JULY 1994
ISSUE # 406
USA $2.95
CANADA $3.95
A WGI Publication
International Edition

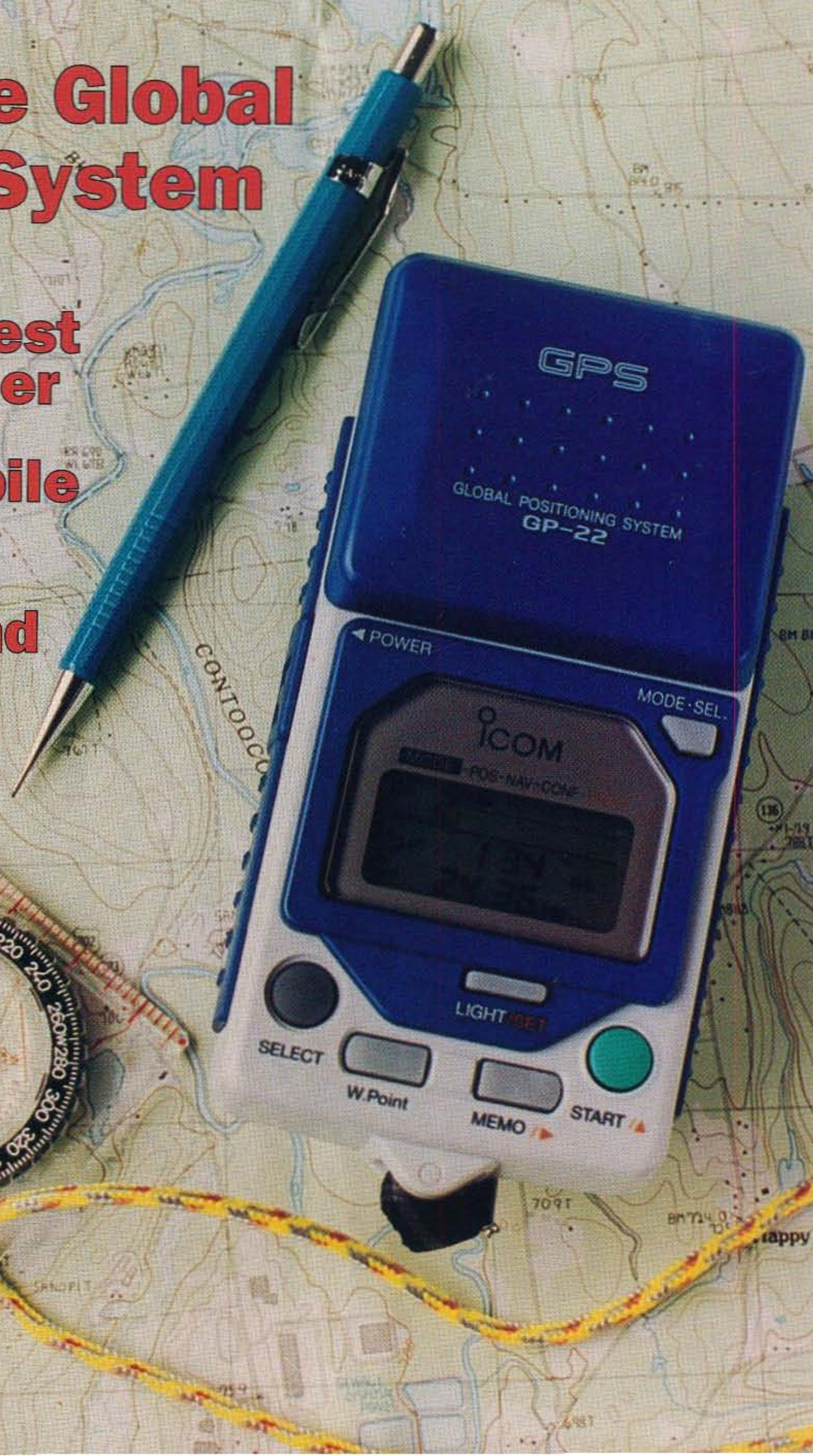
73 Amateur Radio Today

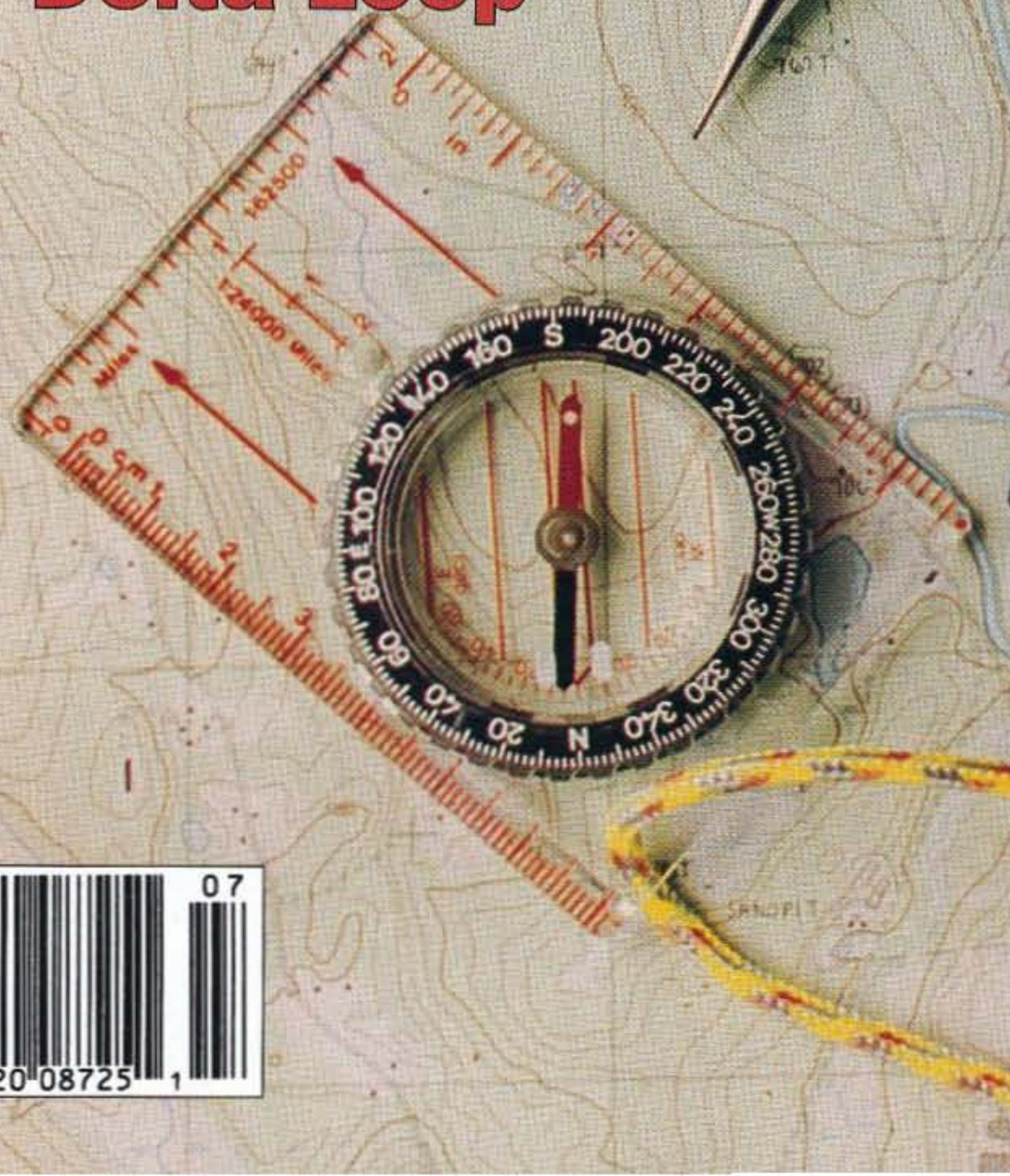
All About The Global Positioning System

World's Smallest ATV Transmitter

RFI-Proof Mobile Installations

Easy Multiband Delta Loop





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Feel The Comfort Of Extended Operations With The IC-T21A!

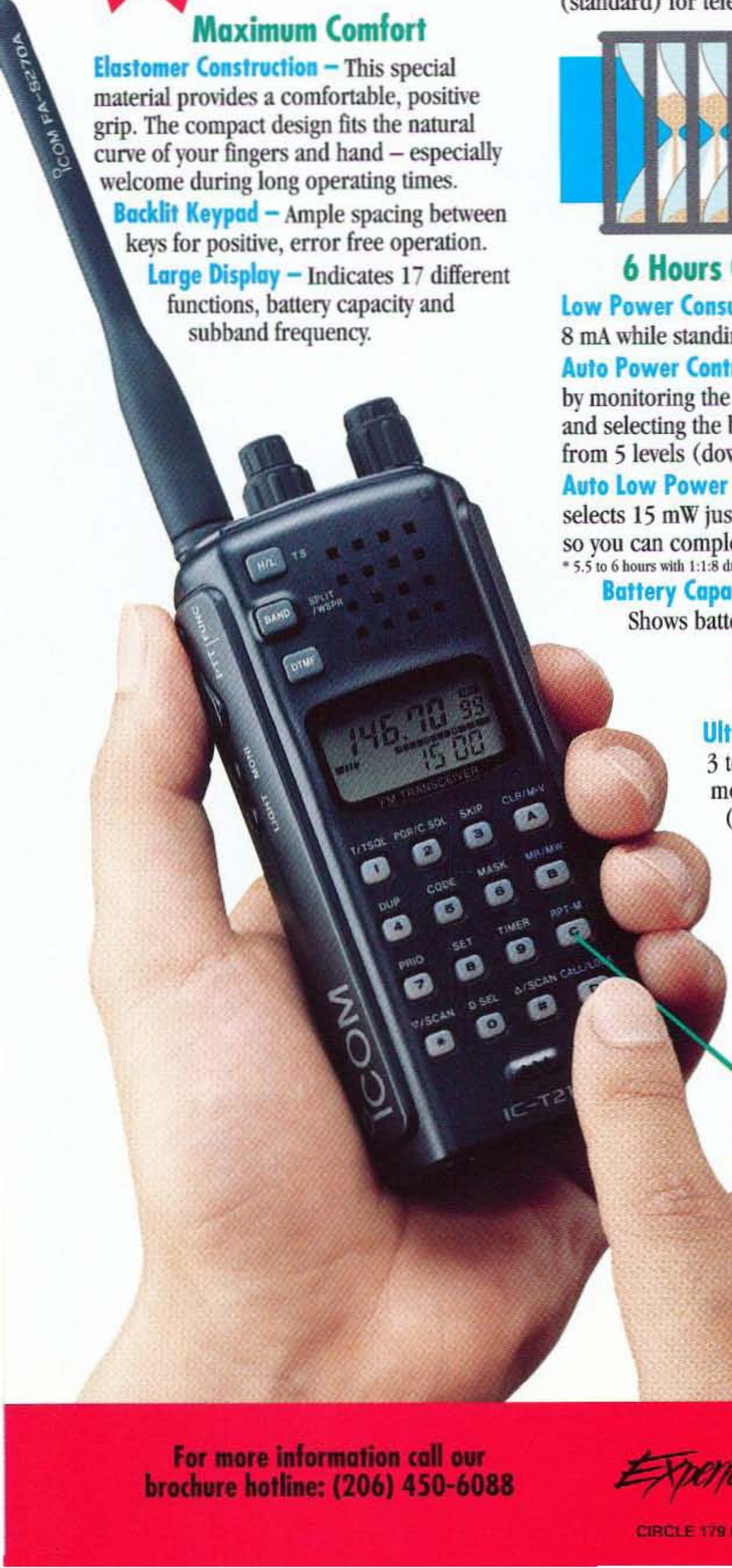
BONUS RECEIVE BAND!

Maximum Comfort

Elastomer Construction – This special material provides a comfortable, positive grip. The compact design fits the natural curve of your fingers and hand – especially welcome during long operating times.

Backlit Keypad – Ample spacing between keys for positive, error free operation.

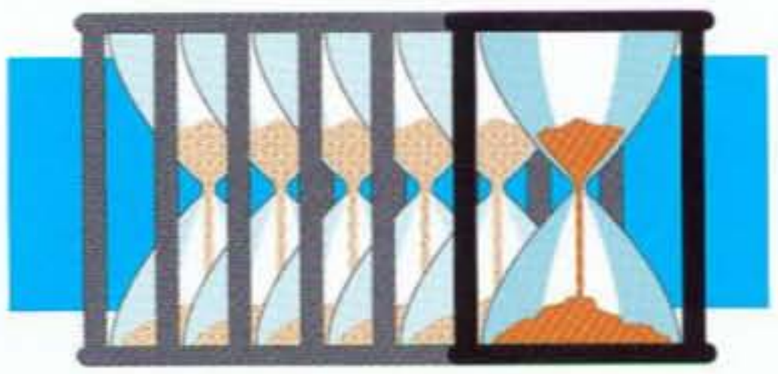
Large Display – Indicates 17 different functions, battery capacity and subband frequency.



Full Crossband Duplex Operation

Dual Band Receive Capability – Permits reception of another band (i.e.: 440 MHz on the IC-T21A).

Full Crossband Duplex Operation – Possible with the unique "whisper mode" microphone (standard) for telephone type QSO's.



6 Hours Operating Time*

Low Power Consumption – Consumes only 8 mA while standing by.

Auto Power Control – Conserves the battery by monitoring the repeater signal strength and selecting the best matching output power from 5 levels (down to 15 mW).

Auto Low Power Function – Automatically selects 15 mW just before battery exhaustion so you can complete your QSO.

* 5.5 to 6 hours with 1:1:8 duty cycle (Tx high : RX : Standby)

Battery Capacity Indicator – Shows battery capacity.

New Scanning Standards

Ultra High Speed Scan – 3 to 4 times faster than most other handhelds (33 channels/sec., 12.5 memory ch./sec.).

Bonus Band – Can be scanned while the main band is being scanned (e.g.: 70 cm for the IC-T21A).

6 Priority Watch Modes – Check for other signals while operating on a VFO frequency.

Ultra-Convenient Repeater Operations

Subaudible Tone Scan – Detects, displays *and programs* the tone frequency into the VFO. Permits access to a repeater when you don't know the tone frequency.

Auto Repeater Function – Automatically activates repeater settings (duplex ON/OFF, duplex direction, tone encoder ON/OFF) when the operating frequency falls in the repeater output range.

Repeater Memory – Quickly recall settings of your last worked repeater (RPT-M key).

5 DTMF Memories – Automatically dial your favorite telephone numbers.

Selectable DTMF Transmission Speed – Adjust the IC-T21A/T41A to the capabilities of the repeater (5 cps, 2.5 cps, 1.6 cps, 1 cps).

Powerful 6 W Output Power*

Our newly designed SC-1257 power module provides all the power necessary to reach fringe areas. Accepts 4-16 V input.

* With a 13.5 V DC power source.

Innovative Memory Functions

114 Memory Channels – Store *all* repeater information.

Memory Select Channels – For quick access, up to 30 can be designated Memory Select Channels.

Memory Transfer – Quickly transfers a memory channel's contents to VFO. Useful for searching for signals near a memory channel.

EEPROM – Memory information is retained virtually forever.

And More!

- Includes Flexible Antenna, Belt Clip, Handstrap, Rechargeable Ni-Cd Battery Pack and Charger
- Built-in Pager, Code Squelch, Pocket Beep & Tone Squelch

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CIRCLE 179 ON READER SERVICE CARD

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FREQUENCY COUNTERS

FIND FREQUENCIES FAST with the *Startek ATH™ Series*
Four *AUTO TRIGGER & HOLD* Models, TWO Priced *Below $200!!*

NEW! ATH-10

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ATH ™ SERIES FEATURES:
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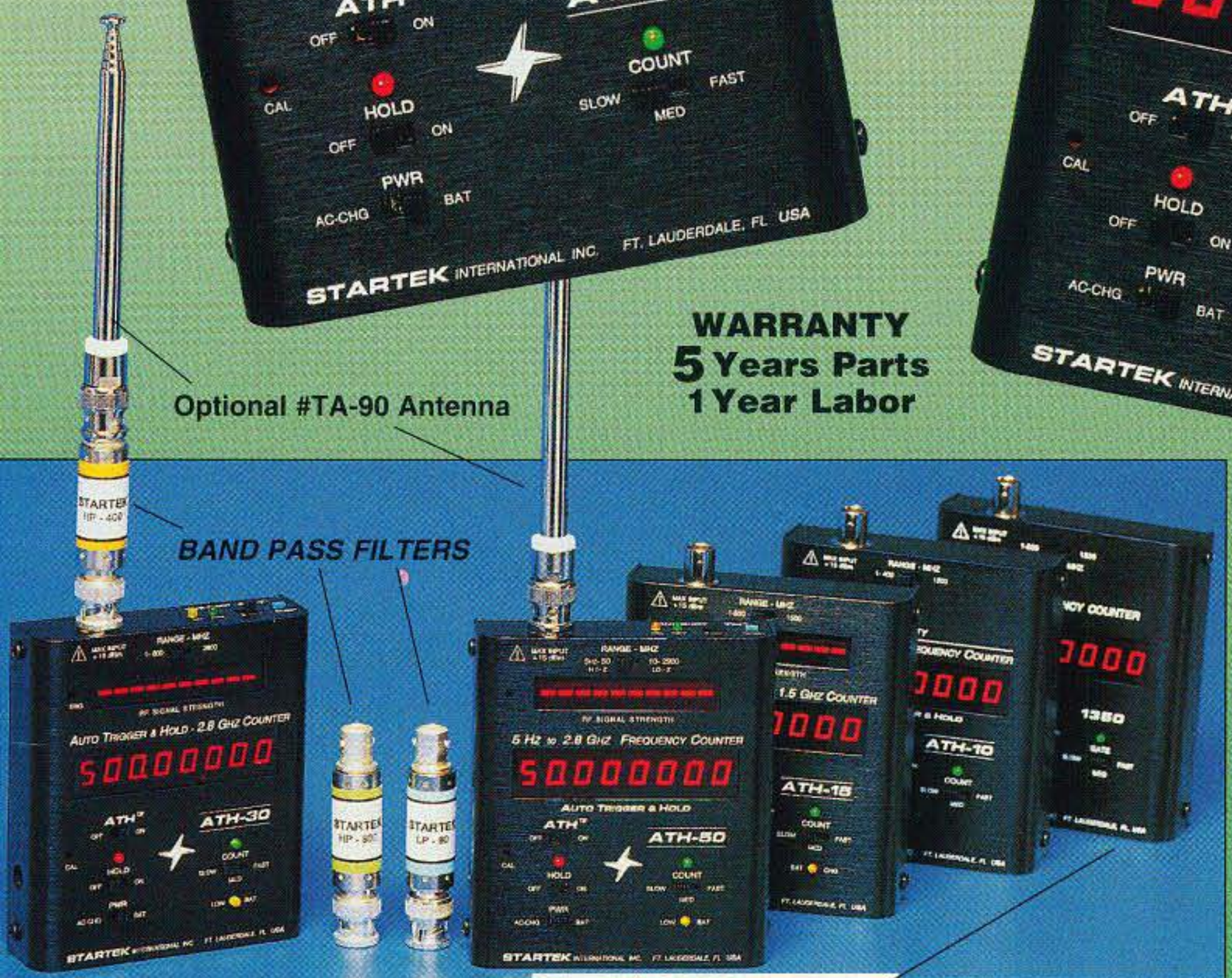
- Ultra fast response time
- Extra **BRIGHT LED** digits
- AC or Battery operation
- Maximized sensitivity

WARRANTY
5 Years Parts
1 Year Labor

Optional #TA-90 Antenna



ACCESSORIES

#CC-90	Soft Case for all models	$12.
#TA-90	Telescope BNC antenna	12.
#TA-90-L	Telescope Elbow BNC antenna	16.
#RD-150	150 MHZ Rubber Duck antenna	16.
#RD-2750	27 & 50 MHZ Rubber Duck antenna	28.
#RD-450	450 MHZ Rubber Duck antenna	16.
#RD-800	Cellular phone band RD antenna	29.
#C/6A	**ABOVE 7 items, SAVE $30**	**99.**
#M-207-IC	Interface Cable MFJ ant. analyzers	10.
#P-110	200 MHZ 1X-10X probe	39.
#LP-22	Low Pass, Audio probe	25.
#DC-10	Direct, 50 OHM probe	20.

Model 1350
Economy Frequency Counter
1-1300 MHZ, 3 gate times, Hold switch
(No ATH or Bar Graph).... **$119.**

FEATURES

	ATH-10 $149 reg $179	ATH-15 $189 reg $235	ATH-30 $249 reg $299	ATH-50 $289 reg $339
FREQUENCY RANGE	1 MHZ - 1200 MHZ	1 MHZ - 1500 MHZ	1 MHZ - 2800 MHZ	5 HZ - 2800 MHZ
AUTO TRIGGER & HOLD	YES	YES	YES	YES
SIGNAL BAR GRAPH	NO	YES	YES	YES
LOW BATTERY IND.	NO	YES	YES	YES
ONE-SHOT & RESET	NO	OPTIONAL	YES	YES
HI-Z LOW RANGE	NO	NO	NO	YES

OPTION #HST-15 is a high accuracy, high stability, time base upgrade that can be ordered with any ATH series model (0.2PPM TCXO)..... **$100.**

Extend readablilty distance with **BAND PASS FILTERS. $49 ea.**

#LP-60	DC - 60 MHZ	#BP-150	130 - 500 MHZ
#HP-400	400 - 1500 MHZ	#HP-800	800 - 2000 MHZ

#BP-4 All 4 Filters $189

All instruments are true Pocket Size: 4" High x 3.5" Wide x 1" Deep, <14 cubic in. and are shipped with factory installed Ni-Cad batteries and AC charger/adapter. Antennas are optional.

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VISA, MC, Discover accepted. Prices & specifications subject to change without notice or obligation.

CIRCLE 247 ON READER SERVICE CARD

JRC

JST-245

160-10 Meters PLUS 6 Meter Transceiver

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

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

★ JST-145 COMING SOON ★

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

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

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

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

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

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

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

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

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

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

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

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

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

15 HEAVY-DUTY POWER SUPPLY • Built-in switching power supply with Power Factor Correction (PFC) and "silent" cooling system designed for continuous transmission at maximum output.

"This device has not been approved by the Federal Communications Commission. This device is not, and may not be, offered for sale or lease, or sold or leased until the approval of the FCC has been obtained."

JRC *Japan Radio Co., Ltd.*

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CIRCLE 159 ON READER SERVICE CARD

73 Amateur Radio Today

July 1994
Issue #406

WAYNE GREEN, INC.

Editorial Offices
70 Route 202N
Peterborough NH 03458
1-603-924-0058;
FAX: 1-603-924-9327

Subscription Services
1-800-289-0388

Foreign Subscribers
1-609-461-8432

Reprints: $3.00 per article.
Back issues: $4.00 each.
Write to *73 Amateur Radio Today*, Reprints, 70 Route 202N,

Printed in the U.S.A. by Quad Graphics, Thomaston, Georgia.

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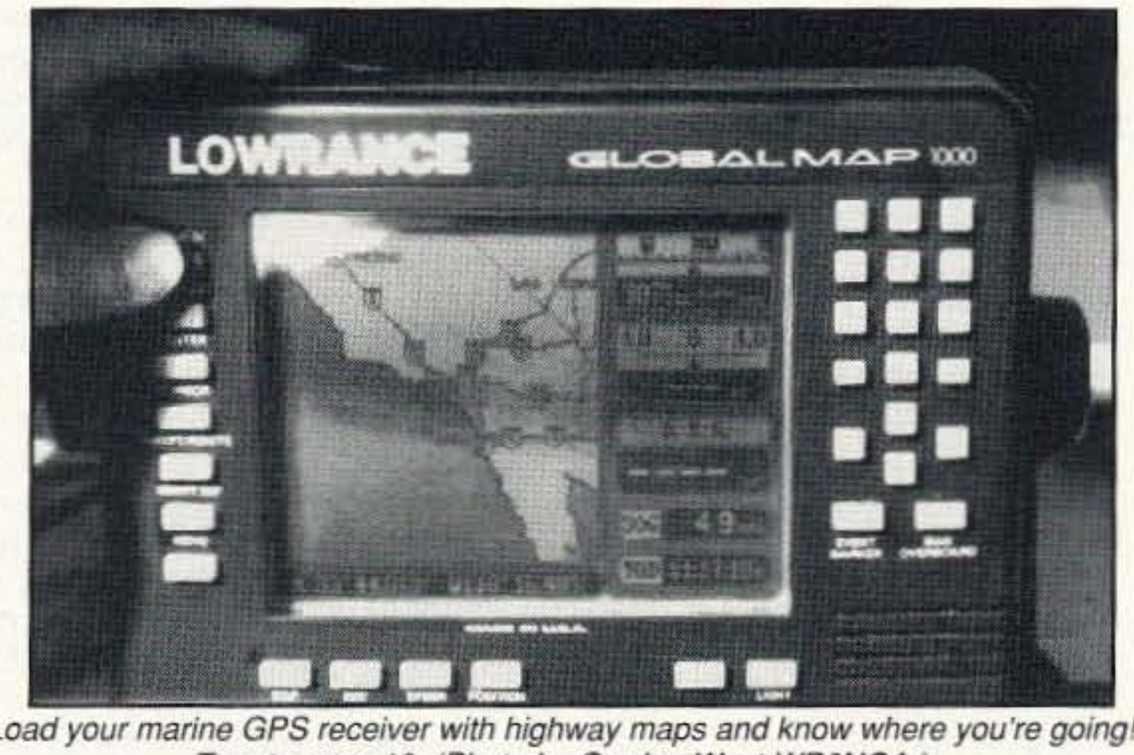

Load your marine GPS receiver with highway maps and know where you're going! Turn to page 10. (Photo by Gordon West WB6NOA.)

**FEEDBACK...
FEEDBACK!**

It's like being there—right here in our offices! How? Just take advantage of our FEEDBACK card on page 17. You'll notice a feedback number at the beginning of each article and column. We'd like you to rate what you read so that we can print what types of things you like best. And then we will draw one Feedback card each month for a free subscription to *73*.

On the cover: Hit the trail with the Icom GP-22 GPS receiver. See this month's cover story, "The Global Positioning System," starting on page 10. (Photo by David Cassidy N1GPH.)

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73 Amateur Radio Today (ISSN 1052-2522) is published monthly by Wayne Green Inc., 70 Route 202 North, Peterborough NH 03458.

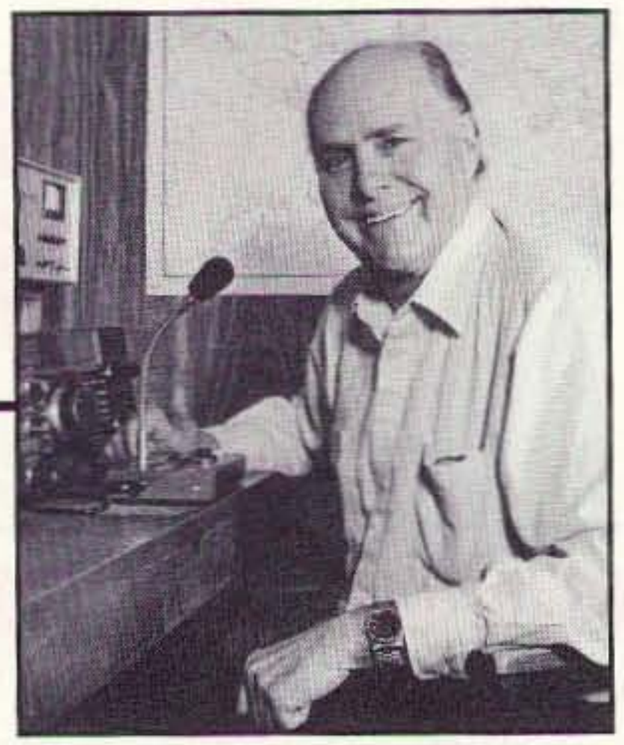
For Subscription Services, write to *73 Amateur Radio Today*, P.O. Box 7693, Riverton NJ 08077-7693, or call 1-800-289-0388. The subscription rate is: one year $24.97, two years $39.97; Canada: $34.21 for one year, $57.75 for two years, including postage and 7% GST. Foreign postage: $19.00 surface or $42.00 airmail additional per year. All foreign orders must be accompanied by payment in US funds. Second class postage paid at Peterborough, NH, and at additional mailing offices. Canadian second class mail registration #178101. Canadian GST registration #125393314. Microfilm Edition—University Microfilm, Ann Arbor MI 48106. POSTMASTER: Send address changes to *73 Amateur Radio Today*, P.O. Box 7693, Riverton NJ 08077-7693.

Contract: Under the power vested in me by the almighty Oz, I command you to get a life! Listening to your endless, mindless rig babble is boring. Don't be a broken record. Get off your center of gravity and try something new.

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1



Here They Go!

Yes, I know you're busy fighting the pileups on 20m and could care less about our 2400 MHz band. You're focused on the here and now and don't want to be bothered about five or 10 years from now. Let the future take care of itself.

The only reason we have our country is that a bunch of fanatics fought for it a couple hundred years ago. They believed in what they were doing. I'm sure glad there's no way for them to see what a mess you've made of their vision and hopes. Yep, you. You're the man. You're the one who has been re-electing your crooks to Washington, and it's Congress that's made the big mess we're trying to cope with.

Well, Congress is at it again. This time they're grabbing 25 MHz of one of your unused UHF bands and putting it up for auction, with the proceeds to go toward supporting even more Congressional pork. They'll get billions for it.

Our 2390-2450 MHz band is the first on the block, with recommendations for selling off the 2390-2400 and 2402-2417 segments. They're graciously planning to leave us the 2400-2402 segment for our satellite communications. They've also targeted 2300-2310 for later sale. That'll carve 35 MHz from our 70 MHz allocation. Half!

In a few years we'll either have a healthy amateur radio hobby which is largely satellite oriented or we'll be a vague footnote in the history books. The world is going high-speed digital and leaving us behind in the dust.

So what can you *do* about all this? Probably not much. You've bet the farm on the ARRL and they're unlikely to take any action that could change things. Congress is run by bribes, with the biggest bribes going to the subcommittee members. Let me be blunt . . . how much money have you personally donated to your congressmen's re-election fund? I'm willing to bet that all 500,000 of the hams who may still be alive have donated well under $50,000. Ten cents a head. Well, a dime may have been big money when old man Rockefeller was handing 'em out in the 1930s, but we don't even bother to lean over to pick up a dime on the street these days. With Congress you get what you pay for and not anything extra. They know you're so stupid you will continue to re-elect them, so why should they care what you think?

Now, if you could start getting some petitions going among your family, friends and co-workers, promising to unelect them if they sell off your heritage of ham microwave frequencies, we might get somewhere. It would take ham clubs in all 50 states to pull it off. One thing you can bet on, I'll be watching the ham club newsletters, looking for some signs that someone out there gives a damn about the hobby. If every ham club in the country started getting petitions signed, with copies to their congressmen and me, we might end up with bigger satellite bands instead of diced and sliced baloney.

Or you can wait for the ARRL to do something, which I doubt will ever happen.

What will I do with a ton of petitions? I've been a registered Washington lobbyist for over 20 years now, so I know exactly what to do. I've been down there before waving a sheaf of petitions and watched the reaction. That was what got us the hearing before the FCC Commissioners 20 years ago, the one which resulted in the biggest changes in ham rules in the history of the hobby. That's when we got back our repeater rights.

Yes, Congress is run by bribes, but they also are influenced by cartons of petitions. Heavily influenced. If they get unelected they're suddenly off the lobbyist gravy train.

But heck, it's only 25 MHz of a band we aren't using, so who cares. Right? Never mind that the camel's nose is in the tent.

Poor, Dumb Wayne

A few years ago I got an interesting letter from George W9EJY proposing a ridiculous new modulation approach. Imagine being able to put a 75 MHz FM signal out on an AM broadcast transmitter! An obviously crazy idea.

But George had stirred up an idea I'd had years before . . . an idea that seemed logical, but if so, why wasn't it being used? I think I even wrote about this in an editorial maybe 20 years or so ago. So I ran the idea by a scientist friend of mine to see if he could shoot it down. He hemmed and awed.

What George has done . . . what I'd wondered about years ago . . . was taking an audio modulated FM signal and dividing it down. Let's say you want to have a nice, full frequency audio signal. We could even start with the normal 75 kHz commercial FM bandwidth, modulating it at 100 MHz, right up in the middle of the FM band. Now we divide it by 5 twice and we've got a 4 MHz signal with 3 kHz bandwidth. Any reason we can't transmit that on 75m and have one heck of an FM channel?

To receive it you'd want to multiply times 5 twice. This would take your 455 kHz IF signal and move it to 284.375 MHz. A local oscillator at 273.675 MHz would give you your 10.7 MHz IF signal for any FM receiver to detect.

Well, if we can do that for FM, how about a 6 MHz-wide TV signal? Well, we'd have to start at around 2500 MHz and divide down by 5 four times. That would again give us a 4 MHz output, but with ±9.6 kHz of modulation. Not bad for ATV on 75m, eh?

Now please tell me why this won't work. Then I'll pass the word to George, who has tested his FM idea on the air with a cooperating AM broadcast station and found it to work just fine. He's been exhibiting at the NAB conventions, looking for a sponsoring company to get involved. He's found that if the AM station keeps its AM modulation at around 85% there is no detectable interference between the AM signal and the micro-modulated FM signal on the same carrier.

As George points out, the exciters used for early FM transmitters started out at around 115 kHz with ±87 Hz phase modulation and then multiplied that up 864 times to the output channel. Sauce for the goose.

The concept was good enough to get George a Technology Award from The Society of Broadcast Engineers in 1992. But is it enough to get you to give it a try?

Progress

So here we are in 1994. And here I am using a Macintosh PowerBook for most of my work. And here I am without a simple program to keep track of and display the sales of my enterprises. This is ridiculous!

The first practical microcomputer was the Radio Shack TRS-80, which debuted in August 1977, just two years after the first micro was announced. The first was the MITS Altair 8800, but that lacked a few things. It came in kit form and had no operating software at all. A few months later Bill Gates showed up at MITS in Albuquerque with his jury-rigged BASIC. The way I recall it, he'd written a BASIC interpreter for the 8008 chip as an exercise in his computer course at Harvard. When the Altair came along, desperately needing something to make it do more than be an expensive paperweight, he cobbled his interpreter so it would work on the 8080 chip, left school, and went to work for MITS. He's doing fairly well.

Commodore came out with a PET microcomputer in around March 1977, but it had a stupid square keyboard, and a marketing plan designed to screw any dealers who sucked into trying to sell it. My recollection is that Jack Tramiel, the president, set up his own separate mail order firm, Contemporary Marketing, in Bensenville, out near Chicago, just to sell the PETs. He refused to let Commodore run any ads for the computer, with only his mail order firm advertising. I visited the factory in California where I was told that only after his mail order company had all the inventory they needed would Commodore ship any units to dealers.

But to use the PET you had to load BASIC from a cassette, and so on. Slow. By the time Radio Shack announced their TRS-80 Model I, the customers were ready for it.

I realized that the only practical way to provide the software these microcomputers were going to need was to manufacture and sell it in quantity. Up until then we had the mainframe computers, starting in the million-dollar range, complete with horrendously expensive software, also running in the million-dollar range. Then came the minicomputers in the $100,000 bracket. The software for these systems was custom-developed for each user and also ran around $100,000 on the average. So I figured that now that we had $10,000 computer systems we were going to have to get soft-ware costs down too, and that meant mass production. That's when I started Instant Software.

My approach was simple. I got the readers of my magazines to send in software they'd developed for possible distribution. I set up a lab with around 30 work stations so we could cover the most popular micros. Incoming software was then evaluated by my people and the best of it was put into shape for production. We started out with a lunar lander, and went on to develop all kinds of games, educational stuff, and quite a few rather good business programs. Our Typing Teacher won prizes, as did our geography programs.

One of the best was Business Analysis. Though that was designed for the Model I, and later it was updated for the Model III. It was so far beyond anything I've seen since that it is frustrating. I sure wish something like that was available for my Mac. If there's a pro-

Continued on page 74

COMET

MODERN, MULTI-BAND ANTENNA SYSTEMS

MOBILE ANTENNA PRODUCTS

Modern, high-performance stations use COMET Antennas, Duplexers, Triplexers and Accessories! COMET products are designed to provide an exceptional level of signal quality and coverage area. Whether operating mobile or from your base station, COMET products make you sound good. No other product line has the selection, convenience, quality and performance!

DUAL-BAND MOBILE ANTENNAS

FL-67S Dual-Band 146/446MHz w/Fold-Over, No Ground Plane Required

Gain & Wave:	VSWR:	Max Power:	Length:	Connector:
146MHz 4.5dBi 6/8 wave 446MHz 7.2dBi 5/8 wave x 3	1.5:1 or less	150 watts	4' 11"	Gold Plated PL-259

FL-62S Dual-Band 146/446MHz w/Fold-Over, No Ground Plane Required

Gain & Wave:	VSWR:	Max Power:	Length:	Connector:
146MHz 3.5dBi 1/2 wave 446MHz 6.0dBi 5/8 wave x 2	1.5:1 or less	150 watts	3' 5"	Gold Plated PL-259

NEW!

SB-7/SB-7NMO Dual-Band 146/446MHz w/Fold-Over, No Ground Plane Required

Gain & Wave:	VSWR:	Max Power:	Length:	Connector:
146MHz 4.5dBi 6/8 wave center-loaded 446MHz 7.2dBi 5/8 wave x 3	1.5:1 or less	70W FM	4' 7"	PL-259 or NMO style

NEW!

SB-5/SB-5NMO Dual-Band 146/446MHz w/Fold-Over, No Ground Plane Required

Gain & Wave:	VSWR:	Max Power:	Length:	Connector:
146MHz 3.0dBi 1/2 wave 446MHz 5.5dBi 5/8 wave x 2	1.5:1 or less	120W FM	38"	PL-259 or NMO style

NEW!

SB-2/SB-2NMO Dual-Band 146/446MHz

Gain & Wave:	VSWR:	Max Power:	Length:	Connector:
146MHz 2.15dBi 1/4 wave 446MHz 3.8dBi 5/8 wave	1.5:1 or less	60W FM	18"	PL-259 or NMO style

NEW!

B-10/B-10NMO Dual-Band 146/446MHz, Cellular Look-a-like

Gain & Wave:	VSWR:	Max Power:	Length:	Connector:
146MHz 0dBi 1/4 wave 446MHz 2.15dBi 1/2 wave	1.5:1 or less	50W FM	12"	PL-259 or NMO style

B-20/B-20NMO Dual-Band 146/446MHz, Cellular Appearance, No Ground Plane Required

Gain & Wave:	VSWR:	Max Power:	Length:	Connector:
146MHz 2.15dBi 1/2 wave 446MHz 5.0dBi 5/8 wave x2	1.5:1 or less	50 watts	30"	PL-259 or NMO style

NEW!

SB-25/SB-25NMO Mono-Band 146MHz w/Fold-Over, No Ground Plane Required

Gain & Wave:	VSWR:	Max Power:	Length:	Connector:
146MHz 4.1dBi 5/8 wave center loaded	1.5:1 or less	100W FM	4' 9"	PL-259 or NMO style

NEW!

COMET products are available from most major dealers. For customer service, or a complete catalog, please call us at 800/962-2611. We're confident COMET products and accessories will enable you to enjoy Amateur Radio to its fullest!

N.C.G. CO. NCG

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Anaheim, CA 92806
(714) 630-4541
FAX (714) 630-7024

TRI-BAND MOBILE ANTENNAS

CX-224/224NMO Tri-Band 146/220/446MHz, w/Fold-Over, No Ground Plane Required

Gain & Wave:	VSWR:	Max Power:	Length:	Connector:
146MHz 2.15dBi 1/2 wave 220MHz 3.6dBi 5/8 wave 446MHz 6.0dBi 5/8 wave x 2	1.5:1 or less	100 watts	3'	PL-259 or NMO style

FJ-15S Tri-Band 52/146/446MHz w/Fold-Over

Gain & Wave:	VSWR:	Max Power:	Length:	Connector:
52MHz 2.15dBi 1/4 wave 146MHz 4.5dBi 6/8 wave 446MHz 7.2dBi 5/8 wave x 3	1.5:1 or less	120 W FM	4' 10"	PL-259

HF MOBILE AND HT ANTENNAS

HA-4S Quad-Band HF 40/*(20)/15/12/10 Meters w/Fold-Over

NEW!

Wave:	VSWR:	Weight:	Length:	Max Power:	Connector:
1/4 wave	2:1 or less	1 lb. 14 oz.	4' 4"	120W SSB (200W SSB 28MHz)	PL-259

*L-14HS Optional 20 Meter Coil

SH-55 Super Flexible 146/446MHz HT Antenna

Gain & Wave:	Max Power:	Length:	Connector:
146MHz 1.5dBi 1/4 wave 446MHz 3.2dBi 5/8 wave x 2	10 watts	15.5"	BNC

CH-722SA High Gain HT Antenna
Gain & Wave: 146MHz 3.0dBi 1/2 wave
446MHz 5.5dBi 5/8 wave x 2
Max Power: 50 watts
Length: 35", 2 sections, 18" each
Connector: BNC

CH-32 Miracle Baby
146/446MHz HT Antenna
Gain & Wave: 0dB 1/4 wave
Max Power: 10 watts
Length: 1.75"
Connector: BNC

DUPLEXERS AND MOBILE MOUNTS

CF-4106K, I, J,
146/446MHz
Band Pass, Ins Loss, Max Pwr.
1.3-150MHz, 0.1dB, 800w PEP
400-540MHz, 0.2dB, 500w PEP
Isolation: 60dB
CONNECTORS:

	4160K	4160I	4160J
Output:	SO-239	SO-239	SO-239
Low In:	PL-259	PL-259	SO-239
High In:	PL-259	N-Male	SO-239

RS-21
Trunk, hatchback, rear door (van, blazer, etc.) mount. Adjustable to virtually ANY angle. Rubber-coated base protects vehicle paint.

NEW!

RS-820
Heavy-Duty, Low Profile Trunk Lip or Hatch Back Mount. Rubber-coated base protects vehicle paint.

WS-1M
Multi-Adjustable Window Clip Mount.
11.5 feet of high quality coax.
Gold-plated UHF Conns. for Antennas up to 40" in height.

NEW!

3D4M Standard Cable Assembly
13.5 feet of low loss coax. Gold plated UHF (PL-259/SO-239) connectors.
3D5M Standard Cable Assembly
Same as 3D4M, but 17 feet of coax

CK-5M Deluxe Cable Assembly
13 feet double shielded very low loss coax + 12" RG-188 teflon coax. Gold plated UHF (PL-259/SO-239) connectors.
CK-5M5 Deluxe Cable Assembly
Same as CK-5M, but 17 feet of coax

MINI SPEAKER/MIC

HM-P2K/F
Mini spkr/mic featuring full TX/RX quality!
Light weight, extremely small: 1'x2" with collar pocket clip.
HM-P2K: Kenwood Version
HM-P2F: Icom/Yaesu Standard/Alinco/etc.

LETTERS

Number 2 on your Feedback card

From the Ham Shack

James W. Searcy WA5WRE, Poplarville MS In July of 1992 there was an amateur in Picayune, Mississippi, who came up on the local repeater there and used all kinds of four-letter words, complaining about a woman driver cutting him off in traffic. As he was spouting off over the air, I called the FCC office in New Orleans and let an FCC engineer listen for a solid five minutes. He told me that there was nothing the FCC could do, for they could not "define" what was obscene. Well, I chewed that, and after choking a few times I managed to swallow it.

Now (April 1) I've had a non-ham come up on my machine here in Poplarville, use our autopatch, and never sign. We caught the individual, called the FCC, talked to the same engineer, and were told, "There's nothing we can do, for we didn't witness the QSO." Not only that, but a business whose owner is an Extra Class amateur sold him the radio.

Well, needless to say, this upset me, but what really hurts is that word got out about the FCC's "non-action," and now one of my students has dropped out of class and is operating on amateur frequencies with a bogus call, stating, "Why worry? The FCC won't do anything to you, so why go through the headache of working for a license?"

I've been an amateur for 42 years and frankly, I've reached the point where I can't blame him. It's like going to a war without your leaders. What are you supposed to do? With no FCC backing, there is no chance of winning.

I don't operate HF at all, but if I did I think I would modify it for CB so that when the time comes I'll be ready.

James—You haven't been reading my editorials. Tsk.

As I've explained, the FCC is understaffed and underpaid, and doesn't want to be bothered with amateur radio. If we aggravate them very much they'll get more interested in ending the hobby. After all, the FCC people get no benefit from hams.

We're no longer living up to any part of our charter, so the less we bother them, the longer we'll be able to use the billions of dollars in spectrum we've inherited.

The fact is that when there is a local problem it's up to the local amateurs to take the solution of the problem as their responsibility. You can't expect the FCC to spend money to help. After all, how much money are you paying for your license? Zilch. And what else are you contributing to the commonweal? Not very much.

The best rule is not to poke the bear while it's sleeping.

73 . . . Wayne

Kevin Elliott NØVNP, on the *73* BBS Wayne, I want to thank you for a few of the things you have unknowingly given me. You and your mag, in the early small-size format, got me interested in ham radio, via the articles and your grasp of the ham community. You gave me the chance to enter through reading the various articles and, of course, your comments.

I bought your tapes in 1978 to learn Morse code. You had a rather odd idea of sending fast, with the spacing in the range needed. With me it was 5 WPM that got me into the area I thought I would not be able to attain. The numerous magazines that my Elmer gave me to read, yours and others, were what got the theory to begin to make a bit of sense. But no matter what subject I wanted to find, articles in your *73* magazine were what I came back to. Your trips and DXpeditions allowed me and others the chance to see what this hobby is all about.

I went on to get my General ticket and worked about 175 countries. Via moving and a divorce I lost about all of my gear and my QSL cards. I lost yours in a fire, and that was probably one of the most treasured of the bunch. I had the early Clipperton, Walvis Bay, on the second day they used that call, and others, but my W2NSD/1 card was at the top of the list. You were nice enough to send me a card a few months back to replace the one I lost, and I thank you.

Last Saturday I took my Advanced test, which I passed with ease, in a large part thanks to reading and learning. Even at age 41 my dreams continue, thanks to your magazine. My license was reinstated from my first call (WBØYHG) to NØVNP because I strayed from the hobby that I have grown to love. But, finding your bigger-size magazine on the newsstand one day about two years ago relit the fire that I hadn't realized had gone out.

Wayne, thanks for the memories that you have given me and for the enjoyment that each month I discover in the pages of your publication. Don't change now—I'm too old to be confused.

By the way, I am getting remarried on August 6 and my future bride will be a ham by then as well. She is taking her Tech (with code) class from a local group, and in large part I can thank you for that as well. Your editorials about education have a very special meaning to us. May all your skip be long and the scuba diving safe.

Gary Moeller N8WVV, from the *73* BBS I love your editorials. They are one of the first things I read each month when I get my copy of *73*. Please keep prodding us—heaven knows, we need someone to keep us thinking. The rest of society seems to want us to go brain dead and you are helping to keep us alive.

Irving L. Chidsey, Havre de Grace MD Wayne, I was perusing my son's copy of the April issue of *73* and noted your column on "Good Science and Bad Science." The quality of what passes for science in public discussion has long been a concern of mine. I am glad to know that it is also a concern of yours, but I am puzzled by your choice of examples, for we seem to be on opposite sides of several issues, and I would like to know what your criteria were. For most of my professional career I was part of the Rocket/Upper Atmosphere program at the Army's Ballistic Research Laboratory, classified as a physicist, or a research scientist, or a research engineer, at the whim of the personnel office. My criteria are that as much as possible I check with the refereed journals (more difficult since I retired two years ago), and that I understand the underlying science. Now that I can no longer easily read refereed journals, I use *The American Scientist*, published by Sigma Chi, *The Scientific American*, *Science*, and *Nature* when I can get them, and books published by recognized scientists. I don't own a copy of Gore's book, but if I did, I would read it to check his understanding of the issues, not to improve mine.

My reading of the scientific journals tells me that scientists are worried about acid rain and its effects on the more fragile ecosystems. The first articles about the increase in atmospheric CO_2 appeared in the *Journal of Geophysical Research*, etc., during the mid '60s, and scientists have been concerned about the probable consequences, global warming and a rise in the sea level, since the early '70s. It was also the scientists who discovered the ozone hole over the South Pole, and they have made great strides in understanding what causes it. The atmospheric science community still believes that a nuclear winter was the expected aftermath of an all-out nuclear exchange between the United States and the USSR. Frankly, I'm quite happy that we didn't try that experiment. After the Gulf War, one very earnest, very prolific, and very wrong nut flooded several discussion groups on the Internet with predictions of doom because they thought the very extensive smoke clouds from the burning oil fields would cause a Gulf War winter. There was a quite measurable cooling where the clouds persisted, about what the theory predicted, but it went away when the fires stopped. To that extent, the nuclear winter theory has been validated.

Your other examples are from fields further from my expertise, but I believe that most of them are valid concerns. I agree that the Alar scare was a panic attack that grew because the scientists hadn't done their research yet. It is true that we won't run out of oil 'til quite awhile after the turn of the century, but we now have to do much of our drilling in very dangerous and inhospitable places, and it is getting harder and harder to find major oil fields. We are losing topsoil and we are paving over, or developing, much of our best cropland; the county I live in has lost over half its farmland to development in the last 40 years. There are areas in our country where the water table has dropped several hundred feet over the last few decades. The example that comes to mind is the Ogallala aquifer in the Plains states; on Long Island, sea water has moved in to replace potable ground water. I think that such examples can be reasonably described as using up our ground water.

Some other examples of bad science, or at least prematurely announced science that didn't pan out, are the 4th state of water, cold fusion, unlimited oil, and laetrile. Several of them were trumpeted by the press before they had gone through the scientific review process. Unfortunately, the loudest protagonists on both sides of these questions tend to be the most irresponsible, and the scientists may be left out of the public discussion.

Remember, we do our science out in the open, and in some cases the science gets communicated to the public while it is still being baked; the press likes to get its stories while they are still hot, without waiting for all questions to be threshed out in the review process. In several of these cases, the news was published too soon; the "good story" was a false lead, an error which the scientific community corrected as soon as it could. The alternative is to study the phenomena in secret, and only inform the public when all the research is done and all doubts removed. I don't think that secret science is either possible or desirable in a free society, and you would be among the first to object if it were tried. Absent carefully-controlled release of only assured results, we have to let the work in progress hang out in public and take our chances that the public will sometimes be led astray. Again, I would like to know what your criteria were for choosing your examples so I may understand why we differ.

Irving—Yes, we do differ. But if you do some homework, I think we'll be in agreement. I suggest you read Environmental Overkill *by Dixie Lee Ray, the former Governor of Washington and Chairman of the Atomic Energy Commission, Assistant Secretary of State, etc. The publisher is Regnery Gateway Commission, $20, 260 p. Then read* Ecoscam *by Ronald Bailey, St. Martin's Press, 228 p.*

These two books, plus several others I've read, all agree that the ozone hole is baloney, and ditto global warming and the coming ice age. Even the nuclear winter data has been seriously challenged in Scientific American, *as has acid rain. Ray demolishes that bugaboo, too (pages 147-150).*

Remember that no scientific issue can be resolved by strongly-held belief, no matter how eminent the authority.

You are indeed out of touch when it comes to cold fusion. Tsk! The premiere issue of "Cold Fusion" *magazine is in my hands: 100 pages, with articles by several well-known scientists. Copies of the magazine are $10, if you're interested in coming up to speed on something you believe didn't "pan out."*

You mentioned Laetrile, which makes me wonder how much you've read about it. Not much, I'll bet. How about what the AMA did to Hoxsey and to Krebiozen? You'll want to read Racketeering In Medicine, The Suppression of Alternatives *by Dr. Carter, Hampton Roads Press, $13, 360 p. Good book.*

You also might read Impure Science *by Bell, Wiley, $23, 300 p. Cheers . . . Wayne* 73

You get more features for your dollar with the

REP-200 REPEATER

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

Kit $1095; w&t only $1295!

- Available for the 143-174, 213-233, 420-475, 902-928 MHz bands.
- **FCC type accepted** for commercial service in150 & 450 bands.
- **Six courtesy beep types**, including two pleasant multi-tone bursts.
- **Open or closed access autopatch, toll-call restrict**, auto-disconnect.
- **Reverse Autopatch,** two types.
- **DTMF CONTROL:** over 45 functions can be controlled by 4-digit dtmf command, via radio or telephone.
- **Owner can inhibit** autopatch or repeater, enable either open or closed access for repeater or autopatch, and enable toll calls, reverse patch, kerchunk filter, site alarm, aux rcvr.
- **Change** cw speed and tone, beep delay, tail timer, and courtesy beep type **at any time** by owner password protected dtmf commands.
- **Auxiliary receiver input** for control or **cross linking repeaters**.
- Color coded LED **status indicators**.

NEW **REP-200T Voice Message Repeater.** As above, except includes Digital Voice Recorder. Allows message up to 20 sec. to be **remotely recorded off the air** and played back at user request by DTMF command, or as a periodical voice id, or both. ..... **kit $1145, w&t only $1395**

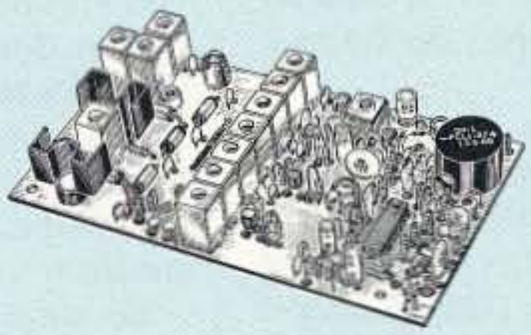
NEW **REP-200C Economy Repeater.** Like REP-200, except uses COR-6 Controller (no DTMF control or autopatch). Features **real-voice ID**. ..... **Kit only $795, w&t $1095**

REP-200N Repeater. Want to use your ACC controller, etc.? No problem! We'll make you a repeater with rf modules only. ..... **Kit only $695, w&t $995**

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

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

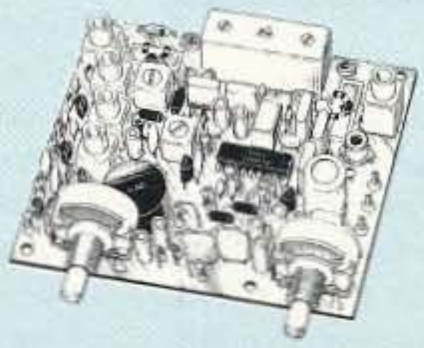
FM EXCITERS: 2W continuous duty. TCXO & xtal oven options. ***FCC type accepted for com'l high band & uhf.***



- **TA51**: 50-54, 143-174, 213-233 MHz .....kit $109, w&t $189.
- **TA451**: 420-475 MHz .....kit $109, w&t $189.
- **TA901**: 902-928 MHz, (0.5W out); w&t $219.

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

FM RECEIVERS:



- **R144/R220 FM RECEIVERS** for 143-174 or 213-233 MHz. **Sensitive** front end, 0.18uV, both crystal & ceramic if filters plus **helical resonator** front end for exceptional selectivity: >100dB at ±12kHz (best available anywhere!) Flutter-proof hysteresis squelch; .....kit $149, w&t $219.
- **R451 FM RCVR,** for 420-475 MHz. Similar to above. ...kit $149, w&t $219.
- **R901 FM RCVR,** for 902-928MHz. Triple-conversion, ...$169, w&t $249.
- **R76 ECONOMY FM RCVR** for 28-30, 50-54, 73-76, 143-174, 213-233 MHz, w/o helical res, if selectivity >100dB at ±12kHz .....Kits $129, w&t $219

NEW **R76 MONITOR FM RCVR Kit** for 10M, 6M, 73 MHz, 2M, hi-band, or 220 MHz. IF selectivity 60dB at ±12kHz. Great for monitoring repeaters, amateur calling frequencies, or packet radio frequencies, and for listening to commercial two-way radio, police/fire frequencies, or weather forecasts. **Good starter kit, too;** easy to assemble and align. .....**Kit only $59!**

- **R137 WEATHER SATELLITE RCVR** for 137 MHz. Special if filters tailored for wideband fm. Lowest cost receiver available .....**kit only $89, w&t $149.**
- We also have preamps and receiving converters for 137 MHz, and we carry the *Weather Satellite Handbook* by Ralph Taggart.

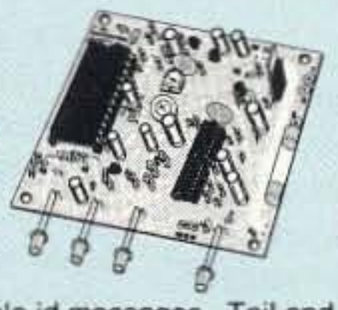
ACCESSORIES

COR-3 REPEATER CONTROLLER. Features adjustable tail and time-out timers, solid-state relay, courtesy beep, and local speaker amplifier. .....kit $49

CWID. Diode programmable any time in the field, adjustable tone, speed, and timer. .....kit $59

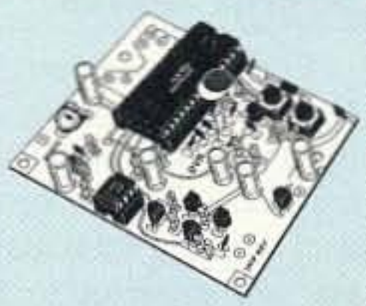
COR-4. Complete **COR and CWID** all on one board. CMOS logic for low power consumption. EPROM programmed; specify call. .....kit $99, w&t $159

NEW **COR-6. COR & Real Voice ID** on one board. Digital ic records up to 20 seconds of your voice.



Can record multiple id messages. Tail and time-out timers, courtesy beep, solid-state relay to key transmitter. kit $99, w&t $149

Versatile DVR-1 DIGITAL VOICE RECORDER Module. As a **voice ID'er for repeaters**, records your voice, using the built-in microphone or external mic. Just the thing for **fox hunt** xmtr id! May also be used as a **contest caller** to play back one or more messages through your transmitter at the press of a switch. Used as a **radio notepad,** it can record the audio output of a receiver — up to 20 sec. of anything you might want to recall later. Play back as often as you like through a small external speaker. Extensive manual tells how to use multiple messages and adapt to many applications.



.....kit $59, w&t $99

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

TD-2 DTMF DECODER/CONTROLLER. 16 digits, programmable, toll-call restrictor. Can turn 5 functions on/off. .....kit $89, wired & tested $149

AP-3 AUTOPATCH. Use with TD-2 for repeater autopatch. Reverse patch and phone line remote control are std. .....kit $89, wired & tested $149

AP-2 SIMPLEX AUTOPATCH Timing Board. Use with above for simplex operation using a transceiver .....kit $39

TD-3 SUBAUDIBLE TONE DECODER/ENCODER. Adjustable for any tone. **Especially for repeaters,** with remote control activate/deactivate provisions .....kit $29, wired & tested $59

DATA MODEMS

MO-202 FSK DATA MODULATOR & DE-202 FSK DEMODULATOR. Run up to 1200 baud digital signals through any fm transmitter & receiver. Radio-link computers, telemetry, etc.

.....kit ea $49, w&t ea $79

9600 BAUD DIGITAL RF LINKS. **Low-cost** packet networking system, consisting of MO-96 Modem and special versions of our 144, 220, or 450MHz FM Transmitters and Receivers. Interface directly with most TNC's. Fast, diode-switched PA's output 15 or 50W. CALL.

Low Cost GaAsFET PREAMPS

LNG-(*)

ONLY $59 wired&tested

FEATURES:
- **Very low noise:** 0.7dB vhf, 0.8dB uhf
- **High gain:** 13-20dB, depends on freq
- **Wide dynamic range** - resist overload
- **Stable:** low-feedback dual-gate FET

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

LNW-(*) MINIATURE PREAMP

ONLY $29 kit, $44 wired&tested

- GaAs FET Preamp similar to LNG, except designed for **low cost & small size.** Only 5/8"W x 1-5/8"L x 3/4"H. Easily mounts in many radios.

**Specify tuning range: 25-35, 35-55, 55-90, 90-120, 120-150, 150-200, 200-270, 400-500 MHz.*

LNS-(*) IN-LINE PREAMP

ONLY $89 kit, $119 wired&tested

- GaAs FET Preamp with features similar to LNG series, except **automatically switches out of line during transmit.** Use with base or mobile transceivers up to 25W. Tower mounting brackets incl.

**Tuning range: 120-175, 200-240, or 400-500.*

HELICAL RESONATOR PREAMPS

GaAs FET preamps with helical resonators **reduce intermod & cross-band interference** in critical applications. **MODEL HRG-(*), *$80 vhf, $110 uhf.***

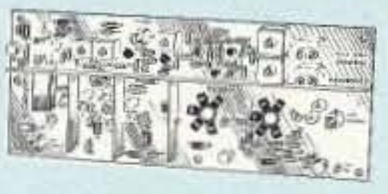
**Specify tuning range: 142-150, 150-162, 162-174, 213-233, 420-470.*

RECEIVING CONVERTERS

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

- Input ranges avail: 50-52, 136-138, 144-146, 145-147, 146-148, 220-222, 222-224 MHz, 432-434, 435-437, 435.5-437.5, and 439.25 (to chan 3).
- **Kit less case *$49*, kit w/case & BNC jacks *$74*, w&t in case *$99*.**

TRANSMITTING CONVERTERS



XV2 for vhf and XV4 for uhf. Models to convert 10M ssb, cw, fm, etc. to 2M, 220, 222, 432, 435, and atv. 1W output. ***Kit only $89.*** PA's up to 45W available.

- Buy at low, factory-direct net prices and save!
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QRX . . .

Number 3 on your Feedback card

FCC Amends Message Forwarding Rules

The Federal Communications Commission has acted on P.R. Docket 93-85 and has relaxed the Amateur Service rules to enable contemporary message forwarding systems to operate at hundreds of characters per second while retaining safeguards to prevent misuse.

A message forwarding system is a group of amateur stations participating in a voluntary, cooperative, interactive arrangement where communications from the control operator of an originating station are transmitted to one or more destination stations via forwarding stations, which may or may not be automatically controlled.

Currently, the control operator of each station is held individually accountable for each message retransmitted, resulting in unnecessary content review and delays. The American Radio Relay League stated that the obligation of the control operator of the first forwarding station should be the establishment of the identity of the station originating the message. Only when this is not done should these control operators be held accountable for improper message content.

