

NUTS & VOLTS

M A G A Z I N E

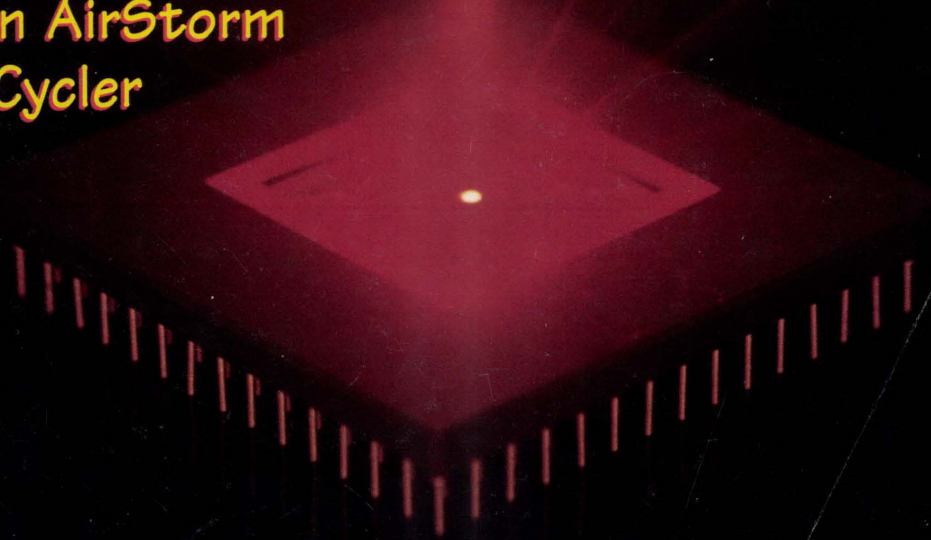


\$3.00

**VOL. 16 NO. 2
FEBRUARY 1995**

Exploring Electronics And Technology For The Hobbyist And Professional

- Latest Ham Rage: Cross-X-Band Remotes
- The BASIC Stamp as a Circuit Detective
- Build a Fruit Powered Digital Clock
- Inside Wire Maintenance — Part 2
- Introduction to the Internet
- Electric Car Chargers
- Operation AirStorm
- Battery Cycler



Rock Solid PERFORMANCE... GUARANTEED!

3 Channel Viewing

Hewlett Packard 1741A
100 MHz Storage
Oscilloscope
\$1295

What a deal on a dual-channel Storage Oscilloscope with a NEW CRT! That's right, for a limited time we're offering our HP 1741A with a brand-new \$2000 Storage CRT. You simply won't find a better price on this a dual-channel storage oscilloscope. The ease-of-use and reliability has continued to make this scope a highly desired instrument covering a wide range of applications. Sensitivity of 5 mV to 20 V/div., 100 mS to over 1 minute of variable persistence and up to 1 hour of storage for outstanding signal viewing. Sweep rates of 50 nS to 2 S/div are available. Other features include: minimum blind time and auto-intensity circuitry, third channel trigger view, and selectable input impedance. This is the right scope at the right price and with a new \$2000 CRT...how can you go wrong?



**FACTORY
NEW
SURPLUS**

Measures Volts & dB

Ballantine 3015A/92

AC Voltmeter.....**\$129**

The Ballantine 3015A is a versatile, general-purpose, wide-band AC Voltmeter, Amplifier, and AC to DC Converter. This unit includes Mod 92 for improved accuracy and AC to DC Converter output. 10 M Ω input impedance with voltage ranges of 1 mV to 300 V in 12 ranges with usable frequency range from 5 Hz to 8 MHz, calibrated from 10 Hz to 4 MHz. Large easy-to-read meter with 0 to 1 V scale (100 div), 0 to 3.2 V (64 div), and logarithmic dB scale from -12 to +2 dB (120 div). AC amplifier output offers 50 Ω output impedance, >150 mV rms for fs meter indication, DC coupled 5 Hz to 10 MHz. AC to DC Converter offers +1 VDC output for fs meter deflection on all ranges. Call and order your Ballantine 3015A/92 today!

**Tucker
PRE-OWNED
Quality**



Seven Functions

Fluke 8012A
Digital Multimeter
\$249

The popular Fluke 8012A at a fantastic price. Put the 8012A to work for you with 3 1/2 digit display (2000 counts) and seven functions including Conductance and a Diode Test. 0.1% basic DC accuracy; true RMS AC from 45 Hz to 50 kHz; resistance range: 0.001 Ω to 20 M Ω ; extensive overload protection. A great meter, a great price, put the 8012A to work for you!

**Tucker
PRE-OWNED
Quality**



Quality Built 4 1/2-digits



Hewlett Packard 3470A/34702A
4 1/2 Digit Multimeter
\$99

**Tucker
PRE-OWNED
Quality**

Complete DMM System, uses clear LED display with four full digits plus 100% over-ranging (4 1/2-digits). Front panel designed to save time and confusion; functions and ranges are clearly labeled and all maximum voltages are indicated at the input terminals. Four ranges for both AC (45 Hz to 100 kHz) and DC voltage: 1, 10, 100, and 1000 V f.s. plus six resistance ranges (100 Ω to 10 M Ω). Call for availability of other meter modules.

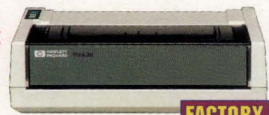
Crisp Text & Graphics

RS-232-C

Hewlett Packard 2225D

ThinkJet Portable Printer.....**\$300**

This convenient desktop printer is quiet and unobtrusive, yet quick and efficient, delivering crisp, easy-to-read text and graphics for letters, reports, even spreadsheets. Features 150 cps printing, disposable print cartridges, and excellent software support. RS-232-C interface.



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GoldStar

WAVETEK

HAMEG

LEADER

EXTECH

Protek

OPTOELECTRONICS

Avionics Special!

5 m Ω to 5.0 Ω

**FACTORY
NEW
SURPLUS**

Shallcross 673-D
Milliohmmer
\$495



If resistance is a concern to you, it won't be with a new 673-D! This Milliohmmer is recommended for real world applications where a Kelvin Bridge is too slow and impractical and an ordinary non-linear ohmmeter is too inaccurate and limited in range. You get the best of both instruments with this factory new Shallcross 673-D...speed, accuracy, and range; all in a practical, portable Milliohmmer. Simple to use; connect to the unknown resistance, press the "TEST" button and read the resistance directly from the large easy-to-read scale from 0.005 to 5.0 Ω f.s. (five ranges). Call us now and order your new 673-D and we'll include new accessories not normally included by the manufacturer. You'll receive the easy-to-use Milliohmmer, a fixed clamp with a terminal block and 15' of cable, a pistol-grip exploring probe with a terminal block and 6' of cable, and a 0.0025 Ω precision test standard recommended for use in calibrating and checking all Low Resistance Test Sets. Encased in a sturdy metal case with hinged cover and a battery compartment, this Milliohmmer is ideal for lab, home, or field use. Measures 10" x 8 3/4" x 6 1/2" and requires two No. 6 dry cell batteries (sold separately).

The Original

Hewlett Packard

10833A, B, C, D

HP-IB Interconnection Cables

10833A 1 meter.....\$35

10833B 2 meters.....\$35

10833C 4 meters.....\$30

10833D 0.5 meters.....\$35

We recently purchased a quantity of HP-IB cables and we're passing the savings to you! These are quality HP cables and feature a connector block at both ends. Each HP-IB cable has a plug on one side and a matching receptacle on the other, allowing several cables to be connected in parallel.



**Tucker
PRE-OWNED
Quality**



10-480 MHz
Classic Generator
Hewlett Packard 608E
Signal Generator
\$239

The HP 608E provides high-quality, versatile performance with distinctive ease of operation. Offers an adjustable, calibrated output of 0.1 μ V to 1 V rms from 10 to 480 MHz. 0 to 95% AM, \pm CW or Pulse modulation. Basic accuracy of \pm 0.5%.

**Tucker
PRE-OWNED
Quality**

Includes a built-in crystal calibrator which provides frequency check points; jack provided for audio frequency output; crystal accuracy better than 0.01%.

100 MHz

Dual-Trace
Hewlett Packard 1740A
Oscilloscope.....**\$795**

The 1740A continually proves itself as a dependable all-around oscilloscope and offers features and ease-of-use that HP is known for. Loaded with capabilities, the 1740A delivers dual-trace, 100 MHz bandwidth, 5 mV/cm sensitivity, third-trigger view, flexible triggering, 1 mV/div deflection factor in the X5 mode, a large 8 x 10 cm CRT, and selectable input impedance. Experience what the industry wants, check out the HP 1740A!



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Silicon Valley
since 1964!

...brings you a potpourri of high-tech goodies for the techno-tinkerer!
For thirty years we have been your source for Silicon Valley exotica!

Large-scale LCD

- From HP laptop computer (model unknown)
- Epson part number of ECM-A0234
- 7" x 9.25" display area
- 16 pin header on .1" centers
- Factory new in antistatic bags

HSC# 15016 **\$24.95**



VGA to RGB Cable

- Ten foot cable
- High-density 15-pin D-sub (VGA type) connector at one end
- 5 BNC Connectors at the other end: Red, Green, Blue, Horizontal and Vertical synch.
- Perfect for those high-res CAD monitors

HSC# 14963 **\$14.95**

Rechargeable Battery

- 4 "D" Cell-size - 4.8VDC 3500 mAh/5hr NiCd
- Sturdy steel case with mounting ears, pin jacks
- Charge regulation circuitry, .5 A Fuse
- Case size 9" x 4.25" x 2.25" (batteries can be unplugged and removed if desired)
- Unused, 1992 date codes (still good)

HSC# 15067 **\$4.95**

Modem Madness!

- Hyundai external 2400 bps modem
- New in box with telco cable, manual, power adaptor
- CCITT V.21/V.22/V.22bis compatible
- MINI Class 5 compatible
- 5" x 1.25" x 8.5" compact size
- RS-232 serial interface
- Communication Software included

HSC# 15179 **\$17.50**

Cool! Peltier Devices

- Up to 65° C temperature differential (needs heatsink)
- Electronic cooling elements use 3 - 12VDC
- One side gets cold while the other gets hot
- With specification sheet.

HSC# 80121 1.17" square **\$20.00**
HSC# 80122 1.56" square **\$29.95**



Laser Pen times two!

- Solid state laser diode
- 4mW at 660 - 680 nm (visible red) wavelength
- Uses two AAA cells (included)
- One year warranty
- A. Brushed Aluminum Case

HSC# MI-16-0006 **\$49.95**
B. High-Tech Aluminum Case, with "Blink" mode
HSC# MI-16-0007 **\$49.95**



Handy Power Supplies

- A) Switching power supply rated at 5VDC, 3A, Measures 2.75 x 3.25 x 5.25", IEC receptacle for universal (100 - 250VAC, 47 - 63 Hz) input, IEC cord not included, 6' Output cord with DIN plug
New in box. HSC#14996 **\$5.95**



- B) Linear supply rated at 12VDC @ 1200 mA. Input is strapped for 240 VAC input, use as is with 110VAC for lower voltage output, or re-strap it for 110VAC use at 12VDC. Measures 2.5 x 4 x 6.5", IEC cord not included.
HSC# 14980 **\$5.95**

- C) Standard 6' IEC power cord for use with above supplies, misc. colors & styles, used. HSC# 80119 **\$9.99**

- D) Multi-output linear supply rated at 5VDC @ 600mA, +12VDC @ 250mA, -12VDC @ 250mA, 110VAC input, measures 2.5" x 3" x 4.75", generous 4' AC input cord, 5-pin DIN output cord, HSC# 15137 **\$14.95**

- E) Same as "D" above, only 5VDC @ 500mA, +12VDC @ 1A
HSC# 15139 **\$9.95**

Macintosh Scanner #1

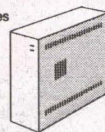
- B&W Hand Scanner, SCSI Interface
- 100 to 400 dpi
- 4.134 inch scan path
- "MacSee" software
- New in box
- 90-day warranty
- Requires Mac Classic, SE, LC, SE/30 or II family, 1 MB

HSC# 14809 **\$49.95**



Small Drive Chassis

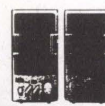
- Upright style case for 3.5" hard drives
- Includes power supply, fan
- 25-pin D-conn can be removed, enlarge hole for your connector
- 2.25" x 6.25" x 7.25" compact size
- Uses IEC power cord (not included)
- Power & drive activity LED's



HSC# 15170 **\$39.95**

Computer Speakers

- External speakers by Labtec, model CS-550
- Use with any sound card or personal stereo system
- 4 watt amplifiers (requires 2 C-cells per side)
- Magnetically shielded enclosures
- "Enhanced bass-response cabinet"
- 3" speakers, 40 - 16000 Hz
- Bass-boost and treble-boost switches
- Factory returns, should be OK.



HSC#14977 **\$9.95**

Network Cable Special

- Dual Workstation Installation Kit
- Two high-quality 10' RG-58 coax BNC cables
- Two BNC tee's
- Two BNC 50Ω terminators
- One BNC coupler
- Enough to cable two Thin-net workstations to the wall-plate distribution point

HSC# 14967 **\$9.95**

Macintosh Scanner #2

- 256 Gray Scale Hand Scanner, SCSI Interface
- 100 to 400 dpi, eight-bit (256 shades of gray)
- Image enhancement software
- 4.134 inch scan path
- New in box
- 90-day warranty
- Requires Mac SE/30 or II family, 8-bit video card, 2 MB

HSC# 14808 **\$79.95**



Laser Diode

- Toshiba TOLD-9200
- 3 to 4 mW at only 75 - 100mA of current
- 670nm wavelength (visible red)
- Brand new prime
- Uncooled, needs current regulation
- Application sheet with suggested circuit supplied

HSC# 15163 **\$17.95**

Computer Parts Specials!

- A. Eight-bit VGA/EGA Video Display Card
 - 256K VRAM, non-upgradeable, may be used
 - HSC# 15059 **\$19.95**
- B. Internal 2400 BPS Modem by Everex
 - New card, no software, cables or book
 - HSC#15101 **\$14.95**
- C. Mini-tower Power Supply, 145 Watts, Used, 30 day warr.
 - 6" motherboard leads, 15" switch leads
 - HSC# 14730 **\$14.95**

External Floppy Drive

- 5.25" half-height 360K floppy drive, beige face
- Sturdy beige enclosure with power supply
- IEC Power cord, 37-pin D cable included
- Case size 6" x 2.25" x 12.5" (great for mounting other external drives, i.e. CD-ROM, etc.)
- New in box, with manual
- 90-day warranty

HSC# 15138 **\$24.95**

Transaction Terminal

- Used VeriFone Tranz 240 terminals
- Vacuum-fluorescent alphanumeric 16-character readout
- 12-key keypad - Z-80 proc. CMOS program EPROM
- Mag-stripe read-head (may have been disconnected)
- Communicates over an RS-485 line
- Needs 8.5 VAC adaptor
- Quantity discounts available



HSC# 14848 **\$19.95**

New! QRP Kit Specials

- Popular QRP ham transceiver kits by Oak Hills Research
- 1.5 Watt (Sprint) & 3 Watt (Explorer) models
- 30, 40 Meter bands avail. for Sprint, 20, 30, 40 for Explorer
- 100% complete kits with chassis, knobs, etc.
- All coils prewound for assembly ease
- QRP Wattmeter kit WM-1 available for \$79.95
- Sprint Transceiver Kit **\$89.95**
- Explorer Transceiver Kit **\$129.95**

Unusual...Bifilar Wire

- Two color-coded enameled conductors bonded together
- Used for inducing RF matching transformers and other exotic inductance applications
- 0.08 millimeters in diameter (looks like the size of a hair!)
- Can be pulled apart (carefully!) and solvent-stripped for solder connection.
- 720 meters on a roll -- Tiniest wire pair we've seen!

HSC# 14376 **\$7.95**

Network in Windows

- Genuine Microsoft Windows for Workgroups Add-on
- Requires Windows 3.1
- Includes Microsoft Mail, Microsoft Schedule +
- Share files, printers with a click of the mouse!
- Connects to Microsoft LAN Manager, Novell Netware
- New in box, adds one workstation

HSC# 15134 **\$12.50**

CD-ROM Starter Kit!

- Sony CDU-535 internal CD-ROM Drive (uses caddies)
- Pulled from defective multimedia enclosures (drive OK)
- Single-speed half-height drive, Sony 40-pin interface
- Front earphone/speaker jack, rear audio connection
- New controller card, cable included (no software, caddy)
- 90-day warranty

HSC# 15191 **\$49.95**

Multimedia Woofer!

- 60-watt air-suspension speaker with built-in crossover
- Mediavision Model 670-0020, used with CDCP system
- 6" speaker, 30 - 300 Hz freq. response, 40 Watts RMS
- Handsome black styling with removable black grille
- 9" x 7" x 17" cabinet, 1/4" phone plug input (cable incl.)
- New in box, 90-day warranty

HSC# 15178 **\$27.50**

12VDC Mega-power!

- LH Research Super-Mite switching power supply
- Provides 12 Volts DC @ 84 Amps!
- Model #SM11-2/115
- Switching supply, so don't run without a load!
- 115 VAC input, 2000 VA, has 5" fan
- Used, 30-day warranty (void if run without 50% load)

HSC# 15185 **\$89.95**

Back-up Tape Drive

- Colorado Memory Systems "Jumbo" model drive
- 120 Megabyte external tape-backup unit
- Requires software (we don't have it, sorry!)
- Interfaces like a floppy drive (37-pin connector on back)
- 6.75" x 2.5" x 10" case with power supply, no IEC cord
- 90-day warranty

HSC# 15171 **\$59.95**

HPIB Cable

- Genuine Hewlett Packard (#92220R)
- HPIB/GPIB interface cable, 1' long
- Has dual stackable 24-conn. connector at each end
- Fully shielded, rugged metal housings

HSC# 14803 **\$12.50**



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R10 AND R20 INTERCEPTORS

Selftuning near field receivers with signal strength indicators.

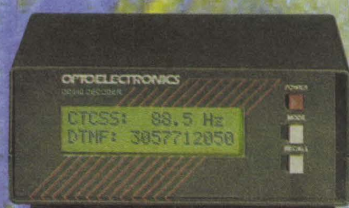
R10.....\$359.00

R20.....\$119.00



R10 Interceptor is the fastest way to pick up nearby two way radio transmission, no matter what the frequency is. The R10 is a totally unique instrument for two way communications test, security, surveillance, and recreational monitoring. Twin LED bargraph for signal strength and deviation are on the front panel. Audio output is suitable for tone decoding with the DC440. Earphone, antenna, internal NiCad batteries, and adapter are included.

R20 RF General purpose Signal Strength detector also can intercept AM signals for earphone monitoring. Its small size and low cost make the R20 useful for transmitter checking, RF room sweeping, and monitoring nearby AM transmissions. R20 comes with a 9V battery and a built-in antenna.



DC440 DECODER

Decodes DTMF, CTCSS, and DCS
CIV compatible, optional nicad.

DC440.....\$259.00

Opt/nicads.....\$39.00

DC440 Decoder works with any receiver, service monitor or the R10 Interceptor to decode Subaudible tones (CTCSS) and codes (DCS) and Touch-tone (DTMF) characters. The display is a two line alpha numeric LCD with back light. Push-button switches control all functions from the front panel. CI-V serial interface supports computer controlled scanning with ScanStar Commercial software. NiCad battery pack is optional.

SCOUT 40

New frequency recorder-records up to 400 frequencies with 250 hits on each frequency and much more.

SCOUT.....\$449.00



Scout is much more than a counter, it is a frequency recorder with a 400 frequency memory. Up to 250 repeat hits are also stored with each frequency. Perfect for discrete, in the pocket frequency collection, or drive by monitoring. Exclusive "Reaction Tune" feature tunes an OS456 or Icom receiver instantly for monitoring. PC software is included to download frequencies and an optional CD, Spectrum for the Scout, can look them up in the FCC database. Rapid Charge, High Capacity Batteries, back lit LCD display, serial interface, beeper and pager style vibrator are included.

OPTOSCAN 456

Computer controlled interface.
For use with the Radio Shack
Pro 2005/6 Series Scanners.

OS456.....\$299.00



OptoScan 456 is the fastest computer controlled scanning system and the only one with Tone (CTCSS) Codes (DCS) and touch tone (DTMF) decoding standard. When installed in the highly regarded Pro-2005/6 receiver the OS456 is also much less expensive than any other computer controlled scanning system. Installation is easy with simple hand tools and only two solder connections. Supported by all popular Scanning Software.

ACCESSORIES

N100-FM Broadcast Band Notch Filter.....\$99.00

CF802-Cellular Band Pass Filter/Amplifier.....\$149.00

BLP70-Low Pass Filter.....\$36.00

BHP70-High Pass Filter.....\$40.00

CX12-RS232/CIV Interface Converter.....\$89.00

TA100S-Telescoping Whip Ant. with BNC connector.....\$12.00

DB32-Dual band VHF/UHF miniature antenna.....\$29.00

Write in 52 on Reader Service Card.

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Call or write for current advertising rates.

CONTENTS

VOLUME 16 NO. 2 FEBRUARY 1995

ARTICLES

- LATEST HAM RAGE:
CROSS-X-BAND REMOTES** *Gordon West*.....10
Take full advantage of being a licensed amateur radio operator with cross-band operation.
- OPERATION AIRSTORM** *Fred Blechman*.....17
Enjoy hours of combat excitement and professional kit building instruction — 3D style — with this amazing simulation program.
- ELECTRIC CAR CHARGERS** *Shari Prange*.....30
The charge you get out of your electric car will only be as good as the charge you put into it.
- THE BASIC STAMP AS A
CIRCUIT DETECTIVE** *Scott Edwards*.....56
Automated testing techniques help discover — and defeat — hidden flaws in circuit boards and cables.
- BUILD A FRUIT POWERED DIGITAL CLOCK** *Fred Blechman*.....66
Go bananas with this unique project.
- INSIDE WIRE MAINTENANCE — PART 2** *Daniel B. Levels*.....74
Learn methods to troubleshoot more difficult noise problems (like crosstalk and RFI) on your telephone line.
- INTRODUCTION TO THE INTERNET** *Jim Benson*.....112
Telnet and FTP.
- BATTERY CYCLER** *Thomas Peterick*.....125
NiCd batteries can be a large portion of the cost of powering portable equipment, so it makes sense to take good care of them.

COLUMNS

- AMATEUR ROBOTICS** *Karl Lunt*.....22
Building a smaller, lighter frame.
- OPEN CHANNEL** *Harry Helms*.....38
Radio from the "Twilight Zone."
- RESOURCE BIN** *Don Lancaster*.....107
A look at sensors and sensing.
- THE LASER EXPERIMENTER** *Anthony Charlton*.....99
New reader-to-reader helpline, plus more laser applications.
- THE SOLDERLESS BREADBOX** *Don Wilcher*.....88
Electromagnetics.

DEPARTMENTS

- ADVERTISER'S INDEX**.....131
- CLASSIFIED AD INFO**.....132
- DEALER DIRECTORY**.....119
- EVENTS CALENDAR**.....48
- MONTH AT A GLANCE**.....129
- NEW PRODUCT NEWS**.....84
- NV ADMART**.....110
- TECH FORUM**.....42

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Nuts & Volts Magazine encourages article submissions and queries.

Send a SASE for a copy of our writer's guidelines.

All submissions should be on 5-1/4 or 3-1/2 inch diskettes and include hard copy as well. If return of materials is requested, include a SASE with your submission.

Deadlines should be discussed in advance with the editor, but generally all material should be submitted by the 1st of the month for the next month's issue.

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If you are moving, notify us AS SOON AS POSSIBLE so we can continue your subscription without interruption.

Your magazine WILL NOT automatically be forwarded to you by the post office, so it's important to submit your change of address directly to Nuts & Volts.

We will not be able to replace missed issues of the magazine due to unreported address changes.

When you send in your new address, include a current mailing label from the magazine with your account number on it. If you do not have a mailing label, be sure to include your old address and the name(s) under which the subscription was submitted.

INDEX TO CLASSIFIED ADS

10. Ham Gear for Sale.....7
20. Ham Gear Wanted.....14
30. CB — Scanners.....15
40. Music & Accessories.....19
50. Computer Hardware.....19
60. Computer Software.....34
70. Computer Equipment
Wanted.....40
80. Test Equipment.....41
85. Security.....70
90. Satellite Equipment.....71
100. Audio — Video —
Lasers.....72
110. Cable TV.....77
115. Telephone — Fax.....82
120. Components.....91
130. Antique Electronics.....92
140. Publications.....93
150. Plans — Kits —
Schematics.....94
155. Manuals — Schematics
Wanted.....97
160. Miscellaneous Electronics
For Sale.....97
170. Miscellaneous Electronics
Wanted.....106
180. Education.....116
190. Business Opportunities.....116
200. Repairs — Services.....121

NOTICE

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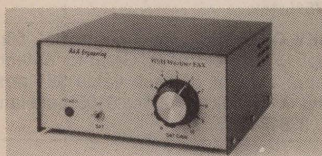
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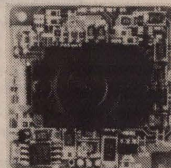
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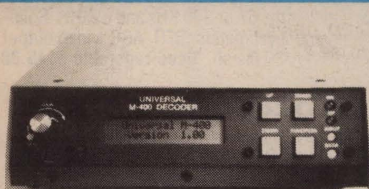
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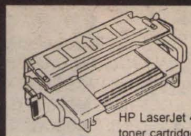
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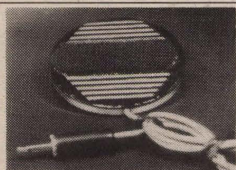
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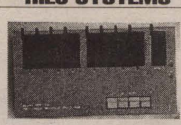
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LATEST HAM RAGE:

CROSS ~~X~~ BAND REMOTES

by Gordon West

Amateur radio operators are flocking to the airwaves in record numbers. The no-code-test-required Technician class license has created a steady increase in amateur radio licensing since its inception just a few years ago. Before the no-code Tech license, the ham population was slowly sinking by 2.5 percent a year. There was no new blood coming in, and attempts at an enhanced Novice license for voice privileges still required the dreaded code test.

Now that the code test has been completely eliminated for the beginner no-code Technician class license, ham radio ranks are swelling to an increase of 10 percent over preceding years. Record growth!

The no-code Technician class license allows full privileges on the bands listed in Table 1.

The most popular bands are two meters and 70 centimeters.

For the new no-code Technician class operator, these bands offer popular repeater communications for extending the range of their low-power handheld or mobile units, packet channels for computer communications, satellite channels for working OSCARS (orbiting satellites carrying amateur radio), simplex unit-to-unit frequencies, autopatch telephone service, contests, and emergency traffic handling.

The two-meter band has wide-open repeater access, and the 70 cm band (sometimes called the "440" band) is filled with sophisticated repeater systems which you will first join and support to learn all of the "up codes" for full access.

Repeaters start out as a \$10,000.00 system that goes high atop buildings or mountain tops for extending the range of portable and mobile two-meter and 440 users. On two meters, just dial up the repeater of your choice, and have fun. On the 70 cm band, you'll probably need to join a repeater "system," and then enjoy all the benefits of autopatch, remote base, linking, and other neat things that allow you to communicate over several states on your little handheld or mobile radio. Yes, there are some open 70 cm repeaters, but the majority of the activity for real sophisticated repeater operation is found in joining closed or private repeater networks.

The ARRL repeater directory — a bargain at \$6.00 — is available at all amateur radio stores and mail-order catalogs, and lists every repeater

on every amateur radio VHF and UHF band for the United States, Canada, and where available, the Caribbean, Central and South America, Pacific Islands under U.S. jurisdiction, and portions of Europe. This is a "must have" book for knowing where the repeaters are throughout the country.

Hams are now buying dual-band transceivers that incorporate both the two-meter band and the

and proper identification cannot easily be achieved with these units. The FCC rules are clear about amateur remote systems and the needed control only above 222 MHz, not on their input and not on the two-meter band. There is also the required 10-minute ID from this unit which can be met by the operators giving their call sign regularly.

Here's how they work. Let's say you live on a

hill, but work down in the valley. You want to stay in touch with all your buddies on two meters, but you can't hear their signals direct, and there's not a local repeater in your area to extend the signals from your little dual-band handheld.

You put the remote up at your house on a big antenna, install the necessary filter-cavities to improve the performance of receiver selectivity on each band (Sinclabs, Tonawanda, NY; 716-874-3682 for cavity information). You run a big fiberglass dual-band antenna hooked into a duplexer so one antenna runs both bands, and set your equipment up for cross-band repeat.

On your handheld down in the valley, you go in on 70 cm, and your signal comes barreling out on two meters. Your buddies trans-

mit back to you on two meters, and you hear them through your cross-band remote on 70 cm. You could actually get by with a 70 cm only transceiver or a handheld, but it's nice to have a dual-band handheld so you can hear your own audio coming out of your home remote base high on the hill.

You would choose two frequencies that are not used in the area for repeaters or other activity. Choose these frequencies carefully, and discuss your choice with local frequency coordinators. You must operate your remote within the band plan in order to stay legal. You just can't dream up any



Don Arnold WD4FSY operates cross-band off of his mobile dual-band Icom transceiver.

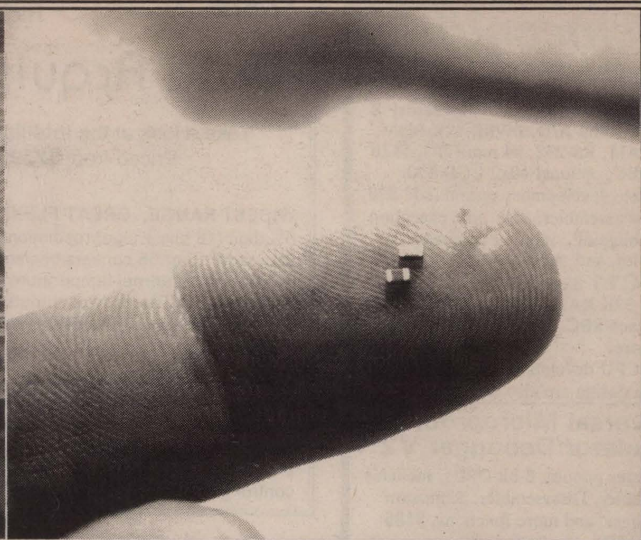
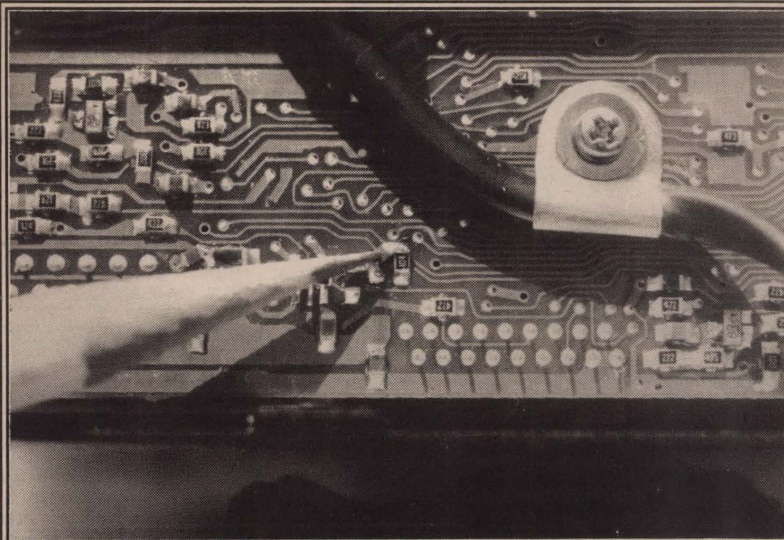
440 band in one nice, neat unit. Most hams start out with a handheld, and then add a mobile unit that gets permanently mounted in the car, or set up on the base. Then they discover something very unique that is barely mentioned in the operational manual — CROSS-BAND REPEAT.

The dual-band mobile (handhelds, too) can be switched into a mode that automatically retransmits anything on one band automatically over to another band. Go in on two meters, and come out on 70 cm. Or go in on 70 cm, and come out on two meters. It's almost like a repeater, but is generally considered a cross-band remote as opposed to a full-blown repeater station.

Some hams love the cross-band remotes — and others hate them. If they're not put on the right frequencies for this type of use, they can be a major headache. There is also concern about the proliferation of these cross-band remotes where the required control above 222 MHz

TABLE 1

| | |
|--------------|---------------------------------|
| 10 GHz | 10,000 MHz-10,500 MHz microwave |
| 5 GHz | 5,650 MHz-5,921 MHz microwave |
| 3 GHz | 3,300 MHz-3,500 MHz microwave |
| 2 GHz | 2,300-2,310 MHz, 2390-2450 MHz |
| 23 cm | 1,240 MHz-1,300 MHz |
| 33 cm | 902 MHz-928 MHz |
| 70 cm | 420 MHz-450 MHz |
| 1-1/4 meters | 222 MHz-225 MHz |
| Two meters | 144 MHz-148 MHz |
| Six meters | 50 MHz-54 MHz |



Cross-band modification on some sets requires a diode-ectomy or modification.

frequency, and light it off.

On the 70 cm band, 433 MHz-435 MHz is received for auxiliary/repeater links. Double check that the equipment you choose will indeed tune below 440 MHz. Some ham sets won't budge below 440 MHz, so this would be beyond the normal transceiver tuning.

On the two-meter band, you might try 445.50 to 445.80 as "miscellaneous and experimental modes." But again, get together with your local frequency coordinator and see what they say about your proposed dual-band remote system.

You must run your dual-band mobile transceiver with full decode squelch. In other words, the only way it will retransmit a signal on the other band is when that signal is accompanied by the proper CTCSS sub-audible tone. This keeps your equipment from "kerchunking" when other non-wanted signals appear on either-band-input.

The equipment could also be run in the dual-band remote mode from your vehicle. I have done this at the scene of disaster communications during earthquakes. Many times I'm inside a Red Cross shelter that has so much shielding within the walls of the gymnasium that I can't get a good, decent signal out to a distant repeater or simplex channel. I will go in on 70 cm to my mobile unit's cross-band repeater, and presto, my mobile unit sends out a powerful signal on two meters. It can either by simplex or through a repeater. When a two-meter signal comes through my mobile, it is cross-banded out on 70 cm.

When operating a cross-band remote through a repeater, it's best to monitor only the repeater input, and transmit on the repeater input, rather than the repeater output. If the repeater output has a prolonged hang time, you won't be able to get control of your own mobile unit until the repeater drops carrier and your cross-band remote now cycles back to receive on the 70 cm band. Also, many repeaters don't repeat-out CTCSS, and you should never operate a cross-band remote without CTCSS engaged.

Mobile cross-band remotes can also take channel changing information via

in case you set them into orbit by inadvertent keystrokes. Very important! If you can't easily get back to your dual-band remote, you need to know how to get it back into the regular dual-band repeat mode.

You would never want to run your handheld as a dual-band cross-band system. It would heat up very quickly on transmit, and soon destroy itself. The handheld does not have the receiver selectivity necessary to operate off an external antenna either. Only choose mobile units with cooling fans built in for cross-band operation, and be sure you have all of the optional CTCSS and DTMF boards

TABLE 2

| |
|--|
| Alinco DR-600TB — No voice read-back |
| ICOM IC-820H — Base station. Better have a big budget. |
| ICOM IC-D100 — Triple-band with voice read-back capabilities |
| ICOM IC-2340H — Cross-band mobile |
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| Kenwood TM-642, 742, 942 — Tri-band with full cross-bands capability |
| Kenwood TM-733A — Dual-band with cross-band |
| Kenwood TS-790A — Dual-band base station with cross-band full remote capabilities, including voice read-back |
| Standard C5718DA — Full duplex cross-band mobile |
| Yaesu FT-5200 & 6200 — Dual-band mobiles for cross-band repeat |
| Yaesu FT-5100 — Dual-band cross-repeat |
| Yaesu FT-736R — Tri-band base with cross-band capabilities with internal modification by a pro |

the keypad on your little handheld and a long list of keystrokes. With your little handheld, you could

switch to different frequencies on your dual-band mobile unit, change CTCSS tones, cycle into VFO and scan up or down, and just about anything else you want going in on the 70 cm band for this operation. Remember, you're not allowed to radio control below 222 MHz.

The more sophisticated mobile units will also speak out their frequencies and parameters

installed to insure your unit doesn't accidentally trigger up, transmit for hours, and ultimately melt down without you being able to control it on the 70 cm band.

And once again, make absolutely sure the frequencies are not regularly occupied by other operators that you might choose for your dual-band remote base operation — which is especially true if you use it as a fixed base on a giant antenna and amplifier system. Watch out for repercussions.

But when run mobile, the equipment listed in Table 2 may go unnoticed, and you'll have your own miniature cross-band repeater that should be run in full compliance with the FCC rules and local frequency coordination.

All dual-band handhelds may be capable of cross-band repeat, but due to their small heat sink capabilities and susceptibility to intermod on an outside antenna, dual-band handhelds should only be used as a communications and programming link to a mobile unit cross-remote radio, and never used ITSELF in cross-band continuous transmit repeat.

Cross-band operation is the latest rage in taking full advantage of the capabilities of becoming a licensed amateur radio operator. **NV**



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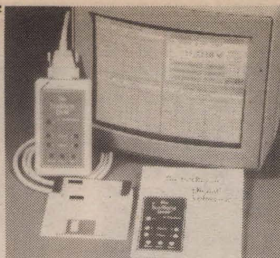
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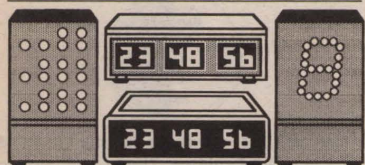
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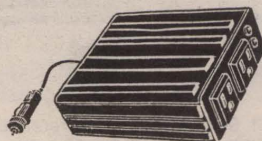
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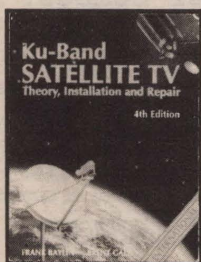
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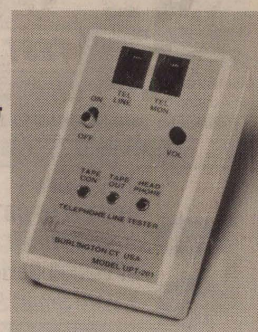
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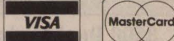
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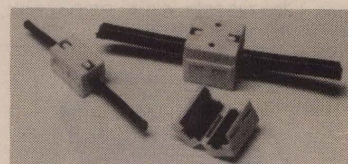
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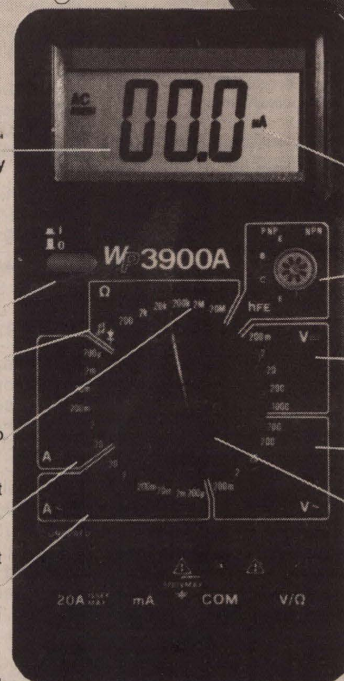
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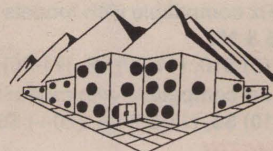
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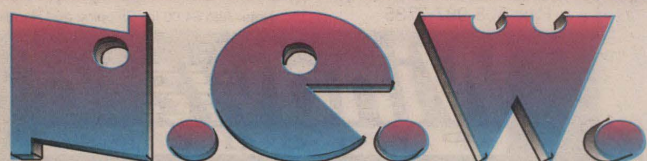
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Operation AirStorm

by Fred Blechman

"Lieutenant Blechman, reporting as ordered, sir."

"At ease, Lieutenant. I just wanted to congratulate you on the major part you played in saving the Novian Republic from the clutches of that cruel Belugan dictator, General Borgia, when he tried, together with his ally Myriad, to invade and conquer Novia. Your eight successful missions, flying Tomcats, Eagles, Apaches, and Stealth Fighters, earned you a chestful of medals and the enduring gratitude of all Novians."

"Thank you, sir. But without my hours of practice and preparation with Expert Software's Operation AirStorm, I could never have done it, Commander..."

Overview

Yes, I completed all eight missions in "Operation AirStorm," and can't remember having more fun with a flight simulator — actually four flight simulators. First, it took me an hour or so to search around the program through all its paths, and then watch the amazing full-motion 3D kit assembly process for the four Revell-Monogram plastic models — the same models as used in the flight simulators. It may be an old cliché, but it certainly applies in this case: "You gotta see it to believe it!"

Once I satisfied my curiosity about the many program features, I concentrated on the flight missions and getting familiar with the cockpit and controls. I found a number of "tricks" not mentioned in the manual, and was able to complete missions that at first appeared hopeless. And at the end of each completed mission I got another medal or trophy from a lovely

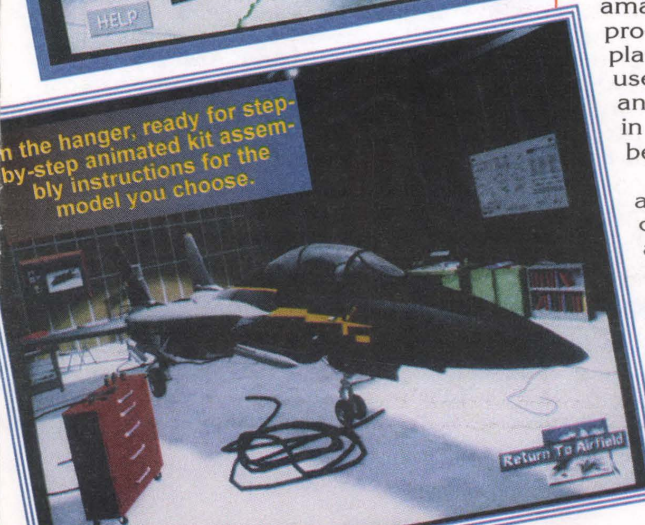
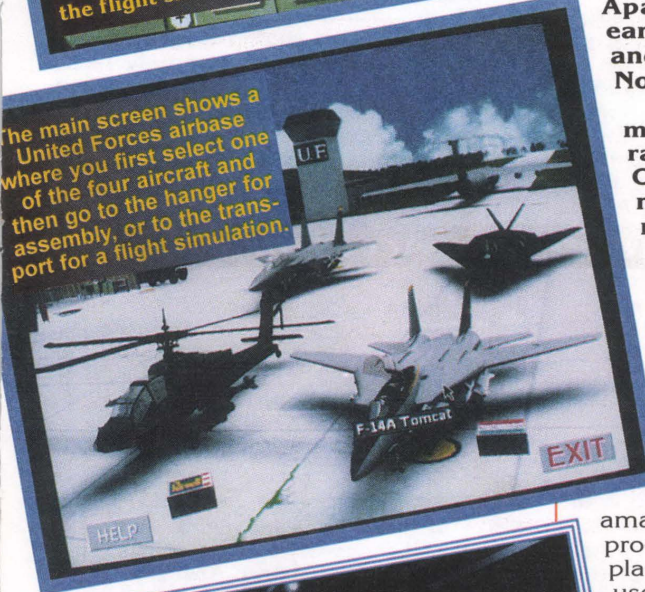
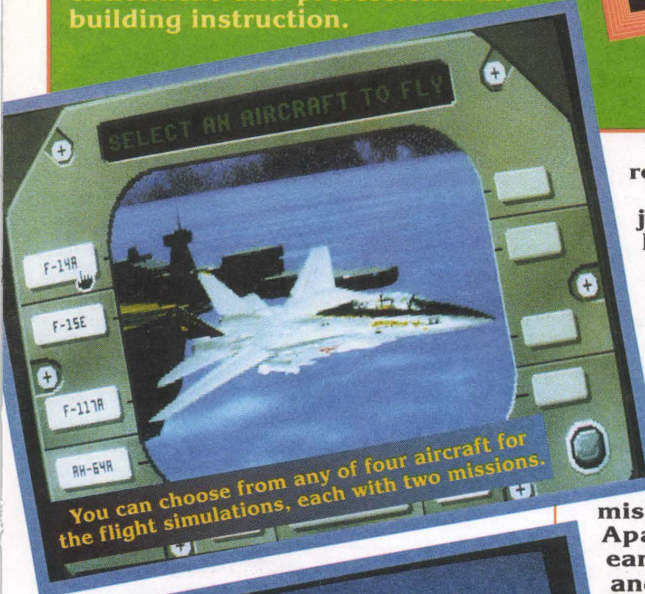
Novian woman, and a big grin and thumbs up from one of the more seasoned pilots — the same guy who gave me a real bad time on earlier attempts! I'll let you in on the tricks later in this review.

I'm amazed at the enormous number of video and animated screens — briefings, scores, medal awards, razzing, mission assignments, maps, etc. — contained on this CD-ROM. Perhaps even more amazing is the suggested retail price of only \$19.95, which means a typical street price of under \$15.00!

Equipment Requirements

This is no "wimpy" program, despite the very low price. You'll need an IBM compatible with an 80386SX or better processor running DOS 5.0 or better, a VESA-compatible SuperVGA card and monitor, 4 MB of RAM, a mouse, a CD-ROM drive with a transfer rate of 150 Kbps or faster, and a hard drive with 13 Mb of free space. For sound (which you really need for briefings and debriefings), you'll need a Sound Blaster compatible eight-bit or better sound board. Although the aircraft can "fly" with mouse or keyboard control, no self-respecting pilot will want anything but a joystick!

Installation requires that you make a boot disk with the proper memory allocations and driver parameters. The provided MAKEBOOT program does this for you, and an INSTALL program puts the necessary drivers onto your hard drive.



Operation AirStorm

Getting Started

When you want to use Operation Airstorm, you boot the computer from a floppy drive with the MAKEBOOT disk, then run the program from your hard drive, which controls the enormous number of screens on the CD-ROM disc.

After an action opening and title screen, you see yourself at a United Forces (U.F.) airbase with hangars, four mission aircraft (F-14A Tomcat, F-15E Strike Eagle, F-117A Stealth Fighter, AH-64A Apache attack helicopter), and a big transport at the end of the runway. Using your mouse, you select one of the combat planes and then either go into combat by clicking on the transport, or go into the hangar for detailed, animated kit-building instructions.

You can also click on a Revell or Monogram symbol and see photos and descriptions of many of their different kinds of kits. Click on a HELP button at the lower left of the airbase screen and a narrator's voice describes your choices. While you're waiting to make up your mind, a flight of four fighters in close formation zooms by periodically.

The 32-page User's Guide is heavily illustrated, but does not go into enough detail on some functions. Through many hours of actual use, I've found a number of "tips" that I'll share with you later — and you'll REALLY enjoy combat. For now, we'll get into some detail about one of the most unique applications of CD-ROM technology that I've seen — animated kit assembly.

Kit Assembly

In the "old days" — the 1940s — we built airplane models of two types: flying models made out of balsa and paper, with a twisted rubber-band powering a flimsy propeller; and solid models with the fuselage carved from a block of balsa wood, and wings cut from thin balsa sheets. The instructions consisted of simple illustrations and templates. Painting the solid models was a real chore, first requiring fine sanding, then priming, then painting.

Things changed in the 50s and 60s with the introduction of inexpensive small piston engines to power larger flying models, and molded plastic kits replacing balsa wood for display models. The plastic

kits were easily built and painted and, as time went on, the kits became more detailed and complex.

Today's display model kits are a tribute to the plastic industry, with complex "parts tree" moldings, hundreds of close-fitting precision parts, as well as accurate painting and detailing with custom decals to replicate the appearance of real-world airplanes. With that complexity has come more detailed printed instructions, another challenge to the kit industry.

But wouldn't it be easier if you had animated, full-motion 3D step-by-step instructions that showed exactly where each part is located on the parts trees, and exactly how it is assembled into the kit? That's what this program does!

While in the hangar, you can see what your plastic model will look like with and without paint, and find out what you will need for building it. You can watch video modeling tips on glueing, painting, and finishing. You can preview the entire model in an animated "exploded" view and watch the pieces come together — and you can choose the animation speed, as well as stop it at any point for closer inspection. You can get a close-up look of the cockpit and weapons, as well as performance information.

When you're ready to build the model, your step-by-step instructions are in motion. At each step, you can select any part shown and a part locator screen shows the appropriate parts tree and exactly where on that tree the specific part is located. This is extremely useful when trying to locate the many tiny parts that populate crowded parts trees.

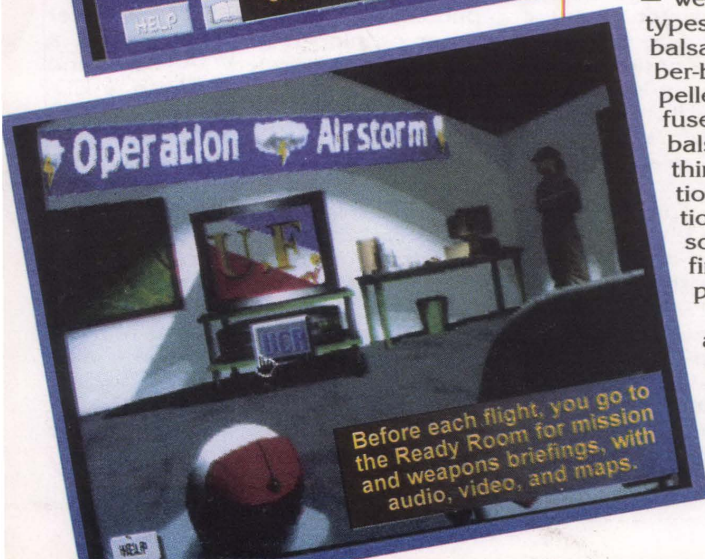
You can select any step sequence, but it is intended that you start with Step 1. It is absolutely fascinating to watch the 3D animation as parts turn and move into position, sometimes flipping completely over or under other parts on the path to their destination. As you progress through the steps, you work with small sub-assemblies that fit into larger assemblies and then the final assembly.

Finishing a kit properly makes all the difference between just a model and a display. The last step shows close-ups of all the decals and their locations. Since parts should be painted while still on their respective parts tree, a paint menu lets you pick a paint color and then "paints" that color on the parts trees where that color is used. Amazing!

Clicking on a HELP button on most screens brings the narrator with voice instructions. You can proceed in sequence, or jump ahead (or back) to check any step of construction. A speed control lets you control the speed of the screen animation, and you can "freeze" the movement any time.

If you buy one of the four kits "constructed" by this program (typical street price: \$9.00-\$19.50), a mail-in Rebate Certificate included in the Operation AirStorm box offers you another of the four kits FREE, postage paid! Such a deal!

Continued on page 120



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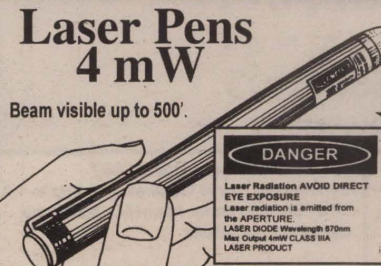
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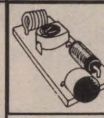
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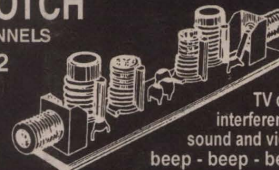
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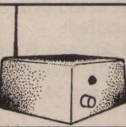
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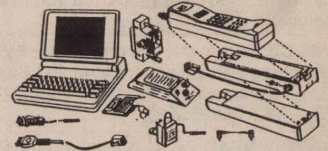
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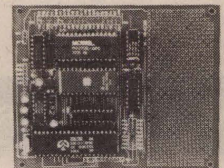
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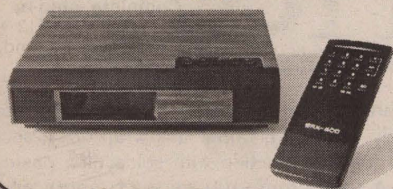


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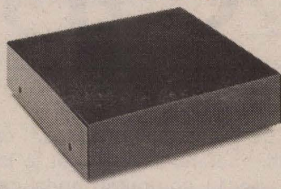
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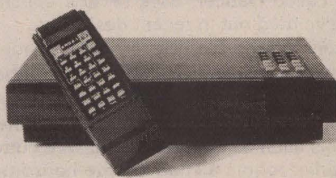
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AMATEUR ROBOTICS

I was in the mood to build a new robot frame. Max, discussed in several previous columns, makes a great platform for large experiments, but Max is, well, large.

I needed a smaller, lighter frame to serve as a base for some sensor experiments I had in mind. Much of this need was driven, as always, by developments within the Seattle Robotics Society (SRS).

The SRS members have shown renewed interest in line-following robots, and we held a club-wide competition recently. My venerable CBE-1, built nearly three years ago, did manage to win the contest. But the gleam in the eyes of the other contestants made it clear that CBE-1's days as champion were numbered.

CBE-1

I'll briefly describe CBE-1, so you get an idea of how I put it together. This is mostly historical information, as I don't intend to build a CBE-2. Incidentally, CBE stands for Crude But Effective, a comment made about my machine's design shortly before it went on to win the first of many line-following contests.

I built CBE-1 around a skeleton made of three pieces of bookshelf frame. You've probably seen this frame material in the larger hardware stores. It usually comes in three- or four-foot long sections, and has pre-drilled holes spaced at about 3/4" intervals along its length. The material is made of U-shaped aluminum or soft steel stock about 1/2" wide.

I started by cutting one piece, about 12" long, to serve as the central brace for the robot. I then bolted two other pieces, each about 10" long, to this brace. I mounted the two shorter pieces to the main brace at their centers, crosswise to the main brace, so the unit formed a plus-sign with two horizontal lines instead of just one.

I then bolted two Maxon gearhead motors, one at either end of the two-piece central brace. The motors fit between the two braces, held in place with circular clamps.

Above the motors, I added two four-cell D-size battery holders. I also added two furniture knob casters, one in front and one in the rear, from the single main brace.

I used a plastic flower pot as the cover, held in place with spacers and hardware to the main brace. Additional hardware held the electronics to the top of the flower pot.

The electronics consist of a motor controller board and a 68hc11 computer board. The motor controller uses two DPDT relays and two power MOSFETs to provide direction and pulse-width modulation (PWM) speed control of the motors. The computer board contains 32K of EPROM and 32K of battery-backed static RAM.

Finally, I mounted a line detector pod, consisting of three cadmium-sulfide (CdS) photocells and three LEDs, to the front underside of the robot, just

behind the front caster.

But CBE-1 was one of a kind. I can't get any more of the motors, I don't want to build another complex 68hc11 computer, and I can't find the Forth compiler or source I used to create CBE-1's code.

Dancer

So I decided to completely start over. The new machine, called Dancer, uses several construction methods I've tried out in recent designs.

Dancer's design features an open frame made of stout brass rod and double-sided copper-clad printed circuit board (PCB) stock. These materials are cheap, easy to find, and can be machined with simple tools such as drills, files, and wire cutters.

My earlier robots all had a large horizontal platform, which supported the electronics and batteries. Dancer's frame has only one small vertical element, set at the back and holding the batteries and modified R/C servo motors. Refer to the accompanying top and side views of Dancer's wire-frame design.

Begin by bending two lengths of 3/32" brass rod to the indicated shape. You can find this rod at

rod around the upper horizontal element, approximately as shown. Crimp this wrap down securely, then coat the junction with solder flux paste, heat with a solder gun (100 watts or more), and flow rosin-core solder into the junction.

You can find the paste and the solder gun at most hardware stores. Most soldering irons suitable for electronics work don't generate enough heat for this type of soldering, and do a lousy job.

After the junction has cooled, wrap the other end of the thinner rod around the lower horizontal element. The two horizontal elements should be spaced about 2-1/2" apart by the vertical element. Crimp the wrap, coat it with paste, then solder the junction. Trim the excess thin brass rod from both ends.

Repeat the above steps to add a vertical element to the other frame section.

The frame sections are designed to hold a circuit board built on a Radio Shack experimenter board (276-158A). If you choose to build your frame for the same size board, you need to space the two frame sections properly. Refer to the accompanying details of additional hardware.

The brass screws for holding the circuit board must be soldered onto the frame elements such

that the screws form a rectangle 2.5" wide by 3-11/32" long. The simplest way to align these screws properly is to use a blank experimenter board as a guide.

Place the two frame pieces side by side, locate a point near the rear edge of the frame, and mark that location on both frame pieces. Using the blank board as a guide, make a second mark near the front bend of each frame for the second set of mounting hardware. The first and second marks on each frame element should now be 3-11/32" apart.

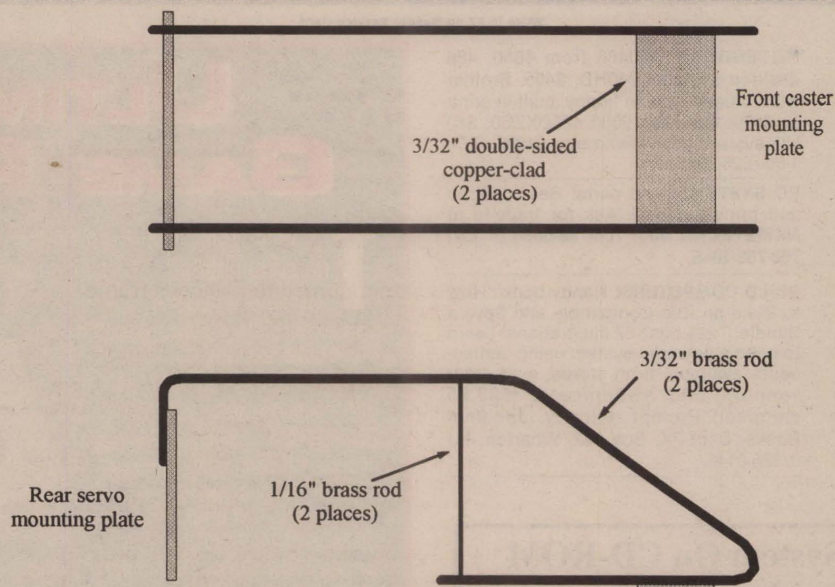
Now you need to attach 1" long brass 4-40 screws, available at most hardware stores, to each of the frame elements at the marked locations. Start by stripping the insulation from a piece of solid copper wire about 2" long.

