NUTS & VOLTS MAGAZINE

OUR 16th YEAR

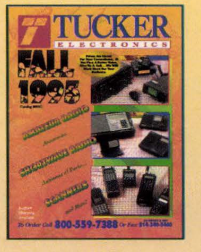
$3.50
VOL. 16 NO. 11
NOVEMBER 1995

Exploring Electronics And Technology For The Hobbyist And Professional

USING DIGITAL AUDIO

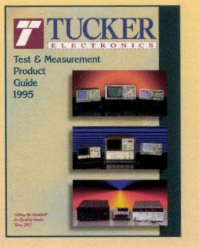
Adding sound to your software or even mastering an audio CD on your PC may be easier than you think!





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Keep Your Analyzer or Scope In Service. . .Brand New CRT's At Up To 80% Off*

*Special Purchase of New CRT's for several popular instruments...at these low, low prices...buy one as a spare, because with a good CRT most instruments can be maintained for a long time. All come in Factory Cartons and have separate shipping cartons as well. Fully Guaranteed! Quantities limited to stock on hand. Call early for best selection! Note carefully the models and types available. *Manufacturer's price.*

Instrument	CRT No.	Special Price
TEK 422	TEK 154-0517-05	$195
TEK 453A,453-703K, 453-703H	TEK 154-0630-10	$195
HP 180E	HP 5083-9023	$195
HP181T	HP5083-1952	$350
HP1740A	HP5083-3552	$300
HP141T	HP5083-2522	$700

Lowest Cost LCR Bridge...Portable / Self-Contained

ESI 815AF Impedance Bridge $299

The 815AF Impedance Bridge is a portable, self-contained instrument providing accurate, reliable measurements. Designed to measure resistance to 12 MΩ, inductance to 1200 H, storage factor "Q" of inductors to 1000, capacitance to 1200 mF, and dissipation factor "D" of capacitors to 1.05. Internal generator makes measurements at 1 kHz and also has external generator capability for measurements at other than 1 kHz. Features include null meter, decade readout, zero check function, and protective cover.



Free UHF Probe "T" Connector, 20 Hz to 700 MHz, 300 VAC

Hickok 1605M Electronic Multimeter $169

Measures a wide range of AC voltage, DC voltage, current and resistance, AC voltage can be measured from 0.5 to 300 V rms from 20 Hz to 700 MHz, DC voltmeter range is from 0 to ±1500 V, accuracy: ±2% of full scale value at any point on the scale, DC current range 0 to 150 mA with special ranges of ±1.5, 5 and 15 nA (using the DC voltmeter probe), Resistance measurements can be made from <1 Ω to >500 MΩ, Similar to HP 410C, For a limited time, receive a free UHF Probe "T" Connector which allows AC probe to be connected to signal path



TV Sync

GoldStar OS-9020A 20 MHz Oscilloscope $379

FACTORY NEW



20 MHz bandwidth (7 MHz magnified), Automatic focus, variable hold-off, TV sync circuit, X-Y operation and a 6-inch rectangular CRT with internal graticule, CH1, CH2, add, dual and chop display modes; horizontal deflection display modes are A and X-Y with 0.2 µS/div to 0.2 S/div in 19 calibrated steps, Deflection factor of 5 mV/div to 5 V/div in 10 calibrated steps with normal mode accuracy of ±3%, Trigger system: auto, norm, TV-V, TV-H with source of CH1, CH2, line and external, Includes 2 year warranty.

7 Digit Readout

Systron-Donner 6152A 512 MHz Timer/Counter $199

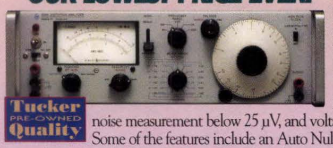
An easy-to-use counter with large 7 digit readout. Frequency range from 0 to 50 MHz (DC), 10 Hz to 50 MHz (AC), 10 to 512 MHz (prescaler range). Resolution of 0.1 Hz to 1 MHz in decade steps. Sensitivity of "A" input 100 mV rms to 200 MHz, "B" and "C" inputs DC to 10 MHz; "D" input 10 mV rms. Period measurements from 1 to 10^5 periods in decade steps and Time Interval measurements from 0.1 µS to 10^5 Sec. Ratio measurements: fA/fB with multiplier from 1 to 10^5 in decades steps; range of 0 to 200 MHz (fA), 0 to 10 MHz (fB). Display storage, 500 µS to 5 Sec sampling times plus hold, and marker outputs. A great price...a great counter!



OUR LOWEST PRICE EVER!

Auto Nulling

Hewlett Packard 334A Distortion Analyzer $695



This valued analyzer covers 5 Hz to 600 kHz range. Measures down to 0.1% full-scale distortion, residual noise measurement below 25 µV, and voltages over a wide range, 300 µV to 300 V rms full scale. Some of the features include an Auto Nulling feature, which speeds up the time consuming portion of measurements, an AM Detector, which has a frequency range from 550 kHz to 65 MHz and a 1 kHz High-Pass Filter, which attenuates frequencies below 400 Hz, reducing the effect of hum components.

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

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VISA MasterCard

WE TAKE TRADE-INS!

AMERICAN EXPRESS DISCOVER

Optoelectronics Scout 40 Frequency Scout $439

FACTORY NEW



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.

Optoelectronics CUB Pocket Sized Frequency Counter $149

The new CUB measures at only 3.7" x 2.75" x 1.2" inches and weighs merely 7.5 oz. The CUB frequency counter is ideal for Communication, Surveillance, and Recreational applications. This frequency counter incorporates all of the other standard features of the 3300 MiniCounter plus the following new features:

NEW ITEM!



FACTORY NEW

- Digital Filter reduces false counts
- Auto Capture acts like an intelligent auto hold button
- 10 hour battery life, works all day like you do
- 8 selectable gate times
- High speed .0001 second gate
- 9 digit LCD display
- An LCD display for best visibility and longer battery life, unlike the outdated LED counters that aren't visible in sunlight and drain the power right out of the counter
- 1 MHz - 250 MHz direct count capability for high resolution.
- 1 MHz - 2.8 GHz frequency range
- 10 MHz timebase
- Maximized sensitivity for picking up radio transmissions
- Direct and Pre-scaled ranges
- The Capture mode allows for a frequency to remain displayed as long as you so desire, with no chance of being overridden by surrounding RF

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Write in 145 on Reader Service Card.