The commission agreed, and thus, the FCC will hold accountable only the licensee of the station originating a message and the licensee of the first station forwarding a message in a high-speed message forwarding system. The licensee of the first forwarding station must either authenticate the identity of the station from which it accepts communications on behalf of the system, or accept accountability for the content of the message. *TNX Westlink Report, No. 670, April 21, 1994.*

See The Light

A young Missouri company has announced what they say is the first fiber optic cable system for home audio and video application. Developers hope the *Mongoose* cable system will soon replace conventional wire cables carrying high-fidelity analog signals in runs of up to 2.4 miles.

Why bother? According to a company vice president, it is the best way to connect both audio and video components. "It is non-conductive, has no impedance, and neither causes nor attracts electrical noise." V.P. of Development of ASM Labs Armando Martinez foresees market demand from both amateur and professional audio and video purists. "The integrity of the original signal is uncompromised," says Martinez, adding that this is the first fiber optic system that is plug-compatible with conventional equipment.

New kHz on the Block

The Federal Communications Commission will hold frequency spectrum auctions this fall, according to Chairman Reed Hundt. The frequencies heading for the auction block are to be used to expand mobile communications, which Hundt says has the potential to become one of the country's largest industries by the end of the century, with at least 87 million customers.

Hundt also says he wants the FCC to promote competition in the communications industry, especially for cable TV, so rate regulation can eventually be eliminated. *TNX Westlink Report, No, 671, April 30, 1994.*

Brain Cells

Energizer Power Systems and National Semiconductor Corp. have developed a new battery that monitors its own power consumption and provides recharging communications with the host equipment. These "smart batteries" are expected to first appear in notebook computer applications.

The new batteries use nickel-metal-hydride and nickel-cadmium rechargeable cells. The internal brains virtually prevent overcharging and allow for useful "time-left" or "% capacity remaining" information to display on the host device.

The announcement comes at a time when portable electronics equipment use is skyrocketing. Duracell International and Intel Corp. have also joined together to develop a smart battery of their own. *TNX Electronic Engineering Times, Issue 797, May 16, 1994.*

FCC Cracks Whip

Fifty-nine Southern California hams are under order from the Federal Communications Commission to retake their amateur radio license exams or face penalties, according to a story in the *Westlink Report*. The commission says all of the licensees in question were passed at sessions conducted by the ARRL-VEC in 1992 and 1993. Those volunteer examiners are also facing government scrutiny.

In a letter sent to those licensees, the FCC flatly accused the applicants of cheating. The letter says, " . . . the irregularities on your examination papers indicate that you were apparently given access to the exact (answer) key used by the volunteer examiners."

Those who were passed at the suspect testing sessions have 60 days to retest. Those who fail would face downgrade or loss of license entirely. Refusing to retest could result in more severe penalties. So far, almost three dozen VEs have been suspended in Southern California, in connection with testing irregularities, under orders of the FCC. *TNX Westlink Report, No. 671, April 30, 1994.*

What's Your $ign?

The callsign of your dreams awaits you, and the price will be $7. That's the word from the Federal Communications Commission. On March 11, the FCC released its Notice of Proposed Rule Making to implement the new fee assessments for licensees who were authorized by the 1993 US Budget Act.

Item 59 of the NPRM notes fees for amateur "vanity" callsigns, that are to take effect whenever the commission's proposal is finally approved. The current plan calls for a fee of $70, or $7 per year for the 10-year license term. *TNX Westlink Report, No. 671, April 30, 1994.*

Top Cop

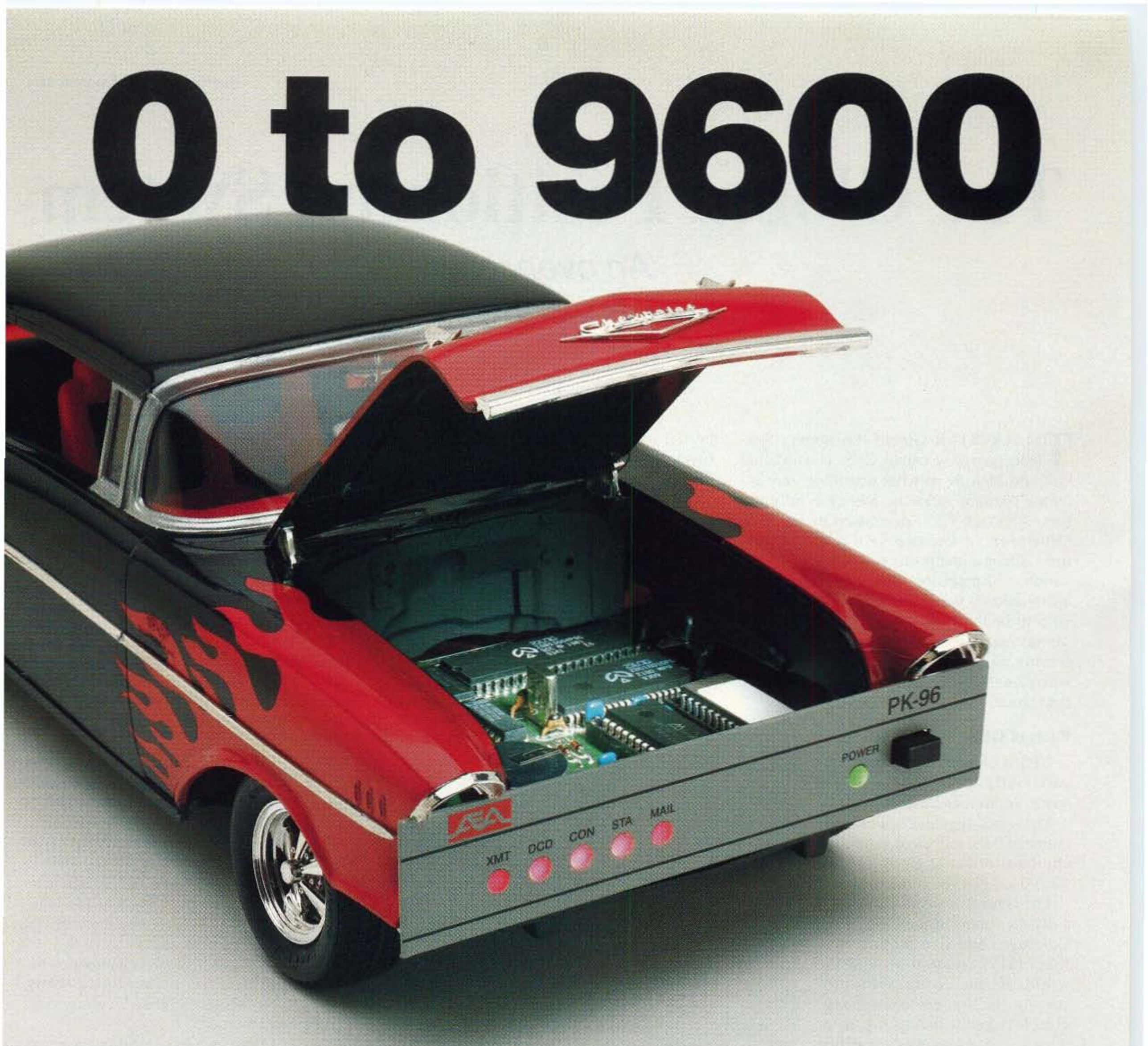
According to Electronic Engineering Times, a group of students at the Massachusetts Institute of Technology recently showed they were "complete engineers" by arranging a rather sophisticated end-of-semester prank. The article quotes Bob Rivers, Human Resource Director at Bose Corp., saying the MIT students displayed a number of desirable qualities his company looks for when hiring engineers: initiative, leadership, technical knowledge, planning and organization, and the ability to handle stress.

So, what did the students do? They somehow constructed an exact replica of a campus police car—right down to a bag of Dunkin Donuts—and lifted it to the dome of one of MIT's main buildings, all in complete secrecy. As you can imagine, the story was highly photographable, and made all the evening newscasts in Boston. Rivers says these young engineers also have another trait that is very desirable in the workplace—a sense of humor. *TNX Electronic Engineering Times, Issue 797, May 16, 1994.*

TNX . . .

. . . to all our contributors! You can reach us by phone at (603) 924-0058, or by mail at *73 Magazine*, 70 Route 202 North, Peterborough, NH 03458. Or you can reach us on CompuServe ppn 70310,775@compuserve.com; or at the *73* BBS at (603) 924-9343 (300-2400 bps), 8 data bits, no parity, one-stop bit. News items that don't make it into *73* are often put in our other monthly publication, *Radio Fun*. You can also send news items by FAX at (603) 924-9327. 73

0 to 9600



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Satisfy your need for speed with the new PK-96 9600 baud packet controller from AEA.

This high-performance machine comes standard with 1200 baud AFSK tone signaling, as well as 9600 baud K9NG and G3RUH compatible direct frequency modulation. The PK-96 makes an excellent terrestrial or satellite data controller. It can be used for high-speed data links to eliminate bottlenecks and increase system capacity.

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Connect with us

The Global Positioning System

An overview.

by Bill Clarke WA4BLC

The NAVSTAR Global Positioning System, generally called GPS, is a satellite radio positioning network providing very accurate position, velocity, and time information. Although GPS, developed by the U.S. Department of Defense (DOD), can provide three-dimensional position, velocity determination, and precision time transfer, position information is the most sought. Plans call for GPS to be the DOD's primary means of radionavigation. The system is capable of serving an unlimited number of users anywhere on the ground, at sea, in the air, and in near space.

Parts of GPS

GPS is comprised of three parts (officially called segments): space, control, and user.

The space segment is a constellation of 24 satellites in semi-synchronous orbits at an altitude of 20,200 km (10,900 miles).

The control segment consists of a master control station located in Colorado, and five monitor stations (MS) situated around the world. As the central GPS processing facility, the control segment is tasked with tracking, monitoring, and managing the satellite constellation.

The user segment consists of the consumers of GPS. They may be military or civilian; however, all must be properly equipped with specially designed receiving equipment, normally referred to as a GPS receiver or receiver/processor, to make use of GPS.

How GPS Works

GPS position determination is based on a concept called time of arrival (TOA) ranging, which is merely the signal's travel time from transmission to reception.

A simple example of TOA ranging: The distance from a thunderstorm to your location can be figured by counting the seconds between a lightning flash and the thunder report (the TOA value). Multiply the TOA value by 0.2 (the approximate speed of sound is two tenths of a mile per second) to calculate the range in miles.

The NAVSTAR satellites are broadcast beacons transmitting L-band signals consisting of pseudorandom noise (PRN). The PRN is predetermined strings of one and zero data bits, generated by an on-board clock that also provides the exact transmit time of the signals. GPS satellites transmit spread spectrum signals on two frequencies: L1 = 1575.42 MHz and L2 = 1227.6 MHz. All radio transmissions are on the same frequencies, with individual satellite identification made via unique individual code sequences.

When the GPS receiver begins tracking the PRN sequences from four satellites (the generally accepted minimum number required to provide adequate accuracy), the receiver's data processor takes over.

The processor samples the receiver's TOA values, makes numerous calculations and corrections that account for clock errors, ionospheric signal delays, receiver noise, etc. Much of the corrective mathematics used in these calculations is variable from time to time. The variables are provided to the GPS receiver as parts of the satellite signal called the navigation message (NAV Msg).

The NAV-msg is superimposed on the satellite signals and contains: GPS system time of transmission, a hand-over word (HOW), orbital position data, clock data, and almanac data for the remaining satellites in the constellation. The coefficients for calculating UTC and the ionospheric delay are also included in the NAV-Msg.

The GPS receiver computes the position fix in coordinate terms, consisting of latitude, longitude, and altitude.

Note: A GPS position fix refers to the electrical phase center of the receiver's antenna, as the antenna is the actual point of signal reception.

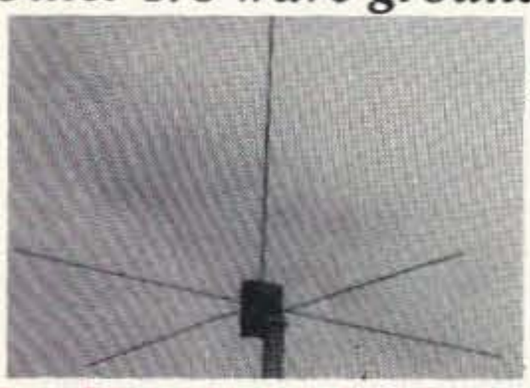
The normal tracking sequence begins with the receiver determining which satellites are visible for tracking, via user-entered predictions or stored satellite almanac information from previous NAV-Msg data. If there is no almanac information, a search of the sky must be made to locate and lock onto a satellite. The receiver can then read the NAV-msg and get current almanac information about the other constellation satellites. This may sound rather complicated; however, the user can relax as the entire process is done automatically by the receiver/processor.

It's interesting to note that the typical satellite received signal level is below the earth's natural radio

Photo A. The Trimble Navigation SCOUT GPS receiver (courtesy of Trimble Navigation, 9020-II Capitol of Texas Highway North, Suite 400, Austin TX 78759; 800-959-9567).

MFJ 5/8 Wave Ground Plane

For an incredible $19.95, you get a 300 watt 5/8 wave ground plane 2 Meter base antenna. Other 5/8 wave ground plantes can't work any better -- no matter how much the cost . . .



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For an incredibly low $19.95, you get a complete 2 Meter 300 watt PEP 5/8 wave ground plane home station antenna. It gives you the maximum possible gain of any single element antenna.

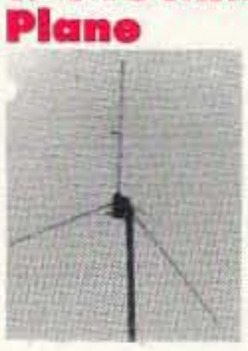
Competitive 5/8 wave ground planes can't work any better -- no matter how much they cost.

You get . . . shunt fed matching that bleeds off unwanted static and gives you lowest possible SWR . . . strong lightweight aluminum construction that's protected by MFJ's *Permanent Molecular Bonding Technology*™ . . . low loss ceramic antenna insulator for maximum radiated power . . . MFJ's *RapidTune*™ radiator for quick accurate tuning . . . super easy installation to any 1 to 1½ inch mast with single U-bolt (included) . . . and it's Made in USA.

MFJ-1752, $19.95, for 220 MHz band.

DualBand 144/440 MHz Ground Plane

MFJ-1754 *New!*
$24.95



Dual band ground plane antenna for 2 Meters and 440 MHz gives you extra long range on 440 MHz with a high gain halfwave over quarter wave radiator. On 2 Meters you get solid quarter wave performance. Mounts on 1 to 1½ inch mast with single U-bolt. Easy-to-tune.

1/4 Wave Ground Plane

MFJ-1740
$12.95

The MFJ-1740 brings up 2 Meter repeaters as well as any ¼ wave ground plane made!

You get easy tuning, low loss ceramic antenna insulator and strong lightweight aluminum construction.

Single U-bolt mounting for 1 to 1½ inch mast. Cutting chart included for 220/440 MHz. Made in USA.

MFJ Pocket Roll-Up™

2 Meter halfwave J-pole antenna

MFJ-1730
$14.95

Roll up this *halfwave* 2M J-pole antenna and stick it in your pocket! It's the perfect *gain* antenna for traveling.

Get home station performance on the go. Just hang your *MFJ Pocket Roll-Up*™ in the clear and plug the BNC connector into your handheld.

It's omni-directional and has significant gain over a 1/4 wave. It doesn't need a cumbersome ground plane so it's convenient for indoors and works great with handhelds.

Dual Band *flexible* Ducks

144/440 MHz flexible ducks for HTs

A. *High Gain FlexiDuck*™. **MFJ-1717, $19.95.** Enjoy dependable QSOs when other rubber ducks give you noise. High gain ½ wave on 440 MHz, full size ¼ wave on 2M. Won't rob you -- bends, twists, flexes with you. 15¾ inches.

B. *FlexiDuck*™, **MFJ-1716,** $16.95. Similar to MFJ-1717. Full ¼ wave on 440 MHz, efficient loaded ¼ wave on 2 Meters. 8¾ inches.

Shorty Duck™ for HTs

MFJ-1718
$12.95

Add this *short*, 4¼ inch *ShortyDuck*™ to your MFJ handheld for a Q-5 signal! Impedance matched for maximum gain. High-Q helical wound radiator.

5/8 Wave 2 Meter Mobile Antenna

MFJ-1728/B
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For *maximum range* while mobile, use MFJ's *Maximum Gain*™ 5/8 Wave 2 Meter Mobile Antenna. You'll get the maximum possible gain of any single element mobile antenna!

Competitive 5/8 wave mobile antennas can't work any better -- no matter how much more they cost.

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You get a heavy-duty magnet mount that holds your antenna tight at highway speeds and a black magnet base that'll look good for years.

You get a stainless steel radiator that'll endure years of harsh mobile use and 12 feet of coax cable.

You get MFJ's one year *No Matter What*™ unconditional guarantee.

Order MFJ-1728 with standard PL-259 coax connector or MFJ-1728B that also includes a BNC adapter for your handheld.

Stacked 5/8 Wave for 2 Meters

gives twice the omni-directional gain of a single 5/8 wave

MFJ-1764
$34.95

MFJ's stacked 5/8 wave radiators give you *more than twice* the *omni-directional* gain of a single 5/8 wave radiator!

Wide 10 MHz 2:1 SWR bandwidth . . . excellent ferrite choke balun feedline decoupling . . . shunt choke for bleeding off unwanted static . . . strong lightweight aluminum.

Fully assembled -- simply attach radiators -- no tuning required. Mounts vertically for FM/Packet or horizontally for SSB. Installs with single U-bolt on 1 to 1½ inch mast or tower leg. 1½ lbs., two 47 inch radiators, 23 inch boom. Made in USA.

Also works as excellent ***6 Meter*** full halfwave centerfed antenna.

MFJ-1766, $89.95, gives you *four times* the gain of single 5/8 wave. Includes 2 MFJ-1764, phasing cables. Doubles gain on 6 Meters.

MFJ-1765, $29.95, phasing cables for 2 MFJ-1764s, other 2M ant.

MFJ dual band 144/440 MHz Yagi

5 elements on 440 MHz . . . 4 elements on 2 Meters . . .$49.95

MFJ-1768
$49.95
New!

Get two Yagis for the price of one . . . enjoy two Yagis in the space of one with single coax feed!

MFJ's *exclusive* dual band balanced feed with *FerriteChoke*™ decoupling prevents pattern skewing and gives you low SWR.

The MFJ-1768 is based on the *National Bureau of Standards* design that's optimized for maximum forward gain with high front-to-back ratio and a clean symmetrical pattern.

Mounts vertically for FM/Packet or horizontally for SSB with single included U-bolt on 1 to 1½ inch mast or tower leg.

High strength 6061-T6 aluminum 5 foot, 1⅛ inch diameter boom. 2 pounds. Elements are electrically isolated from boom. Made in USA.

Portable 3 element Yagi for 2 M

MFJ-1763
$39.95

You can set up or take down MFJ's *portable* 3 elements 2 Meter Yagi in seconds! Elements simply screw into the boom.

You can take it with you wherever you go and have the "oomph" and directivity of a beam.

It's easy to store and sturdy enough to use as your home station antenna.

Mounts vertically for FM/packet or horizontally for SSB. *Center* or *end* mounts with single U-bolt. Great for packet/PacketCluster™.

It's compact 2¾ foot boom gives you a calculated gain within 1 dB of a four element Yagi with a boom nearly twice as long.

Extra thick elements maintain high gain and directivity over entire 2 Meter band. MFJ's *FerriteChoke*™ decouples feedline.

Elements and boom are made from strong lightweight aluminum and protected by MFJ's *Permanent Molecular Bonding Technology*™.

Weighs just 2 pounds. Boom is 30½ inches. Made in USA.

MFJ Dual Band Mobile

Mobile Antenna for 144/440 MHz

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Operate both 144 *and* 440 MHz with a single magnet mount mobile antenna!

You get excellent gain on 440 MHz with a ½ wave over ¼ wave radiator and a *full* ¼ wave on 2 Meters for noise-free, long range QSOs.

Its stainless steel radiator is only 19 inches tall so you can park in your garage without knocking it over.

An extra powerful magnet holds it steady -- even at highway speeds.

Use it with mobiles *and* handhelds!

You get 15 feet of coax with a standard PL-259 coax connector *and* a *free* BNC adapter for your handheld.

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HT Range Extenders

Telescoping antennas for handhelds

A. *Long Ranger*™ 2 Meter Halfwave, **MFJ-1714**, $16.95. For really long range this MFJ endfed halfwave is hard to beat. It outperforms a ⅝ wave on a handheld because the ⅝ wave needs a ground plane. The MFJ halfwave doesn't. It's shorter, lighter, has more gain and places less stress on your antenna connector than a ⅝ wave antenna. When collapsed, it performs like a rubber duck. 40" extended, 10½" collapsed.

A. B. C.

B. *Dual Bander*™ for 2 Meters and 440 MHz, **MFJ-1712**, $14.95. Got a new dual band handheld or separate units? One antenna fits all. It's a ¼ wave for 2 Meters and a ⅝ wave with gain for 440 MHz. 7¼" collapsed, 19" extended.

C. *Pocket Linear*™ ⅜ Wave, 2 Meters, **MFJ-1710,** $9.95. Carry this pen size antenna in your pocket like a ballpoint pen. When you're using your rubber duck, on the fringe and noisy, put on the *Pocket Linear*™, extend it to 24½" and carry on your QSO. Has pocket clip. 5¼" collapsed.

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noise level. After detection, the satellite's signal is multiplied by use of receiver-predicted PRN codes and with the received signal collapsed into the original carrier frequency band, concentrated, and brought well above the natural noise level.

Simply Complex

The average GPS portable receiver somewhat resembles a VHF hand-held transceiver in size and weight. Functionally, you will find the GPS receiver simpler to operate, although somewhat similar in flavor. Buttons operate selection menus and functions are selected from those menus. Referring to the Trimble Navigation SCOUT GPS Receiver in Photo A, note there are only eight buttons for control. By using the buttons and the scrolled menus appearing on the LCD display, the exact location can be determined, routes may be programmed, locations memorized, distance from previous or input locations computed, and speed calculated.

GPS Accuracy

GPS was designed to support a broad spectrum of users with differing requirements of accuracy. Basically, there are two categories of GPS accuracy service:

The *PPS*, precise positioning service, which is extremely accurate and available for use only to those authorized, and the *SPS*, standard positioning service, a less accurate positioning service which is available to all GPS users. PPS and SPS are functionally identical; however, access to the PPS is limited by encryption techniques.

PPS, primarily intended for military purposes, typically provides accuracy of 22 meters horizontally, 27.7 meters vertically, and time within 90 nanoseconds.

SPS, used for civilian purposes, is specified to provide 100 meter horizontal, 300 meter vertical, and 170 nanosecond time accuracy. The horizontal specification includes peacetime degradation of selective availability (a means of tinkering with the system to make it less accurate in the name of national security). For the SPS user, selective availability is the dominant SPS accuracy error source.

In practice, the specifications are easily attained, with much greater accuracy the rule and not the exception.

GPS Receivers

Although the technology of GPS is fascinating, it is not feasible for the average ham to construct a GPS receiver. Not that some hams aren't capable of the job—it just isn't feasible (read: worthwhile). No more so than building a 2 meter HT with all the current bells and whistles would be.

There are several types of basic GPS receivers, varying in complexity, tracking capabilities, speed of information update, and planned use. Unfortunately, corporate marketing has clouded the identity of some receiver types and operational complexities (rarely are complexities a user concern as most GPS receivers are designed for ease of operation). The types of receivers consist of:

Sequencing—This type makes use of one or two hardware (RF) channels by simple stepping from one selected satellite to another on a timed basis. Sequencing receivers use simple circuitry, and have low production costs and low power consumption. They are adequate for most purposes except high-speed navigation.

Continuous tracking—These have a minimum of four hardware (RF) channels and track four or more satellites simultaneously. They are less affected by speed than the sequencing receiver.

Multiplex (MUX)—With this type, a single hardware (RF) channel is switched at a fast rate between satellites being tracked. Switching is typically 50 times a second. The multiplex receiver is based on time sharing and requires only a single code generator and carrier synthesizer for tracking.

Digital—This type uses analog-to-digital conversion techniques with a single receiver IF for signal amplification. Signal processing is accomplished digitally. This type of receiver can be visualized as a single channel radio receiver with five digital channels, each monitoring an individual satellite.

"Now that you have been boggled by the high-tech world of GPS, you might ask, 'What's in it for me?'"

Hams and GPS

Now that you have been boggled by the high-tech world of GPS, you might ask, "What's in it for me?"

Using GPS, a ham can display his exact location and figure distances to other locations. Other locations might include previously-memorized points (locations electronically in the receiver) or latitude and longitude points entered manually.

The exact location of VHF/UHF repeaters can be determined for ease of mapping planned coverage and determination of potential interference with existing repeaters. As the GPS is a three-dimensional system, altitude can also be displayed.

Distance between known points can easily be displayed. Just push a couple of buttons and indicate the points to be referenced. Again, for repeater usage, coverage could be determined by following a line of signal strength and marking locations on a map. Distance calculations can be very important for mountaintop VHF/UHF operations.

The Maidenhead grid locator system (grid squares) is programmed into the SCOUT GPS receiver and indicates grid squares to about 75-foot accuracy. The display consists of the basic field, square, subsquare, and the TGL (Trimble Grid Locator): CM 87 XI 42 LF, which corresponds to latitude/longitude of 37 degrees 20 minutes 33.0 seconds North/122 degrees 2 minutes 46.8 seconds West.

Many hams find themselves involved with search and rescue duties, whether through the Civil Air Patrol or other public service agencies. Using GPS for precise positioning, coverage of search areas is very accurate and efficient, leaving no area overlapped or uncovered. GPS receiver readings can be directly applied to maps, and map-plotted positions quickly located.

Where is GPS Going?

Although initially designed for military usage, the civilian world has discovered GPS. No doubt the system's user simplicity, accuracy, and reliability factors have accelerated its acceptance. It is safe to say that GPS will, at some point in the future, directly impact nearly everyone.

The military uses GPS for aviation, marine, and land navigation. Examples include: aircraft instrument landings and carrier landings, rendezvous such as inflight refueling, improved bombing accuracy and ballistic weapon delivery (smart bombs), close air support, reconnaissance and target location, enhanced site surveying and field artillery placement. Insertion and extraction missions may be carried out with extreme accuracy (with safe and timely deployment and evacuation of troops), including medi-vac.

GPS was used during Operation Desert Storm for land navigation in the desert areas where maps of the deserts were virtually non-existent and desert physical/geographical reference points were scarce.

Marine navigation becomes very simple using GPS and harbor navigation accuracy will be greatly improved over current methods. Waterway and other mapping becomes as simple as pushing a few memory buttons while over-flying or otherwise crossing an area. Later, memory examination allows maps to be drawn.

For civilian purposes, the applications for GPS appear to be without limit. More and more uses are being found all the time, including:

Replacement of the various radio-based aviation and marine navigation systems.

Creation of a differential GPS (DGPS) system to increase the positioning accuracy to about 10 meters (39 ft). DGPS only requires that a local positioning signal be added to the mix of calculations made by the GPS receiver.

An ambitious projected application for GPS is Intelligent Vehicle Highway System (IVHS) technology. IVHS is planned for limited use in the year 2000. Nearly a billion dollars has already been spent or allocated for its development and implementation. IVHS encompasses automated highways and computer-aided vehicle guidance.

Rail systems and trucking agencies are using GPS as the basis for traffic management and scheduling.

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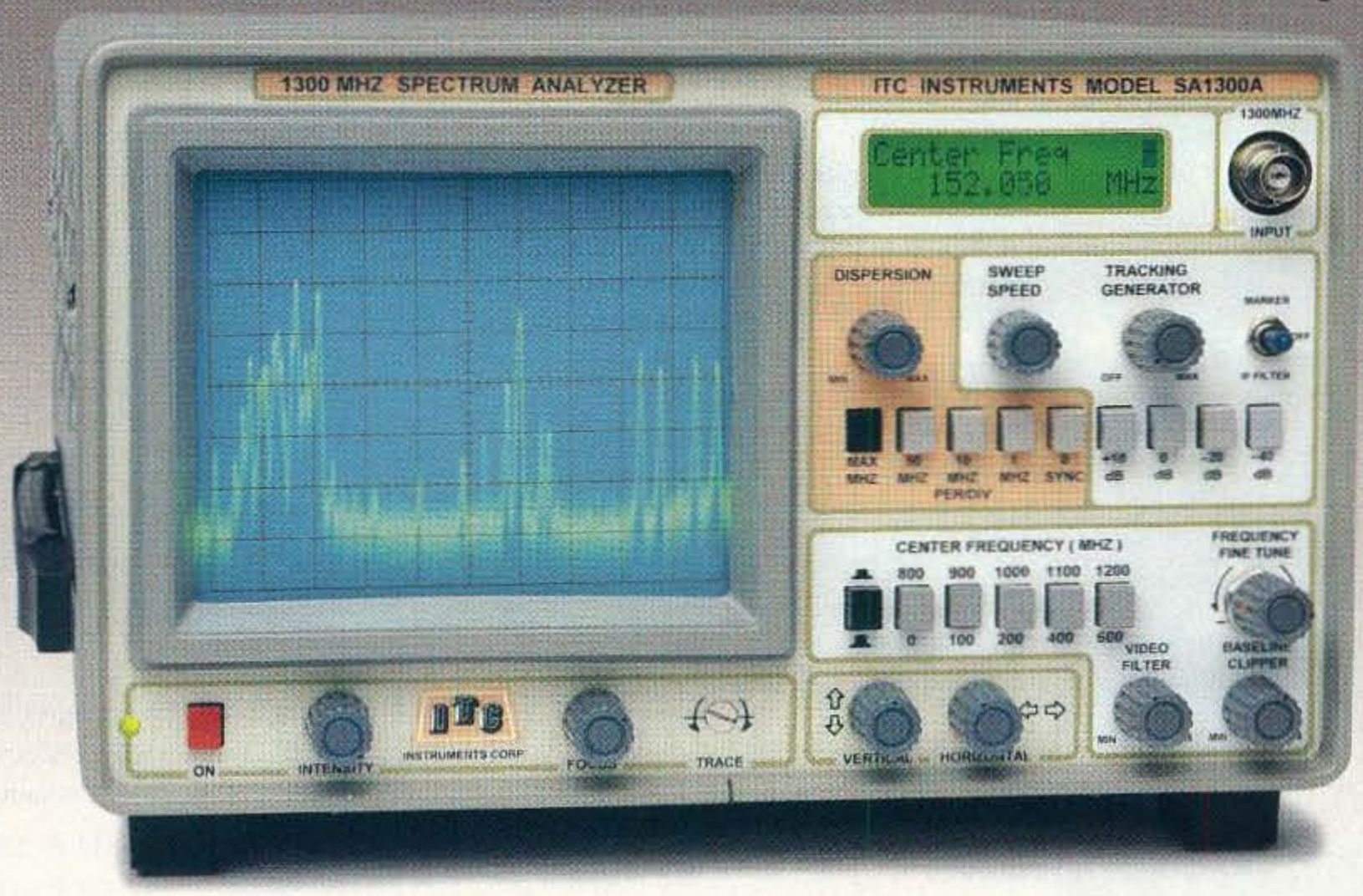

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In the realm of public safety, GPS will assist in resource management, allowing dispatchers to accurately determine where police cars, fire trucks, and rescue equipment are located at any given time. Police dispatchers will know the exact position of every car available or in use and can send a unit to assist whenever necessary, possibly saving an officer's life. Fire departments and rescue squads can use computer-based maps and information giving locations of fire hydrants, water supplies, and directions of travel. Using differential GPS, it is possible to locate individual firefighters inside burning structures.

During natural disasters such as earthquakes or floods it will be easy to locate underground utility lines, boundary areas, and limits of affected areas.

GPS allows land survey and mapping to accuracies of two inches or less. Special techniques and equipment are used for accuracies of this level.

The locations given by a GPS receiver can be applied to maps, preventing hikers from becoming lost. Further, in the event of an emergency, hikers can transmit (via phone or radio) their exact locations.

Important GPS Uses

An expedition scaled the tallest mountain in North America, Mt. McKinley, in June 1989 to determine its exact height by use of GPS. The exact height was determined to be 20,306 feet, which is 14 feet below the 1954 trigonometric measurement (anyone for placing a repeater up there?). Other mountains measured using GPS include:

Mt. Fuji, tallest mountain in Japan, at 12,382 feet.

Mt. Logan, Canada's tallest peak, at 19,546 feet.

Mt. Everest, tallest in the world, at 29,022 ft.

GPS was used to accurately place the position of the *Titanic*. During the Great 1993 Flood of the upper Mississippi River Valley, GPS was used extensively to monitor areas covered with water. Similar advantage of the system was made during the Christmas European Floods of 1993.

GPS—the Global Positioning System—is in your future. 73

For an in-depth study of GPS, see the author's latest book, Aviator's Guide to GPS, *published by TAB-McGraw Hill; telephone: (800) 233 1128.*

GPS Maps and Charts

by Gordon West WB6NOA

Global positioning system (GPS) receivers display latitude and longitude on their LCD or CRT screens. They also show SOG (speed over ground), COG (course over ground), speed, and distance to pre-memorized event or waypoint markers.

The latitude and longitude numbers would lead to position accuracies of approximately 10 feet, but the last significant number regularly changes. Why the change? This is because your position is purposely being diluted by the Department of Defense GPS satellite system to a 100-meter radius of a circle. It's called "selective availability," and purposely denies pinpoint accuracy to civilian users in order to provide a safeguard to national defense.

This selective availability—also called signal dithering—can be all but eliminated by subscribing to commercial or government differential GPS signals. The differential signals correct the selective availability error factor from somewhere within a 300-foot circle down to within a 5-foot circle 95 percent of the time! For the ultimate in accuracy, you would subscribe to your local FM station subcarrier access (SCA) differential GPS signals along with a little black box that hooks into a differential-ready GPS receiver.

For mariners, the differential correction signals come in free of charge from the United States Coast Guard. These are received on the 300 kHz marine radio beacon band, and a DBR that simply plugs into most portable or fixed GPS sets for boating position accuracy of approximately 10 feet. The U.S. Coast Guard differential system covers all of the East Coast, all of the Gulf Coast, and stations are going in right now for the West Coast and Alaska. Canada also participates in the differential GPS program. Hams living within 100 miles of a participating U.S. Coast Guard beacon station should be able to pull in these low-frequency signals, modulated MSK (minimum shift keying), with the right commercial equipment. No monthly user fee!

But latitude and longitude coordinates may not mean much to ham radio operators using GPS equipment for county-line calculations, hiking topo maps, or the common street atlases which rarely list latitude and longitude. Hams need something else, and they now have it!

One expensive solution is to tie a laptop computer into a GPS receiver with differential capabilities, and buy mapping software or maps on CD-ROM. If you have a computer, this is one option for you to consider.

If you need a portable mapping device, Sony is just coming out with their new Pyxis Model IPS-760 that uses micro C-Map cartridges, that are ordered directly from the supplier for approximately $129, covering several hundred square miles of area. These could be cruising charts, topo charts, street maps, or even the popular airplane charts.

Panasonic and Lowrance Electronics are also planning on hand-held GPS chart devices which will give you the cartographic data on a chart-like screen that covers a selected area of interest.

Trimble Navigation (Sunnyvale, California; 1/800/827-8000) combines the power of Thomas Bros. Maps and their hand-held Scout GPS, which converts the incoming signals to grid references in the map book. Or, for the VHF/UHF operator, the unit can actually read out which grid square you are in with *no* map book required!

"Our Scout offers a choice of nine coordinate displays: latitude and longitude in seconds or minutes; universal transverse Mercator map projection; ordinance survey of Great Britain; *Trimble Atlas* from Thomas Bros. Maps; Maidenhead grid locator system, including sub-square accuracy; Trimble grid locator—extension of Maidenhead for additional accuracy."

"With any of these readouts, our GPS equipment is ideal for the ham operator," comments Jim Osdale K6EUD, a local ham operator who teaches GPS navigation (714/779-5003).

Many ham operators have discovered a unique fixed-mount LCD screen GPS receiver from Lowrance, the Global Map 1000, as having the most built-in cartography for the buck. Boat GPS sets usually include an outline of the United States as part of the basic cartography built into the unit. For a close look at a local harbor, you would purchase $150 C-Map or Navionics cartridges, plug them into the GPS mapping unit, and presto, a vague outline of the U.S. will come into local harbor detail. C-Map is also working with Navionics to soon supply cartridges for selected lakes and rivers to cover those hot fishing spots.

But when Lowrance asked for a "canned" map of the United States to be burned into their firmware, little did they know what was going to be supplied—the United States with all major freeways and expressways built into the system without the need for any additional local marine chart cartridges.

"I don't go anywhere without my Lowrance GPS set in a rental car," comments Bill Alber WA6CAX, a traveling marketing consultant who has put away the map books for his new electronic readout. "When I am talking to someone who I will visit in a few weeks, I tell them I must have their latitude and longitude along with their office address. I enter this into the GPS charting device ahead of my trip, and presto, I see exactly where I'm going as I'm pulling out of the parking lot," adds Alber. "When it goes beep on arrival, I am usually within 100 feet of the front door," smiles Alber.

State outlines and many county lines are also included in the canned cartography. Same thing with rivers, too. And if you turn on your trail plotter, you can capture exactly where you have been, and see exactly the route you took. To demonstrate the accuracy of the plotter, see the *73* logo in Photo B.

All marine-type GPS sets are priced at the bottom end of the long list of equipment designed for commercial surveyors. A survey set might run $3,000, but you can buy a marine Garmin GPS-50 for under $400! The inexpensive marine sets also output NMEA 0183 data, and this ties into those $600 LCD chart display systems. Those marine sets also tie in nicely with APRS—automatic packet reporting system. This turns your GPS set into a position enunciator that squawks your location on packet! Not only can you see where you are, but other APRS systems can actually see where you're going on *their* system.

During a recent trip throughout the United States, I found that the GPS antenna/receiver unit worked nicely in the back window of rental cars. Only now and then did the reception drop out when I was in between tall buildings in Miami and Los Angeles.

Marine GPS prices won't dip much below $400, so check out what is available down at the marine stores, and tune into 1575 MHz and get set for hand-held and mobile position finding.

Photo B. The trail plotter feature allows you to display exactly where you've been—in this case, on the 73 trail!

World's Smallest 10 GHz ATV Transmitter

Build one on a PCB using only a few components!

by Angel Vilaseca HB9SLV and Jean-Pierre Morel HB9RKR

The availability of cheap surplus GaAsFETs lately has made a lot of microwave experimenting possible for amateurs. This article describes a new kind of amateur 10 GHz low-power transmitter using a surplus GaAsFET, mounted on a tiny piece of Teflon/glass PCB. Wideband FM modulation is possible for ATV operation.

As microwave-oriented amateurs, we (the authors) began experimenting back in the '80s, using Gunn diodes in waveguide assemblies. These, provided they were home-built, using cheap surplus diodes, were very cost-effective when compared with commercial transceivers (e.g. the Gunnplexer). The main disadvantage was the "plumbing." It took a lot of time and a fairly well-tooled workbench to build waveguide-based designs. For instance, some parts, like the screws used to hold the diodes, could only be made with a lathe.

However, if you were ever drawn away from the 10 GHz band by the mechanical difficulties, this article is for you. The 10 GHz transmitter we are describing could hardly be simpler.

The GaAsFET Oscillator

Trying to design a GaAsFET oscillator with PUFF, a computer program previously described in this magazine, we first considered a design like the one in Figure 1.

Like in many oscillators, the oscillation takes place if there is an adequate feedback from an amplifier's output to its input. In the oscillator shown in Figure 1, the feedback is provided by the two close-coupled stubs connected to the gate and drain microstriplines. The source terminals are connected to the ground plane.

Making the Oscillator Radiate

Any conducting patch etched on a PCB radiates a part of the energy it is fed with. If the dimensions of the patch are small in terms of wavelength, little energy is radiated. As the patch dimensions increase, radiation increases too, until a $\lambda/2$ patch dimension is

Continued on page 18

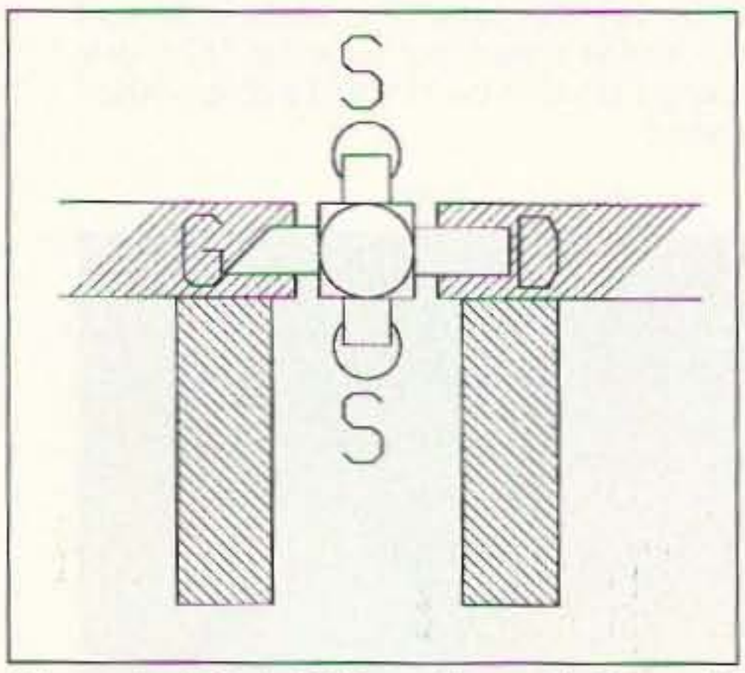

Figure 1. A GaAsFET oscillator. G, D, and S = gate, drain, and source respectively.

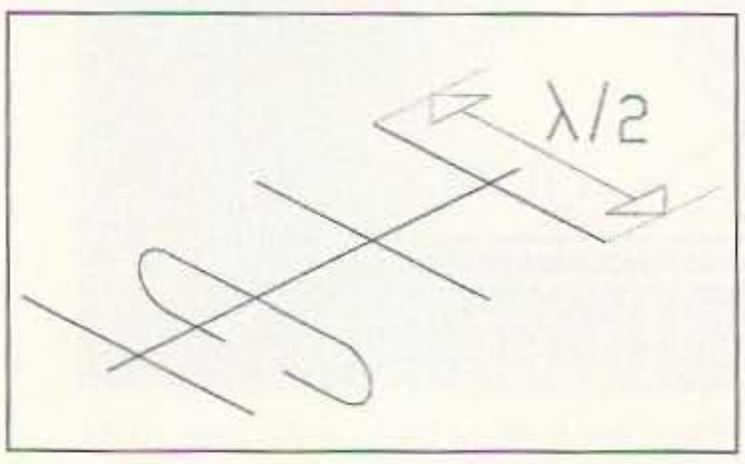

Figure 2. In a yagi antenna, the elements are about a half-wavelength long.

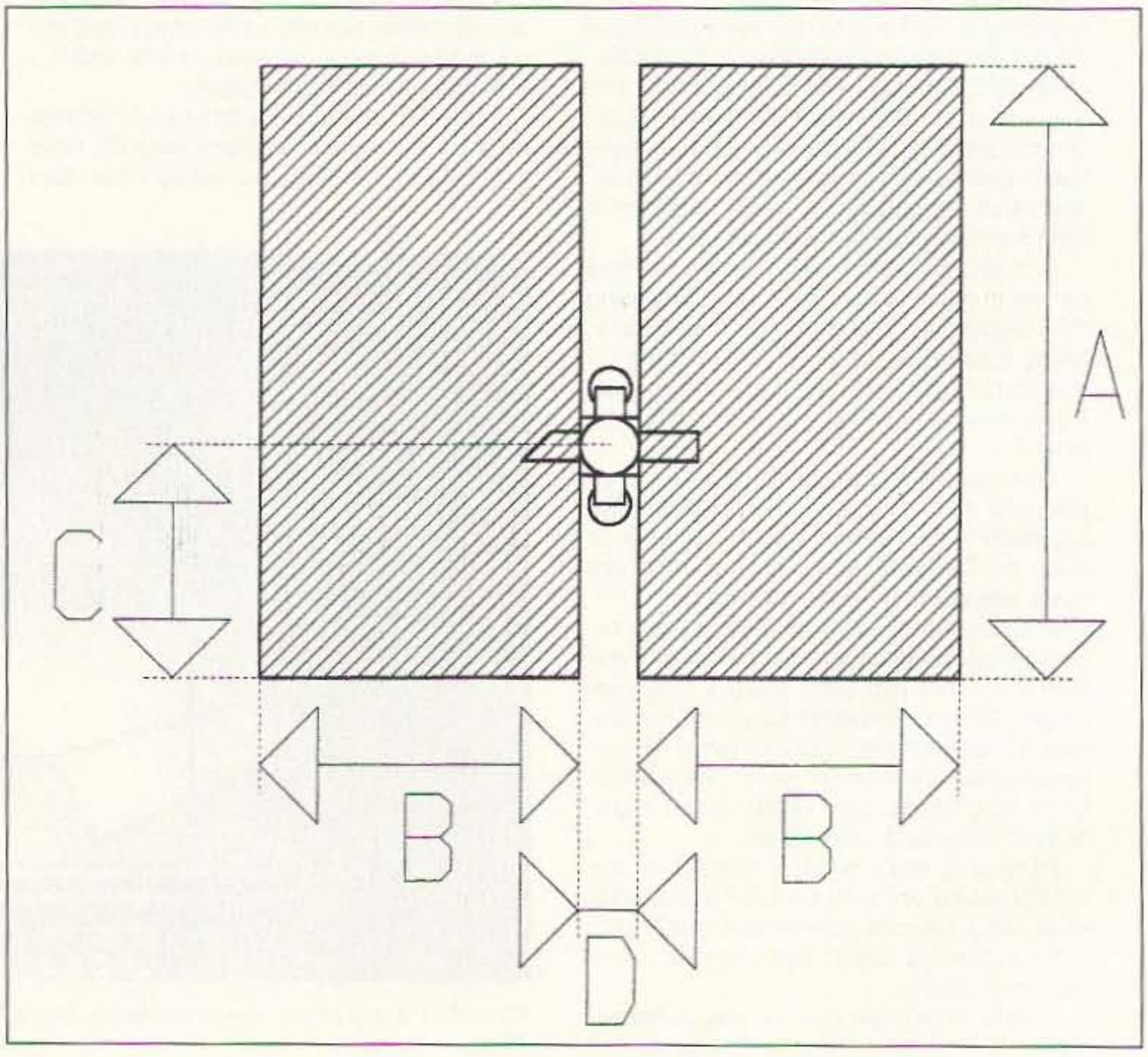

Figure 3. The oscillator circuit dimensions. (See text.)

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In our continuing effort to present the best in amateur radio features and columns, we recognize the need to go directly to the source—you, the reader. Articles and columns are assigned feedback numbers, which appear on each article/column and are also listed here. These numbers correspond to those on the feedback card opposide this page. On the card, please check the box which honestly represents your opinion of each article or column.

Do we really read the feedback cards? You bet! The results are tabulated each month, and the editors take a good, hard look at what you do and don't like. To show our appreciation, we draw one feedback card each month and award the lucky winner a free one-year subscription (or extension) to *73*.

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28 Random Output
29 Propagation

World's Smallest 10 GHZ ATV Transmitter

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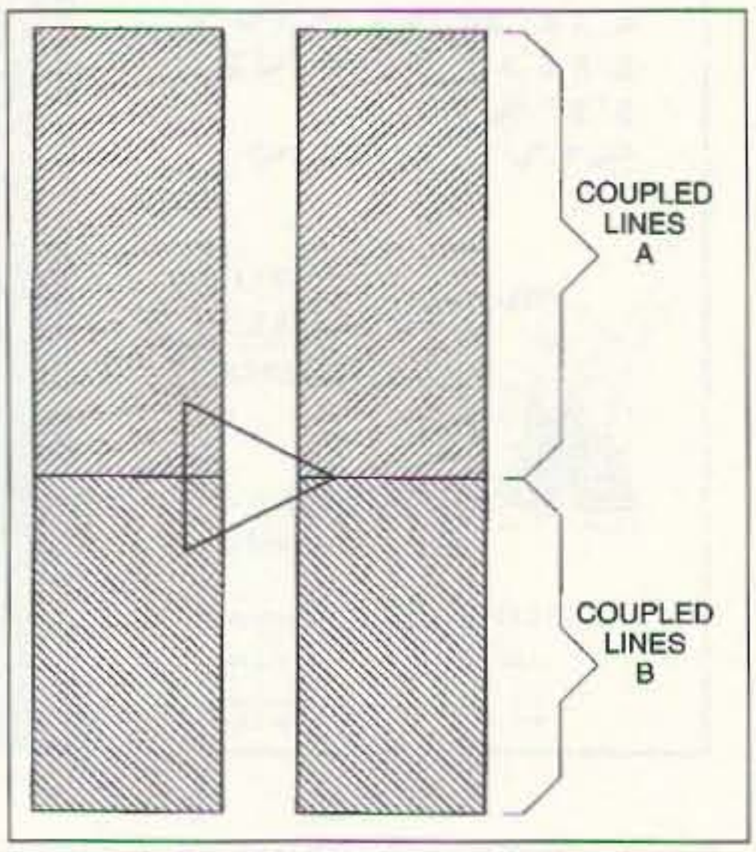

Figure 4. For PUFF, the oscillator is an amplifier with two pairs of coupled lines connected end-to-end. Various A and B lengths were tried, with the overall length A + B remaining λ/2.

reached. This is when radiation efficiency is at its best.

This principle is not new to us: Yagi antenna elements are also about λ/2 long (Figure 2) and they are particularly efficient when it comes to radiating energy from our transmitters! Radiation from microstrip elements is used in so-called *microstrip antennas*.

What we tried to do here was to combine the design of the previously mentioned oscillator with a microstrip antenna. Two microstrip antenna patches were designed close-coupled to each other. The GaAsFET input (gate) was connected to one, and the output (drain) to the other, thus obtaining the following design (Figure 3).

We decided to make both patches with the same dimensions for our first try. In fact, this is questionable, because if the two patches radiate with opposite phases, then their respective radiations would cancel each other!

Perhaps a more in-depth theoretical (and mathematical) approach would be needed here.

However, experimentation showed that some radiation did take place. In fact, some mutual cancellation from the two patches can be desirable if it is thought of as equivalent to limiting the output coupling of a conventional oscillator. If all possible energy is coupled out of an oscillator, its stability will be bad, because its characteristics will be affected by the circuit it is coupled to.

Designing the PCB

Now, there are four dimensions, A, B, C and D (Figure 3) we must decide.

We described the circuit to PUFF in the

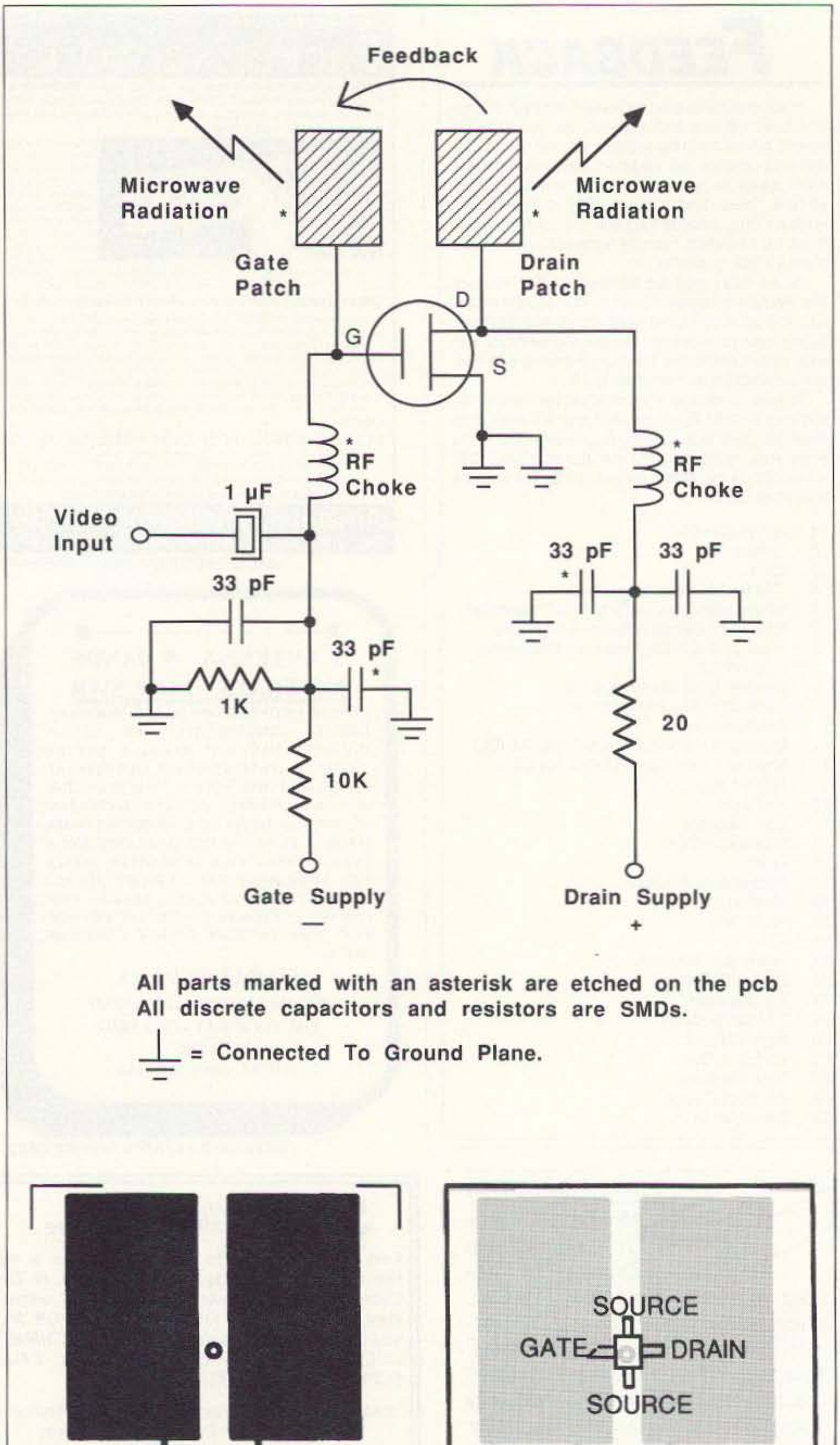

Figure 5. a) Circuit schematic. b) A drilled and etched double-sided PC board for this project is available for $5 plus $1.50 S&H per order from FAR Circuits, 18N640 Field Court, Dundee IL 60118.

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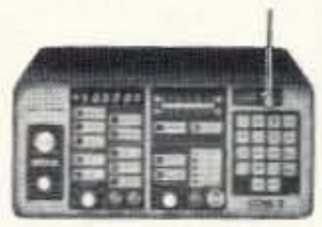

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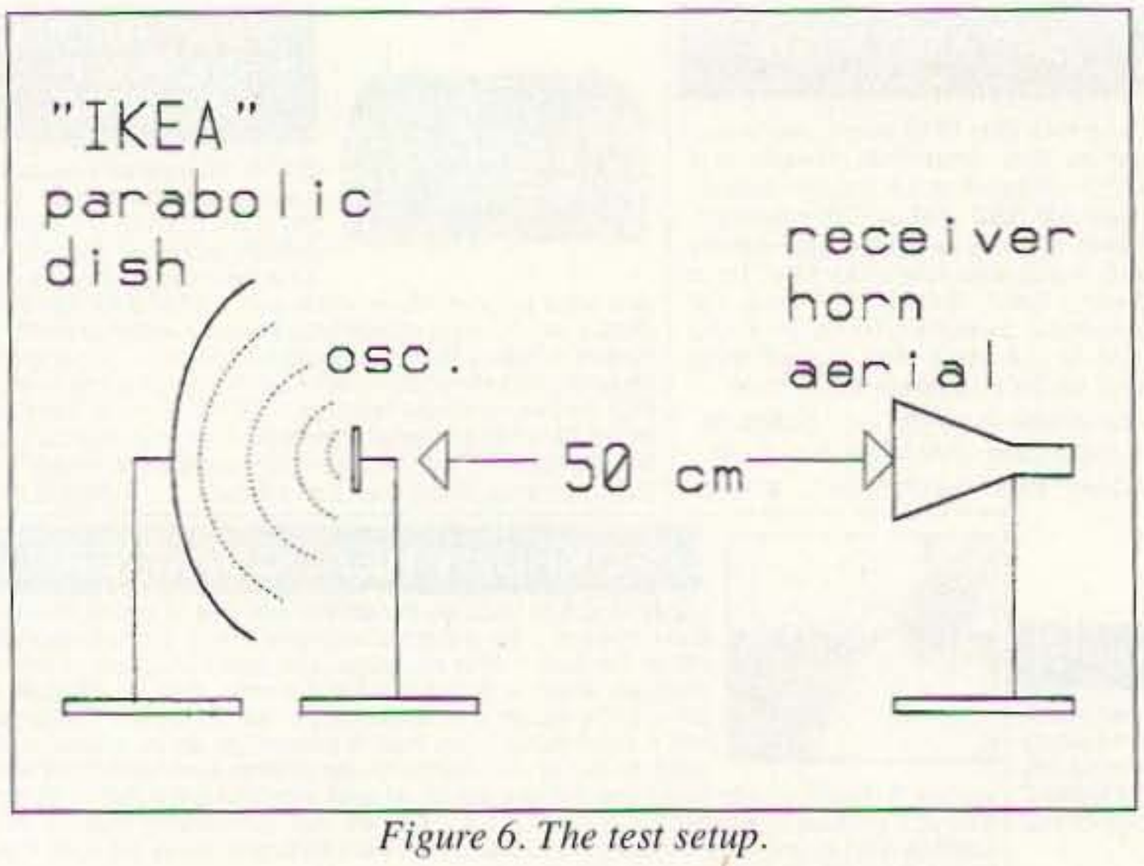

Figure 6. The test setup.

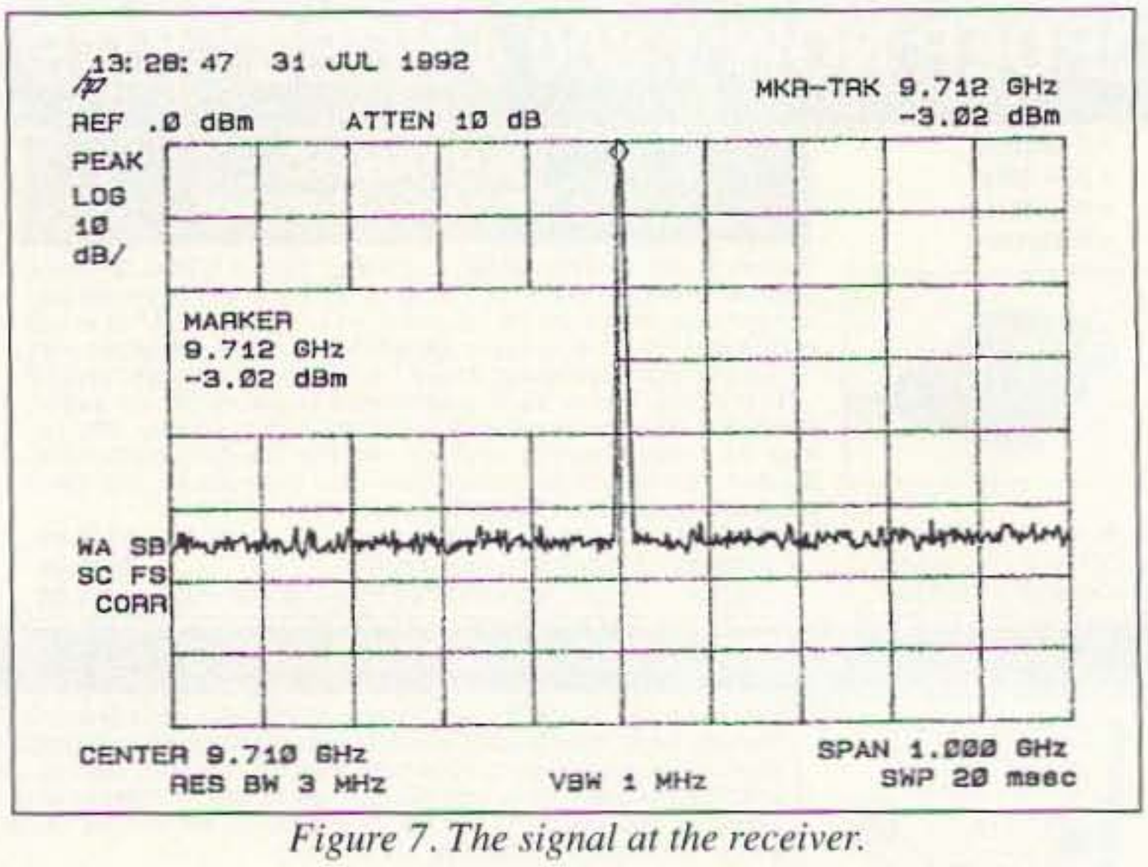

Figure 7. The signal at the receiver.

following way (Figure 4):

First, the coupled lines A and B were chosen with the same low impedance. Low impedance means that they are broad, like a microstrip antenna patch. Dimension B+D+B should be equivalent to about a half wavelength to maximize radiation.

Second, to generate enough feedback for oscillation to occur, they were chosen with tight coupling, which means close to each other. This determines dimension D.

Third, the overall electrical length of both lines put end to end (A) was chosen at about $\lambda/2$ to maximize radiation. The point at which the GaAsFET was attached to the two patches (dimension C) was searched with PUFF, by trial and error, so that S_{12} feedback was as high as possible.

Finally, we decided to start experimenting with the PCB pattern shown in Figure 5.

As an aerial we used an aluminum parabolic reflector, an "IKEA" dish, sold as a lamp, available cheaply in furniture shops. *[Editor's note: The authors' QTH is Switzerland. You may have to improvise if you cannot find the IKEA lamp locally.]* The diameter of this lamp dish is 40cm and its focal length is rather short, at about 11cm. So F/D is low, at 0.27. The oscillator was simply put at the focal point, so it would illuminate the dish . . . no more "penny feed." How is this for simplicity? (Figure 6).

The GaAsFET we used was a "Red Spot" from Birkett, 25, The Strait, Lincoln LN2 IJF, UK.

Dimensions D and B (Figure 3) were held constant throughout the tests: D = 0.5mm, B = 10mm.

