense, if you stop and think about it. We learn to read books, magazines and newspapers where the columns of type are justified, so that's what our eyes are used to. Anything else slows us down. Ragged-left type will lose about seven times as many readers.

Oh, yes, this also applies to club newsletters.

One more piece of the advertising puzzle before I wind up class for today. This has to do with your headline. Copywriters have a simple rule: It usually takes as long to come up with a good solid headline as it does to write the rest of the ad. The headline has to be a grabber. When people are reading a magazine or newspaper they are not usually

doing so mainly to read the ads, so your headline will get a quick glance, and that's about it. You have just that fraction of a second to grab the reader's attention and get him to read further.

It's expensive to advertise, so you want every ad to do the maximum amount of selling possible. Anything less and you are throwing away sales and money.

Class will reconvene again if I get some encouragement from you. Then we can discuss what copy to write — and what *not* to write. I can explain how you can decide how big an ad to run, and how to find out what the best publications are for you to use to reach your target customers.

Mooned

As I mentioned earlier, Sherry recently signed up for a video production class at nearby Keene State College. The course naturally entailed her having to produce a short video. Instead of doing one on how to wash your socks or something like that, she decided to tackle the NASA Moon landing controversy.

She got every photo, video, and book she could find about the Apollo Moon missions. She read René's book, *NASA Mooned America;* Bill Kaysing's book, *We Never Went to the Moon;* and Bill Brian's *Moongate*. She read the autobiographies of the astronauts. I helped her by going through the three Moon books and making a list of the biggest reasons it looks as if the missions had to have been faked.

Sherry did a nice job of exposing some of the more obvious fakery in her "Moongate" short — which got her an A for the course. But this got me busy writing about the 25 main reasons I'm convinced NASA had to have faked the whole show. The result is a 20-page booklet which I have seriously overpriced at $5. It's called *Moondoggle*. If you want to be outrageous and really upset the believers, read the booklet.

Yes, I know, the whole idea that something as important to our country as our Moon landings could have all been faked is so ridiculous that almost anyone's first reaction is that you are crazy to even suggest such a thing. I don't believe this will turn out to be the biggest government hoax of the century, but it sure will at least be the *second* biggest. You'll get many times your five dollars worth of fun when you arm yourself with the information in this booklet. You may even want to get some extra copies to send to friends.

Catastrastroke!

After listening to one Art Bell guest after another predicting humankind's near-mass extinction in the near future, and then reading their books on the subject, I decided it was about time to put these millennial disaster prophecies into one master doom book. I've reviewed a bunch of the doomsday books for you in a new 28-page booklet. The worst part is that several of the prophets making the predictions have an impressive history of accurately predicting events such as earthquakes, volcano eruptions, and major weather changes.

I had a tough time deciding on a title for the book. Apocalypse, Armageddon, millennium catastrophes, disasters, and millennium holocaust scenarios all seemed on target. I finally decided on *Human Extinction Prophecies*.

It was difficult to stop writing because there are more and more millennium doom scenario books being published, keeping me busy buying more books and reading.

My review of our almost certain soon-to-be doom is $5. This will help me buy the new doom books as they come out.

I've covered many of the doom scenarios in my editorials, but this will have them all in one place for you, and without the usual editorial gerrymandering through the magazine. Or the minuscule type.

Yes, of course I offer some advice on how you and your family can at least have a good chance of surviving whatever is coming. Ed Dames, the remote viewing guru, has moved to a South Seas island. Gordon-Michael Scallion K1BWC has a farm not far from mine up here in the mountains of New Hampshire.

Editorial Reprint

My editorials from the May, June, July, and August 1998 issues are now available in a readable-type, un-gerrymandered edition for a semi-paltry $5. I've blown the dust off and gathered my 1997 editorials into three books, each covering a third of the year. And now there are two books for 1998, covering the first two thirds of this year. Each of these books runs around 80-100 pages, which is about as large a book as I can comfortably handle with my system. Each is $5. The 1997 collection totals 320 pages and is $15 for the set.

Smoke

The next time you see a kid smoking you might try passing along the news that a recent study found that 50% of the men over 40 who smoke are impotent and 30% suffer also from a hearing loss.