HSC Electronic Supply

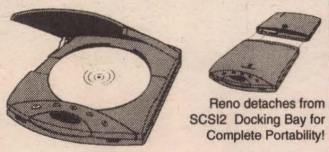
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...brings you a potpourri of high-tech goodies for the techno-tinkerer!
For thirty years we have been your source for Silicon Valley exotica!

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

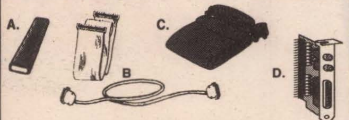
Mediavision *Reno* Kit HSC# 15586 $79.95



Reno detaches from SCSI2 Docking Bay for Complete Portability!

- **Mediavision *Reno* Accessory Package Deal $10.00 (only sold with Reno) consists of the following:**

A. Rechargeable Battery Pack **HSC#15587**
B. Reno Cable Kit (SCSI2 - DB25 cable, 50p. ribbon cable, internal & external audio patch cables) **HSC#15589**
C. Padded Travel Pouch **HSC#15588**



- ***Reno* Accessories Available Separately:**

C. Don't have a Reno, but want a padded travel pouch for your personal CD Player? We have lots! **HSC#15588 $1.95**
D. Internal SCSI IDS50 to DB25 Adapter bracket for IBM, use with Reno cable kit (above) & your SCSI card for convenient SCSI and audio connections. **HSC#15590 $6.95**

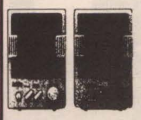
Multimedia Sound Card!

- Mediavision Pro Audio Spectrum SCSI Sound Card
- 8-bit Sound Card with SCSI Port, great for controlling internal CD/ROM's (see CD/ROM Specials at left, below)
- 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 combo!

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.



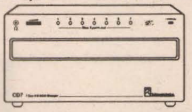
MSS-1000 HSC# 15127 Pair/ $6.95

CS-550 HSC# 15517 Pair/ $9.95

Dealer Inquiries Invited...
Quantity Discounts Available!

Multimedia Kit Deal #3

- Mountain Network Solutions **CD7** CD-ROM Changer
  - Seven-disk CD-ROM Changer holds over 3.5 Gigabytes of storage! SCSI-1 and SCSI-2 selectable interface, headphone jack on front panel, line-level audio outputs at rear.
  - Brand new in OEM box, selectable 110/220 VAC input, 90-day warranty, measures 7.75" x 4" x 12.75".
  - Windows and DOS driver disks, manual included. Works in IBM DOS/Windows environment with Adaptec, Trantor & Future Domain SCSI Controllers with supporting ASPI Drivers (not included). Will work on Mac with special driver available from Ocean Systems (not us, ask for info).
  - Access time avg. 300 KBps (sustained double speed), 1500 KBps (burst)
  - Occupies one SCSI address, appears as seven logical drives to system. Perfect for BBS or Website!



CD7 CD-ROM Changer HSC# 15641 $199.95

Network Card Bargain!

- Racal 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.

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-.2S Dual, 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

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.

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

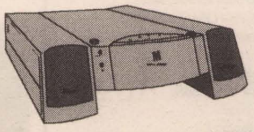
Lower CD/ROM Prices!

- Tested Good CD/ROM Drives removed from systems
- 90-Day Warranty
- 1x, 2x and 3x Speeds available
- Sony is proprietary interface, others are 50-pin SCSI
- Sanyo, Sony are tray-type (no caddy needed)

Sony CDU-31 1X-Drive HSC# 15650 $35.00
Sanyo CDR-H93MV 2X-Drive HSC#15584 $59.00
NEC CDR-510 3X-Drive HSC# 15327 $99.00

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

Handy Power Supplies

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



B) Standard 6' IEC power cord for use with above supplies, misc. colors & styles, used. **HSC# 80119 $.99**

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

Bargain Game Controller!

- Quickshot QS-191 Game pad for IBM Compatibles
- Faster action, less fatigue than a joystick
- Why pay more for a game device?
- Brand new, plugs into 15-pin game port



HSC#15594 $3.95

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% A/UX, 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

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

Motor Mania!

- Small (1.5" x 1.5" x 1") Stepper Motor, 13.2VDC, .45A/Φ, 200 steps per revolution. **HSC# 15597 $5.95**
- Medium (1.5" dia. x 3") Pittman Motor, 19.1 VDC, with optical shaft encoder. **HSC# 15654 $9.95**
- Large (3.25" dia. x 6.25") 20VDC @ 5.7A Sanyo Denki permanent magnet DC Reel Motor, 9/16" shaft is stepped down to 1/2", 580rpm, or use as 70W generator! Attention robotics enthusiasts...this is a heavy-duty beauty! **HSC# 15327 $27.50**

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

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

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The SCOUT™ Has Taken Tuning Your Receiver To a New Dimension

Featuring Automatic Tuning of your AR8000 and AR2700 with the Optoelectronics Exclusive, Reaction Tune (Pat.Pend). Any frequency captured by the Scout will instantly tune the receiver. Imagine the possibilities! End the frustration of seeing two-way communications without being able to pick up the frequency on your portable scanner. Attach the Scout and AR8000/2700 to your belt and capture up to 400 frequencies and 255 hits per frequency. Or mount the Scout and AR8000/2700 in your car and cruise your way into the future of scanning. A simple interface cable will connect you to a whole new dimension of scanning.

The Scout's unique Memory Tune (Pat.Pend.) feature allows you to capture frequencies, log into memory and tune your AR8000/2700 at a later time. A distinctive double beep will inform you when the Scout has captured a new frequency, while a single beep indicates a frequency that has already been recorded. For discreet monitoring, a pager style vibrator will inform you of any hits the Scout captures.