Testing

For our first test, we took A = 18mm and C = 6.5mm. With +V supply = 4 V and -V supply = -3.5 V, Id was 23.4 mA and we received a -3 dBm signal with our horn antenna.

Oscillation frequency was lower than predicted at 9.712 GHz (Figure 7). The received signal was best with the oscillator being shifted away from the focal point, at 16.2cm instead of 11cm. This probably means that the radiation angle from the PCB is too narrow to illuminate the whole dish evenly (Figure 8).

Eventually, the GaAsFET failed (it did draw quite a lot of current) and was replaced by a first-class, expensive CFY 18-23 from Siemens. A was left unchanged at 18mm and C was tried at 7mm. The received signal was much lower, at -17.3 dBm. With C = 8.5, the oscillations stopped.

Most interesting was the fact that this small change in C brought the frequency almost 1 GHz higher at 10.653 GHz.

We replaced the CFY 18-23 with a new red-spot GaAsFET, with C left at 7mm and the frequency remained the same, so it really seems that the frequency shift comes from the C modification, rather than the GaAsFET change.

To lower the frequency down into the amateur band, we fitted two small pieces of copper foil to the ends of both patches, increasing the A dimension to 19mm. This brought the frequency to 10.293 GHz. +V supply was + 3.5V; -V supply was -4V; Id = 16.5 mA.

Figure 9 shows the received signal when the oscillator is frequency-modulated by sending a 4.5 MHz sinusoid to the gate. Linearity is acceptable.

Modifying the power supply voltage did not change the drain current much. Frequency did change but not linearly.

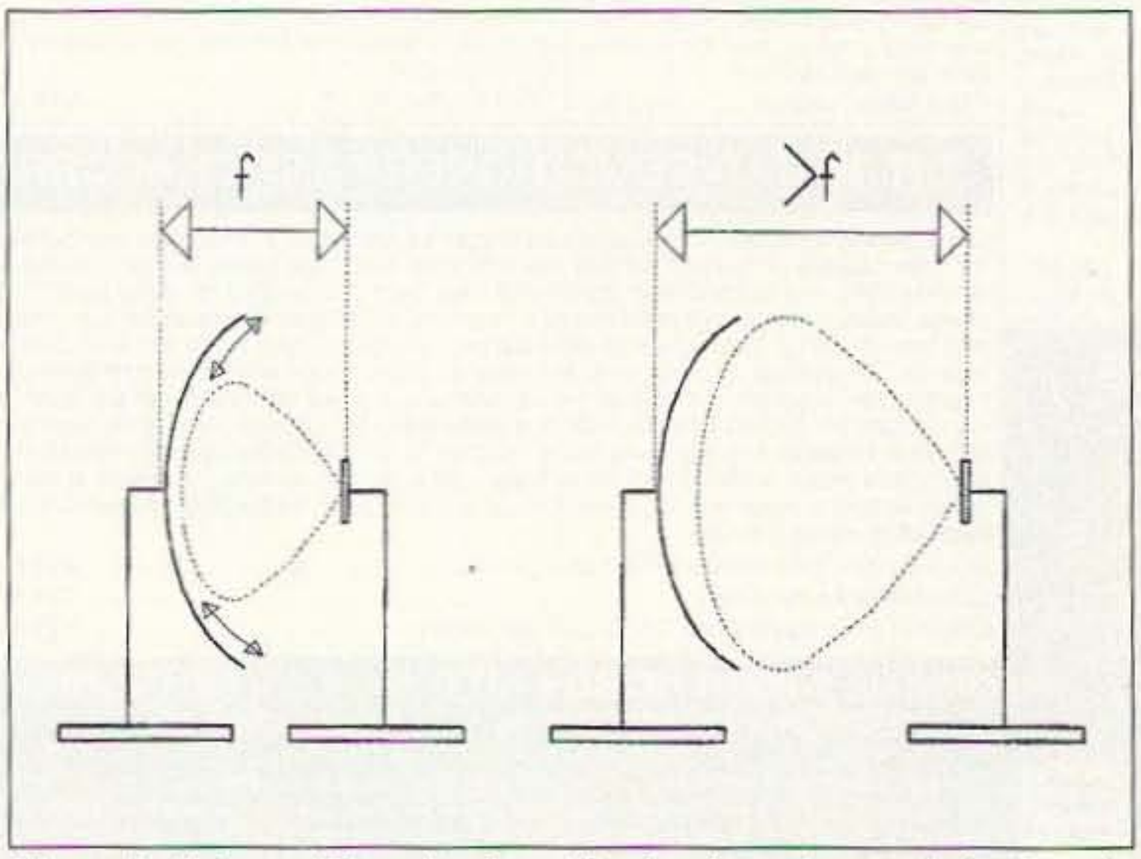

Figure 8. If the oscillator is placed further from the parabola than the focal length, it illuminates the dish more evenly.

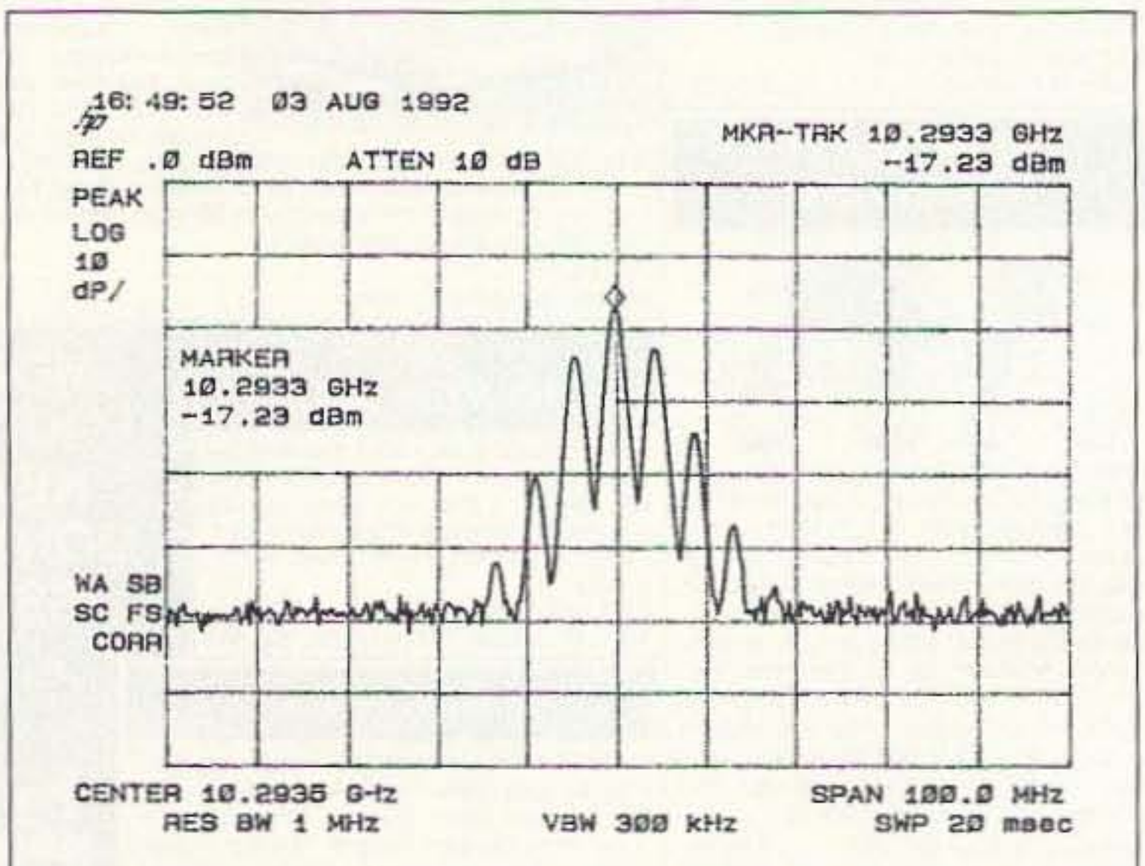

Figure 9. Output signal when the oscillator is frequency modulated.

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CIRCLE 41 ON READER SERVICE CARD

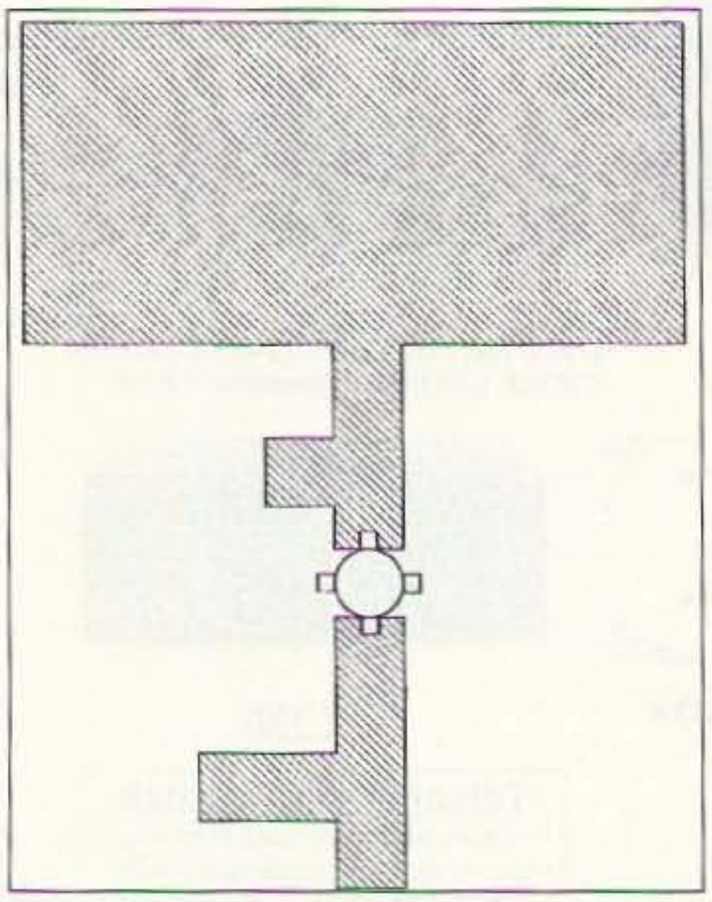

Figure 10. A preamplifier connected to a microstrip antenna.

+V Supply	-V Supply	ID	Frequency
+3.0V	-4V	15.5 mA	10.363 GHz
+3.5V	-4V	16.5 mA	10.354 GHz
+4.0V	-4V	17.5 mA	10.376 GHz

The received signal was best at -17.23 dBm when the PCB was set at 13.5cm from the dish. The cross-polarization attenuation was rather high, with a maximum of 30 dB.

The total radiated power was estimated at about 1 mW: Replacing the circuit under test with a Gunn transmitter of 1 mW known power output gave the same signal on our test bench.

We tried to further decrease C to 5mm. this sent the output power up about 3 dB and the drain current down to 11.4 mA. Oscillation frequency went down to 10.180 GHz, which allowed us to remove the two pieces of copper foil we had fitted to the patches' ends. This brought the frequency back up to 10.430 GHz.

We then discovered that the circuit was radiating both on 10 GHz and 5 GHz! We had not noticed this at first because the short length of waveguide between the horn antenna and the receiver was acting as a high-pass filter; (cutoff frequency of 1" X 1/2" waveguide is about 6.5 GHz). Further shortening the patches cured the problem.

Conclusion and Further Developments

Well, this is it: We have made a seven-component 10 GHz ATV transmitter, possibly a *Guinness Book* record! Stability was good, with little frequency shifts caused by moving objects near the TX. Although we did not try it, temperature stability could probably be enhanced by enclosing the transmitter between two plates of expanded polystyrene. This material has very small losses at 10 GHz. Another improvement could be fitting a dielectric stabilizer to the oscillator.

Simplicity is not the only advantage of building a transmitter of this kind. Having the 10 GHz source directly at the parabola's focus also avoids losses in waveguides, coaxial lines, transitions, relays and so on.

This would be particularly interesting in a receiver. The preamplifier could be built directly at the parabola's focus, the dish being illuminated by a small microstrip antenna attached next to the preamp (Figure 10).

As we know, any loss between the antenna and the preamp severely affects the receiver's noise factor. An assembly like the one shown in Figure 11b should be much less lossy than, say, the one in Figure 11a, and much cheaper, too, when you consider the price of an SMA connector or a microwave T/R relay.

One last word of caution: As for all GaAsFETs, it is highly advisable to turn on the negative gate supply slightly *before* the drain supply, because this keeps the drain current at a safe level. If the gate is left at ground voltage, a large current surge at turn-on could blow the GaAsFET. Microwave semiconductor chips are really tiny devices so their power safety margin is quite small. 73

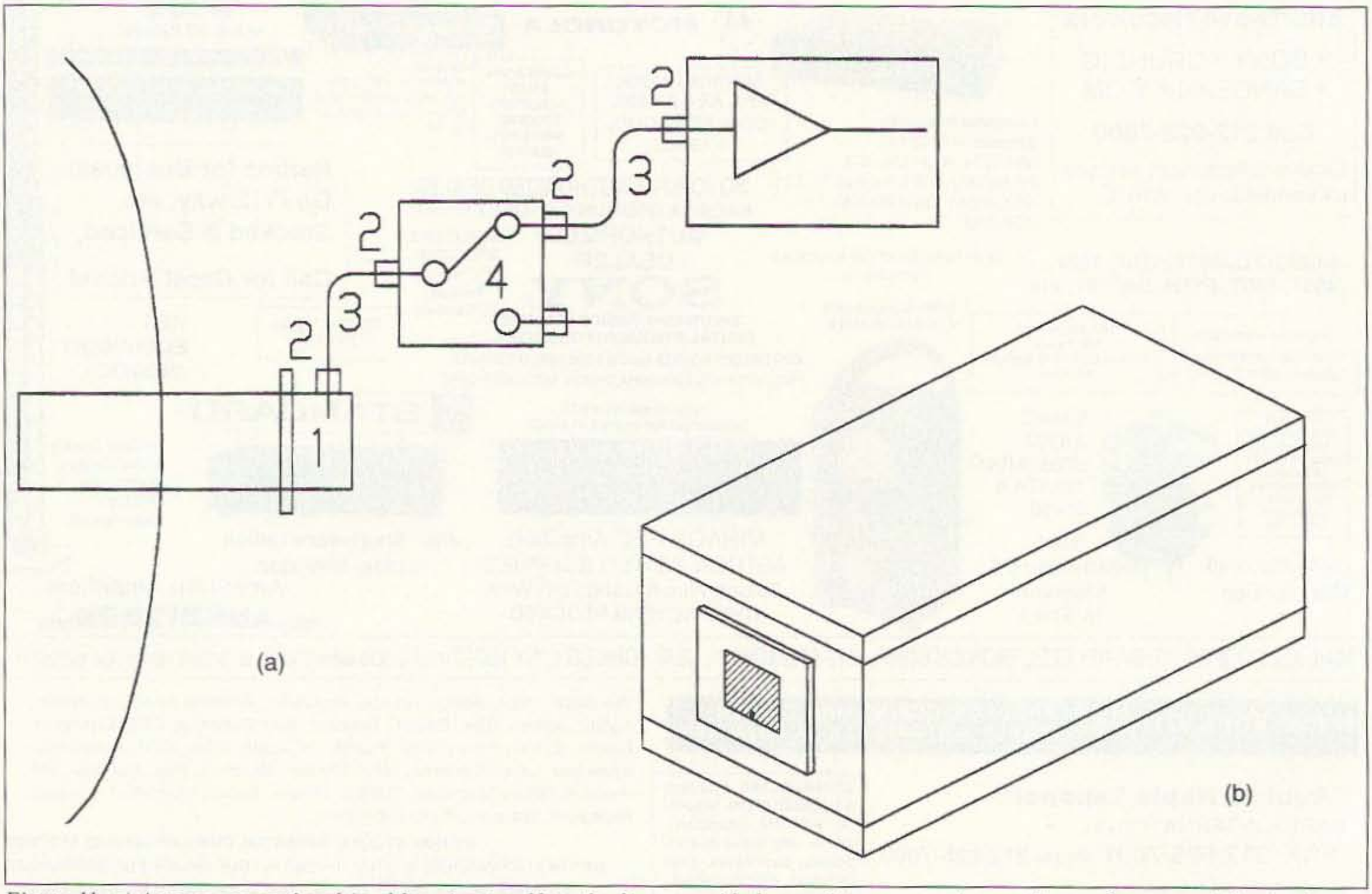

Figure 11. a) A more conventional (and lossy) setup. Note the 1) waveguide losses, 2) connector losses, 3) coax losses, and 4) relay losses. b) The preamp can be enclosed in its shielding box with a small microstrip element glued on the outside. The assembly is placed in front of the parabola with the microstrip patch at the focus.

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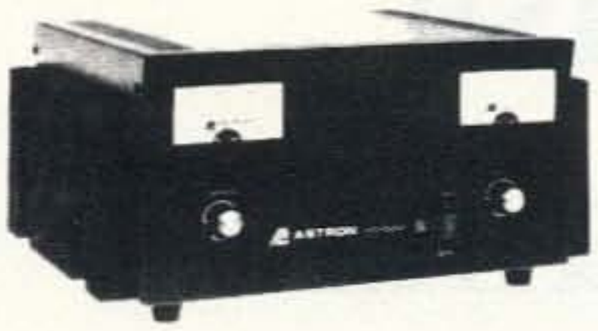

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SL-11R-RA		•	7	11	4¾ × 7 × 9¾	13

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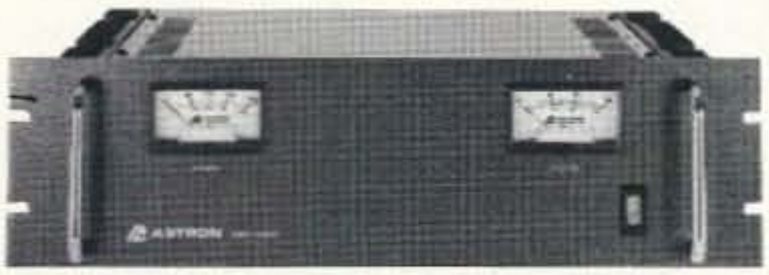
RS-5L	4	5	3½ × 6⅛ × 7¼	7

RM SERIES



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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
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MODEL RS-7A

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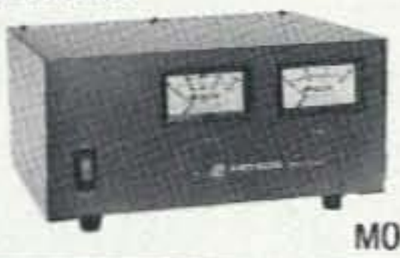
RS-4A	•	•	3	4	3¾ × 6½ × 9	5
RS-5A		•	4	5	3½ × 6⅛ × 7¼	7
RS-7A	•	•	5	7	3¾ × 6½ × 9	9
RS-7B	•	•	5	7	4 × 7½ × 10¾	10
RS-10A	•	•	7.5	10	4 × 7½ × 10¾	11
RS-12A	•	•	9	12	4½ × 8 × 9	13
RS-12B		•	9	12	4 × 7½ × 10¾	13
RS-20A	•	•	16	20	5 × 9 × 10½	18
RS-35A	•	•	25	35	5 × 11 × 11	27
RS-50A	•		37	50	6 × 13¾ × 11	46
RS-70A	•		57	70	6 × 13¾ × 12⅛	48

RS-M SERIES



MODEL RS-35M

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
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• 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

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VS-20M	16	9	4	20	5 × 9 × 10½	20
VS-35M	25	15	7	35	5 × 11 × 11	29
VS-50M	37	22	10	50	6 × 13¾ × 11	46
• Variable rack mount power supplies						
VRM-35M	25	15	7	35	5¼ × 19 × 12½	38
VRM-50M	37	22	10	50	5¼ × 19 × 12½	50

RS-S SERIES

MODEL RS-12S

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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

EMI/RFI Defense Strategies for Hams

Keep those troublemaking signals out of your mobile installation!

by Donald Koehler N7MGT

You just finished the installation of a brand-new VHF (or UHF) FM rig in the car. You turn it on and get a good VSWR and signal check. After cleaning up, your significant other asks for a ride to the mall on the other side of town. You start the car and fire up the rig. Squelch needs adjusting? You crank it up and drive off. Repeater traffic light? Friends complain you don't answer calls? You may be the victim of RFI/EMI.

What is RFI/EMI? Radio Frequency Interference, also known as Electromagnetic Incompatibility, is when one (or more) electronic or electrical device affects or disrupts the normal operation of a "victim" system. In the example above, the new radio was victimized by weak, wideband noise from digital automobile systems. This problem is often exhibited by "lost" calls or high squelch settings.

This article will cover EMI/RFI defense strategies, installation practices, and hazards which may result from using certain EMI/RFI cures. Let's start by examining three broad areas of action which can help resolve EMI.

In the broadest sense, EMI can be combated by *avoidance, attenuation* and/or *isolation*. Any of these, or some combination of the three, may be necessary to eliminate EMI problems with installed equipment.

Avoidance

The least expensive of these strategies may well be avoidance. Avoidance covers several areas:

- Pre-installation checks of the area.
- Use of commercial software to find harmonic "hits."
- Use of service bulletins.
- Power levels appropriate for intended communications.

Each one of these options offers some advantage for the ham or other installer. While not listed in any particular order of importance, these areas should be the first you turn to in installation planning and practice.

The use of a broadband, high-speed scanner can go a long way toward identifying potential EMI sources after a problem arises. Use of the scanner prior to an installation can save time, money and possibly missed emergency traffic. How do you use the scanner in a pre-installation check?

I suggest using scanners in two ways. First, load all of the common channel frequencies you intend to use into the scanner. Then, with the vehicle operating normally (assuming a mobile installation), let the scanner run. Listen for "hits" or EMI on these loaded channels. The hit may sound like static, a whistle or a rough buzz. Open the hood, then carefully work the antenna near the battery and any of the installed "black boxes" (fuel injection computers, etc.). Do the same on the inside of the vehicle. Run the heater or other accessories at this time.

If no noise source appears, switch the scanner to the search mode and set the search limits to just above and below the range of frequencies desired for use in the installed equipment. Most modern scanners, such as the ICOM miniature series and AOR handhelds, cover 100 kHz to 2.0 GHz. They are more than useful for this check. Note the frequencies where the hits occur and see if they are on, or are harmonically related to, planned frequencies. More on this in the "Installation Practices" section.

The use of commercial software to run checks on installed or contemplated frequencies may save a lot of grief up front. Harmonic relationships may be hard to discern, but the problems which crop up are real indeed. Most commercial software is powerful enough to keep you out of trouble. Take a minute to run these checks before installing new equipment into systems or vehicles where communications equipment is already in use.

If you can take a few moments to look through equipment service bulletins prior to installation, you may save time. Look for warnings on minimum equipment clearances, grounding and power requirements, antenna or power cabling restrictions and other information which may impact on the planned installation. Finally, use the least amount of power necessary for the job. Modern radio sets have computer-controlled-and -set wideband frequency and power settings. Never use more power than is called for in the installation package. Besides being bad practice, it can cause EMI or desense in

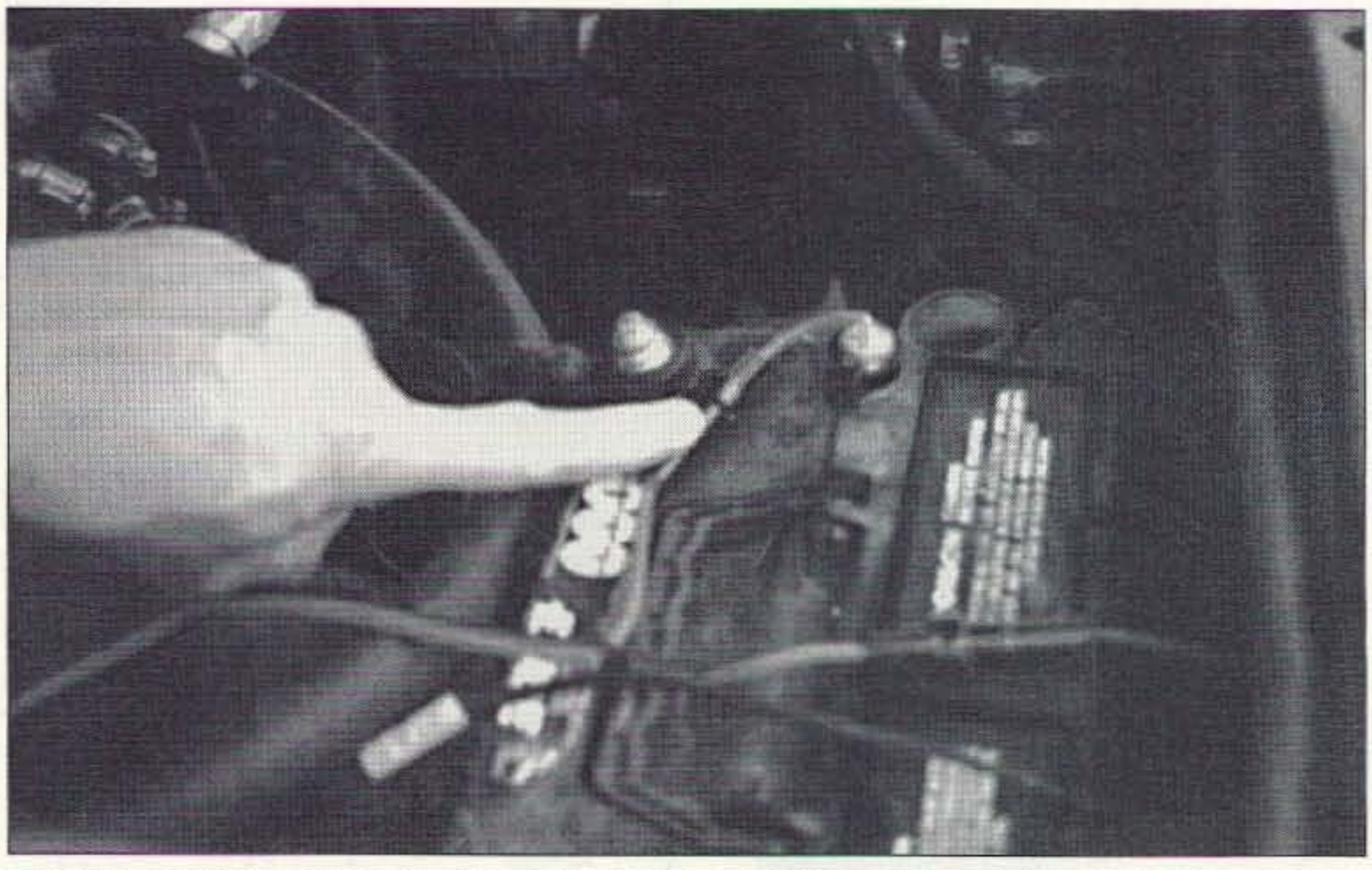

Photo A. Don't leave power wires running unsecured across the engine compartment! Poor installation practices often lead to EMI/RFI problems.

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The RELM WHS150 is our most popular programmable five watt, 16 channel handheld transceiver with built-in CTCSS, which may be programmed for any 39 standard EIA tones. The full function, DTMF compatible keypad also allows for DTMF Encode/Decode and programmable ANI. Weighing only 15.5 oz., it features dealer programmable synthesized frequencies either simplex or half duplex in both 5.0 and 6.25 KHz. increments. Other features include scan list, priority channel, selectable scan delay, selectable 5 watt/1 watt power levels, liquid crystal display, time-out timer and much more. When you order the WHS150 from Communications Electronics Inc., you'll get a complete package deal including antenna, battery, belt clip and user operating instructions. Other accessories are available. A leather carrying case with swivel belt loop part #**LCWHS** is $49.95; rapid charge battery charger, part #**BCWHS** is $69.95; speaker/microphone, part #**SMWHS** is $54.95; extra ni-cad battery pack, part #**BP007** is $59.95. The radio technician maintaining your radio system must order programming instructions part #**PI150** for $18.00 to activate this radio.

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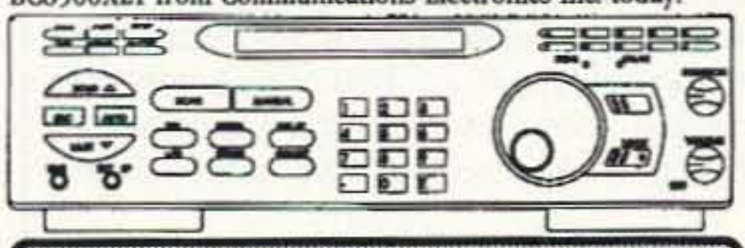
List price $689.95/**CE price $369.95/SPECIAL**
500 Channels · 20 banks · Alphanumeric display
Turbo Scan · VFO Control · Priority channels
Auto Store · Auto Recording · Reception counter
Frequency step resolution 5, 12.5, 25 & 50 KHz.
Size: 10-1/2" Wide x 7-1/2" Deep x 3-3/8" High
Frequency Coverage:
25.000 - 28.995 MHz. (AM), 29.000 - 54.000 MHz. (NFM), 54.000 - 71.995 MHz. (WFM), 72.000 - 75.995 MHz. (NFM), 76.000 - 107.995 MHz. (WFM), 108.000 - 136.995 MHz. (AM) 137.000 - 173.995 MHz. (NFM), 174.000 - 215.995 MHz. (WFM), 216.000 - 224.995 MHz. (NFM), 225.000 - 399.995 MHz. (AM) 400.000 - 511.995 MHz. (NFM), 512.000 - 549.995 MHz. (WFM) 760.000 - 823.9875 MHz (NFM), 849.0125 - 868.9875 MHz (NFM) 894.0125 - 1,300.000 MHz. (NFM).

The new Bearcat 8500XLT gives you pure scanning satisfaction with amazing features like Turbo Scan. This lightning-fast technology featuring a triple conversion RF system, enables Uniden's best scanner to scan and search up to 100 channels per second. Because the frequency coverage is so large, a very fast scanning system is essential to keep up with the action. Other features include ***VFO Control*** - (Variable Frequency Oscillator) which allows you to adjust the large rotary tuner to select the desired frequency or channel. ***Counter Display*** - Lets you count and record each channel while scanning. ***Auto Store*** - Automatically stores all active frequencies within the specified bank(s). ***Auto Recording*** - This feature lets you record channel activity from the scanner onto a tape recorder. You can even get an optional ***CTCSS Tone Board*** (Continuous Tone Control Squelch System) which allows the squelch to be broken during scanning only when a correct CTCSS tone is received. ***20 banks*** - Each bank contains 25 channels, useful for storing similar frequencies in order to maintain faster scanning cycles. For maximum scanning enjoyment, order the following optional accessories: **PS001** Cigarette lighter power cord for temporary operation from your vehicle's cigarette lighter $14.95; **PS002** DC power cord - enables permanent operation from your vehicle's fuse box $14.95; **MB001** Mobile mounting bracket $14.95; **BC005** CTCSS Tone Board $54.95; **EX711** External speaker with mounting bracket & 10 feet of cable with plug attached $19.95. The BC8500XLT comes with AC adapter, telescopic antenna, owner's manual and one year limited warranty from Uniden. Order your BC8500XLT from Communications Electronics Inc. today.



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Sangean ATS800-J portable 20 memory shortwave	$69.95
Sangean ATS803A-J portable with SSB reception & AC adapter	$159.95
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Cobra CP910-J 900 MHz. spread spectrum cordless phone	$249.95
ICOM GP22-J handheld global positioning system	$699.95
WR200-J weather radio with storm alert	$39.95
RELM WHS150-J VHF handheld 5 watt, 16 ch. transceiver	$339.95
RELM RH256NB-J VHF 25 watt synthesized transceiver	$289.95
Ranger RCI2950-J 25 watt 10 meter ham radio	$244.95
Ranger RCI2970-J 100 watt 10 meter ham radio	$369.95
Uniden LRD9000W1-J Super Wideband Laser/Radar Detector	$169.95
PWB-J Passport to Worldband Radio by IBS	$10.95
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Photo B. Using a scanner will help pinpoint problem "black boxes."

other installed equipment. In this case, the old saying "if a little is good, gobs is great" doesn't hold true.

Attenuation

The issue of power output brings us to the next of the major strategies, attenuation. When EMI problems arise, one of the main efforts taken by experienced technicians is to attenuate the interfering signal. This attenuation may take many forms. The most typical is using filters, both RF and IF. You may not normally consider cavity filters, crystal filters and alternate siting of antennas to be a form of attenuation—but that's what they do to the unwanted signal. One filter strategy often overlooked is using ferrite beads on power leads and, occasionally, on RF cables. Finally, bypass capacitors on power leads or power sources offer a low impedance path to ground for EMI signals.

Isolation

The third strategy is isolation. By the use of shielding, bonding, and AC or DC filtering, the communication equipment can be isolated from EMI signals. The shielding may take the form of conductive foils, tubes made of conductive or attenuating material, conductive caulks and conductive tapes. When using these conductive shields, extreme care must be taken to ensure the material will not come loose and short out other equipment. The idea of the shielding is to conduct the EMI signal away from your equipment and to provide a low impedance path to ground. Another way to do this is to ensure that all equipment is properly bonded to ground. New vehicles make extensive use of plastics and exposed metal that often have been coated with anti-rust compounds.

Bonding can take several different forms. Use of conductive strapping, tying together both radio equipment and mounts to the vehicle frame, is a good, low-cost start. Further work to tie the vehicle body, frame and negative battery terminals into one circuit may yield results to reduce background noise. When running power leads, make the run as

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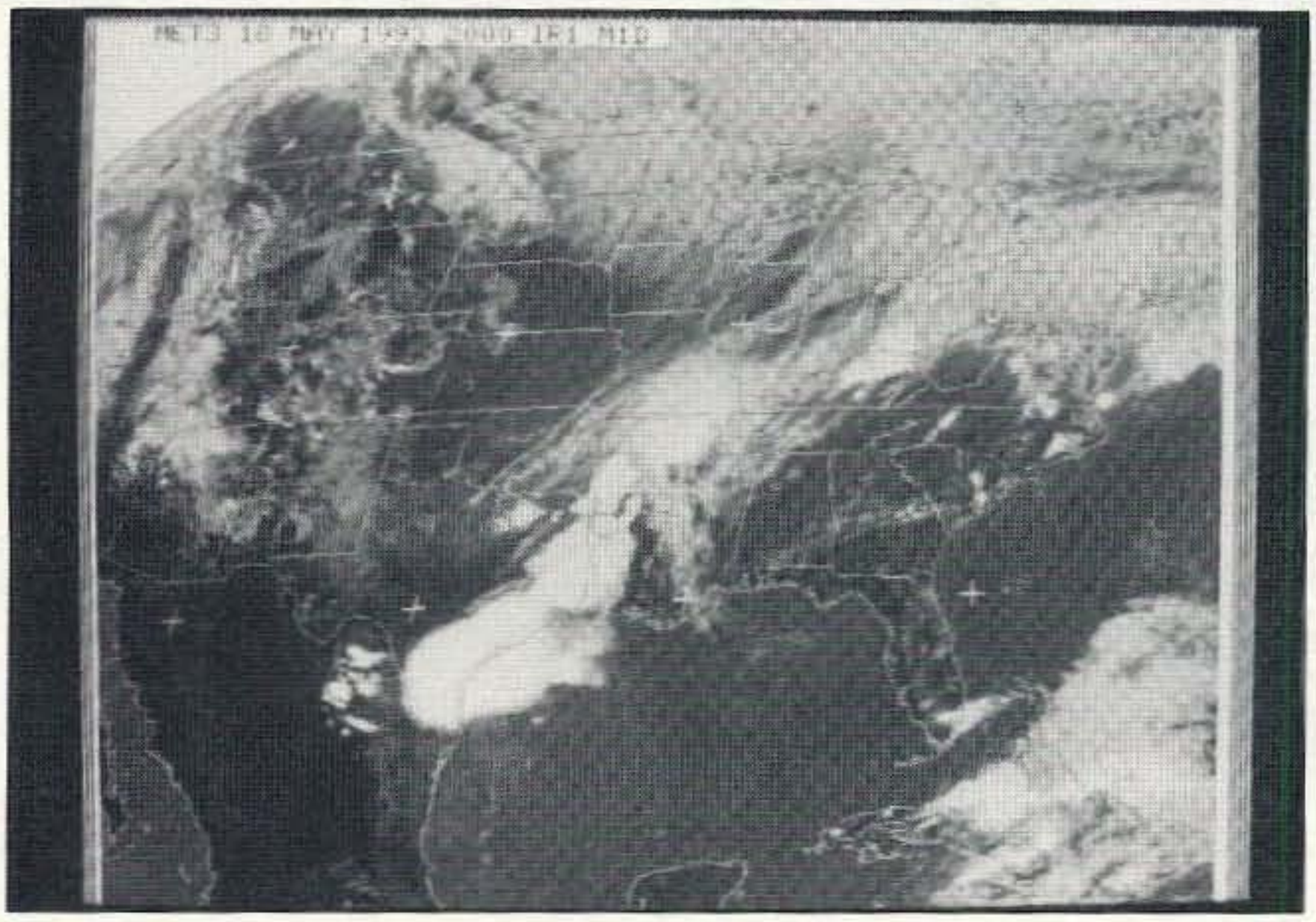

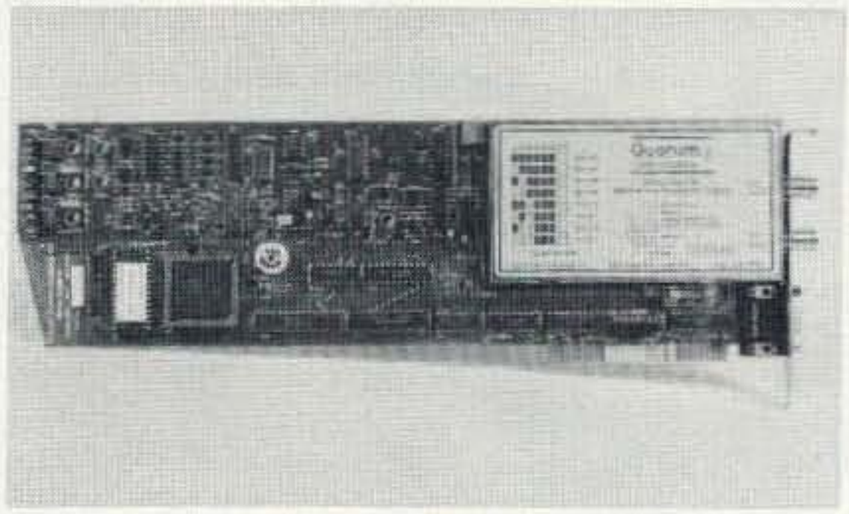

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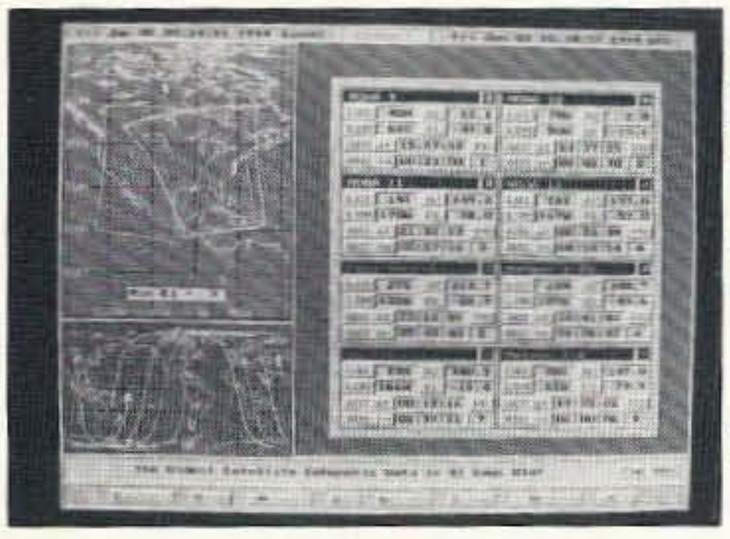

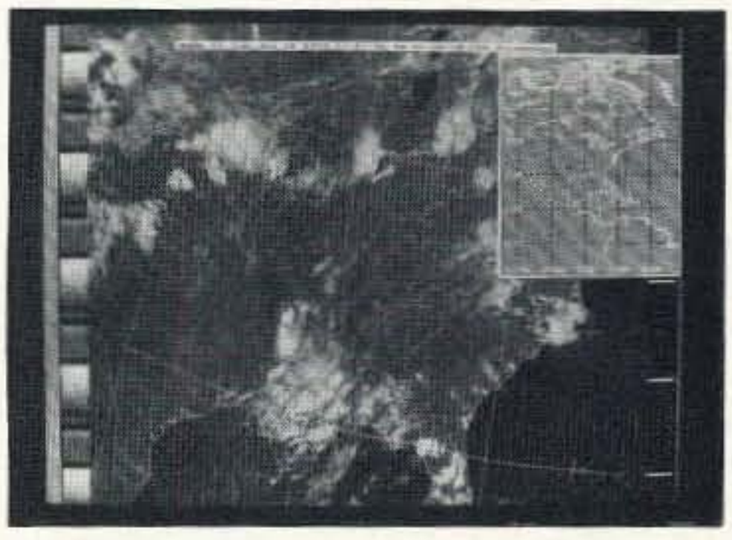

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CIRCLE 257 ON READER SERVICE CARD

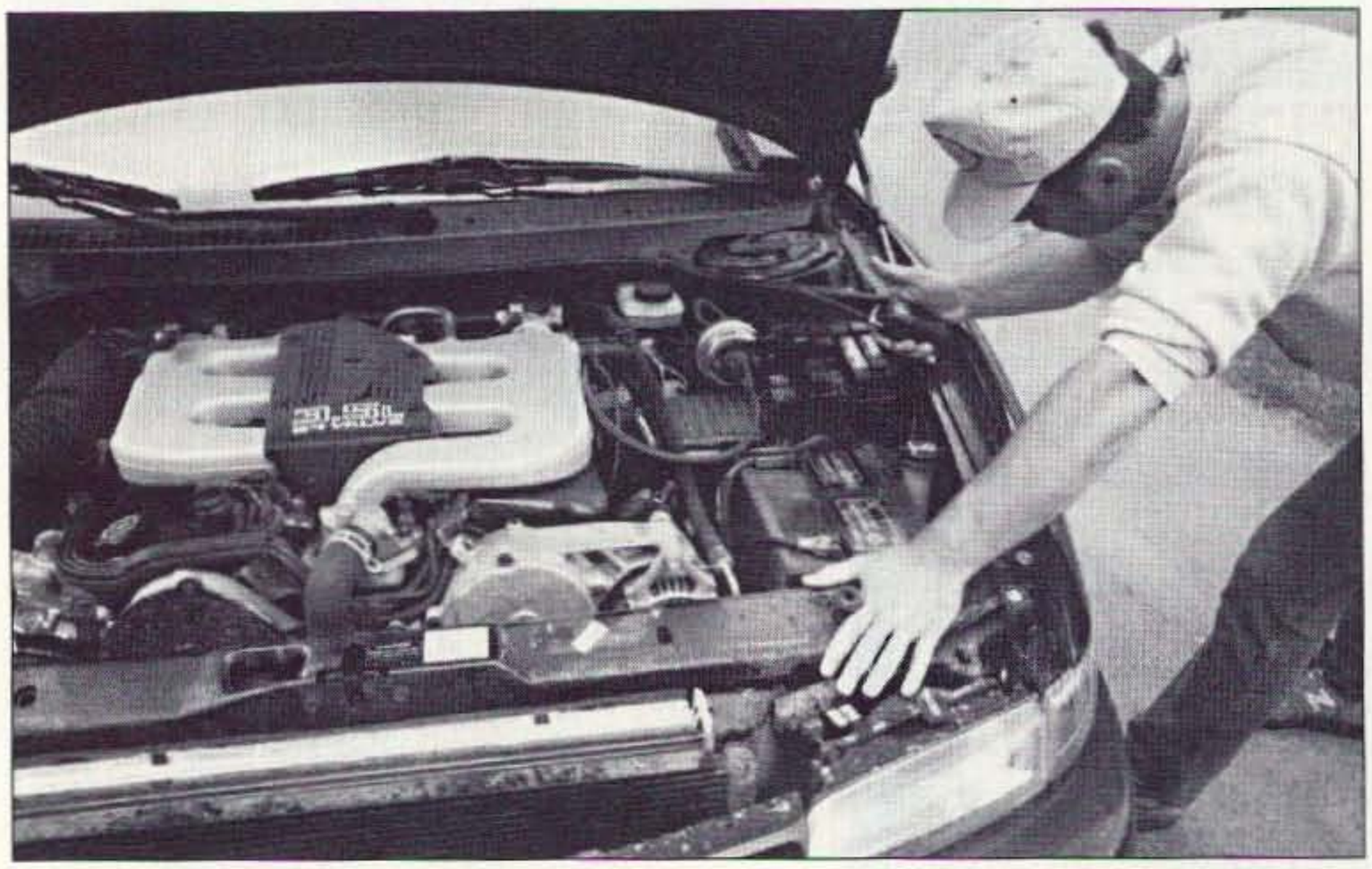

Photo C. Using a scanner to determine the best route for power leads saves time and trouble.

short as possible using proper gauge wire. AC and DC filters such as chokes and capacitors will help to keep "hash" or wideband noise out of equipment. I have had luck with additional filtering gained from ferrite beads placed over the power leads. Secure these ferrite beads with glue or tie-wraps to avoid damage to the bead caused by movement. Now let's tie this information into the installation process.

Installation Practices

When first planning the installation of communications equipment in a vehicle, take a moment to "sweep" the area with a scanner. This should show potential EMI sources. Typical areas are near vehicle black boxes, digital dashes and other displays with multiplex drivers. Once any EMI sources are identified, route power and RF cables away from the source. If the cable routing doesn't allow for avoidance, the use of shielding may be required.

Flexible, conductive tapes, conductive caulks or foils can be used to cover the cabling which runs by the source. Short lengths of cable requiring this EMI cover can be easily fabricated in the field. Grounding of this cover material is usually not necessary. Each application will be unique, though. Common-sense precautions are essential when using conductive materials around power sources. Covering conductive materials with insulating tape will not impair the shielding properties of the material.

Taking the time to bond the radio, the mount and the vehicle body together can eliminate sources of wideband noise. When installing mobile computing equipment, this step may become even more important as this equipment can often generate large amounts of wideband digital noise. Use care to bond the interconnecting cables and connectors. Ensure solid ground paths on the vehicle by sanding the area around the connecting fastener. The use of modern anti-rust compounds can impair or raise the impedance of the ground path. To protect the ground connection and fastener, the use of conductive caulks or grease is recommended. Use of small amounts of conductive caulks under mount "fingers" may improve grounding of blind mount antennas when installing equipment in off-road vehicles or in humid climates.

As always, when installing equipment in off-road vehicles, take the time to read both equipment and vehicle technical data. I have had good luck with these rule-of-thumb procedures when installing radio equipment in vehicles as diverse as aircraft fueling trucks, snowplows, forklifts and fire trucks. If you have questions, talk to your vehicle service personnel or dealer.

Avoiding Hazards

Even the best-planned installation can generate hazardous conditions. Let's look at some of those conditions.

When using conductive materials for attenuation or shielding, be careful! These materials may become conductors of opportunity or part of sneak circuits not protected by fuses. To guard against this hazard, I fuse both positive and negative power leads as close to the battery as possible. Foils used for shielding can cause heat buildup. Before using foil as shielding material, ensure that doing so will not violate the vehicle's warranty. After installation, check all vehicle systems with the installed equipment up and transmitting. Imagine how embarrassing (and dangerous) it could be if your transmitter caused the vehicle anti-locking brake or fuel injection system to fail. While these types of problems are rare, it only takes a moment to check EMI interactions with the vehicle's systems after the installation is complete.

After all, if you didn't install the vehicle alarm, cellular phone or stereo equipment, you must be sure that these common systems don't cause problems for your new mobile rig. Take the time to use some of these strategies, and enjoy your EMI-free mobile operations. 73

Installation Hints

Good installation practices will go a long way toward preventing possible EMI problems. Try these tricks—they work well for commercial and amateur installations:

- Replace the battery terminal clamp with a new, tight-fitting clamp. Use the kind with a new "generator" lead cast into the clamp. Pull the DC buss line power from this clamp.
- Use a multiconnect or "barrier" block for your DC buss. This makes it easier to place bypass capacitors, if necessary.
- Don't splice wires, if at all possible. Each joint is a possible corrosion spot that could cause problems.
- Don't install the radio next to or under heater vents or, on older cars, near the heater or wiper motors.

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73 Review

Number 7 on your Feedback card

by Michael Bryce WB8VGE

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S & S Engineering's Frequency Counter Kit

Now you can count frequencies 'til your heart's content.

When S & S Engineering sent me this frequency counter kit for review, gosh, did it bring back memories. My first home-brew frequency counter came to life in the mid-'70s. Oh, those were the days! Johnny Carson was king of late-night TV, the Bay City Rollers were rocking Top 40 radio, and the USSR and the USA were sneering at each other. All you needed for a frequency counter back then was a VW bus full of TTL logic chips, 15 pounds of solder, yards of multicolored wire and several PC boards to hold everything together. Any ol' 5 volt supply at 27 amps was all it took to fire her up. On a good day, with the wind blowing just right, you might be able to read 10 MHz. Provided you handpicked the first gate chip, a 74HS90.

The S & S Engineering Counter Kit

We've come a long way since my first home-brew frequency counter. S & S Engineering now has available a frequency counter kit for under $50 bucks. Even on its worst day, its top end is 75 MHz. Why, with the exception of two wires for the battery, everything is on one PC board. Best of all, the entire counter can be run by a single 9 volt battery.

The display is a large 1" LCD giving you four-digit resolution. This can be expanded to eight digits later if you wish. The upgrade is simple, easy and, most of all, cheap—less than $20. I highly recommend you get the upgrade to eight digits.

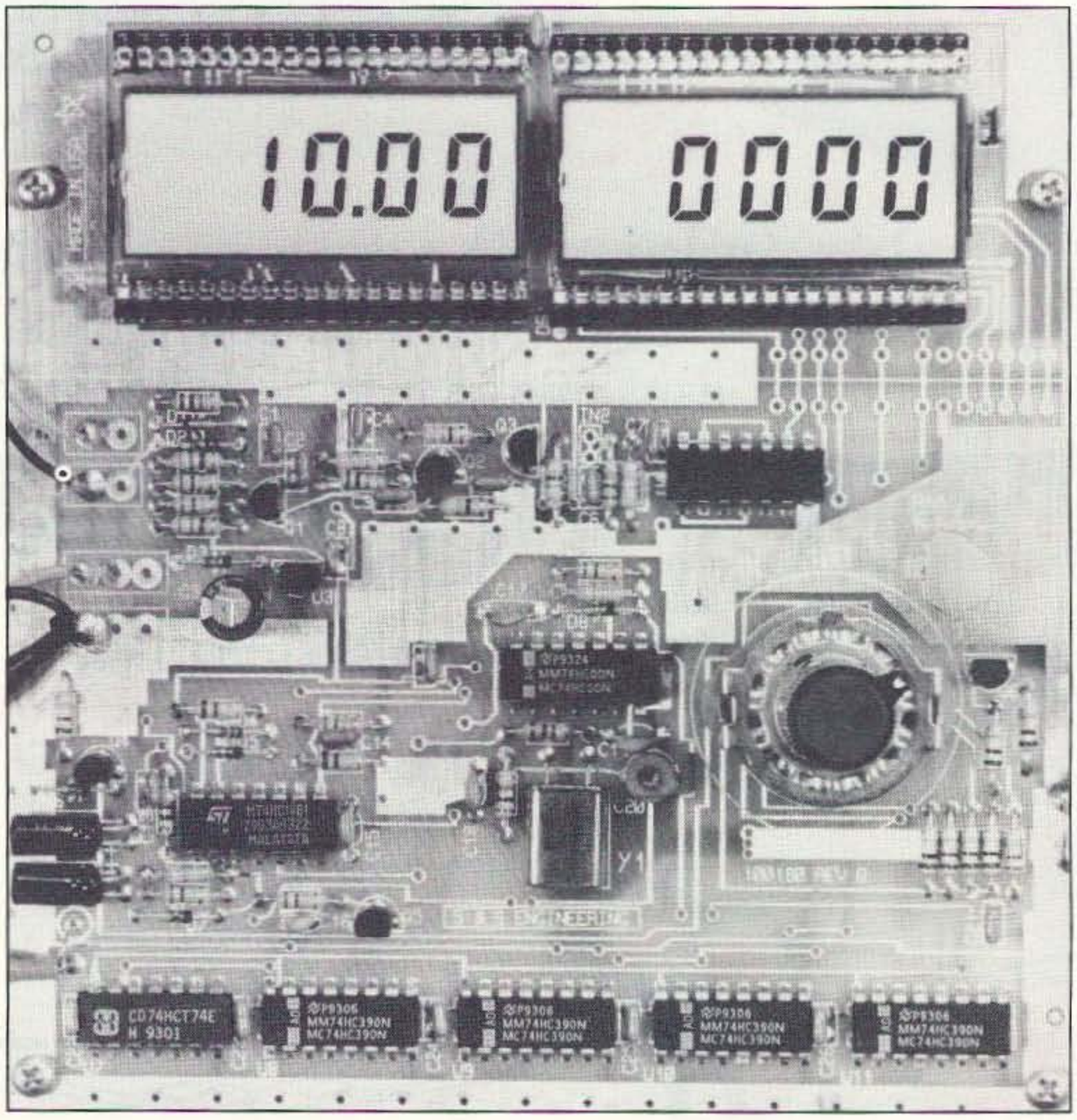
The S & S Engineering counter kit consists of a high quality double-sided PC board with plated-through holes. The PC board has the parts layout silk-screened on it, and it has been laid out so the top third of the board, the portion holding the LCDs, can be cut from the logic section. This way, you can mount the display away from the logic section for a custom installation. There are only 12 wires needed between the display and logic. Ribbon cable would be ideal for this. I did not separate the two for this review.

The kit does not come with a cabinet; that part is left up to the builder. There are four metal standoffs supplied to raise the PC board up. This way, you can leave it as is and just use the bare circuit without a box.

As with all of the S & S Engineering kits, the part quality is first-rate. No "hamfest special" parts or surplus goodies are in this kit. As complex as a frequency counter is, most of the work is done by specialized chips. This reduces the overall part count of the kit to just a handful of IC chips. All the ICs come in static-protective packaging. The kit includes everything you need, including a 9 volt battery snap. Sorry, the battery is not included.

Assembly

Assembly is very straightforward: You start with the resistors, move on to the capacitors, and finish up with the transistors. The ICs are installed next. Although IC sockets are not provided with the kit, you should use them. The IC sockets are cheap insurance in case you solder a chip in backwards or install the wrong chip in the right hole. Unsoldering an IC from a double-sided PC board with plated-through holes is not for the weak-at-heart. The kit requires six 14-pin sockets and one 16-pin socket. There is one 40-pin chip under the LCD display that you can't use a socket on. It would make the chip too tall, and make it impossible to mount the LCDs on the board.



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14.03510-T    0930
14.03510-R    M000
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TNX FER QSO. 73
■
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← Incoming data

← Outgoing data appears here

- Store up to nine 256 character messages.

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14.03510-T    0930
3>CANNED      MSG■
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- Messages can be: edited, sent & appended to outgoing message

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CIRCLE 321 ON READER SERVICE CARD

As with most counters, you can select the gate time of the counter. You can select between 10k, 1k, 100, 10, or 1 Hertz resolution. A multi-pole rotary switch mounted directly on the PC board selects the gate time. There are no interconnecting wires to worry about. But, this switch might prove a pain in the butt if you want to mount the logic board separate from the display. Some forward-thinking would be in order before applying solder to the switch terminals.

Assembly went along without a hint of trouble. The instructions are a bit thin, but they get the job done. All in all, it took me about two hours of work to complete the kit, even with extra-long breaks for Oreo cookies and Diet Coke. I installed the extra LCD and its driver chip, too.

Testing the counter is about as simple as you can get. Apply power, and connect the input of the counter to a test point on the PC board. If everything went in as it should, you'll see 10 MHz on the display. A trimmer capacitor on the PC board calibrates the counter to either WWV or a known 10 MHz standard.

Operation

The counter will operate on a fresh 9 volt battery for several hours. There is no power switch. For use on your workbench, just about any quality source of power will work. Watch out for those wall-wart power supplies! Many are nothing more than one diode with very little filtering. The input supply voltage is between 7 and 15 volts DC. The counter requires about 50-60 mA.

Set the rotary switch to select the gate time and thus the amount of resolution you require. The longer the gate time, the better the resolution of the frequency displayed. The longest gate time is about four seconds to update the display. That's it!

Since the S & S Engineering kit is so self-contained, it opens up a new way of seeing things. I've always used a frequency counter to spot trouble. They make great *sniffers* of RF. The S & S Engineering kit has more than enough sensitivity to sniff out weak signals. In fact, it could read the test point just by holding a wire near the input pin.

I found a particularly useful task for the frequency counter: Reading the VFO of a direct conversion transceiver. You can also use the counter to display your operating frequency in a superhet receiver, too. In fact, there are some suggestions on how this may be accomplished in the assembly manual. Since you don't require the longer gate times, and thus the four extra displays, the standard four-digit unit works best. I would bypass the gate switch with jumper wires. By using this counter, you can add an LCD frequency counter to your latest home-brew project.

The Last Page

This project is simple enough for a beginner to handle. It would be best if you have some idea of how to solder, what end of a diode is what and, of course, the proper installation of IC chips. Except for the calibration adjustment, there's nothing to touch. If you assemble it correctly, it's going to work.

Johnny Carson has retired, the USSR is no more, and you don't need a 700 watt switching power supply to operate this frequency counter. Best of all, you don't need a VW bus to carry it in. The S & S Engineering frequency counter kit is an excellent value. It's easy to build, easy to operate, and has all kinds of possibilities in your ham shack. 73

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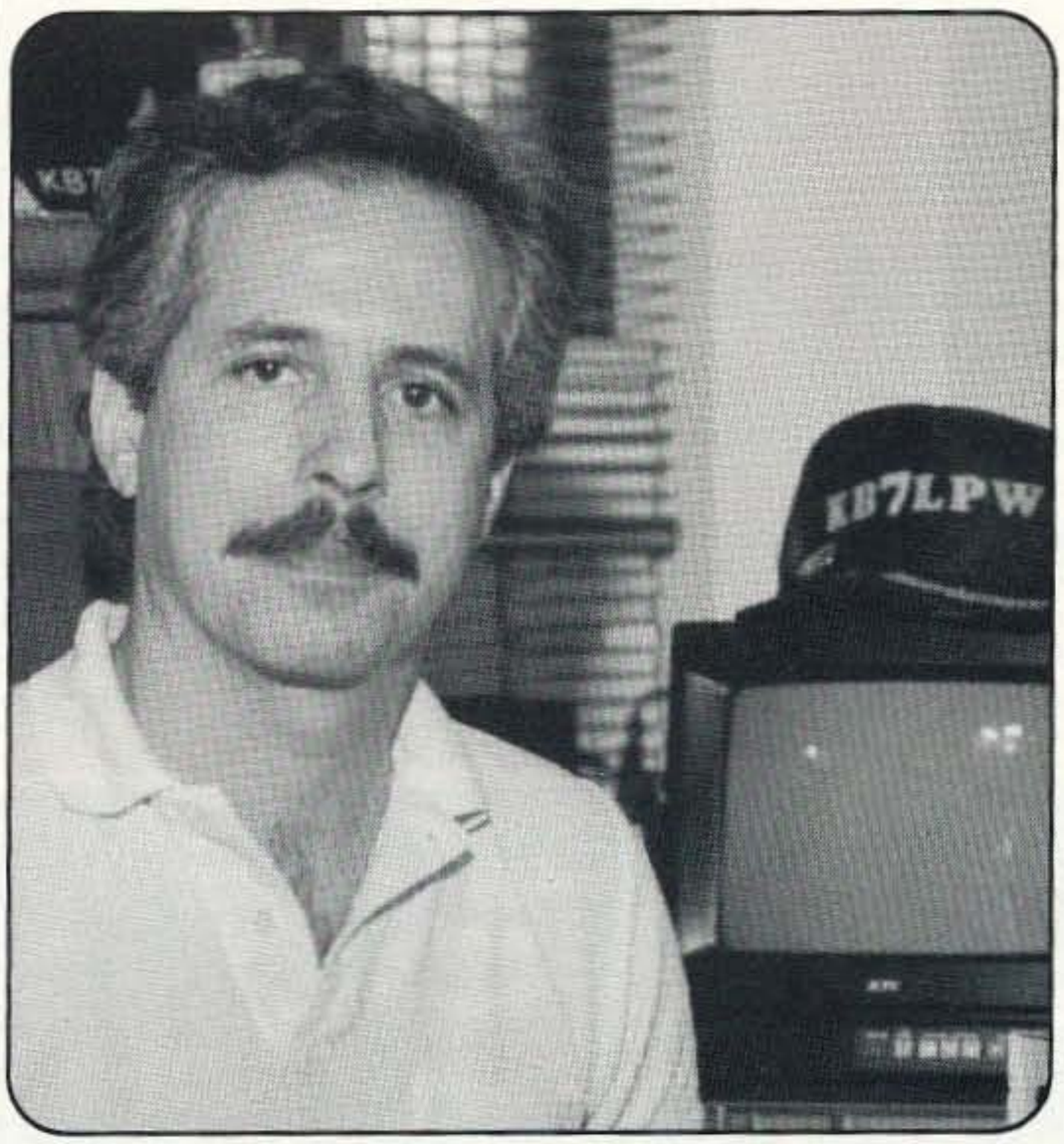

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73 Review

Number 8 on your Feedback card

by Breckinridge S. Smith K4CHE

The LDG Electronics FC-1

A small, flexible fox controller and CW IDer.

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If you are a serious foxhunter, you have probably tried putting together your own "foxbox" with timers, identifiers, etc. You have tried the different circuits using timing capacitor networks and different chips, and you have probably soldered in those countless diodes in that matrix for the IDer. Recently I tested the LDG Electronics Microprocessor Fox Hunt Controller/CW IDer board. This small Maryland-based company has developed a real gem. Yes, the East Coast does produce some foxhunt goodies.

Why do you need a microprocessor controlling your hidden transmitter? What I wanted was a timer/IDer system that was small, reliable, and easy to change. I wanted to spend more time on my own DF equipment, helping beginners, and not spend hours building and testing numerous timing circuits. I wanted to be able to change the identification and timing cycles of the hidden transmitter to suit each individual hunt. I am not an avid computer enthusiast but the LDG ad in *73* said I could program this controller from my PC so I gave up and ordered the board. Time to join the microprocessor crowd.

