

NUTS & VOLTS

M A G A Z I N E



\$3.50
VOL. 16 NO. 10
OCTOBER 1995

Exploring Electronics And Technology For The Hobbyist And Professional

MORPHING SOFTWARE

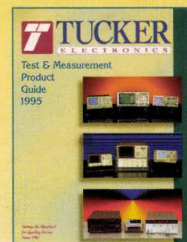
Add your own special effects to computer movie files,
home video productions, and multimedia projects.





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Radios, Test Equipment or Both...The Choice Is Yours



An Incredible Deal . . . A Complete System, A New CRT, and A New Low Price!

Hewlett Packard 141T/8552B Plus RF Plug-In of Your Choice! Spectrum Analyzer System

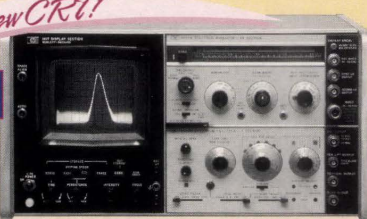
We've reduced the price on these fully calibrated, solid-state Spectrum Analyzer Systems and we're including BRAND NEW CRTs...all for about what a new CRT alone would cost! It's not just a great price with a new CRT, it's a great system too. It offers Variable Persistence Storage capabilities while providing absolute calibration of frequency and amplitude, high resolution and sensitivity, plus a wide dynamic range. Your system will include a Brand New CRT installed in an HP 141T Display Unit along with an 8552B IF section and your choice of either an 8553B or 8555A RF section. Many other plug-ins are available so when your requirements change, your Spectrum Analyzer can too! Call today while supplies last.

With 8553B RF Section \$1995

- Frequency Range: 1 kHz to 110 MHz
- Scan Width: 18 calibrated scan widths from 20 Hz/div to 10 MHz/div in a 1, 2, 5 sequence
- Bandwidth Range: selectable 3 dB bandwidths from 10 Hz to 300 kHz in a 1, 3, 10 sequence
- Measurement Range: -130 dBm to +10 dBm (Log ref. level); 0.1 μ V/div to 100 mV/div (Linear sensitivity)

Brand New CRT!

Tucker
PRE-OWNED
Quality



FULLY CALIBRATED TO NIST SPECS.

With 8555A RF Section \$2495

- Frequency Range: 0.01-18.0 GHz (w/internal mixer), 12.4-40.0 GHz (w/external mixer)
- Scan Width: 16 calibrated scan widths from 2 kHz/div to 200 MHz/div in a 2, 5, 10 sequence
- Bandwidth Range: selectable 3 dB bandwidths from 100 Hz to 300 kHz in a 1, 3, 10 sequence
- Measurement Range: -60 dBm to +10 dBm (Log ref. level); 0.1 μ V/div to 100 mV/div (Linear sensitivity)

All Test Instruments Include Manuals and are Completely Operational Unless Otherwise Stated.



WE TAKE TRADE-INS!



NEW SHIPMENT JUST RECEIVED

Racal RA6790/GM HF Receiver ... \$1495

The RA6790/GM is a fully synthesized, microcomputer-based, tunable, solid-state receiver designed to provide reception capabilities for CW, AM, LSB/USB, and FM over the frequency range of 0.5 MHz to 30 MHz. Frequency tuning can be accomplished by either keyboard entry or single knob control for continuous tuning with selectable rates of 1000 Hz, 30 Hz, and 1 Hz increments and BFO continuous in 10 Hz increments. An 8 digit LCD displays frequency and 3 digit LCD displays sign readout of BFO data relative to IF center. Other front panel displays include an RF Meter, AF Meter, Bandwidth, AGC Mode, Remote and Fault indication. These are fully calibrated Receivers, hurry for the best selection of available filters.

OPTOELECTRONICS GoldStar EXTECH BK PRECISION LEADER Protek WAVETEK HAMEG

RS-232C Optoelectronics 3000A Plus HandiCounter \$349

Advanced hand held 10 Hz to 3 GHz counter with dual 50 Ω /1 M Ω input amplifiers. Measures Frequency, Period, Ratio, & Time Interval. Features high resolution/high speed counting, digital filter and digital auto capture for hands free recording, signal strength bargraph, RS-232C interface and 6+ hour battery operation. Antenna sold separately.



TCXO Time
Base Option
\$100

**FACTORY
NEW**

Optoelectronics 3300 HandiCounter \$139

This pocket sized LCD Frequency Counter covers the range from 1 MHz to 2.8 GHz while providing ten digit resolution! The design of the Model 3300 makes it easy to use and the display has excellent viewing characteristics in both direct sunlight and indoors. The 3300 is

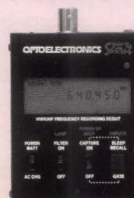
256 times faster than the older models and offers longer battery life. Only 3.7"H x 2.75"W x 1.2"D. Antenna sold separately.



**FACTORY
NEW**

Optoelectronics Scout 40 Frequency Scout \$439

The Scout 40 can record up to 250 hits on each channel and store into memory 400 unique frequencies (10 MHz to 1.4 GHz). Features Digital Filter/Auto Capture and the ability to automatically Reaction Tune or Memory Tune many receivers. 10 digit LCD, EL backlight, and 16 segment signal strength bargraph. Includes NiCad batteries, AC adapter/charger and PC utility disk.



**FACTORY
NEW**

Optoelectronics R10 Communications Interceptor \$359

Excellent for two-way communications tests, security, counter-surveillance and recreational communications monitoring applications. Covers 30-2000 MHz. Measures deviation (wide and narrow band), relative signal strength, signaling tones (CTCSS, DCS, and DTMF) using the companion DC40 Decoder or TC200 Tone

Counter. Features pocket sized, demodulated audio output, and built-in speaker.



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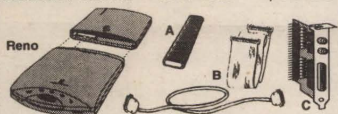
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Multimedia Kit Deal #1

- ◆ Mediavision **Reno** Kit
 - Consists of new external Reno CD-ROM drive, docking bay with SCSI2 port, AC Adapter
 - Double-speed 180mS drive is lightning fast!
 - Drive detaches from docking bay, use with your headphones as a portable personal audio CD player
 - Great for Mac or IBM (with adapter bracket)
 - Brand new in box, 90-day warranty

Mediavision **Reno** Kit HSC# 15586 **\$79.95**



- ◆ **Mediavision Reno Accessories (only sold with Reno):**
 - A. Rechargeable Battery Pack HSC#15587 **\$7.95**
 - B. Reno Cable Kit (SCSI2 - DB25 cable, 50p. ribbon cable, internal & external audio cables) HSC#15589 **\$15.00**
 - C. Internal SCSI IDS50 to DB25 Adapter bracket for IBM, use with Reno cable kit & your SCSI card. HSC#15590 **\$6.95**

CD Player Carry Pouch

- ◆ Carrying pouch for Mediavision Reno Drive (above)
- ◆ Handsome padded neoprene zipper case with straps lets you take Reno (or other CD) with you for portable audio use
- ◆ Storage pocket will hold a couple CD's

HSC# 15388



\$1.95

CD-ROM Specials!

- ◆ Tested Good CD-ROM Drives removed from systems
- ◆ 90-Day Warranty ◆ 2x and 3x Speeds available
- ◆ Standard SCSI 50-pin interface (see above for controller)
- ◆ Both 2X drives are tray-type (no caddy needed)

Sanyo CDR-H93MV 2X-Drive HSC#15584 **\$89.95**

NEC CDR-210 2X-Drive HSC# 15583 **\$89.95**

NEC CDR-S10 3X-Drive HSC# 15327 **\$139.95**

1200 dpi Color Scanner!

- ◆ Dexxa sheet-feed full page (8.5" x 11") color scanner
- ◆ 1200 dpi, 24-bit TWAIN interface, Windows compatible
- ◆ New in box with extensive software bundle
- ◆ Includes OCR Album, Fax, Copy, Image editing, Multimedia Slide Show, Electronic Database, Omni-page
- ◆ IBM compatible interface card & cables included
- ◆ Ninety-day Warranty

HSC#15572

\$249.95

Digital Multimeter Deal!

- ◆ Low-cost Digital Multimeter with High-end Features!
- ◆ 3.5 Digit, case measures 2.75" x 5" x 1"
- ◆ DCV to 1KV, ACV to 750
- ◆ DC Current to 10A, Ohms to 2 Meg
- ◆ Diode, Transistor check with hFE
- ◆ Test Leads, 9V Battery included.
- ◆ Brand New, 90-day warranty

HSC# 80370

\$19.95



Multimedia Sound Card!

- ◆ Mediavision Pro Audio Spectrum SCSI Sound Card
- ◆ 8-bit Sound Card with SCSI Port, great for controlling internal CD-ROM's (see below for CD-ROM Specials)
- ◆ Joystick Port, Mic. input, Line In & Line Out jacks
- ◆ Installation disk, instruction sheet included
- ◆ New in OEM packaging (envelope, no box)
- ◆ 90-day warranty
- ◆ Use with CS-550 speakers below for great sound combol

Mediavision Sound Card HSC# 15585 **\$19.95**

Multimedia Speakers

- ◆ Two styles to choose from, both new in box
- ◆ White plastic enclosures, grey grilles
- ◆ Econo-import model MSS-1000 has:
 - Volume control, Bass boost switch
 - Uses 3 C-cells per side, measures 3.5" x 3.5" x 5"
- ◆ CS-550 by Labtec (pictured below) has:
 - Volume control, Bass boost switch, Treble-boost switch, measures 4" x 4" x 6"
 - CS-550 has 40 - 16000 Hz freq. response, 3" speakers, and power light.
 - 4 watt amplifiers (uses 2 C-cells per side)
- ◆ Both feature magnetically shielded enclosures, "enhanced bass-response cabinet design", and attractive beige styling.



MSS-1000 HSC# 15127
Pair/ **\$6.95**

CS-550 HSC# 15517
Pair/ **\$9.95**

Dealer Inquiries Invited...
Quantity Discounts Available!

Computer Cable Compendium!

- ◆ A collection of often-used computer/peripheral interconnect cables and adapters at rock-bottom prices!

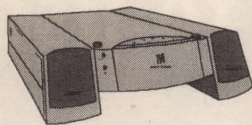
- ◆ 6' DB25 Female-Female Cable HSC#15573 **\$2.45**
- ◆ 6' DB25 Male-Female Cable HSC#15574 **\$2.95**
- ◆ 10' DB25 Male-Female Cable HSC#15575 **\$2.45**
- ◆ 10' DB25 Male-Male Cable HSC#15576 **\$2.95**
- ◆ 6' DB25 Male-Male Cable HSC#15577 **\$2.45**
- ◆ 10' DB25 Male-Male Cable HSC#15578 **\$2.95**
- ◆ DB25 Male-Male Gender Changer HSC#15579 **\$1.75**
- ◆ DB25 Fem-Fem Gender Changer HSC#15580 **\$1.75**
- ◆ DB25 Female - DB9 Male Adapter HSC#15581 **\$1.75**
- ◆ 10' DB25 Male - DB9 Female Cable HSC#15582 **\$2.95**
- ◆ 10' CEN36 Male - Male Cable HSC#15537 **\$3.50**
- ◆ 6' CEN36 Male - DB25 Male Cable HSC#15535 **\$1.95**
- ◆ 25' DB25 Male - Male Cable HSC#15000 **\$8.95**
- ◆ 1' HPIB/GPIB Cable (IEEE-488) HSC#14803 **\$12.50**
- ◆ Two-way CEN36 Switchbox HSC#15539 **\$7.50**
- ◆ Four-way CEN36 Switchbox HSC#15540 **\$8.50**
- ◆ 4' IEC M - F Monitor Power Ext. HSC#15347 **\$1.95**
- ◆ 3' IEC M - F Monitor Power Ext. HSC#14960 **\$1.50**
- ◆ PS2 Mini-DIN M - IBM DIN F Adap. HSC#14662 **\$.99**

Serious Operating Systems!

- ◆ SCO XENIX 386 - Development tools for C, Graphics, Applications. 5.25" Floppies, Manual HSC#15522 **\$99.00**
- ◆ SCO Open Server Ver. 3.0.0 - Tape or CD Format, TCP/IP/Novell/NFS, UNIX V386 Ver. 4.0 HSC#15512 **\$295.00**
- ◆ SCO Open Desktop R2.0/R3.0 - SCO UNIX R4.0/R4.2 Open-look style GUI, 9 Track Tape Cartridge Media, Requires min. 386, VGA, 8MB, 120MB HSC#15513 **\$250.00**
- ◆ Interactive Looking Glass Professional Ver. 2.1.2 - Open-look style GUI, BSD UNIX 4.2 Compatible, Requires min. 386SX, VGA, 4MB, 100MB HSC# 15514 **\$295.00**

Multimedia Kit Deal #2

- ◆ Mediavision **Memphis** Kit (Limited Quantities Available)
 - Consists of used, tested good SCSI double-speed drive, custom enclosure, and detachable Bose active speakers with 10W/Channel amplifiers.
 - Requires 12VDC 2.5A Adapter, not included. We may have some suitable adapters by press time, inquire about possible substitutes when ordering.
 - We don't have the interface cable, but you could make your own SCSI Cable to connect to your SCSI sound card (see below). Unit has a high-density 44-pin connector, or remove it and fabricate your own hookup.
 - Midi ports and audio jacks on back, NEC CDR210 CD-ROM Drive has tray, does not need caddies.
 - Awesome sound from Bose speakers!



Mediavision **Memphis** kit HSC# 15566 **\$139.00**

Network Card Bargain!

- ◆ Rascal Interlan 16-Bit Ethernet Cards
- ◆ High Quality Dual Interface, 10-Base-T or Coax
- ◆ Manual, Software, BNC tee included
- ◆ NE2100 Compatible, NI6510 Compatible
- ◆ Handy 5-pack contains 5 cards, 1 Manual and 2-disk software pack)
- ◆ **Summer Special -- New Lower Price!**

HSC# 15364

\$99.95 / 5pk.

High Power AA NiCads!

- ◆ New Kenwood AA NiCad Batteries
- ◆ High quality, new, shrink-wrapped
- ◆ 1.2V at 800 mAh!
- ◆ Regular AA NiCads are only 300mAh
- ◆ Standard charge 15 hrs. @ 80mA
- ◆ Sorry, no quantity discounts

HSC# 15281

\$2.99 / pr.



386 CPU Special!

- ◆ Special deal on 25MHz 386 Processor / Oscillator Combo!
- ◆ Intel 80386DX-25 Chip (New, prime)
- ◆ Four-pin 50MHz Dip Oscillator for clock rate
- ◆ Many CPU-less motherboards are on the surplus market, here is the inexpensive way to get up & running



HSC# 15375

\$9.95

Trackball for Mac!

- ◆ Mouse Systems A³ Trackball for ADB-type Mac's
- ◆ "Three-button Power Control Panel" Software
- ◆ High Resolution (680 dpr) for smooth, fingertip operation
- ◆ 100% AUX, MacX, X Window and Mac OS compatible
- ◆ Multi-mode operation: Standard or 3-Button Power
- ◆ Reassignable buttons for left- or right-handed use
- ◆ New in box with software, 90-day warranty

HSC# 15432

\$27.50

Tiny Trackball for DOS!

- ◆ Mouse Systems NewPoint Trackball for DOS/Windows
- ◆ Portable Trackball for the Laptop on the go!
- ◆ High Resolution in a small package
- ◆ 100% DOS and Windows compatible
- ◆ Mini-trackball with two buttons, ergonomic shape
- ◆ Clamps to keyboard, comes with padded carrying case
- ◆ New in box with software, 90-day warranty

HSC# 15433

\$19.95

Serial Smartswitch

- ◆ Two computers can share one serial printer or plotter
- ◆ Automatically detects and switches to active line
- ◆ User-selectable Auto form-feed ensures each print job starts on new page
- ◆ Printer-ready light shows status at a glance
- ◆ X-on / X-off light show print job status
- ◆ External power supply, instructions included
- ◆ New in box, 90-day warranty

HSC# 15449

\$19.95

Tektronix Test Equip.

- ◆ Previously-owned, tested Tektronix Scopes & Plug-ins
- ◆ In-stock items as of press time, call for current selection

Mainframes:

7603	100MHz 3-bay	\$195
7704A	200MHz 4-Bay	\$325
7834	400MHz Storage 4-Bay	\$800
7844	400MHz Dual Beam 4-bay	\$695

Vertical Amplifier Plug-ins:

7A13	150MHz Differential Comp.	\$400
7A16A	225MHz 5mV-5V Single Trace	\$100
7A24	350MHz 5mV-1V Dual Trace	\$400
7A26	200MHz 5mV-5V Dual Trace	\$175
7A29	1GHz 10mV-1V Single Trace	\$625

Timebase Plug-ins:

7B10	2nS-2S 1GHz Triggering	\$325
7B15	2nS-2S Delaying, Delta-T	\$350
7B71	2nS-5S Delaying, x1, x10	\$125
7B85	1nS-5S Delaying, x1, x10	\$250
7B92A	.5nS-25 Delay, Delay	\$300

Miscellaneous Plug-ins:

7D11	100nS-1S Digital Delay	\$195
7D13A	3.5 Digit DMM, CRT R/O	\$125
7D15	225MHz Universal Counter, R/O	\$275
7T11	0pS-5mS Sampling Sweep Unit	\$750

Easy File Transfers!

- ◆ SmartSync Software by Nomadic Systems
- ◆ Provides easy way to keep multiple computers in synch
- ◆ Fast and efficient, transfers only the changes
- ◆ Works with modems, cables or diskettes
- ◆ Automatically updates multiple files, single and multi-user
- ◆ Prevents accidental overwrites, can remotely copy

HSC# 15305

\$19.95

SCSI Disk Drive Case

- ◆ Low-profile case for 5.25" drives
- ◆ Perfect for lower-power drives
- ◆ 9.5" x 2.5" x 10.5" overall size
- ◆ 50-pin SCSI daisy-chain connectors
- ◆ Internal audio cable, RCA jacks on back, SCSI ID switch
- ◆ Uses External 15-16VDC, 1-2A Supply (Not Included)
- ◆ Internal Regulator board can deliver +5, +12 @ 1.5A



HSC# 15245 Low-Profile 5.25" Drive Case **\$17.95**

Remote Control for your Computer!

- ◆ Infrared Remote operates your computer from 50 feet
- ◆ Perfect for sales presentations, training, demonstrations
- ◆ Serial Interface (IBM version) or ADB (Mac version)
- ◆ Handheld remote is 7" x 2.5" x .5"
- ◆ Included software provides screen pointer for emphasis
- ◆ Keystroke mapping table can be customized, saved
- ◆ Roam the room, make eye contact with your audience
- ◆ Like using a TV set remote control (easy to set-up, use)

HSC# 15240 IBM Remote Keyboard **\$29.95**

HSC# 15241 Mac Remote Keyboard **\$39.95**

◆ Infrared Remote operates your computer from 50 feet

◆ Perfect for sales presentations, training, demonstrations

◆ Serial Interface (IBM version) or ADB (Mac version)

◆ Handheld remote is 7" x 2.5" x .5"

◆ Included software provides screen pointer for emphasis

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HSC# 15240 IBM Remote Keyboard **\$29.95**

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Featuring The **OptoScan535:**
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Introducing the OptoScan535, the next generation in computer controlled interface boards for the Radio Shack series of scanners. A Pro-2035 with an OptoScan535 is not only faster than an unmodified Pro-2035, it is faster than any other scanner using computer control. And that's just scratching the surface.

The OptoScan535 comes with two built-in CI-V interface convertor jacks, eliminating the need for an external convertor box. The OptoScan535 modification provides decoding on screen of CTCSS, DCS, and DTMF (Touch Tone®).

In addition to the speed and performance computer control offers, the OptoScan535 can also be used with the revolutionary Scout™. The Scout Reaction Tune™ feature allows the Scout to simultaneously tune the Pro-2035 through the CI-V port the OptoScan535 modification provides.

Features:

- Computer control of the Pro-2035
- Decodes CTCSS, DCS, and DTMF tones
- Two built-in CI-V data ports
- Use with the Scout™ for Reaction Tune™
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- Records frequencies into memory locations while unattended
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The closing date for each issue is the 10th of the prior month, e.g., the closing date for the June issue is May 10th. Ad copy to be typeset by Nuts & Volts should be received one week prior to the closing date. Call or write for current advertising rates.

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EDITORIAL CONTRIBUTIONS

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.

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Dear Nuts & Volts:

Something that might be of interest to your readers is our new InterNet website that is dedicated to all phases of electronic instrument prototyping (and low volume production). For the past 15 years we have been developing environmentally friendly techniques for making PCBs in a small shop (or even home) environment. Now we are putting everything we know (including our patented processes) on-line and in the public domain. Ultimately, we hope to have a complete reference library covering topics ranging from PCB design and fab, to making your own shop equipment, sheet metal forming, cabinet making, setting up clean commercial operations and how to access hard-to-find services and supplies. Access is totally free, as is downloading the entire reference for local viewing. Users will need Netscape 1.1n to derive the maximum benefit. A sound card also helps a bit.

The URL for the site is:
"http://www.databahn.net/greenckt/" without the quotation marks.

The site is open and ready for browsing.

Ron Reed
Monument, CO

Dear Nuts & Volts:

Great magazine! Why not a column for science teachers and students? Include instrumentation hardware and kits, software, shareware, surplus, computer projects, experiments, etc. Beat the high cost of such firms as Vernier (or get them to advertise), exchange ideas, lessons.

Rod High School
Teacher of Chemistry/Physics

Editors note:

Sounds like a good idea to me. Are you merely suggesting or proposing to write one? Any qualified persons interested in pursuing this can drop me a note. If something interesting develops...

Dear Nuts & Volts:

I have just received my first *Nuts & Volts* magazine (Aug. '95). It arrived Aug. 11th, after nine days locked in "snail mail." As a senior

with failing eyesight, I feel I must complain about part of your production methods. To wit: shading the information panels with dark gray and then printing black on the gray. Examples: lower p.7; right p.10; upper 9p.27; lower p.35; upper p.37 etc. . . etc. If you must use shading, use a light color (yellow, pink, etc.) or VERY light gray.

Otherwise, I am enjoying the articles.

C.D. Reynolds
Australia

Editors note:

Yes, we have noticed this problem also. We do not EVER shade with dark gray. The background screens sometimes darken considerably during the printing process. We are trying to correct the problem, but have not yet obtained consistent results. I apologize for the inconvenience. Bear with us a little longer, we are experimenting with a new output process that should solve the problem.

Dear Nuts & Volts:

Fellow hobbyists who are looking for an inexpensive PCB-CAD and schematic capture program that really works, should check out Boardmaker from Ohio Automation (by a company named Tsien).

I first tried it at work and was very impressed by its ease of use. Put simply, it packs a lot of bang for

the buck. At just \$100.00 for the introductory version, it handles better than most programs costing 10 times as much that I've tried. Inexpensive it may be, but cheap it ain't. Anyway, the fact is that Ohio Automation even offers a free demo. Wow. This is a nice program. Ten layers and every option you can imagine.

Ohio Automation, 7840 Angel Ridge Rd., Athens, OH 45701, 614-592-1810.

Chris Franklin
San Francisco, CA

Dear Nuts & Volts:

Unfortunately, I won't renew my subscription to *Nuts & Volts*, but it's more a change of interest coming from me and not your magazine lacking interest.

Yes, this has nothing to do with the very interesting things folks like me can find in your magazine, it's just I'm no longer able to find the time to read it, so there is no point in letting the issues pile up on my "to be read later" stash.

I did think I would read the "later" but... It's just I need much more than 24 hours in a day and still haven't got them. So, I'm slowing down on a few things and electronics/computing is one of them.

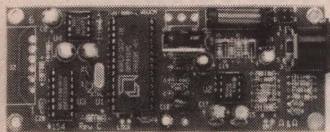
Please remember: I like your magazine just the way it is, and I wish I could help you in telling you what I would like you to do better,

HAM GEAR FOR SALE

10

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PACKET FOR Commodore 64 users. Digicom modem wired, tested. Software and documents. \$49. Crawford Amateur Radio Society, PO Box 653, Meadville, PA 16335.

but no, I like the size (Ah, easier to find in my piles!), the paper (who needs glossy paper? We want the information and reasonable prices, heck!), the ads (gosh I wish I was in the states!), and most of all, all the info packed in there!

Now, any idea how to design a super duper day-stretching machine?
Olivier Deygout

Editors note on Software Wizardry:

Before we get into another round of interplatform wars, let me point out that the purpose of the Software Wizardry column is to introduce the reader to some of the development tools and techniques for developing windows software. The Windows platform was chosen by Harry, not because he feels it is the most technologically advanced, easiest to use, has the fewest system crashes, or any other reason except that there are more users than any other platform, plus the development tools available are better than those available for the others.

Having said that, we frequently get requests for articles and projects using other computers like Macs, Amiga, and others. Unfortunately, we have not had many quality article submissions that deal with them. Drop me a note or E-Mail if you would like to contribute something and we will cer-

tainly consider it. As a publication and as individuals, we have absolutely NO bias toward any particular platform, just a lack of material for anything but PCs.

Software Wizardry has not appeared in the September or October issues due to other demands on Harry's time. We should, however, see a return next month.

The following letters were received as long as several months ago. Due to space restrictions, we weren't able to print them as they arrived.

Dear Nuts & Volts:

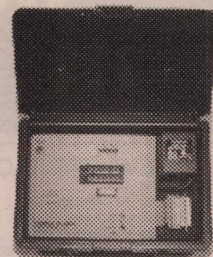
Harry Helms (Software Wizardry) gave his new column a rather shaky start. After informing us that he is a "Macintosh bigot," he then went on to explain all the reasons why he isn't going to be writing a Mac article, or even LINUX, when it would have been sufficient to merely state that the column was going to be WIMP (Windows Intel Microsoft PC - thanks, Dvorak) based. Even though he is wrong in several areas.

The PowerMac is much more significant than he credits it. Apple's original goal of one million units sold the first year was criticized as being unrealistic. Yet they exceeded it. Their growth is taking off at an astounding rate.

The software support for Windows may be better in some

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computers.

**Mark Headrick
Danville, CA**

Dear Nuts & Volts:

I have a few comments for Harry Helms in reference to his response to my letter in the June issue.

I wanted to clarify the point that the user does not need to purchase MSDOS and Windows in addition to OS/2 to run applications for those operating systems. OS/2 Warp includes code to run them. I suppose you can call it DOS and Windows if you like. The original article made it sound like you need to purchase additional packages in order to support those operating systems.

I'll not argue who has the most market share; that's obviously Microsoft. And if IBM doesn't provide support for Win95 in OS/2, they'll lose even more market share.

**Andrew Zimmerman
Fredericksburg, PA**

Editor's Note:

Ron Reis did reply to this particular concern in last month's issue. There were, however, more letters on the subject than we had space for. Here is the rest.

Dear Nuts & Volts:

In your Aug. 95 issue, the electrical safety article (Figure 3, the second DO) implied that a Variac (or
Continued on page 143

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ARTICLE CORRECTION

Figure 5A
The pulse from a 450 KHz squarewave generator.

Figure 5B
The same pulse as in A, but with the coaxial cable connected.

Figure 5C
100 Ω load

Figure 5D
300 Ω load

Figure 5E
22 Ω load

Figure 5F
6 Ω load

Figure 5G
Short-circuited (0 Ω) load

Figure 5H
Open-circuited load

Figure 5I
Shorted at 15.25 meters

Figure 5J
TDR pattern from a Cushcraft R-4 ham antenna.



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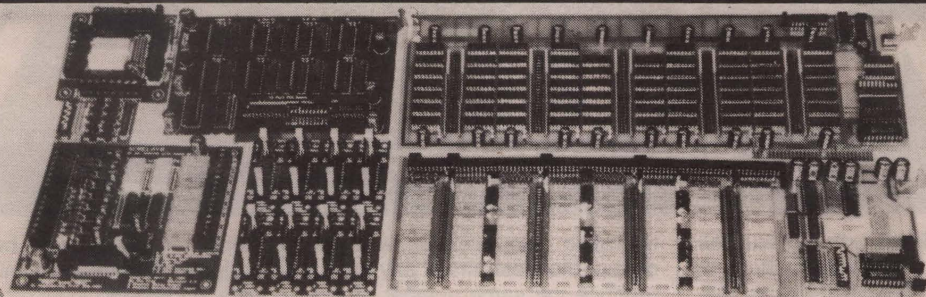
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Nuts & Volts Magazine/October 1995

More Night Vision

This article discusses practical methods of reconditioning Russian image intensifier tubes. Specifically, a second-generation 15 mm microchannel plate (MCP) is analyzed and investigated.

Second generation means that the tube uses a microchannel plate as an additional gain element.

This particular tube has a complete power supply built into the housing. In principle, all that is needed is a nine-volt battery. In reality, only a small number of these tube assemblies actually work. But, in many cases, only the power supply is defective, and the tube itself is in good working condition.

It may be possible to purchase defective tubes of this type at a reasonable price, since night vision vendors do not have in-house resources to replace power supplies.

This 15 mm tube has a fiber optic faceplate, near infrared sensitive photocathode, internal electrostatic lens inverting the image, and a green phosphor anode. 15 mm refers to the size of the light entrance aperture. The microchannel plate is a thin wafer with many holes parallel to each other. The interior of each hole, or microchannel, as it is usually called, is coated with partially conducting electron emissive coating. As a result, each electron reaching the near surface of the MCP produces about 100 electrons emerging out of the far surface.

Electrons are multiplied by successive collisions with walls of the microchannel. The microchannels are inclined from the optical axis, since electrons traveling parallel to the channels never strike the walls, and hence, are not multiplied. It would be undesirable to have a dark spot in the center of the field of view.

The inclination moves the dark spot to near the edge of the field in Russian tubes, and outside the field of view in better quality, more expensive tubes.

The number of secondary electrons depends on the voltage across the microchannel plate, and in the linear operating region also on the energy of the first electron, and hence, the incident photon producing it. The MCP operates linearly from zero to several hundred volts. At a higher voltage, the mul-

tiplication gain levels off, and incident photo electrons of any energy produce the same number of secondary electrons. This operating region is called photon counting mode.

What can be done with a bare tube? Well, the possibilities are endless. The most obvious one is to construct a light-weight night vision scope which actually works and which does not need a cart for transport. When all of the extra bulk is removed, the tube is very light, although still a bit too long. Light-weight casing can be made out of composite fiber epoxy material. It does not have to be very precise if metal insert flanges for the objective and eyepiece lenses are made adjustable. Another possibility is to construct reasonably priced second-generation true binoculars. Russians only have first-generation intensifier tube binoculars, which are rather heavy, and do not have much light gain.

Even US-made binoculars use only a single tube with dual eyepieces, and feature a premium price. Still another use is to couple the tube to a CCD camera in one small package, to output live, low-light level composite video.

Yet another possibility is astronomy. Since the tube connections are now accessible, it can be operated either in linear mode — for direct viewing — or a photon counting mode if high voltage is applied to the MCP. There probably will not be enough gain for a real photon counter, but with photographic film as an integrating detector, it should be possible to record faint images in dark sky locations.

A very ambitious project would be to open two tubes, remove the microchannel plate from one of them, and install it in the other tube, producing a two stage tube with real light gain.

First step of the disassembly is to remove the cover. This is rather easy; the cheap, plastic cover is held together with three rusty screws and slides off without any difficulty. The inner cover has two slots which allow it to slip over the evacuation stems. One of the slots is unevenly cut with an X-ACTO® knife, or some other hand tool. The other was milled, but not quite parallel to the axis. The outer cover has an uneven, hand-drilled hole to allow access to the brightness adjustment, a trimpot on the power supply board. Under no circum-

stances can the slots be added to the mold to eliminate the rework.

With the cover removed, the power supply is now exposed. Considering the quality of workmanship, and the assembly techniques used in the construction of the power supply board, the high defect rate is not surprising. After a cursory functional inspection, it is easy to identify two inverters with voltage multipliers: one 4-stage multiplier supplying several hundred volts to the microchannel plate and the photocathode bias; the other, a 12-stage multiplier supplying the anode phosphor screen voltage of several kilovolts.

Operating frequency of these inverters is not known, since none of them actually worked. The inverters are at the ends of the semiflexible epoxy board, multipliers are in silicone encapsulated shells attached to the edges of the board with metal foil strips. Both inverters seem to be blocking oscillator flyback types, with two transistors connected as darlingtonts. In the middle of the board are some discrete amplifiers and diode string references which were supposed to provide automatic brightness control for the tube. Nine-volt power from the connector is passed through a reverse polarity protection diode, and routed to various parts of the board.

The multipliers seem to be well constructed, encapsulated in real silicone, and possibly may be salvageable, but the rest of the circuitry is not worth the trouble of analyzing it in detail.

To continue with the disassembly, leads to the power connector and the tube need to be cut. The flex board now peels away from the hard white foam in which the tube itself is encapsulated. The D shell style power connector is very interesting. It is a fair-



Figure 1 shows the original tube assembly. Light enters from the left. Note the power connector front, top, and side. There are no other electrical connections to the tube.

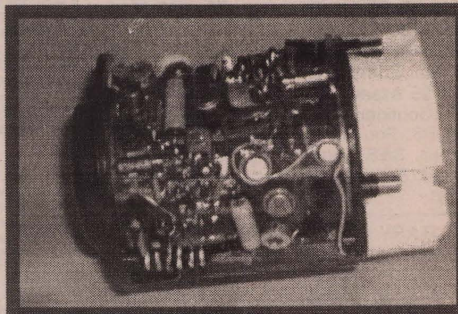


Figure 2 shows the tube assembly with the outer cover removed. Light again enters from the left. Power supply board is now exposed. One inverter is at the lower left. The multiplier is at the bottom. Cover mounting standoffs are at the right, next to some of the stiff white foam.

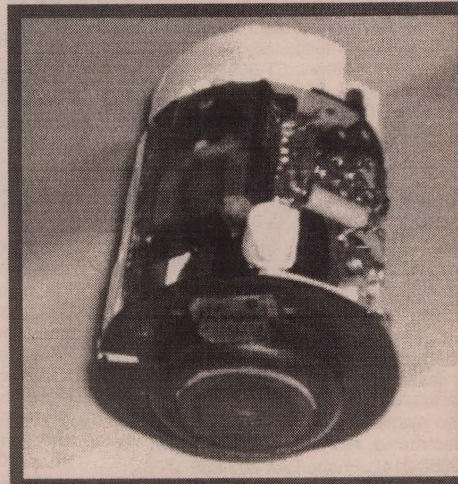


Figure 3 is a front view. The short multiplier is at the left. In the center is a foam covered tube evacuation stem. At the very front, the fiber optic plate is clearly visible.

ly accurate replica of a connector used by Kaiser electronics in the mid-1980s in military avionics modules. Unfortunately, Russian designers forgot to include the spring loaded locking screws, which hold the mated connector together. As a result, when this

tube is used in a rifle scope assembly, the connector unplugs itself after each shot. The rifle scope then needs to be disassembled — in the dark — the connector plugged back in, and the scope reassembled, still in the dark. Perhaps this is a design feature which prevents wasteful use.

Workmanship of the construction is really amazing. There are blobs of solder, holes which did not fit were unevenly hand reamed, and the potting foam was unevenly hand smeared. The assembly simply resembles a hand breadboard prototype constructed for the very first time. Even with only primitive tools available, it does not have to be like this.

Continuing with the disassembly, the white foam is removed. The foam is not very strong, and peels easily with a small screwdriver or a similar tool. When all of the foam is removed, the tube itself becomes exposed. It is rather slim, and can be fit into a much smaller diameter housing than the original plastic shell. The bare tube can now be tested.

At this point you may ask, if the workmanship is so terrible, and the quality of parts so bad, why not simply buy bare image intensifier tubes and lenses in Russia, and assemble the night vision scope using more conventional techniques and better parts elsewhere?

Well, to manufacture complete tubes independently would require investment in the upper six digits, a modest sum, but not readily available.

Simple tests require a DVM, and ambient light. If no voltages can be measured, then a flashlight aimed directly into the fiber optic faceplate produces large enough voltages for this test. It is quite safe to use intense light. Without applied high voltage, the tube will not be damaged. If nothing is observed, then the tube itself is probably defective.

To begin the test, the DVM is set to a low voltage range, and one lead is connected to the photocathode, the other lead to the cathode side of the microchannel plate. When the tube is exposed to ambient light, several hundred mV should be measured. With the DVM still

connected to the cathode, the other lead is now moved to the anode side of the MCP. About 50 mV should be measured. The drop is due to the resistance of the MCP, and the finite input resistance of the DVM. Anode current cannot be measured this way. At least several hundred volts are needed to produce currents measurable with a DVM. If the tube passes, then it needs to be tested with operating voltages applied. No lenses are needed; brightness of the phosphor indicates proper operation of the tube.

Actual power supplies, intended for use with the tube, can be breadboarded on a bench, but not in a small size form. In air, 5 KV voltage will arc over a 5 mm gap with no sharp points, and over a considerably larger gap if there are small wires or sharp edges in the gap. Small size, high-voltage supplies must be encapsulated in some insulating potting compound, such as oil, epoxy, urethane, silicone, or some similar material.

Actual optimized power supply design for the tube is not available at this time, but here are some suggestions on how to construct one. The suggested design has two output sections: one multiplier for cathode supply and the microchannel plate combined; the other higher voltage multiplier for the anode. Taps of the multiplier can be experimentally selected for best results. Adjustment of the anode voltage serves as brightness control, and adjustment of the microchannel plate voltage controls gain, somewhat like contrast control. Both controls are combined with the current limiting resistor, which protects the tube if it is accidentally exposed to bright light. In a better design, both controls should be kept separate.

The inverter is a resonant push-pull with C1 and leakage inductance of the transformer as the resonant elements. R3 and R4 provide initial bias to start the oscillation. The transformer should be wound on a high permeability ferrite core; the secondary should consist of several sections to reduce self-resonant frequency. Wire size of the secondary should be the smallest, which can be handled with

the available winding equipment. If hand winding is used, #48 is a good choice. The short multiplier is separate from the anode multiplier for better resolution in selecting cathode and MCP voltages. Value of C1 depends on the transformer, and should be selected for about 25 KHz operation. Higher frequency requires a carefully constructed transformer. The multiplier capacitors are small and do not store enough energy to be lethal, or damage the tube, nevertheless, 6 KV is a hazardous voltage, and care should be exercised. NV

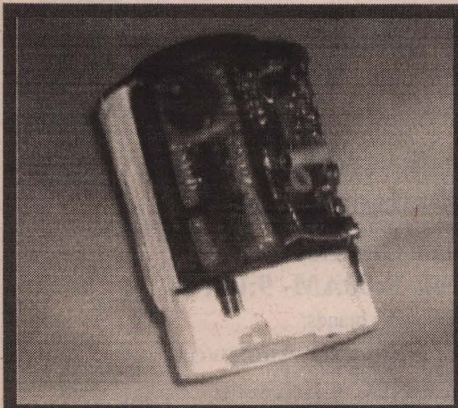


Figure 4 shows the long 12-stage multiplier, encapsulated in transparent silicone. Note the unevenly spread white foam.

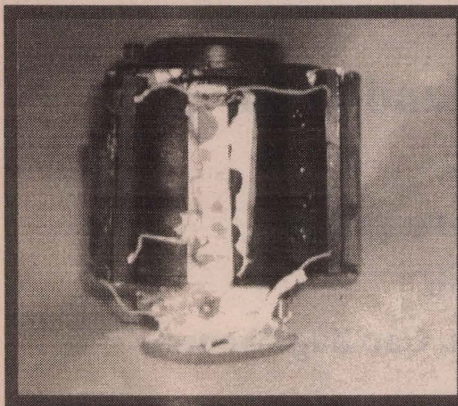


Figure 5 shows the power supply board partially removed. The short multiplier is at the left. Note the connections to the front and back of the microchannel plate, and the cathode. The long multiplier is at the right. It has only two connections; to the cathode at the top, and the anode at the bottom.

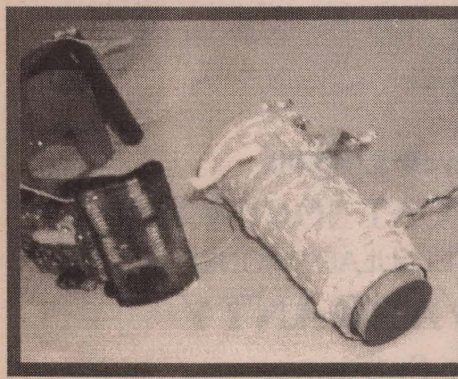


Figure 6 shows the bare tube. Fiber optic entrance plate is at the bottom right. Power supply board is at the left, with the long multiplier nearest the tube. Tube connections are made with foil strips. Cathode connection near the bottom, MCP front in the middle, MCP back is one of the studs near the top, anode is the outer flange at the top. The flange is about 40 mm in diameter.

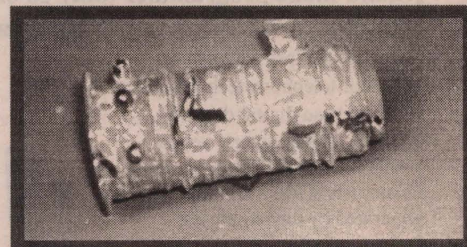


Figure 7 shows another view of the tube. The cathode is at the right, MCP front in the middle, MCP back the bottom stud near the anode, the flange at the left is the anode. Two thick crimp seal evacuation stems are visible near the right side.



Figure 8 shows the relative sizes of the large casing, and the slim bare tube. Length — 80 mm — of both is approximately the same. Light entrance is at the top, phosphor screen at the bottom.

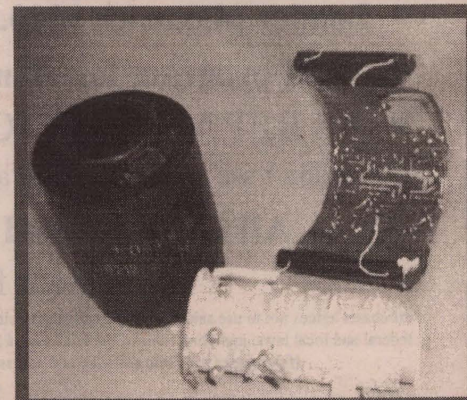


Figure 9 shows all of the parts together after complete disassembly. The casing, the power supply, and the bare tube.



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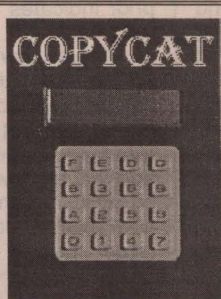


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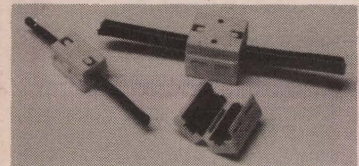
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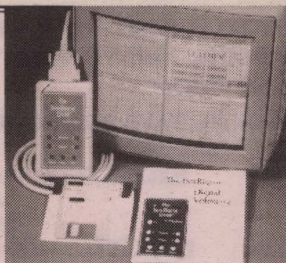
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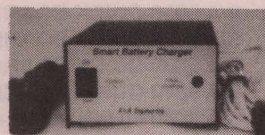
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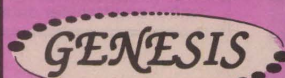
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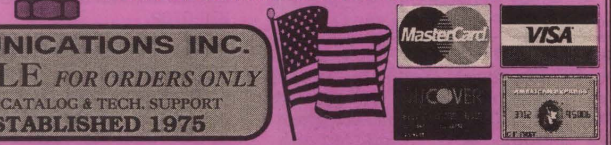


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Morphing Software

by John Iovine

This month, we shall look at three inexpensive, high-quality morphing software packages. Two software packages operate in Windows 3.1, the other operates from DOS.

The term *morphing* (meaning "to morph") is derived from the word metamorphosis. The dictionary defines metamorphosis as "a change of form." This is what morphing software does to pictures; it changes one picture object to another by creating a smooth transitional link between the two pictures. The transitional link is an animation file.

Morphing has become a standard special effect in many Hollywood productions. Using these software packages, you will be able to

add these special effects to your own computer movie files, home video productions, and multimedia projects.

Each of the software packages are able to load a variety of picture files, such as .BMP, .PCX, .GIF, etc. One of the Windows software packages has a truly impressive feature of being able to transform two moving picture files (Windows .AVI files). A great improvement from using static picture files.

Choosing Picture Files

The first step in any morph is choosing the pictures to morph. Choosing suitable pictures is of the utmost importance. In general, the more care one takes in either creating or choosing suitable pictures to

morph, the more successful the appearance of the finished product. For instance, if you are choosing to morph two people, let's say a woman to a man, it is best to use two pictures that have the same general size and outline. So, if the starting picture is a close-up of the woman's face, you wouldn't want to morph it into a full body shot of the man. A better choice is a close-up of the man's face. In addition, matching the overall size of the face and head will improve the transitional quality of the morphing effect.

Picture file manipulation and sizing can be accomplished using many graphic programs like Photoshop and Corel.

Backgrounds

Backgrounds are also important. When starting out, it's better to use an object in front of a single color background. This focuses the morphing effect on the objects being morphed.

Using the same background for each picture is the next best thing. If you are shooting picture pairs to morph, don't move the camera between shots. If you own a photo manipulation program, such as Adobe, you can remove the objects or persons you are going to morph from each picture and place them on identical backgrounds.

The reason for choosing identical backgrounds is when morphing an object against a complex background, a graphic distortion surrounds the object. This appears as a melting and mixing of the background closest to the objects as they are undergoing the morph.

When setting up the morphing points in any of the programs, you should choose points that will tend to limit this type of background distortion. For high-quality morphs, such as those used in Hollywood, a blue screen background technique is used. The blue screen

background can be removed photographically and the morphing sequence is placed on top of an appropriate background. This effectively removes all the background distortion.

PhotoMorph 2 has a blue screen feature we will look at a little later. Many of the decisions we shall make, like choosing the morphing points, are the same for all packages. Of course the mechanics involved in setting the points in each program are different.

Metamorph

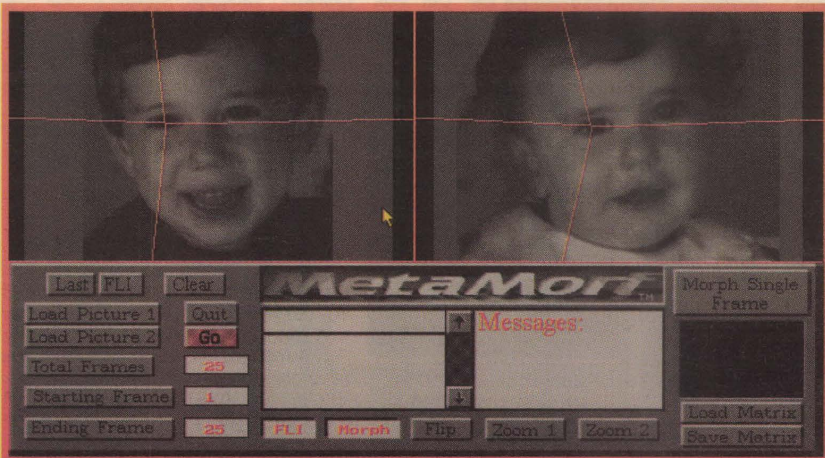
We shall begin by studying the DOS package first. MetaMorph is the DOS-based morphing package. This program requires the minimum amount of computer horsepower of all the packages. The minimum hardware requirements for this package are a 286 computer with 2 MB of RAM, VGA card and monitor, 2 MB free space on a hard drive, DOS 3.1 or greater, and a mouse.

Figure 1 is the opening screen to the Metamorph program. The top area of the screen is the work area for the two pictures that you will be morphing. On the lower left hand side is the control panel. By clicking on the "Load Picture 1" button, a directory of files are presented in the scrollable directory window. Choose any file listed by double clicking on the file name. Next click the "Load Picture 2" button and choose a picture file.

Metamorph can load a variety of picture files like .PCX, BMP, and GIF. The pictures need to be in either a 320 x 200 or a 640 x 400 resolution for the Metamorph program. If not, the picture file will not load.

To help circumvent any problems, Metamorph is packaged with a convert program that will either crop or stretch a non-standard picture file resolution to the exact resolutions needed by the main program.

After the picture files are loaded into the program, you can begin. Typically, one first creates a matrix. The matrix aligns similar features in each picture file. For instance, by aligning the matrix points on the eye, this tells the program that these two points should morph from one into



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eye pupils on each picture. The next pair of lines will align the right pupils. In general, try to match similar aspects of each picture when possible. By keeping points aligned in this manner, when the morph is generated, the starting picture eyes will morph into the ending pictures eyes. Obviously this lends a good deal of credibility to the morph, especially when morphing different species, like a woman to a cat.

You build up matrix by adding and editing morphing points. When you are satisfied with the

matrix, you can generate the morph.

Metamorph allows you to choose how many picture frames the morph will process. The default value is 25 frames. The control panel buttons "Total Frames," "Starting Frame," and "Ending Frame" allow you to edit and control the generated morph.

By hitting the "GO" button, Metamorph first asks for a file name for the .FLI movie, then proceeds with the morph generation.

Metamorph generates an FLI movie of the morph. Metamorph is packaged with

5



cal line is created by clicking the right mouse button on the top or bottom of either picture. Again a vertical line is created in both picture work spaces.

The point where the horizontal and vertical lines intersect is a morphing point. Morphing points can be bent and moved for exact placement by clicking and holding the left mouse button on the intersection and dragging it to the desired point.

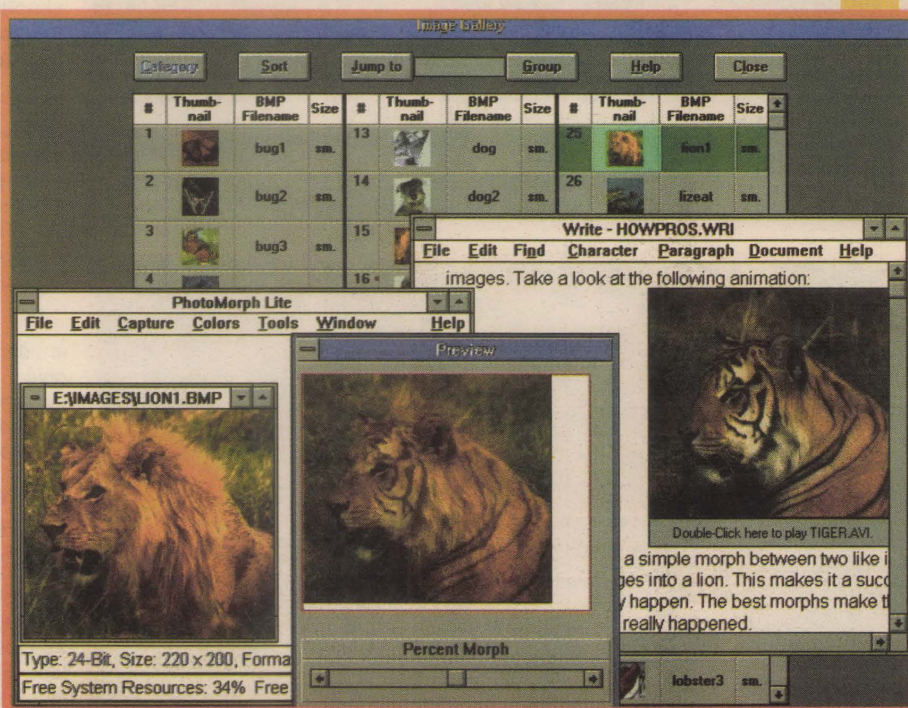
To delete a matrix line, you hold down the "Ctrl" key and click on the line with the left mouse button.

In Figure 2, notice that the first matrix points align the left

the other. In general, this improves the morphing effect.

It is possible to morph two pictures together without using a matrix. The finished product will appear as a fade out of the starting picture and a fade in of the ending picture. Not really a metamorphosis. So, for a true morph, you need to create a matrix.

Creating and editing a matrix is fairly straight forward. To add a horizontal line, click the right mouse button on the right or left edge of either picture. A horizontal line will appear in both picture work spaces. A verti-



an FLI movie viewer for watching the morph movie. It is easy to start up from the main screen — just click on the "FLI" button. Once in the viewer program, you can load and view any FLI movie.

High resolution pictures (640 x 480) can also be morphed. However, Metamorph does not directly create an FLI movie from high resolution pictures. Instead, it generates a sequence of either GIF or TGA picture files, that can be used by another program, not included with Metamorph, to generate an FLI movie.

Keeping in tune with today's multimedia, it is easier and more advantageous to use Microsoft's .AVI movie format than .FLI.

There are shareware programs available that will convert FLI movies to .AVI movies.

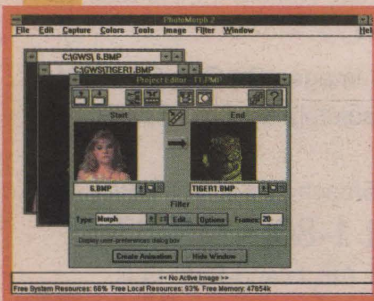
Morphology 101

Morphology 101 is a multimedia CD-ROM package that is comprised of a number of useful programs, see Figure 3. The minimum system requirements for this package are a 386SX 16 MHz computer, VGA monitor, Windows 3.1, and a CD-ROM drive.

Installation is a snap. Place the CD-ROM in your drive. From the program manager, run setup.exe from the CD. The installation program creates two program groups to run the various programs packaged on the CD.

The CD-ROM has an interactive manual titled "How the Pro's Morph." The information in this manual is basic, but it explores the numerous features of PhotoMorph Lite. The 34 page manual is full of morphing animations that can be started with a double mouse click. The animations illustrate different special effects that can be achieved using Photomorph.

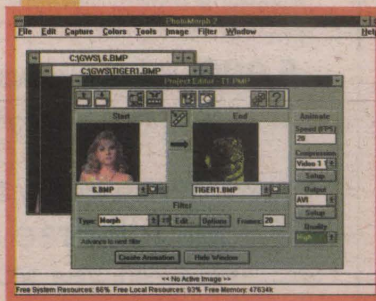
7 The text surrounding the morphing pictures explain



how that particular effect was created.

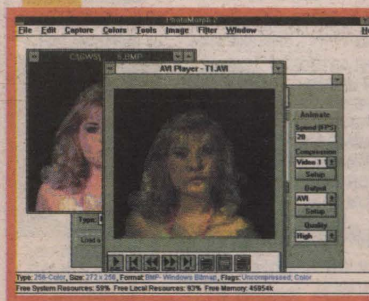
Photomorph Lite is a stripped down version of PhotoMorph 2, also reviewed in this article. Even so, Photomorph Lite is a powerful morphing package. The morphing points placed in the starting picture are points rather than intersecting lines used in Metamorph. This is a more intuitive interface providing greater control over the resulting morph animation, see Figure 4.

8 The program creates a standard Windows .AVI



"animation" file. The fidelity of the resulting .AVI files is good. So good, in fact, that one may use "Video for Windows" (VFW) and "Video Edit" to add a sound track to the .AVI file. This may appear to the reader as, "Well, should you always be able to do that?" Well, yes in theory, but my experience in working with these files is that some programs, while creating a viewable .AVI file, have a corrupt sound track. Once a file has a corrupt sound track, it is next to impossible to correct it easily.

9



PhotoMorph 2

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Photomorph Lite (I keep writing the "Lite" so that the review on this program isn't confused with its more powerful relation PhotoMorph 2) has an animation viewer incorporated into it making it easy to view the resulting .AVI files.

Another great feature of this program is its ability to seamlessly add animations together. For instance, suppose you morphed a woman into a man, then you wanted to morph that man into another person. Well, Photomorph Lite allows you to do that.

The CD-ROM also has an animation gallery. The gallery has 74 morphing animations you may view. The animations used in the interactive tutorial "How the Pro's Morph" are pulled from this gallery.

The Image gallery on the CD-ROM contains approximately 300 still photographs of animals, food, objects, people, plants, scenery, structures, etc. See Figure 5. The photographs may be used royalty free.

Matinee is a second program included on the CD-ROM. The program is billed as an .AVI screen saver. The stripped-down program only allows you to play a few video files. An order form is included for users to purchase the complete program.

Photomorph 2

Photomorph 2 is the most advanced morphing program reviewed, see Figure 6. To say that this is just a morphing package does this software an injustice. It has advanced pre-production and post-production features that make this software suitable for professional broadcast quality video.

In addition to doing standard morphing as described for Photomorph Lite (see Figures 7, 8, and 9), it has the added abilities to morph two .AVI movie files, filters for special effects, masking, blue screen, chroma key, and luminance key. Don't know what these features are? That's okay, we will review them right now. However, a complete discussion of each feature is beyond the constraints of this article. We shall touch upon the highlights of the features; just realize there is more that may be accomplished than what is covered here.

Morphing Movie Files

The two morphing packages reviewed so far, Metamorph and Photomorph Lite, only morph still pictures. Photomorph 2, however, can load two .AVI movie files and create a morph transition. This allows a moving morph to take place. What immediately comes to mind to illustrate this point is the movie Terminator 2. The liquid metal robot morphed from one person to another, while in motion.

Frame and Text Overlay

The text overlay feature allows you to title video clips (.AVI files) and picture files. The feature uses TrueType and PostScript fonts. Photomorph 2 also has a framing feature that allows the user to place a frame around a picture file.

Filters

Filters are a unique feature. They provide interesting special effects. The swirl filter, for example, takes a standard picture and creates an animation in which the picture swirls as if it were a liquid and someone stirred it with a spoon. I've seen this effect used on broadcast TV numerous times.

Photomorph 2 is packaged with the following video distortion filters: Lens; Pinch; Ripple; Rotate; Rotate Center; Rotate and Shear; Shear; Spherize; Comp. Width; Comp.

Height; Swirl; Tear; Tumble; Twirl; Wave; Zigzag; Zoom In; and Zoom Out.

These particular features are accessed through the Distortion Editor.

Blue Screen, Chroma Key, and Luminance Key

Blue screen, chroma key, and luminance key allow the user to make selected parts of an image transparent. The transparent portions allow a secondary screen or background to show through.

Blue screen allows the user to key a range of blue colors to become transparent. Chroma key allows the user to select any color to become transparent. Luminance key allows the user to select a range of luminance or brightness to become transparent.

Blue screen has been used successfully for many years in Hollywood. Here, actors are placed in front of a blue background. The scene is played. In post production, the blue screen is made transparent and a suitable background is used instead. This is the technique used to place actors flying space fighters in outer space. Photomorph 2 is able to blue screen one .AVI clip onto another .AVI clip.

Chroma key is considered more powerful than the blue screen technique because it allows the user to key on any color. Figure 10 is a chroma key example. In this picture, we chroma keyed on the woman's skin.

This allowed the second photograph of the beach scene to show through on this color.

Special Effects with Photomorph 2

The special effects one may accomplish using PhotoMorph can not be properly illustrated in a magazine because the resulting files are movies. The transitions and video distortions possible elevate this program beyond the narrow definition of morphing. This is a high-end program that may be used to create professional effects suitable for broadcast television.

Warping Too

Each of the packages reviewed is capable of warping images. Warping, as its name implies, distorts the image. The amount of distortion is in proportion to where the secondary morphing points are placed. Typically, just the first picture file work area contains a picture. The points are placed on the first picture. The second picture file work area does not contain a picture file.

Recommendations

Each package reviewed occupies its own niche in PC software.

People who are using an older PC computer (AT 286), or like working in a DOS environment, can use the Metamorph software package. The FLI file generated by Metamorph can

be converted to an .AVI using shareware programs available on most BBS systems.

People working in a Windows 3.1 (or higher) environment who just want a basic morphing package, Morphology 101 is an excellent buy. The software operates smoothly and has the added ability of adding .AVI clips together to create longer morphing sequences. The online manual plus the clip art make this a best buy.

Photomorph 2, as described, goes past standard morphing packages. This software has the ability to morph digital movies. The blue screen, chroma keying, luminance, video distortions, and transitions elevate this package to users who want to create professional quality morphs and special effects. **NV**

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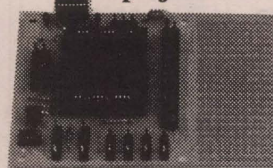
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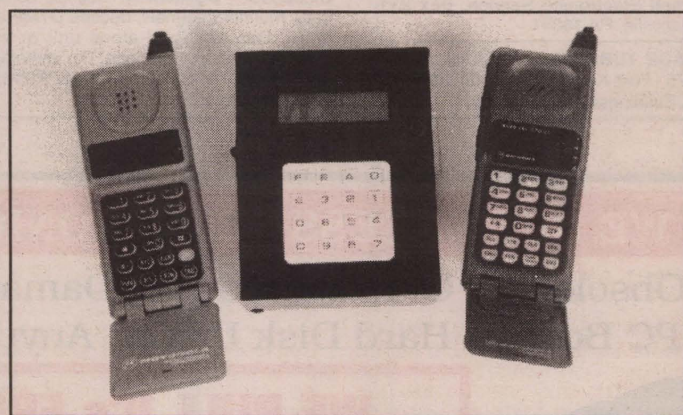
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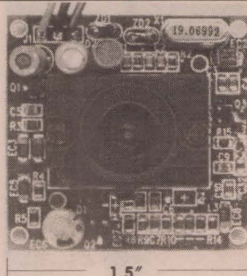
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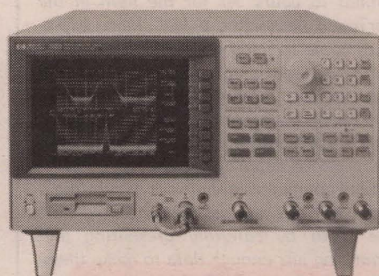
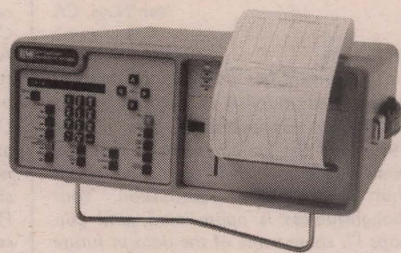
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FULL DUPLEX

COMMUNICATION

with Damien Thorn

"Full Duplex" is an interactive column with *Nuts & Volts* writer Damien Thorn. We'll be reprinting the more interesting letters from readers along with Damien's responses. Questions, comments about his articles, or ideas for future issues are all welcome. Correspondence should be sent directly to Damien Thorn, c/o Phoenix Rising Communications, 3422 W. Hammer Lane, Suite C-110, Stockton, CA 95219. He can also be reached electronically as Damien@prcomm.com via the Internet. Names will not be published if anonymity is requested.

MAILBAG

Dear Damien:

I recently received a document outlining the test mode available with Motorola cellular phones. The document was written by you and looked to be a transcript of an article from a magazine. It provided me with a lot of information. However, I have a problem. The code to activate channel scanning (36xxx#, where xxx is replaced by a pause time) does not work. I have three Motorola phones of various types. The command does not work on any of these phones. The rest of the codes work fine. Is it a typographical error? Is code 36xxx# the right one? Can you help me?

John Black

Mr. Black:

Thank you for the letter. The text file or printout you received is indeed the ASCII version of an article published in the Jan. '93 issue of *Nuts & Volts*. It is one of three articles that have been released in electronic form and downloaded many thousands of times from CompuServe, the Internet, and assorted smaller bulletin board systems.

Your question about the channel scan command has been asked many times, as no one seems to be able to get it to work. The problem is that Motorola included the command only in some very early models of cellular phones. I've not received any official word from Motorola as to when the command was removed, but I do have a copy of the documentation that was included with some cellular phones manufactured in the mid 80s and the channel scan command is listed in the diagnostics section.

Since the routine does not seem to be present in the firmware of any phones recently manufactured by Motorola, technicians must change the frequency loaded in the synthesizer manually by entering the channel number with the 11xxxx# command.

Dear Damien:

I am new at cellular phone phreaking, and would like to learn more. Would you please let me know which phones are best for phreaking, perhaps having the following characteristics:

- 1) Scanning ability.
- 2) Easily resetable.

3) Easiest to program from the keypad, without the need for any ancillary equipment.

4) Built-in diagnostics.

Robert
NY State

Robert:

First off, I have to assume you are using the term "phreaking" to mean experimenting with the hardware in order to better understand its functionality. Phreaking is a term that has permutated over time, and often refers to theft of telecommunications service using the regular telephone system. In the case of theft, my obvious advice is to steer clear of such activities. Ten years of one's life is a hefty price compared to the cost of cellular service, and I'd certainly rather not receive a letter in a few months asking if I have any information on the Folger-Adams electronic gate control systems used in the federal prison system.

As far as diagnostic modes that allow scanning, many phones contain these built-in functions. Some of them were described in "Cellular Test Mode Secrets" an article which appeared in the June, '94 issue of *Nuts & Volts*. Off the top of my head, it seems that the entire current generation of cellular hardware manufactured by Motorola is a favorite of experimenters who appreciate the rich and comprehensive set of diagnostic functions engineered into the firmware.

The Oki series handhelds and their AT&T house-labeled counterparts are also quite popular. Other units with cool channel scanning modes are the Novatel 83xx series. These phones meet all of your criteria, although I'm not exactly sure what you mean by resetable. I'm assuming you are referring to an old security feature in early phones that prevented them from being programmed more than three times without being "reset" by a dealer (or someone who knew the proper diagnostic mode command).

Dear Damien:

Thanks for your letter in response to my question back in Oct. '93 about programming the Nokia LX12C phone. As it turned out, I got AirTouch (a California cellular carrier) service for the phone back on Jan. 4, '94. Thirteen days later the Northridge earthquake hit. Needless to say, things got pretty hectic.

In your letter, you asked that if I ever got programming information, to send it along. Well, belatedly, here it is. I know that you may already have this info by now, but if you don't, I hope you find it useful. I also came across the instructions for the Nokia 101, 1000, N201, 211, and 191 hand-portables. These are enclosed.

Now, I have another question. Enclosed is a copy of the current AirTouch newsletter saying that possession of a cloned phone is a felony. Is an "extension" a cloned phone? Is an "extension" legal? If it is legal to have multiple power booster kits, say mounted in two different cars that use a single handheld phone, how is that any different from a handheld phone and two "extension" phones that share the same phone number by a single user? I would like to pursue the latter, but what is truly legal and what is not? Thanks

Robert
Van Nuys, CA

Hi Robert:

Time sure has flown by. It's hard to believe that my first article on cellular technology was published here in late 1992, and I'm equally amazed that you remembered me when you came across that programming information. Your thoughtfulness is appreciated, and perhaps I'll share some of the data in future columns.

We won't know for sure what is legal and what is not until next month. Some of your questions are addressed in my answer to the next letter, which is very similar to yours. As for the item in the AirTouch newsletter, a few choice expletives come to mind when I see such marketing material that is heavy on hype and short on fact. It's not a problem unique to AirTouch or the cellular industry, but a fact of corporate life. The corporate communications department in most publicly-traded companies are always generating a flurry of press releases that tend to distort the truth by carefully presenting and arranging just enough data to make themselves look good. Such press releases almost always conveniently mention the company's trading symbol on the stock market as well.

Without digressing too far, let me just express my cynical view that all such information is subject to editorial "spin" or "slant" to further the public relations goals of the company. In all fairness, I should admit that I am as guilty of this as any other writer, although I try to present an honest, well-rounded view of the subject being written about. As a writer, I view events a certain way, and my perception obviously colors what I end up writing, but it never results in a gross distortion of reality.

While I'm editorializing like this, allow me to exercise my right under the copyright law and excerpt the passage in question from the page you enclosed:

"AirTouch Cellular works with law enforcement and other government entities to help get new anti-fraud legislation passed. Recently, our education efforts helped make it a felony to clone a cellular phone or be in possession of a cloned cellular phone."

The statement is certainly true in a technical sense. Federal law has recently been modified to specifically address

fraud involving cellular telecommunications. The amended section of the United States Code was addressed here last month, and does indeed make use or possession of a cloned cellular phone a crime, when it is coupled with an intent to defraud. That's the part AirTouch forgot to mention.

What they also neglected to explain is what they mean by "working with..." and their "educational efforts" that helped get the new legislation passed. In my opinion, those educational efforts translate to lobbying Congress, an activity practiced by most special interest groups who desire to see certain legislation passed. Without obtaining a copy of the campaign contribution disclosure statement, or related documents from AirTouch, it is impossible to address the corporation specifically.

What I can do is mention that most cellular carriers are members of the Cellular Telecommunications Industry Association (CTIA), which is the industry trade group. Lobbying elected officials is one of the activities performed by the CTIA, and it has been reported that they are responsible for the passage of assorted notable legislation, including the provisions of the Electronic Communications Privacy Act, making it illegal to monitor cellular calls, and the more recent ban on the manufacture and importation of cellular-frequency capable scanners that was tacked on to the end of an unrelated bill dealing primarily with "900" pay-per-call services.

So yeah, AirTouch did indeed assist with the passage of the new legislation. Whether their educational efforts involved holding classes and seminars for law makers, or simply cutting a fat check to their industry group in Washington, we may never know. AirTouch has obviously chosen not to elaborate on the issue.

While I may have said more than some people wanted to hear, it is increasingly important to let some light shine on issues such as this. As I read carefully constructed press information from assorted trade groups, including those that represent computer software companies and cable television operators, I can't help becoming exasperated by seeing only the convenient portions of a situation being put forth. There's an old adage that a half-truth is more dangerous than a lie. We should all keep that in mind.

Dear Damien:

I am completely confused. I currently have a cell phone (with service) in my car. I recently purchased a Motorola "brick" phone without service. I have been told by various people that cellular cloning was legal as long as there is no intent to defraud the service provider. My service provider (who I also bought the car phone from) said that cloning was illegal. You, in the Sept. '94 issue of *Nuts & Volts* on page 109 said that altering the ESN of the phones is a violation of FCC rules.

What does this mean? Rules are meant to be broken and laws abided by. I want my cake and eat it too! Can I legally have these two phones set up as one or not? If the factory changes the brick to match the car phone, is this legal? Lastly, I was told that the older phones could be altered legally, but the newer ones could not. If this is the case, what is the cut off date and how do I tell if

my brick is one? I guess you can tell I am more concerned about staying out of trouble than getting my brick cloned.

Sam

Dear Sam:

It seems that your priorities are straight in that risking legal trouble is not worth the convenience of having an extension of your existing mobile phone. There is no way to avoid the FCC regulations that prohibit altering the ESN of a cellular phone, or using a phone with an altered ESN. Interestingly, there is no escape clause in the language of the rules that allows a manufacturer or repair facility to alter the serial number for service purposes. We heard an unconfirmed rumor that Motorola may have filed legal action challenging the revised rules which have effectively outlawed the inclusion of their "identity transfer" function within the firmware.

Any intent to defraud using a cellular phone is a federal crime investigated by the Secret Service. Title 18, United States Code, Section 1029 describes these illegal activities and proscribes sentences of 10 to 20 years for those convicted under the statute. There is not much more light I can shed on the subject. I have to stand by my earlier opinion and say that illicit cloning is a serious offense, and so-called "legal" cloning is a violation of the FCC rules. There is certainly a difference in enforcement effort and consequences between an FCC regulation and a federal law, but the bottom line is that cellular carriers do not want us modifying our phones, therefore the government says we're not allowed to do so.

Yes, there is a cause and effect relationship here. Were it not for the cellular industry trade group complaining, none of this legislation would have been enacted, the Electronic Communications Privacy Act would still permit the monitoring of cellular conversations, and an information services bill would not have contained a rider banning the manufacture and import of scanners that cover the cellular frequency allocation. A good portion of the cash you pay your cellular carrier each month has obviously been spread around in Washington, and not to your benefit.

Obviously, I'm not a lawyer and thus not qualified to interpret the law or provide any type of legal guidance. Many people debate back and forth over the issue of cloning cellular extensions, and people on each side generally present a reasonable argument in support of their position. Rather than simply stand on a soapbox and proffer my personal opinion, I wanted to provide a more authoritative and balanced look at the laws and regulations involved in this grey area of cellular technology.

To accomplish this, we've secured the cooperation of Robert J. Keller P.C. KY3R. In addition to being involved in amateur radio, Mr. Keller is an attorney who practices federal telecommunications law in Washington. Mr. Keller has quite a bit of experience representing clients in various issues before the FCC, and is familiar with the debate regarding cellular cloning.

We can look forward to his comprehensive, balanced article on the legal issues involved, and some of the issues that were raised before the FCC when the

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Write in 181 on Reader Service Card.

new rules regarding serial numbers were under consideration. Don't miss the next issue of Nuts & Volts!

BOOK CONFUSION

In response to a reader question last month, I made passing reference to having finally completed a book manuscript on cellular fraud (more than a year behind schedule). This has resulted in Index Publishing Group, ever-exasperated — yet patient —

publisher of my work to be besieged with phone calls and orders for the book. While I certainly did not expect such a response, I should have mentioned that there is a difference between completing a manuscript and having a book completed.

It takes several months for a publisher to edit, lay out, typeset, and print a book. This process will be underway as you read this, and will be completed in a couple of months. As soon as the work is finished, I'll share the news and you'll see a normal advertisement

for it elsewhere in the magazine.

I apologize for the inconvenience that the misunderstanding may have caused, and to everyone who has stuck with me, waiting for the book to be completed. Index Publishing is not responsible for the delay, and has acted in good faith on a timetable provided by me. Unfortunately, the project has taken me far longer than I ever anticipated.