The Scout will also Reaction Tune and Memory Tune Icom CI-V receivers: (R7000, R7100, and R9000) and (Pro 2005/6 equipped with OS456, Pro 2035 equipped with OS535). Download the Scout frequencies to a PC with the Scout Utility Disk and CX-12AR (optional), then compare them to the Spectum CD-ROM/PerCon FCC Database (optional).

Act Now!! Let the Scout Reaction Tune you into The World of Scanning

SCOUT™ $449

Features

- Automatically tunes these receivers with Reaction Tune (Pat.Pend.) CI-V receivers (ICOM's R7000, R7100, and R9000), (Pro 2005/2006 equipped with OS456, Pro 2035 equipped with OS535) or AOR models (AR2700 and AR8000).
- Records and saves 400 unique frequencies
- Records 255 hits on each frequency in memory
- Digital Filter and AutoCapture (Pat.Pend.)
- 10MHz-1.4GHz single frequency range
- View frequencies in RECALL mode
- 10 digit LCD with EL Backlight
- 16 Segment RF signal strength bargraph
- CX-12AR Computer Interface (optional)
- PC Utility Disk for downloading memory to PC
- Rapid charge NiCads with 10 hour discharge time
- Scout Spectrum CD-ROM/PerCon FCC database (optional)
- AC Adaptor/Charger
- DB 32 VHF/UHF mini-antenna shown with Scout (optional)
- Distinctive Beeper/Vibrator indicate frequency hits



At right: Scout shown with CLIPMATE™. A handy windshield mount for Scout, for quick access and visibility.

CLIPMATE™ $25.00

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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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reader FeedBack

Using Your Fax as a Computer Scanner/Printer

This was an interesting article, but it should have been labeled as an advertisement. The article fails to mention that if you bought a fax-capable modem that it probably came with the needed software so that you don't need the software supplied by SVA (mine actually came with the SAME software!). Further, I suspect that the module contains little more than a battery and a resistor. The naivete' of the author can be seen in his statement that BitCom is suitable for Internet usage. I am using the Internet to send you this message, and you are on CompuServe receiving it. Do you have any reasonable idea how BitCom would help in this? Yes, if you are accessing a UNIX server then BitCom could be used, but not by any experimenter that I know.

This is of interest to me, since I was just about to hook my FAX machine up to my computer, and was momentarily excited when it looked like there was an article that could help in this endeavour. What a disappointment.

This still leaves me to design a box to perform the function of the faxSCANNER module mentioned in the article, since I don't wish to spend $50.00 for a nine-volt battery and a resistor and ??? Can you help me? Do you have any information as to what is in the module? It appears to me that the battery draw is around 20 mA, which makes for very short battery life with only a small nine-volt battery — have they solved this in some way?

This appears at first glance to be a case of marketing junk through the restriction of technical information — which appears to be contradictory to the approaches taken in other articles in *Nuts & Volts*. Are you changing? Was it an editorial error to publish this article as it stands? Or do I simply fail to understand the complexities hidden in small black boxes? At the very least, the article should explain the functioning of the module.

To avoid similar problems in the future, I'd be glad to review future articles prior to publication.

In conclusion, please E-Mail or publish any technical information that you have on the faxSCANNER module.

Steve Richfield
N7VCG

Response to Mr. Richfield:

Mr. Richfield feels that my faxSCANNER article (Sep. '95) is nothing but an advertisement and does not include some necessary technical information. He is dead wrong!

I bought and paid retail price for the faxSCANNER from a mail order house prior to contacting SVA Software for some questions about their documentation, and for information on their module. Their documentation for using the module was confusing to me (as stated in the article), thus leading me to supply specific instructions — the balance of the article. They consider their module design proprietary, and would not disclose its design. They merely indicated it was "a telephone line simulator," as I stated in my article.

After my article was submitted, an article appeared in the Oct. '95 issue of Popular Electronics called "Build the 'Faux-Fax' Scanner," with a schematic of a "circuit that provides a talk path..." This appears equivalent to the module supplied with faxSCANNER, although it uses TWO nine-volt batteries.

Incidentally, I've used the single included general-purpose nine-volt battery (not even an alkaline) with the faxSCANNER module for at least 50 "scans," and it still tests high in the "good" range using a battery tester that puts the battery under a 10 mA load.

Mr. Richfield claims I am naive because I mentioned that BitCom can be used on the Internet. This was mentioned together with the other uses of a full-featured communication program. Mr. Richfield is obviously a sophisticated reader, but he apparently does not realize that many readers of Nuts & Volts may not be familiar with modems at all. In my writings (I've had over 700 articles and five books published since 1961), I try to avoid aiming at advanced readers. Perhaps Mr. Richfield, who seems so eager to criticize the work of others, should try writing original articles and see how successful he can be in satisfying all levels of readership in a magazine as diverse as Nuts & Volts.

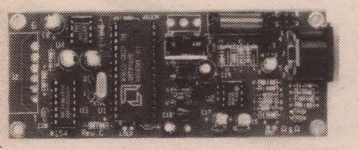
It is true that fax modems come with fax-capable software. However, it is my contention, from my many years of experience with over 25 different microcomputers, that whenever you mix software and hardware FROM DIFFERENT SOURCES you are asking for problems. Some users, perhaps Mr. Richfield, can accommodate the incompatibilities. I largely avoid the struggle by buying items bundled to work TOGETHER — such as the faxSCANNER package. The included Caere OCR, which was of particular interest to me, could very easily be picky about file format for its conversion; using the BitFax software included with the OCR package in faxSCANNER avoids that potential problem. I was a Navy fighter pilot many years ago. I would hate to try to fly a Corsair with Hellcat wings, a Wildcat engine and a Zero empennage!

No, this article was not an advertisement. It was a critical use test report with specific help in overcoming the shortcomings of the included documentation, and

Continued on page 141

HAM GEAR FOR SALE 10

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WANTED: ROCKWELL-Collins HF-8021 3KW Amp. Jim Stitzinger, 805-259-2011, fax 805-259-3830.