Wrap the wire around both the screw and the frame element, so the screw is held snugly against the inside edge

of the frame at one of the marks. Carefully check that the screw is vertically aligned, relative to the rest of the frame element.

Coat the junction between the screw and the frame element with flux paste, then solder the screw to the frame. Repeat this operation to solder a second brass screw at the other marked location on this frame element. Then solder two screws to the other frame element. Make sure you solder all screws to the inside edge of the frame elements.

Now you should be able to mount the experi-



Top and side views of Dancer's wire-frame design

most large hobby stores; price is about 89 cents for a three-foot length.

Trim the rod to length using heavy steel-jawed nippers or stout wire cutters. The brass is soft, but it will probably damage fine diagonal cutters normally used for cutting wire.

Next, cut two pieces of 1/16" brass rod, each 3-1/4" long. I'll describe how to connect one of these pieces to one of the heavier frame sections; follow the same steps for the other piece.

Using heavy pliers, wrap one end of the thinner

menter board to the four screws, using nylon spacers and 4-40 nuts. Double check the screw locations to ensure they are vertical and that the ends of the frame match up. Leave this circuit board mounted to the frame elements for the remainder of the frame construction; this ensures that your frame will stay aligned.

If a screw isn't positioned properly, reheat the junction and realign the screw. If necessary, you can also rebend parts of the frame elements, though the brass will fatigue easily and may break after repeated bending.

Make the rear servo plate from a piece of double-sided PCB stock; cut to a rectangle 3-1/4" by 2-1/2". Position the plate as shown in the details, so the longer side lies horizontally between the frame elements. Mark the mounting locations, then solder one frame element to the plate. Solder the second frame element in place, then reheat the first junction, if necessary.

Cut a second piece of double-sided PCB stock to a rectangle 2-1/2" by 1". This will serve as a mounting plate for the front caster. Drill into this plate whatever holes you need for your selected caster. Since I usually use a plastic furniture knob as a caster, I just drilled a single hole in the center of the plate.

I also drilled two holes, each 1/8" in diameter, in the rear edge of this plate. I positioned the holes properly so I could later attach one half of a Radio Shack experimenter board (276-148). This board's small size makes it an ideal development platform for sensor pods and other experiments.

After you have drilled the needed holes, position the caster plate as shown and solder it to the underside of the frame. Finally, attach your caster.

This completes the construction of Dancer's frame. Now all you have to do is add the motors, batteries, and electronics.

Dancer is built to use modified Futaba S148 R/C servos. You can buy these servos at most hobby stores. You can also order them from Tower Hobbies, usually at prices well below most stores. Tower sells these servos for about \$15.00 each.

I gave full instructions for modifying the S148 servos in my July '93 column; refer to that issue for details.

After modifying the motors, mount them to the inside face of the servo plate, using double-sided foam tape. You can find this tape at most hobby stores and large hardware stores. It holds the motors firmly in place, yet you can (with effort!) remove the motors to replace or realign them, if necessary.

Be sure to clean the plate's surface with alcohol, then dry it thoroughly, before putting the tape in place.

The outside face of the servo plate holds a four-cell AA-size battery holder (270-391). Mount this battery holder in place, also using double-sided foam tape. Be sure to clean the surface of the servo plate before sticking the tape in place.

I made wheels for Dancer by fastening a five-point Futaba control horn to each of two 3-3/4" Dave Brown Lite-Flite wheels. You can get the wheels at any large hobby store, or through the mail from Tower Hobbies. The control horns are supplied with the Futaba servo motors, and the tiny

sheet metal screws are available at any hobby store.

Dancer's frame design makes a light, stylish robot. Since the large wheels help hide the batteries and motors, the robot appears to consist of a circuit board, wheels, and some brass rod.

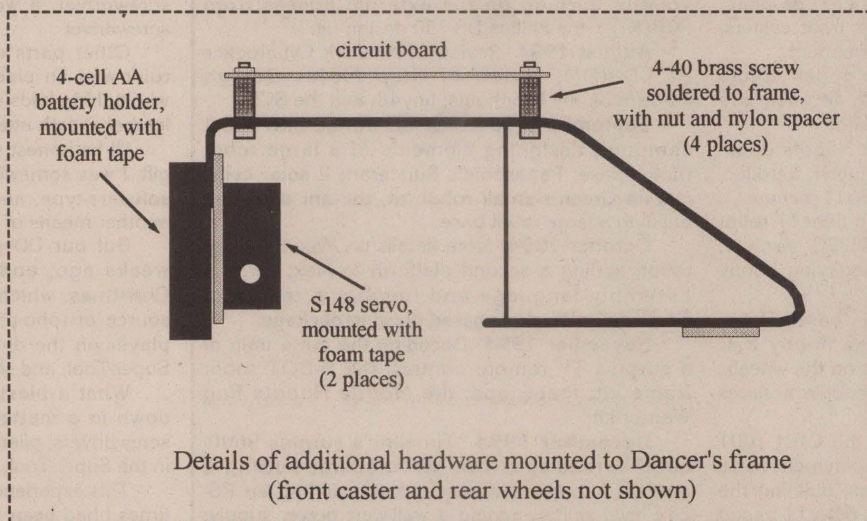
And the open frame design is amazingly strong and rugged. Best of all, you can modify the design at any time, with nothing more than some brass hardware, solder, and a soldering gun.

I built Dancer's 68hc11 computer board by wiring a CGN 1001 68hc11 module into a Radio Shack experimenter's board. I have reviewed a couple of CGN boards in previous columns. If you haven't tried a CGN module before, I strongly recommend you give the company a call and ask about their products. I have been impressed with the quality and design of all their products that I have tried so far.

I also added a handful of male MTA connectors to the experimenter's board, to support various robotic sub-systems. A pair of three-pin connectors let me plug in the Futaba J-connectors from the servo motors.

I used a two-pin connector for the wiring from the AA-battery holder. I used a four-pin connector for the serial data hookup to my PC, needed when I download any programs into the 68hc11.

I also added three four-pin connectors to analog ports AN0, AN1, and AN2 on the 68hc11.



Details of additional hardware mounted to Dancer's frame (front caster and rear wheels not shown)

These let me quickly add custom analog sources to Dancer for experimentation.

Finally, I added a special five-pin connector, wired to +5 VDC, ground, and analog ports AN4, AN5, and AN6. This connector supports a simple three-element robotic eye I am currently developing.

I also added the obligatory power switch, reset switch, power-on LED and dropping resistor, and a large electrolytic filter capacitor. And I still have enough room on the board to add a considerable amount of circuitry.

Line-following

The SRS members have renewed their interest in line-following for several reasons. First, it is a cheap event to hold. You just need a roll of white paper, such as butcher paper, about 3' or 4' wide. You also need a black marking pen that can draw a 1/4" wide line.

Just roll out a suitable length of paper onto a hard, flat surface such as a tile floor. Most of our events use a strip of paper 10' to 12' long, though you can certainly run longer if you like.

We generally apply some strips of wide masking tape on the edges of the paper, to keep it flat on the floor during the event.

All that remains is drawing the line to follow. We use a set of guidelines drawn up for a previous event that helps insure all robots will face a high-quality layout.

The line will be at least 1/4" wide along its entire length. The line will contain no intersections or branches. The line may contain 90-degree turns, either as a rounded arc or as a sharp angle. Turns made of an arc will use a radius no smaller than 6".

Wherever any segment of the line passes near to another segment, the two segments must be separated by at least 6" of white space.

The starting point of the line must consist of a straight line segment no less than 12" long. The starting line will be marked by a faint pencil line, drawn perpendicular to the contest line, 6" from the end of the contest line. The contestant's robot must be placed so no part of its body lies past the starting line before the contest begins.

The contest run is started when the time-keeper signals. Note that some robots might have a built-in delay after power-up before they actually begin moving. In such cases, the time-keeper will start the clock when the robot begins moving.

The contest run ends any of several ways. A robot that leaves the maze paper will be flagged as did-not-finish (DNF) and given a time for that run of

the maximum allowable time, usually 10 minutes. A robot that leaves the line, then rejoins the line at a point significantly farther along the line than where it left, will also be declared DNF.

A robot that is touched during the run by the builder or anyone else, in an effort to correct or improve the robot's performance, will be declared DNF.

A robot that travels the length of the maze line will be timed at the instant the front point of its body reaches the end point. The time-keeper will announce the running time, ideally to a tenth of a second.

Note that sometimes a robot will get turned around and head back to the starting point. This is not cause for disqualification or penalty, other than the extra running time such a move creates. Often,

such a robot will travel to the starting point, turn around, and restart the contest run. Its time continues to run, and is not restarted simply because the robot crossed the starting line a second time.

This type of line event requires very little sophistication, so far as robot design is concerned. In fact, the only difficult part of the line event described above is the right-angle turn.

A robot can successfully make its way from one end of this line layout to the other, using nothing more than two light/dark sensors. Mind you, it won't necessarily be fast or efficient, but it will get through.

A robot using this type of sensor pod often employs a bang-bang type of line-following algorithm. This means that the robot goes forward until one of the sensors, spaced about three line-widths apart at the front end of the robot, runs over the line.

The robot then immediately turns in that direction, until the same sensor sees, then doesn't see the line. This means the line is again between the two sensors, and the robot switches to moving forward.

I call this a bang-bang algorithm because the

INDEX

I often mention previous articles when describing some of my projects. The following index lists major items of interest in previous columns.

October 1992 First column; philosophy; sources for parts and tools; introduction to 8051 MCU; Suncoast Technologies 8051 single-board computer; introduction to BAS051 8051 BASIC compiler.

November 1992 Adding A/D and RAM to the 8051 single-board computer; A/D connector wiring; two-channel DC motor driver; +5 VDC power supply using 7805 regulator; selecting motors for a line-following robot.

December 1992 Tooter, an 8051-based line-following robot; frame construction; wheel selection; controlling electrical noise from motors; change to motor controller board; building the sensor pod; light shielding.

January 1993 An 8051-based Robo-Pet; bumper switches; pulse-width modulation.

February 1993 Starting an 8051-based Sumo robot; rules; designing a belt drive system; ideas for a frame; problems burning an EPROM for the 8051 board; Robix Robotics Construction Set.

March 1993 More Sumo robot; starting the base; 567 used as IR object detector.

April 1993 More Sumo robot; LED dropping resistors; mounting the drive wheels; front casters; review of 1992 All-Japan Sumo Tournament.

May 1993 Windup of Sumo series; Radio Shack IR detector module; 567 tone decoder; 556 tone generator; LM317 voltage regulator.

June 1993 Review of *Mobile Robots* book; parts list for basic 68hc11 robot computer; introduction to 68hc11 MCU; source for PCBUG11 manual.

July 1993 Schematic for basic 68hc11 robot computer; pinout of 68hc11 PLCC socket; schematic for RS-232 converter; modifying hobby R/C servo motors; using PCBUG11.

August 1993 Huey, a 68hc11-based Robo-Pet; frame construction; mounting hobby R/C motors; mounting R/C control horns on the wheels; using the Radio Shack IR detector module; sources for the software.

September 1993 Review of the CGN 1001 68hc11 MCU module; the Rapid Deployment Maze (RDM); construction of switch boxes; building the power unit; RDM rules; making a 68hc11-based RDM robot; building the ping-pong ball grabber; sources for the software.

October 1993 Muscle Wires; report on Robathon Northwest; description of several robots at the contest; subsumption architecture.

November 1993 Review of the CGN 1101

68hc11 MCU module; using a 68hc11 MCU in expanded mode; the 68hc11 reset problem; introduction to Forth.

December 1993 Introduction to tiny4th; tokenizing compilers; using tiny4th; renewable alkaline batteries; sidebar on lithium batteries.

January 1994 Using IR LEDs; the IR Robo-Tool; review of Marvin Green's BOTBoard.

February 1994 Controlling small DC gear-head motors; the TSC4427 MOSFET H-bridge IC; BOTBoard mods; first look at the Pacific Science Center robot project.

March 1994 1994 MIT Lego Robot Design contest (6.270).

April 1994 Detailed look at all facets of the Pacific Science Center robots.

May 1994 Gel-cell batteries; a simple gel-cell charger; getting more voltage from a Radio Shack supply; playing with the Hallmark talking cards; using SMD LEDs for show-bots.

June 1994 Discussion of the 68hc11 SPI subsystem; using the 74hc595 IC with the SPI; connecting a liquid-crystal display (LCD) to the SPI; version 2.1 of tiny4th; mods to Pacific Science Center circuits from April 1994 column.

July 1994 Expanding your 68hc11 system; designing chip-select and write-enable circuits; adding an 82c55 I/O chip; making static RAM non-volatile; turning on the external busses from PCBUG11; the Philips DS-750 design kit.

August 1994 Review of Network Cybernetics AI CD-ROM; review of *Step Motor Design Handbook*, by Leenhouts; tiny4th and the SCI.

September 1994 4th GEAR, the SRS' robot campout; designing elements of a large robot motor base; Panasonic's Sunceram II solar cells; Marvin Green's small robot kit; the ant as robot; building a large robot base.

October 1994 More details on Max, the large robot; adding a second platform to Max; PWM in assembly language and tiny4th; a review of TopDraw, a Windows-based drawing package.

November 1994 Decoding the pulse train of a surplus TV remote control; the B-BOT robot frame kit; foam tape; the *Mobile Robots* Rug Warrior kit.

December 1994 Timeline's surplus 9600-baud spread-spectrum RF modem; putting a modem into two different chassis; adding an RS-232 level shifter; adding a wall-wart power supply; determining antenna length.

January 1995 Adding a third platform to Max; adding a miniature video camera; modifying the Gemini Rabbit video system; using the Maxim MAX642 switching power supply IC; getting sample parts and free journals.

between nodes so it can weed out loops and determine the shortest distance to the finish line.

Line-following contests make super club events. You can build a line-following robot easily and, at least for the first type of line layout, the software is very simple. These events are fun to watch, and even more fun when you have a machine running in them.

Super-Tool

I am writing this on the day after Christmas. My wife, Linda, never knows what robotics-related gifts to give me, even though I try to provide specific details on my gift list. I guess the technology is just too daunting.

This year, however, she came up with the perfect gift. She gave me a Leatherman Super-Tool.

The Super-Tool is sort of the ultimate Swiss Army knife. I have the larger version, which measures 4-1/4" inches long and a little over 1" wide. It consists of two halves, hinged at one end, that open up into a pair of needle-nosed pliers. The pliers contain a wire-cutting edge and a larger, open section for gripping large nuts and bolts.

The handles of the pliers contain fold-out tools of all types. One handle sports a file, a razor-sharp knife, large and medium flat-blade screwdrivers, and an awl/punch. The other handle contains a serrated knife, a can and bottle opener, a Phillips™ screwdriver, a wood saw, and a small flat-blade screwdriver.

Other parts of the Super-Tool serve as a 9" ruler and an electrical connection crimper. The whole thing folds up into a small tool that fits into a leather sheath attached to my belt.

I'll be honest with you. When I first opened this gift, I was somewhat disappointed. After all, I am a software-type, and I usually view tools as simply another means of removing blood from my body.

But our CD player had gone belly-up a few weeks ago, and I had bought a new unit for Christmas, which meant the old one was now a source of robo-parts. Just for grins, I set the old player on the dining room table, opened up the Super-Tool, and started in.

What a blast! I had the defunct player torn down in a matter of minutes. And I had all the screwdrivers, pliers, and knives I needed, right there in the Super-Tool.

This experience made me think back on all the times I had been at a competition or an SRS meeting, when some robot-related gizmo broke down. My tools were at home, and no one had the screwdriver or pliers I needed. Boy, I sure could have used something like the Super-Tool then.

Bottom line: Take a trip to your nearest cutlery store and check out a Super-Tool. Linda says these come in at least two different sizes, and they are highly prized by electricians and engineers who do field work. I haven't had the guts yet to ask how much it cost.

Every part of this tool is made of very high-grade, corrosion-resistant steel. The Leatherman company guarantees the Super-Tool for 25 years, and I have no doubt this device will easily last that long. NV

robot is continually hitting the line with first one sensor, then the other, as if it were banging off a wall.

This algorithm, while useable, suffers from a serious flaw. The robot's computer never knows for sure when the robot is actually on-course; it only knows for sure when the robot has strayed off-course.

This weakness can lead to tacking, where the robot moves down a straight section of line by alternately hitting the line with first the right, then the left sensor. This tacking motion can cost valuable time in a contest run. In fact, each line layout should have at least one very long straight stretch in it, to put such designs to a test.

CBE-1 used left and right sensors, as well as an on-course line sensor. This latter sensor detected when the line was directly below the robot. In such cases, CBE-1 went full-speed ahead, knowing that it

wouldn't have to slow down and turn immediately.

Often, CBE-1 would be out-maneuvered by other robots in the turns and arcs, only to gain back all the lost time in the straight sections.

The next step up in line-following complexity uses a line layout that contains branches and intersections. Such a layout would usually have the finish line at the end of a branching line. This means a robot would have to use some type of a "wall-following" algorithm to explore the maze. Robots that could explore the maze, then determine the solution and run it properly would have a big advantage.

The most complex maze includes branches that loop back onto themselves or onto the main line. Solving this kind of maze requires both mapping and measuring. A robot must not only determine where each intersection occurs, it must also know the distance

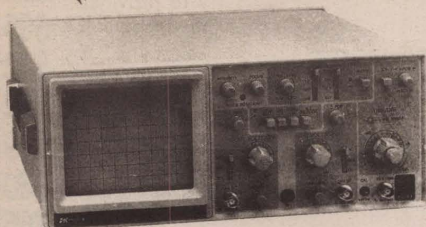
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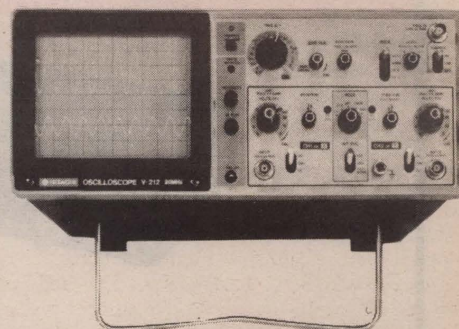
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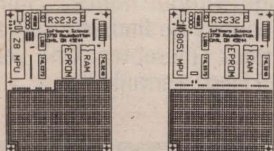
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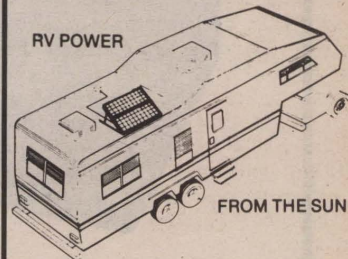
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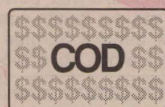


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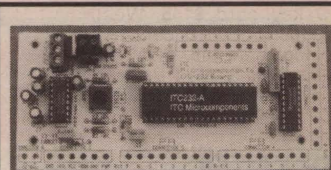
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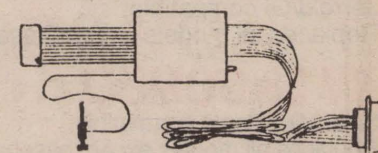
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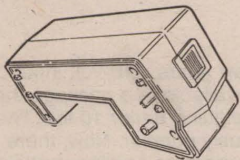
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Electric Car Conversion Chargers

by Shari Prange

The charge you get out of your electric car will only be as good as the charge you put into it. A poor charging system will give you poor range, short battery life, and may be unsafe. A good charger will simply do its job.

The Bad Old Days

The early electric car chargers were simple, often to the point of being crude. Their output was tempered only by a timer or by manual adjustments periodically throughout the charge. Either method was based on guesswork. If the guess was too low, the batteries took too long to charge, or never reached full charge. If the guess was too high, the batteries were overcharged. Overcharging caused them to bubble and gas, making a mess of the battery tops. It also shortened their lifespan.

In addition, these chargers were bulky and heavy. While commercial units were sturdy and safe, home-built models often lacked any safety features, and were potentially dangerous.

Modern Times

Fortunately, there are now much more sophisticated chargers available. These chargers can sense the level of charge in the battery pack and adjust their output accordingly. As the charge in the battery pack comes up, the charger output tapers off. This reduces gassing and extends battery life.

There are several factors you want to consider when matching a charger to your car's system. There is no one right answer for all applications.

Size & Weight

This aspect of chargers is changing rapidly. Ten years ago, the only chargers available were the size of a breadbox, and weighed 70 lbs. or

more. In the past few years, 110-volt input chargers have become available in a package the size of a toaster, and weighing under 10 lbs. These have been enormously popular. Now, there are also 220-volt input chargers coming available in the same small size. Although these are too new to have a track record yet, they are expected to experience the same good performance and popularity as the 110-volt models.

Size and weight determine whether your charger will be carried onboard or left in the garage. This decision is related to what facilities for charging are available to you, and how quickly you need to recharge.

Input Voltage & Current

Until recently, 110-volt input and 220-volt input chargers were entirely different animals. Now, there are compact chargers that can be either one. It's not as simple as flipping a switch. To change the input voltage, you have to open the charger and physically change some connections. However, it does offer you the choice of inputs in one charger.

The 110-volt input chargers have been overwhelmingly the most popular, and only in part because they were the first to be available in the compact size. Outlets for 110 volts are much more common than for 220 volts. Also, they are universal in format, while there are many different styles of 220-volt plugs and outlets. Racers who use 220-volt chargers and travel to different tracks quickly collect a set of adaptors to match their charger's plug to the outlets available.

The trade-off is speed of charging. A 110-volt compact charger usually requires a 20-amp household circuit. It will charge a typical fully-depleted battery pack in 10-12 hours. This works fine for most people, since they charge their cars overnight.

A compact 220-volt charger may require a 20- or 30-amp circuit, and will charge the same battery pack in about half the time. A large off-board charger may require up to 50 amps input, but can charge the car in one third the time of the 110 charger.

For fleet vehicles that always return to the same charging station, 220 chargers are common. The high voltage/high current circuit is no problem for the fleet facility to provide, and relatively quick charging may be important.

For the average private car owner, the compact 110-volt charger is the most popular. If you want to charge at work or at a friend's house, a 110-volt outlet is more readily available.

A transformerless 110-volt charger (bottom left), a booster unit for high-voltage systems (top left), and a transformer-type 220-volt charger (right).



Electric Car Conversion

A DC/DC converter installed in a VW Rabbit conversion to keep the 12-volt accessory battery.

Ideally, you would be charging from a dedicated circuit with no other draws on it. However, this isn't always possible. The charger may also have a knob allowing you to adjust the current level. This way, you can charge at a lower (and slower) rate without overloading the circuit and tripping the breaker.

Output Voltage

Some chargers are set at the factory for a specific size battery pack. You have to specify the voltage of your system when you order them. If you decide to change your system later, you will need to get a new charger, or at the very least a new transformer. This is most often true for the large off-board chargers.

The compact chargers are generally good over a range of output voltages. The charger will come pre-set for a typical battery pack, but will include a selection of resistors and instructions for installing the proper resistor for other system sizes.

The output of the charger must be higher than the voltage of the battery pack for the charger to work. This means that a 110-volt input charger has a problem when used to charge a battery pack of 120 or more volts. The solution is a second booster unit that transforms the 110-volt input to a higher voltage.

Tapering Output Current

It is critical that the output current of the charger taper off as the battery pack comes up to charge. An "empty" battery can accept more current than a nearly full battery. Too much current will cause heat, which causes the batteries to bubble and gas, and can damage the plates, shortening the life of the battery.

Modern chargers are designed to recognize the level of charge in the battery pack, and taper their output current accordingly. They will typically begin charging at a rate between 17 and 35 amps, depending on the charger. As the batteries near full charge, this will drop off to between 2 and 5 amps.

The final low-amperage portion of the charge cycle is the equalizing charge that brings up batteries that are slightly lower in charge until they match the rest of the pack.

Battery Type

The chargers we have been discussing are suitable for traditional flooded lead acid batteries, which are used in most electric cars.

If you venture into other types of batteries, such as gel cells, you will have to search harder for your charger. The commonly available chargers may not offer the charging profile required by other types of batteries. This mismatch can cause the batteries not to receive a full charge, or it might even damage them so they are unusable.

Safety Features

Because of the voltage and current involved, and because it is usually left unattended while operating, a charger must incorporate certain

safety features.

Typically, these include internal fuses and circuit breakers, in addition to the fuses and breakers in the house and in the car. If these blow, it is important to find out why and correct the problem.

Another crucial safety feature is isolation. It is imperative that the electrical current does not reach the metal chassis of the car, where it could cause a dangerous shock.

Part of the isolation is achieved in the car itself. The battery pack is "floating," which means it does not ground to the chassis like the 12-volt system for the accessories.

The other part of the isolation is in the charger itself. A transformer-type charger isolates the AC input from the DC output internally. While this is desirable, these chargers have traditionally been bulky and heavy because of the transformers.

The compact transformerless chargers have a ground fault interrupter. If it senses any current path to the chassis, it shuts down the charger instantly. It is very sensitive, and a trail of moisture that conducts only milliamps from the batteries to the chassis will cause it to shut down.

The new compact chargers use small, lightweight high-frequency transformers and again achieve isolation internally.

Noise Filtering

The better chargers also incorporate filters to reduce electrical noise from the charger. This is important when so many of us have other sensitive electronic equipment online.

Low Voltage Accessory System

The electric car still maintains a separate 12-volt system for the headlights, horn, wipers, etc., but there is no longer an alternator to charge this battery. Although you can install an alternator, using a belt from a second motor shaft, there may not be enough room under the hood for this. Also, you will be sacrificing some horsepower to drive the alternator.

In the early days, most electric cars ran a "total loss" system. This meant the owner installed the biggest 12-volt battery he could fit into the car, and recharged it when he recharged the main pack.

There are many problems with this system. Since most of the chargers do not provide a 12-volt output, a separate charger is needed. Also, if you are driving at night or in the rain, the 12-volt battery will fall off quickly. Then your lights will



grow dim and your wipers and turn signals will become sluggish. If the battery gets too low, it will not be able to provide the 12-volt control current needed for some of the components.

It is not advisable to tap 12 volts from the main battery pack for the accessories. One reason is that this will cause uneven discharge of the battery pack and shorten its life. Another is that this would destroy the isolation of the high-voltage system from the accessory system and the chassis.

Most cars today use a DC/DC converter. This device taps the total voltage of the main battery pack and chops it down to a regulated 13.5 volts output to provide a constant charge to the auxiliary battery. The drain on the pack is only about 6 amps, not enough to affect performance. The converter isolates the high-voltage system from the low-voltage system internally.

The DC/DC converter allows you to use a very small 12-volt battery, but it is not a replacement for the battery. If pack voltage falls too low, the DC/DC will cut out. This could happen as you are nearing home at the end of your trip with low batteries, and you draw down the pack by climbing a hill. If it is night, and the DC/DC cuts out, you will be instantly without lights.

It is important that the DC/DC converter is designed for use in a vehicle. A unit designed for countertop use in a computer or other stationary electronic gear will not withstand the vibrations, temperature extremes, dust, and moisture of life under the hood.

Today and Tomorrow

These are the options that are available to the hobbyist for electric cars today. Next issue, we'll talk about some of the exciting possibilities for the near future. *NV*

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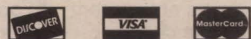
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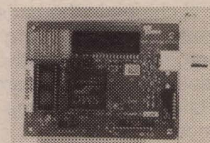
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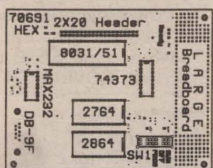
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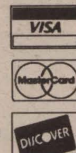
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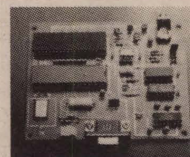


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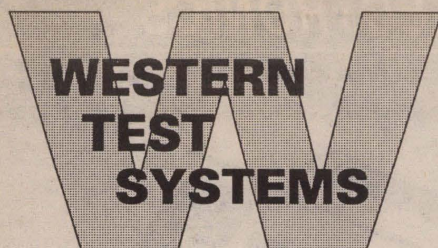
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| | |
|--|----------|
| TEK SG503 Levelled Sine Wave Generator, 0.25-250 MHz, TM500 series | \$850.00 |
| TEK TG501 Time Mark Generator, 1nS-5S, TM500 series | \$750.00 |

WAVEFORM GENERATORS

FUNCTION

| | |
|--|------------|
| HP3310A 5 MHz Function Generator | \$325.00 |
| HP3310B 5 MHz Function Generator, monocyte & burst operation | \$425.00 |
| SYNTEST SI-102 TTL Clock Synthesizer, 0.1 Hz-16 MHz, 6 decade resol. | \$150.00 |
| TEK DD501 Digital Delay & Burst Gen., for function & pulse gen's | \$375.00 |
| TEK FG502 11 MHz Function Generator, TM500 series | \$325.00 |
| TEK FG504 40 MHz Function Generator, TM500 series | \$875.00 |
| TEK RG501 Ramp Generator, TM500 series | \$225.00 |
| WAVETEK 132 2 MHz VCG + Noise Generator | \$600.00 |
| WAVETEK 135 2 MHz Lin/Log Sweep/Function Generator, tone burst | \$275.00 |
| WAVETEK 148 20 MHz Function Generator, AM/FM/PM modulation | \$700.00 |
| WAVETEK 166 50 MHz Pulse/Function Generator | \$1,250.00 |

PULSE

| | |
|---|------------|
| HP214B 10 MHz Pulse Generator, 50 V/50 Ohms, auto duty cycle | \$2,250.00 |
| HP8004A 10 MHz Pulse Generator, double pulse & offset | \$250.00 |
| HP8005B 20 MHz Dual Output Pulse Generator | \$400.00 |
| HP8012B 50 MHz Pulse Generator | \$600.00 |
| HP8080A/81A/82A/83A 300 MHz Word Generator | \$900.00 |
| HP8080A/91A/92A/2x93A 1 GHz Dual Channel Pulse Generator | \$1,650.00 |
| HP8080A/91A/92A/93A 1 GHz Single Channel Pulse Generator | \$1,400.00 |
| HP8080A/91A/93A 1 GHz Clock Generator | \$900.00 |
| HP8082A 250 MHz Dual Output Pulse Generator | \$1,400.00 |
| PHILIPS PM5785B 125 MHz Dual Output Pulse Gen., burst mode, 1 nS Tr | \$1,100.00 |
| TEK PG501 50 MHz Pulse Generator, TM500 series | \$300.00 |

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|---|----------|
| TEK PG502 250 MHz Pulse Generator, Tr<1nS, TM500 series | \$700.00 |
| TEK PG505 100 kHz Pulse Generator, 80V, TM500 series | \$275.00 |
| WAVETEK 801 50 MHz Pulse Generator | \$550.00 |

PROGRAMMABLE

| | |
|--|------------|
| HP8165A Programmable Signal Source, 1 mHz-50 MHz | \$2,600.00 |
| TEK AWG5105 Arbitrary Waveform Generator, 50 MS/s, 12 bits | \$3,000.00 |
| TEK AWG5105-opt.02 Arbitrary Waveform Generator, dual channel option | \$4,250.00 |
| TEK PFG5505 Programmable 12 MHz Pulse/Function Generator | \$1,275.00 |
| WAVETEK 278-opt.02 12 MHz Programmable Synthesized Function Gen., GPIB | \$1,500.00 |

VOLTAGE & CURRENT

VOLTMETERS

| | |
|---|------------|
| HP3457A 7-1/2 digit Voltmeter | \$2,000.00 |
| KEITHLEY 181 6-1/2 digit Nanovoltmeter, 10 nV sensitivity, GPIB | \$1,500.00 |
| KEITHLEY 195A/1950 5-1/2 digit Multimeter, 100 uV/100 pA/0.0001 ohm sens. | \$800.00 |
| SOLARTRON 7150 5-1/2 1/6-1/2 digit Multimeter, GPIB | \$550.00 |
| TEK DM511-opt.02 4-1/2 digit DMM, w/P602 Temp. Probe; TM500 (NEW/BOXED) | \$395.00 |

VOLTAGE SOURCES

| | |
|---|----------|
| HP6114A Precision Dual Range Power Supply, 20 V 2 A / 40 V 1 A | \$875.00 |
| HP6115A Precision Dual Range Power Supply, 50V 0.8A / 100V 0.4A | \$875.00 |

CURRENT METERS & SOURCES

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|--|------------|
| HP428B DC Clip-on Milliammeter, 1 mA-10 A f.s. | \$350.00 |
| HP6177C DC Current Source, to 50V, 500mA | \$600.00 |
| HP6181C DC Current Source, to 10 V, 250 mA | \$675.00 |
| HP6186C DC Current Source, to 300V, 100mA | \$750.00 |
| KEITHLEY 224 Programmable Current Source, 5 nA-101 mA, GPIB option | \$1,400.00 |
| KEITHLEY 225 Current Source, 1 nA-99.9 mA, 10-100 V compliance | \$450.00 |
| KEITHLEY 414A Picoammeter, 0.1 nA-10 mA, analog scale | \$375.00 |
| KEITHLEY 642 Electrometer | \$3,900.00 |
| LEEDS & NORTHROP 4360 Precision Current Shunts, 15-500 Amp | \$650.00 |
| TEK CT-5 High Current Transformer for P6021/A6302, to 1000A | \$650.00 |
| VALHALLA 2575A AC/DC Wideband Active Shunt, 20 mA-100 A | \$1,200.00 |

IMPEDANCE & COMPONENT TEST

IMPEDANCE

| | |
|--|----------|
| HP4800A Vector Impedance Meter, 5 Hz-500 kHz | \$550.00 |
|--|----------|

L.C.R.

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|---|------------|
| BALLANTINE 3205A 4 digit Micro-Ohmmeter | \$875.00 |
| BOONTON 62AD 1 MHz Inductance Meter, 2-2000 uH | \$700.00 |
| BOONTON 72BD 1 MHz Digital Capacitance Meter, 2-2000 pF | \$700.00 |
| E.S.I. 2160 LCR Bridge, 20 Hz-150 kHz | \$2,000.00 |
| E.S.I. 296V 4-1/2 Digit LCR Bridge, 120 Hz & 1 kHz | \$850.00 |
| GR 1666 DC Resistance Bridge, 1 micro-ohm - 100 kilohms | \$1,000.00 |
| HP4328A-001 Milliohmeter, 0.001-100 ohms f.s., battery option | \$1,350.00 |
| HP4329A High Resistance Meter, 500K ohm-2x10E16 ohm, 10-1000V | \$1,350.00 |
| HP4342A Q Meter, 22 kHz-70 MHz, Q=5-1000 | \$2,250.00 |
| MEGURO MQ-171 VHF Q Meter, 20-230 MHz, Q=10-500, freq. readout 100 Hz | \$1,100.00 |

STANDARDS

| | |
|--|------------|
| E.S.I. RS-925 9-Decade Resistor, 0.01 ohm-1.2 Megohm | \$2,000.00 |
| E.S.I. SR1010 Resistance Transfer Standards, 1 ohm-100 K/step | \$800.00 |
| FLUKE 5450A Programmable Resistance Standard, 2 & 4 wire | \$2,750.00 |
| GR 1409-SERIES Standard Mica Capacitors, 0.05% accuracy | \$150.00 |
| GR 1432-N 5-Decade Resistor, to 11,111 ohms, 0.1 ohm res. | \$275.00 |
| GR 1432-U 4-Decade Resistor, 0.111, 10 ohms, 0.01 ohm resolution | \$175.00 |
| GR 1433-X 6-Decade Resistor, to 11,111.0 ohms, 0.1 ohm res. | \$550.00 |
| HP16470B Stable Inductors, set of 4 | \$500.00 |
| LEEDS & NORTHROP 4220-SERIES Milliohm Standards | \$650.00 |

HIPOT

| | |
|--|----------|
| ROD-L M500AV 5000 Volt AC HIPOT Tester | \$700.00 |
|--|----------|

WAVE TRACERS

| | |
|--|------------|
| TEK 576 Curve Tracer, to 220W | \$2,350.00 |
| TEK 577D11/77 Storage Curve Tracer, with standard test fixture | \$2,250.00 |
| TEK 7CT10 Curve Tracer, to 0.5W, 7000 series | \$500.00 |

TDR

| | |
|---|------------|
| TEK 1502-opt.04 Time Domain Reflectometer, 0-2,000 feet, chart recorder | \$2,250.00 |
| TEK 1503-opt.04 Time Domain Reflectometer, 0-5000 feet, chart recorder | \$2,000.00 |

POWER SUPPLIES

SINGLE OUTPUT

| | |
|---|----------|
| GLASSMAN PS/EG-C5R06 5kV CV/CL Power Supply, to 6mA | \$500.00 |
|---|----------|

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|--|------------|
| HP6002A-001 Programmable Power Supply, 0-50 V / 0-10 A / 200 Watts | \$875.00 |
| HP6023A Autoranging Power Supply, to 20 V / 30 A / 240 Watts | \$1,150.00 |
| HP6206B Dual Range Power Supply, 30 V at 1 A / 60 V at 0.5 A | \$250.00 |
| HP6259B-026 10V at 50A CV/CC Power Supply | \$500.00 |
| HP6260B-027 10V at 100A CV/CC Power Supply | \$675.00 |
| HP6261B-027 20V at 50A CV/CC Power Supply | \$675.00 |
| HP6263B 20V at 10A CV/CC Power Supply | \$400.00 |
| HP6264B-011 20V at 20A CV/CC Power Supply, w/voltage crowbar | \$500.00 |
| HP6265B 40V at 3A CV/CC Power Supply | \$350.00 |
| HP6266B 40V at 5A CV/CC Power Supply | \$400.00 |
| HP6267B 40V at 10A CV/CC Power Supply | \$550.00 |
| HP6268B 40V at 30A CV/CC Power Supply | \$850.00 |
| HP6269A 40V at 1.5A CV/CC Power Supply | \$250.00 |
| HP6296A 60V at 3A CV/CC Power Supply | \$400.00 |
| HP6298A 100V at 750 mA CV/CC Power Supply | \$250.00 |
| HP6438B 60V at 5A CV/CC Power Supply | \$375.00 |
| KEPCO ATE-100-1M 100 V at 1 A CV/CC Power Supply | \$300.00 |
| KEPCO JOE-36-15M 36 V at 15 A CV/CC Power Supply | \$375.00 |

MULTIPLE OUTPUT

| | |
|---|----------|
| HP6253A Dual Output 20 V 3 A CV/CC Power Supply | \$500.00 |
| HP6255A Dual Output 40 V 1.5 A CV/CC Power Supply | \$500.00 |

MISCELLANEOUS

| | |
|---|----------|
| ACME PS2L-1000 Programmable Load, to 75V / 150A / 1000 Watts | \$450.00 |
| ELGAR 121B/401V AC Power Source, 0-135 V, 120 W, 45 Hz-10 kHz | \$650.00 |
| HP59501A HP1B Isolated DAC/Power Supply Programmer | \$175.00 |
| HP6827A Bipolar Power Supply/Amplifier, to 100 V, 500 mA | \$800.00 |
| KEPCO BOP 100-1M Bipolar Op Amp/Power Supply, to 100 V, 1 A | \$500.00 |
| KEPCO BOP 1000M Bipolar Op Amp/Power Supply, to 1000 V, 40 mA | \$600.00 |
| KEPCO BOP 36-5M Bipolar Op Amp/Power Supply, to 36 V, 5 A | \$550.00 |
| KIKUSUI PLZ-72W Programmable Load, 4-110 V, 0-12 A, 70 W max. | \$200.00 |

TIME & FREQUENCY

UNIVERSAL COUNTERS

| | |
|---|------------|
| HP5314A 100 MHz/100 nS Universal Counter | \$225.00 |
| HP5315A 100 MHz/100 nS Reciprocal Counter, high res. audio | \$550.00 |
| HP5315A-001 100 MHz/100 nS Universal Counter, TCXO reference | \$650.00 |
| HP5316A 100 MHz/100 nS Universal Counter, HP1B, 1.0 GHz C-chan. | \$750.00 |
| HP5316A-003 100 MHz/100 nS Universal Counter, HP1B, 1.0 GHz C-chan. | \$1,000.00 |
| HP5330B-001 100 MHz Univ. Time Int. Counter, 20 ps single shot, OCXO | \$2,250.00 |
| HP61420A-010,030 VXI card 200 MHz/2 nS Univ. Counter, TCXO 0.5-5 GHz C-ch | \$1,500.00 |
| RACAL-DANA 1992-04E, 55 100 MHz/10 nS Univ. Counter, 1.3 GHz C-ch, OCXO, GPIB | \$950.00 |
| TEK 7D15 225 MHz Universal Counter/Timer, 7000 series | \$275.00 |
| TEK DC5004 Programmable 100 MHz/100nS s Counter/Timer, TM5000 series | \$475.00 |
| TEK DC5009-opt.01 Programmable 135 MHz Univ. Counter/Timer, TCXO, TM5000 | \$750.00 |
| TEK DC5010 350 MHz/3.125 nS Univ. Counter, TM5000 series | \$1,200.00 |
| TEK DC503A 125 MHz Universal Counter/Timer, TM500 series | \$500.00 |
| TEK DC509 135 MHz High Resolution Universal Counter/Timer, TM500 | \$700.00 |

FREQUENCY COUNTERS

| | |
|--|------------|
| EIP 545-opt.05 08 18 GHz Frequency Counter, OCXO and GPIB | \$1,875.00 |
| FLUKE 7220A-opt.111 1.3 GHz Communications Counter, TCXO option | \$650.00 |
| HP5305B/5300B-001 1.3 GHz Counter Package w/TCXO ref., high res. audio | \$450.00 |
| HP5340A-001,006 18 GHz Frequency Counter, OCXO +39 dBm limiter | \$1,900.00 |
| HP5340A-001,011 18 GHz Frequency Counter, OCXO reference, HP1B | \$1,900.00 |
| HP5342A-01,04,05,11 24 GHz Frequency Counter, OCXO, DAC, and HP1B | \$3,900.00 |
| HP5345/5355/5356A-006 Pulsed/CW Frequency Counter, 0.4-18.0 GHz, 75 nS pulse | \$3,500.00 |
| SYSTRON-DONNER 6054B 24 GHz Frequency Counter | \$1,875.00 |
| SYSTRON-DONNER 6054B-opt.05,26 26.5 GHz Frequency Counter, GPIB | \$2,400.00 |
| TEK 7D14 525 MHz Frequency Counter, 7000 series | \$175.00 |
| TEK DC502 550 MHz Frequency Counter, TM500 series | \$400.00 |
| TEK DC504 80 MHz Frequency Counter | \$125.00 |

STANDARDS

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|---|------------|
| AUSTRON 1250A Crystal Frequency Standard, 0.1/1.0/5.0 MHz, AC/batt. | \$900.00 |
| HP5087A-031 Distribution Amp., 0.1/1.0/5.0 MHz x 4 channels each | \$1,800.00 |



90 DAY WARRANTY PARTS AND LABOR • 10 DAY INSPECTION TEST EQUIPMENT WANTED CALL OR FAX LIST • OPEN ACCOUNTS



AUDIO & BASEBAND

SPECTRUM ANALYZERS

| | |
|--|------------|
| HP3580A-002 Spectrum Analyzer, 5 Hz-50 kHz, 1 Hz res., bal. input | \$1,850.00 |
| HP3581A Wave Analyzer, 15 Hz-50 kHz | \$900.00 |
| HP3586C Selective Level Meter, 50 Hz-32.5 MHz, 50 & 75 ohms | \$1,750.00 |
| HP8556A LF Section, 20 Hz-300 kHz | \$500.00 |
| TEK 7L5-opt.25/7803 Spectrum Analyzer, 20 Hz-5 MHz, w/tracking gen., display | \$2,250.00 |

DISTORTION ANALYZERS

| | |
|---|------------|
| HP334A Distortion Analyzer, 5 Hz-600 kHz, -60 dB, auto nulling | \$550.00 |
| HP339A Distortion Analyzer, built-in low distortion osc. | \$2,400.00 |
| TEK DA4084 Programmable Distortion Analyzer, 0.0025% THD, w/frame | \$1,500.00 |

RMS VOLTMETERS

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|---|----------|
| FLUKE 8920A True RMS Voltmeter, 180 μ V-700 V, 10 Hz-20 MHz | \$700.00 |
| HP3400A RMS Voltmeter, 10 Hz-10 MHz | \$250.00 |
| HP400FL AC Voltmeter, 100 μ V-300 V f.s., 20 Hz-4 MHz | \$200.00 |

OSCILLATORS

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|--|------------|
| HP3335A Synthesizer/Level Generator, 200 Hz-80 MHz | \$3,250.00 |
| HP4204A Synthesizer, 10 Hz-1 MHz, 1 mV-30 V / 600 Ohms | \$350.00 |
| ROCKLAND 5100 Synthesizer, 1 mHz-1.999999999 MHz | \$400.00 |

FILTERS, MISCELLANEOUS

| | |
|---|------------|
| KROHN-HITE 3202 Dual High-Pass/Low-Pass Filter, 20 Hz-2 MHz, 24 dB/oct | \$600.00 |
| KROHN-HITE 3342 Dual HP/LP Filter, 0.001 Hz-99.9 kHz, 48 dB/octave | \$1,100.00 |
| KROHN-HITE 3343 Dual HP/LP Filter, 0.01 Hz-99.9 kHz, 48 dB/octave | \$950.00 |
| P.A.R. 189 Filter/Amplifier, 0.1 Hz-110 kHz, variable Q & gain | \$400.00 |
| TEK AM502 Differential Amplifier, 0.1 Hz-1 MHz, TM500 series | \$575.00 |
| WAVETEK/ROCKLAND 752A-002 Dual Low Pass Filter, 1 Hz-100 kHz, 115 dB/octave, GPIB | \$1,100.00 |

RF & MICROWAVE

SPECTRUM ANALYZERS

| | |
|---|------------|
| HP11517A/18A/19A/20A Harmonic Mixer, 12.4-40.0 GHz, for 8555A, 8565A | \$700.00 |
| HP5371A Modulation Domain Analyzer, 125 mHz-500 MHz | \$5,900.00 |
| HP4406A Comb Generator, 1/10/100 MHz increments, to 5 GHz | \$450.00 |
| HP443A Tracking Generator, 0.1-110 MHz, LED display | \$700.00 |
| HP444A Tracking Generator, 0.1-1300 MHz, for 8554B | \$800.00 |
| HP4444A-059 Tracking Generator, 0.5-1500 MHz, for 8554, 8568, etc. | \$1,500.00 |
| HP8552B IF Section | \$750.00 |
| HP8553B RF Section, 1 kHz-110 MHz | \$500.00 |
| HP8554B RF Section, 0.1-1250 MHz | \$800.00 |
| HP8554B/8552B/141T Spectrum Analyzer, 100 kHz-1250 MHz, 100 Hz resolution | \$2,000.00 |
| HP8555A RF Section, 0.01-18 GHz | \$950.00 |
| HP8555A/8552B/141T Spectrum Analyzer System, 10 MHz-18 GHz, 100 Hz res. | \$2,250.00 |
| HP8558B/181TR Spectrum Analyzer, 0.1-1500 MHz, 1 kHz res., w/display | \$2,250.00 |
| HP8559A/181TR Spectrum Analyzer, 0.01-21 GHz, 1 kHz res., w/display | \$4,500.00 |
| TEK 496P Spectrum Analyzer, 1 kHz-1.8 GHz, 30 Hz res., GPIB | \$5,500.00 |
| TEK 7L17/7603 Spectrum Analyzer, 1.5-18.0 GHz, 30 Hz res., w/display | \$3,400.00 |
| TEK TR503 Tracking Generator, 0.1-1800 MHz, for 492/4/5/6 | \$1,750.00 |

NETWORK ANALYZERS

| | |
|---|------------|
| HP11665B Modulator, 0.15-18.0 GHz, for use with 8755/6/7 | \$375.00 |
| HP4807A/8412A/8601A Network Analyzer, 100 kHz-110 MHz, with sweep generator | \$1,250.00 |
| HP85020A Directional Bridge, 0.01-4.3 GHz, N(f), for 8755/6/7 | \$750.00 |
| HP85021A Directional Bridge, 0.01-18.0 GHz, APC7, for 8755/6/7 | \$1,200.00 |
| HP85021C Directional Bridge, 0.01-18.0 GHz, N(f), for 8755/6/7 | \$1,200.00 |
| HP85050D APC7 Calibration Kit, for 8510 series | \$1,100.00 |
| HP85050A-005/8503A/8501 Network An., 0.5-1300 MHz, S-parameters, storage norm | \$6,000.00 |
| HP8755C/11666A-02/181T Scalar Network An. w/di. bridge, 10 MHz-18 GHz & frame | \$1,750.00 |
| NARDA 7000A/7202/7206 Microwave Multimeter System: scalar analysis 0.1-18 GHz | \$1,950.00 |
| WILTRON 560/3x-7550 Scalar Network Analyzer, w/3 detectors, 0.01-18.5 GHz | \$2,000.00 |
| WILTRON 560/560-98K50 Scalar Network Analyzer, w/SWR Autotester 0.01-40 GHz | \$2,950.00 |

SIGNAL GENERATORS

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|---|-------------|
| BOONTON 1020 Synthesized Signal Gen., 0.15-540 MHz, GPIB | \$1,850.00 |
| BOONTON 102C Signal Generator, 0.45-520 MHz, AM, FM | \$850.00 |
| COMSTRON FS-2000-4 Synthesizer, 10 MHz-4 GHz, 1 μ S speed, -140 dBc noise | \$15,000.00 |
| FLUKE 6060A Synthesized Signal Generator, 0.1-1050 MHz, 10 Hz res. | \$3,750.00 |
| FLUKE 6060A/AN Synthesized Signal Gen., 10 kHz-520 MHz, 10 Hz res. | \$2,000.00 |
| GIGATRONICS 875/86 Levelled Multiplier, 26.5-40.0 & 50.0-75.0 GHz outputs | \$8,000.00 |
| HP11720A Pulse Modulator, 2-18 GHz, Tr<10ns, >80 dB | \$1,200.00 |
| HP85100V Frequency Mult., 10-15 GHz in / 50-75 GHz out >0 dBm | \$4,250.00 |
| HP8614A Signal Generator, 0.8-2.4 GHz, AM, FM, Pulse | \$550.00 |

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| HP8616A Signal Generator, 1.8-4.5 GHz, AM, FM, Pulse | \$450.00 |
| HP8640B-003 Signal Generator, 0.5-512 MHz, reverse power protection | \$1,500.00 |
| HP8640B-004 Avionics Signal Gen., 0.5-512 MHz, precision attenuator | \$1,900.00 |
| HP8654A Signal Generator, 10-520 MHz, metered AM/ unmodulated FM | \$650.00 |
| HP86601A RF Plug-in, 10 kHz-110 MHz, for 8660 series | \$650.00 |
| HP8660C/86602B/86633B Synthesized Signal Generator, 1-1300 MHz, AM, FM, HP1B | \$2,750.00 |
| HP8660C/86603A-002/34A Synthesized Sig. Gen., 1-2600 MHz, phase mod. to 10 MHz | \$4,500.00 |
| HP8683B Signal Generator, 2.3-6.5 GHz, AM, WBFM, Pulse | \$5,000.00 |
| HP8684B Signal Generator, 5.4-12.5 GHz, AM, WBFM, Pulse | \$5,000.00 |
| WILTRON 6742A Synthesizer/Sweep Generator, 18.0-26.5 & 26.5-40.0 GHz | \$9,000.00 |

SWEEP GENERATORS

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|--|------------|
| EIP 928-opt.9201 Sweep Gen., 1.0-18.6 GHz, step attenu., power sweep, GPIB | \$4,000.00 |
| HP8601A Generator/Sweeper, 0.1-110 MHz, +20 dBm levelled | \$500.00 |
| HP8620C Sweep Oscillator Frame | \$550.00 |
| HP8620C-011 Sweep Oscillator Frame, HP1B programmable | \$675.00 |
| HP86210A RF Plug-in, 3-350 MHz, +13 dBm levelled | \$450.00 |
| HP86222A RF Plug-in, 0.01-2.4 GHz, +13 dBm levelled | \$1,400.00 |
| HP86222A-002 RF Plug-in, 10-2400 MHz, 70 dB step attenuator | \$1,750.00 |
| HP86222B-002 RF Plug-in, 10-2400 MHz, crystal markers, 0-70 dB atten | \$1,950.00 |
| HP86235A RF Plug-in, 1.7-4.3 GHz, +16 dBm unlevelled | \$600.00 |
| HP86240A RF Plug-in, 2.0-8.4 GHz, +16 dBm unlevelled | \$950.00 |
| HP86241A-001 RF Plug-in, 3.2-6.5 GHz, +8 dBm levelled | \$500.00 |
| HP86242D-004, 008 RF Plug-in, 5.9-9.0 GHz, +10 dBm levelled | \$500.00 |
| HP86260A RF Plug-in, 12.0-18.0 GHz, +10 dBm levelled | \$1,000.00 |
| HP86290A RF Plug-in, 2.0-18.0 GHz, +7 dBm unlevelled | \$1,750.00 |
| HP86290B RF Plug-in, 2.0-18.6 GHz, +10 dBm levelled | \$2,000.00 |
| HUGHES 47723H IMPATT Sweeper, 40-60 GHz, 5 mW unlevelled, w/HP 8620C | \$4,500.00 |
| WAVETEK 1067 Sweep Generator, 1-400 MHz, +10 dBm, 75 ohms | \$500.00 |
| WAVETEK 2001 Sweep Generator, 1-1400 MHz in three overlapping bands | \$850.00 |
| WAVETEK 954 Signal/Sweep Generator, 3.7-7.6 GHz, +7 dBm unlevelled | \$2,000.00 |
| WAVETEK 962 Sweep Generator, 1.0-4.0 GHz, markers, +12 dBm unlvld | \$2,500.00 |
| WAVETEK/MARCONI 8910 Programmable Sweep Generator, 2-20 GHz, +10 dBm, GPIB | \$5,500.00 |

POWER METERS

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|---|------------|
| BOONTON 42B/41-4B Analog Power Meter, with 1 MHz-12.4 GHz sensor | \$475.00 |
| BOONTON 42B/41-4E Analog Power Meter, with 1 MHz-18 GHz sensor | \$650.00 |
| BOONTON 42B/42A-S3 Analog Power Meter, with 1 MHz-8.4 GHz N(f) sensor | \$375.00 |
| GENERAL MICROWAVE 476/4240A Power Meter & Sensor, 0.01-18 GHz, -35 to +10 dBm | \$375.00 |
| HP11683A Range Calibrator, for 435/6/7/8 power meters | \$750.00 |
| HP432A/478A Power Meter, 0.01-10 GHz, -20 dBm to +10 dBm F.S. | \$375.00 |
| HP432C Power Meter, 10 μ W-10 mW, autoranging, digital display | \$325.00 |
| HP435A/8481A Power Meter, 10 MHz-18 GHz, -30 to +20 dBm | \$1,000.00 |
| HP435A/8482A Power Meter, 0.1-4200 MHz, -30 to +20 dBm | \$1,000.00 |
| HP435A/8482H Power Meter, 0.1-4200 MHz, -15 to +34 dBm | \$1,150.00 |
| HP435A/8484A Power Meter, 10 MHz-18 GHz, -70 to -20 dBm | \$1,000.00 |
| HPK486A WR42 Thermistor Mount, 18.0-26.5 GHz, for 432 series | \$400.00 |
| HPQ8486A Power Sensor, 33.0-50.0 GHz, WR22 waveguide | \$1,500.00 |
| HPR486A WR28 Thermistor Mount, 26.5-40.0 GHz, for 432 series | \$400.00 |
| WAVETEK 1034A Portable Analog Power Meter, 1 MHz-18 GHz | \$375.00 |

RF MILLIVOLT METERS

| | |
|---|----------|
| BOONTON 9200A-01 RF Millivoltmeter, 10 kHz-1.2 GHz, GPIB | \$950.00 |
| MILLIVAC MV-723BRS RF Millivoltmeter, 10 kHz-1.2 GHz, 1 mV-30 V | \$375.00 |
| RACAL 9303 TRMS Level Meter, 10 kHz-2 GHz, -77 to +23 dBm, GPIB | \$875.00 |

AMPLIFIERS, MISCELLANEOUS

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OPEN CHANNEL

by Harry Helms

Radio From The "Twilight Zone"

There's no mystery about shortwave radio broadcasters like the BBC, Voice of America, the Voice of Russia (the new post-communist name for Radio Moscow), and Radio Japan. The organizations (either governmental or commercial) behind such stations are well-known, and the actual location of the stations is no secret. At the other extreme, we have the various pirate broadcasters often heard above and below the 40-meter (7000 to 7300 KHz) band on weekend and holiday nights. These stations keep the identities of their operators and station location a close secret, but that's because the operators face severe penalties if caught by the FCC.

However, there are some stations located in the "twilight zone" between mainstream shortwave broadcasters and kids playing at pirate radio. These stations are every bit as professional and powerful as conventional shortwave outlets, but they keep secret — or outright lie — about who is actually sponsoring them or where they are located. Unlike both "legitimate" broadcasters and pirates, these stations are not on the air to entertain or educate; instead, their purpose is to advance some political end for their true sponsors. These stations are the clandestine broadcasters, and listening to them can give you a front row seat to tomorrow's headlines!

target country when they are actually located in a neighboring country. Clandestines may attempt to incite revolution or other violence within the target country. For example, some of the clandestines operated by Nicaragua's Sandinista regime broadcast instructions on how to make "Molotov cocktails" and simple explosive devices for listeners in El Salvador.

The Origins of Clandestine Radio

Clandestine broadcasting began in a big way at the start of World War II. Perhaps the first was Radio España Independiente, the voice of the exiled Spanish Communist Party. This station first took to the air in 1941 from transmitters in the Soviet Union, and continued to broadcast from various locations in Soviet bloc countries until it closed in 1977 following the death of Francisco Franco. Radio España Independiente was in many ways the prototype of all future clandestine broadcasters. During its years of operation, it called itself "the station of the Pyrenees" (the mountains between France and Spain) and tried to convince listeners it was broadcasting "on the run" within Spain itself. After the death of Franco and the resulting sweeping political changes within Spain, the station no longer had a mission and left the air.

Perhaps the most famous clandestine broadcaster of all time was the now-legendary Radio Swan/Radio Americas. In May 1990, shortwave listeners (SWLs) in North America were startled to hear a new station calling itself Radio Swan on 1160 and 6000 KHz. All programming was in Spanish, with a strong anti-Castro slant, and the station claimed to be a commercial venture operating from Swan Island, a speck of land in the southern Gulf of Mexico.