Ozone

I check in with René every now and then to see how he's doing. Recently he spent some hospital time. It seems that he didn't know that breathing ozone can make you sick. He sure knows now. René's the chap who wrote the NASA and Skeptic books I've been touting and you have avoided buying. Tsk.

On the ozone topic, a reader mentioned that Bob Beck has been promoting ozonated water for health. Some outfit is selling a gadget to make ozonated water for $400. It seems to me that one of you out there should be able to come up with a water ozonater that we can make for a few bucks. Any volunteers? Also, what's a good book on using the stuff?

While I'm on health, I've been getting some nice letters from Bioelectrifier users claiming it's been stopping cancer. But I'm still of the opinion that if you give your body the right nutrients and stop poisoning it, you'll be able to recover from almost anything. The details are in my *Secret Guide to Health*. The Bioelectrifier can, I believe, speed up the repair of your immune system from all the damage you've done to it.

New Hampshire

They had a show on PBS recently about New Hampshire's grand hotels. It sure brought back memories. My home town of Bethlehem had 30 hotels and 100 rooming houses, and some of the hotels were huge. The heyday of the big hotels was back in the 1920s, when people came up from New York and Boston by train and the hotels were packed solid all summer. Bethlehem, perched high up on the side of Mt. Agassiz, was particularly prized for its low pollen count, making it an excellent refuge for hay fever sufferers.

The depression of the 1930s hurt business badly, with many of the hotels falling into disrepair. It picked up a little after the war, in the late 1940s, but by the 1950s air travel made it possible for people to vacation anywhere in the country, and by the 1960s anywhere in Europe. Most of the old hotels eventually had to be burned for the insurance, so there aren't many of them left.

In the '30s roadside cabins sprang up all around the state, providing a lower-budget way to travel. Now it's motels, but there are still a few of the old cabins left.

New Hampshire is a beautiful state to visit, with plenty of interesting things to see and do. You really ought to get up here and see why the state always wins the top place on magazine surveys for its quality of life. A recent

report put Manchester as the best place in the Northeast for living, with two other of our cities in the top ten.

But more important are the scenic attractions, which are mostly in the White Mountains. There's the highest mountain in New England, Mount Washington. You can drive up on the carriage road or, better, take the old steam-powered cog railway. If you've the stamina you can climb it. I haven't climbed it lately, but it's a fun and challenging climb.

Just south of Mt. Washington is North Conway, where you'll find some fantastic factory outlet stores, plus have a chance to ride on an old steam train. Don't miss it!

Then there's Cannon Mountain, where you can take the first aerial tramway in North America to the top, snapping pictures as you go. I still have some slides I took when it opened in 1938. This is the mountain with The Great Stone Face on it, the "Old Man of the Mountains." You'll also get some great photos from the top of the mountain.

Just down the road a few miles is the Old Man's Foot Basin, which is a round pool worn in the rocks by the Pemigewasset River. You'll get a bunch of great photos in this area.

Then you'll come to The Flume, which'll use up a couple more rolls of film.

A few miles from there is Lost River Caverns, where you can climb through caves. This is a particular delight for kids.

When you're passing through the southern end of the state don't forget to give me a call. If I've time maybe we can meet in Hillsboro for a fabulous Chinese buffet lunch. Your treat. Mmmm, and it's only $5! You should see the 400-pounders waddling into the place. And you don't have to use chopsticks if you don't want.

Around the first week of October we put on a legendary fall foliage show. The colors have to be seen to be believed. There's only one other area of the world that has colors like these, and that's in northern China.

How about it?

If your hamfest chairman is too cheap to pay my fare to your hamfest for me to talk, come on up here, armed with questions. I love to talk.

Prisoners

Just as it is almost impossible for most scientists to accept anything that's different from what they were taught in school, and what they've thus probably been teaching, so the rest of us are prisoners of what we've been taught and believe, plus that which we can see with our own eyes. But we're also prisoners of our language, which, if it doesn't have the words to express new concepts, keeps us from thinking about them.

For instance, English is particularly bad when it comes to expressing feelings.

Anyone discussing death is up against all of these barriers. Anyone wanting to understand death better must somehow manage to surmount these barriers, which most of us don't even realize are there.