NATIONAL RADIO manuals and MCL2000 parts lists. SASE. Maximillian Associates, 11 Plymouth Lane, Swampscott, MA 01907.

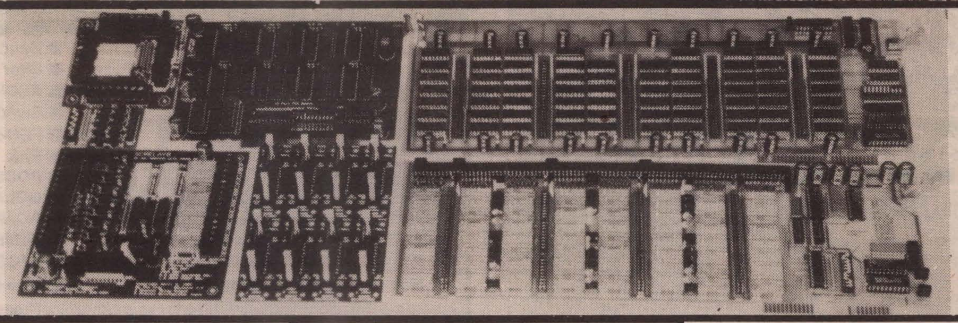
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PACKET FOR Commodore 64 users. Digicom modem wired, tested. Software and documents. $49. Crawford Amateur Radio Society, PO Box 653, Meadville, PA 16335.

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- Cards can share same space via extended I/O.
- Machine pin sockets make field repairs a snap.
- Silk screened, solder masked, & gold plated.
- See SCREWTERM, TERMRACK, SCRELAY8

SCRELAY64
64 Channel Relay Board

- 64 SPST 10VA 100 VDC 70 VAC 0.5 AMP relays.
- Use to drive solenoids, valves, relays, contactors.
- 16 Relays per 64 line gold plated header.
- 2 pins per relay line reduces resistance
- Independent A & B lines on all relays
- High density board reduces computer slots used.
- Sensitive relays minimize power consumption.
- Only 1.0 milliseconds to turn on/off relays.
- Long life relays (10,000,000 operations).
- Cards can share same space via extended I/O.
- Power on reset leaves relays open on power up.
- Uses 16 Byte wide ports. 8 Input + 8 Output.
- Full length PC AT form factor card for 8 bit slot.
- Input ports can read back state of any relay.
- Gold plated 64 line headers support 16 relays ea.
- Silk screened, solder masked, & gold plated.
- Includes manual and software.

SCPROBE
240 Channel Stimulus/Response

- Ideal to test cables, wire harnesess', PCBs
- Use for ATE, testing switch matrices & boxes.
- 240 Output paired with 240 Input channels.
- Use to stimulate any line
- Then monitoring all other lines for responses.
- Set port 0 to stimulate any 1 of 240 channels
- Set port 1 to monitor selected channel.
- Read port 0 to determine resopnse.
- Then scan 1 to 240 channels for response.
- Multiple boards may be used in system.
- Open collector outputs with 5.1K pullups.
- Every output paired with an input channel
- Uses only 4 ports in PC I/O space.
- Full size fuse protected PC/AT form factor card.
- Gold plated 50 line headers. 48 signal+pwr/gnd.
- Machine pin sockets make field repairs a snap.
- Silk screened, solder masked, & gold plated.

SCREWTERM
16 Channel Screw Terminal Board

- Directly interfaces to any port on SCPIO16.
- Supports 8 Input + 8 Output channels.
- LED Bargraph Displays monitor inputs & outputs.
- Screw terminals for all I/O, control & power lines.
- Termination resistors increase noise immunity.
- Fuse protected power lines.
- Screw terminal blocks socketed for quick release.
- Minimize your setup time.
- Reduce maintenance and repair costs.
- Saves many hours of building & wire wrapping.
- Shrouded Gold plated header with ejectors.
- Boards are Solder Masked & Silk Screened.
- I/O, Pwr, Gnd, Cntrl identified with legends.
- 3"x3" board with mounting holes & hardware.

TERMRACK
128 Channel Termination Board

- Directly interfaces to SCPIO16
- Supports full set of 8 SCPIO16 cables.
- Supports 128 channels. 64 Input / 64 Output.
- 2 solder pads for ea. signal, control, & power line
- Provides simple interface to Solid State Relays.
- Easy interface to many other devices.
- Simple interface to wide range of sensors.
- Saves many hours of building & wire wrapping.
- Shrouded Gold plated headers with ejectors.
- Boards are Solder Masked & Silk Screened.
- I/O, Pwr, Gnd, Cntrl identified with legends.
- Large solder pads with plated through holes.
- Wide dual signal traces increase reliability.
- Plenty of well spaced mounting holes.

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SCRELAY8	8 optos + 8 rlys	129.00
TERMRACK	8 hdrs / 128 chnls	35.00
SCREWTERM	1 hdr / 16 chnls	29.00
SCRELAY64	64 Relays	495.00
	32 Relays	295.00
	16 Relays	195.00
Cable set	Four 4' cables	59.00
SCPROBE	240 Channels	489.00
	192 Channels	429.00
	144 Channels	369.00
	96 Channels	299.00
	48 Channels	199.00
Cable set	Five 4' cables	59.00
SCMIDI16	128 Channels	295.00
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8 Optoisolators + 8 Relays

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- Monitor external events & power sources.
- Directly interface to any port on SCPIO16 board.
- 1500 V optically isoated inputs.
- SPST 10VA 100VDC 70VAC 0.5Amp relays.
- Sensitive relays minimize power consumption.
- LED Bargraphs display input & output status.
- Opto inputs monitor AC/DC 0..32 volt lines.
- Independent A & B lines on all relays
- Power on reset leaves relays open on power up.
- Fuse protected power lines.
- Supports use of optional external power supply.
- I/O, Pwr, Gnd, Cntrl identified with legends.
- 5"x5" board with mounting holes & hardware.