The Board

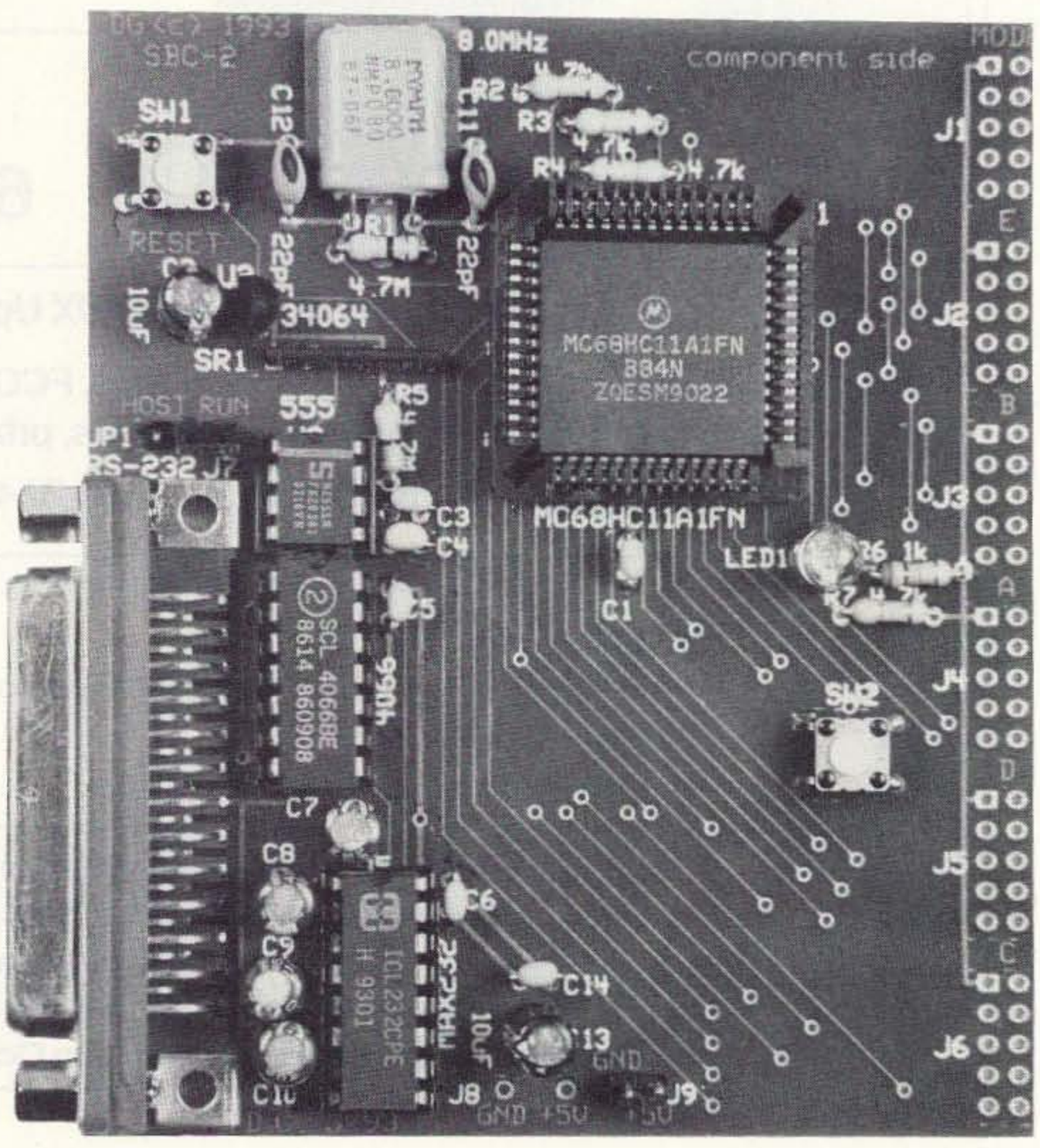
What I got was a small assembled 3.1" by 3.6" board that was not a kit; a board with professional printed circuit traces and a small plug-in module for the audio, keying, and power functions. Included in the package was over 450 pages of documentation contained in four separate handout/books, and a floppy disk with numerous programming files on it. After wading through the information I found the three-page fox controller sheet and the 24-page LDG manual.

Reviewing the documentation, I realized that what I had received in the mail was a foxbox controller and a small single-board computer/processor using the 68HC11 microprocessor. I know that there are more advanced microprocessors out there but, again, you have to start somewhere. You can use the system as a foxbox controller/CW Ider, or do your own experiments with the microprocessor using the 450 pages of documentation. LDG also markets this same basic board as a 16-output DTMF decoder which requires different software and a different plug-in module.

Programming

The controller arrived with a test program loaded. I recommend you test the board initially to get familiar with the different push-buttons and board operations, then proceed with your programming. You load the LDG disk program using their disk into your computer and then you modify the FOXMCW file to suit your identification and timing requirements. Their handout tells you which lines on the files to modify. Using an ASCII file edit program, you may change values on selected lines by typing in different number values for timing, tones, speeds, and real letters for the modulated CW identification. You then "reassemble" your changes using the assembly program which is on the supplied disk. After you assemble the program you can then send to the LDG controller via RS-232 cable.

I told you I wasn't a computer person! The loading program is written in BASIC; I spent 20 minutes trying to type in the command "BASICA Bootload" instead of "GWBASIC," which is what I had installed on my computer. I would have preferred a more detailed step-by-step instruction sheet of the programming



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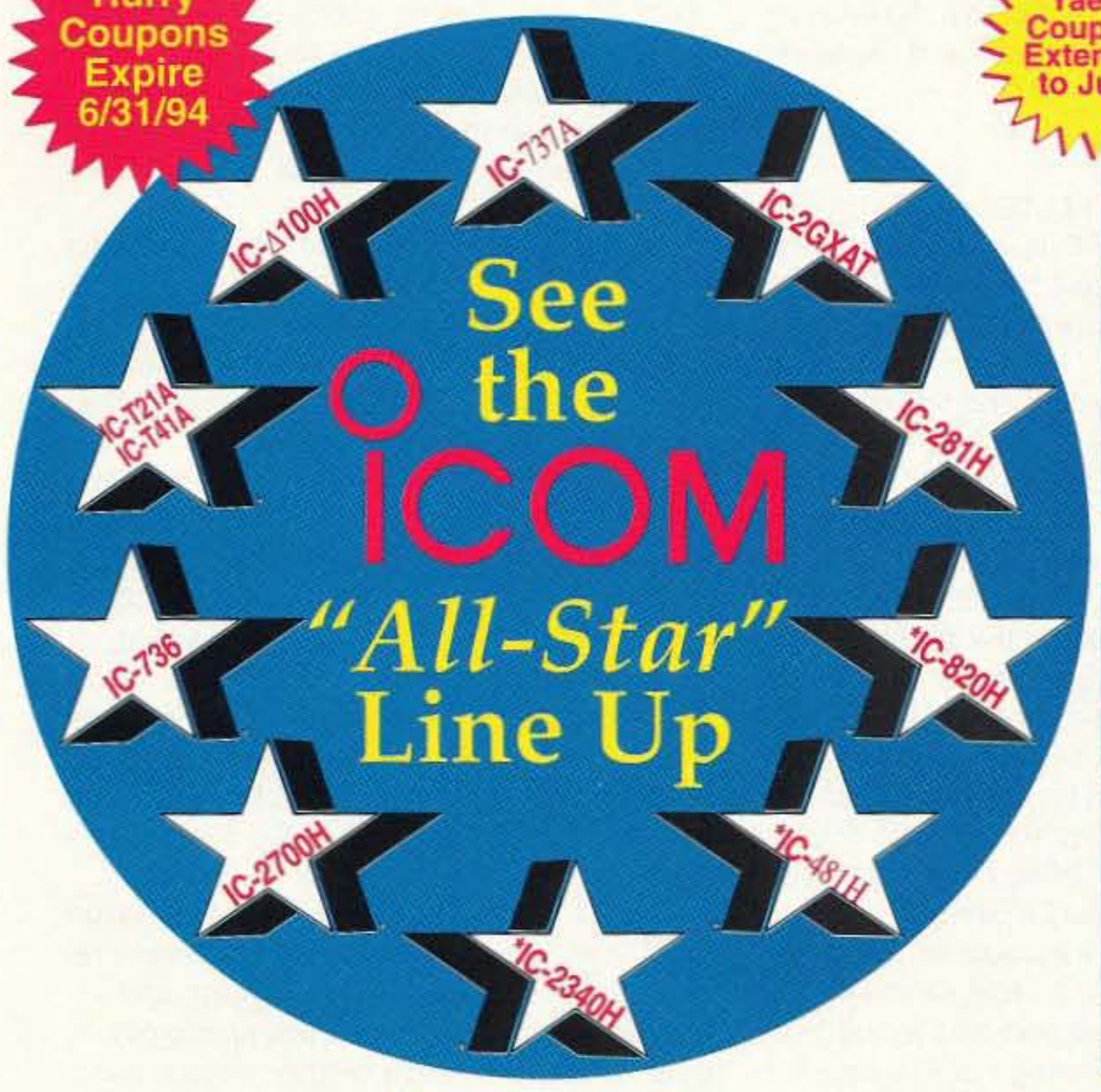

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process, but the instructions supplied are adequate . . . if I can do it, you can do it.

During your programming you may modify the initial delay time prior to startup, the first and second identification messages, and the on and off periods that will be repeated during the hunt. LDG included a second identification message feature which is unique: You can have a push-button on your foxbox wired to the LDG controller's "bit 1 output." When the first hunter finds the box, he pushes the button and presto, the CW message changes over to the "fox found," message, which will now be continuously repeated until the controller is "reset." Here in Delaware we have had some devious hunters who have moved the foxbox. In the case of tampering you could even wire up a mercury "tilt" switch to activate a tampering message to warn the other hunters as well as the hider.

LDG mentions to "feel free to program and reprogram" as the EEPROM in the 68HC11 has a life of 10,000 cycles." *LDG warns you, and I will warn you: Be sure to make a copy of the FOXMCW.ASM file before you start changing the parameters.* If you get completely out of whack you can always start over with the original file. Since this is an EEPROM you can remove voltage from the unit and it will still retain the information that you have programmed.

During your programming of the controller you are limited to 75 characters total for the two messages; exceeding this limit during loading results in a friendly error message later. One observer during a hunt stated that he thought the plain CW messages were boring; you can use the letters "E" "T" to produce multiple dits and dahs and set up a rhythm pattern to break the monotony. Again, you can only use 75 characters, and "spaces" count.

Testing

One handy feature of LDG's programming process using your PC is a test command which allows you to test the board for your programming changes without disconnecting from your PC.

During my programming and testing of the board I found an error in the published computations for timing. The Fox Controller instructions used a value of 130 for each minute, and my controller needed a value of 114.5 for each minute for a "tick" value of 1.9 per second. The values on the supplied LDG disk were correct except for the "tick" value information. I talked this over with LDG and it is my understanding that they will correct their timing information on their handouts. For short timing periods this error is not critical, but for a several-hour initial timing computation a correct value must be used.

The timing range was quoted in the instructions to be from 0 to approximately 7.7 hours, but my computations and actual testing indicated a longer range of 9.5 hours. I again notified LDG of this and appropriate corrections will be made. It's fun to hide a box earlier in the day and have it start several hours later on schedule while you are at the hunt starting site. With the programmable timing you can have multiple boxes start up in stages during the day as a complex hunt unfolds. However, due to slight variances of the internal 8 MHz crystal, be prepared to have a slight error during long timing periods, and of course you must "arm" the controller at the proper time by pushing the reset button. The perfectionist can time his or her own board for a one-hour period and come up with the appropriate corrections.

I have abused this board. I left it laying on my desk for a month connected to my PC with a 9 volt battery dangling on the power leads. I abused the board further when I interfaced it to an old commercial 20 watt boat anchor. I hooked the board up using unshielded wires and mounted it next to the transmitter RF section. RF doesn't seem to affect the processor as I positioned a quarter-wave antenna with 15 watts, 3" away from the exposed unit, with no problems. I then wired the controller to the same power supply as the commercial radio internal power supply section, which has a receive/transmit relay on it. The inductive kick of the transmit relay didn't bother the board. Tests conducted with the traditional hot air blower and freeze spray had very little effect. Overall, the board appears to be rugged and pretty bulletproof.

I thought LDG put a lot of thought into the hardware design of their board. There are four of those little rubber feet underneath the board for shock mounting, and your main hold-down bolts go through the RS-232 connector so that the connector is secure when you plug and unplug the bulky cable. The low power CMOS circuitry can be powered by using just a 9 volt battery or any power source up to 20 volts. During testing with the board on the same power supply as the transmitter, the board voltage regulator continued to function to a low voltage level of 7 volts, which is handy if the fox battery starts to wind down during the hunt.

The push-to-talk output of the board is an open collector keying transistor which you can use with a reed relay (Radio Shack 274-232) to allow flexibility in using different radios for the fox, or if your radio allows just grounding the push-to-talk circuit.

The 8 MHz clock crystal oscillator emits a small signal which can be seen with a spectrum analyzer throughout the VHF range. On my controller the signal was at 144.030, 146.030, 148.030 and could be heard about 20 to 30 feet away with a handheld. If this bothers you, you can shield the complete unit in a box with feed-through capacitors. The reason the harmonic was not on an even MHz is a very minute error in the 8 MHz oscillator.

Overall, the LDG board performs as advertised, has lots of documentation, doesn't require a computer genius to program, and tolerates abuse. It is easy to hook up the power, push-to-talk, and audio outputs to your transmitter. For $69.95 you can have an assembled fox controller/CW IDer to create your own personalized system, and at the same time experiment with a microprocessor. 73

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A Delayed Video Trigger for Your Oscilloscope

Convert your surplus scope.

by Joseph A. Consugar KC3XM

When I began working with video circuits, one of the first things I learned is that you cannot just feed a video signal into an oscilloscope and expect to see anything useful. The amount of time most events I was interested in took to occur was so short when compared to one frame of video, it just didn't work.

This problem can be overcome by using a delayed video trigger. This is a circuit that will cause the oscilloscope trace to begin a set time after some event in the video signal. That event is usually the vertical sync pulse, and many oscilloscopes include a delayed video trigger feature. But what do you do if you are using a surplus scope without this capability and don't want to buy a whole new scope just to get this feature? You apply a little ingenuity and build one.

The Basics of Video

To understand how the circuit I came up with works, you should have at least some idea of the structure of a video signal. This is by no means complete, but it should supply enough information so that you can follow the circuit description.

A video display may look continuous, but it is actually composed of a series of still pictures that is going by so fast they all blend together. Each of these pictures is called a video frame, and each frame is made up of two video fields that are labeled the even and the odd. A new video frame is displayed 30 times per second, so a new video field is displayed 60 times per second.

Each video frame is made up of 525 horizontal lines, which are split equally between the video fields. Displaying 262.5 lines of video in 1/60 of a second means each line requires about 63.5 microseconds.

Out of these 262.5 lines, only 244 of them are used to transmit video information. The remaining lines are used for blanking the display during picture retrace and display synchronization. Figure 1 shows the structure of these lines for the even field.

Picture synchronization is performed using sync pulses that are included as part of the video signal, the main ones being the horizontal and vertical sync pulses. Horizontal sync pulses indicate the beginning of a new line of video and vertical sync pulses indicate the beginning of a new field of video. In Figure 1, note the structure of lines 4 to 6. These are the lines when the vertical sync pulse occurs. During these lines, the sync pulses are much wider than normal, which is the key to determining when a vertical sync pulse occurs.

Circuit Description

The steps necessary to produce a delayed video trigger are illustrated by the block diagram in Figure 2. A schematic of the corresponding circuit is shown in Figure 3.

In order to synchronize the trigger with the vertical sync pulse, you must first identify when the vertical sync pulse occurs. This is accomplished by U1, U2, and their associated components.

The video signal is taken from the source of Q1 (an MPF102 JFET whose purpose is to provide buffering for the video source) and fed to the input of U1, an LM1881 video sync separator. The sync pulses are extracted from the video signal and appear at pin 2.

The sync pulses are routed to U2, which is used to separate the vertical sync pulse from the horizontal sync pulses. U2a, R1, C1, and D3 form a one-shot timer that is triggered by the ends of the sync pulses and whose negative-going output pulse is connected to the clock input of U2b, a D type flip-flop. When the signal from U1 returns high at the end of a sync pulse, the one-shot is triggered and its output goes low. The amount of time spent low is determined by the values of R1 and C1.

The sync pulses are also connected to the data input of U2b. When the output of the one-shot returns high, the value of the sync signal is sampled and appears at pin 12. Normally, the sync pulse is narrow compared to the length of the video line and the signal from U1 is still high when the one-shot output returns high. However, during the vertical sync pulse, the sync pulse is wide compared to the length of the video line, so that the next sync pulse has already begun by the end of the one-shot pulse. Therefore, the output of U2b is normally high, except during the vertical sync pulse, when it is low. This sequence of events is illustrated in Figure 4.

At this point there are two pulses for each frame of video, one for the even field and one for the odd field. To ensure a stable oscilloscope display, the trigger must be keyed to the same field (i.e., the even or the odd) each time. This is accomplished by using the vertical sync pulses from

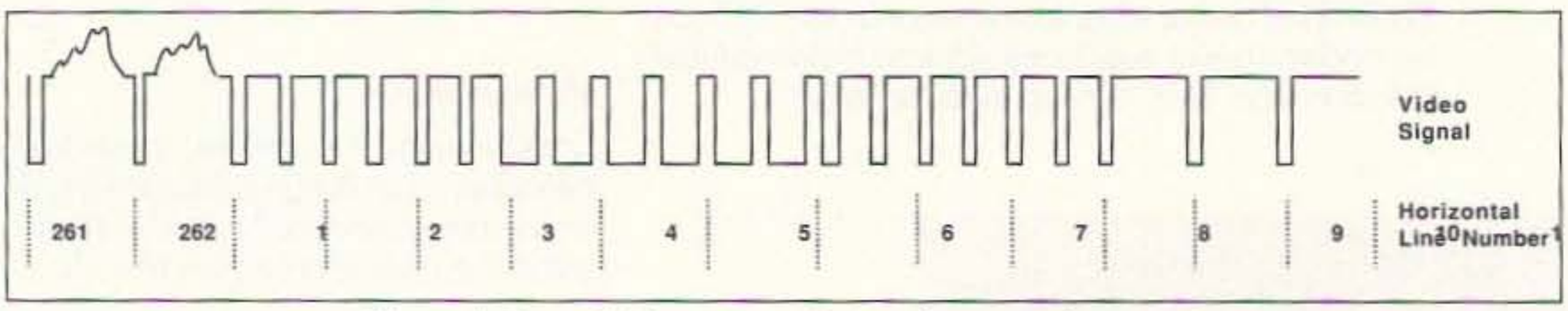

Figure 1. Even-field structure during the vertical interval.

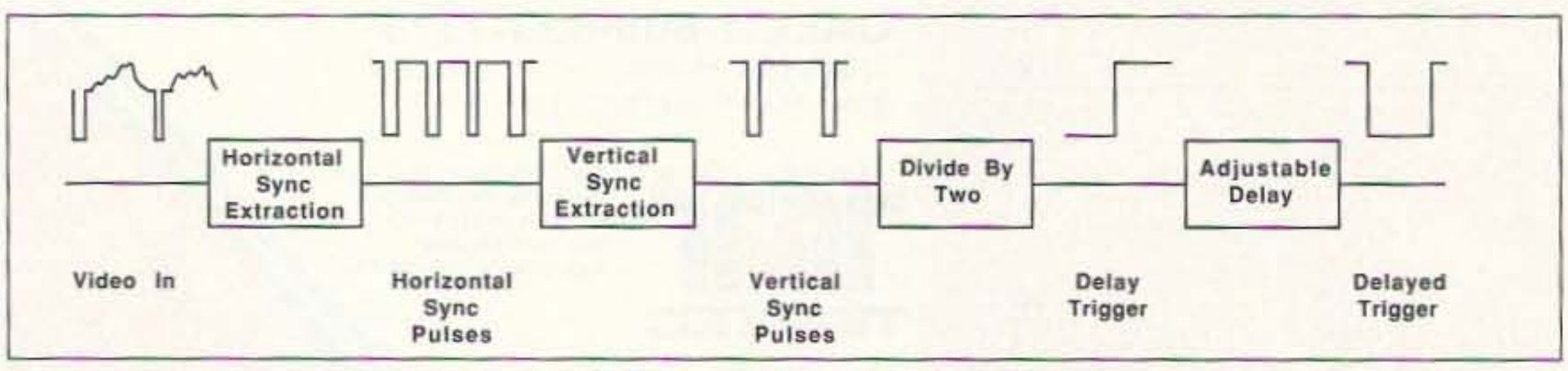

Figure 2. Delayed-trigger block diagram.

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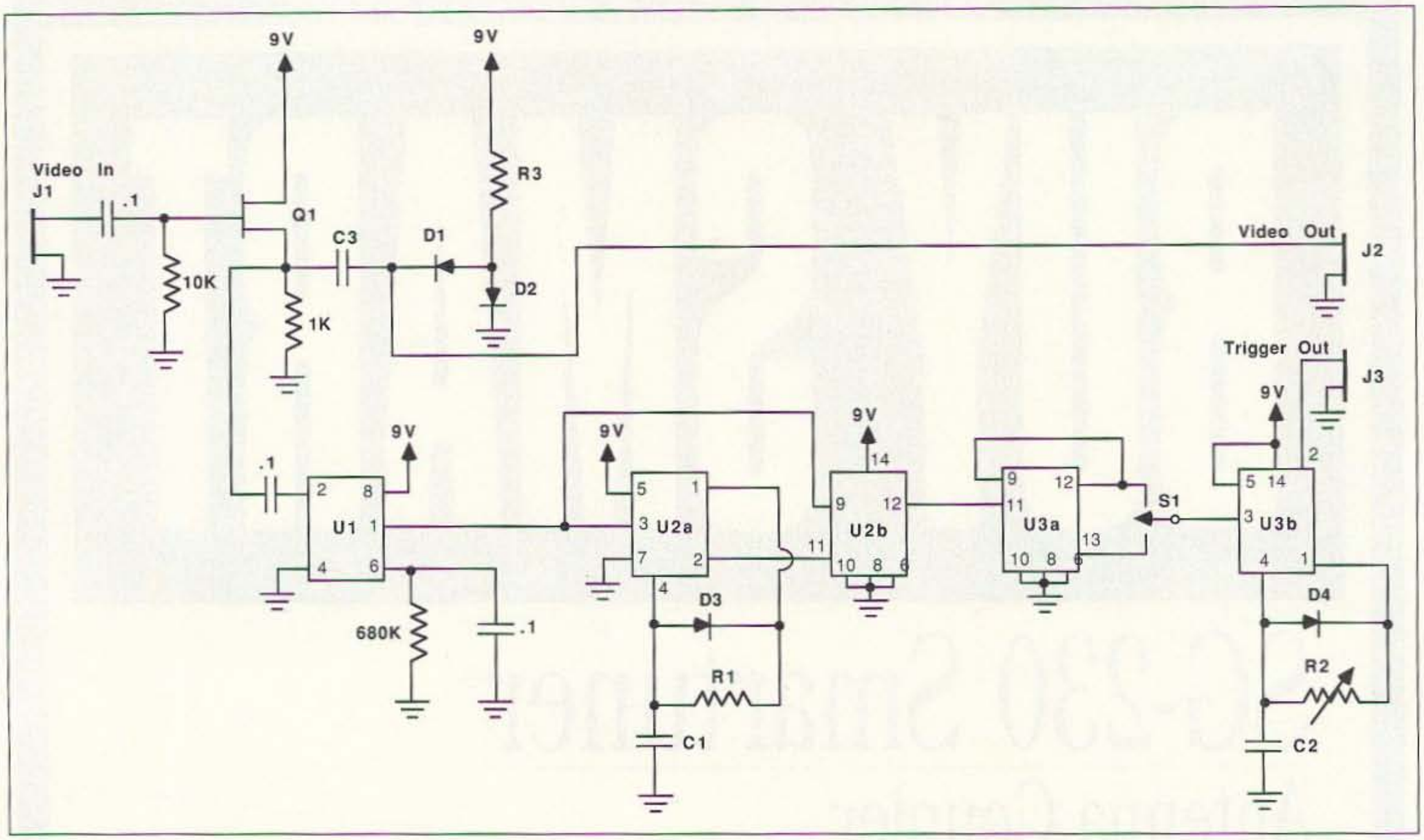


Figure 3. Delayed-trigger circuit schematic.

U2 as the clock for a divide-by-two circuit formed by U3a. Each vertical sync pulse causes the output of U3a to change state. The result is a square wave that goes high once per video frame and can be used as the trigger for the final delay circuit.

The delay circuit is composed of a one-shot timer made up of U3b, R2, C2, and D4. The one-shot is triggered each time the signal from U3b goes high and the pulsewidth can be varied using R2. The end of the pulse is the external trigger for the oscilloscope.

As you look at the schematic, you will notice there are some components whose purposes have not been clarified. D1, D2, R3, and C3 form a video clamping circuit whose purpose is to provide DC level restoration for the AC-coupled video signal. While not strictly part of the delayed trigger circuit, it is useful to keep the oscilloscope display stable when viewing rapidly-changing video signals.

Construction and Use of the Delayed Trigger

The prototype for this circuit was built on a Radio Shack protoboard using point-to-point wiring. Another option would be to make a PC board according to the design in Figure 5. Or you can order one already drilled and etched for $4.25 plus $1.50 S & H per order from FAR Circuits, 18N640 Field Court, Dundee, IL 60118. I recommend that you build the stages separately and make sure each is working correctly before proceeding to the next.

When you have completed construction, connect a 9V battery to the power connections and a video signal to J1. Adjust R2 to its minimum value and examine the delayed trigger output at J3 with an oscilloscope. You should see a series of very short, negative-going pulses whose width increases as R2 is turned clockwise.

Once you have the delayed trigger working, adjust your oscilloscope to accept a positive-going external trigger. Set R2 to approximately halfway. Connect the trigger signal at J3 to the oscilloscope's external trigger input and the video signal at J2 to the vertical input. Adjust the oscilloscope time base so that there are three or four lines of video displayed on the screen. As you vary R2, you should see different parts of the video signal on the screen. The values given for R2 and C2 should allow you to vary the delay from approximately zero to about one-and-one-half video fields.

Final Notes

When you turn on the circuit and connect a video signal, the trigger will randomly latch onto one of the video fields. If the field being displayed is not the one you want to examine, move S1 to its opposite position and the opposite video field will be dis-

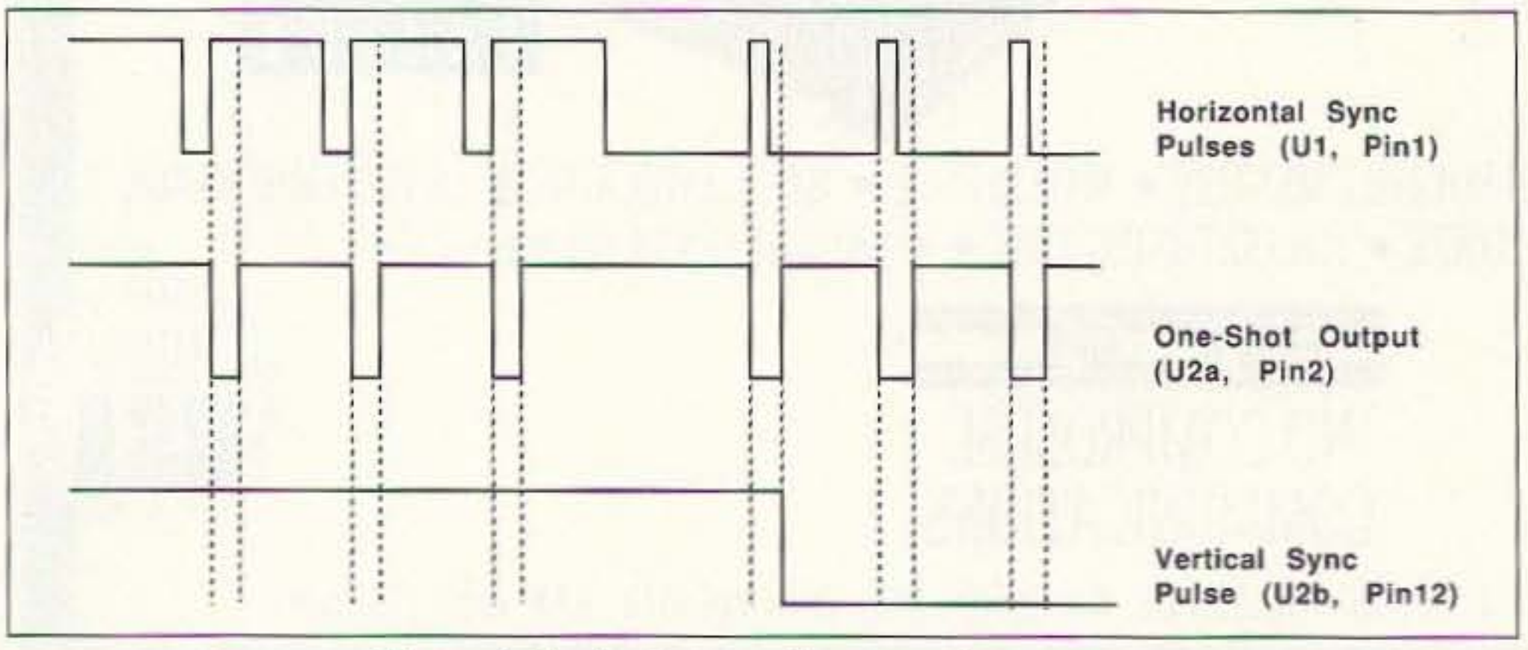


Figure 4. Vertical sync pulse extraction process.

Parts List

R1	3.3k
R2	1 meg potentiometer, linear taper
R3	1k
C1	0.0047 µF
C2	0.033 µF
C3	0.1 µF
D1,D2,D3,D4	1N914 silicon diode
Q1	MPF102 JFET
U1	LM1881 video sync separator
U2,U3	4013 D type flip-flop
J1,J2,J3	RCA phono jack
S1	SPDT switch

Note: Resistors are all 5% 1/4 watt. Capacitors are all polyester type.

played. There is no way to determine which field will be displayed when you turn the circuit on, but you can always get to the one you want.

For those people who are familiar with the LM1881, you may wonder why I didn't take advantage of some of its other features (e.g., the even/odd field indicator). It has been my experience that in order to fully utilize these features, the video signal being examined should conform closely to the video standard. Unfortunately, some video sources (e.g., VCRs and camcorders) take liberties with that standard. The circuit as presented was designed so that, with hope, it would work with as many of these near misses as possible. If you work primarily with standard video, I encourage you to take advantage of the additional features of the LM1881 and share the results with the rest of us. 73

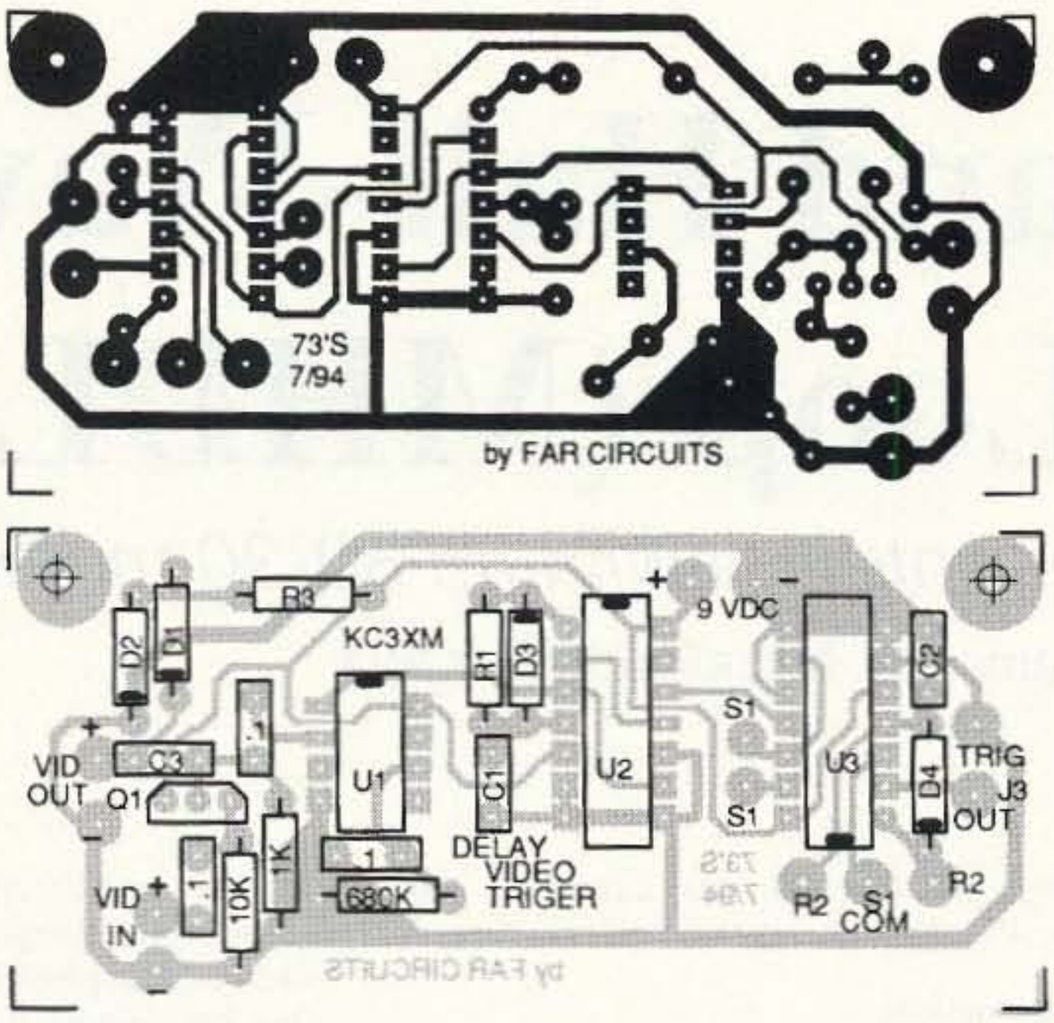


Figure 5. PC board layout and parts placement.

Multiband Half-Wave Delta Loop (MHDL)

A simple 20-10 meter antenna with an 80-30 meter bonus.

by James W. McLelland WA6QBU

While looking through my books for some kind of small antenna that would fit in the attic, I happened upon a short description of half-wave loops. I've always preferred full-wave loops, but a 20 meter one wouldn't fit in my 17' x 25' attic given the fact that I needed to stay away from outside rain gutters, flashing, downspouts, vents and a chimney. As luck would have it, however, I discovered that a half-wave loop fits, with room to spare (I've hung it on my classroom wall as well). While half- and full-wave characteristics are quite different from each other, with the details worked out, the MHDL has proven itself to be an effective indoor reference antenna for the upper (20-10 meter) HF bands. (By the way, there's a slick trick you can use to make it work on 80-30 meters as well.) It's easy to build, requires no alignment, and the XYL can't see it. Try it. This'll be the easiest antenna you've ever built.

Description

The loop is cut for a half wave on 20 meters. Half-wave loops have a very high impedance, in the order of 2,000 ohms, so I needed to bring the impedance down to a more workable value. Using a quarter-wave (including a velocity factor of 0.80) transmission line transformer will drop the impedance to about 50 ohms. I used 300 ohm twin lead (Radio Shack 15-1153) because it works well into a tuner, is inexpensive and has low loss. On 10 meters, the 20 meter half wave becomes a full wave and the impedance drops to about 100 ohms. the feedline is now half-wave and acts as a 1:1 transformer, which your tuner will have no trouble matching. I also found that my tuner could easily resonate and match the MHDL on 17, 15, and 12 meters. If you use a 3/4-wavelength feedline, you can also get an 80-30 meter bonus by shorting the two feedline wires together and tuning it as a top-loaded vertical. This gives you a vertical 3/4 wave on 30 meters, a half wave on 40 meters and a quarter wave on 80 meters. However, you must use a ground to make this mode effective. By the way, it's about 1/8 wave on 160 meters and your tuner might be able to add enough inductance to make it resonate. Anyway, it's worth a try.

Construction

Using insulated #16 or #18 gauge stranded wire, cut the loop to 35' 4" (see Figure 1). Now cut the 300 ohm feedline to odd multiples of 13' 8" (exactly 41' for the 80-30 meter bonus). Solder the feedline to the loop ends and insulate with shrink tubing. Then, to connect it to the balun on my tuner, I installed two banana plugs (the kind that plug into each other) on the end of 6" pigtails, soldered them to the twin lead, and then insulated them with shrink tubing. You'll be done with the construction phase in less than an hour.

Installation

This is the part where you can really get creative. You might even hide the feedline and convince the XYL that your MHDL is a rosebush trellis, but then you'll have to plant and take care of the roses. I opted to hang mine horizontally from the rafters. There is no exact shape requirement except to have as much area as possible. I like equilateral triangles, but squares, diamonds, circles and rectangles work just fine. Changing the shape varies the frequency somewhat (plus or minus 1/2 MHz or so) but I just let my tuner fix it. More important is that the loop fits the space you've got no matter what it looks like and what angle it's mounted at—vertical, horizontal, or somewhere in between. One warning: Stay away from metal objects with the MHDL and feedline, and mount it with some kind of insulating material. If you have extra room, try a vertical and a horizontal model, at least for 20-10 meters. Being able to switch back and forth can really be dramatic because the angle of radiation as well as the polarity will be different. Lastly, if you go for the 80-30 bonus, the feedline should be somewhat vertical and stretched out, but the higher part could be horizontal and work OK. In any case, it's a lot better than nothing and it's all hidden indoors.

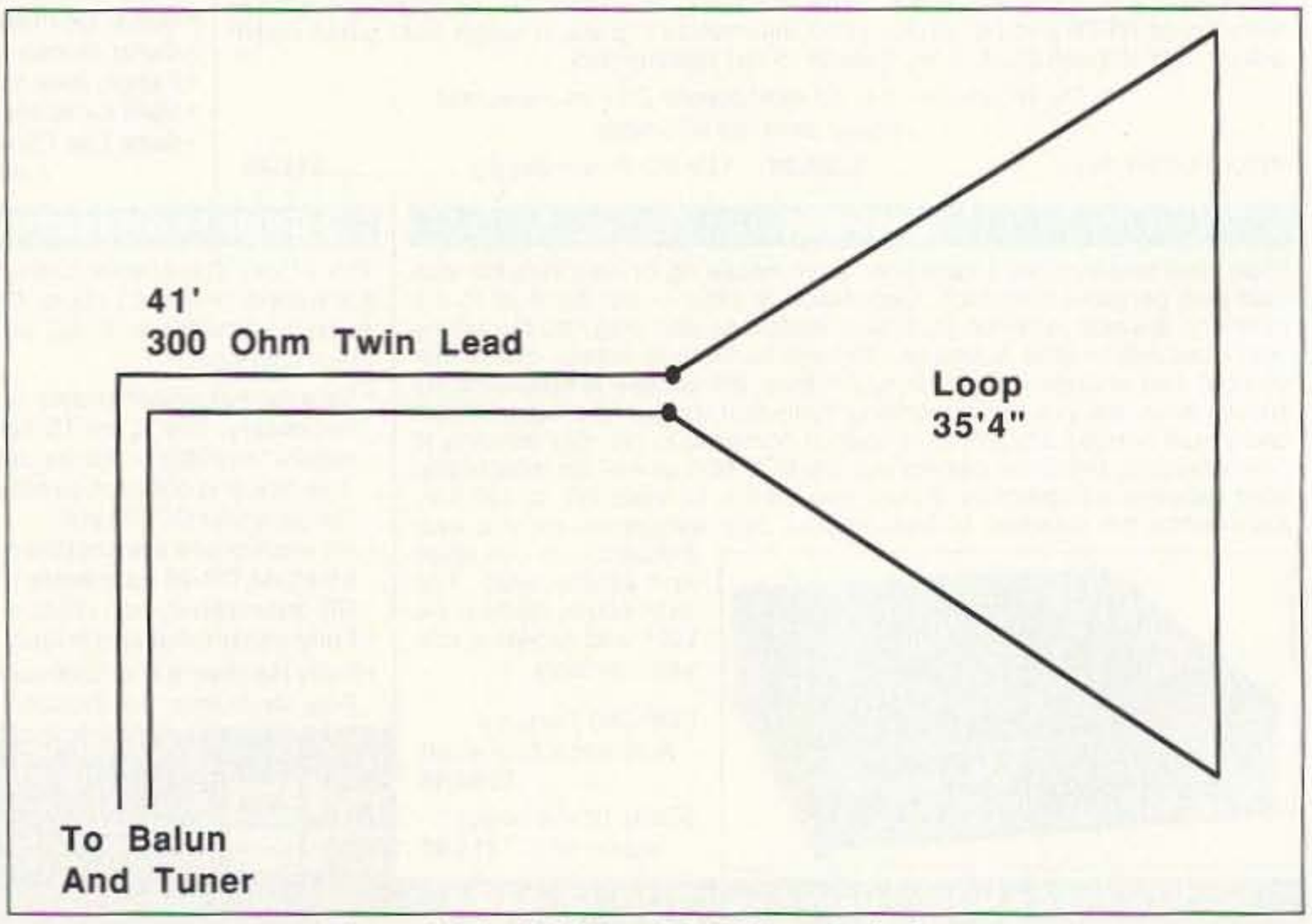


Figure 1. The Multiband Half-Wave Delta Loop.

Parts List

Quietflex #14 antenna wire	36'
Kilowatt 300 ohm twin lead	41'
Shrink tubing, 3/8"	1'
Shrink tubing, 3/16"	1'
Banana plugs	2
Dacron line	50'
Egg insulators	4

Note: All parts needed to build this antenna can be obtained by ordering the Multiband Half-Wave Delta Loop Experimenter's Kit from Antennas West, 1500 N 150 W, Provo UT 84604; Tel. (801) 373-8425. Introductory price w/shipping (40% discount for *73* readers): $24.

Tuning

There really isn't anything that you need to tweak on the MHDL. Sure, you could use a fancy antenna bridge to trim it for 20 and 10 meters once it's installed, but you've got to use a tuner for the other bands anyway, so why bother? For 20-10 meters, just connect it to the balun terminals and tune for minimum SWR with the lowest power you can (check for a clear frequency first), then look for a QSO. On 80 and 40 meters, plug both banana plugs together into the single-ended "wire" terminal on the tuner and connect it to the best ground you can get. For easy band changes, I keep my setting written on a card next to the tuner. It tunes quite broadly so one setting for each band gets me close enough to get started, and then touching it up is very easy.

Testing

Does it work? You bet it does! I've worked as far west as central Russia and as far east as Czechoslovakia, or is it the other way around? North to Alaska, and south to Argentina, New Zealand and Australia were also no problem. OK, OK! I know. The bands aren't as good as they used to be, but it still is a pretty good antenna for being in my attic and if you don't like it maybe the XYL can hang clothes on it—hey, wait a minute! I think I've got an idea. 73

The Improved Resonant Feedline Dipole

A compact, low impedance, end-fed HF antenna that needs no tuner!

by James E. Taylor W2OZH

The end-fed RASER antenna described in *73 Amateur Radio* (September 1992, pp. 8-14) utilized the RFD (Resonant Feedline Dipole) approach. This concept has drawn an enthusiastic response from hams throughout the country. It achieves an end-fed dipole, or a RASER, for any band desired *using a coaxial feedline and without a tuner*. It has been praised by many who have site restrictions which preclude the use of the customary dangling center feedline. A unique feature of these antennas is the use of the T-choke—eg.: a 13-turn coil of coax which is suspended at the input end of the radiator. If, however, you find such a coil cumbersome the present article offers help!

The RFD Concept

As mentioned in the previous articles, an obvious approach to the electrical isolation of the input end of the dipole might involve the use of a current balun. However, calculation showed that this direct approach would not provide sufficient impedance. At that time I chose to use the somewhat more bulky T-choke method of isolation. Nevertheless, the idea of making a more compact choke was rekindled when I found an article in my files by Joe Reisert W1JR (*Ham Radio*, September 1978, pp. 12-15). That article described "a new type of balun" which featured a high permeability toroidal core wound with coaxial cable using opposed windings for reduction of external field, as shown in Figure 1. Based upon that idea, I made a few comparative impedance calculations, which were encouraging. Experiments then led to a simple practical design in which the T-choke is replaced by a compact box.

I will describe the final design of the RFD antenna for the 80 meter band in some detail, and tabulate the results of the calculations in the "Calculations" sidebar. Also included is a tabulation of the calculated number of turns and lengths of the dipole halves for the other popular HF amateur bands.

The Design

In the previous design of the RFD the self-resonant T-choke served two related functions: It gave the high impedance required to isolate the end of the dipole, and it provided the reactance which tuned the system to resonance, thereby enabling an excellent impedance match to the feedline. In the Improved RFD design these functions are achieved by adding a fixed resonating capacitor in parallel with a winding of coax on a toroidal core, as in Figure 1. First, calculation shows that if we use the Type T-200-2 powdered iron core commonly used for baluns in this frequency range the inductance would be an order of magnitude lower than that for the T-choke. Even two such coils in series, tuned to resonance using a 264 pF capacitance, is lower by a factor of five. In spite of this I temporarily wound two 13-1/2-turn coils on these cores for preliminary experiments. The results confirmed the feasibility of the approach but the measured common mode current on the feedline was too high. (The MFJ H-field Antenna Probe is convenient for comparing these currents). However, during this test an important fact was determined—*in order to get the desired 1:1 SWR it was necessary to place a current balun in the line ahead of the tuned coils*. For this I used a 20-turn bifilar coil on a T-200-2 core. This current balun provides impedance balance relative to RF ground.

Further review of the Amidon data sheets indicated that we must consider ferrite material, which provides higher permeability, in order to get the higher inductance desired. However, this comes at the expense of some reduction in temperature stability. The FT-240-61 core was chosen for our desired power levels and frequency range. This core has an initial permeability of 125, and with a core o.d. of 2.4 inches it should handle a kilowatt of power without excessive heating. The calculation of inductance of a 12-turn coil on such a core gave a value of 25 microhenries—much greater than that of the powdered iron cores and even greater than that of the RFD T-choke. Since the loss resistance is roughly a factor of five less than that for the original RFD, the calculated prognosis for the Improved RFD is very promising! (See the Coil Tester comments at the end of this article.)

Construction and Adjustment

For the final coil I wound 6 + 6 turns of RG-8(M), field-opposed, on an Amidon Type FT-240-61 toroidal core (see Figure 1). This coil was mounted in a 6" x 3-3/16" x 1-7/8" plastic box along with the current balun referred to above and the two coax sockets, as indicated in Figure 2. For the

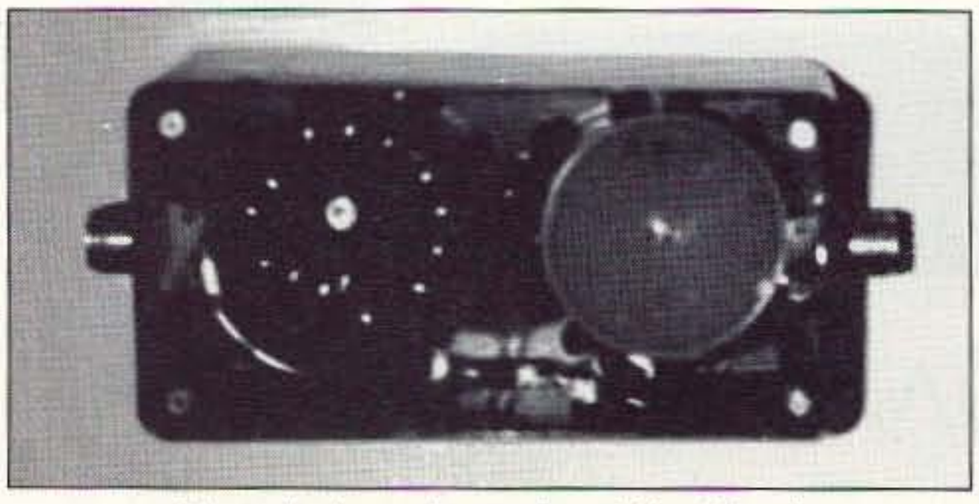


Photo A. An early version of the "box."

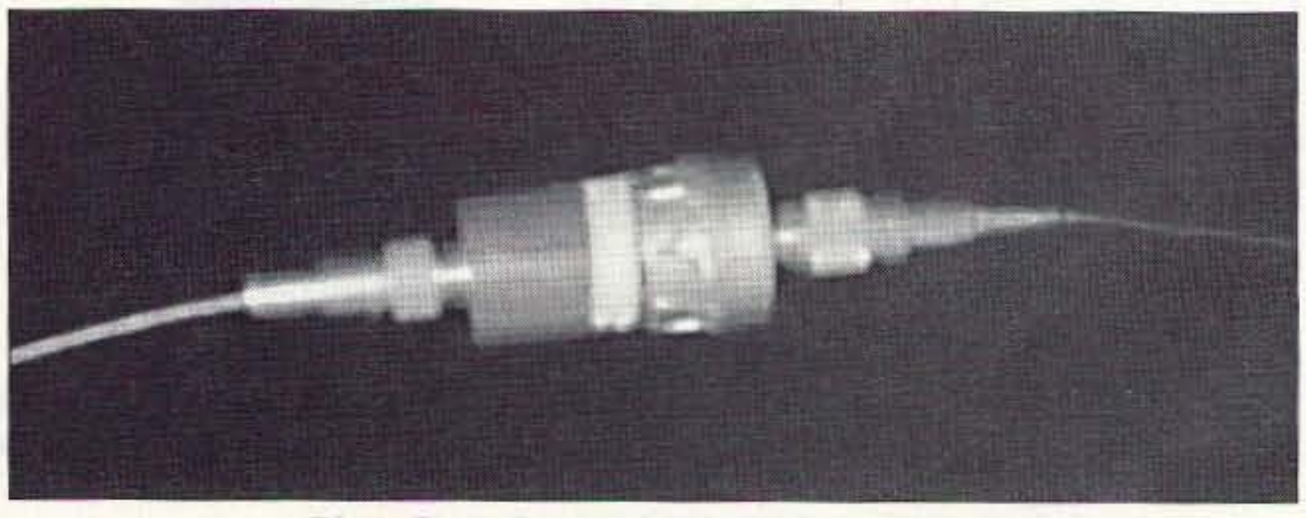
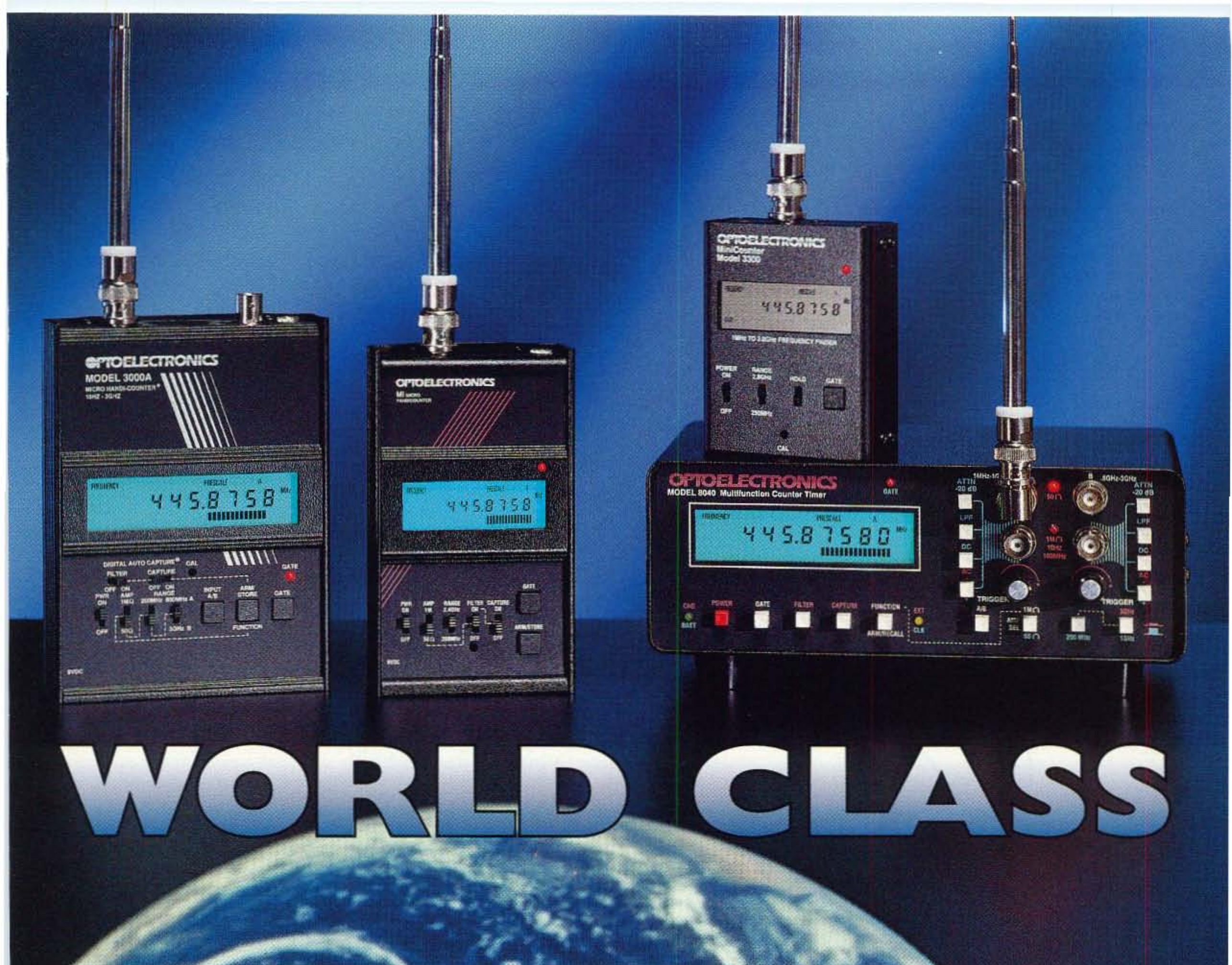


Photo B. A plastic pill bottle does the trick.



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simple bifilar current balun I wound 20 turns of sheathed bell wire on the T-200-2 core, shown schematically in Figure 3. The general packaging is shown in Photo A, which is of an early model. Figure 4 shows the schematic diagram of the circuit. The simplicity of the circuit is apparent—other than wire and coaxial cable fittings, there are only five parts!

I have found that a plastic pill bottle (the popular amber-colored cylindrical one with the locking cap) makes a very useful center insulator for this type of dipole. I mounted SO-239 sockets on the bottom and the top of the box. Connections are as indicated in Figure 5. Photo B shows this compact, rugged assembly. The unit can withstand a surprising amount of tension and the parts are conveniently disconnected, when desired. Figure 6 shows the complete antenna.

The only adjustment required was the choice of the tuning capacitance connected across the coil of coax on the ferrite core. I made a preliminary adjustment by using an air variable across the coil on the bench, and using the coil tester described at the end of this article. I then made the final adjustment with the antenna in place and with the plastic box lowered to stepladder height, using an SWR bridge to indicate 1:1 SWR. These adjustments agreed to within about 10%. The air variable was then replaced with fixed silver micas and the box was raised to normal height. (Since the voltage across this capacitor is high I placed two equal capacitors in series.) For my installation 50 picofarads (2 x 100 pF in series) brought the resonance within 15 kHz of the desired frequency of 3.953 kHz.

Photo C. The radiator, suspended by two 40-foot-high masts. The box is at the lefthand mast and the center insulator is near the righthand mast.

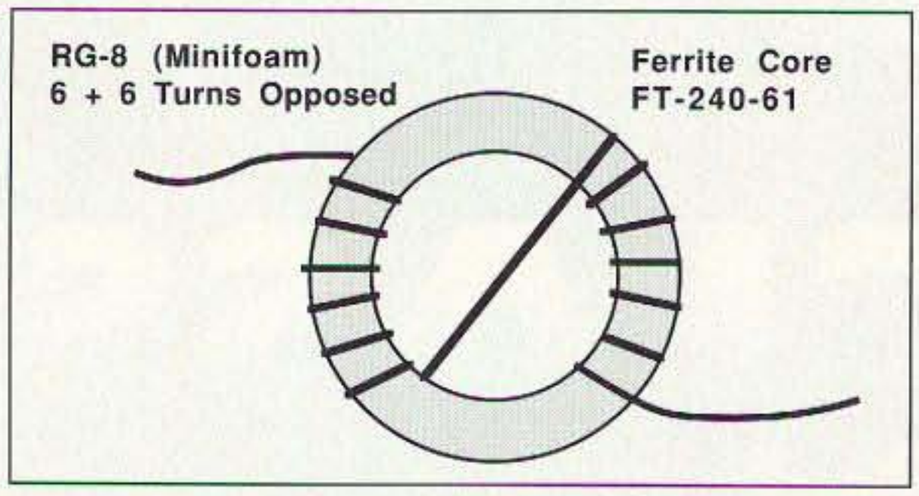

Figure 1. The Improved RFD Antenna's coil.

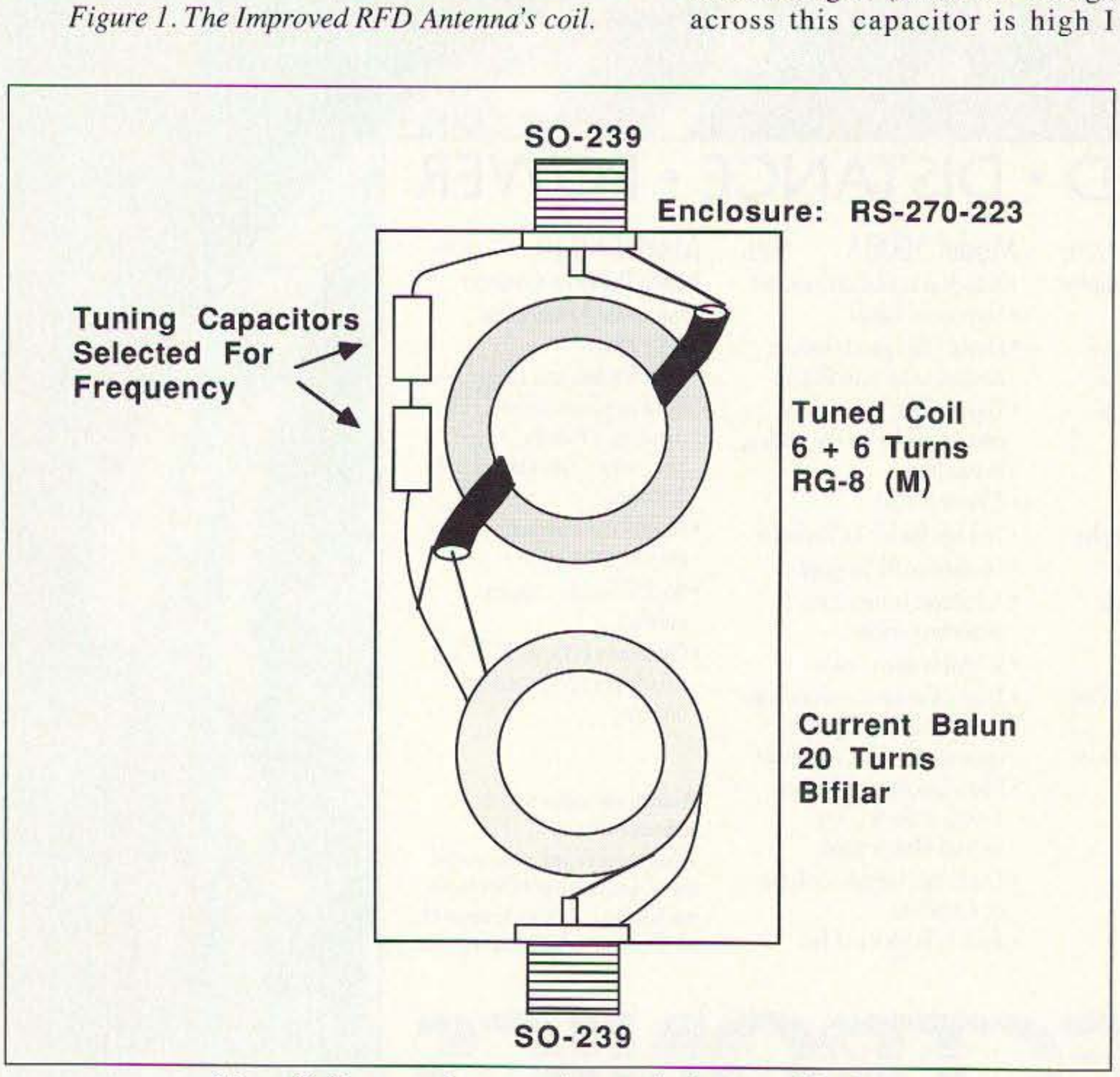

Figure 2. Connect the transceiver to the bottom of the box.

Results

The adjustment and operation of the Improved RFD Antenna on 80 meters was straightforward and satisfactory in all respects. The radiator was suspended between the two 40-foot-high masts which support the two RASER gain dipoles at W2OZH. This can be seen in Photo C, where the box is at the lefthand mast and the center insulator is near the righthand mast. The "terminator" half of the dipole slopes downward off of the photo to the right. (The segmented sections sloping out of the photo from the righthand mast are not part of this antenna system.)

It was interesting to observe the action of the tuning capacitor in limiting the shield radiation and matching the radiator to the feedline. The shield current was indicated by the MFJ H-field probe and the match was measured by an SWR bridge while turning the air variable capacitor. At resonance the shield current showed a sharp null. Also, the SWR was a flat 1:1 at a point slightly off

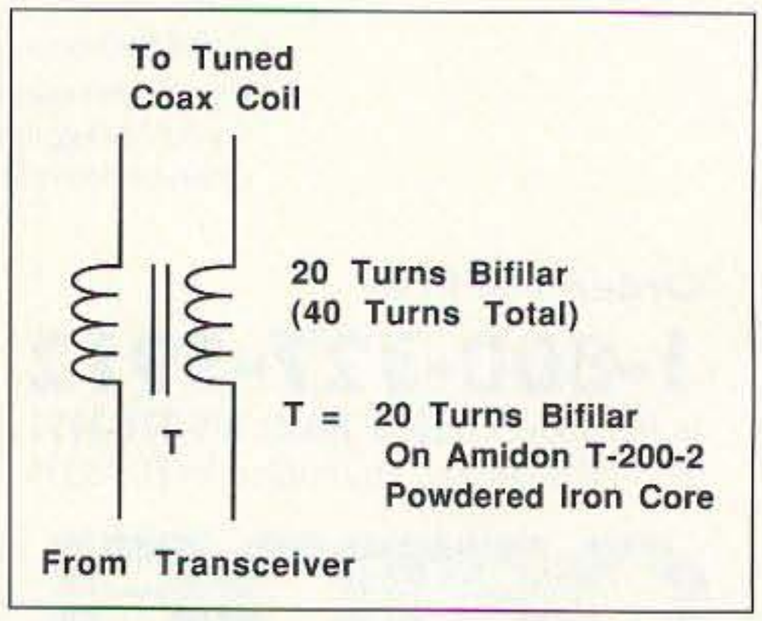

Figure 3. Schematic for the current balun.