We have plenty of hints. No, let's make that data. We have endless reports of young children talking about their previous lives. Anyone can be regressed to previous lives under hypnosis and experience them with a great deal of reality. I've done that personally with over a hundred subjects. We have some excellently researched reports of communications with the dead. We call them "the departed." Psychics are able to part the veil and communicate with the dead. We have several groups around the world communicating with the dead via tape recordings. We have endless reports from people who have had near death experiences (NDEs) and others who've had out of body experiences (OBEs), neither of which are honestly explainable by "science."

We talk of "life" after death. We talk of "the next world." We talk of "different vibrations." And of "heaven and hell." We talk of spirit guides and angels. We talk of God.

We have other hints of things which may or may not tie in with the "afterlife" — like telepathy, clairvoyance, psychokinesis, and precognition — all of which have been scientifically proven far beyond any reasonable doubt. Of course no amount of scientific evidence fazes pathological skeptics, whose beliefs hold them prisoners.

We are such firmly held prisoners of our time dimension that the whole idea that our spirits can travel anywhere and anywhen in time is ungraspable.

When we have an NDE and are met by our "passed over" relatives and friends, we have the idea that they've been waiting around for us.

We have plenty of hints that our spirits are eternal, whatever that is. That we reincarnate every so often to learn things. I like the concept, but I'm afraid I don't believe it. We have been around for hundreds of thousands of years and I see no signs that we have learned anything from previous incarnations. People, in all, are just as lousy today as people were thousands of years ago. Tell me about the Hutus or Tutsis having learned from previous incarnations. Or the Arab fundamentalists. We are just ending the bloodiest century in the history of man.

I like the first line of P.J. O'Rourke's book, *Republican Party Reptile*, "Man developed in Africa. He has not continued to do so there."

Elsewhere we've developed some great technologies and arts, but psychologically we haven't changed much from as far back as our histories go. Will we ever grow spiritually? Or are we doomed to continue repeating our behavior endlessly, or at least until our apparently unlimited supply of bad guys destroys the planet? We now have the technology to destroy it, and a history of never having failed to use the latest technology for war.

We hams have our own proof of the lack of spiritual development of man on 14,313, and on a few of the 75 meter nets.

If we are returning to Earth to learn lessons, this Earthly school seems to be as much of a failure as our American school system. 73

LETTERS

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14.057 MHz, which put it near the center of my transceiver's frequency capability. The SWR continued to be 1:1! Finally, after starting a half-hour late, I began answering stations calling CQ-FD. The results were fantastic! By midnight, I had made contacts in 26 states, both East and West Coasts, plus many states to the north, and two Canadian stations in Ontario (VE3SPC) and British Colombia (VE7RAR). The number of contacts was actually 59. Although there was some fading on 20 meters, the band never quite closed, and I heard a couple of European stations working American stations. I am sure that if I had been running 100 watts or more, I could have made many more contacts, but the fun was in working half the United States with a peanut whistle! The Half-Square DX Antenna should do a great job for you too. It had less noise pickup than other antennas I have tried, and I am looking forward to building more gain wire antennas.

Harold Adams N2TLT. I really enjoyed you on the radio with Art Bell W6OBB. I also enjoy *73 Magazine* very much. Ham radio is a great hobby. The problem is that too many people are not open-minded. They won't buy your great magazine because you have different views and ideas. That difference is what makes you great! An open mind is a beautiful thing.

Continued on page 87

Number 87 on your Feedback card

PROPAGATION

Jim Gray W1XU/7
210 E Chateau
Payson AZ 85541
[jimpeg@netzone.com]

August 1998						
SUN	MON	TUE	WED	THU	FRI	SAT
						1 G
2 G	3 G-F	4 F	5 F-G	6 G-F	7 F	8 F-G
9 G	10 G-F	11 F	12 F-G	13 G	14 G	15 G
16 G	17 G	18 G	19 G-F	20 F-P	21 P	22 P-F
23 F-G	24 G	25 G-F	26 F	27 F-P	28 F-P	29 P-VP
30 VP	31 P					

At last! As I write in mid-May, solar flux values have reached the low 100s and hovered there for the past several weeks. WWV's "Solar-terrestrial Indices" are now using the term "moderate" instead of "low" or "very low" to describe the sun's activity. Whoopee! The HF bands have lots of DX signals on them, and it appears that the 10.7 cm solar flux has begun its long-expected rise toward the peak of Cycle 23, expected in 2001 or 2002.