MIDI **SCMIDI16** **MIDI**

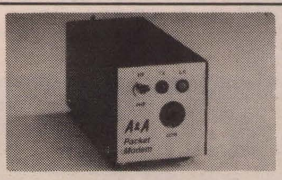
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- Turn 64 digital devices on/off as music plays.
- Accept commands from up to 64 digital inputs.
- FREE I/O Tester board when you buy SCMIDIO
- Accepts MIDI commands from MIDI controllers
- Programable MIDI Channel number 1 .. 16
- On board computer converts notes to Outputs
- On board computer converts inputs to Notes
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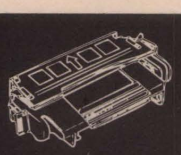
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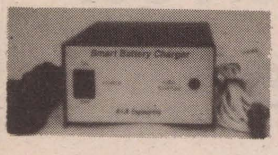
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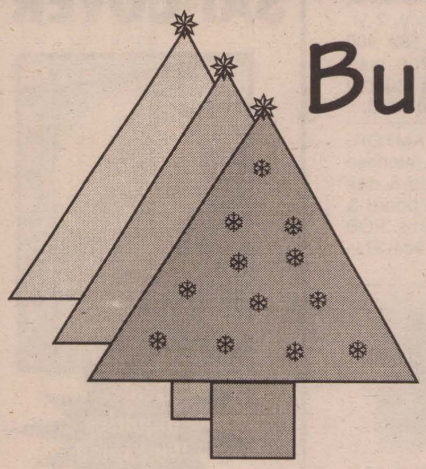
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Build a Sound Activated Christmas Tree

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by Ronald Reis

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Well, maybe not an alternative. Let us say supplement. The 8-1/2' evergreen will always be with us, and well it should. Yet, there now is an 8-1/2" electronic version ready to light up your Christmas in a unique and inexpensive way.

Available in kit form from Cal West Supply, Inc., Westlake Village, CA (see box for ordering information), this Sound Activated Christmas Tree consists of 25 red, green, and yellow LEDs that flash with any sound (voice, music, ambient room noise).

The highly sensitive, three-chip circuit is powered by a single nine-volt battery. Its 4-1/2" x 8-1/2" green printed circuit board is in the shape of a Christmas tree and comes with a stained oak stand. Easy to build, the kit with all parts and PC board, sells for less than $25.00.

While presents usually go under nature's tree, here, the tree itself makes a distinctive gift. Give it to your favorite office colleague to place on his or her desk. Do you operate a retail establishment? Put it on the counter and watch customer reaction. They'll all want to know where to buy one. Or, take the tree home and position it on the fireplace mantle. Whether you supplement or supplant the traditional bush, I guarantee Santa will be delighted. Either way you go, the Sound Activated Christmas Tree is sure to brighten everyone's holiday season.

Theory of Operation

The complete schematic for the Sound Activated Christmas Tree is shown in Figure 1; the parts list is provided in Table 1. The main components are U1, an LM358 dual operational amplifier (opamp); U2, a 4024 CMOS seven-stage binary ripple counter, and U3, a CMOS 4051 Binary to eight-channel demultiplexer. Let's see how the circuit works.

Switch S1, an ON/OFF switch, directs power from the nine-volt battery to the circuit.

The first half of the LM358, U1A, is configured as a high-gain amplifier. Resistors R3 and R4 form a voltage divider that sets the bias voltage at pin 3, holding the amplifier in the off state. Resistors R1 and R2, also forming a voltage divider, set the bias point for the microphone. When the audio input signal, produced by the microphone, exceeds the bias voltage, U1A turns on and operates as a high-gain amplifier (the gain being set by resistor R5). Capacitor C1 couples the microphone's signal to the amplifier's inverting input, pin 2. Resistor R6 and capacitor C2 are used as a filter network for the opamp.

The second half of U1, U1B, is configured as a peak signal detector. It is triggered by the negative half cycle output of U1A. Each negative half cycle of the signal produces a positive clock signal to the input of U2, the seven-stage binary ripple counter. Capacitor C3 stores the average peak level of the input signal while resistor R7 determines C3's discharge time.

Integrated circuit U2 produces a binary count on its Q3 through Q6 outputs that is proportional to the frequency of the audio input signal. The output of Q3 is connected, via capacitor C4, to the enable pin of U3. When the input audio signal causes U2 to conduct, the relatively high frequency output of Q3 enables U3. Resistor R3 maintains U3 in the disabled mode in the absence of any audio input signal.

Finally, U2's outputs, Q4 through Q6, are coupled to the binary inputs (A, B, and C) of U3, the binary to eight-channel demultiplexer. The integrated circuit's output lines, X0 through X7, are turned on and off in rapid sequence causing the LEDs to display a random flashing effect that is, again, proportional to the original audio signal produced by the microphone. Also, you will notice when you turn the circuit on, the LEDs "hang up," that is, stay on, for a fraction of a second after sound ceases, creating an intriguing effect.

Project Construction

In Figure 2, we have the printed circuit board (PCB) artwork for the Sound Activated Christmas Tree. Since the board is single-sided (traces on only one side), you can construct your own using any standard PC board fabrication method. However, cutting your board in the shape of a tree, as shown in the figure, is a bit of a challenge. Nonetheless, with a heavy-duty pair of tin snips, it can be done. The preferred alternative, of course, is to buy the kit, thus getting a pre-etched, drilled, solder coated, and cut-to-shape printed circuit board.