Several peculiar aspects about Radio Swan were

immediately obvious. Swan Island was claimed by both the United States and Honduras, and the FCC even issued amateur radio licenses for operation from there. However, the FCC claimed to know nothing whatsoever about Radio Swan. Despite such denials, numerous SWLs using loop antennas (which can be highly precise on medium wave) were able to take multiple direction-finding bearings that indicated that Radio Swan was clearly coming from Swan Island. Honduras was very vocal in its demands that the United States stop operating a radio station on "its" island.

Radio Swan said it was owned by "Gibraltar Steamship Corporation" which, it turned out after some investigation, had no ships — steam or otherwise — registered to it anywhere in the world. The president of Gibraltar Steamship was Thomas

Cabot, a former head of the U. S. State Department's Office of International Security Affairs (a curious background for the head of a supposed maritime shipping company!).

Radio Swan's few commercials were clearly inadequate to support an operation of its size and obvious expense. Radio Swan managed to so enrage Fidel Castro that he devoted an entire four and a half-hour speech at the United Nations in September 1960 denouncing it.

Any pretense that Radio Swan was merely a commercial station went out the window with the abortive Bay of Pigs invasion in May 1961. Radio Swan transmitted coded messages to the invading forces and guerrillas inside Cuba, suspending normal programming and serving as a communications link for invaders. Shortly after the failed invasion, the station changed its name to Radio Americas. Radio Americas continued to claim it was a commercial station, broadcasting plenty of English and Spanish pop music with anti-Castro speeches.

Why Radio Americas was closed remains a secret, but apparently the CIA decided the station was not effective in its mission of undermining Castro. Just before Radio Americas was closed in May 1968, well-known radio writer Tom Kneitel and the editor of the now-defunct *Electronics Illustrated* magazine were allowed to visit Swan Island under the guise of conducting a ham radio "DXpedition." They found Radio Americas in full operation, and wrote a feature story about it in *Electronics Illustrated*. That issue hit the newsstands about the same time Radio Americas left the air for good! Some SWLs (like this author) believe that the CIA wanted to firmly establish Swan Island as the station's location before removing it from the air, perhaps to protect nations such as Mexico in their relations with Cuba.

Clandestine Radio Today

With Castro still in charge in Cuba, clandestine broadcasters still have him as a target. Today, however, most activity seems to be mainly sponsored by Florida's Cuban exile community rather than the CIA, and the transmitter sites seem to be somewhere in Guatemala and/or Costa Rica.

The big anti-Castro clandestine today is La Voz del Cuba Independiente y Democrática (CID). La Voz del CID uses a variety of frequencies at different times, but it's best heard in the evenings on 0430 UTC (11:30 p.m. Eastern standard time) on 9920 KHz and from 0430 to 0700 UTC (2:00 a.m. Eastern standard time) on 6305 KHz. Both frequencies may vary a few KHz. Programming consists of long political talks, pop music, and sometimes even Catholic mass in Spanish. If you hear La Voz del CID, you can send a reception report for their QSL card to 10021 S.W. 37th Terrace, Miami, FL 33165.

Colombia is currently the site of guerrilla and insurrectionist activity in the western parts of that nation, and Radio Patria Libre is the voice of those rebels. Unlike most clandestines, Radio Patria Libre is apparently just where it claims, namely regions of Colombia outside of the control of the central government. During mid-1994, the Colombian army claimed it had located and destroyed the transmitter facilities of this station in Colombia's San Lucas Mountains. However, it soon returned to the air from another location believed to be in western Colombia. While its schedule is erratic, Radio Patria Libre is often heard from 2100 UTC (4:00 p.m. Eastern standard time) around 15050 KHz using AM or USB. It has also been reported on that frequency around 1400 UTC (9:00 a.m. Eastern



A QSL card received from La Voz del CID for a reception report.

A clandestine broadcaster usually sounds much like any other shortwave broadcaster. However, clandestine stations are overtly political creatures; they exist only to bring about some sort of political change or situation desired by their sponsors. When political conditions in either the target or sponsoring country change, a clandestine station may go off the air or be replaced by another clandestine.

For example, southeast Asia was a hotbed of clandestine radio broadcasting in the late 1960s during the height of the Vietnam War, but those clandestines vanished within days of the fall of Saigon in 1975. More recently, Central America was the site of clandestines sponsored by the Sandanista government in Nicaragua and other stations opposing them operating from neighboring countries. With the electoral defeat of the

standard time). Another common frequency is 6260 KHz, which is often active around 1130 UTC (6:30 a.m. Eastern standard time).

A relatively new Central American clandestine is La Voz Popular, which opposes the current government of Guatemala. This station is believed to be operating from somewhere in Guatemala. Its normal frequency is around 6995 KHz, but sometimes is as high as 7010 KHz or as low as 6985 KHz. The frequency may vary or "jump around" during a broadcast. It is most often heard from about 2330 to 0100 UTC (6:30 to 8:00 p.m. Eastern standard time), with broadcasts lasting from a little over a half-hour to over an hour and a half.

North and South Korea have been waging war through clandestine radio for several years. The Voice of National Salvation operates from North

Korea, but claims to be operating from South Korea. It operates on 3481 KHz and best reception is usually an hour or so before your local sunrise (a good receiver and outside antenna will be a big help with this one if you're on the east coast). South Korea operates a similar station directed to North Korea called Voice of the People. It can be heard on 3912 KHz at about the same time, but reception is often complicated by interference from amateur radio operators.

Perhaps the hottest area at the moment for clandestine broadcasting is the Middle East. Unfortunately, many of these stations are difficult to hear in North America unless you're an experienced SWL with above-average receiving gear. One better-heard one is Voice of the Iraqi People, an anti-Saddam Hussein station using powerful transmitters in Saudi Arabia. It is heard on 9560, 9670,

9980, 13670, 15135, 15235, and 15580 KHz from 1300 to 0100 UTC (8:00 a.m. to 8:00 p.m. Eastern standard time) mainly in Arabic with some Kurdish programs. Frequencies for best reception will vary throughout the day.

Iraq and Iran operate numerous stations aimed at each other. Iraq operates such stations as Voice of Iranian Kordestan, Voice of the Mojahed, Voice of the Struggle of Iranian Kordestan, and the Voice of the Worker. Returning the favor, Iran is the transmitting site for Voice of Rebellious Iraq, Voice of Independent Kurdistan, and Voice of the Islamic Revolution in Iraq.

By now you can see why chasing clandestine shortwave broadcasters can be so fascinating. While hearing these stations is often not easy, they do give you the chance to really be there when history is happening! **NV**

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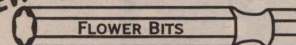
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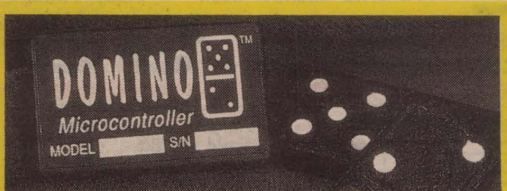
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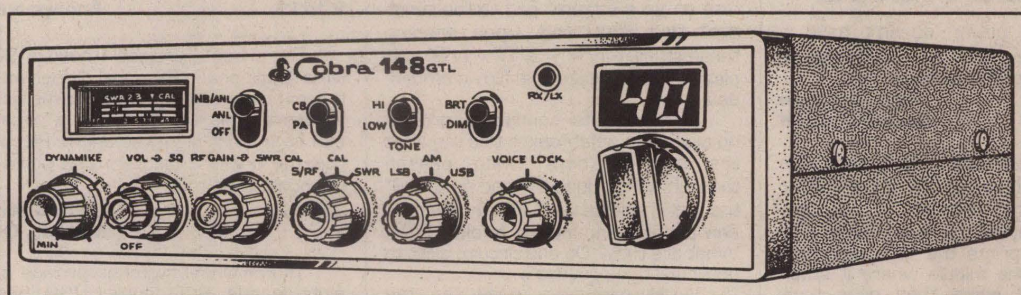
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Questions & Answers

TECH FORUM

This is a READER TO READER Column. All questions AND answers will be provided by *Nuts & Volts* readers and are intended to promote the exchange of ideas and provide assistance for solving problems of a technical nature. All questions submitted are subject to editing and will be published on a space available basis if deemed suitable to the publisher. All answers are submitted by readers and **NO GUARANTEES WHATSOEVER** are made by the publisher. The implementation of any answer printed in this column may require varying degrees of technical experience and should only be attempted by qualified individuals. Always use common sense and good judgement!

QUESTIONS

My CD player doesn't have a record mode. What do I have to do to get it to record. Any ideas?

2951 **Paul Recupero**
Portsmouth, RI

I have an Epson LQ 510 printer. Any time it has had the power off or had the paper removed, it does not print properly for the next 10 lines. For example, it prints the first line, then returns to the middle where it stops for a short while, then goes back where it just came from and prints the next line.

After 10 lines it prints normally until the next paper removal or power down. It also always thinks the bottom of the page is about two lines into the next page.

When I first got it, I complained. The vendor insisted that I had defective software. Now that it is out of warranty, I have a new computer and better software. It still does the same thing. No one I've found has any idea on either problem. What can I do, other than live with it as I have so far?

2952 **Gordon Simkin**
Eustis, FL

The lamp in the switch of my multi-socket 110 volt AC strip flickers in the dark. When I shine my flashlight on the lamp, it stops flickering and shines steadily. What's going on?

The input 110 voltage (AC) measures a constant steady voltage, regardless of the flickering lamp. I don't know whether the lamp is a neon bulb or an incandescent bulb.

2953 **M. Ash**
Santa Monica, CA

I need the DIP switch settings for a TTX 1014 printer, manufactured by Telex Communication Corp.

2954 **Eugene Herbstreit**
Hartwell, GA

I would like to modify some of the functions of my Kenwood R-5000 receiver. It's controlled by a NEC, up7800, 8 bit microcontroller. Is there a program like DEBUG that would allow me to disassemble the code written for the up7800 microcontroller on a PC. If I had a complete instruction set for this device I could even write my own if it weren't already done.

2955 **Peter Trapp**
Longwood, FL

My question concerns the electronic security bars (at exits) that department stores, drug stores, etc., use to alert them to shoplifters when a

small tag moves between them. The cashier usually places your merchandise on an electronic pad to "de-sensitize" this small tag. Upon opening these small 1-1/4" x 3/8" x 1/8" soft plastic tags, a paper-thin film is embedded.

Several tests conducted provide no clue as to what makes this tag alert the security bars when passed through. What does the pad do to "kill" the merchandise tag? These tags cost only pennies and include a fake UPC#. What are they? Do any circuits exist to duplicate this process?

What frequency does the tag operate on? What frequency/other kills the tag? Why is this permanent? Why doesn't something on your person actually make the bars go off, instead of a tag?

2956 **Parker Mott**
Ellaville, GA

I need a simple NE-555 circuit to give me 100 VDC at 20-30 mA. (It doesn't have to be 555, but something cheap, small, and simple.)

2957 **Dave Nadeau**
San Marcos, CA

I have a Motorola desktop MICOM 100 watts HF SSB transceiver, 2 MHz to 18 MHz model L70SCG-1180BM SP3, s/n 312CGA0001, with automatic antenna tuner, but no manual. I would like to use this for amateur PACKET or AMTOR communication. Can you help?

2958 **Rene Matthussen**
AB, Canada

I need to change my heat press from the present dial thermometer and mechanical thermostat to a self-adjusting LED readout setup. I would like to be able to pick a temperature and have the controller cycle on and off the heaters to keep this temperature set. The temperature range is 200-500° F. Heater is 1500 watts, 120 VDC.

2959 **C. Castle**
Redondo Beach, CA

I need information, schematics, etc., to convert a 6 volt automotive voltage regulator to an electronic voltage regulator. I need to keep the original case for appearance reasons. The original is rated at 150 watts.

29510 **Paul Bernardo**
Riverside, CA

I am installing N.D. heat sensors to the fire alarm loop in my house. Is there an easy way to also connect the 9 volt battery powered smoke detectors to the fire loop, so that if one trips, they all sound? Or that in addition to the individual detector sounding, some

type of relay can close and sound the fire loop siren?

29511 **Anonymous**

For a home project, I need a 90 MHz single phase RF signal divided into three phase 30 MHz very precision sinewave. This 30 MHz three phase can be a small signal strength. Please give me a wiring diagram and parts I will need to do this.

29512 **Dale Goodwin**
Midway, GA

Thumb-wheel switches provide an eight-decade BCD output (32 bits) whose maximum value will be 14,300,000 representing 14.3 MHz. I want to multiply the number by 100, yielding up to 14.3E8, and then convert to a 32-bit binary number for use in a direct digital synthesizer, such as the Analog Devices AD7008.

The output may be serial (MSB first), or parallel, 8 or 16 bits at a time (MSGROUP first). Speed is not a concern. The standard devices ('184, '484) require about 50 packages for eight decades. Is this a job for a PIC μ C?

Note: Choosing a clock frequency of approximately 42.95 MHz (.01 * 2³²) yields a frequency resolution of .01 Hz, so the factor of 100 used earlier gives an output frequency resolution of 1 Hz. Of course, this resolution is not needed, but it comes almost free, so why not have fun?

This clock frequency also satisfies the Nyquist sampling criteria, and is within the capability of the AD7008.

29513 **R.W. Thorpe**
San Luis Obispo, CA

Is there a way of automatically muting a television only during commercials? Also, I looking for some source of information on the basics of how CATV works.

29514 **Dan Kinatader**
Wilmington, NC

I have a Marsteic M-800+ hand scanner. The interface card went bad. The scanner itself tested okay with someone else's card. The company is no longer around. Is there any way to interface this scanner another way? 256 Grey, 64 shades, 800 DPI7, black & white.

29515 **Kevin Cramer**
White Lake, MI

I have a 13.8 VDC 10 amp power supply. The supply failed high, i.e., 24 VDC at the output. After replacing the precision regulator chip and installing the new one in a socket (for subsequent failures), the supply is once again giving me 13.8V. I would like to add a "crowbar" circuit using an SCR as

ANSWER INFO

- Include the question number that appears directly below the question you are responding to.

- Payment of \$25.00 will be paid within four weeks of publication if your answer is printed.

- Only one answer per question will be printed.

- If you do not want your name, address, or phone number available to the reader please so indicate or it will be assumed that you have no objection.

- In the event that more than one person submits the same solution, the choice will be made at the discretion of the publisher.

- Due to space limitations, we can not reprint the original questions with the answer. The question number and the issue it appeared in are printed above the answer.

QUESTION INFO

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All questions should relate to one or more of the following:

- 1) Circuit Design
- 2) Electronic Theory
- 3) Problem Solving
- 4) Other Similar Topics

INFORMATION/RESTRICTIONS

- No questions will be accepted that offer equipment for sale or equipment wanted to buy.

- Selected questions will be printed one time on a space available basis.

- Questions may be subject to editing.

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- Be brief but include all pertinent information. If no one knows what you're asking, you won't get any response (and we probably won't print it either).

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added protection against the type of over-voltage failure.

Does anyone have a simple add-on circuit for small DC supplies that will do this?

29516 **Ronnie Smith**
Baton Rouge, LA

I need an audio signal generator (oscillator sinewave) that will fit in a small package (1" x 1" x 4") and produce a .775 volt RMS signal anywhere between 500 Hz-1.5 KHz. Also, does anyone know where to find a power transformer for a Heathkit digital mul-

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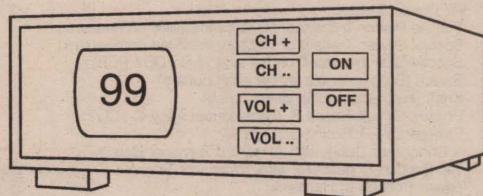
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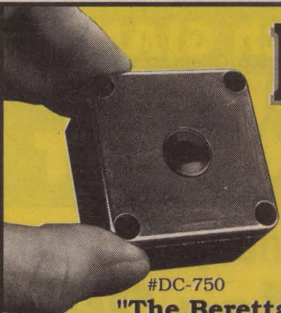
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TEK 7A11 \$150, Tek DL2 \$100, Tek 2901 \$150, Tek P6032 \$65, HP 10529A \$75, HP 5011T \$100, HP 10269A \$75, HP 1640B \$500, HP 493A \$400, HP 495A \$400, HP 1611A \$250, HP 8006A \$100, HP 8620C/86290A \$1750, HP 86242C \$300, HP 86235A \$350, HP 3581A \$500, HP 5329A \$300; EF Electronics, PO Box 326, Aurora, IL 60507. 708-897-1950.

TEST EQUIPMENT, ETC: HP 7580B 8-pen drafting plotter, sizes A-D, \$1,475; **Fluke 540B** thermal transfer standard, \$1,500; Tek 1105 portable battery-operated inverter, for 465, 475, etc. scopes, and TM 500 series mainframes, \$195; **HP 59401A** bus system analyzer for GPIB, \$675; **Tek 390AD** dual-channel waveform digitizer, \$600; **HP 214B** high-power pulse generator, \$1,750; **HP 3575A** gain-phase meter (dual display), \$700; **HP 6002A** autoranging 200 watt power supply, \$750; **HP 6227B** 0-25V 0-2.0A dual tracking lab power supply, \$475; **HP 6443B** 0-120V 0-2.5A power supply, \$450. **Kikusui PLZ 300W** electronic load, \$600; **HP 8405A** vector voltmeter, \$395; **HP 8015A** 50MHz pulse generator, \$425; **GR 1689** LCR meter, \$2,400; **BMI 4800** and **Dranetz 606**, 626 printing power line disturbance monitors. Call, excellent condition! All with warranty. **Pepper Systems**, 214-353-0257.

SIGNAL GENERATORS, HP 3320C 1KHz-13MHz, \$250; HP 3330B, \$500; HP 8614A 800-2400 MHz, \$450; HP 8616A 1.8-4.5 GHz, \$450; Ailtech 360DE 1 MHz-1800 MHz AM FM phase, \$1,200; HP 612A, \$200; HP 620B 7-11 GHz, \$250; HP 628A 15-21 GHz, \$250; HP 8690A, \$200; HP 8699B, \$400; HP 8693B, \$200; HP 8690B, \$250; Wavetek 907 7-11 GHz, \$800; HP 204C, \$150; HP 204D, \$150; HP 651A, \$200; HP 651B, \$250; HP 653A, \$150; HP 654A, \$250; HP 675A .1-32 MHz sweeper, \$300; A-Comm Electronics, 303-290-8012.

OSCILLOSCOPES: TEK, HP, Nicolet, LeCroy, Hitachi; Meters: Beckman, Fluke, HP; Service Monitors: Cushman, Motorola, Singer, IFR; and much more. Call Advanced Test Equipment Corp. for a free brochure, 1-800-404-ATEC ext. 8. Visa & M/C accepted.



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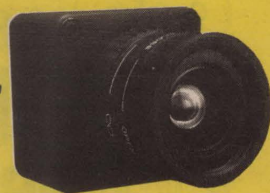
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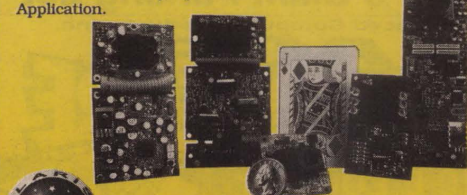


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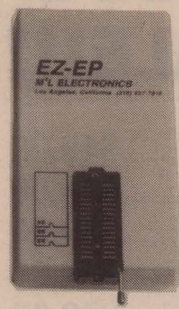
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TEKTRONICS 465M 100MHz dual channel scope. Good condition, \$325. ISA, PO Box 6955, Laguna Niguel, CA 92656. 714-495-5566. Fax 714-495-4742. Call or write for catalog of surplus RF and test equipment.

WAVEFORM ANALYZER Analogic Data Precision 6000. Two units, one with model 620 plug-in, another with model 630 plug-in. With manuals, \$1,500 each. 505-898-2094



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TEKTRONIX 2235, 100MHz, like new, \$800; 485 300MHz, \$800; 475 250MHz scope, \$650; 465B 100MHz, \$550; 465, \$450; 466 100MHz storage, \$800; **AM502**, \$250; **PS501-1** Power Supply, \$100; **DM502**, \$150. 30 day warranty. Call Bob, 214-436-2503.

BAREBONES BASIC HP 5328A COUNTER/TIMER, \$200; Add 520MHz and .00,000,003 percent stability options, \$450. Add DVM option, \$500; Gary, Technical Services & Material 408-385-0301, FAX 408-385-0261.

KIKUSUI MODEL COS6100M 5 channel 100MHz portable scope. Good condition, \$325. ISA, PO Box 6955, Laguna Niguel, CA 92656. 714-495-5566. Fax 714-495-4742. Call or write for catalog of surplus RF and test equipment.

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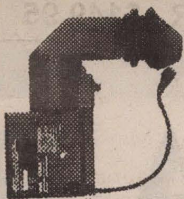
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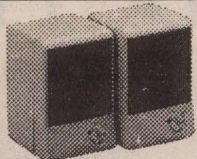
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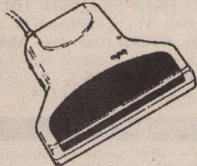
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These units have excellent audio for their small size (approx. 3" x 3" x 5") and are loud enough, too. A 3.5mm stereo plug brings the audio in, and each speaker has its own volume control. They run on 6VDC (four "C" batteries) or an external 6VDC wall transformer. (94V007)
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Use with tape recorder, multimedia computers. Includes on/off switch and 8-ft. cord with 3.5mm plug. (95V002)
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12VAC, 1.25A WALL WART
(94E023)
\$4.95 each

BRICK POWER SUPPLY

Input: 115VAC through EIA male plug. Outputs: +5VDC @ 2A, +12VDC @ 1.5A, -12VDC @ 0.3A. (95E007)
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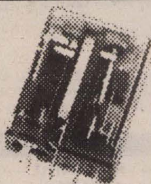
455 KHz center frequency. Band width: nominal, 2.2 KHz; minimum, 1.9 KHz; actual, approx. +3 KHz. Measures 330 pF across input and output. 2K termination. (94A023)
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Our 8049 IC has all the code built in. Breadboard as a morse code character generator for learning the code. The completed unit also functions as a keyer. (94I020)
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Includes various types such as unipolar, bipolar, various voltages, current ratings. (92M001)
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If you spend time away from home searching for goodies, this little gem could pay for itself in a single outing. It's made of real metal, has a 18mm dia. 10X doublet lens, and comes in a leather pouch. This is not a toy! Use it to read part numbers on RAMs and RF devices, check calibration stickers on test equipment for a better estimate of how old it really is. (MJ2723)
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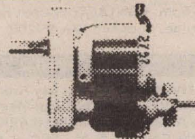


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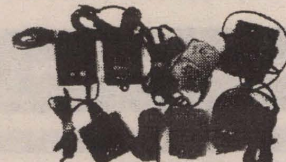
Electret condenser mike, 600 Ohm impedance earphone, 1' curly cord. (94U022)
\$3.95 each



EXTRA BRIGHT LED'S

• Red lens, clear, 1000 mcd. (SE5012H)
59¢ each

• Flashing, 750mcd. (SE5012G)
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WALL WART ASSORTMENT

A random selection of assorted voltages and current ratings. (94E004)
10 for \$14.95

SEALED LEAD-ACID BATTERIES

Five different new, rechargeable units operate in any position. Charge at 10% of AH capacity for 14 hours, less if partially discharged. (Limit charge voltage to 14.5V for 12V units, 7.25V for 6V units.) Sizes given are approximate.
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\$9.95 each

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\$6.95 each

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\$7.95 each

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\$4.95 each

• 6V, 3AH, 1.875" x 2.375" x 5.25". (95E006)
\$2.95 each



12VDC MINI FAN
60mm (2.375") square. (94F004)
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Mini Circuits Labs. #ZSC2-1W-1. 1-650 MHz "BNC" connectors. (92J052)
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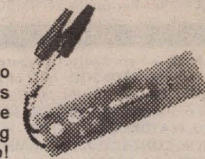


FLASHING LED KIT

Three extra-bright LEDs flash in unison on this 9V battery powered board. Use as safety warning for auto or bicycle, party gimmick, sea buoy, etc. Kits may be used in series to form an array. (95K001) Kit
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When hooked up to your phone line, this unit will Answer the line after the first ring - then hang up! Originally used for testing. Can be used to thwart prank phone callers. Two alligator clips make hookup easy. (95Z002)
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Slotted walls to accept PCBs. ABS black plastic. Screws included. Will not crack or split when drilled or punched.
PB114A - 1" x 3" x 2" **\$2.20**
PB114B - 0.8" x 4.25" x 2.188" **\$2.50**
PB114C - 1.563" x 3.875" x 2.938" **\$3.00**
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Events CALENDAR

WESTERN REGION

FEBRUARY 4

CA - SANTEE — Ham Radio, Computer & Electronics Swap Meet. **SPONSOR:** ARC of El Cajon. **LOCATION:** Santee Drive-In, 10990 N. Woodside. **HOURS:** 6:30am-7. **ADMISSION:** 50¢. **TALK-IN:** 146.520. **FEATURES:** C-E-F-F/R-H. **DEALER INFO:** \$6 vehicle. **CONTACT:** Pat, WA6MHZ, ARCEC, Box 50, El Cajon CA 92020. 619-561-0052.

FEBRUARY 5

CA - LIVERMORE — East Bay Area Amateur Radio/Electronics/Computer Swap Meet **SPONSOR:** Livermore Amateur Radio Klub (LARK). **LOCATION:** Los Positas College, N of I-580 at Airway Blvd. exit. **HOURS:** 7am-12noon, rain or shine. **ADMISSION:** Free. **TALK-IN:** 147.045 + fr west, 145.350- (100Hz) fr east. **FEATURES:** E-H-FP-F/R. **DEALER INFO:** Setup after 6am only. \$10 space fee. Covered spaces avail. if rain. **CONTACT:** Noel Ankham KC6QZK, 510-447-3857 eves or 510-783-2803 message days.

FEBRUARY 18

CA - SAN DIEGO — Fest West '95. **SPONSOR:** So. Cal. Computer Group. **LOCATION:** Fabulous Inn, 2485 Hotel Circle Pl. **HOURS:** 9am-6pm. **ADMISSION:** \$5. **FEATURES:** AC-C-DP-FP. **CONTACT:** James Lanman, POB 152535, San Diego CA 92195. 619-270-4864.

CA - SANTEE — Ham Radio, Computer & Electronics Swap Meet. **SPONSOR:** ARC of El Cajon. **LOCATION:** Santee Drive-In, 10990 N. Woodside. **HOURS:** 6:30am-7. **ADMISSION:** 50¢. **TALK-IN:** 146.520. **FEATURES:** C-E-F-F/R-H. **DEALER INFO:** \$6 vehicle. **CONTACT:** Pat, WA6MHZ, ARCEC, Box 50, El Cajon CA 92020. 619-561-0052.

OR - RICKREAL — Salem Hamfair & Electronic Swapmeet. **SPONSOR:** Salem Repeater Assoc. & Oregon Coast Emergency Repeater, Inc.. **LOCATION:** Polk County Fairgrounds. **HOURS:** 9am-4pm. **HOURS:** \$6 adv., \$7 door. **TALK-IN:** 146.86 Repeater. **FEATURES:** CB-DP-FM-F/R-RV/S. **DEALER INFO:** Swap table set up Fri, 2/17 6pm-9pm, Sat, 2/18 7am. Tables: \$13 ea, \$15 ea. w/power. **CONTACT:** Evan Burroughs, 7N1FJ, 503-585-5924.

MARCH 4

CA - SANTEE — Ham Radio, Computer & Electronics Swap Meet. **SPONSOR:** ARC of El Cajon. **LOCATION:** Santee Drive-In, 10990 N. Woodside. **HOURS:** 6:30am-7. **ADMISSION:** 50¢. **TALK-IN:** 146.520. **FEATURES:** C-E-F-F/R-H. **DEALER INFO:** \$6 vehicle. **CONTACT:** Pat, WA6MHZ, ARCEC, Box 50, El Cajon CA 92020. 619-561-0052.

MARCH 5

CA - LIVERMORE — East Bay Area Amateur Radio/Electronics/Computer Swap Meet **SPONSOR:** Livermore Amateur Radio Klub (LARK). **LOCATION:** Los Positas College, N of I-580 at Airway Blvd. exit. **HOURS:** 7am-12noon, rain or shine. **ADMISSION:** Free. **TALK-IN:** 147.045 + (PL 94.8) fr west, 145.350- (PL 100) fr east. **FEATURES:** E-H-FP-F/R. **DEALER INFO:** Setup after 7am only. \$10 space fee. Covered spaces avail. if rain. **CONTACT:** Noel Ankham KC6QZK, 510-447-3857 eves. or 510-783-2803 message days.

MARCH 18

CA - SANTEE — Ham Radio, Computer & Electronics Swap Meet. **SPONSOR:** ARC of El Cajon. **LOCATION:** Santee Drive-In, 10990 N. Woodside. **HOURS:** 6:30am-7. **ADMISSION:** 50¢. **TALK-IN:** 146.520. **FEATURES:** C-E-F-F/R-H. **DEALER INFO:** \$6 vehicle. **CONTACT:** Pat, WA6MHZ, ARCEC, Box 50, El Cajon CA 92020. 619-561-0052.

MARCH 19

OR - MILTON FREEWATER — 49th Annual W7DP Swapfest. **SPONSOR:** Walla Walla Valley ARC. **LOCATION:** Milton Freewater Community Center. **HOURS:** 8am-3pm. **ADMISSION:** Free with sign-in. **TALK-IN:** 147.280. **FEATURES:** DP-F/R. **DEALER INFO:** Swap tables: radio gear & related equipment only. **CONTACT:** David L. Pence, KB7WRT, 810 E. Sumach St., Walla Walla WA 99362-1348. 509-525-2529.

MARCH 27-28-29-30-31

CA - SANTA CLARA — PCI Bus Industry Conference & Exposition. **SPONSOR:** Annabooks & EDN. **LOCATION:** Santa Clara Westin Hotel & Convention Center. **FEATURES:** C-S. **CONTACT:** Chip Stockton, PCI '95 Conference Mgr., c/o Annabooks, POB 270708, San Diego CA 92128-2417. 619-673-

The Events Calendar is a free service limited to electronic events such as computer shows, hamfests, flea markets, etc. If your organization is sponsoring an event and would like a free listing, contact us at least 60 days prior to the event. Include your flyer, estimated attendance, name of person to contact and phone number. Complimentary issues are available upon request for distribution to your attendees. A street address for UPS shipment is required.

While we strive for accuracy in our calendar, we cannot be responsible for errors or cancellations. The information contained in this column is for the use of the readers of Nuts & Volts and may not be republished in any form without the written permission of T & L Publications, Inc.

0870, 619-673-1432 FAX, CompuServe 73204.3405.

APRIL 1

CA - SANTEE — Ham Radio, Computer & Electronics Swap Meet. **SPONSOR:** ARC of El Cajon. **LOCATION:** Santee Drive-In, 10990 N. Woodside. **HOURS:** 6:30am-7. **ADMISSION:** 50¢. **TALK-IN:** 146.520. **FEATURES:** C-E-F-F/R-H. **DEALER INFO:** \$6 vehicle. **CONTACT:** Pat, WA6MHZ, ARCEC, Box 50, El Cajon CA 92020. 619-561-0052.

WA - SPOKANE — Hamfest & Computer Show. **SPONSOR:** Inland Empire Hamfest Association. **LOCATION:** Spokane Interstate Fairgrounds. **HOURS:** 9am-5pm. **ADMISSION:** \$6 adv., \$7 door, 12 & under free. **FEATURES:** CB-EX-S. **DEALER INFO:** Swap tables \$13. Dealer tables \$13 + dealer & one person free. Set-up Fri. March 31st 9am-6pm. **CONTACT:** Warren Kelsey, S. 1405 Crestline, Spokane WA 99203.

APRIL 2

CA - LIVERMORE — East Bay Area Amateur Radio/Electronics/Computer Swap Meet **SPONSOR:** Livermore Amateur Radio Klub (LARK). **LOCATION:** Los Positas College, N of I-580 at Airway Blvd. exit. **HOURS:** 7am-12noon, rain or shine. **ADMISSION:** Free. **TALK-IN:** 147.045 + (PL 94.8) fr west, 145.350- (PL 100) fr east. **FEATURES:** E-H-FP-F/R. **DEALER INFO:** Setup after 7am only. \$10 space fee. Covered spaces avail. if rain. **CONTACT:** Noel Ankham KC6QZK, 510-447-3857 eves. or 510-783-2803 message days.

APRIL 15

CA - SANTEE — Ham Radio, Computer & Electronics Swap Meet. **SPONSOR:** ARC of El Cajon. **LOCATION:** Santee Drive-In, 10990 N. Woodside. **HOURS:** 6:30am-7. **ADMISSION:** 50¢. **TALK-IN:** 146.520. **FEATURES:** C-E-F-F/R-H. **DEALER INFO:** \$6 vehicle. **CONTACT:** Pat, WA6MHZ, ARCEC, Box 50, El Cajon CA 92020. 619-561-0052.

APRIL 30

CA - SACRAMENTO — Ham Radio/Computer Swapmeet. **SPONSOR:** CSUS Student ARC. **LOCATION:** California State Univ. at Sacramento, US 50 & Howe Ave. **HOURS:** 7am-12pm. **ADMISSION:** Free. **TALK-IN:** 145.230 (-dup PL 162.2). **FEATURES:** FP-F/R. **DEALER INFO:** Sellers 10. **CONTACT:** Gary Webbenhurst, KC6URB, 916-381-6602 evenings.

CENTRAL REGION

FEBRUARY 4

OH - TOLEDO — Toledo Giant Used Computer & Camera Show. **LOCATION:** Meadowbrook Place, 4480 Heatherdowns Blvd. across road from Masonic Temple at Reynolds Rd. **HOURS:** 9am-3pm. **ADMISSION:** \$4. **FEATURES:** C. **DEALER INFO:** 150 8-ft. tables \$45 ea. **CONTACT:** Photorama USA, 20219 Mack Ave, Groves Pointe Woods MI 48236. 313-884-2242.

FEBRUARY 5

MI - GRAND RAPIDS — Computer Trade Show. **LOCATION:** Holiday Inn Crown Plaza, 5700 28th St. SE. at I-96 Exit 43A. **HOURS:** 10am-4pm. **ADMISSION:** Adults \$4; Seniors & students w/ID \$3; under 12 free w/adult. **FEATURES:** C-DP. **CONTACT:** Computers & You, 313-283-1754.

OH - COLUMBUS — Columbus Computer Festival. **SPONSOR:** Computer Support Services. **LOCATION:** Aladdin Temple, 3850 Stetzel Rd. **HOURS:** 10am-4pm. **ADMISSION:** \$4, seniors/students \$3, under 12 free. **FEATURES:** C-DP-F/R. **DEALER INFO:** 8' tables draped & covered. 1-4 tables \$35

ea., 5+ tables \$30 ea. **CONTACT:** Computer Support Services, POB 1350, Taylor MI 48180. 313-295-2237.

FEBRUARY 11

IN - NOBLESVILLE — Giant Noblesville Computer Fair. **LOCATION:** Hamilton County 4-H Grounds, off SR37. **HOURS:** 10am-3pm. **ADMISSION:** \$5, under 12 free. **FEATURES:** C-DP. **CONTACT:** Ben Yanto, AGI Computer Fairs.*

MN - BLAINE — Midwinter Madness. **SPONSOR:** Robbinsdale ARC. **LOCATION:** National Sports Center. **HOURS:** 7:30am-2:30pm. **FEATURES:** CB-DP-FM. **CONTACT:** Robbinsdale ARC, Inc., POB 22613, Robbinsdale MN 55422.

FEBRUARY 12

MI - SOUTHGATE — Computer Trade Show. **LOCATION:** Crystal Gardens, 16703 Fort St. **HOURS:** 10am-4pm. **ADMISSION:** Adults \$4; Seniors & students w/ID \$3; under 12 free w/adult. **FEATURES:** C-DP. **CONTACT:** Computers & You, 313-283-1754.

OH - DAYTON — Computer Blowout Sale. **SPONSOR:** MBE Computers. **LOCATION:** Hara Arena. **HOURS:** 10am-4pm. **FEATURES:** C-DP-FP-F/R. **DEALER INFO:** Setup 7:30am-9:30am. 200+ tables. \$60 per table, 4 or more tables \$55 ea. Fax inquiries to 517-646-9885. **CONTACT:** For more information call 517-646-9895 or 313-572-0038.

OH - MANSFIELD — Mansfield Mid-Winter Hamfest/Computer Show. **LOCATION:** Richland County

All listing information should be sent to:

**Nuts & Volts Magazine
EVENTS CALENDAR
430 Princland Court
Corona, CA 91719
Phone 909-371-8497
FAX 909-371-3052**

FEBRUARY 18

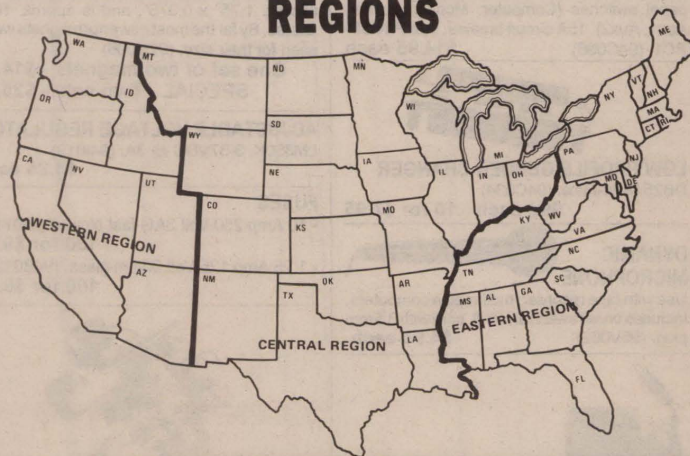
IN - INDIANAPOLIS — Indianapolis Computer Fair. **LOCATION:** Knights of Columbus, 2100 E. 71st St. **HOURS:** 10am-3pm. **ADMISSION:** \$4, under 12 free. **FEATURES:** C-DP. **CONTACT:** Ben Yanto, AGI Computer Fairs.*

MI - LIVONIA — Computer Trade Show. **LOCATION:** Elks Lodge Hall, 31117 Plymouth Rd., 1 block E of Merriman. **HOURS:** 10am-3pm. **ADMISSION:** Adults \$4; Seniors & students w/ID \$3; under 12 free w/adult. **FEATURES:** C-DP. **CONTACT:** Computers & You, 313-283-1754.

FEBRUARY 19

IL - ROCK ISLAND — 24th Annual Davenport Hamfest. **SPONSOR:** Davenport Radio Amateur Club. **LOCATION:** QCCA Expo Center, 2621 4th Ave. **HOURS:** 7:30am-3:30pm. **ADMISSION:** \$4 adv., \$5 door. **TALK-IN:** 146.28/88, 146.04/64. **FEATURES:** CB-DP-EX-FM-F/R. **DEALER INFO:** Commercial Booth \$20, Tables \$10 before 2/1/95. **CONTACT:** Kent Williams, K9UQJ, 309-796-0718 voice 4pm-10pm or send SASE to: 4245 10th St., East Moline IL 61244, FAX 10pm-4pm 309-796-0629. Info on GE Exams, send SASE to: Roger Franke, K9AYK, 2506 E. 29th Ct., Davenport

REGIONS



FEATURES KEY

| | |
|------|-----------------------------|
| AC | — Air-conditioned |
| B | — Banquet |
| C | — Computers |
| CB | — Commercial Booths |
| DP | — Door Prizes |
| E | — Electronics |
| EX | — FCC exams |
| F | — Forums |
| FM | — Flea Market |
| FP | — Free Parking |
| F/R | — Food & Refreshments |
| H | — Amateur Radio |
| RV-H | — RV Parking w/hookups |
| RV-S | — RV Parking Self-contained |
| S | — Seminars |
| T | — Tailgating |

COMPUTER SHOW PROMOTER INFO

AGI Computer Fair - 317-299-8827
CMA Computer Shows - 804-272-1570
KGP Computer Shows - 908-297-2526
MarketPro Computer Shows - 415-388-8893
NARISAM Computer Shows - 404-663-0983
800-436-6707
Northern Computer Shows - 508-744-8440

Events CALENDAR

IA 52803.

IN - SOUTH BEND — Camera/Computer Swap Meet. **LOCATION:** Centuray Center, downtown south Bend, IN. **HOURS:** 10am-3pm. **ADMISSION:** Adults \$5.00, under 12 free. **DEALER INFO:** 8' tables \$50 ea. **CONTACT:** Roger L. Smith, 8863 E. Black Point Rd., Syracuse, IN 46567. 219-856-3863 voice or FAX.

MI - MADISON HEIGHTS — Computer Trade Show. **LOCATION:** UF & CW Hall, 876 Horace Brown Dr., 1 block E of I-75. **HOURS:** 10am-4pm. **ADMISSION:** Adults \$4; Seniors & students w/ID \$3; under 12 free w/adult. **FEATURES:** C - DP. **CONTACT:** Computers & You, 313-283-1754.

MI - FLINT — Computer Trade Show. **SPONSOR:** 5 Star Productions. **LOCATION:** Flint Holiday Inn, Gateway Centre, US-23 at Hill Rd. Exit 2 miles S. of I-69. **HOURS:** 10am-4pm. **ADMISSION:** \$4, \$3 w/this ad. **FEATURES:** AC - C - CB - DP - F - R. **CONTACT:** Five Star Productions, 2436 Nerredia St., Flint MI 48532. 810-768-6058 (pager), 810-230-0988 (after 4pm).

MI - NOVI — Great Lakes Computer Expo & Sale. **SPONSOR:** Progressive Computer Productions. **LOCATION:** Sheraton Oaks Hotel, I-96 & Novi Rd. Across from Twelve Oaks Shopping Center. **HOURS:** 10am-4pm. **ADMISSION:** Adults \$4, Seniors/Students \$3, under 12 free w/adult. **FEATURES:** C - DP - F - R. **DEALER INFO:** Covered 8' \$35 ea. **CONTACT:** Progressive Computer Productions, 23814-Michigan Ave., Ste 237, Dearborn MI 48124. 313-425-9276.

FEBRUARY 25

IN - LAPORTE — Laporte Cabin Fever Hamfest. **SPONSOR:** Laporte ARC. **LOCATION:** Laporte Civic Auditorium, 50 mi. E of Chicago. **HOURS:** 8am-2pm. **ADMISSION:** \$4. **TALK-IN:** 146.610 (-131.8 PL), 146.520. **FEATURES:** F/R. **DEALER INFO:** Tables \$5 ea. **CONTACT:** TX John, 219-362-1121 or SASE to: POB 30, Laporte IN 46351.

MI - TAYLOR — Computer Trade Show. **LOCATION:** Democratic Club of Taylor, 23400 Wick Rd., 4 blocks E of Telegraph. **HOURS:** 10am-3pm. **ADMISSION:** Adults \$4; Seniors & students w/ID \$3; under 12 free w/adult. **FEATURES:** C - DP. **CONTACT:** Computers & You, 313-283-1754.

MI - WESTLAND — Great Lakes Computer Expo & Sale. **SPONSOR:** Progressive Computer Productions. **LOCATION:** Wayne-Ford Civic League, 1645 Wayne Rd, 1 blk S of Ford Rd. **HOURS:** 10am-4pm. **ADMISSION:** Adults \$4, Seniors/Students \$3, under 12 free w/adult. **FEATURES:** C - DP - F - R. **DEALER INFO:** Covered 8' \$35 ea. **CONTACT:** Progressive Computer Productions, 23814 Michigan Ave., Ste 237, Dearborn MI 48124. 313-425-9276.

ND - BISMARCK — 5th Annual CDARC Hamfest. **SPONSOR:** Central Dakota Amateur Radio Club. **LOCATION:** Radisson Inn, 800 S 3rd St. **HOURS:** 8am-7. **ADMISSION:** \$4 adv, \$5 door. **TALK-IN:** 146.85/146.94. **FEATURES:** C - CB - H. **DEALER INFO:** \$5 table. **CONTACT:** Central Dakota Amateur Radio Club, POB 7162, Bismark ND 58507-7162.

TX - ORANGE — Hamfest. **SPONSOR:** Orange ARC. **LOCATION:** VFW Hall, Hwy 87N. **HOURS:** 8am-5pm. **ADMISSION:** Free. **TALK-IN:** 147.48/18. **FEATURES:** CB - EX - F - R. **DEALER INFO:** Tables \$5. Dealers \$15. **CONTACT:** Paul Tullier, 409-769-1231; Irene Thomas, 409-745-3061; Fay Metz 409-768-1255. Or write: OARC, POB 232, Orange TX 77630.

FEBRUARY 25-26

OH - CINCINNATI — ARRL Great Lakes Division Convention 1995. **LOCATION:** Cincinnati Gardens Exhibition Center, 2250 Seymour Ave. at Langdon Farm Rd. **HOURS:** 8:30am-5pm both days. **ADMISSION:** \$6 adv., \$8 door. **FEATURES:** CB - DP - EX - F - FM - F - R. **DEALER INFO:** 8'x9' commercial \$55, 8'x4.5' flea market \$30, 8'x4.5' flea market \$20. **CONTACT:** Stan Cohen, Chairman, W8QDQ, 513-531-1011.

FEBRUARY 26

IL - GLEN ELLYN — Computer Central. **LOCATION:** College of DuPage, Physical Education Bldg, Main Arena, Park Blvd. & College Rd. **HOURS:** 9:30am-3pm. **ADMISSION:** Adults \$6, 8-12 \$2, under 8 free. \$1 off reg. adult admission w/this ad. **FEATURES:** AC - C - F - R. **CONTACT:** Computer Central, Jay B. Robinson, 708-940-7547.

KY - LOUISVILLE — Computer Fair South. **SPONSOR:** MEKA Enterprises, Inc. **LOCATION:** Executive West Hotel, I-65 & 264 Freedom Way at the Fairgrounds. **HOURS:** 10am-3pm. **CONTACT:** William Ibarra, Meka Enterprises, 2656 E. 2nd St., Bloomington IN 47401. 812-333-4484, FAX: 812-333-4650.

MI - ANN ARBOR — Great Lakes Computer Expo & Sale. **SPONSOR:** Progressive Computer Productions. **LOCATION:** Holiday Inn, US-23 & Plymouth Rd. **HOURS:** 10am-4pm. **ADMISSION:** Adults \$4,

Seniors/Students \$3, under 12 free w/adult. **FEATURES:** C - DP - F - R. **DEALER INFO:** Covered 8' \$35 ea. **CONTACT:** Progressive Computer Productions, 23814 Michigan Ave., Ste 237, Dearborn MI 48124. 313-425-9276.

MI - BRIGHTON — Computer Trade Show. **LOCATION:** Brighton High School, 7878 Brighton Rd., Exit #145 off I-96 S. to Main, turn right, go to 7th St., turn left. **HOURS:** 10am-4pm. **ADMISSION:** \$2. **FEATURES:** C - DP. **CONTACT:** Computers & You, 313-283-1754.

MI - DEARBORN — 25th "Silver Anniversary" Swap 'N Shop. **SPONSOR:** Livonia ARC. **LOCATION:** Dearborn Civic Center. **HOURS:** 8am-3pm. **ADMISSION:** \$5 door. **TALK-IN:** 145.350 Rptr., 146.52 Simplex. **FEATURES:** EX. **DEALER INFO:** Tables: \$15 plus adv. adm. \$4. **CONTACT:** Send 4x9 SASE c/o Neil Coffin, WA8GWL, Livonia ARC, POB 2111, Livonia MI 48151 or phone 313-261-5486.

OH - CUYAHOGA FALLS — 41st Annual Hamfest, Computer Show & Flea Market. **SPONSOR:** Cuyahoga Falls ARC, Inc. **LOCATION:** Emidio & Sons, 48 Bath Rd. **CONTACT:** Carl Hervol, N8JLQ, or Betti Hervol, KB8PXS, 216-497-7047.

WI - NEW BERLIN — Swapfest & Computer Fair. **SPONSOR:** South East Wisconsin FM ARS, Inc. **LOCATION:** Kuglitsch's Entertainment Center, 16000 W. Cleveland Ave., Exit 57 & I-43. **HOURS:** 8am-2pm. **ADMISSION:** \$3 adv., \$4 door. **TALK-IN:** 146.820 Repeater. **FEATURES:** AC - C - CB - DP - E - EX - F - FM - F - R - H - RV-S - S - T. **DEALER INFO:** Setup 6am \$1 per foot table space plus admission ticket. **CONTACT:** Send SASE to: Sewfars/Mace Swapfest, POB 102, Delafield WI 53018 or phone: 414-771-1250, FAX: 414-542-7474. E-Mail: craigc@execpc.com.

MARCH 4

IA - CEDAR RAPIDS — 12th Annual Eastern Iowa Computer Fair. **SPONSOR:** Commo-Hawk Computer Users Group. **LOCATION:** Teamsters Union Hall, 5000 [St. SW. **HOURS:** 8am-6pm. **ADMISSION:** \$2 donation. **CONTACT:** Leland Horsford at 319-393-4631 (voice, evening), 319-393-4852 (FAX), leland@ins.infonet.net (Internet).

MI - WATERFORD — Computer Trade Show. **LOCATION:** NOCC CAI Building, 5640 Williams Lake Rd., Exit 89 off I-75, go W 3.5 mi. to Walton Blvd., turn right. **HOURS:** 10am-3pm. **ADMISSION:** Adults \$4; Seniors & students w/ID \$3; under 12 free w/adult. **FEATURES:** C - DP. **CONTACT:** Computers & You, 313-283-1754.

OK - ELK CITY — Hamfest. **SPONSOR:** W. Central OK ARC. **LOCATION:** Civic Center, Exit 41 off I-40. **HOURS:** 9am-5pm. **ADMISSION:** \$5 adv., \$8 door. **TALK-IN:** 146.16/76. **CONTACT:** WCOARC, POB 2023, Elk City OK 73648. 405-472-3442 days or 405-473-2572 eves.

MARCH 10

MO - ST. LOUIS — 35th Annual Ham Radio Auction. **SPONSOR:** Jefferson Barracks Amateur Radio Club. **LOCATION:** Concordia Turners Hall, 6432 Gravois ave. **HOURS:** 7:30pm-7. **ADMISSION:** Free. **TALK-IN:** 146.34/94, 144.61/145.21. **FEATURES:** F/R. **CONTACT:** Carl H. Hohenberger, W8BZP, 5266 Parker Ave., St. Louis MO 63139-1340. 314-351-7084.

MARCH 10-11-12

LA - LAFAYETTE — Hamfest. **SPONSOR:** Acadiana ARA. **LOCATION:** Holiday Inn Holidome, E. Service Rd. off I-49. **HOURS:** Fri. 5pm-7pm, Sat. 8am-4pm, Sun. 8am-12pm. **ADMISSION:** \$3 adv., \$5 door. **TALK-IN:** 147.63/03, 146.22/82, 144.73/145.33, 147.81/21. **FEATURES:** EX - F. **CONTACT:** Carolyn Oubre, 601 Sugar Mill Rd., New Iberia LA 70560. 318-364-2857.

MARCH 11

IN - INDIANAPOLIS — Indianapolis Computer Fair. **LOCATION:** Quality Inn East, 3525 N Shadeland, near Pendleton Pike. **HOURS:** 10am-3pm. **ADMISSION:** \$4, under 12 free. **FEATURES:** C - DP. **CONTACT:** Ben Yanto, AGI Computer Fairs.*

ND - FARGO — Amateur Radio & Computer Fair. **SPONSOR:** Red River Radio Amateurs. **LOCATION:** West Fargo Fair Ground. **HOURS:** 8am-3pm. **ADMISSION:** \$6, 12 and under free. **TALK-IN:** 146.76 WOLO. **FEATURES:** C - H - S. **CONTACT:** ARCEF '95, POB 3215, Fargo ND 58108-3215.*

MARCH 12

IN - INDIANAPOLIS — Indiana Hamfest & Computer Show. **SPONSOR:** Morgan County Repeater Assn. **LOCATION:** Indiana State Fairgrounds, Pavilion bldg. **HOURS:** 8am-7. **ADMISSION:** \$7. **TALK-IN:** 147.06. **FEATURES:** C - FM. **DEALER INFO:** 8' table \$15. Setup 3:11 3pm-9pm, 3:12 6am-8am. **CONTACT:** Deanne Martin, N9TEJ, 39 Lake Shore Dr. #14, Martinsville IN 46151. 317-342-4307.

OH - CIRCLEVILLE — Hamfest. **SPONSOR:** Teays ARC. **LOCATION:** Pickaway County Fairgrounds,

4-H Bldg., St. Rt. 22. **HOURS:** 8am-7. **ADMISSION:** \$4 adv., \$5 door. **TALK-IN:** 147.180+. **FEATURES:** C - DP - FM - F - R. **DEALER INFO:** Tables: \$5 adv., \$6 door. **CONTACT:** Dan Grant, W8UCF, 22150 Smith-Hulse Rd., Circleville OH 43113. 614-477-3026.

OH - CONNEAUT — 9th Annual Hamfest & Computerfest. **SPONSOR:** Conneaut Amateur Radio Club. **LOCATION:** Conneaut Human Resource Center, 327 Mill St. **HOURS:** 8am-3pm. **ADMISSION:** \$4 adv, \$5 door. **TALK-IN:** 147.39. **FEATURES:** C - EX - F - R. **DEALER INFO:** Tables \$8, Setup 6am. **CONTACT:** Clarence Baugher, W8FAS, 109 Daniels Ave., Conneaut, OH 44030-2315. 216-593-3038.

MARCH 18

KS - COLBY — Hamfest. **SPONSOR:** Trojan ARC. **LOCATION:** Colby National Guard Armory on K-25. **HOURS:** 8am-2pm. **ADMISSION:** \$2. **TALK-IN:** 146.82. **FEATURES:** EX - F - F - R. **DEALER INFO:** Tables \$5. **CONTACT:** TARC, POB DX, Colby, KS 67701-0983.

MARCH 18-19

TX - MIDLAND — St. Patrick's Day Swapfest. **SPONSOR:** Midland Amateur Radio Club. **LOCATION:** Midland County Exhibit Bldg. **HOURS:** Sat: 9am-5pm, Sun: 8am-2:30pm. **ADMISSION:** \$7 adv, \$8 door. **FEATURES:** DP - FM. **DEALER INFO:** Tables: 1-2 \$10 ea., 3+ \$15 ea. **CONTACT:** Midland Amateur Radio Club, POB 4401, Midland TX 79704.

MARCH 19

IL - STERLING — 35th Annual Hamfest. **SPONSOR:** Sterling Rock Falls Amateur Radio Society. **LOCATION:** Sterling High School Field House, 1608 4th Ave. **HOURS:** 7:30am-7. **ADMISSION:** \$3 adv, \$4 door. **TALK-IN:** 146.25/146.85 W9MEP Repeater. **FEATURES:** C - E - FM - F - R - H - RV-S. **DEALER INFO:** Tables \$5, w/electricity \$6. Set up Sat. 6pm-9pm, Sun 6:30am. **CONTACT:** Lloyd Sherman, KB9APW, POB 521 Sterling IL 61081-0521. 815-336-2434.

WI - JEFFERSON — Hamfest. **SPONSOR:** Tri County Amateur Radio Club. **LOCATION:** Jefferson County Fairgrounds. **HOURS:** 8am-7. **ADMISSION:** \$4. **DEALER INFO:** 6' tables \$5. Set up 7am. **CONTACT:** W9MQB, 213 Frederick St., Ft. Atkinson WI 53538. 414-563-6381 eves.

MARCH 25

IN - MICHIGAN CITY — Hamfest & Computer Flea market. **SPONSOR:** Michigan City Amateur Radio Club. **LOCATION:** Rogers High School, 8466 Pahs Rd. **HOURS:** 8am-2pm. **ADMISSION:** \$4. **TALK-IN:** 146.37/97 (131.8 Hz PI). **FEATURES:** CB - FM - H. **DEALER INFO:** 6' tables \$6, elec. hook-ups \$2. Early set up for vendors. **CONTACT:** Ron Stahovik, N9TPC, 213 So. Dickson St., Michigan City IN 46360. 219-872-6594.

MARCH 26

IL - GRAYS LAKE — 16th Annual Lamarsfest '95. **SPONSOR:** Libertyville & Mundelein ARS. **LOCATION:** Lake County Fairgrounds, Rts. IL-120 & US-45. **HOURS:** 8am-2pm. **ADMISSION:** \$4 adv. w/SASE, \$5 door. **TALK-IN:** 147.945/345, 146.52. **FEATURES:** C - CB - E - F - R - H. **DEALER INFO:** Commercial tables \$25, wall tables \$15, swapfest table \$10. Setup 6am. **CONTACT:** Lamarsfest '95, 650 Green Bay Rd., Lake Bluff IL 60044. Frank Avellone, W9GLO, 708-234-4124 before 10pm.

KY - LOUISVILLE — Computer Fair South. **SPONSOR:** MEKA Enterprises, Inc. **LOCATION:** Executive West Hotel, I-65 & 264 Freedom Way at the Fairgrounds. **HOURS:** 10am-3pm. **CONTACT:** William Ibarra, Meka Enterprises, 2656 E. 2nd St., Bloomington IN 47401. 812-333-4484, FAX: 812-333-4650.

MI - ANN ARBOR — Colossal Computer Sale. **SPONSOR:** Jewish Community Center. **LOCATION:** Washtenaw Community College's Morris Lawrence Bldg. **HOURS:** 9:30am-4pm. **ADMISSION:** \$4. **FEATURES:** C - F - R. **DEALER INFO:** Tables \$30. **CONTACT:** Merle Goldman, 313-971-0990.

MI - FLINT — Computer Trade Show. **SPONSOR:** 5 Star Productions. **LOCATION:** Flint Holiday Inn, Gateway Centre, US-23 at Hill Rd. Exit 2 miles S. of I-69. **HOURS:** 10am-4pm. **ADMISSION:** \$4, \$3 w/this ad. **FEATURES:** AC - C - CB - DP - F - R. **CONTACT:** Five Star Productions, 2436 Nerredia St., Flint MI 48532. 810-768-6058 (pager), 810-230-0988 (after 4pm).

MARCH 31-APRIL 1

AR - LITTLE ROCK — Little Rock Hamfest & ARRL State Convention. **LOCATION:** Little Rock Expo Center. **HOURS:** Fri: 4pm-9pm, Sat: 8am-5pm. **FEATURES:** AC - CB - F - FM - T. **CONTACT:** Jim Blackmon, KB5IFV, 1008 Pine St., Arkadelphia AR 71923-4919. 501-246-6734 or 501-246-7833.