Band-by-band propagation this month:

10–12 meters

Poor to Fair DX conditions on north-south paths during local afternoon, with occasional daylight sporadic-E short skip out to a thousand miles at times of intense ionization.

15–17 meters

Fairly good DX openings to the southern hemisphere during daylight hours. Occasional east-west openings to Europe and Africa during local afternoon hours, with sporadic-E short-skip openings between 750–1300 miles during times of intense ionization.

20 meters

The best band for worldwide propagation from shortly after local sunrise until well after local sunset. Peak conditions should exist during early morning and late afternoon or early evening hours. Short skip should prevail beyond 500 miles during the daytime.

30–40 meters

Good DX openings during the evening and night, and at sunrise. Peak conditions to the east should occur at around local midnight, and to other directions just before sunrise. Remember that thunderstorms will limit DO activity due to their covering up weak DO signals with atmospheric noise (static, QRN). Short skip to 1000 miles during the day and 2000 miles at night will prevail on most days.

80–160 meters

Little if any daytime signals will be heard due to high absorption levels on these bands. However, some DX may be possible (limited by thunderstorm activity) around the predawn hours to some areas of the world. Short skip during the day to about 250 miles and during the night to about 2000 miles will be common, except as hindered by QRN.

Make sure your antenna systems are well grounded during these summer thunderstorms, and be certain that your station equipment is lightning-protected. Plan your DX operations with the accompanying calendar: G Good; P Poor; F Fair; VP Very Poor; G-F Good to Fair, etc. W1XU.

Note about chart: The indicated band is only a guide. Always check the next higher or lower band. Where 10 meters is shown, listen on 12; where 15 meters is indicated, listen on 12 and 17; and so forth. 73

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20					
ARGENTINA	20	20	20	40	40						10	15
AUSTRALIA				20	20	40	20	20				
CANAL ZONE	15	20	20				20	20	20		10	15
ENGLAND	20		40/80	40/80						20	20	20
HAWAII	15	20	20	20	40	40						15
INDIA	20	20										
JAPAN							20					
MEXICO	15	20	20				20	20	20		10	15
PHILIPPINES							20					
PUERTO RICO	15	20	20				20	20	20		10	15
RUSSIA (C.I.S.)	20	20/40	20/40								20	20
SOUTH AFRICA		40	40	20	20						20	20
WEST COAST	40	80						20	20	20	15	40

CENTRAL UNITED STATES TO:

ALASKA			20			40		20				
ARGENTINA	20/40	20/40	20	40				15	15	15	15/20	20
AUSTRALIA	15	15	15/20	20	20	40	20	20			15	15
CANAL ZONE	20	20	20	40	40		20	20	15/20	15	10	10
ENGLAND	20		40	40			20	20			20	20
HAWAII	15	15	20	20	20	40	20	20				15
INDIA	20	20					20	20				
JAPAN			20			40		20				
MEXICO	20	20	20	40	40		20	20	15/20	15	10	10
PHILIPPINES							20	20				
PUERTO RICO	20	20	20				20	20	15/20	15	10	10
RUSSIA (C.I.S.)							20	20				
SOUTH AFRICA			40	20	20							

WESTERN UNITED STATES TO:

ALASKA				20	20	20	40	20	20			
ARGENTINA	15	20	20	20				20				15
AUSTRALIA	15	15	15	20	20	20/40	40	20/40				
CANAL ZONE	10	15	20	20	40	40		20	20		15	10
ENGLAND	20	20	20					20				20
HAWAII	15	15	15/20	20	20	20/40	40/80		20		15	15
INDIA			20	20				20	20			
JAPAN				20	20	20	40	20	20			
MEXICO	10	15	20	20	40	40		20	20		15	10
PHILIPPINES				20	20			20	20			
PUERTO RICO	10	15	20	20	40	40		20	20		15	10
RUSSIA (C.I.S.)	20	20	20					20				
SOUTH AFRICA				20	20							
EAST COAST	40	80						20	20	20	15	40