The component placement

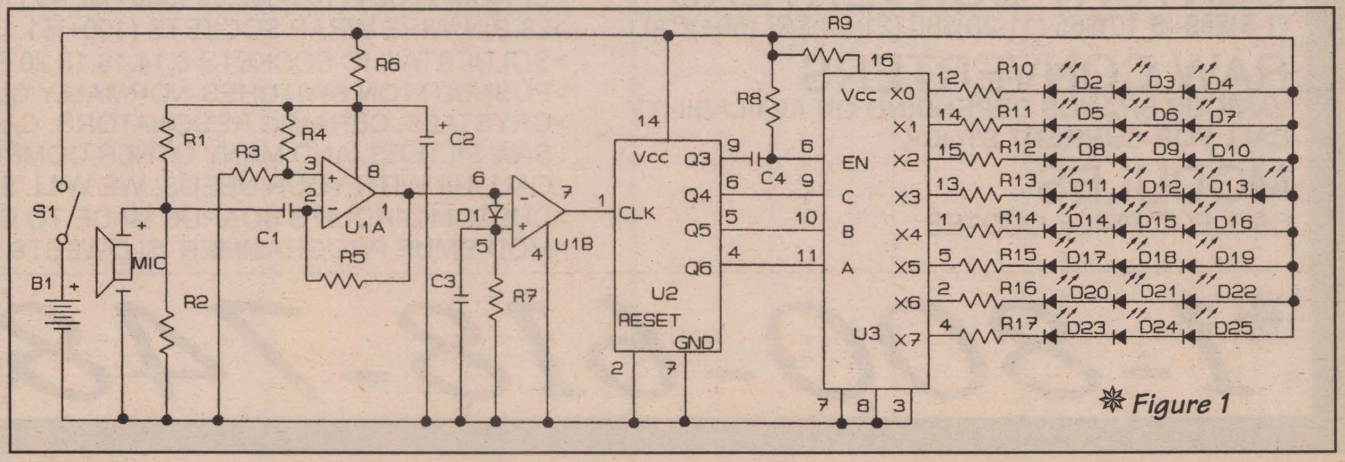


Figure 1

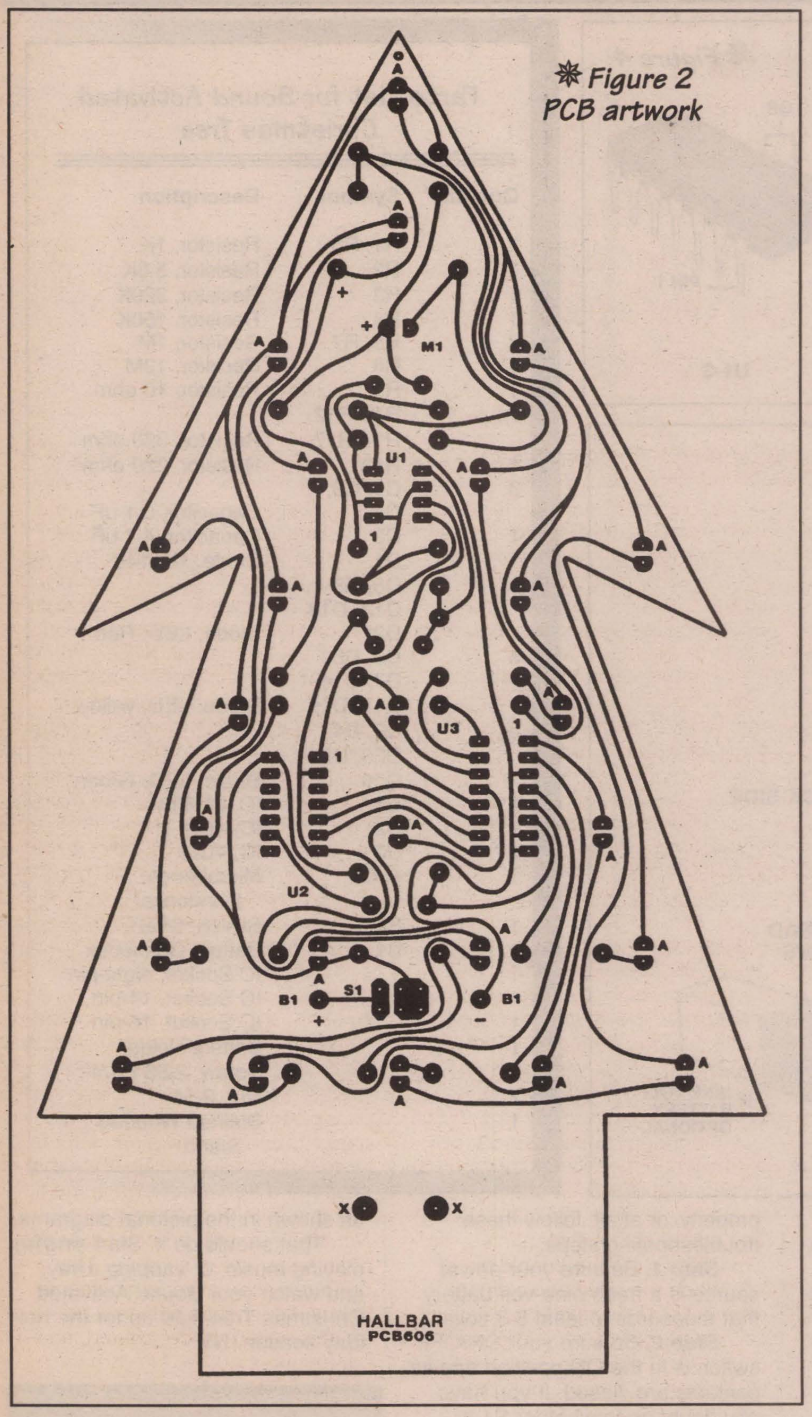


Figure 2
PCB artwork

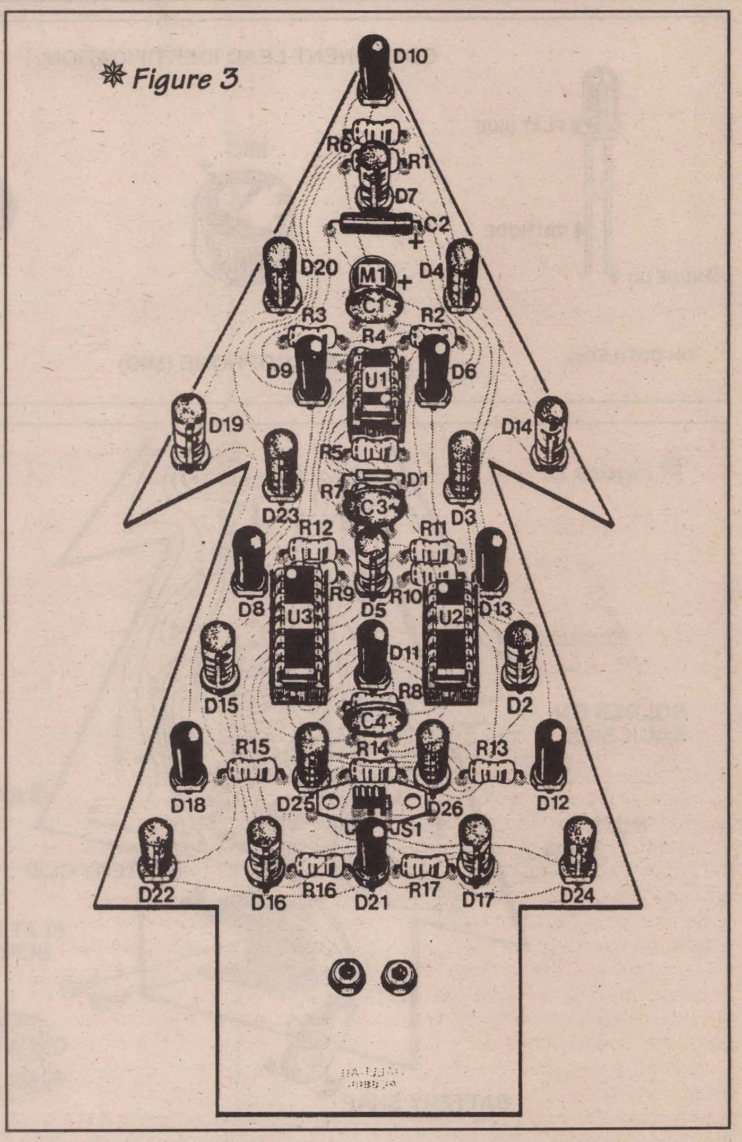


Figure 3

drawing for the tree is shown in Figure 3. Figures 4 and 5 provide component lead identification and battery snap/holder assembly information. You will want to refer to all three drawings, as well as Figure 2, as you go through the following 15 construction steps:

Step 1. Mount and solder the three IC sockets to the PCB. Be sure pin 1 goes into the proper hole.

Step 2. Mount the following resistors to the PCB:

A R1 and R6, 1K (brown, black, red)

B R2, 5.6K (green, blue, red)

C R3, 220K (red, red, yellow)

D R4, 150K (brown, green, yellow)

E R5 and R7, 1M (brown, black, green)

F R8, 10M (brown, black, blue)

G R9, 10 ohms (brown, black, black)

H R10 thru R12, and R14 thru R17, 330 ohm (orange, orange, brown)

I R13, 220 ohm (red, red, brown)

Step 3. Solder all resistors to the PCB. Cut off any excess lead length.

Step 4. Mount the following capacitors to the PCB:

A C1, C3, and C4, 0.1 uF