Thanks for your understanding, and keep the letters and questions coming! NV



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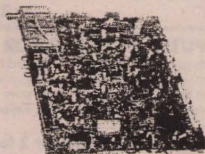
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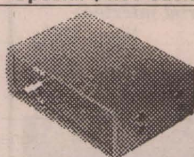


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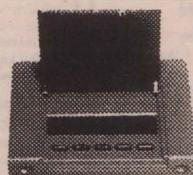


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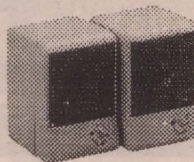


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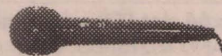
DISK MAGNET

3/4" diameter with 1/4" center hole, 1/4" thick.
95N005 25¢ each



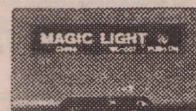
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94V007 \$9.95/pair



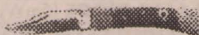
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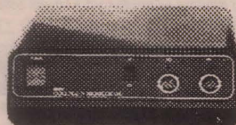
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12VDC. Originally for automotive electric windows.
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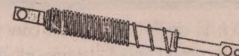
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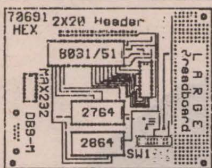


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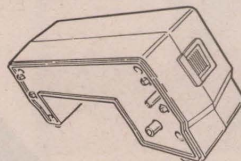
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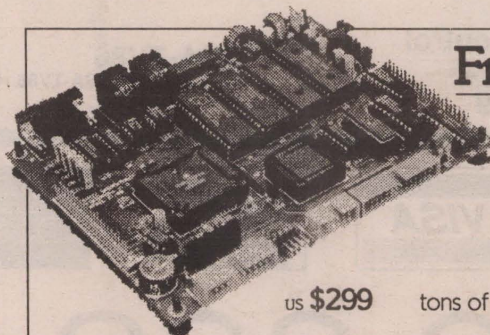
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





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



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



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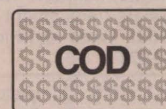
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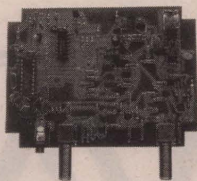


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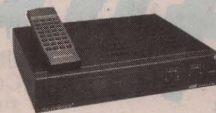
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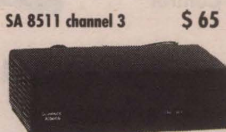
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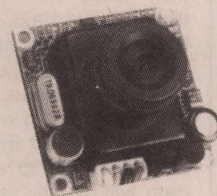
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Nuts & Volts Magazine/October 1995

Part 19 – The Final Installment

Driving Electric Cars

The success of an electric conversion depends in part on building the car properly, and in part on using it properly. This means using it for applications that are appropriate to its capabilities, as well as using the optimum driving techniques. In general, electric cars are driven the same way as gas cars. There are no major differences to learn.

However, there are several subtle skills that can make an adequate conversion into a star.

by Shari Prange

passengers and the transmission synchros to use it. Without the clutch, the torque of the electric motor can make starting from a stop an abrupt experience.

Know Your Mission

An electric car is a mission-intensive vehicle. Like a pickup truck, it is perfect for some jobs and inappropriate for others. The primary niche of an electric car is the kind of local driving most of us do most of the time: commuting, running errands, etc. It is not a long distance car. It is not a heavy hauler. While it can handle hills, too many of them will decrease its range and speed, and long continuous grades are not practical.

You don't ask a sports car to carry a softball team, and you don't ask a minivan to be nimble and economical. If you use the electric car for appropriate missions, you will be happy. If you try to make it be everything, you will not.

Road Test

Get used to your electric car when you are not under time pressure. Don't take it for its maiden voyage on your Monday commute. If the car has just been converted, it should have several short shakedown runs close to home to be sure nothing comes loose or overheats. Whenever you switch from a familiar car to an unfamiliar one, your reflexes will be slightly out-of-sync until you get a feel for the new vehicle. This is true from one gas car to another, and from a gas car to an electric.

Most of the time, we drive without really consciously thinking about it. When you first start driving your electric, however, you should make a point of thinking about it for a few short trips, to help you get to know the car. Explore how the brake pedal and braking performance feel, on the flat and on downhills. Check out the handling in corners. Listen to the sounds and watch the gauges.

Auditory Cues

You may be surprised to learn how much you use your ears when driving a gas car. The first time you notice this will be when you get in and automatically turn the key all the way to the right, and then sit holding it, waiting for the sound of the starter. If you have a vacuum pump for power brakes, you may hear a short buzz from it when you first turn the key. It should not run more than a few seconds, and once you are in motion you won't notice it again.

If the car has older technology, you may hear a fan come on when the key is turned. Modern cars, however, don't need forced air, and will be completely silent when sitting still.

As you depress the throttle, you may hear a faint clack from the main contactor as it closes. In cars with certain controllers, if they are wired

properly, the contactor will open each time you release the throttle. After a while, you will no longer consciously notice this sound. Your subconscious, however, will use it as a reassuring clue that everything is functioning properly.

As you roll into motion, the main sound you will hear will be the tires on the pavement. The motor does have a soft whine. This will become even softer after the first few weeks as the brushes bed in. With practice, you will know when to shift gears by the sound of the motor, just as you did in a gas car.

A car with an older technology controller will have a growl or whine from the controller as well. The newer models are completely silent at speeds above about 15 mph.

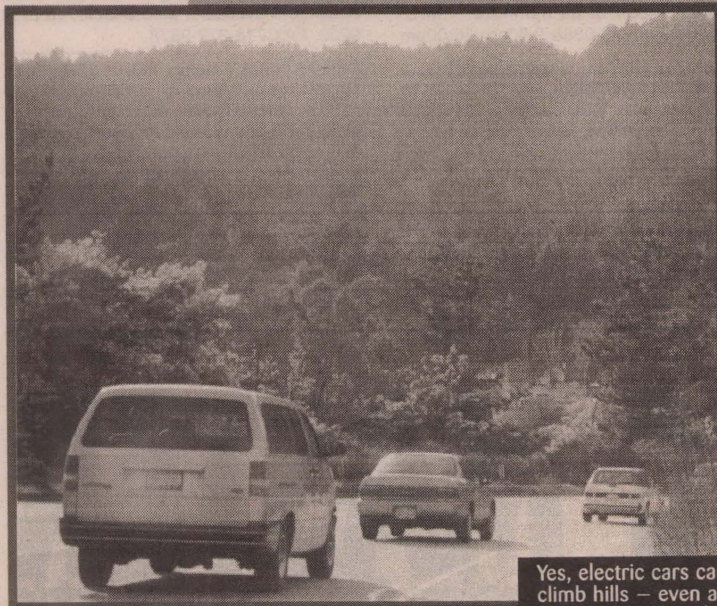
If, while driving, you notice a sudden whine from the controller combined with a partial loss of power, you may have hit the controller's overheat protection circuit. This happens most of the time on extended grades, especially in hot weather. Easing back on the throttle or shifting to a lower gear will usually solve the problem.

The combined sounds of the electric car in motion are still much quieter than the engine of a gas car. For this reason, you will be able to hear warnings of mechanical problems much sooner. A worn wheel bearing or constant velocity joint will become apparent in its early stages of failure.

Shifting and Using the Clutch

Although you can, technically, drive an electric car without using the clutch, it is easier on the

Shifting gears is done in much the same way as in a gas car. If you are proficient with a stick shift, you might want to leave the throttle partially depressed while shifting. This keeps the motor



Yes, electric cars can climb hills – even as imposing as this ridge.



When driving uphill, you will shift to a lower gear sooner than you would in a gas car.

ELECTRIC CAR CONVERSION

RPM — and efficiency — high. However, the throttle should not be depressed more than part-way, and not for more than a brief moment, with the car out of gear. Excessive unloaded throttle can over-rev and destroy the motor.

On flat roads, the shift points will be much the same as in the gas version of the car. You are not likely to use fourth or fifth gears, however, since third is valid for even freeway speeds, and is more efficient.

On uphill, you will want to shift to a lower gear sooner than in a gas car. How your car performs will depend partly on how much voltage the system has. A higher voltage car will perform better on hills. If you have good momentum, you can climb a moderate hill in third gear. However, if the car seems to be straining, shift down to second and take it at a slightly slower pace. On

that gear on that grade. Added throttle will only waste energy and overheat components.

Electric cars can climb impressive hills, such as those in San Francisco. Only the high-performance high-voltage cars can do it at competitive freeway speeds. Long continuous grades of more than a mile can cause heating problems, and are not recommended.

On downhill, it is necessary to shift up, even though the car will be coasting. With no dynamic braking from the motor, the car gathers speed quickly and the motor freewheels. In a low gear, this can cause the motor to over-rev and damage itself.

Brakes should be used by occasionally pumping them rather than holding them continuously. Constant braking can cause the brakes to heat up and lose braking ability.

If the downhill is followed by another uphill, use your momentum to "slingshot" up the grade.

When you come to a complete stop, it is not necessary to use the clutch. If you brake without it, the motor will simply come to a stop at the same time the car does. You can't "kill" an electric motor at stops, because it's normal for it to stop running.

However, if you do use the clutch to stop and park, put the car into neutral before releasing the clutch. The electric motor will spin for at least one minute after the car has stopped moving before it slows to a stop. If you dump the clutch, the car will "buck" as the motor tries to move the car.

Efficiency Gauge

All the same driving techniques that give good gas mileage also give good efficiency in an electric car. This includes smooth starts, and watching the flow of traffic to maintain an even pace. However, the electric car has a few extra tricks up its sleeve.

The electric car has an efficiency gauge. This is the ammeter. The goal is to keep this gauge as low as possible while achieving the desired performance.

The ammeter can tell you when to shift gears. As you start out in a gear, the gauge will momentarily peg, then begin to fall off as you accelerate. When it stabilizes, you have reached the top performance (and efficiency) for that gear. Further throttle will only waste energy. To accelerate higher, shift up (except on uphill).

The car is most efficient at the top of the RPM band for each gear. For example, let's say the redline shift point from second to third is at 45 mph. You are driving at 40 mph. This is prime territory for second gear. If you shift to third and hold the same speed, you will see your ammeter jump up 60 amps or more. This speed is at the bottom — and less efficient — portion of third gear's range.

Watching the ammeter will teach you efficient techniques. Sometimes a slightly lighter touch on the throttle will draw as much as 50 amps less

without a noticeable loss of speed.

Typically, the ammeter will peg on acceleration from a stop, or just after an upshift. At constant speed on the flat, it will read about 100 amps at moderate speed and 200 amps at high speed. On upgrades, it will read 300 amps or more. (This should not be maintained steadily for more than a couple minutes.) Coasting or at a stop, it will show zero.

Coasting

Speaking of coasting, don't use the energy when you don't need it. With well-inflated, low-rolling resistance tires, an electric car can coast surprisingly far and fast. You should never need any throttle on a downhill. Don't be too quick to get back on it at the bottom, either. The car's speed will not drop off instantly when the road flattens. Let the car tell you when it needs throttle again.

In traffic, break the habit of using the throttle right up to a stoplight, then immediately braking. Instead, release the throttle early, when you can see the stop approaching. The car will roll at traffic speeds for a block or more, and you can gently finish stopping it with the brake at the light.

As I said earlier, if you have a downhill followed by an uphill, pace yourself in traffic so that you can use your downhill momentum to carry up the next rise.

Out of Juice

The big question everyone asks is, "What happens when you run out of electricity before you get home?" The truth is that you have to work at it pretty hard to get stuck in an electric car.

First, most people can't use up a car's whole range in a single day's drive around town. Second, since the electric car tends to be used on the same routes day after day, you have a pretty good idea how much range you have. Third, the car should have some kind of voltmeter or state-of-charge gauge to tell you where you stand at all times.

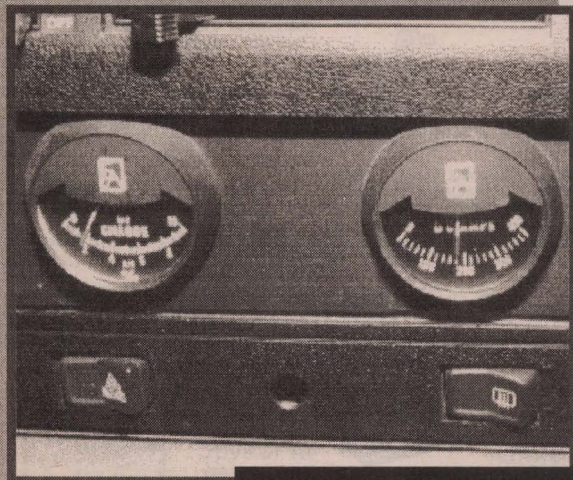
Finally, an electric car doesn't just run out of juice and quit like a gas car. As it reaches the bottom 25% of usable charge, performance will gradually become sluggish. At some point, the car becomes too slow to keep driving. If this happens, pull over to the side of the road and let the car rest for ten minutes. The batteries will pick up voltage merely from resting. Then you can drive on for another couple of miles. Although not recommended for daily use, this procedure can be done several times if necessary to get home.

Try that in an empty gas car!

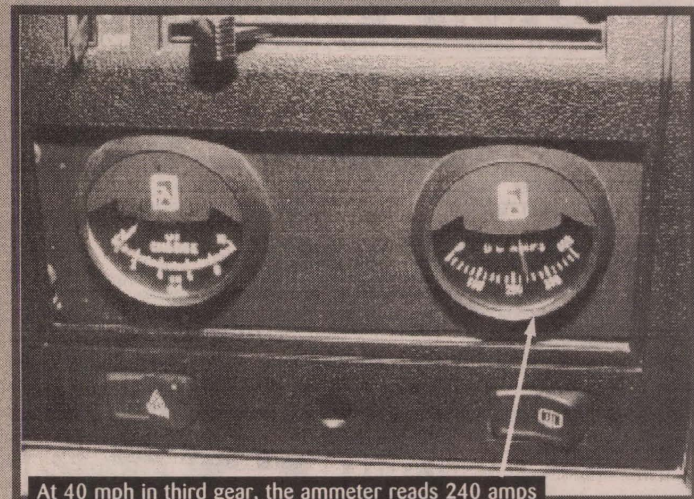
Let The Good Times Roll

There is one final aspect of driving an electric car that you need to know. If you have any graphics on the car identifying it as electric, you should plan a little extra time into your schedule. You'll need it for all the people who want to stop and talk about your car. **NV**

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At 40 mph in second gear, the ammeter reads 180 amps. This is the more efficient gear for this speed.



At 40 mph in third gear, the ammeter reads 240 amps — 60 amps higher than in second gear. Note also that the state-of-charge gauge is "drawn down" lower under this load than it was in second gear.

steep hills, you will probably need first gear.

If more throttle does not give you more speed, back off to the point where the throttle responds again. That is the maximum speed for



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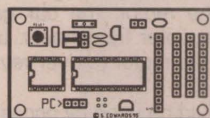
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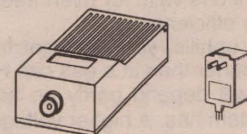
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STOCK #	DESCRIPTION	PRICE
6032-KTN	FM Mike Kit	\$10.95

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Easy introduction to electronic locks. 2 boards; one with 1-9 touch pads & connected to 2nd board by 3ft. cable. 2nd board has decoding IC's, matrix to set 4 number code, & relay to control external loads. Auto reset if wrong number entered. Runs on 9V battery.

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STOCK #	DESCRIPTION	PRICE
6005-KTN	Stairway Game	\$15.95

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STOCK #	DESCRIPTION	PRICE
6016-KTN	Phone Xmitter	\$9.95

VOX SWITCH FM TRANSMITTER KIT

Sound activated circuit with FM Xmitter. Sensitive electret mike picks up audio which is amplified & used to modulate FM RF Xmitter. Circuit requires the ability to "Tweak" RF circuits by stretching/compressing coils. Operates on 6V DC, 4 cell "AA" battery holder supplied.

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STOCK #	DESCRIPTION	PRICE
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STOCK #	DESCRIPTION	PRICE
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6004-KTN	Linear P/S Kit	\$18.95

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STOCK #	DESCRIPTION	PRICE
6018-KTN	9V FM Xmitter	\$9.95

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P/N: PS32
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Output: 13.8V 30A(32A Surge)
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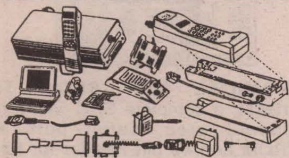
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STOCK #	DESCRIPTION	PRICE
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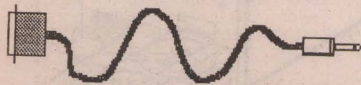
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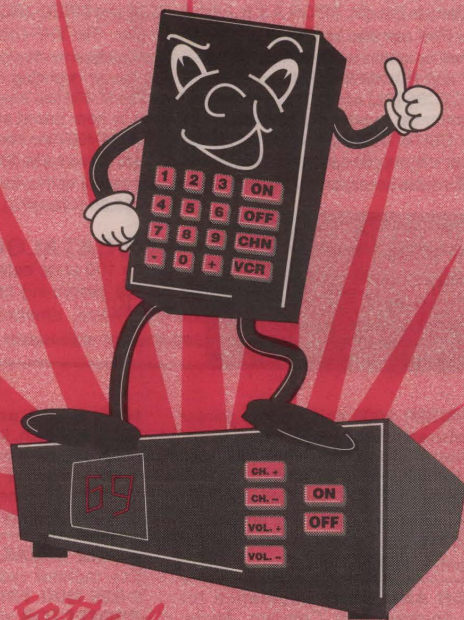
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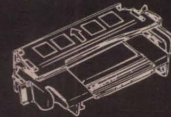
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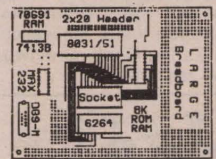
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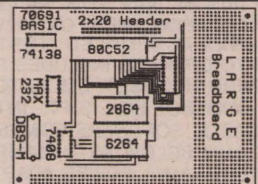
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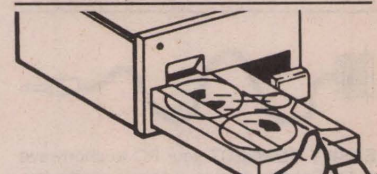
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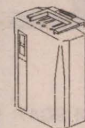
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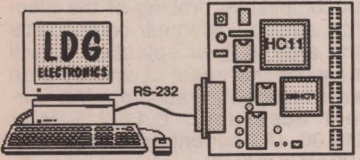
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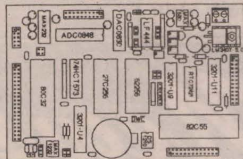
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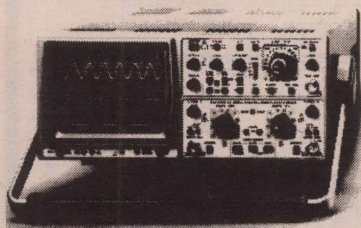


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HAMEG HM305



HAMEG Instruments announces the introduction of the HM305, a 30 MHz, dual-channel analog and digital storage oscilloscope. This instrument is a successor to the 20 MHz, HM205, a low-budget, high-performance digital storage scope.

The HM305 offers sensitivity down to 1 mV/cm (and as high as 20 V/cm). The scope can trigger on signals greater than 100 MHz (with inputs less than 1/2 a division) and the fastest sweep rate is 10 ns/div. The HM305 offers two-channel, digital storage at 40 MSamples/second with a 2 Kbyte storage memory.

When used in the digital storage mode, sweep speeds as slow as 50 seconds/division is available.

Operation in refresh, single, and roll mode is possible and a 50% pre-trigger capability is provided. The oscilloscope can be used in the alternate trigger mode to display two asynchronous signals.

One special feature of this instrument is the use of "cold" switching that logically configures signal pathways, which minimizes inter-scale differences, simplifies construction/repair and improves product reliability.

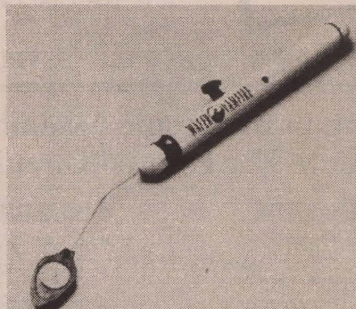
The oscilloscope has a parallel digital port that drives both HAMEG's HD148 Graphic Printer and HAMEG's H079-4 Multifunction Bus Interface that provides RS-232, IEEE-488, and Centronics interface outputs.

As in most of HAMEG's oscilloscopes, this product contains the built-in component tester, dual-frequency probe calibration, and active video sync circuitry. The compact 11 x 5 x 15", nominal, package size weighs only 13.2 pounds.

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News

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Measure RF current at the lowest cost and see board current flow with precision using the IA7 RF current measurement accessory. The entire 0.4 oz assembly mounts directly on the tip of our 107 Spectrum Probe to provide spectrum analyzer RF current measurements from 30 mA to 100 mA (to more than 1 A with protective cap). Low-frequency rejection is excellent with 60 dB rejection of 60 Hz fields to measure RF current from line-powered equipment.

The internal micromachined assembly, only 0.01" wide, provides the magnetic structure for 0.003" resolution. (There is no need to open the magnetic path.) This reads the magnetic field created by the current in a conductor as small as 0.01" whether a circuit track, semiconductor lead, or wire. It rejects other magnetic fields nearby, as close as 0.05". Shielding is provided to minimize electrostatic pickup.

The magnetics are molded within soft rubber to provide mechanical protection. The outside is covered with a tough plastic skin for abrasion and chemical protection.

The IA5 RF current measurement accessory is similar except that a more rugged 0.1" width magnetic structure is employed. The IA5/255 Spectrum Probe combination provides current measurements from 150 mA to 400 mA.

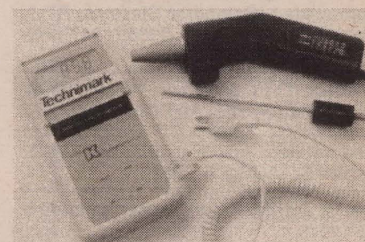
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New Product News

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To facilitate building protection into other products, The Protector is available in three forms: printed circuit board only for \$8.50, kit of circuit board and all board-mounted parts for \$39.95, and assembled and tested units for \$69.95.

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O-SCOPE II



The Allison O-Scope II is the newest addition to the company's family of PC-based instruments. This compact module plugs into the printer port, transforming a PC into a dual-trace digital storage oscilloscope.

Displayed sweeps can be frozen on the screen, printed out, or saved to disk. Operating parameters such as input range, sweep rate, and trigger level are displayed and easily adjusted through the computer keyboard. A versatile external trigger is included. In the frequency spectrum mode of operation, sweeps of a selected frequency range are presented on a calibrated graph with the option of averaging.

The O-Scope II features simultaneous two-channel data capture for accurate phase measurements in an X-Y presentation. Bandwidth is 250 KHz with sampling rates up to 1,000,000 per second. The minimum PC required is a 286 with 12 MHz speed.

Uses for the O-Scope II include audio/stereo equipment, automobile diagnostics, data logging, field ser-

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The O-Scope II is priced at \$349.00. Other models are available starting at \$169.00.

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Programmable Designs, Inc., introduces a powerful family of electronic test instruments, called SuperProbes™ that are unlike any other test equipment currently available. These oscilloscope triggering devices work with any oscilloscope to provide a wide range of event-triggering options that allow the scope to be used more effectively for digital circuit checkout or debugging.

With up to four unique triggering modes, fast input-to-trigger timing, numerous status indicators, and exceptional portability, SuperProbes are superior to logic analyzers for most triggering applications, and are also much less expensive.

There are four models to choose from, ranging in price from \$99.00 to \$649.00.

SuperProbe II is the pacesetter for the new SuperProbe family, with 18 signal inputs, plus a clock input, and supporting three clocked triggering modes and one combinatorial (pattern-match) triggering mode.

SuperProbe II supports flexible logic combinations for specifying trigger events, including no-match triggering used to trigger when certain unexpected events occur. The unit has separate "Pattern-Select" and "Don't Care" configuration DIP switches, and has numerous status LEDs for monitoring power, input signals, triggering activity, and clock activity. SuperProbe II comes with a deluxe interface cable that has gold-plated, machined-pin contacts designed to fit easily onto IC clips, 0.025" square posts, and the included through-hole/surface-mount component grabbers.

Two SuperProbe IIs can also be connected together for even greater capabilities.

SuperProbe II and all of its accessories fit conveniently into the

unit's custom padded carrying case, and the instrument sells for \$649.00.

SuperProbe I is a pattern-match (or word-recognition) triggering device with 17 signal inputs. While offering more limited functionality than its SuperProbe II sibling, SuperProbe I meets the scope-triggering needs of many users, allowing a logical combination of up to 17 signals to be specified for the trigger event.

In microprocessor-based systems, for example, this can allow triggering on a processor write or read operation to a selected memory or I/O device location.

SuperProbe I is offered in two versions: standard and deluxe. The standard version (\$249.00) includes an interface cable with permanently attached grabbers designed primarily for through-hole component leads. The deluxe version (\$395.00) includes a SuperProbe II-like deluxe interface cable with machined-pin contacts and removable through-hole/surface-mount grabbers, and also includes a custom padded carrying case.

SuperProbe Basic-8 is at the low-end of the SuperProbe family, supporting pattern-match triggering with up to eight signal inputs. The Basic-8 includes a cable with permanently attached through-hole component grabbers, and is capable of meeting the triggering needs of many basic circuit checkout and debugging applications. SuperProbe Basic-8 is priced at only \$99.00.

All SuperProbes are reliable, lab-quality instruments, and are backed by a limited one-year parts and labor warranty. Signal inputs are over-voltage protected to +12V, and power inputs are reverse-polarity protected. All SuperProbes also come with a custom DIP switch configuration tool for convenient operation.

In addition to a free SuperProbe product brochure and comparison chart, Programmable Designs is offering a 15-minute product-overview video for \$5.00 that includes a \$5.00 credit towards the purchase of any SuperProbe.

For more information, contact:

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41 ENTERPRISE DR., DEPT. NV
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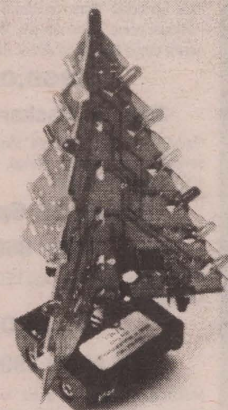
The following are GPS capabilities: 1) Multiple string parsing — users select as many as four of the GPS unit's NMEA data strings. 2) Storage of outgoing data in tracking buffers — GPS data can be stored for later retrieval and is accessible via and KPC-3's mailbox. 3) Time-slotted location broadcasting based on the GPS clock — users specify beacon start time and amount of time between beacons, so multiple stations report without collision. 4) Remote access — system operator can reconfigure the GPS unit from a remote location. 5) APRS compatibility.

All these features are now standard in the KPC-3 version 6.0. For versions prior to 6.0, Kantronics offers a very low-cost EPROM upgrade.

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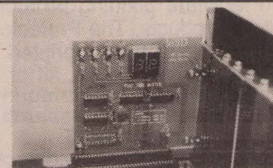
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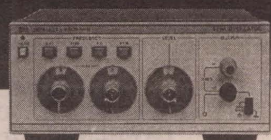
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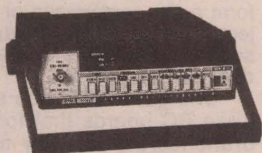
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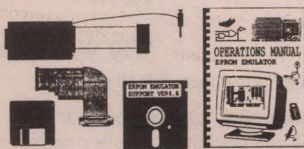
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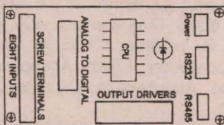
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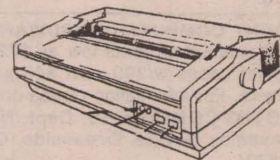
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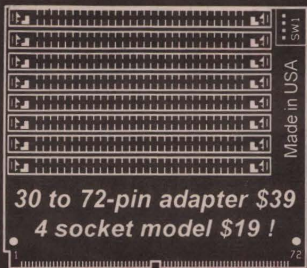
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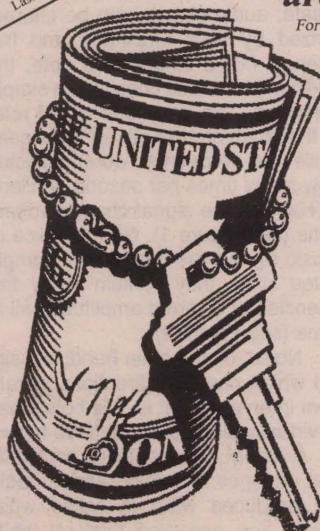
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Build a Pink Noise Generator



on their ears to set up the equalizer to where it sounds correct. Of course, most people are not quite sure how everything should sound and therefore these controls are sometimes set in a rather inconsistent or even random fashion. For use as a room equalizer, however, a more consistent, technical approach is needed.

One piece of equipment that is almost always used when testing frequency response, especially of acoustics, is a pink noise generator. Basically, this device puts out a precise signal which contains all audio frequencies at once. The response of the entire audio system can then be checked by placing a spectrum analyzer in the listening environment and measuring the sound level vs. frequency. Since most of us do not own (or cannot borrow) a spectrum analyzer, this article will describe a less expensive approach.

We'll start with a quick course in audio basics. Then we'll describe white and pink noise and show you how to build a pink noise generator for less than \$20.00 dollars. Finally, we will outline a procedure for using pink noise to set up an equalizer using equipment that you already have.

Audio Basics

The human ear responds to sound waves that vibrate approximately between 20 and 20,000 times per second. To create sound in an audio system, a speaker is used to convert electrical signals into the mechanical motion needed to produce sound. It is these electrical signals that are generally referred to as audio.

Like the sound waves that they create, audio signals can be characterized by their amplitude and frequency. For a single pure note, the audio signal would consist of a simple sine wave. The amplitude would refer to the level, or strength, of the signal, while the frequency would indicate how many times per second (in Hertz or Hz) that the signal changed directions (see Figure 1). Normal voice or music signals are much more complicated since they contain many frequencies of different amplitudes all at once (see Figure 2).

Noise, on the other hand, is a signal which changes directions at random intervals. That is, it is composed of virtually all frequencies (see Figure 3). A signal with constant amplitude that changes in a truly random fashion produces what is called white noise. You can also think of white noise as a signal that contains every

frequency at the same amplitude. To get an idea of what white noise sounds like, just tune to an unused TV channel or in between radio stations and listen to the static.

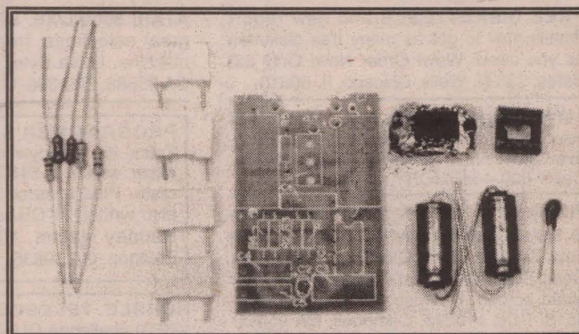
The Color of Noise

Pink noise and white noise both refer to a complete mixture of all frequencies in one signal. The difference between the two is in the relative amplitude of each frequency. As previously mentioned, white noise is characterized by "equal energy per frequency." Thus there would be the same energy within any equal range of frequencies or bandwidth. For example, there would be an equal amount of energy, or loudness, in the frequencies between 20-40 Hz as there would be between 40-60 or 1000-1020 Hz.

Pink noise, on the other hand, is characterized by "equal energy per octave." Since an octave is a doubling of frequency, this means that there would be the same volume from the frequencies between 20-40 Hz, 40-80 Hz, or 640-1280 Hz. This is why the controls of an octave equalizer follow a doubling pattern with the bandwidth of each control increasing by a factor of two. Figure 4 shows the spectrums of white and pink noise.

Pink noise can be created by simply feeding white noise through a "pinking filter," which reduces the amplitude of the higher frequencies. Since white noise has

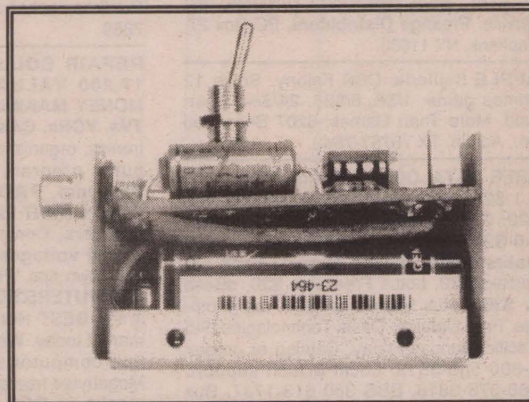
equal energy per bandwidth, and since the bandwidth per octave doubles, there is twice as much energy per octave with white noise. Thus, it is necessary to pass the white noise through a filter that cuts down the amplitude of the signal by one half, or -3 dB, per octave. By the way, the color pink was chosen in analogy to the frequencies of light. Red light corresponds to the lower frequency por-



Parts for constructing the Pink Noise Generator.



Additional parts for making a self-contained unit.



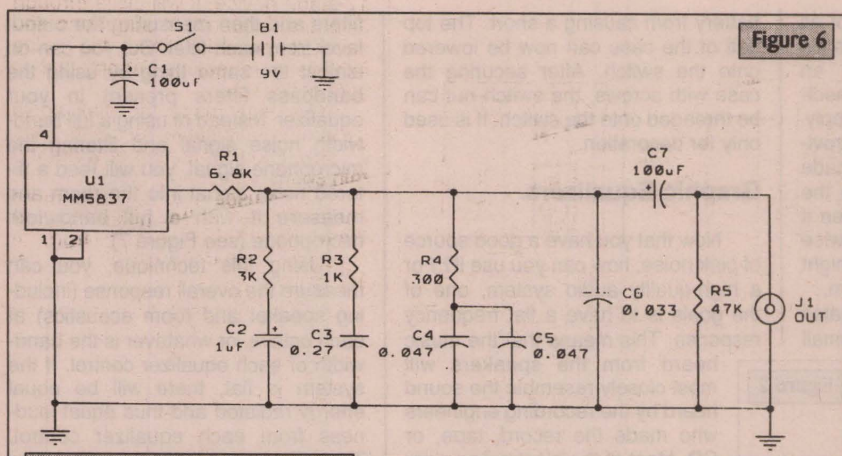
An insulator is placed between the circuit board and battery to prevent shorts.

Avital component in any sophisticated audio system is a graphic equalizer. This is a device that allows you to taper the overall frequency response of the system. Equalizers are most commonly used to match the audio system to the acoustics of a room for an overall flat response. Minor variations can then be made to please an individual's personal taste or to correct for other equipment deficiencies.

A typical equalizer can have as few as five or as many as 30 individual controls per channel depending upon how finely the audio frequency spectrum has been divided. The most common is the octave equalizer where each control covers a complete octave, or doubling of frequency. Since the audio spectrum covers about 10 octaves, these units typically have 10 controls for each channel.

Some owners treat a graphic equalizer like a "super tone control." Without the proper equipment to set these controls properly, they must rely

tion of the visible spectrum and a mixture of all frequencies produces white light. Thus, a mixture of light with heavier emphasis on the lower fre-



Schematic diagram of the Pink Noise Generator.

Preparing to use the Pink Noise Generator

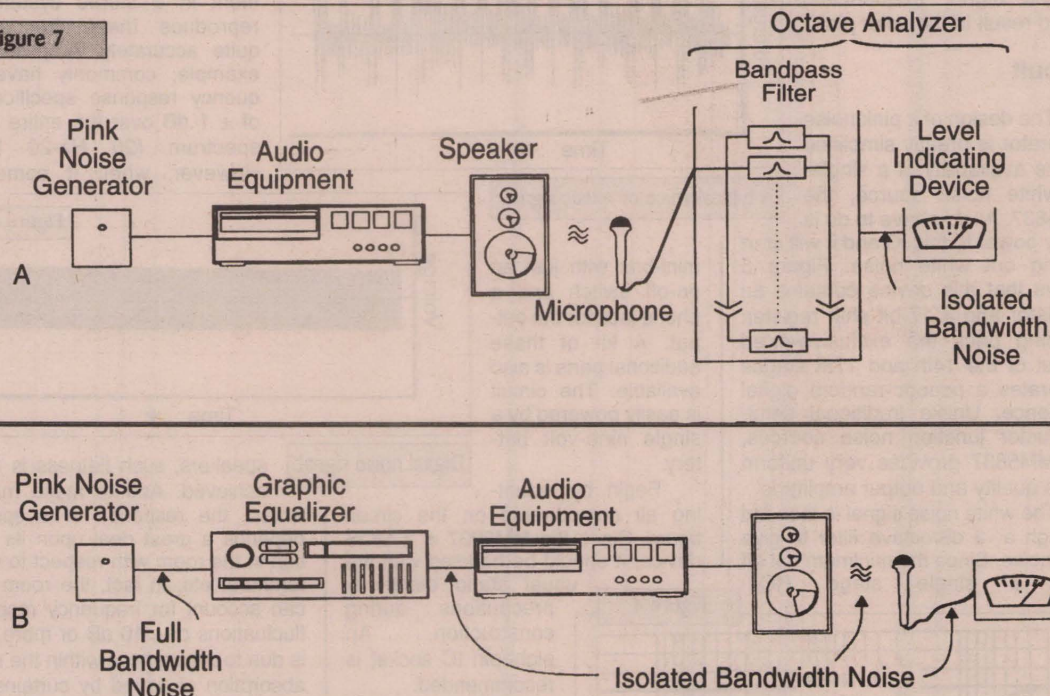
To use the generator, simply turn it on and connect it to your system. If the unit has been installed inside the equalizer, this would be done at the input to the equalizer. When used externally, feed the signal into the AUX, TAPE, CD, or other high level input. Do not use a PHONO input as this would most likely introduce some additional equalization. In a stereo system, each channel is equalized separately. See Figure 8 for a typical set-up.

When testing with pink noise, you must be careful not to misinterpret the results. A strict procedure should be followed to eliminate any problems before they affect the final equalizer settings. Start with all the equalizer controls in their mid-position. Then set up a microphone in the normal listening position and connect it to the level indicating device such as the input of a tape recorder with a VU meter. If a tape recorder is used, make sure that there are no automatic level control (ALC) or frequency dependent circuits that would affect the meter reading. Set the recorder so that it reads only the microphone level (i.e., turn down any line-input level controls).

Most equalizers have separate controls for each stereo channel. Since each channel must be set independently, start by feeding the signal into just the left channel. You should also turn the system's BALANCE control all the way to the left.

With the pink noise generator on, a static-like sound should be heard from the left speaker. Turn the volume up to a fairly loud level and then set the microphone input level control so that a 0 VU reading is obtained. The next step is to check for back-

Figure 7



In the traditional measurement set-up:

- A — The filter sections in the analyzer are used to isolate each octave.
B — The filter sections in the equalizer perform this function.

ground noise. Turn the pink noise generator off. The level meter should drop almost all the way down. Any residual reading is either electrical noise (e.g., hum) or background room noise such as heater/air conditioning blower noise or conversation going on nearby. If the meter does not drop by at least 3/4 (-10 dB) do not proceed

must be applied prior to these circuits as is usually the case with AUX or CD inputs. If a filter is necessary to reduce the leakage noise, then leave it in when setting all controls but the extreme control for which it affects. That is, if the low cut filter is needed, leave it in when setting all but the lowest frequency control on

any further until the background noise is reduced.

Next turn the generator back on ("0" reading on meter) and place all the equalizer controls to their minimum positions. As each control is turned down, the meter reading should drop and finally, with all controls down it should read less than 2/3 scale (-8 dB). If this does not happen, then there is too much leakage through the equalizer. Try turning on a high cut (hiss) or low cut (rumble) filter or both. Remember that for these filters to have any effect, the pink noise

the equalizer.

Determining Equalizer Settings

Since all controls will be adjusted relative to each other, one control can be arbitrarily set anywhere. For convenience, make this control the middle one (or the one that affects frequencies around 1000 Hz) and set it to its center or flat ("0 dB") position. All other controls should still be at their minimum positions. Re-adjust the volume control for a 0 VU reading. Now, turn the middle control back down and bring up the first control (the one which affects the lowest frequencies). Raise this control until

the meter again reads 0 VU. This position of the control is then marked in pencil on the equalizer (or a note taken of its position on a scale alongside the control) and then the control is returned to its minimum position.

Each control is successively turned up and adjusted in this manner. If the frequency response of the microphone is known, then the equalizer can be adjusted to this curve to make the true response of the system

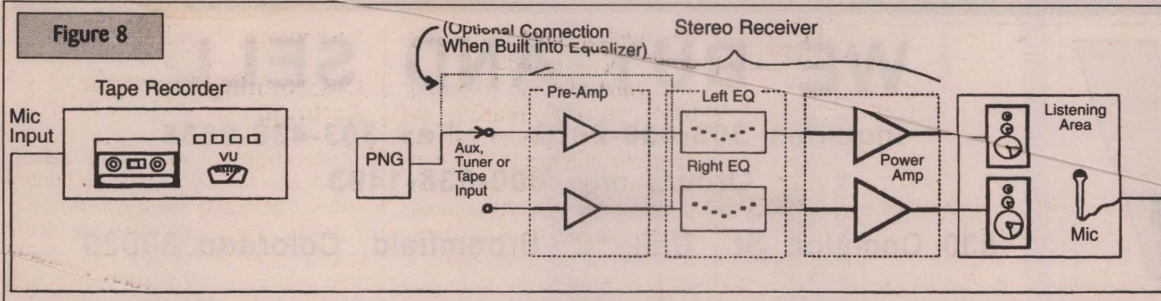
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 - R2 - 3,000 ohms, 1/4 watt, 5% carbon resistor
 - R3 - 1,000 ohms, 1/4 watt, 5% carbon resistor
 - R4 - 300 ohms, 1/4 watt, 5% carbon resistor
 - R5 - 47,000 ohms, 1/4 watt, 5% carbon resistor
 - C1, C7 - 100 µF, 15 VDC electrolytic capacitor
 - C2 - 1 µF, 15 VDC tantalum capacitor
 - C3 - 0.27 µF, 15 VDC, 10% metalized polyester capacitor
 - C4, C5 - 0.047 µF, 15 VDC, 10% metalized polyester capacitor
 - C6 - 0.033 µF, 15 VDC, 10% metalized polyester capacitor
 - IC1 - MM5837 (National) or S2688 (AMI) digital noise source
 - S1 - SPST switch
 - B1 - Nine-volt battery (optional)
 - J1 - Phono jack (optional)
 - Misc. - Battery clip, eight-pin IC socket, case

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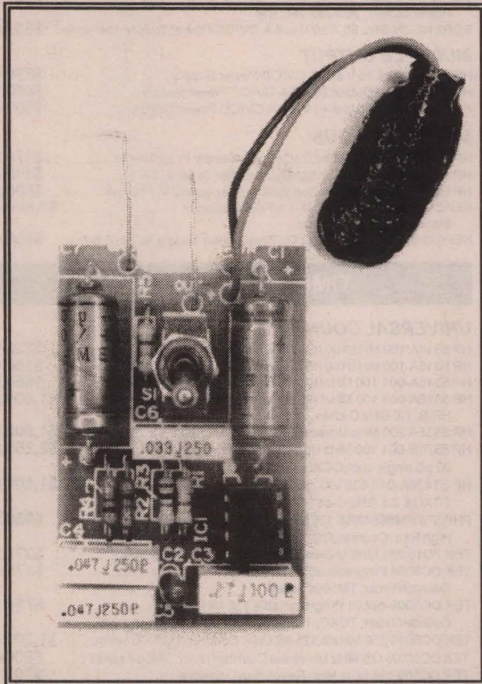
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Figure 8



Typical stereo set-up: The microphone is placed in a normal listening position and each channel is equalized separately.



Completed circuit board. Note the resistor leads used to attach the board to the phono jack.

flat. Otherwise the procedure is as accurate as the response of the microphone. Note that when setting the lower frequency controls, the level meter may oscillate back and forth with the low frequency "beat" produced by the pink noise generator. By watching the needle carefully, however, you should be able to set it to bounce equally on either side of the 0 VU level. After you have finished setting the left channel controls, repeat the entire procedure for the right channel.

When all controls have been set properly, the generator is disconnected and all sliders are placed at their marked positions. This position of the controls marks the flattest response setting for the room. Minor alterations to the response can now be made relative to this setting to account for personal taste or other deficiencies such as poor highs from a tape recording.

Microphone Frequency Response

A vital part of pink noise testing relies on the frequency response of

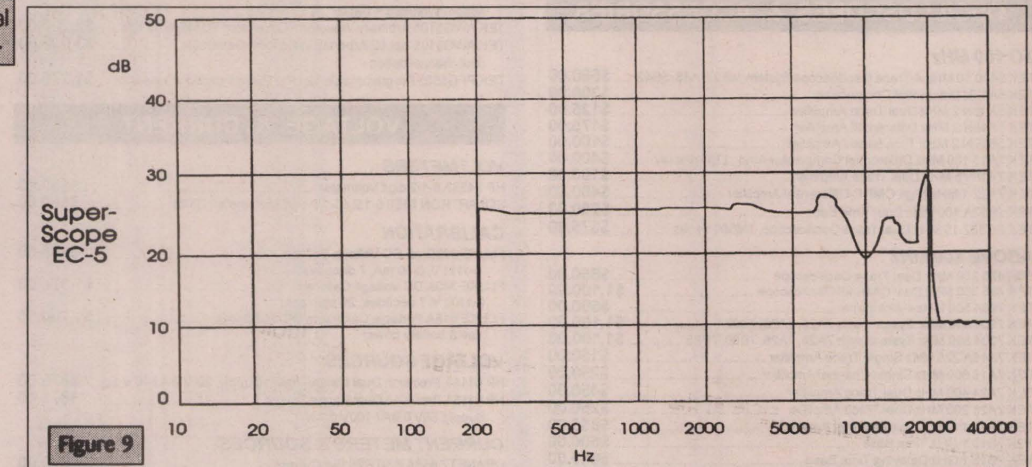


Figure 9

Frequency response for a typical electret microphone.

the microphone used. Because of this, it is important to have some idea of its true frequency response. Many manufacturers supply some information of this nature, sometimes in the form of a graph.

Electret condenser microphones offer the best frequency response for a reasonable price. Figure 9 shows the response of a typical microphone in this category.

Note that it is quite flat from 200 Hz-8 KHz which makes it very suitable for pink noise testing.

The odd response between 10 KHz and 20 KHz is not of great concern. Since one control usually covers this entire octave, you can use the average value over this range. In this case, you could estimate the overall response of the microphone in this octave as -2.5 dB. By setting the last equalizer control for a reading of -2.5 dB during set-up, you effectively cancel out the nonflatness of the microphone. Set the equalizer controls for the same reading that would correspond to the frequency response of the microphone for that octave. This can be applied to any microphone whose frequency response is known no matter what the actual response looks like. If your meter is not calibrated in dB, this can also be approximated by setting the control for the 0 VU level and then altering it the required amount by reading the dB scale alongside the equalizer controls.

A Few Words of Caution

The above procedure will work only with equalizers whose controls follow some regular pattern; that is, each control must cover a multiple or submultiple of an octave. Thus, for example, parametric equalizers, which are extremely useful for other purposes, cannot be set up this way; they require a real-time or spectrum analyzer for proper set-up.

Any changes made to the listening area can alter the room acoustics. For example, closing the drapes in a large room could drastically affect the system response and necessitate re-equalization. You might consider placing several marks on the equalizer for these varying conditions. Also note that the response will be slightly different at different places in the room. Thus it is not necessary to set the controls exactly — plus or minus 1 dB is sufficient.

Finally, on the odd chance that you have one of those equalizers whose controls do not cover equal octave ranges, don't give up. If the bandwidth of each control is known, you can use this to determine at what level on the meter each control should be set.

For example, if the middle control covers one octave, but the low frequency control covers 1/2 octave, then set this control for a reading that is 3 dB below the reference setting.

One Final Note

Since the MM5837 is a digital

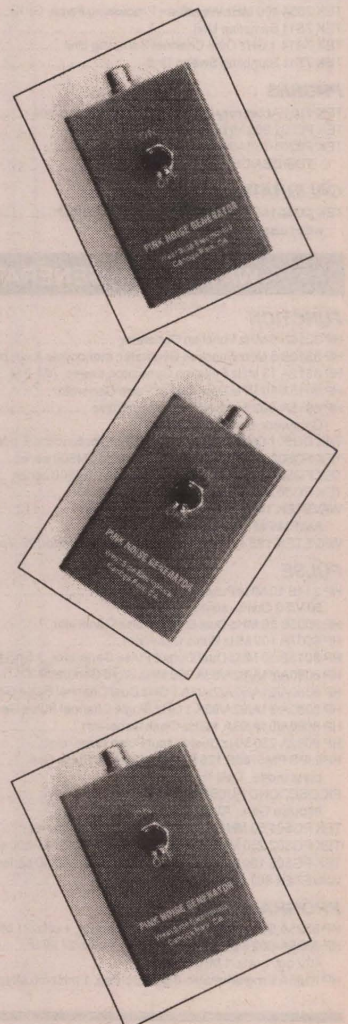
17-stage device, it will cycle through its entire sequence in about one and one-half seconds. Thus, the noise exhibits a repeating pattern that is very noticeable.

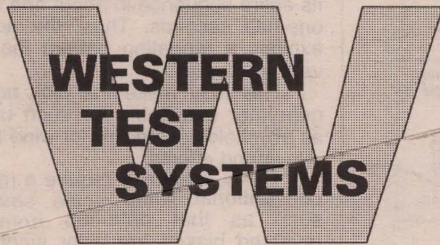
This may make the pink noise generator unsuitable for such uses as psychological testing or wind and rain sound effects.

These uses may require a more conventional white noise source such as that obtained from a reversed biased transistor junction. NV

REFERENCES

Bohn, Dennis, *Audio Handbook*, National Semiconductor, 1977, pp. 2-56 — 2-59.





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OSCILLOSCOPES & ACCESSORIES

TO 100 MHz

TEK 5440 50 MHz 4-Trace Oscilloscope System, w/(2)5A48, 5B42	\$650.00
TEK 5A13N Differential Comparator	\$300.00
TEK 5A18N 2 MHz Dual Trace Amplifier	\$125.00
TEK 5A19N 2 MHz Differential Amplifier	\$175.00
TEK 5B10N 2 MHz Time Base / Amplifier	\$100.00
TEK 7A13 100 MHz Differential Comparator Amp., LED display	\$400.00
TEK 7A18 75 MHz Dual Trace Amplifier	\$100.00
TEK 7A22 1 MHz High CMRR Differential Amplifier	\$400.00
TEK 7B53A 100 MHz Dual Time Base	\$200.00
TEK SC502 15 MHz Dual Trace Oscilloscope, TM500 series	\$375.00

ABOVE 100 MHz

TEK 475 200 MHz Dual Trace Oscilloscope	\$850.00
TEK 485 350 MHz Dual Channel Oscilloscope	\$1,100.00
TEK 7904 500 MHz 4-slot frame	\$500.00
TEK 7904 500 MHz System, with 7A24, 7A26, 7B92A	\$1,100.00
TEK 7904 500 MHz System, with 7A24, 7A26, 7B80, 7B85	\$1,100.00
TEK 7A16A 225 MHz Single Trace Amplifier	\$150.00
TEK 7A19 600 MHz Single Channel Amplifier	\$250.00
TEK 7A24 400 MHz Dual Trace Amplifier	\$450.00
TEK 7A26 200 MHz Dual Trace Amplifier	\$250.00
TEK 7A29 1 GHz Single Channel Amplifier	\$850.00
TEK 7B10 1 GHz Time Base	\$500.00
TEK 7B15 1 GHz Delaying Time Base	\$600.00
TEK 7B80 400 MHz Delayed Time Base	\$200.00
TEK 7B85 400 MHz Delta Delaying Time Base	\$250.00
TEK 7B92A 500 MHz Dual Time Base	\$450.00

STORAGE

TEK 5441 50 MHz 4-Trace Storage System, w/(2)5A48, 5B42	\$850.00
TEK SC503 10 MHz Dual Trace Storage Oscilloscope, TM500 series	\$700.00

SAMPLING

TEK 7854 400 MHz Waveform Processing frame, GPIB	\$1,500.00
TEK 7S11 Sampling Unit	\$450.00
TEK 7S14 1 GHz Dual Channel Sampling Unit	\$700.00
TEK 7T11 Sampling Sweep Unit	\$950.00

PROBES

TEK 1101 Accessory Power Supply, for FET probes	\$250.00
TEK P6201 900 MHz 1X/10X/100X FET Probe	\$500.00
TEK P6205 750 MHz 10X FET Probe, for TDS/DSA/CSA/11000 series	\$275.00

CALIBRATION

TEK CG551AP/TM506A Oscilloscope Calibrator, with pulse head & power module	\$3,500.00
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WAVEFORM GENERATORS

FUNCTION

HP 3310A 5 MHz Function Generator	\$325.00
HP 3310B 5 MHz Function Generator, monocyte & var. phase trigger	\$425.00
HP 3312A 13 MHz Function Generator, sweep, AM, FM	\$850.00
HP 8015A 50 MHz Dual Output Pulse Generator	\$650.00
HP 8015A-002 50 MHz Dual Output Pulse Generator, burst mode option	\$750.00
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 148A 20 MHz Function Generator, AM/FM/PM modulation	\$750.00
WAVETEK 188 4 MHz Sweep/Function Generator, 20 Vp-p	\$275.00

PULSE

HP 214B 10 MHz Pulse Generator, 50 V/50 Ohms, auto duty cycle	\$2,250.00
HP 8005B 20 MHz Dual Output Pulse Generator	\$450.00
HP 8007B 100 MHz Pulse Generator	\$650.00
HP 8013B 50 MHz Dual Output Pulse Generator, 3.5 nS fixed Tr	\$700.00
HP 8080A/81A/82A/83A 300 MHz Word Generator	\$900.00
HP 8080A/91A/92A/93A 1 GHz Dual Channel Pulse Generator	\$1,650.00
HP 8080A/91A/92A/93A 1 GHz Single Channel Pulse Generator	\$1,400.00
HP 8080A/91A/93A 1 GHz Clock Generator	\$900.00
HP 8082A 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
PICOSECOND PULSE LAB 4600A 10V Step/3V Impulse Gen., 70 pS Tr, 0-100 kHz rep. rate	\$650.00
TEK PG501 50 MHz Pulse Generator, TM500 series	\$300.00
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

HP 3325A Synthesizer / Function Generator, 1 uHz-21 MHz	\$2,500.00
HP 3325A-002 Synth/Function Gen., 1 uHz-21 MHz, 40V out 1 uHz-1 MHz	\$2,650.00
HP 8165A Programmable Signal Source, 1 mHz-50 MHz	\$2,600.00

TEK AWG5102 Arb. Waveform Gen., 20 MS/s, 12 bits, 50ppm synthesis <1MHz	\$1,800.00
TEK AWG5105 Arbitrary Waveform Generator, 50 MS/s, 12 bits	\$2,200.00
TEK AWG5105-opt.02 Arbitrary Waveform Generator, dual channel option	\$3,000.00
TEK PFG5505 Programmable 12 MHz Pulse/Function Generator	\$1,275.00

VOLTAGE & CURRENT

VOLTMETERS

HP 3456A 6-1/2 digit Voltmeter	\$850.00
SOLARTRON 7150 5-1/2 / 6-1/2 digit Multimeter, GPIB	\$550.00

CALIBRATION

FLUKE 332B/AF DC Voltage Calibrator, 0-1111 V, 0-50 mA, 7 decades	\$675.00
FLUKE 343A DC Voltage Calibrator, 0-1100 V, 7 decades, 20 ppm acc.	\$1,375.00
FLUKE 515A Portable Calibrator, DC/AC/Ohms, line & battery power	\$1,700.00

VOLTAGE SOURCES

HP 6114A Precision Dual Range Power Supply, 20 V 2 A / 40 V 1 A	\$875.00
HP 6115A Precision Dual Range Power Supply, 50V 0.8A / 100V 0.4A	\$875.00

CURRENT METERS & SOURCES

DRANETZ 656A / (3)TR2019A Current Demand Analyzer, w/(3) current probes 300A max.	\$5,000.00
HP 6177C DC Current Source, to 50V, 500mA	\$600.00
HP 6181C DC Current Source, to 100 V, 250 mA	\$675.00
HP 6186C DC Current Source, to 300V, 100mA	\$750.00
KEITHLEY 225 Current Source, 1 nA-99.9 mA, 10-100 V compliance	\$450.00
KEITHLEY 414A Picoammeter, 0.1 nA-10 mA	\$325.00
KEITHLEY 480 Picoammeter, 1 nA-1 mA f.s., 3 digit	\$450.00
KEITHLEY 642 Electrometer	\$3,900.00
LEEDS & NORTHRUP 4360 Precision Current Shunts, 15-500 Amp	\$650.00
TEK CT-5 High Current Transformer for P6021/A6302, to 1000A	\$650.00

IMPEDANCE & COMPONENT TEST

L.C.R.

BOONTON 62AD 1 MHz Inductance Meter, 2-2000 uH	\$700.00
E.S.I. 296V 4-1/2 Digit LCR Bridge, 120 Hz & 1 kHz	\$850.00
HP 4261A 3-1/2 digit LCR Meter, 120 Hz/1 kHz	\$1,100.00
HP 4262A-101 3-1/2 digit LCR Meter, 120 Hz/1 kHz/10 kHz, HPIB	\$2,100.00
HP 4275A Multi-Frequency LCR Meter, 10 kHz-10 MHz	\$6,250.00
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	\$700.00
FLUKE 5450A Programmable Resistance Standard, 2 & 4 wire	\$2,750.00
GR 1409-SERIES Standard Mica Capacitors, 0.05% accuracy	\$150.00
GR 1413-5-Decade Precision Capacitor, 0.1-1110 uF, 1 pF res.	\$1,675.00
GR 1422-N Precision Cap., 100-1150 pF, 0.2 pF res., 1% to 10 MHz	\$650.00
GR 1432-N 5-Decade Resistor, to 11,111 ohms, 0.1 ohm res.	\$275.00
GR 1432-N 4-Decade Resistor, 0-111.10 ohms, 0.01 ohm resolution	\$175.00
GR 1433-X 6-Decade Resistor, to 111,111.0 ohms, 0.1 ohm res.	\$550.00
GR 1434-G 7-Decade Resistor, 0-1,111,111.0 ohms, 0.1 ohm res.	\$500.00

HI & LO RESISTANCE

GR 1666 DC Resistance Bridge, 1 micro-ohm - 100 kilohms	\$1,000.00
HP 4328A-001 Milliohmeter, 0.001-100 ohms f.s., battery option	\$1,350.00
HP 4329A High Resistance Meter, 500K ohm-2x10E16 ohm, 10-1000V	\$1,000.00
VALHALLA 4150-ATC 4-1/2 digit Ohmmeter, 20 milliohms-2 kilohms, 4-wire	\$1,000.00
TEK 577D1/177 Storage Curve Tracer, with standard test fixture	\$2,250.00

CURVE TRACERS

TEK 577D2/177 Curve Tracer, with standard test fixture	\$1,950.00
TEK 7C71N Curve Tracer, to 0.5W, 7000 series	\$500.00

T.D.R.

TEK 1503-opt.04 Time Domain Reflectometer, 0-50,000 feet, chart recorder	\$2,000.00
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POWER SUPPLIES

SINGLE OUTPUT

GLASSMAN PS/EG-05R06 5kV CV/CL Power Supply, to 6mA	\$500.00
HP 6023A Autotransforming Power Supply, to 20 V / 30 A / 240 Watts	\$1,000.00
HP 6201B 20 V at 1.5A CV/CC Power Supply	\$200.00
HP 6207B 160 V at 200 mA CV/CC Power Supply	\$300.00
HP 6260B-027 10V at 100A CV/CC Power Supply	\$675.00
HP 6261B-027 20 V at 50 A CV/CC Power Supply	\$675.00
HP 6263B 20 V at 10 A CV/CC Power Supply	\$400.00
HP 6266B 40 V at 5 A CV/CC Power Supply	\$400.00
HP 6267B 40 V at 10 A CV/CC Power Supply	\$550.00
HP 6268B 40 V at 30 A CV/CC Power Supply	\$850.00

HP 6299A 100 V at 750 mA CV/CC Power Supply	\$250.00
HP 6384A 4.0-5.5 V at 8 A CV/CL Power Supply	\$175.00
HP 6521A 1000 V at 200 mA CV/CC Power Supply	\$500.00
KEITHLEY 240A HV Power Supply, 0-1200 V, 0-10 mA, CV/CL	\$250.00
SORENSEN DCR 110-45T 110 V at 45 A CV/CC Power Supply	\$2,200.00
SORENSEN DCR 300-8A 300 V at 8 A CV/CC Power Supply; 208/230 VAC line	\$950.00
SORENSEN SRL 60-8 60 V at 8 A CV/CC Power Supply, low noise	\$950.00

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HP 6227B Dual 25 V at 2 A CV/CC Power Supply	\$650.00
HP 6253A Dual Output 20 V 3 A CV/CC Power Supply	\$500.00
HP 6255A Dual Output 40 V 1.5 A CV/CC Power Supply	\$500.00

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HP 6827A Bipolar Power Supply/Amplifier, to 100 V, 500 mA	\$800.00
KEPCO BOP-100-4M 100 V, 4 A Four Quadrant Bipolar Supply / Amplifier	\$1,000.00
KEPCO BOP-36-5M Bipolar Op Amp/Power Supply, to 36 V, 5 A	\$550.00

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HP 5315A 100 MHz/100 nS Reciprocal Counter, high res. audio	\$550.00
HP 5315A-001 100 MHz/100 nS Universal Counter, TCXO reference	\$650.00
HP 5316A-003 100 MHz/100 nS Universal Counter, HPIB, 1.0 GHz C-chan.	\$1,000.00
HP 5335A 200 MHz Universal / Statistical Counter	\$1,500.00
HP 5370B-001 100 MHz Univ. Time Int. Counter, 20 pS single shot, OCXO	\$2,250.00
HP E1420A-010, 030 VXI card 200 MHz/2 nS Univ. Counter, TCXO & 2.5 GHz C-oh	\$1,500.00
PHILIPS PM6654/056 120 MHz/2 nS Programmable High Res. Counter, OCXO, GPIB	\$950.00
TEK 7D15 225 MHz Universal Counter/Timer, 7000 series	\$275.00
TEK DC5004 Programmable 100 MHz/100nS 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
TEK DC510 350 MHz/3.125 nS Universal Counter, TM500 series	\$900.00

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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
HP 5305B/5300B-001 1.3 GHz Counter Package w/TCXO ref., high res. audio	\$450.00
HP 5340A-001, 011 18 GHz Frequency Counter, OCXO reference, HPIB	\$1,900.00
HP 5342A-001, 011 18 GHz Frequency Counter, OCXO, HPIB	\$2,750.00
HP 5342A-01, 04, 05, 11 24 GHz Frequency Counter, OCXO, DAC, and HPIB	\$3,900.00
HP 5361A-006 20 GHz Pulsed/CW Frequency Counter, 10 Watt protection	\$6,750.00
SYSTRON-DONNER 6054B 24 GHz Frequency Counter	\$1,875.00
SYSTRON-DONNER 6245A-opt.12 18 GHz Frequency Counter, OCXO option	\$1,500.00
TEK 7D14 525 MHz Frequency Counter, 7000 series	\$175.00
TEK DC504 80 MHz Frequency Counter	\$125.00

STANDARDS

HP 5087A-031 Distribution Amp., 0.1/0.05/0.0 MHz x 4 channels each	\$1,800.00
HP 5359A Time Synthesizer, pulse width 5 nS-160 mS, jitter<20pS	\$2,000.00

AUDIO & BASEBAND

SPECTRUM ANALYZERS

HP 3580A-002 Spectrum Analyzer, 5 Hz-50 kHz, 1 Hz res., bal. input	\$1,850.00
HP 3581A Wave Analyzer, 15 Hz-50 kHz	\$1,000.00
HP 3586C Selective Level Meter, 50 Hz-32.5 MHz, 50 & 75 ohms	\$1,750.00
HP 8556A LF Section, 20 Hz-300 kHz	\$500.00

DISTORTION ANALYZERS

HP 334A Distortion Analyzer, 5 Hz-600 kHz, -60 dB, auto nulling	\$550.00
HP 339A Distortion Analyzer, built-in low distortion osc.	\$2,400.00
HP 8903A Audio Analyzer, 20 Hz-100 kHz; THD, SINAD, S/N	\$2,750.00
TEK DA408A Programmable Distortion Analyzer, 0.0025% THD, w/frame	\$1,500.00

RMS VOLTMETERS

FLUKE 8920A True RMS Voltmeter, 180 uV-700 V, 10 Hz-20 MHz	\$700.00
HP 3400A RMS Voltmeter, 10 Hz-10 MHz	\$250.00
HP 400FLAC Voltmeter, 100 uV-300 V f.s., 20 Hz-4 MHz	\$200.00



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HP 204D Oscillator, 5 Hz-1.2 MHz, 5 VRMS, 80 dB step attenuator	\$200.00
HP 209A Sine/Square Wave Generator, 4 Hz-2 MHz, 5 VRMS max.	\$225.00
HP 652A Test Oscillator, 10 Hz-10 MHz	\$300.00
ROCKLAND 5100 Synthesizer, 1 mHz-1.999999999 MHz	\$400.00

FILTERS, MISCELLANEOUS

HP 3575A-002 Phase-Gain Meter, 1 Hz-13 MHz, dual display	\$900.00
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
TEKAM502 Differential Amplifier, 0.1 Hz-1 MHz, TM500 series	\$575.00

RF & MICROWAVE

SPECTRUM ANALYZERS

HP 11970A WR28 Harmonic Mixer, 26.5-40 GHz	\$1,100.00
HP 11970C WR22 Harmonic Mixer, 33-50 GHz	\$1,400.00
HP 11970U WR19 Harmonic Mixer, 40-60 GHz	\$1,400.00
HP 11971A WR28 Harmonic Mixer, 26.5-40.0 GHz, for 8569B	\$1,100.00
HP 11971K WR42 Harmonic Mixer, 18.0-26.5 GHz, for 8569B	\$1,100.00
HP 5371A Modulation Domain Analyzer, 125 mHz-500 MHz	\$5,900.00
HP 8406A Comb Generator, 1/100/100 MHz increments, to 5 GHz	\$450.00
HP 8434A Tracking Generator, for 8553B, LED display	\$700.00
HP 8444A Tracking Generator, 0.1-1300 MHz, for 8554B	\$800.00
HP 8444A-059 Tracking Generator, 0.1-1500 MHz, for 8554B, 8568, etc.	\$1,500.00
HP 8445B Preselector, 1.8-18.0 GHz, for HP 8555A	\$800.00
HP 8552B IF Section, 1 kHz-110 MHz	\$750.00
HP 8553B RF Section, 1 kHz-110 MHz	\$500.00
HP 8554B RF Section, 0.1-1250 MHz	\$800.00
HP 8554B/8552B/141T Spectrum Analyzer, 100 kHz-1250 MHz, 100 Hz resolution	\$2,000.00
HP 8555A RF Section, 0.01-18 GHz	\$950.00
HP 8555A/8552B/141T Spectrum Analyzer System, 10 MHz-18 GHz, 100 Hz res.	\$2,375.00
HP 8555A/8552B/8445/141 As above, w/1.8-18 GHz Preselector, opt.003 freq display	\$3,000.00
HP 8558B/181TR Spectrum Analyzer, 0.1-1500 MHz, 1 kHz res., w/display	\$2,250.00
HP 85711A CATV Measurements Personality, for 8590 series	\$375.00
TEK 496P Spectrum Analyzer, 10 kHz-1.8 GHz, 30 Hz res., GPIB	\$5,500.00
TEK 7L/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

HP 11590A Bias Network, 1.0-12.4 GHz, N(f/f)	\$375.00
HP 11590A-001 Bias Network, 1.0-18.0 GHz, APC7	\$450.00
HP 11665B Modulator, 0.15-18.0 GHz, for use with 8755/6/7	\$375.00
HP 8407A/8412A/8601A Network Analyzer, 100 kHz-110 MHz, with sweep generator	\$1,250.00
HP 85021A Directional Bridge, 0.01-18.0 GHz, APC7, for 8755/6/7	\$1,200.00
HP 85027E Directional Bridge, 10 MHz-26.5 GHz, for 8757 series	\$2,000.00
HP 85050D APC7 Calibration Kit, for 8510 series	\$1,100.00
HP 8505A-005/8503A Network An., 0.5-1300 MHz, w/S-Parameter & phase lock	\$6,000.00
HP 8755C(3)/11664A/181T Scalar Network An. w/3 detectors, 10 MHz-18 GHz & frame	\$1,750.00
HP 8756A(3)/11664A Scalar Network Analyzer, w/(3) detectors, 0.01-18 GHz	\$3,750.00
NARDA 7000A/7202/7206 Microwave Multimeter System: scalar analysis 0.1-18 GHz	\$1,950.00
WILTRON 560/3x-7S50 Scalar Network Analyzer, w/3 detectors, 0.01-18.5 GHz	\$2,000.00
WILTRON 640/G50/E(2)/7B50(2) Network An., w/1-1500 MHz source, (2) log amp, (2) det.	\$1,675.00

SIGNAL GENERATORS

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
FLUKE 6060A-488 Synth. Signal Gen., 100 kHz-1040 MHz, 100 Hz res., GPIB	\$3,500.00
FLUKE 6060A/AN Synthesized Signal Gen., 10 kHz-520 MHz, 10 Hz res, GPIB	\$2,000.00
FLUKE 6071A-830,870 Synthesized Signal Gen., 0.2-1040 MHz, 1 Hz res., GPIB	\$4,000.00
GIGATRONICS 605/101-0.8, opt.3 Synthesized Source, 10 MHz-8 GHz, 1 kHz res.	\$3,000.00
GIGATRONICS 605/10-18, opt.3 Synthesized Source, 10-18 GHz, 1 kHz res.	\$3,000.00
GIGATRONICS 605/6-12, opt.3 Synthesized Source, 6-12 GHz, 1 kHz res.	\$3,000.00
GIGATRONICS 875/50 Levelled Multiplier, x4, 50.0-75.0 GHz output, -3 dBm	\$3,500.00
GIGATRONICS 875/86 Levelled Multiplier, 26.5-40.0 & 50.0-75.0 GHz outputs	\$7,000.00
HP 85100V Frequency Mult., 10-15 GHz in / 50-75 GHz out >0 dBm	\$4,250.00
HP 8640B-001,002,003 Signal Gen., 0.5-1024 MHz, AM, FM, var. audio osc.	\$2,750.00
HP 8654A Signal Generator, 10-520 MHz, calibrated AM & uncal. FM	\$625.00
HP 8660B/86601A/86633B Synthesized Signal Generator, 0.1-110 MHz, AM, FM	\$1,500.00
HP 8660B/86602A/86632A Synthesized Signal Generator, 1-1300 MHz, AM, FM	\$2,500.00
HP 8660C/86602B/86633B Synthesized Signal Generator, 1-1300 MHz, AM, FM	\$2,750.00

HP 8660C/86603A/86633B Synth. Sig. Gen., 1-2600 MHz, AM, FM, digital sweep	\$4,500.00
HP 8683B Signal Generator, 2.3-6.5 GHz, AM, WBFM, Pulse	\$5,000.00
HP 8684B 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

EIP 928-opt.9201 Sweep Gen., 1.0-18.6 GHz, step atten., power sweep, GPIB	\$4,000.00
GIGATRONICS 900/0.05-12, opt.3 Synthesized Sweep/Sig. Gen., 50 MHz-12 GHz, 1 kHz res.	\$4,500.00
HP 8350A/86290B-H08 Programmable Sweep System, 2.0-22.0 GHz, +4 dBm lvd	\$5,500.00
HP 8601A Generator/Sweeper, 0.1-110 MHz, +20 dBm levelled	\$500.00
HP 8620C Sweep Oscillator Frame	\$550.00
HP 8620C-011 Sweep Oscillator Frame, HP1B programmable	\$675.00
HP 86222A-002 RF Plug-In, 10-2400 MHz, 70 dB step attenuator	\$1,750.00
HP 86222B-002 RF Plug-In, 10-2400 MHz, crystal markers, 0-70 dB atten	\$1,950.00
HP 86230B RF Plug-In, 1.8-4.2 GHz, +10 dBm unlevelled	\$675.00
HP 86240B RF Plug-In, 2.0-8.4 GHz, +13 dBm levelled	\$1,000.00
HP 86241A-001 RF Plug-In, 3.2-6.5 GHz, +8 dBm levelled	\$500.00
HP 86242D-004,008 RF Plug-In, 5.9-9.0 GHz, +10 dBm levelled	\$500.00
HP 86245A RF Plug-In, 5.9-12.4 GHz, +16 dBm levelled	\$1,100.00
HP 86250D-001 RF Plug-In, 8.0-12.4 GHz, +10 dBm levelled	\$700.00
HP 86260A RF Plug-In, 12.0-18.0 GHz, +10 dBm unlevelled	\$1,000.00
HP 86260A-H04 RF Plug-In, 10.0-15.0 GHz, +10 dBm unlevelled	\$1,100.00
HP 86290A RF Plug-In, 2.0-18.0 GHz, +7 dBm levelled	\$1,750.00
HP 86290B RF Plug-In, 2.0-18.6 GHz, +10 dBm levelled	\$2,000.00
WAVETEK 1001A Sweep Generator, 0.5-300 MHz, +10 dBm	\$350.00
WAVETEK 1067 Sweep Generator, 1-400 MHz, +10 dBm, 97 ohms	\$500.00
WAVETEK 907 Sweep/Signal Generator, 7.0-11.0 GHz, 0 dBm levelled	\$1,000.00
WAVETEK 954 Signal/Sweep Generator, 3.7-7.6 GHz, +7 dBm unlevelled	\$1,750.00
WAVETEK 962 Sweep Generator, 1.0-4.0 GHz, markers, +12 dBm unlvld	\$2,000.00
WILTRON 6619A Programmable Sweep Gen., 2.0-8.0 GHz, +10 dBm levelled	\$1,900.00

POWER METERS

BOONTON 4200-01B/4G Power Meter w/sensor, 1 MHz-26.5 GHz, -60 to +10 dBm, GPIB	\$1,500.00
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 478/4240A Power Meter & Sensor, 0.01-18 GHz, -35 to +10 dBm	\$375.00
HP 11683A Range Calibrator, for HP 4356/7/8	\$750.00
HP 432A/478A Power Meter, 0.01-10 GHz, -20 dBm to +10 dBm f.s.	\$375.00
HP 432A/8478B Power Meter, 0.01-18 GHz, -20 to +10 dBm f.s.	\$500.00
HP 432C Antoranging Digital Power Meter, 10 uW-10 mW f.s.	\$425.00
HP 435A/8481A Power Meter, 10 MHz-18 GHz, -30 to +20 dBm	\$1,000.00
HP 435A/8482A Power Meter, 0.1-4200 MHz, -30 to +20 dBm	\$1,000.00
HP 435A/8482H Power Meter, 0.1-4200 MHz, -15 to +34 dBm	\$1,150.00
HP 435A/8484A Power Meter, 10 MHz-18 GHz, -70 to -20 dBm	\$1,000.00
HP 4K86A WR42 Thermistor Mount, 18.0-26.5 GHz, for 432 series	\$400.00
HP Q486A Power Sensor, 33.0-50.0 GHz, WR22 waveguide	\$1,500.00
HP 4R86A WR28 Thermistor Mount, 26.5-40.0 GHz, for 432 series	\$400.00

RF MILLIVOLTMETERS

MILLIVAC MV-723BBS 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

AILTECH 7616 Noise Source, 1.0-12.4 GHz, N(m), 15 dB ENR	\$375.00
AILTECH 7618E Noise Source, 10 MHz-18 GHz, SMA(m), 15 dB ENR	\$500.00
AMPLIFIER RESEARCH 1W1000 Amplifier, 30 dB gain, 1-1000 MHz, 1 Watt output	\$650.00
BOONTON 824D FM/AM Modulation Meter, 10-1300 MHz	\$1,000.00
ENI 403LA Amplifier, 37 dB gain, 150 kHz-300 MHz, 3 Watts	\$700.00
ENI 600L Amplifier, 24 dB, 0.8-1020 MHz, 150 mW	\$450.00
ENI A150 Amplifier, 55 dB, 0.3-35.0 MHz, 150 Watts	\$2,000.00
ENI A300 Amplifier, 55 dB, 0.3-35.0 MHz, 300 Watts	\$3,500.00
HUGHES 1177H01F000 TWT Amplifier, 30 dB, 2-4 GHz, 10 Watts	\$1,750.00
HUGHES 1177H02R000 TWT Amplifier, 30 dB, 4-8 GHz, 10 Watts	\$1,750.00
M.P.D. LAB2-1020-2A Amplifier, 34 dB, 1.0-2.0 GHz, 2 Watts	\$1,000.00
M.P.D. LAB2-714-3A Amplifier, 34 dB, 0.7-1.4 GHz, 3 Watts	\$1,000.00
MARCONI TF2304 AM/FM Modulation Meter, 18-1000 MHz, FM dev.1.5-150 kHz	\$500.00
MICROWAVE SEMI CORP. MC5112 Noise Source, 25.5 dB ENR, 1.0-12.4 GHz, N(m), +28 VDC	\$325.00

COAXIAL & WAVEGUIDE

AEROWAVE 15-3000/10 WR15 Directional Coupler, 10 dB, 50-75 GHz	\$400.00
AEROWAVE 22-3000/10 WR22 Directional Coupler, 10 dB, 33-50 GHz	\$400.00
ANZAC MDC-171 Mixer, RF/LO=4-18 GHz, LO +7 dBm, IF=DC-4 GHz, SMA	\$135.00
AVANTEK Y083-4037 YIG Tuned Osc., 5.4-10 GHz, +15/-5 V, TUNE & FM coils,NEW	\$100.00
FXR/MICROLAB S3-02N Triple Stub Tuner, 200-1000 MHz, 100 Watts max., N(m/f)	\$90.00

GR 874-LTL Constant Impedance Trombone Line, 0-44 cm, DG-2 GHz	\$450.00
GR 900-LB Precision Slotted Line, 0.3-8.5 GHz, 50 Ohms 0.1% tol.	\$450.00
GR 900-Q GR900 14mm Inter-series Adapters	\$125.00
HP 11691D Directional Coupler, 22 dB, 2-18 GHz	\$500.00
HP 11692D Dual Directional Coupler, 22 dB, 2-18 GHz	\$900.00
HP 33330D Detector, 0.01-33.0 GHz, APC3.5(m)/SMC(f)	\$275.00
HP 775D Dual Directional Coupler, 20 dB, 450-940 MHz	\$275.00
HP 776D Dual Directional Coupler, 20 dB, 940-1900 MHz	\$275.00
HP 777D Dual Directional Coupler, 20 dB, 1.9-4.1 GHz	\$275.00
HP 778D Dual Directional Coupler, 20 dB, 100-2000 MHz	\$550.00
HP 779D Directional Coupler, 20 dB, 1.7-12.4 GHz	\$375.00
HP 8472A Crystal Detector, 10 MHz-18 GHz, neg. pol., SMA(m)	\$150.00
HP K422A WR42 Flat Broadband Detector, 18.0-26.5 GHz	\$350.00
HP K532A WR42 Frequency Meter, 18.0-26.5 GHz	\$500.00
HP Q752D WR22 Directional Coupler, 20 dB, 33-50 GHz	\$650.00
HP R422A WR28 Flat Broadband Detector, 26.5-40 GHz	\$400.00
HP R532A WR28 Frequency Meter, 26.5-40.0 GHz	\$500.00
HUGHES 45342H-1110 WR22 Dual Directional Coupler, 10 dB, 33-50 GHz	\$875.00
HUGHES 45751H-2000 WR28 Direct Reading Phase Shifter, 0-360 deg., 26.5-40GHz	\$1,200.00
KRYTAR 202020016 Directional Det., 2-20 GHz, SMA(f)/m)/SMC(f), 10 uV/uV	\$200.00
M/A-COM 3-19-300/10 WR19 Directional Coupler, 10 dB, 40-60 GHz	\$450.00
MAURY MW. 2640D Slide Screw Tuner, 1.8-18.0 GHz, APC7	\$375.00
MAURY MW. J320-series WR22 Calibrated Mismatch, VSWR values 1.1-2.0	\$375.00
MILLIWAVE S91-1777B Amplifier, 2.7 dB, 18.0-26.5 GHz, +19 dBm Po, SMA(f)	\$150.00
MITEQ AMP-1269 Amplifier, 30 dB gain, 700-1200 MHz, 1 Watt, 24V 500mA	\$175.00
NARDA 26298 20 dB Attenuator, 150 Watts, DC-1 GHz, N(f/f)	\$200.00
NARDA 3000-SERIES Directional Couplers	\$150.00
NARDA 3022 Bi-Directional Coupler, 20 dB, 1-4 GHz	\$350.00
NARDA 3024 Bi-Directional Coupler, 20 dB, 4-8 GHz	\$300.00
NARDA 3090-SERIES Precision High Directivity Couplers	\$225.00
NARDA 4000-SERIES SMA Miniature Directional Couplers	\$75.00
NARDA 4203-6 Directional Coupler, 6 dB, 2-18 GHz, SMA(f/f/f)	\$225.00
NARDA 4246B 10 Directional Coupler, 10 dB, 6-18 GHz, SMA(f)	\$100.00
NARDA 5070-SERIES Precision Reflectometer Couplers	\$300.00
NARDA 792FF Variable Attenuator, 0-20 dB, 2.0-12.4 GHz	\$375.00
OMNI-SPECTRA 2082-5810-02 Adj. Phase Trimmer, 8-18 GHz, 10 deg./GHz range, SMA(m/f)	\$50.00
PRD N233A/232 Slotted Line, 3-12 GHz, N(m/f), w/cariage & detector	\$175.00
RLC AV-70124-R Level Set Attenuator, 0-20 dB, 7.0-12.4 GHz, SMA(f/f)	\$75.00
SPACE LABS DQ-1 WR22 Flat Broadband Detector, 33-50 GHz	\$550.00
TRG V510 WR15 Precision Rotary Vane Attenuator, 0-50 dB, 50-75 GHz	\$1,000.00
TRG V551 WR15 Frequency Meter, 50.0-75.0 GHz	\$600.00
TRG/ALPHA V559-10 WR15 Directional Coupler, 10 dB, 50-75 GHz	\$400.00
WAVELINE 808C WR42 Var. Phase Shifter, 0-180 deg., gage read, 18-26.5GHz	\$375.00
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WEINSCHIEL 3200-1 Programmable Step Atten., 0-127 dB, DC-2 GHz, SMA "NEW"	\$200.00
WILTRON 60A50-opt.1 SWR Bridge, 5-2000 MHz, APC7 test port, 46 dB dir.	\$550.00
WILTRON 60N50 SWR Bridge, 5-2000 MHz, N(m) test port, 40 dB dir.	\$475.00
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HP 8170A-002 Logic Pattern Generator, 2 MB/s, address driver option	\$1,400.00
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COMMUNICATIONS

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P.A.R. 5205-94,95,96,98 Lock-In Amp, 20 Hz-20 kHz, int. osc., lin/log, GPIB	\$2,750.00
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TEK 5006 5000-series 6-slot Programmable Power Module	\$600.00
TEK TM503 500-series 3-slot Power Module	\$175.00
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TEK TM506 500-series 6-slot Power Module	\$250.00
TEK TM515 500-series 5-slot Traveller Power Module	\$275.00

Alternative VHF/UHF Wire Antennas for Scanner Receivers

This month, we will take a look at some wire antennas that are normally thought to be lower frequency antennas, but are actually quite viable in the VHF/UHF bands (30-1,200 MHz) covered by scanner receivers. A quick look at the sales catalogs shows that there is a huge number of scanner receivers on the market, and they sell briskly. Also apparent is the lack of cheap, easy-to-build antennas for those frequencies. Before we get to the topic at hand, however, let's take care of some housekeeping issues.