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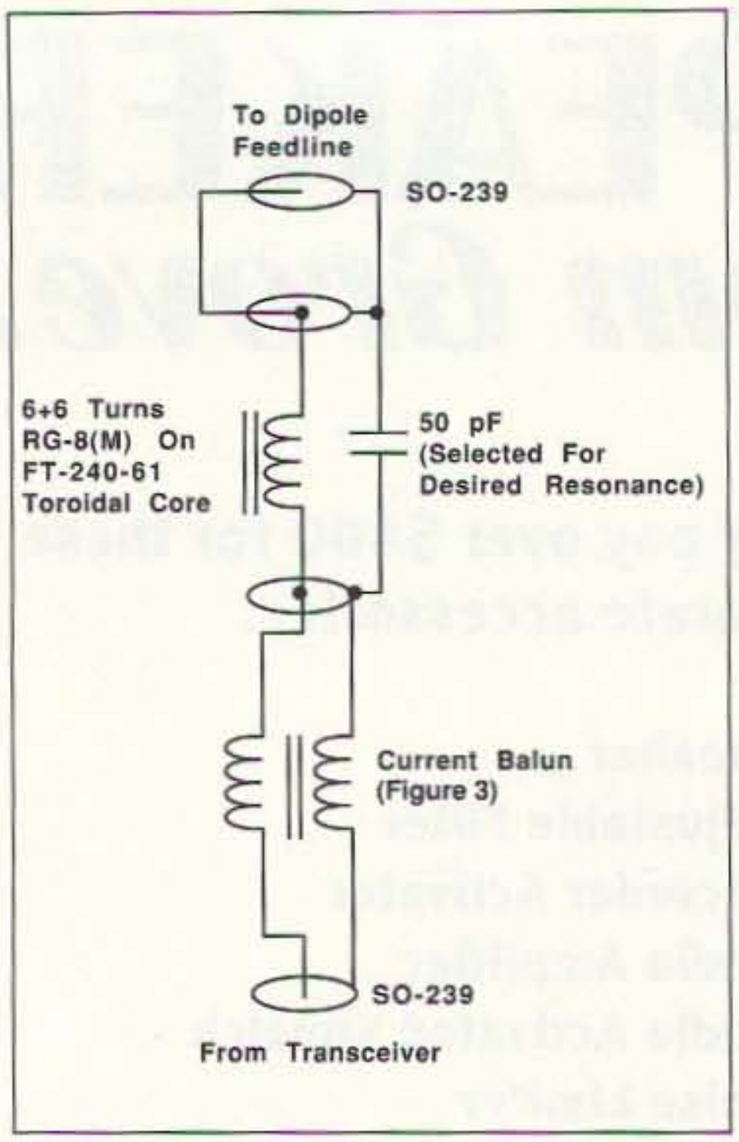

Figure 4. Schematic for the Improved RFD's box.

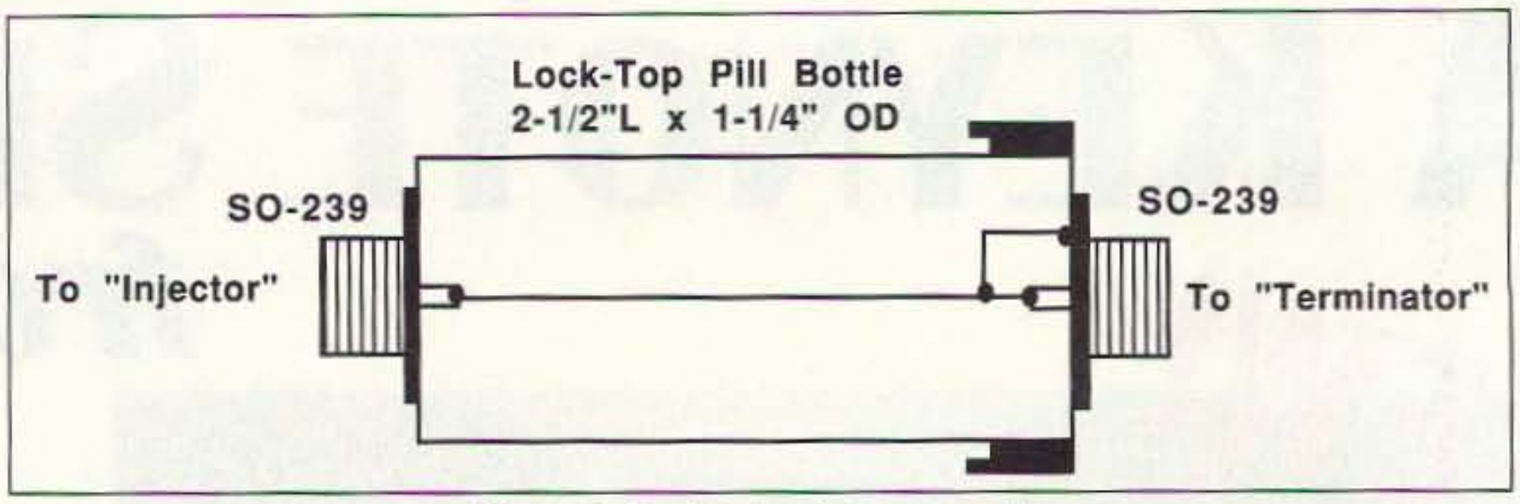

Figure 5. Center insulator assembly.

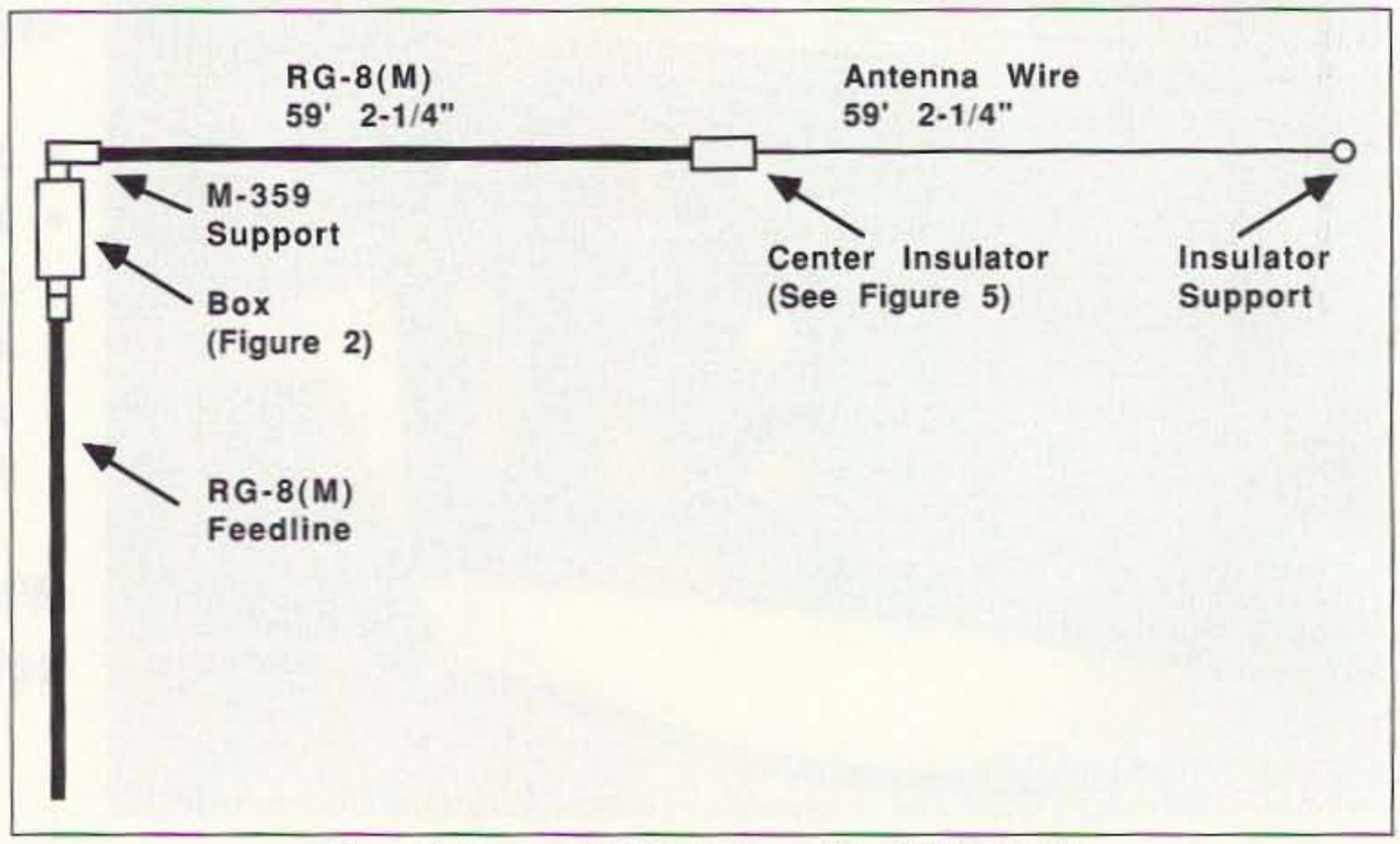

Figure 6. Improved RFD Antenna (for 3.9535 MHz).

Specifications for Other Bands

Band	Freq.	Turns	Dipole Half Length
160m	1.9	17	123'2"
80m	3.954	12	59'2"
40m	7.263	9	32'3"
20m	14.29	7	16'5"
17m	18.14	6	12'11"
15m	21.38	5	10'11"
10m	28.65	4	8'2"

Parts List

Description	Part Number	Optional Supplier
1 ferrite core	FT 240-61	Amidon Associates
1 powdered iron core	T-200-2	Amidon Associates
1 enclosure box	270-223	Radio Shack
1 plastic pill box	1-1/4" o.d., 2-1/2" H	Any pharmacy
Silver mica caps	Assorted (100/$5)	Fertik's, 5400 Ella St., Phila. 19120
Antenna wire	#14 stranded	Radio Shack
4 coax sockets	SO-239	Radio Shack
5 coax plugs	PL-259	Radio Shack
5 coax reducers	UG-176	Radio Shack
1 right angle conn.	M-359	Radio Shack
Coaxial cable	RG-8 (Minifoam)	Radio Shack
Twin bell wire	(Sheathed)	Any home supplier

Calculations

Item	Equation	Value
13 Turn T-Choke:	$L = a \times n^2 \times J =$	20 µH
	$Z_{i\ (OLD)} =$	$25 \times 10^4/R_{1\ (OLD)}$
2 x 13.5 Turn T200-2: (i.e. IRFD1)	$L = 10^{-4} \times N^2 \times A_L \times 2 =$	4.3 µH
	$Z_{i\ (RFD1)} = L/C \times R_1 =$	$2.4 \times 10^4/R_{1\ (IRFD1)}$
6+6 Turn FR-240-61: (i.e. IRFD2)	$L = 10^{-6} \times N^2 \times A_L =$	25 µH
	$Z_{i(IRFD2)} = L/C \times R_1 =$	$64 \times 10^4/R_{1\ (IRFD2)}$
Z Comparison:	$Z_{i(RFD1)}/Z_{i(RFD2)} =$	0.25
	$Z_{i(IRFD2)}/Z_{i(RFD1)} =$	12.5

resonance, as expected. Noise bridge measurements confirmed this resonant frequency and indicated an input of 52 ohms. The measured bandwidth of the system was 170 kHz between the "SWR = 1.2" points, which is very acceptable. The common mode shield current was appreciably less than for a standard well-balanced center-fed dipole. Stations worked reported no difference in signal strengths between these dipole antennas.

Conclusion

The Improved RFD Antenna is an end-fed dipole using coaxial cable without a tuner. It achieves the same advantages as the original RFD system, while replacing the T-choke coil with a compact box. It also provides a more convenient method of adjustment to resonance.

I wish to acknowledge the patience of the number of hams who gave signal strength comparisons which confirmed the viability of the design.

Coil Tester

Michael Covington (*73 Magazine*, Sept. 1990, pp. 48-51) described a simple coil tester which gives a direct measurement of the resonant frequency of a parallel-tuned coil. This tester, together with my Alfa digital multimeter (which measures frequency up to 20 MHz) gave a direct preliminary measurement of this antenna's tuned-coil frequency.

Core Kit

The two toroidal cores for the Improved RFD are available as a kit from Amidon at a reduced price of $12 by referring to this article. 73

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Over the past few months, we have looked at a few shareware programs for RTTY. This month, let's take a look at a commercial package—a package that offers quite a bang for the buck.

The program is BMK-MULTY, a PC program for running RTTY with an ordinary "dumb" terminal unit and an IBM-compatible computer. Developed by G4BMK, who has been writing RTTY software for many years, this program takes advantage of the processing power in the personal computer to integrate the functions of a terminal node controller into the software.

With this setup, some of the problems associated with the hardware of a TNC, such as extra RF noise, is eliminated. This presumes, of course, that your computer is adequately shielded. Since the computer itself is the TNC, communicating with the demodulator is integral to the system, eliminating concerns over internal baud rate, data bits, and the like.

Let's take a look at this package and see just what it can do. First off, as noted, it will run on just about any PC-compatible, from the oldest 8088 running at 4.77 MHz to the latest superhot screamer. Some highly intense modes, such as PacTOR and SSTV, however, may not run well on a slow machine. While not rated to run under Windows, some users have been able to make this work with a fast computer and full screen display.

I have alluded to the modes that BMK-MULTY supports, so I suppose I should give you some details. How about RTTY, CW, AMTOR and PacTOR, with a standard demodulator, such as the CP-1 we have been talking about, or a Hal ST-5 or ST-6, Flesher TU-170 or TU-470, iRL FSK-1000, Heath HD-3030, or even an old homebrew? There is even an extended audio package that includes an audio spectrum analyzer, with reception of HF WEFAX and SSTV.

A "Logger" module includes a callsign and QSO database, which operates within the communications program. Captured callsigns that are already in the database are so indicated, and a pop-up window is available to enter QSO data as needed.

Multi-sampling algorithms in both the RTTY and CW modes are used, to ensure the best possible reception under the most difficult conditions. The display can be configured to the user's preference, whether a split-screen display with separate receive and transmit windows, or a simulated teleprinter, with all combined in one display. Functions and features are accessed with function and ALT key combinations.

BMK-MULTY is the only commercially available software that I am aware of that implements AMTOR with a dumb terminal unit. While using advanced programming techniques, the program is capable of surpassing the performance of compromise designs within multi-mode controllers.

Another mode, PacTOR, combines the features of AMTOR and packet radio. Unlike straight packet, PacTOR, which is highly effective on the HF bands, runs at 100 or 200 baud, depending on the conditions. With data compression, PacTOR can achieve data transfer rates more than three times higher than AMTOR. With handling of the full ASCII character set, PacTOR allows full text, and even binary, data transfer, all with the lowest chance for error.

Now, I have indicated that BMK-MULTY works with almost any garden variety RTTY demodulator. But what about the ham who has invested in a multimode controller. Many RTTY-active hams no longer have an ST-6 on the shelf. Well, Schnedler Systems, the source for BMK-MULTY, has produced an adapter board for the AEA PK-232 which allows access of the modem section of the PK-232, bypassing the TNC and data processing logic built into the box. While this might seem like a step backward, the truth is that for the modes that BMK-MULTY supports, this really does create an enhancement.

The adapter itself is a small, "L" shaped printer circuit board that is installed as a pass-through device between the PK-232 and the computer. A short jumper connects to the "external modem" connector on the back of the PK-232, and inside the PK-232, shorting blocks are installed to change the logic of data flow. A push-button on the board sets things back to "normal" for conventional PK-232 operation, such as with packet.

Now, you can order all of this from Schnedler Systems, AC4IW, 25 Eastwood Road, P.O. Box 5964, Asheville, North Carolina 28813. The base communications package, which includes AMTOR, RTTY, CW, and the logger sells for $95. The base package plus PacTOR is $145. The base package plus the extended audio package is $140. And all three packages together go for $175. The PK-232 adapter board is $49. These prices are correct as of this writing, and do not include shipping. I would advise you to contact Schnedler Systems for current information on pricing, shipping and availability, letting them know, of course, that you read about it in *73* magazine's "RTTY Loop"!

Now, here's a follow up to material we've covered in recent months. I received an E-mail message from John Skubick K8JS via America On-line. Jack reminds us that computer ports are fairly standard. When looking at devices such as modems, TNCs, printers, and the like, if it can plug into the serial port of a PC-compatible computer and work, than this same hardware should work as well on an AMIGA computer, or any other computer that supports standard port pin assignments. Thanks to Jack for that tip, which he directed to me through Internet.

And, while we're on the subject of terminal units, here's a question received via E-mail on Delphi: Emory WA4TTO has been reading *73* magazine since 1976. Back in 1978 or 1979, he built a DT-600 demodulator, by Data Technology Associates, from scratch based on the documentation. He says that it far out-performed any other RTTY demodulator that he has been able to construct. Since he lost the documentation years ago, and someone disposed of his DT-600 when he was indisposed, he has been unable to duplicate the device. If there are any readers out there with information about this demodulator, we would love to hear from you, as would Emory, I am sure.

A brief note about the growing collection of RTTY programs available to the readers of this column: There are now five "RTTY Loop" disks, each one holding over 1.2 Mb of assorted stuff. A list of available programs is yours for a self-addressed, stamped envelope. I can E-mail you the list, as well. Just send me a message via CompuServe (ppn 75036,2501), Delphi (username MarcWA3AJR), America On-line (MarcWA3AJR), or Internet (MarcWA3AJR @aol.com). The plans are to upload the collections, as well, to the Delphi Radio SIG detailed last month.

I've waited until the end of this column to toot my horn. This month marks the beginning of the 18th year of "RTTY Loop." I guess it can vote now! I can't begin to tell you what it means to get the support I have been receiving for these many years. I look forward to your letters, your E-mail, your questions and your criticisms. I hope that we are able to spend more time together in the future, to explore the wide world of digital communications, here in "RTTY Loop." 73

Number 13 on your Feedback card

HAMSATS

Amateur Radio Via Satellites

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The Digital Satellites

Digital communication via the amateur-radio satellites has been around since the early days of packet-radio activity. Before the first ARRL (American Radio Relay League) Amateur Radio Computer Networking Convention in 1981 at the National Bureau of Standards in Gaithersburg, Maryland, AMSAT (The Radio Amateur Satellite Corporation) earmarked Special Service Channels (SSCs) on future high-orbit satellites for packet communications. Dr. Hank Magnuski KA6M, designer of one of the first packet digipeaters, was in charge of setting standards for SSC use. This came at a time when AMSAT was still recovering from the loss of Phase 3A in 1980, which was to be the first high-orbit, long-life hamsat. Phase 3A met a watery end when its Ariane Launcher failed to achieve orbit.

Packet operation through analog satellite transponders is comparable to direct user-to-user packet procedure. Early tests were made at 1200 bps (bits per second), but activity at 300 bps using HF modems was more reliable, due to the weak-signal nature of satellite communications at the time. The use of the analog transponder space for packet experiments was never popular. The store-and-forward potential of the AX.25 packet protocol was not addressed via the analog transponder system. A digipeater in space, or some other digital mailbox setup, was needed.

At the 1983 ARRL Amateur Radio Computer Networking Convention in San Francisco, Phil Karn KA9Q presented the paper "Modulation and Access Techniques for PACSAT," while Don Connors KD2S presented the "The PACSAT Project." Don's paper described the design goal of "total global access by all hams to a store-and-forward packet message handler" via satellite. He explained the need for packet satellites and characterized the on-board systems and technical parameters for the required equipment.

Phil's paper on modulation techniques, when viewed with Don's, laid down the blueprint for many of today's digital satellites, from frequency selection to modulation methods. It was shown that a form of phase-shift keying (PSK) would perform better than standard audio-frequency-shift keying (AFSK) on an FM carrier for packet-satellite downlinks. AFSK-FM has advantages that include cost, simplicity and easy Doppler tracking, but it has some tradeoffs. These include inefficient bandwidth usage and poor noise performance. Today we have satellites that use both types of downlink schemes. All are in low earth orbits.

In 1984 when UoSAT-OSCAR-11 (built by the University of Surrey in England) went to orbit, it carried the Digital Communications Experiment (DCE) which provides a proof-of-concept test-bed for PACSAT work. The experiment acts as a mailbox in orbit to try various digital communication software and to provide data on hardware survivability, current consumption and operational behavior in space. Only a small number of hams around the world are active as gateway stations through the DCE, but others can route their messages to these gateways for uplinking to U-O-11. The concept not only worked in 1984, but is still operational today. Messages can sometimes be seen between telemetry frames on the 145.825 MHz downlink at 1200 bps.

When Fuji-OSCAR-12 was launched in August 1986 from Japan, hams had their first opportunity to find out what PACSATs were all about. Whenever the "J" (2 meters up and 70 cm down) digital transponder was active, stations could access the mailbox and leave messages for hams next door or on the other side of the world. The system used FM for the uplink and PSK on the downlink. Signals were good but battery problems made continuous activity impossible. After only a day or two the system needed recharging with corresponding down periods and loss of all the messages in memory. Even with these difficulties, the open digital mailbox was an exciting packet experience. Fuji-OSCAR-20 was launched in February 1990 as a replacement for F-O-12. F-O-20 also has battery and heat problems requiring some downtime, but it is quite active today for those wishing to use an orbiting digital mailbox without special software.

In January 1990 the first batch of four Microsats were launched by an Ariane rocket as secondary payloads. Two new UoSAT's were also passengers. Sent aloft were UoSAT-OSCAR-14, UoSAT-OSCAR-15, AMSAT-OSCAR-16, DOVE-OSCAR-17, WEBERSAT-OSCAR-18 and LUSAT-OSCAR-19. Today A-O-16 and L-O-19 provide 1200 bps operation using FM up and PSK down. Special PC-based, broadcast-protocol packet software is required to communicate with these satellites. W-O-18, sponsored by Weber State University in Ogden, Utah, sends images in a special binary format. D-O-17, sponsored by AMSAT-Brazil (BRAMSAT), currently transmits telemetry that can be heard on 145.825 MHz FM. A standard amateur-radio TNC (Terminal Node Controller) in conjunction with a computer or terminal and an FM receiver can be used to see the data and messages from this hamsat. DOVE is also capable of speech, but has yet to fulfill its potential, due to minor hardware difficulties and software needs. Work continues on Dove's recovery. U-O-15 died shortly after launch and, although U-O-14 is currently in commercial service on non-amateur frequencies, it provided digital hamsat chasers their first opportunity to try 9600 bps communications with FM up and down, using the broadcast protocol.

AMSAT-OSCAR-21 provided the first operational German RUDAK system. RUDAK is a complex RISC-based (Reduced Instruction Set Computer) digital transponder. It can be programmed to accept uplinks of many types ranging from analog voice to high-speed digital data, with a corresponding wide range of downlink options. While it spends the largest percentage of its time in a voice transponder mode with a downlink of 145.987 MHz FM, it has also sent packet telemetry, WEFAX transmissions of uploaded images, and prerecorded voice messages. A-O-21 is a part of a Russian navigational satellite and another amateur-radio payload, RS-14. The voice uplink to A-O-21 is on 435.016 MHz.

Several other digital satellites have been launched in recent years. UoSAT-OSCAR-22 is used for 9600 bps operation as a replacement for U-O-14. The majority of the traffic on U-O-22 is terrestrial packet mail forwarding.

Kitsat-OSCAR-23 is another 9600 bps satellite with the highest orbit of the digital hamsats. This satellite was built at the University of Surrey in England but was sponsored by the Korean Advanced Institute of Technology (KAIST). Files found on K-O-23 include short text messages, utility software, picture files, music (midi) files, voice mail and even game programs. If it's digital, it's probably been sent via K-O-23. Kitsat-OSCAR-25 is almost identical to K-O-23, with a slightly lower orbit and more advanced hardware. Both satellites have on-board cameras for earth-imaging experiments.

ITAMSAT-OSCAR-26 is another microsat-style satellite. It was built by AMSAT-Italy. It currently uses 1200 bps with FM up and PSK down with the broadcast protocol. It can also operate at higher data rates when appropriate software is checked out. I-O-26 is fully capable of the popular FM-up/FM-down 9600 bps format of the UoSATs and Kitsats. In addition, a telemetry decoding program known as TLMDCITA is available from AMSAT-Italy.

AMRAD-OSCAR-27 was built by Interferometrics and the Amateur Radio Research and Development Co. (AMRAD of McLean, Virginia) in the Washington, DC, area. It is primarily a commercial microsat with amateur-radio capabilities. Most daytime operation is ham-related as a single-channel FM voice transponder with a 145.850 MHz uplink and 436.800 MHz downlink. It is capable of high-speed data operation experiments and is used on non-amateur frequencies as EYESAT to demonstrate the usefulness of store-and-forward commercial communications with low-orbit satellites. A telemetry decoder program is available from the AMRAD BBS at (703) 734-1387 or via anonymous ftp through the Internet at ftp.funet.fi or ftp.digex.net.

POSAT, sometimes called POSAT-OSCAR-28, is a UoSAT-based satellite from Portugal. Like A-O-27, it has commercial uses and shares its time in orbit between ham and industry-related activities. It has been operational on ham frequencies at 9600 bps.

Finding More Information on Digi-Sats

The unique types of digital hamsats in orbit require different hardware and software. It is beyond the scope of this introduction to detail all the requirements. Fortunately, there are several sources of information on how to get active via these satellites. AMSAT-NA has several books and software programs to provide advice on how to begin. The *Satellite Experimenter's Handbook* by Martin Davidoff K2UBC is published by the ARRL and provides good general information on satellites with specifics covering the amateur-radio satellites and packet satellites. *Decoding Telemetry from the Amateur Satellites* by G. Gould Smith WA4SXM gives in-depth coverage of telemetry systems on the amateur satellites, with emphasis on the digital hamsats. The *Pacsat Beginner's Guide* explains the methods of communicating with packet satellites and includes a disk containing the PC software for the broadcast protocol. "Getting Started in Amateur Satellites" is a VHS video tape from CQ Communications that covers all modes of satellite operation and includes demonstrations of the broadcast protocol via digital satellites. Tracking software is also available from AMSAT for most types of computers.

Many articles in *QST, CQ, 73 Amateur Radio Today, Worldradio, QEX, OSCAR News (AMSAT-UK)* and *The AMSAT Journal* (AMSAT-NA) have been written over the last 10 years describing past, present and future amateur-radio digital satellites. The January/February 1994 issue of *The AMSAT Journal* contained a complete *AMSAT Journal* index compiled by WA4SXM. Over 20 articles about digital satellites in a four-year period are noted. The "Hamsats" column in *73 Amateur Radio Today* has featured digital satellite updates several times. Note Table 1 for a current list.

Getting Started

There are several easy ways to get started with the digital satellites. If you have a Bell 202-style modem and can modify it for mark and space bit inversion, you can monitor U-O-11 on 145.825 MHz FM. The satellite sends ASCII data at 1200 bps. The continuous data and messages can be easily

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Table 1. Digi-sat "Hamsats" columns in 73 Amateur Radio Today.

received, and even captured for later study using a computer in conjunction with communications software that can work with the modem.

D-O-17's standard AX.25 packet downlink is also on 145.825 MHz FM. Power levels from the satellite are typically 10 times stronger than U-O-11 and can be heard on almost any antenna. Anyone who is currently active on VHF packet can hear the signals and see the resulting telemetry and messages on a CRT or other display device. For those who can capture the data to disk, programs are available to decode the data and display information on the satellite's activities and health. One program available from AMSAT-NA for $20 is TLMDC-II. All of the data channels can be decoded and examined with this program.

The Russian *Mir* space station has a packet BBS (Bulletin Board System) on 145.55 MHz. Like *DOVE*, the downlink is AFSK FM and is compatible with a standard TNC, but is fully interactive like a terrestrial packet BBS.

When the space shuttle takes SAREX (Shuttle Amateur Radio EXperiment) to orbit, one mode of operation is the packet ROBOT. The downlink is 145.55 MHz, but unlike *Mir*, the uplink is different. Earthbound stations must transmit on 144.49 MHz to connect to the SAREX TNC.

Table 2 is a list of the digital-ready hamsats. The list is not complete, but shows the principal activity of each satellite and typical frequencies of operation. For 1200 bps FM/PSK operation, a special modem is needed in addition to the usual TNC, computer, radios and software. These PSK modems are available from Tucson Amateur Packet Radio Society (modem kit), PacComm (add-on modem), L. L. Grace Communications Products (DSP unit) and others. For 9600 bps activity, a high-speed modem is required, along with some modifications to the TNC, transmitter and receiver. High-speed modems and complete 9600-bps TNCs are also available from TAPR (kit), PacComm (add-on modem), Kantronics, AEA (DSP unit) and L. L. Grace (DSP unit). Some devices, like the DRSI DPK-9600 TNC, are much more difficult to properly interface for satellite work, due to their emphasis on terrestrial-style hardware compatibility.

Satellite	Uplinks	Downlinks	Current Activity and Notes
U-O-11		145.825	1200 bps ASCII (Bell 202)
		435.025	
		2401.500	
U-O-14			9600 bps commercial service
A-O-16	145.900	437.051	1200 bps FSK/PSK "PB"
	145.920	437.026	PB call = PACSAT-11
	145.940	2401.143	PG call = PACSAT-12
	145.960		
D-O-17		145.825	1200 bps FSK AX.25 data
		2401.220	
W-O-18		437.075	1200 bps PSK binary data & pix
		437.100	
L-O-19	145.840	437.150	1200 bps FSK/PSK "PB"
	145.860	437.125	PB call = LUSAT-11
	145.880		PG call = LUSAT-12
	145.900		
F-O-20	145.850	435.910	1200 bps FSK/PSK AX.25 BBS
	145.890		
	145.910		
A-O-21	435.016	145.983	FM Voice transponder (see text)
U-O-22	145.900	435.120	9600 bps FSK "PB"
	145.975		PB call = UOSAT5-11
			PG call = UOSAT5-12
K-O-23	145.850	435.175	9600 bps FSK "PB"
	145.900		PB call = HL01-11
			PG call = HL01-12
K-O-25	145.870	436.500	9600 bps FSK "PB"
	145.980	435.175	PB call = HL02-11
			PG call = HL02-12
I-O-26	145.875	435.867	1200 bps FSK/PSK "PB"
	145.900	435.822	PB call = ITMSAT-11
	145.925		PG call = ITMSAT-12
	145.950		
A-O-27	145.850	436.800	FM Voice transponder (see text)
P-O-28	145.925	435.250	9600 bps FSK "PB"
	145.975	435.275	PB call = POSAT1-11
			PG call = POSAT-12
MIR	145.550	145.550	1200 bps AX.25 BBS
SAREX	144.490	145.550	1200 bps AX.25 ROBOT

Table 2. The Digital Hamsats' current activity. Primary downlink frequencies (MHz) are shown first. All uplink frequencies are simultaneously active.

The Future

More digital hamsats are on the way. Some are based on the microsat bus, like UNAMSAT from Mexico, while others are being designed around the UoSAT structure. Data rates are expected to increase to 38.4 kbps and beyond, and higher frequencies will be more common. Digital compression techniques and immense satellite on-board memories will allow larger files and even digital full-motion video experiments. PACSAT was only an idea in the early 1980s. Today it has many forms and has become the dominant low-earth-orbit hamsat. Commercial and government interest in small digital-ready satellites has expanded dramatically since the launch of the microsats in early 1990. This has caused competition for "leftover" space on launchers, but can also be seen as recognition for a pioneering effort that was begun in the amateur-radio community. 73

CARR'S CORNER

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Dumping AM BCB Interference

The AM broadcast band (AM BCB) runs from 540 kHz to 1700 kHz. (You read right: The FCC raised the upper limit from 1600 to 1700 kHz not long ago.) Most stations are local, and relatively low-power. A few stations are large regionals or clear-channel 50,000 watt blowtorches. Because AM BCB stations are largely local there are lots of them, so it's a pretty safe bet that many, perhaps most, ham operators are close to at least one station. When I was a recent graduate from Novice ranks, a friend of mine, the late Johnnie H. Thorne K4NFU, lived across the street from WARL in Arlington, Virginia. The station operated with 1,000 watts on 780 kHz. The fifth harmonic of 780 kHz landed right in the middle of the 75 meter phone band. So what?

If you are any distance at all from an AM BCB, there is practically zero chance that a fifth harmonic will be found. Right? After all, AM BCB stations are regulated a lot heavier than ham stations. While we need to keep our harmonics -40 dB down from the carrier, AM BCB stations are typically -60 dB down, or more. One AM BCB engineer showed me spectrum analyzer reports from a consulting engineering firm that showed the second harmonic down -85 dB from the carrier, and the higher order harmonics even lower. So what's the big deal?

Well, it seems that any time a strong RF signal of any frequency is present at the input of a radio receiver, it is possible for the signal to bust through whatever front-end tuning or bandpass filtering exists to overbias the input device (transistor, IC, tube), and cause it to go nonlinear. In this condition, a harmonic-free signal from the AM BCB station will *generate harmonics in the receiver.* K4NFU's station receiver at the time was a late 1950s vintage Hammarlund HQ-110 which, by all reports, was at least a decent receiver, if not spectacularly so. But when the receiver was located only 100 yards from the WARL antenna, it overloaded and produced harmonics well past the 40 meter band. The solution to the problem is to put either an AM BCB high-pass filter in line with the antenna, or to put a specific frequency parallel resonant wavetrap (tuned to the offending station's frequency) in line with the signal line. Alternatively, a series-resonant trap across the signal line could be used. In either case, the offending signal is attenuated seriously.

AM BCB Wavetraps

Two simple wavetraps are shown in Figure 1, while a "universal" printed circuit board for these circuits is found in Figure 2. (These Universal Wavetrap boards are available for $4 plus $1.50 S & H per order from FAR Circuits, 18N640 Field Court, Dundee IL 60118.) The circuit in Figure 1A is parallel resonant, so is placed in series with the signal line between input (J1) and output (J2). This is done because a parallel resonant circuit has a high impedance to its resonant frequency, and a low impedance to all frequencies removed from the resonant frequency by more than a little bit. Thus, your HF ham band signal will pass through with little attenuation, while the offending AM BCB signal is blocked.

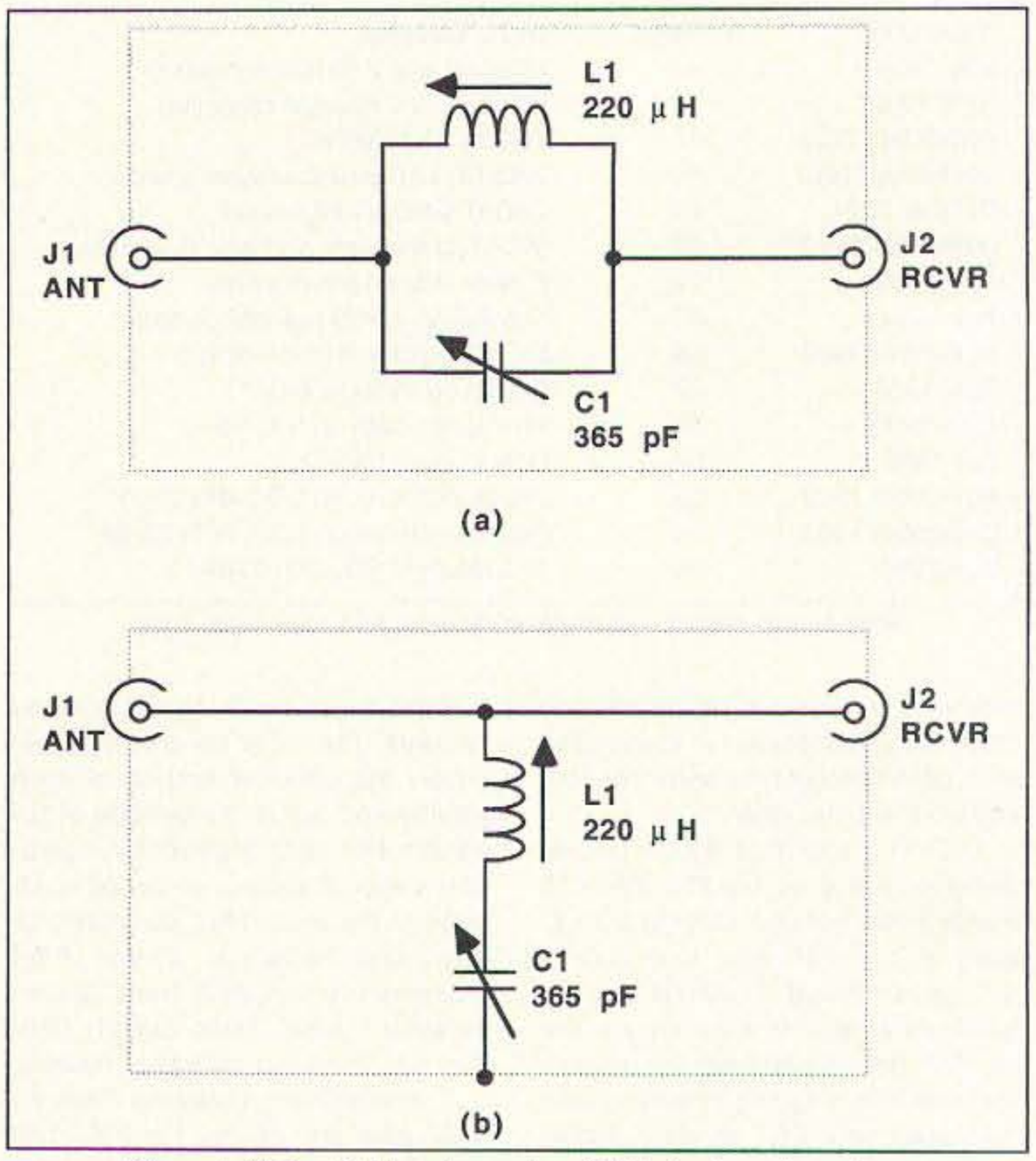

Figure 1. A) Parallel-tuned wavetrap. B) Series-tuned wavetrap.

The version in Figure 1B is series resonant, so it is placed in parallel with the signal line. Series resonant signals have a low impedance to the resonant frequency, and a high impedance to frequencies removed from resonance.

In both cases, we use a 220 µH slug-tuned coil and a 14-365 pF variable capacitor. The capacitor can be a standard single-section "broadcast variable." These capacitors are a little hard to find in the USA (although not in England), but Ocean State Electronics [POB 1458, 6 Industrial Drive, Westerly RI 02891; (401) 596-3080 (voice), (401) 596-3590 (FAX) or (800) 866-6626 (orders only)] has several offerings in their catalog. Order No. BC-14400; it is a 14-365 pF model.

The printed circuit board can be used either with the off-board broadcast variable capacitor, or with a trimmer capacitor and as many disk ceramic capacitors as needed to achieve the required capacitance. If you elect to use on-board capacitors, then note that C1A is a trimmer capacitor, while C1B, C1C and C1D are as many fixed disk ceramic capacitors as are needed to make the correct capacitance. The capacitors selected are the SG-series from Digi-Key (POB 677, Thief River Falls MN 56701-0677; (800) 344-4539). The SG-3014 is a 10-180 pF trimmer. In most cases, not all capacitor slots on the board will be needed.

The inductor on the printed circuit board could be a toroid inductor, al-

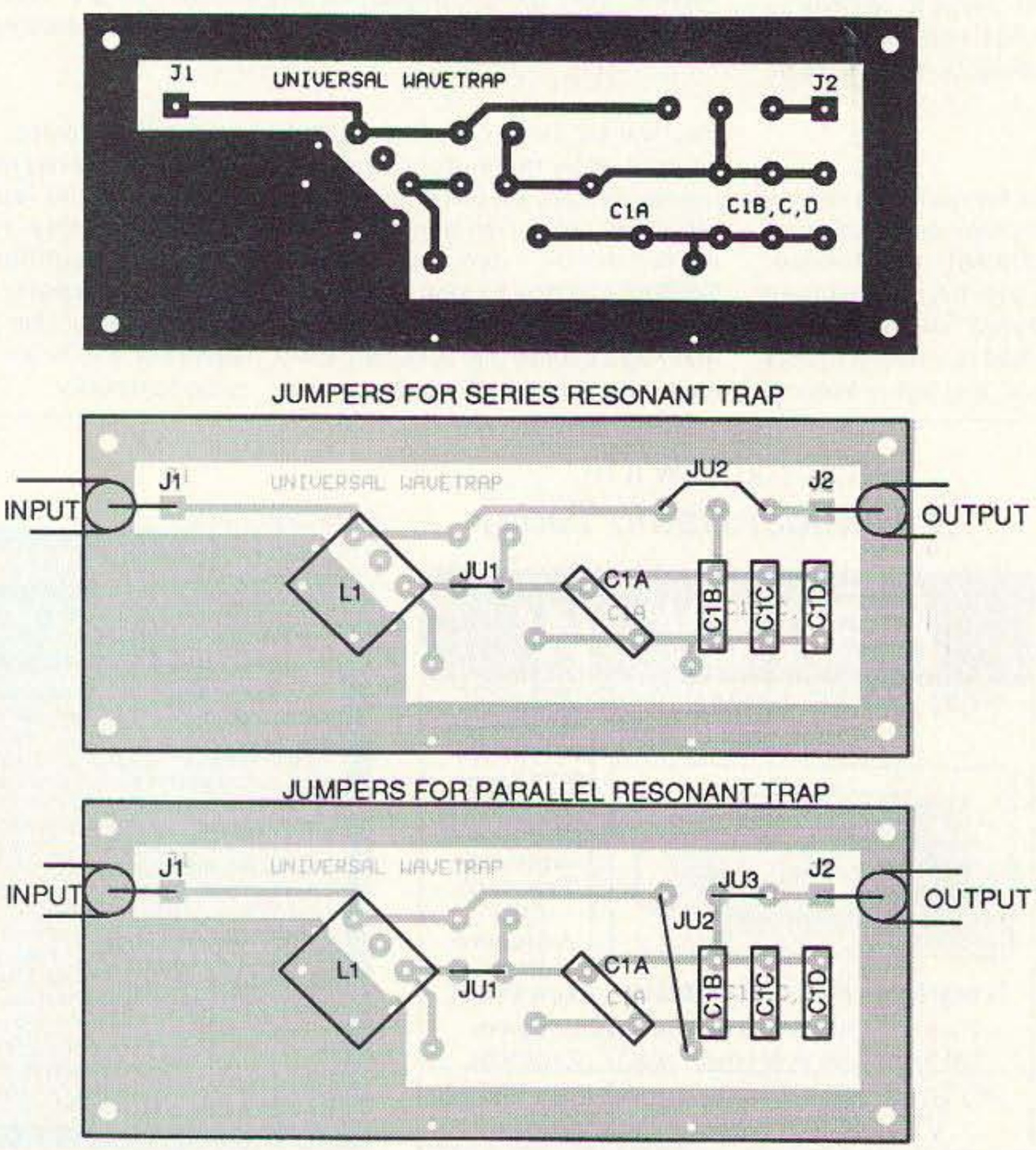

Figure 2. A) Printed circuit layout for Universal Wavetrap; B) jumpers for series resonant trap; C) jumpers for parallel resonant trap.

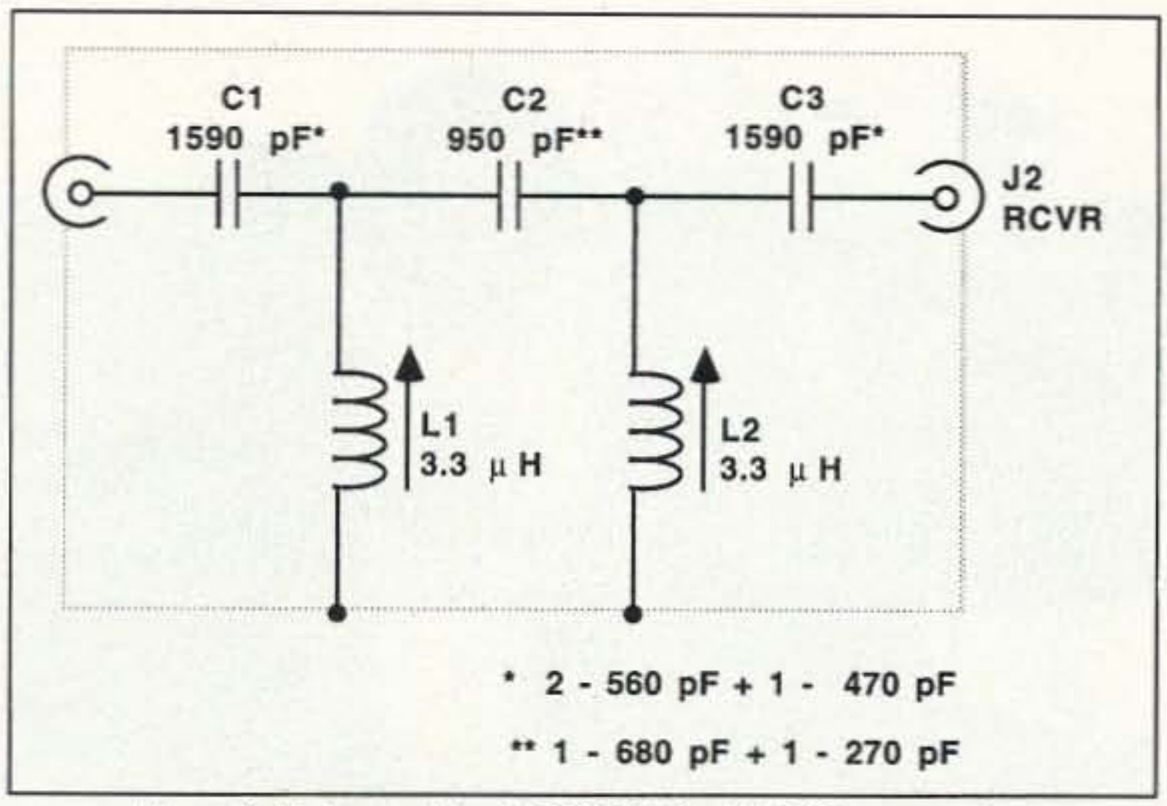

Figure 3. High-pass filter (1,900 kHz) for AM BCB suppression.

though the number of turns may prove excessive for some of us to wind. The particular pattern, however, is for a Toko-brand slug-tuned coil. In the Digi-Key catalog, these are the 10 mm size coils (e.g. 10EZ, 10EZC, 10EZH, etc.). For example a Digi-Key cat. no. TK-1223 is a 220 µH type 10EZ coil.

High-Pass Filter Approach

The alternate approach is to use a high-pass filter between the antenna and the receiver antenna terminals. The filter should be as close as possible to the receiver antenna terminals. In a transceiver, the filter may have to be inside the rig's case unless, you have one that permits a separate receive antenna.

The circuit for the basic filter is shown in Figure 3; the printed circuit board in Figure 4. The capacitor slots on the printed circuit board are designed for a variety of different types of capacitor: disk ceramic, silver mica, polyethylene, and other forms. That's why there are four sets of holes each for C1, C2 and C3. In most cases, you will have to mix and match the capacitors to make the desired values. The 1590 pF capacitors (C1 and C3) are made from two 560 pF and one 470 pF capacitor; C3 (950 pF) is made from one 680 pF and one 270 pF capacitor. The inductors could easily be toroid inductors. A T-37-15 (RED/WHT) toroid requires about 19 turns of enameled wire to make the required inductance. As before, however, the printed circuit holes are designed for a shielded Toko coil (e.g. Digi-Key TK-1414). Builders can buy the Universal High-Pass Receiver Filter boards for $4.50 plus $1.50 S & H per order from FAR Circuits (see address above).

The components for the filter in Figure 3 are intended for a cutoff frequency of about 1.9 MHz, which means that signals in the AM BCB are attenuated. However, the printed circuit board and basic design can be used for any cutoff frequency desired from VLF to VHF. Just calculate the values for the frequency you want to use as a cutoff.

The component values for the filter were calculated using the "ANTLERS for Windows" software. This software package is designed to calculate antenna lengths, but has a "Tuning Circuits" function in which one of the menu items is "Filters." Both high-pass and low-pass cases are covered. "ANTLERS" can be used to calculate the values for filters up to 30 MHz, in case you want to make one other than 1.9 MHz.

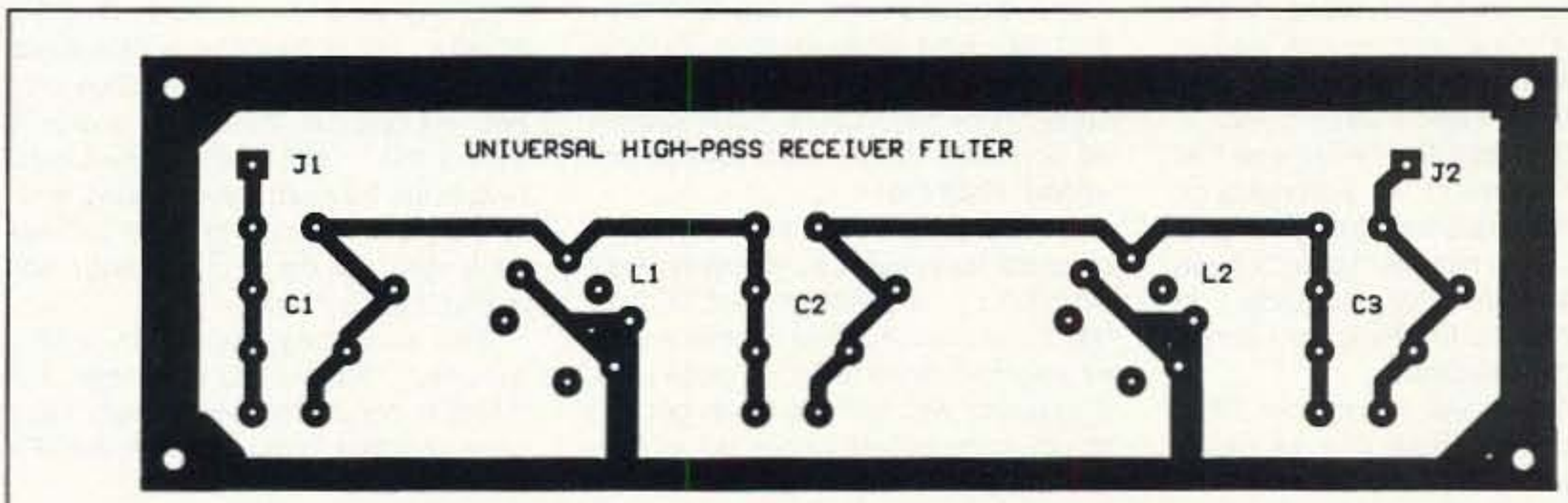

Figure 4. Printed circuit board for Universal High-Pass Receive Filter.

"ANTLERS for Windows" Software

"ANTLERS" has the following functions: HF antennas (3–30 MHz), VLF-MW loop antennas (10–7,500 kHz), low frequency antennas (500–7,500 kHz), VHF/UHF antennas (30–2,000 MHz), and Tuning Networks (10 kHz–30 MHz).

Antennas covered in the HF function include: half-wavelength standard dipole, folded dipole, inverted-vee dipole, G5RV, off-center-fed doublet (OCFD), Windom, double-extended Zepp, Franklin array, Lazy-H, one-wavelength loop, half-delta loop, two-wavelength bi-square loop, quarter wavelength verticals, half-wavelength verticals, five-eighth wavelength verticals, three-element yagi beam, two-element quad, phased vertical array, bobtail curtain, and Thorne array. The lengths of the elements and any matching sections are included.

In the loop antenna function, the program calculates inductance of a loop of "A" side length and "B" depth, as well as the capacitance needed to resonate the loop to a specific frequency. Square, triangle, octagonal and hexagonal loop shapes are covered.

The low-frequency antennas function works to 7,500 kHz, so it is useful to hams on 160m, 75/80m and 40m. It includes the simple dipole, the inductively-loaded dipole (two cases: inductors at the feed point and inductors in the center of each element), the twin-lead tee antenna (TLTA), and the loaded discone (or "dippy discone," as some call it).

In the VHF/UHF function, the program calculates the element lengths and matching section lengths (if used) for all three dipoles also used in the HF region (see above), quarter wavelength verticals, 5/8 wavelength verticals, three-element and six-element yagis, and two-element and three-element quads.

In the tuning networks function, "ANTLERS for Windows" calculates the number of turns needed to achieve a desired inductance on a toroid coil form, the resonance of an LC circuit (when C is known or when L is known), and filters (LPF and HPF cases). It will also calculate the component values for antenna tuning units, or impedance matching networks if you prefer, such as inverted-L section, L-section, reverse-L section, pi-network and the split-capacitor network.

In all cases, information is available for the specific type of antenna being calculated. The program uses scroll bars to input data such as frequency, inductance, and so forth (as needed).

"ANTLERS for Windows 2.00" can be obtained from me for $30 postpaid at P.O. Box 1099, Falls Church VA 22041. 73

Number 15 on your Feedback card

HAMS WITH CLASS

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

Up! Up! And Away!

When the invitation first arrived to attend the launch of the space shuttle *Endeavour's* mission STS-59, I was, of course, ecstatic for the entire first week of April. There are few things in life that are quite so exciting as watching the 122-foot-long orbiter lift off like a rocket, orbit like a spacecraft and return to earth on a landing strip like a glider.

This invitation from Mission Specialist Jay Apt N5QWL was especially exciting because I was able to bring guests with me. After my own two children nose-dived across the room at me for the invitations, I decided to make this into an incredible opportunity for some lucky student in my ham radio program.

I ran a contest for my sixth-, seventh- and eighth-graders. They were asked to write an essay, describing why they should be chosen to attend the launch. Hundreds of children put their feelings about the Space Program down on paper. They were all wonderful. It was great to see such enthusiasm. Usually, when someone mentions that they've visited a special place near Orlando, the other kids assume it must have been Disney World.

One of my eighth-grade young ladies, Renée Hoehn KB2QMR, was chosen to go. Renée participated in last year's Ocean Challenge and has spoken to several of the astronauts on the CQ All Schools Net during the past two years. She has expressed a keen interest in all the space projects I do with the children. Renée is considering becoming an astronaut.

Both Renée and her mother Ellen were in constant touch with me as the big day grew near. The entire school got involved with our trip. Children who aren't even in my program were stopping by to ask questions about the *Endeavour's* mission. So much interest and enthusiasm was generated that it really became a school-wide event. Long computer banners were hung in the hallways, wishing us a good trip. Renée became somewhat of a local celebrity, and her eagerness was contagious. She was only too happy to share her expectations with the ham radio operators she spoke with on our school radio station.

The Launch

On April 6th we left for Florida with the best wishes of the student body and staff of Intermediate School 72 in Staten Island, NY. Everyone really seemed to be proud that two representatives of our school would be there in person to witness this spectacular event.

The *Endeavour* had its share of setbacks getting launched. On Friday, April 8, we were up at 3:30 a.m. to enjoy breakfast together and to get over to the Kennedy Space Center to see the sun come up over the shuttle on the launch pad. It was positively awe-inspiring.

It was so incredible to be part of the group of onlookers with cameras and binoculars poised and ready for the big moment. There was definitely something surrealistic about the early-morning scene. We even got to meet some media people from Germany that day who were making a documentary movie. NASA and the space agencies of Italy and Germany provided the $366 million radar equipment aboard *Endeavour*.

The sky, however was definitely overcast that day. "Everything in every direction . . . is solid overcast," Robert "Hoot" Gibson reported from a weather airplane more than an hour after *Endeavour* was to have taken off. The clouds parted slightly later, but as they did, dangerous winds kicked up across a nearby runway where the shuttle would try to land in case of an emergency shortly after liftoff. "It would appear we've traded one vagary for another," launch commentator George Diller said at the Kennedy Space Center.

Photo A. Left to right: Renee KB2QMR, Mrs. Hoehn, Carole WB2MGP, and Lori KA2TCC (Carole's daughter), early in the morning at the launch site.

We listened carefully to the live broadcasts over the speaker system at the viewing site. They spoke about the backgrounds of the six astronauts on board. We listened especially attentively to the plug for amateur radio when they spoke about Dr. Jay Apt N5QWL and Dr. Linda Godwin N5RAX. Jay is the Mission Specialist. He is the Commander of the Blue Shift and will operate the shuttle systems during the "night" shift, while Linda, who is the Payload Commander, is responsible for overall operation of three large radars in the shuttle's cargo bay during the "day" shift.

The secondary payload is Shuttle Amateur Radio Experiment, or SAREX. Nine different schools have been selected to participate in SAREX for this mission.

Saturday morning, April 9, at 7:05, all conditions were perfect for liftoff. Renée's mom said that the shuttle seemed to "glow magnificently as it lifted off into the sunrise. As the final rocket boosters separated and fell into the water, they looked like falling stars." For days afterwards both Renée and her mother said that viewing the liftoff of the *Endeavour* was "the experience of a lifetime."

When we returned to school everyone was eager to hear about what we had seen. I commandeered Renée to speak to several of my ham radio classes. I smiled to myself as she described the sounds and feelings of the moment of liftoff. All the children wanted to know what it sounded like. Renée described it as being like "millions of firecrackers going off at the same time."

One of the many nice things about being a teacher at a time like this is that an incredible, out of the ordinary, experience such as witnessing a shuttle launch can be shared with so many children. It adds a new meaning to "show and tell." 73

QRP

Number 16 on your Feedback card

Low Power Operation

Michael Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

More Modifications

If the DX is not running and the bands seem dead, what do you do? Well, you could do like Scott N8JSK does and raise aphids, or you could heat up the soldering iron and make some modifications to your equipment.

This month I've got several modifications for you. The first deals with the very popular MFJ QRP rigs.

MFJ QRP Rigs

The first production run of these nifty little rigs suffered from low audio gain. The poky LM386 audio power amplifier was again pressed into use. In the MFJ 9020, the LM386 is supplied with its operating voltage from the rig's main voltage regulator. In the case of the 9020, the regulator is an LM317. The output of the regulator is set for 10.5 volts. This is the voltage the rig runs on, with the exception of the final RF output transistor. Since the audio amplifier is also being powered by the 10.5 volt VCC, its output runs lower than usual. The fix is simple. All you have to do is rewire the VCC run so the LM386 is supplied by the unregulated side of the LM317. The extra 2 volts or so really makes an improvement in gain.

Don't try to adjust the LM317 for a higher output—you'll screw up some of the other circuits that require the 10.5 VCC. Also, since the LM317 requires at least 2 volts over the regulated output, you'll lose regulation of the VCC line. Figure 1 shows how simple this is to do: Cut a trace on the PC board and run one wire. That's all there is to it.

MFJ made this modification to later production runs of the rigs. If you're not sure if yours has the modification, check pin #6 of the LM386 with your VOM. If the VOM says 10.5 volts, then the modification has not been done. If the VOM reads the supply voltage, say 13 volts, then the modification is factory-installed.

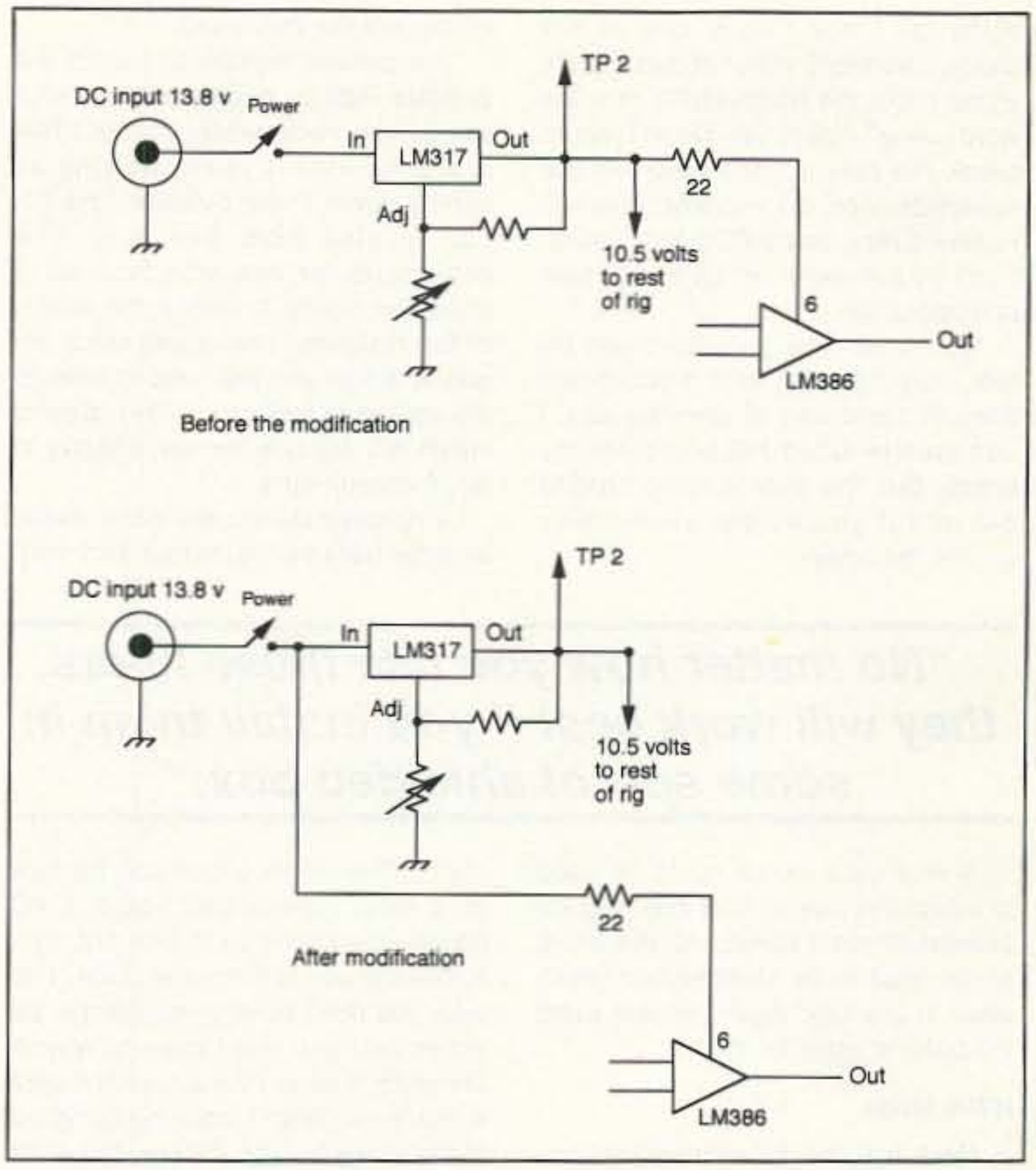

Figure 1. Modification to correct low audio gain in some MFJ QRP Rigs.