APRIL 1

CO - LONGMONT — LARCFEST. **SPONSOR:** Longmont ARC. **LOCATION:** Boulder County Fairgrounds, Hover & Nelson Rds. **HOURS:** 8am-3pm. **ADMISSION:** \$4. **TALK-IN:** 147.27/87 146.52. **FEATURES:** CB - EX - F - R. **DEALER INFO:** Tables \$8 + admission. **CONTACT:** Send SASE: Randy Stevens, NONMD, 5280 Cypress Dr., Boulder CO 80303. 303-499-1106.

IN - COLUMBUS — Hamfest. **SPONSOR:** Columbus ARC. **LOCATION:** Bartholomew County 4-H Fairground, Family Arts Bldg., State Road 11. **HOURS:** 8am-2pm. **ADMISSION:** \$3.50 adv., \$4 door. **TALK-IN:** 146.790/146.190. **DEALER INFO:** Tables: 8' \$6, 6' \$4.50. Set-up: Fri. 6pm-10pm, Sat. 6am. **CONTACT:** Marion Winterberg, WD9HTN, 11941 W. Sawmill Rd., Columbus IN 47201. 812-342-4670.

APRIL 2

WI - MADISON — 23rd Annual Madison Swapfest. **SPONSOR:** Madison Area Repeater Assoc. **LOCATION:** Dane County Exposition Center Forum Bldg. **HOURS:** 8am. **ADMISSION:** \$4 adv., \$5 door. **TALK-IN:** 147.75/15. **FEATURES:** C - CB - E - FM - F - R. **DEALER INFO:** Tables \$10 + admission. Adv. only. **CONTACT:** MARA, POB 8890, Madison WI 53708-8890.

APRIL 8

MN - FERGUS FALLS — 8th Annual ARRL Affiliated Hamfest. **SPONSOR:** Lake Region ARC. **LOCATION:** Ottertail County Fairgrounds, Hockey Arena, Hwy. 59 S. **HOURS:** 8am-3pm. **TALK-IN:** 146.040/146.640. **FEATURES:** EX - F - R. **CONTACT:** Wm. Morgan, Rt. 6 Box 43, Fergus Falls MN 56537.

MO - JOPLIN — JARC Hamfest '95. **SPONSOR:** Joplin ARC. **LOCATION:** John Q. Hammons Convention Center, 3615 Rangeline. **HOURS:** 8am-3pm. **ADMISSION:** \$6, under 12 free. **TALK-IN:** 147.21 +. **FEATURES:** DP - EX. **DEALER INFO:** Tables \$7.50. Setup 6:30am-8am Northside. **CONTACT:** JARC, POB 2983, Joplin MO 64803. 417-782-5848 evenings, or 417-673-8371 Andy Gabbert, KA0TUD.

OK - LAWTON — 49th Annual Hamfest. **SPONSOR:** Lawton Ft. Sill ARC. **LOCATION:** Comanche County Fairgrounds. **HOURS:** 8am-5pm. **ADMISSION:** \$4 adv., \$5 door. **TALK-IN:** 146.91/31. **FEATURES:** DP - EX - F. **DEALER INFO:** Tables \$8 adv., \$10 door. **CONTACT:** Bob Morford, KA5YED, 1415 NW 33rd St., Lawton OK 73505. 405-355-6120.

WI - GREEN BAY — Swapfest. **SPONSOR:** Ashwallbenon High School Tech Club & Brown County ARES. **LOCATION:** Ashwallbenon High School, 2391 South Ridge Rd. **HOURS:** 8am-12pm. **ADMISSION:** \$3 adv., \$4 door. **TALK-IN:** 147.075 +. **FEATURES:** C - EX - FM - F - R - H. **DEALER INFO:** Tables: Adv. 4' \$4, Door 4' \$5. Setup Fri. 7-10pm. **CONTACT:** Chad Stiles, N9PAY, 2171 Barberrly Ln., Green Bay WI 54304. 414-494-2936. Lisa Kolbusz, N9VJL, 520A Columbia Ave., Green Bay WI 54303. 414-497-1807.

APRIL 15

IN - INDIANAPOLIS — Indianapolis Computer Fair. **LOCATION:** Quality Inn East, 3525 N. Shadeland Ave. **HOURS:** 10am-3pm. **ADMISSION:** \$4, under 12 free. **FEATURES:** C - DP. **CONTACT:** Ben Yanto, AGI Computer Fairs.*

APRIL 23

IL - ARTHUR — 33rd Annual Hamfest. **SPONSOR:** Moultrie ARK. **LOCATION:** Moultrie/Douglas Fairgrounds. **ADMISSION:** \$4, 14 & under free. **TALK-IN:** 449.275/444.275 146.055/146.655. **FEATURES:** CB - FM. **DEALER INFO:** Inside tables \$8, outside flea market setup free, indoor setup Sat. 12pm-4pm, Sun. 6am-8am. **CONTACT:** M.A.R.K., POB 91, Lovington IL 61937. Or Ralph Zancha, WC9V, 217-873-5287.

APRIL 28-29-30

OH - DAYTON — 44th Annual Dayton Hamvention. **SPONSOR:** Dayton Amateur Radio Association. **LOCATION:** Hara Arena. **ADMISSION:** \$12 adv., \$15 door, good all 3 days. **FEATURES:** B - C - DP - E - EX - F - FM - H. **DEALER INFO:** Flea Market: 3 spaces max. (Must purchase admission ticket.) \$35/space, \$70/2, \$160/3. Electricity \$40 per space. Covered tent: \$230 ea. Exhibit info: 513-276-6931, FAX 513-324-2159. Flea Market info: 513-276-6932. **CONTACT:** General info: 513-276-6930.

EASTERN REGION

FEBRUARY 4-5

FL - MIAMI — 35th Annual Tropical Hamboree Amateur Radio & Computer Show. **SPONSOR:**

Continued on page 124

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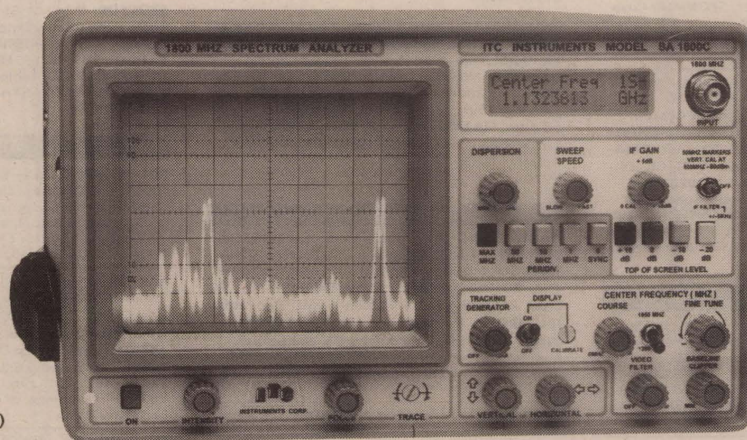
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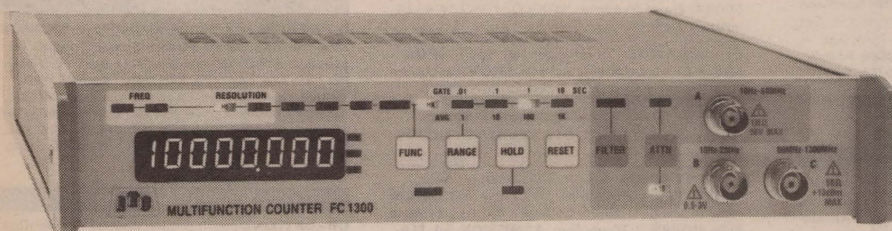
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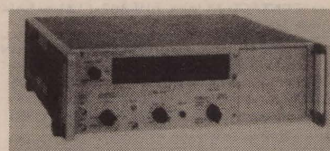
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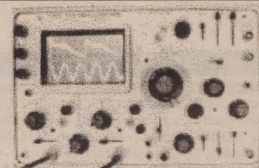
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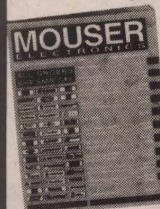
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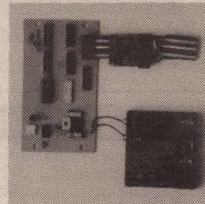
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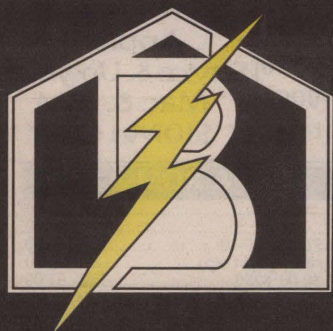
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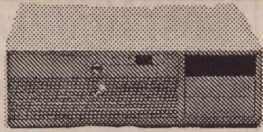
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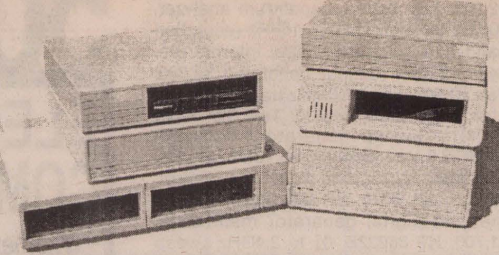
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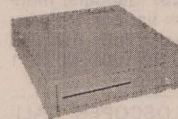
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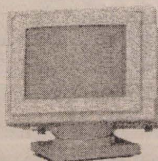
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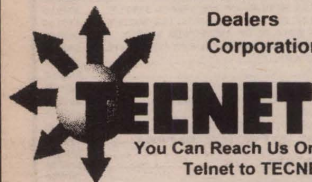
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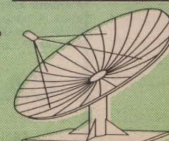
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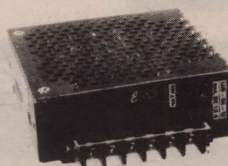
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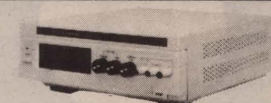
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74S
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74C
74HCT
74HCOO.
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73X
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30F

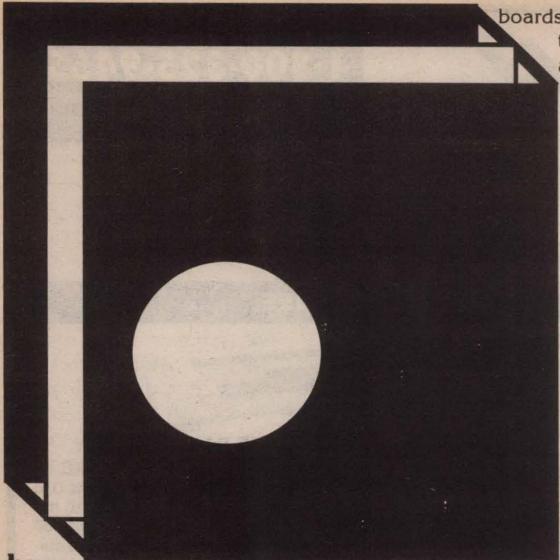
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Write in 72 on Reader Service Card.



by
Scott Edwards

It's a physical reaction, and a lot like food poisoning. You break out in a cold sweat and your stomach does a slow roll: Some of those 350 printed circuit boards you ordered are defective. Worse, the defects are hidden and random; undetectable by a visual inspection. You face the prospect of using a continuity tester to "buzz out" at least 14 connections per board times 350 boards . . . 4900 connections. No

boards. But you still have to find those boards, and you face the prospect of going through this again, or paying the outrageous testing fee on the next production run.

That's exactly the situation I recently found myself in, as

a flexible piece of programmable test equipment.

Interfacing Test Equipment

When you test with a meter or continuity checker, you make a temporary connection to the circuit with probes, alligator clips, or micro hooks. The most common of the three is definitely the probe — little more than a shiny nail, a wire, and a

contact cycles.

To use these probes, you must:

(1) Identify the points in your circuit that you want to test, either from past failures or knowledge of the board/cable layout. Generally, unless the circuit is very simple, you can't afford to test everything.

(2) Construct a jig to hold the probes in the right positions. I sacrificed a known-bad circuit board and

The BASIC Stamp as a Circuit Detective

Automated Testing Techniques Help Discover — and Defeat — Hidden Flaws in Circuit Boards and Cables

my little business makes the transition from primarily kits and services to small runs of manufactured products. But you don't have to be a manufacturer to find yourself faced with a testing headache. What if you, your club, or employer needs a batch of

handle.

Getting good contact between a probe and a circuit can be tricky. If you don't press hard enough, you may not make good contact through thin layers of oxides and grime. Press too hard, and the probe can slip, possibly nicking delicate traces.

Clips and hooks can be better, provided there's something you can clip them to. That's usually not the case with an unpopulated circuit board. Clips and hooks also take time and care to attach and remove.

Since we're talking about automated testing, imagine trying to simultaneously make reliable contact with 28 probes at one time, or attach 28 clips to various locations around a circuit. Not easy.

Fortunately, big manufacturers have created a large and technically astute market for automated test equipment. There is an amazing variety of high-reliability test probes available at less than a dollar apiece in small quantities. Figure 1 is a chart of probe types and their applications, courtesy of the manufacturer, Interconnect Devices Inc. (IDI).

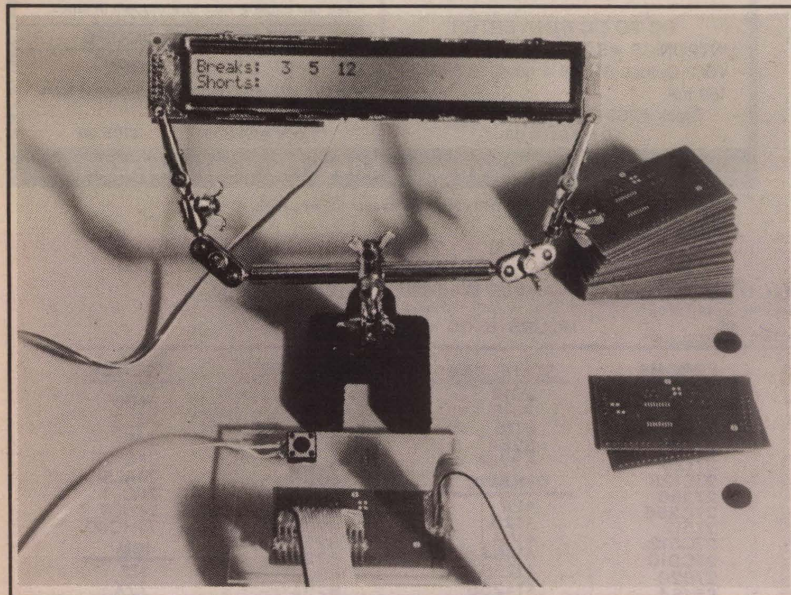
All of the probes — regardless of tip style — are spring-loaded, with up to 1/4" of travel. This helps them make positive contact in spite of small misalignments. Unlike solid probes, they maintain sure, steady pressure against the test point. They're gold-plated for good conductivity. And, with proper care, they're designed for half a million

used it as a template to drill probe mounting holes in a scrap of clear acrylic plastic. I mounted probe sockets into the acrylic jig with "super" (cyanoacrylic or CA) glue, then reinforced the assembly with hot glue. The added hot glue prevents side forces from bending and possibly damaging the probes and sockets.

(3) Select the correct probe types for the desired test points. Figure 1 is an excellent guide. I picked wrong — using a spherical radius tip for circuit board pads — and still got good results. Of course, I was due for a little good luck.

(4) Build a wiring harness to connect the probe sockets to your test gear. I used ribbon cable, connecting the test-equipment end to header sockets that plug directly onto the stakes of a BASIC Stamp or Stamp Stretcher.

(5) Install the probes in the sockets. They just push into place with a fingertip.



THE CIRCUIT BOARD TEST JIG IN ACTION

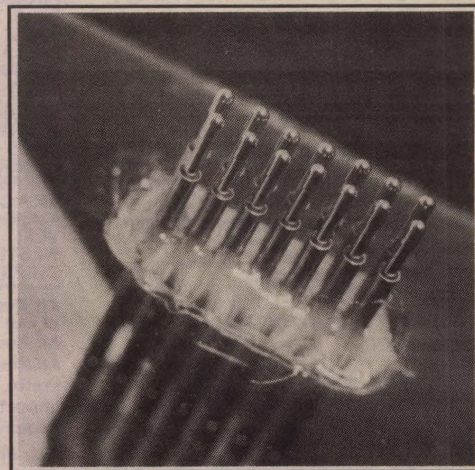
doubt about it, food poisoning would be better.

It gets worse. You call the circuit board manufacturer. Surely they'll replace the bad boards once you identify them. Nope. Company policy is that they're only responsible for defects if you sign up for their automated testing program — at an extra cost of 33 percent per board. You did read the fine print, didn't you?

After some negotiation, the board house agrees to bend the policy this once and replace your bad





















circuit boards or complex cables? Or if you're called upon to maintain a system that's a rat's nest of interconnected wiring? Or if you have to reverse-engineer a piece of obsolete equipment to modify it?

Anyone who frequently finds him or herself setting the multitester to "continuity" and putting in mind-numbing hours of checking connections can benefit from the automated test techniques discussed in this article. If you're a BASIC Stamp user, you'll see the Stamp in a new light; as

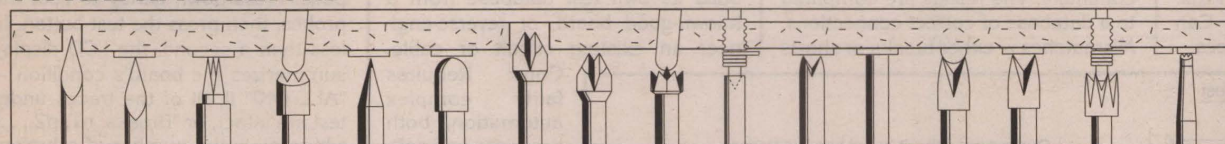


CLOSE-UP OF TEST-PROBE MOUNTING

SELECTION GUIDE

| Plunger | Tip Style | Application | Plunger | Tip Style | Application |
|---------|--|---|-----------|--|--|
| A or G |  Concave | Long Leads, Terminals and Wire Wrap Posts | P |  Speared Cone | Long Leads, Terminals or Wire Wrap Posts |
| B |  Spear Point | Lands, Pads or Plated through Holes | S |  Chisel | Plated through Holes, Lands or Pads |
| C or F |  Flat | Gold Edge Fingers - No indentations or marks | SN |  Single Needle | Contaminated Boards or Conformal Coatings |
| D or J |  Spherical Radius | Gold Edge Fingers - No indentations or marks | SP |  Chiseled Spear | Lands, Pads or Vias - Contaminated Boards |
| E |  Convex | Lands, Pads or Plated through Holes | TN |  Tri-Needle | Lands, Pads, Contaminated Boards or Conformal Coatings |
| FX |  Flex Tip | Contaminated Boards or Conformal Coatings | U |  Crown | Lands, Pads, Leads or Wire Wrap Posts - Self-Cleaning |
| H |  Serrated | Lands, Pads, Leads or Terminals | UT or UST |  Tapered Crown | Small Pads, Lands or Vias - Contaminated Boards |
| K or T |  Chisel | Plated through Holes, Lands or Pads | V, W or Z |  Crown | Lands, Pads, Leads or Wire Wrap Posts - Self-Cleaning |
| LM |  Star | Plated through Holes, Lands or Pads - Self-Cleaning | X |  Tapered Crown | Lands, Pads, Leads or Plated through Holes - Self-Cleaning |
| NT |  Needle Teeth | Lands, Pads, Contaminated Boards - Self-Cleaning | Y |  Tulip | Lands, Pads, Leads or Wire Wrap Posts - Self-Cleaning |

TYPICAL APPLICATIONS



INTERCONNECT DEVICES, INC.

Source List

The Stamp Stretcher and LCD Serial Backpack are available from: Scott Edwards Electronics, 964 Cactus Wren Lane, Sierra Vista, AZ 85635; Phone: 602-459-4802; FAX: 602-459-0623. Prices are as follows:

- Stretcher I kit: \$30.00.
- Stretcher I assembled: \$45.00.
- LCD Serial Backpack kit, no LCD: \$22.00.
- LCD Serial Backpack assembled, no LCD: \$29.00.
- LCD Serial Backpack assembled, 16x1 LCD: \$40.00.
- (See listing below for other LCDs.)

All prices postpaid (first-class mail) to the U.S. Scott Edwards Electronics accepts VISA and MasterCard orders by phone, fax, and mail. Of course, you can still order by mail with your personal check or money order. Qualified institutions and schools may order with a P.O. for net-30 terms.

The Stretcher and Backpack were featured in the Sept. and Oct. '94 issues. You can order whole-issue reprints from N&V, or request copies of the articles from Scott Edwards (address and phone above). Do you have questions about this article? Contact the author via E-Mail:

Compuserve 72037,2612; Internet 72037.2612@compuserve.com.

The BASIC Stamp and Stamp Stretcher are available in assembled form from Parallax, Inc., 3805 Atherton Road No. 102, Rocklin, CA 95765; Phone: 916-624-8333. Parallax also carries assembled LCD Serial Backpacks with a 16x1 display. Contact them for a catalog and pricing information.

Spring-loaded probes made by Interconnect Devices, Inc., are available through Newark Electronics. Phone their headquarters at 800-281-4320 for the office serving your area. The IDI probes used in this project are available from Newark in packages of 10 for \$8.20; the corresponding solder-type sockets are \$4.20. Most other styles are priced similarly. See their catalog for a complete listing.

Excellent technical data on selecting and using spring-loaded test probes is available from: Interconnect Devices, Inc., 5101 Richland Avenue, Kansas City, KS 66106; Phone: 913-342-5544. Their assistance was invaluable in preparing this article.

New/surplus LCDs, including the 40x2 unit shown here, are available from: Marlin P. Jones and Associates, Phone: 407-848-8236. Timeline, Inc., Phone: 800-233-9977, stocks a wide variety of LCDs in most sizes and configurations.

Once you have a way to make reliable, temporary connections to a circuit board, everything else is a snap. I was able to string together off-the-shelf items (BASIC Stamp, Stamp Stretcher, and LCD Serial Backpack) to create a rapid board-testing system in just a few hours. Once my immediate testing crisis was over, I started to tinker with the system and formulate some testing strategies to apply in the future.

Testing Strategies

There are many kinds of automated testing, ranging from simple continuity checks to transmission-line characterization of high-speed boards and cables. We're going to stay at the shallow end of the pool and assume that all you need to do is make sure that traces or wires . . .

connect where they should connect, and
don't connect (short) where they shouldn't.

Depending on the board or cable design, you may even get away with checking only for breaks or only for

FIGURE 1.
Test probes come in an amazing variety of styles to match almost any application.

(Reprinted with permission of Interconnect Devices, Inc.)

shorts. A single-sided board with lots of closely spaced traces is much more likely to have shorts than breaks — and the shorts may be harder to spot by visual inspection. My board was double-sided with lots of vias — tiny metal-plated holes that connect the top and bottom sides of the board. Shorts were nearly impossible, but failures in the plating of vias (resulting in broken connections) turned out to be nightmarishly common.

It's simpler to look for connections than shorts. If you designed the circuit, you know what all the right connections are. But you don't necessarily know where random wrong connections (shorts) might crop up. So let's look at scanning a board or cable for connection continuity first, and tackle the stickier problem of shorts later.

Figure 2 shows several possible ways to test a group of connections for continuity, starting with the simplest approach first. Each of these methods has strengths and weaknesses. All of the

methods can be automated using a simple single-board computer, such as the BASIC Stamp.

Let's take a closer look at these methods:

Wired-AND Maze.

The probes are wired so that the circuit is completed only if all of the traces are intact. A beep from the continuity checker indicates that all of the traces are good. Silence means that one or more of the traces are broken. Pros: Simple to use. Requires only one channel of continuity testing. Cons: Cannot identify which trace is broken. Can be fooled by a board that contains both shorts and broken traces.

Simultaneous Continuity Checks.

Each probe is connected to conduct current for a separate continuity indicator, such as the LED lamps depicted in the drawing. Bad traces are indicated by LEDs that don't light up when the probes are applied. Pros: Identifies broken traces. Cons: May require many indicators if a large number of traces are to be tested at one time. Can be fooled by shorts between traces.

LISTING 1. SEQUENTIAL TEST USING ONE STAMP STRETCHER

```

' Program: EZTEST.BAS
' This program uses one Stamp Stretcher to test 14 traces on a
' printed circuit board. The Stretcher's pins 1 through 14 are
' connected to pads at one end of the traces--the other ends are all
' grounded. The Stretcher has two 100k resistor packs installed to
' pull up its inputs. Therefore, an intact trace shows up as a 0
' (because the direct connection to ground overcomes the 100k
' (because the direct connection to The program outputs its results
' via an LCD Serial Backpack display unit connected to a 40x2 LCD
' module.

Symbol I = 254
(Backpack).
Symbol ClrLCD = 1
Symbol prn_top = 137
Symbol endLine = 160

Symbol Line = b2
Symbol breaks = b4
Symbol pin = b6

let Line = prn_top
pause 1000

serout 2,n2400,("DB",0,0)
Gosub SetScreen
Gosub Hold

' Here's the main test loop. Check each pin for a 0 input. If a 1
' is input instead, print the number of the pin under test to the
' LCD and increment the "breaks" counter.
Again:
let breaks = 0
for pin = 1 to 14
    serout 2,n2400,("B",pin)
    serin 2,n2400,bit0
    if bit0 = 0 then skip1
    let breaks = breaks+1
    gosub handle_fault
skip1:

' Instruction toggle command
' Clear-LCD instruction (Backpack).
' Display RAM origin, top line.
' Rightmost permissible cursor
' position.
' Line pointer.
' Number of broken connections.
' Pin under test.

' Set beginning cursor position.
' Let the LCD wake up.

' Set all Stretcher pins to input.
' Set up LCD screen.
' Wait for button push.

' When all of the pins are tested, if there are no breaks, print
' "ALL OK!" Then get ready for next test.
if breaks > 0 then skip2
serout 0,n2400,(I,136,I)
serout 0,n2400,("ALL OK!")
skip2:
let Line = prn_top
gosub Hold
gosub SetScreen
goto Again

' Subroutine to print the pin number of the broken trace on the LCD.
' If too many traces are broken for all of the numbers to fit on
' the display, print "+" to indicate "more."
handle_fault:
serout 0,n2400,(I,Line,I)
if Line < endLine then skip' Position the LCD cursor.
' If the cursor is too far right for
' more
serout 0,n2400,("+")
return
skip:
serout 0,n2400,("#pin)
let Line = Line + 3
return

' Subroutine to wait for the button connected to Stretcher pin 15
' to be pressed.
Hold:
serout 2,n2400,("B",15)
serin 2,n2400,bit0
if bit0 = 1 then Hold
return

' Check the button.
' Get its bit state.
' Not pressed? Loop.
' Else return.

' Print the fixed label to the LCD screen.
SetScreen:
serout 0,N2400,(I,ClrLCD,I)
serout 0,N2400,("Breaks: ")
return

```

Sequential Continuity Checks.

The traces are tested one at a time by a rotary switch, or the equivalent electronic switching. Pros: Identifies broken traces. Cons: Can be fooled by shorts between traces.

Sequential Exhaustive Test.

All combinations of the two rotary-switch settings are checked for continuity. The results are compared to a database of correct connections. Mismatches — either breaks or shorts

— are reported. Pros: Provides 100 percent continuity/short-circuit checkout of the probed traces. Can build its own test database from a known-good board, or reverse-engineer an existing circuit or cable.

standpoint, it worked like this: Place the transparent plastic tester over the board and align the probes with the pads. Press down gently to seat the probes, then press the test button. In less than a second, the LCD display summarizes the board's condition — "ALL OK!" if all of the traces under test are intact, or "Breaks: n1, n2..." where nx is the number of a broken trace.

From a hardware standpoint, Figure 3 may not be very enlightening if you haven't been a faithful reader of *Nuts & Volts* lately. I used three off-the-shelf items to create my test jig: the BASIC Stamp, Stamp Stretcher, and LCD Serial Backpack. Here are brief descriptions of each:

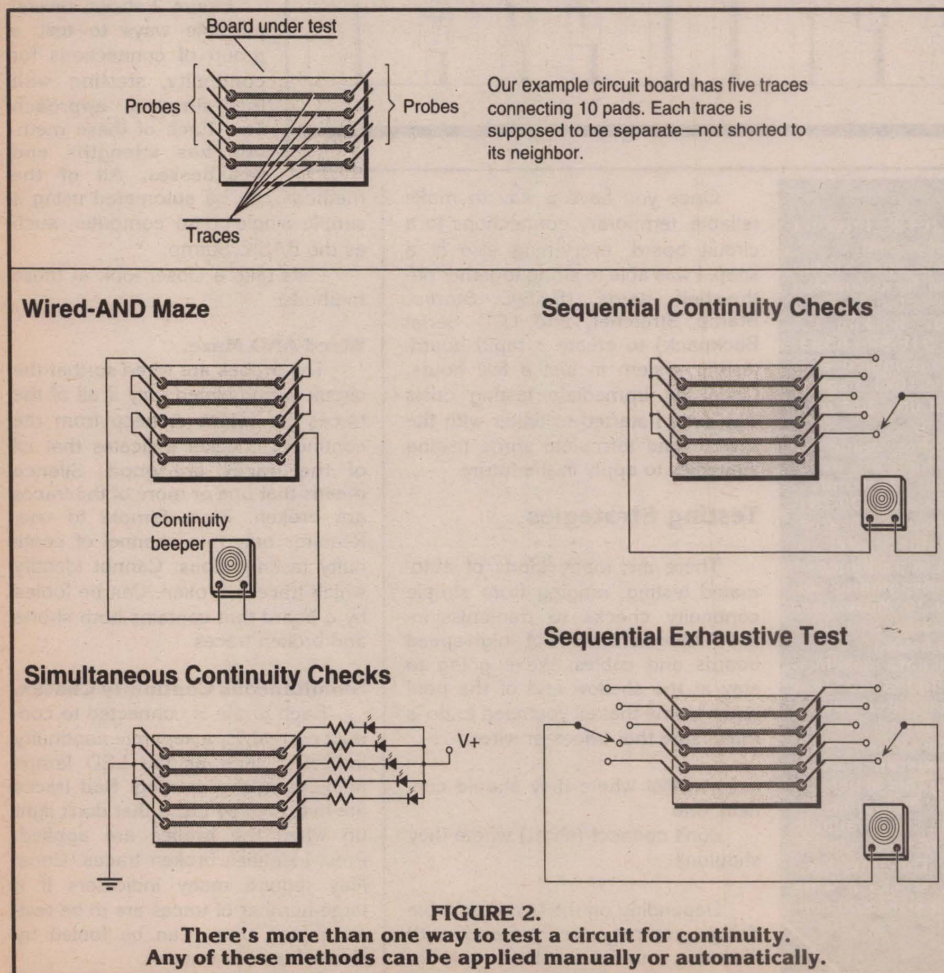
BASIC Stamp: An inexpensive single-board computer offered by Parallax, Inc. You can program it in BASIC from your PC, then disconnect it for a stand-alone digital controller. It has eight input/output (I/O) lines and a surprisingly powerful small dialect of BASIC that includes digital, serial communication, and limited analog capabilities. In my test application, the Stamp serves to coordinate the operation of additional I/O lines (the Stretcher) and a user-friendly display (the LCD Serial Backpack).

Stamp Stretcher: My I/O expander for the BASIC Stamp. The Stretcher has 16 digital I/O lines that can be read and written under the control of a 2400-baud serial link with the BASIC Stamp. For example, to make pin 11 of the Stretcher output low (actively outputting a 0), the Stamp sends serial data as follows:

SEROUT 0,N2400,("L",11)

Test Procedure

Figure 3 and Listing 1 show how I set up my original test. From the operator's





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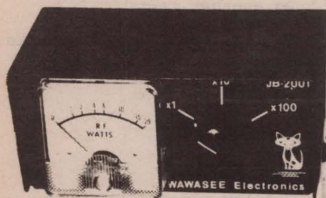
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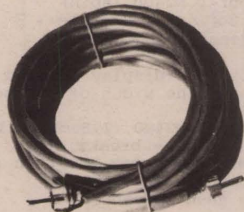
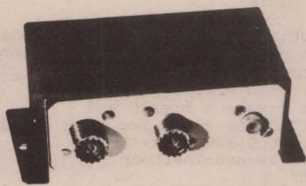
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That test was sufficient to rapidly sort my boards into "good" and "bad" piles. Later, I thought it might be interesting to program a sequential, exhaustive test. I connected a second Stretcher in place of the grounds shown on the right side of the board in Figure 3. Then I wrote the software in Listing 2 to scan every possible combination of connections between the circuit board pads. This kind of test can detect not only breaks in traces, but also shorts between traces.

The set-up was wired so that Stretcher A's pin 1 connected through a trace to Stretcher B's pin 1; pin 2 to pin 2; pin 3 to pin 3 . . . and so on. This simplified the program logic tremendously. If a connection was not detected between two like-numbered pins, then the corresponding trace was broken. If two unlike-numbered pins were connected, then there was a short.

Note that with some minor changes, this type of program could survey a series of connections and prepare a summary: 'Pin 1 connects to pins 1, 4, 5 . . .'. If various types of standard sockets were substituted for the test probes, you'd have an easy way to determine how a cable was wired.

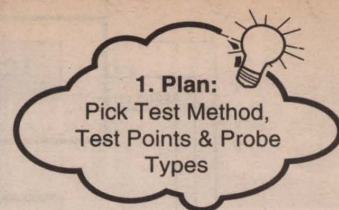
This ability to discover unknown connections was dramatically illustrated when I ran the test program. I had forgotten that my circuit board had one intentional "short;" pin 1 and pin 5 were jumpered together on the board. So when I ran the program on a good board, I got the indication, "Shorts: 1 5."

This points out a possible improvement: For more complex boards, it would be desirable to create a small database summarizing the connections. The program could check test results against this database to determine whether any traces were shorted or broken.

Summary and Epilogue

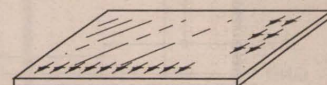
Figure 4 summarizes the process of designing and constructing a test jig like the one described in this article. The planning stage is definitely the most important. In fact, I intend to design test jigs for new boards while I design the boards themselves.

By the way, the situation I described at the beginning of this article turned out okay. After expe-



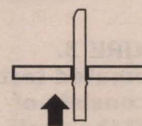
2. Construct Jig:

- a. Cut piece of transparent acrylic to size and mark with probe locations

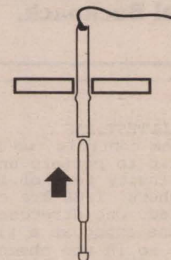


- b. Drill holes for probe sockets.

- c. Install sockets into holes. Use fast-setting glue to tack, then hot glue or epoxy to secure.



- d. and e. Attach wires to probe sockets. Press probes into sockets.



3. Wire the Hardware:

Connect probes to I/O lines of computer or Stretcher-type I/O extender.

4. Write and Test the Software:

Choose the easiest approach that will allow you to determine whether or not the board is good. Use the software on known-good and known-bad samples of the board to verify correct operation.

FIGURE 4.
A step-by-step approach to automated testing.

riencing a 14-percent failure rate with one board maker, I took my circuit board design to another. The new guy has shaved 10 percent off the old price. He also replaces defective boards with only one restriction; the defective boards must be returned. This is to prevent a surprisingly common scam. Shady characters report more boards bad than actually are defective in order to get additional boards free. The one-for-one exchange thwarts the crooks, and allows the board house to troubleshoot their process. **NV**

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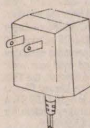
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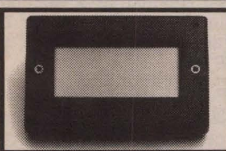
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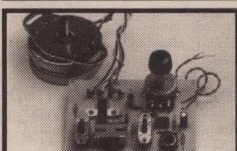
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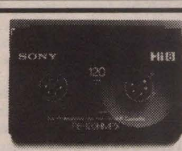
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The new Bearcat 890XLT gives you pure scanning satisfaction with amazing features like Turbo Scan to scan and search up to 100 channels per second. This base and mobile scanner is ideal for weather watchers because it has a built-in tone activated Weather Alert Feature. Other features include 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. 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; BC002 CTCSS Tone Board \$54.95; EX711 External speaker with mounting bracket & 10 feet of cable with plug attached \$19.95. The BC890XLT comes with AC adapter, telescopic antenna, owner's manual and one year limited warranty from Uniden.

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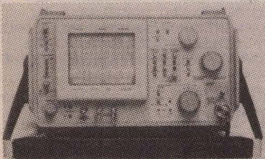
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Output: 10mV, 1mV & 0.1mV
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INT. MODULATION: 400KHz, 1KHz $\pm 1\%$, 1Vrms, distortion < 5% L-R Separation: >50dB.
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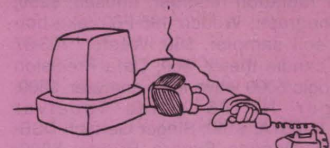
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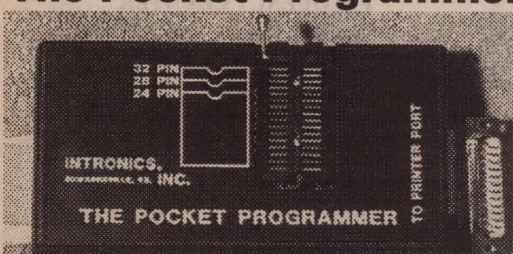


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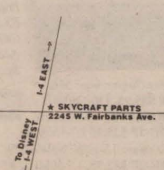
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Build a Fruit Powered Digital Clock

by Fred Blechman

You can build your own fruit or vegetable powered clock or buy an inexpensive mostly-assembled kit that uses a digital clock module with special pre-wired probes. You can display date and time — to the second — using just about any fruit or vegetable to provide the small required power. This would make a good school science project, especially if you prepare a report showing voltage readings for various fruits and vegetables.

RECIPE FOR A FRUIT POWERED CLOCK

Ingredients:

- * Typical battery-powered digital clock module
- * Two copper bars, 2" long, .25" wide, .12" thick
- * Two zinc bars, 2" long, .25" wide, .12" thick
- * Approx. 17" of .125 diameter metal rod
- * One 6" length of red insulated hook-up wire
- * Two 6" lengths of black insulated hook-up wire
- * Two pieces of .3" diameter red heat-shrink insulation
- * Two pieces of .3" diameter black heat-shrink insulation
- * .6" diameter rubber disk, .25" thick with .12" center hole

* A fruit or vegetable

Recipe:

Remove the battery compartment cover of the clock module and take out the button battery cell. Solder a red wire to the positive battery terminal in the clock, and a black wire to the negative battery terminal.

Shape the copper and zinc bars so they are pointed at the ends. Slip a red heat-shrink insulator on the red wire and a black heat-shrink insulator on the black wire. Solder a shaped copper bar to the end of the red wire, and solder a shaped zinc bar to the black wire. Slip the insulator at each end over the soldered connection and then shrink the insulation over each bar connection with a heat gun.

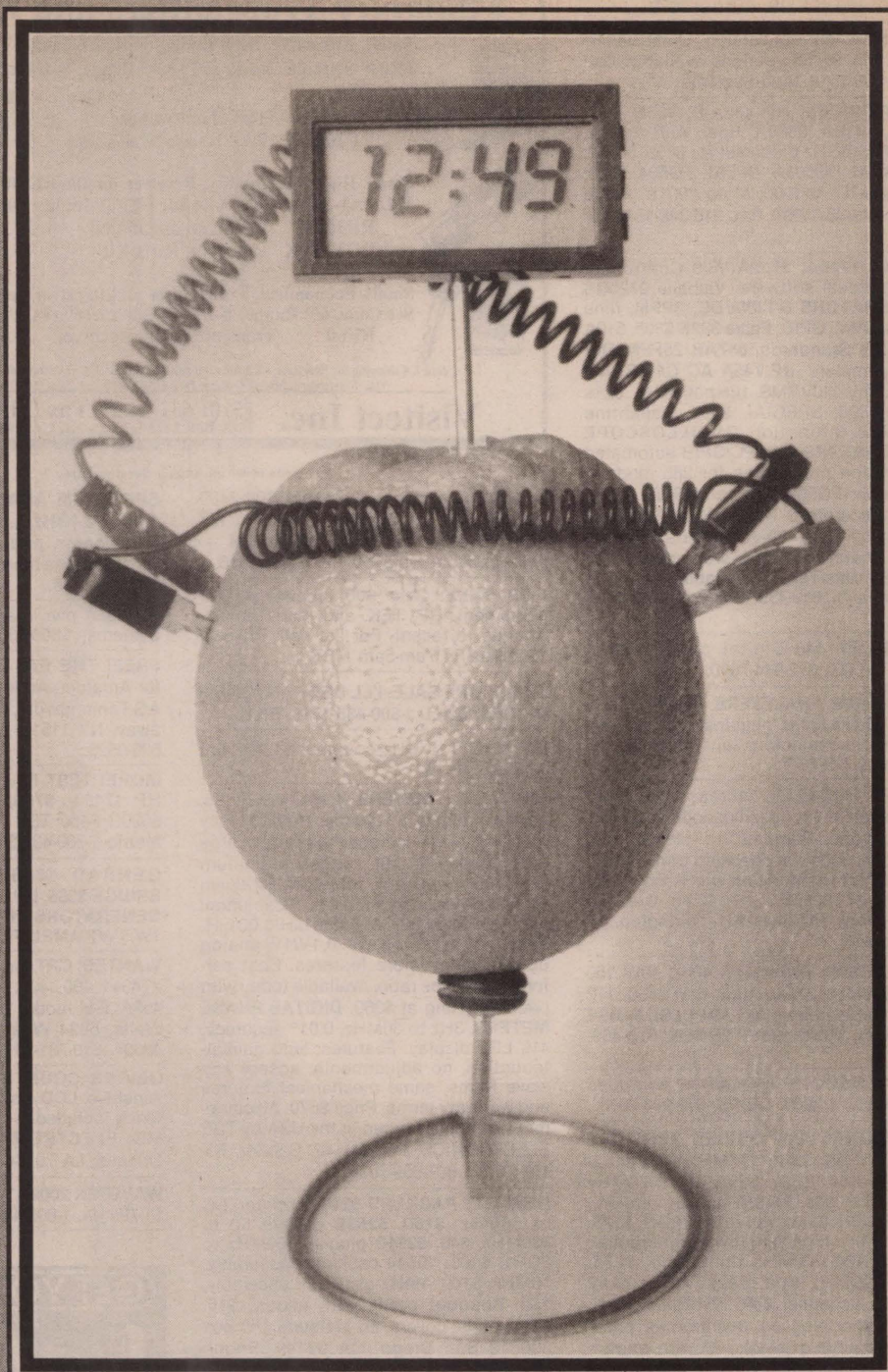
Put a red heat-shrink insulator near one end of the third hook-up wire, and a black heat-shrink insulator near the other end. Solder the remaining shaped copper bar to the end of the wire near the red insulator, and solder the remaining shaped zinc bar to the end of the wire near the black insulator. Slip the insulator at each end over the soldered connection and then shrink the insulation over each bar connection with a heat gun.

Using a file or grinding wheel, shape a point at one end of the 17" long rod and then form the rod into a stand as shown in the photo. This is

now the mounting base for the fruit or vegetable and the clock module.

Install the rubber disk by pushing it on the mounting base. Mount the fruit or vegetable (we'll just use the word "fruit" from here on) by stabbing it onto the mounting base and pushing it down against the rubber disk. Adjust the height of the fruit by moving the rubber disk up and down until about 1.25" of the mounting base is sticking up above the fruit.

Mount the modified clock module to the mounting base above the fruit using any convenient method. This might be tape, a bracket, cable clamp,



or whatever — anything to firmly hold it in place.

Now you're ready to power the clock module. See Figure 1. Take the copper probe (clock red wire) and push it into the fruit. Insert the zinc (black wire) probe into the fruit at a point furthest away from the copper probe. Next, take the wire with the probes at each end and insert the copper (red) probe about .25" from the zinc (black) clock probe already in the fruit. Make sure the probes don't touch, but are near each other. Now insert the remaining zinc (black) probe into the fruit about .25" from the copper (red) clock probe already in the fruit. The clock should now display four digits — usually 12:00! Follow the instructions for setting your clock and you're done.

If the clock display does not come on, squeeze the fruit and twist or reposition the probes until the display shows high contrast.

The Easy Way

You can gather all the necessary "ingredients" and follow the "recipe" above, or you can purchase — for only \$15.00 — a complete kit with almost all the construction and assembly done for you! The "Fruit Powered Clock" (Schylling Associates, Inc., P.O. Box 667, Ipswich, MA 01938. \$15.00 plus \$2.50 postage and handling. Phone: 800-541-2929) comes with a digital clock that is prewired and designed to fit directly on the pre-formed mounting base. No soldering, cutting, heat-shrinking, filing, or grinding is required.

All you need to do is mount the fruit or vegetable on the stand, slide the clock module onto the base, insert the four pre-fabricated probes — and

you're done! A simple instruction sheet, with a photograph and clock-setting procedure, is included in a distinctive and attractive tubular plastic case.

How Does It Work?

A simplified "Background and Scientific Description" is offered by the instruction sheet that comes with the Fruit Powered Clock. It states that Alessandro Volta (1745-1827), a professor of physics at the University of Padua in Spain, is credited with the invention of the electric cell. On March 20, 1800, he sent a letter to the Royal Society of London describing a revolutionary discovery. He had stacked a zinc disk, a leather disk soaked in a mild solution of lemon juice, and a copper disk. He found a small flow of electrical current between the copper and zinc.

Several different acid solutions, called "electrolytes," allow "electrons" (negative charges) to flow through them. Volta discovered that when two dissimilar metals ("electrodes") are separated by an electrolyte, electrons flow between the metals, creating a "battery."

When copper and zinc are used, the copper electrode develops a shortage of electrons (a positive charge), while the zinc electrode develops a surplus of electrons (a negative charge). This represents a measurable electrical potential force, named "volts" in honor of Alessandro Volta.

By inserting a device that is powered by a flow of electrons (current) between the two electrodes, the battery can do useful work. In the case of the Fruit Powered Clock, the fruit or vegetable is the electrolyte, and the copper and zinc probes are

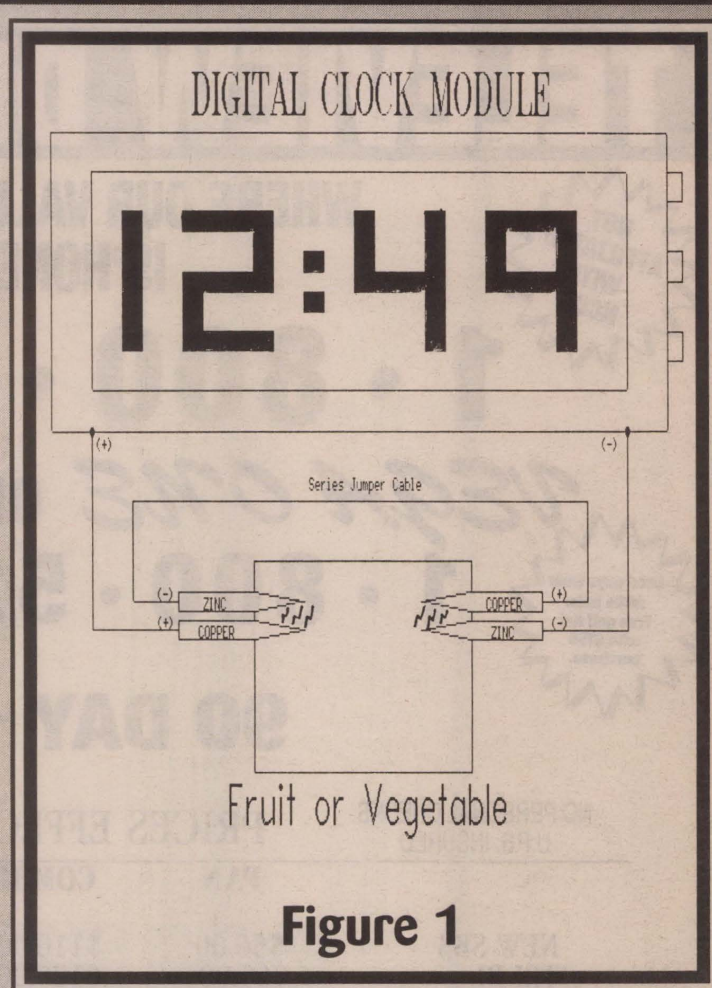


Figure 1

the electrodes.

But why four electrodes instead of just two? Each set of electrodes creates a small voltage — typically, .6 volts — but not enough to operate the digital clock module. The second set of electrodes creates another approximate .6 volts, in "series" with the first set of probes, adding the two voltages. It's like having two batteries in series. The resulting approximately 1.2 volts is enough to run the clock module circuitry and display. The current flowing through the fruit is only about 70 microamperes.

Accuracy and Duration

Students Craig Gudeman and Tony Barone, seventh graders at St. John the Baptist School (Winfield, IL) performed a science project using a Fruit Powered Clock powered at different times by an orange, apple, grapefruit, banana, or tomato in an unspecified environment. They measured and recorded the displayed time and the voltage at the clock probes for each "battery" every other day.

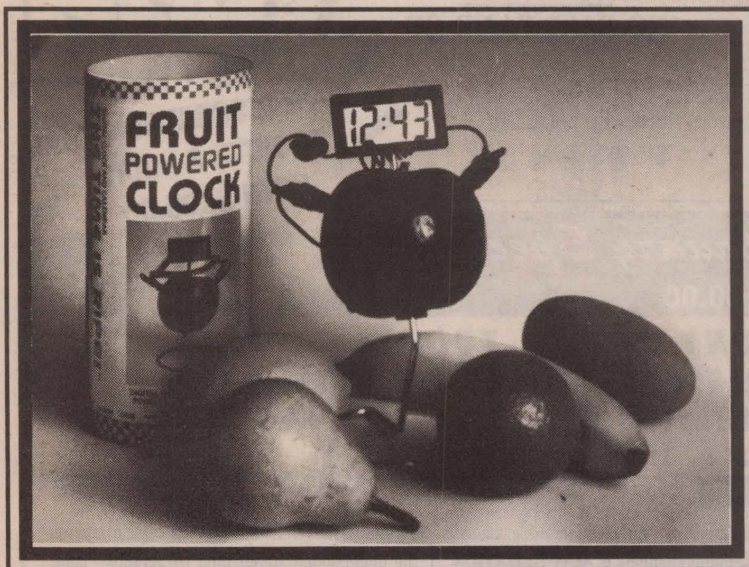
Although the digital clock module supplied with the Fruit Powered Clock is crystal controlled for accuracy, the displayed time varied considerably

from actual time over several days. Also, the "battery" voltage seemed to vary, usually decreasing with time (as you would expect), but sometimes increasing. No cause for this behavior was offered, but I would guess temperature and humidity caused these variations. In their tests, the orange "worked the best."

In my own limited testing, I found an apple provided the longest and most accurate time display, and suffered less juice dripping when the probes were inserted. Typical operation was just a few days. Sometimes it was necessary to twist or reposition the probes when the display got weak, usually resulting in having to reset the clock.

Summary

The Fruit Powered Clock, virtually pre-assembled, is the easiest way to build this unique clock, although you could actually make your own. Don't expect great accuracy, and you'll have to reset the clock and change the powering fruit or vegetable every few days — but it makes a good school science project and a great conversation piece. Just don't get rid of your wrist-watch! NV



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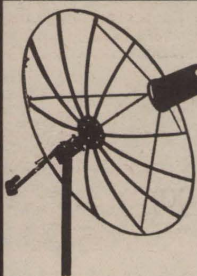
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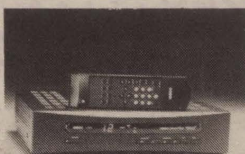
900038 Pico Peaker S&H \$5 \$89.95



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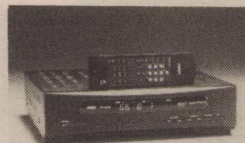
4527008 Ultra S&H \$22 \$379.00



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The UST 4600 sets a standard in value and performance for home satellite receivers. This unit features automatic satellite programming, 160 favorite channels can be instantly recalled for easy access. All 160 can be changed or updated at any time. This IRD features a stereo processor, enabling you to tune both left and right channels for a full stereo effect from over 100 radio stations found in satellite. The QuickTune feature quickly optimizes the satellite picture for the sharpest image. The 4600 offers other features including IR/UHF remote, 55 satellite position memory and direct satellite access. The versatility makes this an excellent choice.

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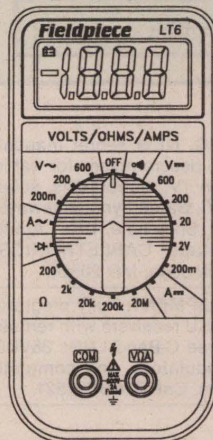
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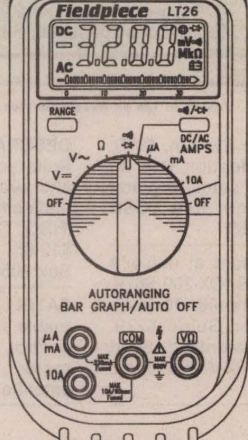
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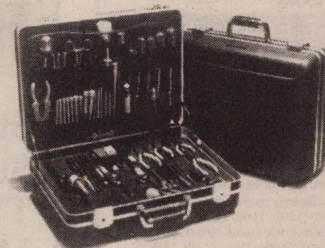
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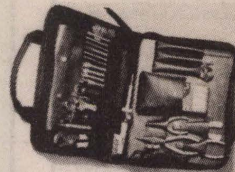
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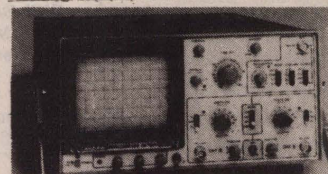
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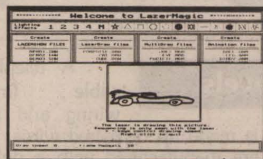
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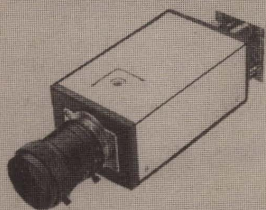
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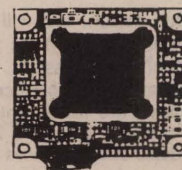
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Last month, we explored methods to troubleshoot your telephone line for basic noise complaints, such as static. In review, the local telephone company (telco) delivers service to a "point of demarcation" (demarc) located on the side or rear of your home. Modern demarc devices are equipped with an RJ11-type jack/plug combination that provides a quick way to determine if a problem is in the telco network, or your CPE (customer provided equipment).

mine their telephone number or address. If the voices are that of a neighbor, trouble is likely in the telco network. If your demarc is a modern style NID (network interface device, as detailed in last month's article), simply disconnect all CPE wiring, connecting a test set or phone to the telco network jack. If xtalk persists, contact telco repair service. If your demarc is not an NID, you can still disconnect CPE wiring, but use care when re-connecting CPE wiring. Most xtalk trouble reports are caused by improper wiring and/or improper installation of CPE.

If other voices sound almost as loud as your own, two telephone lines are probably crossed by physical contact. This was a common problem in older

crosstalk will be traced to CPE facilities, yet no physical crosses can be measured. This represents the largest number of crosstalk complaints for customers with two or more lines. The problem stems from the type of IWs (inside wiring) selected for installation. There is a difference between telephone "wire" and telephone "cable."

Over the years, many types of wiring have found their way into the telephone network. It is not uncommon to discover the use of: romex electrical wire, thermostat wire, antenna lead, and other types of wiring installed in homes and some businesses serving extension jacks, loud ringing bells, etc. These types of wiring all share a common trait: parallel construction.

22 gauge. This becomes increasingly important when installing long runs of IW in factories, hospitals, large offices, etc. Longer runs are exposed to more noise sources and will be more susceptible to xtalk. Imbalanced pairs due to open conductors in bridged legs of cable will also increase the opportunity for xtalk.

Another cause of xtalk is a condition I refer to as "cordextrus." This problem is caused by the need for extension telephones without the desire to install new cabling and jacks. Manufacturers are selling extra-long line cords (the flat, grey line that connects the telephone to the wall jack), offering "do it yourself" kits for installing additional jack locations. The cords are offered in lengths up to 25 feet and can be extended via couplings to

Inside Wire Maintenance — Part 2

This month, we will examine more difficult noise problems, such as crosstalk and RFI (radio frequency interference). Since these problems are usually intermittent, they can be difficult to resolve. Recording times and dates of occurrences will greatly improve your chance of successful mitigation of the trouble. Let's begin with a look at the fastest growing complaint: crosstalk.

Crosstalk (xtalk) is the ability to hear other persons on your line during a normal conversation. This trouble has increased in recent years, and generates many trouble reports. Let's draw a distinction between xtalk and RFI.

With RFI, you also hear others on the line, but can usually determine the pattern of a radio transmission, such as ham or CB. RFI from a commercial radio station is also easily identified. On the other hand, xtalk sounds just like another telephone conversation, including signalling components such as tone dialing, ringing, and data from fax machines or PC modems.

When a customer complains of crosstalk, the first question asked is "Do you have a cordless phone?" When the answer is yes, many technicians feel they have isolated the problem because cordless phones have developed a bad reputation and many troubles are blamed on this instrument. While cordless phones do introduce some element of interference, it is wrong to blame this technology for every noise/xtalk problem.

WARNING!

Use caution when testing telephone lines and equipment. Normal 50 VDC @ 60 mA will jump to 90-130 VAC during ringing cycles. Additionally, longitudinal currents due to power line induction can lead to dangerous voltage levels. Use insulated equipment and avoid contact with wiring and test points.

The key to correcting xtalk is to identify the origin of the offending signals. If the signal is voice, try to communicate with the other party(s) to deter-

10A2 "key system" telephones using "key strips" and the

cross only appeared when a certain line button was depressed. This created an intermittent trouble since the problem would disappear when the buttons were returned to the normal (up) position.

The best way to troubleshoot crosstalk in older type key equipment is to identify the location of all telephones. Your helper should access the most commonly used phone and place a call on the troubled line. Test every phone on the system by depressing each line button with handset lifted. You will locate a phone that, when a certain line button is depressed, causes crosstalk. Replacement of the keystrip will correct the problem.