Whistler Hunters Take Note

A couple months ago, we took a look at Whistler hunting. Whistlers are natural radio signals, occurring mostly in the 1 to 10 KHz region of the electromagnetic spectrum, and are believed to be generated by lightning bursts. Simple receivers, consisting largely of some bandpass filtering and a high-gain audio amplifier, are used to find whistlers. In the article, I mentioned Mike Mideke's *Whistler Hunter's Guide*, and gave his address as a source for the guide. Mike wrote me and stated that he was no longer in the mail order business, and is not in a posi-

tion to fill orders. He gave me permission to sell copies of the 25-page guide. If you want a copy, then send me \$8.00 and I'll send the guide back postpaid.

Contacting Me

My snail mail address has been published in this column before, but here it is again:

J.J. Carr
P.O. Box 1099
Falls Church, VA 22041

Recently, I added E-Mail capability. You can also contact me on the Internet or through America On-Line at the address:

CARRJJ@AOL.COM

Wire Antenna Arrays

If you had a small, fixed amount of money to add an accessory to improve your scanner operation, which would you buy first: a preamplifier or a better antenna? Although there are some situations where a low-noise preamplifier is the correct choice, the most usual case is to put the money into beefing up the antenna system. Why? Because an antenna contributes less noise to the system, plus will offer some directivity that allows one to discriminate

Open Channel

by Joseph J. Carr
K4IPV

against unwanted signals that are not in the same direction as desired signals.

If you have the money, then a large Yagi beam antenna, with rotator, is a good selection, especially if you want to receive signals only over a narrow band. But even with the Yagi, we can improve matters by using two Yagis and a "stacking harness" between them. But there is also a set of antenna designs that are easy to build, provide gain, and are reasonably well behaved (i.e., they tend to work when built correctly).

These antennas are any of

several array designs that use quarter wavelength, half wavelength, or other radiator elements arranged in a fixed array. There are several ways to categorize array antennas. A *collinear array* consists of two or more elements, ranging in length from 0.5λ to 0.65λ , fed such that the currents in the elements are in-phase with each other. Arrays are also classified according to the directivity: *broadside arrays* radiate and receive along a line perpendicular to the plane of the antenna, while an end-fire array radiates and receives off the ends of the elements.

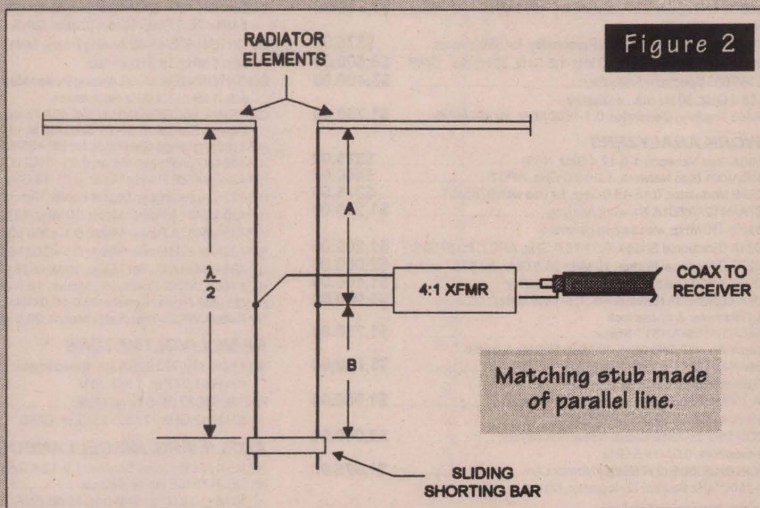


Figure 2

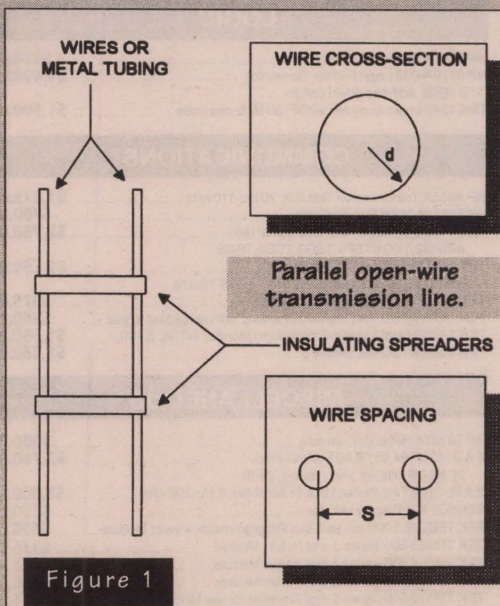


Figure 1

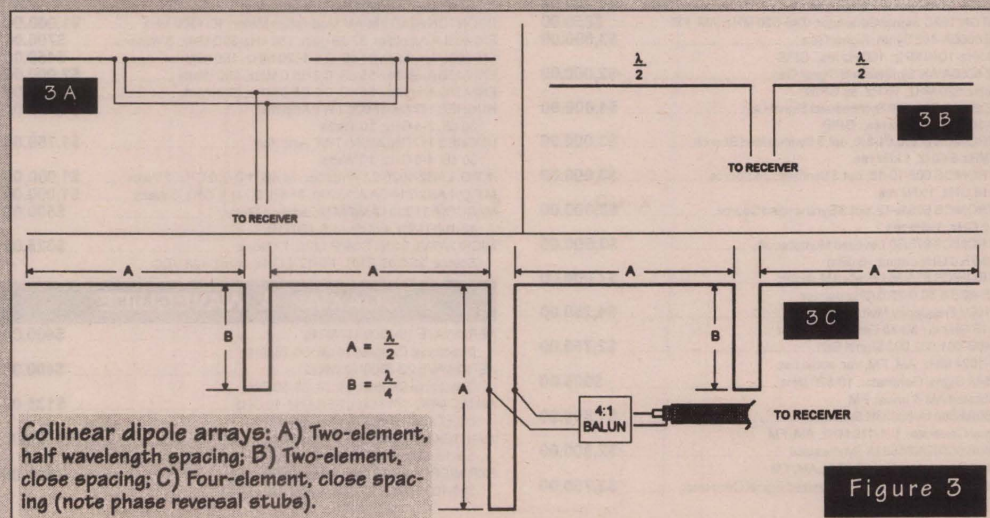


Figure 3

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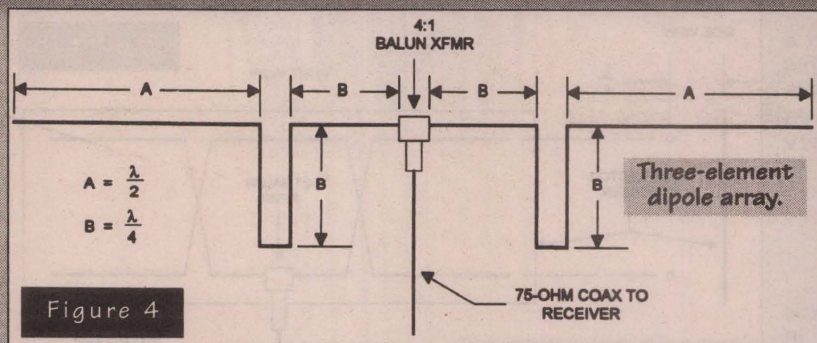


Figure 4

The down side of these types of antennas is that many of them require parallel open-line transmission line (although some can use 300-ohm or 450-ohm twin-lead), and impedance matching stubs. But we can handle that problem. Figure 1 shows what parallel line looks like. It consists of a pair of conductors, either wire or tubing, parallel to each other, and kept separated by insulating spacers. The spacers can be either homemade or store-bought. Detailed instructions on how to make your own parallel line can be found in my book *Joe Carr's Receiving Antenna Handbook* (HighText Publications, P.O. Box 1489, Solana Beach, VA 92075; \$19.95).

The two factors that affect the characteristic impedance of parallel line are the spacing(s) between conductor centers, and the radius of the conductors (d). Although you can calculate the spacings needed (and the wire diameters are given in my book), there are some general guidelines given in Table I.

The conductor type is along

the vertical axis on the left, and the characteristic impedances are along the horizontal axis at the top. The entries in each cell are the spacings (s) in inches. Thus, to make 400-ohm parallel line from 1/4" tubing, space the conductors 3.5" apart.

Some of the antennas can be fed directly with a 4:1 or 1:1 BALUN transformer and 75-ohm coaxial cable, but in many cases a matching stub is needed. Figure 2 shows the basic "universal stub" that will work with a large number of different antennas. There are two things you can do with this stub: tune to resonance by adjusting the sliding short; and match the impedance by picking the point on the stub at which the transmission line is attached (i.e., the A/B ratio). The adjustments are best done with an SWR analyzer, VSWR bridge, antenna impedance bridge, or some other instrument (a number of alternatives, from low-cost to out-of-sight, are available in shortwave/scanner receiver catalogs). Now let's look at the antennas.

The BALUN transformers

can either be homemade or store-bought. Although antenna and scanner supplies distributors sell VHF BALUN transformers, you can also use television-style BALUN transformers. These may not be called BALUNS, but are recognized by the fact that they have a coaxial "F" connector on one end, and a piece of 300-ohm twin-lead on the other.

Two-Element Collinear Array

One of the simplest forms of gain array antenna is the two-element collinear array (Figure 3A). It consists of two half wavelength dipoles spaced half wavelength apart. This antenna gives a gain of 3 dB, and is a broadside array. (When viewed from above, the pattern is perpendicular to the line between the antenna elements.)

Each antenna element is half wavelength. The physical length is found from $L_{\text{inches}} = 5904/F_{\text{MHz}}$, where F_{MHz} is the frequency in megahertz. Thus, at 150 MHz, half wavelength is 39.4"; at 450 MHz it is 13.12", and at 800 MHz it is 7.38".

The antenna in Figure 3A is a little inconvenient in one respect: It requires two transmission lines connected in parallel. This is easily accomplished by using 75-ohm coaxial cable from each antenna element to a "tee-connector," and then a piece of 52-ohm cable from the "tee" connector to

the receiver.

A different solution is shown in Figure 3B. The antenna elements are separated by only a few inches, rather than half wavelength. The gain drops to 1.6 dB for two elements (although for three elements it is 3 dB and for four elements it's 4.2 dB). The antenna is fed by 450- to 600-ohm parallel line or twin-lead. The feedpoint impedance will be as low as 1K ohms if tubing is used, up to 4 to 6K ohms if wire is used. This is one of those antennas where a matching stub is needed.

The four-element version of the antenna is shown in Figure 3C. This antenna is similar to the two-element version of Figure 3B, but with an additional half wavelength element tacked onto the ends. The additional elements are separated by quarter wavelength phase reversal stubs. The stubs are needed to keep the phase of the currents flowing in the outer elements the same as the currents flowing in the center elements. These stubs are made from the same type of transmission line as the half wavelength matching stubs, but are half as long.

Another collinear array is shown in Figure 4. This antenna offers 3 dB of gain, and can be fed directly from 75-ohm coaxial cable through a 4:1 BALUN transformer. The antenna con-

Table 1 Characteristic Impedance (Z₀)

Conductor	100	200	300	400	500	600
#12 Wire	—	—	—	1.1	2.5	6.0
#10 Wire	—	—	0.5	1.5	3.5	8.0
#8 Wire	—	—	0.75	1.75	4.0	—
1/4" Tubing	—	0.6	1.5	3.5	—	—
3/8" Tubing	—	1.0	2.5	5.5	—	—
1/2" Tubing	0.8	1.2	3.0	7.0	—	—

Figure 5

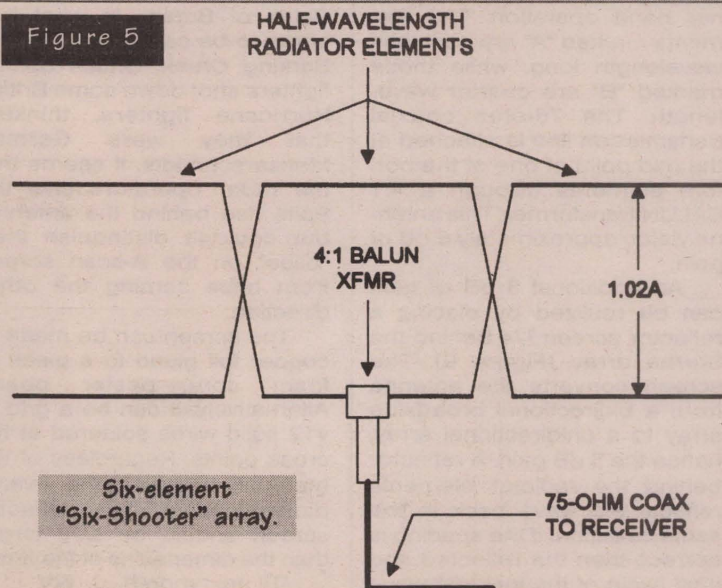
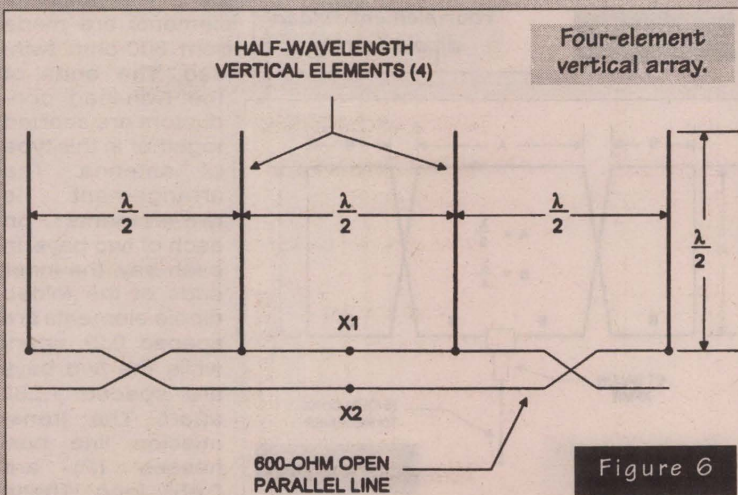


Figure 6



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sists of three half wavelength elements, but the center element is fed at the center point (quarter wavelength from each end). The quarter wavelength phase reversal stubs are used between the center element and the two outer elements.

Six-Element Array

Figure 5 shows a six-element array that is similar in structure to a three-element version of Figure 3B. This antenna consists of six half wavelength elements arrayed in two bays of three each. The two bays are separated by slightly more than half wavelength (1.02). Figure 5 is shown as a side view. Because it is a broadside array, the maximum sensitivity will be along a line perpendicular to the paper (i.e., in and out of the page). The two bays of elements are connected to each other via a piece of 600-ohm transmission line at two points. These lines are shown crossed because of phasing requirements. If you don't want to use parallel line, the antenna will also work well with 450-ohm twin-lead, but it has to be twisted once to cre-

ate the phase reversal.

According to Bill Orr's W6SAI *Radio Handbook*, this type of array (Figure 5) can produce up to 7.5 dB of gain. Given that the elements are not very long, that's real useful at VHF/UHF frequencies!

Four-Element Broadside Array

A four-element vertical broadside array is shown in Figure 6. This antenna has four half wavelength elements spaced half wavelength from each other. Like the antenna above, the radiation direction is perpendicular to the line between the antennas, or in and out of the page.

The antenna elements are fed by a length of 600-ohm parallel line that connects all four together. But notice that the outside elements are fed by reversing the phase. This means that the transmission line must be twisted before being connected to the end elements; the unused conductor is left floating. The feedpoint impedance of this antenna is 200 to 300 ohms, so it can be coax fed with either 52-ohm or 75-ohm coaxial cable if a 4:1 BALUN transformer is provided. Gains on the order of 6 to 8 dB are realized with this antenna.

Folded Dipole "X-Array"

The array shown in Figure 7 uses four folded dipole antennas arranged in an "X-array" pattern to provide about 6 dB gain. The antenna elements are made from 300-ohm twin-lead. The ends of the twin-lead conductors are shorted together in this type of antenna. The arrangement is two-elements in each of two bays. In each bay, the inner ends of the folded dipole elements are spaced 0.2λ apart, while the two bays are spaced 1.25λ apart. The transmission line harnesses (P) are 0.45λ long. These

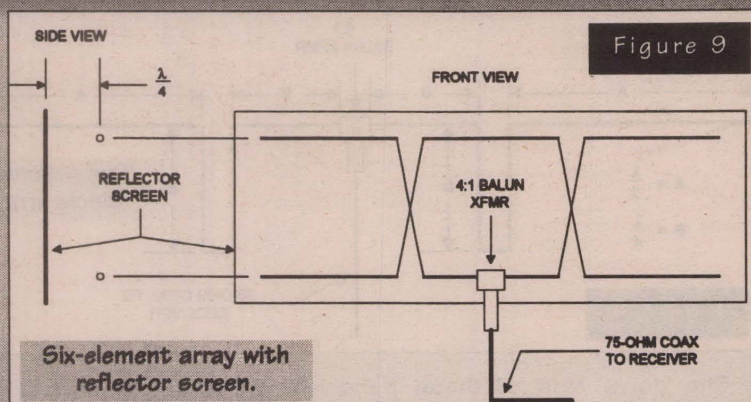


Figure 9

Six-element array with reflector screen.

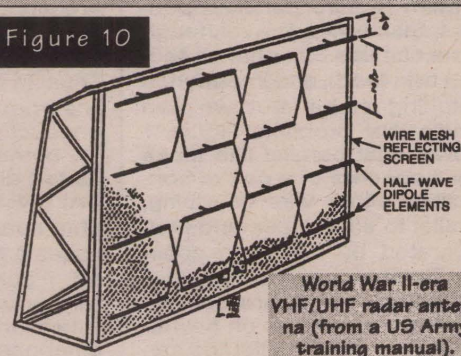
transmission line harnesses are connected in-phase with each other at the high impedance side of a 4:1 BALUN transformer; 75-ohm coaxial cable carries the signal to the receiver. All four elements in Figure 7 are in the same plane, and the direction of radiation/reception is perpendicular to that plane (i.e., in/out of the page).

Sterba Curtain Array

The Sterba curtain array is normally thought of in terms of international shortwave broadcasters. Many an HF international broadcaster uses the Sterba curtain to boost their signal strength and squirt it in the right direction. Figure 8 shows a small Sterba (they can be made with many more sections than shown here!) that is easily built for VHF/UHF scanner band operation. The elements marked "A" are each half wavelength long, while those marked "B" are quarter wavelength. The 75-ohm coaxial transmission line is attached at the mid point of one of the bottom elements through a 4:1 BALUN transformer. This antenna yields approximately 6 dB of gain.

An additional 3 dB of gain can be realized by placing a reflector screen $\lambda/4$ behind the Sterba array (Figure 9). The screen converts the antenna from a bidirectional broadside array to a unidirectional array, hence the 3 dB gain. A reflector behind the radiator elements reflects the wave back in the same direction. If the spacing is correct, then the reflected and next cycle of the incident wave

Figure 10



World War II-era VHF/UHF radar antenna (from a US Army training manual).

will add constructively, resulting in re-inforcement of the signal.

This method was used in VHF/UHF World War II radar antennas (Figure 10.) In the days before microwave transmitters and receivers became available, radar was carried on in the VHF region.

In fact, the earliest operational radar, the British Chain Home stations, operated in the HF region. The lack of reflectors on the original dipole antennas used in Chain Home stations resulted in an embarrassing event at the very outset of the Battle of Britain. In what has come to be called the Battle of Barking Creek, British Spitfire fighters shot down some British Hurricane fighters, thinking that they were German Messerschmidts. It seems that the radar operators saw the Spits rise behind the antenna, but couldn't distinguish their "blibs" on the A-scan screen from blibs coming the other direction.

The screen can be made of copper foil glued to a piece of foam core poster board. Alternatively, it can be a grid of #12 solid wires soldered at the cross points. Regardless of the material, however, the overall dimensions of the reflector screen should be $\leq \lambda/8$ larger than the dimensions of the array.

'Til next month... NV

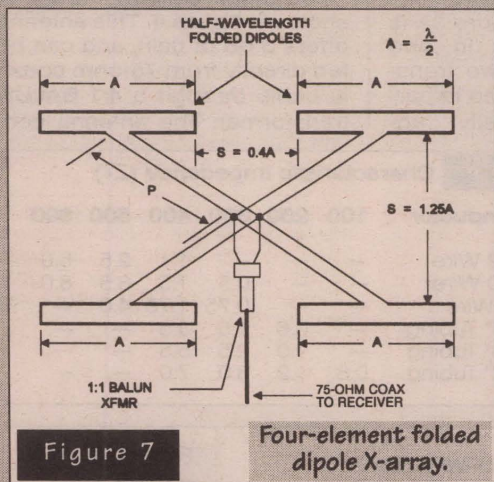
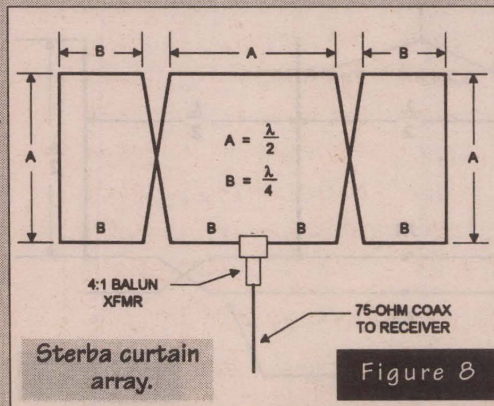


Figure 7

Four-element folded dipole X-array.



Sterba curtain array.

Figure 8

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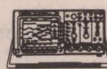
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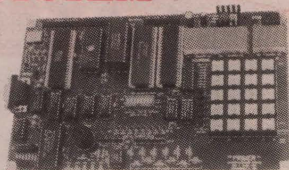
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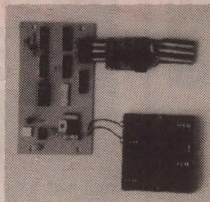
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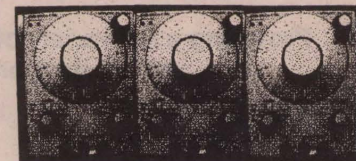
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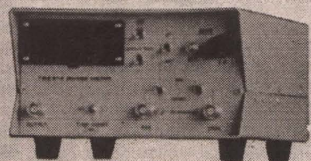
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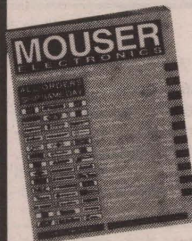
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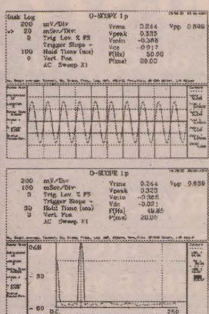
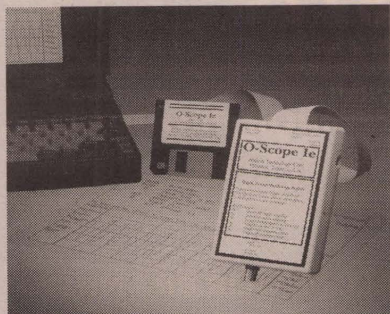
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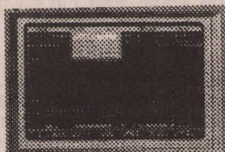
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Nuts & Volts Magazine/October 1995

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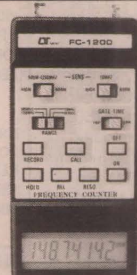
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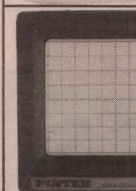
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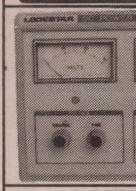
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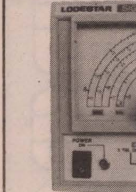
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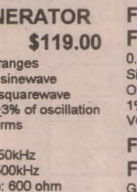
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Output impedance: 600 ohm



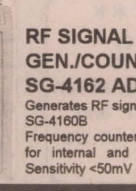
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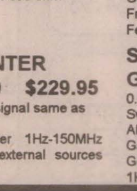
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Nuts & Volts Magazine/October 1995

57

Stamp Applications:

Putting
the Spotlight on
BASIC Stamp Projects,
Hints, and Tips

by Scott Edwards

Encoding and decoding DTMF tones — those musical “touch tones” you hear when you dial the phone — is the current fad in electronics projects. There are gadgets that capture and display or store dialed digits, others that dial stored numbers, and still others that use the hardy dual-tone, multi-frequency digits for data transmission or remote control.

Rotary Encoders Help You Program a Friendly Spin-and-Grin Interface

A sad consequence of the digitization of electronics has been the gradual disappearance of knobs. Digital equipment likes its input in terms of digits, not twists of the wrist.

Knobs are elegant and intuitive. Twist clockwise and the parameter being controlled increases; counter-clockwise and it decreases. Natural as breathing. Thankfully, the user-interface used by the largest number of people and requiring the most precise and reflexive control, the steering wheel of a car, is a big knob.

Knobs are battling back from the brink of extinction, though, now that digital versions called rotary encoders are being used in more designs.

In this month's column, I'll show you a simple method for converting the output of a standard rotary encoder into data your Stamp can use.

In the second half of the column, I'll introduce you to a technique for making tidy wiring harnesses that connect to those ubiquitous square header posts (like the pins on the Stamp board).

Rotary Encoders

The rotary encoders we're going to discuss

The sequence of bits appearing on the output phases of a rotary encoder tells the direction of rotation.

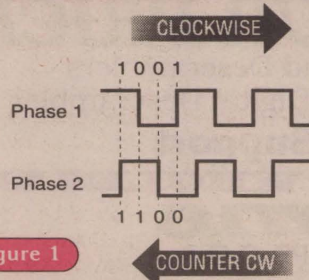


Figure 1

today are properly known as “incremental rotary encoders.” There are others known as “absolute” encoders. An absolute encoder outputs a binary value that's proportional to the angle of the shaft, much the same as an analog pot's resistance depends on its shaft angle. The resolution of an absolute encoder is a function of the number of output bits: An eight-bit encoder breaks a full rotation (360 degrees) into 256 parts; 10 bits, 1024 parts; 12 bits, 4096 parts.

An incremental encoder is different. It has only two output bits, regardless of its angular resolution. As the shaft rotates, the bits change in the sequence shown in Figure 1. The encoder's resolution determines how far you must turn the encoder shaft before there is a change in one of the outputs.

Given the output bits shown in the figure, it's fairly easy for a controller to figure out the direction of the encoder shaft's rotation. Let's say that the bits are now 01 and they change to 00. Figure 1 shows that as clockwise rotation. If the bits start at 01 and change to 11, that's counterclockwise.

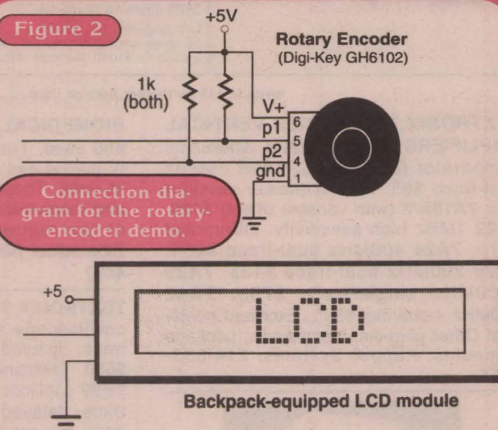
So, one way to interpret the output from an encoder would be to look up the sequence in a pair of tables. However, there's an efficient shortcut method using the exclusive-OR (XOR) operator (expressed as ^ in PBASIC). XOR's effect on bits can be stated as, “If bit A or bit B (but not both) = 1, then bit C = 1.” In table form:

A	XOR	B	=	C
0	^	0		0
0	^	1		1
1	^	0		1
1	^	1		0

XOR has quite a few uses in programming. Any bit XORed with 1 is inverted; bits XORed with 0 are unchanged. If two bits are equal they XOR to 0; if not equal they XOR to 1.

In the case of

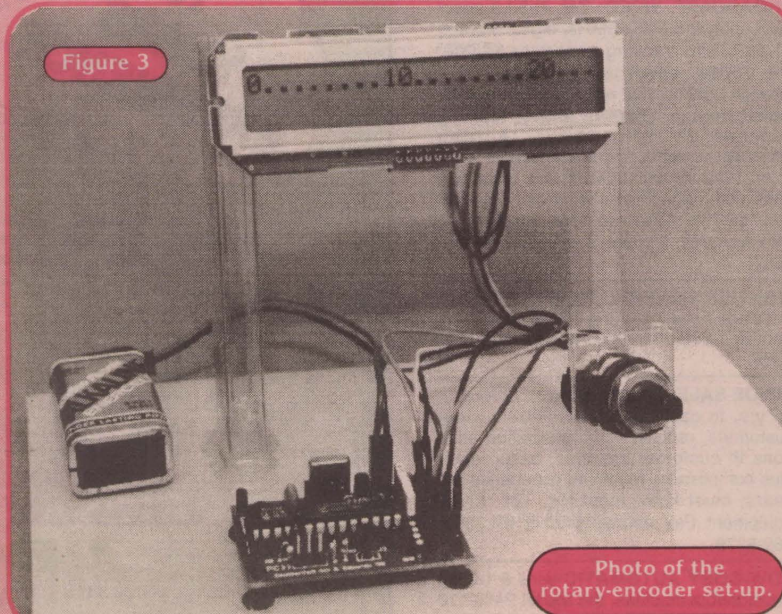
Figure 2



the encoder sequence, it turns out that for any given sequence, XORing the righthand bit of the old value with the lefthand bit of the new value tells you the direction of rotation. For example, take the clockwise sequence 01 00: 1 XOR 0 = 1. Now the counter-clockwise sequence 01 11: 1 XOR 1 = 0. This relationship holds for any pair of numbers in either direction.

Figure 2 and Listing 1 demonstrate how a rotary encoder could be employed in a user-interface application. I got the idea for it from one of my customers. He used a Backpack-equipped LCD to simulate a radio “bandspread” tuning dial. Turn the encoder to the left and the display scrolls to the left; turn it right, the display scrolls right. In my customer's application, the Stamp also updat-

Figure 3



Stamp Applications:

PROGRAM LISTING DEMONSTRATING USE OF A ROTARY ENCODER

' Program: Rotary.BAS (Read a rotary encoder and scroll a display)
' This program demonstrates the use of a digital rotary encoder
' as a unique user-interface control. Turning the knob scrolls a
' virtual tuning dial displayed on an LCD. To keep the code and
' hardware as simple as possible, the LCD is equipped with an
' LCD Serial Backpack, which interprets data and instructions sent
' to it serially.

```
SYMBOL old = b0      ' Previous state of encoder bits.
SYMBOL new = b1      ' Current state of encoder bits.
SYMBOL directn = bit0 ' Direction of encoder travel; 1=CW.
SYMBOL index1 = b2    ' For/Next counter variable.
SYMBOL index2 = b3    ' For/Next counter variable.
SYMBOL I = 254        ' Instruction-toggle for LCD.
SYMBOL LCD_cls = 1    ' Clear-screen instruction for LCD.
SYMBOL left = 24      ' Scroll-left instruction for LCD.
SYMBOL right = 28     ' Scroll-right instruction for LCD.
```

' The program starts by printing a scale on the LCD screen.
' The LCD's RAM can hold up to 80 characters and scroll them
' circularly across the display. The code below prints...
' 0.....10.....20.....30.....40.....50.....up to 70.
' Only the first 24 characters are initially
' visible on the display, but turning the encoder knob scrolls
' them into view, like an old-fashioned radio tuning dial.

```
pause 1000          ' Let LCD initialize.
serout 0,n2400,(I,LCD_cls,I) ' Clear LCD screen.
for index1 = 0 to 70 step 10 ' Scale: 0-70 (uses 80-char LCD RAM).
  serout 0,n2400,(#index1) ' Print number on the screen.
  for index2 = 1 to 8
    serout 0,n2400,(".") ' Print "....." between numbers.
  next
next
```

' Before entering the main loop, the program stores the beginning
' state of the encoder bits into the variable 'new.' It ANDs the
' pins with %11000000 in order to strip off all bits except for
' 6 and 7. (ANDing a bit with 0 always produces 0; ANDing with 1
' copies the state of the bit.)

```
let new = pins & %11000000 ' Mask off all but bits 6 & 7.

start:
  let old = new & %11000000 ' Mask bits and copy new into old.
again:
  let new = pins & %11000000 ' Copy encoder bits to new.
  if new = old then again    ' If no change, try again.
  let directn = bit6 ^ bit15 ' XOR right bit of new w/left bit of old.
  if directn = 1 then CW    ' If result = 1, encoder turned clockwise.
  serout 0,n2400,(I,left,I) ' If result = 0, counterclock (scroll left).
goto start                 ' Do it again.
CW:
  serout 0,n2400,(I,right,I) ' Clockwise (scroll right).
goto start                 ' Do it again.
```

ed a frequency synthesizer chip. This gave him knob-controlled tuning with the advantages of digital control and display.

Figure 3 is a photo of my breadboard set-up. I used an assembled Counterfeit kit (my Stamp-compatible controller; see Sources) running at four times the normal Stamp speed (16 MHz). This allowed the program to keep up with all but the fastest spins of the dial. If the controller isn't fast enough to track every transition of the encoder's outputs, "slippage" errors occur; the display gets out of sync with the knob. So speed is important.

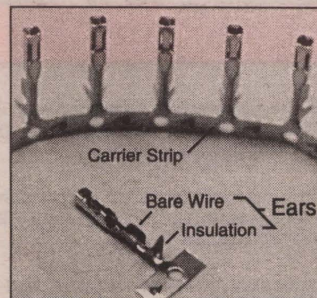
Because the Counterfeit was running at 16 MHz, all of its instructions were proportionately accelerated. Although the program specifies 2400 baud for serial output to the Backpack-equipped LCD, the actual baud rate is four times

that — 9600 baud. I installed a jumper on the Backpack's baud-rate

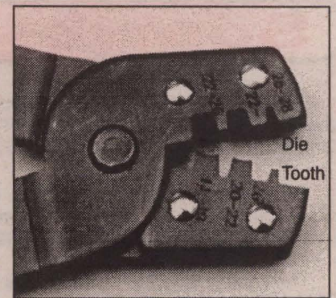
header to set it for 9600 baud too. Figure 3 also provides a nice introduction to this column's second topic, making jumper wires for convenient breadboarding with the Stamp, Counterfeit, and accessories. Everything in the picture is hooked up with the kind of jumpers described in the next section.

Making Connections

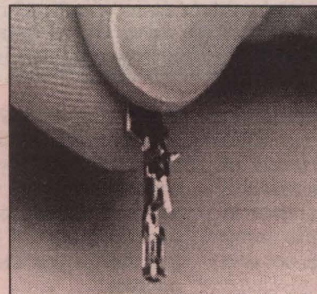
The Stamp, its cousin the Counterfeit, and accessories like the Stretcher and Backpack, provide 0.025-inch square metal posts for making connections to the outside world. I've slowly become aware that most users aren't quite sure what to do with these connectors, known as header stakes. They usually end up wire-wrap-ping to make their connections.



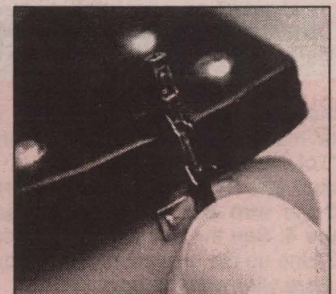
0.025" Socket Crimp Pins



Crimping Tool

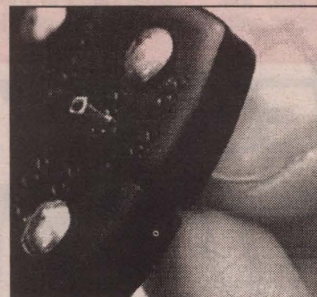


Grasp the wire and socket, using carrier-strip tab as a handle.

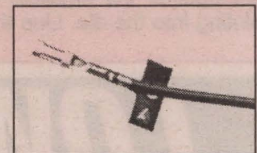


Use the end of the tool and gently pinch the ears to fit the die.

Figure 4



Put the connector into the tool with the ears facing into the die. Squeeze hard.



Done. Give the bare-wire ears a final crimp to ensure good contact, and break off the carrier-strip tab.

Making Stamp-compatible jumpers is easy with this step-by-step procedure.

They also end up unwrapping old connections. And fixing bad connections.

There's a better way. If you're willing to invest \$8.00 in a tool and a few bucks more in a supply of connectors, you can make slick, secure jumper wires and wiring harnesses.

Jameco (Sources) carries "female crimp pins" that are designed to fit 0.025-inch header stakes. The pins are stock number 100765 and cost a dime apiece in quantities of 10 or more. These pins are designed to fit into plastic housings to make tidy, detachable wiring harnesses of the sort you find inside PCs.

You can crimp these pin/sockets onto the ends of 22, 24, or 26-gauge stranded hook-up wire with the help of Jameco's tool, stock number 99442 (\$7.95). Here's how:

The crimp pins come attached to a ribbon of metal called a carrier strip. Cut a one-pin section from the end of this strip, leaving the pin attached

Stamp Applications:

Sources

For more information on the BASIC Stamp, contact **Parallax Inc.**, 3805 Atherton Road #102, Rocklin, CA 95765; phone (916) 624-8333; fax (916) 624-8003; BBS (916) 624-7101; E-Mail info@parallaxinc.com

For female header pins and the crimping tool discussed in this column, get a catalog from **Jameco Electronic Components**, 1355 Shoreway Road, Belmont, CA 94002-4100; phone (800) 831-4242.

The rotary encoder used in this application is available from **Digi-Key**, 701 Brooks Avenue South, P.O. Box 677, Thief River Falls, MN 56701-0677; phone (800) 344-4539.

Send questions, suggestions, or requests for future Stamp Applications to: **Scott Edwards Electronics**, 964 Cactus Wren Lane, Sierra Vista, AZ 85635; phone (520) 459-4802; fax (520) 459-0623; E-Mail (CompuServe)

at 72037,2612; Internet 72037.2612@compuserve.com

Scott offers Stamp-related kit goodies, including the following: The Counterfeit controller, a kit alternative to the BASIC Stamp, is \$29.00. Double- and quad-speed options are \$2.00 and \$4.00, respectively. The Counterfeit Development System, required to program Counterfeits (also for programming original BASIC Stamps, like the BS1-IC) is \$69.00 and includes a 150-page manual, downloading cable kit, Parallax software, and one Counterfeit controller kit. All Counterfeit hardware and software is 100-percent compatible with the BS1 and original BASIC Stamp.

The LCD Serial Backpack is a tiny daughterboard that attaches to one- and two-line LCDs to convert their fussy parallel interface to Stamp-compatible serial at 2400 or 9600 baud. The assembled Backpack is \$29.00; with a preinstalled 16x1 LCD, \$40.00; or with the 2x24 LCD shown in the photo, \$50.00.

Prices are postpaid (express shipping and CODs extra). Visa, MasterCard, American Express accepted for phone/fax orders. POs accepted on approved credit. Personal checks, money orders welcome for orders by mail.

to the piece of metal. This tab of carrier-strip metal makes a nice handle for the tiny pin. Strip 1/4" of insulation from the end of a piece of hookup wire. Hold the pin by the carrier tab and load the wire into the crimp pin as shown in Figure 4. See the two sets of ears on the crimp pin? Line up the insulation with the back set and the bare wire with the front set.

Using the very end of the crimping tool, pinch the ears gently inward toward the wire. This ensures that it will fit into the concave crimping die. Next, position the back end of the crimp pin against the smallest tooth with the ears pointing into the die. Line the ears up with

the funnel-shaped opening of the die, and squeeze the handles of the tool. When you open the crimp tool, you'll see that it has neatly wrapped one set of ears around the insulation, and the other around the bare wire. Pinch the bare-wire part of the crimp with the corners of the tips of the tool as final insurance of good contact.

You can use this connector as-is, or you can cover it with a short piece of heat-shrink tubing. If your wiring scheme permits, you can even use one of those neat plastic housings listed on the same page of the Jameco catalog as the pins. Just slip the pins into the housing until you hear

a click. A latch inside the housing prevents the pin from slipping out.

One more benefit of header-socket pins: they fit perfectly on 22-gauge solid hook-up wire for making temporary connections to breadboards and other circuits.

By the way, if you're a manufacturer of wire and cable goodies who could make the above-described jumper wires in the low thousands for a reasonable price, get in touch (see Sources for my contact information). I'd love to add prefabricated header-socket jumpers to my expanding line of Stamp goodies, but I haven't found anyone to make them for a decent price. **NV**

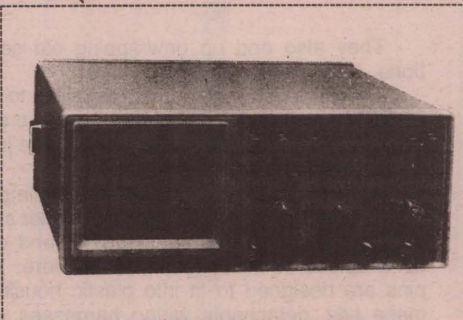
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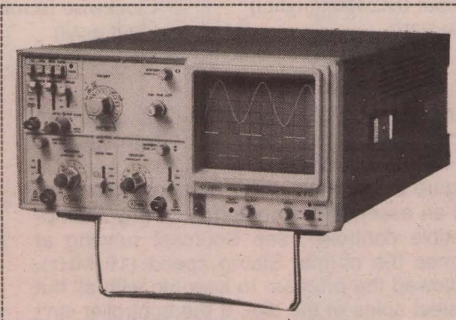
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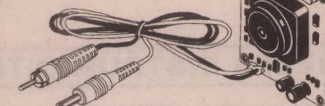
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THE LASER

EXPERIMENTER

Conducted by
Anthony Charlton

Welcome! We are finding out some interesting and positive results with our Laser Gravity Detector — last month's topic — that I would like to share with you.

First, we found that it was easier to fabricate the Detection Mass (see Figure 1 and the drawings from last month's column) from a combination of old barbell weights and concrete.

Three five-pound, plastic covered weights were first glued together using a cyanoacrylate superglue, then the heavy-duty music wire is crimped at the end, and concrete was poured into the hole through the center of the weights, and thus secured the wire into the assembly.

This turned out better than the concrete ball alone, which is difficult to form into a sphere, and thus will try and bend the 1/8" music wire. While super-strong and simultaneously flexible, the wire will bend and be ruined if the mass tilts away; the whole thing is necessarily top-heavy, anyway. Spurious vibrations seem to be a problem with this experimental set-up. But such problems are expected to arise with any new experiment. Several types of vibrations have been identified as interfering with the clarity of the gravity detection results. Or, to put the definition of gravity more accurately: the effects of masses upon the curvature of spacetime and each other, which produces the phenomenon we humans have nicknamed gravity. Those problems are identified as thus:

1. Local vibration effects such as passing cars, our "company cats" which are pets that serve to eliminate rodents (when they are not doing so, they chase each other noisily around) and surprisingly, the two vibrator type airpumps which run the filters on our salt and freshwater fishtanks!

2. Wind on the structure of the building (only 2.5

stories, and it has a definite effect).

3. Anything electrical that turns on or off. Air conditioners, the refrigerator, or the processing equipment for various things in the works, like PC board fabrications; even the PC's printer will disrupt the experiment at their own mechanical will.

4. Walking around the experiment (vibration) or disrupting it because of the airflow generated by bringing the experimenter's body too close, too fast, and generating a small draft that will deflect the Gravity Detector's sensor.

5. There may be an effect from that old Moon! This is exciting, as once the above bugs are worked out of the system, I really look forward to putting the chart recorder on super-slow mode, and see if there is a quantifiable effect upon the small sensor mass of the Gravity Detector. One may have to locate it in an isolated area though, to avoid the above effects one through four. We shall see.

To help eliminate these experimental problems, first off I spoke with a professional friend who is an expert in Holography — the science of creating three-dimensional pictures using a laser and specific optical techniques. He suggested several vibration-reducing techniques that will help clarify the results of our experiment. One is the attachment of Sorbothane pads on the base of the experiment. This is sketched in Figure 1, too. Sorbothane is a plastic that mimics the elasticity of human skin, and thus is a good vibration damper. But until those pads arrive and we have a chance to try them, it will be next month before we get a clear-cut look at how the Laser Gravity Detector will work.

Cosmological and Relic Gravitational Waves

Einstein predicted in his revolutionary *Theory of Relativity* that gravity was an effect from mass, no matter how small or big, bending the 'fabric' of a four-dimensional element he called the "Space-Time Continuum." This is a fascinating subject if you look into it with moderate perseverance. Learning his theory changes the way us humans normally think about such matters in our usual three-dimensional geometric manner, and {1} translates that way of thinking.

As best that Einstein could relate, he leads us into a quantified description of the strangeness of the universe we live in; and thus elevates our consciousness in the process. Interesting, his theory is almost a hundred years old. Cosmological gravity waves are the ones that should happen when an event occurs with sufficient violence or power that we can detect on earth. Orbiting massive objects, coalescing stars, exploding stars called Novas or Supernovas, orbiting neutron stars (or ones that collide with themselves) or other celestial objects of sufficient mass, all theoretically can be detected.

The final and most powerful player in this cosmic (as being different from relic) game of gravitational music-making could be the black holes. Objects once believed to be just theoretical possibilities, recent discoveries have indicated that such objects may indeed exist, although at distances too great to consider sending a robot space probe to investigate them. Unless we develop near-light speed space drive technologies and have a thousand or more years of patience span! But theories and observations suggest that these objects — perhaps the size of Manhattan Island or even as small as a freight train (albeit they will always be a perfect sphere because of the smoothing effect of the incredible gravitational com-

pressive force) may harbor in this small volume the weight of our sun or greater! Such objects could generate waves detectable here on earth despite great distances.

Relic gravitational waves may be the result of the incidences that occurred during the "Big Bang" — which is now called *The Standard Cosmological Model*, indicating its acceptance by the scientific community as the best theory describing the beginning of the universe. The SCM has been verified by several kinds of instrumental observations and numerous mathematical calculations. Relic gravitational waves may be detectable by sensitive space-based laser detection instruments.

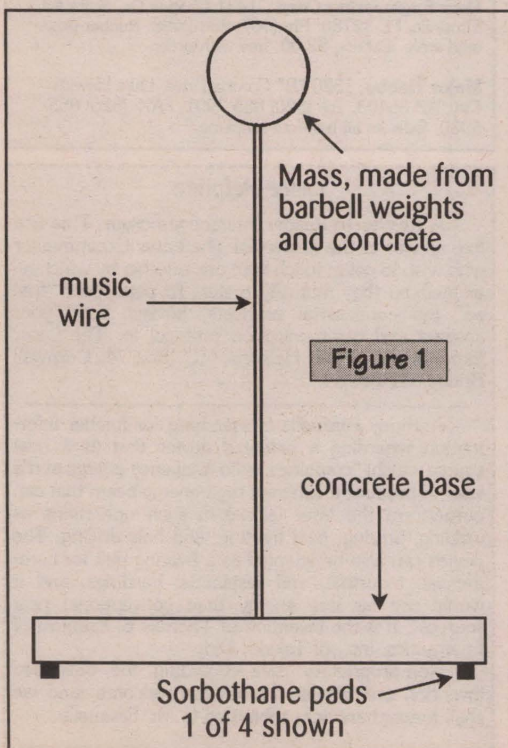
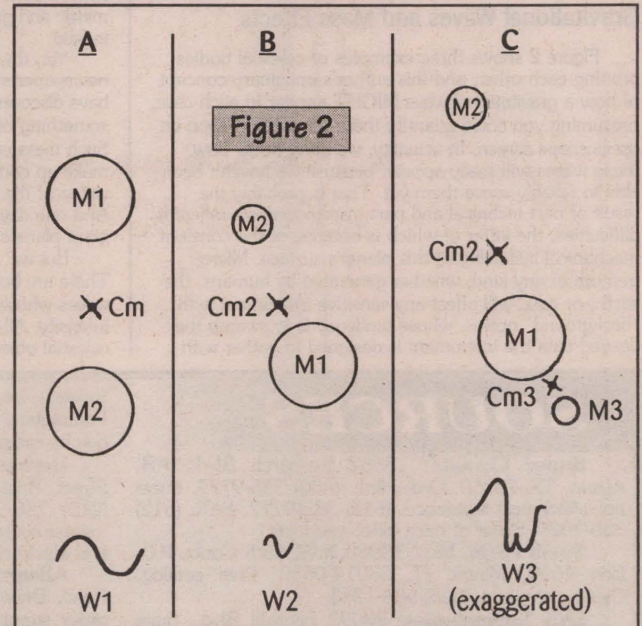
One wonders what may transpire in the next hundred years, and perhaps the laser will be an apex instrumental tool in this quest; it would certainly appear likely at this juncture, as the laser's influence is ubiquitous in many other forms of theoretical and certainly practical industrial usages and may follow suit in this arena.

Let us describe a Gravity Wave Detector next. Our home-brew instrumentation cannot hope to be capable of detecting such waves, as they are so small in intensity, but we can take a journey in our minds and see what the scientific community is doing with actual and proposed detectors that are a great deal more powerful.

The Strange Universe and Gravity Waves

Everyday intuition does not prepare us for cosmological/physical events such as absolute zero, the total vacuum at the Moon's surface, or the incredible, tens-of-thousands of degrees of heat at the surface of the Sun. Yet, those extreme elements exist in nature, just as cer-

{1} Humans don't strictly think in a geometric manner like honeybees do, as the human world is too filled with variables, complexities and unpredictabilities. Yet, we have an unmistakable tendency to impose organization upon our surroundings; just consider the layout of a city block or the instructions that control operation of a microcomputer. Both examples indicate this geometric organizational tendency tempered and influenced by the element in which that tendency is immersed, be it the combination of dwellings and concrete and people, or structured silicon and the regulatory movement of its channeled electrons in a logical manner within a computer chip.



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tainly as the placidity of a summer Hawaiian day is contrasted sharply by the nightmare of the occasional powerful hurricane hitting those islands. The philosophical upshot is this: To grasp the counter-intuitive aspects of nature (and science, which is the logical discovery and quantification of natural laws), one has to "disconnect" from everyday reality . . . to a rational point. That is, disconnect surely, but not lose the perspective or duties of the everyday.

Gravitational Waves and Mass Effects

Figure 2 shows three examples of celestial bodies orbiting each other, and this author's imaginary concept of how a gravitational wave MIGHT appear in each case, presuming you could quantify them like a trace upon an oscilloscope screen. In actuality, we don't know how these waves will really appear, because we haven't been able to reliably sense them yet. That is probably the result of part technical and part insurmountable inherent difficulties, the latter of which is because of the constant mechanical instability of this planet's surface. Micro-tremors of any kind, whether generated by humans, the earth, or cats, will affect any sensitive instrument with "background" noises, whose tendency is to swamp the desired data the instrument is designed to gather with

undesirable signals.

There are three types of simple celestial interactions shown in Figure 2: A, B, and C. The masses are identified by M1, M2, etc., depending upon how many there are. Of course, in the real world, there are celestial systems much more complicated than in this diagram; considering we have nine planets revolving around just our sun alone, with a total of an additional 61 moons, according to the latest data I have. Probably several other small moons exist we haven't discovered yet. So the geometric and gravitational picture can become complex indeed.

Yet, this leads to remarkable propositions; I recall a newspaper story describing an astronomer claiming to have discovered a planet orbiting a distant star with something on the order of 50 times the mass of Jupiter! Such mass can, under the right density and elemental make-up conditions, become a shining star eventually by virtue of the natural physical laws governing its destiny. And one day, we may be able to directly detect these giant planets using a gravitational wave detector array.

But we can guess about the nature of these waves. There are bound to be several types of gravitational waves whose type varies in frequency, waveshape, and intensity. All will move at the speed of light. Since the celestial objects generating these waves are of different

character, so will be the waves too. Figure 2A shows two bodies orbiting each other whose masses are similar. The Center Of Mass — CM — is equidistant between the two bodies, M1 and M2, and labelled as a common center of mass. Gravitational waves created by the orbiting masses will probably assume the shape of a sinewave, shown in W1. Again, we have to stress that the extreme distance of such bodies results in little signals available for our detection.

Figure 2B shows a big mass, M1, orbited by a small mass, M2. The center of mass will be closer to M1, as indicated by the point CM2, the juncture of which the gravitational pulls of these two bodies are equal. The wave may be similar to Figure 2A, but the waveshape will be smaller, as shown in W2, because the summed involved masses are less.

Figure 2C shows two bodies orbiting a central, massive object. M2 is presumed to be equal to M3 in weight, but the difference is the distance at which they orbit M1. Then, we find the wave shape is interactionary between the three masses, and perhaps will look something like the wave shown in W3.

The center of masses are where the gravitational pulls of the two orbiting objects relative to the central mass are labelled CM2 and CM3, respectively.

We also have to consider that there is an attraction between M2 and M3, because nothing can stop the attraction of gravity; it will go right through any mass because of its character.

Some of you may remember the science-fiction writer H.G. Wells' imaginary gravity-insulating substance "Cavorite" and the movie that was later based on his popular story. Cavorite was supposed to insulate his hero's moon-bound spaceship from the effects of gravity, and by opening and closing various control surfaces on the craft, enable its control and propulsion throughout space. Well, there isn't any gravity-insulating substance around, that is a physical scientific impossibility. Gravity indeed goes through everything.

SOURCES

Super Circuits, 13552 Research Blvd., #B, Austin, TX 78750. Order line: (800) 335-9777, questions/technical assistance: (512) 335-9777, FAX: (512) 335-1925. Seller of microvideo products.

Small Parts, Inc., 13980 N.W. 58th Court, P.O. Box 4650, Miami, FL 33014-0650. Free catalog. Catalog requests: (305) 558-1255

LNS Technologies, 20993 Foothill Blvd., Suite 307, Hayward, CA 94541. Inquiries: (510) 886-9296, orders: (800) 886-7150. Visible laser diodes and a driver kit, also carries a line of high-technology electronic kits. Accepts major credit cards. Catalog \$1.00.

MWK Industries, 1269 West Pomona, Unit 112, Corona, CA 91720. Ph: (909) 278-0563, FAX: (909) 278-4887. Hours: 8-5 PST weekdays, 10-3 Saturdays. Free catalog. Source for new and used laser equipment, supplies and optics. Carries a wide variety of He-Ne and other lasers suitable for the experimenter & hobbyist.

Images Company, P.O. Box 140742, Dept. N, Staten Island, NY 10314. Ph: (718) 698-8305. Carries holography supplies, optical components, components for laser power supplies, stepper motors.

Geo-Monitor, 65 Washington Street, #400, Santa Clara, CA 95050. Ph: (408) 749-6770, FAX: (408) 249-3780. Publishes a technical newsletter about earth science, and may be useful to those interested in using lasers to record seismic activity.

Edmund Scientific Company, 101 East Gloucester Pike, Barrington, NJ 08007-1380. Ph: (609) 573-6250, FAX: (609) 573-6295. Free catalog. Supplier of a wide variety of educational and scientific equipment including lasers and an extremely comprehensive line of optics.

Midwest Laser Products, P.O. Box 2187, Bridgeview, IL 60455. Ph: (708) 460-9595, FAX: (708) 430-9280. Free catalog. Carries new and used laser equipment and inexpensive start-up systems.

Mouser Electronics, Mouser is a first class hobbyist and industry supplier of a very wide range of new electronic parts, equipment and supplies. Free catalog. Call (800) 346-6873 for catalog and location of facility nearest you.

Amidon Associates, P.O. Box 956, Torrance, CA 90508. Ph: (310) 763-5770, FAX: (310) 763-2250. Hobbyist and experimenter supplier of ferrite materials in many shapes and sizes.

Digi-Key Corporation, 701 Brooks Avenue South, P.O. Box 677, Thief River Falls, MN 56701-0677. Ph: (800) 344-4539, FAX: (218) 681-3380. Free catalog. Top quality new electronic parts supplier.

Imaging Concepts Bulletin Board Service. A free scientific bulletin board that contains, among other

topics, laser information. Georgia area code. Parameters: 9600 baud, N81. Accessable 24 hours a day by calling (404) 466-3932.

Herbach & Rademann, P.O. Box 122, 17 Canal Street, Bristol, PA 19007. Ph: (215) 788-5583, FAX: (215) 788-9577. Free catalog. An excellent experimenter source for quality mechanical, optical, electronic, and electromechanical surplus.

Allegro Electronic Systems, 3 Mine Mountain Road, Drawer NV, Cornwall Bridge, CT 06754. Mail order supplier of He-Ne laser systems, Experimenter-level laser communication & data acquisition kits; plans, specialized equipment & hard-to-find electronic parts. Catalog \$1.00.

Viking Office Products. Quality office products of all kinds at a discount. Listed here because of the value to the experimenter wanting to organize his or her laboratory. Viking features free catalogs and unsurpassed delivery promptness. Call (800) 421-1222 or FAX to (800) SNAPFAX [(800) 762-7329] for free catalog. Accepts prepaid, net 30 and credit card orders. Free delivery of orders over \$25.00 and free UPS pick-up of items that have problems or you aren't satisfied with.

Dyna-Art Designs, 3535 Stillmeadow Lane, Lancaster, CA 93536-6624. Ph: (805) 943-4746, FAX: (805) 943-3776. Desk-top fabrication equipment for printed circuit boards; toner-transfer paper for easy hobbyist & OEM prototype do-it-yourself PC board making.

Society for Amateur Scientists, 4951 D. Clairemont Square, Suite 179, San Diego, CA 91777. Ph/FAX: (619) 239-8807. Internet: scarlon@sas.org

Lionel Trains, Inc., P.O. Box 748, New Baltimore, MI 48047-0748. Ph: (800) 727-7297, FAX: (810) 949-5429. Source of inexpensive CCD camera capable of seeing near infrared spectrum, as well as visible light.

The Electronic Goldmine, P.O. Box 5408, Scottsdale, AZ 85261. Free catalog. Ph: (602) 451-7454, FAX: (602) 451-9495. SMC components and a wealth of high-tech experimenter electronics, components and project kits.

Industrial Fiber Optics, P.O. Box 3576, Scottsdale, AZ 85271-3576. Laser and fiber optic project kits primarily for the educational market. Sells mostly through distributors; Digi-Key is one. OEM sales as well. Ph: (602) 804-1227, FAX: (602) 804-1229.

Anderson Lasers, Inc., 2883 West Royalton Road, Broadview Heights, OH 44147. New and surplus industrial and scientific lasers & equipment. Carries high-power commercial grade equipment, not a hobbyist supplier. Professional inquiries contact: Richard Anderson, ph: (216) 237-6629, FAX: (216) 237-0656.

Be sure and mention Nuts & Volts when you contact the above suppliers so your request goes to the right department.

Laser-Cut Model Airplane Kit Resources

Byron Originals, Inc., P.O. Box 279, Ida Grove, IA 51445. Ph: (712) 364-3165, FAX: (712) 364-3901. Giant scale models. Beautiful ones!

Easy Built Models, Box 425, Lockport, NY 14095-0425. Rubber-powered scale. Catalog \$1.00.

Herr Engineering Corp., 1431 Chaffee Dr., Suite #3, Titusville, FL 32780. Ph: (407) 264-2488. Rubber-powered scale. Catalog \$2.00, free with order.

Major Hobby, 1520 "B" Corona Drive, Lake Havasu City, AZ 86403. Tel: (520) 855-7901, FAX: (520) 855-5930. Sells an all laser-cut sailplane.

Laser Helpline

A Reader-To-Reader Interactive Forum. This is a free service to the readers of The Laser Experimenter who wish to get in touch with one another by whichever medium they mutually prefer. To place your "free ad" (no commercial products, please), send your abstract and communication protocol to: The Laser Experimenter, Laser Helpline, P.O. Box 74, Cornwall Bridge, CT 06754.

Anthony Fasanella is searching for further information regarding a patented device that (is a heat source which) "combines radio frequency energy and a laser to produce a coherent high-energy beam that can outperform the laser (alone) in such operations as welding, brazing, heat treating, and hole drilling. The device can also be adapted as a heating unit for commercial, industrial, and residential buildings, and it would use far less energy than conventional heat sources." It is the invention of Thomas E. Fairburn of Energistics, Inc., of Toledo, OH.

Non-proprietary data regarding the described invention and similar devices are welcome, and we shall forward any info submitted to Mr. Fasanella.

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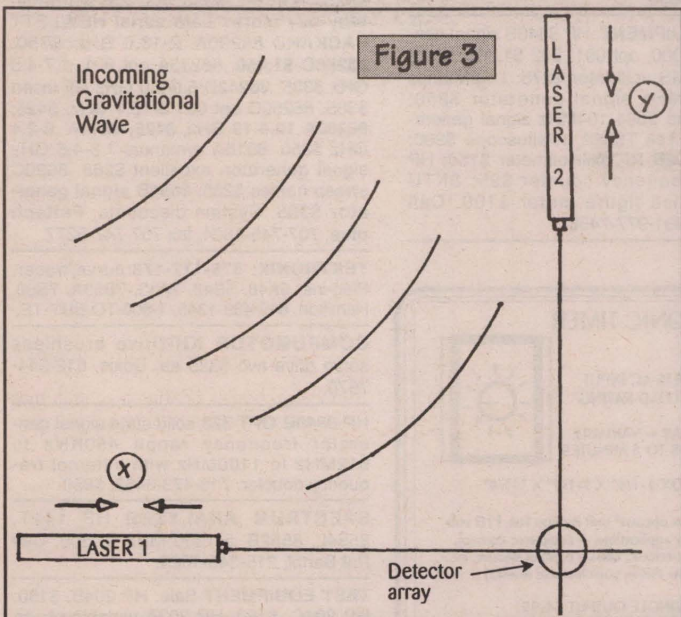


Figure 3

Enter LIGO

LIGO is the acronym for Laser Interferometer Gravitational Wave Observatory, first briefly described in LEJan94. It was (and still presumably is) located at CalTech. Its mechanism involves two lasers situated at right angles to each other, as shown in Figure 3.

An incoming gravitational wave will distort the space-time continuum, and render one laser beam path shorter than normal, and the other longer than normal. So, the lasers will have their beams altered about the X-Y matrix, depending upon where the wave came from. The Detector Array serves to alert the experimenter that a wave has been sensed. Figure 4 shows a very basic diagram of a detector. Note that it is based on Interferometric principles, which we discussed at length in LEJan94. As the laser beam enters from the left, it is divided by the beamsplitter into two satellite beams. One goes to the left to a set of mirrors, the other to the right to an identical set of mirrors. If all is exactly aligned, the beams bounce off the mirrors and are combined to exit the detector as an interfered laser beam.

Now, the interesting part is that if the beam path remains exactly the same, the lasers and optical system are arranged in such a way so that the crests and troughs of the combined beams cancel each other out, and the output from the detector is zero or almost zero light. Any gravity wave strong enough to change the length of the beam path will alter that crest vs. trough relationship of the beams, and the laser light will flicker. The longer the total beam path, the more sensitive the

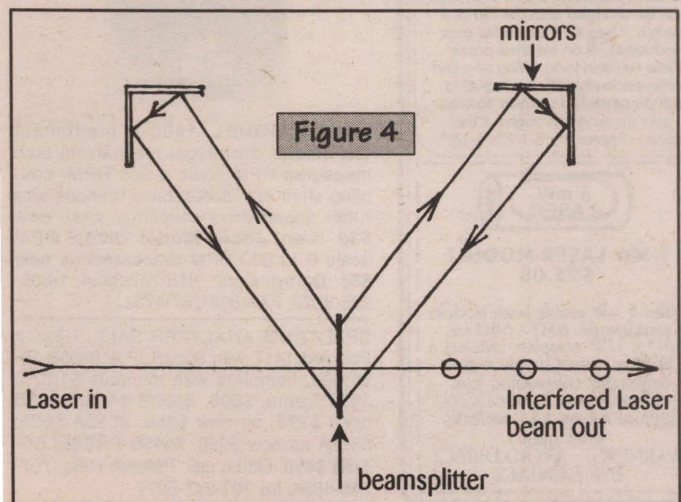


Figure 4

gravity wave detector will be, just like the larger an antenna, the more sensitive it will be.

Future plans for LIGO-type detectors were mentioned in a fascinating PBS documentary circa 1991 in a program called "Space Age — Waves of the Future." Among the most interesting are the possibility of constructing a LIGO detector in space, away from earthly micro-tremors.

Another idea would be to situate several here on Earth (or maybe the Moon?), which could serve as a collective "Gravity Telescope." How is this possible?

By having several instruments situated around the world, an incoming gravity wave, say from an exploding star, would take several milliseconds to travel through the planet.

Computers could then calculate using three-dimensional mathematical vector analysis where the wave originated, and astronomers could be alerted to point their optical and radio telescopes at the point of origin. Several hours might elapse before the exploding

star would be detectable at electromagnetic wavelengths, because such massive processes have a time delay and don't generate electromagnetic signals instantly, whereas the fluctuation of gravity WOULD transmit instantly, and at the speed of light across space. The more gravity wave detector instruments, the better, since the resolution of a worldwide array, and hence the accuracy of its locating power, is directly related to the number of linked instruments.

Lasers are Everywhere!

No matter where you go, it seems that lasers are playing more and more part in our daily lives. Two recent examples: our local hardware store now has radial saws which contain a small, solid-state laser that guides your cutting. They are indeed impressive. And lasers are finding their way into the hobby world, too.

By way of introduction, I like building flying model airplanes, and am currently working on a radio-controlled sail/sport plane with a six and a half foot wingspan. It is boosted to soaring altitude by an electric motor, a fascinating thing in itself, as these motors now are the size of a small baby-food jar and can generate 1/5 of a horsepower for several minutes off the charge on an 8-to-12 pack of C-sized Ni-Cad batteries!

This project has taken half a year, because one does not have too much spare time for hobbies these days, but mostly since each of the about 300 parts has to be fastidiously cut by hand from the plans, and individually fitted together. The completed plane has to be geometrically accurate; no twisted fuselage or warped wings, or it won't fly right, and perhaps even crash. Considering there is about 200 hours in the project so far with about 50 to go, and \$350.00 in the plane, radio and motor, one would hate to have it crash, eh?

Enter the laser. Hobby suppliers are now selling kits where all those little pieces, like wing ribs and so forth, are cut by a laser from light-weight balsa wood. The edges are all completely smooth, like they were burnished, and appear slightly blackened by the intense heat of the laser, but that's no drawback at all. Presumably the cutting is done by a CO2 laser. And the fit of each part is absolutely dead-accurate, so it goes together well and quickly. I haven't built a laser-cut airplane kit yet, but did examine one and was impressed enough to promise

CLOSING QUOTE:

"The force of gravity — though it is the first force with which we are acquainted, and though it is always with us, and though it is the one with a strength we most thoroughly appreciate — IS BY FAR THE WEAKEST KNOWN FORCE IN NATURE. It is first and rearmost."