New Front End

Although you can't really call this a modification, the circuits shown in Figure 2 may improve the performance of your receiver. The values are for the 40 meter band. The circuit at the top seems to work the best for me. I'd recommend it over the other one, but that, too, works quite well. Use the cores specified in the schematic. The variable capacitors are Arco trimmers. I used hamfest junk box units in my project.

For transceiver operation, you must break the connection between the receiver and the transmitter. Insert the filter in the receiver's antenna line only. If your transceiver has diode switching, with a pick-off from the transmitter's output filters, you may have to play with the values of the filter's components. I find this circuit really keeps the unwanted critters out of my direct conversion receiver.

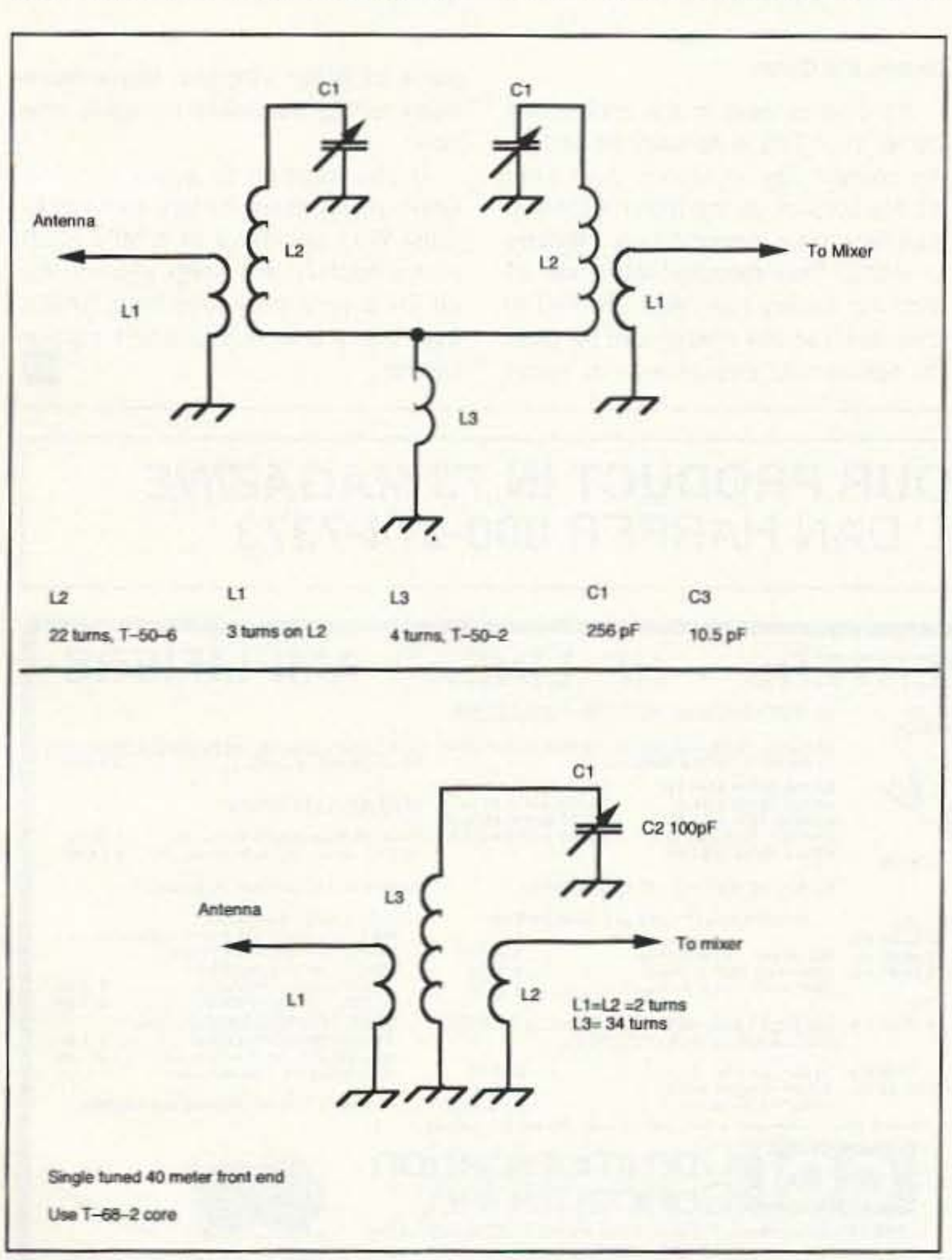

Figure 2. Two circuits that might be able to improve your receiver's front end. Values shown are for 40 meters.

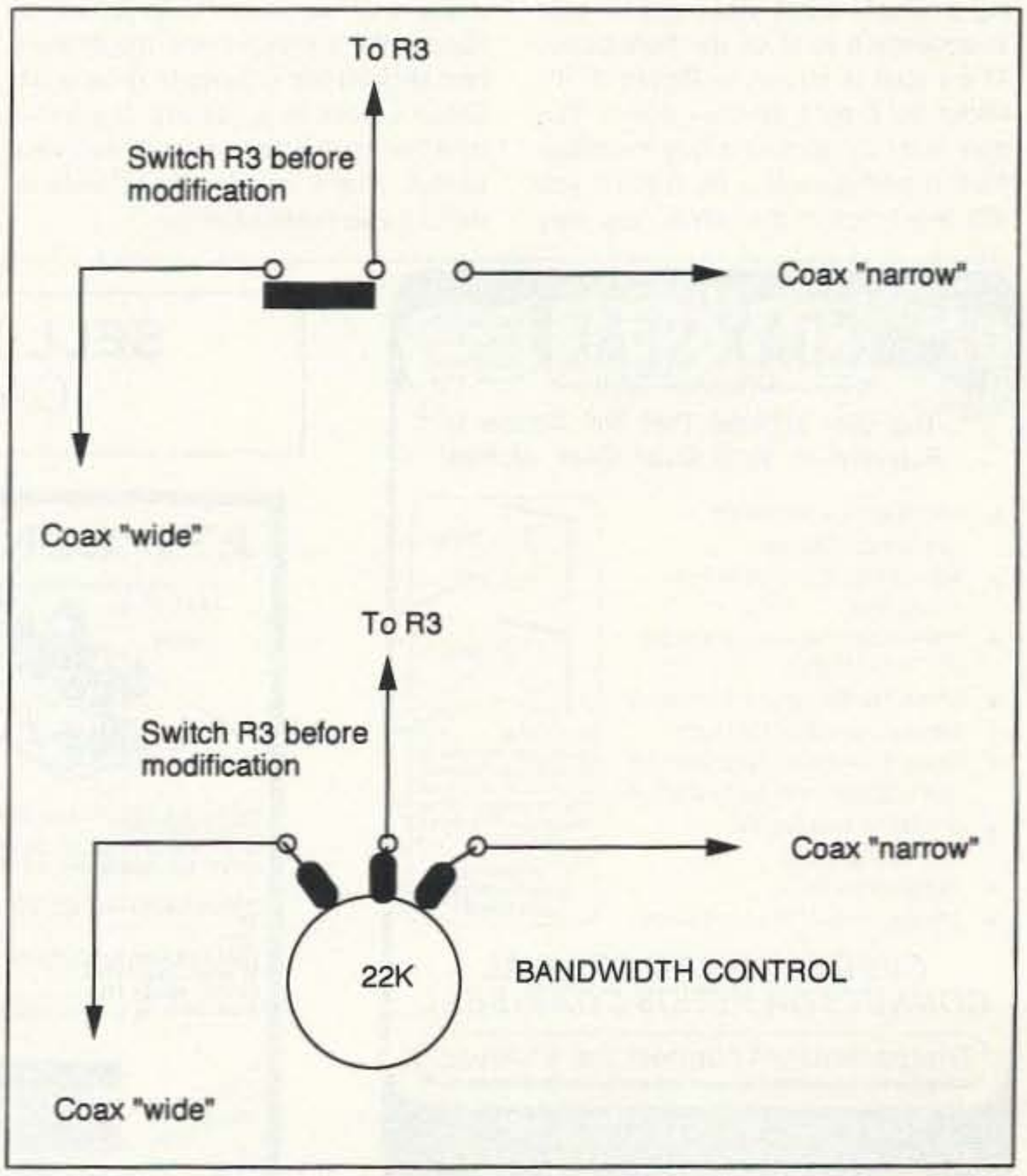

Figure 3. A modification for your Heath HW-9 which will replace the selectivity switch with a pot.

Although I don't have one in my shack, I wonder if either of these filters would make the Heath HW-7 receiver worth using? Again, you would have to break the connections between the transmitter and the receiver. This will require cutting some PC board traces. Don't try it if you're not up to this type of modification.

No matter how you use these filters, they will work best if you install them in some sort of shielded box. I use double-sided PC board for my boxes. But, the stuff is really hard to get into if you solder all the way around the edges.

"No matter how you use these filters, they will work best if you install them in some sort of shielded box."

A multi-pole switch could be used to select the proper front-end filter for several different bands. All the filters would need to be shielded from each other in one box. Again, double-sided PC board is great for this.

HW-9 Mods

Here are two more modifications for the Heath HW-9 QRP transceiver. The first one is rather simple and I've seen this same modification done to the HW-8. It requires removing the selectivity switch and replacing it with a pot. In this case, the switch is replaced with a 22k pot. Since this modification came from DL7GK in Germany, I'd say you could get by with a standard 20k pot and have the same effect as with a 22k pot. By using a miniature pot, you might be able to squeeze it to fit on the front panel. The circuit is shown in Figure 3. It's about as simple as they come. You may want to hard-wire this modification in and give it a try before you drill any holes in the HW-9. You may or may not like the results.

The second modification turns the S-meter into an expanded voltmeter so you can track battery voltage. This is a great idea if you're working on battery power in the outback. This circuit is also from Germany. The schematic for this modification is shown in Figure 4. Notice the values of the resistors. The values listed are only a guide; you will need to change the values to suit your HW-9. Seems Heath did not use the same meter in all production runs.

A double-pole double-throw switch selects between S-meter and voltmeter. The entire circuit can be built on a small hunk of perf board. A PC board could also be drawn out, too. Notice the use of the meter scale. This way, you don't have to recalibrate the meter and you don't have to rework the meter's face. Take a look at Figure 4. You'll see what I mean by using the meter's face to read voltage. Nope, it's not a Fluke 77, but it's better than nothing. And, you don't have to carry another piece of gear with you when you travel.

Since I have sold my HW-9, I can't say if either of these modifications work. Proceed on your own with caution!

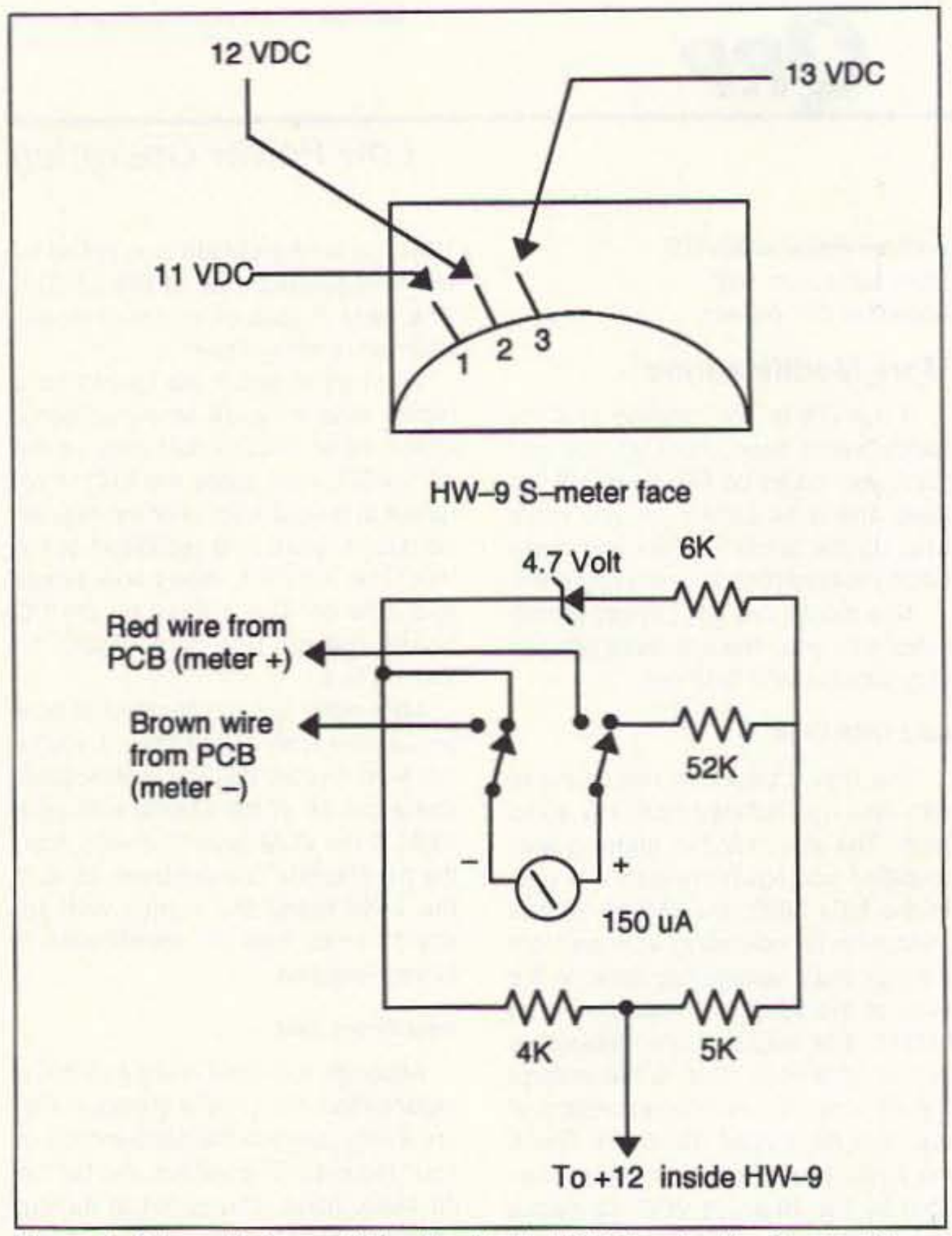

Figure 4. Schematic for modifying the Heath HW-9, turning the S-meter into an expanded voltmeter so you can track battery condition.

Longer Columns

Thanks in part to my new toy, an Apple Powerbook, I've been able to expand on some of these columns. Having the computer with me at work has allowed the column to grow a bit. Since I work in a factory, the extra time between setups has proved very useful. That's why I've been able to make these columns longer.

Damn, It's Cold!

It's cold up here in the middle bay crane! Yup! This is January 19 and it's the coldest day on record. As I work on this column, all the major electricity suppliers have asked heavy industry to reduce their electrical demands. In fact, our factory has been ordered to shut down so the energy can be used for residential customers. In some parts of West Virginia, there have been rolling blackouts for up to one hour.

If you happen to enjoy running QRP, you'll never notice the blackouts! Why, an HW-9 or a MFJ 9020 and a battery will keep you on the air for a very, very long time. That's especially true if you don't smoke cigars! 73

Number 17 on your Feedback card

PACKET & COMPUTERS

Digital Amateur Radio

Jeffrey Sloman N1EWO
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Peterborough NH 03458

OK, I'm back after a month's absence. The column tried to compete with moving and lost. Moving is one of my least favorite activities, and this one was worse than expected. On the other hand, we're here and things are smoothing out.

This month I have a few things to deal with, so I will not be doing a "regular" installment of the TCP/IP series. Instead, I need to cover some "administrative" information, and I'll also discuss some IP odds and ends that should be interesting.

First, the administrative. Many of you write to me, both on paper and via the bit stream. I really appreciate hearing from you, and read everything. Replying can be somewhat more difficult. I am not ignoring you. First, I get Email from my other writing work as well, and the combination of *73* mail (you guys aren't shy), and other traffic can be overwhelming at times. I really appreciate all of the feedback—praise and not-praise—but I just don't have a good way to reply to everyone.

Second, many of you have written asking for reprints and executables. I cannot provide these. Reprints come from *73*—call (603) 924-0058 to obtain these; reprints are $3 per article, back issues are $4 each. For the executables, I do not have the time to copy and mail diskettes. Many of you have sent prepaid diskette mailers and disks. I have not been able to do anything with these. You can get any executable or text file I describe on the *73* BBS at (603) 924-9343, 300-2400 baud, 8 data bits, no parity, one stop bit.

Now wait a minute—I know that many of you have tried to find these files on the BBS and they just haven't been there. I must take the blame for this, but I will be changing it.

Now, a personal note to an unknown reader: If you sent me some cash, please write again and let me know who you are. You can identify yourself by telling how much you sent and why. Some time ago, a bunch of mail that included a collection of checks, diskettes, and mailers got separated from the letters that went with them. I do not cash checks sent to me, and I want to return your money.

OK—Here's the last bit of administrative nonsense: how (and how *not*) to contact me. I can be reached three ways:

1. Email on the Internet: This is the preferred method of contacting me and stands the best chance of getting a response. Those of you who subscribe to online services like CompuServe, Genie, AOL, Prodigy, BIX, Delphi, and the like can all reach me at this address. The exact method can vary considerably—get help on your system in addressing mail to the Internet. My Internet address is: jsloman@bix.com.

2. Paper Mail: This is an acceptable way of contacting me if you do not have access to electronic mail (you should, you know). Please write to me c/o *73* magazine, at the address listed above.

3. Packet Mail: Of course I want to hear from you via packet! *But, I cannot answer questions about the column or magazine this way.* Too many of you write to me via packet radio and ask things that, were I to answer, would constitute doing business on the radio. This is *very* frustrating: You have good questions. I am *not* ignoring you, I just *can't* answer—sorry. Please send me packet traffic for fun, to try it, to let me know that you've got something working. But if you want me to respond, don't mention the magazine, *please*. So, with that preamble, address your packet traffic to me at:

N1EWO@NØARY.#NOCAL.CA.USA.NOAM

(Note the NOAM at the end—for North America. Do not use NA, the people in Namibia are not too happy with the folks that do.)

On to other business. First, let me tell you about the latest, and last DOS version of JNOS: 1.10c. WG7J has announced that he is now concentrating on developing a WIN32 version of JNOS (a very good thing indeed), and so 1.10c is the last version that he will release for DOS. Where can you get it? Well, as of this writing you *cannot* get it on the *73* BBS. You *can* get it via anonymous FTP from several of the ham archives. I will avoid specifying a site—this has gotten me in trouble in the past. You should be able to get it from places like CompuServe as well, but I can't guarantee that. JNOS is very widely distributed; ask around.

Version 1.10c adds several features which will be completely new to those of you who are using non-release (x) .10 versions. First, there is a very useful status bar which displays using the top three lines of the display. It offers some nice at-a-glance info:

On the first line—time memory status number of sessions using the various servers (conv, links, bbs, fwd, ftp, smtp), a list of active terminal sessions, specified by number; these blink when there is text waiting in a session not currently displayed.

On the second line is a list of current BBS users by callsign. Each callsign is preceded by a character indicating which activity the user is engaged in.

On the third line is information about the currently-displayed session, including the connection and information about retry timers.

(Users of WNOS are already familiar with this type of status display. This excellent feature is now available to JNOS users.) The status display is configurable in two ways: color and number of lines. The specific colors of the text and background of each line are configurable. You can also choose to display one, two or three lines of status information. Speaking of color, the text display colors are now configurable at startup as well. This is very useful because of another new feature—a command line in the trace window.

You can now execute commands directly in the trace window. This is very useful, for example, when testing using ping. You can ping a station and see the interaction from the very beginning. No more attempts at lightning-fast switches to the trace window with the F9 key are necessary.

There are many other features you will find useful in this new and last version. Get a copy and give it a try—tests here show it being very stable.

TCP/IP Routing Using Digipeaters

You and a friend want to communicate using JNOS on each end; the trouble is, you need to use a digi to make the connection, a digi that doesn't know anything about TCP/IP. Hmmm, how can you make the connection?

The impossibility of using a plain-old-digi for TCP/IP is only a misunderstanding of how the system operates on amateur radio. TCP/IP over ham radio has two different layers. There is a logical layer that handles TCP/IP messages and traffic, and then there is a hardware layer. It is in this hardware layer that the digipeater lives.

When you attempt to connect to a friend's station which *can* hear you directly, the first thing your station will do is to send an ARP request over the default interface. ARP means Address Resolution Protocol, and is the way the an IP station finds out the hardware address associated with the IP address which it has been told. Let's see how this works:

You type "telnet 44.48.70.22" at the JNOS command prompt. JNOS responds by opening a new session window. At the top of the window is the message "Resolving 44.48.70.22." JNOS has just transmitted and ARP request. This is a broadcast message saying, "I need to know the hardware address associated with the IP address 44.48.70.22."

Your friend's station recognizes its address and responds, saying that N1EWO handles IP traffic for 44.48.70.22. Your station places this information in your ARP table, and establishes the connection.

This is the way that it should work, if stations can hear each other. But what if they cannot? In this case we can't rely upon the automatic ARP process, and instead have to make it happen manually. To do this we'll need to make our own arp entries, and also add AX.25 routing information. ARP entries are soft; that is; they will go away when you restart JNOS. To make them "permanent," put them in the AUTOEXEC.NOS.

Here are the facts about the station we wish to reach:

IP address: 44.48.70.22 hardware **address:** N1EWO
(note that hardware address=AX.25 address)
digipeater: KB9BWE

So first let's make the ARP entry so that the station does not have to generate an ARP request which could not be answered. We do this from the command line, using:

arp add 44.48.70.22 ax25 n1ewo dsp

arp	the ARP command for JNOS
add	tells JNOS to add the following information to the ARP table
44.48.70.22	the host ID of the station for the entry (this could be alphanumeric [e.g.: N1EWO] if you have the appropriate entry in your DOMAIN.TXT file)
ax25	tells JNOS to use the ax25 hardware layer
n1ewo	the hardware address of the station for this entry
dsp	the name of the interface that should be used for this entry

Now, when you attempt to connect to 44.48.70.22, this ARP entry will be used. So, we're halfway to the solution—JNOS will now use the correct hardware address for N1EWO. What about the digi?

JNOS also maintains a routing list for AX.25 traffic. Using a very similar technique, we add the information about KB9BWE—our digi—to the AX.25 table. From the JNOS command prompt:

ax25 route add n1ewo dsp kb9bwe

ax25	the JNOS AX.25 command
route	the route sub-command
add	tells JNOS to add the following information to the AX.25 route table
dsp	the name of the interface to use
kb9bwe	the name of the digi (more than one can be specified)

Now, JNOS knows everything it needs to about how to reach 44.48.70.22 from your station. When you "telnet 44.48.70.22" it finds the hardware address already in its ARP table and the AX.25 route table tells it to use a digi to get there.

More next month. 'Til then 73 de N1EWO. 73

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. . . Read your antenna SWR from 1.8 to 170 MHz . . . built-in 10 digit LCD frequency counter . . . RF Resistance Meter™. . . smooth vernier tuning . . .

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Measure antenna resonant frequencies and 2:1 SWR bandwidths. Adjust mobile antennas, antenna tuners and matching networks in seconds.

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

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World's most popular antenna tuner covers 1.8-30 MHz, has lighted *peak/ average* Cross-Needle SWR/ wattmeter, 4:1 balun for balanced lines and *full size* 300 watt dummy load.

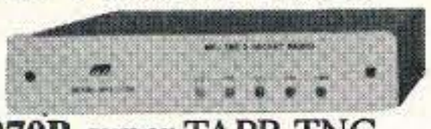
Versatile 8 position antenna switch lets you *pre-tune* MFJ-949E into dummy load to minimize QRM.

Custom inductor switch was carefully engineered to withstand extreme voltages and currents.

Cabinet has *tough* vinyl coating and molecular bonding -- not paint.

VHF/HF Packet TNCs

MFJ-1270B **$119.95**



MFJ-1270B *super* TAPR TNC clone has a world wide reputation as *the most reliable packet TNC in the world* -- many work 24 hours a day for years without a single failure!

Fully TAPR TNC-2 compatible, VHF *and* HF operation, *free* AC power supply, new *enchanced* mailbox expandable to 512K with auto/reverse mail forwarding, WeFAX mode lets you print weather maps, optional plug-in 2400/9600 baud modems, KISS interface, MFJ Host mode.

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MFJ-1272B **$34.95**

Switch between your TNC or microphone by pushing a button!

Just plug pre-wired cables into your rig's mic connector and TNC.

Plug-in jumpers let you use nearly any rig with 8 pin mic connector.

MFJ-1272B, $34.95 /MFJ/TAPR TNC2 clones; **MFJ-1272BX**/PK-232; **MFJ-1272BYV**/KAM VHF/KPC3; **MFJ-1272BYH**/KAM HF Port; **MFJ-1272BZ**/PK-88, $39.95 each.

For 8 pin RJ45 modular phone jack replace B with M in model number above.

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The *world class* MFJ-1278B Multi-Mode and MultiCom™ software is packed with features *no other* multi-mode gives you.

You get *10 digital modes* . . . Packet, AMTOR, PACTOR (at no extra cost), RTTY, ASCII, Navtex, Color SSTV, 16 Gray Level FAX, CW and Memory Keyer plus an *enchanced* 32K Mailbox.

You'll have fun joining worldwide *packet* networks and exchanging *color SSTV* pictures with your buddies around the world. You'll marvel at *full color FAX* news photos as they come to life on your screen. You'll see weather changes on highy detailed *weather maps* in all 16 gray levels. You'll eavesdrop on late breaking news as it happens on *RTTY*. You'll enjoy error free HF QSOs on *PACTOR* and *AMTOR* and receiving packet mail in an *enchanced 32K mailbox*. Want to copy some *CW*? Just watch your screen.

MFJ-1289, $59.95, MultiCom™ software and cables.

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6 bands: 40, 20, 15, 10, 6, 2 Meters . . . No radials or ground needed!

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It's only 12 feet high and has a *tiny* 24 inch footprint! You can mount it anywhere from ground level to the top of a tower -- on apartments, condos, small lots, even on motorhomes. Perfect for vacations, field day, DX- pedition, camping.

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Here's why the MFJ-989C is the finest 3 KW antenna tuner money can buy . . .

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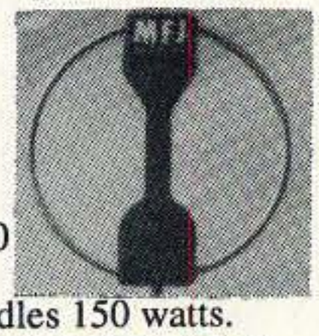

Tiny 36 inch diameter high efficiency loop antenna covers 10-30 MHz *continuously* with low SWR. Handles 150 watts.

Ideal for home installations where space is limited-- apartments, condos, small lots. Take on trips.

All welded construction.

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MFJ-1782, $269.95, like MFJ-1786 but remote control has only slow/fast tune buttons.

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Mobile Antenna for 144/440 MHz

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MFJ *dual band* magnet mount mobile antenna for 144/440 MHz has 19 inch stainless steel radiator, low SWR. For mobile rigs with SO-239 UHF connector *and* handie-talkies with *included* BNC adapter.

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Maximum Gain™ 5/8 Wave 2 Meter *magnet mount* mobile antenna has stainless steel radiator, 12 ft coax, low SWR. UHF mobile (MFJ-1728) or BNC handie-talkie (MFJ-1728B) connector.

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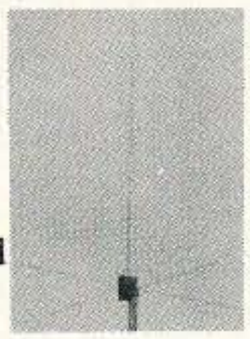

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HOMING IN

Radio Direction Finding

Joe Moell P.E. KØOV
P.O. Box 2508
Fullerton CA 92633

Attenuators Made Easy

Carefully planned deception can make the difference between a simple hidden transmitter hunt and a real challenge. Just as a football team relies on deception to foil the opponent's defense, hiders in radio direction finding (RDF) contests (called foxhunts or T-hunts) do their best to cause hunters to make incorrect assumptions about direction and distance to their location.

Last April's Fullerton Radio Club mobile hunt is a good example. WA6OPS and I helped WB6GCT and WB6UZZ hide it. At the starting point, our signal was from the north and was quite weak. S-meter readings were about the same with the hunters' yagis and quads set to either horizontal or vertical polarization.

Figuring that the T was near the distant boundaries, some teams bolted for the freeway to head north. Others, suspecting that we were reflecting our signal from the front range of the mountains 25 miles away, headed east or west on a hunch. All 15 teams lost the signal upon leaving the starting hill, but they kept going.

All had been deceived. Our T was only three miles north of the start, on the side of a hill that blocked the signal toward the freeway. A paltry 2.5 microwatts drove an 11-element beam pointed toward the start. It was two hours later that the first team found the transmitter. The six teams that managed to find it that night had driven from 22 to 52 miles. They were fooled by the carefully-controlled power level and antenna position.

Our fox transmitter put out such a meager signal that a hunter could drive from the start point to within 100 feet of its antenna without the S-meter ever registering full-scale. That's very unusual, since the 5 to 50 watt hidden transmitters encountered on most mobile hunts usually pin hunters' signal indicators when they are several miles away. Typical VHF-FM receiver S-meters have only a 20 to 30 dB range.

Antidotes for Overload

Every T-hunter who gets bearings with a directional antenna and S-meter requires some method for knocking down strong signals to the point that amplitude changes can be discerned. But RF gain controls are provided in only a few VHF transceivers, usually the relatively expensive multimode models. If you are thinking of purchasing such a rig just to have RF gain control for T-hunting, be sure to test it before you buy. In many cases, lowering the RF gain control adversely affects S-meter action. You may not be able to take bearings with gain reduced.

If you enjoy performing minor electronic surgery inside receivers, you can add internal RF gain reduction that won't upset S-meter action. Control the supply voltage to the RF preamp and first mixer stages, or change the bias of the FETs in these stages. The "Homing In" column in the March 1989 issue of *73 Amateur Radio Today* provides plans for a voltage-reduction internal attenuation system for popular VHF-FM transceivers.

A simpler and much more popular way to knock strong signals down to size is to connect an attenuator box between your antenna and receiver input. A resistive (sometimes called a "passive") attenuator has several shielded sections, each with resistors to soak up the RF signal and a double-pole double-throw switch to put the section into and out of the line (Photo A).

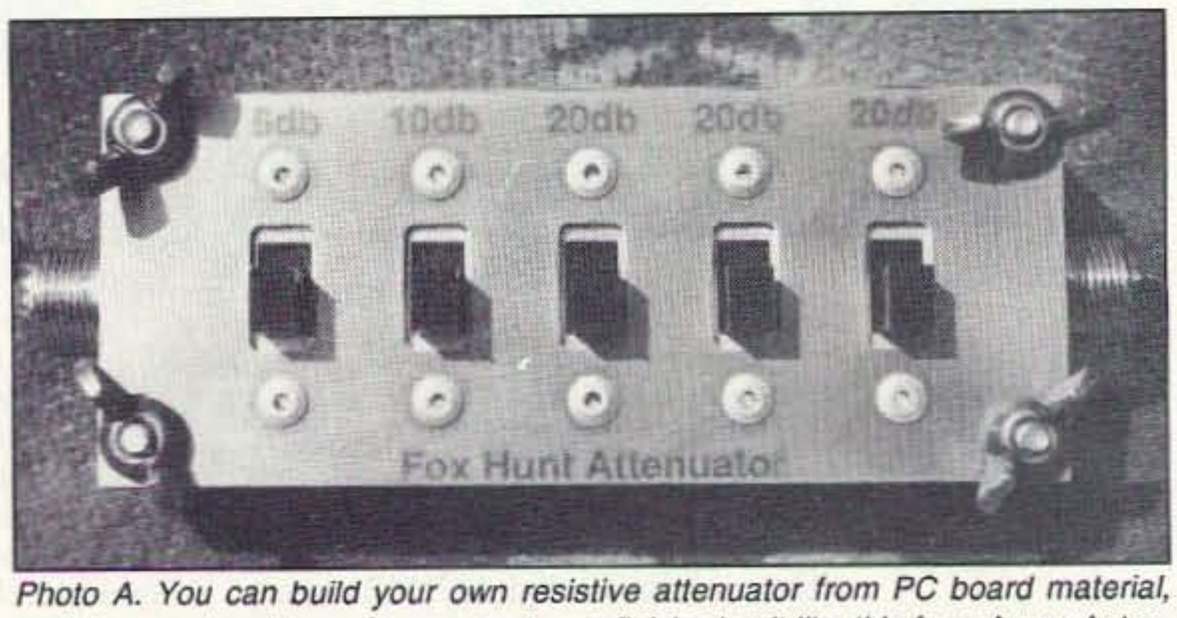

Photo A. You can build your own resistive attenuator from PC board material, switches, and resistors. Or you can buy a finished unit like this from Arrow Antenna. Its copper-clad case measures 2" x 4-3/4" x 1-1/4".

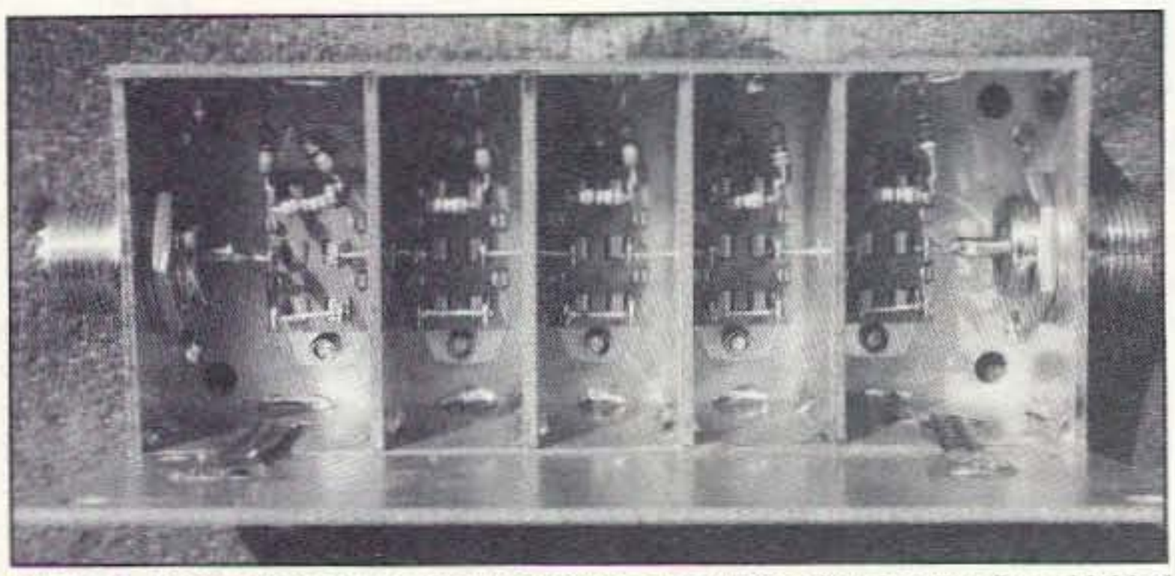

Photo B. Inside view of the Arrow resistive attenuator showing the five shielded cells and two hinges made from copper braid.

With the circuit in Figure 1, you can select signal reduction in 5 dB steps from zero to 75 dB. RF leakage across the switch makes attenuation of more than 20 dB per section impractical. If your receiver is especially well-shielded, you can add another 20 dB section to get 95 dB maximum. More than four 20 dB sections are not worth the effort, due to the likelihood of RF coupling around the attenuator and leakage through the receiver case.

This attenuator is an easy and inexpensive construction project. Build the multi-cell enclosure out of double-sided unetched PC board material or sheet copper. Solder the dividers and end caps in place with a continuous bead of solder before mounting the resistors, connectors, and switches.

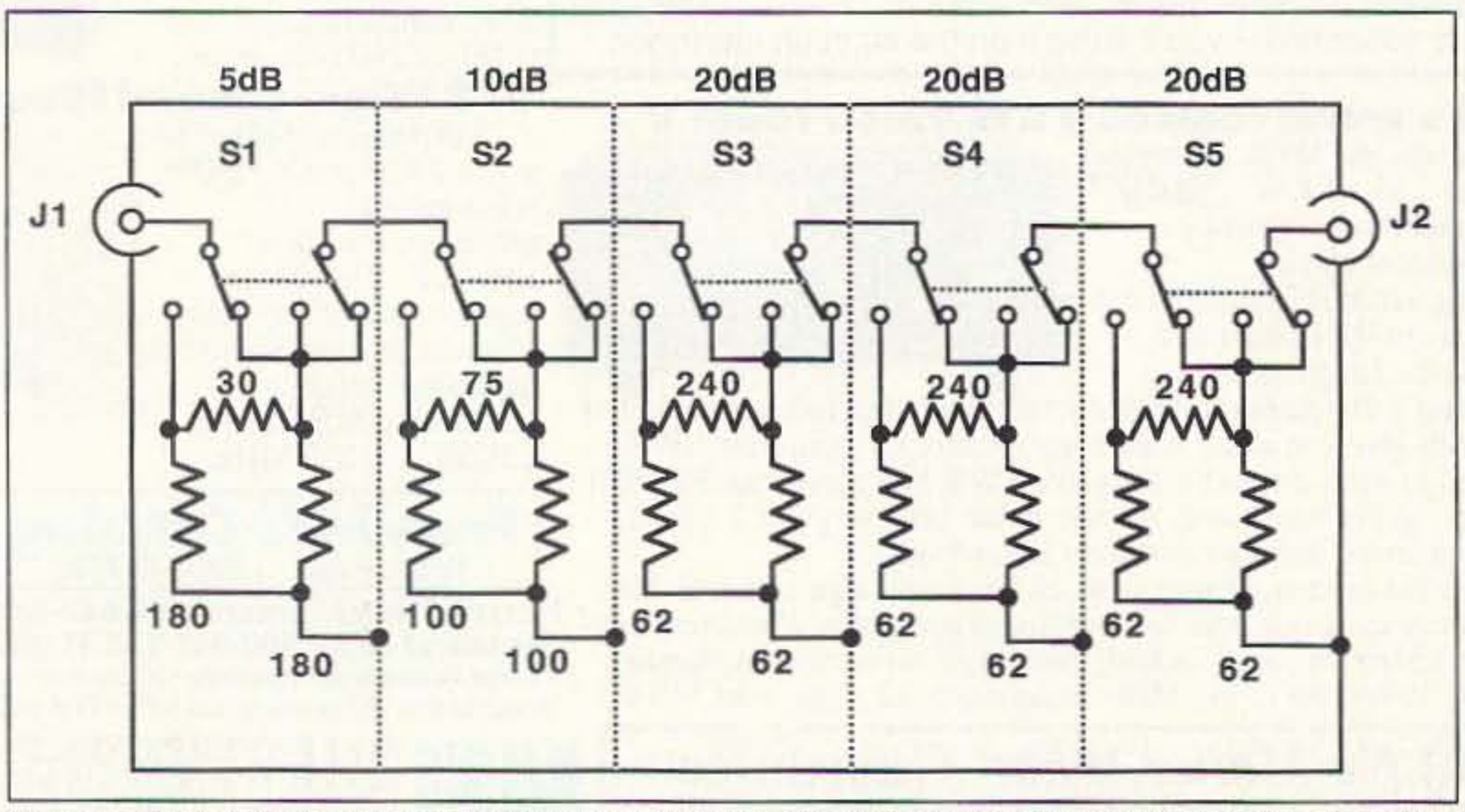

Figure 1. Schematic diagram of a simple five-section resistive attenuator for T-hunting on any ham band from 160 meters through 70 centimeters. Resistor values are in ohms. Switches are shown in down (attenuation out) position.

Photo C. The Arrow Antenna offset attenuator is in a 2-3/8" x 3-3/4" x 1" plastic box.

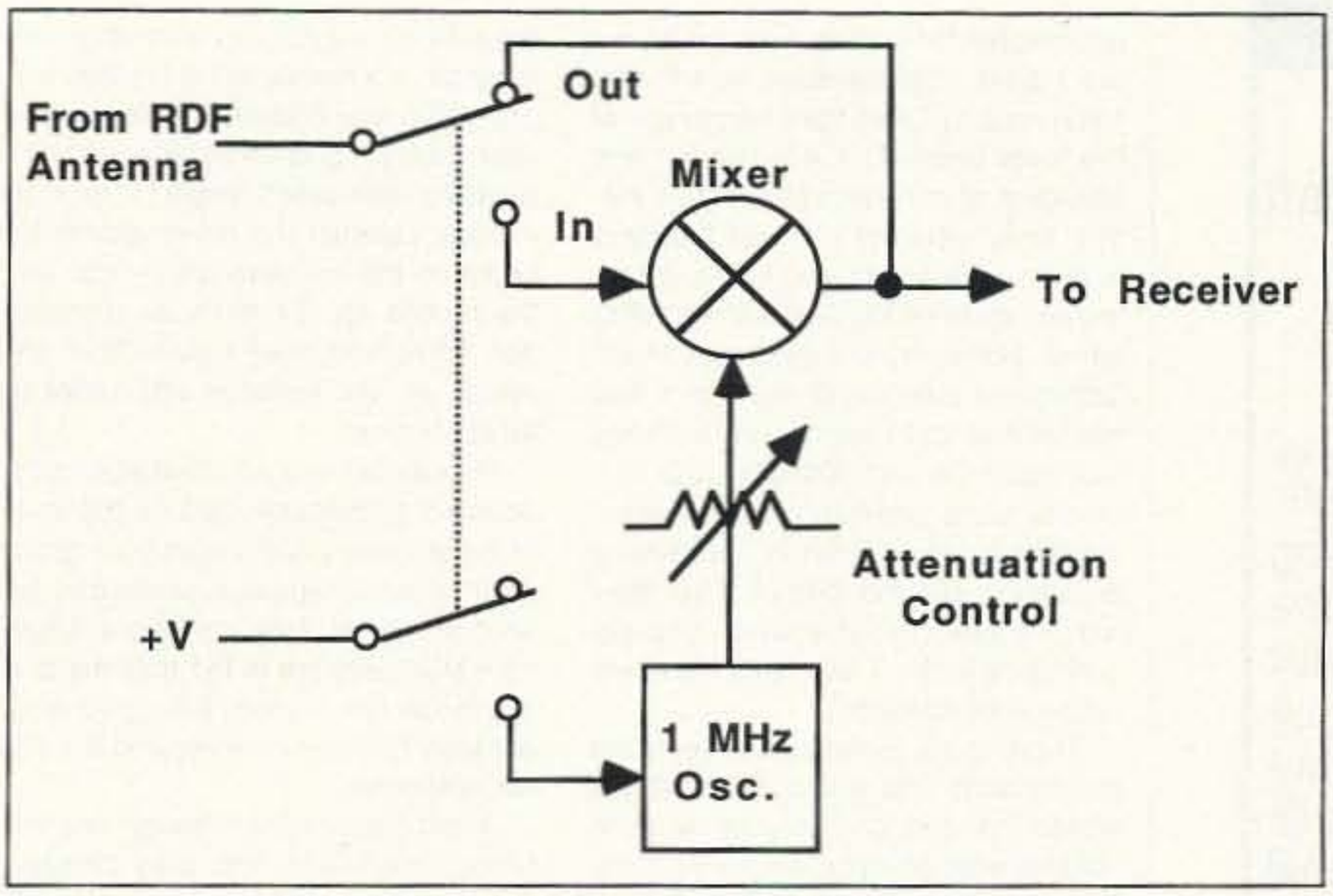

Figure 2. Block diagram of the external offset attenuator.

Do not secure the back cover with a long solder bead, because that will make it difficult to open for repairs. Instead, make hinges out of braid material and install them as shown in Photo B. Bolt the cover closed or fasten it with copper tape. The hinges hold the cover and prevent unwanted leakage and coupling. A hinge in each cell is best.

The resistor values shown in Figure 1 ensure that the receiver and antenna remain terminated with the same impedance as the 50-ohm coax line at all attenuation levels. Use only carbon composition or carbon film resistors for RF attenuators—never wirewound or metal film types.

Quarter-watt resistors are OK, but I prefer half-watt parts. They withstand accidental transmissions for longer periods. It's even better to use 1 or 2 watt resistors, but installing them in the cramped cell space is very difficult. Keep all resistor leads and jumper wires as short as possible. Jumpers between cells are straight insulated wires passing through small holes in the dividers.

Good quality slide switches give better RF performance at VHF than toggle switches, but they require a rectangular hole and are less liquid-proof than toggle switches, which I use. Subminiature or micro-mini size toggle switches fit and work better than miniature types, but they are more fragile. In 18 years of T-hunting use, I have never accidentally burned out any of the half-watt resistors in my home-brew attenuator, but I have replaced several subminiature toggle switches that wore out or were damaged.

Build or Buy?

Commercial resistive attenuators are available, but most are expensive precision units for laboratory measurements. Many do not have enough 20 dB sections for T-hunting. Nevertheless, it is a good idea to watch at swap meets and surplus outlets for suitable ones at bargain prices.

T-hunting enthusiast Allen Lowe NØIMW now sells attenuators as part of his Arrow Antenna line of products. His resistive model has the same configuration as shown in Figure 1. The case is made from Fiberglas PC board material. It uses slide switches with gold contacts and quarter-watt resistors. Bolts and wing nuts hold the rear cover, so it is easy to open for repair. You can choose either UHF (SO-239) or BNC connectors when you order.

I tested the unit in Photo A on the 2 meter band with a well-calibrated signal generator. Performance was typical of T-hunt attenuators. Insertion loss with no attenuation was 2 dB. Each step had accuracy of 1 dB or better. Maximum attenuation with all sections switched in was 71.5 dB.

To Solve Leakage, QSY

Handie-talkies and scanners are notorious for poor case shielding. A passive attenuator cuts down the signal level into the antenna jack, but strong signals will still penetrate the case and pin the S-meter. One way to get bearings on nearby foxes with these sets is to convert the strong on-frequency signal into a weaker off-frequency signal. Then you can tune your receiver to the offset signal and measure its strength versus direction.

Figure 2 is the block diagram of a simple unit for level-controlled frequency conversion. When this scheme was originally described in *QST* magazine, November 1992, by Anjo Eenhoorn PAØZR, it was called an active attenuator. Since there are other kinds of attenuators that are also called "active," I prefer to call it an offset attenuator. That term describes how it solves case leakage by offsetting the frequency.

An offset attenuator consists of a local oscillator (LO) connected to a diode mixer through the attenuation control. The higher the LO level, the higher the amplitude of the offset signal applied to the receiver. To increase attenuation, decrease the LO signal into the mixer with the control.

Arrow Antenna's new attenuator line includes an improved version of the PAØZR design (Photo C). Instead of a 500 kHz L-C oscillator, the Arrow unit features a 1 MHz SaRonix crystal clock module, which has higher accuracy and stability. 1 MHz is a good choice for the frequency offset, because it is easy to remember and program into your radio.

The trade-off for improved stability is higher supply current, approximately 35 milliamperes. A three-terminal regulator provides 5 volts to the LO, so performance is stable with battery voltage down to 6.7 volts. A 9-volt alkaline battery should power the unit for at least 12 hours. Arrow does not provide a power-on or battery condition indicator, but there is room to add them if you wish.

The unit I tested was one of the first made by Arrow, and did not include an instruction sheet. No problem—it is very easy to use. Using BNC jumper cables, hook it between your directional antenna and receiver. The connectors are not labeled. With the simple 1N4148 diode mixer in the Arrow unit, it does not matter which port goes to the antenna and which to the receiver.

In my tests on 2 meters, insertion loss of the switched-off unit was 0.3 dB. On-frequency attenuation with power on ranged from 7 to 17.5 dB with adjustment of the attenuation control. Tuning the receiver up 1 MHz gave attenuation of 11.5 to 101 dB over the control range.

The LO module puts out a TTL square wave. Its harmonics, especially odd multiples, are very strong. You can tune up or down in 1 MHz steps and hear the target signal at varying attenuation levels. Unfortunately, this means that the chance of interference from cross-modulation products is much greater than if the oscillator put out a pure sine wave. For example, if you are hunting a T on 147.48 MHz, you will get interference from strong paging transmitters on 152.48 MHz.

Figure 3, which charts my measurements of minimum attenuation at the 10 closest offset frequencies, can help you predict the level of cross-modulation interference and select the best offset frequency to use. Generally speaking, cross-mod is less severe when your offset is an odd multiple away from the desired signal and an even multiple away from the undesired signal. In the example above, the paging transmitter will cause strong QRM to the 149.48 and 151.48 offset signal, but much less interference to 148.48 and 150.48.

Arrow literature says that the unit is

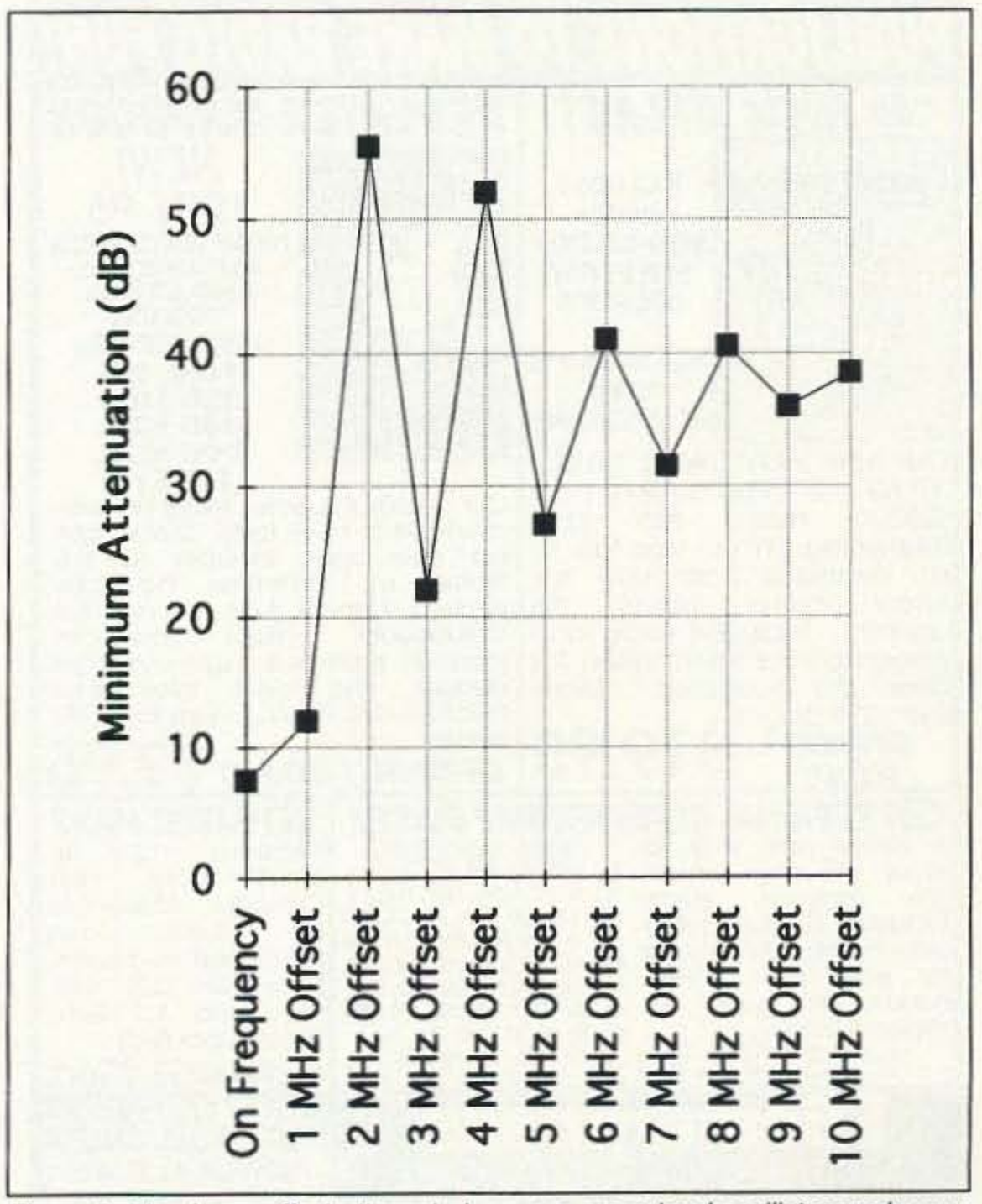

Figure 3. The Arrow offset attenuator's square wave local oscillator produces a multitude of heterodyne signals at 1 MHz intervals with different levels. This chart shows the relative amplitudes at the receiver, with respect to the input signal level. Attenuation control is set to minimum.

not suitable for hunting a fox on an exact 1 MHz multiple (such as 147.000 MHz), due to QRM from harmonics of the oscillator. The harmonics are strongest at minimum attenuation setting. They were full-scale on 2 meters in my mobile setup, and half to three-quarter scale on the 222 and 440 MHz bands. However, with extra care in adjusting the attenuation control, I was still able to get bearings on a strong test signal on 147.000 MHz. LO harmonics are a problem when an even-megahertz fox signal is just strong enough to pin the S-meter, but they will not cause trouble when you get very close to the T and raise the attenuation control setting.

There is no isolation between the mixing diode and your antenna. Offset signals not only go into your receiver, but they also go back to your RDF antenna, where they are radiated. This may cause cross-modulation QRM to nearby receivers, even outside the ham bands.

The Bottom Line

An offset attenuator is excellent for on-foot foxhunting, whether you use it for "sniffing" at the end of a mobile hunt or for European/Asian style in-the-woods radiosports. It works with directional antennas or just with a rubber duckie as an aid to the "body shield" maneuver.

On the other hand, a resistive attenuator is a better choice for mobile RDF, in most cases. Passive attenuators avoid the problems of images and re-radiation that are far more harmful in mobile situations than on foot.

Usually, the only time an offset attenuator is superior to a resistive attenuator in a mobile setup is when you are close to a powerful hidden T and your mobile rig is overloaded with all resistive attenuation steps in. In such a case, connect the offset attenuator between the resistive attenuator and the mobile rig. To minimize re-radiation QRM from your mobile RDF antenna, set the resistive attenuator to 20 dB or more.

Remember that an offset attenuator does not significantly reduce the level of on-frequency signal into your radio, so it does not provide protection for your receiver's front end. If you touch your RDF antenna to the antenna of a powerful fox transmitter, you may damage both the receiver and the offset attenuator.

Avoid transmitting through any external attenuator. You may damage the resistors in a passive unit. You will transmit strong spurious signals if you key up through the offset attenuator, and you may burn out its diode. Disconnect the mike if you are T-hunting with a mobile rig. Set the power output down to the lowest possible level on your hand-held. Fortunately, if you forget and cause a failure, repairs are easy and inexpensive.

Mail-order price of the Arrow offset attenuator is $59. The resistive attenuator sells for $49. For more information on Arrow products, contact Arrow Antenna, 1461 Peacock Place, Loveland, CO 80537; (303) 663-5485. To contact me, write to my California address under the heading. Remember that a self-addressed stamped envelope for the reply is always appreciated. 73

Number 19 on your Feedback card

HAM HELP

We are happy to provide Ham Help listings free on a space available basis. To make our job easier and to ensure that your listing is correct, please type or print your request clearly, double spaced, on a full (8 1/2" x 11") sheet of paper. You may also upload a listing as E-mail to Sysop to the 73 BBS /Special Events Message Area #11. (2400 baud, 8 data bits, no parity, 1 stop bit. (603) 924-9343). Please indicate if it is for publication. Use upper- and lower-case letters where appropriate. Also, print numbers carefully—a 1, for example, can be misread as the letters 1 or i, or even the number 7. Specifically mention that your message is for the Ham Help Column. Please remember to acknowledge responses to your requests. Thank you for your cooperation.

I have recently "inherited" a RADIO SHACK TRS-80 Model III with no software, operating system or documentation. My local Radio Shack has been unable to help me. Since I am planning on dedicating the machine to packet, I knew I would be better off relying on my fellow Amateurs. I will gladly reimburse you for your expenses. Thank you. *Johnny P. Brown N1QQS, P.O. Box 1305-226, Brunswick ME 04011.*

I need the schematic for HEATH Company Model SA-5010 Keyer. Your help will be greatly appreciated. *Tom Stepanov RA6AR/WN1R, P.O. Box 555, Sochi-355, Russia 354355.*

WANTED: Manual (for copy) for ICOM IC-245 2-meter transceiver. I only need the sideband adapter information, or any computer interfacing information. *Claude J. Cook KD6NFJ, 34A Springbrook Rd., Westerly RI 02891.* 73

ATV

Number 20 on your Feedback card

Ham Television

W4HTB Repeater

Hank Cantell W4HTB of Bowling Green, Kentucky, decided to stir up some ATV activity in the region with an ATV repeater. He obtained permission from the local TV station (channel 40) to locate the repeater at their transmitter site about 15 miles north of town (700 feet above average terrain). With his antenna at the 160-foot level, Hank's repeater provides great coverage that includes Glasgow, Kentucky (about 30 miles to the northeast).

Features

The repeater has both in-band and crossband capabilities. The input is on 439.25 MHz with outputs on both 426.25 MHz AM TV as well as 1280 MHz FM TV (5.8 MHz audio).

One of the most unusual features of the repeater is the ability to transmit two different audio channels through the use of both subcarrier and on-carrier sound on the 426.25 MHz output. The subcarrier audio channel relays the normal ATV audio signal while the on-carrier channel listens to the 144.34 MHz FM receiver that's located at the repeater site. Not only does the system work as an ATV repeater but as a crossband FM voice repeater as well!

Touchtone control via the VHF receiver allows the users to turn the 426.25 MHz output off so that the system works solely as a crossband TV repeater to allow link capability with other repeaters. Hank plans to install an additional receiver on 421.25 MHz to allow his repeater to relay the output of the KJ4ZQ ATV repeater in Nashville, Tennessee (50 miles to the south).

Another Touchtone command allows the user to turn on the repeater continuously for DX contacts (essentially links the receiver directly to the transmitter without the need for sync trigger).

Additional commands will turn on the video ID, switch in another video source or a live shack or tower camera.

The Hardware

The repeater is horizontally polarized on the 70 cm band. A stacked set of "Quad Little Wheels" by Olde Antenna Labs is mounted at the 160-foot level of the tower, feeding a 200-foot run of 1" hardline to the equipment room. The signal is split to the receiver and the transmitter using a TX-RX #26-66-01A duplexer.

The receive system consists of a P.C. Electronics ATVR-4 receiver that delivers video to the video switch and sync detector circuit. The video ID and alternate video sources can be routed through the video switch as well (controlled by Touchtone commands via the VHF receiver). In addition, the 426.25 MHz transmitter can be controlled by Touchtones. The video signal from the switcher goes to both the 426.25 MHz AM-TV transmitter and the 1280 MHz FM-TV transmitter. The 426.25 exciter was made by Bestlink and feeds into a Pauldon 18-watt amplifier (PD-440N) and routes back into the duplexer. The 1280 MHz FM-TV transmitter is a Wyman Research system that includes an exciter into an SC1043 amplifier brick. The 1280 MHz antenna is a 9 dB gain Diamond vertical.

Activity

If you're in the Bowling Green area, try giving the local ATVers a call on 144.34 MHz. They usually are active every evening after about 8:30 p.m. If you're operating mobile TV, the repeater is located right next to I-65 (near exit 39). Some of the more active ATVers in the region are Hank W4HTB, Dean K4NQV, Fred KA4CFW, Ben WD4MNI, Bob KB4FEN, Randy KD4AMR, and Paul K4VXP (located 60 miles away in Campbellsville).

Night-Vision R/C

During a recent visit to the W4HTB QTH, Hank treated me with a demonstration of his night-vision ATV rover. He mounted an ATV transmitter and an infrared sensitive CCD camera on a USA-1 Monster Truck R/C car. This vehicle is capable of traversing incredibly difficult terrain due to its four monster balloon tires. The camera is offered by Marshall Electronics and has six high-intensity infrared LEDs mounted around the lens, allowing the camera to see about 15 feet in total darkness. Hank has great fun driving the vehicle around under the house as well as venturing out in the woods at night looking for nocturnal creatures. A vehicle like this has a number of interesting applications including potential use as hazardous emergency support. 73

Photo B. The component parts of the W4HTB repeater are assembled in Hank's final test facility.