Line connections at your home may also be crossed at jack/splice locations or may be crossed in the NID. To test for physical line crosses, disconnect all CPE by removing the RJ11 plug at the NID. Measure all lines with a volt ohmmeter, looking for leakage resistance between conductors. As we discussed last month, electronic telephones exhibit a characteristic resistance signature. In fact, modern two-line electronic telephones may appear to have high resistance crosses between lines. Since this is a normal attribute for these phones, disconnect them while testing for line crosses. Again, if crosses are on the network side of the demarc, contact your telco repair service.

In many cases,

by daniel b. levels

A telephone cable (inside wiring and telco

cable) is made up of paired wires. Two wires are manufactured with a definite twist around each other and then jacketed with other pairs. The twisting method is utilized to eliminate the inductive coupling effect of parallel conductors. Using parallel (non-paired) wiring is acceptable for single line installations, but employing this wiring design with two or more lines will cause xtalk.

Telephone wiring is available for inside installations designated as "four wire" or "four conductor" cabling. This is parallel construction wiring and is not intended for multi-line installation. Originally, these cables served extension phones, and the third and fourth conductors provided low voltage AC power to lighted dial and keypads.

For multi-line installations, select a cable identified as "two pair" or "three pair," etc. (see Figure 1). The conductors will be "paired" or twisted into separate lines.

The longer the cable length, the more important this principle becomes. Avoid 26 gauge wiring with paper-thin insulation. The preferred cable is 24 or

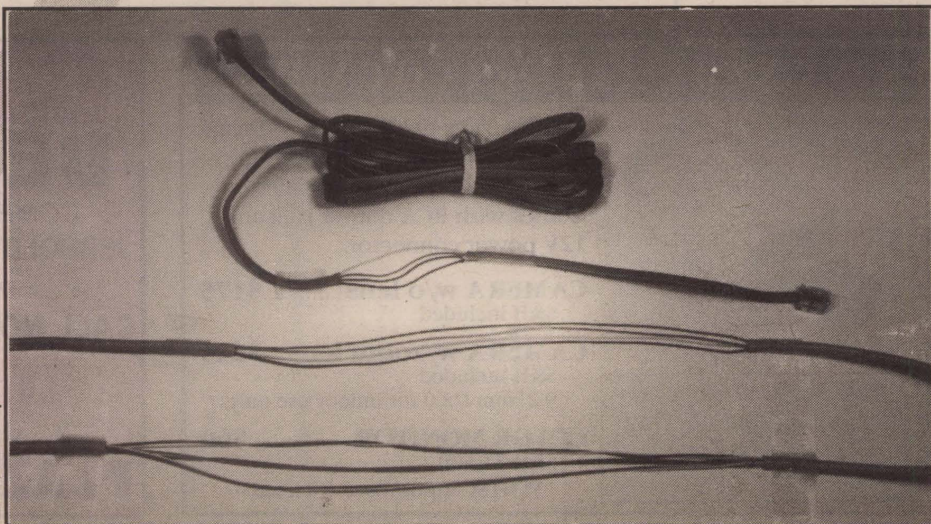
allow 50+ feet of line cord to serve telephones or other devices.

The appeal of low cost and no installation charge is hard for many to pass up. For single line installations, these cords can offer noise and static after being exposed to the mop, heel, and vacuum cleaner. However, when used as extension cords for modern, electronic two-line phones, these cables offer high levels of xtalk.

The line cord does indeed have four conductors, enough for connecting two lines. The middle two conductors serve line one, the outer two conductors line two. Therefore, the conductors for line two are straddling line one. When installed for two-line operation, Fax machines and PC modems bleed over on these cables every time! If you employ two-line phones, use the six foot cord ONLY and do not use extension line cords. Avoid using these cords to serve several devices for multi-line service. Instead, install twisted pair cabling (IW) terminated onto RJ-type jacks.

The following laboratory experiment will illustrate the difference between various types of wiring. Xtalk can be measured by transmitting a signal of known amplitude and frequency on line one,

Figure 1
Top — Line cord
Middle — Four conductor IW
Bottom — Three pair IW



while measuring with a frequency selective meter on line two of the same cord/cable. In our tests, we employed a Hewlett Packard 3336B Synthesizer/Level Generator and matched 358B Selective Level Meter (see Figure 2).

Desired results would be 100 dB separation between lines in the same jacket (line cords, IWs, etc.). This will never be achieved in practice, and typical results for twisted pair yield separation of more than 80 dB. Typical readings for line cords are in the 50-60 dB range, as illustrated in Figure 3. Notice the consistent 20 dB improvement of twisted pair over line cords. Also notice that parallel wiring is an improvement over line cords, but doesn't come close to the performance of twisted pair.

Using a typical two-line installation, let's consider the effect of utilizing line cords, rather than twisted pair wiring. The cumulative effect of employing line cords will cause a significant change in the level of electrical separation (xtalk) between line 1 and line 2. The result is a xtalk figure of 55-60 dB.

Dial tone is generated at the telco CO (central office) or remote unit at approximately -15dBm. Additionally, the local loop will account for an average 5 dB (8.5 dB, max) of signal loss, amounting to a -80 dB xtalk signal presented to the telephone instrument. While this signal would be negligible to older, passive instruments, modern telephones contain operational amplifiers, producing 5 dB to 10 dB of gain. The result is a signal in the 70 dB range, which can have an interfering affect on normal conversations in a quiet room. Actual Bell Labs studies have determined that signals down to -90 dBm (0 dBm) can cause interference.

Tone dialing signals are transmitted at -6 dB to -7 dB, resulting in a xtalk signal of -62 dB. With amplifier gain, this signal approaches -55 dB and is easily heard during a normal call. Similarly, fax machines and PC modems transmit signals in the 1.7-2.5 KHz range. While these signals are transmitted at approximately -10 dBm, notice the increase in xtalk at frequencies above 2 KHz. These signals are also easily detected.

The previous information should convince you to install twisted pair IWs for multi-line installations. Since many employers are encouraging the "Work at Home" ethic, there has been a significant increase in orders for additional lines at homes and small businesses. There has also been a significant increase in the number of xtalk complaints. Now you know why!

We'll break here for an admission that the telco is responsible for some xtalk complaints. The most common cause of xtalk in telco facilities is "split"

cable pairs. This occurs at a splice location where one side of a line is inadvertently spliced to one side of another line (see Figure 4). If the pair is "re-split" at the terminating location, the customer will experience xtalk (if not re-split, they will experience no service). Pairs may also be split on a side leg of cable and cause this condition.

These problems seldom occur and are corrected when discovered. You will cause the same problem in your own cables by splitting pairs. Split pairs also cause frequency response problems for PC modems and fax machines.

Special terminal equipment such as radio tele-patch or telemetry transceivers also cause xtalk. This equipment allows the output level to be manually adjusted from -30 dBm to +10 dBm. When operation becomes erratic, many technicians merely crank up the gain, causing the signal to bleed over onto several lines. The output should never be adjusted "hotter" than 0 dBm. If a stronger signal is desired at the far end of the circuit, the telco engineering department should design a system with gained repeaters at select office locations.

RFI is becoming a frequent complaint in urban areas. Not only are more people involved in radio hobbies, modern telephone instruments are excellent radio receivers. As these two worlds collide, the telephone user suffers the most aggravation. Older telephones were passive instruments with one or two nonlinear elements to contend with (duo-diode click filter in handset), but newer phones are microchip and microprocessor controlled magic! Unfortunately, they also demodulate radio signals!

This can be a most difficult problem to correct, but RFI can be eliminated if these directions are followed in a step-by-step manner, i.e., don't skip around. First, determine if the radio signal is being picked up via IWs and telephone instruments (fax machines, PC modems, answering machines, alarm systems, auto-dialers) or if they are being delivered to you via telco cables and wiring. Disconnect all IWs and telephones at the

demarc device. Connect a PASSIVE instrument to the test jack and place a call while listening for RFI. If no interference is present, reconnect all IWs but leave all phones unplugged. Place test calls from each jack using a PASSIVE

this service (probably not for free). It used to be feasible to build filters and RF traps into the phone at the field location, but since de-regulation, it is not practical to make such modifications to every make and model of telephone. Manufacturers

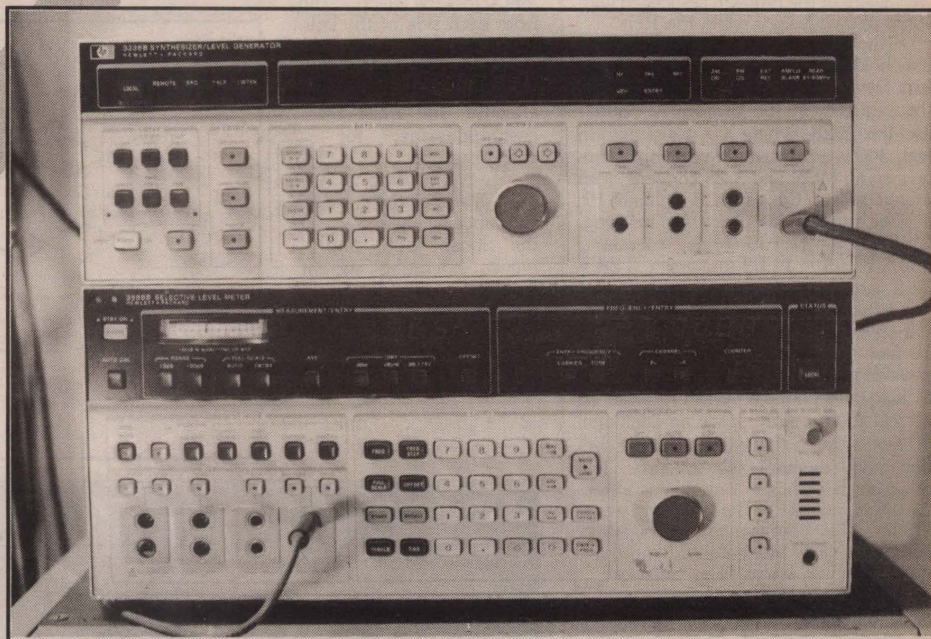


Figure 2 Measuring Xtalk

should design and build instruments that will function properly in the real world. Again, since few customers ever experience this problem, it is not cost-effective to build RFI rejection into every telephone model.

If RFI is present at the telco demarc with ALL IWs and electronic phones disconnected, call local repair service. They will test their cables for open sheath bonds and proper grounding and, if necessary, install an RFI filter at the demarc.

Just as with xtalk, it is helpful if you can determine where the RFI originates and what frequency is being transmitted. When the interference is in the commercial AM/FM bands, this is fairly simple. If you suspect ham or CB radios, check around the neighborhood for a new antenna. Once you feel you have located the transmitter, ask the radio operator to perform a test broadcast with you to determine the

interfering frequency(s). Most legitimate radio operators will be glad to help out. They don't desire the neighbors blaming them for a problem. Remember, the problem is with the design of your phone, not his/her radio. Let me qualify that: Illegal power levels and/or improper radio/antenna installations will cause harmful (noise) interference and do NOT fall under the control of the local telco. The FCC will not accept a second party

instrument, again listening for RFI. A passive instrument is an older style phone, preferably with a rotary dial. This must be a known good instrument, as a high resistance component (such as a dirty contact) may act as a RFI detector. If RFI is now being detected, your station wiring is acting as an antenna and "tuning" you into the interference. (More on this in a moment.)

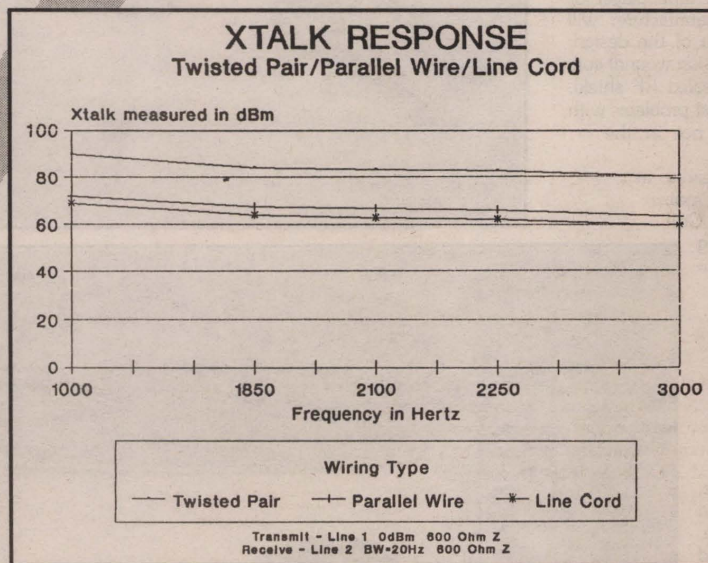


Figure 3 Xtalk analysis for wiring types

If no RFI is present, connect telephone equipment one at a time while listening for RFI. You will determine that one or more of the instruments are susceptible to RFI. In many cases, the phones are not picking up the signal from the IW or cable, they are picking up signals from free air, just as your AM/FM radio. Ask the telephone manufacturer to modify your equipment to reject RFI. Many domestic companies will provide

SNC Manufacturing Co., Inc.
101 Waukau Ave.
Oshkosh, WI 54901
414-231-7370

Coil Sales & Mfg.
Charles Center
5600 Apollo Dr.
Rolling Meadows, IL 60008
708-806-6231

Opto-Tech Industries, Inc.
P.O. Box 13330
Ft. Pierce, FL 34979
407-468-6032

complaint, but must be contacted by the end user. The most recent decision by the understaffed FCC is to only investigate the most serious infractions and they will urge you to try several mitigation techniques to resolve the problem. They are well aware of the problem associated with some phone designs relative to RFI.

Knowing the offending frequency may hold the key to correcting your problem. Determine the wavelength (in feet) of the frequency by the formula: $X = 300/f$ (in MHz) 3.28. Where X = wavelength in feet, 300 is a constant for velocity, f = frequency (in MHz) and 3.28 converts from meters to feet. Consider CB Channel 19, a once popular frequency for traveling. Ch. 19 is 27.185 MHz, therefore, $300/27.185 = 11.03$ (meters) $\times 3.28 = 36.2$ feet.

What is the length of each of your station wires? One may be very close to 36 feet (with line cord) and is the exact wavelength of the transmitted frequency, making your phone a perfect receiver. To correct the problem, splice an additional 20 feet of IW to the existing 36-foot section and "de-tune" the antenna. The other consideration is if the IW is a fraction or a multiple of the offending wavelength. This interference occurs when you are in close proximity to the radio transmitter or tower. The antenna propagation pattern may have a lobe that affects you while the houses next door have no problems.

Several filters are available to remove RFI and some require special installation (see Figure 5). The SNC Manufacturing Co. of Oshkosh, WI produces a model which plugs into the AC outlet (to pick up a ground only) and offers RJ11 jacks on the front for easy installation. It is called the RID (radio interference damper) and resembles a power transformer for a tape player or calculator. While the manufacturer will not allow total disclosure of the design, the filter is a tuned (precision wound) coil, low-pass L filter with sealed RF shield. This device will solve most problems with RFI if the problem is not in the phone instrument.

SNC is also the leader in Power Line Harmonic noise mitigation products. Coil Sales & Mfg. of Rolling Meadows, IL also produces a line of RFI filters. These small, compact units are weather-resistant and one model is field-tunable. Opto-Tech Industries of Ft. Pierce, FL has a new line of filters available, offering modular design for easy installation. These filters are potted into a small modular unit equipped with a jack/plug combination, and can be installed between the handset and telephone base.

All the filters listed above are effective at attenuating RFI signals. Proper installation is a trial and error process, beginning with installation at the NID. Severe conditions may require several

filters, located at each end of the IW, and also between the handset and telephone instrument. Filter prices range from a few dollars to about \$75.00 each.

Symmetrical shunt filters can be installed by placing .01 uF capacitors across the telephone line, and from each side of the line to ground. All components should be rated at 600 volts. LC filters are the most effective and must be custom-designed for each installation.

Avoid using RCL filters, as the resistance will add to the local loop and reduce operating current. Also, the pass band of the filter must be 20 Hz - 4,000 Hz, with a roll-off of no more than .5 dB across the band.

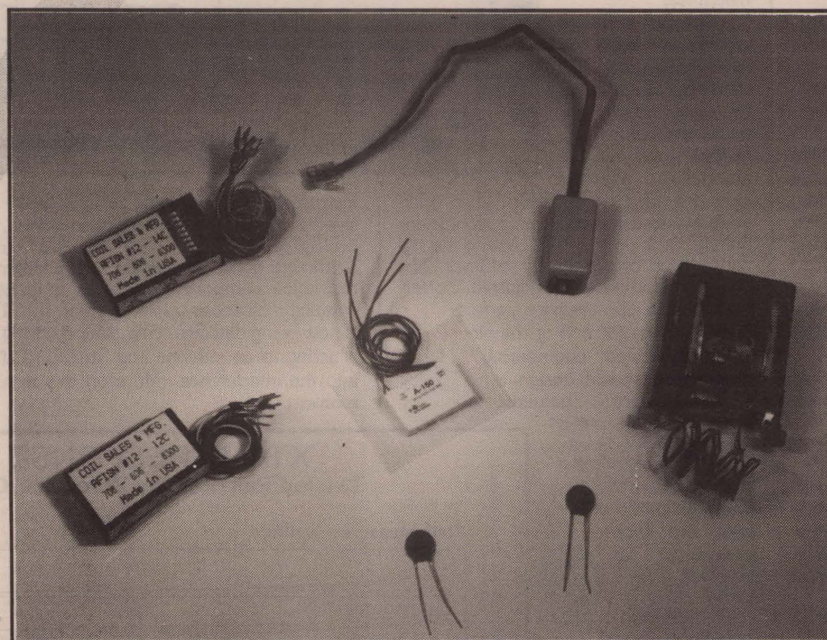
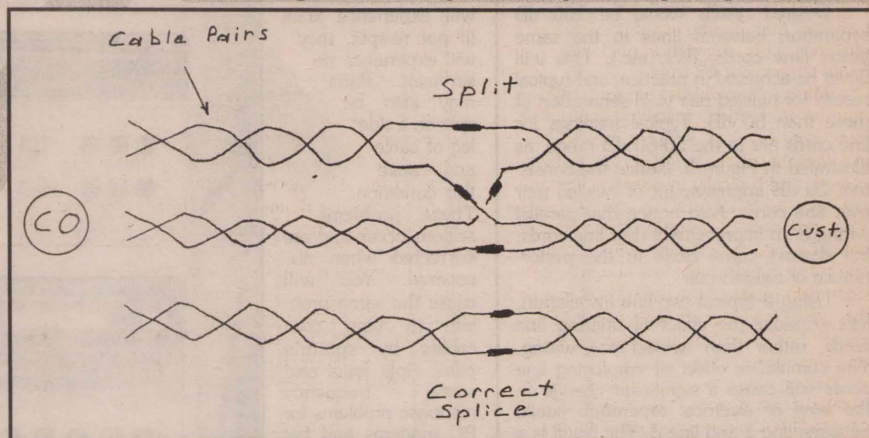
The filter must be able to

withstand potentials of 400 volts (90-130 VAC RMS = 255-368 VAC PP biased at -50 VDC), while passing (if series filter) 20-50 VDC @ 60 mA (see Figure 6). As you can see, we are asking a lot from

this filter.

Additionally, larger value capacitors add to the load imposed during ringing cycles, and may "look" like several additional ringers to the telco ringing circuit.

Figure 4 Split cable pair at splice point



Home-brew circuits are fun to create and must also pass all criteria listed above.

Once you have narrowed the trouble down to station wiring (IWs) or electronic telephones, it's time to begin experimenting with filter designs. Before launching into a full-blown engineering session, install RF beads at the NID and each jack location, forming at least two loops on the bead. RF beads are available at most electronics stores and you can purchase quantities at good prices from vendors in this magazine.

In some cases, no amount of filtering seems to alleviate the problem. When this happens, you will likely discover RFI being detected by unshielded components on the telephone's printed circuit board, and there are no practical methods for repair. Several of the commercial filters are designed for quick installation, allowing you to

Figure 5A RFI Filters



experiment with installation locations. Remember that factory-made filters have been lab tested for liability considerations. If the commercial filters (or home-brew) fail to correct the RFI for a single instrument, you will have to decide if replacement is worth the effort.

If RFI is due to station wiring (or some phones), the filters will eliminate the problem. However, some telephones will always accept RFI, regardless of any attempt to eliminate interfering signals. In this case, filters may only reduce the signals to a "low annoyance" level.

Replacing IWs with shielded wiring can be effective if the shield is grounded at both ends. While some would have you believe this sets up a ground loop, you can use the third member safety ground as a reference for the shield. This will also keep the shield from becoming a current carrying conductor. Grounding shields at a single end allows the un-grounded end to be a different potential than other ground sources nearby, creating a safety hazard. In addition, ground all unused

Figure 5B Handset filter installed

conductors in each IW section (shielded or not).

While responsibility for RFI mitigation lies with the offended party (just as with RFI on televisions), radio operators can reduce the likelihood for interference. Often the antenna can be raised 10 feet, changing the "skirt" of the radiation pattern, so that nearby neighbors are not effected. This suggestion will probably invite letters, but it's true!

Many "snowbirds" spend winter months in Florida, installing temporary ham shacks in a spare room. These installations often lack proper electrical design, and typically involve mobile units powered with 12 VDC power supplies. The antenna installation also leaves something to be desired, with the feedline run through a window and little consideration given to grounding systems. In this case, radios can leak RF into the power line, transmitting spurious radiation into surrounding homes.

Stand-alone power supplies can be isolated from ground, allowing the radio case to "float" above ground potential and presenting a safety hazard to the user. With the case ungrounded, there is an impedance between the case and ground, making the case an effective radiator.

Installing a ground bus for the power supply, radio case, and antenna feedline will eliminate the safety hazard and reduce/eliminate RFI from radiation on the power line. This is important for frequencies below 100 MHz. Install .001 uF capacitors (select broadgauge value base

on Tx freq.) across the power leads and from each lead to ground for added protection. Keep leads short, and close to the radio case.

When installing a grounding system, do not rely on a single driven electrode for protection. Any man-made ground (driven electrode) should be tested via approved methods (fall of potential, preferably) to determine electrical worth. Man-made grounds must be qualified as 25 ohms or less to meet code requirements.

In addition, all driven elements on the property must be bonded together if power outlets are served by the same power meter. This avoids serious safety hazards regarding difference of potential between two independent grounding systems.

The ground rod at the power meter is connected to the power company MGN (multi-grounded neutral) and is the prime source for interconnection of all additional grounding systems.

Use approved mechanical grounding connectors, such as compression fittings and bolt-on clamps when connecting ground conductors to rod. Avoid the temptation to solder the ground wire to the rod. While it may look great, power spikes and lightning strikes will weaken the connection and the connection will eventually become resistive. If you must solder, place

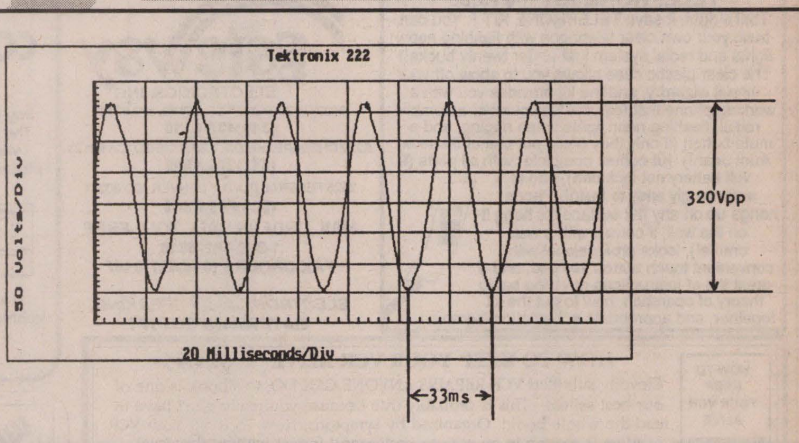
a clamp over the joint.

Be sure to bond across tower section joints to keep the tower from radiating (unless the tower IS the antenna!). Ensure all rain gutter and downspouts are not equal to your Tx wavelength.

Next month, we will wrap-up this series by demonstrating a test set that actually measures noise signals and telephone operating parameters, and we will examine the last two noise types: EMI (electro-magnetic interference) and power line interference. NV

Daniel B. Levels has enjoyed a 20-year career with two telephone companies. As technical support engineer, he provides training and assistance to technicians, engineers, and manufacturers. His technical writings are intended to "express, not impress," allowing a wide range of readers to understand difficult subjects. He has published a book entitled *Tech Notes from a Telephone Engineer*, a 125-page, large-format book covering all aspects of home and office telephone repair, including fax machines and PC modem troubles. Enjoyed by thousands, the book contains actual case studies and over 50 illustrations and charts. The book is available for \$18.95 + \$3.50 S&H by check or money order to: db levels, P.O. Box 1125, Tallavest, FL 34270-1125. The author may also be reached at SBMF11F@PRODIGY.COM.

Figure 6 30 Hz ringing signal



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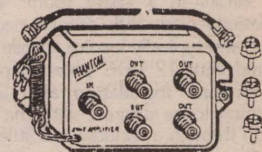
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High quality, true AM broadcast band transmitter is designed exactly like the big commercial rigs. Power of 100 mW, legal range of up to 1/4 mile. Accepts line level inputs from tape and CD players and mike mixers, tunable 550-1750 KHz. Complete manual explains circuitry, help with FCC regs and even antenna ideas. Be your own Rush Limbaugh or Rick Dees with the AM-1! Add our case set for a true station look.

AM-1 Transmitter kit\$24.95

CAM Matching case set\$14.95

SCANNER CONVERTER

Tune in on the 800-950 MHz area using your existing scanner. Frequencies are converted with crystal referenced stability to the 400-550 MHz range. Instructions are even included on building high performance 900 MHz antennas. Well designed circuit features extensive filtering and convenient on-off/bypass switch. Easy one hour assembly or available fully assembled. Add our matching case set for a professional look.

SCN-1 Scanner converter kit\$49.95

SCN Matching case set\$14.95

SCN-1WT Assembled SCN-1 and case\$89.95

STEREO FM TRANSMITTER

Run your own Stereo FM radio station! Transmits a stable signal in the 88-108 MHz FM broadcast band up to 1 mile. Detailed manual provides helpful info on FCC regs, antenna ideas and range to expect. Latest design features adjustable line level inputs, pre-emphasis and crystal controlled subcarrier. Connects to any CD or tape player, mike mixer or radio. Includes free tuning tool too! For a pro look add our matching case set with on-board whip antenna.

FM-10A Stereo transmitter kit\$34.95

CFM Case, whip ant set\$14.95

DR. NI-CAD CONDITIONER/FAST CHARGER

Quit spending big bucks for replacement battery packs, rejuvenate and condition your batteries for peak capacity. Advanced circuitry has optimized discharge before charge to eliminate memory effect and to condition batteries that have been poorly cared for in the past. Quick charge rapidly brings battery to full charge in less than an hour—just 15 minutes for some types! And "top-off" charge mode squeezes every last bit of energy into each cell for the absolute most capacity. Switch-mode regulator controls constant current charge while being monitored by a negative delta-V system that cuts off the fast charge at the exact point of full charge—batteries are charged, not cooked! Charges NiCads or NiMH packs from 2 to 10 cells (easily expanded) and current capacities up to 10 Amp-hours. Runs on 12 to 15 VDC. Quit cooking your batteries, buying new packs, waiting hours for recharge, get a Dr. Ni-Cad today! Available in money saving kit form or wired and tested with case at a special price. Kit builders: add our matching case set for a snazzy finish.

DN-1 Dr. Ni-Cad conditioner/fast charger kit\$49.95

CDN Matching case set\$14.95

DN-1WT Fully assembled Dr. Ni-Cad with case\$89.95

SPEED RADAR

New low-cost microwave Doppler radar kit "clocks" cars, planes, boats, horses, bikes or any large moving object. Operates at 2.6 GHz with up to 1/4 mile range. LED digital readout displays speed in miles per hour, kilometers per hour or feet per second! Earphone output allows for listening to actual Doppler shift. Uses two 1-lb coffee cans for antenna (not included) and runs on 12 VDC. Easy to build—all microwave circuitry is PC stripline. ABS plastic case with speedy graphics for a professional look. A very useful and full-of-fun kit.

SG-7 Complete kit\$99.95

STEREO PEAK HOLD BARGRAPH

Finally a dual LED bar graph with a peak hold display! Bar graph displays are neat and eye catching but their speed is their downfall - they just can't capture the peaks. Our kit is like two units in one, a fast display to show the signal and a long persistence display to capture peaks, similar units go for hundreds of bucks! We offer 3 models: Linear for general use, Semi-Log for audio VU meters, and Log for power displays. Dual - for stereo! - 10 segment multi-colored LED display for snazzy, eye grabbing display and easily set ranges for virtually any signals, from voltmeters to audio VU meters to audio power amps to SWR meters. Complete instructions for easy hook-up to most any device. Add our matching case set for a sharp looking unit.

PH-14 Dual Linear bargraph kit\$39.95

PH-15 Dual Log bargraph kit\$39.95

PH-16 Dual Semi-Log bargraph kit\$39.95

CPH Matching case set\$14.95

SPEECH SCRAMBLER

Descramble most scramble systems heard on your scanner radio or set up your own scramble communication system over the phone or radio. Latest 3rd generation IC is used for fantastic audio quality - equivalent to over 30 op-amps and mixers! Crystal controlled for crystal clear sound with a built-in 2 watt audio amp for direct radio hook-up. For scramble systems, each user has a unit for full duplex operation. Communicate in privacy with the SS-70. Add our case set for a fine professional finish.

SS-70 Scrambler/descrambler kit\$39.95

CSSD Matching case set\$14.95

SS-70WT Assembled

SS-70 and case set\$79.95

CRYSTAL RADIO

Relive the radio past with a crystal set like your grandfather built. Uses genuine Galena crystal and catwhisker. Several different types of radios are built, including standard AM broadcast, shortwave and even WW II foxhole type. To compare modern semiconductor detectors, we include a diode for comparison. No soldering required and we even give antenna ideas. Radio for fun, get it now before Clinton taxes it!

CS-1 Crystal set kit\$19.95

TOUCH-TONE DECODER

Grab Touch-Tone numbers right off the air, phone or tape. A simple hook-up to any radio speaker or phone line is all that is required to instantly decipher touch-tone phone numbers or codes. A 256 digit memory stores decoded numbers and keeps its memory even in the event of power loss. An 8 digit LED display allows you to scroll through the memory bank to examine numbers. To make it easy to pick out number groups or codes, a "dash" is inserted between sets of digits that were decoded more than 2 seconds apart. A "central-office" quality crystal controlled decoder is used allowing rapid and reliable detection of numbers at up to 20 digits per second! For a professionally finished look, add our matching case set. Start cracking those secret codes tomorrow with the Tone Grabber!

TG-1 Tone Grabber kit\$99.95

CTG Matching case set\$14.95

TG-1WT Fully assembled TG-1 and case\$149.95

DIGITAL VOICE RECORDER

Chatterbox digital voice storage unit will record your message of up to 20 seconds. Time is split up into four 5 second blocks which can be played separately or cascaded for longer messages. An LED display shows message location and current mode for easy operation. Nifty built-in interfaces allow simple connection to transmitters for automatic keying when the PTT is initially closed or after it is released. You can even loop your rig's mike through the Chatterbox. For contest or fun use, the CB-1 can drive an external speaker. Includes a built-in electret mike. For that finishing touch, add our matching case set.

CB-1 Voice recorder kit\$59.95

CCB Matching case set\$14.95

ORDERS CALL 1-800-4 HOBBY KITS (446-2295) ORDERS ONLY
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TERMS: Satisfaction guaranteed. Examine for 10 days. If not pleased return in original form for refund. Add \$4.95 for shipping, handling and insurance. For foreign orders add 20% for surface mail. COD (U.S. only) add \$5.00. Orders under \$20 add \$3.00 NY residents add 7% sales tax. 90-day parts warranty on kit parts. 1-year parts & labor warranty on wired units.



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MOTOR TRANSLATOR DRIVES

The 230-t electronically convert input pulses into drive signals of the proper sequence and power required to operate a stepping motor: one input pulse being "translated" into one motor step.

To drive the motor, a technique called "chopping" is used. The voltage applied to the motor windings is turned on and off very rapidly, or chopped. The voltage level and chopping frequency are precisely controlled so that the desired current is produced. The instantaneous current in the drive circuit is sensed and is used to control the current to the motor.

The translator circuitry accepts a single pulse at a time as an input and determines which windings of the motor must be turned on and off in order to advance the motor shaft one step. The translator circuit is fully self contained and is not accessible through any of the function pins.

SUPPLY VOLTAGE NEEDED: 28VDC, NOMINAL
24 MIN TO 36 MAX INCLUDING RIPPLE.
SUPPLY CURRENT: 2.5 AMPERES
FILTER CAPACITOR REQUIREMENT:
MINIMUM OF 250MFD. 50VDC NEEDED ACROSS
V_{IN}-V_{OM} AT DRIVE TERMINALS
CONTROL INTERFACE REQUIREMENTS:
MIN PULSE WIDTH LOW: 16 MICROSECONDS
MIN PULSE WIDTH HIGH: 50 MICROSECONDS
RISE AND FALL TIME: LESS THAN 2 MICROSECONDS

TYPE 230-T



SLO-SYN MICRO SERIES
TYPE 230-T 2A 38V

DESCRIPTION:
BI POLAR, 2 PHASE STEPPING
MOTOR DRIVE WITH TRANSLATOR
POWER SEMICONDUCTOR TYPE: H-BRIDGE
POWER IC TRANSLATOR: INTERNAL IC

PERFORMANCE:
RESOLUTION: HALF-STEP OR FULL STEP
STEP RATE: 0 TO 10,000 FULL STEPS/SEC
0 TO 10,000 HALF STEPS/SEC

CHOPPING FREQ: 20 kHz NOMINAL

SPEED/TORQUE: ALL SPECS USE TYPICAL DATA

DIRECTION: CW/CCW

MOTOR COMPATIBILITY: M001-M082

NO OF LEADS: 4, 6, 8

SIZE: 3.15" X 2.70" W X 1.31" H

WEIGHT: 1 LB

BRAND NEW - INDIVIDUALLY FACTORY PACKED. COMPLETE WITH INSTRUCTION MANUAL AND SPEC SHEETS

BRIGAR SPECIAL PRICE \$79.95

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MINIATURE PCB RELAY

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|--------------|---------------|----------------|
| 24 | 35 | 740 |

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HIGH DIELECTRIC 4000 VRMS.

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AMPAX 100 STEPS/REVOLUTION
STEPPING BI POLAR WOUND FACE
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DUTY. VOLTS: 3.2VDC 6.8 AMPS
2 PHASE, 3.6 STEP ANGLE, TORQUE
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PRE DRILLED HOLES 2 5/8" ON CENTER
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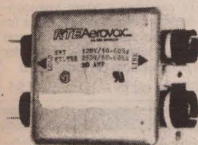
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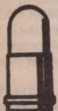
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1-1/8" BORE
1" STROKE



- Sheffer \$6.95 • Double acting
- Ports 1/8 NPT
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- Rod 5/16", 5/16-24 thread, with clevis
- Force exerted approx 1.15 of air pressure
- Nose and bore block mount
- Back end has shock absorber 5/16-18 stud removed from equipment

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BASE STYLE: MIDGET FLANGED # CM385

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12 VDC 0.5 AMPS - 120CFM - BALL BEARING

CONTROL TEMP 40°C - BRUSHLESS

5 BLADE PLASTIC IMPELLER - ALUM. HOUSED

SIZE: 4 1/16" SQ. X 1 1/2" THICK. 8" WIRE

LEADS. FAN COMPLETE WITH THERMOSTAT

CONTROL SENSOR. BRAND NEW FACTORY

PACKED. BRIGAR SALE PRICE \$12.95

BUILT IN THERMISTOR IN FAN SENSES THE TEMP. OF THE AIR THROUGH THE FAN. AS THE EXHAUST AIR INCREASES, FAN SENSES THE CHANGE & ADJUSTS SPEED OVER A 2-1 RANGE FROM IDLE TO FULL SPEED. FAN WILL ATTEMPT TO HOLD TEMP TO 3°C OF THE CONTROL TEMP. AT THE CONTROL TEMP. FAN WILL BE AT FULL SPEED.



TELEDYNE

SOLID STATE RELAYS

PART# 615-8500

Control Volts: 3-32vdc

Rated: 10A @ 250VAC

50/60Hz - Opto isolated

Connection: screw or quick connects. (Removed from un-used equipment)

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5-9W DC/DC Converters

LOW-COST UNREGULATED

PC-Mountable Excellent Isolation

PI Input Filter High Efficiency



COMPUTER PRODUCTS MODEL # EM951S

5-9W DC/DC CONVERTERS

■ PI INPUT FILTER

■ 500V ISOLATION

■ SHORT CIRCUIT PROTECTED

■ HIGH EFFICIENCY - 75%

■ NON-CONDUCTIVE PLASTIC ENCLOSURE

2" X 2" X 0.4" PACKAGE

OUTPUT VOLTAGE ±12V/ ±375MA

INPUT VOLTAGE: 5VDC

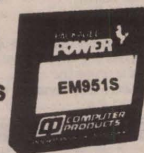
REGULATION LINE: 1.2% LOAD 8%

REFLECTED RIPPLE: 75mA P-P

5 PIN PC MOUNTABLE

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Protects home appliances and home computers from voltage surges and EMI/RFI noise interference. Absorbs harmful sudden increases in electrical power before components can be damaged. Noise protection will reduce, or eliminate, static on audio equipment, snow on TV's and data problems on computers.

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SPECIFICATIONS:

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|-----------------------------------|---------------------------|
| Electrical Rating | 15 Amp, 120 VAC 60 Hz |
| UL 1449 Suppressed Voltage Rating | 400 Volts (H-N) |
| Protection Devices | Metal Oxide Varistors |
| Maximum Energy Dissipation | 90 Joules (2 x 45 Joules) |
| Full Line Protection | H-N, H-G, N-G |
| Clamping Response Time | < 5 nsec |
| EMI/RFI Noise Rejection | up to 15 db |

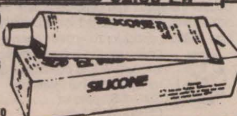


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ZINC OXIDE FILLED SILICONE GREASE WITH OUTSTANDING HEAT TRANSFER PROPERTIES. DOES NOT SOFTEN UNDER HIGH TEMPERATURES & WILL NOT DRY OUT OR HARDEN. PROVIDES A HEAT SINK WHEN MOUNTING TRANSISTORS TO CHASSIS AND METALLIC HEAT SINKS



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PART# PN2222A MFG. Rohm

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|-----|-----|-----|----------|
| CEO | MHZ | MA | MIN MA |
| MIN | MIN | MAX | 100 150 |
| 40 | 300 | 800 | |

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USED FOR INDUSTRIAL & LAB APPLICATIONS TO CONTROL

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INPUT VOLTAGE: 120VAC 60HZ

ISOLATED OUTPUT: 0 - 60VAC,

ISOLATED PRIMARY, CONSTANT

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SECRET DESCRAMBLER additions for all universal decoders. Info \$1. Robert Snow, POB 22048, Lansdowne, St. John, Canada E2K 4T7.

TEST AIDS: SA8600, SA8590, SA8580, SA8570, \$35 ea; SA8550, SA8555, \$25 ea; SA8535/36 \$30 ea; SA8550 DF Kits \$35 ea; R2/V5/CFT \$40 ea; new 8590-11 & DP7113/V5 units @ \$275, SA8550 DF units \$190; Call 203-283-9492.

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Cellular Fringe Area Yagi Antennas



- 10 element Yagi antenna
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- Easy to erect & hook-up

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CFT 2000 remotes 50@ \$8, PMI, PZI \$100, VC II modules \$90, Tocom compatible cable pulls \$40 ea. 5 lot. 50 lot R2 \$8. 1-800-219-8618.

WIRELESS CABLE dipole/feedhorn w/ built in cable ready downconverter and power supply \$125. About half price. 36 channels. 30dB gain "stinger" type. 512-259-4770. 10AM-6PM CST.

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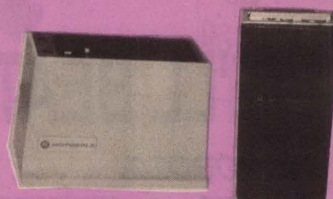
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SCIENTIFIC ATLANTA 8580 \$200, 8550 \$150, 8500 \$120. Software available. SA, Pioneer. Will program your 8550, 8500 earoms for \$7.50. Cable security key gets past collars \$25. Add \$5 shipping. No TX sales. Send postal money order to: K. Perry, PO Box 816, Leander, TX 78646-0816. Phone: 512-259-4770.

R2, V5, CTF new DP7 compatible activation circuits \$29. New Pio-5XXX-6150 never reset E-4, \$29. Minimum 10. We also carry most activation CBTv circuits. 405-634-3338.

DEALERS ONLY: Test fixtures at below wholesale prices. Scientific Atlanta compatible quick-boards and 40 pin micros. Jerrold compatible for all models DP, DPV, DPBB, CFT, RZV5. Pioneer and Zenith compatible, plus others. Prices too low to print. Software and master files available for qualified buyers. We will save you \$\$\$\$. We accept Visa, MC and COD orders. 1-800-618-7480.

DESCRAMBLE CABLE with simple circuit added to Radio Shack RF Modulator part # 15-1273 and using cable ready VCR as tuner instructions, \$10. Telcom, Box 832-V, Brusly, LA 70719.

DESCRAMBLER. "SUPREME-7," compatible with all Jerrold models except BB-CFT, Ch-3 output, dynamic switching between three levels of sync suppression and two modes, ignores camouflage signals, \$60 each (any quantity), money order please. Surplus Electronics, POB 10009, Colorado Springs, CO 80932.

BUYING TOCOM, SCIENTIFIC ATLANTA 8536s, 8550s, 8580s, 8590s, and 8600s. **JERROLD** DPV and DPBB. **PIONEERS**, all, and Zeniths, all. Any quantity. Top \$\$\$ paid. Contact National Cable Brokers, Plymouth, IN. Phone 219-935-4128.

R2/V5/CFT Test-Kit. Now \$15 each, minimum 10. 718-349-6506. No NY sales.

CONVERTER DESCRAMBLER combination units in full test mode w/remotes. Jerrold compatible, Scientific Atlanta 8580, Zenith Z-TAC, (brand new) 6 mo. warranty only \$199 ea. Includes S&H (quantity discount). 415-920-9644. C.M.A., 236 West Portal Avenue, Suite 830, San Francisco, CA 94127, Checks or COD.

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UNIVERSAL DESCRAMBLER. One unit works on all DPBB7, DPV7, CFTXXXX box. Automatically accommodates frequencies 97.5, 106.5, 108.5. Unit price \$125 each. For quantity, please call, 212-978-3535.

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CABLE TV TEST MODULES
EXPERT DESIGNS. 1-800-233-0570
See our DISPLAY AD
on Page 13.

BASEBAND CFT. New! Remote. Full-serv. \$200 min. 5 or \$300 ea. 1-800-973-9278. Call for more information. No FL sales.

PIONEER BA5XXX/BA6XXX COMPATIBLE TEST KIT CLEARANCE. Factory new small 3-wire, with NO map program. \$15 each. (Minimum 3 kits). **Voice message 407-676-2530 or Fax 407-727-8640.** No Florida sales.

1-PIECE COMBO: S/A 8580: \$195, 8590: \$275, Pio-BA: 5135: \$175, 6110: \$210, 6310: \$230. 1-Year Warranty, no minimum. Call: 405-634-3338.

SCIENTIFIC ATLANTA 40 pin processors for the 8580-7 button, 8590-11 button and 8600, \$22. Will install for free. Master program files, \$60 each. Blanks \$17. 714-744-2786.

"TVT" COMBO \$150. Test mode devices for BA-51XX, BA-61XX \$40 ea., BA-63XX \$45 ea. Call Ben at 1-800-484-7250 then dial 7525.

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115

MOTOROLA SPIRIT pagers UHF w/chargers \$15. Reads \$10/set. MX modules. (2) Mocom 70 VHF consulates \$75 ea. Westronics, 601-366-6469.

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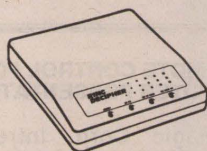
UNION JACK'S®, AMPS CELLULAR, DIRECT PROGRAMMING SYSTEM, FOR MOTOROLA BRICK, FLIP & BAG PHONES. Program firmware to 9122s without a loader phone, with loader phone firmware to 9340s. (Loader phone, Flip-Brick or Bag requires firmwares below 9122.) **UNION JACK'S®** complete AMPS program includes backup service & yearly updates **UJMP-1 SOFTWARE \$199.95**. COMBINATION OFFER: (SAVE \$29.95) COMPLETE REPROGRAMMING SYSTEM *\$399. Nothing extra to purchase. Includes **UNION JACK'S® AMPS SOFTWARE PROGRAM UJMP-1 \$199**, 3 TYPES LESS BUSTER'S, MOTOROLA COMPATIBLE, COMPUTER PROGRAMMING CABLE HARDWARE SETS, 1-6PC-CSFF FOR FLIP PHONES \$99.95, 1-3PC-CS689 FOR BRICK PHONE \$99.95 and 2PC-CS2-3BF FOR BAG PHONES \$29.95. *PRICES: Computer & Cellular loader phone not included. UPS, COD, Cash, 2nd DAY AIR \$12.00. Additional details, Cable Sets, etc., SEE OUR ADVERTISEMENT (LESS BUSTER'S ELECTRONICS) N&V AD CLASSIFICATION 115. TELEPHONE/FAX. CATALOG FREE. 702-642-0325.

TURN ON your CELLULAR PHONE through keypad programming. Manual \$22. CABLETRONICS, BOX 30502R, Bethesda, MD 20824.

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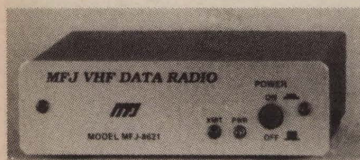
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NEW PRODUCT EDITOR,
430 PRINCELAND CT., CORONA, CA 91719

News

"PACKET ONLY" VHF DATA RADIO



The MFJ-8621 Data Radio, from MFJ Enterprises, will monitor "Packet Only" on your favorite packet channel for continuous 24 hour a day duty for only \$119.95. The MFJ-8621 is a two-meter FM data receiver that will run all data rates through 9600 straight out of the box.

To operate just plug in an appropriate TNC cable (also available), your antenna, a 12 VDC power supply and it's ready to enjoy.

It will operate on 145.01 MHz with crystals pre-installed, but you can also order plug-in crystals for the packet channel of your choice. Additional features of the MFJ-8621 include: direct modulation; ultra-fast PIN diode switching; a dual conversion receiver, 0.25 uV low noise pre-amp, and a double-tuned front end; a narrow 10.7 MHz IF filter plus a special full data-bandwidth 455 KHz IF filter; and unswitched audio feeds directly to your TNC for lightning-fast DCD response, and the receiver local oscillator is crystal-controlled. It runs full-time, so there is no start-up drift or synthesizer lock-up delay.

The MFJ-8621 also works well for portable packet because it is 5 x 5 x 1 1/2 inches in size and draws 15 mA on receive and less than 1 amp on transmit on 12 VDC power supply.

For more information, contact:

MFJ ENTERPRISES, INC.
P.O. BOX 494, DEPT. NV
MISSISSIPPI STATE, MS 39762
601-323-5869 FAX: 601-323-6551

ULTIMATE SKIERS GUIDE

The *Ultimate Skiers Guide*, a brand new product from Next Generation Software, which offers information on over 650 ski resorts in the United States and Canada. This multimedia Skiers Guide is available on either diskettes or CD-ROM for \$34.95.

The package includes over 150 different items of information on the ski resorts in North America. Included with the extensive amount

of information for each ski area are trail maps, area pictures, and video clips shown through Next Generation's "Photo-Show" window, giving the ski enthusiasts an opportunity to see themselves right in the action.

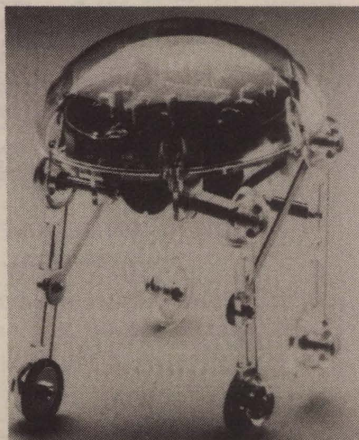
Once you've had a chance to look through literally hundreds of ski photos, trail maps and video clips, you can visit over 650 mountains through a simple graphical interface, that not only pin-points every area's location, but also allows the user to easily view every ski resort in a particular area.

Further information available for all ski areas in North America includes: number of trails, longest run, total area, night skiing, snowboarding allowed, halfpipe available, additional activities available within short drive of the area, credit cards accepted, restaurants, bars, day-care, medical services, instruction available including: junior, handicapped, snowboarding, bumps, powder, X-country, lodging phone numbers and availability, directions, distances, and travel times, lift prices and more.

For more information, contact:

NEXT GENERATION SOFTWARE
662 EXTON COMMONS, DEPT. NV
EXTON, PA 19341
610-524-7500 FAX: 610-524-8912

MOONWALKER ROBOT KIT



Moon Walker, a new battery-operated robot kit that demonstrates the principles of solar sensing and walking motion, is now being offered by the Movit division of OWI Incorporated.

The clear colored Moon Walker

kit is intended for both the educational and adult-hobby markets, and can be finished using only basic hand tools and a soldering iron. A clear plastic housing displays the electronics that provide directional control. The solar sensor detects shades of light. Four legs driven by crank motion propel the robot. The Moon Walker's suggested retail price is \$48.95.

For further details, write or call:

OWI INCORPORATED
1160 MAHALO PL., DEPT. NV
COMPTON, CA 90220-5443
310 638-4732 FAX: 310-638-8347

REMOTE CONTROL FOR COMPUTER PRESENTATIONS

SoftMagic Corp. introduces PowerControl, a remote control for computer/multimedia presentations.

PowerControl includes F/X PowerTools™, software that allows the user to take advantage of their favorite special effects with any Windows™ program.

New tools include: roll credits feature, pens, timers, zoom, custom cursors, sound file launcher, blank screens (which allow you to display a blank screen or a bitmap logo), and more. F/X PowerTools can all be used with or without the remote control.

Other enhancements to PowerControl include a cable that allows the user to plug the infrared receiver and mouse into the same serial port, and support for diagonal mouse movement. PowerControl is a handheld, wireless remote for controlling computer presentations given on IBM PC or compatibles. The remote control allows you to concentrate on your audience instead of your keyboard and mouse. Simply assign keystrokes, mouse commands, or a special effect to any button on the remote to use with any Windows application.

PowerControl is pre-programmed to control nine popular presentation software packages including: Microsoft®, PowerPoint®, Software Publishing Corporation's Harvard Graphics®, and Lotus®, and Freelance Graphics®. Simply click on an icon and you are set to control the show. PowerControl works with any projection device, mouse, or trackball. The remote control is easy enough to use for the computer novice, but is fully pro-

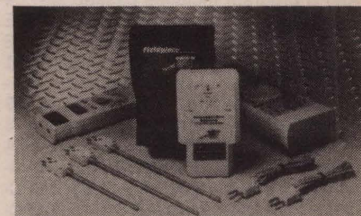
grammable to allow flexibility for use with authoring software and interactive multimedia presentations.

PowerControl can also provide keyboard and mouse control to most DOS programs by accessing them through the DOS box within the Windows environment. A TSR is included for controlling DOS programs without Windows running. Your IBM PC or compatible must be a 386 or higher and have at least one serial port. You must also have Windows 3.1 or higher, and DOS 3.0 or higher. Installation is as easy as loading the software and plugging the infrared receiver into the serial port on your PC.

For pricing and/or other information, contact:

SOFTMAGIC CORPORATION
72 MALLARD WAY, DEPT. NV
WALTHAM, MA 02154
617-899-9966 FAX: 617-899-1458

DUAL TEMPERATURE CONVERTER



Fieldpiece Instruments, now has available a dual temperature converter accurate enough for the HVAC technician.

The model ATH3 dual temperature converter has inputs for two K-type thermocouples and converts temperature to MVDC at a rate of 1° F in 1 MVDC. Set the meter on the MVDC range to display temperature directly to 0.1° F. A slide switch selects T1, T2, or T1-T2. Calibration pots on the faceplate enable field service technicians to easily calibrate the whole measurement system (meter, converter, thermocouple) to an accuracy of one degree over a temperature range of -50 to 165° F. Just put the thermocouples in ice water and dial in "32".

Fieldpiece designed the ATH3 to slide down over the top of the Fieldpiece HS20 "stick" series heavy duty multimeter to form a one piece temperature meter. To use with the Fieldpiece HB70 series heavy duty multimeter or any other multimeter with Fluke style jacks (including Fieldpiece's own LT series meters), use the ADL2 deluxe test leads. Unplug the probe tips and plug the handles into the bottom of the ATH3 head.

The ANC2 nylon carrying case holds one ATH3 temperature head or any other Fieldpiece accessory head. The case has a belt loop on the back.

The ATH3 measures 4.4"H x 2.5"W x 1.1"D. It operates from -30° F to 120° F and measures for -50° F to 1800° F. Power is supplied by a standard 9V battery inside the case. A green LED indicates on, a red LED indicates low battery.

The ATH3 temperature head is priced at \$89.00 including two bead-

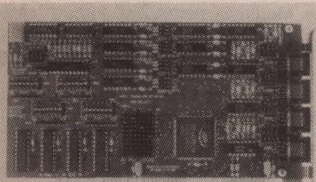
New Product News

ed thermocouples; the ANC2 nylon case at \$7.95; and the ADL2 deluxe test leads at \$12.95.

For further information, contact:

FIELDPIECE INSTRUMENTS
231 E. IMPERIAL HWY. STE. 250,
DEPT. NV
FULLERTON, CA 92635
714-992-1239 FAX: 714-992-6541

MULTIPURPOSE FOUR PORT SERIAL BOARD FOR PCs



B & B Electronics Manufacturing Co. now has available Model 3PXCC4A serial card, featuring four serial ports in a single slot. This design saves valuable space for other applications.

Each of the 3PXCC4A's ports can be independently configured for any I/O address and any IRQ, as well as RS-232, 422, or 485 data protocols, allowing you to fit any serial application. TD, RD, RTS, CTS, DSR, DCD, and DTR port lines are supported by the RS-232 mode, with each port using a buffered, high speed UART (16550A). Additionally, the 3PXCC4A has interrupt sharing capabilities and an Interrupt Status Register to increase throughput in shared IRQ applications, as well as increase the number of available interrupts in your system.

The 3PXCC4A uses eight conductor RJ45 connectors. Pre-wired adapter kits (Models MDB9 & MDB25) are available which enable you to convert to DB-9 or DB-25 connectors.

For more information, contact:

**B & B ELECTRONICS
MANUFACTURING CO.**
707 DAYTON ROAD
P.O. BOX 1040, DEPT. NV
OTTAWA, IL 61350
815-434-0846 FAX: 815-434-7094
BBS: 815-434-2927 INTERNET:
techsupt@b&b_elec.com

HIGH PERFORMANCE LF/VLF ANTENNA

Curry Communications is now offering the AW1194 Active Antenna, a professional grade low frequency broad band antenna covering the LF and VLF frequencies from 5 KHz through 530 KHz. The revolutionary design will considerably improve reception for low frequency communications enthusiasts without considerable expense or real estate.

Many radio enthusiasts today

enjoy monitoring the LF/VLF bands, receiving European longwave DX, aeronautical beacons, 1750 and 600 Meters, and other unusual signals.

A major drawback to the low frequency bands, however, is local man-made noise and receiver/antenna overload from local AM broadcast stations. These types of interference can be prolific, requiring specialized antenna technology for reduction. Virtually all antenna's pick up some amount of random noise or interference, yet little has been done until now to optimize the low frequency antenna. The AW1194 will provide superior results in an urban or suburban environment, where noise is at its worst. Virtually all modern receivers now cover the LF/VLF bands, making this antenna a worthy choice for all frequencies below 530 KHz.

For more details, call or write:

CURRY COMMUNICATIONS
737 N. FAIRVIEW ST., DEPT. NV
BURBANK, CA 91505
818-846-0617

SOLAR POWERED PRODUCTS



Sun-Mate Corp., is now offering a variety of products which use the basic principle of charging, using the sun's energy and then storing that energy in rechargeable built-in batteries with the product.

Sun-Mate's new Solar Powered Address Light is completely weatherproof and can pinpoint the exact location for emergency calls, deliveries, etc. Only four hours of sun will run the Address Light for three nights! It turns on at dusk and turns off at dawn.

Sun-Mate's Solar Car Battery Charger prolongs the life of your car battery, by preventing the battery from discharging itself, as well as maintaining the battery under normal conditions. The charger plugs into the cigarette lighter outlet and

has an LED indicator to confirm charging activity.

The Sun-Mate Dynamo Radio does not require batteries and can charge under an incandescent lamp, in addition to direct sunlight. The Dynamo Radio can also be charged with an AC/DC adapter, as well as with the Dynamo crank, and functions in complete darkness.

The new Sun-Mate Sports Radio also does not require batteries and can charge under an incandescent lamp, in addition to direct sunlight as well.

To find out about these or other solar products, contact:

SUN-MATE CORP.
8223 REMMETT AVE., DEPT. NV
CANOGA PARK, CA 91304
818-883-7766 FAX: 818-883-8171

P-1500 DIGITAL RF POWER/V.S.W.R. INDICATOR



RF Applications, Inc., announces the availability of their P-1500 Digital RF Power/V.S.W.R. Indicator, the newest addition to the company's family of digital RF power measurement equipment. The P-1500 features a four digit numeric and a bar graph style display. Forward power, V.S.W.R., reflected power, and true power can be displayed. Using a built-in sensor, the P-1500 automatically selects from three ranges (0-120 W, 0-750 W, and 0-1500 W), so there are no range switches. Frequency coverage is 1.8 to 30 MHz. The P-1500 continuously monitors V.S.W.R., and there are indicators to signal V.S.W.R. over 3.0 and less than 1.5 (even when V.S.W.R. is not selected on the display). The P-1500 operates on 12 VDC and measures 4" wide by 3.5" high by 4" deep.

The P-1500 lists for \$219.95. For further information, contact:

RF APPLICATIONS, INC.
9310 LITTLE MOUNTAIN ROAD,
DEPT. NV
KIRTLAND HILLS, OH 44060
216 974-1961 FAX: 216-974-9506

CMOS IAMBIC KEYER/CONTROLLER CHIP

Radio Adventures Corp. now has the C1 advanced CMOS Iambic Keyer/Controller chip. The C1 combines various keying functions with

timing and sequencing features in an 18 pin DIP package.