— Isaac Asimov, American Biochemist/Author

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.

myself that would be the next project! You may want to look into these, and we have provided a resource list of some of the laser-cut flying model plane manufacturers.

Laser Experimenter P.O. Box Refresher

Once again, we invite your comments, suggestions, and questions at The Laser Experimenter's P.O. Box listed elsewhere in this article. We love to hear from our readers! One thing we should mention is that this is a FREE service to our readers, yet one that we don't get a monetary compensation for — its rewards arise from YOUR contact! Occasionally, it will take time to answer your questions. A FAX number always speeds up the reply cycle. Also, for any readers doing projects from past issues, we re-iterate the offer to supply one or a couple of each FREE:

- 22 megohm resistors
- 0.1 ohm resistors
- An abbreviated listing of all prior Laser Experimenter columns and which issue of this magazine they appeared in. This last item will include an update for all '95 columns. If you requested and did not receive this listing, try again as we had a minor snag in coding that mixed this request up with another article published elsewhere.

Another item is sometimes we receive a great idea, but the reader expects some free R & D on it, or at least a return letter that would take several hours to research and compose. These kind of requests are difficult to respond to, and even though my conscience bothers me and I realize this kind of letter may take its writer many hours to accomplish, such letters have diminished chances of getting answered. Simply because I'm the lone laserized brain who has to compose each reply.

We do appreciate and want to thank the hundreds of people who have written over the approximately 2-1/2 years this column has been running, and invite you to keep in touch, just please limit those 10-plus page letters so YOU won't be disappointed.

Conclusion

We're going to start our Laser Video project next month, where video pictures can be transmitted over a laser beam. This month, we simply ran out of "space and time" (if you'll forgive that pun) because the subject of gravitational waves took more space and time than anticipated. We decided that it would be counterproductive to chop the video subject up and try and get just only part of it in this month.

So, stay tuned — this is bound to be a fun project! In the meantime, you may want to check out the video camera that is being offered by Lionel Trains, whom appears in "Sources" and in addition, a TERRIFIC source of all kinds of micro-miniature CCD cameras is Super Circuits, also listed. NV

AUDIO OUTPUT Meter, TS-585 output meter for audio amps, filters, oscillators. Ranges .1 to 5000 milliwatts. $-10 \pm 37\text{dBm}$ on 3.5 in. meter. Multiplier circuit yields impedances of 2.5 to 20000 ohms. **\$35, manual \$5**, volume discounts available. **Psitech Plus**, 707-745-4804, FAX 707-747-5277.

FW BELL Gauss/Tesla Meter, handheld model 4048, used very little, has all attachments, manual, case. Paid \$600, asking \$250 shipped. Send MO or cashiers check to: Joel Rains, 28 Travis Rd, Rossville, GA 30741 or call 706-858-0897.

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TEKTRONIX: 576-177-178 curve tracer. Plug-ins; 5A48, 5B42, 7A13, 7B53A, 7B80. Hamilton, 619-439-1345, 1-800-TO-BUY-TE.

COMPUMOTOR KH-Drive brushless servo drive two \$325 ea. Dexis, 612-944-7670.

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SENCORE VA48 TV-VTR-MATV and video analyzer \$155, **SG165** AM-FM stereo analyzer \$110. Dexis 612-944-7670.

SENCORE VC-93 VCR analyzer. New! \$2,000. 513-753-9456.

WANTED: 7L12 Tektronix plug-in for parts. State price and condition. Prefer SN over B200000. Bob, PO Box 1081, Sausalito, CA 94966. 415-332-3905, FAX 415-332-1305.

VENABLE MODEL 350A system (5060 frequency response analyzer, computer, plotter, and software), \$9,850. Kishen, 709 Imperial Woods Drive, Vestal, NY 13850. Phone 607-748-4621.



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8 Candellas of bright red or yellow light, visible over a mile away! This super-bright LED is secured in a tough ABS case and runs on a 3V lithium battery (included!) It won't burn out because it is an LED! Specify red or yellow when ordering. Battery has a 5 year shelf life and lasts up to 11 hours. (replacement battery \$0.98). Great for home or office use, popular with fire and rescue professionals, pyrotechnicians, stage performers, and more.

BE A FLY ON THE WALL!!!

Well, actually, those little wings would look pretty stupid on you, but you can build a miniature "bug". Surface mount technology is the latest techno-buzz word, and a challenging new frontier for kit builders. The manufacturer understood that the first try might be a bit rough, so they included enough components to assemble two units. (so it is o.k. to lose or damage a SMT component!) With the entire FM broadcast band (from 88 - 108 MHz) for your receiver, and a transmit range of 300 feet, even James Bond would like this kit!

This unit is powered by a 1.5 volt watch battery (included) and features an electret type high gain microphone for superior audio quality and extended pick up range - hear a whisper at 10 feet. A lot of fun in less than a square inch!!!
Micro Size FM Wireless Transmitter Kit \$19.95

ultra low-profile camera with pinhole lens! \$175.00

PINHOLE - that means you can conceal this camera behind almost anything and you only need a hole the size of a pin for it to "see" through! For the super-spy in all of us, here's the latest in little CCD cameras. It is about 1/2" thick and about one square inch (like those little crackers that are good for you!) It can be housed in almost anything due to its small size. Requires 12 VDC and a little imagination. This camera is a tiny 1.3"x1.3"x0.6", features a pinhole lens, a 0.4 lux 1/3 CCD sensor, 380 lines of resolution, and electronic shutter time of 1/100,000 sec. Whether you're spying on your mother-in-law or navigating your RC car, this is the ultimate in miniature surveillance.

LIGHTED HEADSET MAGNIFIER \$27.50



A great new item, this is a hands-free way to see little tiny parts as you work on them without having to be a contortion artist with a soldering iron! The headband style magnifier features bright side lights (4 AAA batteries not included) so you can add a little light to the area without clutching a flashlight under your chin! The velcro adjustable headband fits comfortably around your head, and the "goggles" pull down over your eyes for easy visibility. The visor has a built-in 1.8X lens plus a flip-down magnifier lens and a pull-down loupe for extra magnification power up to 4.8 times! AAA BATTERIES AVAILABLE \$0.50 EA.

MINI TORX SET \$12.95

7 popular sizes, T6, T7, T8, T9, T10, T15, and T20. One handy plastic holder, and a fabulous price! With quality CVM tool steel blades, hardened and tempered exact fit machined tips. Right-angle key design for easy use in compact spaces. Perfect for pocket or toolbench!

305 Projects \$27.70

The fifth in the series of Elektor project books, this one covers a broad range of projects including audio & hi-fi, computers & microprocessors, music and electronics, radio, television and communications and test & measurement. From simple to complex circuits, this book demonstrates the practical aspects of electronics through projects and includes all the important board layout and schematic information as well as theory and construction information. A great addition to any electronics library.

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115 VOLTS AC INPUT
10 AMP LOAD RATING

TIME DELAY ~ VARIABLE
5 SECONDS TO 8 MINUTES



APPROX 3-1/4" X 3-1/2" X 1-3/4"

this "delay on operate" unit is great for 110 volt power delay applications ~ EQUIPMENT CONTROL, ELECTRONIC TIME RELEASE, CLIMATE CONTROL SYSTEMS, ETC., (IMAGINE this in your HAUNTED HOUSE!)

SINGLE OUTPUT \$4.95
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127 THERMOCOUPLES Peltier JUNCTIONS

The peltier junction is a solid-state thermovoltage device. Current applied to the device will produce heat on one side of the device and a cold surface on the other side. Water placed on the surface will freeze or boil depending on polarity of applied voltage. Ideal for applications from 3-12 VDC -- grab a battery and let your imagination run wild! DOCUMENTATION INCLUDED!!!
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(approximately 1.56"x1.56"x.15")



Passive Infra-red Talking Motion Detector III \$27.50



"Stay out of that refrigerator!" "Watch your step!" ... The possibilities are mind-boggling with this talking motion detector. You speak into it to record your message (upto 12 seconds long), turn the unit on, and instantly your voice (or your mother-in-law's) reminds anyone in the vicinity that you were expecting them. Message can be changed with the flip of a switch. Uses 4 AA batteries (not included), or an external power source (built-in jack). May be used independently (80 db output) or with an amplified speaker to blast your message throughout the house. Approx 4"x3-1/2"x1-1/2".



5 MW LASER MODULE \$55.00

Mini 5 mW visible LASER module WAVELENGTH 630 - 680 NM. 3/4" x 1/2" COMPLETE UNIT HAS A built-in power supply and an adjustable collimating lens. OPERATES ON 3 VOLTS DC (A pair of AA or AAA BATTERIES WORK GREAT)
WARNING: AVOID DIRECT EYE CONTACT

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TEST EQUIPMENT FOR SALE/WANTED: RF, microwave, video and fiber optic, cable TV, broadcast TV, satellite and related industries. Wavetek, Tektronix, Hewlett Packard and other manufacturers. Spectrum analyzers, signal level meters, sweep systems, TDRs, OTDRs, and much more. PTL Cable Service. Phone 407-747-3647, FAX 407-575-4635.

WANTED: ENVIRONMENTAL simulation equipment; acceleration centrifuge, light weight shock, vibration, temp/hum chambers, sand and dust. FAX info, Attn: Bill 516-737-1497.

TEKTRONIX: 7633 oscilloscope with 2-7A26 1-7B53A \$450, Fluke 8520A digital multimeter \$175, HP 3586B selective level meter opt. 1 \$600. Ty Miller, Southcoast Surplus, 714-830-9170, Fax 714-454-9841.

HP/IB CABLES: HP 10833A 3.3 ft, \$15 ea.; 10833B 6.6 ft, \$25; HP 10833D, \$10. A-Comm Electronics, 303-290-8012.

TEST EQUIPMENT: Fluke 335A DC voltage standard \$500; Fluke 1120A IEEE-488 translator \$100; Fluke 2200A printer \$75; Fluke 7260A counter/timer \$300; GR 1390-B noise generator \$60; GR 1432J decade resistor \$60; HP 403B AC volt meter \$70; HP 431C power meter w/478A mount \$200; HP 461A amplifier \$75; HP 5150A printer \$200; HP 7015B X-Y recorder \$200; HP 7221T 8-pen plotter w/RS232 \$400; HP 7440A 8-pen plotter w/RS232 \$200; HP 8010A pulse generator \$200; HP 8410A network analyzer mainframe \$120; HP 8413A phase-gain indicator \$100; HP 59301A ASCII-to-Parallel converter \$75; HP 59307A dual VHF switch \$100; HP 59401A bus analyzer \$450; Sony/Tektronix 308 data analyzer \$500; Tektronix 7834 storage scope mainframe \$350. Jim Stevenson, Phone: 908-722-6157, Fax: 908-722-6391.

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WANTED CESIUM and rubidium standards, any condition. I also have a few nice ones available for sale, inquire. I am looking for an HP 8660B with option 100 and the 2.6GHz plug-in in trade for one of my cesium standards! Repairs on all makes with free estimates. Also want manuals for cesium standards. Corby Dawson, 805-736-0288.

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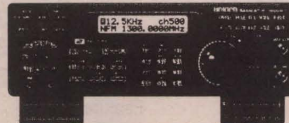
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\$10 FOR your dead HP 8640B output and modulator amplifiers. Example P/N: 08640-67003, -67007, -67022, -67923, and many others. Advanced Engineering & Calibration. 410-643-1581, FAX 410-643-1158.

HP 5314A 100MHz counter \$150, **TEK 501-1** 3-1/2 digit power supply plug-in \$150, **FLUKE 8050A-01** 4-1/2 digit DMM calibrated, rechargeable batt. \$250. Service manual for HP 3562A (sealed) B/O, **SIMPSON 420** 1MHz function generator \$59, **TRYGON** power supply 0 to 160 VDC, 0 to 8 amps built-in V-A meters \$390. 415-244-9254.

Scanners/CB/Weather Stations



Bearcat® 9000XLT-U Radio Scanner

Mfg. suggested list price \$769.95/CE Special \$369.95
500 Channels • 20 banks • Alpha numeric display
Turbo Scan • VFO Control • 10 Priority channels
Auto Store • Auto Recording • Reception control
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The Bearcat 9000XLT gives you pure scanning satisfaction with amazing features like TurboScan™ to search VHF channels at 300 steps per second. This base and mobile scanner is ideal for surveillance professionals because it has a selectable attenuator to help eliminate annoying intermodulation from adjacent frequencies in highly populated areas and selectable AM, Wide FM and Narrow FM modes that allow you to change the default receiving mode of the BC9000XLT. 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. **Hi-Cut filter** to help eliminate unwanted static noise. You can even get an optional **CTCSS Tone Bore** (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; **BC005** CTCSS Tone Board \$54.95; **EX711** External speaker with mounting bracket & 10 feet of cable with plug attached \$19.95. The BC9000XLT comes with AC adapter, telescopic antenna, owner's manual and one year limited warranty from Uniden.

CB/GMRS Radios

The Maxon GMRS 210+3 transceiver is a PTL synthesized 10 channel radio on General Mobile Radio Service frequencies. It's the ideal radio for long range communications. Two repeater channels are programmable and one channel (462.675 MHz) is set aside for emergency and safety communications. The seven remaining interstitial frequencies 462.5625, 462.5875, 462.6125, 462.6375, 462.6875 & 462.7125 MHz are all-purpose GMRS radio channels. 2 watts of RF power for exceptional transmitting range. Up to 5 watts when used with the supplied 12 volt vehicular DC power cord. CTCSS built-in. Includes 450mAh Ni-cad rechargeable battery pack, AC/DC wall battery charger, owner's manual, FCC license application, belt clip, antenna. Call 1-800-USA-SCAN to order.

Maxon GMRS210+3-U GMRS transceiver \$188.95

SPECIAL Buy 2 or more GMRS210+3 at \$174.95 each

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WT46GN2-U Ni-cad pack gives 2 watts power with 210+3	\$29.95
WT46GA-U Alkaline battery case - requires 6 AA batteries	\$9.95
WT46GA-U Carrying case for Maxon GMRS210+3	\$29.95
WT46CU-U Speaker/microphone for Maxon GMRS210+3	\$18.95
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WE SELL/rent/buy all types of test equipment: logic ana: PHI 3385/60, HP 16500, dataloggers: Fluke & Campbell Scientific: DMMs HP 3465A/B, 3466A/B, 3437A, spectrum ana: HP 8565A, 3582A, Counters HP 5345A, 5328A, 5314A, 5315A, charge amps: B&K 2635, calibrators: FLU 5100B/3/5, Gaussmeters: Bel 9200/610/ 615, sweepers: HP 8602B 8621A, 8620A/8621B.

HP 8150A OPTICAL SIGNAL SOURCE. Laser power measured both in/out has 36 control buttons +5 switches on front. Has HP-IB. 310-867-2654.

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Police and fire departments depend on the REL WHS150 transceiver for direct two-way communications with their police, fire department, civil defense agency or ham radio repeater. The WHS150 is our most popular programmable five watt, 16 channel handheld transceiver that has built-in CTCSS, which may be programmed for any 39 standard EIA tones. Frequency range 148.000 to 174.000 MHz. Will also work 144.000-148.000 with slightly reduced performance. The full function, DTMF compatible keypad also allows for DTMF Encode/Decode and programmable ANI. Weighing only 15.5 oz., it features dealer programmable synthesized frequencies either simplex or half duplex in both 5.0 and 6.25 KHz increments. Other features include scan list, priority channel, selectable scan delay, selectable 5 watt/1 watt power levels, liquid crystal display, time-out timer and much more. When you order the WHS150 from Communications Electronics Inc., you'll get a complete package deal including antenna, battery, belt clip and user operating instructions. Other accessories are available. A leather carrying case with swivel belt loop, part #LWHS is \$49.95; rapid charge battery charger, part #BCWHS is \$69.95; speaker/microphone, part #SMWHS is \$54.95; extra Ni-cad battery pack, part #BP007 is \$59.95. The radio technician maintaining your radio system must order programming instructions part #P1150 for \$18.00 to activate this radio. FCC license required for United States operation.

Other neat stuff

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REL WHS150-U VHF handheld 5 watt, 16 channel transceiver \$299.95
REL H256NB-U VHF 25 watt, 16 channel synthesized transceiver \$289.95
Ranger RC12950-U 25 watt 10 meter ham radio transceiver \$239.95
Cobra KD7125W-U Safety Alert & Super Widespread Laser/Radar receiver \$159.95
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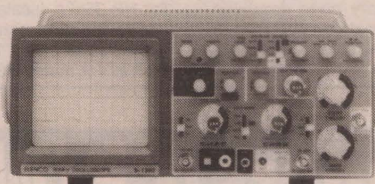


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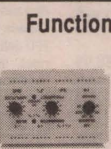
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HP CIRCUIT boards for 5005 signature analyzer, P/N 05005-60009, 60011, 60012, all 3 \$290. **HP:** 335, P370C, P375A, 393A, G424A, H424A, (6)P486A, M486A, X486A, 520, P532A, J532A, 766A, 777D, 798C, 805A, 805C, (3)P810B, X810B, (3)X910A, X910B, X912A, 3320A, 3376B, 3390A, 5254A, 5480B, 8620C, 8690A, 8694B, etc. 8733B, 11507A, 11521A. Hadron 108. Narda Microline 3073, 5074. Narda 779, 3093, 3094. Waveline/HP 606-20/X370D, (2)702-10/P372C, 702-20/P372D, 770-20, 602-?/X372C. Coleman Microwave small two channel tunable filter modules 201600, (2)201575, (2)501800, new, all 5 \$280. Logimetrics TWT amplifier A300/U/opt 6.7 107watt 12.6-18 GHz as-is \$220. EG&G/Princeton 173 potentiostat/galvanostat with 179 digital coulometer plug-in \$575. Hughes T500-1220 semi-automatic slide back voltmeters, differential, internal standard cell, \$175. For huge list, send three 32¢ stamps. Also send your lists of equipment, manuals, catalogs and mfr. directories. Art Klinger, 4601 Yellowleaf Dr., Fort Worth, TX 76133. Home, 817-370-2575.

BAUSCH & LOMB StereoZoom 4 w/boom stand & ring light, 15X eyepieces. \$775. **Bausch & Lomb or Milton Roy Spectronic 20** Spectrophotometer, 340-960 nm. \$350. **Corning "Mega-Pure One Liter" Water Still.** Produces over one L/hr. distilled water. Fully enclosed for wall or bench mount. \$275. **Hastings DV-23** vacuum gauge tubes. Brand new! \$25. 30 day guarantee. Visa/MC. **Lehman Scientific**, 717-244-7540, Fax 717-252-4266.

ACOPIAN POWER supply 2-60 V @ 0-5 amps, \$80, **Sencore CB-42** w/assoc & manuals \$475, **Swan Astro 150** SSB transceiver 80 to M \$350, **VHF HT-90** w/charger, \$150, **Weller WTCN** soldering stations \$45 @ **HP117A** VLF comparator w/loop \$600. 919-469-9650.

ULF RECEIVERS: **Fluke 207-5**, complete \$450; **EE Co. 880**, missing recorder \$100; **Empire devices NF315**, 20Hz, 250KHz \$250; **Empire devices 105** accessory kit \$250; **NF 105** receiver w/T1, T2, T3, TA plug-ins \$200; **Defense Electronics TMR5A** receiver, no plug-in \$90; **TMHJ5**, L5A, U5B plug-ins \$50 each. **MBS TEST EQUIPMENT**, 305-477-6192.

WANTED: LATE MODEL TEST EQUIPMENT (Tektronix, HP, Fluke). Especially: **Tek SG 505/2**, **Tek S-6**, **Tek 2465A/B**. Also, we buy test equipment **service manuals and catalogs**. **Pepper Systems:** 214-353-0257; 214-902-9511 FAX.

ELECTRONIC DEVELOPMENT 501J DC programmable standard, 6 digit ranges 0.1V and 10V giving microvolt resolution. Has 1-2-4-8 programming plus IEE488. Very precise. Call 310-867-2654.

RADIO REPAIR: Commercial and amateur two-way. Portables a specialty. Reasonable rates. Call Mike N9VWW at **REYNOLDS RADIO**, 219-482-5630.

POWER SUPPLIES for HP 9872 plotter. No. 09872-60292 complete unit in orig. pack, gov't. spares surplus, \$15 ea. plus shipping. **Tartan Electronics, Inc.**, Box 36841, Tucson, AZ 85740-6841. 520-577-1022.

FLUKE 8505A 6.5 digital multimeter \$550. **Fluke 8520A** digital multimeter \$550. **ESI Dekavider DV411** \$125. **ISA**, PO Box 6955, Laguna Niguel, CA 92607. 714-488-0010, Fax 714-488-0299. E-Mail: sklar@cerf.net.

REWARDS: IEEE488 programmer to awaken **WJ8617B** wanted; 21.4MHz filters (180-230 KHz), 72 ohm hardline, 1GHz frequency synthesizers. **W8CV**, 810-620-0853.

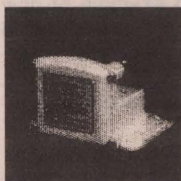
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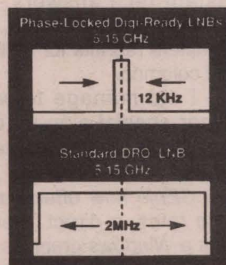
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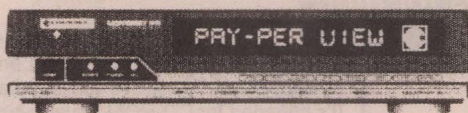
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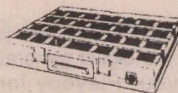


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Don Lancaster's

RESOURCE BIN

number forty-five

Mightily manic multimedia magazine madness.

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 (520) 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.

GENIE now offers far lower day-time rates, a direct Internet access, plus a Windows graphics interface, so it's an even better deal than ever.

See the trailer blurb for details.

Multimedia Resources

This month, I thought we'd review a few of those multimedia resources. I won't define multimedia for you. Just as with pornography, you will know it when you see it. The really amazing thing is that there seems to be around 35 different multimedia magazines for each person in the field.

The advertisers haven't picked up on CPM meaning "cost per millireader, rather than "cost per thousand."

At any rate, I thought I'd tell you all my favorite multimedia resources, along with several others that I do not particularly care for.

Before we do, I thought I would go over my two key tools for finding the best magazines and trade journals in any field. These are ...

Factsheet Five and Ulrichs

Factsheet Five covers the 'zines and newsletters. Plus topics guaranteed to offend just about everybody. But they are the low end resource for labor-of-love publications. Super high energy stuff from them that's doin'.

At the other extreme is the rather old line *Ulrichs Periodical's Dictionary*. Five volumes located on the refer-

ence shelf at your local library. Or online at *Dialog* or *GENIE*. Holds the top 240,000 magazines and newspapers with full descriptions. Also in CD-ROM.

Another favorite "where to go and get stuff" mag is *Whole Earth Review*. "Access to tools" is their motto.

U & Ic

Your most bizarre multimedia pub anytime ever is *U & Ic*. Short for *Upper and lower case*. And, at least to me, is by far the very finest of all.

This is really a house organ for *ITC*, otherwise known as that *International Typography Corporation*. Their creative design is outstanding.

Focus is on type and typography. They are most definitely moving into new online and interactive topics.

Another trade journal is *Electronic Publishing*. An oversized ad tabloid on the latest and finest in fonts, printers, and laser typesetters.

NEXT MONTH:
Don looks at resources and opportunities for high power electronics.

Wired

Calling themselves the mouthpiece of the digital generation, this is sort of your *Playboy* for the 90s. Tightly targeting everything in cyberspace. Included are great interviews, useful news, and outrageous articles.

But far too brash for some tastes.

One competitor to *Wired* is *Morph's Outpost*. In a large and well-written tabloid format. Haven't seen this one lately. Hope it is still in print.

Computer Graphics

The best multimedia show is the big annual *SIGGRAPH* gathering. They are a special interest group of *ACM*, the *Association for Computer Machinery*.

These folks have a superb quarterly *Computer Graphics* journal. One which is very big on underlying math theory and fundamental algorithms. Usually their fall issue #3 includes

their full *SIGGRAPH* Proceedings.

One competing trade journal is that *CGW*. As in *Computer Graphics World*. Who also have *Siggraph* reviews. And do cover such topics as animation and visualization software.

Video Toaster User

A fine example of a magazine with genuinely useful technical content. At one time, the NewTek Toaster had low-cost video editing all to itself. Between that Amiga debacle and PC and Mac coming on strong, they've got lots of new competition.

NewTek is fighting back with the latest in *nonlinear editing* techniques. Particularly their *Video Flyer* and their *Video Toaster for Windows* products. And their greatly improved *LightWave* animation rendering software.

A nonlinear editing eliminates any need for videotape. Your entire ad or presentation or movie or whatever is stored on hard disks. Giving instant access to any part in any order. And forever eliminating crude "cuts only" or "A/B roll" editing.

This is still one of my favorite pubs. And a good example of how readable and concise tech info should be the foremost goal of any magazine.

NewTek has free toaster videos.

New Media

One thick and competent monthly mag. Although a tad heavy on glitzy ads. Lots of reviews and product info. Topics include JPEG, MPEG, high end Mac reviews, kiddy titles, more. Plus Scott Kim's end-of-mag puzzles.

Multimedia Producer

I've only seen one copy of this one. "For the creators and developers of interactive multimedia." It's intended for CD-ROM developers.

Computer Video

This is the new kid on the block. An oversized, bimonthly tabloid providing outstanding technical content. Highly readable. Free to qualified readers.

These folks also offer *Radio World* and *TV Technology*. Two quality mags for TV and radio production.

Bove and Rhodes

A longtime alternative multimedia info resource, Tony Bove and Cheryl Rhodes offer a number of publications and services. Their *Bove and Rhodes Insider's Report* is one example. You contact them directly for more info.

Movie Stuff

The best traditional trade magazine here appears to be *Film & Video*.

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Computer Graphics World 1 Technology Pk Dr Westford MA 01886 (508) 982-0700	Imaging Business 1201 Seven Locks Rd #300 Potomac MD 20854 (301) 340-1520	Multimedia Law Report One Penn Plaza New York NY 10119 (800) 950-1216	Publish 501 Second St #600 San Francisco CA 94107 (415) 243-0600	3D Design 600 Harrison Street San Francisco CA 94107 (415) 905-2200	Wired 544 2nd St 3rd Fl San Francisco CA 94107 (415) 904-0664

apparently the 3-D *Design* out of San Francisco. *VSM* is on Video Software Management. Otherwise known as running a video rental store. Lots of ads for cheap vids. Especially if you don't care about the title.

VR World is a virtual reality mag, while *Response TV* will let you hit it big with late night TV advertorials.

Interactive Video News is a pricey high-end newsletter. On multimedia, pay-per-view, shopping, new demand video, and such. *Information Display* is a rather dull and dreary trade journal from the *Society for Information Display* folks. Mostly on liquid crystal display and related wannabes.

Electronic Entertainment, *CD-ROM*, and *NEXT Generation* are mostly for end users. So are both *Videomaker* and *Video Pro*. *Technique* is a "how to guide to successful communications." What *Publish* should have been. *Inform* is an odd publication by the *Association for Information and Image Management*. And *Multimedia Technology Licensing Law Report* is a pricey newsletter.

Two multimedia book sources are *KIPI Bookshelf* and *MIX Bookshelf*.

Additional multimedia resources do appear in HACK71.PDF.

This Month's Contest

For our contest this month, just tell me about any multimedia resource I don't already know about.

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. **NV**

Microcomputer pioneer and guru Don Lancaster is the author of 33 books and countless tech articles. Don maintains his no-charge tech helpline found at (520) 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 an offer code, enter DMD524.

You can also reach Don at Synergetics, Box 809, Thatcher, AZ 85552. Or send any messages to his Internet address of SYNERGETICS@GENIE.GEIS.COM

And your finest special effects magazine is now *Cinefax*. I particularly like all of their insider film secrets.

I have posted other special effects resources in HACK72.PDF.

Printshop Magazines

By far the most useful trade journal is *Quick Printing*. Especially for their *Helene's Hotline* product location data base. A competitor is *Instant and Small Commercial Printer*. Two others are the *Printer's Hotline* shopper and *Printer's Shareware* software store.

For T-Shirt stuff, check *Impressions*, *Printwear*, or *Screen Printing*. More on printshop stuff in HACK27.PDF.

Publish

Well, because it's there, I guess. This is a rather high circulation ad-driven magazine centering on page layout and such. After talking to some other graphic artists, we've all reached the same conclusion: *Publish* always gets the "before" and "after" shots *mixed up* on their page remakes! Usually, they trash a clean layout by ultra glitzing it. With results only an ad director's mother could love.

Imagining Inane Imaging Issues

Does it really matter that there are several dozen multimedia magazines having virtually the same name? Not really, because most of

them seem to me to be blitzzy, highly ad-driven rags totally devoid of any genuinely useful content. Most of these are free and worth every cent of it.

One exception is *Advanced Imaging*. This one is mostly a trade journal for the high-end scientific needs. They are particularly big on solid-state video cameras and machine vision. *SPIE* is a second tech info source here.

Some "also rans" here are *Imaging Magazine* on "Document Solutions for Business;" a *Photo Electronic Imaging*; *Integrating Photography*, *Electronic Imaging*, and *Graphics*; *Copy Imaging & Reproduction* on copiers.

Or *Digital Imaging* "A magazine for Graphics Service Users;" and *Imaging Business*, "The voice of the Document Imaging Channel."

Three more equally exciting mags are *Color Publishing*, *PC Graphics*, *Video* and *AV Video* "Production and Presentation Technology."

Online Resources

There's great heaping bunches of multimedia stuff online. All of those commercial services have at least one offering. On *GENie*, my PSRT covers a few multimedia topics. Especially on compression and digital halftones. Three more extensive *GENie* resources are *Desktop Publishing* over at DTP and *Computer Game Design* at CGD. Plus the computer musicians at MIDI.

But the best *GENie* resource of all

is MULTIMEDIA\$. Having a *RoundTable* and a *Product Catalog*. They also do publish a *Cybernetic Report*.

The usual <http://www.yahoo.com> is a good search engine for locating nearly any Internet subject. There are plenty of others. Including some brand new CD-ROM based services way too new for review. The printed edition of the *Gale Guide to Internet Data Bases* seems curiously silent on multimedia as a subject. But is otherwise handy.

There are lots of online newsstands. Most of these range from dismal on down to mesmerizingly awful.

Some of the better ones are *VIBE Online*, *BUZZnet*, and *Hot Wired*.

The problem with all of these is that the HTML web mark-up language gets *totally useless* whenever it comes to attractively presenting info. Waiting in the wings is the infinitely superior *Adobe Acrobat*. Which fully preserves all fonts, photos, and graphics. In tightly compacted files.

I've got scads of *Acrobat* support up on *GENie* PSRT. Including all the key *Adobe* tech notes and hundreds of files. Start with *ACROBAT.PDF*

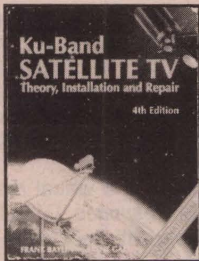
The Dregs

One of the immutable physical laws here at *Synergetics* is that something has to be at the bottom of the pile. So, here is my collection of oddball and interesting stuff which is "not quite" centered on multimedia:

3-D Artist is a graphic design mag out of Santa Fe. Their competitor is

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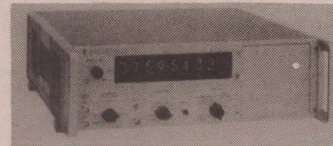
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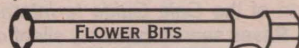
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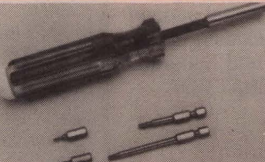
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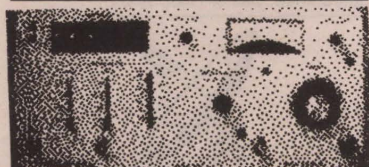
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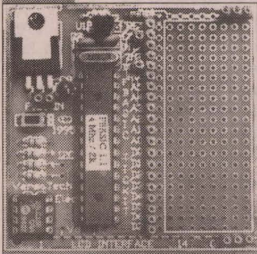
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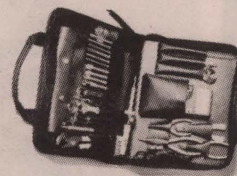
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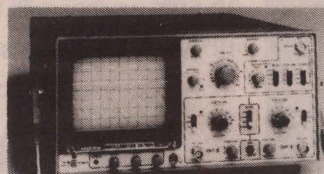
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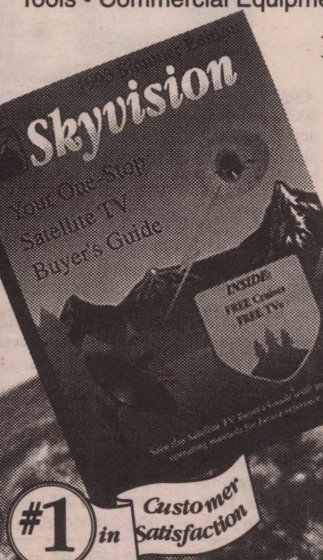
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SQUELCHING THE SQUAWK

by Gordon West

When it comes to receiving antenna systems for programmable radio scanners and mobile/handheld VHF and UHF transceivers, BIGGER may not always be BETTER.

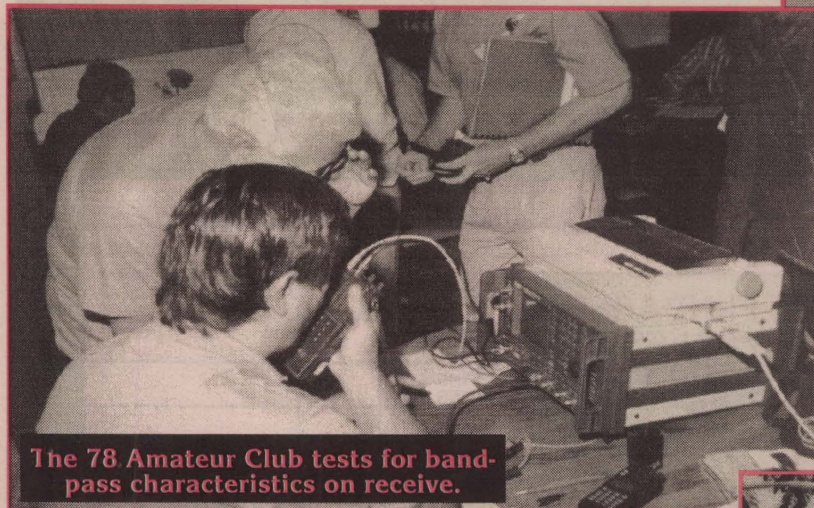
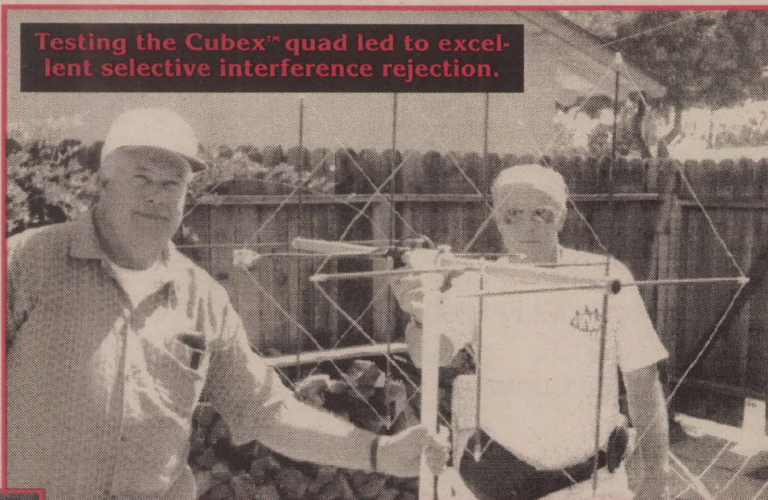
Take the situation of radio enthusiast, ham operator, law enforcement radioman, Bill Alber WA6CAX, near San Francisco. His residence is located on the outskirts of town, and he needs to monitor and communicate with VHF and UHF base and mobile radio units over a distance of 35 miles simplex.

"Because I needed to monitor frequencies on 30-50 MHz low-band, plus COMM channels on VHF near 154 MHz and the two-meter band, plus several UHF frequencies near 450 MHz, I started out with a discone antenna system," comments Alber.

back to normal — in fact, dramatically improved," adds Alber. The problem here was overload.

Most scanners have a front-end transistor for RF amplification that literally swamps when driven by a receiver pre-amp in front of it. External pre-amplifiers might be effective on some very old scanners with insensitive front-end tubes or transistors, but pre-amps on the modern scanner usually lead to major overload

Testing the Cubex™ quad led to excellent selective interference rejection.



The 78 Amateur Club tests for band-pass characteristics on receive.

The discone is a wide-band antenna which exhibits omnidirectional reception from frequencies 40 MHz and up with the add-on, low-band (30 MHz-50 MHz) whip assembly. It is considered unity gain and offers reasonable signal capture all the way up to 1500 MHz with no appreciable hot-spots in its tuning capability. Most operators use this antenna for receiving only, but some have enjoyed okay range transmitting into the discone as well.

Our radio operator, Bill, couldn't quite make out the stations at the edge of his 30-mile desired reception range, so swapped out the unity-gain discone antenna with some \$100+, single-band, dual-band, and tri-band tall base antennas from Comet (Anaheim, CA 714-630-4541) and Diamond (San Marcos, CA 619-744-0900). These two companies offer more models of base and mobile high-gain transmission and reception white fiberglass vertical antennas than anyone else in the amateur radio market.

"My base scanner immediately shut down when I went to the bigger antenna," comments Alber. "When I took out the pre-amplifier, reception was

and degradation of incoming signals.

"On the handheld scanner, the big new antennas brought in so much garbage that I had to go back to the little discone in order to hear anything on frequency," adds Alber. Same problem — front-end overload and the little handheld programmable scanner with no

single-band and combo-band antennas made a big improvement.

Lesson learned — trying to hook programmable scanners and small amateur radio handheld transceivers into high-gain base antennas could result in severe receiver degradation due to the effects of out-of-bands swamping the receiver and creating undesired mixing within the front-end of the handheld leading to on-channel signals being covered up by other radio services 10 or 20 MHz away.

Have you ever heard the National Weather Service and taxi cab calls coming in simultaneously over your local ham radio repeater channel? If only your little handheld on a big external antenna picks it up, and no one else hears what you are hearing, chances are the problem is occurring as overload within your own unit.

pre-amp in front of it, will sometimes be unusable near major metropolitan areas when nearby transmitters overload it.

But on his mobile amateur radio and commercial mobile radio equipment, the big Diamond and Comet high-gain antennas dramatically improved transmission and reception capabilities. Bill could hear stations well beyond what the little discone could receive, and could communicate up to 60 miles away with stations that the little discone couldn't even hear. The big white fiberglass collinear VHF and UHF

VHF antenna testing to see how well a quad can help reduce near-frequency interference. It did!



Another strange problem occurred when public safety officials were fighting a local brush fire and lost radio communications when they drove within one-half mile of the mountain-top radio relay system.

"I couldn't hear my own base station 10 miles away through all the garbage coming out of my mobile unit," comments Al Palantonio NN1U, retired public safety officer. "The base station could hear me clearly, but all of the other radio signals coming out of the nearby hill-top transmitters were completely clobbering any reception I might have," adds Palantonio.

Again, the problem is front-end overload and the mixing of many nearby frequency signals within a mobile radio not designed to specifically fight this kind of problem in rural areas.

Are there mobile units and handhelds that SPECIFICALLY keep receiving noise-free when there are other signals on adjacent frequencies nearby pounding the front-end transistors? Indeed so — but these handheld and mobile units are old, big "bricks" that feature HELICAL RESONATORS to keep on-channel signals coming through loud and clear to the next RF stage, and keeping OUT those signals beyond the pass-band of the tuned cavities.

The helical resonator found inside high-quality mobile radios, plus miniature versions found in single-band handheld radios, are composed of a coil inside a shielded resonant cavity specifically tuned for a high-Q response to the desired signal with steep skirts to minimize undesired out-of-band signals. The well-constructed helical resonator within the radio equipment is pre-tuned by the factory and offers relatively low-signal dB loss compared to the benefit of attenuating out-of-band signals from overloading the next RF stage.

You can usually spot the internal helical resonator by its brass tuning screw or air-variable capacitor across the open end of the helix. In some amateur and land-mobile radios where large frequency excursions may be encountered, the varactor diode is employed which "track tunes" where the receiver is operating. But varactors can sometimes self-defeat because of self-generated spurious emissions created by incoming out-of-band strong

signals pounding into the receiver section.

Many ham operators who live near large radio-active metropolitan areas have almost asked for this interference problem themselves. I include myself as a ham who desires a handheld transceiver that receives aeronautical at 110 MHz to government at 170 MHz, full coverage please, plus full reception from 420 MHz through 512 MHz on UHF — again, full receive capabilities, please. The equipment I use could not perform at full sensitivity with internal helical resonators — one for high band, and one for UHF, because the helicals would restrict receiver sensitivity outside of their band pass.

Also, manufacturers are scaling down the size of their mobile units; and when you pack handheld-sized electronics inside a mobile unit, you cannot expect that mobile transceiver to retain some of the band-pass characteristics that it originally had when it was larger and had more isolated stages within its body.

But there are solutions! Selective solutions. Hollow cavities! You see these giant cavities at radio repeater sites resembling tall, gold-anodized aluminum cans. And that's actually what they are — hollow one-quarter wavelength coaxial cavities that could measure up to four inches in diameter and five feet long for low-band operation near 50 MHz.

Although internal helical resonators within the equipment are relatively small and offer about the same unloaded Q as cavities, the external cavities have the advantage of filtering out incoming off-frequency signals long before they get to any stages of the RX input.

Relatively inexpensive VHF band-pass filters come from two well-known Canadian manufacturers:

Sinclabs
Tonawanda, N Y
(716) 874-3692

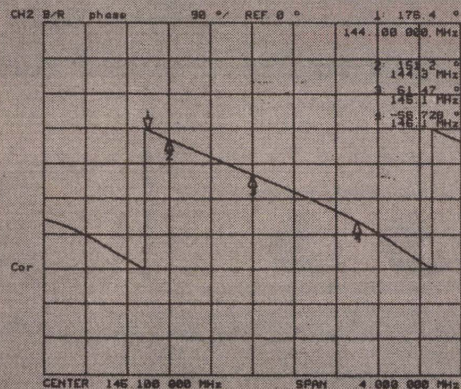
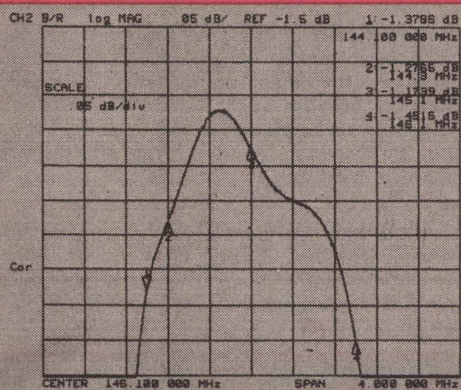
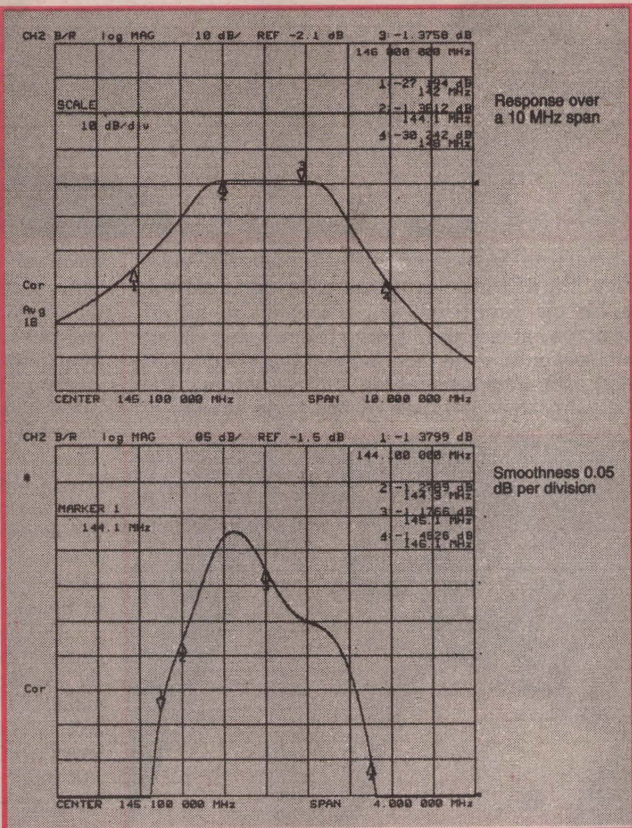
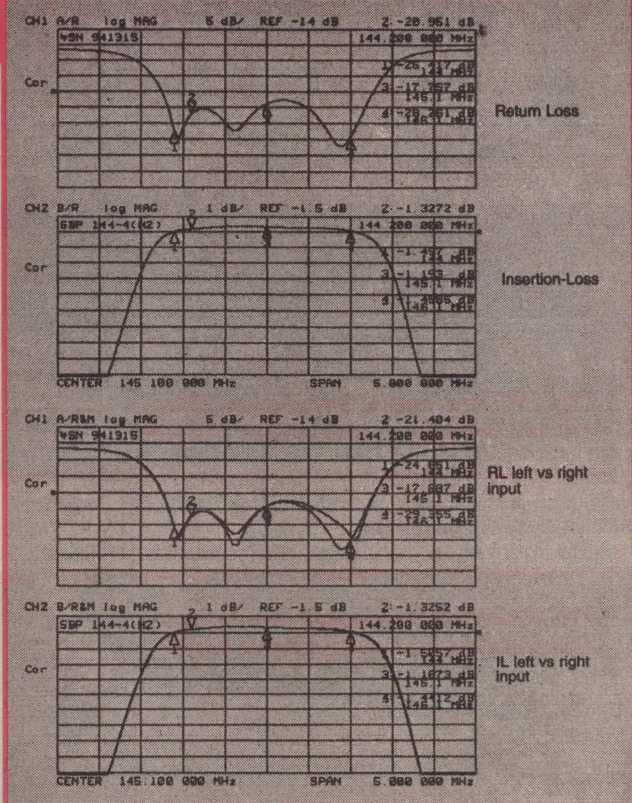
DCI Digital Communications
White City, Saskatchewan
(306) 781-4451
with USA distribution like Sinclabs.

Both companies produce relatively inexpensive (\$80-\$150) band-pass filters that are specifically tuned to your VHF communications frequency that you want to home in on, while canceling out overload problems on adjacent frequencies separated by at least 5 MHz.

The DCI filter design is four helical resonators with aperture coupling. The filters are made of extruded aluminum, copper, and brass, and have no components inside to

burn out or fail. They are simply tuned resonators — cans — and require no external power. You hook up the filter network between the radio and the antenna.

For instance, an amateur operator wishes to work the two-meter band with mobile or handheld transceivers in an area with strong land-mobile radio activity on each side of the two-meter band. The two-meter band extends from a low of 144 MHz to a high of 148 MHz. The idea is to minimize incoming signals beyond the band pass of the filter,



compiled by
Dana Shtun,
VE3DSS
BASc, P. Eng

D.Shtun
Aug 1994



The DCI two-meter band-pass filter was our favorite — and under \$90.00!

yet not attenuate weak signals that are on frequency just above the noise floor.

The DCI-146-4H band-pass filter compares

relief from out-of-band chatter.

The filters worked so well that it was tough to hear the VHF weather band at 162 MHz. Keep this in mind if you plan to use the filters on a programmable handheld, mobile, or scanner where you plan to go well beyond the excursion of the two-meter band.

For law enforcement, radio operator Bill Alber had DCI tune the filters to 154 MHz, and they did a terrific job in keeping out a weather band mix, as well as interference from a nearby paging transmitter.

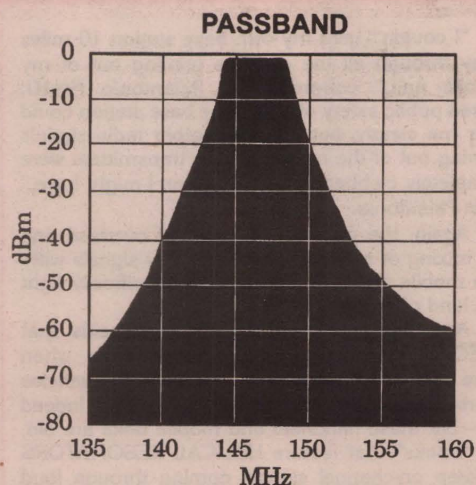
"A handheld radio usually operates properly with a rubber duck antenna, but when it is connected to a mobile or base antenna, the HT becomes susceptible to intermodulation," comments

Ralph at DCI. "Intermodulation occurs because some of the signals become strong enough to drive the RF amplifier non-linear." Ralph points out that his DCI-146-4H filter allows amateur operators to benefit from the gain of a high-performance antenna without creating an intermodulation problem.

You can run up to 200 watts through the small four-cavity Sinclabs and DCI filters — small meaning 12" x 3" x 5", and weighing less than three pounds. The DCI filters all come with a spectrum analysis of their response, and hook-up is as easy as dropping the antenna cable from your radio, screwing the antenna cable into the filter, and then running a short patch cable from the output of the filter to the input of the transceiver.

DCI presently offers *Nuts & Volts* readers a limited-time 800 number to call for specification sheets and inquiries — (800) 563-5351. Ask for Ralph. He's a ham with both Canadian and U.S. call signs, and really knows his stuff! His filters are gorgeous, and we received tremendous factory response during our filter testing from DCI Digital Communications, Inc.

Finally, another interesting way to "filter out" annoying signals is using a directive single-band "short quad" directional antenna system. The quad antenna offers moderate natural filtering to signals outside of its cut-tun-



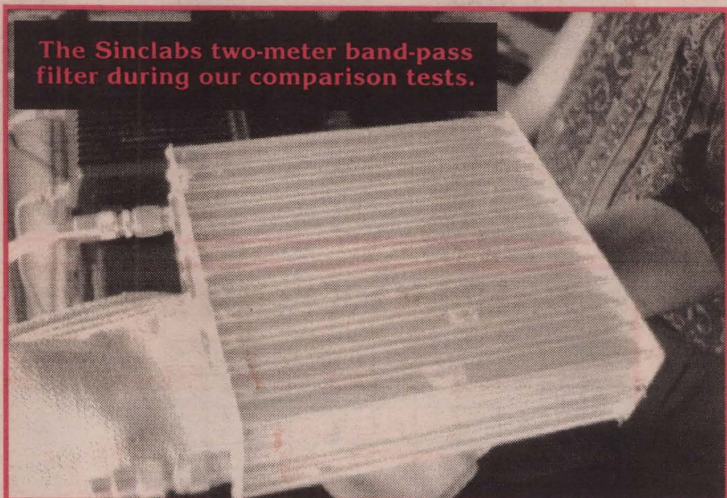
Passband curve of the DCI and Sinclabs filter.

ing range, and also offers good side lobe and rear attenuation while giving you a good strong forward lobe to zero in on the transmitting station. A wonderful quad antenna system called the "Cubex Yellow Jacket" features a two-meter, four-element quad that is pre-fabricated and all color-coded for radio operators to put together in less than 20 minutes.

Radio operators needing to establish a temporary "fix" from strong off-frequency interference could utilize the quad to peak up the desired signal, and hopefully null out the off-frequency overloading. During tests with the Cubex, we found it an effective way to rapidly deploy a handheld radio system, with capabilities to lessen the response of overload from the back of the quad (Cubex Company, Brea, CA 714-557-9009). For under \$35.00, the portable four-element VHF quad that comes pre-assembled was a delight to work with.

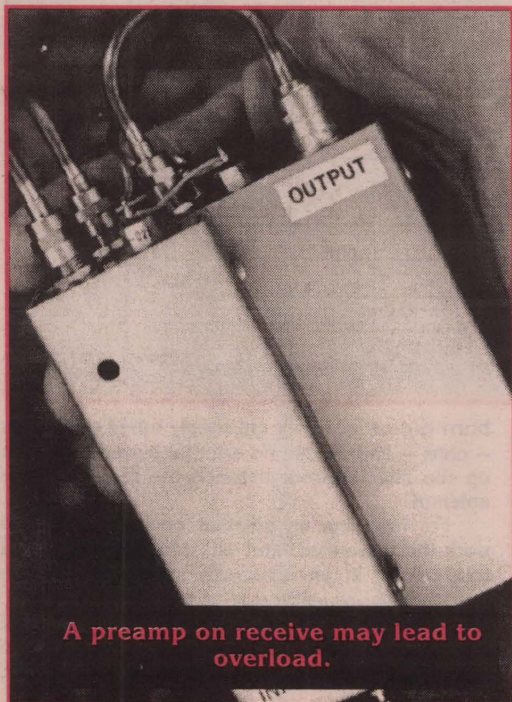
Will radio operators see handheld transceivers and mobile equipment coming out with better band-pass capabilities? I doubt it. The trend has been scaled-down, smaller sized equipment, and this necessitates the elimination of internal tuned helical resonators because of their size. The demand of radio operators for wide-frequency response to cover 30 to 40 MHz of spectrum on VHF and UHF also eliminates the capabilities for internal band-pass filters.

The passive external Canadian band-pass filters from Sinclabs and DCI are an affordable way to increase selectivity over 2-4 MHz of desired operating area. Call these companies for more details about their products. **NV**



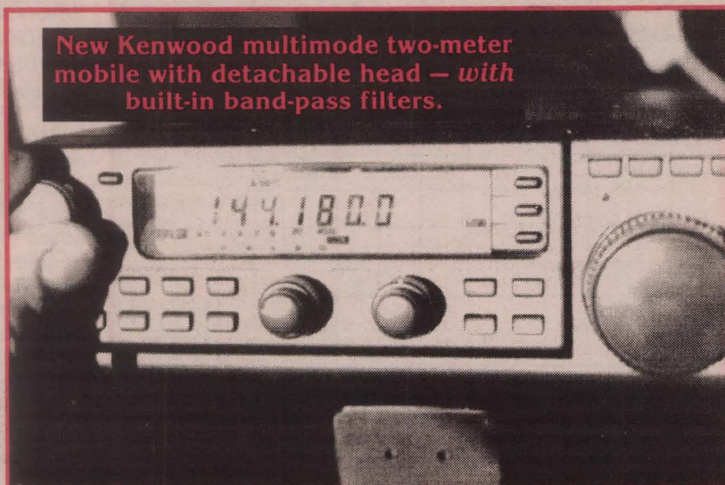
The Sinclabs two-meter band-pass filter during our comparison tests.

favorably to the more expensive Sinclabs SBP144-4 filter. The DCI filter was measured at only .3 dB loss within the pass band, and offered up to -55 dB selectivity at federal 140 MHz channels, and -40 dB attenuation to those signals pounding in from 154 and 155 MHz land-mobile radio services. The Sinclabs filters also gave us this same amount of



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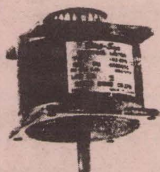
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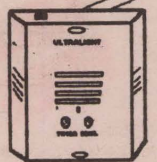
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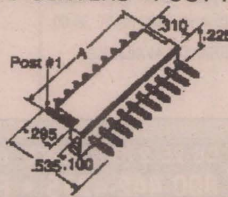
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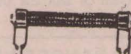
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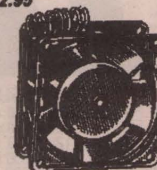
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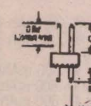


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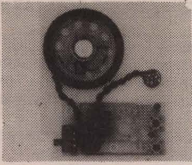
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OCTOBER 1

CA - BUENA PARK — Computer Marketplace. **SPONSOR:** National Productions. **LOCATION:** Sequoia Conference Center. **HOURS:** 10am-5pm. **ADMISSION:** \$5. **CONTACT:** National Productions, 408-778-5200 or 1-800-800-5600. FAX 408-779-1374.

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

OCTOBER 6-7-8

CA - BAKERSFIELD — 2nd National Hamfest. **SPONSOR:** Kern County Central Valley ARC. **LOCATION:** Costerlan Lake. **TALK-IN:** 147.540, 223.500. **FEATURES:** DP - EX - F/R - RV-S. **CONTACT:** Al Chadwick N6THC, 805-396-1012 or Neal Jansen N6YQG 805-831-6027. KCCVARC Hamfest, POB 743, Bakersfield CA 93302.

OCTOBER 7

AZ - BULLHEAD CITY — Fallfest. **SPONSOR:** Tri-City ARC. **LOCATION:** Chamber of Commerce Bldg, 1251 Arizona, Hwy 95. **DEALER INFO:** Inside tailgating: \$15, outside: \$5. **CONTACT:** Dave Sumner KG7XZ, 520-763-2589.

CA - BAKERSFIELD — MarketPro Computer Show & Sale. **LOCATION:** Holiday Inn Select. **HOURS:** 10am-5pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

CA - REDWOOD — Annual Amateur Radio Auction. **SPONSOR:** Palo Alto ARA. **LOCATION:** Ampex Cafeteria, 401 Broadway. **HOURS:** 7:30am-7. **CONTACT:** 510-271-7587, 415-593-5613.

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 - FM - F/R - H. **DEALER INFO:** \$7 vehicle. **CONTACT:** Pat WA6MHZ, ARCEC, Box 50, El Cajon CA 92020. 619-561-0052.

ID - NAMPA — Hamfest & Computer Fair. **LOCATION:** Nampa Civic Center, 311 3rd St S. **HOURS:** 8am-4pm. **ADMISSION:** \$2. **TALK-IN:** 147.240, 443.600. **FEATURES:** C - CB - DP - EX - FM - F/R - H - S. **DEALER INFO:** Dealers: adv only \$60, non-dealers: adv \$6.50, Door \$8.50. **CONTACT:** Jan Dyer, WA7VEF, 208-467-3245. Elvin Hightower, KA7BER, 208-466-2011.

OCTOBER 7-8

CA - POMONA — Los Angeles Computer Fair. **SPONSOR:** National Productions. **LOCATION:** Fairplex Expo Center. **HOURS:** 10am-5pm. **ADMISSION:** \$5. **CONTACT:** National Productions, 408-778-5200 or 1-800-800-5600. FAX 408-779-1374.

CA - SACRAMENTO — MarketPro Computer Show & Sale. **LOCATION:** Cal Expo. **HOURS:** 10am-5pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

OCTOBER 8

CA - FRESNO — MarketPro Computer Show & Sale. **LOCATION:** Holiday Inn. **HOURS:** 10am-5pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

OCTOBER 14

CA - FONTANA — Amateur Radio & Electronic Equipment Swap Meet. **SPONSOR:** Inland Empire ARC & A.B. Miller High School ARC. **LOCATION:** A.B. Miller High School, 6821 Oleander Ave. **HOURS:** 7am-7. **ADMISSION:** Free. **FEATURES:** E - FP - F/R - H. **DEALER INFO:** Tailgate space \$6. Set-up 6am. **CONTACT:** Bill Gruber 909-822-4138 eves. VE exams are now on the first Sat of each month at 8am; contact Ken Canfield, 909-685-7694.

CA - SANTA BARBARA — Computer Marketplace.

CALENDAR

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 the person to contact, and phone number.

Complimentary issues are available upon request for distribution to your attendees. A street address for UPS is required.

While we strive for accuracy in our calendar, we can not 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.

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
CompuServe 74262,3664
Internet
74262,3664@compuserve.com

SPONSOR: National Productions. **LOCATION:** Earl Warren Showgrounds. **HOURS:** 10am-5pm. **ADMISSION:** \$5. **CONTACT:** National Productions, 408-778-5200 or 1-800-800-5600. FAX 408-779-1374.

OCTOBER 14-15

CA - OXNARD — MarketPro Computer Show & Sale. **LOCATION:** Community Center. **HOURS:** 10am-5pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

CA - VALLEJO — MarketPro Computer Show & Sale. **LOCATION:** Solano Co. Fairgrounds. **HOURS:** 10am-5pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

OCTOBER 15

CA - ANAHEIM — Computer Fair & Swap Meet. **SPONSOR:** North Orange County Computer Club. **LOCATION:** Anaheim Marketplace parking lot, 1440 S Anaheim Blvd, between Ball & Katella. **HOURS:** 8am-2pm. **ADMISSION:** Free. **FEATURES:** C - E - FP - H. **CONTACT:** 714-521-6915.

OCTOBER 20-21-22

CA - CONCORD — Pacific Division Convention. **CONTACT:** Lauren Styles, WA6CIE, 1910 Sunshine Dr, Concord CA 94520. 510-676-2186.

OCTOBER 21

CA - DEL MAR — MarketPro Computer Show & Sale. **LOCATION:** Del Mar Fairgrounds. **HOURS:** 10am-5pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

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 - FM - F/R - H. **DEALER INFO:** \$7 vehicle. **CONTACT:** Pat WA6MHZ, ARCEC, Box 50, El Cajon CA 92020. 619-561-0052.

OR - MEDFORD — Swapmeet. **SPONSOR:** Rogue Valley ARC. **LOCATION:** Medford Armory, 1701 S Pacific Hwy. **HOURS:** 9am-4pm. **ADMISSION:** Adv \$5, Door \$6. **TALK-IN:** South/147.160 repeater, North/146.940 repeater. **FEATURES:** C - CB - DP - EX - FP - F/R - H RV-S. **DEALER INFO:** Non-commercial tables \$10. **CONTACT:** RVARC, 1707 E Main St, Medford OR 97504 or W5HVK: 503-770-5631. VE Exams: Paul Miller KE7VO, 503-878-3433.

OR - PORTLAND — Computer Swap Meet. **SPONSOR:** CP/M Users Group Northwest. **LOCATION:** Tigard Senior Center, 8815 SW Omara. **HOURS:** 8am-2pm. **ADMISSION:** Free. **FEATURES:** C - CB - E - FP - T. **DEALER INFO:** Tables: Free. **CONTACT:** Don Taylor 503-452-1937, dont@agora.rdrop.com.

OR - RICKREAL — Swap-toberfest & ARES/RACES Convention. **SPONSOR:** Mid-Valley ARES. **LOCATION:** Polk County Fairgrounds. **HOURS:** 9am-4pm. **ADMISSION:** Adv. \$6, Door \$7, under 12 free. **TALK-IN:** 146.86 repeater. **FEATURES:** C - EX - F - FM - RV-S. **DEALER INFO:** Swap tables: \$13. w/power: \$15 Gary Zinn KC7BSX: 503-378-3702. **CONTACT:** Evan Burroughs N7IFJ: 503-585-5924. VE Testing: Sandy Berry N7TQQ, 503-588-7685.

OCTOBER 22

CA - STOCKTON — MarketPro Computer Show &

Sale. **LOCATION:** Civic Auditorium. **HOURS:** 10am-5pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

OCTOBER 28

CA - SANTA ROSA — MarketPro Computer Show & Sale. **LOCATION:** Sonoma County Fairgrounds. **HOURS:** 10am-5pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

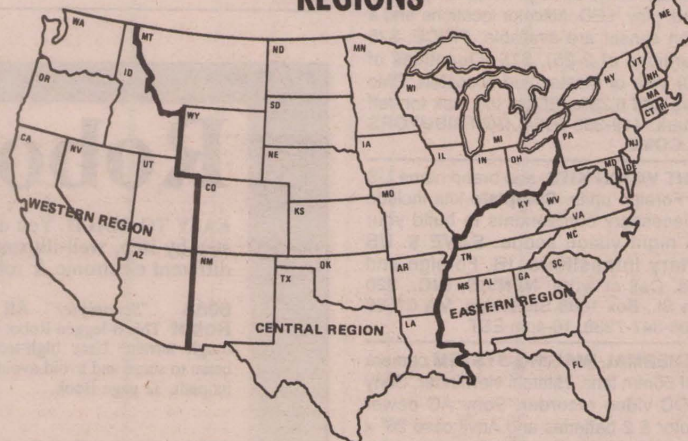
OCTOBER 28-29

CA - POMONA — Computer Marketplace. **SPONSOR:** National Productions. **LOCATION:** Fairplex Expo Center. **HOURS:** 10am-5pm. **ADMISSION:** \$7. **CONTACT:** National Productions, 408-778-5200 or 1-800-800-5600. FAX 408-779-1374.

OCTOBER 29

CA - ANTIOCH — MarketPro Computer Show & Sale. **LOCATION:** Contra Costa Fairgrounds. **HOURS:** 10am-5pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

REGIONS



FEATURES KEY

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

COMPUTER SHOW PROMOTER INFO

AGI Computer Fair — 317-299-8827
KGP Computer Shows — 908-297-2526
MarketPro Computer Shows
West (CA) — 415-388-8893
East (MD, OH, PA, VA) — 301-365-9696
N.E. (CT, MA, NJ, NY, RI) — 201-265-1075
NARISAAM Computer Shows — 800-436-6707
Northern Computer Shows — 508-744-8440

Events CALENDAR

NOVEMBER 4-5

CA - SACRAMENTO — MarketPro Computer Show & Sale. **LOCATION:** Cal Expo. **HOURS:** 10am-5pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

NOVEMBER 5

CA - BUENA PARK — Computer Marketplace. **SPONSOR:** National Productions. **LOCATION:** Sequoia Conference Center. **HOURS:** 10am-5pm. **ADMISSION:** \$5. **CONTACT:** National Productions, 408-778-5200 or 1-800-800-5600. FAX 408-779-1374.

CA - LIVERMORE — East Bay Area Amateur Radio/Electronics/Computer Swap Meet **SPONSOR:** Livermore Amateur Radio Klub (LARK). **LOCATION:** Las 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) from W, 145.350- (PL 100) from E. **FEATURES:** E - H - FP - F/R. **DEALER INFO:** Set-up after 7am only. \$10 space fee. Covered spaces avail if rain. **CONTACT:** Noel Anklam KC6QZK, 510-447-3857 eves or 510-783-2803 message days.

NOVEMBER 11

CA - FONTANA — Amateur Radio & Electronic Equipment Swap Meet. **SPONSOR:** Inland Empire ARC & A.B. Miller High School ARC. **LOCATION:** A.B. Miller High School, 6821 Oleander Ave. **HOURS:** 7am-7. **ADMISSION:** Free. **FEATURES:** E - H - FP - F/R. **DEALER INFO:** Tailgate space \$6. Set-up 6am. **CONTACT:** Bill Gruber 909-822-4138 eves. VE exams are now on the first Sat of each month at 8am; contact Ken Canfield, 909-685-7694.

CA - FRESNO — MarketPro Computer Show & Sale. **LOCATION:** Fresno Fairgrounds. **HOURS:** 10am-5pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

NOVEMBER 12

CA - SAN DIEGO — MarketPro Computer Show & Sale. **LOCATION:** Scottish Rite Center. **HOURS:** 10am-5pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

CA - VALLEJO — MarketPro Computer Show & Sale. **LOCATION:** Solano County Fairgrounds. **HOURS:** 10am-5pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

NOVEMBER 18

CA - BAKERSFIELD — MarketPro Computer Show & Sale. **LOCATION:** Holiday Inn Select. **HOURS:** 10am-5pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

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 - FM - F/R - H. **DEALER INFO:** \$7 vehicle. **CONTACT:** Pat WA6MHZ, ARCEC, Box 50, El Cajon CA 92020. 619-561-0052.

CA - STOCKTON — MarketPro Computer Show & Sale. **LOCATION:** Civic Auditorium. **HOURS:** 10am-5pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

NOVEMBER 18-19

CA - POMONA — Computer Marketplace. **SPONSOR:** National Productions. **LOCATION:** Fairplex Expo Center. **HOURS:** 10am-5pm. **ADMISSION:** \$7. **CONTACT:** National Productions, 408-778-5200 or 1-800-800-5600. FAX 408-779-1374.

NOVEMBER 19

AZ - PHOENIX — Computer & Electronic Swap Meet. **SPONSOR:** Electronic Materials & Computers. **LOCATION:** Electronic Materials & Computers parking lot, 3102 W. Thomas Rd. #902. **HOURS:** 8am-3pm. **ADMISSION:** Free. **FEATURES:** FP. **DEALER INFO:** Vendor spaces \$15. **CONTACT:** 3102 W Thomas Rd. #902, Phoenix AZ 85017. 602-272-3200.

NOVEMBER 26

CA - SANTA ANA — ACP Computer Swap Meet. **SPONSOR:** Advanced Computer Products. **LOCATION:** 1310 E. Edinger. **HOURS:** 8am-2pm, rain or shine. **ADMISSION:** Free. **FEATURES:** C - E - FP.

DEALER INFO: All spaces \$75 in advance. Call for multiple pricing. **CONTACT:** Mary Russo - 714-558-8813.

DECEMBER 2

AZ - MESA — Superstition Hamfest. **SPONSOR:** Superstition ARC. **LOCATION:** Mesa Community College, SE corner of Dobson Rd & Southern Ave, off Hwy 60. **HOURS:** 7am-7. **ADMISSION:** XS1 per car. **TALK-IN:** 147.12, 449.60. **FEATURES:** DP - EX. **DEALER INFO:** Commercial \$10, tailgate \$5. **CONTACT:** Rick Checketts KA0KZB, 602-898-9158. VE Exams: Larry Kuck, 602-986-2298.

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 - FM - F/R - H. **DEALER INFO:** \$7 vehicle. **CONTACT:** Pat WA6MHZ, ARCEC, Box 50, El Cajon CA 92020. 619-561-0052.

DECEMBER 3

CA - LIVERMORE — East Bay Area Amateur Radio/Electronics/Computer Swap Meet **SPONSOR:** Livermore Amateur Radio Klub (LARK). **LOCATION:** Las 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) from W, 145.350- (PL 100) from E. **FEATURES:** E - H - FP - F/R. **DEALER INFO:** Set-up after 7am only. \$10 space fee. Covered spaces avail if rain. **CONTACT:** Noel Anklam KC6QZK, 510-447-3857 eves or 510-783-2803 message days.

DECEMBER 3-4-5-6

CA - SAN FRANCISCO — Software Support National Conference. **SPONSOR:** Service News & Software Support Professionals Assn. **LOCATION:** ANA Hotel. **CONTACT:** Service News, 207-846-0600.

DECEMBER 9

CA - FONTANA — Amateur Radio & Electronic Equipment Swap Meet. **SPONSOR:** Inland Empire ARC & A.B. Miller High School ARC. **LOCATION:** A.B. Miller High School, 6821 Oleander Ave. **HOURS:** 7am-7. **ADMISSION:** Free. **FEATURES:** E - H - FP - F/R - H. **DEALER INFO:** Tailgate space \$6. Set-up 6am. **CONTACT:** Bill Gruber 909-822-4138 eves. VE exams are now on the first Sat of each month at 8am; contact Ken Canfield, 909-685-7694.

DECEMBER 16

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 - FM - F/R - H. **DEALER INFO:** \$7 vehicle. **CONTACT:** Pat WA6MHZ, ARCEC, Box 50, El Cajon CA 92020. 619-561-0052.

CENTRAL REGION

OCTOBER 1

IN - HUNTINGTON — ARRL Hamfest. **SPONSOR:** Huntington County ARS. **CONTACT:** Ray Tackett KC9DZ, POB 284, Huntington, IN 46750. 219-786-0029.

MI - GRAND RAPIDS — Computer Trade Show. **LOCATION:** Holiday Inn Crown Plaza, 5700 28th St SE, E of I-96 Exit 43B. **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 - PORT HURON — ARRL Hamfest. **SPONSOR:** American Red Cross AR Service. **CONTACT:** Darryl Smith KB8UKO, 2817 16th Ave, Port Huron MI 48060. 810-987-3818.

MI - TROY — Computer Show. **LOCATION:** American Polish Cultural Center, 2975 E Maple Rd, NW corner of Dequindre Rd. **HOURS:** 10am-3pm. **ADMISSION:** Adults \$4, students & seniors w/ID \$3, under 12 free. **FEATURES:** C - DP. **CONTACT:** International Computer Trade Shows, 810-858-2416.

OH - ASHLAND — North Central Ohio Hamfest. **SPONSOR:** Ashland Area ARC. **LOCATION:** Ashland County Fairgrounds. **HOURS:** 8am-3pm. **ADMISSION:** Adv \$3, Door \$4, under 15 free. **TALK-IN:** 147.15+. **FEATURES:** DP - FM - H. **DEALER INFO:** Indoor tables: \$7, Flea Market Space \$3. **CONTACT:** Wally Green W3YXS, 3 East Liberty St., Ashland OH 44805. 419-281-3903.

OH - COLUMBUS — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Ohio Expositions Center. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

OH - LIMA — ARRL Hamfest. **SPONSOR:** Northwest Ohio ARC. **CONTACT:** Greg Schwark N8WBD, 600 Sunset Dr, Spencerville OH 45887. 419-647-6321.

OCTOBER 7

IN - INDIANAPOLIS — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Indianapolis State Fairgrounds. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

IN - INDIANAPOLIS — Indianapolis Computer Fair. **LOCATION:** Indianapolis Events Center, 3655 E Raymond @ Sherman, 5 mi E of downtown Indianapolis. **HOURS:** 10am-3pm. **ADMISSION:** \$4, under 12 free. **FEATURES:** C - DP. **CONTACT:** Ben Yanto, AGI Computer Fairs.*

ND - GRAND FORKS — Hamfest/Computer Fair. **SPONSOR:** FORX ARC. **LOCATION:** University Lutheran Church, 2122 University Ave. **HOURS:** 7am-2pm. **ADMISSION:** \$5. **TALK-IN:** 146.34/.94 WA0JXT. **FEATURES:** B - C - DP - EX - F - H. **DEALER INFO:** Flea Market tables: Adv \$1, Door \$5. **CONTACT:** Jeff Sorell N0PPW: 701-594-5013.

TX - BELTON — Ham Expo '95. **SPONSOR:** Temple ARC. **LOCATION:** Bell County Expo Center. **HOURS:** 7am-7. **ADMISSION:** Free. **TALK-IN:** 146.82. **FEATURES:** AC - EX - H - T. **DEALER INFO:** Display Hall tables: \$10, Indoor tailgate arena: \$10. **CONTACT:** Temple ARC, 2014 S 53rd, Temple TX 76504. Mike W4SEQQ: 817-773-3590.