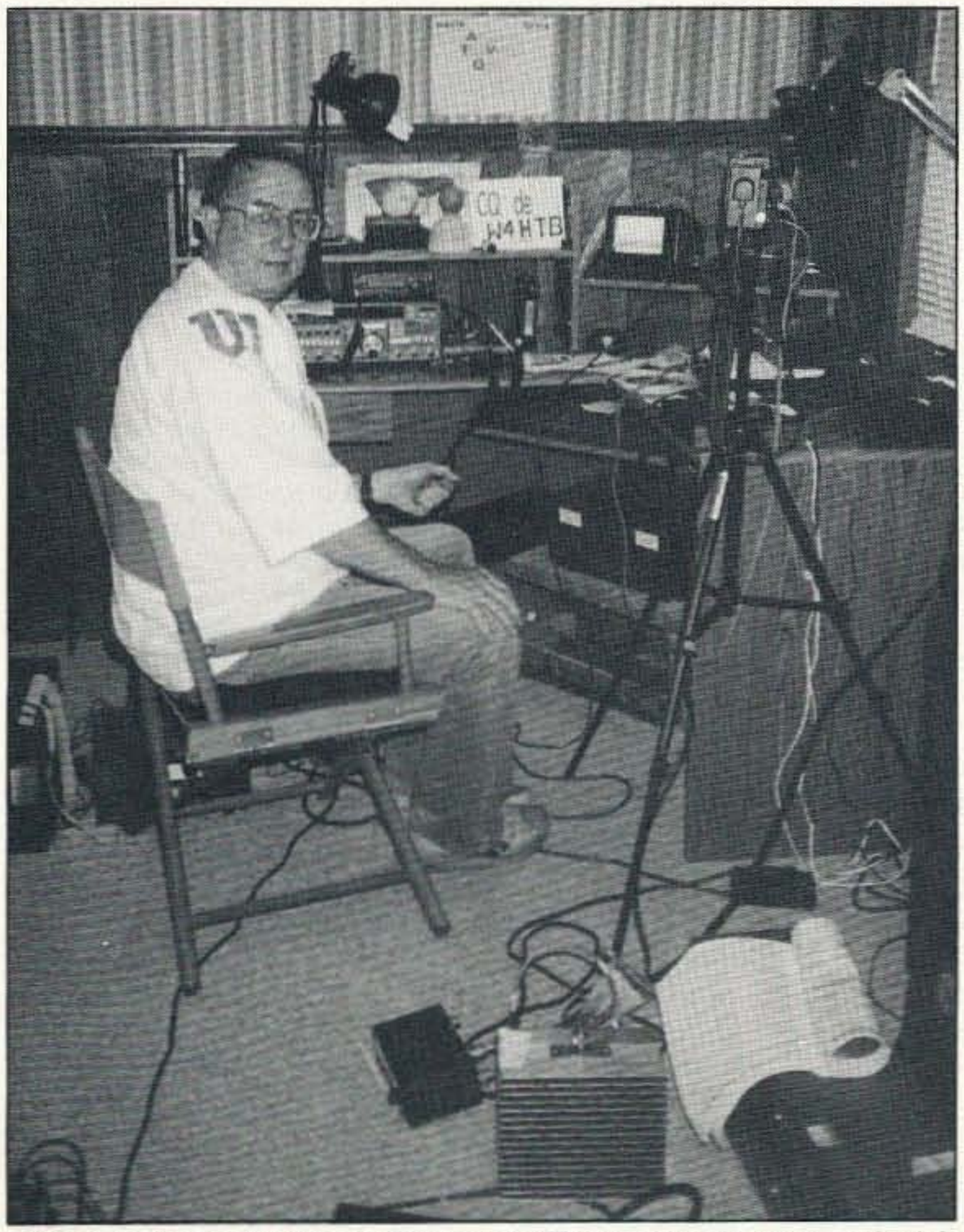

Photo A. Hank Cantrell W4HTB working his ATV repeater from his ham shack in Bowling Green, Kentucky.

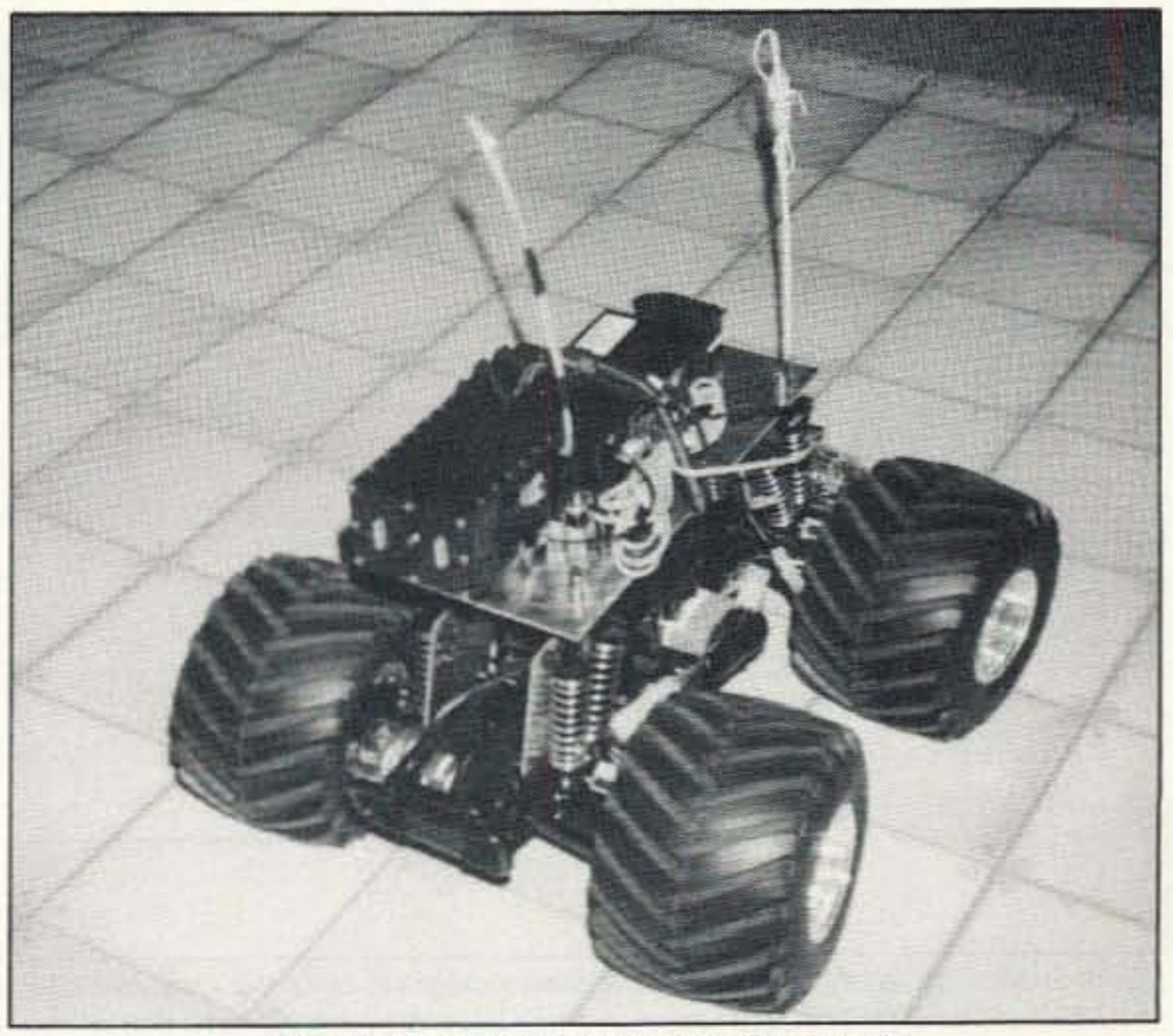

Photo C. The W4HTB night-vision R/C vehicle.

Number 21 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

Frequency

Last month we discussed converting a phase-locked synthesizer/oscillator for 2.xxx GHz. This month I will build on last month's project and describe in detail the multiplier, the filter, and the oscillator drive amplifier. These components serve as an oscillator multiplier, which could be used in conjunction with a 10 GHz converter. The attempt here is to utilize inexpensive surplus components and PC boards to fill a need, and to construct a converter package that is small and functional, and doesn't cost an arm and a leg to duplicate.

Falling back for just a minute, I would like to touch base on the synthesizer, in particular on the power supply you construct to power these PC boards. These devices require a very *clean* DC power supply. By that I mean that the ripple content has to be quite pure or else you will have modulation on your oscillator caused by the AC ripple component riding on the DC in your power supply. It does not take much to cause noise or FM modulation on the synthesizer. To make sure this doesn't happen to you, filter your DC supply well.

Pete Bauer W6DXJ, who has done quite a few of the conversion details on the synthesizer unit, recommends using a good voltage regulator to maintain DC regulation. Additionally, using some ferrite beads on the DC distribution leads at the oscillator to suppress AC and other RF will prove useful. I usually bypass the output of my voltage regulators with not just a suitable electrolytic cap, but with a couple of extra bypass types (0.1 µF and 0.001 µF) as well, to cover all bases on the positive lead. See Figure 1 for the schematic detail of power supply configuration.

The PC boards that I am modifying here were part of a microwave transmitter/receiver used on trucks for communication and data. As such, they were built quite ruggedly and, needless to say, are solid-state, with GaAsFETs in almost all of the circuitry. This month I'll describe the second portion of the oscillator system, namely the oscillator multiplier. Please note that this is but one of many methods used to obtain a 10 GHz injection for 10 GHz operation. The PC boards that are described here are being made available; you can order them for $10 per board ppd from the author.

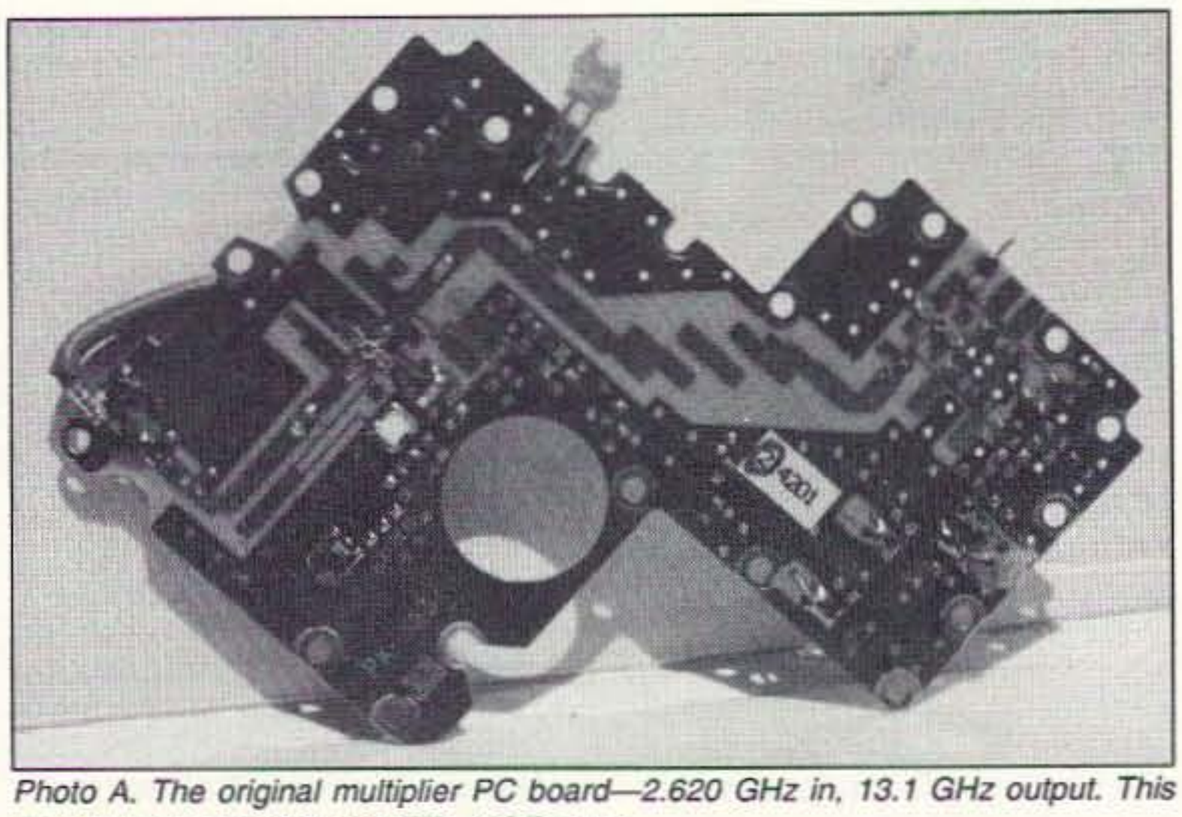

Photo A. The original multiplier PC board—2.620 GHz in, 13.1 GHz output. This uses two Mitsubishi GaAsFETs, MGF-1302.

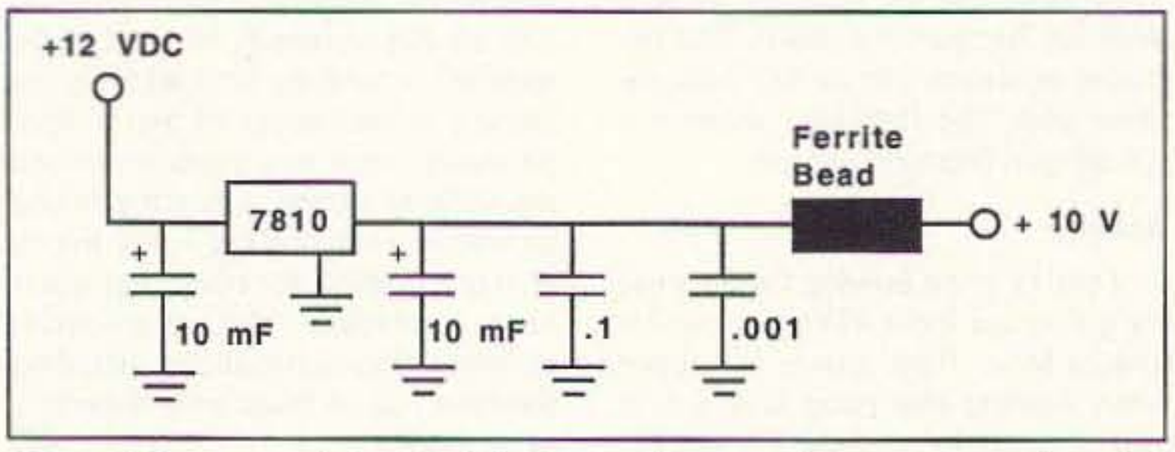

Figure 1. Power supply feed details. Basic voltage regulator power supply; output capacitors vary in value 10-0.1-0.001 µF for wide-range bypass filtering.

A brief description of these PC boards: As stock they were made to operate at 2.620 GHz (synthesizer), and the multiplier was a times-five, providing 13.1 GHz output from the set of PC boards. Multiplication was done in the first stage of the second board in an MGF-1302 GaAsFET device. The output of this stage was coupled into a stripline filter resonant at 13.1 GHz to allow bandpass operation of the desired 5th harmonic and reduce all other frequencies. The filter output is coupled with a small-value capacitor to an output amplifier tuned to 13.1 GHz, another MGF-1302 GaAsFET device.

In the original system, the amplifier of the multiplier assembly was fed to a distribution amplifier system on a third PC board. This board contained an input amplifier and power splitter. A power splitter is a stripline device that looks like a tuning fork with the top terminated in a resistance load. Its purpose is to split the signal (one source) into two equal sources: one source for receive and the other for transmit. Two additional amplifiers are located in the transmit path, and there is one in the receiver path. These amplifiers have been removed from this PC board by cutting the board and making two 10 GHz amplifiers, a two-stage and a single-stage unit. This board is not required in the multiplier modification, but can be used by removing the single- and dual-stage amplifiers and converting into individual amplifiers. These amps can be used at 10 GHz as gain blocks with stripline snowflake retuning from 13.1 GHz. See Figure 2, the splitter board block diagram.

The multiplier PC board is of prime concern now, along with our attempt to modify it to a frequency multiplication of four. In this regard we need to modify the output circuit of the first stage from 13.1 GHz to 10.2 GHz. The stripline filter was too difficult to attempt retuning to 10 GHz. A better method is to eliminate the stripline filter by removing the copper foil with an X-Acto knife. Our plan here is to replace the filter with another type of filter that can be easily constructed and assembled—something easier than the original stripline filter. The answer to this problem is an adjustable cavity resonator tuned to our 4th harmonic.

Where do you find such a filter? In the plumbing section of your hardware store. What we used is a 1/2" copper pipe cap plug. Sounds crazy, yes, but it works perfectly and is easy to adjust. Credit for this filter construction goes to the North Texas Microwave Society for passing on the information on the filter construction.

The copper pipe cap works quite well, being simple to construct and adjust. A finished filter will have about 1 to 1.5 dB loss and a bandwidth of about 50 to 100 MHz. I haven't measured the "Q" of the filter but believe it to be about 100. Essentially, the pipe cap filter is a resonant cavity with two probes, input and output.

These probes are copper or brass pins about 0.030" in diameter and 3/16th" long. The pins are inserted from the trace side of the PC board through to the foil side and are about 3/16" high on the foil side. They are

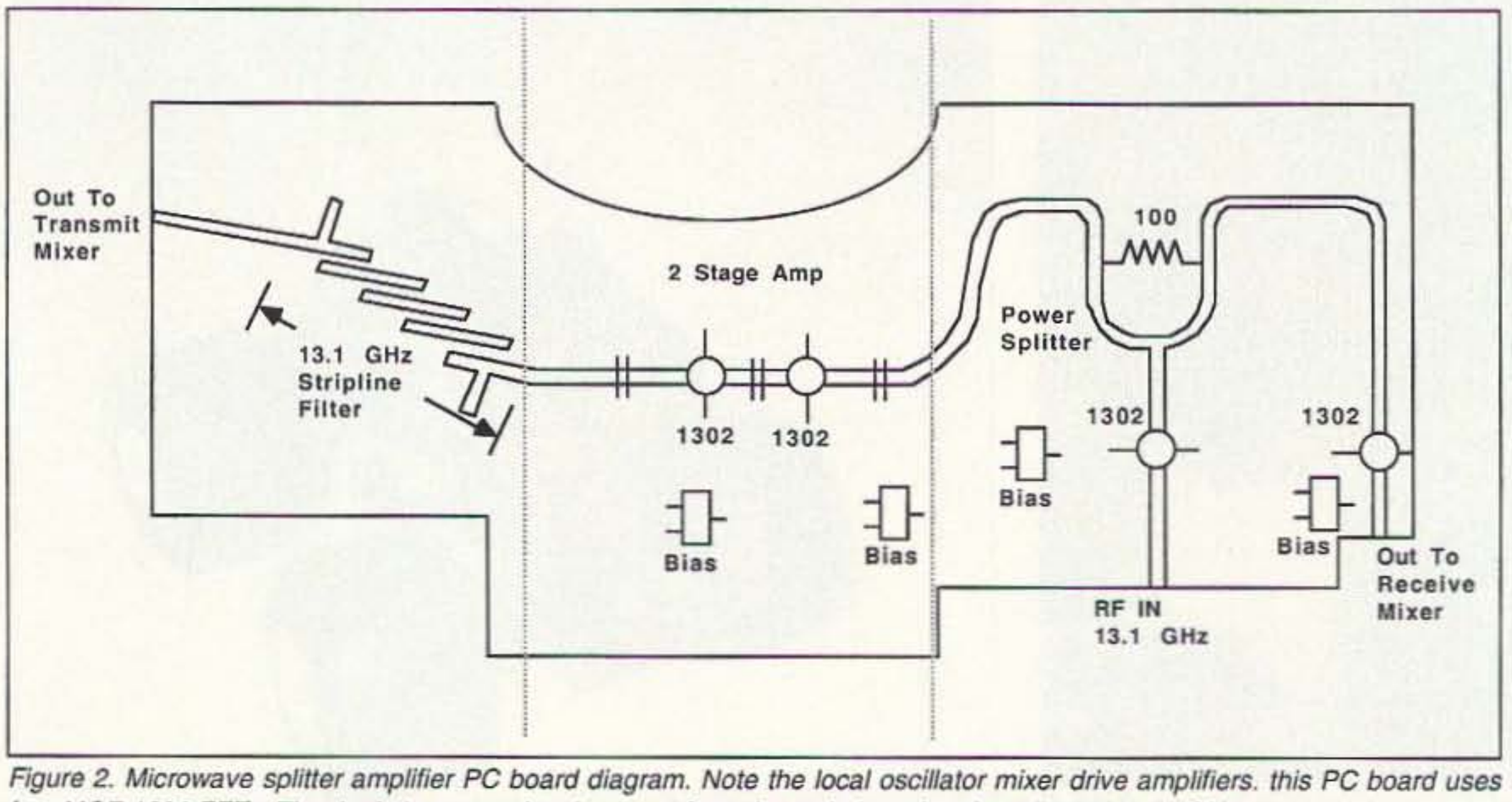

Figure 2. Microwave splitter amplifier PC board diagram. Note the local oscillator mixer drive amplifiers. this PC board uses four MGF-1302 FETs. The dual-stage amp has been cut from the main board and readjusted to 10 GHz.

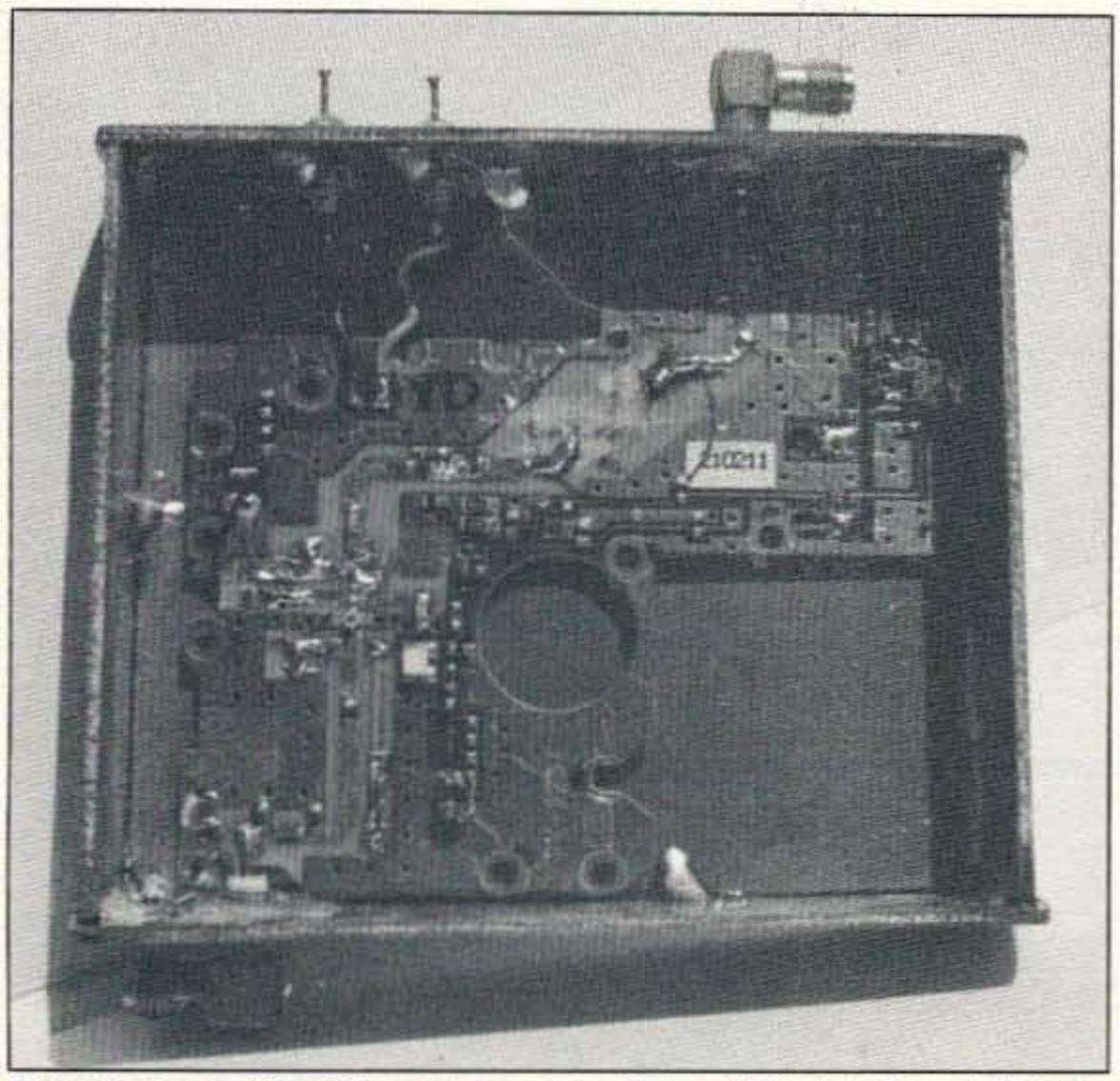

Photo B. The modified PC board, converting the multiplier to a times 4. Note the ink circle mark and the PC strips removed from the filter area, located just above the circle cut-out.

soldered to the remaining ends of the old filter stripline positioned about 1/16" from the inside wall for the pipe cap when it is soldered to the foil side. Note the circle drawn for the pipe cap positioning on the foil side. The stripline that remains from the original stripline filter is now nothing more than 50 ohm stripline which feeds the two probes of the pipe cap filter. You will have to patch the PC board with a few small scraps of copper foil or solder bridge the traces to extend the new 50 ohm stripline to filter probes. See Figure 3 for filter construction details. Exact compliance is not necessary.

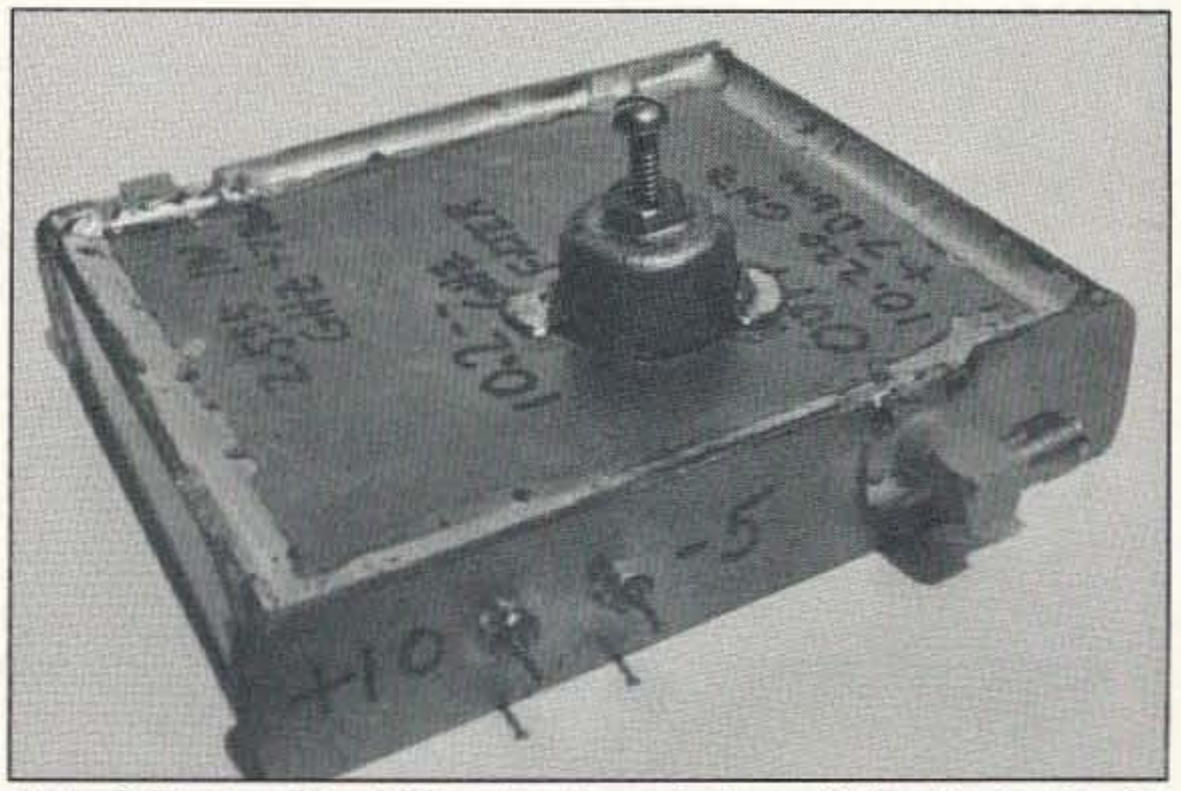

Photo C. The top of the PC board enclosure for the multiplier, showing the pipe cap filter and adjusting screw poking through the lid of the PC board case. Coax connectors for input output and DC feed-through capacitors have been added.

I started the modification on the multiplier board by removing the filter traces on the PC board with an X-Acto knife. See Photo A, the original unmodified PC board, and Photo B, the modified PC board. As you can see in Photo B, I drew a circle representing where the pipe cap will be soldered on the opposite side of the PC board, and left copper traces on the stripline side to solder to the probes.

The bottom of the PC board (ground side), where the filter probes are to be, is reamed away to give clearance for the brass pins. This prevents possible grounding of the pins. To ensure this and to give them a rigid structure, I used a portion of Teflon from a scrap SMA microwave connector to slip over the pins for positioning and insulation. If you don't have a connector to scrap, use the pin from a DB-9 or DB-25 connector, as the diameter is just right, and insulate. If you have a Teflon insulator or tubing, slide it over the pin to make the pin rigid and hold the pin vertical and not grounded.

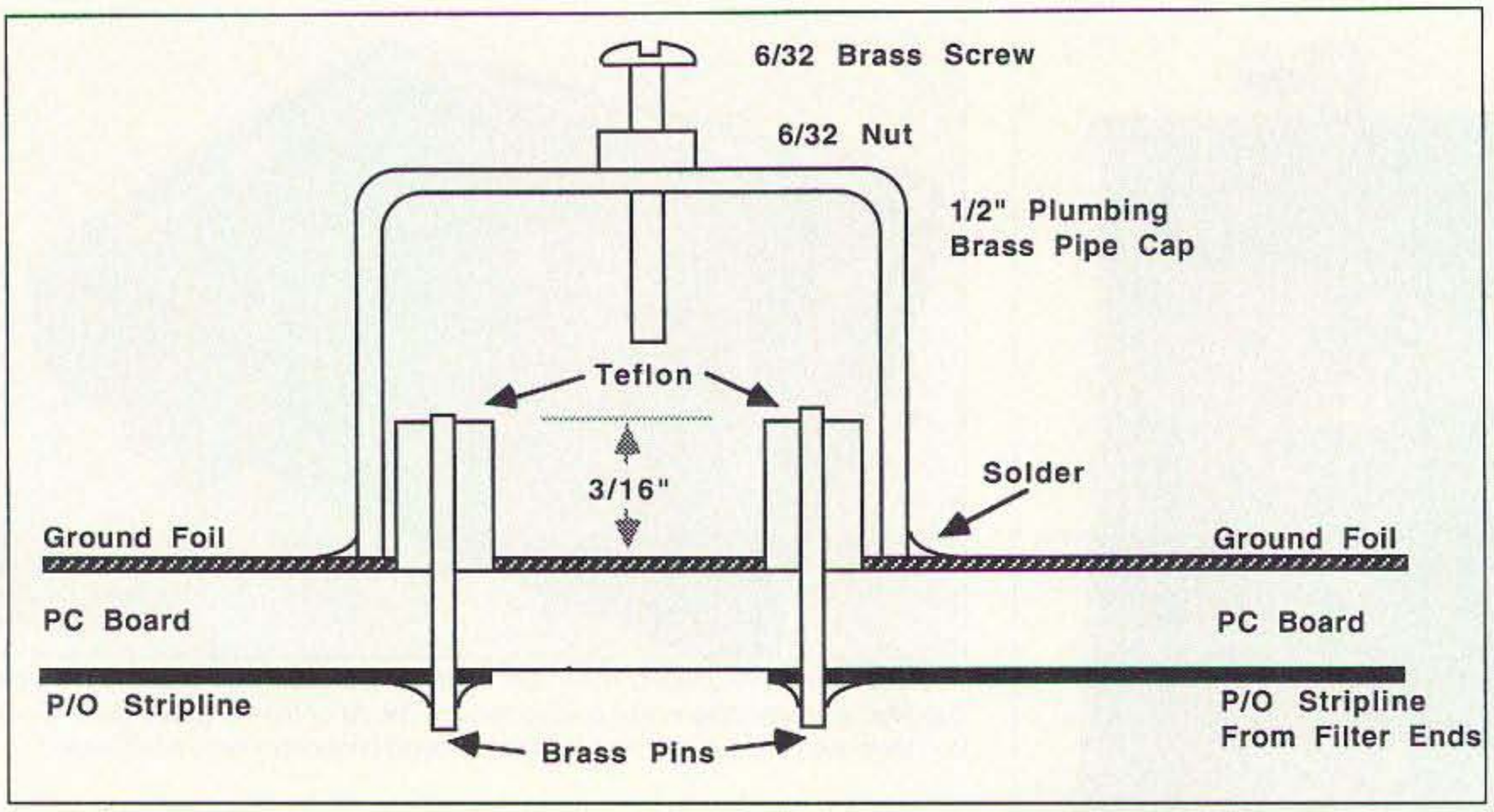

Figure 3. Pipe cap filter construction for 10 GHz operation. The brass pins are 3/16" long inside cavity. Round Teflon insulator is slipped over the pins to hold them vertical and to insulate from the cavity and the 6-32 screw.

Prepare the top of the pipe cap by drilling a hole in the top center of the cap. Tap for 6/32 threads and solder a brass nut over the hole. I used a steel screw to facilitate this operation, as the steel screw will not take solder well. The steel screw is to be used as a centering tool. The idea here is that the steel will resist the soldering operation and only allow the nut to be soldered to the top of the pipe cap assembly (centered on the hole drilled for the 6/32 screw). After the solder cools, the steel screw can be removed from the cavity. A brass 6/32 screw with a nut run up on the screw is placed into the cavity top. If you are not sure what kind of screw you have, test it with a magnet. I am sure you will identify many different screws that you thought were steel or plated steel, and you'll find that they are nonmagnetic and are most likely plated brass. Any of these are OK to use for cavity retuning. See Figure 3 and Photo C for pipe cap cavity details. The design is rather forgiving in the positioning and length of the probes and frequency resonance. The loss of the filter and coupling will be affected by probe length. I find about 3/16" to be a good choice for probe length.

When soldering the cavity (about and insulated from the coupling pins) to the PC board position, (use some form of sleeving on the pins to ensure they stand straight up and are insulated from the cavity side wall. Be ginger with solder in this application and try not to get solder inside the filter—it's very lossy at microwave levels. Don't overheat the pipe cap as components on the other side of the PC board might unsolder with too much heat. Tack-solder the cavity to the ground foil over the probes, near your planned ink line drawn on the opposite side of the board. An exact fit is not necessary; just center the 6/32 screw about the center of the probes and keep the cavity side wall off of the probes. If the cavity wall touches the Teflon, that's OK.

As you can see from Photo B, the finished multiplier assembly I made used scrap copper PC board material to fashion a case for the multiplier. It also made it quite easy to attach coax connectors to the very soft Teflon PC board. This gave the board a rigid feel that made modifications and operations easier on the workbench. During the re-adjustment step of modification I found that most of the gain improvements to the circuit were made on the

multiplier stage. Initially, I connected about +5 dB @ 2.555 GHz to the multiplier input and tried to observe output at 10.5 GHz, the 4th multiple. I cheated and used a bench oscillator for this retuning test and not the modified synthesizer (versatility and test control).

I connected a power meter to the output and found almost nothing for power out (less than -20 dBm). I started to tune the pipe cap filter (inserting the screw into cavity), and as I did the power increased. I tuned the filter for the best power output I could obtain and it was about a -6 dBm. I took a look on the spectrum analyzer and found out that the frequency was what I wanted, and further identified that the filter would only tune to the fourth harmonic, making the conversion of the filter quite easy. In other words, I was quite lucky. With this in mind, I am quite confident that you will not need a spectrum analyzer to make modifications as only a microwave power meter is needed.

To bring the power up I applied the standard "snowflake" copper tuning tools to the PC board to find hot spots. For those not familiar with tuning microwave circuitry and "snowflaking," I am referring to using bits of copper material to be moved about the RF portions of circuit board to retune the circuitry. Instead of moving bits of copper about the board much like a shuffleboard, construct some tools to do the job for you. The tuning tools are made by super-gluing small bits of copper foil to toothpicks. I used round toothpicks and cut off one end to make a slight flat spot to adhere the copper bit to. Make several of various-sized copper bits. I started off by getting some copper foil (from hobby or model railroad shops) and cutting it into miniature pieces about 0.050 to 0.100 square—the exact size is not important. I usually close my eyes and chop up a small piece of copper foil and then select what I want from the cutoffs. Some of these bits will be attached to toothpicks, and the others will be soldered on the PC board traces, duplicating the size and position that the toothpick "snowflake" test produced.

When moving the tools about the PC board, keep the DC power on and be careful not to short anything out—go slow. Remember to turn off DC power when you solder copper bits to the trace, with a duplicate bit of copper as indicated by the tuning tool, on a hot spot. These hot spots found in the "snowflake test" are places where you either add or remove copper from the existing trace. If by coming near a trace the power reduces, this might indicate that you need to remove copper foil or modify the trace at this point. It's like the drop in power is saying, "I don't want any more copper circuitry (in the form of traces), but I want less, so remove some (copper foil)." In some cases the width of a PC board trace need be reduced.

When making any changes, do it in a slow methodical manner and do not make large changes; go slow—a few thousandths at a time—and check for change. The rule is: wide traces, very low impedance; narrow traces, very high impedance. A 50 ohm trace on this type of PC board is about 0.035" wide or so. My hedge on this is that I don't know the exact dielectric constant for the material to calculate it exactly, so this is an estimate. As an example, 100 ohms = 0.015", and 20 ohms = 0.100" wide.

If, on the other hand, power increases when the area is approached by moving the toothpick with a copper bit attached, add copper to this area. Be careful to not short out traces with the copper bits as DC power is on when you are testing with the toothpick tools. When you add or remove traces to the board, turn off the power and use a static-free work station and grounded soldering iron. A temperature-controlled iron is the best iron to use. They operate from low voltage DC and are usually grounded. Static and high voltage soldering irons can produce enough voltage to zap a sensitive GaAsFET device. To minimize static at my work station, I connect a ground wire from my iron's ground to the work piece, a copper circuit board that serves as a common grounded work station. Don't forget the wrist strap with a built-in high resistance discharge path. The high resistance is there for your protection, as well as for static elimination. Ground the PC board with a clip lead to the common workpiece. Everything at common ground should eliminate any static problems.

In hindsight, I found that most of the gain improvements were made in the multiplier stage of the PC board. I obtained a +7 dBm output at 10.220 GHz by using a drive source at 2.555 GHz. No retuning was necessary in the 13.1 GHz stage to obtain this result. More power or better efficiency could be obtained by retuning the 13.1 GHz stage. I just stopped the modification without retuning this stage as +7 dBm power was all that was needed for a good mixer injection level. If you want to re-tune the multiplier's amplifier go about it in the same manner as the multiplier stage.

Well that's it for this month. As always, I will be glad to answer questions about this topic and related material. Please Send an SASE for a prompt reply. Next month I will cover a surplus Loran receiver that can be computer-operated to give you Lat-Long positions and convert them to six-figure grid squares for grid-square hopping. 73 Chuck WB6IGP

Number 23 on your Feedback card

ASK KABOOM

Your Tech Answer Man

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Getting Clipped

Radio as we know it today is an analog medium. Oh, sure, there's lots of digital control, and some digital signal processors have begun to appear. Still, in the end we modulate a carrier of some sort with some kind of analog information, even when we actually want to send digital data. The possible exception is CW, although that's debatable. But what exactly separates the digital and analog universes, and what happens when you push them beyond their limits? Let's take a look at some of the ways, both analog and digital, to represent information, and then examine the consequences of overdriving, or "clipping," them.

Squash

Just what is clipping? Well, imagine you're a circuit of some kind. You have limits, beyond which you just can't give any more. Along comes this signal which is so strong you can't handle it all. So, you give as much as possible and, when the signal goes out of bounds, you just stay at your output voltage limit until it comes back within your range. If we now graph your output or look at it on an oscilloscope, the highest and lowest points will be squashed flat, or clipped. That's serious distortion, and it has differing consequences, depending on what's being clipped.

In an analog system, information is represented by a changing signal which in some way mimics what you want to send. There are various ways to do that, and each behaves differently under clipping. Let's look at a few.

Baseband

You may have heard this term used to describe many kinds of signals. But, underneath all the definitions, such as video, data or audio, lies a common concept. Baseband refers to the original modulating signal, before it is impressed on something else. So, in a stereo system, baseband audio is just plain audio. In other words, it is not digitized, FMed, or whatever-ed. In video, it refers to the video signal as it comes from the camera, VCR or other video source. Especially in video, where RF modulators are common, the term really helps to keep things straight; is this switch handling baseband or RF? In radio, baseband refers to the signal you wish to send, or the one you've received after demodulation.

Sometimes, though, the definition can get murky. Let's say you receive an SSTV signal on 20 meters. Out of your speaker come the warbling tones which represent a picture. Are they baseband? Well, as far as the radio is concerned, they are, because they are demodulated audio. But, SSTV is sent as FM, meaning that the frequency of the warbling tones is proportional to the instantaneous brightness to be displayed on the TV screen. So, we don't really get to baseband *video* until the SSTV converter's FM circuits demodulate the tones into a varying voltage representing the picture elements. That voltage is truly the "baseband" video signal, albeit slowed down. Even more confusingly, the time-converted video signal actually sent to the TV monitor is also baseband video fast-scan video.

When you clip a baseband signal, its tops and bottoms get flattened. With audio, it sounds like tremendous distortion. With video, it disturbs the sync pulses, which are at the bottom of the signal, and it turns high-brightness points, such as facial highlights, to white. The sync disturbance can result in wiggly pictures which tear and roll as the scene changes. ATVers often have to wrestle with this problem, because it is hard to make RF transmit amplifiers which stay completely linear from edge to edge.

AM

This is one of the earliest modes, yet still one of the most complex. The modulating signal changes the strength of the carrier. Seems simple, right? At first, that appeared all there was to it. After a short time, it became clear that much more was going on. The concept of sidebands, in which the modulation appears in mirror images on either side of the carrier's frequency, was not immediately believed. It took quite a bit of mathematical development, and significant measurement and observation, before the sideband theory was accepted. Even now, you can hear debates as to exactly how much power is going into the sidebands and how much into the carrier, which is presumed not to actually change strength, despite how it looks on a scope!

Clipping an AM signal has drastic consequences. The amount the sidebands spread from the carrier depends on the modulating frequencies. When we clip, though, the rate of change of the carrier at the moment of clipping becomes very high, implying a

much higher modulation frequency than is actually present. That results in all kinds of sidebands very far from the carrier, which we call "splatter." It's a mess, both spectrally and legally.

SSB

Sideband, which is a special form of AM, suffers from the same problems when overdriven. But how can we clip a carrier when there isn't one? Well, remember that we are generating an RF signal and then making it cancel itself out in the modulator. The object is to create sidebands, one of which we then throw away and the other of which we send on to the antenna. If we clip the modulator, it generates the same kinds of false sidebands we'd get with AM, and we wind up sending those on one side. Of course, the sideband filter will keep the extra-wide ones in check. But, if the clipping occurs in the final amplifiers, the mess makes it to the antenna because it happens after the sideband filter.

FM

Is it possible to clip an FM transmitter? In theory, no. After all, we're just wiggling a carrier's frequency back and forth, so there should be no limit as to how wide we make it. In practice, though, the circuit stages have bandwidth limits. When we deviate the signal far enough to run into those, they will begin to cut the signal off as it approaches the outside points. The result is an "AM-ing" of the signal as its strength goes up and down, along with AM-like splatter and distortion.

The FM receiver is a special case. Its clipping points are set by the IF bandwidth and, especially, the detector bandwidth. If the transmitted signal exceeds the IF bandwidth, it'll get AM-ed just like it would in the transmitter example. If the signal exceeds the linear bandwidth of the detector, it'll clip the audio just as if it were an overdriven baseband amplifier.

"Baseband refers to the original modulating signal, before it is impressed on something else."

There's one place, though, where clipping is deliberately employed in an FM receiver in order to reduce susceptibility to impulse noise and other amplitude phenomena. In fact, this kind of clipping is what is responsible for FM's inherent superiority to AM in that respect.

The basic technique is to push the IF amplifiers beyond their linear limits, forcing them to clip. That flattens any noise spikes or other changes in amplitude riding on the received carrier. What's left is just the carrier signal, with nice, flat ends. Of course, it's a kind of serious distortion, but does it matter?

Not in this case. Remember, with FM the information is in the wiggling of the carrier's frequency, not in any amplitude changes. That frequency will survive the clipping process just fine. In fact, it'll be the only thing left, which is just what we want.

By the way, that rushing noise you hear when there's no signal on an FM receiver is caused by the same process; the small amount of internally generated noise in all circuits is amplified by the clipper (also called the "limiter") to the point where it wings from rail to rail (the upper and lower limits) and is detected as random noise.

Intermod

Intermod is caused by clipping, usually in the front end of a receiver. The overloading signals cause the front-end amplifier to distort, creating all kinds of sidebands of its own. Those then look like phantom signals. Also, clipping causes mixing of otherwise-unrelated signals, causing odd blends of them all over the dial. And, when a very strong foreign signal is present at a transmit antenna, intermod can occur in the final amplifier of the transmitter, making it broadcast the mess all over town, or even all over the world. If you don't believe me, ask any urban repeater owner.

Well, I hope you've enjoyed getting clipped in the analog domain. Next time, we'll take a look at what happens when signals clip in digital circuits. Now, let's look at a letter:

Dear Kaboom,

I have two mobile 2 meter rigs. With a strong signal, they're both fine. But, when I listen to a weak signal, the older one always seems to pick up lots of ignition noise, while the newer one doesn't hear it, even when I use the same antenna. Is the staticky one broken, or can I adjust it somehow?

Signed,
Headache #12

Dear Headache,

What a relevant letter for this month's discussion! No, neither of your rigs is broken, and there's nothing you can adjust. The quieter receiver has better-designed IF clipping stages, so it rejects more AM, which is what ignition noise spikes appear to the rig to be. I'm afraid you're stuck with it.

Until next time, 73 de KB1UM. 73

Number 24 on your Feedback card

73 INTERNATIONAL

Arnie Johnson N1BAC
43 Old Homestead Hwy.
N.Swanzey NH 03431

Notes from FN42

Before I started the column this month, I just had to reread the report from the Peter I DXpedition written by Peter ON6TT. He has such a great sense of humor spread throughout the report. I just wish that we had the space to print it all.

Another Mother's Day approaches as I am working on this column, which means that Hosstraders is just a few days away (the Friday/Saturday of Mother's Day weekend). It is another "great happening" similar to Dayton and others, but mostly tailgating out-of-doors.

There is much for all—one person's junk is another's treasure. It is really something to just sit back and watch the smiling faces go by lugging a "boat anchor" from days past. You've probably seen that same boat anchor go by during past Hosstrader's, too, if you really kept track.

I've already been given my "marching orders" from headquarters (my XYL): "No new stuff unless you get rid of some of the old stuff." She's said it in the past, and this time she really means it! If you saw some guy crying as he unloaded some of his "treasures" at bargain prices, it was probably me!. I hope that you were one of the lucky ones to get one of my "treasures." 73 'til next month.—Arnie N1BAC

Roundup

Brazil *From the WWSA News—Jan/Feb 1994:* The Brazilian magazine *Antenna-Electronica Popular* invites all amateurs worldwide to participate in the 13th edition of the well-known WWSA CW Contest.

The contest is held on the second full weekend in June (June 11-12, 1994) starting on Saturday at 1500 UTC and lasting until Sunday at 1500 UTC. A separate log for each worked band must be sent no later than July 31 to: WWSA Contest Committee, PO Box 282, ZIP 20001-970, Rio de Janeiro, RJ-Brazil.

Germany *From the Deutscher Amateur Radio Club (DARC):* How to Apply For a German Short-Term Amateur Radio Licence: Licenced foreign amateurs staying temporarily in Germany (on visit or in transit) may obtain a short-term amateur radio licence from the Deutsche Bundespost, valid for a period of three months, by directing their application, at least six weeks in advance, via Deutscher Amateur Radio Club, International Affairs, Postfach 11 55, W - 3507 Baunatal 1, Germany to Oberpostdirektion Dusseldorf. Licence fee and handling costs for a three-months' licence amount to DM15 (deutsche marks). This sum should be transferred, at the same time as the application is sent, in German currency (no IRCs, no stamps please) by postal money order to: Postscheckkonto (postal cheque account), no. 56 13-430 at Postscheckamt Essen, BLZ 360 100 43, for DARC—International Affairs—w—3507 Baunatal 1.

A German licence will only be granted if the applicant possesses a valid amateur radio licence of his national administration which is at least equivalent to the German licence class requested.

In the application, the following should be given: 1) Nationality of applicant; 2) First name and surname; 3) Date and place of birth; 4) Home address; 5) Home callsign, class of licence; 6) The three months' period requested; 7) Address of location of operation; 8) Address to which the licence document is to be sent; 9) Confirmation that the licence fee has been forwarded to the Postscheckamt Essen (photostat of payment slip); 10) Photostat of your home amateur radio licence, together with an indication of the date of issue and duration of validity, class and comparable German class of licence (Class C—144 & 430 MHz only; Class B—All HF band frequencies and 144 & 430 MHz; Class A—3520-3700, 21090-21150, 28000-29700 kHz, 144 & 430 MHz.); 11) Membership in a national amateur radio society (yes/no), and the name of the society. German short-term amateur radio licences are issued to foreign amateurs for periods of three months only, beginning on the first day of the month, as requested by the applicant. The short-term licence will entitle the foreign amateur to operate a fixed, mobile, or portable amateur station.

Peter I *Info from Peter ON6TT, European Coordinator 3YØPI:* There was excellent propagation during the first days of the operation. Europe was coming in fairly weak during the first week, which was of major concern to us. Propagation was very unpredictable. Sometimes we could work EU on 20m, from 0400 on, while the next day we could not hear them at all during the EU-morning. Sometimes 40m to EU opened up at 0000, sometimes as late as 0600. During the second week (excluding the weekend, unfortunately), signals from EU were fairly strong, but it seemed that despite 2 kW and yagis, EU could not receive us very well.

30m was a disaster. The band was almost completely covered with South American SSB pirates. On 40m and 80m we had problems attracting EUs' attention, especially in SSB. We would hear very strong signals, but could not get anyone to answer us. In that case, we answered somebody's "CQ DX" (most of the time he would not believe it was us answering his call) and asked him to look for a frequency clear for us to transmit on. Normally, this worked. Reception on the low bands was very good, though (no man-made noises). We had only one good opening to EU on 160m.

After one day of operation, we found that stateside would cover up all EU signals, so we favoured EU from the moment we could hear them. Sometimes, we tried to work very weak EU-signals, leaving 9+30 USA people waiting for a while. Nevertheless, we could not leave any continent waiting for too long a time, so sometimes it could happen that you would hear us with weaker signals working the USA, and not working Europe. And believe me, this was not easy. We held statistics on what continents were worked on what bands and modes, so we would give everybody an equal chance for as many band modes as possible.

Living conditions: We had two operating shelters of 8 x 8 ft. (one CW and one SSB), a kitchen shelter of 8 x 12 ft. (used to sleep, awaiting evacuation of the island), and a sleeping shelter of 12 x 24 ft. Shelters were warmed with propane heaters (six bottles of 100 kg propane each). Our separate top-open toilet shelter with a homemade toilet seat proved to be very useful (but we had to count on digging out five feet of snow before "taking a sit").

Power: Two 4 kW Onans and two 5 kW Hondas, with 14 barrels of gasoline (200 liters each). Don't worry if the

Onans lose parts like bolts, nuts, mufflers and pilots. As long as they keep on vibrating on their wooden crate-cover bases, while trying to mate with the Honda next to them, they tend to keep on working.

Antennas: 15, 20, and 40m mono-yagis; 10-15-20 tribanders, 12-17-30 tribander, HF verticals, wire antennas, and 70cm/2m yagis for satellite.

Radios: Nine Kenwood rigs of various kinds (four died during the operation); four Alpha amps, which ran beautifully without a hiccup. Various satellite and RTTY gear was QRT upon arrival (rough handling) or went QRT shortly thereafter.

Computers: For various reasons, computers were only used for RTTY, and by one op for logging. After five days we were left with only one working computer power supply. Most of the logging was done on paper. Yes, you can run RTTY pileups, even if the only way to switch between transmit and receive is by resetting the modem.

Luckily, all people involved (hams from the London area, Falklands, Punta Arena, locals from Falklands, the Antarctic bases and South America) were *very* helpful; we were well prepared (shelters, clothing, transportation) and had extensive spare equipment; we had the pilot stations (thank you John ON4UN and Mark ON4WW for the super job as the European pilots!) to keep us linked to the DX community, to our homes, and to all kinds of people involved in this operation (transportation, manufacturers, etc.). Both of you put in so much time, effort, and quality in your tasks that it is difficult to thank you enough; as operators, we were very motivated to bring this challenge to a good end. I think it was this motivation that got us through.

It is really difficult to describe all of the non-radio stuff involved in such an operation. Come to one of the upcoming presentations and you will understand. One thing: We were not complaining about the hardship we went through. On the contrary, all of us are proud, very proud of what we did.

[I wish that I could have printed the complete report from Peter ON6TT. It has a genuine humor that makes easy reading and makes certain humorous points about the living conditions endured to bring the rest of us contacts from one of the "rare ones." Thank you all for a job well done!—Arnie]

MONACO

Daniel Plett 3A2LZ
B.P. 349
MC 98007

Greetings to all from Monaco. This has been a rather quiet spring here in the Principality—not too much unusual going on. The Association des Radio-Amateurs de Monaco had its annual meeting. The first order of business was the election of the council for this year. Most of the council members remained the same. The only change was at the position of General Secretary. Claude Passet 3A2LF, who has worked hard at that position for a number of years, is taking a year off. Serge Salganik 3A2HN is filling the position for this year.

A number of projects are in the works. Last year, some of the local hams were asked at the last minute to help the Monaco Red Cross during the Monaco Grand Prix. They apparently liked the help and have asked us to help again this year.

A foxhunt/direction-finding competition is planned for June 19.

The Monaco repeater is about the only repeater between the Italian border and Nice, France. The mountains further complicate VHF communications in the area. The Monaco repeater has an unusual split though which cannot be accommodated with many 2 meter rigs. One of our projects is to modify it to work on a normal split.

There is no further news on the 6 meter situation. 6 meter activity in Monaco and the nearby part of France is still prohibited.

Finally, I1YRL was legally active from Monaco the beginning of April, especially on 30 meters. Congratulations if you worked him.

Let me remind you again that the Monaco QSL bureau can only be used for members of the A.R.M. We receive a number of QSLs for nonmembers, and this causes problems. And, the only correct address for the A.R.M. is Box 2, Monaco. A number of other addresses appear in various DX publications but are incorrect.

Best 73 from Monaco. Daniel 3A2LZ.

PHILIPPINES

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Neg. Occ.
Philippines

First, thanks for the many letters from the readers of this column. I enjoy answering my mail but can't afford to answer letters without an S.A.S.E. I already have a lot of BURO QSLs to answer for IOTA OC-129, and also many direct cards without S.A.S.E.s, which I have no choice but to return via BURO.

This month I decided to bring our readers up to date with the additional guidelines for the renewal of an amateur radio license and application for amateur radio examination.

I. Renewal of Licenses: 1) Before an Amateur Radio License or Operator's Permit is renewed, the applicant must show proof of his/her involvement in amateur radio activities. An Amateur Radio License holder may be involved in any of the following: a) DX—He/she must be able to present Log Extracts and/or QSL cards, DX Awards earned as a result of his/her DX activities; b) Technical Experimentation—He/she must show proof of being involved in the technical aspects of the hobby, which may include propagation tests and exploration, electronic innovations (such as the improvement of present equipment and accessories), home-brewing of equipment and accessories. These must be properly documented with the submission of test results, drawings and circuit diagrams where necessary; c) Emergency Communications—He/she must show proof of having been involved in purely Amateur Emergency Communications and, in the case of an emergency or disaster situation, participation and active membership in the Amateur Radio Emergency Service (ARES) will suffice; d) Active membership in an Amateur Radio Club—An amateur radio enthusiast can only grow and progress in his/her hobby through an exchange of ideas and the support of his/her fellow amateurs. Membership in an NTC recognized Amateur Radio Club therefore is vital and important. This is optional but highly encouraged; e) Field Expedition—This amateur activity is highly encouraged for radio amateurs. A group can conduct a field expedition by securing for a permit from the Commission (NTC) and a corresponding special DX callsign will be assigned for the purpose.

2) The proof of Amateur activity will come in a form to be submitted by the applicant with his/her application for renewal (Form ARSCP-001). This form must be endorsed by a local club, duly recognized by the NTC as an Amateur Radio Club or a Class "A" Amateur Radio license holder. The applicant need not be a member of the club where the endorsement was obtained from, but the club or Class "A" endorser shall be held responsible for such endorsement of the applicant.

II. Applicant for Amateur Radio Examination: 1) An applicant for the Class "C" or "D" amateur radio examination is required to attend an orientation seminar conducted by an authorized radio club or a Class "A" amateur license holder with corresponding endorsement before he/she is allowed to take the corresponding examination; 2) The authority of an amateur club or Class "A" amateur license holder to hold seminars and endorse examinees can only be issued by the Amateur Radio Consultative Panel. The authority given to an amateur club or a Class "A" Amateur license holder shall be for a period of one year only (renewable) unless sooner suspended, canceled, or revoked for failure to comply with the standards and agreement set-forth by the Amateur Radio Consultative Panel. 73

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Never Say Die

Continued from page 4

gram like this and I've missed it, please let me know.

It allowed me to enter the monthly sales figures for up to 10 years of sales and would display them. Then I could ask it to do a graph of the figures and it would give me max and min numbers and ask what max and min I preferred for the graph. Once I typed those in it would present the graph, showing the sales for the 10-year period. Okay, we probably have programs today that'll do that much. The next step was to ask it to do a moving average of sales. It would ask over what period. I'd tell it 12 months. It would consider that for a minute and give me a chart of the numbers. Then I'd graph the moving average. These graphs and charts could be easily printed, just by hitting a key combination.

Now we come to the more valuable part. It could calculate the second derivative of the sales figures, showing the acceleration or deceleration of sales. I found that the number of pages of ads in *73* and in *QST* both had a curious 18-month sine curve that continued for years. Even more valuable was the ability of the program to project sales into the future, based on trends and taking into consideration periodic changes, such as seasonal sales changes. Is there anything out there that can do this? I'll buy it!

We're not talking Einstein here. The math required for all this is relatively simple, it's just that no one has bothered to build this into a program for the last 15 years. Phooey. Instead they've been busy providing us with three-dimensional graphs and junk like that. Hey, guys, keep it simple!

So what happened to Instant Software? It was a good idea and it did fairly well, but when I sold my computer magazines to IDG, they didn't want to be bothered with mass-produced software. And without the infrastructure provided by the magazines, it couldn't continue. But we learned a lot and had tons of fun doing it.

For instance, we learned not to try to sell educational software to schools. We wondered why some of our prize-winning stuff was selling so poorly. When we studied our sales we found that we were selling one copy to each school and they were making all further needed copies. A couple years later we did another study and found that by then we were selling one copy to each school district. I talked with several other software companies and found they had the same experience. That's when educational software stopped being produced. And that's one reason we still don't have much of it that's any good.

At our peak in 1983 we had around a hundred people employed, were supporting over 250 good programs, were expanding rapidly into Europe and considering opening an Irish plant. Then IDG pulled the plug.

Let me know if you ever see a good business analysis program for the Mac.

Ahh, the Mac. I went out to Cupertino for the unveiling of the original Mac. There was tremendous hoopla, but I wasn't impressed. The IBM PC had come on the market the year before and it almost instantly wiped out the TRS-80. Up until then the microcomputer market was split with Radio Shack having 40% of sales, Apple another 40% (Apple II), and about 200 smaller companies sharing the other 20%. Old-timers will remember CompuPro, Morrow, Ohio Scientific, Midwest Scientific, and a bunch more.

Apple was semi-friendly to third-party supporting businesses, but Radio Shack was hostile. Really hostile. So when IBM came along, they had no problem in capturing most of the third-party support from Radio Shack, and that quickly collapsed Radio Shack sales. They went, in about one year, from 40% of the market to about 4%, and have never really recovered. The chairman, John Roach, never forgave me for predicting that this would happen unless they changed their policy of fighting third-party support. But did he learn from this? Har-de-har. So Radio Shack has been a very minor player ever since and Radio Shack lost billions in potential sales. Tens of billions. My view is that they could have prevented the IBM putsch, if they hadn't been so blinded by their own greed.

The Mac? It didn't really get anywhere until desktop publishing came along. The Mac has stayed a year or two ahead of the PC in that field, and that's been its main strength. The Mac PowerBook was a major step ahead for writers like me. I'd tried several PC-type laptop computers, but none of them were as easy to use as my old Radio Shack TRS-80 Model 100, which I bought the day it came out in 1983. That went everywhere in the world with me.

Last year I was about to start a PowerBook magazine when I saw the trouble coming for Apple as a result of Scully's ego-fascination with the Newton. That got him fired, which was well-deserved, I thought. But his replacement seemed weak, so I was afraid that Apple would be rudderless. And that's about the way things have turned out. My decision to not start the PowerBook magazine last year has proven to be prescient.

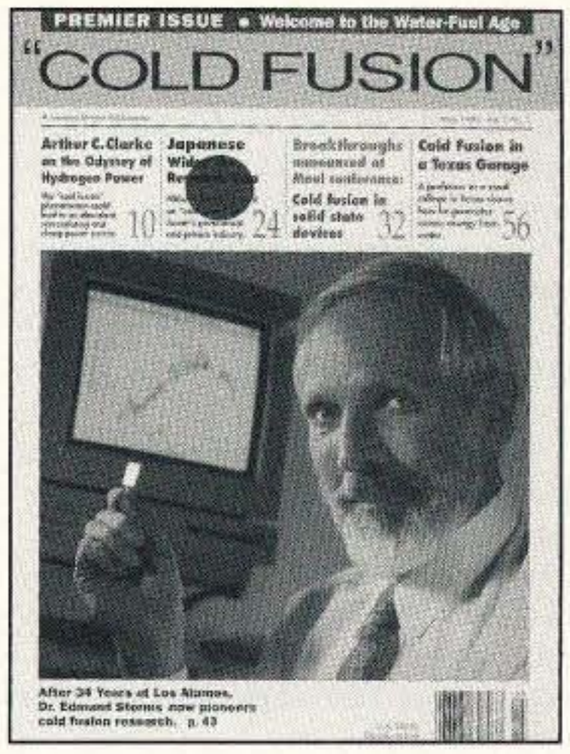
Scully, swept up in his visions of the information superhighway, jumped without looking very carefully to another firm, which turned out to be built mostly on vapor, which is a common enough foundation in the computer field. So Scully is joining the parade of has-beens in the field . . . like Jobs, Tramiel, Busey (TI), DeCastro (Data General), Olson (DEC), and An Wang.