LETTERS

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Well, open, but not drafty. Harold, it's a tough uphill fight. Our schools, our culture, our media, our peers and even our parents have so befogged our minds with lies that getting the truth out is a major undertaking. We believe in our schools, doctors, jobs, and even our government. Hey, many hams even believe in the ARRL! … Wayne 73

Number 88 on your Feedback card

Barter 'n' Buy

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it, rather than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The *73* Flea Market, Barter 'n' Buy, costs you peanuts (almost)—comes to 35 cents a word for individual (noncommercial!) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

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

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

Send your ads and payment to: *73 Magazine*, Barter 'n' Buy, 70 Rt. 202N, Peterborough NH 03458 and get set for the phone calls. The deadline for the November 1998 classified ad section is September 10, 1998.

MAHLON LOOMIS, INVENTOR OF RADIO, by Thomas Appleby (copyright 1967). Second printing available from **JOHAN K.V. SVANHOLM N3RF**, SVANHOLM RESEARCH LABORATORIES, P.O. Box 81, Washington DC 20044. Please send $25.00 donation with $5.00 for S&H. BNB420

QSL CARDS. Basic Styles; Black and White and Color Picture Cards; Custom Printed. Send 2 stamps for samples and literature. RAUM'S, 8617 Orchard Rd., Coopersburg PA 18036. Phone or FAX (215) 679-7238. BNB519

TELEGRAPH COLLECTOR'S PRICE GUIDE: 250 pictures/prices. $12 postpaid. **ARTIFAX BOOKS**, Box 88, Maynard MA 01754. Telegraph Museum: [http://wltp.com]. BNB113

BIOELECTRIFIER™ 5 Hz micro current supply for plant and animal research. Semi-Kit $38.00. Assembled complete with batteries and silver electrodes $89.50. Add $2.50 postage. **Thomas Miller**, 314 South 9th Street, Richmond IN 47374. BNB343

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aviation communications at Sacramento Executive Airport in northern California.

Airport officials had complained to the FAA that several communications channels were receiving interference from a radio station that appeared to be drifting or changing frequency. Pilots flying over the area had also reported hearing a radio station over the air traffic control radio channel.

The investigation led to an unlicensed station operating on 107.2 MHz. Its location was the office of Dollar and Sense Productions in a south Sacramento office.

This incident marks the fourth time in the last five months that the FCC had to locate and remove illegal radio stations from the airwaves for interfering with air traffic control communications.

From *Newsline* #1077, adapted from *CGC Communicator*. 73

The New Approach to HF Radio!

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The Kachina 505DSP Computer Controlled Transceiver

Features:

- Works with any Computer Running Windows 3.1, 95 or NT
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The Kachina 505DSP Computer Controlled HF Transceiver After twenty years of building commercial transceivers in Arizona, Kachina has decided the time is right for a new approach to amateur radio. The Kachina 505DSP is nothing short of a revolution in HF transceivers.

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16/24 Bit DSP/DDS Performance In addition to 100% computer control, the Kachina 505DSP offers exceptional 16/24 bit DSP/DDS performance. IF stage DSP, "brick-wall" digital filtering, adaptive notch filters and digital noise reduction, combined with low in-band IMD and high signal-to-noise ratio, produce an excellent sounding receiver. Sophisticated DSP technology achieves performance levels unimaginable in the analog world. The transmitter also benefits from precise 16/24 bit processing. Excellent carrier and opposite-sideband suppression is obtained using superior phasing-method algorithms. The RF compressor will add *lots* of punch to your transmitted signal without adding lots of bandwidth, and the TX equalizer will allow you to tailor your transmitted audio for more highs or lows.

Seeing is Believing American-made and designed, and able to stand on its own against the world's best, the 505DSP is bound to set the standard for all that follow. But don't take our word for it. Visit our website at http://www.kachina-az.com for detailed specifications, to download a demo version of our control software, or to see a current list of Kachina dealers displaying demonstration models in their showrooms.

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JRC

JST-245

160-10 Meters PLUS 6 Meter Transceiver

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

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

★ JST-145 COMING SOON ★

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

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

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

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

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

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

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

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

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

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

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

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

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