OCTOBER 7-8

MI - DEARBORN — Vintage Radio Auction. **SPONSOR:** Estes Auctions. **LOCATION:** Henry Ford Museum, 20900 Oakwood Blvd. **HOURS:** Sat: 10am-5pm, Sun: 10am-7, preview Fri: 3pm-6pm, Sat & Sun: 8am-10am. **CONTACT:** Estes Auctions: 216-769-4992, 216-769-3987. Henry Ford Museum, 313-271-1620.

TX - EL PASO — 8th Annual International Hamfest. **SPONSOR:** Various Area ARCs. **LOCATION:** National Guard Armory. **HOURS:** Sat: 8am-5pm, Sun: 8am-2pm. **ADMISSION:** Adv \$5, Door \$6. **CONTACT:** Intern'l Hamfest, POB 10496, El Paso TX 79995. Clay Emert K5TRW: 915-859-5502.

OCTOBER 8

IN - BEDFORD — Hoosier Hills Hamfest '95. **SPONSOR:** Hoosier Hills Ham Club. **LOCATION:** Lawrence County 4-H Fairgrounds, 4 mi SW of Bedford on US Hwy 50. **HOURS:** 6am-3pm. **ADMISSION:** \$6. **TALK-IN:** 146.730. **FEATURES:** C - CB - DP - E - EX - F/R - H - RV-H. **CONTACT:** Larry Foster WB9DNB, 812-275-3688.

IN - SOUTHBEND — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** St. Joseph's Fairgrounds. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

MI - ANN ARBOR — Colossal Computer Sale. **SPONSOR:** Jewish Community Center. **LOCATION:** Washtenaw Community College, Morris Lawrence Bldg. **HOURS:** 9:30am-4pm. **ADMISSION:** \$4. **CONTACT:** 313-971-0990.

MI - LANSING — Hamfair '95. **SPONSOR:** Central Michigan ARC & Lansing Civil Defense Rptr Assn. **LOCATION:** Gardner Middle School. **HOURS:** 8am-1pm. **ADMISSION:** \$4. **TALK-IN:** 145.390-. **CONTACT:** Bil Blick ABGL, 617-675-5558.

MI - MADISON HEIGHTS — Computer Trade Show. **LOCATION:** UFCW Hall, 876 Horace Brown Dr, 1 blk E of I-75, 1 blk S of 13 Mile Road. **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 - SPRINGFIELD — Hamfest & Computer Show. **SPONSOR:** Springfield Independent Radio Assn. **LOCATION:** Clark County Fairgrounds. **HOURS:** 8am-3pm. **ADMISSION:** Adv \$4, Door \$5, under 12 free. **TALK-IN:** 145.45. **FEATURES:** C - FP - F/R - H. **DEALER INFO:** Tables: Adv \$10, door \$12. Set-up Sat 6pm. **CONTACT:** Sales: 513-323-6680 days, General: 513-964-8618. SIRA, POB 523, Springfield OH 45501.

OCTOBER 14

IL - CHICAGO — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Inland Convention Center (Westmont). **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

MI - ALPENA — Hamfest & Computer Fair. **SPONSOR:** TBARC. **LOCATION:** Hinks Elementary School. **HOURS:** 8am-3pm. **ADMISSION:** Adv \$3, Door \$4, under 12 free. **TALK-IN:** 146.76. **FEATURES:** C - DP - E - EX - FP - F/R - H. **DEALER INFO:** Tables: Adv \$5, Door \$6. **CONTACT:** TBARC, POB 764, Alpena MI 49707-0764. Bill NBYKG, 517-354-8867.

MI - TAYLOR — Computer Trade Show. **LOCATION:** Democratic Club of Taylor, 23400 Wick Rd, 4 blks 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.

OH - TOLEDO — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Seagate Convention Centre. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

OCTOBER 15

IL - CENTRALIA — 6TH Annual Hamfest. **SPONSOR:** Centralia Wireless Assn & Kaskaskia College REACH Club. **LOCATION:** Kaskaskia College, 27210 College Rd. **HOURS:** 8am-3pm. **ADMISSION:** \$2, under 12 free. **TALK-IN:** 147.27/87, 443.2/8.2. **FEATURES:** C - DP - EX - FM - FP - F/R - H - RV-S - T. **DEALER INFO:** Tailgating: free. Flea market tables: 8' \$8, 6' \$6. Set-up 7am. **CONTACT:** Bud King WA9QJ, Daisy King AA9EK, 776 Bethel Rd, Sandoval IL 62882. 618-532-6606.

IL - CHICAGO — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Pheasant Run (St. Charles). **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

IL - ORLAND PARK — The Orland Park Computer Show. **LOCATION:** Orland Park Civic Center, 147th St & LaGrange Rd (Rte 45). **HOURS:** 9:30am-3pm. **ADMISSION:** Adults \$5 - \$1 off with copy of this ad, 8-12 yrs \$2, under 8 free. **FEATURES:** A - C - CB - DP - FP - F/R - All indoors. **CONTACT:** 24-hour Hotline 708-974-3123.

IN - FT. WAYNE — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Allen County Fairgrounds. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

MI - FLINT — Computer Show. **LOCATION:** Holiday Inn Gateway Center, 5533 Gateway Center, I-75 N to I-475 (exit 111), 1 mi to Hill Rd (exit 2), turn left, go approx 3 mi. **HOURS:** 10am-4pm. **ADMISSION:** Adults \$4, students & seniors w/ID \$3, under 12 free. **FEATURES:** C - DP. **CONTACT:** International Computer Trade Shows, 810-858-2416.

MI - KALAMAZOO — 13th Annual Hamfest. **SPONSOR:** Kalamazoo ARC & SW Michigan ART. **LOCATION:** Kalamazoo County Fairgrounds. **HOURS:** 8am-7. **ADMISSION:** Adv \$3, Door \$4. **TALK-IN:** 147.040 repeater. **FEATURES:** DP - FP - F/R - H - T. **DEALER INFO:** Tables: \$150/ft, electrical hook-up \$5. Trunk sales: \$5/space, set-up 6am. **CONTACT:** Kalamazoo Hamfest, 616-657-4482 or Gary Hazelton KB8PL, 75075 M-40, Lawton MI 49065.

OH - AKRON — Computer Trade Show. **SPONSOR:** Peter Trapp Shows. **LOCATION:** Tadmor Shrine Temple. **HOURS:** 10am-3pm. **ADMISSION:** \$6, \$1 off w/this ad or coupon, under 12 free. **FEATURES:** AC - C - FP - F/R. **CONTACT:** Peter Trapp Shows, 607-369-2796.

OCTOBER 21

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

MI - JACKSON — Computer Trade Show. **LOCATION:** Jackson Catholic Middle School, 915 Cooper St, Approx 1 mi S of I-94. **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 - SAUGATUCK — Westshore Hamfest & Computer Expo. **SPONSOR:** Holland ARC. **LOCATION:** Holland Christian High School. **HOURS:** 8am-1pm. **ADMISSION:** \$4, under 12 free. **TALK-IN:** 147.060+ w/94.8 PL. **FEATURES:** C - DP - EX - F/R - H. **DEALER INFO:** 8' table: \$8, 5' table: \$6. 616-857-1343. **CONTACT:** Barb Siebelink, 6418 Otis Rd, Saugatuck MI 49453.

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 - FP - F/R - S. **DEALER INFO:** Covered 8' table \$35 ea. **CONTACT:** Progressive Computer Productions,

Continued on page 139

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AM486DX-33 (PGA) \$49.95	8742.....\$4.95
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80287XL.....\$24.95	8748H.....\$6.50
80387SX-16.....\$17.95	8749.....\$5.95
80387SX-20.....\$19.95	8749H.....\$6.50
80387SX-25.....\$22.95	8751.....\$8.95
80387DX-20.....\$17.95	8751H.....\$9.95
80387DX-25.....\$24.95	8752.....\$13.95
80486SX-25 (PGA) \$34.95	8755.....\$6.95
8741.....\$3.95	

All parts, all socket pulls (must be cleaned & erased). *Note: Speed selection available at additional charge and all parts subject to availability.

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2716.....\$0.65	27512.....\$2.45
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All DRAMS are clean socket pulls and have full leads.

4164-15.....\$0.18 Ea.	41256-15.....\$1.00 Ea.
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Laptop replacement or up-grade 2.5" hard drive. Logical Translation 989 Cyl./10 heads/34 Sec. Check your BIOS. 15ms +5Vdc 0.5 Amp. (P/N 84G1745). IBM-H2172-A2/(84G1745).....\$124.95 Ea.

NEW MITSUMI 1.2 MEG 5-1/4" FLOPPY DRIVE

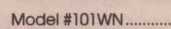
5-1/4" half height Mitsumi Model #D509V2 White face plate only. Mitsumi 1.2M FDrive.....PRICE REDUCED \$28.95 Ea.

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Pulled from working equipment tested with 30-day warranty. Board supports two floppies and up to seven SCSI devices. Note: No manual or software supplied with card. UltraStor U24F-10F.....\$79.95 Ea.

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4 ft. coil cord with PS/2 type 6 PIN MINI DIN connector. AT and XT DIP switch selectable. Model #101WN.....\$24.95 Ea.

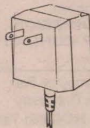


NEW MICROSOFT TWO-BUTTON PS/2 MOUSE

The old-style type, but old reliable. Note: No software included with mouse. MS PS/2 Mouse.....\$19.95 Ea.

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Quantity Pricing Available

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12Vdc 100Ma.....\$1.25 Ea.
12Vdc 200Ma.....\$1.50 Ea.
12Vdc 500Ma.....\$2.95 Ea.
12Vdc 600Ma.....\$3.95 Ea.
12Vdc 800Ma.....\$6.95 Ea.
12Vdc 830Ma.....\$4.95 Ea.
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NEW 80486SX-25 BABY MOTHERBOARDS

Supports up to 32MB of RAM on-board. 256KX9/1Megx9/4Megx9/(80NS) 30 pin type SIMM. Five 16 Bit Slots and One 8 Bit Slot. AMI BIOS/Supports loadable hard drive parameters 720K/1.2Meg/1.44Meg/2.88Meg (with proper controller) 8K Internal cache only. 486SX-25 Baby Motherboard (CPU included) (O-K RAM).....PRICE REDUCED \$74.95 Ea.

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Brand New True 256 Gray Scale Hand Scanner. Resolution: 25-400 DPI. Scan Width: 4.2 in. Scan Length: 11 in. Interface: 16 Bit high speed (ISA) card, 64K SRAM. System Requirements: 286/386/486 PC Compatible (16MHz). Available 16-Bit Interface slot, Windows 3.1, 4 Meg RAM, 10 Meg of Available HD space (Min.). Mouse or Other pointing device. Software Included: Picture Publisher LE 3.1, (Imaging Software), Perceive Personal 2.1, (OCR Software) Niscan/GS Plus.....\$69.95 Ea.



USED 150MEG SCSI TAPE BACK-UP DRIVE

Pulled from working equipment 150Meg SCSI Cipher P/N ST150-II. 30-Day Guarantee. 5-1/4" Half Height, off-white color faceplate. Interface: SCSI/1, 50 Pin. Cipher ST150S-2.....\$49.95 Ea.

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SVGA (Tseng ET4000 1Meg).....\$39.95 Ea.

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1.2Vdc 800Ma/Hr. Charge Rate 15 Hours @ 80Ma. Manufacturer Kenwood/Batteries have nipped end. Kenwood NB-88 (KR-AA).....\$1.75 Ea. Kenwood NB-88 (KR-AA) 4 or more.....\$1.50 Ea.

NEW 250 MEG 2.5" IDE HARD DISK DRIVE

Laptop replacement or upgrade 2.5" hard drive. Logical translation 723 Cyl./11 heads/63 sec. Check your BIOS. 17ms +5VDC 0.5 Amp. Quantum Daytona 256AT.....\$179.95 Ea.

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Pulled from working equipment. The Adaptec's first generation 1540A SCSI-2 ISA BUS card. Includes 2 Device 50 Pin SCSI cable. (NO Software) (No Floppy support) 30-Day Guarantee. ADPTEK 1540A.....\$34.95 Ea.

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New style type (Melted bar of Soap). DB9 Connector Female Connector only. Note: No software included with mouse. MS Serial Mouse.....\$29.95 Ea.

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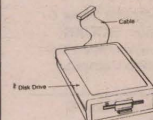
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CABLE TV

110

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WE CARRY most CBTv major brands. Call for free catalog. White-Star Electronics, 405-631-5153, Fax 405-631-4788.

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Build a Digital Tester

by Fred Blechman

Here's a real handy "test-almost-anything" gadget that will be useful to electronic designers, troubleshooters, and experimenters. Extensive use assumes some electronic background, especially in digital testing. However, its versatility allows even relative beginners to find it useful in testing analog amplifier and broadcast receivers, as well as individual electronic parts. It costs well under \$10.00 to build from scratch.

Most of the parts are commonly available from advertisers in *Nuts & Volts*. Where the part is less common, a source is given. Also, two different inexpensive "packaging" designs are described.

Overview

The "Digital Tester" is basically a three-speed squarewave generator that can be used for testing electronic circuits and components. Used as a "signal injector," it can test digital and analog amplifiers. It can also be used — together with a speaker or earphone and a battery — to test various types of components.

Before getting into the details of "how it works," a brief description of "how it's used" will make it easier to follow the technical explanation that follows.

The "controls" consist of two two-position slide switches and a pushbutton switch. Power is normally supplied by the circuit under test, or an external nine-volt battery.

With the MANUAL/AUTO slide switch in the MANUAL position, simply depress the pushbutton switch whenever you want an output state change from LO to HI, or HI to LO. If you want slow-speed operation, you set the MANUAL/AUTO switch to the AUTO position and the FAST/SLOW switch to SLOW. Then the output changes automatically about once or twice each second, and holds each state for about the same time. By setting the FAST/SLOW slide switch to the FAST position, the output "speed"

increases to approximately 460 Hz (cycles per second), still a square-wave.

For TTL, DTL, or CMOS circuits, you clip the red (positive) and black (ground) leads to the power source, and, depending on switch settings, the yellow output lead provides a HI or LO, or a "slow" or "fast" square-wave "clock." This is particularly useful when experimenting with counting or logic circuits and you want to slow things down so you can see what's happening.

You can trigger all kinds of digital counters and flip flops, and even linear devices and transistors with this extremely simple one IC device.

For testing amplifiers and radios, the squarewave is like a sinewave rich in harmonic frequencies that go up into the high kilohertz range, so the signal even goes through broadcast-band AM and FM

tuned circuits.

Circuit Operation

The schematic of the Digital Tester is shown in Figure 1. Two of the six sections of the CMOS 4069 hex inverter IC are used in a bistable circuit; two sections are used in an astable multivibrator circuit; and two sections are used as buffer/drivers for the output.

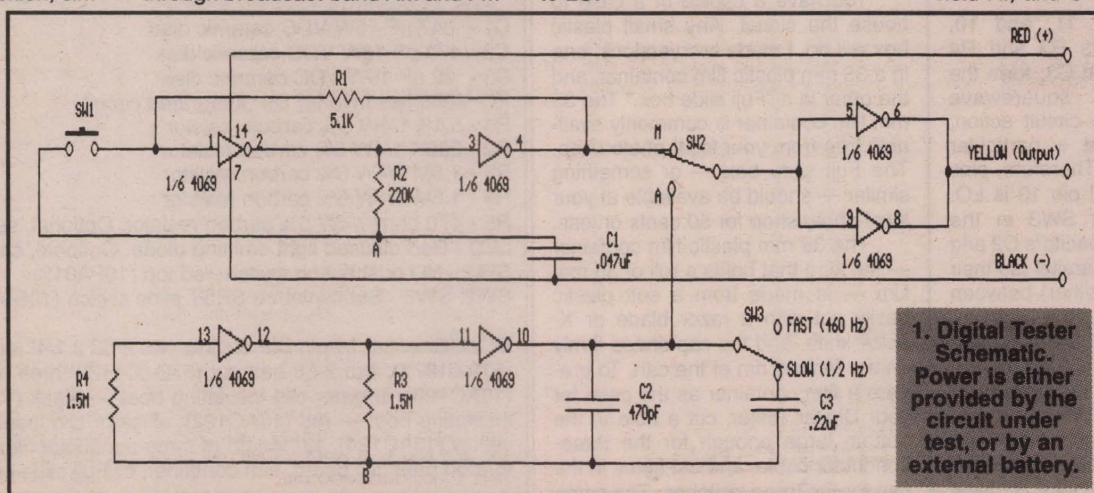
IC pins 1, 2, 3, and 4, together with resistors R1 and R2, capacitor C1, and pushbutton switch SW1, form the bistable circuit. Actually, this is a latched flip-flop arrangement which changes state, and holds the "new" state each time the pushbutton is pressed. If the pin 4 output is LO, then pressing the button changes pin 4 to HI. The next operation of the pushbutton will drop pin 4 to LO.

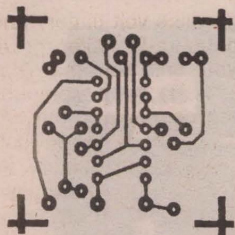
To describe the circuit action, say pin 1 is LO and pushbutton switch SW1 is open. Because this is an inverter, pin 2 is HI. Since pin 2 is directly connected to pin 3, pin 3 is HI, and the inverted output at pin 4 is LO. The circuit is stable in this condition, and C1 is charged to almost the supply voltage through R2.

Now, when SW1 is closed, the positive charge on C1 is applied to pin 1, which instantly goes HI; pins 2 and 3 go LO, and pin 4 goes HI. As long as SW1 is held closed, a voltage divider to the LO at pin 2 is formed at Point A, with HI voltage fed through R1 from pin 4. Since R1 is such a low value compared to R2, the voltage at Point A and pin 1 is held HI.

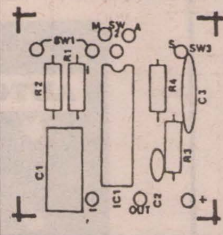
However, when SW1 is released (opened), Point A is no longer held HI, and C1 discharges through R2 to the LO at pin 2. The RC time constant keeps C1 HI long enough to eliminate the effect of switch contact bounce, so this circuit is fully "debounced."

Since pin 1 is still HI, there is no change of state when SW1 is opened; pin 4 is still HI. At the next closure of switch SW1, pin 1 sees "ground" at Point





2. Printed circuit layout, actual size.



3. Parts layout using printed circuit board. Observe orientation of the integrated circuit chip.

the capacitors discharge through R3 until Point B drops below threshold voltage. Pin 13 snaps LO back to where we started.

Resistor R4 is connected from the timing circuit (R3, C2, C3) to pin 3 to limit current to the built-in CMOS diode protection gate input circuit. The action keeps repeating at a rate determined by the setting of switch SW3 — SLOW or FAST. When in the FAST position, the larger capacitor C3 is removed from the circuit; since the total capacitance is now much lower, and the charge/discharge times are shorter, the circuit changes state faster.

When MANUAL/AUTO switch SW2 is placed in the AUTOMATIC (A) position, the bistable circuit output is disconnected and the output of the multivibrator (FAST or SLOW, as set by SW3) is connected to the buffer/inverters, which trigger the Digital Tester output (yellow) lead.

Construction

The Digital Tester can be assembled on perforated board or you can make a printed circuit board as shown in Figure 2. There is nothing critical about parts layout if you use perforated board; if you use the printed circuit, Figure 3 shows the parts layout.

It's a good idea to use a 14-pin integrated circuit socket instead of soldering the 4069 IC directly to the board. Solder the socket and component leads carefully, using .031 diameter resin-core solder and a fine-tipped 25-50 watt soldering iron. Clip off the excess leads and examine the soldering carefully for unintentional solder "bridges." When you plug the 4069 IC into its socket, be sure the notch is oriented as shown.

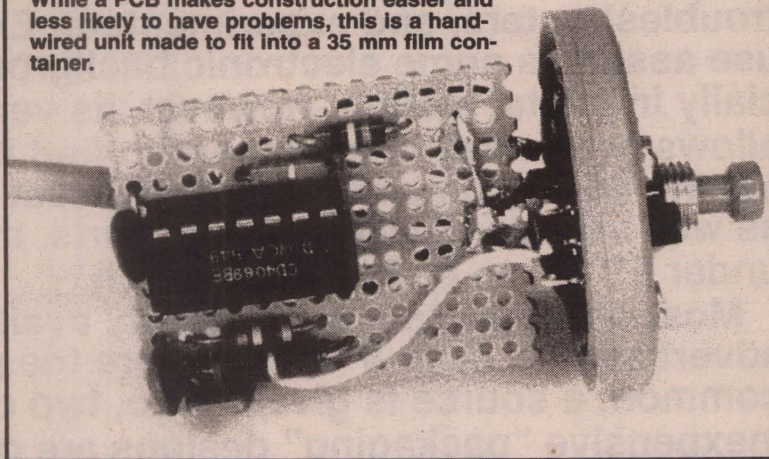
You have a choice of a case to house the circuit. Any small plastic box will do. I made two versions, one in a 35 mm plastic film container, and the other in a "Fuji slide box." The 35 mm film container is commonly available free from your local photo shop. The Fuji slide box — or something similar — should be available at your local photo shop for 50 cents or less.

The 35 mm plastic film container — the kind that holds a roll of 35 mm film — is made from a soft plastic easily cut with a razor blade or X-acto® knife, and the cap snaps firmly on the formed rim of the can. To prepare a film container as the case for your Digital Tester, cut a hole in the bottom large enough for the three-conductor cable, and cut holes in the cap for the three switches. The push-

Three switches, three clip-leads, a 35 mm film container, and a few electronic parts (including one IC) make a really handy digital pulse/tester.



While a PCB makes construction easier and less likely to have problems, this is a hand-wired unit made to fit into a 35 mm film container.



button switch is held in position with the large nut that comes with the switch. If you use a film container as the case, you'll need subminiature slide switches (see parts list) that are held to the cap with #2-56 screws and nuts. Figure 4 shows the layout of the switches.

The Fuji slide box (and I'm sure there are other brands besides Fuji) is a rectangular box made from thin plastic, used to hold 36 developed slides. It usually comes free when you have slide film processed. You can put all the switches on the lid, and the board with all the parts

inside. Also, the wiring is less crowded and you can use standard size slide switches.

In either case, next wire the board assembly to the switches as shown in Figure 5 (if you use the PC board legends shown in Figure 3), or based on the Figure 1 schematic. Be sure that none of your wires and switch terminals are shorted together.

Now, connect one end of the three-wire cable to your circuit board, solder the clips on the other ends of the wires, slip the proper colored insulator over each clip, and your Digital Tester is complete!

A (since C1 is discharged) and pin 1 instantly goes LO. Pins 2 and 3 go HI, with pin 4 going LO. As long as the switch is closed, R1 holds pin 1 LO, since it is the lower leg at Point A of the voltage divider formed by R2 and R1 being fed a HI voltage from pin 2. When the switch opens, C1 charges through R2, again taking enough time to debounce the switch; pin 1 stays LO. We're back where we started.

When switch SW2 is placed in MANUAL (M position), the HI or LO on pin 4 is applied to pins 5 and 9 of two sections of the IC, which are connected in parallel to increase the current available at the output. These invert and isolate the output so even a low impedance, such as an eight-ohm speaker, won't load down the circuit.

IC pins 13, 12, 11, and 10, together with resistors R3 and R4 and capacitors C2 and C3, form the astable "two-speed" squarewave oscillator. To illustrate circuit action, let's assume that, at a particular instant, pin 13 is LO. Therefore, pins 12 and 11 are HI and pin 10 is LO. With selector switch SW3 in the "slow" (S) position, capacitors C2 and C3 are connected in parallel (so their capacitances add together) between pin 10 and Point B.

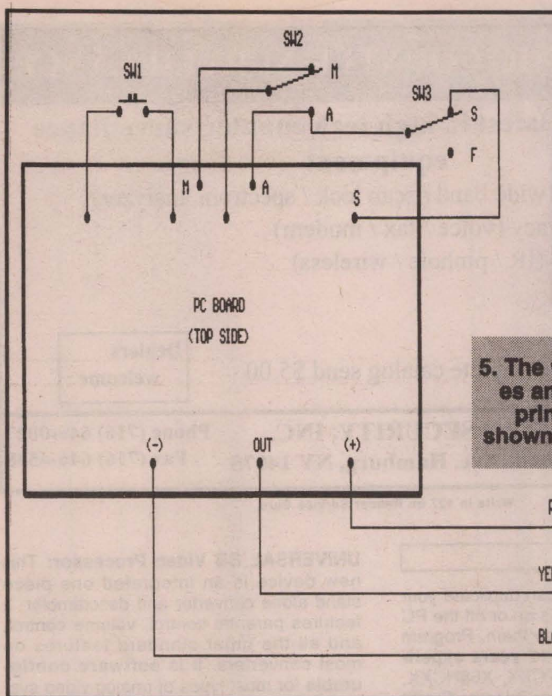
If pins 12 and 11 have just gone HI, capacitors C2 and C3 are charging through R3, thus the voltage at Point B is increasing. When the voltage at this point reaches transfer voltage, pin 13 snaps HI, pins 12 and 11 go LO, and pin 10 goes HI. Now

PARTS LIST

Note: Mouser part numbers are shown in parentheses for the relatively uncommon parts. (Mouser Electronics, 2401 Hwy. 287 N., Mansfield, TX 76063-4827. Call 800-346-6873 for a free catalog that will make you DROOL!)

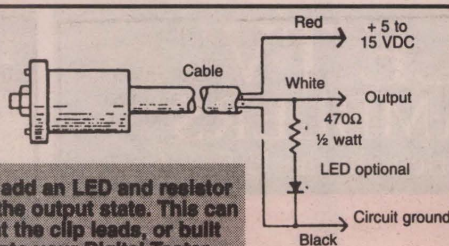
- C1 - .047 uF 16W VDC ceramic disc
- C2 - 470 pF 16W VDC ceramic disc
- C3 - .22 uF 16W VDC ceramic disc
- IC - 4069 hex inverter DIP integrated circuit
- R1 - 5.1K 1/4W 5% carbon resistor
- R2 - 220K 1/4W 5% carbon resistor
- R3 - 1.5M 1/4W 5% carbon resistor
- R4 - 1.5M 1/4W 5% carbon resistor
- R5 - 470 ohm 1/4W 5% carbon resistor. Optional, see text.
- LED - Red diffused light emitting diode. Optional, see text.
- SW1 - NO pushbutton switch, red top (10PA012)
- SW2, SW3 - Subminiature SPST slide switch (10SM007). See text

Miscellaneous: 14-pin DIP socket, two 2-56 x 1/4" long screws, round head (572-01875); two 2-56 hex nut (572-00482); three miniature alligator clips (13AC120); alligator clip insulating boot — black (13AC121); alligator clip insulating boot — red (13AC122); alligator clip insulating boot — white or yellow (13AC124); 12" length of three-conductor cable (515-4062-12); perforated phenolic board, film container, or Fuji slide box.



5. The wiring of the switches and clip leads of the printed circuit board shown in Figure 2 is used.

7. You can add an LED and resistor to indicate the output state. This can be done at the clip leads, or built directly into your Digital Tester.



output lead.) In the MANUAL mode, the LED lights when the output is HI, it blinks at the cycle rate when in SLOW, and appears to be on all the time when in FAST mode (although it is only on half the time).

Actually, if you want to add the LED and resistor to your Digital Tester as a status indicator, you can mount the LED in the top of the case permanently; however, the current requirement for the Digital Tester will go from about 1 mA without the LED to over 5 mA with the LED.

The Digital Tester can also be useful in testing amplifiers, radios, and many electronic components. In typical transistor radios, which operate on 6, 9, or 12 volts, the Digital Tester can be powered by the radio power supply. If inconvenient to do this, use a standard

bad part.

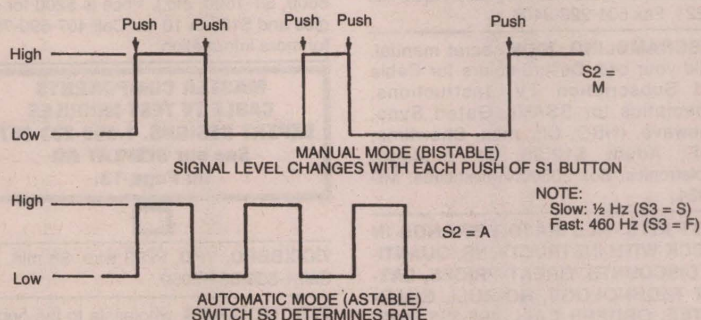
Using a nine-volt battery and a small eight-ohm speaker or earphone, you can put the Digital Tester to work as a component tester when operating in the FAST mode. See Figure 8. When testing resistive devices, the sound from the speaker will be loudest at lowest resistance, and you will still be able to hear some sound from the speaker with up to 15K ohms in series with the speaker.

When testing capacitors, the larger the capacitance, the louder the sound through the speaker. Capacitors as small as .001 mF (1000 pF) will still be audible. When testing polarized capacitors (electrolytic, tantalum, etc.) be sure test-point "X" is connected to the positive lead. The rectifier/diode/LED test also determines polarity, since the speaker is silent if the connection is reversed from that shown. An LED under test will light when connected as shown, with current limiting provided by the IC output and the speaker impedance.

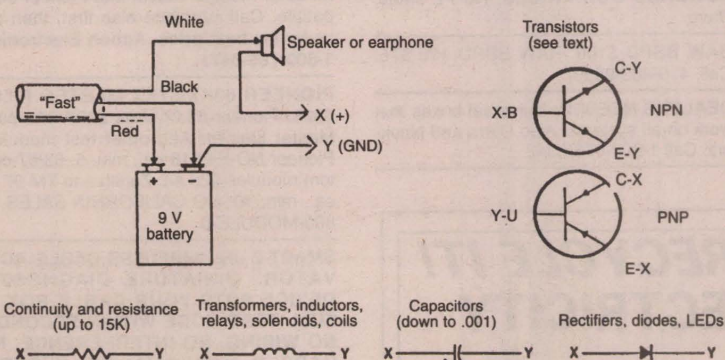
Transistors are tested as if they were composed of two diodes with a common base. First determine which leads are the base, the emitter, and the collector. Clip the "X" test lead to the base and alternately connect "Y" to the collector and emitter. Speaker sound in both cases tells you the transistor is a functioning NPN type. If the speaker is silent, reverse the leads so test lead "Y" is connected to the base, and "X" alternately connected to the collector and emitter. Sound now means you have a functioning PNP transistor.

Many other components, such as switches, incandescent bulbs, photocells, earphones, some microphones, potentiometers, patch cords, etc., can be tested for continuity. Also, you can use any battery from 5 to 15 volts for these tests. If you choose, you can build all the circuitry in a larger case to include a Digital Tester, battery, LED, and speaker, and have a portable "universal" tester!

Simple, small, inexpensive, portable, easy-to-build and very versatile in its applications, the Digital Tester can become one of your most useful items of test equipment. NV



6. You can operate the Digital Tester manually, as shown in the upper trace, or automatically, as shown in the lower trace.



8. The Digital Tester, operating in its FAST mode, can be used to test various kinds of components by using a battery and speaker. See text.

Using the Digital Tester

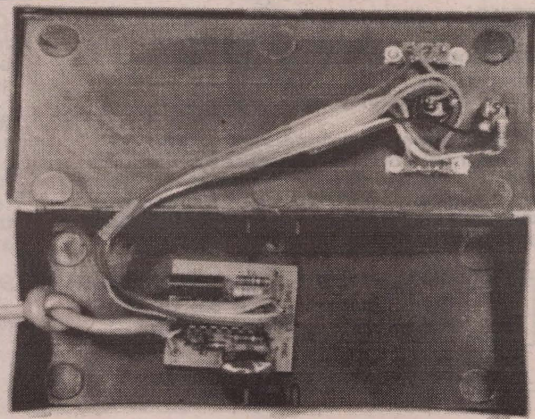
The basic use for the Digital Tester is to trigger digital circuits — a digital pulser. Connect the red clip to circuit positive voltage, the black clip to ground, and use the yellow clip as the "trigger," setting the switches for the operating mode you desire. Figure 6 shows the bistable and astable signal level changes.

In the MANUAL mode, you can trigger a counting circuit, for example, and hold the desired state as

long as you want. You can determine if the circuit operates on a positive-going or negative-going pulse edge with a voltmeter, scope, or LED status indicator connected between the yellow and black leads.

Figure 7 shows you how to monitor the output signal with an optional LED (light emitting diode) and a resistor. (Note: Figure 7 and Figure 8 show the output lead as "white" instead of "yellow." It's a matter of which color insulating sleeve you use over the small alligator clip of the

The controls and LED can be mounted in the lid of the slide box, with the circuit board in the bottom.



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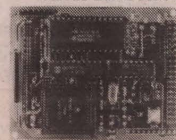
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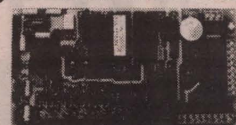


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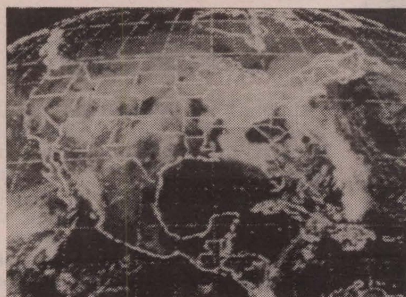


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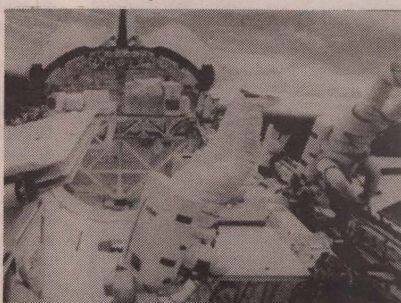


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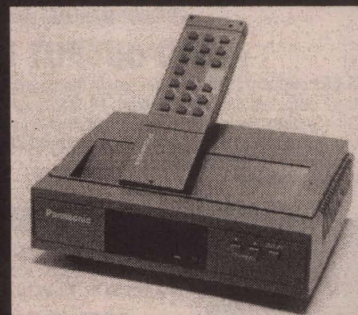


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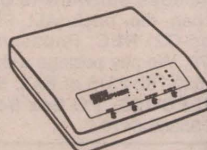
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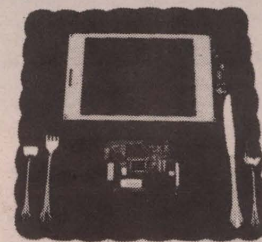
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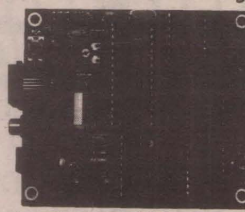
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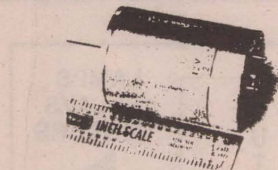
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Gleanings from the surplus mines. My July 30 "Parade" Sunday newspaper supplement cover shows Ret. Maj. Gen Chuck Sweeny sitting in the cockpit of a B29, perhaps the Enola Gay. He is a pilot who flew on both the Hiroshima and Nagasaki missions.

Something caught my eye in the bottom right corner of the photo. There it was, the ubiquitous **Norden** bombsight. My association with the Norden goes back to the beginnings of my interest in surplus. In the late Forties, Canal Street NYC was lined with shops that sold war surplus. The stuff was so cheap they just put it out on the sidewalk. I was hooked. I trembled with excitement on Saturdays when, clutching the few dollars I could dig up I took the BMT to Canal. One of the greatest items was an optical contraption, with curved mirrors, beamsplitters and various mechanisms. It cost \$1, came wrapped in tissue paper. Later on, I bought complete Nordens, using the gyros for the infamous "briefcase that wont go around corners" trick.

Now I find a similar thrill in finding "state of the art" technology that my customers can experiment with, build from, and learn from, at a price they can afford. I hope you find these items as exciting as I do. Yours truly, Franklin G. Fink

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THE SOLDERLESS BREADBOX

by Donald Wilcher

I/O Control and Computers

Controlling "real-world" devices has always been a fascinating area of electronics to explore.

I remember reading the original *Popular Electronics* magazines with articles on controlling real-world devices using such machines as the Color Computer or Model 100. I would read this material intensely, soaking up every diagram and component shown in the article. I was so amazed at how a computer could generate the necessary voltage levels based on a simple "BASIC" program.

It wasn't until college where I began to understand the mystery behind I/O control using microprocessors and computers. The course was a microprocessor interfacing class where I/O (input/output) control, assembly language, and flowcharting were explained in their entirety.

In addition to the micro class, I also experimented on my own using a color computer to do simple I/O control and data acquisition. The Model 100's serial port was also explored with commands such as "OUT" and "INP." These two instructions allow the machine to write and read devices wired into the serial port.

Now, it's 1995 and the ultimate challenge is to use my Macintosh SE computer in the same capacity like the CoCo and the Model 100 units. I could have designed a circuit that allowed me to interface the Mac with the real world, but I knew there had to be an off-the-shelf board that I could connect to my computer.

After searching through several computer and electronic magazines, my quest was ended by reading the July/Aug '95 issue of *SciTech Journal* for Macintosh users. For as little as \$85.00, I was able to purchase an eight-bit input/output board that I could connect to my Mac and embark on a voyage into the mysterious realm of computer interfacing.

Although the information presented in this month's column is written for Mac machines, the same information can be adapted to PC users as well. Whatever machine that you have, a little experimentation goes a long way. So don't be afraid to explore the inner workings of your machine.

The main intent for this article is to show what it takes in connecting a computer to the real world and to explain how the computer is able to detect and con-

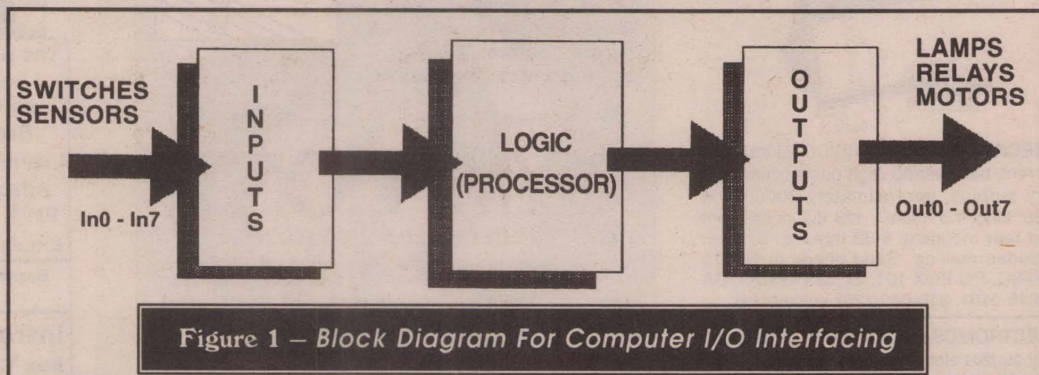


Figure 1 - Block Diagram For Computer I/O Interfacing

trol its surrounding environment. So, let's begin our voyage of computer interfacing with an explanation of computer I/O control.

Computer I/O Control Basics

The block diagram in Figure 1 shows how computer I/O control is accomplished. The input portion of the system relates to devices that provide current or voltage to the computer. These devices can be switches and sensors. Switches can provide real-world data by the on/off transition of their contacts. Faster switching speeds mean more environmental data is being provided to the computer.

Generally speaking, switches usually provide logic (digital) data to the computer. Applications of interfaced switches are counting parts on a conveyor, monitoring liquid levels, and determining rotational speed.

Sensors, on the other hand, provide varying (analog) values of data to the computer. This information relates to how something is changing over a period of time. Sensors are used to provide information about the physical nature of an environment. Example applications of interfaced sensors are light detection, wireless control, and sound monitoring.

Figure 2 shows a diagram of a simple switch and sensor, and their applications. The logic or processor unit is responsible for interpreting the data received by either a switch or sensor. By using a computer program, the data produced by the input can be manipulated or "crunched" for future processing.

The processor unit is the brains of the computer I/O system. The processor allows the appropriate electronic switches inside of the computer to be switched and then routes the finished data to the correct output ports of the machine. The speed in which this data manipulation happens is in microseconds. But exactly how does the computer turn on/off devices wired to it? Simply, by using the output ports.

All computers have output ports that allow the machine to "communicate" with the real world. Printers, external hard drives, and modems are examples of output ports the computer controls via instructions received from the processor. The method in which communication

exists between the computer and these devices is by serial or parallel techniques. Serial communications are where a "string" of pulses produced by the sender/receiver represent data obtained from the environment.

Parallel communication transmits its data all at once or in a "parallel" manner. Serial communication requires one line for sending and receiving data whereas parallel communication needs multiple lines for sending and receiving each data bit. Figure 3 illustrates these communication modes. Modem ports are serial in function, and printer ports fall under the parallel communication category.

The interface board for the Mac is of the serial persuasion. There are various books and articles that discuss how to use a printer port to control the outside world. One book that would be of interest to PC users is *Controlling The World With Your PC* by Paul Bergsman. This high tech book published by HIGHTEXT Publishing describes how to use the parallel port of a PC to control such devices as motors, lamps, and relays, as well as how to interface switches and sensors to the machine. The book comes with full schematics of the circuits to build and a listing of all the programs needed to make the projects work. A 3-1/2" disk accompanies the book so that the programs can be downloaded to the PC without a lot of typing. All the programs are written in BASIC and "C" languages. The cost of the book is \$35.00 and it can be found at any local bookstore.

Now, that the basics are understood about computers and I/O control, let's take a look at how the Mac can be used to control external devices.

A Serial I/O Board for the Mac

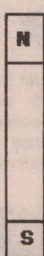
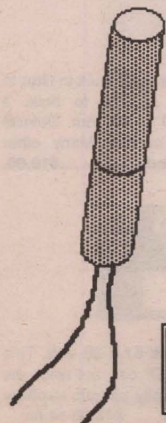
As mentioned earlier, an \$85.00 serial I/O board can be purchased from the *SciTech Journal*. The board is quite unique because it uses a UART for receiving and sending information to the Mac for data manipulation. UART is short for Universal Asynchronous Receiver Transmitter and it is a 40-pin IC that is used for reading and driving external devices. The serial I/O board is an eight-bit unit which means it can read and control 16 devices total.

The disk that accompanies the board has several programs for demonstrating I/O control. The Serial Monitor program is useful because it allows the serial I/O board to be checked quickly.

By selecting the eight-bit pattern shown on the window screen, outputs can be turned on and off. The input portion of the screen will show a closed or open

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Use to switch voltage and detect a magnetic field



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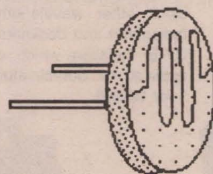


Figure 2

Switch And Sensor With Applications

THE SOLDERLESS BREADBOX

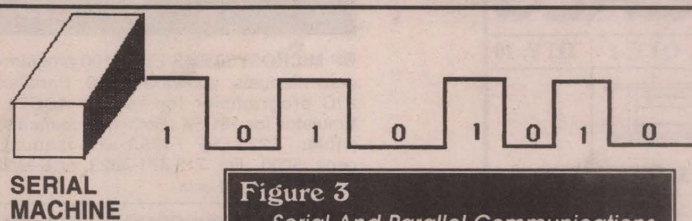


Figure 3
Serial And Parallel Communications

tions for the board such as a computerized timer, an event counter, a programmable frequency generator, digital logic experiments, and light detection/sensing projects.

So, to illustrate how to use the Mac Serial I/O board, let's take a look at how to get the board functioning correctly.

These pulldowns prevent the inputs from toggling between 5V and 0V. Once these potential problem areas have been cleaned up, the serial I/O board is ready for some hardcore computer interfacing.

One project that can be experimented with is tying a switch to any input and having its associated output change states upon its contacts changing.

The wiring diagram in Figure 5 shows how this change can be implemented. As the switch is depressed, the output will change and this operation can be seen using the serial monitor program. Other types of switches can be wired into the board such as magnetic, rotary, and toggle devices. To give the Mac real-world control, wire a transistor relay driver circuit to the output. Not only will you have a visual indicator of output status, but hardware control will exist as well.

Further Thoughts & Experimentation

This concludes our first voyage into the world of computer control. I would like to repeat that this information is based on using the Macintosh computer, but personal computers can be adapted to this interfacing philosophy as well.

Another application that can be carried out using the information provided is to create a computerized switch tester. By writing a simple Basic program, the Macintosh computer can log the number of times a switch has passed or failed the test. Have the screen print "Testing Has Started" and, after the test, the computer will log the switch's status. The results of this application will be discussed in next month's column.

For other applications on computer interfacing, check out your public library. They have tons of books on this subject on both the card index and the Dialog computer service. Ask the librarian for assistance on using these research tools.

Speaking of research, the folks from the Society For Amateur Scientists are an excellent resource for subjects ranging from computer interfacing to astrophysics. Shawn Carlson, the Executive Director, and his staff have tons of stuff on any area related to science. Their focus is to attract as many folks in their web of **Science Should Be Part Of Your Lifestyle!** Their Electronic Forum allows professional and amateur scientists to exchange ideas and opinions on any science-related subject. Yours truly is a member and I have been quite active on this forum discussing my *Nuts & Volts* projects and topics on science education. So, give the SAS a call and tell Shawn I sent you. You'll be glad that you did! Enuf said, see ya in the next breadbox!!

NV

E-Mail address: t6790dw@infoctr.chrysler.com

RESOURCES

To order the Mac Serial I/O board, call the office of *SciTech Journal* at (508) 755-5242. The board is available in kit and assembled versions.

Jameco Electronics Catalog has several pages devoted to I/O boards for personal computers. Contact them at (800) 237-6948 to receive a free catalog.

Shawn Carlson and the **Society For Amateur Scientists** can be reached at (619) 239-8807.

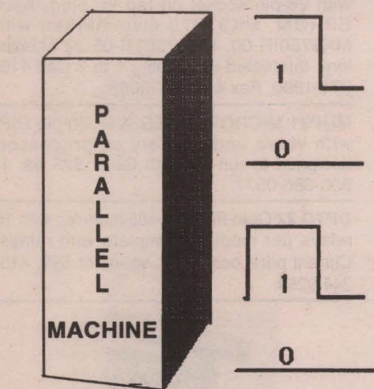
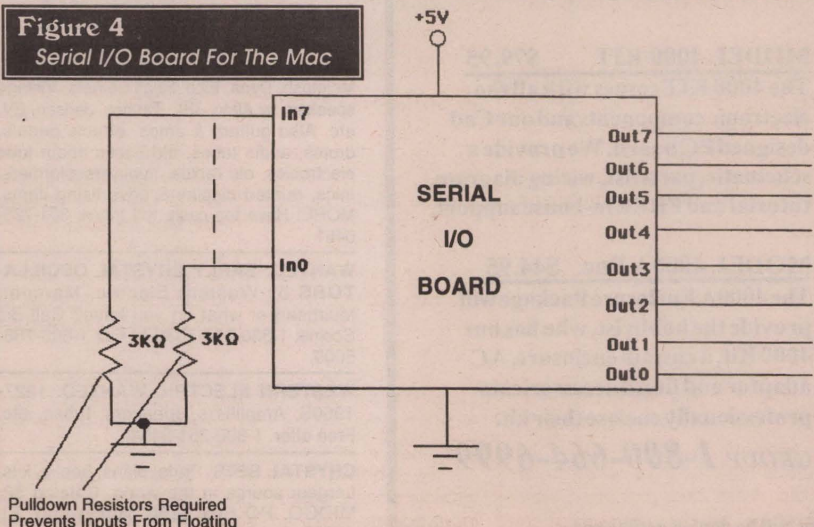


Figure 4
Serial I/O Board For The Mac



Pulldown Resistors Required
Prevents Inputs From Floating

Oh, before I forget, Mike Cook's E-Mail response helped in developing these QuickBasic programs. Thanks a lot for the info, Mike!!

Mac Serial I/O Basics

In order to use the board for I/O control, a few items of importance must be addressed. The first one is serial board to Mac communications.

To make sure that proper communication is established between the Mac and the serial I/O board, this network should be tested using the monitor program on the accompanying disk.

Upon powering up the board and running the software, the screen will display a window showing all eight inputs and outputs. If there are "Xs" on this window, then the problem resides in the serial cable.

The male pins of the cable should be tied to opposite pins on the female end. If not, the cable should be reworked by cutting it in half and splicing the wires inside of the insulated sheave to the appropriate pins.

Another item that needs to be cleaned up is the floating inputs of the serial board. If the monitor program is showing the input data bits toggling, they should be tied to ground via 3K-ohm resistors.

Figure 4 shows the wiring diagram for adding the resistors.

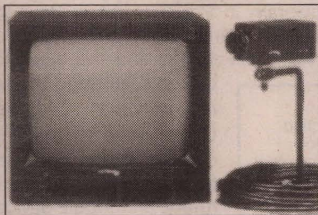
Figure 4 shows the wiring diagram for adding the resistors.

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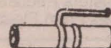
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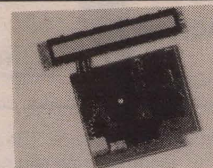
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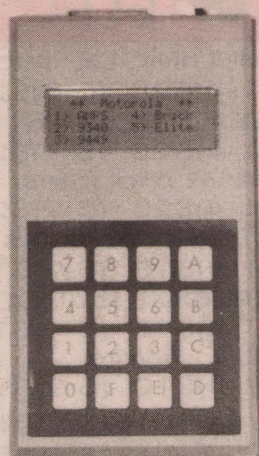
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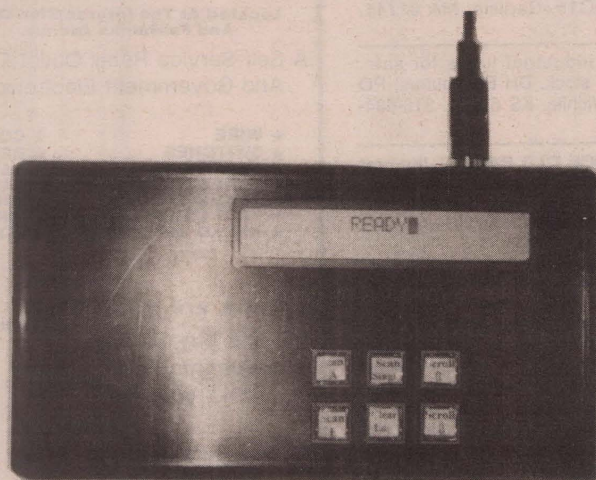
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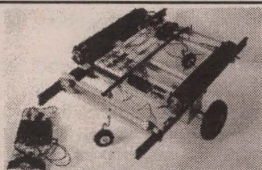
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Questions & Answers

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

On my PC compatible's main board is a four prong connector for the speaker. The outside two prongs go directly to the speaker. The speaker is rated: 0.3 watts 8W. I would like to put a 1.5 watt speaker in its place. To save the circuit on the main board, I need a high impedance amplifier. The sound output needs to be medium to higher fidelity and it should use a 12 VDC supply. And, if possible, a volume control.

10951 Anonymous

I need information, circuit, schematics to play back EPROMs (27128, 27256, 27512) programmed with "Windows Way" type files or "AU" type audio compensation for the circuits or information.

10952 Lou Pryor Sterling, VA

I have an IBM PS-2 model 30 computer with 640K RAM. I would like to increase the memory to run Windows and I need economical solutions to this problem. I've been told it can't be done on this model.

10953 George Terry Yorktown, VA

I'm having problems with the pre-selector stage in a Yaesu 100EE. There are several adjustments of the slugs which produce enough drive for the PA, but most of them cause the 12BY7 to oscillate, not amplify and the carrier control has no effect. It acts like a tuned grid-tuned plate oscillator. Has anyone else had the problem and do you have a fix?

10954 W. Forsland Oroville, CA

How do I replace a 2050 Thyratron Vacuum Tube with solid-state components? Please show schematic (from the 2050 socket) and part numbers for the components.

10955 Bob Putnak Monongahela, PA

I would like to make a device that would test the water in aquariums. I want it to test for nitrite (NO₂) and ammonia (NH₃/MH₄) and if possible pH and chlorine (CL₂). It has to display it in parts per million.

10956 Gregg Fuchs Painesville, OH

I am in the process of converting a transformer for a battery charger (18 ampere) to a disk drive power supply. I want it to test what gauge wire to use to supply power to my disk drives and interfaces. I have had a short argument with a person that declares that

the amperes is the same for any voltage. But, I feel differently! Why else does automotive wiring go for such heavy gauge wire and why the difference in 6 volt and 12 volt wiring? Then I read in the last issue the letter by Robert Tiffany and reply by Shari Prange.

In regards to the letter by Robert Tiffany and reply by Shari Prange in the Jul. '95 issue of *Nuts & Volts* and the readers feedback column, I need to know what gauge wire to use to carry five volts at five amperes with a wire run of five feet from the disk drive power supply to the disk drives where it will be divided out to the individual disk drives to avoid a power drop more than the allowable $\pm 1\%$. With my orphan obsolete Timex Sinclair 2068 computer and the various disk drive interfaces (four different) that I have for it, the worst possible power consumption is five times 1 ampere; for the four disk drives plus 1 ampere for the disk drive interface. I don't need to worry about the 112-volt supply since it requires a lesser gauge of wire than the 5-volt supply to carry the amperage. Amperes is amperes is amperes except when you change the voltage, else why do the power companies go to such high voltage lines to transfer power from point A to point B?

10957 Donald S. Lambert Auburn, IN

I would like to find out the switch settings and cable requirements to use a teletext TS-800A terminal for packet radio. Any help will be greatly appreciated. My TNC is an MFJ1278.

10958 George Whitfield Manassas, VA

I own a Mitsubishi MIT800 trans-portable cellular phone. I want to learn more about how the ESN and related data are stored in the EPROM. The EPROM is a Fujitsu MBM27C256A-20. When I read this EPROM into my reader/programmer, I get no understandable information. The ESN, MIN, etc., do not seem to appear anywhere in hex or ASCII. I have read that some PROMs have a security fuse that once blown, disables the ability to read to PROM. The other possibility is that a security algorithm is being used. Can anyone help me out with information on how the data is stored in the EPROM and how I can access it?

10959 Andy Zaayenga Freehold, NJ

I am in need of some information for the AC adapter/charger for an Everex laptop computer (Tempo LX, 386SX/20, vintage 1988.) The "DC IN" connector is a mini-DIN with eight pins. The battery is not easily remove-

able to measure the relevant voltage(s). Any info on the pinout of the mini-DIN, voltage and current requirements for operation, and other info concerning the computer itself (I have no manuals for it), or sources for info (Everex phone seems to be disconnected), would be appreciated.

109510 Steve Bepko Baltimore, MD

Would any experienced amigo help me with the following question? I have bought a 10 ft. solid antenna manufactured by Andrew that I will use in my TVRO C band system. How can I calculate the angle to transform the antenna in a offset type? Can this be done?

109511 Antonio Loreto Venezuela, S. America

Is there an agency that monitors the RF Spectrum on a minute-to-minute basis? I am looking for North America Spectrum Patterns (strip chart recordings) on April 19, 1995, from 9 to 9:05am, near Oklahoma City, OK. I am interested in patterns that could be generated by 50KV wideband RF generator: 318-365-5625.

109512 Al Trautman Lydia, LA

I have need of a schematic and parts list for the construction of a replacement for the Amperite Ballast Tube (Type 3TF7) used in the Radio Receiver R-390A/URR. These tubes are getting hard to obtain and I am sure that an electronic substitution device exists. The electrical characteristics (as spelled out in the manual) are RT 510 Resistor; current regulator; 0.310A, 8.6 VAC Ballast 3TF7. The purpose of this ballast tube is to regulate the current through the filaments of two 6BA6W tubes wired in series which is powered by a 25.2 VAC transformer. The tubes function as the BFO and the VFO. These two circuits establish the stability of the receiver.

109513 Richard F. Gurske Jacksonville Beach, FL

I need instructions for using an Okidata Microline 184 turbo "nine-pin serial only printer" with an IBM XT computer. Need DIP switch settings, etc. and software (batch file, etc.) instructions.

109514 George Taylor Muscle Shoals, AL

Being a hobbyist, I am now exploring remote control projects. I would like to know how to design a circuit which the output starts with one-half the battery power. Then, using a remote, I would like to stepup (+0.5 VDC up to full battery potential) or stepdown (-0.5 VDC down to ground level) the

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

TO BE CONSIDERED FOR PUBLICATION

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.

HELPFUL HINTS

- 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).
- Write legibly (or type). If we can't read it, we'll throw it away.
- Include your Name, Address and Phone Number. Only your name will be published with the question, but we may need to contact you.

output. Battery weight is very important. I would like to use rechargeable 1/3 AA, 3.6 VDC batteries or lighter! Later, I plan to use sensor(s) to replace the remote.

Any suggestions?
109515 Robert Kratzer Allentown, PA

Is the General Electric type 6BY4 (size of the eraser on the end of a pencil) the smallest vacuum tube ever made? Do you know of one smaller?

109516 Dave Leising Lowell, MI

Any calls over 60 are lost on my caller ID. I need them for a mailing list. How can I get a printout of this useful information automatically?

109517 Tom Keeley
Cape Coral, FL

I am interested in the "service menus" of different brands of color TV. Does anyone have a list of TV brands and the keystroke sequence to call up the "service menus"?

109518 Cy Kramer
Danville, VA

I obtained a Compaq motherboard. I believe the board is a Presario 933. Does anyone know the pinout of the power supply?

109519 Frank Bowen
Fresno, CA

I have two projects that seem to need a similar solution:

1. We have a dual outlet under the kitchen sink, one receptacle is controlled by a switch and the other is not; however, both are on a single ground fault interrupter. To the unswitched outlet is connected an under-the-sink water heater (9 amps?). To the switched outlet is connected a garbage disposal (12 amps?). The problem, of course, is that when the heater happens to be on, use of the garbage disposal causes the breaker to open. The solution is that the water heater must be turned off automatically before activation of the disposal. There are disposals that feature such a capability, but there does not appear to be an after-market commercial device to do so. Solid-state switch?

2. We have a surround sound decoder that should be turned on and off when the associated projection TV is turned on or off. (Eventually there will also be a subwoofer amplifier that will need to be similarly controlled.) Unfortunately, neither the TV nor the decoder have a switched outlet. The problem is both the inconvenience of having to get up and turn off the surround sound unit — which has no remote control — and the fact that the Dolby decoder lets out a disturbing beep as it tries to decode the collapsing audio output from the TV. The solution is that the TV must switch the decoder on or off. Solid-state switch?

109520 Dean Bekken
San Diego, CA

Can anyone tell me how to connect or adapt a free-standing monitor to an IBM PS2 model 25 computer main board? There is a 14-pin connector for the display cable, but I do not know what the function of each pin is.

109521 Ronald Bauman
New Smyrna Beach, FL

Is it possible to "daisy chain" PCMCIA cards?

109522 Kyei
Virginia

I would like any information available concerning the control computers on-board 1985 through 1994 Chrysler cars and vans and how the serial interface with the test plug works. I would like to be able to access the on-board data in real time via a laptop computer in order to troubleshoot

the engine. Are there other shade tree mechanics/hackers out there who have this information? I can read the error codes from the flashing of the "Check Engine" light, but I need more extensive data than that to effectively troubleshoot a problem.

109523 Don Shirley
Boerne, TX

Is it possible to replace an ETACS phone chip with an AMPS phone chip and let it work on an AMPS system and vice-versa.

109524 Kyei
Virginia

I am needing plans for an electronic Cub Scout pine wood derby race track device that will determine first thru sixth place using lights to show at least first and second place. I would like to mount two lights over each lane. Top light first place, bottom second. No light worse than second.

109525 Anonymous

I have a Zenith 19" TV Model number SS 6043S, Serial #221-04320092, manufactured in August 1992. The problem is no color. The picture is perfect except for no color. The on screen display is color when called up with the remote or front controls. Any ideas?

109526 Randy Pain
Raleigh, MS

I require information on interfacing my 17 inch NCD monitor to appropriate PC video card, monitor has 10 BNC connectors, RGB video in/out and hor/vert sync in/out. Any information on this monitor, such as hor/vert sync frequencies, schematics, etc., much appreciated.

109527 Dino Cawadias
Ottawa Canada

I have a DEC LA50 printer (serial). Does anyone know how to connect this printer to an IBM PC? How does one connect the serial interface cable (which pins to which)?

109528 Piet W. Tax
Chapel Hill, NC

1) How can the conductivity be restored to conducting rubber contact switches?

2) Is there a tool/technique to open cases held together by hidden plastic latches which minimizes the breaking of the latches?

109529 H.R. Radoski
Alexandria, VA

Does anyone have information as to how one might monitor the pH of water using a BASIC stamp? A source for the pH sensor would be appreciated.

109530 Peter Maluk
Providence, RI

I have a Panasonic KX-T2100 telephone answerer. When you listen to the day's messages from a remote phone you can either save them or dump them. But after listening to new messages from the console, they become old messages. You can then hear them again, but it means listening to all old messages on the tape. When family members come home at differ-

ent times, you want to hear new messages at the console without dumping them. How can I modify the electronics to add this option?

109531 Tom Clark
Marble Falls, TX

ANSWERS

ANSWER TO #79520 - JULY 1995

The only significant precious metal commonly used in electronic components and assemblies is gold. Gold can be visually identified. Solders and alloys contain no significant precious metals. Gold is used as plating of circuit board contacts, connector pins, come IC package pins, and transistor packages. If contacts are plated, it is obvious, otherwise no gold. In some ceramic IC packages the internal cavity is gold plated. This can be determined by inspection, after unsoldering the lid on a hot plate. Other use of gold is in box wires. These wires connect IC die to the package lead frame. Again, gold is obvious, else aluminum wire with no scrap value is used. Plastic IC packages almost never contain any gold. Few exceptions are prototype parts which use gold wires, and eutectic die attach. Gold plating can be stripped in sodium cyanide solution. Gold presence is determined by inspection when equipment is scrapped.

Jan Zaluda
Mountain View, CA

ANSWER TO #8958 - AUGUST 1995

A device you seek is called an RGB demodulator. For example, Motorola TDA3563 is such a device. It inputs NTSC composite signal, and outputs RGB video and sync. These can be directly displayed on a CGA monitor since the scan rate matches. To display NTSC video on other monitors, the video must be first digitized, and then resampled. Video digitizers now fit in a small handheld box, and cost under \$200.00. One of many sources is LBI industries 1-800-886-5424, the product is called Snappy.

Jan Zaluda
Mountain View, CA

ANSWER TO #89510 - AUGUST 1995

Answering this question with a "given" such as "any radio can be interfaced with a computer," and "if the rig is out of warranty, all you need is a valid bill of sale and a ham ticket" would not be of much use to you, but you really have not provided enough information to answer this question properly. Some of the new ham transceivers have provisions for remote control via special ports designed only for that brand of equipment while others have standard RS-232 serial ports, and some have nothing at all. Which is yours? Do you want to control all functions of the set, or just a few? Or do your plans only involve connecting the computer to the mike and phone jacks as in slow scan TV or other data handling? And most important of all, do you want to do this as a serious learning effort which is one of the best purposes of ham radio.

I will guess that it is the latter and that you want full computer control, and that you want to use the serial port. Also that your rig is solid-state and has no provisions for remote con-

trol whatsoever, and also that you have the manual with complete schematics.

Now comes the hard part. How does the band switching work on your rig? If it is with a large, many, many wafer rotary switch involving lots of LC circuits, it might be possible to gear a very small motor to the band switch shaft. If this can be done, it will be easy to build a circuit to change to any band.

The next change involves frequency selection. Does your rig use several variable frequency oscillators or is it a synthesizer? If it's a VFO type of rig, you can use anything from a tiny servo motor to variactor diodes, depending on the circuits involved. If it is a synthesizer, there is a chance that it is microcontroller controlled and you can get at the data I/O lines of the micro. All other functions such as gain settings, sideband or filter selection, and so forth are comparably trivial. The modifications would have to be internal and it all depends on whether you have the mechanical ability and are not afraid of damaging the set. If you are serious about this modification, send me a copy of the print care of *Nuts & Volts* and I will see what I can do to give some reasonable ideas for computer control.

Frank Williams

ANSWER TO #8956 - AUGUST 1995

About the cheapest, simplest, and easiest way to do what you want, is to get a cheap PC serial mouse which has encoder wheels (round wheels with a bunch of holes in it), tear it apart and use the opto couplers and encoder wheels (or make a larger encoder wheel with a bunch of little holes in it) and attach to your az/el movements. The mice usually have one small chip in them and nothing else! Hook the serial mouse output to your PC serial port, minimal software, and you have a VERY accurate encoder system.

Breck Ricketts
Lenexa, KS

ANSWER TO #89516 - AUGUST 1995

Any processor can be programmed in assembly language from a dumb terminal. This includes IBM clones. Just set console to COM1 using CTTY COM1, connect a dumb terminal to COM1, and run DEBUG.COM. With similar functionality software this can be done with any processor. It is still done commercially when developing simple embedded systems with a monitor EPROM, for which better tools are too expensive to buy or rent, for only a short project.

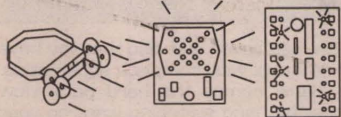
Jan Zaluda
Mountain View, CA

ANSWER TO #8955 - AUGUST 1995

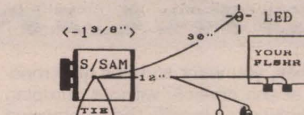
The five-pin DIN connector is a common connector for keyboards. However, there is no written standard establishing this connector as the keyboard connector. Just because two keyboards have this connector does not mean that they will interchange. Also, you may find this connector used in other applications.

Even if you managed to connect a keyboard to the eight-pin DIN connector on your Wang computer, it may not work. This is because the keyboard is a small computer itself. It translates the

Continued on page 146



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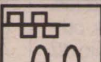
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SCANNER CONVERTER

Tune in on the 800-950 MHz action 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
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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, 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
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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 batteries 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.

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CDN Matching case set...\$14.95
DN-1WT Fully assembled Dr. Ni-Cad with case...\$89.95

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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-b coffee cans for antenna (not included) and runs on 12 VDC. Easy to build—all microwave circuitry is SC stripe. ABS plastic case with speedy graphics for a professional look. A very useful and full-of-fun kit.

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PH-16 Dual Semi-Log bargraph kit...\$39.95 CPH Matching case set...\$14.95

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CSSD matching case set...\$14.95
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TG-1WT Fully assembled TG-1 and case...\$149.95

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MANUALS — SCHEMATICS WANTED 155

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WANTED: COLLINS Radio Company literature. Jim Stitzinger, 805-259-2011, FAX 805-259-3830.

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WANT COPY of schematic wiring diagram for programmable 10 channel Regency desk scanners; Model M100 and Model Z10. Will pay copy and mailing expenses. Thank you. Send to: Adam Kol, Box 613, Troy, MI 48099.

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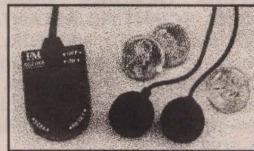


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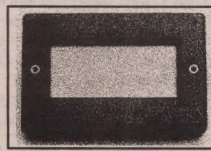


Fit an entire orchestra in the palm of your hand and still have room for the concert tickets with this Mini FM Radio that has an incredible sound. Features on/off button, seek button and reset button. Includes battery. If this isn't the world's smallest, it's close to it. But the sharp, clear sound that comes out will make you think you have a jam box. Black.

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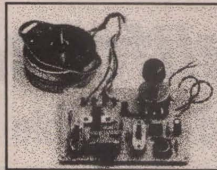
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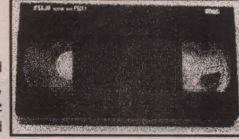


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SUPER VHS PRO VIDEO TAPES

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CAT #FM-32 \$10.95 each

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THE AMAZING EMERGENCY LIGHT!

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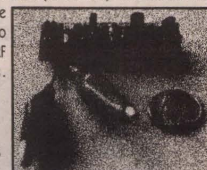


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TELEPHONE TRANSMITTER KIT

JUST LIFT THE HANDSET!

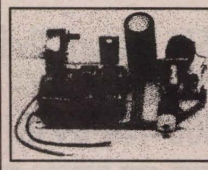
Phone line powered and activated when handset is lifted. Uses phone wires for antenna. Transmits over short distance (100ft) to the lower part of FM broadcast band (90-95MHz). Circuit does not require the ability to "tweak" RF circuits. WT .06



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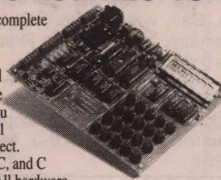
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Breadboarding in the 1990s: A Half-Dozen Ways to Go

Solderless Circuit Board

Universal Printed Circuit Board

Surface Mount Component Breadboarding

Even with the advent of software simulation breadboards, "real" hands-on breadboarding is very much alive and well. But, there are so many methods to choose from, how's the hobbyist and technician to know where to begin?

In this article, we will illustrate and summarize the characteristics of six popular breadboarding approaches. Starting with (1) *Cut-Slash-and-Hook*, a tried and true technique for connecting heavy-duty components; we'll then proceed to (2) *Solderless Circuit Board*; (3) *Wire Wrap*; (4) *Universal Printed Circuit Board*; (5) *Electronic Network Designer (END)*; and (6) *Surface Mount Component Breadboarding*.

After completing this article, you will understand today's breadboarding and how to select which method, or combination of methods, is appropriate for turning a particular design into a working circuit.

Breadboarding, a circuit assembly system that allows components and interconnections to be assembled and changed in their design stage easily, has been going on at least since the early Atwater Kent radios were assembled on actual breadboards, using nails and bare wire, back in the 1920s. Today, nails, though not wires, are out. Breadboarding itself, however, is still very much in — with a host of methods that we will examine in a moment.

Before we get started though, it is important to remember two points: First, there is no right or wrong procedure; one particular technique is not necessarily better than any other. Which one you choose depends on the type of circuit you are building. Second, you may combine different methods to meet particular needs. This is often done with the wire-wrapping and universal printed circuit board approaches, for example.

Cut-Slash-and-Hook (CSH): Tried and True

CSH has been around for decades and is used at the breadboarding, prototyping, and production stages. In fact, there was a time not that long ago,

when the *only* way to build anything in electronics required cut-slash-and-hook, or what is generally referred to as point-to-point wiring. Today, CSH is used at the breadboarding stage only with circuits requiring large amounts of current, such as big power supplies and audio amplifiers. In such cases, it is a method that still offers many advantages.

With CSH, you take a piece of wire, cut it to length, strip it on both ends, and hook it around a terminal post before soldering. The same thing is done with component leads, but of course the lead is not stripped of insulation.

Using the CSH method, terminal strips or push-in terminals are attached at various locations to a breadboard material usually made of perforated phenolic (plastic) 1/16" or 3/32" thick (Figure 1). The terminals either are fastened with screw and nut or pressed into place. A wire or component lead is then simply hooked around the terminal and soldered in place.

Electronic components too heavy or bulky to tie directly to a terminal can be screwed or strapped down onto the breadboard. Wire of almost any gauge is then used to connect the component terminals to the terminal strip.

The CSH method of breadboarding still has a number of things going for it. It's easy to do, and the skills required to perform cut-slash-and-hook are quickly learned. However, the CSH technique has some major drawbacks, too. It is very time consuming, it takes up a great deal of space, and with CSH it is difficult to change things. But perhaps the biggest disadvantage of all has to do with compatibility. The CSH procedure of breadboarding is totally unsuitable for the assembly of many modern electronic circuits, especially those using integrated circuits. Digital and many

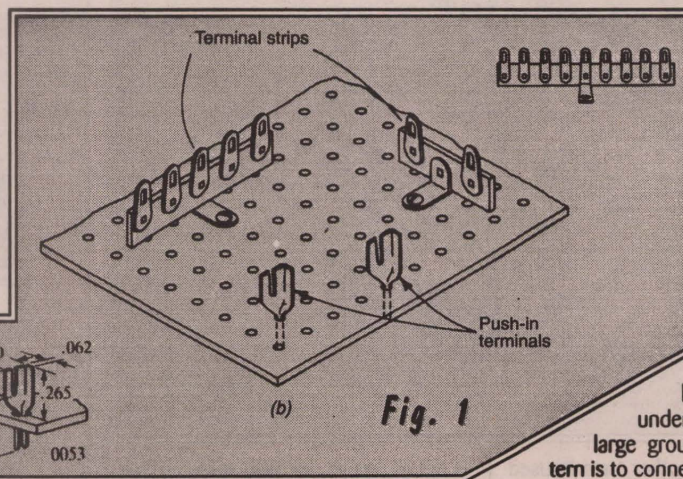


Fig. 1

regular intervals, 0.10" apart. Some boards have number and letter designations for each column and row of holes to aid in component lead and wire placement.

Each hole has a tiny metal lug inside. The lugs are connected underneath in small and large groups. The usual pattern is to connect five lugs in a ver-

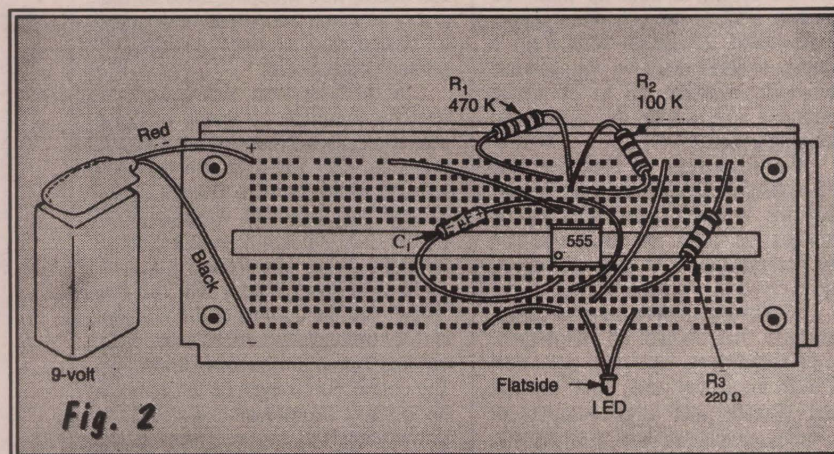


Fig. 2

analog circuits simply cannot be breadboarded with this method.