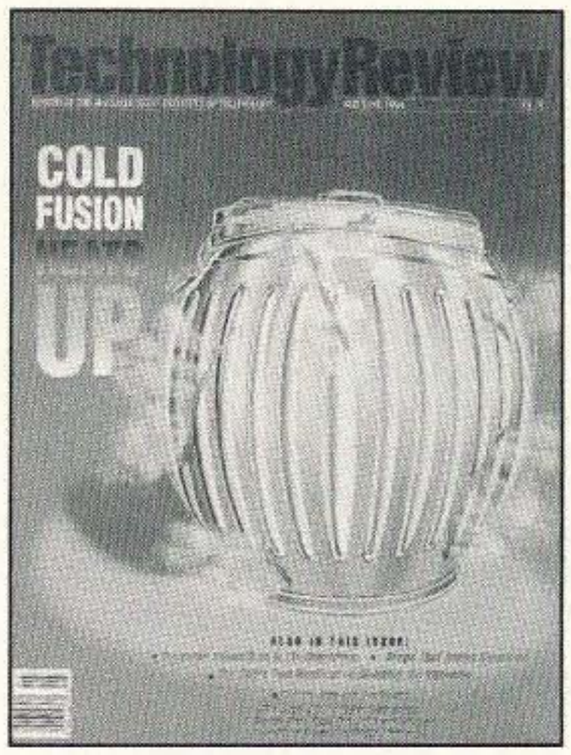
Oh, you probably don't care about all that old stuff anyway. I just can't help remembering how interesting it was in the early microcomputer days. I really should write about them some time.

Cold Fusion Validation!

The *Popular Science* article last August saying that cold fusion had been given a premature burial by some powerful vested interests almost got me to thinking. Like many others, I'd been excited over the prospects cold fusion offered when Pons and Fleischmann announced the break-through in 1989. Then the whole idea was trashed by some vocal scientists, who were given the usual extensive media coverage providing bad news.

Then I read in the Rensselaer *Review* that students had confirmed the generation of excess heat as reported by Pons and Fleischmann. This was followed by two books blasting cold fusion as a hoax. What in heck is going on here?





Next I heard from a *73* reader who was deeply involved in the cold fusion field. He assured me that the effect was quite real, despite the naysayers. He started sending me information confirming that researchers worldwide had successfully duplicated the early experiments and were busy developing the technology. He convinced me that there was a need for a magazine to help this new technology grow into an industry. It didn't take a lot of convincing.

I'd seen the power of a magazine when I decided to try and pull amateur radio out of its deep decline following the catastrophic ARRL relicensing effort in 1964, when our growth went from 11% per year to around a 3% negative growth. We needed something new to get the hobby going again and 2 meter FM and repeaters seemed like the ticket.

So I began publishing hundreds of articles on the subject in *73.* Then I started the *Repeater Bulletin,* to further push the technology. That was followed by a series of books and repeater atlases. It was the Chicago hams who developed the cellular approach for their repeater system. Once I saw that I knew that it wouldn't be long before this service would be made available to the general public.

Within a couple of years we went from having isolated repeaters put up by pioneers to a nationwide network. I found myself able to make repeater-assisted phone calls while I was on skis in Vermont, almost anywhere in New Hampshire, and even from the ski slopes in Aspen! Sure enough, GE and Motorola grasped the significance of what we'd developed and cellular telephones were born.

Personal Computers

It was my success with repeaters that got me to thinking about the critical importance of a publication to help new technologies develop into industries. The articles I published in *73* and the *Repeater Bulletin* had helped the pioneers speed up their research by providing the needed communications. Further, my publications attracted the interest of more pioneers and helped bring them up to speed. And lastly, they made it possible for entrepreneurs to go into business supplying the pioneers, building an industry.

Within three years repeaters had become the largest single interest in amateur radio and built a $100-million new ham industry. I particularly enjoyed that because the first reaction of the *73* readers was to complain bitterly about my publishing so many repeater articles. I got hundreds of letters threatening to cancel subscriptions if I didn't cut it out. Then gradually I began to get letters saying, hey, this stuff is fun . . . thanks. At the time I was the only ham publisher covering this new technology, so I felt that *73* deserved most of the credit for what resulted.

When, in January 1975, the first microcomputer was announced, I saw the significance of the technology and decided it was time to see if I could do it again. I started trying to find an editor who understood computers. For months I chased after the editors of computer hobbyist newsletters to see if they might be interested in working with me. Finally, in May, I found a chap in Boston who had been publishing a hobbyist newsletter with about 200 circulation. He was game to give it a try.

I set to work getting articles from ham authors who'd been submitting computer-oriented material to *73.* I got the names and addresses of anyone who'd ever written to the suppliers of parts for computers. Some of them, like Bill Godbout, had been advertising

quite successfully in *73*. I got shoe boxes full of names from these companies and sent out subscription offers. The response was incredible. Most direct mail is considered a success if one percent of the potential customers buy. I was getting 20%!

The first issue of *Byte* came out in August 1975 and looked pretty good as a starter. The *73* editorial and production staff had done most of the work. It was just five weeks from the time we'd decided to start the magazine until the first issue went on the presses! I decided to visit the prospective advertisers personally, so I made a trip to Albuquerque to talk with Ed Roberts, who started it all with his MITS 8800 Altair microcomputer. I also visited Sphere in Salt Lake City, a computer game group in Phoenix, and Southwest Technical Products in San Antonio, bringing copies of the first issue with me. I also stopped by to say hello to my old friend Ed Juge, a *73* advertiser who owned a ham store in Fort Worth. I gave him a copy of *Byte* and warned him that microcomputers would turn into a huge industry. Ed had managed to survive the "Incentive Licensing" holocaust, but by 1975 was ready to give up trying to run his store.

Later I found that he'd gotten so excited over the magazine I'd left that he bought an MITS Altair and had become addicted. When Radio Shack got into the business with their TRS-80 Model 1 in 1977, Ed got one and started programming it. In fact, when I went into the business of selling software in 1978, two of my first program releases had been written by Ed. The next thing I knew Ed was working for Radio Shack. He's still there.

Between *Byte, Kilobaud, Microcomputing, 80 Micro, Desktop Computing, InCider,* and a few of my other publications, plus dozens of books and hundreds of software programs, the personal computer industry grew rapidly. By 1982 *Byte* was the largest consumer magazine in the country and my *80 Micro* was the third largest. *Vogue* beat it out for second place.

Compact Discs

When the compact disc was introduced to America in 1982 I decided there was a need for a magazine to help this new technology grow. I started work on this in 1983 and within a couple years it had become the most influential music magazine in the country. CDs became the fastest growing consumer industry in history.

When Sony came out with 8mm video I tried to interest them in a supporting magazine. I was unable to get any cooperation from them. They didn't see the importance and refused to talk about it. I wonder how big that industry might be today if Sony hadn't been run by marketing people with blinders.

Cold Fusion

Considering the strength of the opponents of cold fusion, mostly made up of scientists getting billions of dollars to try and develop hot fusion, and rightfully afraid that cold fusion might drain some research dollars . . . or even put them out of business . . . getting a supporting magazine started looked like an uphill job. Worse, since everything was still in the research phase, there were few potential advertisers.

As I looked into the situation I found that while labs around the world were reporting success in generating unexplainable heat, no one had a theory that explained what was being reported. Researchers were empirically trying this and that. They needed better communications.

The prestige science magazines refused to publish anything about the field. Since what was being reported was "impossible," therefore every scientist involved had been making stupid mistakes or else lying about their data. This mindset controlled the Department Of Energy (DOE), and even the US Patent Office, where cold fusion was classed as being as impossible as perpetual motion.

Pons and Fleischmann were so upset over all this that they left the country. The Japanese quickly took advantage of the situation. Toyota approached Pons and Fleischmann and offered to set them up with a dream laboratory on the French Riviera . . . where they are making great progress with their research.

I decided to go ahead with a publication. I announced it at the Fourth Cold Fusion Conference on Maui in December. My editor was Dr. Eugene Mallove, the author of *Fire From Ice,* the only even-handed book on cold fusion. At the conference I listened to hundreds of papers reporting the progress in the field and had an opportunity to meet the scientists involved. Yes, including Pons and Fleischmann. It was an exciting conference.

Upon returning to New Hampshire we started working on *"Cold Fusion"* magazine. We put the title in quotation marks because no one yet has a good theory of where the enormous amounts of heat being generated are coming from. The first issue was mailed in April, dated May on the cover. I didn't need any jokes about it being an April Fool magazine.

In late March the BBC and CBC (Canadian) broadcast well-researched documentaries on cold fusion. They gave time to the naysayers, but they left no doubt that the phenomenon was quite real and probably the most important scientific discovery of the century.

This was followed by the May issue of MIT's *Technology Review,* which had a cover feature on cold fusion, complete with an 11-page article by Dr. Ed Storms, who was our cover scientist for the first issue of *"Cold Fusion,"* so things were beginning to break. Just to give you an idea of how positive this article was, let me give some quotes.

"Some cold fusion experiments have reportedly produced power densities higher than those of uranium-fueled fission reactors . . . Experiments that use crack-free palladium and follow the proper procedures now routinely produce heat, nuclear products, or both . . . For cold fusion to occur, the palladium probably must transform into a special condition of matter, akin to superconductivity . . . None of the proposed explanations for cold fusion accounts for the full range of experimental observations."

My predictions of cold-fusion-powered cars with a sealed unit that would provide power for years was being backed up by Nobel-Laureate scientists. Sure, the first products will be big and expensive. You only have to visit any science museum to see what early steam engines and internal combustion engines looked like. But as we find out more about this power source I believe we'll have fuel-less planes and $100 round trips to Africa. We'll probably have micro-sized generators powering wrist communicators. Shades of Dick Tracy! Our homes will be heated and powered by units smaller than a bread box. No more need for oil, gasoline, natural gas, coal, those big wind turbines, or even inefficient solar power.

Free power? Just about. No more gas stations or oil spills. No more coal mining or well drilling. Well, we needed something. With the known reserves of fossil fuels already 50% used up, the era of low-cost oil and coal was coming to an end.

The Opportunity

With the deathblow to the naysayers by the *Technology Review* article, we'll start seeing some money going into R&D here in the US. Japan is way ahead of us in this field, so we've a lot of catch-up to do. Considering the head start Toyota has, I'm predicting that perhaps as soon as the 1999 model year we may see a free-energy Toyota announced.

We're going to see many more millionaires and billionaires as a result of this new industry. And we're going to see a mighty scramble by the power and oil companies to cope with the changes. The power companies haven't been as impressed by the naysayers as the government, so they've been helping to fund some research. I suspect they've a game plan of reducing the cost of electricity with this new technology, and thus hoping to stave off a massive move toward home power units.

One outfit, ENECO, has been working quietly to get as much control of the patent applications in the field as possible. This could pay off big for them. The scientists involved need a business organization to represent their interests, and to help fund their continuing research, so it's a good marriage.

With the publication of *"Cold Fusion,"* the TV documentaries, and the MIT article, I think we'll even see the media beginning to take a positive look at what's been going on.

Yes, the chemistry and physics involved with cold fusion seem formidable. But when you remember that even the experts are unable to explain what's happening, maybe coming up to speed in this new technology isn't as impossible as self-defeated people alibi. When solid-state electronics came along in the 1950s many of the old tube people gave up and didn't even try to keep up. Transistors turned into ICs, which got ever more complex. In an effort to build a universal controller chip, Intel came out with the 4004. This was upgraded to the 8008, the first 8-bit chip. Hobbyists took one look and decided they could turn this controller chip into the heart of a microcomputer by adding appropriate software. That was the beginnings of the microcomputer revolution. Intel upgraded to the 8080 chip, which Ed Roberts, a computer hobbyist, used as the heart of his Altair 8800. This product came just in time to save MITS. They had bet the farm on solid-state calculators, which they were selling for $130. Just as calculator prices dropped by about 90% Ed announced the Altair and got over $5 million in orders in 1975.

So I had to start over and learn how computers worked. It wasn't easy at that time because there weren't any textbooks worth a damn.

Now I'm learning about palladium loaded with hydrogen. Again there are no textbooks to help. I'm learning about nickel and hydrogen, and so on. And I'm not doing one single thing that you couldn't do, if you had the interest. I'm learning about deuterium, tritium, neutrons, gamma rays, and so on. It's exciting. I'm almost beginning to understand the arcane language of the scientists working with this stuff.

And like almost everything else I've tackled, I've found that it isn't a question of brains, it's just one of perseverance. Edison pointed out that genius is 99% perspiration and I have no reason to question him on it.

Oh, it does help to keep an open mind and absolutely refuse to ignore anomalies. Pretty soon you find that things start fitting together and making sense.

No, no one yet has a good theory for how the cold fusion effect works. But then we don't have a theory we agree on yet for electricity, gravity, and even inertia. Many scientists are going back to the concept of "ether" as a medium in which radio and light "waves" travel. If you read much, you'll be reading about all that.

As you get into all this you'll find there are a mass of newsletters and departments on CompuServe and the Internet dedicated to discussing these ideas. What there isn't is any guide to all this. And don't ask me to volunteer for that one . . . I've got my hands full with cold fusion. 73

Number 25 on your Feedback card

SPECIAL EVENTS

Ham Doings Around the World

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the January issue, we should receive it by October 31. Provide a clear, concise summary of the essential details about your Special Event. Check ***Special Events File Area #11*** *on our* ***BBS (603-924-9343)****. for listings that were too late to get into publication.*

JULY 4

HARRISBURG, PA A Hamfest will be held by the Harrisburg RAC, 8 AM-2 PM (Set-up at 6 AM). Location: Bressler Picnic Grounds. Contact *Steve Gobat KA3PDQ, 1600 Old Trail Rd., Etters PA 17319; (717) 938-6943.*

JULY 8-10

GANDER, NF, CANADA The ARC of Central Newfoundland (ARCON) will host a Hamfest at Hotel Gander. Flea Market, Seminars, Banquet. Contact *ARCON, P.O. Box 281, Gander, NF, Canada A1V 1W6.*

JULY 9

SOUTH MILWAUKEE, WI The South Milwaukee ARC Inc. will hold its 25th annual "SWAPFEST" at the American Legion Post #434 grounds, at 9327 S. Shepard Ave., Oak Creek WI, from 7 AM-2 PM CDT. Talk-in on 146.52 WA9TXE/9 or phone *(414) 762-3235.*

JULY 9-10

INDIANAPOLIS, IN The Indianapolis Hamfest Assn. will host the ARRL Central Div. Convention at the Marion County Fair Grounds. Flea Market. Exhibits. Forums. Banquet. T-Hunts. Contact *Indianapolis Hamfest Assn., P.O. Box 11776, Indianapolis IN 46201. Tel. (317) 251-4407.*

JULY 10

BALTIMORE, MD The Maryland Hamfest/Computer Fest will be held at Timonium Fairgrounds on York Rd. Set-up 2 PM Sat., July 9th. Tailgating area opens at 6 AM Sun., July 10th; buildings open at 8 AM. VE Exams will be given at 10 AM only. Pre-registration is required. Call *Les McClure W3GXT, (410) 833-8667* to pre-register. Talk-in will be on 147.03 and 224.96 MHz Rptrs. For Hamfest info, call *(410) 467-4634;* or write *BRATS Hamfest, P.O. Box 5915, Baltimore MD 21208.*

PITTSBURGH, PA The 9th annual Hamfest of the North Hills ARC will be held 8 AM-3 PM at Northland Public Library, 300 Cumberland Rd. Flea Market. Seminars. Silent Key Estate Sale. Talk-in on 147.69/.09. Contact *Don Jackson N3LAZ, 915 Dale Ave., Bradford Woods PA 15015. Tel. (412) 935-3343.*

JULY 16

LANCASTER, PA A Computer and Electronics Show, sponsored by Red Rose Repeater Assn., will be held 9 AM-3 PM at McCaskey H.S. Set-up at 7 AM. Talk-in on 147.015+. Vendors contact *Larry Harman, Box 182, Leola PA 17540. Tel. (717) 656-0129. Fax (717) 656-3474.*

JULY 17

VAN WERT, OH The Van Wert County Fairgrounds Commercial Bldg. will be the location for a Hamfest sponsored by Van Wert ARC (W8FY). Time: 8 AM-4 PM. Talk-in on 146.850. VE Exams, pre-register by July 10th: Contact *Bob High KA8IAF, 12838 Tomlinson Rd., Rockford OH 45882; Tel. (419) 795-5763 (before 5 PM.* T-Hunt. Hamfest. For info, call: *Bob WD8LPY, (419) 238-1877, after 5 PM.*

JULY 24

QUEENS, NY The Hall of Science ARC Hamfest will be held at the New York Hall of Science parking lot, Flushing Meadow Park, 47-01 111th St. Doors open 9 AM. Set-up at 7:30 AM. Contact (at night only), *Charles Becker WA2JUJ, (516) 694-3955;* or *Arnie Schiffman WB2YXB, (718) 343-0172.* Talk-in on 444.200 WB2ZZO/R, or 146.52 simplex.

STICKNEY, IL Hamfest '94, sponsored by the Dupage ARC, will be held at Hawthorne Race Course, 3500 South Cicero Ave. Flea Market. VE Exams and CW testing 9 AM-12 noon., walk-ins welcome. Please have your original license, a photo copy and a photo ID. For table info, call *(708) 985-9256.* For advance tickets, send SASE and a check payable to DARC to *Hamfest '94, 7511 Walnut Ave., Woodridge IL 60517.*

JULY 30

ASHEVILLE, NC The 19th annual Western Carolina Hamfest (ARRL sanctioned) will be held 8 AM-4 PM at Haywood County Fair Grounds (near Waynesville and Lake Junaluska). For Dealer and Flea Market info, contact *Miriam Smith KB4C, (704) 683-4251.* Get general info from *Dick Critchell KY2Y, (704) 299-7856.* Ticket contact is *Ray Crepeau WB1HGO, (704) 298-7289;* or mail an SASE to *WCARS, P.O. Box 1488, Asheville NC 28802.*

JULY 31

SUGAR GROVE, IL The Fox River Radio League will hold its annual Hamfest at Waubonsee Community College, Route 47 at Harter Rd. Open to the public at 8 AM. Set-up Sat. July 30th at 7 PM, and Sun. July 31st, 6 AM-8 AM. VE Exams at 10 AM. Talk-in on 145.470 (-600). Contact *Bill Schaben WA9AUW, (708) 208-4870;* or *Mark Hougaard KB9FCC, (708) 979-1717.*

AUG 1

DOYLESTOWN, PA The Wyndmoor AR Repeater Club of Doylestown will meet at the Doylestown Township Bldg. Community Room on Wells Road, at 7:30 PM. Interested persons may call *Bob Agans, (215) 348-7966.* The Club features speakers and videotapes on topics concerning amateur radio, and they get together to study for license tests, etc. They often schedule weekend excursions to ham radio events.

AUG 5-7

VERNON, BC, CANADA The 3rd annual Sky High Hamfest will be held by the North Okanagan RAC, at Silver Star Mt. Resort. Flea Market. Dinner & Dance. HF Station. More. Contact *North Okanagan ARC, P.O. Box 1706, Vernon BC V1T 8C3, Canada.* For hotel reservations, call *1-800-663-4431.*

AUG 6

INDIANAPOLIS, IN The annual WA9SNT Hamfest will be held at ITT Tech. Inst., 9511 Angola Ct., from 8 AM-3 PM. Set-up at 6 AM. This event is sponsored by the ITT Radio Club. Talk-in on 145.25-. Contact *Dave Johnston K9HDQ, (317) 875-8640.*

VALPARAISO, IN The Porter County Hamfest and Computer Show, sponsored by the Porter County ARC in co-operation with The Porter County Tourism Bureau, will be held at Porter County Expo Center. Doors open at 8 AM (set-up at 6 AM). VE Exams 9 AM-12 Noon. Talk-in on 146.775/-6kc 131.8 PL and 146.520 simplex. Contact *Rich N9QLQ, (219) 762-8701;* or send SASE to *PCARC HamFest, P.O. Box 1782, Valparaiso IN 46384-1782.*

AUG 6-7

JACKSONVILLE, FL The Greater Jacksonville Amateur Radio/Computer Show/ARRL Northern Florida Section Convention. will be held at Osborn Convention Center in downtown Jacksonville. Flea Market. Hours: 9 AM-5 PM Sat.; 9 AM-3 PM Sun. Set-up at 2 PM-6 PM Fri. and 7 AM-9 AM Sat. VE Exams Sun. at 9 AM. Contact *Greater Jacksonville Hamfest Assn., P.O. Box 27033, Jacksonville FL 32205. Tel. (904) 350-9193.*

AUG 7

CROOKED LAKE, ANGOLA, IN The Annual Land of Lakes Angola Hamfest, sponsored by the Land of Lakes ARC, will be held 6 AM-2 PM at Steuben County 4-H Fairgrounds, corner of 200W & 200 N. VE Exams for all classes. Talk-in on 147.180, 145.090 packet, 444.350 131.8 tone, 444.900/.100, 224.94, 53.050. Contact *Sharon Brown WD9DSP, 905 W Pkwy. Dr., Pleasant Lake IN 46779. Tel. (219) 475-5897.*

MARSHFIELD, WI The Marshfield Area ARS will hold their 3rd annual Picnic, in Wildwood Park, beginning around 11 AM. This is a Potluck/Swapfest. Talk-in on 147.180. Contact *Guy A. Boucher KB9GPJ, 107 West Third St., Marshfield WI 54449. Tel. (715) 384-4323. PACKETT:KB9GPJ @ W9IHW.WI.USA.NA.*

NORTH TARRYTOWN, NY The Westchester Emergency Comm. Assn. (WECA) will hold their "WECA Summerfest 1994" at Westchester County Center, Junction of Rte 119 and Bronx River Pkwy. Talk-in on 147.06/.66. Vendors, Forums, VE Exams, and more. Contact *Jeanne Raffaelli, (914) 962-9666.*

PEOTONE, IL The 60th annual Hamfest/Computer Festival, sponsored by Hamfesters Radio Club, Inc., will be held at Will County Fairgrounds 6 AM-3 PM. Flea Market. Set-up Sat. Aug. 6th at 6 PM-12 midnight. Talk-in on 146.52 simplex, 146.64 (-) (courtesy of STARS); 146.94 (-) (courtesy of KARS). For info, call *(708) 535-AHAM.* Get advance tickets (SASE and check by July 20th) from *David F. Brasel NF9N, 6933 W. 110 St., Worth IL 60482. Tel. (708) 448-0580.*

SPECIAL EVENT STATIONS

JULY 3

RUSSIAVILLE, IN The Kokomo ARC will sponsor a Special Events Station honoring the Sesquicentennial celebration of Howard County. Operation will be on 80, 40, and 20 meters in the bottom 25 kHz of the General class bands, and in the 15 and 10 meter Novice class bands. The station will be on the air at 1400 UTC and will continue for 12 hours. Please QSL w/SASE to *Dick Elliot N9IPA, P.O. Box 128, Russiaville IN 46979.*

JULY 4

COEBURN, VA The Lonesome Pine ARS will operate 0300Z-2200Z to commemorate Coeburn's 100th Centennial Celebration. Operation will be SSB in the General phone portions of 10, 20, and 40 meters. For a certificate, please send a 9" x 12" SASE to the *Lonesome Pine ARS, P.O. Box 2955, Wise VA 24293.*

JULY 4-5

PLEASANTON, CA Livermore ARK will operate N6FQQ 1700Z July 4th-0100Z July 5th, to commemorate the Centennial Anniversary of the City of Pleasanton. The station will operate from the Alameda County Fairgrounds. Frequencies: CW 7.125; phone 14.250 and 28.485. For a QSL, send your QSL and SASE to *Eliot Ross WA6PYH/AG, 7005 Corinth Ct., Dublin CA 94568.*

WILLIAMSBURG, VA The Williamsburg Area ARC will operate W4TMN 1200Z July 4th-0100Z July 5th, to celebrate the 218th Anniversary of the signing of the Declaration of Independance. Frequencies: 146.58, 28.350, 24.950, 21.350, 18.150, 14.270, 7.270 and 3.870. For an unfolded certificate, send QSL and a 9" x 12" SASE to *Hershel Kreis KE4GWV, 145 Sand Hill Rd., Williamsburg VA 23188.*

JULY 4-10

AUSTIN, TX Amateurs affiliated with the American Sunbathing Assn., the Naturist Soc., and the Federation of Canadian Naturists, will observe the 19th annual North American Nude Awareness Celebration by operating a Special Event Station near 14.265, 21.365, and 28.465 +/- QRM. For a certificate, please send QSL and a 9" x 12" SASE to *Bob Redoutey KF5KF, P.O. Box 200812, Austin TX 78720.*

JULY 7

RUTLEDGE, GA Atlanta Chapter 49, QCWA, will demonstrate amateur radio on HF/VHF starting at 2 PM-9 PM, EDST, in support of the National Kidney Foundation of Georgia's annual "Camp Independence," for young transplant eligibles at Camp Twin Lakes. It allows young people to see and participate in amateur radio communications. Frequencies: 7250, 14250, and 21,250 +/- QRM, using W4NZJ. All contacts welcomed and invited. For a special QSL card, please send your contact info and QSL card w/SASE to *Judson F. Whatley W4NZJ, 2156 Windsor Dr., Snellville GA 30278.*

JULY 7-9

PITTSBURGH, PA Station WA3BAK will be on the air Thurs., Fri., and Sat., July 7th-9th, 09:00 to 23:00 hours, in conjunction with the 56th annual Soc. for Preservation and Encouragement of Barber Shop Quartet Singing in America (SPEBSQSA) Intern'l Convention. Frequencies: 20 me-

ters - 14.225/.245 MHz; 15 meters - 21.300/320 MHz; 10 meters - 28.300/.320 MHz; 2 meters - 146.610 -600 kHz; 220 MHz band, 224.00 -1.60; 440 MHz band, 440.000 -5 MHz. Packet: W3HID @ W3IXR.#SWPA.PA.USA.NA. Bob Schlesinger is Anchor Operator. All QSOs will be confirmed by a special commemorative QSL card, courtesy of Yaesu, USA. QSL cards are available to WA3VBAK SWL's who send a SASE to *Barber Shop Singers, 4952 Esther Dr., San Jose CA 95124 USA.*

JULY 9

EAST GREENWICH, RI The Fidelity ARC will operate K1NQG from 1300Z to 1800Z, to coincide with the annual Yankee Tune Up at the New England Wireless and Steam Museum. Operation will be: Phone—lower portion of the 20 meter General subband; CW—Novice portion of the 40 meter band. For a certificate, send QSL and SASE to *Bob Ritoli NE1E, P.O. Box 168, 8 Locust Ct., Fiskeville RI 02823.*

EASTON, PA The Delaware-Lehigh ARC will operate W3OK 1200Z-2400Z from the Canal Festival. Operation will be on 3.965, 7.265, 14.265, 21.365, and 28.365 MHz. For a special QSL, send QSL, Contact number, and SASE to *DLARC RD 4, Greystone Bldg., Nazareth PA 18064.*

JULY 9-10

FULTON, NY Station KY27 will be operated 1200Z-2100Z each day from the Spirit of Central New York Hot Air Balloon Festival and Air Show at the Oswego County Airport. Sponsor: The Oswego AR Emergency Service. Operation will be in the middle of the General 80, 40, 20, 15 and 10 meter phone bands; the Novice portion of 10 meters, and 147.75/.15 MHz. For a certificate, send your QSL card and a large SASE to *Fred Swiatlowski KY2F, P.O. Box 5227, Oswego NY 13126.*

ST. LOUIS, MO The Monsanto ARA will operate WB0BBN from 1300 UTC-0300 UTC (both days), to commemorate the St. Louis Gateway to the Gold 1994 Olympic Festival closing. Operation will be in the General portion of 40, 20, and 15 meters, the Novice portion of 10 meters, 147.36+, 224.98-, and 443.55+. For a special QSL, please send a 9" x 12" SASE for an unfolded QSL, or a legal size SASE for a folded QSL, to *M.A.R.A., P.O. Box 1596, Maryland Heights MO 63043.*

JULY 21-30

EDMONTON, ALBERTA, CANADA The Radio Amateur Educational Society will operate VE6KDA during the annual Klondike Days Exposition. Frequencies: 1.870 when conditions permit, 3.750 0200 UTC-0500 UTC; 7.2000 2300 UTC-0200 UTC; 14.165, 21.220, 28.300, and 14.050 (CW) when conditions permit. For a QSL, send QSL and SASE to *RAES, Ritchie Postal Outlet Box 75038, Edmonton AB T6E 6K1, Canada.*

JULY 23-24

PENANG, MALAYSIA The Malaysian AR Transmitter Soc. will sponsor a CW Contest 0001Z Sat. July 23rd-2359Z Sun. July 24th, as part of an invitation for hams to visit Malaysia and attend the "SEANET 94" Convention in November. Operation will be on 160, 80, 40, 20, 15, and 10 meters (no WARC bands). The Contest call is "CQ SEA." Contact *Seanet Contest Manager 1994, Eshee Razak 9M2FK, P.O. Box 13, 10700 Penang, Malaysia.*

STRATFORD, NY The Fulton County Mahlon Loomis Committee will operate W2ZZJ from 1300Z-2000Z on the General class phone portion of 40, 20, and 15 meters, and on the Novice 10 meter phone band, to celebrate the 168th Anniversary of the birth of Dr. Mahlon Loomis, the American wireless telegraphy pioneer. For literature and a certificate, send QSL, contact number, and a #10 SASE to *W2ZZJ, 5738 STHWY 29A, Stratford NY 13470.*

JULY 25-31

CANTON, OH The Canton ARC will operate W8AL to celebrate the Pro Football Hall of Fame Greatest Weekend. Time: 1400 UTC-0200 UTC. Frequencies: SSB - 28.350, 24.950, 21.350, 18.150, 14.270, 7.270, and 3.870 MHz; CW - 28.125, 24.910, 21.125, 18.080, 14.050, 10.120, 7.125, and 3.700 +/- QRM. There will also be RTTY, Packet, AMTOR, Satellite, 2-meter and 6-meter FM/SSB. SWLs are welcome. For an unfolded certificate, send your QSL with contact number and a 9" x 12" SASE, with two units of first-class postage. For a QSL or a folded certificate, send your QSL with contact # and a #10 (business size) SASE to *Randy Phelps KD8JN, 1226 Delverne Ave. SW, Canton OH 44710-1306.*

JULY 30-31

DANBURY, CT The Candlewood ARA and its members will sponsor the 1994 Connecticut QSO Party from 2000Z July 30th-2000Z July 31st, with a rest period 0400Z-1200Z. Get details from *Frank Etzler N8WXQ, (203) 350-3523.*

AUG 5-7

MILWAUKEE, WI Members of the Milwaukee ARES will operate Station W9WK to celebrate the 4th annual "Picnic Ham" held at Menomonee Park in Lannon WI. Operation will be in the General phone and CW bands on 75, 40, 20, 15 and 10 meters. For a certificate, send QSL and a 9" x 12" envelope (with 2 units of postage) to *W9WK, c/o John Leekly, 757 N. Broadway, Suite 306, Milwaukee WI 53202.*

AUG 6-7

BARNEGAT LIGHT, NJ The Old Barney ARC will operate W2OB from "OLD BARNEY," the Barnegat Lighthouse (Long Beach Island IOTA NA-111), to commemorate National Lighthouse Day. Time: 3000 UTC-0000 UTC each day. Frequencies: Look in the lower 25 kHz of the General phone bands; 40, 20, 15, and 10 meters, plus 146.52 simplex, 146.835 Rptr., and other local Rptrs. For a special QSL, send a 9" x 12" SASE with 2 units of postage, via NU2F. For more info, contact *QSL W2OB via NU2F, Joe Fleishinger Sr., 75 Joshua Dr., Manahawkin NJ 08050 USA.*

AUG 7-13

POTTSVILLE, PA The Schuylkill ARA will operate N3ILC Aug 7th-Aug 13th, to celebrate the Schuylkill County Fair. Operation will be both CW and phone on the General and Novice subbands. For a certificate, send QSL and SASE to *Ed Brennan N3ILC, 520 Spring Garden St., Pottsville PA 17901-1651.* 73

RANDOM OUTPUT

Continued from page 88

got a big laugh around the office, since I'm so conservative I make Rush Limbaugh look like a "New Dealer."). I also got accused of being a fascist. One angry gent who didn't have the courage to give his return address wrote to Wayne instead of me and said I must be a new ham, since I didn't know the first thing about radio or regulations, and that I should not be allowed to write any more columns (for the record, I've been licensed for 21 years). Go figure.

At the very least, I expect the same respect from you as I give. I do not write down to you, nor do I assume that you are all ignorant. I do not care how long you've been a ham, nor do I assign any prestige or instant authority to any particular class of license. If you're going to bother to write to me, please have a little respect for yourself *and* me. We can disagree, but let's remember to use logic to make our points, not insults.

All I did was suggest that we give some thought to why we find it necessary to carry around radios capable of transmitting on police and other public service frequencies. I wanted you folks to *think* about it. If you feel threatened by that, then I suggest you probably need to do a lot more self-examination on this issue than the rest of us.

As always, I appreciate every single letter that comes in. I don't care if you agree with my opinion as long as you actually have one. Having an opinion means more than just a knee-jerk reaction to something that offends or threatens your belief systems. It means taking all of the available input and forming *your own* ideas. It's not difficult and you don't have to be a college graduate to do it, but it does take effort. Mental effort. 73

Number 26 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 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 junebe you can help make a ham sure it still works right and junebe 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 the Barter 'n' Buy, Judy Walker, 70 Rt. 202N, Peterborough NH 03458 and get set for the phone calls.

The deadline for the August classified ad section is June 9, 1994.

ALL ABOUT CRYSTAL SETS. Theory and construction of crystal set radios. $9.95 each, ppd USA. Send to: **ALLABOUT BOOKS**, Dept. S, P.O. Box 22366, San Diego CA 92192. BNB200

CUSTOM MADE-HAND TOOLED leather products with your initials, name, call letters. Photo's & estimates available. Key rings, wallets, belts, purses, hanging signs, specialty items. GREAT GIFT. **LEATHER & WEST,** 67 Causeway Rd., West Swanzey NH 03469. (603)352-6256. 9-4 pm. M-F ET. BNB215

SELL: NCG 15m QRP transceiver, used ittle, A1 condition, $200.00. S.V. Couch, 2029 JoAnn, Newton KS 67114. BNB220

QSL SAMPLES- 50 cents. **SAMCARDS,** 48 Monte Carlo Dr., Pittsburgh PA 15239. BNB275

ATTENTION HAMS! Subscribe to *6-50 Worldwide for Six Meter Enthusiasts*, *DX Digest for DX Chasers*, or *The Novice/Tech Report*. Call (817)694-4047 or FAX (817)694-2522. BNB292

COMMODORE 64 REPAIR. Fast turn around. **SOUTHERN TECHNOLGIES AMATEUR RADIO,** 10715 SW 190th Street #9, Miami FL 33157. (305)238-3327. BNB295

KIT BUILDERS—Announcing a NEW, SYNTHESIZED qrp Transmitter/Transceiver, the ARK4. Get on the air for only $99.95! (Transmitter Kit only) Buy as little or as much as you want. Full Transceiver Kit w/case only $199.95. One board, no wiring, top quality components & PCB. GUARANTEED TO WORK. For info send SASE; Call/Write to order: **S & S ENGINEERING**, 14102 Brown Road, Smithsburg MD 21783; (301)416-0661. BNB304

WANTED: Electron Tubes, ICS, Semiconductors. **ASTRAL,** P.O. Box 707ST, Linden NJ 07036. Call (800)666-8467. BNB307

KENWOOD AUTHORIZED REPAIR. Also ICOM, Yaesu. **GROTON ELECTRONICS,** Box 379, Groton MA 01450. (508)448-3322. BNB310

RCI-2950 OWNERS: New modification manual including Power increase. Clarifier modification. Modulation increase. Operating hints, and more. Parts included. Only $20.00 ppd in U.S. (Missouri residents add $1.15 tax). **SCOTT**, P.O. Box 510408, St., Louis MO 63151-0408. (314)846-0252. Money Orders or C.O.D. BNB340

HR2510, RCI2950, CONNEX 3300, COBRA 148, GALAXY SATURN, plus many more kits to increase your modulation, $19.95. **(800)536-0109.** BNB350

KIT BUILDERS! Complete list of 165+ kit vendors. #10 SASE + $3.00 USD to: **RUTENBER ENGINEERING,** 38045 10th St. E. #H75-AR, Palmdale CA 93550. BNB365

QSL CARDS — Standard and custom. Your ideas or ours. Excellent quality. Foil stamping available. Many designs and type styles. Catalog and samples $1.00 refundable. **WILKINS**, Dept. A, Box 787, Atascadero CA 93423. BNB370

MANUALS KW940 Owner and Shop manual with schematic, $20.00; also Heathkit SB220-1 manual and schematic, $20.00; also NEW 3-500Z, $85.00. (210)435-6190. BNB381

NEW NN1G CW SUPER-HET SINGLE BAND TRANSCEIVER KIT. Available in 20M, 30M, 40M, 80M. $59.95 plus $3.75 S/H. (Catalog-2 Stamps). **DAN'S SMALL PARTS & KITS,** 1935 South 3rd West #1, Missoula MT 59801. BNB385

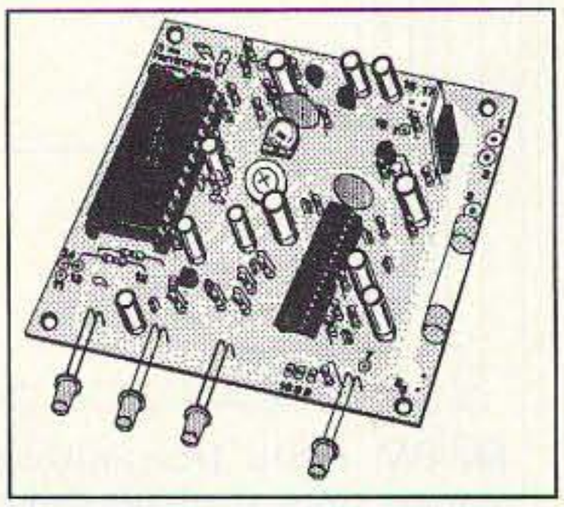
Continued on page 83

Number 27 on your Feedback card

NEW PRODUCTS

Compiled by Charles Warrington WA1RZW

HAMTRONICS



Hamtronics has announced the new COR-6 module—a voice ID repeater controller combining COR circuits and a real-voice ID on one board. It can be used with transmitter and receiver modules to make a simple, low-cost repeater.

A digital IC records up to 20 seconds of your voice, using audio from the repeater receiver. The unit includes tail and time-out timers, courtesy beep, and a solid-state relay to key the transmitter.

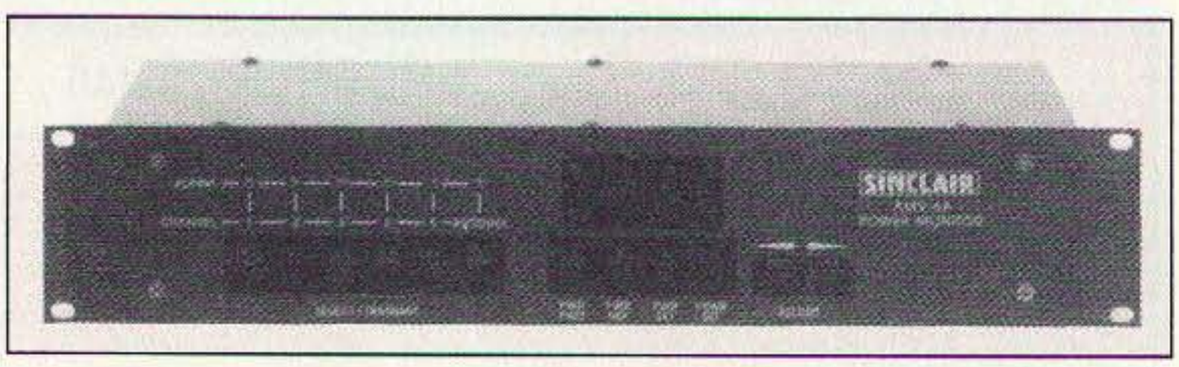
The kit price is $99, or the unit is available wired and tested for $149. A catalog is also available. For more information contact *Hamtronics, Inc., 65-F Moul Rd., Hilton, NY 14468-9535; (716) 392-9430, FAX (716) 392-9420.* Or circle Reader Service No. 202.

B+K PRECISION

B+K has introduced their first digital multimeter that is truly pocket-sized—the instrument is only 4.4" x 2.2" x 0.4" and weighs only 3.5 ounces with batteries. The Model 2700 DMM measures AC and DC volts and resistance, with data hold, range hold, audible continuity test, diode test, bar graph, and 3200 count LCD display.

Data hold freezes the display to hold a reading. Range hold allows the user to defeat autoranging and select one specific voltage or resistance range for all measurements. This is the only pocket DMM to offer all these features.

For more information, visit your favorite dealer or contact *B+K Precision, 6470 W. Courtland St., Chicago, IL 60635; (312) 889-1448, FAX (312) 794-9740.* Or circle Reader Service No. 204.

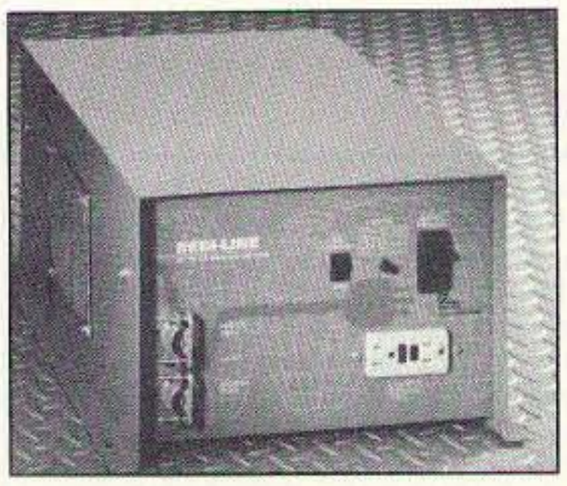


SINCLAIR RADIO LABS

Sinclair Radio Labs has introduced an intelligent site monitor for remote RF transmitters and associated antenna equipment. The AMV-6A measures RF power from 1 to 990 watts in both the forward and reflected mode simultaneously, allowing for easy VSWR calculations.

Near intuitive setup and programming make this power monitor simple to use, and no computer or other ancillary equipment is required for installation. The unit allows system power and VSWR tests without disconnecting coax lines.

For more information contact *Sinclair Radio Laboratories, Inc., 675 Ensminger Rd., Tonawanda, NY 14150; (716) 874-3682, (800) 288-2763, FAX (716) 874-3682.* Or circle Reader service No. 206.



PACIFIC SCIENTIFIC

The same commercial duty reliability found in Redi-Line mobile electric generators is now available in an electronic inverter to meet your portable power needs. The Redi-Line model DA12I-2400Q solid-state inverter operates from 12 VDC vehicle batteries to run 120 VAC, 60 Hz equipment wherever commercial power is not conveniently available.

The new Redi-Line inverter will operate sensitive electronic equipment requiring a regulated output, including personal computers, and is ideal for equipment requiring up to 2000 watts (continuous), 2400 watts (for up to 15 minutes), and surge output of up to 5900 watts, for loads like heavy-duty power tools with high starting currents. Power conversion efficiency is between 85-93%.

A brochure with specifications and other practical information is available for $4 to cover shipping and handling. For more information contact *Pacific Scientific, Inquiry Handling Department, 1084 Old Colony Road, Lake Forest, IL 60045; (815) 226-3100, FAX (815) 226-3080.* Or circle Reader Service No. 201.

TIARE PUBLICATIONS

Work the world with 1 watt! Make contacts of over a thousand miles using just milliwatts! That's just a sample of the fascinating fun you can have with the new book *Low Power Communications - Volume 2 - Advanced QRP Operating.*

Conceived, coordinated, and edited by Richard H. Arland K7YHA, the book's eight chapters were written by some well-known QRPers, including *73's* own Mike Bryce WB8VGE. Chapters cover: QRP DXing, contesting, satellites, antennas, solar power, micro- and milli-watting, and DXpeditioning on a QRP budget.

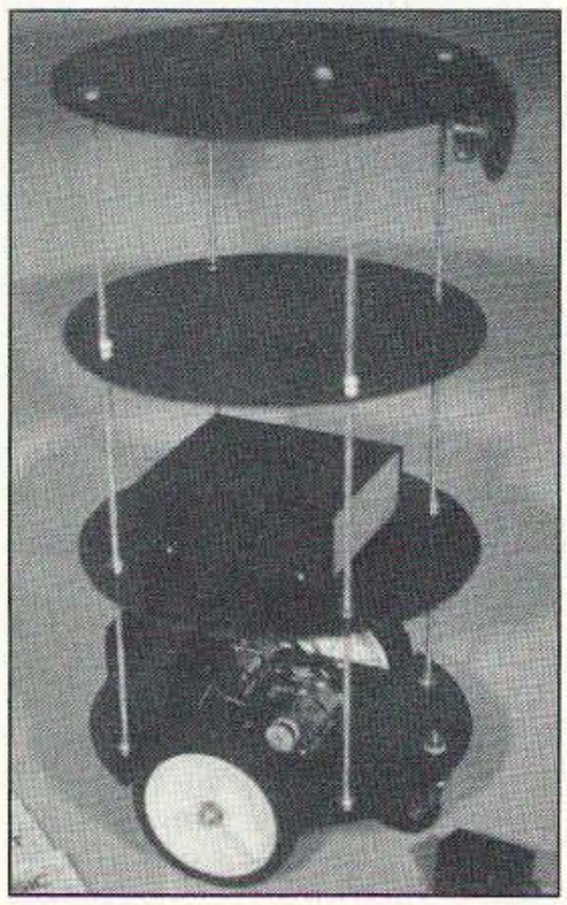
The book is illustrated, and is priced at $19.95. It is available from your favorite dealer, or order direct from Tiare (add $2 USA, $3 elsewhere for S & H). For more information contact *Tiare Publications, P.O. Box 493, Lake Geneva, WI 53147; (800) 420-0579, (414) 248-4845.* Or circle Reader Service No. 203.

KANGAROO TABOR SOFTWARE

Kangaroo Tabor Software has announced the new CAPMAN 2.0 computer-assisted prediction manger. This is a professional-quality IONCAP package that allows anyone to use the most advanced propagation routine interfacing with the ELNEC and MININEC antenna analysis gain patterns.

CAPMAN is the versatile menu-driven skyway analysis package developed by Kangaroo Tabor Software and the prime author of IONCAP. CAPMAN delivers IONCAP input file construction and management, two integrated execute functions: the ability to view and manipulate huge output files, and graphical display of output parameters for multiple target locations and time periods.

This product contains a full-featured location database and can be easily customized. The CAPMAN package requires a 386 or better PC or compatible. The IONCAP program is included in the CAPMAN package, which is priced at $89 ppd. in the USA (elsewhere add $3.50 S & H). For more information contact *LUCAS Radio/KangarooTabor Software, 2900 Valmont Rd., Suite H, Boulder, CO 80301; (303) 494-4647, FAX (303) 494-0937.* Or circle Reader service No. 205.



ACLYPSE CORPORATION

Aclypse Corporation has announced the ADR-1 Robot Kit, a little something different for the ham who has everything. The robot is 27" tall x 14" in diameter and weighs 16 pounds. The complete kit has an onboard computer system that features voice recognition capabilities, English speech output, power motor drive, and a battery with monitoring and recharge system.

No electronics or advanced computer experience is required. Construction takes two to six hours and requires no special tools. The robot has its own operating system and a BASIC programming language is built in. The complete kit is priced at $299.

For more information contact *Aclypse Corporation, Rt. 2, Box 213H, Worthington, IN 47471; (812) 875-2852, BBS (812) 875-2836.* Or circle Reader Service No. 207.

BARTER 'N' BUY

Continued from page 81

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Number 28 on your Feedback card

RANDOM OUTPUT

David Cassidy N1GPH

I'm Back!

You thought you'd gotten rid of me, didn't you? You thought, "Cassidy has finally stopped beating his head against the wall and given up," didn't you? Ha, Ha Ha . . . No such luck!

Actually, an overwhelming number of readers called or wrote, demanding that I break the self-imposed silence and resume writing this column (OK, OK, it was only 12 letters). To that brave dozen go my heartfelt thanks. If you're wondering why I took a few months off, it's simple. One, I was trying to put together the Amateur Radio Child Search organization that I wrote about back in February (more on this later). Second, I simply ran out of things to say. Sure, I could have put together a couple of puff pieces to get me over the last few months, but frankly I have more respect for you than that. Judging from my mail, most of you who read "Random Output" at least have a pulse. Many of you can actually write a decent letter and form a logical argument, either agreeing with me or disagreeing with me (more on this later, too). I figured you would be able to tell that I was spinnning my wheels so, unlike many of the writers in this field (no names mentioned, please), I simply decided to say nothing, since I had nothing to say.

I don't write this column to feed my ego (contrary to what some of my critics say). I write this column because I think ham radio ought to be more than chasing DX and giving out signal reports. I think hams should be involved and concerned about their hobby and about the world around them. I try to send out sparks in this column, and hope that at least one person will give some thought to whatever topic I bring up. I don't want you to agree with me, but I do want you to think and develop *your own* opinion about things. If nothing else, I hope my column can provide something to talk about during a QSO, other than the make and model of your store-bought rig.

Amateur Radio Child Search

To pick up where we left off a few months ago, you'll recall that I requested those of you who were interested in assisting in the formation of Amateur Radio Child Search to drop me a note so I could gauge whether or not the idea could get off the ground.

I received three letters telling me why I shouldn't even try to do this. I think you can figure out where I told those naysayers to go. I received a phone call at my home on a Sunday afternoon, and the caller got angry with me when I suggested that it would be more appropriate if he contacted me during business hours at my office. I even received a call from a high-level employee of a well-known national service organization, outlining a possible funding source. I asked him to send me some info so that I could prepare a proposal for his organization, but he never did. I don't have this gentleman's phone number (I know, that's *my* fault), so that avenue turned into a dead end (at least so far). That was disappointing, because a single source of funding would have made this idea an immediate reality. I was (and am) willing to do all the organizing work, travel, and whatever else it takes to get this going, but a commitment of funding from a major organization sure would make it a lot easier.

When you take out the flakes, kooks and nuts, I received approximately 60 responses from people all across the country, pledging their support. Over 100,000 people cast their eyes upon these pages every month (if you believe the research that shows most magazines are read by at least two people). Even if you only take our paid circulation figures, at least 50,000+ people had the magazine in their hands. Sixty responses out of 50,000 people is not what I would call an overwhelming outpouring of support. In fact, I'd call it downright embarassing.

To those who responded, I regret to tell you that it doesn't look like this idea is going to get off the ground. I would urge you to think about forming a local group, or making it a club service project to contact local law enforcement and set up something like what I suggested. You don't have to make it fancy. Just be prepared to provide an organized and trained search group for whenever your local law enforcement agency needs it. If you need my help, give me a call (at my office, please). I am keeping a database of all of you who wrote to me. If a funding source *does* present itself, I'll be in touch.

Out-of-Band Radios

My column on the use and ownership of radios capable of out-of-band transmissions generated the most response of anything I've written in the last three-and-a-half years. Unfortunately, the reading comprehension level of some people isn't what it should be. Either that, or many of you didn't bother to read the whole article (the fact that the closing paragraph of my original text got chopped off without my knowledge didn't help, either).

Many of you sighted the regulations giving us permission to use any means at our disposal to save life or property. Many of you simply thought I was trying to confiscate your radios. I got accused of being a socialist (which

Continued on page 80

Number 29 on your Feedback card

PROPAGATION

Jim Gray W1XU

Jim Gray W1XU
210 East Chateau Circle
Payson AZ 85541

As I write these words (late April), the month of July does not look particularly good for HF band propagation. There are several reasons for this: generally declining sunspot activity; higher daytime absorption of signals during the summer; probable violent magnetic field storms which would adversely affect the ionosphere, hence HF band propagation during several days surrounding the 10th, 16th, and 29th; and possible other geophysical events such as hurricanes, volcanic eruptions and earthquakes. That is not to say they *will* occur, or that—if they do—they will happen in the U.S.A. However, my records taken over a period of about 16 years indicate a very high probability of such events taking place when the sun's disturbances cause strong magnetic field disruptions on earth.

On the positive side of the ledger, it is interesting to note that when HF bands are the poorest, the VHF bands are often the best . . . and that can happen during this month. There will be meteor shower propagation (delta Aquarids peaking on the 29th), and a possibility of strong auroral and sporadic E ionization on or around the dates given above. Sporadic E propagation via fast-moving ion clouds often results in short contacts on 10, 6 or 2 meters with very low path loss and high signal levels.

The band-by-band situation looks very much like last month's forecast.

10 and 12 Meter Bands

Sporadic E during daylight hours on many Good days (G), with strong skip signals from 500 to 1,500 miles, and with abrupt termination of contact as the ion cloud moves out of range.

15 and 17 Meter Bands

Good sporadic E contacts between 300 and 1,300 miles on most Good (G) days. Also, you may find trans-equatorial skip into the Southern Hemisphere, with decent but not outstanding signal strength.

20 Meter Band

Consistent DX to most parts of the world on Good (G) days during daylight hours, and on particularly favorable days, often until midnight local time. This band will be your DX workhorse.

30 and 40 Meter Bands

Nighttime DX between local sunset and sunrise ought to be good-to-excellent on days marked Good (G) on the chart, and often on Fair (F) days. Thunderstorm activity usually abates several hours after sunset, but QRN will obscure weak signals. Day and night short skip will occur on many days, with daytime skip averaging up to 1,000 miles and nighttime skip up to 2,000 miles. Beware of high absorption levels around local noon.

80 and 160 Meter Bands

Forget any daytime activity, but when conditions are Good (G) you may well discover occasional DX at night, especially when QRN from thunderstorms isn't present. There will be few, if any, really good DX contacts on 160 or 80 during July. Short skip at night, however, can be pretty good out to about 1,000 miles or so.

Always listen to WWV and the propagation forecasts at 18 minutes after any hour, when up-to-date reports of Boulder K and A indexes are given along with solar flux readings. 73

EASTERN UNITED STATES TO:

GMT	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA						20	20					
ARGENTINA	20	20	20	40			20	20	15	15	15	15
AUSTRALIA		20	20	20	40	40	20					
CANAL ZONE	15	40	40	40	40'	40		15	15	15	10	10
ENGLAND			40'	40			20	20	20	20	20	20
HAWAII			20		40		20					
INDIA												
JAPAN						20	20					
MEXICO	15	40	40	40	40'	40		15	15	15	10	10
PHILIPPINES							20					
PUERTO RICO	15	40	40	40	40'	40		15	15	15	10	10
SOUTH AFRICA			40	40		20	20				20	
U.S.S.R.							20	20		20		
WESTCOAST	20	40	40	40'	40'	40						20

CENTRAL UNITED STATES TO:

ALASKA		20	20					20	20			
ARGENTINA	15	20	20	40			20	20		15	15	15
AUSTRALIA	15	20	20	20	40'	40		20			20	
CANAL ZONE	15	20	20	20	40'	40	20	20	15	15	15'	10
ENGLAND	20	40					20	20		20	20	20'
HAWAII	15	15	20	20	20	40	20	20				
INDIA												
JAPAN		20	20					20	20			
MEXICO	15	20	20	20	40'	40	20	20	15	15	15'	10
PHILIPPINES		20	20				20	20				
PUERTO RICO	15	20	20	20	40'	40	20	20	15	15	15'	10
SOUTH AFRICA							20				20	20
U.S.S.R.								20			20	

WESTERN UNITED STATES TO:

ALASKA		20	20						20			
ARGENTINA	15	20	20	40	40			20	20		15	15
AUSTRALIA		20	20	20	20	40'	40'		20		15	15
CANAL ZONE	15	15	20	20'	40'	40		20	20	15	15	15
ENGLAND	20							20	20			20
HAWAII	20	15	15	20	20	20'	40'	40	20		20	20
INDIA				20					20			
JAPAN		20	20						20			
MEXICO	15	15	20	20'	40'	40		20	20	15	15	15
PHILIPPINES				20					20			
PUERTO RICO	15	15	20	20'	40'	40		20	20	15	15	15
SOUTH AFRICA			40						20			
U.S.S.R.									20			
EAST COAST	20	40	40	40'	40'	40						20

1 = Possible 80 meter openings * = Check next lower band G = Good, F = Fair, P = Poor

JULY 1994

SUN	MON	TUE	WED	THU	FRI	SAT
					1 P-F	2 P-F
3 F	4 F	5 F-G	6 G	7 G-F	8 F-P	9 P-VP
10 VP	11 P	12 P-F	13 F	14 F-P	15 P-VP	16 VP
17 P	18 P	19 P-F	20 F-G	21 G	22 G-F	23 F
24 F-G	25 G-F	26 F	27 F-P	28 P	29 P-VP	30 VP
31 VP						

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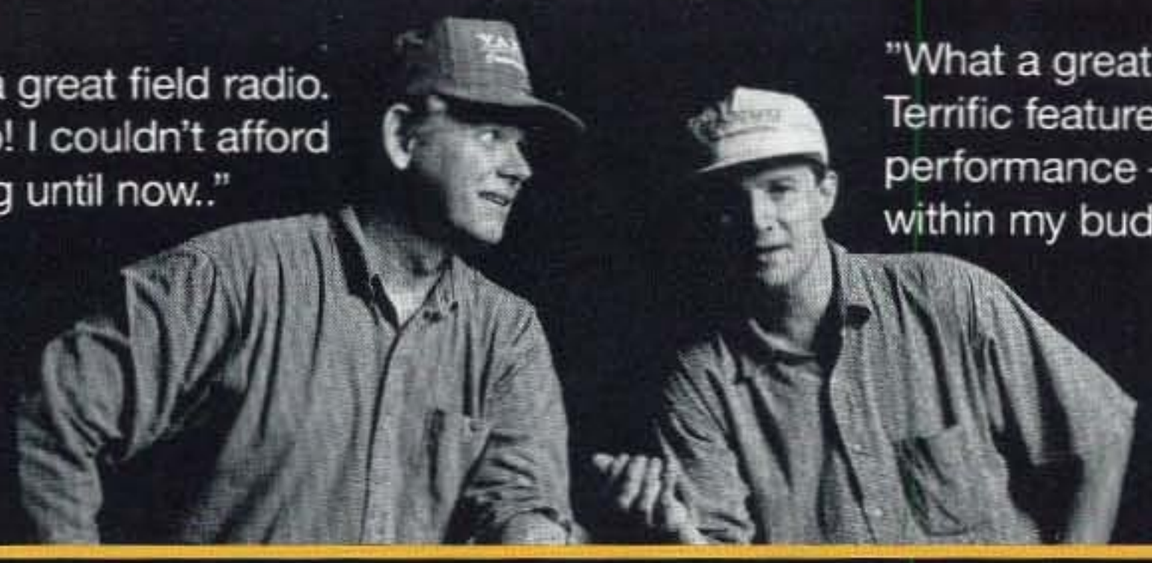

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- FM* Repeater Operation Automatic 10-Meter Repeater Offset w/Selectable CTCSS Encode
- CW Reverse Feature
- Choice of Two Optional Antenna Tuners:
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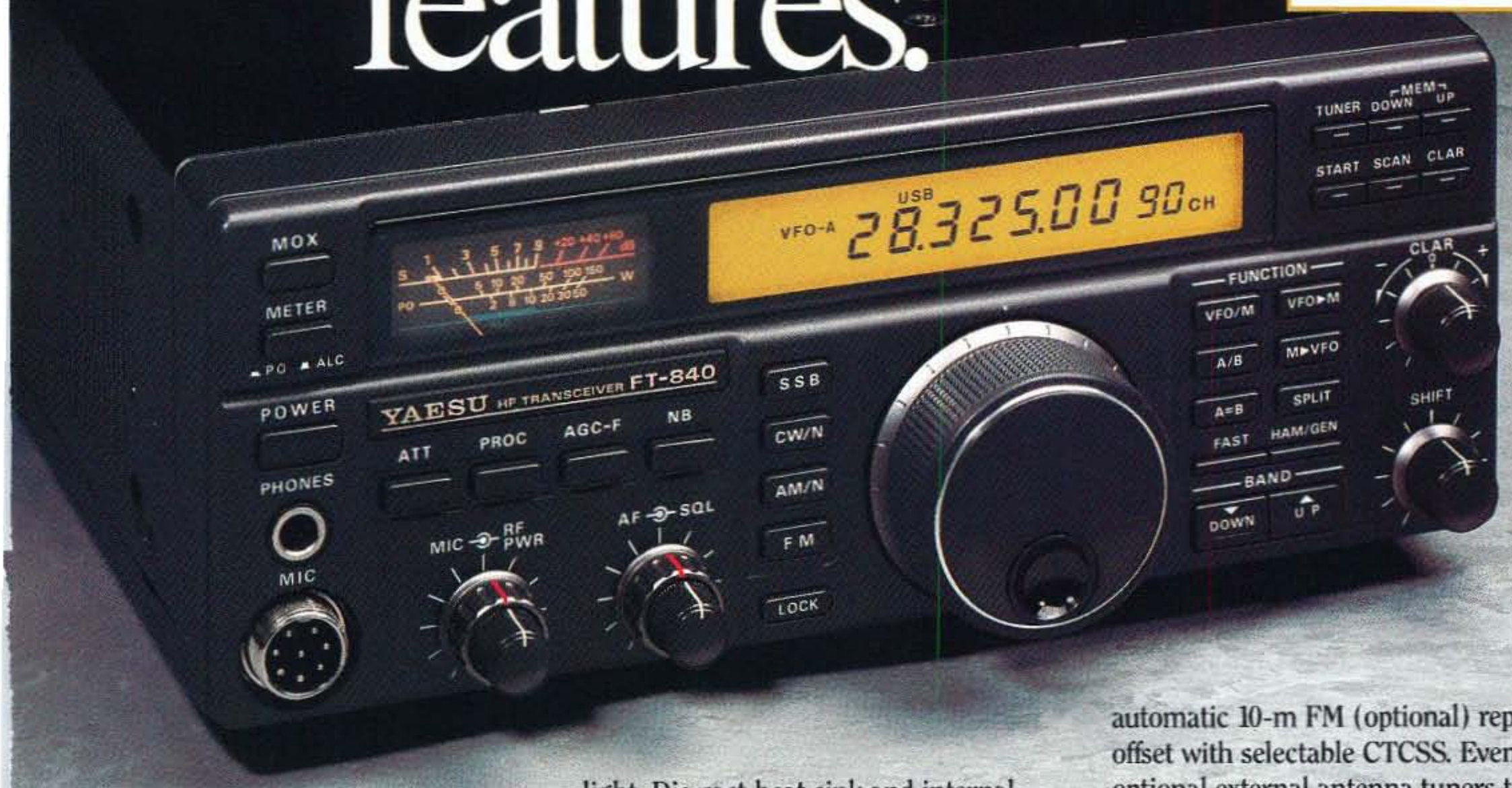
  FC-800 External Remote Antenna Tuner
- **Accessories:**
  Contact your Dealer for full details.

* Optional



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