B C2, 4.7 uF. Be sure the "+" lead is inserted through the hole marked "+"

Step 5. Solder all capacitors to the PCB. Cut off any excess lead length.

Step 6. Mount diode D1 to the PCB. Be sure the cathode lead (lead nearest the color band) is inserted into the PCB as shown in Figure 3.

Solder the diode to the PCB, being careful not to apply too much heat. Cut off any excess lead length.

Step 7. Mount and solder the following LEDs to the PCB. Be sure the anode lead goes into the hole marked A (Figure 2). Note: Not all LEDs are inserted in the same direction. Five of the 25 LEDs have their anodes pointing down, the rest, pointing up. Also, when mounting, it is best to leave a space of approximately 1/8" between an LED and the PCB.

A D6, D8 thru D13, D18 and D21, "Red" LEDs.

B D2, D5, D7, D14 thru D17, and D19, "Yellow" LEDs.

C D3, D4, D20, and D22 thru D26, "Green" LEDs. Cut off any excess lead length.

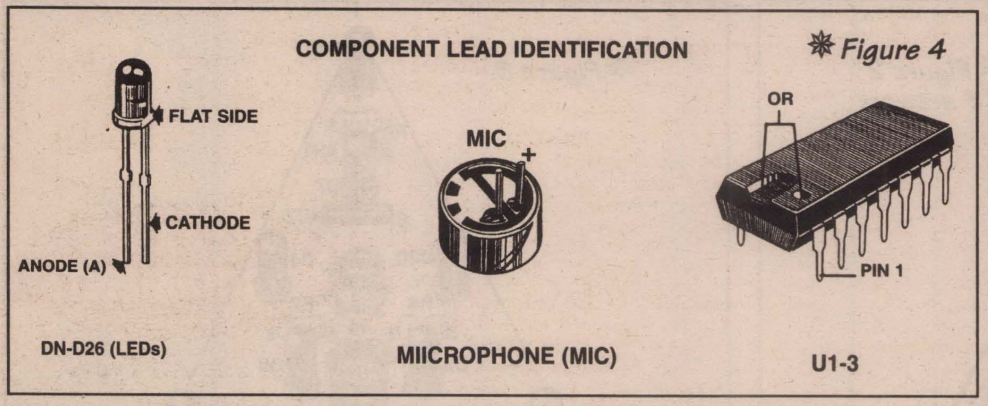
Step 8. Mount and solder the condenser microphone (MIC) to the PCB. Be sure the "+" lead is inserted through the hole marked "+." Refer to Figure 4. Cut off any excess lead length.