Solderless Circuit Boards: Breadboarding Modern Circuits

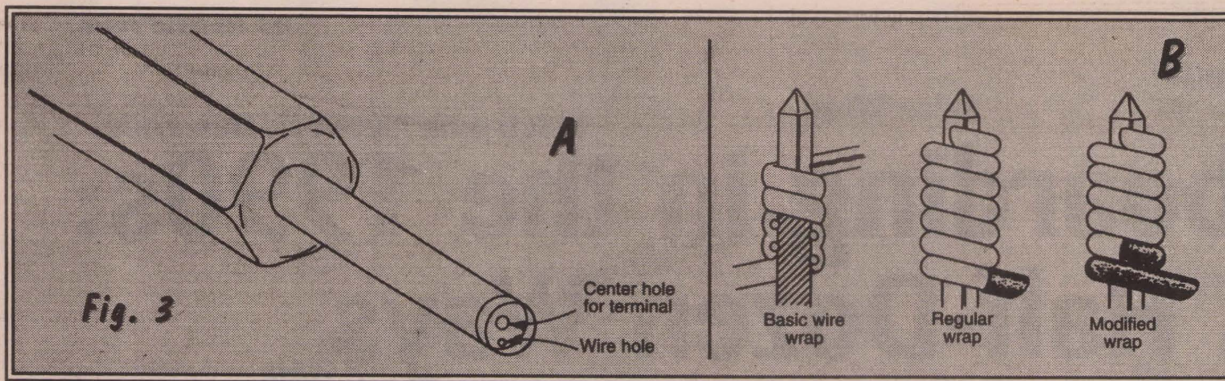
A method that was actually designed with today's through-hole IC technology in mind has been around for some time now. Known by the generic term, solderless circuit board, it is made up of a plastic breadboard with hundreds of holes in it (Figure 2). The boards come in many different sizes, 1/4" x 2" x 5" being the most popular. They can be snapped or butted together to increase the working surface. The holes are placed in a rectangular grid at

tical column of small groups and 25 to 40 or more lugs in large horizontal groups known as *buses*.

The system works like this: Two or more component leads or wires inserted in the same group are "shorted" together by the lug-connecting strip underneath. The wire (or component lead) can usually be pushed in or pulled out with your fingers, although needle nose pliers are handy.

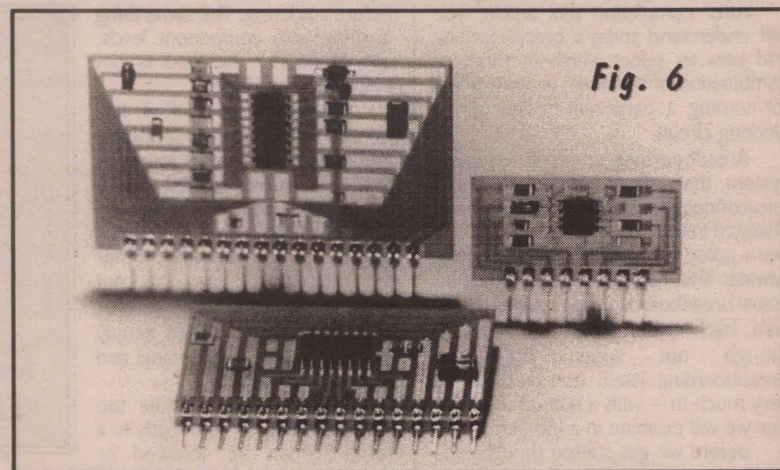
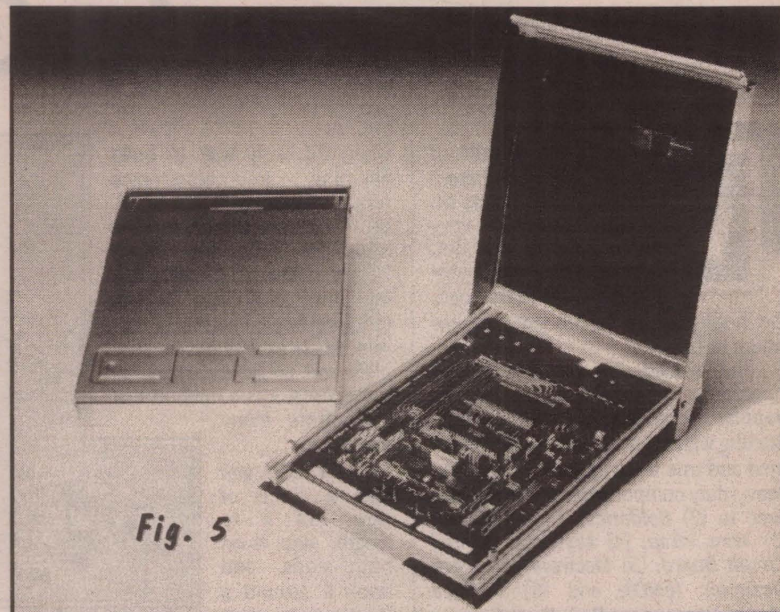
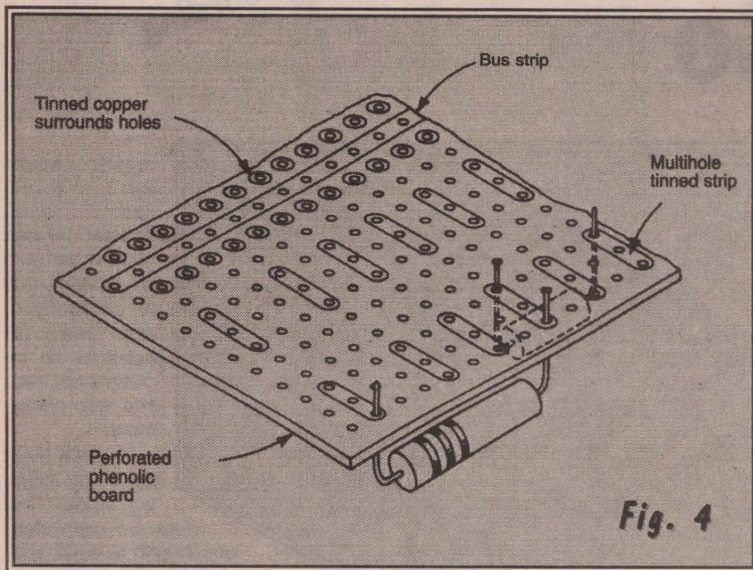
One important feature of every solderless circuit board, regardless of the manufacturer, is the center channel. Integrated circuits are straddled across the channel so that one row of IC pins does not "short" to the row on the opposite side.

In addition to the solderless circuit



secure connections.

Like all breadboarding systems, wire wrapping does have one or two disadvantages. Wire wrapping materials tend to be a bit expensive. Furthermore, the process is time-consuming, especially when compared with breadboarding on solderless circuit board. But if you are looking for a stable, more or less solderless circuit construction method compatible with today's components, then wire wrapping should definitely be given a try.



board itself, the only other material used with the system is hook-up wire. You can buy a kit of pre-cut, pre-stripped, single-strand 22 gauge wire from a number of distributors. Or, you can use commonly available 22 to 30 gauge telephone wire and do the cutting and stripping yourself.

The advantages of breadboarding with solderless circuit board are numerous: it's a great time-saver; circuit changes are quick and easy; you can use components over and over again; and everything is laid out in front of you.

In all fairness, there are a few disadvantages that should be mentioned. Some technicians, who do a great deal of radio frequency work, point out that their circuits need large amounts of shielding, which is difficult to create with this type of breadboard. And, of course, the circuit assembly itself can be somewhat flimsy. You do have to be careful how you handle the finished breadboard. Yet, when you compare the important advantages against these limited drawbacks, you quickly see that solderless circuit board makes for an ideal breadboarding approach to be used with modern electronic circuits.

Wire Wrap: Twisting the Night Away

Wire wrapping is a breadboarding method that is not only compatible with modern electronic circuits, but also provides a strong and secure bond between components — without the use of solder. Although circuit construction

is not as fast as that with solderless circuit board, wire wrapping takes considerably less time than would be required to design and produce a dedicated printed circuit board.

In the wire-wrap technique, connections are made by simply wrapping wire ends around rectangular or square terminals. The key is to use terminals with right-angle corners. Using a special (though inexpensive) wrapping tool (Figure 3A), you tightly wrap a piece of 28 or 30 gauge wire around a terminal six to eight times (Figure 3B). The wire "bites" into the corners of the terminal, and the two materials are actually "welded" together to form a solid connection. The connection is even better than solder because no cold joints are possible. Unwrapping is as easy as wrapping. Just twist the tool in the direction opposite to that when wrapping the wire.

In addition to the wire wrap tool, to do wire wrapping you are going to need perforated phenolic board with holes spaced 0.1" apart. Into these holes will go wire-wrap IC sockets and various wire-wrap posts. The sockets have long rectangular pins to take two or three levels of wrapped wire. The posts are square throughout their length and have a trifurcated clip on the top. Electronic components with round leads are soldered to the clip, and the posts are joined by wire wrapping. Remember, you cannot wire-wrap round component leads.

Another approach to handling small components, such as transistors, low-wattage resistors, and disc capacitors, is

to solder them directly to a parts carrier, or header. The header is pressed into a wire-wrap IC socket, which is then wrapped in the usual way to make the circuit interconnections.

When wire wrapping, you can't use just any wire; it has to be 28 or 30 gauge, bare or insulated, and if insulated, stripped back on both ends. The wire comes in either rolls or pre-cut/pre-stripped lengths. Many colors are available, the most popular being red, blue, white, black, and yellow.

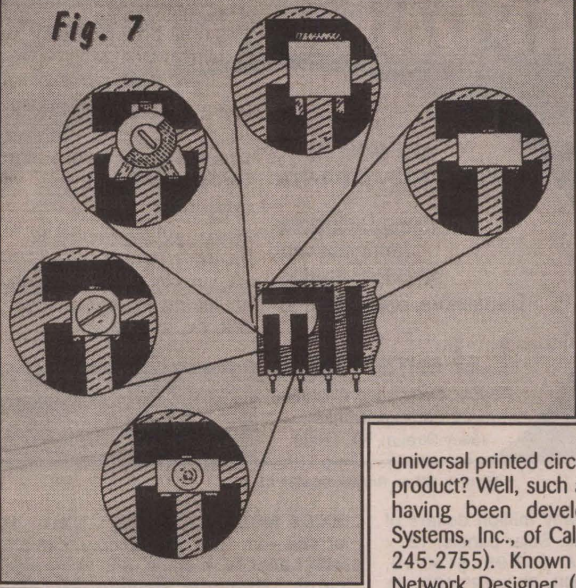
Wire wrapping has the advantage that, like the solderless circuit board method, it is compatible with modern circuits. But unlike the latter, this circuit construction method results in solid,

Universal Printed Circuit Boards

Universal printed circuit boards are not what you might think. They are actually more like a wire-wrap board than a printed circuit board and are designed to make wire wrapping more convenient. Why they are called universal printed circuit boards nobody seems to have quite figured out.

Universal printed circuit board is basically wire-wrap board in which rings of tinned copper surround holes on one side of the board (Figure 4). On some boards, strips of copper tie two or more holes together. Also included are bus strips, which can run the entire length

Fig. 7



many wires and component leads to a widely used common circuit point.

Electronic Network Designer (END)

Wouldn't it be great if there was a way to combine the advantages of solderless circuit board and

universal printed circuit board in a single product? Well, such a device does exist, having been developed by Platform Systems, Inc., of Calgary, Canada (403-245-2755). Known as the Electronic Network Designer (END), it fuses the quick assembly and easy exchange of components exemplified by solderless circuit board with the ruggedness and dependability of a universal printed circuit board. Using the END product not only saves breadboarding time, but eliminates wiring errors that inevitably crop up when redoing a circuit that was first assembled on solderless circuit board then reconfigured on a universal printed circuit board.

The END consists of an aluminum frame which places a thin circuit board over a solderless circuit board-like matrix (Figure 5). Components are inserted through the circuit board into the sockets of the solderless circuit board-matrix. The circuit board is thin enough that short leaded components such as integrated circuits and SIP resistor packages fit snugly into the matrix pins. The circuit is prototyped as per usual.

When the design is complete, the designer can tidy up the wiring and make minor changes. Next, the cover is closed and the case is then flipped upside down. The bottom panel is lifted up freeing the components from the socket pins and exposing the component leads for soldering. Diced conductive foam holds the components in place for soldering. When complete, the tested and soldered board is removed from the frame.

As you can see, the END system takes breadboarding one step further, to true circuit prototyping.

Surface Mount Component Breadboarding

Of the five breadboarding approaches discussed so far, four are clearly out of the question when it comes to working with tiny, rice-grain size surface mount components. There is simply no way you are going to breadboard a surface mount technology (SMT) circuit using the cut-slash-and-hook, wire wrap, universal printed circuit board, and electronic network designer methods. The only approach that seems even remotely possible is solderless circuit board. But remember, with SMT, you're working with components that for the most part have no leads. Or if they do, the leads are not spaced or shaped "right." Clearly the solderless circuit board technique, by itself, isn't going to work. Someone has to come up with a better idea.

Fortunately, someone has! He's Rob Laschinski, president of Capital Advanced Technologies, Inc., in Carol Stream, IL (708-690-1696). His company has developed a unique breadboarding method specifically designed for surface mount components. It's called "Surfboards," and you don't have to be a "Beach Boy" to appreciate how easy and effective this approach is.

The Surfboard concept involves the use of specially designed universal PC boards with single in-line pins (SIPs) spaced 0.100" apart (Figure 6). The pins fit into a solderless circuit board. Thus, in a sense, this method too combines the universal PC board and solderless circuit board concepts.

The boards themselves incorporate foil patterns that accommodate a wide variety of component mounting footprints, both discrete and IC. Several device sizes can be mounted on the universal foil pattern (Figure 7).

There are a number of ways to solder the surface mount components to the boards. You can hold the components in place temporarily with ordinary clear tape, then solder the component terminals to the foil pads, after which you then remove the tape. Or, you can glue the components down, then solder as above. Finally, you can use the tag solder method. Here you would first flow-solder one pad. Then, using tweezers, hold the SMC in place and reflow the solder. You then solder the other pad in the normal manner. ICs are soldered in place using any of the three methods.

Unfortunately, we do not have space to discuss in detail how surface mount components are attached. Perhaps that can be the subject of a future article. In any case, with the use of Surfboards, you have a great way (if not the only way) to breadboard surface mount technology components.

There you have it — six ways to breadboard, six ways to prove out a design before committing to a full-blown prototype or mass production.

As a final note, keep in mind you can mix-and-match these methods as necessary. You don't have to commit to one over the other. Use your creativity to produce the most effective working circuit possible. NV

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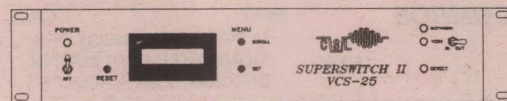
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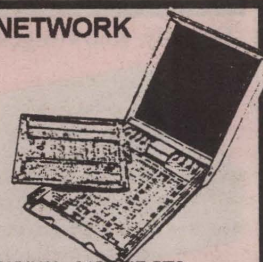
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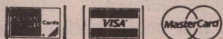


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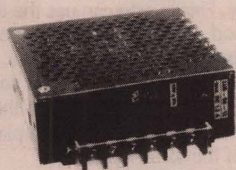
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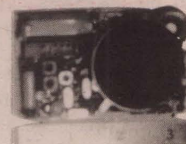
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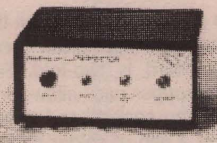
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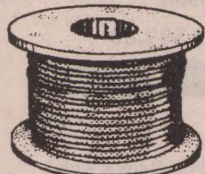
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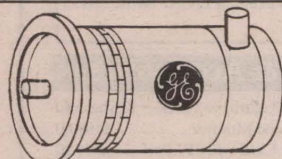
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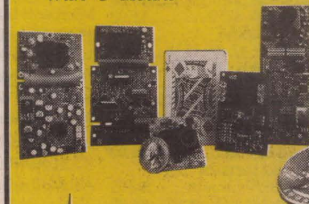


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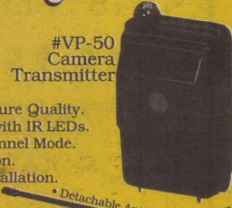
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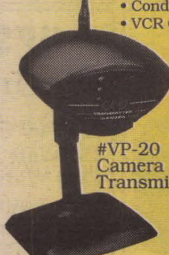


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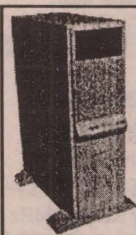
VISA DISCOVER AMERICAN EXPRESS

Nuts & Volts Magazine/October 1995

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COMPUTER PARTS - SCSI DRIVE ACCESSORIES - SURPLUS ELECTRONICS

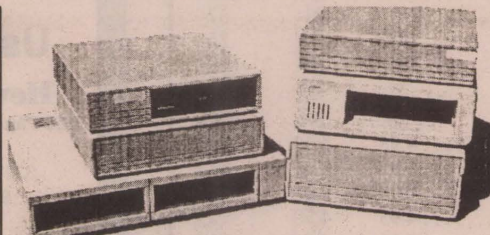
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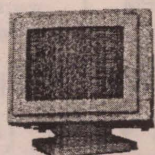
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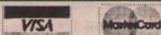
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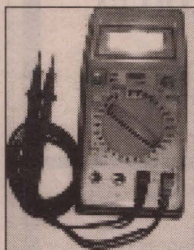
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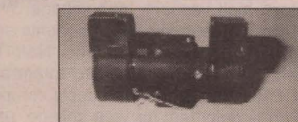
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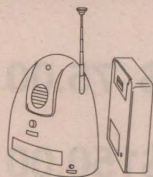


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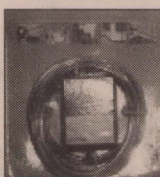
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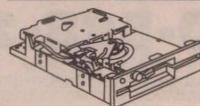


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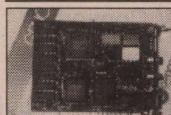
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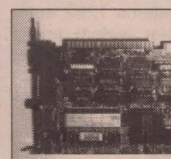


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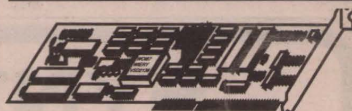
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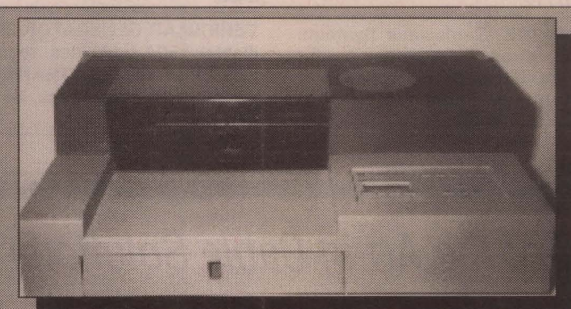
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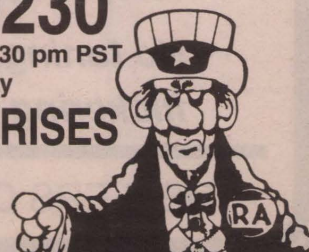
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Build a Milliohm Adapter for your DMM

Digital multimeters are probably the handiest and most often used piece of test equipment on your workbench. However, they have their limitations. For instance, the ability to measure low resistances. Most multimeters have a resolution

of 0.1 ohms, enough for most electronic measurements. But sometimes a unique need crops up, such as the ability to measure the resistance of a meter shunt, a motor's armature, or a relay's contact resistance. Another use is measuring the resistance of circuit board traces to catch those which have failed, are about to fail, or are simply too thin to carry high-current loads reliably. Example of the latter might be low-voltage, high-amperage power supply PC board traces, or those traces which are subject to rapid pulses of high current such as in avalanche circuits, which are designed to deliver high currents for brief durations to a load.

Wouldn't you like to be able to measure these kinds of things without having to buy an expensive DMM, or a dedicated, laboratory-grade ohmmeter that will cost you much more dollars?

The answer is a Milliohm ADAPTER, which is a deceptively simple circuit that is designed to amplify the ability of your present DMM or DVM to measure down into the milliohm range, and in some cases, into the micro-ohm range. This circuit can be built for about \$15.00, depending upon whether you have to purchase an enclosure, which

adds to the cost. The prototype was made to fit into a small, inexpensive experimenter box available from Radio Shack and through mail order vendors, so the cost was just slightly over the estimation.

Mixed Technology Used

This project uses both Surface Mount

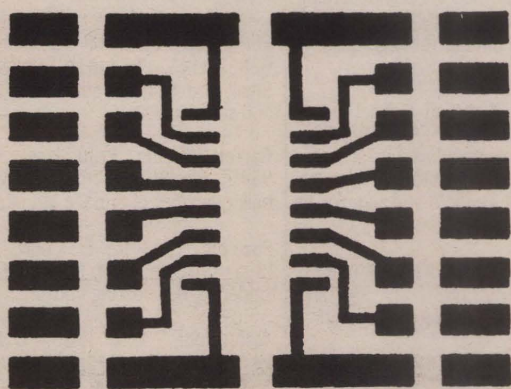
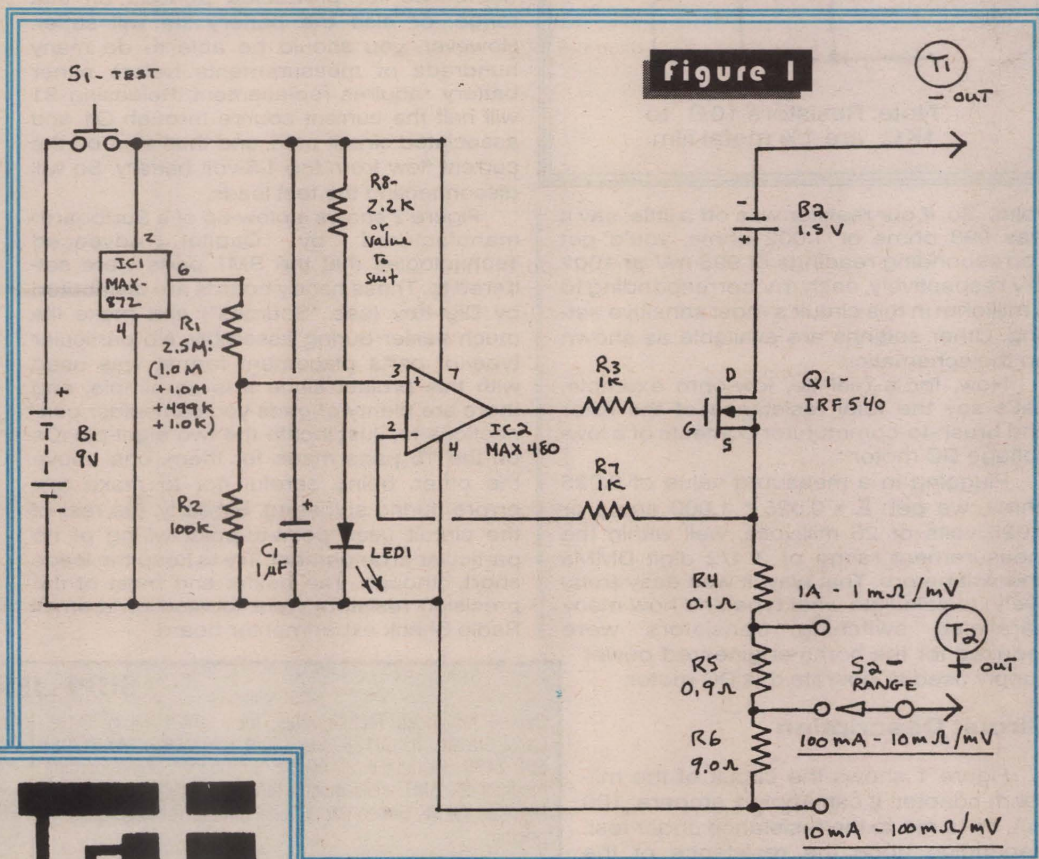


Figure 2

Technology and "conventional" technology, but as we pointed out in a prior article, SMT is the conventional technology of the day, at least in the manufacturing arena. By mixing the technologies, we can build our adapter more economically and gain

experience in the area by assembling both technologies at once. The circuit is based around two SMT type integrated circuits: the MAX872 voltage reference and the MAX480 op-amp. Both are available in SMT and DIP packages. So, if SMT is too small for you to work with (our joke here is not to drink too much coffee or cola, or you'll have a difficult time putting SMT circuits together!), then you have the option of using DIP

technology and not bypass the project because it's suggested to use SMT.

Parts sources for both package types are listed in the "Supplier List" box, Maxim being the supplier of the SMT versions and Digi-Key the DIP technology, but they probably will carry the SMT versions eventually, as they are adding many Maxim SMT ICs to their stock line each month.

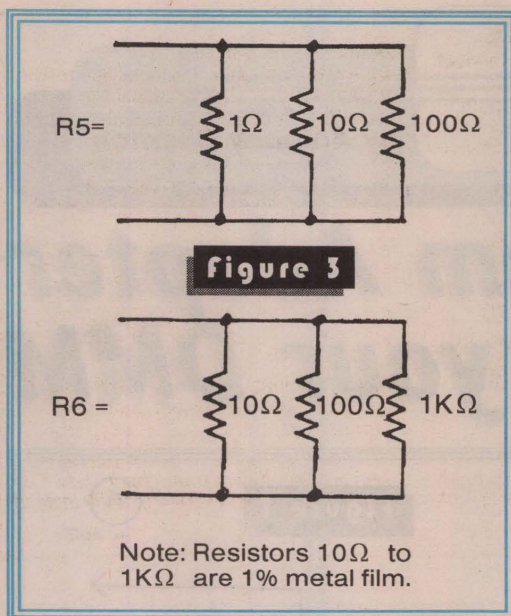
How Ohmmeters Work

Ohmmeters work by the principle of applying a current to the resistance (or device) under test, and then measuring the voltage drop across that resistance. Thus, if one wants to measure a hypothetical 1,000-ohm resistance, a current source of 1,000 amps is applied to that 1,000-ohm resistance, and by the simple formula:

$$E = R \times I$$

where: E is the voltage, R the resistance, and I the current source in amps.

You get 1,000 volts (a thousand milli-



volts). So, if our resistor was off a little, say it was 998 ohms or 1.002 ohms, you'd get corresponding readings of 998 mV or 1002 mV respectively, each mV corresponding to a milliohm in this circuit's most sensitive setting. Other settings are available as shown on the schematic.

Now, for a real-life, low-ohm example. Let's say the total resistance of the rotor and brush-to-commutator contacts of a low-voltage DC motor.

Plugging in a measured value of 0.025 ohms, we get: $E = 0.025 \times 1.000$ amps or 0.025 volts or 25 millivolts, well within the measurement range of 3 1/2 digit DMMs and voltmeters. That way, it was easy (relatively) to calculate what type and how many paralleled switching transistors were required for the home-engineered power supply used to operate this DC motor.

Circuit Description

Figure 1 shows the circuit of the milliohm adapter. It can apply 1 ampere, 100 mA, or 10 mA to the resistance under test. Depending upon the resistance of the device under test (DUT), the current application will indicate directly in millivolts its resistance if your voltmeter is set on the two-volt range. S1 is the high-current source, an alkaline battery capable of generating the 1 ampere used in the circuit's highest current application mode. This MUST be an alkaline battery, as carbon-zinc batteries don't supply enough current to do the job properly.

A three-position switch enables user-selection of the desired applied current to the DUT. S1 performs as a dual-function on/off switch. When a measurement is to be made, depressing S1 turns on the circuit which consists of a micropower voltage reference chip, IC1 and an op-amp, IC2. IC1's output is 2.500 volts, and that voltage is divided by R1 and R2 producing 0.1 volts at the input of IC2. That integrated circuit is connected as a non-inverting voltage follower, so it produces the same output voltage as its non-inverting input. So, 0.1 volts appears at its output. This turns on Q1, creating a 0.1 volts potential at its source terminal. The resistive divider, R4, R5, and R6 form a current source along

with Q1, the 1.5 volt battery and the DUT's resistance. That is applied to the DUT through the two output terminals, T1 and T2.

When you connect your voltmeter across these terminals, you can directly read the resistance of the DUT. An optional LED shows when the circuit is in test mode. While not really necessary, it adds to the appeal of the finished instrument, at an expense of battery consumption, however.

Since there is a very small drain of about 30 microamps on the nine-volt battery, if you don't include the LED, it can last for a very long time. The one-amp range of the instrument will drain the 1.5-volt alkaline battery faster than the 9-volt battery, so it is advisable for reasons of economy not to keep S1 depressed for protracted periods on that range, or else the battery life will suffer. However, you should be able to do many hundreds of measurements before either battery requires replacement. Releasing S1 will halt the current source through Q1 and associated circuit path, and thus shut off the current flow from the 1.5-volt battery. So will disconnecting the test leads.

Figure 2 shows a blow-up of a Surfboard™ manufactured by Capital Advanced Technologies that the SMT parts were soldered to. These handy boards are distributed by Digi-Key (see "Sources") and make life much easier during assembly. No particular type of parts placement format was used with this project since it is so simple, and there are plenty of pads you can solder connections to. Just locate the two eight-pin ICs on the 16 pads made for them, one above the other, being careful not to make any errors during soldering. Similarly, the rest of the circuit uses point-to-point wiring of no particular arrangement. Try to keep the leads short, though. The hexfet and most of the precision resistors were located on a small Radio Shack experimenter board.

Accuracy and 1% Resistors

The circuit accuracy is dependent upon the tolerance of the resistors R1-R6, while R3 is really not critical. I chose to use 1% resistors throughout, except I had to settle for a 0.1 ohm and a 1.0 ohm, 5% tolerance resistor where noted on the schematic because they are not available in 1% tolerance that I could find. Both of these parts were tested on another milliohm meter adapter which was calibrated to about 1% accuracy, and the closest fits were chosen. Note that R5 and R6 consist of an array of 1% resistors. These are soldered as shown in the schematic in Figure 3 to achieve the required resistance and close tolerance. Use heavy wire for the connections to the 1.5 volt battery, the output of the instrument, and connections to the hexfet, as this will affect the measurement accuracy. I used a heavy-gauge multimeter lead as this contributes little resistance error.

The input offset voltage of the op-amp is another factor in the accuracy of the circuit, as is the basic accuracy of the DVM. Remember, accuracy deviations can either add, subtract, cancel each other out, or come somewhere in between with all electronic circuits, not just this one. So if I had a -1% accuracy with the instrument and a -2% accuracy with the DVM, the total error would be -3%. Similarly, if I had a +1 and +2 percent accuracy, the reading would read 3% high. The 1% resistors are available inexpensively from Digi-Key. As shown, the circuit has about a $\pm 2\%$ accuracy, which is certainly adequate for daily work. I suggest soldering all the resistors in the current path and the associated wiring in carefully, avoiding cold solder joints. Use a good quality solder, and plenty of it. Error will certainly be added to the circuit if the soldered joints are poor, or the test leads are in less than top condition.

SUPPLIER LIST

Capital Advanced Technologies, Inc., 309-A Village Drive, Carol Stream, IL 60188. Ph: (708) 690-1696, FAX: (708) 690-2498. Manufacturer of the Surfboard™ breadboarding medium for SMT, sells mostly through distributors such as Digi-Key. OEMs can contact Capital directly for large quantity pricing.

Maxim Integrated Products, Inc., 120 San Gabriel Drive, Sunnyvale, CA 94086. Ph: (408) 737-7600, FAX: (408) 737-7194. Specialty analog and digital integrated circuits of amazing diversity and use. Call for nearest distributor, or sales rep (in the case of OEMs). Will give out free info and samples to qualified companies.

Contact East, 335 Willow Street, North Andover, MA 01845-5995. Ph: (508) 682-2000, FAX: (508) 688-7829. SMT and electronic repair tools, chemicals. Free catalog.

DataK Corporation, 55 Freeport Blvd, Unit #23, Sparks, NV 89431. Ph: (702) 359-7474, FAX: (702) 359-7494. Dry transfers for PWB fabrication, chemicals, Circuit-Fix™ products. Free catalog.

Digi-Key Corporation, 701 Brooks Avenue South, PO Box 677, Thief River Falls, MN 56701-0677. Ph: (800) 344-4539, FAX: (218) 681-3380. Top-of-the-line supplier of SMT components; features a large selection. Free catalog.

DynaArt Designs, 3535 Stillmeadow Lane, Lancaster, CA 93536-6624. Ph: (805) 943-4746. Provider of and seller (through distributors as well) of the Toner Transfer System (TTS) method of PCB fabrication. Also sells a desk-top integrated package for small OEM and prototype PCB fabrication.

Electronic Goldmine, P.O. Box 5408, Scottsdale, AZ 85261.

Ph: (602) 451-7454, FAX: (602) 451-9495. SMT surplus PWB's and SMT components. Some great values here. Free catalog.

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Garrett/IEU, Inc., 3130 Skyway Drive #104, Santa Maria, CA 93455. Ph: (805) 922-0594, FAX: (805) 922-3643. Small and bulk quantities of Surface Mountable Components.

Pace Inc., 9893 Brewers Court, Laurel, MD 20723-1990. Ph: (301) 490-9860, FAX: (301) 498-3252. Manufacturer of SMT soldering/desoldering equipment and workstations.

Techni-Tool, 5 Apollo Road, P.O. Box 368, Plymouth Meeting, PA 19462. Ph: (215) 941-2400, FAX: (215) 828-5623. Soldering/desoldering equipment and electronic tools of all types.

All Electronics Corporation, P.O. Box 567, Van Nuys, CA 91408-0567. Ph: (800) 826-5432, FAX: (818) 781-2653. Some SMT parts and occasional surplus SMT boards useful for parts salvage and experimentation. Free catalog.

Carolina Biological Supply Company, 2700 York Road, Burlington, NC 27215. Ph: (919) 584-0381, FAX: (503) 656-4208. Laboratory supplies including test tubes, plastic, and glass vials handy for use categorizing SMCs. Contact for current price of their 30,000 item, full-color catalog.

Be sure to mention **Nuts & Volts** when you contact the above suppliers, so they can process your requests properly.

Shorted or Weak PCB Trace Measurements

You can now determine whether the traces on your PC board are giving you problems, and even approximately where. Either lead of the adapter instrument may be connected to two suspect traces on the PCB. Then check the output of the adapter using your DVM as you press S1. The highest reading on one trace, and lowest on the other shows you where the short is located. The use of a magnifying glass and a strong spotlight source will speed up the location cycle of the trace problems because you can see likely areas where problems may occur, and premeditate them.

Weak traces — ones that cannot carry the current to a particular circuit required for reliable operation — can be detected simply by measuring the resistance of the trace in question. A few particulars to watch out for: "spongy" traces caused by overetching or insufficient resist protection, reducing the safe current carrying capacity of the circuit; traces that are almost broken through because of any number of factors that may allow this trace to catastrophically fail under a high (or normal) current condition; and trace(s) that are too thin to support the current they should carry. While elegantly thin, I have seen such traces evaporate even in my own circuits! I think this especially applies with low-voltage circuitry that may occasionally draw high currents from a battery source, such as when those circuits are initially charging a capacitor that has been previously totally discharged.

Another Fun SMT Circuit!

Capital Advanced Technologies let us reprint another of their neat SMT Application Notes shown in Figure 4. This project is a simple Logic Status Indicator which can show the logic state of any circuit you desire at a glance. It can also be adapted to CMOS logic, so you may use other voltages than the +5 volt level shown.

Adaptation is very simple. All one needs to do is determine the desired current through the LED by the simple formula:

$$R = \frac{VCC - V1\{sat\} - V2\{led\}}{I}$$

= where: VCC is the supply voltage, V1 is the collector-to-emitter voltage drop of the driver transistor, and here we're presuming it will be fully turned on or "saturated."

This specification is listed as V(ceo) in transistor 'spec sheets, V2 is the voltage drop across the LED, I is the desired current for the LED, and result R is the calculated resistor value.

Although the resistor should be chosen so that not too much current gets to the

LED, R needn't be a precision component like those used in the previous project. A 5% resistor will do just fine.

Any number of these status indicators can be put together to monitor any number of logic lines. Loading on the logic line is almost nil.

Consider that R2 at a value of 10K will draw only half a milliamp. Note the resistor size is 1206, a package large enough to be handle-able by nearly everyone, but tiny enough so that each status indicator occupies only about 3/8" square.

Conclusion

We'll continue our foray into the world of experimenter-buildable SMT projects for the next several months. And any suggestions for such projects are most welcome! You can send your correspondence to the Today's Electronics Reader Helpline listed elsewhere in this article. **NV**

Parts List

Surface Mount Technology Devices

IC1 — MAX872, 10 uA, low dropout, +2.500 precision voltage reference
IC2 — MAX480, high precision, low-voltage, micropower op-amp
C1 — 1 uF, electrolytic or tantalum capacitor, 10 WVDC or higher

Through-Hole Technology Devices

IC1 (*) — #MAX872CPA-ND, 10 uA, low dropout, +2.500 precision volt reference
IC2 (*) — #MAX480CPA-ND, high precision, low-voltage, micropower op-amp

Q1 — #IRF540-ND hexfet
LED1 — LED indicator to suit

R1 — 2.50 megohm resistor, which are the following 1% resistors wired in series: 1.0 megohm + 1.0 megohm + 499,000

ohms + 1,000 ohms
R2 — 100,000 ohm, 1% metal film resistor
R3, R7 — 1,000 ohm 1% metal film resistor
R4 — 0.1 ohm, 1% if procureable, otherwise best value fit
R5 — 0.9 ohm array, see Figure 3
R6 — 9.0 ohm array, see Figure 3
R8 — 2,200 ohm or value to suit (see text)

B1 — 9-volt alkaline battery
B2 — 1.5-volt D-cell alkaline battery

S1 — SPST pushbutton switch
S2 — Three-position selector switch

Misc. — Binding terminals, test leads, enclosure, battery holders, Surfboard, experimenter board, etc., as needed.

Numbers prefixed by the pound (#) sign are Digi-Key part numbers*. Use if you want to apply DIP technology instead of SMT to this project.

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BUILD THIS SURFACE MOUNT

Figure 4

LOGIC STATUS INDICATOR

HANDY MODULE PLUGS IN WHERE NEEDED WHEN BREADBOARDING
CIRCUIT CAN BE REPEATED ON STANDARD SURFBOARDS TO MONITOR UP TO 5 LINES

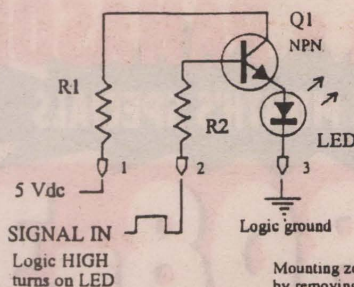
Here is a very useful circuit that is typical of one of the many excellent applications for SURFBOARDS. At one time or another almost everyone working with electronics needs to monitor the status of logic signals in a circuit. Although this can be done with a logic probe, it is often desirable to employ a more permanent indicator in the circuit, or to monitor several signals at one time. If you have such a need then this circuit is for you. The best part about this circuit is the fact that the completed modules can be used in many different circuits by simply plugging them into your breadboard and making a few simple connections. You could easily perform this function with conventional discrete components, but you won't get the advantages of small size and plug in convenience, not to mention the fact that you will spend the time and effort to build up the circuit every time you need it.

Part list / description

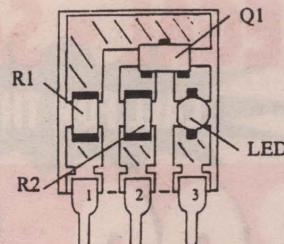
SURFBOARD 6103*
Q1 — 2N2222 SOT-23
R1 — 1-K 1206
R2 — 10-K 1206
LED (see text)

* Use Surfboard models 6106, 6109, 6112, or 6115 if you want to increase the number of logic indicator circuits on the same module.

BASIC CIRCUIT



SURFBOARD BASED CIRCUIT MODEL 6103



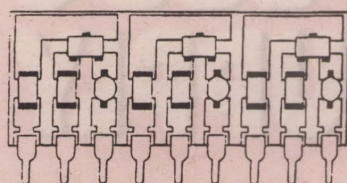
LED INFO

If surface mount LEDs are not available or not bright enough, you can use any small conventional LED's.

Small "pill package" LED's work well.

Standard small LED's are bright and readily available. Form leads for mounting.

NOTE: You can also mount the LED's on the back side of the board by drilling two holes for the leads.



3 - LINE INDICATOR
Built on SURFBOARD model 6109 by repeating circuit 3 times.

As you can see in the example at left, multiples of the circuit (up to 5 on model 6115) can be readily built. If desired, you can jumper the power and ground connections on the Surfboard so that only one of each needs to be connected to the circuit being breadboarded. This will minimize the number of connections required to the circuit being tested.

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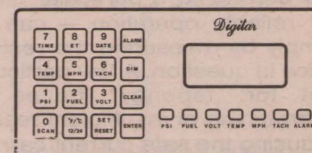
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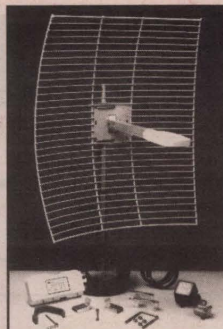
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PHOENIX RISING COMMUNICATIONS

3422 W. Hammer Lane, Suite C-110

Stockton, California 95219

by Karl Lunt

Author's note: I thought I'd turn this month's column over to a couple of guys I know in the Seattle Robotics Society. I hope you'll find their story interesting.

AMATEUR ROBOTICS

So, do you have a machine ready for the big contest?

Ted asked by way of greeting, as he dropped his backpack onto the floor next to my workbench.

I was slumped in front of my '486, victim of a recent contract software *Job from Hell*. The pay's okay, but sometimes the hours cut into my hobby.

"Sorry, Ted," I replied, "but I just ran out of time. The meeting's tomorrow, and Robothon '95 is the next day. I'm not going to have anything ready by Sunday."

His reply was typical Ted. "Good, that means you'll have time to do some software for my robot. Check this out." Ted placed a wire-frame robot on my computer table. The hobby servos for motors, the 68hc11 computer board, and a small caster up front clued me that he had modified a Dancer robot from a previous *Nuts & Volts* issue. But, he had made a design addition. I pointed to the third hobby servo, nestled inside the robot's mid-section. "Cute hack, Ted. What's it for?"

"That's where I'm going to fasten the pen holder. This is our entry for the Robot Art contest."

Ted was referring to one of the six robotic events in Sunday's Robothon '95. The SRS had set up this day-long competition so everyone in the club could show off their machines, and spend some quality time with their hobby.

R-95 would take place at the Renton Technical College, a new site for the SRS. The club had approached one of the instructors with the idea of holding the event at RTC; the response was immediate and enthusiastic. In fact, it looks like RTC will be the new home of future SRS meetings.

For Sunday, Tom Dickens and his organizers had set up a club-wide competition with contests such as Robot Art, Sumo, the Rapid-Deployment Maze, the Grand Maze, Line-Following, and Dead-Reckoning Navigation.

Ted had already finished most of his Robot Art competitor, lacking only the pen holder and some software. The pen holder problem, being mechanical, didn't worry Ted. But as usual, he came to me for the software.

"Here, I've sketched out how I'm going to add the pen holder. It's really pretty simple." Ted showed me his engineering notebook, opened to this new robot, dubbed Artist.

"The third servo is a Futaba S148, just like the two drive motors, only it hasn't been modified; it only moves back and forth. I fastened it down to that piece of copper-clad on the underside of the frame, using some double-sided foam tape."

"Next, I'll cut a 4" length of thin brass rod, which I can bend into a pen holder. You can get an idea of the shape from the sketch."

"Finally, I'll mount the pen holder to this round servo control horn, using some #2 hardware and hot glue. Add some masking tape to attach the pen to the holder, and

'bingo,' it's ready for your software." Ted looked at me expectantly.

I tried hard to muster a frown, ready to claim overwork, but no dice. Our friendship goes back too far. Ever since our early pinewood derby days in Cub Scouts, we had pooled our talents on projects, each knowing the other would help out on the rough spots.

In this case, as in most robot projects, I contributed the software while Ted did the mechanics, and we worked together on the electronics. Which meant it was time for me to dust off the keyboard and start coding. "Okay, Ted, what do you have in mind for our Artist robot?"

"I figured we could make the robot lower its pen, then draw a very simple design, maybe just three or four lines. The end of the design would leave the robot pointed at a slightly different angle than the starting alignment. Then, it would simply repeat the same design, over and over. The finished pattern should be a repetition of the basic figure, folded in upon itself many times. Kind of like this." Ted grabbed his pen and notebook, and started sketching.

I glanced at his notes, already juggling code in my mind as I talked.

"Looks pretty simple. I'll need routines to move the drive motors, position the pen, and map out the lines. That means I'll also need some simple timer software, so I can track elapsed time."

"Well, I'll leave that part to you," Ted said. "I'm going to start on the pen holder. Where do you keep your brass rod?"

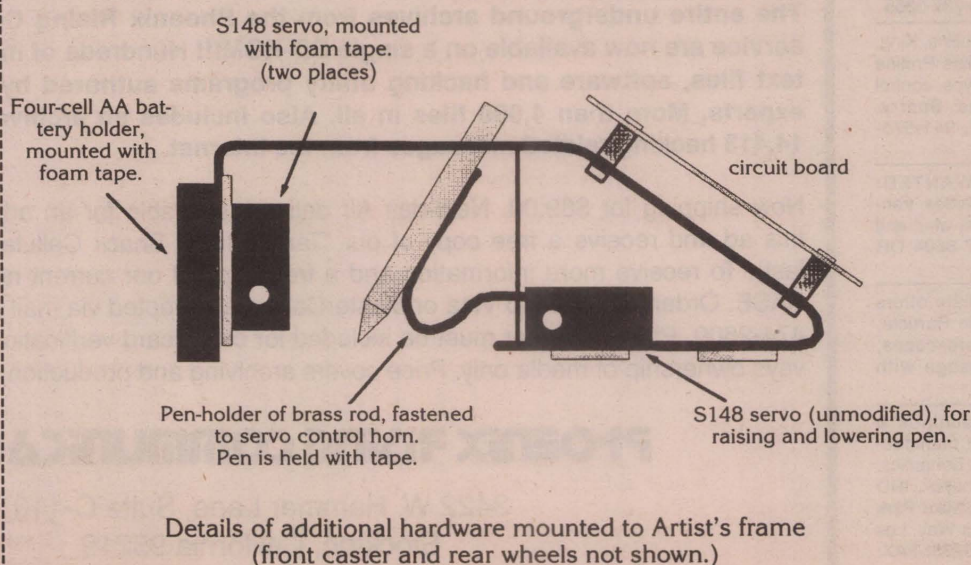
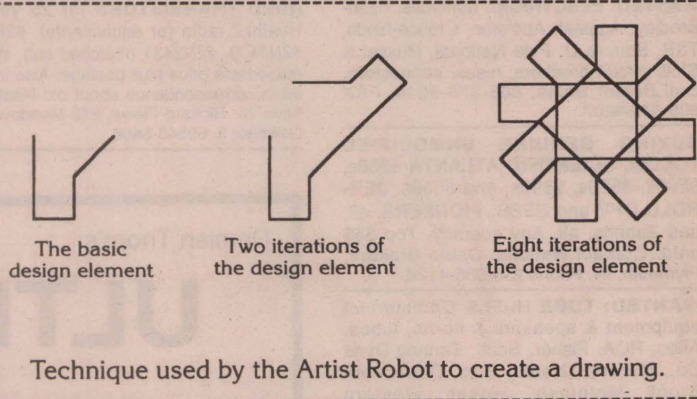
I left Ted rooting through the closet in search of some thin brass stock. He already had the hot-glue gun plugged in and ready to go. I turned my attention to the computer.

Ted's Artist robot used a custom 68hc11 computer board, complete with 8K of external EEPROM. This was way more memory than the program would need, but Ted probably just grabbed whatever computer board was within reach.

Well, before I was done with the first draft of my code, Ted had finished the pen holder. He taped a red washable marker in place, then manually moved the holder up and down, to gauge the range of motion. Satisfied, he returned to look over my shoulder. "Good, you're using SBasic," he commented. I smiled; he had been half afraid I would write the code using tiny4th or assembly language. Ted could puzzle through most of my Forth programs, but was completely lost when it came to 68hc11 assembly.

"I figured SBasic would be simpler to follow, and easier to maintain. Besides, if I use SBasic, you can work on the program yourself, after the contest." I turned back to the keyboard. Ted started downstairs, headed for the kitchen. "I'll find something for our lunch while you work on the code. Watching you type always makes me antsy."

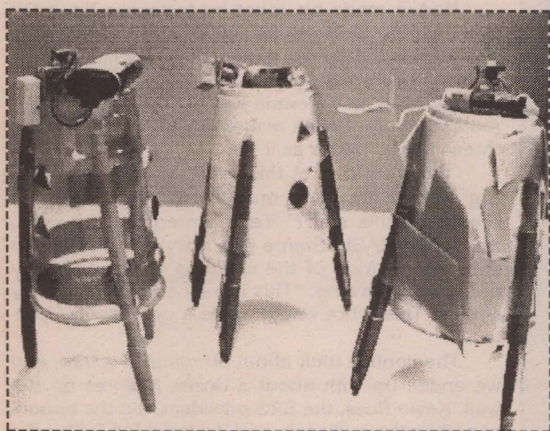
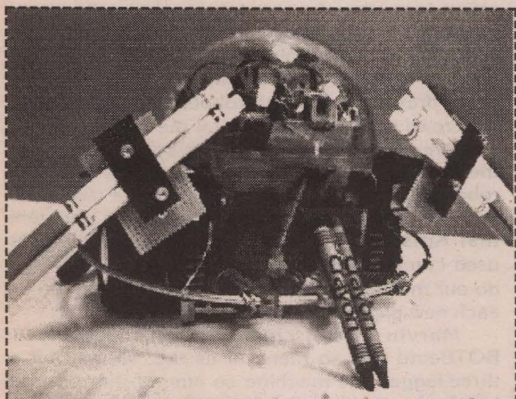
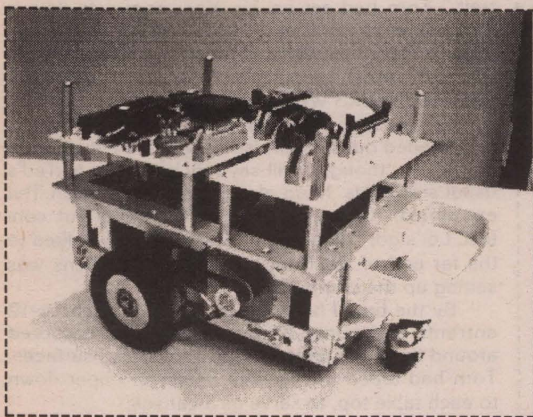
He returned after what seemed like only min-



utes, but was really an hour. "Your larder was pretty empty, so I biked down to the deli," he said, hoisting giant sandwiches out of his backpack. "You got salami, Meunster, and onion. Want half of my turkey, liver, and sauerkraut?"

Appalled as always by Ted's taste, I shook my head and reached for a Ballard Bitter. We both enjoy the ale, which started in a local micro-brewery. Besides, you gotta love a brewery whose motto announces its Scandinavian heritage: "Ya, sure, ya betcha!"

After lunch, Ted zeroed in on the software. "Is it code yet?" he asked.



"Actually, I think I've got it. Here's a printout; you can see there isn't much to it." I started to walk Ted through the program, but he jumped in ahead of me.

"I can see you used a bunch of CONSTs to declare speeds for the right and left motors; that must be what all the `rmtr_` and `lmtr_` names are for."

"And I can see that you hooked the right drive motor to the 68hc11's TOC2, the left motor to TOC3, and the pen positioning motor to TOC4. But what about the `deg90` constant?"

"Well," I explained, "the drive motors don't have encoders on them, so the only way the software can measure distance is to count the amount of time a motor is running. That delay contains the number of 4.2 msec ticks needed to turn the robot 90 degrees with both motors running full speed."

Ted picked up the thread again. "That means you must be using the 68hc11's Real Time Interrupt to count out the delays." He searched through the listing until he found the RTI interrupt service routine.

"There it is, at the `INTERRUPT $FFF0` line." He studied it for a moment. "Boy," he exclaimed,

"there's nothing to it!"

"No, the code is amazingly simple when you see it written out in SBasic," I agreed. "All the ISR code has to do is look at some timer variable, WAIT in this case, and decrement it if it hasn't already hit 0." "Next, the code rearms the RTI by setting the proper bit in the TFLG2 register. The END statement causes the 68hc11 to resume processing wherever it left off when the RTI interrupt occurred."

"This little ISR turns WAIT into a down-counting variable. Whenever WAIT is set to something other than zero, it will automatically decrement by one every 4.2 msec, which is the RTI timer rate. When it hits zero, it stops decrementing. Really simple, and very effective."

Ted pointed to some code below the label MAIN. "Of course, you still have to set up the RTI initially. That must be what the POKEBs into TMSK2 and TFLG2 do. But that still doesn't look very complex."

"No, it isn't tough to figure out. The hardest part, actually, is wading through the Motorola technical literature, to figure out which bits in which registers need changing." I moved to the code inside the `InitServos` routine. "You recognize this code, don't you?" I asked.

"Well, I know what it needs to do." He pondered the code for a moment. "The software has to slave the three servo motors to the main timer, TOC1. After all, that's how all of the servos that we hook to 68hc11s work."

"And you've set it up so the three servo signals go low when TOC1 hits 0. Then, each servo signal goes high individually, when a TOC channel reaches its timeout count. But your other programs were never this easy to understand."

I had to agree. "This is the first real servo program you've seen in SBasic. I've written the same thing before, in assembler and in tiny4th, but SBasic really simplifies the code."

Ted was already looking at something else. "What's going on here inside the Delay routine?"

I noticed he was pointing to the POP() statement. "Well, SBasic doesn't support passing arguments to subroutines, so I used the data stack to handle arguments."

"Whenever code calls Delay, it first pushes an argument onto the data stack. The Delay routine then pops the value off the stack before setting up the delay. This lets me change the delay duration at each call."

Ted seemed to have run out of questions, so I hooked the 68hc11 board to my PC's serial port, fired up PCBUG11, and downloaded the compiled SBasic program into the 'hc11's memory. We set the robot down on a piece of paper, uncapped the pen, and pressed the reset switch. Our little robo-Picasso began drawing its masterpiece.

The SRS meeting

Saturday morning, Ted picked me up in his old Toyota two-door, affectionately known as the "Beater." His car looked as if it had been through a few serious wrecks, but Ted was actually a very careful driver. All of the Beater's "damage" resulted from large robotics experiments, many of which didn't pan out.

The parking lot already contained about 20 cars by the time we pulled in, so this looked to be a full house. Sure enough, by 10 o'clock the place was SRO, with about 50 people (and nearly that many robots) attending.

The sheer number of robots at these meetings always surprises me. Ted and I go back to the late 1980s, when the SRS was lucky to muster 10 people at a meeting, with just one or two robots under construction.

More than half the discussion time centered

on the next day's contest. We hammered out final details on schedule, location, and event logistics. The meeting also touched on the newly-installed SRS Web page. I hadn't had time to check this out, but Ted had browsed it, and was really excited. The club's Webmaster, Jared Reisinger, made sure everyone had the proper URL: <http://www.hhhh.org/srs/> and gave us a quick tour of what the page offered. He also asked for a volunteer to bring a digital video camera to R-95, so he could get pictures of the event, and that was quickly arranged.

Several people showed off new robots, built specially for R-95. Each robot immediately triggered talks about motor controllers or sensors, so the meeting went into its "fits and starts" phase. After a couple of hours, the meeting morphed into the usual robo-chaos, with about a dozen simultaneous technical discussions taking place. At the lunch break, Ted and I headed off to the local surplus houses for some last-minute shopping.

Robo-thon '95

Bright and early Sunday morning, Ted aimed the Beater into a parking place at Renton Technical College. We collected our robots and other gear, then headed to the downstairs seminar rooms for R-95. The venue looked perfect. The room was well-lit, nearly 80' x 40', with enough tables and chairs for at least 100 people. The floor sported a neutral color, short-nap carpet, ideal for running small robots.

Ted summed it up. "I like it; restrooms around the corner, vending machines up the hall, and it's got a video monitor and VCR hanging on the wall. Looks like a keeper."

As sponsor of the Line Following event, I had some early duties to handle. This mostly involved moving tables to clear an area for the event, then taping down an eight-foot length of blank 30" wide drawing paper.

Working carefully with a black marking pen, I drew a line the length of the paper, to mark out the contest's course. The 1/4" wide path contained some right-angle bends and some smooth arcs, with the starting point at one end and the finish line at the other.

Other sponsors were also setting up their contests, and before long we had a Sumo ring in one corner, and the Dead Reckoning course set up in another.

Ted wandered over about this time. "Somebody showed up with some robotic art he did. It doesn't move yet, but he wants the SRS to help him add motion to his work."

"He's a local sculptor, and he makes these neat pieces, about three-feet high, welded out of springs and hardware he found at Boeing Surplus. The two he brought today are kind of like little metal people. One of them holds out a pan so you can throw in some pennies; the guy wants to add a tape deck so his robot can hit you up for loose change."

Ted helped me run the Line Following contest, the first event of the day. Four people entered machines, and Gary Teachout took first place with a speedy little machine that basically used two photodetectors straddling the line. Whenever a photodetector saw the line, it switched the drive motors to turn back towards the line. This simple bang-bang design usually results in a robot that crabs back and forth across the line, taking far too long to run the course. Gary made up for this flaw by running his machine at an insanely high speed.

As always, you can reach me at:

Karl Lunt

2133 186th Pl., S.E.

Bothell, WA 98012

E-Mail: karl@mav.com

ROBOTICS . . . ROBOTICS . . . ROBOTICS . . . ROBOTICS . . . ROBOTICS

As Ted said, "Heck, the machine probably only saw the line about ten times in the entire run!" The robot took just 6.5 seconds for the fastest of its three runs, down a twisty course that probably measured five feet long.

Contrast that time with Tom Dickens' second-place finish of 16.7 seconds. Karl Lunt came in third with his venerable CBE-1, clocked at 23.9 seconds; Bill Harrison's machine was not able to finish the course.

The crowd definitely got into the LF contest, and each contestant got a good round of applause and lots of encouragement. It set the stage for a great robot day.

Ted glanced over at the far end of the room, then added, "Looks like the Dead Reckoning contest is getting started. Let's go take a look."

The premise behind the DR contest seems simple. A robot must start at a marked location,

then travel two meters in a straight line, turn 45 degrees to the right, and travel an additional two meters.

The target point, where the robot *should* stop, is marked with a tiny icon. A robot is judged by the absolute distance between its ending point and the target point. Obviously, the smaller the delta, the better the score.

All three entrants used stepper motors to drive their robot. After three heats, Bill Bailey was declared the winner; his machine's best run ended with a delta of 5/16th of an inch from the target point. Gary Teachout's design (different from his line-following 'bot) turned in a low of 11/16th of an inch, good for second place. Ken and Mike Birdwell's machine finished third with a 2" difference.

After each contest, Tom Dickens had the entrants bring their robots over for a "family por-

trait." Tom had set up his Mac, complete with a QuickTime camera, and took a .GIF of the robots. In fact, Tom took .GIFs of most of the robots at R-95, and Jared, the club's Webmaster, later put them on the SRS Web page.

By this time, Ted was feeling a mite peckish, and headed out to snare some lunch. I'll spare you the details, though I will say lunch was up to Ted's usual standards. I had almost recovered when Ted exclaimed, "Okay, it's time for the Robot Art contest. Let's go!" He grabbed Artist and fast-walked to the far end of the room, where Tom Dickens was setting up the competition.

By the time I had arrived, a crowd of about 12 entrants and some 25 bystanders had gathered around the three tables set up as drawing surfaces. Tom had taped a three-foot length of paper down to each table top, to serve as a canvas.

The RA contest couldn't be simpler. Set your robot down, then have it draw, paint, chalk, spray, or whatever, some type of artistic creation. You get a maximum of five minutes for your run, then the paper is removed and hung up on the wall with the other drawings. After all robots have performed, the crowd votes by applause for the winner.

Since Ted had worked his way to the front of the crowd, Tom let him start the event. The little robot performed as expected, and got a nice hand for its effort. However, it quickly became apparent that Artist was too simplistic. Following robots used complex patterns and multiple colors to out-do our machine, and Ted's face fell a little more as each new picture went up on the wall.

Marvin Green, inventor of the 68hc11 BOTBoard that so many of us use, showed off a three-legged art machine so simple that several kids had entered similar devices.

Marvin made his robot by fastening three felt pens, points down, to an upside-down coffee cup. The cup rested on the three pen tips, while a small battery-powered motor, mounted on the cup, quickly spun an eccentric weight. The offset weight made the cup vibrate across the table top, leaving three colored tracks as it went.

"Will you look at this?" demanded Ted, holding one of Marvin's machines. "How does he dream up this stuff?" Ted showed me the servo motor and BASIC Stamp that Marvin had added, to shift the position of the spinning motor and vary the robot's drawing. "This is a nice touch, and very simple. This robot would make a great school project."

The contest took about 30 minutes to run, and we ended up with about a dozen pictures on the wall. Kevin Ross, the SRS president, did the honors of polling the audience, and declared Bill Bailey the winner.

Bill had taped a felt pen to the front of his Dead Reckoning entry, then done some hasty software writing during lunch. Now, his machine repeatedly drew a large, ornate pattern of lines and curves. Due to tiny differences in the drive system, the designs precessed as the robot drew.

It was basically the same concept Ted and I had envisioned for Artist, but on a much larger and more elegant scale. "Oh well," said Ted, "we'll just do a better job for the next contest."

So the day continued, with contests, lots of robots, and plenty of excitement. By 3:30, when we were supposed to clear out, the SRS members had enjoyed about seven solid hours of high-intensity robotics. We cleaned the place up, gave a big "Thank you!" to our host from Renton Technical College, and departed for home.

Ted summed up the day. "You know, we filled that room with robots and robot builders, we spent all day doing and talking robots, and it was only a club event! What's it going to look like in the spring, when the SRS holds a Robothon open to everyone?"

"No idea," I replied. "But I know we'll be there." **NV**

```
' artist.bas  SBasic program to draw line art,
' using a wire-frame robot similar to Dancer.
```

```
include "regs11.lib"
```

```
' Declare constants for various motor speeds, for
' both the right and left motors.
```

```
const rmtr_fwd = $f800
const rmtr_rev = $f200
const lmtr_fwd = $f200
const lmtr_rev = $f800
const rmtr_fwd75 = $f740
const rmtr_rev75 = $f2c0
const lmtr_fwd75 = $f2c0
const lmtr_rev75 = $f740
const rmtr_fwd50 = $f680
const rmtr_rev50 = $f380
const lmtr_fwd50 = $f380
const lmtr_rev50 = $f680
const rmtr_stop = $0
const lmtr_stop = $0
```

```
' Declare constants for pen positions.
```

```
const pen_up = $f500
const pen_down = $f300
```

```
' Declare constants for the TOCs attached to
' the three servo motors.
```

```
const rmtr_toc = toc2
const lmtr_toc = toc3
const pmtr_toc = toc4
```

```
const seconds = 254
const deg90 = 345
```

```
declare wait      ' universal timer
declare n          ' temp variable
```

```
' InitServos  initialize servo control system.
```

```
' This version uses three servos, hooked to TOC2
' TOC3, and TOC4. All servo control lines are
' pulled high when TOC1 times out. Each line
' then drops low when the corresponding
' TOC channel times out.
```

```
InitServos:
poke toc1, 0      ' clear TOC1
pokeb tcl1, $fc   ' set TOCx on time-out
pokeb oc1m, $70   ' slave TOCx to TOC1
pokeb oc1d, $00   ' 0s to TOCx on time-out
gosub StopMotors  ' shut off motors
return
```

```
StopMotors:
```

```
poke rmtr_toc, rmtr_stop ' stop the right motor
poke lmtr_toc, lmtr_stop ' stop the left motor
return
```

```
GoRight:
```

```
poke rmtr_toc, rmtr_stop
poke lmtr_toc, lmtr_fwd ' turn left motor
return
```

```
GoLeft:
```

```
poke rmtr_toc, rmtr_fwd ' turn the right motor
poke lmtr_toc, lmtr_stop
return
```

```
PlacePen:
```

```
poke pmtr_toc, pop() ' make it so
return
```

```
Delay:
```

```
wait = pop()      ' set the delay
do loop while wait <> 0 ' wait it out
return
```

```
interrupt $fff0
```

```
if wait <> 0      ' RTI isr
wait = wait - 1  ' if need to drop it...
drop it
```

```
endif
pokeb tflg2, %01000000 ' rearm RTI
end
```

```
main:
```

```
pokeb baud, $30   ' 9600 baud
pokeb sscr2, $0c  ' turn on SCI
```

```
wait = 0          ' clear the wait timer
pokeb tmsk2, peekb(tmsk2) or %01000000
pokeb tflg2, %01000000 ' start RTI system
interrupts on      ' allow interrupts
```

```
print "Artist...";
gosub InitServos  ' start servo system
push pen_down    ' flag for pen down
gosub PlacePen   ' place the pen
push 2*seconds   ' get a delay
gosub Delay      ' and wait
```

```
for n = 1 to 12
gosub GoRight
push deg90
gosub Delay
```

```
gosub GoLeft
push deg90 * 3
gosub Delay
```

```
next
```

```
gosub StopMotors  ' all done
push pen_up       ' raise the pen
gosub PlacePen
```

```
print "done"
```

```
end
```


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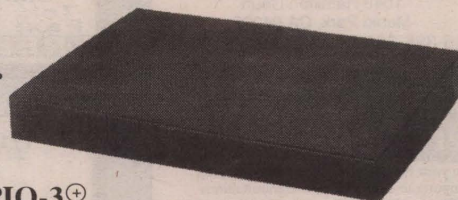
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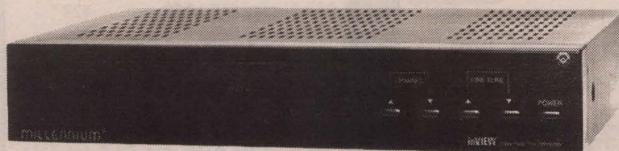
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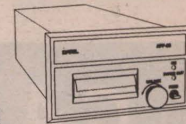
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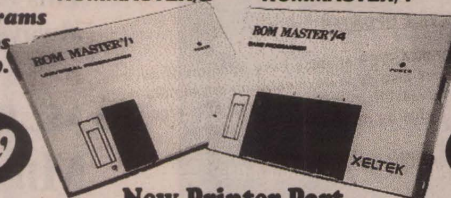
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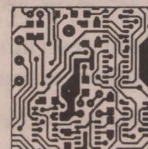
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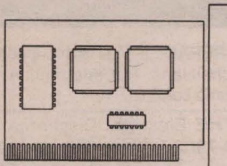
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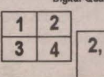
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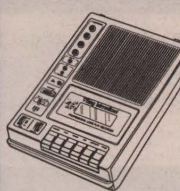
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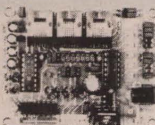


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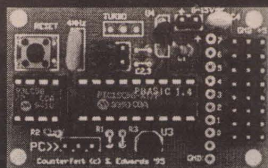
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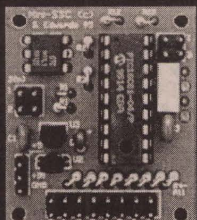
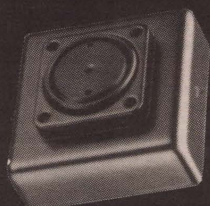
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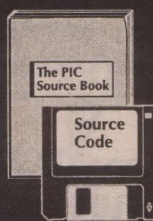
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The PIC16C84 Programmer

Build this PIC16C84 programmer and discover the world of microcontrollers today!

by Chris Sakkas

You've probably read many articles that praise Microchip's PIC family of microcontrollers for their low-cost, versatility, and simplicity. You may have even wanted to learn how to use them in your own designs.

Unfortunately, the high cost of PIC device programmers may have deterred you from experimenting with these fabulous microcontrollers. Add to that the cost of an EPROM eraser, and it is understandable why many hobbyists are reluctant to begin using microcontrollers.

If the cost of equipment has deterred you from learning about microcontrollers in the past, then the PIC16C84 programmer is for you.

This article details the construction of an inexpensive and easy-to-build programmer for Microchip's EEPROM microcontroller — the

RB7 pin is used for entering commands and data input/output.

Software is available (see the Sources sidebar) for using an IBM-compatible PC as a host system for the PIC16C84 programmer. This software performs well on most any Microsoft DOS based systems. See the PIC16C84 Programming Software sidebar for information on how to use the software for this programmer.

For more information on the serial and parallel method of programming the PIC16C84 microcontroller, consult Microchip document DS30189C. (See the Sources sidebar for more information.) This document provides all the details for those readers interested in developing their own programming software.

Circuit Description

The schematic for the PIC16C84 programmer is shown in Figure 2. Power is supplied to the circuit via a wall transformer in the 12-16V AC range connected to jack J1. A full-wave bridge rectifier is used along with capacitor C2 to convert the voltage to DC. LED D3 indicates that power has been applied. Voltage regulator U1, a LM78L05ACZ, provides a steady 5V supply. Variable voltage regulator U2, a LM317LZ, is programmed by resis-

tors R10 and R9 to supply a 13V output needed for programming the PIC16C84.

Five parts of the 7406 (a hex inverting buffer with open collector outputs) are used to buffer the signals from the DB-25 male connector on the programmer to the parallel port of the PC. Transistors Q1 and Q2 are used to switch the 5V and 13V sources as needed to the VDD and *MCLR pins, respectively. LED D1 glows when device programming occurs. Because of

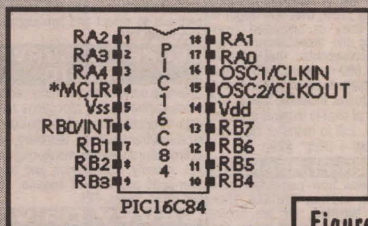
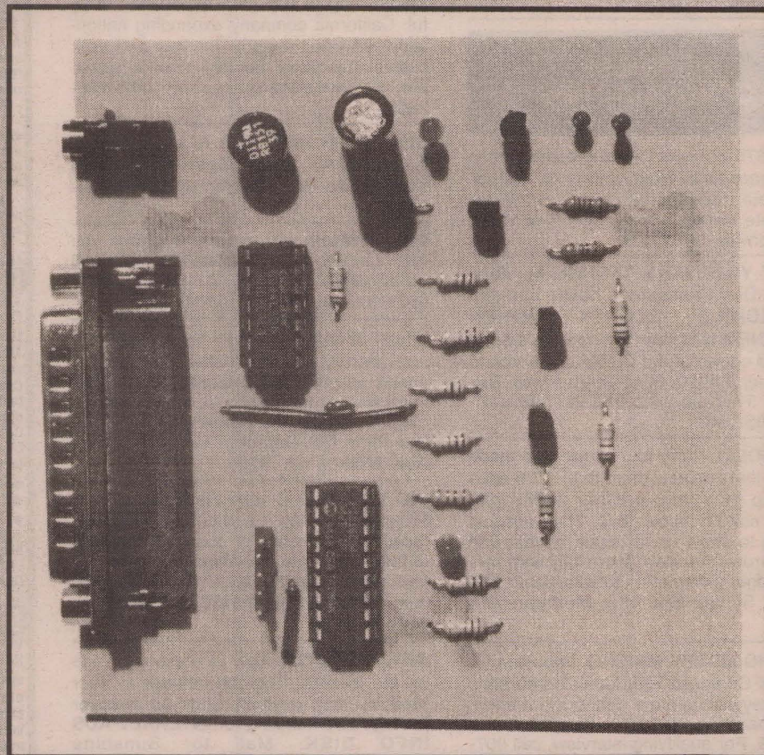


Figure 1

PIC16C84 — that is easily connected to the parallel port of your IBM-compatible PC.

The PIC16C84 is unique in the PIC family because of its use of electrically erasable programmable read-only memory (EEPROM) for its program and data memory. This means that no additional equipment is needed for erasing the microcontroller before re-programming and that in-system programming (ISP) is also possible.

Programming the PIC16C84

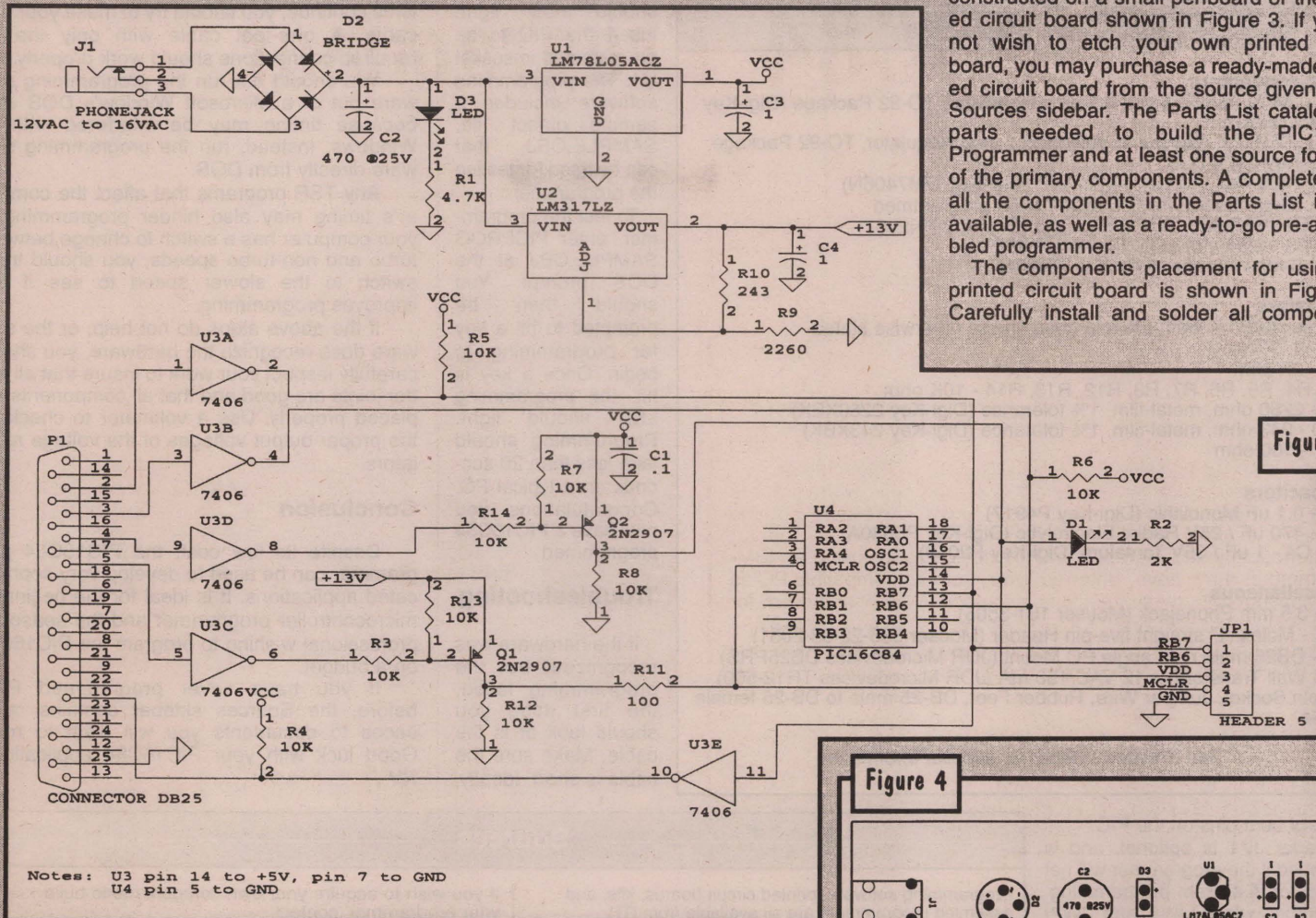
The PIC16C84 microcontroller can be programmed in either serial or parallel mode. While parallel mode is faster, serial mode provides simplicity and in-system programmability. Therefore, the PIC16C84 programmer serial mode is used.