The C1 supports Iambic A and B modes, straight keys, semi-automatic keys (bug) and provides a bug-like mode using single or double lever paddles. Speed, spacing, weight, and sidetone pitch are adjustable and when using a straight key or bug, the C1 provides a user selected auto space mode that inserts a space after each element is sent.

Default settings for space, weight, and pitch are available for those who want to eliminate those adjustments. Crystal control is used for high accuracy over the full voltage and temperature range.

The C1 debounces all key inputs and provides a convenient way to key and control home built and commercial transmitters and transceivers in full and semi break-in modes.

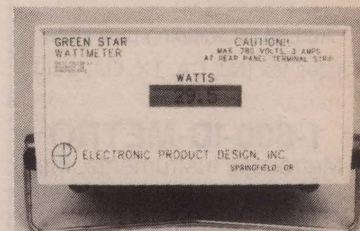
The C1 operates from 3.0V to 6.0V with a typical operating current of less than 2 mA and less than 5 uA during sleep.

Single unit price is \$14.95.

To find out more, contact:

RADIO ADVENTURES CORP.
P.O. BOX 339, DEPT. NV
SENECA, PA 16346
814-677-7221 FAX: 814-677-6456

GREEN STAR WATTMETER



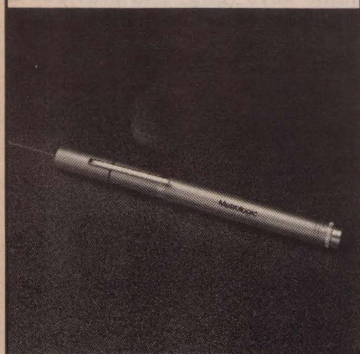
The Green Star wattmeter, available from Electronic Product Design, is designed to enable measurement of power consumed by electrical loads specific to the National EPA Energy Star Computer Program. Basic metering requirements include the ability to measure true-power to .5 watts with a minimum resolution of one tenth of a watt, bandpass up to the 100th harmonic of 60 Hz., and a worst case crest-factor of 6 to 1. The Green Star wattmeter satisfies all of these requirements.

This is a single phase meter that measures 120 or 240 volt power, with an RMS current limit of 3 amps. The current is sensed via an internal shunt resistor accessible via a rear panel terminal strip. Voltage is also connected here. Power is provided to the internal electronics via 120 volt power connections at the terminal strip.

Custom options include RMS current and voltage measurements, calculations providing Watt-hours, Va, power-factor, and VARS, and an

Continued on page 130

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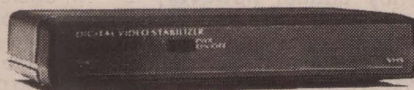
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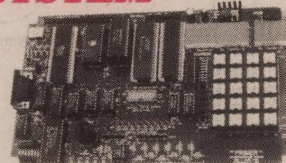
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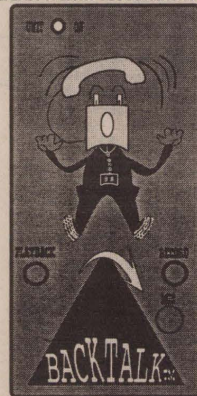
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by Donald Wilcher

Electromagnetics

One course that is required for obtaining an Electrical Engineering degree is Electromagnetic Theory. As I sat and listened to the lectures, I thought I would never use this stuff on the job. Just the idea of using Integral and Differential Calculus to find how a spherical object such as a metal dome can be uniformly distributed with charged particles seemed useless.

Well, my past has come back to haunt me. I am now responsible for testing automotive electronic module's response to electromagnetic waves for Chrysler Corporation. This job responsibility is more interesting than reading boring theories about electromagnetic interference because of the hands on approach. So, I thought it would be interesting to show how the theory and science of EMI/EMC (Electromagnetic Interference/Electromagnetic Compatibility) can be explored hacker style. But before we begin our exploration into electromagnetics, let's review what EM waves are and who discovered electromagnetism.

What are Electromagnetic Waves?

To get this discussion flowing about electromagnetic (EM) waves, let's describe what they are and how they were discovered. Simply, EM waves are vibrations of electric current that travel at 3×10^8 m/s (186,000 mps). This rate of travel is equal to the speed of light in a vacuum. Light is also a form of electromagnetic waves because it has little

bundles of energy called photons that vibrate when released from their electron shells. Electromagnetic waves, just like light, can refract and reflect their vibrations and differ only in frequency and wavelength.

These two components together make up the ELECTROMAGNETIC SPECTRUM. The EM Spectrum includes all forms of radiation with frequencies below the infrared region. But who discovered this phenomenon of science?

Hans Christian Oersted: Father of Electromagnetism

Electromagnetic wave theory owes its existence to a 17th century Danish physicist and chemist, Hans Christian Oersted (pronounced Er-sted). Oersted discovered electromagnetism during an evening lecture at the University of Copenhagen in April 1820. Hans observed that a magnetic needle aligns itself perpendicularly to a current

carrying wire. This phenomenal discovery helped to establish Oersted as one of the outstanding physicists of his time.

Now that we have an understanding of electromagnetic waves and who discovered electromagnetism, it's time for some experimental investigation of our own.

In the following paragraphs, we will analyze some parameters of electromagnetism using a simple compass, a wire wound coil, and a solenoid. Finally, an Electromagnetic Pulse Generator will be presented and explained in terms of using it to test conducted susceptibility levels of electronic products. So, let's begin our examination of electromagnetism by understanding Ampere-Turns and Field Intensity of magnets.

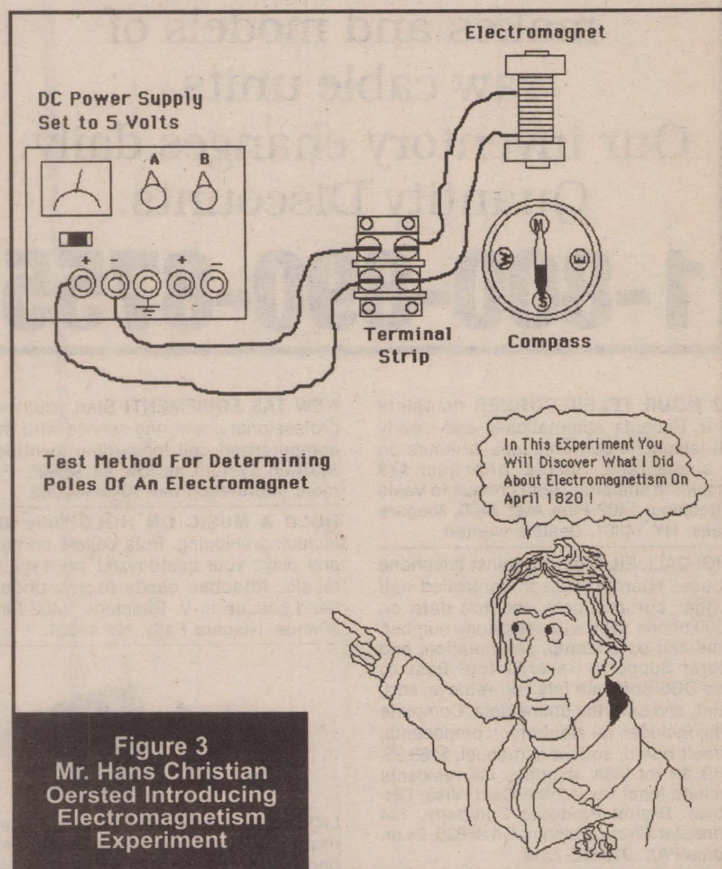


Figure 3
Mr. Hans Christian Oersted Introducing Electromagnetism Experiment

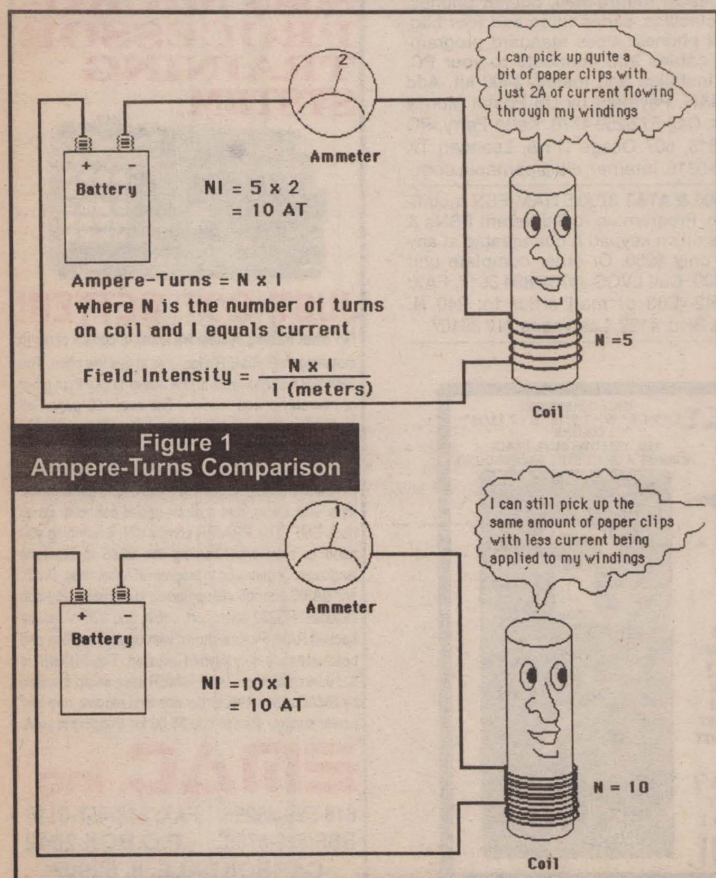


Figure 1
Ampere-Turns Comparison

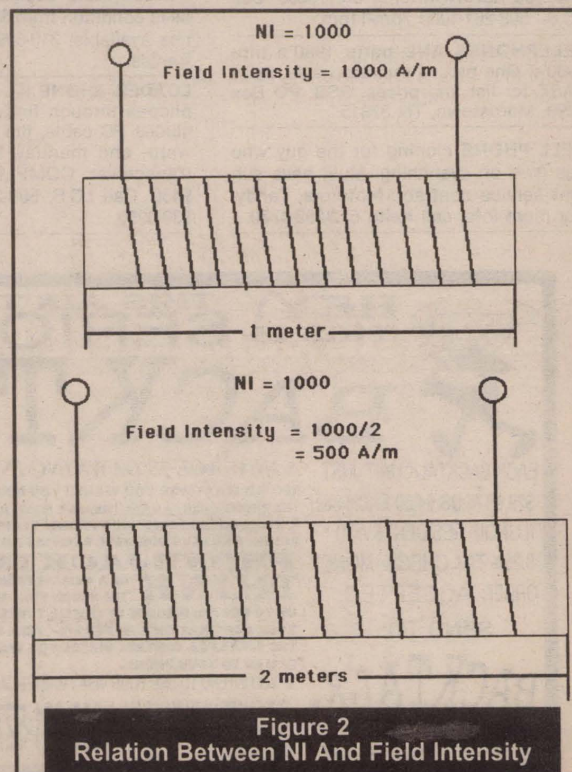
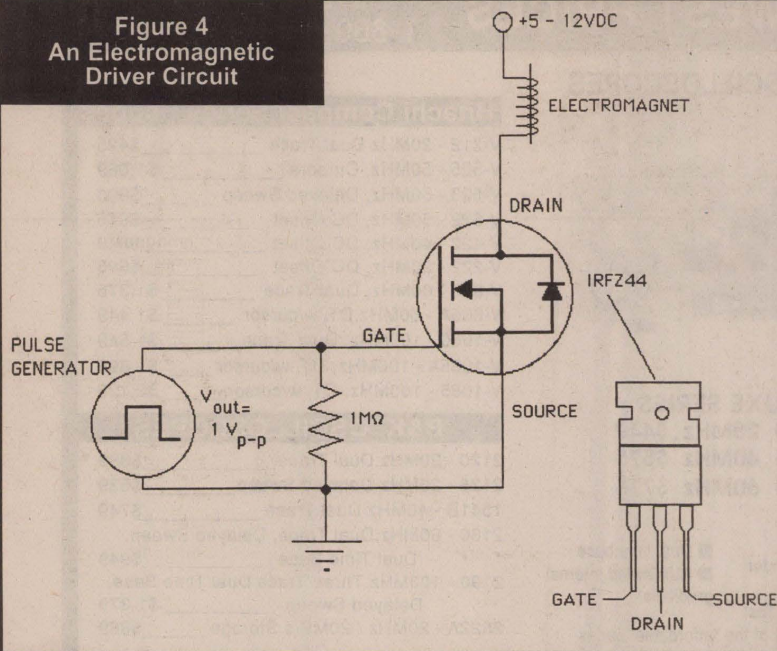


Figure 2
Relation Between NI And Field Intensity

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Figure 4
An Electromagnetic Driver Circuit



Ampere-Turns and Field Intensity

With a coil magnet, the strength of the magnetic field depends on how much current flows in the coil of wrapped wire. The more current, the stronger the magnetic field. Also, more turns in a specific length of coil concentrates the magnetic field. The coil acts as a bar magnet with opposite poles at the ends providing a magnetic field proportional to the ampere-turns.

Figure 1 shows the relationship between the number of turns and magnetic strength of the coil. An important item to note about ampere-turns is that it specifies the magnetizing force of the wire wrapped coil. The intensity of the coil depends on the physical length of the coil. At any point in space, a specific value of ampere-turns for a long coil must produce less field intensity than a short coil that concentrates the same ampere-turns. Figure 2 illustrates this comparison.

Electromagnetic Experiments

The principles of ampere-turns and field intensity can be demonstrated easily using the experi-

tion of the compass needle. If the needle points to "S" on the compass, the pole of the electromagnet is north. The reason being is that opposite poles attract. By reversing the power supply leads attached to the electromagnet, the pole should be opposite and the compass should read "N."

But suppose we're interested in making the compass needle oscillate without connecting-disconnecting the power leads of the power supply,

mental arrangement shown in Figure 3. The core and the compass are part of a science fair kit that can be purchased from Radio Shack. (The catalog number is 28-143.)

Just as a side note, this kit allows the experimenter to construct electromagnets, galvanometers, and an electric car. All components necessary to build the mentioned projects come complete with the kit. Now back to our story!!

This arrangement allows you to identify the electromagnet's pole by the deflec-

tion of the compass needle. If the needle points to "S" on the compass, the pole of the electromagnet is north. The reason being is that opposite poles attract. By reversing the power supply leads attached to the electromagnet, the pole should be opposite and the compass should read "N."

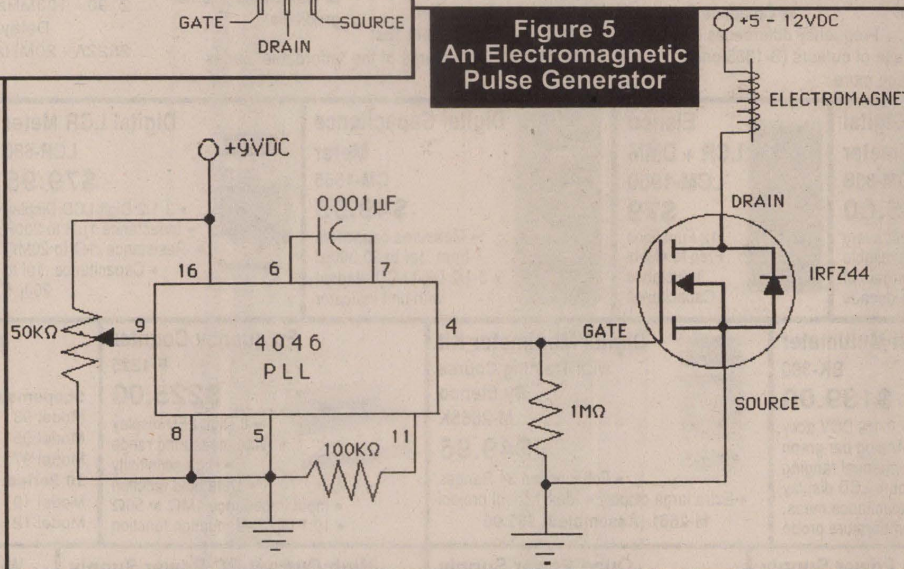
What is required is an electronic switch that can turn on/off the current flowing through the coil of the magnet at a rate of milliseconds to microseconds. As shown in Figure 4, by using a power MOSFET we are now able to switch current through the electromagnet's coils quite easily and efficiently.

The rate of change for energizing/de-energizing of the coil is determined by the pulse generator's output frequency. In order for this circuit to operate properly, a minimum output of one volt is required. Now an important feature about this arrangement is that the circuit can be designed into a neat piece of test equipment.

Figure 5 shows the diagram for an Electromagnetic Pulse Generator. Frequencies of 0-25.9 KHz can be produced via the 4046 PLL (Phase Locked Loop) circuit. The output pulses can be heard through an AM radio or observed on TV via Channel 3.

One important note to mention, is that radios, TVs, and other electronic products have a susceptibility range of frequencies they can tolerate before acting weird. In the auto industry, the SAE (Society Of Automotive Engineers) has published guidelines for testing and measuring the susceptibility levels of automotive electronic modules and systems. The document is SAE J1113 and can be found in the SAE Handbook. This book can be found at any local university library.

Figure 5
An Electromagnetic Pulse Generator



Further Thoughts and Experimentation

Well, you just received a small dose of what electromagnets are and how to use them in a practical testing application.

The electromagnet-coil of the circuits discussed can be replaced with a solenoid. At low frequencies, the core of the solenoid will move in/out of the coil at the rate selected by the generator. At higher frequencies the core will stay stationary, but a buzzing/oscillatory sound will be heard at the selected frequency. Experiment with the solenoid and see if you can distort the picture on Channel 3. Well, enuf said, see ya next month in the breadbox! NV

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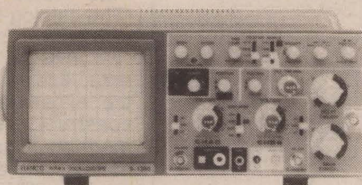


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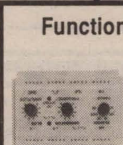
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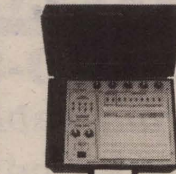


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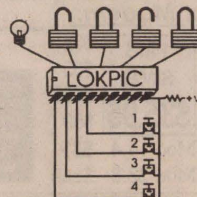
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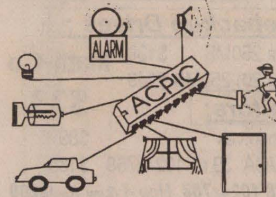
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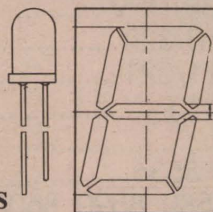


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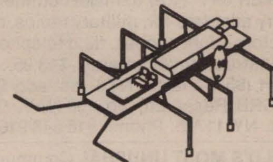
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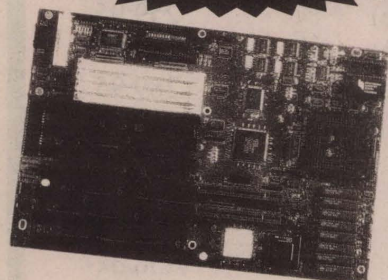
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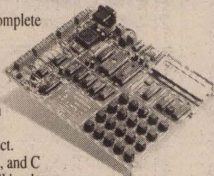
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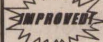
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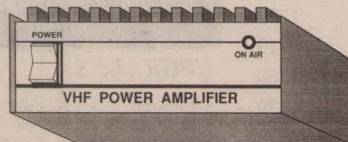
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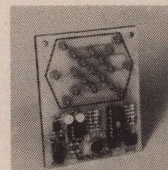


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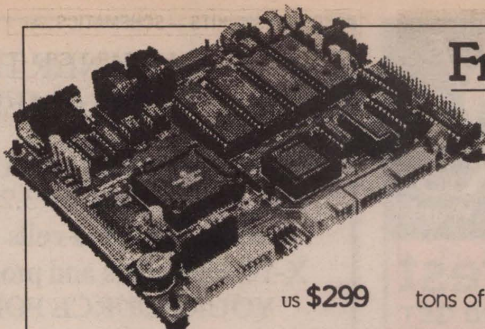
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


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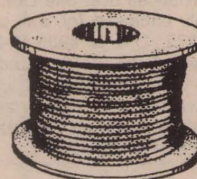
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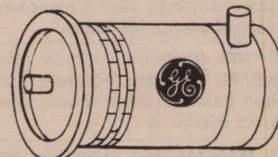
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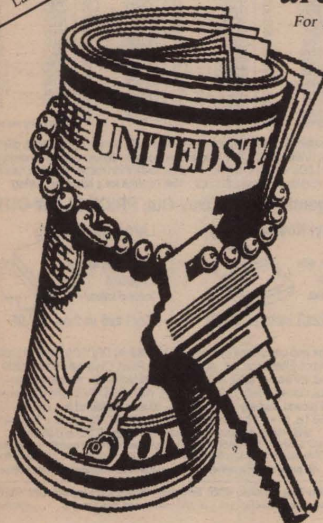
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THE LASER EXPERIMENTER

Conducted by
Anthony Charlton

Welcome! This installment we introduce a new feature: a direct reader-to-reader Laser Helpline! This is in logical response to the many questions received at The Laser Experimenter's P.O. Box. Some of these questions we just can't answer, especially if they contain "mixed" technology, such as experiments and devices that combine say, lasers and chemical reactions. So, reader's questions will stand a much better chance of being answered if the whole audience can have a chance to respond to them instead of just yours truly.

I have found the readers of *Nuts & Volts* to be very well informed, and many actively pursue fascinating and diverse forms of technology, some for hobby and intellectual reasons and some for what you might call "hobby-professional," where an interest has grown so strong in a subject that the person(s) has achieved a professional level of expertise. In many cases, this is the kind of audience you have accessible; I have had very few off-the-wall communiques. It's been a fascinating experience being in contact with you! Sometimes though, it takes a while to find the chance to answer your inquiries. Hopefully, this time delay will be reduced in the near future, since I plan to conscript more slaves...

So, here is the way this new feature will work. First, there is absolutely no charge or "hidden" fees. Consider it similar to free advertising (but it is NOT for sales of goods or services). Send your letters to the Laser Experimenter's P.O. Box, Attn: Laser Helpline. Include any information you want to be published, such as phone numbers, Internet, E-Mail, P.O. Box numbers, FAX numbers, and so forth; anything you don't mind going public. Then, we'll read your letters and extract a paragraph of meaningful content to publish along with what you wish to appear in print about how to be reached. Let's take an imaginary example:

"Professor Johnathan Livingston at the University of Antarctica wishes to contact people interested in evolving technology where a laser will send serial data through the air to a receiver a mile away across a ravine. Radio technology is unusable, as it interferes with his delicate instruments. The laser will remotely control a stepper motor, connected to the steering gear system of an ultraviolet-sensitive telescope. Prof. Livingston is interested in 2400 baud serial data communications, seeking Mitsubishi #42SH-32KGA, 3.75 degree, stepper motor maximum torque specs, and serial data modulation hints for a Hitachi 30 mW infrared laser diode model #123xyz. All information is welcomed. Postage, copying costs and a reasonable wage for your efforts will be reimbursed. He can be reached at: Postal Box 1, Thiel Mountains, Antarctica."

(Don't laugh... We've actually been getting some letters of exotic nature similar to this, but exotic is not a prerequisite for assistance. We always welcome communications from students, experimenters, and the curious. Laser Helpline is not discriminatory — all communications are equal!)

Ergo, the reader(s) that were interested in "Prof's" advertisement could contact him by the media of choice, leaving a message. Both the reader and the advertiser can choose just how accessible they want to be; we realize some people are VERY busy, and maybe don't want to answer the phone; they'd rather write or use E-Mail. Advertisers: Be specific about any data you DON'T want printed, such as a portion of your project you are trying to patent.

Letters will be edited for brevity and will appear in

Nuts & Volts, usually about two months after you send them. To be in print the fastest, the following schedule is suggested: Say you are shooting for the February issue; send your letter to arrive by December 15th. Possibly, there may be a delay if we have a busy month, but that's unavoidable. All letters that are "fit to print" will be printed; please don't send any stuff about hyperspace and so forth, because the aim is to promote productive, rational scientific relations between people and to further progress of the laser field in general.

What do you, the respondent get out of all of this? First, a chance to contact interesting new people; this is of course the essence of networking. And you never know where it will lead. You might find the answer to your most puzzling questions through some chap or a fellow he knows. It is also a chance for those who have the answers to do some R & D work if both parties want this.

We hope this will be a huge success and encourage you to try it out. And, as usual, private replies will be given through the Laser Experimenter's P.O. Box; nothing will change in that area. The first real Laser Helpline request appears in this month's column, so you can check that out.

More Laser Applications

Laser applications is an area that the laser experimenter has virtually a limitless space to work within. As mentioned previously in this forum, we have an exquisite tool, totally unimagined by people just several decades ago. One subject that frequently appears in the science of lasers is the effect of Index of Refraction. Although we've touched on this before, it's a good idea to continue to look at it.

For instance, when working with fiber optics, there are a few kinds that are available. One is the GRADED INDEX, where the refractive index is adjusted more or less linearly throughout the diameter of the fiber. STEPPED INDEX is different, because it involves two or more distinct steps of refractive index, and the laser beam bounces between these layers and the outer cladding in its path down the fiber.

Visible Refractive Index Demo

A very dramatic demonstration of the nature of refractive index can be produced with a small fish tank, water, ordinary sugar, and a few drops of milk. Figure 1 shows the experimental set-up. The tank is first cleaned, and then filled with warm water. For a five-gallon tank, you would next add about 20 drops of milk (proportionally adjust the amount according to the tank's volume). Stir. Then (still assuming five gallons) add about 1/2 cup of sugar. Allow the sugar to dissolve of its own accord,

Figure 1

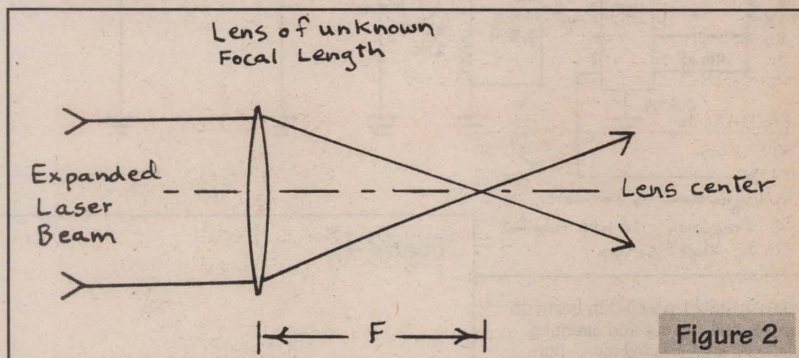
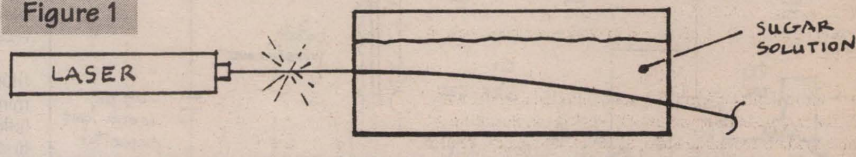


Figure 2

which may take overnight. Do not stir the solution.

As the sugar becomes dissolved, the denser, heavier solution remains on the bottom, while the lighter solution of less density layers out, with the least dense on top. Next, shine your laser horizontally through different depths of the tank. See how the beam bends toward the bottom? That is because the refractive index of the sugar solution increases as the concentration becomes greater.

To look at the situation in a quantum physics light, the photons of the laser light are actually travelling slower through the heavier part of the solution than in plain water, and that's what causes the light beam to bend, almost as if it were in the presence of a powerful gravitational field.

A prism operates in a similar way, since it can separate the colors of white light from one another, by virtue of the fact that the different colors travel at quite different speeds through a dense medium like glass.

Determining a Lens' Focal Length

A collimated laser beam is a very useful tool for determining the focal length {F} of a converging lens. Figure 2 shows this process. It is probable that buyers of surplus lenses are sometimes mystified by their purchases regarding the precise focal length. We can easily measure the diameter of such lenses, but not the focal length without an experiment.

A collimated laser beam is shined from a good distance (10 feet or more is advised for accuracy) as close as possible through the geometric center of the lens under test (LET). The experimenter should use a white card in a semi-dark room to do this experiment and, given such conditions, it is a very simple matter to measure the distance between the LET and the focal spot on the card so that you can determine the exact focal point of the LET.

Laser + Weather Creates Natural Art

During a recent snowstorm, I decided to try an experiment. I shone a 5 mW He-Ne laser out the window, up into the sky. Wow... What a captivating display! The snowflakes reflected the laser beam and, with a pair of binoculars, I could see the beam at least a hundred yards into the sky, despite the fact it was uncollimated. Stepping back a hundred yards, one could see the beam lance its way through the sky, beginning as an

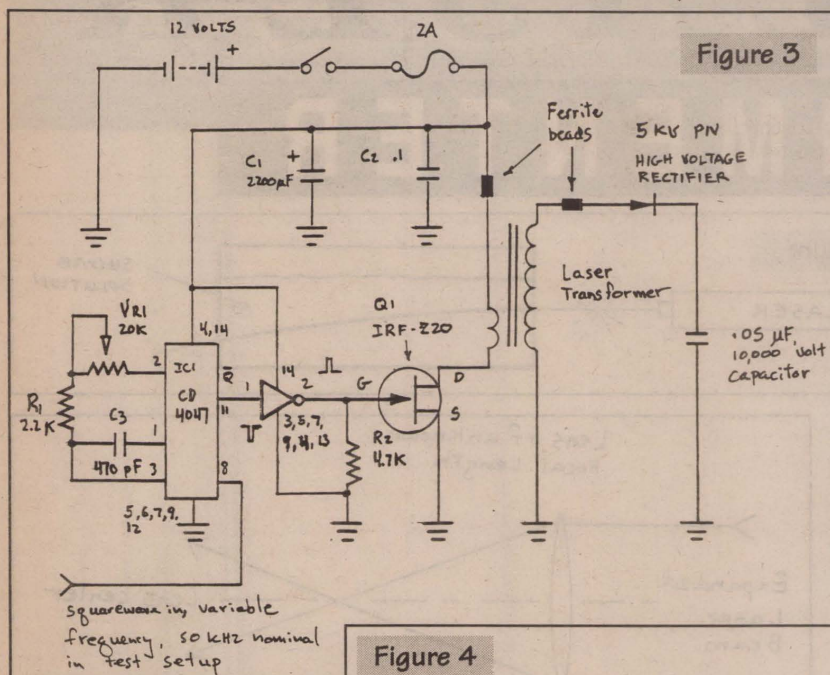


Figure 3

quantity. Thus, you could calibrate the receiver to read "light, medium, or heavy" snowfall, rainfall, or fog, similar to an RF signal strength meter used in many radio receivers.

Another thought came to mind recently. A little background first: I used to own a tropical fish store, and naturally tried my hand at breeding fish. This proved in some cases rather easy, and in others, exceptionally difficult and disappointing. I think a

aquarium, the balance of nature is bound to be somewhat off-kilter from the real thing, and the eggs are subject to bacterial invasion and consequent death of the developing embryo. So, in many cases, the egg will never get to the hatching stage. Not to mention, it is difficult enough to raise the egg-layers from birth to maturity, considering that special food must be provided at various growth stages.

But, to get over the hump of the initial bacterial infection of the egg is the hardest part with some species. To give you an idea of how difficult this can be, I once spawned Zebra Danios (a small, active, hardy fish) the first time off, and wound up with about 85 of the little critters from that effort. At the opposite end of the scale are Angelfish, an elegant, desirable and somewhat delicate tropical fish.

In the case of Angelfish, you have to put an antiseptic dye solution in the water to keep the eggs from becoming infected after the pair spawns. The dye is strong enough you have to remove the parents, or it will kill them, and indeed, the youngsters as well. You have to time this all very carefully and drain off the dye shortly before the babies hatch out. You can tell when, as most tropical fish eggs become transparent as the embryo develops, so you can see within.

The big problem is, of course, the bacteria. If we can

detect the presence of bacteria, we can guess whether the spawning will result in a successful hatch or not.

Although I haven't tried this yet, it seems reasonable that a concentrated laser beam, passed through the water, will detect the presence of bacteria and minuscule dirt particles that bacteria may cling to. Even though there are some very good filters on the market these days, sometimes they aren't working at peak efficiency, and bacteria will get into the water and multiply.

As an example, there is a filter that strains water through diatomaceous earth — the chalk-like substance composed of innumerable

intensely bright pencil-thin beam at the lab, fanning out and dimming gradually until it faded away, hundreds of feet in the air.

I remembered a conversation I had with a fellow four or five years ago that tried the same experiment with fog, which he seems to get a lot of in his area. He claimed to be able to see the beam the better part of a mile up. In his case, he was using a 8 mW He-Ne that was collimated.

There is a difference between the two experiments. Even though water is involved in both cases, with snow (which is, of course, ice) the multiple geometrically symmetrical surfaces of the snowflakes serve to bend the light rays, and where they exceed the angle of refraction — called the CRITICAL ANGLE — the beam exits the snowflake's ice structure. As a result, you see a portion of the beam that escapes the ice crystals, and reaches your eye.

With fog, I think the effect is actually much brighter for an equivalent mass density of material. That is because fog is an AEROSOL, or finely divided liquid suspended in a gas (air). The laser beam is reflected by the fog droplets, not because they are shiny, but because the beam enters the droplet, circles within it, and is returned to the observer's eye with a greater intensity, since the amount of drops per given volume is very much greater than the amount of snowflakes per given volume, even though the drops are much smaller.

Thus arises a couple of possible further experiments. Can we quantify the rate of snowfall or the density of fog using a laser? It should be possible, using a detector that will receive the reflected laser light from the precipitation. One possible idea is to utilize a phototransistor or solar cell that converts the reflected light into a linear voltage, and then reference that voltage to a known

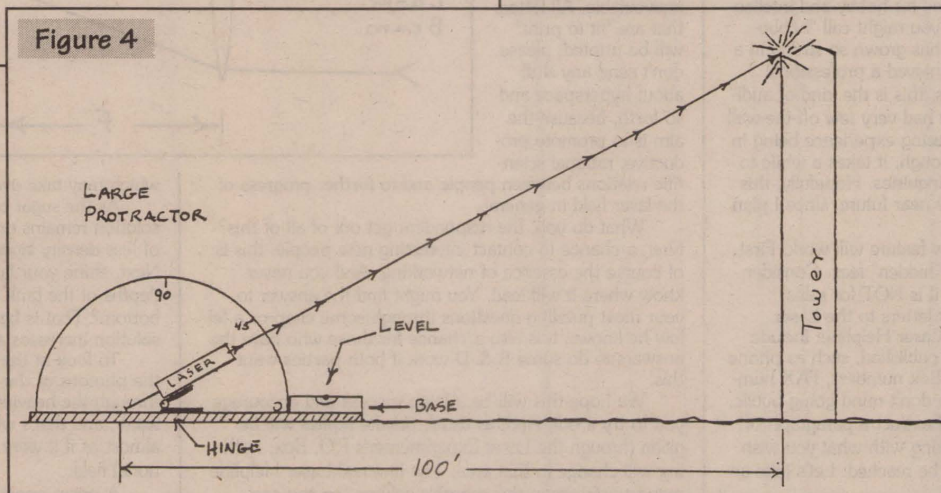


Figure 4

laser can make the process more successful.

People familiar with this hobby are well aware of how easy it is to breed livebearing fishes, i.e., the type that carry their offspring until fully formed, and give birth to them live. But the egg-layers are the type of fishes where the females lay or scatter their eggs and the males fertilize the eggs on the spot. Theoretically, the eggs develop, and the young hatch in several days. But in an

tiny silica skeletons of microscopic diatoms that have existed for hundreds of millions of years. Diatoms possess intricate skeletal structures, which serve to trap tiny bits of debris, including bacteria. But these filters have drawbacks, and those include the fact that if the diatomaceous earth is not perfectly clean, or the filter bag which contains it is not clean, or has a tiny hole (you probably couldn't see this by unaided eye), bacteria can still escape

LASER NEWS AND DEVELOPMENTS

Solid Plastic Laser Rods May Replace Lasing Liquid

Liquid dye-based lasers have some capabilities that just cannot be substituted by using solid, semiconductor, or gas lasers. But there are considerable engineering obstacles to surmount when designing a dye laser. These obstacles add greatly in cost of the instrument. They include such things as liquid circulating pumps, coolant systems, large reservoirs of spare lasing dye, and delicate optical systems external to the dye cell — itself a delicate and complex piece of apparatus. So all in all, a dye laser is a bulky, complicated, expensive, and difficult-to-service device. Another drawback is many of the solvents used to dissolve the dyes are poisonous, and present not only a personal hazard, but an environmental disposal

problem.

A new and exciting development may change all that. A research team under the direction of polymer scientist Robert Hermes at Los Alamos National Laboratory in New Mexico has developed PLASTIC dye laser rods, where the lasing dye is contained in a two-polymer plastic called hydroxypropyl acrylate with methyl methacrylate. Thus, all the bulky, delicate systems of dye lasers could be replaced simply by slipping the appropriate emission wavelength plastic laser rod in the optical cavity next to the laser pumping flashlamp. The new, patented plastic was developed as a weapon — for use in flashblinding gangs, terrorists, hostage takers, or perpetrators of riots. The flashblindness would be only temporary, but would suffice to stop the lawbreaker in his tracks cold.

Weaponry isn't the only area where plastic laser rods will prove useful. Any application

where a low-power laser could be used that needed almost instant tunability of wavelength would greatly benefit. For instance, in the medical field, wavelength changes of a few nanometers could be accomplished by adjusting the optical cavity — a simple mechanical procedure. Larger wavelength changes could be done by inserting a laser rod of the appropriate color into the optical cavity. It wouldn't require trained personnel to go through the procedure of changing the liquid dye in the lasing cell. This would be a boon to operating room personnel, as several laser light-stimulated procedures could be performed in one session, rather than in subsequent sessions. Example procedures include photodynamic therapy for cancer, a combination technique using a photoactivated drug and a laser to destroy tumors, and various optical biopsy and surgical techniques.

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with the variable pulse width, allows one to achieve high efficiency and power from T1 simultaneously.

How Tall Is The Tower?

Figure 4 shows a non-contact method of measuring the height of a tall object. I should imagine this would come in handy when felling trees. Since, unless the eye is very experienced, a tree can look shorter or longer than it is. I've had a couple of experiences where a tree came a little too close for comfort to a building, and will use the laser measuring method from here on in to see if there is a good safety margin. (If the tree has dead branches, it can "throw" them while falling, and even if one weighs a few pounds, it can take out a picture window if the angle is right. Hasn't happened to me yet — thank goodness — but it has happened to others.)

Set up the laser as shown, exactly 100' away from the object. Level the base of the laser. Place the beam spot on the top of the object (or wherever). You may have to collimate the beam if the distance is too far in order to see it. Binoculars help here. Read the angle on the protractor. Next, turn on your scientific calculator and enter the angle in degrees. Press the TAN (tangent) button. Multiply that calculation by 100, and you have the height in feet.

Next month, we'll get into more laser applications, and start a new project, which I'm sure some of the readers are going to find very interesting! NV

the filter's straining influence and contaminate the spawn. So much so that it took me 13 tries before I got the first successful hatch!

I would suggest to fish breeders the following: Keep your Diatom filter on at all times until the eggs hatch, but with the intake restricted and towards the top of the tank. You will have to position the filter intake according to the type of eggs to protect; it, of course, would be wrong to locate the intake near the top with floating eggs. Use the disinfectant dye (Methylene Blue or whatever is called for) in normal quantities and shine your laser through the tank. The beam should be invisible. If it's not, then some particulate contaminant or bacteria is present. This should be a good way to detect whether the embryo is about to hatch, too.

As they near hatching, fish embryos become more active and react strongly to light. Use a low-power laser, spread the beam out to 6" or so (so it won't harm the developing fish's eyes) and observe whether the light causes them to twitch within the eggshell. It should be a simple matter to guess whether the egg is about to hatch this way. Dead eggs should be easier to identify, as they will appear orange and milky (usually, depending upon species), whereas live ones will have the dark silhouette of the embryo visible. If any of you try this, I would be happy to hear your results if you send them in to the Laser Experimenter's P.O. Box listed elsewhere in this column.

Laser Power Supply

Good progress has been made with the Helium-Neon laser power supply. Figure 3 shows a generic test set-up for high voltage inverting transformers that was used with our home-brew laser transformer. (In case you missed this, the articles appeared in #LEoct94, #LEnov94 and #LEdec94.)

This circuit is nice since you can change the width of the pulse by adjusting VR1. A CMOS monostable multivibrator, IC1, controls the width of the output pulse. It is $2.48 R \cdot C$ in duration, where R is in megohms and C in microfarads.

This pulse width adjustability is handy because you can match the circuit to different transformers easily. It turns out that the best frequency for the transformer

using the capacitive load shown is about 50 KHz. I was able to get over 1,000 volts with this set-up, in fact, the circuit tended to "creep" upwards, so I added ferrite beads as shown to suppress the ringing waveform that it was producing, and which was responsible for the creep of voltage.

The passive components on the HV side are deliberately overrated, as I didn't know quite what to expect. But the important point is the transformer held up under maximum voltage stress. Now, we'll put a heavy load on it and see if it'll take that. When the transformer is proven — probably by next issue — we'll jump ahead and wrap up this project. We'll also have a nice PC board pattern and a source for a complete kit for you, as I am co-developing this project with a supplier, and that's one reason it's been presented in installments.

Here's how the circuit works: IC1 was chosen both since it will operate at 12 volts, and since the output width of the pulse is the same regardless of the input width. IC2, one of six gates of a Schmitt Trigger, inverts the NOT Q output of IC1, and amplifies the current to the point where it will drive Q1. Be sure and ground the unused inputs of the Schmitt Trigger, or it may break in oscillation and destroy itself. Q1 is a Hexfet — a type of super-transistor — and features an ON resistance of only 0.1 ohm, so it's ideal for driving T1. R2 keeps the Hexfet off when the pulse from IC2 is off, so it won't "float." Capacitor C1 provides a "reservoir" of current for Q1 as it switches, and thus increases the efficiency of the circuit. The input frequency is variable and, in conjunction

The Laser Experimenter is a reader-interactive column. We like to hear from the reader, and in many cases the best projects have come directly from your suggestions. If there is some particular facet of laser science that interests you, we would welcome hearing from you at: The Laser Experimenter, P.O. Box 74, Cornwall Bridge, CT 06754. Questions, comments, suggestions, and material relating to lasers are all welcome. We would like to publish letters in Reader Feedback occasionally. Indicate whether using your name and address is okay. We can now respond to your letters personally on an "as time permits" basis. Your FAX number, which will be kept confidential, will speed replies.

Laser Helpline: A Reader-To-Reader Interactive Forum

Anthony Charlton, the writer of this column, would be very interested to hear from anyone who has knowledge about the retroreflector left on the moon by one of the Apollo missions. That reflector is used to return laser pulses fired from the earth; the purpose being to measure the transit time of the laser beam, and thus the distance between the earth-moon system. He needs the location of the device (lunar longitude and latitude), advice as to whether it requires permission to occasionally perform measurements, and from whom that permission comes. He would also like to hear from anyone who has successfully performed measurements using the retroreflector and what type of laser and optics were used.

His second request centers around (quality) surplus ruby laser rods, and whether readers know if they are still obtainable and from whom. You can contact Mr. Charlton at: The Laser Experimenter, P.O. Box 74, Cornwall Bridge, CT 06754.

CLOSING QUOTE:

"I believe most simply in the nobility of this great effort to understand nature, and what we can of ourselves; that is science."

— J. Robert Oppenheimer

Anthony Charlton is an active electronics and science "do-it-yourself" project designer, does custom R & D and writes technical articles. Previous work experiences include design of hardware & software for microprocessor-based process control systems and electronic design. His hobbies include lasers, gardening, target shooting, and model rocketry.

MP1

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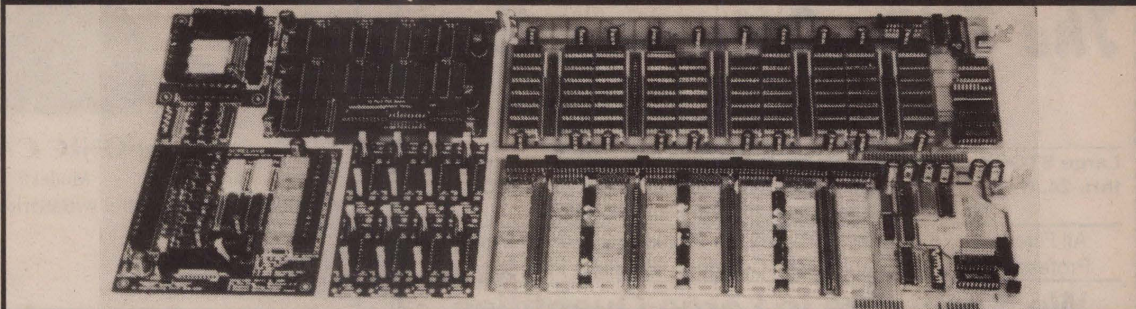
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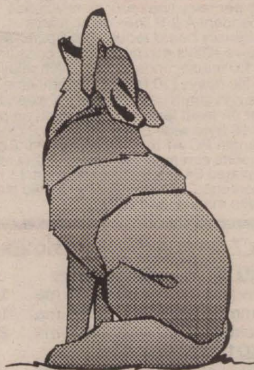
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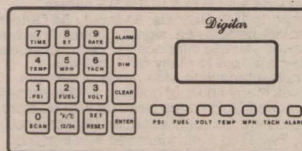
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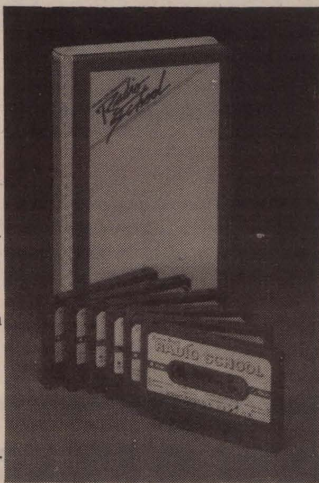
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RESOURCE BIN

number thirty-seven

A look at sensors and sensing.

Our usual reminder here that the *Resource Bin* is now a two-way column. You can get tech help, consultant referrals, and off-the-wall networking on nearly any electronic, *tinaja questing*, personal publishing, money machine, or computer topic by calling me at (602) 428-4073 weekdays 8-5 Mountain Standard Time.

A portion of my PSRT RoundTable on *GENie* has also been set aside for you *Nuts & Volts* readers. This is the place you go for instant tech answers. Among the many files in our library, you will find complete reprints for all the *Resource Bin* columns.

I did manage to wrangle one super special sign-up deal for you *Resource Bin* readers. Ten free hours and new Internet access features. See the trailer blurb for details.

Sensors and Sensing

This month, I thought we'd take a look at sensors and sensing. A *sensor* is any device that converts some other physical attribute into an electrical or electronic signal. Sensors of one sort or another are involved in just about any electronic project.

And they sure are one hot topic on our helpline and on PSRT.

Usually, there will be two stages involved in any sensor problem. First, you'll have to do your actual sensing. This gets done using a *transducer* of some type. The result is often a very small signal, possibly a few tens of millivolts. Noise is *always* a problem in any sensing situation. And *extreme* caution is required to take care of this very weak signal.

Next, you will typically have to do some *signal conditioning* to convert the sensed signal into something useful. Such as a higher current, a pulse train, or a digital word.

Signal conditioning tricks include shielding, differential mode sensing, isolation, offsetting, amplifying, temp comp, filtering, and A/D conversion. For really small signals, synchronous detection, correlation, integration, or averaging can also be applied.

Four sources of conditioning

chips are *Analog Devices*, *Crystal*, *Signetics*, and *Linear Technology*.

Unusual newer sensor technologies and ideas often appear in courses and publications from *SPIE*.

Sensor Trade Journals

As I may have mentioned a time or two before, those free trade journals are the best way to get informed in a big hurry on almost any subject. Start with *Ulrich's Periodicals Dictionary* on your library's reference shelf.

This gem lists some 150,000 trade journals and other magazines.

At any rate, your horse's mouth trade journal is *Sensors*. From Carl Helmers of early *Byte* magazine fame.

Also try *Measurement & Control*.

You can also go to industry specific mags for all sorts of useful stuff. Say *Pollution Equipment News* for

NEXT MONTH: Don looks at high frequency techniques and hackable resources.

typical environmental sensors, *Powder & Bulk Solids* for level controls, or *American Laboratory* for chemical sensors. Or even *Weight Engineering* for coverage on strain gauges.

One Stop Shopping

Your highest profile source for just about any sensor is *Omega*. These folks offer scads of impressive free catalogs on temperature, level, flow, pH, strain, pressure, data acquisition, and bunches more. Pricey, though.

One shirtsleeves source for nearly any industrial sensing instrument or tool is *Abbeon Cal*.

Temperature

The traditional way of accurately measuring temperatures is to use a *thermocouple*. This is simply a pair of connected, but *dissimilar* metals. The millivolt-size output voltage ends

up related to absolute temperature.

You do have to provide a *cold side compensator*, which usually will offset to ambient room temperature or zero degrees. And you have to be careful not to allow other dissimilar contacts anywhere in your sensing loop.

Thermocouples are identified by letter. In order of increasing temp, as types T, J, E, and K. Type J is made of iron and constantan.

The free *Temperature Handbook* from *Omega* is the thermocouple bible.

Thermocouples are often best for the high temperature measurement of kilns or whatever. But the usual rule is to avoid them when you can.

Your standard hacker temperature sensor is the ordinary silicon diode. These change by *minus* two millivolts per degree C. Usable to 150 C.

The 272-0123 from *Radio Shack* is a low-cost digital thermometer using a diode sensor. Other low-cost sources advertise in, of all places, *Food Service Product News*.

Which is also a great diet mag. Just read it before each meal.

And then guess whether that blue glop in the big bottle is a new dessert topping or a grease trap clarifier.

The semiconductor folks have long ago discovered that any pair of silicon diode junctions operating at different currents gives a linear output that is proportional to absolute temperature. The earliest example of this was the *National LM224*. Also carded at *Radio Shack*. Output current changes by one percent for every three degrees C.

A handful of really exciting new chips have recently been announced. *Dallas* has a DS1620 combined digital thermometer and thermostat. *Analog Devices* sells a TMP01 programmable controller. Range of both devices is -55 to +125 C. One obvious use is as a hot tub controller.

People Detectors

A person emits a very distinctive spectrum in the far infrared. The old way of dealing with this was with a *pyrolytic detector*. Any and all sanely priced people detectors have a unique problem. They are basically capacitors and only respond to *changes*.

One older workaround was to chop up your signal using a fan blade or a vibrating reed. A better and newer method is to use a special *Fresnel* lens that has "hot" and "cold" optical areas. As the person crosses the beam, the signal strength changes.

A newer and cheaper approach to people sensing is the *kynar piezo*

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film from AMP Piezo. This is just a plastic sheet that is sensitive to both flexure and infrared inputs. Free samples are literally stapled to their data sheets. Besides people detectors, this product builds shock sensors, heat detectors, and really great microphones.

Because the Fresnel lens design is tricky, you are better off starting with a commercial \$12.00 occupancy detector and kitbashing it. A California law mandates these in all new building construction, so they are a commodity part. Electrical supply wholesalers are your usual source. *Leviton* is a major manufacturer.

Pressure

Silicon pressure sensors are rapidly becoming low-cost commodities.

These are basically a "drum-head" etched into bulk silicon. Strain sensors are implanted on the drum-head. As the pressure changes, the drumhead flexes, causing a resistance change.

There are two main pressure sensor types. The *absolute* sensor compares pressure against a perfect vacuum. A *differential* sensor instead compares a pressure difference that's between two ports. If one of those ports is left open to your ambient air, then you have a variant called a *gauge* sensor.

Temperature compensation and a lot of amplification are often needed when sensing pressure. Some sensors are offered both as raw chips or with signal conditioning and temperature compensation built in.

Your two most obvious sources for the pressure sensors are *Motorola* and *Microswitch*. But the real action comes down from *Sensym*, *I.C. Sensors*, and *Novasensor*.

Sensym has a *Solid State Pressure Sensors* handbook. This one includes a great slide chart.

An oddball use for pressure sensors is in low pressure tire alarm systems. *Fleet Specialties* is one source.

There's also some purely resistive approaches to pressure sensing. One source is *Interlink Electronics*. With mice and music apps.

For ultra cheap, you can sometimes get by using nothing but the black anti-static foam that chips arrive in. But repeatability and reliability can be big problems here.

At the high end, *Force Imaging* sells subminiature and quite thin sensors that work from 1 to 20,000 PSI.

A modification to a pressure sensor will let it measure acceleration. The motion of a mass is sensed. The rate of change of motion of the mass is the mass velocity. The rate of change of the velocity is the acceleration. Except for airbag sensors, these devices are still very expensive.

One source is *Silicon Designs*.

Light

There are a wide variety of light sensors out there. The *photoconductive* sensors made from cadmium sulfide vary their resistance over a wide (but highly nonlinear) range with temp.

Again carded at *Radio Shack*.

Ancient *photomultiplier tubes* still remain the sensor of choice for ultra sensitive astronomy and similar uses. *Hamamatsu* is the leader here.

Solar cells will generate a current proportional to input irradiance. For self-powered calculators, or remote site power generation. Lots of these in *Home Power* magazine.

Three variations on solar cells are *phototransistors*, *photodarlingtons*, and *phototriacs*. These amplify to produce a much stronger signal. But they do need external supply power. These get used for everything from dusk to dawn sensors, door openers, power isolation, and shaft encoders.

Lots of ads for these right here in *Nuts & Volts*. *Burr-Brown* is one source for low-cost, large-area detectors with built-in conditioning. The MOC3020 is a typical *Motorola* phototriac.

But *Texas Instruments* has just run away with all the marbles. They have an exciting new line of low-cost and hassle-free *light-to-frequency converters*. Their first device is the programmable TSL230. They've also got a TSL235 in a lower cost vertical package. Under a buck and a half in quantity.

For starters, pick up their *TSL230 Applications Brief*. More use details in NUTS33.PS and HACK80.PS posted to my *GENie* PSRT.

It's a Gas

Gas sensors can be used for alcohol breath analyzers, in carbon monoxide alarms, and fuel vapor

detectors.

These are magic compounds heated by a platinum wire. The resistance is a function of the concentration of your target gas. These are usually *not* very selective, so other activating gases can cause problems.

Your leading source here is *Figaro*. More details and working circuits in my *Hardware Hacker* reprints.

pH

A *pH sensor* measures the acidity or alkalinity of a chemical solution. The most likely use you'd have for one is for swimming pool maintenance. Or maybe for water quality checks. The sensor probes are a chemical cell the shape of a small test tube.

Ion conductivity through a porous membrane generates a voltage that is proportional to pH.

These *demand* DC amplifiers having a super high input impedance. Temp comp and tracking is a must.

Calibration is also important. Many older systems do this by using stock *buffer solutions* for adjustment.

A circuit and more details on a pH meter in my *CMOS Cookbook*.

Sources for pH probes are *Omega*, *Fisher*, *Corning*, *Markson*, *Cole-Parmer*, *lotron*, and *pHoenix Electrode*.

Current theoretical info shows up in *Analytical Chemistry*.

There's a brand new pH measuring scheme called the *field sensitive FET*. I'm still trying to chase this one down.

Please let me know if you can find me any more details on these. A free *Incredible Secret Money Machine II* for your trouble.

Magnetic Fields

The stock solutions to sensing fairly strong magnetic fields are devices using the *Hall Effect*. Which is just a current related to field strength.

Two main sources here are *Allegro/Sprague*, who offer a great *Hall Effect Optoelectronic Sensors* data book. And *MicroSwitch* who has their older, but highly useful *Hall Effect Transducers* applications manual.

Linear Hall Effect parts output a voltage which is proportional to the magnetic field. Digital parts output a logic level or pulse train.

Nearly all Hall devices are woefully insensitive. They only work properly with *strong* magnetic fields such as a *nearby* magnet. One that is *very* close. One quarter inch is really pushing it. Still, these are the low-cost device of choice for position and speed sensors. Also for use with proximity sensors and flowmeters.

RESOURCE BIN

Two main sources of premium Hall magnetic sensors and instruments are *F.W. Bell and Walker Scientific*.

But note that Hall devices are *totally* unsuitable for compass sensing of the earth's magnetic field. They miss by two to three orders of magnitude.

One compromise solution builds a compass with a rotating magnet and then decides that magnet's position. Low-cost *Dinsmore Instruments* parts do just this. But their accuracy is often limited to 22.5 degrees or so.

Mechanical motion is involved.

Instead, the device to use for high quality compasses is the *fluxgate*. This is simply a small magnetic core. One winding switches the core into and out of saturation. When not saturated, the core "gathers in" nearby lines of the earth's field.

When saturated, the core "releases" the lines. A pair of X and Y windings senses this gathering and releasing, producing output pulses that end up proportional to the local strength of the earth's field.

One source of hacker fluxgates is *Magnetic Research*. A quality source of fluxgate compasses is *KVH*. Others do advertise in *GPS World*.

The *Institute of Navigation* is another extremely useful resource here. As is the *Navtech Bookstore*.

A fluxgate alternative is offered by *Precision Navigation*.

A construction project on fluxgates appeared in the Jan. '94 issue of *R.F. Design* on pages 24-32. And full construction info on a unique low-cost fluxgate compass project appears in my *Hardware Hacker III* reprints.

Humidity

The *humidity* is the amount of water vapor in the air. Which might be the *absolute* quantity of water present. Or else the *relative* amount of moisture compared against your max possible without fog or rain. Humidity is a very strong function of temperature, so you nearly always have to measure the temperature as well.

Zero cost humidity sensors include horsehair, an unwashed blond human hair, or a nylon fishline. They all get longer and shorter in response to the humidity. Surplus fishline humidity controllers are available from several *Nuts & Volts* advertisers.

The most accurate way to measure humidity is with a *chilled mirror*. A mirror on a thermoelectric cooler gets adjusted to the *dew point*, the temp where condensation first occurs. Light either does or does not get scattered to servo the temperature to the dew point. A simple (but highly nonlinear) calculation finds the humidity.