Figure 1 displays the pin configuration for the PIC16C84. Two power supplies are required for programming the PIC16C84: one for the VDD pin (4.5V to 5.5V) and one for the *MCLR pin (12V to 14V). In serial operation, the RB6 pin is used as a clock input pin and the

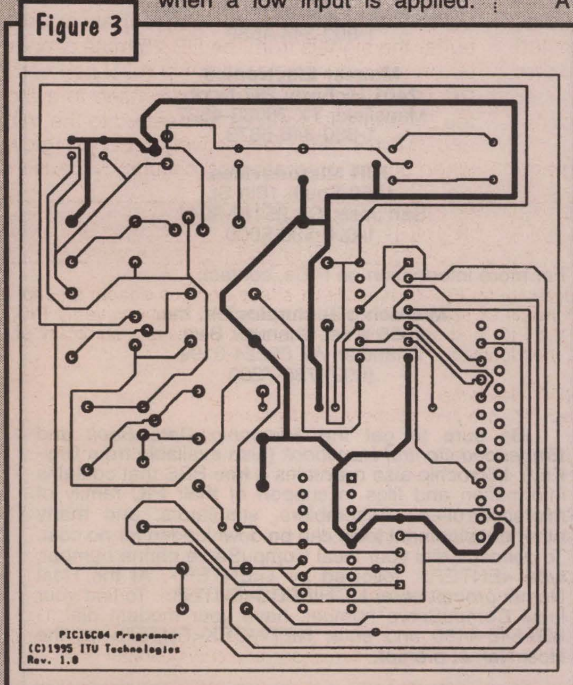
PIC16C84 Programming Software

The programming software for IBM-compatible PCs (see Sources sidebar for supplier information) consists of several files that program PIC memory, verify PIC memory, configure the PIC, and erase the PIC contents. Below is a summary of the commands and their function:

- PICPROG** <filename>
- Program PIC program memory with filename
- PICVERIFY** <filename>
- Verify PIC program memory against filename
- PICDATA** <filename>
- Program PIC data memory with filename
- PICCONFG**
- Configure PIC by answering questions presented
- PICERASE**
- Erase program memory, data memory, and configuration



the open collector nature of the 7406, the output of the 7406 appears to be an open circuit when a low input is applied.



Therefore, resistors R4, R5, and R6 are used as pull ups to 5 volts.

A five pin header, JP1, is also shown on the schematic. This header is used for in-system programming of your own designs. All signals needed to program a PIC16C84 are provided by the pins of this header.

For in-system programming, your designs must provide a means of isolating the corresponding pins of the PIC16C84 device from the other parts of your circuit. This can be accomplished easily by using five two-post headers, with one end connected to the PIC and the other to the remaining circuitry.

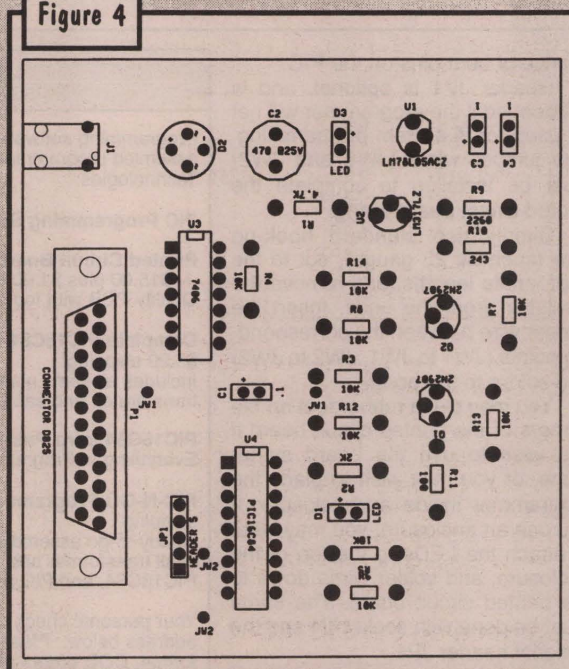
These posts must be jumped together for normal operation. Simply remove the jumpers and connect the pins from the PIC16C84 programmer to the in-circuit PIC when programming is needed. The jumpers must then be re-installed after programming.

Construction

The PIC16C84 programmer can be

constructed on a small perfboard or the printed circuit board shown in Figure 3. If you do not wish to etch your own printed circuit board, you may purchase a ready-made printed circuit board from the source given in the Sources sidebar. The Parts List catalogs all parts needed to build the PIC16C84 Programmer and at least one source for each of the primary components. A complete kit of all the components in the Parts List is also available, as well as a ready-to-go pre-assembled programmer.

The components placement for using the printed circuit board is shown in Figure 4. Carefully install and solder all components



into place. Pay particular attention to the orientation of the TO-92 packages (transistors and voltage regulators) and to the polarities of the capacitors, bridge rectifier, and LEDs.

All of these components have either one longer lead to indicate positive polarity, or are clearly marked for polarity on the package.

Sockets should be used for U3 and U4. A ZIF (Zero Insertion Force) socket may be used for U4 to make insertion and removal of a PIC to be programmed easier and to lessen the

Parts List

Semiconductors

U1 - LM78L05ACZ 5 volt 0.1 amp Regulator, TO-92 Package (Digi-Key LM78L05ACZ)
 U2 - LM317LZ Adjustable Voltage 0.1 amp Regulator, TO-92 Package (Digi-Key LM317LZ)
 U3 - 7406 Hex Inverter 14-pin DIP (Digi-Key DM7406N)
 U4 - 18-pin Socket for PIC16C84 to be programmed
 Q1, Q2 - PN2907, TO-92 Package (Digi-Key PN2907)
 D1, D3 - 2.54 mm LED (Digi-Key P363)
 D2 - Bridge Rectifier (Digi-Key RB151)

Resistors

All resistors 1/4 watt, 5% tolerance unless otherwise stated
 R1 - 4.7K ohm
 R2 - 2K ohm
 R3, R4, R5, R6, R7, R8, R12, R13, R14 - 10K ohm
 R9 - 2260 ohm, metal-film, 1% tolerance (Digi-Key 2260XBK)
 R10 - 243 ohm, metal-film, 1% tolerance (Digi-Key 243XBK)
 R11 - 100 ohm

Capacitors

C1 - 0.1 uF Monolithic (Digi-Key P4917)
 C2 - 470 uF / 25V Radial Electrolytic (Digi-Key P5630A)
 C3, C4 - 1 uF / 35V Tantalum (Digi-Key P2059)

Miscellaneous

J1 - 3.5 mm Phonejack (Mouser 161-3505)
 JP1 - Molex .1" straight five-pin Header (Mouser 538-22-03-2051)
 P1 - DB25 male right angle PC Mount (JDR Microdevices DB25PRS)
 T1 - Wall Transformer 12 VAC/150 mA (JDR Microdevices TR12-500)
 14-pin Socket, Jumper Wire, Rubber Feet, DB-25 male to DB-25 female cable

See Sources sidebar for supplier information

The power LED should now light. Insert the PIC to be programmed in socket U4. The programming software includes a sample object file, SAMPLE.OBJ, that can be used for testing the programmer.

To test the programmer, enter PICPROG SAMPLE.OBJ at the DOS prompt. You should then be prompted to hit a key for programming to begin. Once a key is hit, the programming LED should light. Programming should take less than 20 seconds on a typical PC. Congratulations, you now have a PIC16C84 programmer!

Troubleshooting

If the hardware was recognized, but the programming failed, the first thing you should look at is the cable. Make sure the cable is short. Ideally,

this should be less than three feet, but if problems continue, you should try to make your own cable. A one-foot cable with only the six required connections should work properly.

You should not run the programming software out of a Microsoft Windows DOS shell because timing may be interfered with by Windows. Instead, run the programming software directly from DOS.

Any TSR programs that affect the computer's timing may also hinder programming. If your computer has a switch to change between turbo and non-turbo speeds, you should try to switch to the slower speed to see if this improves programming.

If the above steps do not help, or the software does recognize the hardware, you should carefully inspect your work to insure that all solder joints are good and that all components are placed properly. Use a voltmeter to check for the proper output voltages of the voltage regulators.

Conclusion

Despite its low cost, the PIC16C84 programmer can be used to develop very sophisticated applications. It is ideal for the beginning microcontroller programmer and the seasoned professional wishing to program the PIC16C84 on a budget.

If you have never programmed PICs before, the Sources sidebar contains references to documents you will want to read. Good luck with your PIC16C84 applications! NV

chance of bent pins on the PIC.

Header JP1 is optional, and is not needed if the programmer will not be used for in-system programming. Two jumper wires (JW1 and JW2) must be installed to complete the printed circuit board wiring.

Simply use standard hook-up wire (such as 22 gauge), cut to the appropriate lengths, and remove the insulation from the ends. Insert the jumper wire between the corresponding points (JW1 to JW1, JW2 to JW2) and solder to the board.

You may place rubber feet on the corners of the printed circuit board if you wish to use the board stand-alone, or you may wish to place the programmer inside an enclosure. If you use an enclosure, you may want to attach the LEDs to the top of the enclosure, and solder wires down to the printed circuit board. The same must be done with socket U4 and the optional header JP1.

Test and Use

The PIC16C84 programmer is now ready for use! After you have obtained the programming software, connect a short DB-25 male to DB-25 female cable between the PC's parallel port and the programmer's DB-25 connector. Plug the wall transformer to an AC outlet and insert the plug into the jack on the programmer.

Sources

Programming software, printed circuit boards, kits, and assembled programmers are all available from ITU Technologies:

PIC Programming Software — \$5.00 plus \$1.00 shipping.

Printed Circuit Board and PIC Programming Software

— \$15.00 plus \$1.00 shipping.
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Complete PIC16C84 Programmer Kit — \$29.00 plus \$5.00 shipping.
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PIC16C84 Intro-Pak — \$39.00 plus \$5.00 shipping.
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PIC-N-GO Programmer — \$59.00 plus \$5.00 shipping.
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Please call or write if you would like to receive our catalog of other electronic products.

If you wish to acquire your own components to build your programmer, contact:

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 Thief River Falls, MN 56701-0677
 1-800-344-4539

Mouser Electronics
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 Mansfield, TX 76063-4827
 1-800-346-6873

JDR Microdevices
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 San Jose, CA 95112-9941
 1-800-538-5000

For more information on PICs, contact:

Microchip Technologies, Inc.
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 (602) 786-7200

Be sure to get the *Microchip Data Book* and *Embedded Control Handbook* (also available from Digi-Key). Microchip also maintains a free BBS that contains information and files in support of their PIC family of microcontrollers. Assemblers, simulators, and many other development tools can be downloaded for no cost. To connect, dial your local CompuServe phone number, type <ENTER>, followed by +<ENTER>. At the Host Name: prompt enter MCHIPBBS<ENTER>. To find your local CompuServe number, have your modem dial 1-800-848-4480 and enter NETWORK<ENTER> at the Host Name: prompt.

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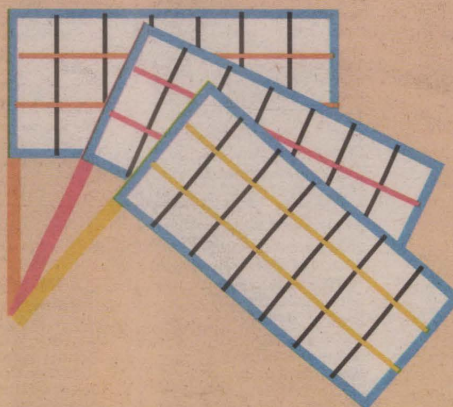
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Ham Radio and the Baja 1000

by Jim Ford N6JF



November 8-11, 1995 marks the 28th running of the largest off-road race in the world — the Baja 1000 — as well as its long association with ham radio support. Every third year the race starts in Ensenada and finishes in La Paz, a distance of slightly over 1,000 miles. This year is different in that it starts in Tijuana and finishes in La Paz.

The race is international in scope with usually over 300 entries from all over the world. The majority are from the USA and the host country, Mexico.

In the past, there have even been Japanese riders that bought package deals which included the rental of a motorcycle and all the necessary support — gas, tires, pit crews, hotel rooms, etc.

Race Details

SCORE, the sponsor, divides the entries into over 14 different classes (six different classes for motorcycles alone). The non-motorcycle classes range from pickup trucks to dune buggies and the fast "rails." There is even a special Safari class where classic cars such as a '57 Chevy or others

can compete in a more limited mileage competition.

The entry fee for the race is on the order of \$300.00 to \$500.00 depending upon the class of entry. The prizes are from two sources: SCORE and corporate sponsors. The top few finishers in each class will get a part of their entry fee back. This is not very exciting, but the real money comes from the sponsors such as the tire companies, motorcycle manufacturers, spark plug companies, etc. Over \$500,000 in contingency fees are often posted. This might seem to be a good prize bank, but contingency means, for example, if a tire manufacturer offers a \$50,000 prize, the winner must use their tires. If three tire manufacturers offer the same prize, two will not be awarded, because the winner didn't use their tires. This brings the real prize money down considerably.

Sponsors help the racers by giving them good breaks on products and sometimes provide pit support. The top teams get a lot of help from corporate sponsors. The vast majority do not make any money on the race.

The first motorcycle starts at 6:00 AM with another every 30 seconds. At 8:30 AM the cars are started. The faster vehicles start

first to minimize the necessity of passing, however, bumping is allowed to emphasize the need to pass under certain conditions.

The motorcycles are faster over all, but each year the rails improve and last year, in one race, the overall winner was not a motorcycle. The last full course motorcycle elapsed time was 16 hours 50 minutes, but the four-wheel rail was only three minutes slower. The finishers must get stubs from all check points (13 in 1992) and complete the race by 42 hours after they start. Some of the faster vehicles average over 60 MPH (overall winner 61.333 MPH this year) on roads that most people would drive 5-15 MPH if attempted.

Many drivers wear totally enclosed head gear with air pumper helmets to combat dust. Some motorcycle drivers wear headlights on their helmets. Fog, mud holes, and sometimes cows in the road are hazards of the night. Three or four riders are often used because this race is so grueling.

Support Essential

Support of all kinds is necessary for this race. Pit crews often "crew" for more than one vehicle. These crews are located near the checkpoints. They often hopscotch down the course.

The reason that the full length

course from Ensenada (this year Tijuana) to La Paz is chosen only every three years over loop races just a couple hundred miles south of the border is due to expense and the "stringing out" of pit crews, etc.

Crews with names such as Team Green or Rough Riders

carry spares of all kinds, even welding equipment. The desire to finish even if you're not "in the money" is strong. It is not uncommon to see a vehicle come through a check point with one wheel missing entirely, or no brakes, and still keep going. Approximately 50% finish the race although this varies with road conditions and support.

Medical support is a necessity, with one medic team per check point when possible, but roving teams are common. Broken arms and legs are almost a guarantee with every race. Serious injuries such as head or spine also occur. The race has had a few fatalities. Most of the equipment and volunteers are from the USA, but Mexico also supplies ambulances and volunteers.

When a serious injury occurs, the local medical team does what it can in communication with the medical director, and they decide where to take the injured. The nearest local hospital or clinic may be the right choice, but they may elect to transport the injured by ambulance or plane to the USA. Sometimes travel to the USA is not possible, or delayed because of citizenship problems, or because night flying except by large commercial aircraft is generally illegal in Mexico.

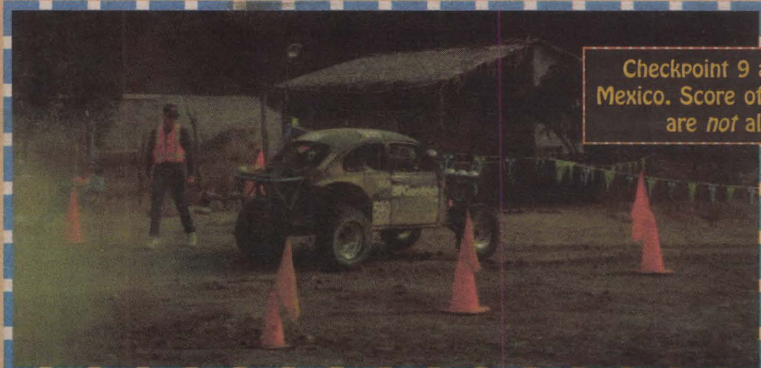
Enter Ham Radio

Communications are vital to all parts of the race. This is where ham radio helps. The organization that supports all the Baja races (there are 250-and 500-mile races as well) is BARRA — Baja Amateur Radio Racing Association, spearheaded by Bob Ward WB6WTE. This organization has been in existence before the first Baja race. BARRA manned 11 of 13 checkpoints in the last full course race, as well as the start and finish. BARRA's function is to provide health and welfare information.

Most of the communications traffic handled consists of passing times relayed to net control, either at the start or the finish (both ends want the same data). Passing times mean, for example, vehicle 567 passed check point 9 at time 11:37. These times are put in a data base at both ends. When someone asks at any location what happened to their vehicle, their request is relayed to net control and the data base is accessed to see the checkpoint and time last seen.

Manning the race data base is a big job in itself. Since most pit crews are located near the checkpoints, many inquiries are from pit crew members just walking over to us and asking about the vehicles

Checkpoint 9 at San Javier, BCS Mexico. Score officials are those who are *not* allergic to dust.





The popular pick-up class — note the heavy duty endorsements painted on the truck.

they are supporting.

Stuck stub info is also relayed to specific checkpoints or net control. A "stuck stub" is something all racers carry — it is simply a piece of paper stating their problem. For example, a stuck stub might say, "Stuck 15 miles north of checkpoint 9 with broken front axle, contact Team Green, vehicle 567, signed B. Smith." All racers are expected to pick up these stuck stubs from stranded racers and deposit them at the next checkpoint.

Medical co-ordination is sometimes necessary, particularly when the race course is not a loop and long distances need to be covered. Many of the pit crews, medics, and racers have VHF "Business Band" transceivers in the 151 MHz range. VHF often does not have good enough range for the medics. This is where ham-radio HF (short-wave) can provide vital assistance and co-ordination. Of course, medical communications traffic takes first priority on all "channels."

A somewhat humorous co-ordination of a different nature was required one year at checkpoint 9 in San Javier manned by Terry Neal AA6TN, Jim Sanders KA6MOB, and myself. A non-English speaking Japanese rider with a broken motorcycle was

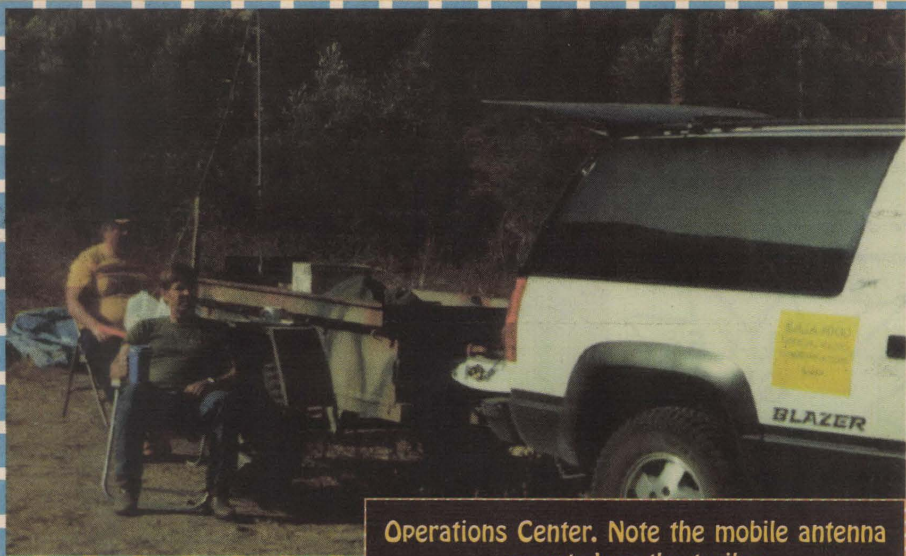
brought to us. His bike was still 25 miles north of the checkpoint. We asked net control at La Paz to find a Japanese speaking person to reassure him. They did find somebody who spoke some Japanese, but were unable to find his rented pit crew even though he waited half the day. He was finally taken to La Paz by a different pit crew chase team with a note pinned on him that described his problem. We wondered if he would buy that package deal again.

Much of the pit crew communications are handled by the VHF business band transceivers. They even have a plane that flies around and does voice relays called "The Weatherman." It is relatively new that the Mexican government allowed this plane to fly at night.

Ham radio has HF communi-

cations to solve some of the limitations of the business band. The vast majority of the HF traffic was on approximately 3850 and 7200 KHz. Forty meters was best during the day and into early evening at which time the net changed to 80 meters. HF is really the

backbone of the full length course although VHF can work good when there is shorter or loop races. We used a Kenwood 690 transceiver, and a 450-ohm ladder line fed 80 meter inverted V dipole with a balanced transmatch. Our checkpoint in the last full course



Operations Center. Note the mobile antenna mounted on the trailer.

was set up 100 yards west of the San Javier church. (We used the church to hook up one end of the inverted V.) This church, incidentally, was completed in 1757 and was the second oldest of the famous mission churches (the first was in Loreto, 21 miles east).

VHF both voice and packet are used for shorter races. Packet is useful for the "passing time" traffic. Leon Braskamp AA6GL wrote a special data base program just for the race. Packet limitations are getting all stations equipped and familiar with this type of communications, as well as multi-path bounce distortion. Often, strong signals that seem like they should work, don't

because of multi-path. This can be a problem for the mountainous desert of Baja CA. We are still trying to solve some of these problems.

The mountains of central Baja have a 10,000'+ peak called Mt. Diablo (the Devil). This would seem like an answer to many path problems especially since there is a road up to the top. We have tried it in the past, but Mt. Diablo is also an observatory. The access to the very top is limited because they are afraid the transmissions may disrupt their studies. Also, as you might imagine, you can't have any lights on either.

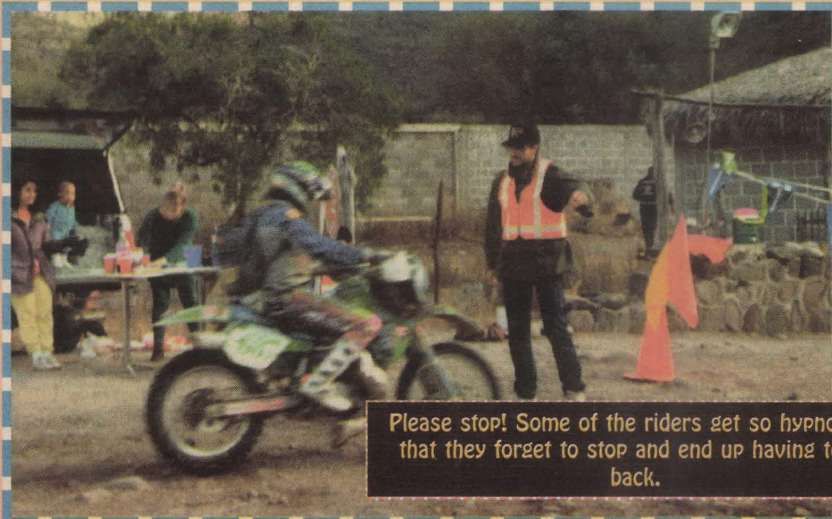
There was also an extra level of permission needed to get near the observatory along with its associated snafus. Camping in the dark at 10,000' in November also requires hardy volunteers, such as George Hiscox WA6RIK. This juicy sight may have to be passed in the future.

BARRA got all the Mexican

ham licenses at no cost to any of the volunteers. They use the format XE2/your call. These licenses have always been valid for a limited time (for about a week around the race). Recently, people have paid \$60.00 for a six month Mexican license.

Mexican ham licensing is in a state of flux. The United States just implemented a reciprocal licensing agreement with Mexico. The details of how Mexico will implement this agreement and cost (if any, the US is free) are overdue.

Mark your calendars for the start date of Thursday, November 8th to listen in on the fun. For those who think they might enjoy the combination of camping, ham radio, and the race, you might want to contact Bob Ward WB6WTE, P.O. Box 290519, Phelan, CA 92329-0519. **NV**



Please stop! Some of the riders get so hypnotized that they forget to stop and end up having to go back.

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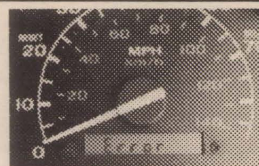
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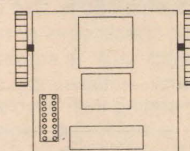
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OCTOBER 22

CO - GOLDEN — RMRL Hamfest & ARRL State Convention. **SPONSOR:** Rocky Mountain Radio League. **LOCATION:** Jefferson County Fairgrounds, 15200 W 6th Ave. **HOURS:** 8am-2pm. **ADMISSION:** \$4. **TALK-IN:** 144.62/145.22. **FEATURES:** DP - EX - F - F/R - H. **DEALER INFO:** Tables: \$10. **CONTACT:** Joe Dickinson WT0C, 303-771-9577.

IL - PALATINE — Computer Central. **LOCATION:** Harper College, building M on W side of campus, at Algonquin and Roselle Roads. **HOURS:** 9:30am-3pm. **ADMISSION:** Adults \$6, 8-12 \$2, under 8 free. \$1 off reg adult admission w/this ad. **FEATURES:** C - C - FP. **CONTACT:** Computer Central, Jay B. Robinson, 708-940-7547.

MI - DEARBORN — Computer Trade Show. **LOCATION:** Dearborn Civic Center, 15801 Michigan Ave, corner of Greenfield. **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 — Five Star Computer Shows. **SPONSOR:** Five Star Productions. **LOCATION:** Flint Holiday Inn, Gateway Centre, US-23 at Hill Rd Exit 2 mi S of I-69. **HOURS:** 10am-4pm. **ADMISSION:** \$4. **FEATURES:** C - DP - FP. **CONTACT:** Five Star Productions, 810-239-3640.

MI - SOUTHGATE — Computer Show. **LOCATION:** Southgate Civic Center Annex, 14700 Reaume Rd, Dix-Toledo to Reaume Rd. **HOURS:** 10am-3pm. **ADMISSION:** Adults \$4, students & seniors w/ID \$3, under 12 free. **FEATURES:** C - DP. **CONTACT:** International Computer Trade Shows, 810-858-2416.

MI - WARREN — USECA Swap. **SPONSOR:** Utica Shelby Communications Assn. **LOCATION:** Our Lady of Redemption Conf Center, 425 Cole, just NE of Van Dyke & 12 Mile. **HOURS:** 8am-2pm. **ADMISSION:** \$4, under 11 free. **TALK-IN:** 147.18+ (100 Hz tone), 147.42 Simplex. **FEATURES:** C - E - EX - FP - F/R - H. **DEALER INFO:** Tables: \$15. **CONTACT:** Kevin Everett N8QVX, 810-772-8082, 21947 Birchwood, Eastpoint MI 48021.

OCTOBER 27-28-29

OK - KINGSTON — ARRL Hamfest. **SPONSOR:** Texoma Hamaram Association. **CONTACT:** Charles Bilbay, K1SCG, Rte 2, Box 301, Bokchito OK 74726, 405-924-0687.

OCTOBER 28

IL - EVANSTON — Chicago TI International World Faire. **SPONSOR:** Chicago T199/4a User Group. **LOCATION:** Evanston Public Library, 1730 Orrington. **HOURS:** 9am-4pm. **ADMISSION:** \$2, group members: free. **CONTACT:** Hal Shanafield, TI User Group, POB 7009, Evanston IL 60204-7009 or 708-864-8644.

MN - ST. PAUL — Hamfest Minnesota & Computer Expo. **SPONSOR:** Twin Cities FM Club. **LOCATION:** St. Paul Civic Center, Main Arena, Kellogg & West 7th Street. **HOURS:** 8am-4pm. **ADMISSION:** Adv \$5.50, Door \$7. **TALK-IN:** 146.16/76. **FEATURES:** C - CB - DP - EX - FM - F/R - H - S. **DEALER INFO:** Flea Market Table: \$20, set-up Fri, 6pm-10pm, Sat 7am-8am. **CONTACT:** PO Box 5598, Hopkins MN 55343, or call, 612-535-0637.

MO - ST. LOUISE — ARRL Hamfest. **SPONSOR:** Gateway to Ham Radio Club & St. Louis ARC. **CONTACT:** Dennis McCarthy AA0A, 5022 Lansdowne Ave, St. Louis MO 63109, 314-351-3568.

NE - LEXINGTON — Amateur Radio/Computer Auction. **SPONSOR:** Heartland ARA. **LOCATION:** Knights of Columbus Hall, 6th & Taft. **HOURS:** Preview 9am, Auction 11am. **ADMISSION:** \$1 for bidders. **TALK-IN:** 147.135+, 146.52s. **FEATURES:** C - E - FP - F/R - H. **CONTACT:** Hoppy W4YDN, 308-987-2161 or Randy WB0SAO, 308-987-2312.

TX - AUSTIN — Classic & Orphaned Computer Swap Meet. **SPONSOR:** Austin Atari Computer Enthusiasts. **LOCATION:** Bethany United Methodist Church, 10010 Anderson Mill Rd., 183 N, near 620. **HOURS:** 1pm-5pm. **ADMISSION:** Free. **FEATURES:** AC - C - CB - E - FM - FP. **DEALER INFO:** Tables: \$5 & \$10, set-up at noon. **CONTACT:** Jerry 512-432-8598, Rick 512-453-8195.

OCTOBER 29

IA - DES MOINES — ARRL Hamfest. **SPONSOR:** Tikva Tracers ARC. **CONTACT:** Randal Lees, MOLMS, 1575 NW 78th St, Clive IA 50325-1255, 515-279-4241.

IL - GLEN ELLYN — Computer Central. **LOCATION:** College of DuPage, 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 - FP. **CONTACT:** Computer Central, Jay B. Robinson, 708-940-7547.

IN - LEBANON — Hamfest. **SPONSOR:** Boone & Clinton County ARCs. **LOCATION:** Boone County 4-H Fairgrounds, Warm & Dry Community Bldg on I-65, 17 mi N of Indianapolis. **HOURS:** 8am-4pm. **ADMISSION:** \$3. **TALK-IN:** 147.105/443.150. **FEATURES:** CB - EX - FM - FP - F/R - T. **DEALER INFO:** Table space: \$5, set-up 6am. **CONTACT:** Michael Ottinger NX9Q, 317-482-1866, 809 E Walnut St, Lebanon IN 46052.

OH - MARION — 21st Annual Hamfiesta & Computer Show. **SPONSOR:** Marion ARC. **LOCATION:** Marion County Fairgrounds. **HOURS:** 8am-3pm. **ADMISSION:** Adv \$4, Door \$5. **TALK-IN:** 147.90/30. **FEATURES:** C - DP - FP - F/R - H. **DEALER INFO:** Tables: \$10. **CONTACT:** Karen Eckard N8JDH, 6583 South St, Meeker OH 43302, 614-499-3565, Betty Krist N8JDT, 132 N Seffner Ave, Marion OH 43302, 614-387-3533 eves.

NOVEMBER 4

IL - GODFREY — Midwest Amateur Radio Expo. **SPONSOR:** Lewis & Clark Radio Club. **LOCATION:** Lewis & Clark Community College, Riverbend Arena, off US 67. **HOURS:** 8am-2pm. **ADMISSION:** \$4. **TALK-IN:** 145.23. **FEATURES:** CB - DP - F - FM - FP - F/R - H - T. **DEALER INFO:** 8' tables: \$10, set-up Fri 5pm-9pm. **CONTACT:** Gen. Info: Harold Elmore, 618-466-1909, vendors: Larry Roberts, 618-466-0041, Exams: Richard Morgan 618-466-2306.

OK - ENID — Hamfest. **SPONSOR:** Enid Hamfest Group. **LOCATION:** Garfield County Fairgrounds, Hoover Bldg, Oxford & 4th St. **HOURS:** 8am-5pm. **ADMISSION:** \$2. **TALK-IN:** 147.375+. **FEATURES:** DP - EX - FP - F/R - RV-S. **DEALER INFO:** Tables

\$1, set-up 7pm-9pm. **CONTACT:** Fred N5QJX 405-242-3551, Tom N5LWT 405-233-8473, Dick N5HEL 405-233-9869.

WI - MILWAUKEE — Friendlyfest '95. **SPONSOR:** Milwaukee Repeater Club. **LOCATION:** Waukesha County Expo Center Forum, N1 W24848 Northview Rd. **HOURS:** 8am-1pm. **ADMISSION:** \$4. **TALK-IN:** 146.31 Rptr, 146.52. **FEATURES:** C - DP - E - EX - F/R - H. **DEALER INFO:** 4' tables: \$5 at door + admission, elec \$8. **CONTACT:** Burt N9VBI, 414-328-0535.

NOVEMBER 4-5

IL - CHICAGO — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Lake County Fairgrounds (Grayslake). **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

OH - CINCINNATI — Computer Fair. **SPONSOR:** Trade Show Productions. **LOCATION:** Cincinnati Gardens, 2250 Seymour Rd. **HOURS:** Sat: 10am-5pm; Sun: 10am-3pm. **ADMISSION:** \$5, good both days. **FEATURES:** C - CB - FM - S. **DEALER INFO:** 513-263-3378. **CONTACT:** Trade Shw Productions, Mark Hanslip, 143 Schloss Ln, Dayton OH 45418.

TX - ODESSA — 12th Annual Hamfest. **SPONSOR:** West Texas ARC. **LOCATION:** Ector County Coliseum, Exhibit Bldg B. **HOURS:** Sat: 8am-5pm, Sun: 9am-2pm. **ADMISSION:** Adv \$7, door \$8. **FEATURES:** DP - EX - F/R - H - RV-2. **DEALER INFO:** Tables \$8 + admission, setup Fri 4pm-10pm & Sat 7am. **CONTACT:** Robert Jordan N5RKN, 915-335-7980, E-Mail: rjordan903@aol.com.

NOVEMBER 5

MI - FLINT — Computer Show. **LOCATION:** Holiday Inn Gateway Center, 5353 Gateway Center, I-75 N to I-475 (Exit 111), 1 mi to Hill Rd (Exit 2), turn left, go approx 3 mi. **HOURS:** 10am-4pm. **ADMISSION:** Adults \$4, students & seniors w/ID \$3, under 12 free. **FEATURES:** C - DP - . **CONTACT:** International Computer Trade Shows, 810-858-2416.

MI - LATHRUP — 1995 Swap & Shop. **SPONSOR:** Oak Park ARC & Spirit of 76 ARC. **LOCATION:** Southfield-Lathrup High School, 19301 W 12 Mile

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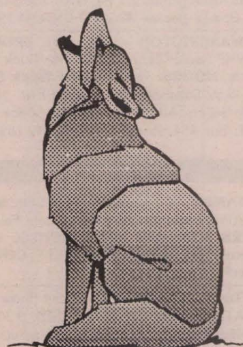
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Events CALENDAR

Rd. **HOURS:** 8am-7 **ADMISSION:** \$5. **TALK-IN:** 146.76. **FEATURES:** DP - EX. **DEALER INFO:** Tables: \$15 (adv only). **CONTACT:** Swap Hotline, 810-559-2442, VE exams: Jeff N8WRY, 810-642-3608.

OH - MASSILLON — Auctionfest '95 Hamfest. **SPONSOR:** Massillon ARC. **LOCATION:** Knights of Columbus Hall, 988 Cherry Rd NW. **HOURS:** 8am-7. **ADMISSION:** Adv \$4, door \$5. **TALK-IN:** 147.78/18, 442.85+5. **DEALER INFO:** 8' table: \$8, set-up 7am. **CONTACT:** Jack Cale N8FEB, 6021 Longbrook St SW, Massillon OH 44646, 216-477-8261.

WI - KAUKAUNA — Hamfest. **SPONSOR:** Fox Cities ARC. **LOCATION:** Starlite Club, Corner of 55 & JJ. **HOURS:** 8am-7. **ADMISSION:** \$4. **TALK-IN:** 146.76, PL-100.0. **DEALER INFO:** Tables: \$6. **CONTACT:** FCARC, 2410 E Newberry Ct, Appleton WI 54915. Dan Vanevenhoven: 414-739-5101.

NOVEMBER 11

IN - INDIANAPOLIS — Indianapolis Computer Fair. **LOCATION:** Indianapolis Events Center. **HOURS:** 10am-3pm. **ADMISSION:** \$4, under 12 free. **FEATURES:** C - DP. **CONTACT:** Ben Yanto, AGI Computer Fairs.*

LA - MONROE — Hamfest. **SPONSOR:** Twin City Ham Club. **LOCATION:** West Monroe Convention Center, corner of North 7th & Ridge Ave. **HOURS:** 8am-3:30pm. **TALK-IN:** 146.85-. **FEATURES:** DP - EX - F - F/R - H. **CONTACT:** TCHC, POB 1871, West Monroe LA 71294.

OH - TOLEDO — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** SeaGate Convention Centre. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

NOVEMBER 12

IL - MACOMB — ARRL Hamfest. **SPONSOR:** Lamaine Emergency ARC. **CONTACT:** Kathy Page AA9KL, 580 West Penn, Roseville IL 61473. 309-426-2723.

IN - FT. WAYNE — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Allen County Fairgrounds. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

MO - CARTHAGE — Hamfest. **SPONSOR:** Carthage ARS. **LOCATION:** Memorial Hall, Garrison & Oak Sts. **HOURS:** 8am-1pm. **ADMISSION:** \$3. **TALK-IN:** 147.42. **DEALER INFO:** Tables: \$5. **CONTACT:** Jim Dixon WX0J, 417-358-2761, POB 783, Carthage MO 64836.

NOVEMBER 18

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 - F. **S. DEALER INFO:** Covered 8' table \$35 ea. **CONTACT:** Progressive Computer Productions, 23814 Michigan Ave, Ste 237, Dearborn MI 48124. 313-425-9276.

NOVEMBER 18-19

IN - FORT WAYNE — 23rd Annual Hamfest/Computer Expo & ARRL State Convention. **SPONSOR:** Allen County Amateur Radio Technical Society. **LOCATION:** Allen County War Memorial Coliseum, Exposition Center. **HOURS:** Sat: 9am-4pm; Sun: 9am-3pm. **ADMISSION:** \$5, under 11 free. **TALK-IN:** 146.88-. **FEATURES:** C - CB - DP - F - FM - H. **DEALER INFO:** Tables: Flea market \$15, Premium \$30, Elec \$25. John Rufner 219-483-6305. **CONTACT:** ACARTS, POB 10342, Fort Wayne IN 46851. Don Gagnon 219-484-3317.

NOVEMBER 19

IL - ORLAND PARK — The Orland Park Computer Show. **LOCATION:** Orland Park Civic Center, 147th St & LaGrange Rd (Rte 45). **HOURS:** 9:30am-3pm. **ADMISSION:** Adults \$5 - \$1 off with copy of this ad, 8-12 yrs \$2, under 8 free. **FEATURES:** A - C - CB - DP - F/R - All indoors. **CONTACT:** 24-hour Hotline 708-974-3123.

MI - FLINT — Five Star Productions Computer Shows. **SPONSOR:** Five Star Productions. **LOCATION:** Flint Holiday Inn, US-23 at Hill Rd Exit 2 mi S of I-69. **HOURS:** 10am-4pm. **ADMISSION:** \$4. **FEATURES:** C - DP - FP. **DEALER INFO:** \$35 tables negotiable. **CONTACT:** Five Star Productions, 810-239-3640.

MI - MADISON HEIGHTS — Computer Show. **LOCATION:** UFGCW Hall, 876 Horace Brown Dr, 1

blk E of I-75, 1 blk S of 13 Mile Rd. **HOURS:** 10am-4pm. **ADMISSION:** Adults \$4, students & seniors w/ID \$3, under 12 free. **FEATURES:** C - DP - . **CONTACT:** International Computer Trade Shows, 810-858-2416.

OH - AKRON — Computer Show & Sale. **SPONSOR:** Peter Trapp Shows. **LOCATION:** Tadmor Shrine Temple. **HOURS:** 10am-3pm. **ADMISSION:** \$6, \$1 off w/this ad or coupon, under 12 free. **FEATURES:** C - FP - F/R. **CONTACT:** Peter Trapp Shows, 607-369-2796.

NOVEMBER 24-25

OH - DAYTON — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Montgomery County Fairgrounds. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

NOVEMBER 25

IL - KANKAKEE — Computer Expo. **SPONSOR:** Kankakee River Valley Computer Users Group. **LOCATION:** Kankakee County Fairgrounds, Hall of Industry. **HOURS:** 9am-2pm. **ADMISSION:** \$4, 10 & under free. **FEATURES:** C - CB - DP - E - FP - F/R. **CONTACT:** 815-935-1605.

IL - LITCHFIELD — ARRL Hamfest. **SPONSOR:** Central Illinois/St. Louis Area Amateur Television Club. **CONTACT:** Scott Millick K9SM, 907 Big Four Ave, Hillsboro IL 62049-1009. 217-532-3837.

IN - EVANSVILLE — 3rd Annual Winter Hamfest. **SPONSOR:** EARS. **LOCATION:** Vanderburgh County Fairgrounds, US 41 @ Boonville - New Harmony Rd. **HOURS:** 8am-2pm. **ADMISSION:** \$5. **TALK-IN:** 145.150-. 146.925-. **FEATURES:** CB - FM - FP - F/R - H. **DEALER INFO:** Tables: \$10, Set-up 6am. **CONTACT:** Neil WB9VPG: 812-479-5741. EARS, 1506 S Parker Dr, Evansville IN 47714.

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

LA - CHALMETTE — 1995 Greater New Orleans Hamfest. **LOCATION:** St. Bernard Cultural Center. **HOURS:** 8am-2:30pm. **ADMISSION:** \$3. **TALK-IN:** 146.85. **FEATURES:** DP - EX - F - FM - F/R - T. **CONTACT:** GN0H, POB 51822, New Orleans LA 70152-1822, or call Hamfest News Line 1-800-343-7332.

NOVEMBER 26

IL - GLEN ELLYN — Computer Central. **LOCATION:** College of DuPage, 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 - FP. **CONTACT:** Computer Central, Jay B. Robinson, 708-940-7547.

OH - COLUMBUS — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Ohio Expositions Center. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

DECEMBER 1-2

AR - LITTLE ROCK — Arkansas DX Convention. **CONTACT:** Dennis Schaefer W5RZ, 181 Schaefer r. Dover AR 72837. 501-967-4372.

DECEMBER 2

IL - JACKSONVILLE — Central Illinois Winter Superfest. **SPONSOR:** Illinois Valley ARC & Jacksonville ARS. **LOCATION:** Turner Junior High School, 664 S Lincoln Ave, one blk N of Wal-Mart. **HOURS:** 8am-2pm. **ADMISSION:** \$3 or 2 for \$5, under 16 free. **TALK-IN:** 146.775-. 444.675+. **FEATURES:** C - EX - FM - FP - F/R - H. **DEALER INFO:** Tables \$10 + admission, set-up 6am. Rich Tavender KB9IXO, 7621 E State, Jacksonville IL 62650. **CONTACT:** VE Exam: Tim Childers KB9FBI, 217-245-2061.

FL - OCALA — Marion County Outdoor Tailgate Hamfest. **SPONSOR:** Marion County Repeater Owners Assn. **LOCATION:** Booster Stadium parking lot, NE 36th Ave. **HOURS:** 8am-3pm. **ADMISSION:** Free. **FEATURES:** XC - E - FM - FP - F/R - H - RV-S - T. **CONTACT:** Mario N4TSV, 904-245-9514.

LA - MINDEN — Hamfest. **SPONSOR:** Minden ARA. **CONTACT:** George Winford AA5OL, 111 Fuller St, Minden LA 71055-3420. 318-377-5019.

MN - FAIRBAULT — Annual Courage Center Handi-Ham Winter Hamfest. **LOCATION:** Eagles Club. **HOURS:** 8:30am-7. **FEATURES:** FM - F/R. **CONTACT:** Don Franz W0FIT, 1114 Frank Ave, Albert Lea MN 56007.

DECEMBER 3

MI - HAZEL PARK — 30th Annual Swap & Shop. **SPONSOR:** Hazel Park ARC. **LOCATION:** Hazel Park High School. **HOURS:** 8am-2pm. **ADMISSION:** \$4. **TALK-IN:** 146.640. **FEATURES:** DP - FP - H. **DEALER INFO:** Tables: \$13, adv only. **CONTACT:** HPARC, Box 368, Hazel MI 48030.

DECEMBER 16

MI - FLINT — Five Star Productions Computer Shows. **SPONSOR:** Five Star Productions. **LOCATION:** Flint Holiday Inn, US-23 at Hill Rd Exit 2 mi S of I-69. **HOURS:** 10am-4pm. **ADMISSION:** \$4. **FEATURES:** C - DP - FP. **DEALER INFO:** \$35 tables negotiable. **CONTACT:** Five Star Productions, 810-239-3640.

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 - FP - F/R - S. **DEALER INFO:** Covered 8' table \$35 ea. **CONTACT:** Progressive Computer Productions, 23814 Michigan Ave, Ste 237, Dearborn MI 48124. 313-425-9276.

DECEMBER 17

IL - ORLAND PARK — The Orland Park Computer Show. **LOCATION:** Orland Park Civic Center, 147th St & LaGrange Rd (Rte 45). **HOURS:** 9:30am-3pm. **ADMISSION:** Adults \$5 - \$1 off with copy of this ad, 8-12 yrs \$2, under 8 free. **FEATURES:** A - C - CB - DP - F/R - All indoors. **CONTACT:** 24-hour Hotline 708-974-3123.

EASTERN REGION

OCTOBER 1

DE - NEW CASTLE — Tri-State Computer Fair. **SPONSOR:** Tri-State Fairs. **LOCATION:** Nur Temple. **DEALER INFO:** Tables \$75/\$60. 135 tables. **CONTACT:** 201-533-1991.

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.*

MA - ROCKLAND — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Sons of Italy, Rtes 123 & 139; Rte 3, Exit 14 to Rockland Center. **HOURS:** 10am-3:30pm. **ADMISSION:** \$7, under 14 free w/adult. **FEATURES:** C. **DEALER INFO:** Set-up 8am. **CONTACT:** Northern Computer Shows.*

NY - HEMPSTEAD — Computer Show. **LOCATION:** Hofstra University Field House, use Meadowbrook Parkway Exit M-4 to Hempstead Tpke, 1 mile past Coliseum. **HOURS:** 10am-3pm. **FEATURES:** C. **DEALER INFO:** 500+ tables. **CONTACT:** KGP Computer Show.*

NY - QUEENS — Semi-Annual Hamfest. **SPONSOR:** Hall of Science ARC. **LOCATION:** Hall of Science, 47-01 111 St, Flushing Meadow Park. **HOURS:** 9am-3pm. **ADMISSION:** \$5, under 12 free. **TALK-IN:** 444.200 Repeat PL 136.5. **FEATURES:** C - CB - DP - FP - F/R - H. **DEALER INFO:** Sellers \$10 per space, (includes 1 admission). **CONTACT:** Arnie Schiffman WB2YXB 718-343-0172 eves. Charlie Becker WA2JUU 516-694-3955 eves.

PA - WARRINGTON — Hamarama. **SPONSOR:** Mt. Airy VHF Radio Club. **LOCATION:** Buck County Drive-In. **HOURS:** 7am-7. **ADMISSION:** \$5. **TALK-IN:** 146.52 Simplex. **FEATURES:** F/R - H. **DEALER INFO:** Sellers: Admission + \$8 per space. **CONTACT:** Box 451, Montgomeryville PA 18936.

OCTOBER 7

FL - TAMPA — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Florida State Fairgrounds. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

NY - TROY — MarketPro Computer Show & Sale. **LOCATION:** Troy Armory. **HOURS:** 9:30am-4pm. **ADMISSION:** \$6, under 12 free w/adult. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

SC - FORT MILL — Rock Hill Hamfest & Computer Fair. **SPONSOR:** York County ARS. **LOCATION:** Knights Stadium, I-77, exit 88. **HOURS:** 6am-7. **ADMISSION:** Adv \$5, door \$6. **TALK-IN:** 147.03 - 600. **FEATURES:** C - CB - DP - EX - F/R - H - T.

DEALER INFO: YCARS Hamfest, 2129 Squire Rd, Rock Hill SC 29730. **CONTACT:** George Trunk AB4BG, 803-327-4344.

OCTOBER 7-8

GA - NORCROSS — Atlanta Computer Show. **LOCATION:** North Atlanta Trade Center, 1700 Jeurgens Court, I-85 N to Exit 38 & turn right to Oakbrook Parkway, turn right to Jeurgens Court. **HOURS:** Sat: 9am-5pm, Sun: 10am-4pm. **ADMISSION:** \$5 both days, \$4 Sun. only. **FEATURES:** AC - C - DP - FP - F/R. **DEALER INFO:** 8' tables \$45. **CONTACT:** Computer Show, POB 295, Riverdale GA 30274. 770-907-6225.

MS - BILOXI — ARRL Delta Division Convention. **CONTACT:** Donna Alexander, KA5OER, 22 Yorkshire Pkwy, Gulfport MS 39503. 601-896-4984.

OCTOBER 8

CT - DURHAM — Nutmeg Hamfest, Computer Show & State Convention. **SPONSOR:** Meriden, Middlesex & Shoreline ARCs. **LOCATION:** Fairgrounds, on Rte 17. **HOURS:** 9am-3pm. **ADMISSION:** \$5, under 12 free. **TALK-IN:** 145.29. **FEATURES:** C - CB - EX - F - FM - FP - F/R - H - T. **DEALER INFO:** Inside table: \$25, tailgate space: \$20, both include admission, set-up Sat @ 4 pm. Dan Murphy KA1SZP, 203-349-1304 eves, 162 Tri-Mountain Rd, Durham CT 06422. **CONTACT:** Bill Wawrzniak W1KFF, 203-269-8252 eves. VE exams: Joel Curnell N1JEO, 203-235-6932.

FL - CLEARWATER — October Computer Fair. **SPONSOR:** "We're Show Offs!". **LOCATION:** Elks Club, 2750 Sunset Point Rd. **HOURS:** 10am-3pm. **ADMISSION:** Adults \$4, \$3 w/ad, under 12 free. **FEATURES:** AC - C - FP - FP. **DEALER INFO:** Adv tables \$40/1 table, \$70/2 tables, \$25 ea additional table. **CONTACT:** "We're Show Offs!" 813-545-5265.

FL - ST. PETERSBURG — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** St. Petersburg Coliseum. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

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 - FP. **DEALER INFO:** Set-up 8am. **CONTACT:** Northern Computer Shows.*

NJ - LINCROFT — Shore Area Hamfest & ARRL State Convention. **LOCATION:** Brookdale Community College, Garden State Pkwy exit 109, West on Rte 520. **HOURS:** 8am-7. **ADMISSION:** Adv \$5 w/2 stubs, Door: \$6 w/1 stub, under 12 free. **TALK-IN:** 145.485/-6. **FEATURES:** AC - C - CB - DP - EX - F - FP - F/R - H - T. **DEALER INFO:** 8' indoor table \$25, outdoor space \$10, set-up 6am. **CONTACT:** Al Allen K2JLQ, Shore Area Hamfest, POB 635, Eatontown NJ 07724, 908-495-3246.

NY - MIDDLETOWN — Tri-State Computer Fair. **SPONSOR:** Tri-State Fairs. **LOCATION:** Orange Cty Fairgrounds Arena. **DEALER INFO:** \$75/\$60. 200+ tables. **CONTACT:** 201-533-1991.

NY - WHITE PLAINS — MarketPro Computer Show & Sale. **LOCATION:** Westchester County Center. **HOURS:** 9:30am-4pm. **ADMISSION:** \$6, under 12 free w/adult. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

OCTOBER 9

MA - FALL RIVER — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** White's of Westport Columbus Day, Exit 9 E or Exit 10 W off I-195. **HOURS:** 10am-3:30pm. **ADMISSION:** \$7, under 14 free w/adult. **FEATURES:** C. **DEALER INFO:** Set-up 8am. **CONTACT:** Northern Computer Shows.*

NY - TARRYTOWN — Tri-State Computer Fair. **SPONSOR:** Tri-State Fairs. **LOCATION:** Westchester Marriott. **DEALER INFO:** Tables \$75/\$60 + \$25 for electricity. 125 tables. **CONTACT:** 201-533-1991.

OCTOBER 13

NJ - LIVINGSTON — Tri-State Computer Fair. **SPONSOR:** Tri-State Fairs. **LOCATION:** Travelodge Hotel. **HOURS:** 5pm-9:30pm. **DEALER INFO:** Tables \$45. 85 tables. **CONTACT:** 201-533-1991.

OCTOBER 13-14

NH - MANCHESTER — Annual Convention. **SPONSOR:** Quarter Century Wireless Assn. **LOCATION:** Holiday Inn. **CONTACT:** Leonard Hadley W1YGC, 617-894-2468.

Events CALENDAR

OCTOBER 13-14-15

GA - ATLANTA — Expo '95. **SPONSOR:** Grove Communications. **LOCATION:** Airport Hilton. **FEATURES:** B - F - S. **CONTACT:** Grove Enterprises, POB 30 S Hwy 64, Brasstown NC 28902. 800-438-8155.

OCTOBER 14

GA - AUGUSTA — 47th Annual Hamfest & Computer Show. **SPONSOR:** ARC of Augusta. **LOCATION:** Evans Middle School, @ Washington Rd & Belair Rd. **HOURS:** 9am-4pm. **ADMISSION:** \$5. **TALK-IN:** 145.49-. **FEATURES:** EX - F - RV-S. **DEALER INFO:** Indoor tables: \$10 + admission, outdoor sales: one free space w/admission, adl space \$5. Set-up Fri 6pm-9pm, Sat 6am-9am. **CONTACT:** Richard KR4XN, 706-860-3828, Rhonda KE4DIM, 706-560-9600 or ARCA, POB 3072, Augusta GA 30914.

PA - LEBANON — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Lebanon Valley Expo Center. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

OCTOBER 14-15

KY - LOUISVILLE — Greater Louisville Hamfest & State Convention. **LOCATION:** Kentucky Fair & Exposition Center. **ADMISSION:** \$5. **DEALER INFO:** Bill Rufner W9CBQ, 812-948-0037. **CONTACT:** Herbert Rowe, W4WQD 812-294-4905. Greater Louisville Hamfest, POB 34444-E, Louisville, KY 40232-4444.

MA - MARLBOROUGH — Computer Show. **LOCATION:** Royal Plaza Trade Center, take MA Tpke to I-495 N, go 4 miles, use Exit #24-B, 1/2 mile on right. **HOURS:** Sat: 10am-4pm, Sun: 10am-3pm. **FEATURES:** C. **DEALER INFO:** 500+ tables. **CONTACT:** KGP Computer Show.*

TN - MEMPHIS — ARRL Hamfest. **SPONSOR:** Mid-South ARA. **CONTACT:** Mary Moore, AC4GF, 5140 Woods Landing Cove, Memphis, TN 38125. 901-758-0661.

VA - ANNANDALE — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Northern Virginia Community College. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

OCTOBER 15

KY - LOUISVILLE — Computer Fair South. **SPONSOR:** MEKA Enterprises, Inc. **LOCATION:** Executive West Hotel, 165 & 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.

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 - W1XW/R. **FEATURES:** C - FP - H - T. **DEALER INFO:** Tailgate room for 600 sellers. \$10 per space at gate, \$8 ad includes 1 admission. Set-up 7am. For info call 617-253-3776. Mail advance reservations before the 5th. **CONTACT:** W1GSL, POB 397082 MIT BR., Cambridge MA 02139-7082.

MD - COLUMBIA — CARA Hamfest. **SPONSOR:** Columbia ARA. **LOCATION:** Howard County Fairgrounds. **HOURS:** 8am-3:30pm. **ADMISSION:** \$5, children free. **TALK-IN:** 146.52 Simplex, 147.135/735 Rptr 222.32/92 Rptr. **FEATURES:** C - E - EX - F/R - H - T. **DEALER INFO:** Tables \$20, tailgate space: \$10, call 410-992-8209. **CONTACT:** CARA Hamfest Committee, POB 911, Columbia MD 21044.

NJ - FAIRFIELD — MarketPro Computer Show & Sale. **LOCATION:** Radisson Hotel. **HOURS:** 9:30am-4pm. **ADMISSION:** \$6, under 12 free w/adult. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

PA - MONROEVILLE — Tri-State Computer Fair. **SPONSOR:** Tri-State Fairs. **LOCATION:** Palace Inn. **DEALER INFO:** Tables \$75/\$60. 150 tables. **CONTACT:** 201-533-1991.

PA - WILKES BARRE — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Genetti's Best Western. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

OCTOBER 20

NJ - EDISON — Tri-State Computer Fair. **SPONSOR:** Tri-State Fairs. **LOCATION:** Raritan Inn. **HOURS:** 5pm-9:30pm. **DEALER INFO:** Tables \$45.

CONTACT: 201-533-1991.

OCTOBER 20-21

FL - STARKE — Hamfest & Computer Show. **SPONSOR:** Bradford Area ARC. **LOCATION:** Bradford County Fairgrounds, on US-301. **HOURS:** Fri: 4pm-9pm; Sat: 8am-4pm. **ADMISSION:** Families: \$3. **TALK-IN:** 145.15, 146.52, 146.82. **FEATURES:** C - DP - H. **DEALER INFO:** Tables: \$5, tailgating \$4. **CONTACT:** Dan Phillips K4RVD, 8214 Carl Brook Rd., Keystone Hts FL 32656. 904-475-2695.

OCTOBER 21

NH - SALEM — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Rockingham Park Race Track, 1-93 Exit 1, next to 175 store Mall. **HOURS:** 10am-3:30pm. **ADMISSION:** \$7, under 14 free w/adult. **FEATURES:** C. **DEALER INFO:** Set-up 8am. **CONTACT:** Northern Computer Shows.*

NY - ALBANY — Tri-State Computer Fair. **SPONSOR:** Tri-State Fairs. **LOCATION:** New Scotland Armory. **DEALER INFO:** Tables \$75/\$60. 175 tables. **CONTACT:** 201-533-1991.

NY - BUFFALO — MarketPro Computer Show & Sale. **LOCATION:** Buffalo State College. **HOURS:** 9:30am-4pm. **ADMISSION:** \$6, under 12 free w/adult. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

PA - PHILADELPHIA — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Philadelphia Park (Bensalem). **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

PA - SENECA — Ham Radio Auction & Flea Market. **SPONSOR:** Fort Venango Mike & Key Club. **LOCATION:** Christian Life Bldg, Rte 257 between Rte 3 & Rte 62. **HOURS:** 8am-7pm. **ADMISSION:** \$3, under 12 free. **TALK-IN:** 147.12+, 145.23, 145.19, 444.125+. **FEATURES:** DP - FM - F/R - H. **DEALER INFO:** Tables: \$5, Mary Housholder N3QCR, 814-437-2036. **CONTACT:** Fort Venango Mike & Key Club, RD1, Box 591, Cranberry PA 16319.

SC - SUMTER — 9th Annual Hamfest & Computer Show. **SPONSOR:** Sumter ARA. **LOCATION:** Sumter County Exhibition Center, 700 W. Liberty St. **HOURS:** 8am-4pm. **ADMISSION:** \$5. **TALK-IN:** 147.015. **FEATURES:** C - DP - EX - F - FM - F/R - H - T. **DEALER INFO:** Tables/tailgate space: \$6, set-up Fri: 4pm-9pm & Sat: 6am. **CONTACT:** Mike Dunlap KC4HUT, 803-481-4611 or Tommy Dubose KB4CIH, 803-469-5093.

TN - GRAY — Tri-Cities Hamfest. **SPONSOR:** Kingsport, Bristol & Johnson City ARCs. **LOCATION:** Appalachian Fair Grounds, off I-181. **ADMISSION:** \$5. **FEATURES:** FM - RV-H. **CONTACT:** POB 3682 CRS, Johnson City TN 37602.

OCTOBER 21-22

AL - HUNTSVILLE — Huntsville Area Computer Show. **LOCATION:** Von Braun Civic Center, 700 Monroe Street, Exit 19-C off I-565. **HOURS:** Sat: 9am-5pm, Sun: 10am-4pm. **ADMISSION:** \$5 both days, \$4 Sun only. **FEATURES:** AC - C - DP - FP - F/R. **DEALER INFO:** 8' tables \$45. **CONTACT:** Computer Show, POB 295, Riverdale GA 30274. 770-907-6225.

FL - WEST PALM BEACH — Hamfest & Computer Show. **SPONSOR:** Palm Beach Repeater Assn. **LOCATION:** South Florida Fairgrounds, Southern Blvd. **HOURS:** Sat: 9am-5pm, Sun: 9am-3pm. **ADMISSION:** Door \$5, good both days. **TALK-IN:** 147.165/147.765. **FEATURES:** AC - C - EX - FM - H - RV-H. **DEALER INFO:** Flea Tables: \$20 + admission, set-up Fri: 2pm-8pm Vi Kiekenapp KC4LCF: 407-585-9074. **CONTACT:** PBRA Hamfest, POB 461, Lake Worth FL 33460.

KY - LOUISVILLE — Computer Fair. **SPONSOR:** Trade Show Productions. **LOCATION:** Kentucky Fair & Expo Center. **HOURS:** Sat: 10-5, Sun: 10-3. **ADMISSION:** \$5, good both days. **FEATURES:** C - CB - FM - S. **DEALER INFO:** Commercial booth: \$200, Flea Market space: \$30. **CONTACT:** Trade Show Productions/Mark Hanslip, 143 Schloss Ln, Dayton, OH 45418. 513-263-3378.

OCTOBER 22

DE - NEWARK — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** University of Delaware, Bob Carpenter Center. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

ME - PORTLAND — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Verrillo's Conv. Ctr at Howard Johnson Motor Lodge, I-95 Exit 8. **HOURS:** 10am-3:30pm. **ADMISSION:** \$7, under 14 free w/adult. **FEATURES:** C.

DEALER INFO: Set-up 8am. **CONTACT:** Northern Computer Shows.*

NY - ROCHESTER — MarketPro Computer Show & Sale. **LOCATION:** The Dome Center. **HOURS:** 9:30am-4pm. **ADMISSION:** \$6, under 12 free w/adult. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

NY - SYRACUSE — Computer Trade Show. **SPONSOR:** Peter Trapp Shows. **LOCATION:** NY State Fairgrounds. **HOURS:** 10am-4pm. **ADMISSION:** \$6, \$1 off w/this ad or coupon, under 12 free. **FEATURES:** C - FP - F/R. **CONTACT:** Peter Trapp Shows, 607-369-2796.

PA - GREENSBURG — Hamfest. **SPONSOR:** Foothills ARC. **LOCATION:** Greensburg Hose Company #1, off Rte 66, N of Greensburg. **HOURS:** 8am-2pm. **ADMISSION:** \$2. **TALK-IN:** 147.18+. **FEATURES:** FM - T. **DEALER INFO:** Inside tables: \$10, tailgating \$3. **CONTACT:** Al Compton N3LQX, 412-512-3727. Foothills ARC, 555 Agnew Rd, Greensburg PA 15601-9701.

PA - SELLERSVILLE — Hamfest. **SPONSOR:** RH Hill ARC. **LOCATION:** Sellersville Fire House, Rte 152, 5 mi S of Quakertown. **ADMISSION:** \$5. **TALK-IN:** 145.31. **FEATURES:** EX. **DEALER INFO:** Indoor space w/table: \$18, outdoor space only: \$6. **CONTACT:** Linda Erdman: 215-679-5764 or POB 29, Colmar, PA 18915.

OCTOBER 27

NY - BAYSIDE — Tri-State Computer Fair. **SPONSOR:** Tri-State Fairs. **LOCATION:** Adria Hotel. **HOURS:** 5pm-9:30pm. **DEALER INFO:** Tables \$45. **CONTACT:** 201-533-1991.

OCTOBER 27-28

SC - GREENVILLE — Vintage Radio Trade/Show. **SPONSOR:** SC Chapter of the Vintage Radio Unique Society. **HOURS:** Fri: 1pm-5pm, Sat: Dawn-2pm. **ADMISSION:** \$3, good both days, spouses free. **TALK-IN:** +147.285. **FEATURES:** S - T. **CONTACT:** George Hall, 803-244-9797 eves. Jerryl Sears, 910-765-4302, 312 Auburndale St, Winston-Salem NC 27104.

OCTOBER 28

CT - WATERFORD — Ham Radio Auction. **SPONSOR:** Tri City ARC. **LOCATION:** Senior Citizens Center, Waterford Municipal Complex. **HOURS:** 10am-7pm. **ADMISSION:** Free. **TALK-IN:** 146.37/97. **FEATURES:** F/R. **DEALER INFO:** Set-up 9am. **CONTACT:** Bob KA1BB: 203-739-8016.

FL - PORT ST. LUCIE — Hamfest '95. **SPONSOR:** Port St. Lucie ARA. **LOCATION:** Port St. Lucie Yacht Club, 500 Prima Vista Blvd. **HOURS:** 8am-3pm. **ADMISSION:** \$2. **TALK-IN:** 146.955, 146.520. **FEATURES:** DP - F/R - H - T. **DEALER INFO:** Inside tables: \$10, tailgate space: \$5. **CONTACT:** Bill Perciaspe, 407-879-4020, Roy Cox, 407-340-4319.

MA - PLYMOUTH — Amateur Radio Flea Market. **SPONSOR:** Mayflower ARC. **LOCATION:** Plymouth Memorial Hall Bldg, Court St (Rte 3A). **HOURS:** 9am-3pm. **ADMISSION:** \$2, under 12 free. **FEATURES:** H. **DEALER INFO:** Tables: Adv \$12, Door \$14. **CONTACT:** Mayflower ARC, POB 766, Plymouth MA 02362. Jon WS1K, 508-746-0162, Jim NM1F, 508-747-2224.

MA - TOPSFIELD — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Topsfield Fairgrounds, I-95 Exit 50 (North Shore). **HOURS:** 10am-3:30pm. **ADMISSION:** \$7, under 14 free w/adult. **FEATURES:** C. **DEALER INFO:** Set-up 8am. **CONTACT:** Northern Computer Shows.*

MA - WEST SPRINGFIELD — MarketPro Computer Show & Sale. **LOCATION:** Eastern States Exposition. **HOURS:** 9:30am-4pm. **ADMISSION:** \$6, under 12 free w/adult. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

NJ - TEANECK — Tri-State Computer Fair. **SPONSOR:** Tri-State Fairs. **LOCATION:** Marriott at Glenpointe. **DEALER INFO:** Tables \$75/\$60. **CONTACT:** 201-533-1991.

PA - BETHLEHEM — Computer Trade Show. **SPONSOR:** Peter Trapp Shows. **LOCATION:** Stabler Arena. **HOURS:** 10am-3pm. **ADMISSION:** \$6, \$1 off w/this ad or coupon, under 12 free. **FEATURES:** C - FP - F/R. **CONTACT:** Peter Trapp Shows, 607-369-2796.

OCTOBER 28-29

MD - GAITHERSBURG — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Montgomery County Fairgrounds. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

NJ - HACKENSACK — Computer Show. **LOCA-**

TION: Fairleigh Dickinson University, Rothman Athletic Center, Rte 4 to Hackensack Ave South, left at first light (Temple Ave). **HOURS:** 10am-4pm. **FEATURES:** C. **DEALER INFO:** 500+ tables. **CONTACT:** KGP Computer Show.*

PA - MONROEVILLE — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Pittsburgh Expo Mart. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

OCTOBER 29

MA - LEOMINSTER — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Italian Center, Rte 117 off I-90, Exit 7. **HOURS:** 10am-3:30pm. **ADMISSION:** \$7, under 14 free w/adult. **FEATURES:** C. **DEALER INFO:** Set-up 8am. **CONTACT:** Northern Computer Shows.*

MA - SOUTHWICK — Amateur Radio Flea Market & Electronics Show. **SPONSOR:** Hampden County Radio Assn. **LOCATION:** Southwick Recreational Center, Powder Mill Rd, off Rte 57. **HOURS:** 9am-7pm. **ADMISSION:** \$3. **TALK-IN:** 146.52, 446.00. **FEATURES:** DP - EX. **DEALER INFO:** Tables \$15, tailgating \$6 per car, set-up 6am. **CONTACT:** Barry Mason N1IJK, 413-747-7010, John Walker N1QXV, 413-572-4592 or Hamfest Committee, 36 Kenwood Ter., Springfield MA 01108-1716. VE Exams: York Phillips, 413-566-3010.

MD - WESTMINSTER — Mason-Dixon Computer & Hamfest. **SPONSOR:** Carroll County & Penn-Mar ARCs. **LOCATION:** Carroll County Ag Center. **HOURS:** 8am-7pm. **ADMISSION:** \$5, under 12 free. **TALK-IN:** 145.410. **FEATURES:** C - EX - F - F/R - H - S - T. **DEALER INFO:** 8ft inside tables: Adv \$15, Door \$20. Tailgate space: \$5, set-up 6am. **CONTACT:** Larry Martin N3DQK, 410-374-4544, Mason-Dixon Computer & Hamfest, POB 763, Hanover PA 17331.

NJ - CHERRY HILL — Tri-State Computer Fair. **SPONSOR:** Tri-State Fairs. **LOCATION:** Garden State Park (racetrack). **DEALER INFO:** Tables \$75. 350 tables. **CONTACT:** 201-533-1991.

NY - LINDENHURST — Long Island Hamfest & Computer Show. **SPONSOR:** Suffolk County ARC & Great South Bay ARC. **LOCATION:** Knights of Columbus Hall, 400 S. Broadway. **HOURS:** 9am-4pm. **ADMISSION:** \$5. **TALK-IN:** 146.685, PL 4Z 136.5. **FEATURES:** C - F/R - H. **CONTACT:** Andy Feldman WB2FXN, 516-928-3868, Walt Wenzel KA2RGL, 516-957-0218.

NY - POUGHKEEPSIE — MarketPro Computer Show & Sale. **LOCATION:** Mid-Hudson Civic Center. **HOURS:** 9:30am-4pm. **ADMISSION:** \$6, under 12 free w/adult. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

PA - NEWTON — Ham & Computer Trade Show. **SPONSOR:** Penn Wireless Assn. **LOCATION:** Bucks County Comm. College, next to Tyler State Park on Swamp Rd. **HOURS:** 8am-4pm. **ADMISSION:** \$5, XYL's & under 12 free. **TALK-IN:** 146.520-PL131.8, 145.250-PL131.8, simplex 146.520. **FEATURES:** C - EX - H. **FEATURES:** Indoor space: \$12, outdoor \$10. **CONTACT:** Steve: 215-752-1202.

NOVEMBER 4

AL - MOBILE — ARRL Hamfest. **SPONSOR:** Mobile ARC. **CONTACT:** Richard Ireland KD4TDD, 10341 Hwy 188, Grand Bay AL 36541. 334-824-2749.

FL - DAYTONA — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Ocean Center. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

FL - EUSTIS — Lake County Hamfest & Electronic Expo. **SPONSOR:** Lake ARA. **LOCATION:** Lake County Fairgrounds, @ Ste Rte 44 & Cnty Rd 452. **HOURS:** 9am-5pm. **ADMISSION:** Adv \$4, Door \$5, under 13 free. **TALK-IN:** 147.255, 442.900. **FEATURES:** DP - E - EX - FP - F/R - H - T. **DEALER INFO:** Tables: \$15 (includes one admission), tailgaters: \$5 + admission. **CONTACT:** LARA, % Tim Morrison, POB 881, Tavara FL 32778. Tony Summeline: 904-787-1449.

FL - WEST PALM BEACH — Free Flea. **SPONSOR:** West Palm Beach ARC. **LOCATION:** John Prince Park in Lake Worth at Mound Circle Picnic Area. **HOURS:** 8am-2pm. **ADMISSION:** Free. **TALK-IN:** 147.135+, 146.670. **FEATURES:** FP - F/R - H - T. **DEALER INFO:** Sellers: free. **CONTACT:** Marvin Kaskawits KD2CK, 407-683-2930.

NC - SANFORD — CCARS Fall Festival. **SPONSOR:** Central Carolina ARS. **LOCATION:** Lee County Civic Center, Nash St. **HOURS:** 8am-4pm. **ADMISSION:** Free. **TALK-IN:** 147.105, 442.375, 145.330. **DEALER INFO:** Tables: \$5, tailgating free, set-up 7am. **CONTACT:** April Maggart KD4QMU or Pat Maggart WA9UTM, 919-774-4510.

PA - YORK — Computer Show & Sale. **SPONSOR:**

Events CALENDAR

Peter Trapp Shows. **LOCATION:** York County Fairgrounds, Horticultural Bldg. **HOURS:** 10am-3pm. **ADMISSION:** \$6, \$1 off w/this ad or coupon, under 12 free. **FEATURES:** C - FP - F/R. **CONTACT:** Peter Trapp Shows, 607-369-2796.

VA - MANASSAS — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Manassas Fairgrounds. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

NOVEMBER 4-5

GA - STONE MOUNTAIN — Hamfest '95 & Computer Expo. **SPONSOR:** Alford Memorial Radio Club. **LOCATION:** Gwinnett County Fair Grounds. **HOURS:** Sat: 9am-5pm, Sun: 9am-3pm. **ADMISSION:** Adv \$6, Door \$8, Students \$6, under 12 free. **TALK-IN:** 146.76, PL 107.2. **FEATURES:** C - EX - FM - FP - F/R - H - RV-H - T. **DEALER INFO:** Tables: \$20 both days, tailgate space: \$5 per day + admission. **CONTACT:** Hamfest Hotline: 404-410-3989. AMRC Hamfest '95, POB 1282, Stone Mountain GA 30086-1282.

PA - FORT WASHINGTON — Computer Show. **LOCATION:** Ft. Washington Expo Center, PA Turnpike Exit #26, 1/2 mi to light, turn right and follow signs to Center. **HOURS:** Sat: 10am-4pm, Sun: 10am-3pm. **FEATURES:** C. **DEALER INFO:** 500+ tables. **CONTACT:** KGP Computer Show.*

NOVEMBER 5

FL - ORLANDO — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Central Florida Fair. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

MD - GREENBELT — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Martin's Crosswinds. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

NC - CONCORD — Hamfest/Swap Meet. **SPONSOR:** Cabarrus ARS. **LOCATION:** Cabarrus County Fairgrounds. **HOURS:** 8am-3pm. **ADMISSION:** Adv \$5, door \$6, under 12 free. **TALK-IN:** 146.655/.055. **FEATURES:** CB - DP - EX - FM - H. **DEALER INFO:** Fleamarket tables \$10. Set-up Sat 3pm-10pm, Sun 6am. **CONTACT:** Dealer info: Bill Hickok WDBSAS, 802 Williamsburg Dr, Concord NC 28025, 704-788-2873. General Info: Jeff Parker WA1WXL, 704-933-7238.

NH - NASHUA — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Sheraton Tara Hotel. **HOURS:** 10am-3:30pm. **ADMISSION:** \$7, under 14 free w/adult. **FEATURES:** C. **DEALER INFO:** Set-up 8am. **CONTACT:** Northern Computer Shows.*

NY - MELVILLE — Ham Expo '95. **SPONSOR:** Radio Central ARC. **LOCATION:** Huntington Hilton Convention Center. **HOURS:** 9am-4pm. **ADMISSION:** \$7. **TALK-IN:** 145.15/4Z. **FEATURES:** CB - EX - H - S - T. **DEALER INFO:** Exhibitor tables \$20, tailgate \$10, set-up 6am. **CONTACT:** Days: Ron Katz WB2DVK, 516-689-3279, Eves: Emil Tillona KD1F, 516-696-0610.

PA - FT. WASHINGTON — Photographic Swap/Shop Show. **SPONSOR:** OMM Productions. **LOCATION:** Ft. Washington Expo Center, Exhibit Hall B, 1100 Virginia Dr. **HOURS:** 10am-4pm. **ADMISSION:** \$4. **FEATURES:** Tables: \$60, set-up Sat 6pm-9pm, Sun 8am-10am. **CONTACT:** OMM Productions, POB 173, Bryn Mawr PA 19010-0173, 610-527-5903.

NOVEMBER 11

AL - MONTGOMERY — 18th Annual Hamfest & Computer Show. **SPONSOR:** Montgomery ARC. **LOCATION:** South Alabama State Fairgrounds, Garrett Coliseum, on Federal Dr. **HOURS:** 8am-3pm. **ADMISSION:** \$4. **TALK-IN:** 146.24/4. **FEATURES:** C - EX - FM - FP - H. **DEALER INFO:** Steve, 334-270-0536 eves., FAX 334-264-1150, or mail to: Hamfest Tables, 2736 W Aberdeen Dr, Montgomery AL 36116. **CONTACT:** Hamfest Committee, 2141 Edinburg Dr, Montgomery AL 36116-1313. Phil: 334-272-7980.

FL - FORT LAUDERDALE — Narisaam Computer Show. **LOCATION:** Holiday Inn-West, 5100 N State Road 7. **HOURS:** 9:30am-3:30pm. **ADMISSION:** \$5, \$4 w/this ad, under 12 free. **FEATURES:** AC - C - FP. **CONTACT:** Fred Ahmadi, Narisaam Computer Shows.*

FL - TITUSVILLE — 1995 Hamfest. **SPONSOR:** Titusville ARC. **LOCATION:** Fox Lake Park, 1 mi W of town, over I-95, on Fox Lake Rd. **HOURS:** 9am-5pm. **ADMISSION:** Free. **TALK-IN:** 146.910+. **FEATURES:** FM - FP - F/R - H - T. **DEALER INFO:** Tables \$5, tailgate \$3. **CONTACT:** Cliff KC4SYD or Joan KE4SXU Hoag, 407-267-7030, 2670 Hutchinson Pl,

Titusville FL 32780

NY - SYRACUSE — Computer Show & Sale. **SPONSOR:** Peter Trapp Shows. **LOCATION:** New York State Fairgrounds, Horticultural Building. **HOURS:** 10am-3pm. **ADMISSION:** \$6, \$1 off w/this ad or coupon, under 12 free. **FEATURES:** C - FP - F/R. **CONTACT:** Peter Trapp Shows, 607-369-2796.

PA - HERSHEY — Hamfest. **SPONSOR:** Central Pennsylvania ARC. **LOCATION:** Hershey Armory, 28th Div. Infantry, on Baum St off 422. **HOURS:** 8am-2pm. **ADMISSION:** \$4. **TALK-IN:** 145.47. **FEATURES:** EX - FP - T. **DEALER INFO:** Adv tables: \$15, tailgate space: \$5, set-up 7am. **CONTACT:** Harold Baer KE3TM, 619 W 2nd St, Hummelstown PA 17036. 717-566-8895.

PA - NEWTOWN — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Bucks County Comm. College. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

SC - MYRTLE BEACH — Beachfest '95. **SPONSOR:** Grand Strand ARC. **LOCATION:** Myrtle Beach High School, 38th Avenue, North. **HOURS:** 9am-4pm. **ADMISSION:** Adv \$5, door \$6, under 12 free. **FEATURES:** CB - DP - EX - F - FP. **DEALER INFO:** Tables: \$12, elec \$5.50. Set-up Fri after 5 pm. **CONTACT:** David C Berry KE4OOW, POB 2135, Myrtle Beach SC 29578-2135. 803-248-9401.

NOVEMBER 11-12

NC - DURHAM — Durham Area Computer Show. **LOCATION:** Durham Civic Center, 201 Foster St. **HOURS:** Sat: 9am-5pm, Sun: 10am-4pm. **ADMISSION:** \$5 both days, \$4 Sun only. **FEATURES:** AC - C - DP - FP - F/R. **DEALER INFO:** 8' tables \$40. **CONTACT:** Computer Show, POB 295, Riverdale GA 30274. 770-907-6225.

NJ - EDISON — Computer Show. **LOCATION:** Raritan Center Exposition Hall, NJ Tpke Exit #10, right at toll, follow signs to Raritan Center. **HOURS:** 9:30am-4:30pm. **FEATURES:** C. **DEALER INFO:** 500+ tables. **CONTACT:** KGP Computer Show.*

NOVEMBER 12

CT - BRANFORD — 16th Annual Flea Market. **SPONSOR:** SouthCentral CT ARA. **LOCATION:** Branford Intermediate School, 185 Damascus Rd. **HOURS:** 9am-2. **ADMISSION:** \$5. **TALK-IN:** 146.01/61. **FEATURES:** EX. **DEALER INFO:** Tables: Adv \$15, door \$20. **CONTACT:** SCARA, POB 705, Branford CT 06405-0705. Brad, 203-265-9983.

DE - NEWARK — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** University of Delaware. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

FL - WEST PALM BEACH — Narisaam Computer Show. **LOCATION:** Palm Beach Airport Hilton, 150 Australian Ave. **HOURS:** 10am-4pm. **ADMISSION:** \$5, \$4 with this ad, under 12 free. **FEATURES:** AC - C - FP. **CONTACT:** Fred Ahmadi, Narisaam Computer Shows.*

MA - SWANSEE — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Venus de Milo, Rte 6 Exit 3 off I-95. **HOURS:** 9:30am-2:30pm. **ADMISSION:** \$7, under 14 free w/adult. **FEATURES:** C. **DEALER INFO:** Set-up 8am. **CONTACT:** Northern Computer Shows.*

NOVEMBER 17-18

MS - OCEAN SPRINGS — Ham/Swapfest 1995. **SPONSOR:** West Jackson County ARC. **LOCATION:** Latimer Community Center, 4 mi N of exit 50 on I-10. **HOURS:** Fri: 6pm-9pm; Sat: 8am-3pm. **ADMISSION:** \$1. **FEATURES:** C - DP - H. **DEALER INFO:** Tables: \$5, set-up: after noon on 17th. Kim N5XGI: 601-826-5811. **CONTACT:** Stan Hecker: 601-875-0222, Ernie Orman: 601-392-2816.

NOVEMBER 18

FL - TAMPA — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Florida State Fairgrounds. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

PA - SCRANTON — Computer Show & Sale. **SPONSOR:** Peter Trapp Shows. **LOCATION:** Days Inn at Montage Manor. **HOURS:** 10am-3pm. **ADMISSION:** \$6, \$1 off w/this ad or coupon, under 12 free. **FEATURES:** C - FP - F/R. **CONTACT:** Peter Trapp Shows, 607-369-2796.

VA - ANNANDALE — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Northern Virginia Community College. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:**

C - FP. **CONTACT:** MarketPro Computer Shows.*

NOVEMBER 18-19

FL - TAMPA — 20th Annual Suncoast Radio/Computer Show & ARRL State Convention. **SPONSOR:** Florida Gulf Coast Amateur Radio Council. **LOCATION:** Florida Expo Park, Expo Hall. **CONTACT:** FGARC, 1556 56th Ave N, St. Petersburg FL 33703. Jean: 813-525-5178, eves.

MA - WILMINGTON — Computer Show. **LOCATION:** Shriners, N of Boston at I-93, right at bottom of ramp, follow signs to hall. **HOURS:** Sat: 10am-4pm, Sun: 10am-3pm. **FEATURES:** C. **DEALER INFO:** 500+ tables. **CONTACT:** KGP Computer Show.*

PA - KING OF PRUSSIA — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Valley Forge Convention Center. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

TN - NASHVILLE — Nashville Area Computer Show. **LOCATION:** Tennessee State Fairgrounds, Wedgewood & Rains Ave. **HOURS:** Sat: 9am-5pm, Sun: 10am-4pm. **ADMISSION:** \$5 both days, \$4 Sun. only. **FEATURES:** AC - C - DP - FP - F/R. **DEALER INFO:** 8' tables \$40. **CONTACT:** Computer Show, POB 295, Riverdale GA 30274. 770-907-6225.

NOVEMBER 19

FL - ST. PETERSBURG — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** The St. Petersburg Coliseum. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

IL - CHICAGO — Ham Auction. **SPONSOR:** Chicago ARC. **LOCATION:** DeVry Institute of Technology, 3300 N Campbell Ave. **HOURS:** Noon-7. **CONTACT:** 312-545-4740.

MD - BOWIE — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Bowie State University. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

NC - BENSON — JARSFEST '95. **SPONSOR:** Johnston ARS. **LOCATION:** American Legion Complex, Hwy 301 N. **HOURS:** 8am-4pm. **ADMISSION:** Adv \$4, door \$5, under 12 free. **TALK-IN:** 147.270+. **FEATURES:** DP - EX - F/R - T. **DEALER INFO:** Inside tables \$8 + admission, outside tailgate space \$4 + admission. Inside set-up 6am. **CONTACT:** JARS, POB 302, Benson NC 27504. 919-894-3352, 894-3100, & 894-5479 7pm-10pm. Exam Info: Vince AA4MY 919-847-8512.

NY - BINGHAMTON — Computer Show & Sale. **SPONSOR:** Peter Trapp Shows. **LOCATION:** Kalurah Temple, Endicott. **HOURS:** 10am-3pm. **ADMISSION:** \$6, \$1 off w/this ad or coupon, under 12 free. **FEATURES:** C - FP - F/R. **CONTACT:** Peter Trapp Shows, 607-369-2796.

PA - HOGSTON — ARRL Hamfest. **SPONSOR:** Washington Amateur Communications. **CONTACT:** Walter Piroth, N3BKW, 218 Hodgson Ave, Houston PA 15342. 412-258-5353.

PA - WASHINGTON — 8th Annual Tri-State Hamfest & Computer Fair. **SPONSOR:** Washington Amateur Communications. **LOCATION:** Chartiers-Houston High School. **HOURS:** 8am-3pm. **ADMISSION:** \$2, under 12 free. **TALK-IN:** 145.49-. **FEATURES:** C - DP - EX - FP - F/R - H. **DEALER INFO:** Tables: Adv \$10, door \$12. **CONTACT:** Ted Lockman WB3BZK, 412-222-6473 or Russ Burhenn N3NEL 412-222-4037. Fax 412-258-8342. WACOM, POB 1386, Washington, PA 15301.

NOVEMBER 24

MD - BALTIMORE — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Martin's Westwind. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

NOVEMBER 24-25-26

GA - ATLANTA — Atlanta Area Computer Show. **LOCATION:** Cobb County Civic Center, 548 S Marietta Pky, Exit 112 at I-75, Hwy 120 W. **HOURS:** Sat: 9am-5pm, Sun: 10am-4pm. **ADMISSION:** \$5 both days, \$4 Sun. only. **FEATURES:** AC - C - DP - FP - F/R. **DEALER INFO:** 8' tables \$40. **CONTACT:** Computer Show, POB 295, Riverdale GA 30274. 770-907-6225.

NOVEMBER 25

MD - BALTIMORE — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Martin's Eastwind. **HOURS:** 10am-4pm. **ADMISSION:** \$6, free w/membership. **FEATURES:** C - FP. **CON-**

TACT: MarketPro Computer Shows.*

PA - HARRISBURG — Computer Show & Sale. **SPONSOR:** Peter Trapp Shows. **LOCATION:** Farm Show Complex, East Building. **HOURS:** 10am-3pm. **ADMISSION:** \$6, \$1 off w/this ad or coupon, under 12 free. **FEATURES:** C - FP - F/R. **CONTACT:** Peter Trapp Shows, 607-369-2796.

NOVEMBER 25-26

NJ - PENNSAUKEN — Computer Show. **LOCATION:** South Jersey Expo Center, Off NJ Tpke Exit #4 on Rte 73. **HOURS:** Sat: 10am-4pm, Sun: 10am-3pm. **FEATURES:** C. **DEALER INFO:** 500+ tables. **CONTACT:** KGP Computer Show.*

NOVEMBER 26

KY - LOUISVILLE — Computer Fair South. **SPONSOR:** MEKA Enterprises, Inc. **LOCATION:** Executive West Hotel, 165 & 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.

DECEMBER 9

FL - LAKE CITY — Tailgate/Hamfest. **SPONSOR:** Columbia ARS. **LOCATION:** Florida Sports Hall of Fame, I-75, Exit 82 to US 90 West. **HOURS:** 8am-3pm. **ADMISSION:** Adv \$4, door \$5. **TALK-IN:** 145.49. **FEATURES:** FP. **DEALER INFO:** Tables \$7, tailgate \$6, set-up Fri 4pm-8pm. **CONTACT:** Colen Boutwell WASRRK, POB 1649, Lake City FL 32056, 904-755-7969.

SC - UNION — Swap-fest. **SPONSOR:** Union County ARC. **LOCATION:** Union National Guard Armory, Industrial Park Rd. **HOURS:** 8am-2pm. **ADMISSION:** \$3. **TALK-IN:** 145.250. **FEATURES:** FM - H - T. **DEALER INFO:** Inside table for dealers or outside tailgate space included in admission. **CONTACT:** Roger Gregory KD4YFB, 803-427-1462 or Ron Crisp WB4VZN, 803-429-4186.

DECEMBER 9-10

GA - PERRY — Middle Georgia Computer Show. **LOCATION:** Georgia National Fairgrounds & Agricenter, 401 Larry Walker Pky (I-75 at Exit 42). **HOURS:** Sat: 9am-5pm, Sun: 10am-4pm. **ADMISSION:** \$5 both days, \$4 Sun only. **FEATURES:** AC - C - DP - FP - F/R. **DEALER INFO:** 8' tables \$35. **CONTACT:** Computer Show, POB 295, Riverdale GA 30274. 770-907-6225.

FL - FORT LAUDERDALE — Narisaam Computer Show. **LOCATION:** Holiday Inn-West, 5100 N State Road 7. **HOURS:** 9:30am-3:30pm. **ADMISSION:** \$5, \$4 with this ad, under 12 free. **FEATURES:** AC - C - FP. **CONTACT:** Fred Ahmadi, Narisaam Computer Shows.*

DECEMBER 17

FL - WEST PALM BEACH — Narisaam Computer Show. **LOCATION:** Palm Beach Airport Hilton, 150 Australian Ave. **HOURS:** 10am-4pm. **ADMISSION:** \$5, \$4 with this ad, under 12 free. **FEATURES:** AC - C - FP. **CONTACT:** Fred Ahmadi, Narisaam Computer Shows.*

EVENTS CALENDAR Month at a Glance

OCTOBER 1995

OCTOBER 1

CA - Buena Park - Computer Marketplace
CA - Livermore - Swap Meet
DE - New Castle - Tri-State Computer Fair
FL - West Palm Beach - Narisaam Computer Show*
IN - Huntington - ARRL Hamfest
MA - Rockland - Northern Computer Show*
MI - Grand Rapids - Computers & You Show
MI - Port Huron - ARRL Hamfest
MI - Troy - Computer Show
NY - Hempstead - KGP Computer Show*
NY - Queens - Semi Annual Hamfest
OH - Ashland - North Central Ohio Hamfest
OH - Columbus - MarketPro Computer Show*
OH - Lima - ARRL Hamfest
PA - Warrington - Hamarama

OCTOBER 6-7-8

CA - Bakersfield - 2nd National Hamfest

OCTOBER 7

AZ - Bullhead City - Fallfest
CA - Bakersfield - MarketPro Computer Show*
CA - Redwood City - Annual Amateur Radio Auction

Events CALENDAR

reader FeedBack

Continued from page 7

other variable autotransformer is an isolation transformer. It isn't. Do NOT, repeat NOT use a Variac as an isolation transformer. You will get zapped sooner or later.

Charles S. Crawford, Jr.
Wellesley Hills, MA

Dear Nuts & Volts:

In the Aug. '95 issue, Scott Edward's PCB prototyping article was especially interesting. Even though I have made quite a few circuit boards already, I still learned a lot.

The safety article by Ronald Reis was also very informative and contained many good reminders, even for people with lots of experience. However, there was one mistake in Figure 3 on page 72, where it says "Do use an isolation transformer or Variac (autotransformer) while working on AC-powered equipment. These devices isolate the powered equipment from the power source, adding a strong measure of safety."

An autotransformer, by definition, has only one winding, so it cannot isolate the line from the load. All Variacs I have ever seen are autotransformers, so they should always be used with a separate isolation transformer to prevent the possibility of a life-threatening situation.

I would like to add that a GFCI breaker in the line that powers your workbench outlets is also a good idea.

Marvin K. Nolt
New Holland, PA

Dear Nuts & Volts:

I have just read your Vol. 16 No. 8 issue August 1995 and feel obligated to make a comment on the article written by Ronald Reis on "Electronics Safety — It's Your Life." Usually I read the articles published in your magazine and ignore the minor discrepancies which from time to time occur, however, in an article considering such a serious topic as safety, such discrepancies cannot be ignored and should not be allowed to stand uncorrected.

In Figure 3, Do's and Don'ts: Working with Electricity, the second bullet recommends using "...an isolation transformer or Variac (autotransformer) while working on AC powered equipment." While the use of an isolation transformer is correctly and most highly recommended, equating a Variac or autotransformer with an isolation transformer is extremely dangerous, not to mention "dead" wrong.

The brand names "Variac" and "Powerstat" (depending on the manufacturer), have been around for many years and for most of us they represent variable autotransformers which are generally connected to the AC line to allow adjustment of the

CA - Santee - Ham, Computer & Elect. Swap Meet
FL - Tampa - MarketPro Computer Show*
ID - Nampa - Hamfest & Computer Fair
IN - Indianapolis - AGI Computer Fair*
IN - Indianapolis - MarketPro Computer Show*
ND - Grand Forks - Hamfest/Computer Fair
NY - Troy - MarketPro Computer Show*
SC - Fort Mill - Rock Hill Hamfest & Computer Fair
TX - Belton - Ham Expo '95

OCTOBER 7-8

CA - Pomona - Computer Marketplace
CA - Sacramento - MarketPro Computer Show*
CT - Durham - ARRL State Convention
GA - Norcross - Atlanta Area Computer Show
MI - Dearborn - Vintage Radio Auction
MS - Biloxi - ARRL Delta Division Convention
TX - El Paso - 8th Annual International Hamfiesta

OCTOBER 8

CA - Fresno - MarketPro Computer Show*
CT - Durham - Nutmeg Ham/Computer Show/Conv
FL - St Petersburg - MarketPro Computer Show*
IN - Bedford - Hoosier Hills Hamfest '95
IN - Southbend - MarketPro Computer Show*
MI - Ann Arbor - Colossal Computer Sale
MI - Madison Heights - Computers & You Show
NH - Manchester - Northern Computer Show*
NJ - Lincroft - Shore Area Hamfest/ARRL State Conv.
NY - Middletown - Tri-State Computer Fair
NY - White Plains - MarketPro Computer Show*
OH - Springfield - Hamfest & Computer Show

OCTOBER 9

MA - Fall River - Columbus Day Computer Show*
NY - Tarrytown - Tri-State Computer Fair

OCTOBER 13

NJ - Livingston - Tri-State Computer Fair

OCTOBER 13-14

NH - Manchester - Annual Convention

OCTOBER 13-14-15

GA - Atlanta - Expo '95

OCTOBER 14

CA - Fontana - Amateur Radio & Elect. Swap Meet
CA - Santa Barbara - Computer Marketplace
GA - Augusta - Hamfest & Computer Show
IL - Chicago - MarketPro Computer Show*
MI - Alpena - Hamfest & Computer Fair
MI - Taylor - Computers & You Computer Show
OH - Toledo - MarketPro Computer Show*
PA - Lebanon - MarketPro Computer Show*

OCTOBER 14-15

CA - Oxnard - MarketPro Computer Show*
CA - Vallejo - MarketPro Computer Show*
KY - Louisville - Hamfest/State Convention
MA - Marlborough - KGP Computer Show*
TN - Memphis - ARRL Hamfest
VA - Annandale - MarketPro Computer Show*

OCTOBER 15

CA - Anaheim - Computer Fair & Swap Meet
IL - Centralia - 6th Annual Hamfest
IL - Chicago - MarketPro Computer Show*
IL - Orlando Park - Orlando Park Computer Show
IN - Ft Wayne - MarketPro Computer Show*
KY - Louisville - Computer Fair South
MA - Cambridge - MIT Flea Market
MD - Columbia - CARA Hamfest
MI - Flint - Computer Show
MI - Kalamazoo - 13th Annual Hamfest
NJ - Fairfield - MarketPro Computer Show*
OH - Akron - Computer Show & Sale
PA - Monroeville - Tri-State Computer Fair
PA - Wilkes Barre - MarketPro Computer Show*

OCTOBER 20

NJ - Edison - Tri-State Computer Fair

OCTOBER 20-21

FL - Starke - Hamfest & Computer Show

OCTOBER 20-21-22

CA - Concord - Pacific Division Convention

OCTOBER 21

CA - Santee - Ham, Computer & Elect. Swap Meet
IN - Noblesville - AGI Computer Fair*
MI - Jackson - Computers & You Computer Show
MI - Saugatuck - Hamfest & Computer Expo
MI - Westland - Great Lakes Computer Expo & Sale
NH - Salem - Northern Computer Show*
NY - Albany - Tri-State Computer Fair
NY - Buffalo - MarketPro Computer Show*
OH - Marion - 21st Hamfiesta & Computer Show
OR - Medford - Swap Meet
OR - Portland - Computer Swap Meet
OR - Rickreid - Swap-toberfest & ARES/RACES Conv.
PA - Philadelphia - MarketPro Computer Show*
PA - Seneca - Ham Radio Auction & Flea Market
SC - Sumter - 9th Annual Hamfest & Computer Show
TN - Gray - Tri-Cities Hamfest

OCTOBER 21-22

AL - Huntsville - Huntsville Area Computer Show
CA - Del Mar - MarketPro Computer Show*
FL - West Palm Beach - Hamfest & Computer Show
KY - Louisville - Computer Fair

OCTOBER 22

CA - Stockton - MarketPro Computer Show*

CO - Golden - RMRL Hamfest & ARRL State Conv.
DE - Newark - MarketPro Computer Show*
IL - Palatine - Computer Central
ME - Portland - Northern Computer Show*
MI - Dearborn - Computers & You Computer Show
MI - Flint - Five Star Productions Computer Show
MI - Southgate - Computer Show
MI - Warren - USECA Swap
NY - Rochester - MarketPro Computer Show*
NY - Syracuse - Computer Show & Sale
PA - Greensburg - Hamfest
PA - Sellersville - Hamfest

OCTOBER 27

NY - Bayside - Tri-State Computer Fair

OCTOBER 27-28

SC - Greenville - Vintage Radio Trade/Show

OCTOBER 27-28-29

OK - Kingston - Texoma Hamarama

OCTOBER 28

CA - Santa Rosa - MarketPro Computer Show*
CT - Waterford - Ham Radio Auction
FL - Port St. Lucie - Hamfest '95
IL - Evanston - Chicago TI Int'l World Faire
MA - Plymouth - Amateur Radio Flea Market
MA - Topsfield - Northern Computer Show*
MA - West Springfield - MarketPro Computer Show*
MN - St. Paul - Hamfest Minnesota & Computer Expo
MO - St. Louis - ARRL Hamfest
NE - Lexington - Amateur Radio/Computer Auction
NJ - Teaneck - Tri-State Computer Fair
PA - Bethlehem - Computer Show & Sale
TX - Austin - Computer Swap Meet

OCTOBER 28-29

CA - Pomona - Computer Marketplace
MD - Gaithersburg - MarketPro Computer Show*
NJ - Hackensack - KGP Computer Show*
PA - Monroeville - MarketPro Computer Show*

OCTOBER 29

CA - Antioch - MarketPro Computer Show*
IA - Des Moines - ARRL Hamfest
IL - Glen Ellyn - Computer Central
IN - Lebanon - Hamfest
MA - Leominster - Northern Computer Show*
MA - Southwick - Radio/Electronics Fleamarket
MD - Westminster - Mason-Dixon Hamfest
NJ - Cherry Hill - Tri-State Computer Fair
NJ - Lindenhurst - Hamfest & Computer Show
NY - Poughkeepsie - MarketPro Computer Show*
OH - Marion - Hamfiesta & Computer Show
PA - Newton - Ham & Computer Tradefest

NOVEMBER 1995

NOVEMBER 4

CA - Reseda - Computer Marketplace
CA - Santee - Ham, Computer & Elect. Swap Meet
CA - Ventura - MarketPro Computer Show*
FL - Daytona - MarketPro Computer Show*
FL - Eustis - Lake County Hamfest/Electronics Expo
FL - West Palm Beach - Free Flea
IL - Godfrey - Midwest Amateur Radio Expo
NC - Sanford - CCARS Fall Festival
OK - Enid - Hamfest
PA - York - Computer Show & Sale
VA - Manassas - MarketPro Computer Show*
WA - Payallup - MarketPro Computer Show*

NOVEMBER 4-5

CA - Sacramento - MarketPro Computer Show*
GA - Stone Mountain - Hamfest '95 & Computer Expo
IL - Chicago - MarketPro Computer Show*
OH - Cincinnati - Computer Fair
PA - Ft. Washington - KGP Computer Show*
TX - Odessa - 12th Annual Hamfest

NOVEMBER 5

CA - Buena Park - Computer Marketplace
CA - Livermore - Swap Meet
FL - Orlando - MarketPro Computer Show*
MD - Greenbelt - MarketPro Computer Show*
MI - Flint - Computer Show
MI - Lathrup - 1995 Swap & Shop
NC - Concord - Hamfest/Swap Meet
NH - Nashua - Northern Computer Show*
NY - Melville - Ham Expo '95
PA - Ft. Washington - Photographic Swap/Shop Show
WI - Kaukauna - Hamfest

NOVEMBER 11

AL - Montgomery - Hamfest & Computer Show
CA - Fontana - Radio & Electronics Swap Meet
CA - Fresno - MarketPro Computer Show*
FL - Fort Lauderdale - Narisaam Computer Show*
FL - Titusville - 1995 Hamfest
IN - Indianapolis - AGI Computer Fair*
LA - Monroe - Hamfest
NY - Syracuse - Computer Show & Sale
OH - Toledo - MarketPro Computer Show*
PA - Hershey - Hamfest
PA - Newton - MarketPro Computer Show*
SC - Myrtle Beach - Beachfest '95

NOVEMBER 11-12

NC - Durham - Durham Area Computer Show
NJ - Edison - KGP Computer Show*

NOVEMBER 12

CA - San Diego - MarketPro Computer Show*
CA - Vallejo - MarketPro Computer Show*
CT - Branford - 16th Annual Flea Market
DE - Newark - MarketPro Computer Show*
FL - West Palm Beach - Narisaam Computer Show*
IN - Ft Wayne - MarketPro Computer Show*
MA - Swansea - Northern Computer Show*
MO - Carthage - Hamfest

NOVEMBER 17-18

MS - Ocean Springs - Ham/Swapfest 1995

NOVEMBER 18

CA - Bakersfield - MarketPro Computer Show*
CA - Santee - Ham, Computer & Elect. Swap Meet
CA - Stockton - MarketPro Computer Show*
FL - Tampa - MarketPro Computer Show*
MI - Westland - Great Lakes Computer Expo & Sale
PA - Scranton - Computer Show & Sale
VA - Annandale - MarketPro Computer Show*

NOVEMBER 18-19

CA - Pomona - Computer Marketplace
FL - Tampa - Radio/Computer & ARRL State Conv.
IN - Ft Wayne - Hamfest/Computer & ARRL Conv
MA - Wilmington - KGP Computer Show*
PA - King of Prussia - MarketPro Computer Show*
TN - Nashville - Nashville Area Computer Show

NOVEMBER 19

AZ - Phoenix - Computer & Electronic Swapmeet
FL - St Petersburg - MarketPro Computer Show*
IL - Chicago - Ham Auction
IL - Orlando Park - Orlando Park Computer Show
MD - Bowie - MarketPro Computer Show*
MI - Flint - Five Star Productions Computer Show
MI - Madison Heights - Computer Show
NC - Benson - Jarsfest '95
NY - Binghamton - Computer Show & Sale
OH - Akron - Computer Show & Sale
PA - Washington - Tri-State Hamfest & Computer Fair

NOVEMBER 24

MD - Baltimore - MarketPro Computer Show*

NOVEMBER 24-25-26

GA - Atlanta - Atlanta Area Computer Show
OH - Dayton - MarketPro Computer Show*

NOVEMBER 25

IL - Kankakee - Computer Expo
IN - Evansville - 3rd Annual Winter Hamfest
IN - Indianapolis - AGI Computer Fair*
LA - Chalmette - 1995 Greater New Orleans Hamfest
MD - Baltimore - MarketPro Computer Show*
PA - Harrisburg - Computer Show & Sale

NOVEMBER 25-26

NJ - Pennsauken - KGP Computer Show*

NOVEMBER 26

CA - Santa Ana - ACP's Computer Show
IL - Glen Ellyn - Computer Central
KY - Louisville - Computer Fair South
MI - Flint - Five Star Production Computer Show
OH - Columbus - MarketPro Computer Show*
VA - Richmond - MarketPro Computer Show*

DECEMBER 1995

DECEMBER 1-2

AR - Little Rock - ARRL Arkansas DX Convention
AR - Mesa - ARRL Superstition Hamfest

DECEMBER 2

CA - Santee - Ham, Computer & Elect. Swap Meet
IL - Jacksonville - Central Illinois Winter Superfest
LA - Minden - ARRL Hamfest
MN - Fairbault - Winter Hamfest

DECEMBER 3

CA - Livermore - Swap Meet
MI - Hazel Park - 30th Annual Swap & Shop

DECEMBER 3-4-5-6

CA - San Francisco - Software Support Conference

DECEMBER 9

CA - Fontana - Amateur Radio & Elect. Swap Meet
FL - Lake City - Tailgate/Hamfest
SC - Union - Swapfest

DECEMBER 9-10

GA - Perry - Middle Georgia Computer Show

DECEMBER 10

IN - Indianapolis - AGI Computer Fair*

DECEMBER 16

CA - Santee - Ham, Computer & Elect. Swap Meet
FL - Fort Lauderdale - Narisaam Computer Show*
MI - Westland - Great Lakes Computer Expo & Sale

DECEMBER 17

FL - West Palm Beach - Narisaam Computer Show*
IL - Orlando Park - Orlando Park Computer Show
MI - Flint - Five Star Productions Computer Show

DECEMBER 23

MI - Flint - Five Star Production Computer Show
*See Computer Show Promoter Info Box

reader FeedBack

input line voltage either below (or to some extent) above nominal, depending on how they're wired. Usually there are four terminal devices, which may lead some to conclude that there are two separate DC isolated windings: there are NOT! An autotransformer "self" transforms, using only one winding, offering no DC isolation, whatsoever. In conventional wiring schemes, the AC line remains directly connected to the load at least at one point, and if the variable wiper contact happens to be set coincidental with one of the stationary input taps, then both sides of the AC line are directly connected to the output terminals and the transformer winding is simply in parallel with the load. **This offers absolutely no safety protection at all in the form of isolation!**

Please don't mislead your readers into thinking that autotransformers will isolate. It could kill somebody! Two independent DC insulated windings are required for true line isolation.

M.J. Bauer
Fairfax Station, VA

There is a mistake in an article in the Aug. '95 issue. In the article titled "Batteries: Playing Pinball with Atoms," on page 109, first column, under the heading "PINBALLS ARE LOADED," Tim wrote "...we send electrons from the anode (-) to the cathode (+)." It should read "we send electrons from the cathode (-) to the anode (+)."

Bill Jackson
Kensington, MD

Yes, I'll bet you can hear it now . . .

Either you are desperately short of material or have taken leave of your senses. Do you really have space to advise me that "injury to the eyes can cause permanent blindness?" And my workbench should be "bathed in direct and indirect light?" Really, don't you think we have quite a sufficiency of nannies about these days? Their TV has Americans running scared, so why do you need to yell "BOO?"

Jack D. Dennon

Dear Nuts & Volts:

1) I believe the published answer to Tech Forum question 79518 is not correct. I have replaced hundreds of bad flyback transformers. None of

these replacements were done to correct/cure dim display/raster symptoms. I suggest that dim display is due to: 1) Bad CRT = low emission, or 2) Circuit problems — video or CRT drive.

A CRT tester rejuvenator can be used to determine if the CRT is bad. If necessary, troubleshooting the video circuit or CRT drive circuitry will isolate any component failures.

2) General comments regarding answers submitted by Frank Williams. I have read and re-read Frank's answers and by and large can't follow any of them. Frank writes above our heads. Perhaps Frank is a professor, because his answers tend to raise more questions. For example, his answer to 7956: 1) Low-frequency signal: sinewave or squarewave? Frequency? 2) What is a plus or minus detector? How is it configured? 3) He mentions the same interaction occurs when using the speakers as microphones. What's the significance? Is interpreting measurements of concern?

3) I wonder if your Tech Forum editorial staff reviews or critiques any of the published answers. I would hope that at least a cursory review

occurs.

Ken Walker
Westminster, CA

Dear Nuts & Volts:

Nuts & Volts and Monitoring Times both have published timely and interesting articles recently dealing with Sporadic-E TV and FM-DX. But I believe both have also left some incorrect impressions that I would like to clarify.

First, who am I. To give you an outline, I TV-DXed via Sporadic-E (Es) from Orlando, FL all summer in 1950, and from many other locations from Maryland to California over the next few years. During the International Geophysical Year (IGY), I did a lot of monitoring of F2 MUF, and received many European TV stations from both Maryland and California. About this same time, I was International DX editor for the American Ionospheric Propagation Association (AIPA) which dealt primarily with TV DX. I corresponded with TV DXers from many parts of the world and tabulated their reports.

I also operated ham radio stations W6KUH and K7JDK on six meters for years, primarily for Es DX. From 1963 to 1967, I operated

Dear Nuts & Volts:

Reference the article "Using a Printer as a Chart Recorder" by John Iovine in the Apr. '95 issue, and the Reader Feedback letter by Noel Nyman in the Aug. '95 issue.

I'm sure the article and Mr. Nyman's letter prompted much response, and I'd like to share my idea of the data collection program since it incorporates some modifications which may be of interest.

My version is interactive (hate that word!) which allows the program user to set all the variables from the screen before the sampling is started. Also, in line with Mr. Nyman's idea, I have allowed the user to select a data recording format which can be used either with a LOTUS or EXCEL spreadsheet program for subsequent analysis and graphing. This feature is user selectable at program startup.

The program was written using QUICKBASIC 4.5 and I'm using a compiled version which works well on either a 486-80 or a 4.7 MHz 8088.

Mr. Iovine and Mr. Nyman are to be congratulated on proving a very simple and useful way of collecting and analyzing data.

Robert M. Harkey W4CUG
Charlotte, NC

'FILENAME: CHAREC. SEE N&V, APR 95 AND AUG 95. THE PROGRAM SAMPLES A 'JOYSTICK GAME PORT FOR AN ANALOG VALUE AND PRINTS THE DATA TO A FILE 'IN EITHER AN EXCEL OR LOTUS USABLE FORMAT. ORIGINAL PROGRAM BY JOHN 'IOVINE WITH SUBSEQUENT MODIFICATION BY NOEL NYMAN AND BOB HARKEY.

```
DECLARE SUB PRTEXCEL (I, SAMPLESTOTAKE&, JN) 'COMMA DELIMITED FOR
EXCEL
DECLARE SUB PRTLLOTUS (I, SAMPLESTOTAKE&, JN) 'DOUBLE QUOTES FOR
LOTUS
DIM ENDTIME AS SINGLE 'TIMER VALUE TO END LOOP
DIM TOTALSAMPLETIME AS LONG 'LENGTH OF TIME SAMPLES WILL BE TAK
DIM SAMPLETIMEINSEC AS INTEGER 'SAMPLE LENGTH IN SECONDS
DIM SAMPLESTOTAKE AS LONG 'NUMBER OF SAMPLES TO TAKE
DIM JN AS SINGLE 'EVENTS
DIM I, B AS INTEGER 'LOOP COUNTERS
CLS
PRINT "DATA COLLECTION USING GAME PORT"
PRINT
INPUT "Do you want to collect data in EXCEL (E) or LOTUS (L) format?"; I$
PRINT
PRINT "What is the total data collection time in:";
INPUT "Hours:"; H:
INPUT "Minutes:"; M:
INPUT "Seconds:"; S:
HR = H * 3600: MIN = M * 60: SEC = S * 1:
TOTALSAMPLETIME& = HR& + MIN& + SEC&: 'CONVERT TOTAL TIME TO SECONDS
PRINT
INPUT "How often, in seconds, do you want a sample taken"; SAMPLETIMEINSEC
SAMPLESTOTAKE& = TOTALSAMPLETIME&/SAMPLETIMEINSEC
```

```
PRINT
INPUT "What is the path and filename for data recording"; FILENAME$
OPEN FILENAME$ FOR OUTPUT AS #1
PRINT
PRINT "There will be a total of "; SAMPLESTOTAKE&; " samples taken."
PRINT
PRINT "Press any key to start. (Press 'Q' to quit after start)"
WHILE INKEY$ = "": WEND
PRINT
PRINT "Data collection started at "; TIME$
FOR I = 1 TO SAMPLESTOTAKE&
ENDTIME = TIMER + SAMPLETIMEINSEC
WHILE TIMER < ENDTIME
JN = STICK (0)
IF UCASE$(INKEY$) = "Q" THEN 'EASY WAY TO QUIT
IF I$ = "E" OR I$ = "e" THEN
CALL PRTEXCEL (I, SAMPLESTOTAKE&, JN)
ELSE
IF I$ = "L" OR I$ = "l" THEN
CALL PRTLLOTUS (I, SAMPLESTOTAKE&, JN)
END IF
END IF
PRINT "Sampling stopped at "; TIME$
CLOSE
END
END IF
WEND
IF I$ = "E" OR I$ = "e" THEN
CALL PRTEXCEL (I, SAMPLESTOTAKE&, JN)
ELSE
IF I$ = "L" OR I$ = "l" THEN
CALL PRTLLOTUS (I, SAMPLESTOTAKE&, JN)
END IF
END IF
NEXT
CLOSE
END
SUB PRTEXCEL (I, SAMPLESTOTAKE&, JN)
PRINT #1, DATE$; " "; TIME$; " "; JN
LOCATE 19,1
PRINT "Sample #"; I; "of"; SAMPLESTOTAKE&; "has a value of"; JN
PRINT
END SUB
SUB PRTLLOTUS (I, SAMPLESTOTAKE&, JN)
PRINT #1, CHR$(34); DATE$; CHR$(34); " "; CHR$(34); TIME$; CHR$(34); " "; JN
LOCATE 19,1:
PRINT "Sample #"; I; "of"; SAMPLESTOTAKE&; "has a value of"; JN
PRINT
END SUB
```


reader FeedBack

an ionospheric sounder (as part of the Vandenberg AFB missile launch operations) where I observed and plotted ionospheric data directly on a continuous basis. And not to be forgotten is that I obtained world wide data booklets from other ionospheric sounders with much Es data, which I studied for years, tabulated, and summarized. However, since my work after 1967, I completely left ionospheric data, and I had to move many times. All such data, summaries, and logs have long since been given away or otherwise eliminated. Hence, I am stuck on memory, which is usually better 10 to 40 years ago than for the last year. I did keep the National Bureau of Standards book *Circular 582, World-wide Occurrence of Sporadic E* which tabulates a lot of TV DX reports (including some of my own). But now that I have retired and returned to shortwave related employment (Consulting Engineer for Prophecy Countdown's WVHA, especially as related to frequency selection), I have renewed interest and a tad bit of time to TV-DX myself.

Peak times of the day for Es

This depends upon what direction you are to receive your DX from. Let us assume that an Es "cloud" forms over Kansas City at 9:00 am local. A DXer north or south of Kansas City would receive DX at 9:00 am. But a DXer east (in the next time zone) would get DX at 10:00 am his time, while a DXer west (one or two time zones) would get DX at 8:00 am or even 7:00 am at his time. So, it seems to me that the best time should be stated as "mid-point time."

The paths where I have lived often started with very good TV DX by 9:00 am mid-point time and often last for three hours, although usually changing the area of reception. The evening times are likewise better stated as 7:00 pm mid-point time. Here again, there can be two or three hours difference in the time one sees DX depending on whether they are looking at the same "cloud" from west to east or east to west.

Peak months for Es

The fact of life is that mid-June to mid-September is clearly the time of the most Es activity (in North America). But it is unfortunate for the DXing community that so much is said about when Es is NOT seen. All too often, TV-DX is not seen only because no one is looking. And the more we say when it is not seen, the fewer people look and the more DX is not seen. How about a prize for the first DXer to prove he got Es DX in October or March?

Motion of the Es "clouds"

Although there has been more than one theory expounded as to what causes Es "clouds," the motion

of the daylight "clouds" was never questioned in the days I was active. Everyone I communicated with agreed that they move as if they were somewhat locked to the sun, hence they moved from east to west. I say "somewhat," as it seemed to move slower by up to half the speed of the rotation of the earth. This was especially noted when DX reports from all across the nation were tabulated and compared. One Es "cloud" could often be followed for 1,000 miles or more in its trek. I would be very interested to know if such correlation has recently been done that shows the motion to be different than that. Then the after sunset "clouds" seemed as if there was very little motion. On a number of occasions I watched programs for up to three hours on the same DX station (usually around 900-1,100 miles away) with no evidence that the "cloud" moved at all. However, any motion observed still seemed to follow the earth's rotation.

Polarization

At one location, I had both horizontal and vertical polarized antennas on six meters. I found very clear evidence that the narrow band ham AM signal polarizations were rotating. When one polarization went dead, the other was always maximum. This does not show on wide-band TV pictures since I believe the polarization rotation is very frequency sensitive. Hence, there is always a signal at every polarization.

Antenna

Indeed a simple antenna can do marvels. In fact, an inside plain dipole may be the best (for strong signals where there is local interference at least), as one can rotate it rapidly in three dimensions (rotation and position) to null out the interference or to maximize the wanted signal. I logged a 2,000 watt station over 800 miles away with such a dipole inside my garage on channel 3 where I had severe interference on channel 2 many years ago. The dipole was not even tuned to channel 3, but rather to the FM band!

Distance of the skip

Most Sporadic E "layers" occur very close to 110 KM, which is 68 miles. Although such layers have been seen down to 95 KM and up to 130 KM, my data indicated that as they departed from 110 KM, they were often of a lesser quality. At 110 KM, the maximum distance (if you can transmit and receive at zero degrees, doubtful) is 1,450 KM. Statistically, the most commonly received distance was around 1,000 miles. I believe it is rare to get single hop Es DX over 1,500 miles and usually limited to 1,200 or 1,300 miles. But multiple hop Es DX can occur at 800 miles.

Relation of DX on various bands

The description to monitor a lower frequency (like channel 2) before worrying about higher frequencies is basically sound, but it

does have some pitfalls. If there is no channel 2 at the DX location, you might have channels 3, 6, and who knows what all else coming in with nothing on channel 2. This is less common today, but the possibility should not be forgotten. Further, once you know there is any Es DX coming in, don't wait for channel 6 to get down to 800 miles before checking higher frequencies. If the Es "cloud" is very large (hundreds of square miles in areas), then you may find a good indicator by noting the shortness of the channel 6 signal. However, if the Es "cloud" (or intense area) is smaller (any intense clouds may often be associated with large clouds, but not always) then the intense reflection will be around only the midpoint of this maximum intensity, and there would not be this noted shortening of the skip first. For example, take the Kansas City example again. Assume that this "cloud" is small but intense. A person 600 miles away will get only DX at 1,200 miles (about). To get DX at 800 miles requires that the Es "cloud" is present and intense at 400 miles away. But there may not even be any Es "clouds" there. Hence, the DXer may see nothing shorter than 1,200 miles and miss the DX of a lifetime. Again, once Es DX is known to exist, always check every possible frequency periodically.

Types of visual interference on TV-DX

People may not know what causes the various lines that are seen when two or more TV stations are received at the same time. It is the beat frequency (exact carrier difference) between the two carriers, modulated or not. Since the vertical sweep is just under 60 cycles (for color TV), if the difference was exactly the vertical sweep speed, then you would see a "hum bar," just one dark and light horizontal bar, stationary on the screen. This rarely occurs. It is more common for the difference to be in the area of 300 to 900 cycles. This then produces from 5 to 15 horizontal bars (pairs of black and white). Since they are also rarely an exact multiple of the vertical sweep, they will drift up or down, depending on their relation to the vertical sweep speed. Since most exciters are more stable than exact, two different TV stations commonly seen will usually produce about the same bar pattern. This effect is so sensitive that one can see the interference from a second station that is too weak to see a picture if the strong station goes off the air.

To eliminate those easily seen bars, the FCC realized something had to be done to allow stations on the same channel to operate at a reasonably short distance. For this reason, the FCC devised the sub-channel assignments. When the difference (or beat) frequency is at the horizontal scan rate (or multiples), vertical bars are seen. But if the dif-

ference is made well away from either, only very fine lines are seen that are not so obvious. Many people do not know that TV stations on any given channel number are not all assigned to the same carrier frequency. Take channel 2 for example. It is listed in almost all listings as 55.250 MHz. They do not tell you that there are actually three assignment frequencies: 55.240, 55.250, and 55.260 MHz. These are the assignments given to stations on channel 2, but the same pattern is used on all TV channels. (This does not apply to satellite TV where the modulation is FM.) This allows three stations on the same channel within the distance that will allow frequent weak signals from one station to the other. The difference frequencies are around 10 or 20 KHz. This frequency will not be easily seen by the casual observer, but the DXer can learn to spot those fine lines, which actually make the picture look a little coarser. Furthermore, if you have a table of these offset assignments (usually marked by a "+" or "-") and know for sure what one station is, you can eliminate some stations from your thoughts of possible stations by observing the interference pattern. You can know if it is the same offset or different. It is harder to tell if it is 10 or 20 KHz by observation alone.

Signal strength

It is indeed true that the signal can be very strong. I have seen DX stations with a measured signal strength much more than a local off the back of the antenna. When one deals with a maximum power local only a few 10s of miles away and a DX station hundreds of miles away, classical field strength theory will tell you that can't happen. But it does, and often. It is obvious therefore that Es "clouds" are not flat bottomed, but rather slightly curved. Therefore, focusing can and does occur where the signals from various angles of the transmitted antenna are combined and focused on YOU! Now, we see another reason for the severe fading. As these ES "clouds" move, you are first in an area where all the focusing energy adds to make it very strong, while in a few seconds they cancel partly or totally and make it very weak. TV DXers have usually seen ghosting on such DX. This is caused where part of the multiple points of reflection (refraction is the correct word here) are at significant different path lengths, which causes the ghosting. But when you see very strong, ghost-free TV DX, the focusing has to be just about perfect, and even this is not uncommon, although usually short lived. Even the color phase which is more time critical is often correct.

Misc.

The "D" layer of the ionosphere is rarely known to actually reflect radio signal. I have seen the D-layer on the vertical ionospheric sounder

reader FeedBack

that I operated, but that is not common. There is no known Sporadic D or Sporadic F, although the F2 layer does get intense enough to bring in TV DX up to channel 2, 3, or maybe 4 in some areas. This only occurs at high sunspot numbers, and we are now in a sunspot minimum. Very little, if any TV DX via F2 can be seen anywhere in the world today. I would be very interested in any documented reports of D-layer horizontal propagation.

**Gordon Simkin W7LBS
Bellevue, FL**

Dear Nuts & Volts:

Jan Zaluda's article on night scopes was not enlightening at all. He gave me the impression that night scopes are either just short of useless or too expensive to own for the average experimenter. They are

neither. Anyone can purchase the first-generation, Vietnam era tubes and although they are long and bulky, they have excellent resolution, and enough gain to see perfectly clear on a moonless night out in the country with no illuminators.

Three tubes are stacked together to get the gain up to well over 50,000x, and to point this at the weakest star in the night sky will scar the final tube instantly if the voltage is set too high.

I have built several of the tube assemblies and with one, I attached a 1000 mm folded telescope with a very slow aperture of f/11, and an eye piece multiplier of 15x power to get a 600 times power equivalent scope that can spot an ant in pitch black night at well over 500 yards. This whole assembly was made up of second-hand parts and including power supply and telescope, cost around \$600.00. As to illuminators

for weaker scopes, the 3 to 5 mW, 780 nm laser diodes light up any object brighter than most scopes can handle even at distances of over a mile. With an adjustable lens for the laser, you can flood or spot with it. With my 1000 mm lens, scope, and laser, I have seen the laser dot on the nearest mountain range to my property, which is 12 miles away. I hope you can print this to encourage readers to buy American and build them yourself if you want a good night vision scope. They are cheap and a lot better than the article makes them out to be.

**Chris
Bieber, CA**

Jan Zaluda's Response:

There are no off-the-shelf night vision scopes with multiple stacked tubes. Russian first-generation scopes need well over 100 mW IR light source, even with an

efficient collimator, to illuminate trees, or similar low reflectance objects at 200m or more. This is the limit of commercial high power single die IR LEDs. Narrow beam laser diodes project a small bright dot, but do not enable the user to identify objects at a distance which is the real purpose of an illuminator. Red beam from 1 mW He-Ne laser can be seen with a 12 in. f/11 telescope on a grassy hill about 10 miles away without any intensifiers, yet it has little value as an illuminator.

If you buy an off-the-shelf commercial first-generation scope, you will most likely be disappointed, unless you make extensive modifications.

I am sure that Nuts & Volts readers would like to read about the instruments that you have constructed, but please do not give them unrealistic expectations.

Continued from page 105

TECH FORUM

key strokes into codes that are then serially transmitted (not RS-232) to the computer via the keyboard cable. These scan codes are then translated by a chip on the motherboard called a keyboard controller. The keyboard controller controls the data exchange between the motherboard and the keyboard processor. Obviously, all of these components including the ROM BIOS must be compatible for the keyboard to work with your particular computer. Your best bet is to find a Wang keyboard that is compatible to your system. You will probably be able to find one from any of several vendors in

Nuts & Volts that deal in used parts for older computers.

**Michael E. Young
Newville, AL**

ANSWER TO #8957 - AUGUST 1995

This is something that I did when I was a kid, and it sure brings back memories. The spinner was rotated by electric discharge from sharp points on the pin-wheel. The discharge is a high voltage one and works best with higher voltages, but will work fine with any continuous spark that can jump a half inch or so. This high voltage, of course, is provided by the ignition coil,

which in the case of the early T Ford coil was almost continuous. This was because in that coil a built-in vibrator/chopper was part of the primary circuit. This chopper chopped up the current flow in the primary, and this caused a high-voltage pulse in the secondary. Without something to interrupt the flow of current in the primary circuit you will have only a few weak pulses of high voltage to work with. These are caused as you connect and disconnect the battery. I suspect that the reason for the whirligig not turning is either not steady enough current or the spinner not built right. As I remember, the Ford coil used the magnetic field of the coil to move the armature in order to chop up the current, though they might have used a separate coil inside the box. But I always used a regular coil and a home made buzzer. If you want to take one of yours apart, there are two very small hard-to-see brands holding the sliding lid closed.

Since those Model T buzzer boxes have probably not been used for a very long time, it is possible that all of them have dirty contacts in the buzzer assembly. The box is just a bit bigger than an old box of kitchen matches and on one end is a single Fahnestock clip. Connect this to the positive post of the battery. At the opposite end is the buzzer assembly. Along one side are two more clips. The clip closest to the buzzer is for the other battery connection. It is also the common point for both coils. The side clip closest to the end clip has the high voltage. Clip a short length of wire in this connector and bring it to about a quarter inch or so of the clip nearest to the

buzzer. With 6 volts DC connected between the end clip and the clip nearest to the buzzer you should see a solid stream of sparks jump across the gap. You will also see a bit of sparking at the points in the buzzer. If you do not get high voltage, those points need to be cleaned! Once the high voltage path is going, it should be strong enough to jump well over a half inch. This is where the problem arises. If the voltage is left too high for too long it might break down some of the insulation and form a carbon path that shorts out the high voltage. This was avoided when there was a maximum spark path set by the spark plug, but this is not here now. You might try opening up the wire gap to no more than about an inch and if you are using a variable supply for power, reduce it to 3 or 4 volts, it should be good for up to 4 amps when at 6 volts and less with reduced voltage.

The path for the high voltage is between the high-voltage terminal, the whirligig, air, and the clip closest to the buzzer, which is connected to the other end of the high-voltage secondary winding. This clip also has the battery lead on it so this wire is involved also. A simple spinner can be made of a few inches of light wire bent into the shape of an S. It is the reaction to the discharge of electricity from the tips of the whirligig that makes it spin. So the tips should be filed to smooth sharp points. Hammer the center flat enough to dimple it so it can be balanced on the point of a pin of some sort. The pin is connected to the coil and its point acts as the bearing for the pinwheel. The pinwheel should be set up so as to be horizontal and look like an S from above. The force is very weak so it should be made light enough to spin horizontally while balanced on the point of the pin or nail, if you blow on it very gently. Don't try this while electricity is on! It can bite. In the dark you should see a steady fan of electricity radiating out into the air from the tips only.

Because high-voltage corona dis-

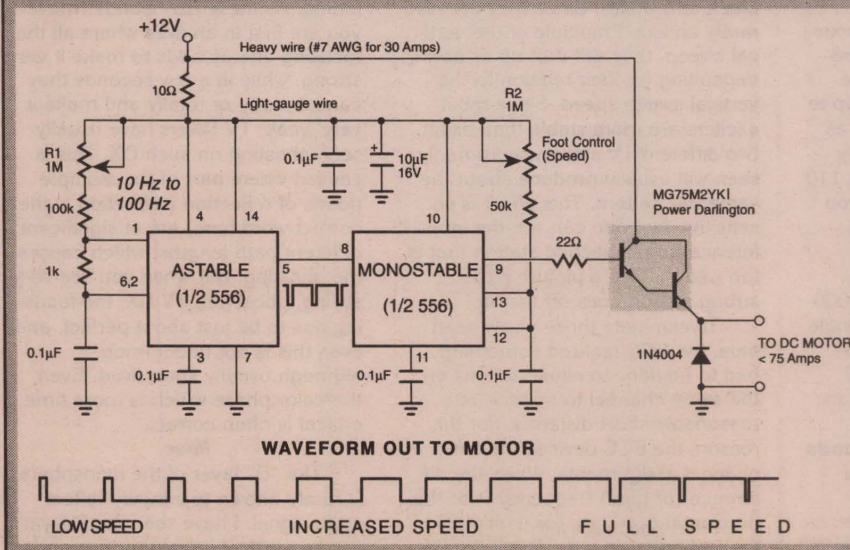
ANSWER TO QUESTION #5954 - MAY 1995

For your DC boat motor application, this circuit will work well (I use it on my drill press). Adjust R1 at low speed to prevent stalling. This could be a trim pot and controls the repetition of the astable half of the circuit, R2 controls the pulse width of the monostable half of the circuit.

The 75 amp Darlington and most other parts are available from: **Johnson Shop Products**, P.O. Box 2843, Cupertino, CA 95015, 408-257-8614.

Make sure you mount the power Darlington on a large heatsink (or perhaps use the side of the boat, if aluminum). As for the foot speed control, you might check at a local music store for the foot control used in controlling the Leslie Effect on organs. A wa foot control would also work. The whole drive circuit could be mounted inside the foot control.

**R. D. Van Dyke
Charlo, MT**



TECH FORUM

charges best from sharp points, try to smooth out any other point that you see the corona discharge from. The S shaped wire was mentioned to show that the pinwheel is driven by the discharge from the tips, just as if there were a couple of rocket motors there. You can build the spinner any way you want; aluminum foil is good, but it has to be very light weight, conduct electricity, and the discharges have to reinforce each other; so check in a dark room that you don't have one driving clockwise and another driving counterclockwise.

The idea here is to have corona discharge from the tips, so if you have nothing but sparks flying everywhere, reduce input voltage until you have only corona discharge. Too low and the buzzer will stop so you may have to adjust the spring tension. You also may try reversing the power connection as a last resort.

Remember that while the coil is running, it is putting out a magnetic field that might interfere with a heart pacemaker. Good luck and if there is any problem contact me via *Nuts & Volts* or if you want, send me one of the coils and I will set it up and return it.

Frank Williams

ANSWER TO #89515 - AUGUST 1995

To extend the range of your 900 MHz cordless telephone try the following:

First, your phone probably has a tiny rubber whip antenna. This must go. Unless your antenna attaches to the phone using a BNC (British Nut Connector) connector, you must find an adapter or modify it to do so. Find the parts at a specialty electronics store.

Second, attach an Anli RD-78 Dual Band Antenna. This 15-inch antenna is available for under \$25.00. One source for it is Tucker Electronics in Dallas at (800) 527-4642.

If this enhancement does not provide adequate signal, move on to step three.

Third, try moving the base unit to a better position — such as a nylon-screened patio or a loft-based office area. Also, you may benefit from attaching the base unit antenna to an external antenna, if available.

JQ LaVielle

ANSWER TO #79523 - JULY 1995

Concerning miniature florescent tubes for his 386 notebook computer. I too, have had difficulty in finding replacements for such computers. However, I did manage to find a company that sells these tubes that range from 2 to 8 inches in length. I recently phoned them regarding a 6-inch tube and they do carry one for \$10.00. Their address is: JKL Components Corporation, 13343 Paxton Street, Pacoima, CA 91331. 1-800-421-7244, in CA call 818-896-0019.

**Marschell D. Ray
Walkill, NY**

ANSWER TO #9953 - SEPT. 1995

There was an excellent article/construction project by Steve Ciarcia, author of the "Circuit Celler" series once published in *Byte Magazine*. His AC wattmeter — AC power monitor — used a modified

power strip with a current sense resistor made from a steel paper clip. His circuit interfaced to a PC through the parallel printer port and used a simple BASIC program to calculate and track kilowatt-hours and power consumption.

A compilation of many of his articles has been published by McGraw-Hill Book Company as the "Ciarcia's Circuit Celler" series. The particular book covering the wattmeter construction article previously described is in Volume 5, ISBN #0-07-010967-2.

**Kevin Goodwin
Oceanside, CA**

ANSWER TO #9955 - SEPT. 1995

Since the display uses DMF prefix, it is a graphic bit map graphic display, and not a character display which uses DMC prefix. No display called DMF614 has been listed since 1988. The closest part number in standard product offerings is DMF6014, which is a 256 x 128 display. It uses a 14-pin connector. No standard Optrex display uses a 25-pin connector. The largest connector is a 22-pin used by DMF676 which is a 720 x 400 graphic display. It is very common for LCD manufacturers to sue a custom connector for OEMs. Pinout varies from model to model, but all displays use similar signals. Commonly used signals to drive graphic displays are +5V, Gnd, -20V, -12V contrast adjust, frame sync, row latch sync, bit clock, four or eight data bits, power for backlight. You may contact Optrex USA at 213-214-1791 for more information.

**Jan Zaluda
Mountain View, CA**

ANSWER TO #79535 - JULY 1995

It is possible to use 8" drives with the original IBM 765 based floppy controller. The 8" drives are very similar to the 360 K 5-1/4" drives, except that clock rate is double, and the number of sectors and tracks differ, and 8" drives used head load instead of motor start. The data separator circuit needs to be changed. Standard Microsystems used to make a single chip digital data separator which was very easy to use. Also 50 conductor cables with a similar function, but different pinout, are needed. As for software, a sample 765 floppy controller routines can be found in the original IBM AT technical reference manual. It is easier to keep the default address for the modified 8" controller, and use a commercial alternate floppy controller board with bundled driver for the regular PC floppies.

None of these modifications are particularly difficult. It probably makes sense to do this as an educational exercise.

**Jan Zaluda
Mountain View, CA**

ANSWER TO #9956 - SEPT. 1995

A good source of replacement belts are "O"-rings. A good hardware store has a large assortment in the plumbing department. They come in many overall diameters with a choice of "belt" diameters. I did a temporary fix on my VCR with one four years ago and haven't got around to replacing it yet with a factory part!

**Jim Schmidt
Deer Lodge, MT**

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Exp. _____ Name _____

New breakthrough clones TV signals and sends them to any other TV in your home

Recoton's new development duplicates cable, TV, VCR and satellite signals and transmits them...without any wires!

by Charles Anton

Today, television choices are virtually unlimited. Between cable, satellite TV, videos and network programming, it's almost a full-time job trying to keep up with all the alternatives. And it promises to get more complicated in the future. Breakthroughs in fiber optic technology will bring over 500 channels into your home.

Home broadcasting breakthrough. The problem with all this technology is the expense required to maintain your system and keep it up-to-date. Now, a wireless video broadcasting system from Recoton gives you the power to utilize this technology without the hassle and expense of re-wiring your entire home.

Today, Recoton introduces the next generation in wireless broadcasting. The wireless video broadcaster transmits (re-broadcasts) cable, TV, VCR or satellite programs to any other TV in your home...wirelessly!

Wave of the future. Never drag your VCR from room to room again: Recoton's wireless video broadcasting system transmits video or TV signals to any other TV in your home.

Because the system is totally wireless, you won't have to worry about running miles of wires. Besides, who wants to install cable in every room of their home? With Recoton's wireless video broadcasting system, you



Wireless Video Breakthrough...

Cable Broadcast cable channels, even premium channels, to other TVs in your home that are not wired for cable.

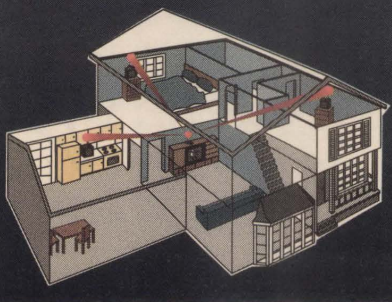
Videos Transmit signals from one VCR to any room, even if someone is watching TV in the room that the VCR is in.

Satellite programs Watch satellite programs throughout your home without stringing miles of cable everywhere.

Live video View home videos as you film them or turn your camcorder into a security camera.

Network programs If the main TV is hooked up to an antenna, you can broadcast its clear signal to all the others.

Recoton's video broadcasting system clones the accessories (cable, satellite, VCR, etc.) of one TV and broadcasts it to any other TV in your home...without wires!



won't have to. You can even watch one program on your main TV while someone else watches something different on another TV. It's just like having a personal broadcasting system in your home—and it's legal in every state.

Hi-tech home broadcast. Recently, the Federal Communications Commission allocated a band of radio frequencies specifically for wireless, in-home product applications. Recoton took advantage of the FCC ruling by creating and introducing wireless equipment that can transmit within the prescribed frequency over distances of up to 150 feet.

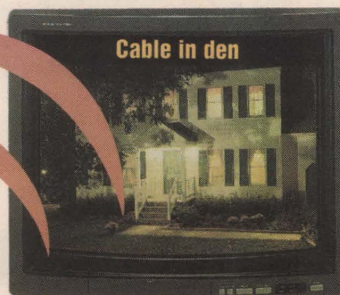
One transmitter, unlimited receivers.

One transmitter will operate an unlimited number of receivers. This means that a transmitter in the den can send signals to a TV in the living room, kitchen, bedroom and anywhere else you may have a TV. Recoton puts your favorite programs where you want them most.

Unlimited choices.

Since the broadcasting system uses the latest in 900 MHz frequency signals, there is no time-consuming or complicated wiring. The receiver can be easily moved from one television to another.

The transmitter will also broadcast to multiple receivers, so you can watch the same program on multiple TVs simultaneously. The transmitter connects to the source TV; the receivers simply connect to the others.

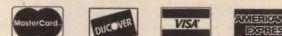


Exclusive factory-direct offer. With this breakthrough in home video broadcasting technology, you can have the convenience of your own personal wireless broadcasting system for a fraction of the cost of owning your own TV station. For a limited time only, we are offering Recoton's wireless video broadcasting system (one transmitter and one receiver) for the low price of \$99. You can order additional receivers for other TVs for just \$59 each.

Risk-free offer. The wireless video broadcasting system by Recoton is backed by Comtrad's exclusive risk-free home trial. Try it, and if you are not completely satisfied, simply return it within 30 days for a full "No Questions Asked" refund. It also comes with a 90-day manufacturer's limited warranty. Most orders are processed within 72 hours and shipped UPS.

Video Broadcasting System \$99 \$9 S&H
Includes one transmitter and one receiver.
Additional receivers (each) \$59 \$7 S&H
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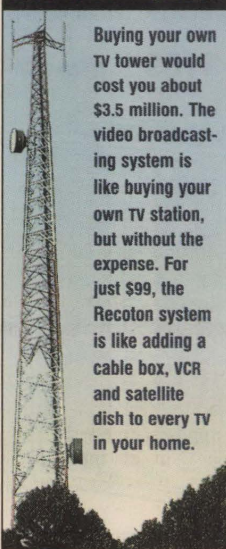


To order by mail, send check or money order for the total amount including S&H (VA residents include 4.5% sales tax). Or charge it to your credit card by enclosing your account number and expiration date.

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ADD A TV TOWER?



Buying your own TV tower would cost you about \$3.5 million. The video broadcasting system is like buying your own TV station, but without the expense. For just \$99, the Recoton system is like adding a cable box, VCR and satellite dish to every TV in your home.

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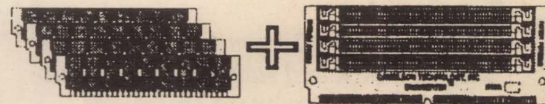
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Allows 30 Pin memory to be used on 72 Pin mother Board

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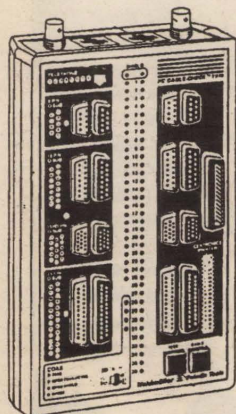


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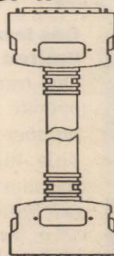
6' SCSI I to SCSI II

\$26⁰⁰ #CC-686

3' SCSI II to SCSI II

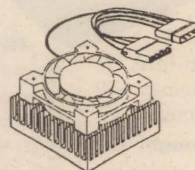
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Easy power hook-up!
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Pentium 586/66 CPU

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Pentium 586/90 CPU

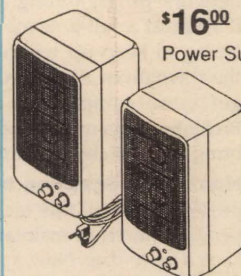
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10 Watt per channel
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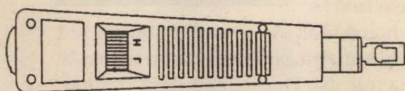


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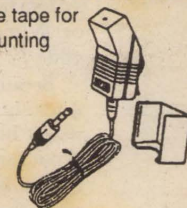
\$15⁰⁰



Microphones

This is microphone is ideal
for sound input into your
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7ft cord 1/8" stereo jack
Includes stand with double
face tape for mounting

\$3⁰⁰ #TM-MIC2



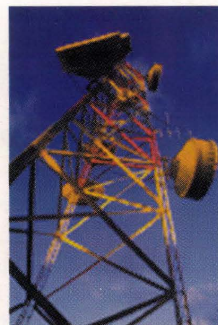
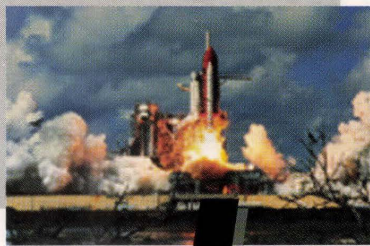
Anti-Static Strap

Adjustable velcro strap

\$5⁰⁰ #TM-STP



\$10.00 minimum order required • Add \$4.50 for shipping for pre-paid orders • California residents add 8.25% tax
Call for quantity discounts • No out of state checks accepted • Most orders shipped same day • Drawings are representations only



Are You Listening?

CATCH THE Action WITH an INTERCEPTOR!

R10 INTERCEPTOR

If searching out RF signals is your thing, then the R10 Interceptor is the answer. The R10 searches out nearfield signals and locks on in 8ms. It provides a shield of protection that no RF signal can penetrate without being detected. Unlike scanners and receivers that must be tuned to a specific frequency or scanned through a fixed frequency range, the INTERCEPTOR will provide an exciting new dimension in recreational monitoring with near instant response to strong signals. Communications monitoring hobbyists will be able to take the R10 on cruise ships, to military bases, theme parks, zoos, airports, to space shuttle launches, parades, sporting events, car races and anywhere two way FM communications is used. •Check Deviation with 10K or 100K range •Check Relative signal strength •Continuous 30MHz-2GHz coverage in less than 1 second •Built in Speaker •Thumb wheel volume and squelch control •Supplied with telescoping whip antenna, Internal NiCad battery pack, and an AC charger

R20 INTERCEPTOR

The R20 is a compact RF signal strength detector with a 10 segment bargraph display. There is also an audio output from the detector for monitoring AM communications. The audio output is useful for room sweeps where in close proximity to a transmitter a quieting effect can be heard due to detector saturation.

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Nuts & Volts Magazine/October 1995

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BASIC STAMP[®] MODULES

Stamp II has many useful new instructions

BASIC Stamps are perfect for many applications, from controlling model trains to monitoring factory sensors. They have 8 or 16 I/O lines, which can be used for a variety of digital and analog purposes. And to keep life simple, they're programmed in BASIC. Our special "PBASIC" language includes familiar instructions, such as GOTO, FOR...NEXT, and IF...THEN, as well as instructions for serial I/O, button debounce, DTMF tone generation, etc.

The BASIC Stamp Programming Package contains everything you need to program Stamps using your PC. The package includes our editor software, programming cables, manuals, application notes, and free technical support. The package is available for \$99; Stamps and carrier boards must be purchased separately.

1	ABC 2	DEF 3
GHI 4	JKL 5	MNO 6
PRS 7	TUV 8	
*	OPER 0	#



DTMFOUT *

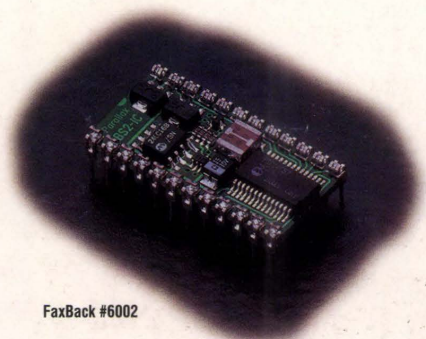
Generates DTMF tones with just one I/O pin, two capacitors, and a speaker. Another related instruction, **FREQOUT**, generates one or two tones simultaneously. Each tone is programmable in 1-Hz increments from 0-Hz to 32767-Hz.



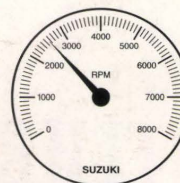
XOUT *

Generates standard X-10 powerline control signals using two I/O pins and an inexpensive TTL-to-AC convertor module. Signals are received by small modules that control lights and appliances. Receiver modules are available from Parallax, Radio Shack, and other convenient sources.

* Only available on the Stamp II.



FaxBack #6002



COUNT *

Counts cycles on an I/O pin. Makes tachometer and other count/time programs simple.

BASIC Stamp II Module (BS2-IC)

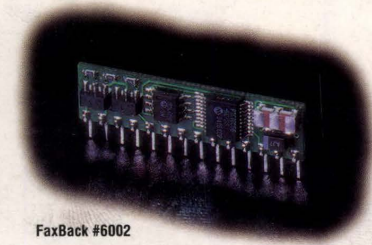
16 general-purpose I/O lines
2048-byte program space (600 instructions)
20-MHz clock (38400 baud serial, etc.)
\$49, \$69 with optional carrier board

SHIFTOUT *

Uses two I/O pins to control common serial-to-parallel shift registers. Can be used as a means of controlling many devices without using too many of the Stamp's I/O pins.

74HC595

OUT1	1	16	VCC
OUT2	2	15	OUT0
OUT3	3	14	SERIN
OUT4	4	13	OE
OUT5	5	12	RCLK
OUT6	6	11	SCLK
OUT7	7	10	SCLR
GND	8	9	OUT7



FaxBack #6002

BASIC Stamp I Module (BS1-IC)

8 general-purpose I/O lines
256-byte program space (100 instr.)
4-MHz clock (2400 baud serial, etc.)
\$34, \$49 with optional carrier board



If you have an interesting Stamp application, please consider sending us a photo for placement in this box. You can be in the photo, if you like, or just your project. We'll show the photo and a brief sentence or two describing it. If your photo is used, you'll receive free Parallax products, as well as a month or two of fame.

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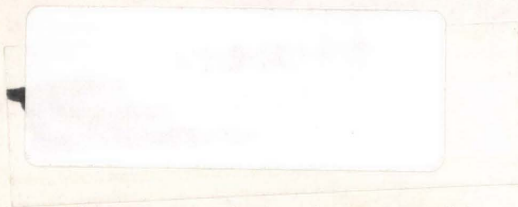
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