A variation on dewpoint is the *sling psychrometer* or those related *wet bulb and dry bulb* systems.

Sadly, there is no really cheap and universal solid-state humidity sensor. Those that do work operate only over a limited humidity range. And they tend to be outrageously expensive in small quantities.

Several of the better sensors are capacitors whose dielectric constant changes with humidity. These can be micropowered and directly generate a frequency in a simple RC oscillator. Sources include *General Eastern* and *Panametrics*. Related moisture sensors are offered by *HyCal*.

Since surface absorption is often involved, most humidity sensors are easily contaminated. Certain sensors can get flushed or otherwise cleaned; but others can not.

There's also older resistive sensors. But not used much, though.

One very low-cost source of analog hygrometers is *Klockit*. *Abbeon Cal* sells better grade instruments.

This Month's Contest

As our contest for this month, just tell me about any unusual or little known sensor resource. Or tell me about some new off-the-wall sensor use or application.

There will be a largish pile of my new *Incredible Secret Money Machine II* books going to the dozen or so better entries, plus an all-expense-paid (FOB Thatcher, AZ) *tinaja quest* for two that will go to the very best of all.

I have just picked up some more Apple II+ and IIE computers, cheap enough to put to use as dedicated controllers. And even including a few rare and collectible Apple IIIs, as well. Lots of cards, drives, monitors, and parts, too. Call for info.

Let's hear from you. **NV**

Microcomputer pioneer and guru Don Lancaster is the author of 32 books and countless tech articles. Don maintains his no-charge tech helpline found at (602) 428-4073, besides offering all of his own books, reprints, and all of his consulting services. He also has a free catalog full of his resource secrets waiting for you. Your best calling times are 8-5 on weekdays, Mountain Standard Time.

Don is now the sysop of GENIE PSRT, where a special Resource BIN topic has been reserved for Nuts & Volts readers. For modem access: (800) 638-8369. When prompted, enter JOINGENIE. When asked for a keyword, enter DMD524.

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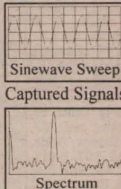
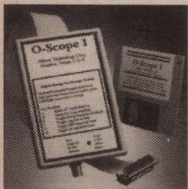
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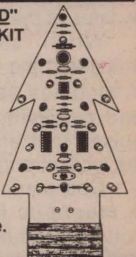
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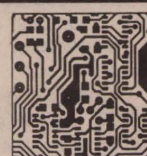
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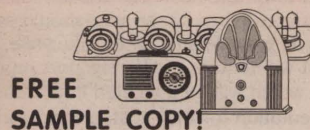


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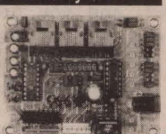
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| DPDT/CENTER-OFF | S135 | 6A/125V | Solder | 91 .81 |
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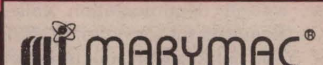
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INTRODUCTION TO THE INTERNET

Telnet and FTP

by Jim Benson

This column will help you to become familiar with the telnet program which enables you to log into thousands of host computers on the Internet. We will also learn about FTP which is the main method of downloading some of the hundreds of thousands of programs and information files that are available to you on the Internet.

Background

As discussed in a previous column, the Internet functions by connecting one computer to another over short or long distances. Packets of information are routed from one end of the connection to another, based on the TCP/IP addresses and routing scheme. Internet addresses are of two forms, each equivalent of the other.

The human readable domain name address is of the form microsoft.com, and its equivalent numeric IP address is 131.107.1.3. In using the Internet, you will almost always use the domain name rather than the IP address. I will refer to both as the site or host address.

Most programs that you will be using on the Internet — such as telnet, FTP, gopher, www browsers, etc. — all are written to certain specifications or standards. In the Internet world, these are called protocols and are based upon written documentation called RFCs (Requests for Comments), FYIs (For Your Information documents), and STDs (Standards).

A repository of these documents can be found at is.internic.net, and at a variety of other sites. The is.internic.net site has an amazing wealth of information about the Internet. These are the documents to read if you wish to have a detailed, and more technical understanding of how the Internet works internally. The documents can

be obtained through either telnet or FTP, with FTP the preferred method.

Telnet

The program named telnet is based on one of the older Internet protocols, and is one of the most widely used programs for logging on to another computer over the Internet.

With telnet, you can establish connections with library catalogs, campus information systems of various universities, full-text databases, data files (e.g., statistics, oceanographic data, meteorologic data, geographic data, etc.), and other online services.

Like most other programs used on the Internet, telnet is a client-server system. When you fire up your telnet program, you are on the client end because you will be requesting services from a remote server which recognizes and responds to the telnet protocol. If you attempt to log into a host that does not make the telnet protocol available, your telnet client program will not be able to complete the connection.

Client-server systems require that a client program attempt a connection to the server program. No other communication is possible until the client and server have "introduced" themselves through the appropriate protocol handshake.

Your telnet program (and all other Internet utilities) will most likely reside on your own PC, or on the Unix host system operated by your Internet service provider, if you are using a shell account.

To use telnet in a Windows environment (Macintosh is very similar) over a SLIP (serial line internet protocol), or PPP (point to point protocol) dial-up connection, you first dial into your Internet service provider and establish a connection by entering your ID and password given to you when you subscribed to the service.

At this point, I assume that you already have these programs and capabilities, as discussed previously.

Once your connection is established, you simply select the telnet program from Windows Program Manager. If you have a telnet program, but have not created a Program Manager icon for it, you should do so. After double clicking on the telnet icon, your specific telnet program will start up, and you will have the opportunity to select or enter any host computer address you desire. See the list of telnet sites in the sidebar.

The details of how to use telnet under Windows will vary with each different version of telnet, but these instructions should be general enough to get you started. Please see the documentation that came with your telnet program, or refer to its online help.

All telnet programs emulate at least the DEC VT100 terminal, since it was the most popular and widely used terminal at the time telnet was at its peak. In addition to the VT100, your telnet program may also emulate a plain vanilla ASCII TTY (from the teletype era), ANSI, and more variations of DEC terminals. Since the VT100 is the de facto minimal standard, use it as your default emulation.

If you are using a shell account on your Internet service provider's unix machine, you will need to dial-in using your regular PC communication software. Be sure to set your comm program for VT100 terminal emulation, so it will match what the telnet servers expect. Now, log onto your service provider system, as instructed by your provider. Once on, you will be at the unix prompt. This is where you will run all of your programs (like telnet, FTP, etc.).

Telnet will need to know what host computer you intend to log onto. Most telnet programs will permit either the domain name or the IP address to be used. If you use the domain name, the IP address will be

looked up on your Internet service provider's domain

name service system which will translate the domain name into the IP address, behind the scenes.

Most Windows telnet programs will allow you to assemble and save a list of frequently contacted telnet sites, and further allow you to enter a descriptive name of your choosing. Then, when you want to connect to a certain host, you just pop up your list, click on the descriptive name, and the telnet program does the rest.

In addition to a host, telnet also needs to know what port to try to connect to on the host. The default telnet port is number 23, so you should set this as your default. Once in a while, a host will require a different port number which will be specified in the documentation for that host, and you will need to replace port 23 with the one specified.

To start telnet from your provider's Unix prompt, enter either the word telnet, or telnet and a host name. For example: telnet psu-pen.psu.edu. If you just enter telnet, you will then get the telnet prompt which looks something like this:

```
telnet>
```

At the telnet prompt you can enter a ? or the word help. This will result in a list of available telnet commands and a short description of their use. If you started with just the word telnet, and you are at the telnet prompt, you can enter:

```
open psu-pen.psu.edu
```

and this will attempt the connection to that site.

Until you become familiar with the use of telnet, and other similar programs run from the Unix prompt, be sure to notice and write down how to leave the host you have connected to. It can be frustrating to be "trapped" in a host and you can't get out. Many hosts have different ways to log off, so be on the watch for such instructions when you first log on.

With either a Windows telnet client, or running telnet from the Unix prompt, you will see the same thing; usually another prompt or a menu. If you are in Windows or some other graphical user interface environment, your telnet client is really a VT100 terminal emulator running under Windows. Follow the instructions given to you by the telnet host you logged onto, and begin exploring what it has to offer.

FTP

FTP is a high level protocol for transferring files from one computer to another. You will find this to be one of the most frequently used programs in your Internet toolkit.

Some Interesting Telnet Sites To Try

Agriculture Telnet: psupen.psu.edu. User name: Your two-letter state code or WORLD.

AIDS Telnet: callcat.med.miami.edu. Log in: library.

Amateur Radio Telnet: callsign.cs.buffalo.edu 2000 or ham.njit.edu 2000. When you connect, you tell the system how you want to search and what you're looking for. For example, if you want to search for hams by city, you would type city city-name and hit enter (for example: 'city Kankakee').

Calculators Telnet: hpcvbbs.cv.hp.com. No log-in is needed.

Chemistry Telnet: camms2.caos.kun.nl. No password needed.

Congress, Library of Telnet: locis.loc.gov. No password needed.

Current Events, CIA Fact Book Telnet: info.umd.edu. Choose a terminal type and hit enter (or just hit enter if you are using VT100). At the Gopher menu, choose the number next to "Educational Resources" and hit enter.

Dictionary Telnet: info.rutgers.edu. No log-in name is needed. At the main menu, type reference.

Environment Telnet: epalbm.rtpnc.epa.gov. No password or user name is needed. At the main menu, type public and hit enter (there are other listed choices, but they are only for use by EPA employees). You'll then see a one-line menu. Type ols.

Geography Telnet: martini.eecs.umich.edu 3000. No password or user name is needed. Type in the name of a city, a zip code, or a geographic feature and hit enter. The system doesn't like names with abbreviations in them (for example, Mt. McKinley), so spell them out (for example, Mount McKinley).

Government Telnet: fedworld.gov. Log on as new.

Health Telnet: fdabbs.fda.gov. Log in: bbs. You'll then be asked for your name and a password you want to use in the future. After that, type topics and hit enter.

Hiring and College Program Information Telnet: fedix.fie.com. User name: fedix (for the federal hiring database) or "molls" (for the minority-college system). Both use easy menus to get you to information.

History Stanford University maintains a database of documents related to Martin Luther King. Telnet: forsythetn.stanford.edu. Account: socrates. At the main menu, type 'select mlk' and hit enter.

Space. The system maintains a large file library of GIF-format space graphics, but you can't download these through telnet. If you want them, you have to dial the system directly, at (205) 895-0028. Telnet: spacelink.msfc.nasa.gov. When you connect, you'll be given an overview of the system and asked to register and choose a password.

Supreme Court Decisions. The University of Maryland Info Database maintains U.S. Supreme Court decisions from 1991 on. Telnet: info.umd.edu. User name: info.

Telnet Addresses. Hytelnet, at the University of Saskatchewan, is an online guide to hundreds of telnet sites around the world. Telnet: access.usask.ca. Log in: hytelnet.

Time to find out the exact time: Telnet: india.colorado.edu 13. You'll see something like this: Escape character is '^J'. Sun Apr 5 14:11:41 1992 Connection closed by foreign host. The middle line tells you the date and exact Mountain Standard Time, as determined by a federal atomic clock.

Transportation. The Subway Navigator in Paris can help you learn how long it will take to get from point A to point B on subway systems around the world. Telnet: metro.jussieu.fr 10000. No log-in is needed. When you connect, you'll be asked to choose a language in which to search (you can choose English or French) and then a city to search. You'll be asked for the station you plan to leave from and the station you want to get to.

Weather. The University of Michigan's Department of Atmospheric, Oceanographic and Space Sciences supplies weather forecasts for U.S. and foreign cities, along with sking and hurricane reports. Telnet: madlab.spri.umich.edu 3000 (note the 3000). No log-in name is needed.

(The above excerpted from Big Dummy's Guide to the Internet by Adam Gaffin with Jorg Heitkotter. This is an electronic document and is located on a world wide web server at http://gopher.metronet.com:70/0h/bdg/bdg_toc.html#SEC208.)

There are so many FTP sites that it is impossible to keep track of them, and like many resources on the Internet, sites come and go, change their names, become closed to the public, while hundreds of new ones open up. No reference work or list of Internet resources can ever be up-to-date or completely accurate because of the dynamic nature of the Net.

FTP is more specialized than telnet, because telnet allows you to connect to a host computer and then get a menu and do whatever the host permits you to accomplish. FTP, on the other hand, is designed to access directories on the target host computer, list the files, and permit you to download them to your own PC, or to upload files, if that is permitted by the FTP server you are attached to.

So, like most other programs used on the Internet, FTP is a client-server architecture. You will mostly run the client side and connect to FTP servers. Since FTP has been around for a while, and because it is so frequently used, there are many different FTP programs available, for every operating system, but by the nature of file transfers, they all operate on the same basic principles.

A typical Windows FTP client will allow you to enter and save any number of frequently used FTP sites, and the specifics for each site. For example, NetManage Chameleon permits you to save — for each FTP site entry — its: description, host domain name, user ID, password, the system type, an account number, remote directory, and local directory.

You enter any description that is meaningful to you, such as Indiana Univ, or Gutenberg Project, or IRC Stuff at BU, etc.

Under Host, you must accurately enter the domain name of the FTP host. For example: ftp.cica.indiana.edu, or info.umd.edu, or cs-ftp.bu.edu, using the three servers above.

For most public access FTP servers, use the User name of "anonymous" without the quotes. This is the default standard for such servers, although some may require "guest." If a host does not accept either anonymous or guest, then it may not be open to the public.

For password, always try your E-Mail address first, for example jsmith@host.domain.name. If that does not work, try leaving password blank.

Not all FTP programs allow you to specify the System type, but if yours does, set it for Unix, unless you know for certain that the host server is some other operating system, then

enter that instead of Unix.

After entering the host and user name, click on OK, or whatever starts your program, and a connection will be made. If the host accepts anonymous for the user ID, and your E-Mail address for the password, you are in, otherwise you may have to enter the password manually.

If you are on the Internet through a Unix shell account, just enter the name of the program FTP, as with most Unix programs. Or, you can enter ftp host.name (substituting a real host computer name like cs-ftp.bu.edu). As with telnet, you can also enter ? or help at the FTP prompt, if you did not enter a host name. If you are at the FTP prompt and wish to connect to a host, enter: open host.name.

It is beyond the scope of this column to provide detailed instructions on the use of each program, but you should be at least familiar with the following FTP commands before logging onto an FTP host (if you are using Unix from a shell account): cd, dir, ls, get, more, and q.

Since many of the programs you will be downloading to your computer will be compressed, it will be necessary for you to have handy such common file decompression programs as pkunzip, etc.

Once connected and logged on to the FTP server, you will normally be at the top of the file system, or whatever directory starting point the system starts at. You use your interface to go down through the directories, searching for promising sounding subdirectory titles, or just go to the directory you were told to look in.

Once at the appropriate place, you will be able to select one or more files for downloading directly to your PC or to your shell account at your Internet service provider. There is great variation in the features and functions available to you, depending on the FTP software you are using.

For example, Chameleon provides the following buttons: change, create, and remove directories; get info about files; append, copy, view, delete, and rename files. You simply select the desired host directory and file on one side of the window, and the local directory on the other side of the window, and click on copy.

If you are using a Windows program and a personal or business-type domain name account through your service provider, your files will be downloaded directly to your PC. If you are using a shell account on your provider's Unix machine, you will be downloading files in two steps.

FTP will perform the download to your shell account on the service provider's machine. You will then need to know how to perform a file transfer from the provider Unix box to

Ports and Sockets

Ports and sockets are important concepts that you might be interested in learning more about.

Ports are somewhat visible to users of systems, while sockets are not at all visible, but together they are a most important ingredient in moving packets of information from one place to another. As you already know, TCP/IP is a pair of protocols for specifying addresses and the format of packets, and their movement from one IP address to another, in sequence, without errors.

At one level lower, an IP address has one or more ports that can send and/or receive packets. By convention, certain ports are commonly used for certain functions. For example, port 23 can usually be counted on to be the host computer telnet port, while port 6667 is usually the available port for IRC (Internet Relay Chat) on IRC servers.

A list of commonly used ports is shown in Table 1.

If you were to tell telnet that you wanted to connect to some arbitrary port number instead of 23, your telnet program would faithfully send out the initial handshake messages that are part of a telnet client attempting to connect to a host running the telnet server. In this case, the port contacted would either not exist or it would be expecting some other protocol, and your attempted connection would fail.

As a further side note, it can be fun to try to connect to different ports with telnet and see what happens. If, for example, you have read the RFC 1459 which describes the IRC protocol, you can actually use telnet to connect to port 6667 and manually initiate an IRC session. You cannot get much beyond that point, but it is an interesting experiment to explore the interactive nature of the mostly ASCII driven, interactive nature of the Internet.

A port is a logical device and multiple connections can be handled by a single logical port number. This is because the server software sits behind its assigned port, listening for a matching client using the correct protocol to attempt a connection. When this occurs, the server software creates a new socket behind the port and directs the newly connected client software to send and receive on that newly created socket.

So, sockets are one level below the port, and each socket is a thread, or one of many tasks running in a multitasking system. A pair of sockets (one on the client end and the other on the server end) form a logical, virtual connection, each with its own buffers, but each controlled by the protocol program above, e.g., telnet, FTP, etc.

Sockets are a fundamental part of the Unix operating system, and a recent addition to the Windows operating system. To run this type of communications, it is required that you have a file named winsock.dll and that it be version 1.1 or later. Your communication software will have provided this DLL. Most new operating systems are now delivered with the winsock file, and perhaps with their own TCP/IP stack and associated utilities like telnet, FTP, etc.

To summarize, ports are where certain programs reside, waiting for a remote, compatible program to perform the initial handshake. Once this has occurred, the server software creates a new I/O socket and hands off your client to the socket to perform the low level input and output as separate tasks under the server. Of course, this is all invisible to you.

your PC, using your comm program and a file transfer program like zmodem or kermit. Kermit is slow and old, so try to use a more modern program like zmodem. Your provider will have to tell you what file transfer programs they

cols of the Internet. Together they give you access to an incredible amount of information to browse or to download to your own PC. Yet, these are only the beginning. There are gopher servers and archie searches of entire collections of the contents of many hosts, the World Wide Web and their multimedia servers, 8,000 news groups, Internet Relay Chat, and much more!

If you have not begun to explore the Internet, don't delay. The Internet is so

support.

Here are some of my favorite FTP sites: ftp.cica.indiana.edu for an amazing number of Windows programs; cs-ftp.bu.edu for all documents and software related to Internet Relay Chat (IRC); is.internic.net for all documentation about the Internet itself; ftp.microsoft.com for a variety of Microsoft drivers, information, etc.; sunsite.unc.edu for Unix, and especially Linux documentation, source code, etc.; and wuarchive.wustl.edu for a wide variety of PC programs of all types.

So, there you go. Telnet and FTP are two of the foundation proto-

colly important and growing so fast that many large companies are trying to figure out how to capture it and turn it into their own kind of service.

Today, you can still get on the Internet for a flat monthly fee, and connect to any site in the world, and transfer any amount of information, at any speed up to 28.8 kbps — all for no extra charges on distance, volume, etc. No other service offers so much for so little, so get on now and use and protect this valuable and unique resource. NV

Sources to Get You Started

The Internet Complete Reference
Harley Hahn and Rick Stout
Osborne/McGraw Hill, ISDN 0-07-881980-6, 800 pages, \$30.00.

The Internet Yellow Pages
Harley Hahn and Rick Stout
Osborne/McGraw Hill, ISDN 0-07-882023-5, 445 pages, \$28.00.

Finding it on the Internet
Paul Gilster, John Wiley & Sons
ISDN 0-471-03857-1, \$20.00.

TABLE 1 — Port/socket numbers, network standard functions

| | | | | |
|-------------------|-------------------|--------------------|---------------------|-------------------|
| echo.....7 | discard.....9 | systat.....11 | daytime.....13 | netstat.....15 |
| ftp.....21 | telnet.....23 | smtp.....25 | timeserver.....37 | nameserver.....42 |
| whois.....43 | mtp.....57 | tftp.....69 | rje.....77 | finger.....79 |
| tylink.....87 | supdup.....95 | execserver.....512 | loginserver.....513 | |
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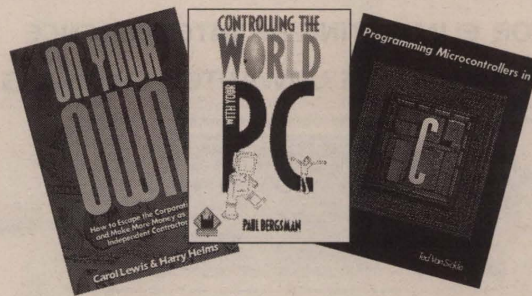
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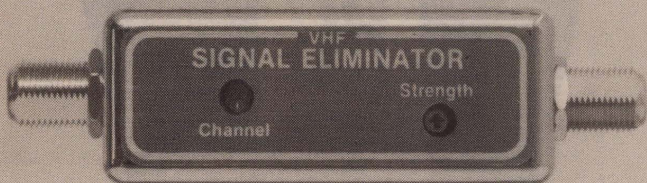
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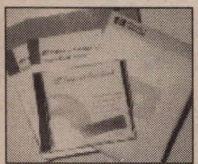
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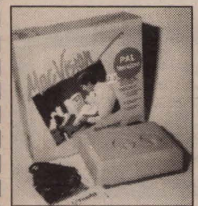
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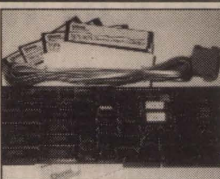
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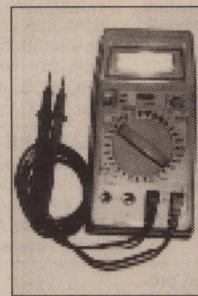
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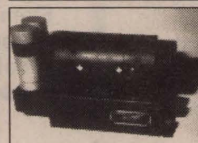
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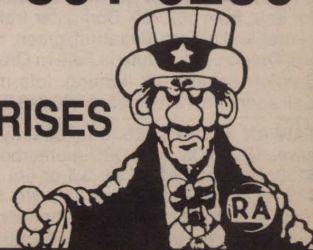
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Operation AirStorm

Continued from page 18

Once in the air, switch to a radar display (F10), set control sensitivity for your hardware, then turn to the nearest enemy fighter and select your weapon.

When you complete a mission, the computer returns you to base for an automatic landing.

You'll be shot down by an enemy missile in no time, and end up in a ball of flame — although you'll receive the Novian Purple Badge of Honor posthumously!

I suggest that while you are in the Ready Room and getting your briefings, click on the computer screen and select the following OPTIONS: Joystick, Sound ON, Detail HIGH, Skill Level EASY, Auto Resupply YES, Weather GOOD, Copilot ON — unless you want to be a dead hero. With the Easy Skill Level, you can't be shot down, and you can even fly "underground" (meaning you better pull the stick back to get airborne again!). The Auto Resupply won't let you run out of weapons or fuel. When you're ready to go out and save the Novian Republic, click on the helmet.

Once you're in the air (you can hit the Enter key to bypass some aircraft launching scenes after you've seen them a few times), you must first calibrate (ALT-J) if using a joystick. Then try some turns, climbs, and glides. I found the default settings for control sensitivity (not even mentioned in the manual) were far too high for my computer and joystick. The F5 and F6 keys determine control sensitivity. I was ready to give up on the flight simulations in Operation AirStorm until I discovered the use of F5 and F6 on a help screen (found by hitting escape while flying — not mentioned in the manual).

Wow! What a difference! I dropped the sensitivity from the preset 100 to 41, and now all the aircraft fly very much like the real thing. This, of course, depends on your hardware, so try flying first, and if you seem to be overcontrolling, use F5 to decrease the joystick sensitivity, or F6 to bring it back up. If you choose to control the aircraft with the keyboard (yuck) or the mouse (double-yuck), the sensitivity setting does not seem as important.

These are high performance aircraft. They are fully aerobatic, make sharp turns, and gain or lose altitude very quickly. Except for the Apache helicopter, that is. This is slow, won't bank more than 30 degrees, and flies a little differently than a fixed wing aircraft; pushing the stick forward lowers the nose and increases the airspeed, but does not change altitude! To change altitude, you use the numeric keypad (-) key to go up, the (+) key to descend. [Look at the keyboard and you'll see why this seems backwards; the (-) key is ABOVE the (+) key.]

Your cockpit display shows a general view of the area, but it is not effective. Hit the F10 key and your display becomes a radar screen showing bandits (X) and targets (+) in bearings from your nose. Now you must make some decisions. If there is an enemy aircraft anywhere near you,

head directly for it and choose your air-to-air missile weapon. When you spot the enemy targeted in your windscreen (and shown in your display), and the box around it flashes red, fire your missile. When your missile hits the target, you see a bright explosion, and you are usually notified by a voice message. You also get a voice message when you miss the target.

Enemy aircraft usually fly in twos, so when you shoot one down, look for his wingman nearby. If one of these guys gets behind you, you will soon find a missile up your tailpipe! If no enemy plane is nearby, go for the assigned target, first choosing your weapon. But always give enemy aircraft the priority, heading straight for them! And don't even think of trying to shoot one down with your cannon; use a missile.

For ground targets, you not only need to locate the target, but with some weapons you must guide the air-to-ground missile until it strikes — and this takes very gentle and precise control. Your display targeting "pipper" must be kept relatively steady for you to get a hit, and be careful of target fixation that has you flying into the ground!

There are eight missions — two for each aircraft — with significant variety between them. You can choose individual missions for practice, and then go on a campaign, where your commander assigns you all of the eight missions. All missions involve scoring and are tallied against the pilot's name. Clicking on the banner in the Ready Room shows all scores. If you don't complete a mission, you are penalized points. If you do complete a mission (destroying all assigned targets) you are returned to base and several screens show you landing. If you complete a mission successfully, the pretty Novian lady (Princess?) appears on video to give you an award — and the awards get larger with each successful mission.

Do I Like It?

I can't recall spending as much time, being more challenged, or having as much fun, with any flight simulator I've flown in my last 16 years flying microcomputer flight simulators. More than just shoot-'em-ups, the missions are tough, but they can be accomplished (in Easy Skill Level).

The animated kit assembly potion is an amazing and practical application of CD-ROM technology. Oddly, nowhere on the Operation AirStorm packaging is there any mention of the animated 3D kit instructions, which I consider the most unusual feature of this CD-ROM disc. And considering the very low price, you should feel like a thief when you buy it from your local software outlet, mail-order house, or order it directly from Expert Software at 800-759-2562. **NV**

Fred Blechman has written almost 700 magazine articles and five books about electronics and microcomputers since 1961.

Saving the Novian Republic!

As entrancing as it is to watch the animated kit-building portion of Operation AirStorm, there are those of us who can't suppress our Walter Mittyish urge to get into aerial combat! Although I personally was a Navy fighter pilot in the early 1950s, flying F4U-5 Corsairs, I was with the Sixth Fleet guarding the Mediterranean during the Korean War years, and never saw combat. We had a lot of mock-combat training, but not the real thing. Here was my chance, with Operation AirStorm, to show my stuff!

Well, let me advise all you "nuggets" (newcomers) out there, the flight simulations offered in Operation AirStorm take more briefing and instruction than the User's Manual (good as it is) provides. After some introductory screens during which you enter your name, pick a plane, and a mission, you'll find yourself in the Ready Room, where you can make a number of selections. It's a very good idea to click on "Mission Briefing" and "Maps and Targets." The briefings are audio, video, or both, and you need them to understand what you'll be trying to do. The video briefings are particularly good, with General Borga (the bad guy) really hammering it up, and the mission leader laying it right on the line.

I can tell you that trying to fly in the EXPERT mode is absolutely suicide.

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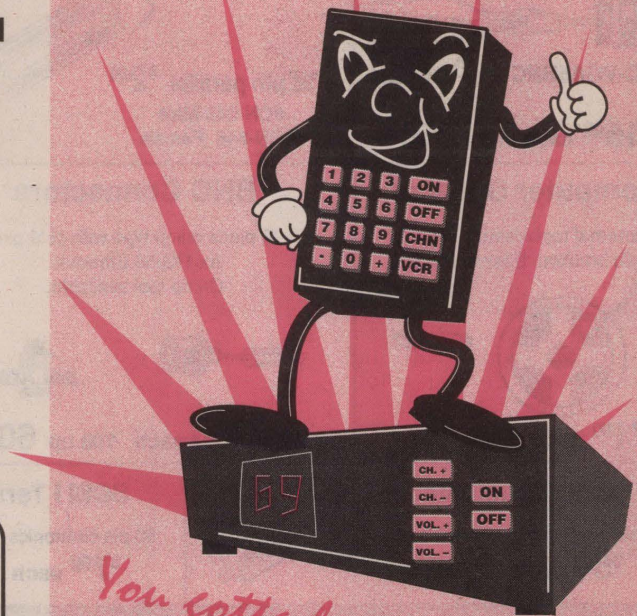
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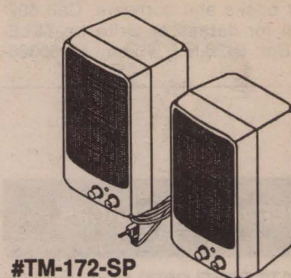


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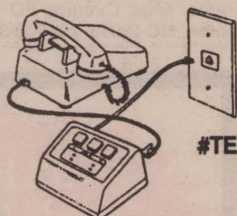
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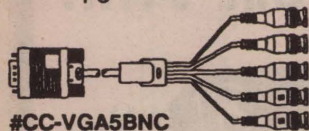
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10' HD15 to 5 BNC male to male
VGA to high-end monitor
PC



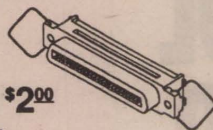
#CC-VGA5BNC

\$15⁰⁰ each 4 for \$50⁰⁰

Centronics IDC Connectors

50 pin SCSI \$3⁰⁰

#CN-681 Male
#CN-680 Female



36 pin parallel \$2⁰⁰

#CN-545 Male
#CN-546 Female

CD ROM Audio Cables

Soundblaster

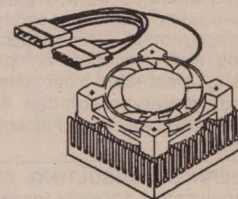
#CC-NEC-SB NEC to Soundblaster
#CC-SON-SB Sony to Soundblaster
#CC-MIT-SB Mitsumi to Soundblaster
#CC-TEX-SB Texcel to Soundblaster
#CC-PAN-SB Panasonic to Soundblaster
#CC-TOS-SB Toshiba to Soundblaster
#CC-PLX-SB Plextor to Soundblaster *

Pro Audio

#CC-TOS-PA Toshiba to Pro Audio
#CC-PAN-PA Panasonic to Pro Audio
#CC-SON-PA Sony to Pro Audio
#CC-NEC-PA NEC to Pro Audio
#CC-MIT-PA Mitsumi to Pro Audio
#CC-TEX-PA Texcel to Pro Audio
#CC-PLX-PA Plextor to Pro Audio *

\$2⁵⁰ each

* Call for price
Call for quantity pricing



Heat Sink with Fan

Easy hook-up to power!
Clips to chip.

486/AT CPU

#TM-FAN-2 \$7⁰⁰ each

586/AT CPU

#TM-FAN-66 \$12⁰⁰ each

586/AT CPU

#TM-FAN-90 \$12⁰⁰ each

Computer Speaker

2" Internal replacement speaker
with bracket. Easy to install.

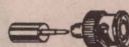


#TM123

\$1⁰⁰ each 6 for \$5⁰⁰

BNC Connectors

3 piece crimp type with gold pin
for RG-58 Ethernet.
Crimp tool available.



#CN-548 75¢ each 100 up 60¢ each

SCSI I Terminator

50 pin centronics one male only

\$5⁰⁰ each #CA-019



SCSI I Terminator

50 pin centronics male female

\$7⁰⁰ each #CA-020



SCSI II Terminator

HD50 one male only

\$15⁰⁰ each #CA-021



Accessories

Motherboard Standoffs

Nylon #CN-475
10 for \$1⁰⁰

Brass #CN-474
10 for \$1⁰⁰



DB Nuts

Male Stud Kit

#CN-566
10 for \$1⁰⁰



Female to Female
#CN-565

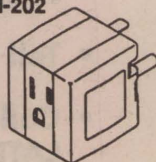
10 for \$1⁰⁰



Surge Suppressor

Single Outlet
Wall Mount Adaptor
3-Wire Grounded
UL Listed

#TM-202



\$1⁰⁰ each 6 for \$5⁰⁰

AC to DC Converter

Universal 1 Amp
Multi-voltage 1.5v - 12v DC
6 Different Connectors
Polarity Switch

#TM-310



\$5⁰⁰ each

Game Port to MIDI Keyboard Cable

6' DB15 male-female
2 - 5 pin DIN male

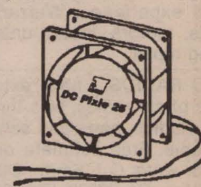


#CC-155

\$17⁰⁰ each

Cooling Fan

12 VDC
3.5" x 3.5" x 1"



#TM-FAN

\$5⁰⁰ each 5 for \$20⁰⁰



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MILLENNIUM³

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- volume control
- restores picture-in-picture
- remote A/B switch
- remote control included
- favorite channel memory
- accessory kit included
- parental control
- watch one channel/record another

Introductory Offer! For a limited time, the 10-lot price for the Millennium3 is only:

\$55



Panasonic & SA Converters

Panasonic TZPC 145 Converter SA 8511-300 Converter

Units sold with wireless remote control & batteries
Features include: parental control (Panasonic only), last channel recall, favorite channel memory, sleep timer, channel 2 or 3 available.

In quantities of 10 or more, **\$65**

Also: Panasonic TZ - PC 175 Series Converter w/volume.
Topcases for Panasonic, SA and Jerrold (all models) also available. Call for pricing and availability.



Panasonic TZPC 145 **\$65**
channel 2 or 3; 10-lot prices

SA 8511 channel 3 **\$65**



Quality, low-cost capacitors

| Capacitor | Cost | Capacitor | Cost |
|--------------|------|-------------|------|
| 1uF - 50V | .12 | 3.3uF - 50 | .12 |
| 100uF - 50V | .18 | 33uF - 35V | .13 |
| 100uF - 63V | .16 | 33uF 50V | .13 |
| 1000uF - 16V | .22 | 330uF - 50V | .31 |
| 1000uF - 50V | .61 | 330uF - 63V | .34 |
| .22uF - 50V | .11 | 4.7uF - 50V | .13 |
| 22uF - 50 V | .11 | 47uF - 50V | .14 |
| 2200uF - 16V | .48 | 47uF - 63V | .24 |
| 600uF - 50V | .43 | 470uF - 50V | .43 |

Security Bits (10 Lot)

Pioneer 6300 Oval Bit **\$15.50**

Jerrold-compatible bits

1/4" Female Bit **\$9.50**
1/4" or 5/16" Bits **8.50**
AVSAFE #4 round D series **14.50**

TORX Bits

Tocom T - 7 **\$3.95**
Zenith T - 10, T - 15 **3.95**
Pioneer T - 20 **3.95**
SA T-20 **3.95**
Magnetic bit driver **4.75**

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Remote Controls (10-lot prices)

Introducing the Novaplex R1000 Universal Remote!

This new 6-in-1 remote control from Novaplex is guaranteed to operate TV, VCR, Satellite, Audio, Cable Box and more. **\$11.50**

Coming Soon: Plex Multi Remote!

Single remote is compatible with virtually any converter. Quantity prices start as low as **\$4.95**

New Item!

Novaplex R1000 Universal Remote

6-in-1 for TV, Cable, Satellite, VCR, Audio & More **\$11.50**

Jerrold-compatible 400/450/550 **6.50**

Scientific Atlanta-compatible

075 / 175 **6.50**

475 with volume control **7.00**

8600 with on-screen display **7.00**

Zenith-compatible (all Z-TACs)

7.25

Panasonic-compatibles

120 / 140 **8.90**

170 with volume control **9.90**

Pioneer-compatible for 81 / 82

7.75

Tocom-compatible (all models)

7.75

Dozens of other items in stock!

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Call for quantity discounts!

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Jerrold-compatible bezels from **.95**
IC Socket/14 count (28-pin wire wrap) **1.19**

Call for your free catalog!

Ask about our dealer program!



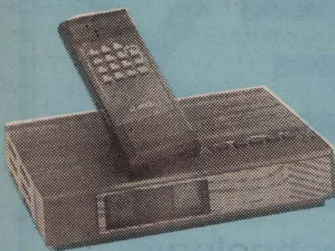
Call Toll-Free 8am-6pm PST 800-644-6682

Novaplex, Inc. 8818 Bradley Ave, Sun Valley CA 91352
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JERROLD 400 DRX-105



\$35 50+
SINGLE \$49.95
HAND CONTROL
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1 YEAR WARRANTY

REGAL 550 MHZ

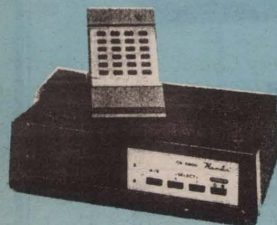


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BRAND NEW!
5 YR. WARRANTY
PARENTAL CONTROL
FAVORITE CHANNEL
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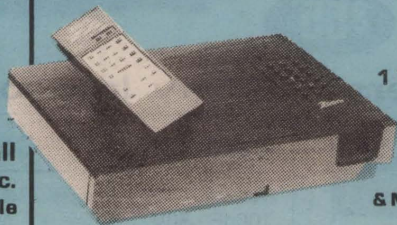
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Last Channel Recall
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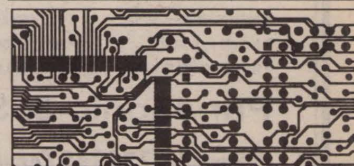
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Events CALENDAR

Continued from page 49

Dade Radio Club of Miami, Inc. **LOCATION**: Youth Fair Expo Center, 10901 SW 24 St. (Coral Way). **HOURS**: Sat: 9am-5pm, Sun: 9am-4pm. **ADMISSION**: \$5 adv., \$7 door. **FEATURES**: C - CB - EX - F - FM - FP - F/R - H - RV-H. **DEALER INFO**: Setup Friday, Feb. 3, 1995, 9am-9pm. Swap tables \$25 ea. plus reg. ticket. Power \$10 per user. **CONTACT**: Evelyn Gauzens, W4WYR, 2780 NW 3 St., Miami FL 33125. Tel: 305-642-4139, FAX: 305-642-1648.

FEBRUARY 5

MA - SWANSEA — Computer Shows & Sales. **SPONSOR**: Northern Computer Shows. **LOCATION**: Venus DeMillo, I-195 to Exit 3 (Rt. 6). **HOURS**: 10am-3:30pm. **ADMISSION**: \$7, under 14 free w/adult. **FEATURES**: C. **DEALER INFO**: Setup 8am. **CONTACT**: Northern Computer Shows.*

PA - LATROBE — 1st Annual Winterfest. **SPONSOR**: Chestnut Ridge ARC. **LOCATION**: Latrobe American Legion, 40 mi. E of Pittsburgh. **ADMISSION**: \$2. **TALK-IN**: 145.150-600. **FEATURES**: DP - F/R. **DEALER INFO**: Indoor tables \$10 ea. **CONTACT**: Tim Bartlow, KA3BXA, 213 S. Washington Ave., Greensburg PA 15601, 412-834-6517.

FEBRUARY 11

FL - JACKSONVILLE — Computronics Fest. **SPONSOR**: "We're Show Offs!" **LOCATION**: Ramada Inn/Conference Center, 3130 Hartley Rd. **HOURS**: 10am-3pm. **ADMISSION**: Adults \$4, \$3 w/ad, under 12 free. **FEATURES**: AC - C - DP - E - FP - H. **DEALER INFO**: Adv. tables \$50/1 table, \$80/2 tables, \$25/ea. add. table. **CONTACT**: "We're

Show Offs!" 813-545-5265.

FL - PENSACOLA — Pensacola Hamfest. **CONTACT**: Pensacola Area Hamfest Association, 1050 W. Carlton Rd., Pensacola FL 32534. 904-476-8537.

KY - OWENSBORO — OARC Winterfest. **SPONSOR**: Owensboro ARC. **LOCATION**: National Guard Armory, 1501 Parrish Ave. **HOURS**: 8am-2pm. **ADMISSION**: \$5. **TALK-IN**: 147.21. **FEATURES**: C - CB - DP - E - EX - F/R. **DEALER INFO**: Tables: \$7, Set-up 6am. **CONTACT**: George Stokes, KD4CKT, 1218 W 3rd St., Owensboro KY 42301, 502-926-1304.

SC - CHARLESTON — 22nd Annual Charleston Hamfest & Computer Show. **SPONSOR**: Charleston Amateur Radio Society. **LOCATION**: Charleston Landing State Park under the dome, off Hwy. 171. **HOURS**: 8:30am-4pm. **ADMISSION**: \$5, under 12 free. **FEATURES**: Setup Friday after 5pm. Tables \$8 adv., \$10 door. **CONTACT**: Jenny Myers, WA4NGV, 2630 Dellwood Ave., Charleston SC 29405-6814, 803-747-2324.

FEBRUARY 11-12

MA - WILMINGTON — Computer Show. **LOCATION**: Shriner's, N of Boston at I-93, right at bottom of ramp, follow signs. **HOURS**: Sat: 10am-4pm, Sun: 10am-3pm. **FEATURES**: C. **DEALER INFO**: 400+ tables. **CONTACT**: KGP Computer Show.*

NJ - TRENTON — Computer Show & Sale. **SPONSOR**: MarketPro. **LOCATION**: Trenton State College. **HOURS**: 9:30am-4:30pm. **ADMISSION**: \$6. **FEATURES**: C - FP. **DEALER INFO**: \$70 per table. Setup 7am-9am. **CONTACT**: MarketPro, POB

41044, Bethesda MD 20814, 301-530-2355.

VA - ANNANDALE — Computer Show & Sale. **SPONSOR**: MarketPro. **LOCATION**: NOVA. **HOURS**: 9:30am-4:30pm. **ADMISSION**: \$6. **FEATURES**: C - FP. **DEALER INFO**: \$70 per table. Setup 7am-9am. **CONTACT**: MarketPro, POB 41044, Bethesda MD 20814, 301-530-2355.

FEBRUARY 12

FL - ORLANDO — Computronics Fest. **SPONSOR**: "We're Show Offs!" **LOCATION**: Days Inn/Universal, 5827 Caravan Ct. **HOURS**: 10am-3pm. **ADMISSION**: Adults \$4, \$3 w/ad, under 12 free. **FEATURES**: AC - C - DP - E - FP - H. **DEALER INFO**: Adv. tables \$50/1 table, \$80/2 tables, \$25/ea. add. table. **CONTACT**: "We're Show Offs!" 813-545-5265.

NY - FREEPORT — Hamfest. **SPONSOR**: Long Island Mobile ARC. **LOCATION**: Freeport Armory, 63 Babylon Turnpike. **HOURS**: 9am-3pm. **ADMISSION**: \$6 door. **TALK-IN**: 146.25/85. **FEATURES**: F/R. **DEALER INFO**: \$25 per table. **CONTACT**: Neil Hartman, WE2V, 516-462-5549.

FEBRUARY 17-18-19

FL - ORLANDO — 49th Annual Orlando HamCation. **SPONSOR**: The Orlando ARC. **LOCATION**: Central Florida Fairgrounds, 4603 W. Colonial Dr. (State Road 50). **FEATURES**: AC - CB - DP - EX - F - F/R - T. **CONTACT**: HamCation, POB 547811, Orlando FL 32851-7811, 407-657-9052.

FEBRUARY 18

FL - FORT MYERS — Computronics Fest. **SPONSOR**: "We're Show Offs!" **LOCATION**: Holiday Inn/airport, 13051 Bell Tower Dr. **HOURS**: 10am-3pm. **ADMISSION**: Adults \$4, \$3 w/ad, under 12 free. **FEATURES**: AC - C - DP - E - FP - H. **DEALER INFO**: Adv. tables \$50/1 table, \$80/2 tables, \$25/ea. add. table. **CONTACT**: "We're Show Offs!" 813-545-5265.

MA - MARLBORO — Flea Market. **SPONSOR**: Algonquin ARC. **LOCATION**: Marlboro Middle School, Bolton St. **HOURS**: 10am-7. **ADMISSION**: \$2. **DEALER INFO**: \$12 for tables and/or spaces. **CONTACT**: Ann Weldon, KA1PON, Box 258, Marlboro MA 01752 or before 9pm, 508-481-4988.

MA - ROCKLAND — Computer Shows & Sales. **SPONSOR**: Northern Computer Shows. **LOCATION**: Sons of Italy, Rts. 123 & 139 to Rockland, Rt. 3, Exit 14 to Rockland Center. **HOURS**: 10am-3:30pm. **ADMISSION**: \$7, under 14 free w/adult. **FEATURES**: C. **DEALER INFO**: Setup 8am. **CONTACT**: Northern Computer Shows.*

MD - BALTIMORE — Computer Show & Sale. **SPONSOR**: MarketPro. **LOCATION**: Martin's West. **HOURS**: 9:30am-4:30pm. **ADMISSION**: \$6. **FEATURES**: C - FP. **DEALER INFO**: \$70 per table. Setup 7am-9am. **CONTACT**: MarketPro, POB 41044, Bethesda MD 20814, 301-530-2355.

Continued on page 127

about 1.1 volts per cell. If an array of NiCd cells is discharged to 0 volts, there is a risk of one of the cells reversing potential and not properly recharging. It is much

cycled occasionally. Memory problems also occur when the battery is charged for long periods and then discharged only once in a while. Fortunately, both of these problems are reversible. The Battery Cycler can fully resuscitate any NiCd battery that is suffering from memory syndrome. The Battery Cycler cannot recover shorted or open NiCd cells. These must be discarded and replaced.

Battery Cycler

safer to keep the full discharge voltage above 1.0 volt per cell.

NiCd CYCLING

We all use our portable equipment on a demand or as needed basis; that is the purpose. This is not necessarily the best case scenario for long NiCd battery life.

INTRODUCTION

Nickel Cadmium (NiCd) batteries are found in many areas of the electronic marketplace, from portable hand tools to laptop computers. These batteries can make up a large portion of the cost of the portable equipment they power, so it makes good sense to take care of them.

The typical NiCd cell can typically undergo 500 or more full discharge cycles without failing and 20,000 or more partial discharge cycles. How do we ensure that the NiCds we purchase will meet these expectations?

First, store them at moderate temperatures (25 C. or less). High temperatures tend to dissipate electrolyte and cause permanent battery failure.

Second, fully cycle your batteries occasionally. This doesn't mean running the cells down to a 0-volt potential, but down to

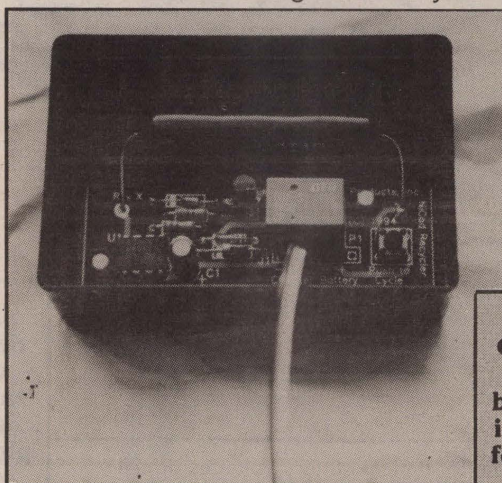
by Thomas Peterick

USE

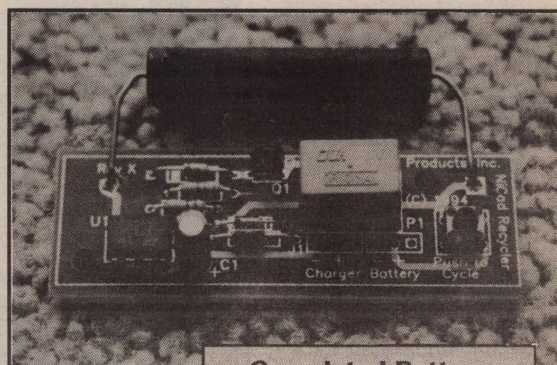
The Battery Cycler should be used every 100 cycles or every three months depending upon the way your portable equipment is used. If the battery is used as a standby device, i.e.,

not often discharged, the batteries should be cycled every three months. If the battery is used regularly, then the 100 cycle rule of thumb should be applied.

When the Battery Cycler is used, the batteries should be cycled two or three times for best results. If you measure the recharge volt-



The Battery Cycler installed in the plastic box. All it needs is some notches for cable access, and the cover installed.



Completed Battery Cycler ready for installation into a plastic box.

To meet the 500 or more cycle life expectancy, they need to be charged and discharged within certain limits. Generally, the manufacturers have done a good job of optimizing the battery life from a charging standpoint. The long, slow (18 or more hours), recharge time for most portable equipment ensures minimal electrolyte loss and heat generation during the recharge cycle, even if they are left on the charger continuously. However, the manufacturers have little or no control over the discharge cycle of the equipment; that is up to you.

Shallow cycling is as bad for NiCd batteries as running them to less than 1 volt per cell. Shallow cycling is one way of causing a phenomenon known as "memory." Memory problems occur when the battery is not fully

age after every deep cycle, you will notice that the voltage at the end of a full charge is slightly higher than the last full charge-discharge cycle. This improvement usually levels out after three cycles, indicating that the

batteries are restored.

To deep cycle the NiCd pack, simply plug the cycler and charger into the battery, press the cycle switch, and let it discharge and recharge the batteries. The complete cycle takes about 21 hours; two or more hours to discharge and 18 hours to recharge the batteries.

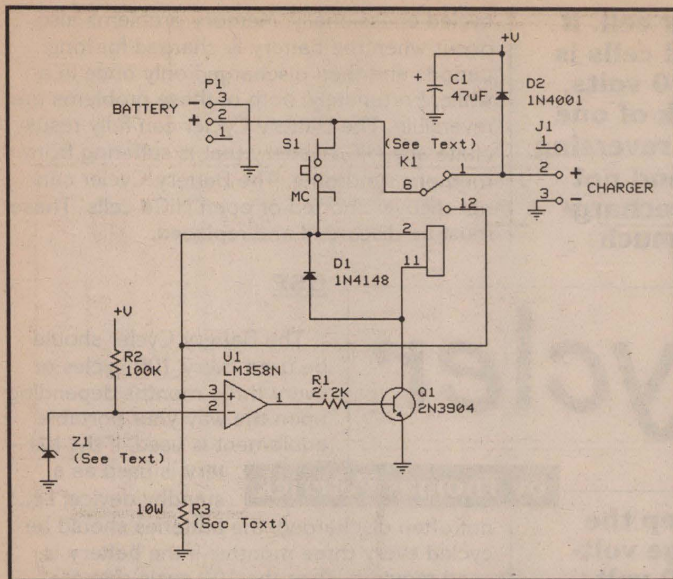
CIRCUIT DESCRIPTION

The Battery Cycler works with NiCd configurations between three and nine cells. Cell combinations are accommodated by selecting Z1, K1, and R3, based upon the number of cells in the battery pack.

The circuit is quite simple. It is basically a voltage comparator (U1), voltage reference (Z1) and a switch (Q1 & K1). The Op Amp (U1) compares the reference voltage generated by the zener diode (Z1) and the battery. When the battery voltage matches or is less

Component Selector by Ni-Cd Cell Count

| Number Of Cells | Relay (K1) | Zener Diode (Z1) | Load Resistor Value (R3) | Nominal Cutoff Voltage | Nominal Full Charge Voltage | Nominal Current Draw |
|-----------------|------------|------------------|--------------------------|------------------------|-----------------------------|----------------------|
| 3 | 5V | 1N4684 | 12 | 3.3 Volts | 4.5 Volts | 0.38 mA |
| 4 | 5V | 1N4687 | 18 | 4.4 Volts | 6.0 Volts | 0.33 mA |
| 5 | 6V | 1N4690 | 27 | 5.5 Volts | 7.5 Volts | 0.28 mA |
| 6 | 9V | 1N4692 | 36 | 6.6 Volts | 9.0 Volts | 0.25 mA |
| 7 | 9V | 1N4693 | 43 | 7.7 Volts | 10.5 Volts | 0.24 mA |
| 8 | 12V | 1N4695 | 56 | 8.8 Volts | 12.0 Volts | 0.21 mA |
| 9 | 12V | 1N4697 | 68 | 9.9 Volts | 13.5 Volts | 0.20 mA |



than the reference, the switch is turned off and the battery is allowed to charge.

While the battery voltage is above the reference voltage, it is discharged through resistor R3. The resistor has been selected to discharge the battery at a rate between 200 and 300 mA. This rate keeps the power dissipation in R3 below three watts and reduces the risk of opening any fuses in the battery circuitry located in the portable equipment.

The push-button switch S1 initiates the discharge process. If the battery voltage is below the reference when S1 is pressed, the unit will not discharge the battery as the lower operating limit of the battery has already been exceeded. If your batteries are in this condi-

tion, charge them for 18 hours and measure the voltage. If the batteries are still below the cut-off voltage, there is a problem with one or more cells in the battery pack. Repair or replace the battery pack.

CONSTRUCTION

The first step in constructing the Battery Cyclor is to establish the values of Z1, K1, and R3 for your NiCd cells. If you know how many cells are in the battery pack, simply look up the values of these components in Table 1. If you don't know and can't count the number of cells, the process becomes a little trickier.

First, check the owner's

with fresh, new cells.

Now that the components have been selected, construction consists of installing the components into the printed circuit board or on a perf board. Use the assembly drawing shown as a reference for component placement.

R3 is installed on the bottom and placed beside the printed circuit board to save board space. Leave the leads long enough to bend R3 away from the PCB so it will fit in the plastic case.

The Battery Cyclor is intended to be placed in series with the battery charger that was supplied with the batteries. This approach saves money and the difficulty of locating the right connector to match your portable equipment. I just cut the charger cable and solder the new ends directly to locations P1 and J1.

If you are a purist and don't want to alter the charger, locate a matching set of connectors for your charging circuit and simply wire

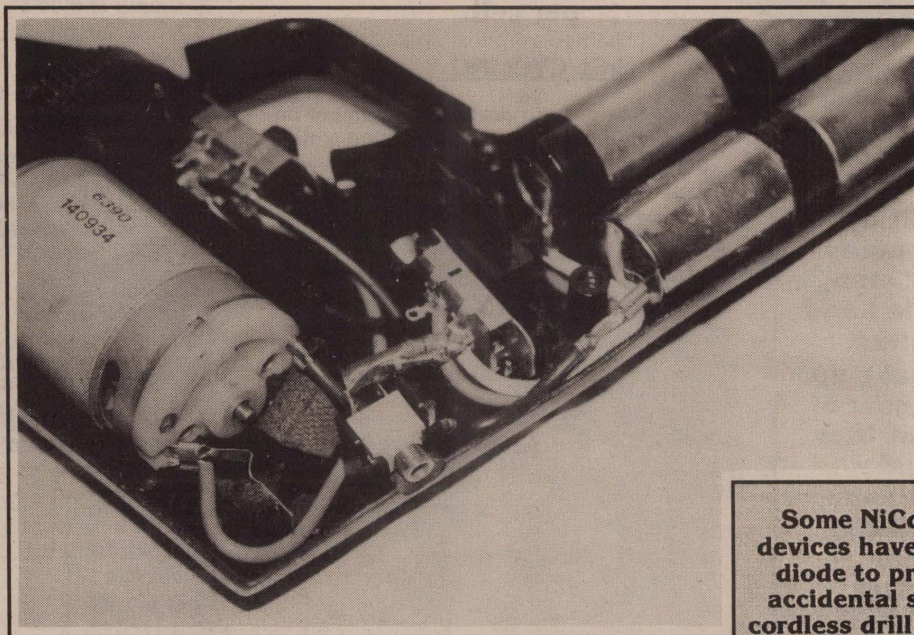
the circuit so that the charger plugs into the Battery Cyclor and the Battery Cyclor plugs into the portable equipment where the charger used to connect.

Mount the PCB into the case using the plastic feet supplied in the kit and some Super Glue™ or 1/4" long stand-offs and 2-56 screws and nuts. R3 does get a little warm; try to keep it away from the case to prevent any warping. Measure and drill a hole to operate the push-

button switch. I used 4-40 hardware as the actuator for the switch. It isn't pretty, but it is adjustable and it works.

Notch the

Some NiCd-operated devices have an internal diode to protect from accidental shorts. This cordless drill has a 1 amp pico fuse installed in parallel with the diode to maintain the safety factor while allowing the Battery Cyclor to do its job.



manual for typical battery voltages or cell count.

Second, measure the battery voltage with the battery fully charged and discharged.

Use the table to estimate the number of cells in the pack. This is an estimate; if the battery pack contains a weak or shorted cell, the voltage number will be off. This method works best if it is used

Here is the completed Battery Cyclor with the cover off showing the installation for a cordless drill.



case to accept the cables from the charger and to the charging jack for your battery pack. Add a knot to each cable to provide some strain relief for the PCB connections.

INSTALLATION

Some NiCd equipment has protection diodes installed to reduce the risk of damage if the equipment is plugged into the wrong charging circuit. The diodes allow the current to flow in one direction: into the batteries. When this type of protection circuitry is encountered, some additional work is required to allow for battery cycling.

The simplest method is to install a 1/2 amp pico fuse across the protection diode in the equipment. The fuse provides a level of safety while allowing the batteries within to be cycled. (See photo which illustrates this being

BILL OF MATERIALS - NiCd Battery Cycler

| ITEM | QUAN. | PART DESCRIPTION | REF. DES. |
|------|-------|--|-----------|
| 1 | 1 | NPN TRANSISTOR, 2N3904 | Q1 |
| 2 | 1 | ZENER, See Table 1 | Z1 |
| 3 | 1 | SWITCH MOMENTARY N.O. PANASONIC EVQ QS2051 | S1 |
| 4 | 1 | RELAY SPDT Aromat HD1E-M-DCxV See Table 1 | K1 |
| 5 | 1 | RESISTOR, See Table 1, 10W, 5% | R3 |
| 6 | 1 | RESISTOR, 2.2K, 1/4W, 5% | R1 |
| 7 | 1 | RESISTOR, 100K, 1/4W, 5% | R2 |
| 8 | 1 | LM358N - DUAL OP-AMP | U1 |
| 9 | 2 | CONNECTOR .025 POST 3 POSN .1 SPACING | J1,P1 |
| 10 | 1 | DIODE, 1N4001, | D2 |
| 11 | 1 | DIODE, 1N4148, | D1 |
| 12 | 1 | PRINTED CIRCUIT BOARD | |
| 13 | 1 | PROJECT BOX With COVER Polycase P-2309TX & C0203-N | |
| 14 | 2 | MOUNTING HARDWARE KIT Simco PBM-125R | |

NOTE: Three following parts are available from:

Electro Technical Products, Inc.
P.O. Box 16658
West Palm Beach, FL 33416-6658

Printed Circuit Board Part # PCB1001 - \$7.00
An Entire kit of parts, including the Printed Circuit Board, Box and mounting. Please specify number of NiCd Cells for R3, K1 and Z1.
Part # K1001 - \$17.50

Please include \$1.00 Postage and handling for the Printed circuit board
Please include \$2.50 Postage and handling for the kit of parts
Florida residents must add 6% sales tax

done to a rechargeable drill.)

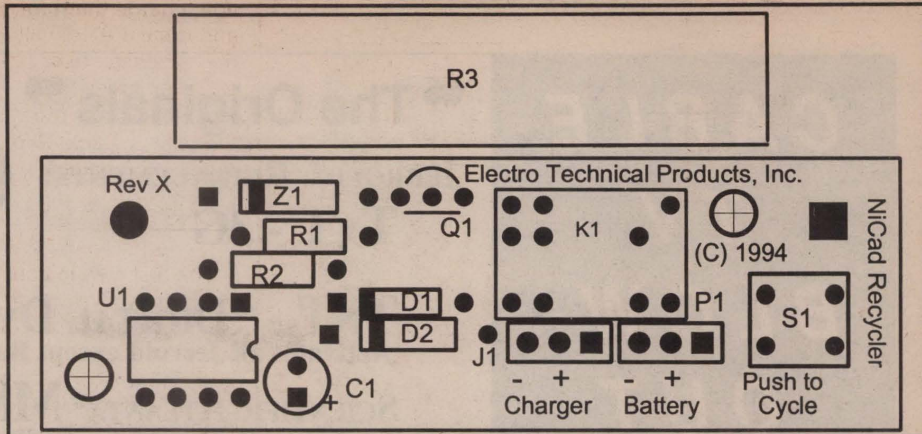
CHARGER CHECK-OUT

NiCd batteries contain a tremendous amount of energy. Be very careful when wiring the Cycler to the charger and batteries. If you reverse the polarity of either side of the Cycler, you may destroy your equipment, or the charger, or worse: cause a fire. Double-check the polarity prior to connecting the batteries or applying power to the charger.

Connect the Battery Cycler to the charger

only. Plug the battery charger into the wall power. Check the voltage at U1 pin 8; it should be a positive 5 to 18 volts DC, depending upon the operating voltage of your charger. Check the voltage at the terminals that go to the battery from the Cycler; the voltage and polarity should match the original charger voltage and polarity. Connect the battery to the Cycler battery connection. Press and release the cycle switch. The relay should click. Measure the voltage across R3; the voltage should match the cell rating in Table 1.

Check the voltage across zener Z1; the voltage should be within 5% of the nominal cutoff voltage listed in Table 1. If the battery charger has a charging indicator, don't be alarmed that it isn't on when the unit is cycling the battery. It will come on when the Cycler fully discharges the battery and switches back to the charge mode. NV



TOP

BOTTOM

Mr. Peterick is a hardware engineer with over 15 years of experience in interfacing computers to the real world. His background includes all aspects of product development including specification, packaging, and general design. Mr. Peterick has successfully completed designs in both the military and commercial sectors of industry. Mr. Peterick has been a principal at Electro Technical Products, Inc., for the past 11 years and works as a consultant and independent contractor. He may be contacted at: Electro Technical Products, Inc., P.O. Box 16658, West Palm Beach, FL 33416-6658.

Events

CALENDAR

Continued from page 124

FEBRUARY 18-19

GA - MARIETTA — Marietta Area Computer Show. **LOCATION:** Cobb County Civic Center, 548 S. Marietta Parkway, Exit 112 at I-75 (Hwy. 120 West). **HOURS:** Sat: 9am-5pm, Sun: 10am-4pm. **ADMISSION:** \$5 both days, \$4 Sun. only. **FEATURES:** AC - C - DP - F. **DEALER INFO:** 8-ft tables \$40. **CONTACT:** Computer Show, POB 295, Riverdale GA 30274. 800-746-9001.

FEBRUARY 18-19-20

NJ - EDISON — Computer Show. **LOCATION:** Raritan Center Exposition Hall, NJ Tpke. Exit #10, right at toll, follow signs. **HOURS:** Sat: 9:30am-4:30pm, Sun & Mon: 10am-4pm. **FEATURES:** C. **DEALER INFO:** 1000+ tables. **CONTACT:** KGP Computer Show.*

FEBRUARY 19

FL - PETE — Computronics Fest. **SPONSOR:** "We're Show Offs!" **LOCATION:** Best Western/Mirage, 5005 34th St. N (US 19 N). **HOURS:** 10am-3pm. **ADMISSION:** Adults \$4, \$3 w/ad, under 12 free. **FEATURES:** AC - C - DP - E - F - H. **DEALER INFO:** Adv. tables \$50/1 table, \$80/2 tables, \$25/ea. add. table. **CONTACT:** "We're Show Offs!" 813-545-5265.

MD - GREENBELT — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Martin's Crosswinds. **HOURS:** 9:30am-4:30pm. **ADMISSION:** \$6. **FEATURES:** C - F. **DEALER INFO:** \$70 per table. Setup 7am-9am. **CONTACT:** MarketPro, POB 41044, Bethesda MD 20814. 301-530-2355.

ME - PORTLAND — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Verrillo's Conv. Center, at Howard Johnson Motor Lodge, I-95 Exit 8. **HOURS:** 10am-3:30pm. **ADMISSION:** \$7, under 14 free w/adult. **FEATURES:** C. **DEALER INFO:** Setup 8am. **CONTACT:** Northern Computer Shows.*

FEBRUARY 25

FL - FORT LAUDERDALE — Narisaam Computer Show. **SPONSOR:** Narisaam, Inc. **LOCATION:** Holi-

day Inn West, 5100 N State Rd. 7. **HOURS:** 9:30am-3:30pm. **ADMISSION:** \$5, \$4 w/ad, under 12 free. **FEATURES:** AC - C - F. **CONTACT:** Narisaam.*

FL - BROOKSVILLE — Hamfest. **SPONSOR:** Hernando County ARC. **LOCATION:** Hernando County Fairgrounds, 1/2 mi. S of Brooksville on US Rt. 41. **HOURS:** 8am-5pm. **ADMISSION:** \$4 adv., \$5 door. **TALK-IN:** 146.715. **FEATURES:** T. **DEALER INFO:** Tailgating: \$5. Tables: \$10. **CONTACT:** Clem Rountree, N4PIE, POB 1721, Brooksville FL 34605. 904-799-3202.

GA - DALTON — Hamfest. **SPONSOR:** Dalton ARC. **LOCATION:** North Georgia Fairgrounds. **HOURS:** 9am-3pm. **ADMISSION:** \$4. **TALK-IN:** 145.23. **FEATURES:** F/R. **CONTACT:** Harold Jones, N4OTC, 706-673-2291 (after 6pm EST); James Jordan, K4FLG, 706-278-0630; or write Dalton ARC, POB 143, Dalton GA 30722-0143.

VT - MILTON — Northern Vermont Winter Hamfest. **SPONSOR:** Radio Amateurs of Northern Vermont. **LOCATION:** Milton High School, Rt. 7, in Milton, 5 miles North of I-89 exit 17. **HOURS:** 8am-3pm. **ADMISSION:** \$3, under 18 free. **TALK-IN:** 145.15. **FEATURES:** C - E - EX - F - FM - F/R - H - T. **DEALER INFO:** Tables free while they last. Call for large setups. **CONTACT:** WB2JSJ, 802-879-6589.

FEBRUARY 25-26

MD - GAITHERSBURG — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Montgomery Co. Fairgrounds. **HOURS:** 9:30am-4:30pm. **ADMISSION:** \$6. **FEATURES:** C - F. **DEALER INFO:** \$70 per table. Setup 7am-9am. **CONTACT:** MarketPro, POB 41044, Bethesda MD 20814. 301-530-2355.

FEBRUARY 26

FL - WEST PALM BEACH — Narisaam Computer Show. **SPONSOR:** Narisaam, Inc. **LOCATION:** Palm Beach Airport Hilton, 150 Australian Ave. **HOURS:** 10am-4pm. **ADMISSION:** \$5, \$4 w/ad, under 12 free. **FEATURES:** AC - C - F. **CONTACT:** Narisaam.*

MA - WESTFORD — Radio XXVI Old Radio Flea Market. **SPONSOR:** Greater Boston Antique Radio Collectors. **LOCATION:** Westford Regency Inn,

I-495 at Exit 32. **HOURS:** 8am-1pm. **ADMISSION:** \$4, spouse/children free. **FEATURES:** FM - F/R. **DEALER INFO:** Tables \$12-\$14. Four table limit. Reservations 508-371-0512. **CONTACT:** Dave Crocker, 6 Raymond St., Sandwich MA 02563. 508-888-6236.

NH - MANCHESTER — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Center of NH. Expo Complex at Holiday Inn, I-293 Exit 5 or 6. **HOURS:** 10am-3:30pm. **ADMISSION:** \$7, under 14 free w/adult. **FEATURES:** C. **DEALER INFO:** Setup 8am. **CONTACT:** Northern Computer Shows.*

VA - VIENNA — Winterfest. **SPONSOR:** Vienna Wireless Society. **LOCATION:** Vienna Community Center. **HOURS:** 9am-3pm (Frostbite tailgate open 6am). **ADMISSION:** \$5 XYL free. **TALK-IN:** 146.91/146.685/146.131. **FEATURES:** DP - T. **DEALER INFO:** Tailgate space \$10, incl. DXCC field checks. **CONTACT:** Christine, KE4HWE, 703-560-7399. Jorje, KE4DQG, 703-729-4711.

WV - FAYETTEVILLE — Hamfest. **SPONSOR:** Plateau ARA. **LOCATION:** Fayetteville High School, Exit: Laurel Creek Rd., Exit East about 2 blocks off Rt. 19. **HOURS:** 9am-4pm. **ADMISSION:** \$5. **TALK-IN:** 146.79. **FEATURES:** CB - DP - EX - FM - F/R. **DEALER INFO:** Tables \$5. **CONTACT:** John Witt, WB0QC, 135 Daniels St., Fayetteville WV 25840. 304-574-0532.

MARCH 4

NJ - ABSECON — "Springfest '95" Hamfest. **SPONSOR:** Shore Points ARC. **LOCATION:** Holy Spirit High School, on Rte 9 (about 3/4 mi. S of Rte 30). **HOURS:** 9am-7. **ADMISSION:** \$5, non-ham XYLs and children free. **TALK-IN:** 146.385/985 repeater. **FEATURES:** EX - FM - F/R - H - T. **DEALER INFO:** Indoor tables: \$7/8', reservations accepted, setup 7am. Outdoor tailgating, weather permitting: \$5/painted parking space. First come, first served, no reservations accepted. **CONTACT:** SPARC, POB 142, Absecon NJ 08201.

MARCH 5

MA - NORTHAMPTON — 11th Annual MTRAR Amateur Radio Flea Market. **SPONSOR:** Mt. Tom

Amateur Repeater Assn. **LOCATION:** Smith Vocational School, Rte 9. **HOURS:** 9am-7. **ADMISSION:** \$3, under 12 free. **FEATURES:** DP - F/R - T. **DEALER INFO:** Vendor setup 8am. Tables \$12 adv. \$15 door, includes 1 admission. Tailgating \$5 per parking space, weather permitting, does not include admission. Vendor reservations: Jim, K1MEA, 413-527-3199 eves before 2200 EST. **CONTACT:** Mr. Tom Amateur Repeater Assn, Inc., 316 Main St., Easthampton MA 01027.

MA - TAUNTON — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Taunton Holiday Inn, Exit 9 off I-495, between Rte. 24 & I-95. **HOURS:** 10am-3:30pm. **ADMISSION:** \$7, under 14 free w/adult. **FEATURES:** C. **DEALER INFO:** Setup 8am. **CONTACT:** Northern Computer Shows.*

MARCH 11-12

NC - CHARLOTTE — 1995 Charlotte Hamfest & Computerfair. **SPONSOR:** Mecklenburg Amateur Radio Society. **LOCATION:** Charlotte Merchandise Mart, Liberty Hall. **HOURS:** Sat: 9am-5pm, Sun: 9am-2pm. **TALK-IN:** 144.69/145.29. **FEATURES:** C - CB - DP - F - S. **DEALER INFO:** Ken Boyd, WA4ONZ, Charlotte Hamfest, POB 221136, Charlotte NC 28222-1136. 704-377-8873.

MARCH 12

CT - BRISTOL — Annual Hamfest Fleamarket. **SPONSOR:** Insurance City Repeater Club, Inc. **LOCATION:** Bristol Eastern High School, King St. (Rte. 229). **HOURS:** 9am-1pm, snow date March 19th. **ADMISSION:** \$4. **TALK-IN:** 146.88, 224.80. **DEALER INFO:** Tables \$10 ea. For table reservations, send SASE to: Al Gerke, NJ1JWF, 63 N Washington St., Apt 2, Plainville, CT 06062-1921 or call 203-747-1925. Amateur Radio Exams at 10am. Send SASE to ICRC, POB 165, Pleasant Valley, CT 06063. Pre-registration only.

NH - PORTSMOUTH — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Frank Jones Center, Exit 5 off I-95 to Rt. 1 Bypass South. **HOURS:** 10am-3:30pm. **ADMISSION:** \$7, under 14 free w/adult. **FEATURES:** C. **DEALER INFO:**

Continued on page 129

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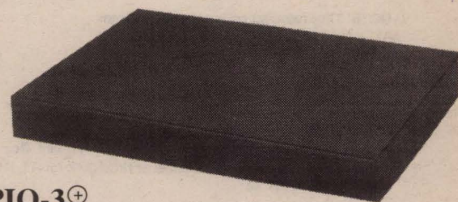
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- Favorite channel memory
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Events CALENDAR

Setup 8am. **CONTACT:** Northern Computer Shows.*

PA - YORK — 8th Annual York Springfest. **LOCATION:** York fairgrounds, The Old Main Bldg. **HOURS:** 8am. **ADMISSION:** \$5, 12 and under free. **TALK-IN:** 146.97(-). **FEATURES:** DP - F/R - T. **DEALER INFO:** 6am vendor & tailgate setup. Tables \$19 & \$25 (add \$10 for electricity). Tailgating \$5 per space. **CONTACT:** 717-843-7864, leave msg. Write: York Springfest, POB 256, Red Lion, PA 17356.

MARCH 18

NH - SALEM — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Rockingham Park, I-93 Exit 1. **HOURS:** 10am-3:30pm. **ADMISSION:** \$7, under 14 free w/adult. **FEATURES:** C. **DEALER INFO:** Setup 8am. **CONTACT:** Northern Computer Shows.*

MARCH 18-19

FL - FORT WALTON BEACH — 25th Annual Hamfest/Swapfest. **SPONSOR:** Playground ARC. **LOCATION:** Ft. Walton Beach Fairgrounds. **HOURS:** Sat: 8am-5pm, Sun: 8am-3pm. **FEATURES:** FM. **DEALER INFO:** For tables, call Bud, K8YNU, 904-243-5404, 9am-5pm CDT; or Scott, KE4BT, 904-244-3182, 5pm-9pm CDT. **CONTACT:** For RV space only, call Roberta 904-862-0211. Address all inquiries to PARC, POB 873, Ft. Walton Bch. FL 32549.

GA - NORCROSS — Atlanta Area Computer Show. **LOCATION:** North Atlanta Trade Center, 1700 Jeurgens Ct. I-85 N. to exit #38 (Indian Trail) & right to Oakbrook Parkway, turn right to Jeurgens Ct. **HOURS:** Sat: 9am-5pm, Sun: 10am-4pm. **ADMISSION:** \$5 both days; \$4 Sun. only. **FEATURES:** AC - C - DP - F. **DEALER INFO:** 8' table \$45 + \$6.00 business license. **CONTACT:** POB 295, Riverdale GA 30274. 404-907-6225.

MARCH 19

NH - NASHUA — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Sheraton Tara. **HOURS:** 10am-3:30pm. **ADMISSION:** \$7, under 14 free w/adult. **FEATURES:** C. **DEALER INFO:** Setup 8am. **CONTACT:** Northern Computer Shows.*

NY - YONKERS — WECAS '95. **SPONSOR:** Westchester Emergency Communications Assoc.. **LOCATION:** Yonkers Raceway. **HOURS:** 9am-2pm. **ADMISSION:** \$6, under 14 free w/paid adult. **TALK-IN:** 147.060. **FEATURES:** C - CB - DP - E - EX - F - FP - F/R - H - T. **DEALER INFO:** Indoor tables: \$20 + 2 free admissions w/first table. Outdoor tailgating: \$10 w/1 free admission. Reservations required. 914-962-9666. **CONTACT:** Tom (WB2NHC) and Jeanne (N2NQY) Raffaeili, 544 Manhattan Ave., Thornwood NY 10594.

MARCH 25

FL - FORT LAUDERDALE — Narisaam Computer Show. **SPONSOR:** Narisaam, Inc. **LOCATION:** Holiday Inn West, 5100 N State Rd. 7. **HOURS:** 9:30am-3:30pm. **ADMISSION:** \$5, \$4 w/ad, under 12 free. **FEATURES:** AC - C - FP. **CONTACT:** Narisaam.*

MARCH 25-26

MD - TIMONIUM — Hamfest & Computerfest. **SPONSOR:** Baltimore Amateur Radio Club. **LOCATION:** Timonium Fairgrounds. **HOURS:** 8am-4pm both days. **ADMISSION:** \$5 one day, \$8 weekend (adv. only). **FEATURES:** B - C - CB - E - EX - FM - F/R - H - T. **DEALER INFO:** Call for info. **CONTACT:** Donald Baker, N2MCG, Commercial Sales, POB 95, Timonium MD 21094-0094. 410-426-3378 or 1-800-426-3378.

MARCH 26

FL - WEST PALM BEACH — Narisaam Computer Show. **SPONSOR:** Narisaam, Inc. **LOCATION:** Palm Beach Airport Hilton, 150 Australian Ave. **HOURS:** 10am-4pm. **ADMISSION:** \$5, \$4 w/ad, under 12 free. **FEATURES:** AC - C - FP. **CONTACT:** Narisaam.*

PA - MONROEVILLE — 23rd Annual Hamfest/Computer Fair. **SPONSOR:** Two Rivers Amateur Radio Club. **LOCATION:** Greater Pittsburgh EXPO/MART. **HOURS:** 8am-3pm. **ADMISSION:** \$4. **DEALER INFO:** 6' tables \$12, setup Sat: 4:30pm-10pm, Sun: 6:30am-8am. **CONTACT:** Two Rivers ARC, POB 225, Greenock PA 15047.

MARCH 31-APRIL 1

FL - GAINESVILLE — 8th Annual Poorman's Hamfest & Computer Show. **LOCATION:** Alachua County Fairgrounds. **HOURS:** Fri: 5pm-11pm, Sat: 8am-4pm. **ADMISSION:** \$5. **FEATURES:** C - DP - F/R - H. **DEALER INFO:** Tailgate \$6, Tables \$7. Setup 12 noon Fri & 6am Sat. Overnight camping \$10 per night. **CONTACT:** Bill Wells, K4ROP, POB 1397, High Springs, FL 32643. 904-454-3105.

APRIL 1

CT - WATERFORD — Ham Radio Auction. **SPON-**

Continued from page 127

SOR: Radio Amateur Society of Norwich. **LOCATION:** Waterford Senior Center. **HOURS:** 10am. **ADMISSION:** Free. **TALK-IN:** 146.730(-). **FEATURES:** FP. **CONTACT:** Tony, AA1JN, 203-859-0162, or Mike, N1HFX, 203-546-9498.

NY - WHITE PLAINS — Computer Show & Sale. **SPONSOR:** Allied Expositions. **LOCATION:** Westchester County Center. **HOURS:** 10am-3pm. **FEATURES:** AC - C - FP. **DEALER INFO:** Tables \$45. **CONTACT:** Allied Exposition, 44 Pinnacle Rock Rd., Stamford CT 06903. 203-329-2141.

APRIL 2

CT - SOUTHTON — Flea Market. **SPONSOR:** Southington ARC. **LOCATION:** DePaolo Jr. High School, Pleasant St. **HOURS:** 9am-1pm. **ADMISSION:** \$10 8:30am-9am, \$3 after 9am. **TALK-IN:** 145.490, 147.345, 224.800, 444.250. **FEATURES:** C - DP - EX - F/R - H. **DEALER INFO:** Tables: \$12 adv., \$18 door. Set up 6:30am. **CONTACT:** Steve, N1GCV, 203-621-6191. Southington ARC, POB 873, Southington CT 06479.

NJ - TRENTON — Hamcomp '95. **SPONSOR:** Delaware Valley Radio Assoc. **LOCATION:** Trenton State College, Student Rec Center. **HOURS:** 7:30am-1pm. **ADMISSION:** \$5. **TALK-IN:** 146.67 (2m), 442.650 (70cm). **FEATURES:** FP - F/R. **DEALER INFO:** Tables: \$20, Tailgaters \$12. Set up 6:30am. **CONTACT:** DVRA Hotline, 609-882-2240.

APRIL 7-8-9

GA - ATLANTA — Ham Radio '95. **SPONSOR:** South Eastern DX Club. **LOCATION:** North Atlanta Trade Center at Exit 38 I-85. **HOURS:** Fri, 1pm-6pm, Sat, 9am-5pm, Sun, 8am-1pm. **FEATURES:** B - CB - FM - RV-H. **T. DEALER INFO:** Exhibit Booths \$200. Flea Market tables \$25 ea., Tailgate \$10 ea. **CONTACT:** Ham Radio Foundation, 4343 Shallowford Rd. E-6, Marietta GA 30062. 404-518-7376.

APRIL 8

KY - BOWLING GREEN — Hamboree '95. **SPONSOR:** Kentucky Colonels ARC. **LOCATION:** Knights of Columbus Hall, 911 Searey Way. **HOURS:** 7am-3pm. **ADMISSION:** \$4. **TALK-IN:** 146.25/85, 147.93/33. **FEATURES:** AC - C - CB - E - EX - F - F/R - H - T. **DEALER INFO:** Tables \$10. Set-up Fri, 6pm-7:30pm, Sat, 6am. **CONTACT:** Leon Garrett, 502-842-5307. Don Meredith, 502-781-6600. Hamboree '95, POB 9781, Bowling Green KY 42102-9781.

ME - PORTLAND — Hamfest. **SPONSOR:** Portland Amateur Wireless Assoc. **LOCATION:** University of Southern Maine, Sullivan Gymnasium, Falmouth St. **HOURS:** 6:30am-8am Earlybird, 8am-1pm. **ADMISSION:** \$6 Earlybird & vendors, \$4 door. **TALK-IN:** 146.73/13. **FEATURES:** DP - E - EX - FM - F/R. **DEALER INFO:** Tables free. Setup 6:30am. **CONTACT:** Marty Feeney, K1OYB, 207-772-1682.

APRIL 8-9

TN - KNOXVILLE — Knoxville Area Computer Show. **LOCATION:** Tennessee Valley Fairgrounds, 3301 Magnolia Ave. **HOURS:** Sat: 9am-5pm, Sun: 10am-4pm. **ADMISSION:** \$5 both days; \$4 Sun. only. **FEATURES:** AC - C - DP - FP. **DEALER INFO:** 8' table \$35. **CONTACT:** Computer Show, POB 295, Riverdale GA 30274. 404-907-6225.

APRIL 9

MA - FRAMINGTON — Spring Flea Market. **SPONSOR:** Framington ARA. **LOCATION:** Framington High School, A Street. **HOURS:** Early Bird: 9am. General: 10am-7. **ADMISSION:** Early Bird: \$5. General: \$2. **TALK-IN:** 147.15. **FEATURES:** C - DP - E - EX - FM - FP - F/R - H - T. **DEALER INFO:** Tables: \$10 adv., \$14 door + 1 free admission. Tailgate space: \$10. Setup 8am. **CONTACT:** Lew Nyman, K1AZE, c/o FARA, POB 3005, Framingham MA 01701. 508-879-7456.

APRIL 16

MA - CAMBRIDGE — Tailgate Electronics, Computer & Amateur Radio Flea Market. **SPONSOR:** MIT Radio Society and Harvard Wireless Club. **LOCATION:** Albany & Main Sts. **HOURS:** 9am-2pm rain or shine. **ADMISSION:** \$2. **TALK-IN:** 146.52, 449.725/444.725 - pl 2A - W1XXM/R. **FEATURES:** C - FP - H - T. **DEALER INFO:** Tailgate room for 600 sellers. \$10 per space at gate, \$8 adv. Includes 1 admission. Setup 7am. For info call 617-253-3776. Mail advance reservations before the 5th. **CONTACT:** WIGSL, POB 397082 MIT BR., Cambridge MA 02139.

APRIL 22

AL - TALLADEGA — TRACFEST. **SPONSOR:** Talladega ARC. **LOCATION:** National Guard Amory. **HOURS:** 9am. **ADMISSION:** \$2. **FEATURES:** CB - EX - FM - F/R - H. **DEALER INFO:** Tables \$5, Tailgating \$2. **CONTACT:** JT Martin, 4181 Allison Mill Rd., Talladega AL 35160. 205-362-0478, or call Linda Pettis at 205-362-5212.

APRIL 22-23

GA - MARIETTA — Marietta Area Computer Show. **LOCATION:** Cobb County Civic Center, 548 S. Marietta Parkway, Exit 112 at I-75 (Hwy. 120 West). **HOURS:** Sat: 9am-5pm, Sun: 10am-4pm. **ADMISSION:** \$5 both days, \$4 Sun. only. **FEATURES:** AC - C - DP - FP. **DEALER INFO:** 8' tables \$40. **CONTACT:** Computer Show, POB 295, Riverdale GA 30274. 800-746-9001.

NJ - WEST WINDSOR — 20th Annual Trenton Computer Festival '95. **LOCATION:** Mercer County Community College. **HOURS:** Sat: 10am-6pm, Sun: 10am-4pm. **ADMISSION:** \$8. **FEATURES:** B. **CONTACT:** TCF '95, POB 129, Kirkwood PA 17536-0129. 717-529-6134.

APRIL 23

CT - HARTFORD — Fire-fighting Home Robot Contest. **SPONSOR:** Trinity College & The Connecticut Robotics Society. **LOCATION:** Trinity College. **CONTACT:** Jake Mendelsohn, c/o Trinity College Engineering Dept., Hartford CT 06106.

FOREIGN

FEBRUARY 19

CANADA - Vancouver, British Columbia — Hamfest. **SPONSOR:** Burnaby ARC. **LOCATION:** Westminster Armouries, 6th St. at Queens. **HOURS:** 10am-2pm. **ADMISSION:** \$3. **TALK-IN:** 145.35, 442.85. **FEATURES:** FP - F/R. **DEALER INFO:** Tables \$10. Setup 9am. **CONTACT:** The Club Net on Monday at 8pm local time on 145.35. Or write: Box 72012, 4429 Kingsway, Burnaby BC Canada V5H 4P9.

Month at a Glance

FEBRUARY 1995

FEBRUARY 4
OH - Toledo - Photorama Used Computer/Camera Show
FEBRUARY 4-5
FL - Miami - 35th Annual Tropical Hamboree
FEBRUARY 5
CA - Livermore - Livermore ARC Swap Meet
MA - Swansea - Northern Computer Shows*
MI - Grand Rapids - Computers & You Computer Show
OH - Columbus - Support Services Computer Festival
PA - Latrobe - Chestnut Ridge ARC 1st Annual Winterfest
FEBRUARY 11
FL - Jacksonville - Computer Fair
FL - Pensacola - Pensacola Area Hamfest Assn. Hamfest
KY - Owensboro - OARC Winterfest
MN - Blaine - Robbinsdale ARC Midwinter Madness
SC - Charleston - Charleston ARS Hamfest/Computer Show
FEBRUARY 11-12
MA - Wilmington - KGP's Computer Shows*
NJ - Trenton - MarketPro Computer Show*
VA - Annandale - MarketPro Computer Show*
FEBRUARY 12
FL - Orlando - Computer Fair
NY - Freeport - Hamfest
OH - Dayton - MBE Computer Blowout Sale
OH - Mansfield - Mid-Winter Hamfest/Computer Show
FEBRUARY 17-18-19
FL - Orlando - 49th Annual Orlando HamCatCon
FEBRUARY 18
CA - San Diego - Fest West '95
FL - Ft. Myers - Computer Fair
MA - Marlboro - Algonquin ARC Flea Market
MA - Rockland - Northern Computer Shows*
MD - Baltimore - MarketPro Computer Show*
OR - Rickreall - Salem Hamfair & Electronic Swapmeet
FEBRUARY 18-19
GA - Marietta - Atlanta Area Computer Show
FEBRUARY 18-19-20
NJ - Edison - KGP's Computer Shows*
FEBRUARY 19
CANADA - British Columbia - Vancouver - Hamfest
FL - St. Petersburg - Computer Fair
IL - Rock Island - Daveport Radio Amateur Club Hamfest
IN - South Bend - Camera/Computer Swap Meet
MD - Greenbelt - MarketPro Computer Show*
ME - Portland - Computer Show & Sale
MI - Novi - Great Lakes Computer Expo & Sale
FEBRUARY 25
FL - Brooksville - Hamfest
FL - Ft. Lauderdale - Narisaam Computer Show*
GA - Dalton - Hamfest
IN - Laporte - Laporte ARC Cabin Fever Hamfest
MI - Westland - Great Lakes Computer Expo & Sale
ND - Bismarck - 5th Annual CDARC Hamfest
TX - Orange - Hamfest
VT - Milton - Northern Vermont Winter Hamfest
FEBRUARY 25-26
MD - Galthersburg - MarketPro Computer Show*
OH - Cincinnati - ARRL Great Lakes Div. Convention
FEBRUARY 26
FL - West Palm Beach - Narisaam Computer Show*
IL - Glen Ellyn - Computer Central Computer Show
KY - Louisville - Computer Fair South
MA - Westford - Old Radio Flea Market
MI - Ann Arbor - Great Lakes Computer Expo & Sale

MI - Dearborn - Livonia ARC 25th Swap 'N Shop
NH - Manchester - Northern Computer Show*
OH - Cuyahoga Falls - Cuyahoga Falls ARC Hamfest/Compt
VA - Vienna - Winterfest
WI - New Berlin - SEWFARS/MACE Swapfest/Computer Fair
WV - Fayetteville - Plateau Amateur Radio Assn. Hamfest

MARCH 1995

MARCH 4

IA - Cedar Rapids - Annual Eastern Iowa Computer Fair
NJ - Absecon - Springfest '95
OK - Elk City Hamfest

MARCH 5

MA - Northampton - MTARA Amateur Radio Fleamarket
MA - Taunton - Northern Computer Shows*

MARCH 10

MO - St. Louis - Annual Ham Radio Auction

MARCH 10-11-12

FL - Orlando - 49th Annual Orlando HamCatCon
LA - Lafayette - Hamfest

MARCH 11

IN - Indianapolis - AGI Computer Fair*
ND - Fargo - Amateur Radio & Computer Fair

MARCH 11-12

NC - Charlotte - Charlotte Hamfest & Computerfair

MARCH 12

CT - Bristol - Hamfest
IN - Indianapolis - Indiana Hamfest & Computer Show
OH - Circleville - Hamfest
OH - Conneaut - 9th Annual Hamfest & Computerfest
PA - York - 8th Annual York Springfest

MARCH 18

KS - Colby - Hamfest

MARCH 18-19

FL - Ft. Walton Beach - Hamfest/Swapfest
GA - Norcross - Atlanta Area Computer Show
TX - Midland - St. Patricks Day Swapfest

MARCH 19

IL - Sterling - 35th Annual Hamfest
NY - Yonkers - WECAS '95
OR - Milton Freewater - 49th Annual W7DP Swapfest
WI - Jefferson - Hamfest

MARCH 25

FL - Ft. Lauderdale - Narisaam Computer Show*
IN - Michigan City - Hamfest & Computer Flea Market

MARCH 25-26

MD - Timonium - Hamfest & Computerfest

MARCH 26

FL - West Palm Beach - Narisaam Computer Show*
IL - Grayslake - Lamarsfest '95
KY - Louisville - Computer Fair South
PA - Monroeville - 23rd Annual Hamfest/Computer Fair

MARCH 27-28-29-30-31

CA - Santa Clara - BUS Industry Conference & Exposition

MARCH 31-APRIL 1

AR - Little Rock - Hamfest & ARRL State Convention
FL - Gainesville - Poorman's Hamfest/Computer Show

APRIL 1995

APRIL 1

CT - Waterford - Ham Radio Auction
CO - Longmont - LARCFEST
IN - Columbus - Hamfest
NY - White Plains - Computer Show & Sale
WA - Spokane - Hamfest & Computer Show

APRIL 2

CT - Southington - Flea Market
NJ - Trenton - Hamcomp '95
WI - Madison - 23rd Annual Madison Swapmeet

APRIL 7-8-9

GA - Atlanta - Ham Radio '95

APRIL 8

KY - Bowling Green - Hamboree '95
ME - Portland - Hamfest
MN - Fergus Falls - Hamfest
MO - Joplin - JARC Hamfest '95
OK - Lawton - 49th Annual Hamfest
WI - Green Bay - Swapfest

APRIL 8-9

TN - Knoxville - Knoxville Area Computer Show

APRIL 9

MA - Framington - Spring Flea Market

APRIL 15

IN - Indianapolis - AGI Computer Fair*

APRIL 22

AL - Talladega - Tracfest

APRIL 22-23

GA - Marietta - Atlanta Area Computer Show
NJ - West Windsor - 20th Annual Trenton Computer Festival

APRIL 23

CT - Hartford - International Robotics Contest
IL - Arthur - 33rd Annual Hamfest
KY - Louisville - Computer Fair South

APRIL 28-29-30

OH - Dayton - Hamvention

APRIL 30

CA - Sacramento - Ham Radio/Computer Swapmeet

New Product News

isolated RS232 port. Other custom options include increasing the voltage range or current sensitivity. The cost of the standard Green Star wattmeter is \$868.00. Traceable calibration is included in the price.

To find out more, call or write:

ELECTRONIC PROD. DESIGN, INC.
6963 BLUEBELLE WAY, DEPT. NV
SPRINGFIELD, OR 97478
503-741-0778

ANTENNA ANALYST



Advanced Electronic Applications has added a new product to their handheld Antenna Analyst line — the 30-137 Antenna Analyst (30-137 MHz continuous coverage). The 30-137 Antenna Analyst provides comprehensive antenna performance information in an easy-to-read graphic format for commercial, government, and military applications. The instrument is designed to fit the needs of aircraft maintenance personnel.

The 30-137 graphically displays antenna's Standing Wave Ratio (SWR) vs. frequency plots on an LCD screen over an SWR range of 1:1 to 10:1. The unique LCD read-out displays the SWR curve over the entire frequency range, as well as at single frequencies. The 30-137 also measures return loss in dB. The keypad allows users to select the center frequency, frequency range, step size, and other parameters.

As with the 150-400 Analyst and the SWR-121 HF and V/U, the 30-137 Analyst is equipped with a serial interface to allow computer control. With optional software (AACOM), users can store SWR plots obtained by the Analyst in a PC for later reference, comparison, or printing. Now users can make tuning adjustments and immediately see and record the results.

Light weight (1 lb., 10oz.) compact size (4.30"W x 2.25"H x 8.50"L), and battery power makes the 30-137 Analyst perfect for use in the field. For battery conservation, the unit has a built-in battery saver.

The Analyst can also be powered with an external 12-16 VDC source.

The suggested retail price for the 30-137 Antenna Analyst is \$750.00.

For more information, contact:

ADVANCED ELECTRONIC APPLICATIONS, INC.
P.O. BOX C2160, DEPT. NV
LYNNWOOD, WA 98036
206-774-5554
FAX: 206-775-2340

LOW-COST DMM FIELDPACK



Fieldpiece Instruments has introduced the LT16 fieldpack. With this meter, a technician can: determine the rotation direction of a motor before it is turned on; measure start and run capacitors to determine if he/she can replace only the capacitor instead of the whole motor; measure volts (AC & DC), ohms, amps (AC & DC); indicate continuity with a beep; and test power semiconductors for catastrophic failure.

With the current clamp (included), he/she can also measure AC current up to 300A with resolution to 0.1A. Because the meter has the 200 mV range, he/she can measure relative humidity to 0.1% and temperature to 0.1°F with optional Fieldpiece accessories.

The multimeter comes in a zippered vinyl case with deluxe test leads, a yellow lead with an alligator clip, and a current clamp.

The meter included in the LT16 fieldpack measures volts up to 600V (AC and DC); amps up to 2A (AC and DC) and up to 300A (AC) using the current clamp (included); capacitance up to 20,000 microfarads; ohms up to 200 megohms; and frequency up to 100 KHz.

"Phase rotation" makes the LT16 unique. It tells how to connect a three-phase motor so that it rotates in the right direction. The problem is that the motor terminals are marked, but the wires supplying three-phase power are not marked. If the power wires are not connected to the correct motor terminals, the motor runs backwards. To solve this problem without connecting the motor, connect all three jacks of the meter to the power wires using the test leads. The jacks on the multimeter are marked like a motor. The multimeter tells him/her if the motor will rotate forwards or backwards. If

backwards is indicated, he/she reverses any two leads.

Accessories are modular. All connections are standard banana plugs and jacks. For hard-to-reach test points, replace the standard probe tips with the optional long probe tips into the meter or into the test leads. "Daisy chain" test leads to form extra long test leads. Plug an optional alligator clip into the test lead handle to tie one lead off to ground for convenient and safe "one-handed" testing. To measure current up to 300A (AC), remove the probe tips from the deluxe test leads and connect them to the current clamp.

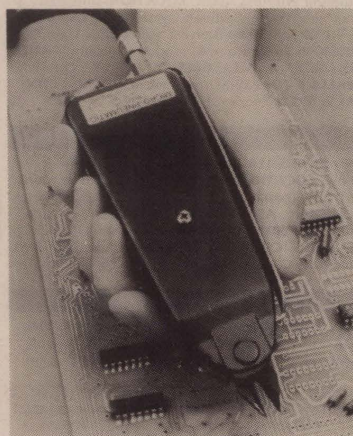
The LT16 fieldpack includes the following modular test accessories: a pair of deluxe test leads with sleeved male banana plugs on the end and female banana plugs built into the handle; two short probe tips; one 300 AC current clamp head; and one yellow wire with an alligator clip.

The LT16 low-cost fieldpack is priced at \$99.00.

For further information, contact:

FIELDPIECE INSTRUMENTS
231 E. IMPERIAL HWY. STE. 250,
DEPT. NV
FULLERTON, CA 92635
714-992-1239 FAX: 714-992-6541

PNEUMATIC CUTTER



A compact, vibration-free pneumatic cutting tool that fits comfortably into the palm and is actuated by a side trigger to effortlessly trim wire leads, cable, plastic gates, and tubing has been introduced by Xuron Corp.

The Xuron Model 590 Micro-Pneumatic™ Cutter is ergonomically designed to fit into the palm and can be actuated by either the thumb or forefinger. Featuring Micro-Shear® cutter blades, with patented bypass edges to assure a clean cut, it utilizes internal bellows that are inflated by compressed air to close the blades.

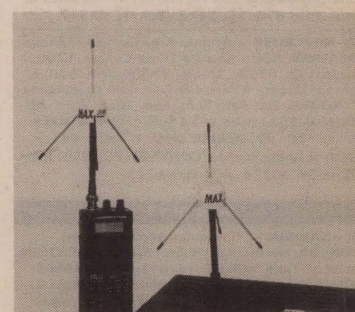
Unlike cylindrically shaped pneumatic tools that are awkward to hold and employ a ram to close the blades, the Xuron Model 590 Micro-

Pneumatic Cutter produces no recoil and less than 60 dB of noise. Measuring only 5.5"L x 1.5"W x .6" thick, it weighs under 6 oz., and operates from 50 psi air. Effortless to use, the side actuator "trigger" bar requires only 1/16" travel. The Xuron Model 590 Micro-Pneumatic Cutter sell for \$144.00 (list). Literature is available upon request.

For more information, contact:

XURON CORP.
60 INDUSTRIAL PARK RD., DEPT. NV
SACO, ME 04072-1840
207-283-1401 FAX: 207-283-0594

MAX 800 RE-DESIGNED



The improved MAX 800 Ground Plane Antenna, from Cellular Security Group, has been re-engineered for optimum performance on the new generation of scanners.

Two versions are available, connecting directly to the BNC fitting on handheld or base scanners. List prices are: handheld \$31.95, and base \$35.95. The MAX 800 is sold through dealers.

Dealer information is available by phone or fax. Contact:

CELLULAR SECURITY GROUP
4 GERRING RD., DEPT. NV
GLOUCESTER, MA 01930
508-281-8892 1-800-487-7539

1000 ELECTRONIC ACRONYMS

For all those stumped by BORSCHT, BLOB, OOF, POTS, OR SWEAT, a new 28-page handbook available from Rothschild & Associates, takes the mystery out of the bewildering array of acronyms and abbreviations used in today's electronics.

Named *HOTCAKE* — Handbook Of a Thousand Current Acronyms to Know in Electronics — this handy reference defines hardware and software acronyms in communications, IC design, computer architecture, RF and microwave, video graphics, and networking (including Internet).

Also included are world wide standards, societies, organizations, government agencies and programs, as well as commonly used electronic engineering and business terms.

Individual copies of *HOTCAKE*

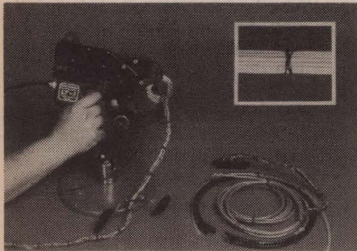
New Product News

are \$9.75 including U.S. postage, or \$29.00 for a two-year subscription of four issues.

For more information, contact:

ROTHSCHILD & ASSOCIATES
175 KNIBLOE HILL RD., DEPT. NV
SHARON, CT 06069-2215
203-364-1915 FAX: 203-364-1917

LT-1 TYING TOOL



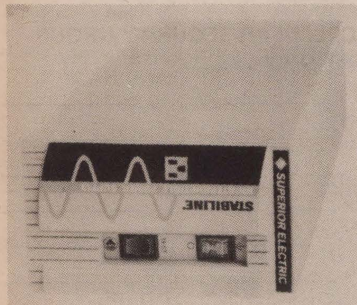
The LT-1 Tying Tool, distributed by Productivity Automation, Inc., seals a bag or wraps a bundle up to 1.18 inches in diameter with a PVC-covered nylon string, then ties a strong, secure knot, cutting the ends in a final operation.

In about a second, the item is secured, enabling the operator to move to the next tying position. The result is also a higher level of tamper evidence than other tying methods.

For more information, contact:

PRODUCTIVITY AUTOMATION, INC.
P.O. BOX 853, DEPT. NV
NEWTOWN, PA 18940
215-750-7909 FAX: 215-750-7909

STANDBY POWER SUPPLIES



The new SP Series STABILINE™ Standby Power Supplies from Superior Electric, provide a cost-effective, compact, and efficient power quality solution of PCs, workstations, POS systems, cash registers, and electronic devices by instantly switching to battery power when an AC power outage occurs.

SP Series units utilize economical synthesized sinewave (step-wave) output technology and come complete with audible and visual alarms. Optional computer interface software for Novell, UNIX, and other platforms is available on the 400 VA model. All units incorporate advanced battery management fea-

tures to ensure prolonged battery life, speedy recharge time, and advance notification of impending battery service requirements.

A bi-directional filter allows protection to and from the critical load and power line. For example, if the load creates electrical noise, it is filtered so the noise does not return to the line. If there is noise on the line, it is filtered so the noise is not passed to the load.

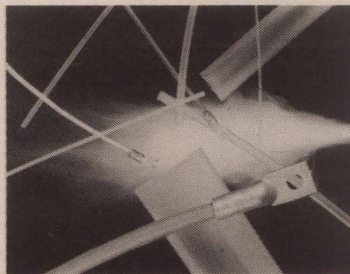
For additional protection, all units have a site wiring fault indicator that illuminates when the unit is turned on and connected to an outlet with improper wiring.

SP Series units are available in North American 120 VAC, 60 Hz, and international 230 VAC, 50/60 Hz types with power ratings of 250 and 400 VA. North American types are UL1778 listed and CSA certified.

For full information, write, fax, or phone:

SUPERIOR ELECTRIC
383 MIDDLE ST., DEPT. NV
BRISTOL, CT 06010
203-585-4500 FAX: 203-582-3784

IRRADIATED HEAT SHRINK



A line of Kynar® (PVDF) heat shrink that is UL VW-1 approved and supplied in a thin wall translucent grade is now available from Insul-Tab, Inc. of Woburn, MA.

Insul-Grip HSK-600 Kynar® Heat Shrink is a semi-rigid translucent thin-wall tubing that is self-extinguishing and has good dielectric properties along with excellent chemical and abrasion resistance. Rated for 150°C continuous operation, this 2:1 ratio irradiated heat shrink is an effective strain relief and antichafe guard.

Manufactured to MIL-I-23053B/8 AMS-3632C specifications, Insul-Grip HSK 600 Kynar Heat Shrink comes in sizes from 3/64" with a .010" recovered wall to 1 1/2" with a .020" recovered wall. Dielectric strength is 1164 volts/mil., volume resistivity is 10 14 ohm/cm, tensile strength is 5522 psi and the secant modulus is 110,000 psi.

For more information, contact:

INSUL-TAB, INC.
50 EVERBERG RD., DEPT. NV
WOBBURN, MA 01801
1-800-468-4822 617-935-0800
FAX: 617-935-0879

ADVERTISER'S INDEX

| | | | |
|---|----------------|--|------------|
| ABC Electronics..... | 45 | Jaguar Electronics..... | 83 |
| ACP Super Store..... | 46 | Javanco..... | 15 |
| Add-On America Corp..... | 98 | J.E.S., Inc..... | 124 |
| Advantage Instruments..... | 50 | JM Electronics..... | 73 |
| AES..... | 96 | Just Computers..... | 21 |
| Alan Components..... | 91 | KD Video..... | 21 |
| Alfa Electronics..... | 28 | La Paz Electronics Int'l..... | 46 |
| All Electronics Corp..... | 34 | Lectionic Research Labs..... | 33 |
| Allison Technology Corp..... | 44 | LJ Enterprises..... | 35 |
| Allstar Electronics..... | 25 | Lu-Tech..... | 77 |
| Alltech Electronics Co..... | 52 | M ² L Electronics..... | 46 |
| Alltronics..... | 47 | Martronics..... | 82 |
| Andromeda Research..... | 7 | Master Components..... | 13 |
| Angle Technology, Inc..... | 95 | MD Electronics..... | 32 |
| AP Circuits..... | 33 | MDM Radio, Ltd..... | 82 |
| Ar ² Communications Products..... | 14 | Metric Equipment Sales, Inc..... | 44 |
| Asset Sales, Inc..... | 94 | Metrologic Instruments..... | 86 |
| B & S Sales..... | 35, 45, 72, 87 | MFM Communications..... | 82 |
| Backtalk..... | 87 | MicroCom Industries..... | 128 |
| Basic Electrical Supply & Warehousing Corp..... | 51 | Micromint, Inc..... | 40 |
| Battery-Tech, Inc..... | 33 | Microplex..... | 102 |
| Baylin Publications..... | 13 | Micro Video Products..... | 65 |
| Bisme Computer, Inc..... | 92 | Midwest Electronics..... | 8 |
| Black Feather Electronics..... | 61 | Motron Electronics..... | 77 |
| Boss Distributors..... | 121 | MWK Industries..... | 65 |
| Brigr Electronics..... | 80 | National Electronic Wholesalers..... | 16 |
| BWC Company, Inc..... | 83 | Northeast Electronics, Inc..... | 46 |
| C & C Electronics..... | 93 | Novaplex..... | 123 |
| C & H Sales Co..... | 55 | Optoelectronics..... | 4, 134 |
| C & S Sales, Inc..... | 90 | Paradise Cable..... | 15 |
| Cable Box Wholesalers, Inc..... | 9 | Parallax, Inc..... | Back Cover |
| Capital Electronics, Inc..... | 92 | Plazac Sales, Inc..... | 73 |
| Cellsoft..... | 81 | PM Electronics..... | 14 |
| Cellular Security Group..... | 116 | Polaris Industries..... | 45 |
| C.G.C..... | 97 | Prime Electronic Components, Inc..... | 61 |
| Cheneko Products..... | 8 | Print Products International..... | 25 |
| Code Quick..... | 81 | R & D Electronics..... | 35 |
| Communications Electronics, Inc..... | 62 | R & S Surplus..... | 14 |
| Communications Systems Labs..... | 16 | Radio School..... | 117 |
| Computer Disk Service..... | 8 | RA Enterprises..... | 118 |
| Comtrad..... | 133 | Ramsey Electronics, Inc..... | 79 |
| Consumertronics..... | 109 | Roger's Systems Specialist..... | 122 |
| Copper Electronics, Inc..... | 41 | SC Engineering..... | 103 |
| Corby Access Control Systems..... | 29 | Self-Reliance Co., Inc..... | 92 |
| Creative Micro Electronics, Inc..... | 7 | Skycraft Parts & Surplus, Inc..... | 64 |
| Cunard Associates..... | 54 | Skyvision, Inc..... | 70 |
| Danbar Sales Co..... | 20 | Solar Electric, Inc..... | 89 |
| Davilyn Corp..... | 12 | Solo Power..... | 25 |
| Debco Electronics..... | 97 | SPI Semiconductor..... | 55 |
| DeltaQuest..... | 12 | Star Circuits..... | 116 |
| Dominator Technologies..... | 51 | Starlite Electronics..... | 93 |
| E.H. Yost and Company..... | 83 | Startechs Electronics..... | 116 |
| Electro Automotive..... | 32 | Sun Equipment Corp..... | 63 |
| Electro Tool, Inc..... | 71 | Symphony Electronics Corp..... | 106 |
| Electronic Rainbow, Inc..... | 19 | Synergetics..... | 107 |
| Electronics Brokers..... | 53 | Team America..... | 9 |
| EMAC, Inc..... | 87 | Tecnet..... | 54 |
| Fair Radio Sales..... | 7 | Televue Distributors..... | 68 |
| Falkner Enterprises of America..... | 98 | Televue, Inc..... | 135 |
| FCS Marketing, Inc..... | 106 | Test Equipment Sales..... | 32 |
| Fieldpiece..... | 71 | The Filter Company, Inc..... | 104 |
| Flashback Systems..... | 13 | The Greater Baltimore Hamboree & Computerfest..... | 61 |
| Forest Electronics, Inc..... | 60 | The Halcyon Group..... | 86 |
| Fotronic..... | 44 | The RF Connection..... | 93 |
| Futura Components..... | 6 | Thacker Electronics & Computers..... | 2 |
| Games Partners, Inc..... | 21 | Ucando..... | 104 |
| Gateway Electronics, Inc..... | 78 | Universal Electronics, Inc..... | 71 |
| General Device Instruments..... | 9 | Universal Radio..... | 8 |
| General Science & Engineering..... | 73 | U.S. Cable TV, Inc..... | 98 |
| GMP Parts Company..... | 73 | VGR Systems Corp..... | 29 |
| Greenleaf Electronics..... | 69 | Video Communication Systems, Inc..... | 105 |
| Halted Specialties Co..... | 3 | Video Connection, Inc..... | 29 |
| Highlander..... | 26-27 | Video Equipment, Inc..... | 86 |
| HighText Publications, Inc..... | 115 | Vision Distributors..... | 39 |
| HoopsWare..... | 91 | Visitect, Inc..... | 65 |
| H.T. Orr Computer Supplies..... | 72 | Visual Communications, Inc..... | 64 |
| Independence Electronics, Inc..... | 55 | Wawasee Electronics..... | 60 |
| Index Publishing Group, Inc..... | 65 | Western Test Systems..... | 36-37 |
| Intec Inventions, Inc..... | 97 | Wholesale Cable..... | 54 |
| International Overseas Dist., Inc..... | 87 | Windward Products..... | 15 |
| Intronics, Inc..... | 64 | Xandi Electronics..... | 54 |
| J & M Microtek, Inc..... | 12 | | |
| Jade Products..... | 96 | | |

How to get surround sound without buying the theater...

Chase Technologies brings you an amazing new patent pending surround sound decoder that turns your stereo into a five-channel home theater.

By Charles Anton

As much as I love renting videos, it's just not the same as seeing a movie in a theater. I remember the first time I saw *Jurassic Park*—I nearly jumped out of my seat when the dinosaurs roared. One of the reasons movies seem so real is because surround sound makes it seem like you're actually there when events are happening. Now there's an incredible new device that lets you use a stereo receiver to get that same surround sound in your home.

It takes more than five speakers to get surround sound; there needs to be a way of separating the signals. The new Chase Technologies HTS-1 decoder does just that, and in a revolutionary way that rivals the best Dolby Pro-Logic and THX systems.

Wins over critics. In the September '94 issue of "High Performance Review," noted audio critic Daniel Kumin said "the HTS-1 can do quite a job of recreating a 3D theatrical experience...surround effects emanated with satisfying fullness...sound was clean at any level...with quite involving and natural sound ambience." Plus, John Sunier, the leading authority on surround sound and producer of *Audiophile Audition*, a nationally syndicated radio program for audio enthusiasts, says,

"...the new Chase HTS-1, when used to decode the hidden ambience in all musical recordings, definitely outperforms all the Dolby and THX processors (which could cost you up to \$3,000)...I am impressed!"

Passive circuit. Last year, audio industry veteran and Chase president Bob Rapoport invented a new five-channel "passive" circuit for decoding every surround sound encoded movie available. This new decoder can be used with two, three, four, or five channels of amplification, making it the most cost effective method for upgrading an existing stereo system to full home theater performance on the market today.

Breakthrough. The HTS-1 is able to decode the *Dolby Surround™* signals in a stereo, videotape or laserdisc because the spatial and depth cues have been matrixed into the "out-of-phase" L minus R portion of the program. By decoding passively, the HTS-1 avoids costly and noisy signal processing. Plus you don't need any extra amps! Just connect the HTS-1 to your existing stereo, add two speakers for

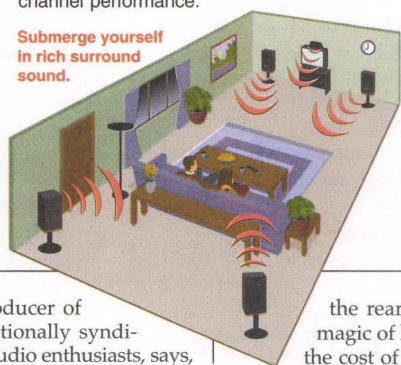
The secret of surround sound

Surround sound has become the rage of the 90's because it adds depth and realism to stereo sound, giving you the home theater experience. It makes you feel like you're actually at a concert or theater. To "fill a room" with surround sound, you need more than two channels. The HTS-1 provides five channels of sound from any two-channel stereo source.

Free center channel. By connecting your VCR or laserdisc player to your TV, you get sound from your TV speaker; this acts as the fifth or "center channel."

Upgradeable. The new HTS-1 gives you the ability to upgrade by adding the "Dialog" powered center channel speaker (instead of using your TV speaker.) The decoder can also feed an extra amp for the rear speakers if you want the ultimate in discreet five channel performance.

Submerge yourself in rich surround sound.



the rear, and you'll experience the magic of home theater at a fraction of the cost of all other systems.



Easy installation. Hooking up the HTS-1 is easy—just connect the speaker outputs of your receiver or amp to the HTS-1, then connect speaker wire to the front and rear speakers. The rear channel speakers don't have to be big. We suggest the Chase ELF-1 in either black or white finish to match your decor.

Center Channel.

The "Dialog" powered center channel speaker is the perfect add-on for home theater. It keeps voices and sound effects centered on screen for stunning localization and clarity.

Risk-free home trial.

The best way to evaluate surround sound is in your home, not in a showroom. That's why we're offering this risk-free home trial. We're so sure that you'll be delighted with the quality of these products and the surround sound experience that we are giving you 30 days to try them for yourself. If they're not everything we say, return them for a complete "No Questions Asked" refund.

HTS-1 Home Theater Decoder\$99 \$10 S&H

Speakers designed by Chase for the HTS-1:

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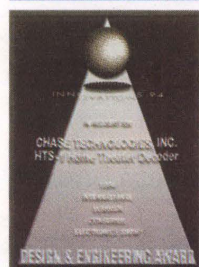


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The Remarkable *New* Frequency Scout!

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- ▶ The Scout automatically finds and records frequencies, will tune a receiver and can differentiate between random noise and coherent RF transmissions!
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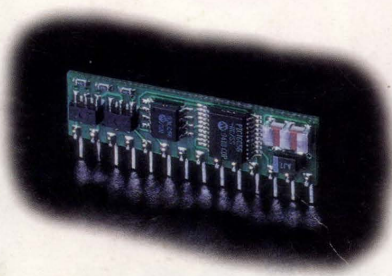
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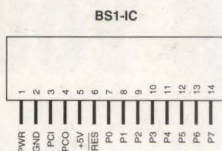


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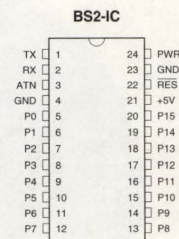
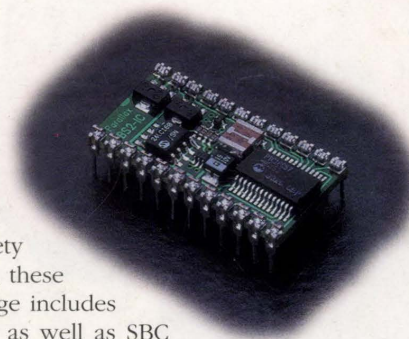
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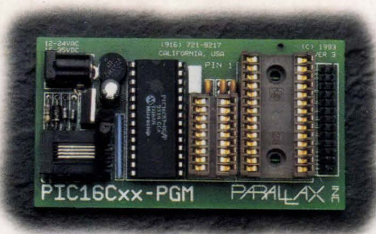


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