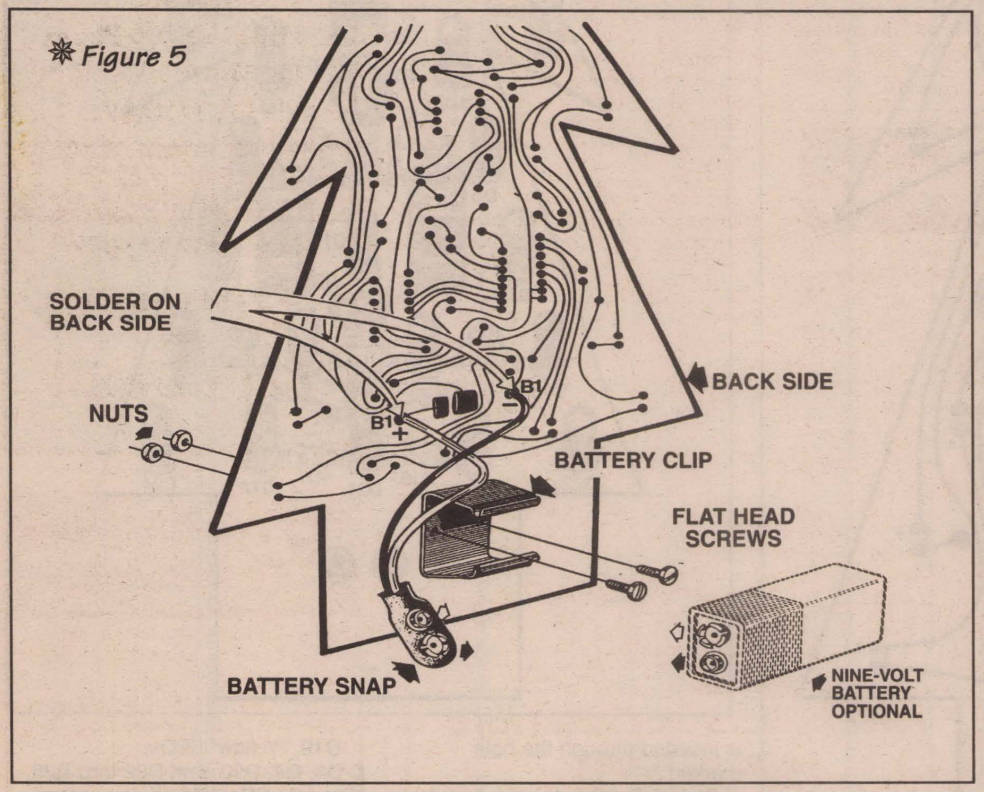
Step 9. Mount and solder slide switch S1 to the PCB.

Step 10. Using two 2-56 screws and nuts, mount the battery holder on the rear side of the PCB through the holes marked "X." See Figure 5.

Step 11. Connect and solder the battery connector to the rear side of the PCB. See Figure 5. Be sure the black wire is inserted through the hole marked "-" and the red wire is inserted through the hole marked "+." Cut off any excess lead length.

Step 12. Insert integrated circuit U1, the LM358, into its socket. Be sure that pin 1 goes into the proper hole.





Parts List for Sound Activated Christmas Tree

Quantity	Symbol	Description
2	R1, R6	Resistor, 1K
1	R2	Resistor, 5.6K
1	R3	Resistor, 220K
1	R4	Resistor, 150K
2	R5, R7	Resistor, 1M
1	R8	Resistor, 10M
1	R9	Resistor, 10 ohm
7	R10-R12 R14-R17	Resistor, 330 ohm
1	R13	Resistor, 220 ohm
3	C1, C3, C4	Capacitor, 0.1 uF
1	C2	Capacitor, 4.7 uF
1	D1	Diode, 1N4148
9	D6, D8-D13, D18, D21	Diode, LED, Red
8	D2, D5, D7, D14-D17, D19	Diode, LED, yellow
8	D3, D4 D20, D22-D26	Diode, LED, Green
1	U1	IC, LM358
1	U2	IC, 4024
1	U3	IC, 4051
1	MIC	Microphone, Condenser
1	S1	Switch, SPST
1	B1	Battery Connector
1		IC Socket, eight-pin
1		IC Socket, 14-pin
1		IC Socket, 16-pin
1		Battery Holder
2		Screw, 2-56 x 1/4"
2		Nut, 2-56
1		Stained Wooden Stand

Step 13. Integrated circuit U2, the 4024, is a CMOS device. As such, it is sensitive to static electricity. Before handling the device, firmly touch a working surface (table, desk, etc.) with your hands to discharge the static electricity build-up on your body. Insert U2 into its socket. Be sure pin 1 goes into the proper hole.

Step 14. Integrated circuit U3, the 4051, is also a CMOS device and the same handling precautions as listed above should be followed. Insert U3 into its socket. Be sure pin 1 goes into the proper hole.

Step 15. Place the base of your Sound Activated Christmas Tree PCB into the slot of the stained wooden stand.

Project Operation

Before applying power, give your project a complete once-over. Make absolutely certain the ICs are inserted in the right direction. Same thing for the LEDs. And, above all, be sure the battery snap connections are not reversed. You're now ready to see if your project works.

Connect a nine-volt battery to the battery clip. Snap the battery into place in the battery holder mounted on the rear side of the printed circuit board.

Turn the ON/OFF slide switch, S1, to the ON position. With any ambient sound, the LEDs will flash in a random-like pattern.

Make sure all of the LEDs light at some time in response to sound. Note that at higher frequencies, the flash rate of the LEDs increases.

If your Sound Activated Christmas Tree fails to operate in the manner just described, turn S1 off and refer to the troubleshooting section below.

Project Troubleshooting

If your project does not operate properly, or at all, follow these troubleshooting steps:

Step 1. Be sure your power source is a fresh nine-volt battery that measures at least 8.5 volts.

Step 2. Be sure your ON/OFF switch is in the ON position and its contacts are closed. If you have any doubt as to whether S1 is good, temporarily short it out with a clip lead.

Step 3. Check the placement of all component and wire leads. Be sure they are as shown in the pictorial diagrams.

Step 4. Be sure all solder connections are good. A good solder connection is smooth and shiny.

Step 5. Check for any "solder bridges" (solder making connection between foil traces or pads).

Step 6. Be sure no copper trace or pad is cut, broken, or missing on the printed circuit board.

Step 7. Check all polarized components for correct orientation as shown in the pictorial diagrams.

That should do it. Start singing, playing music, or yapping away, and watch your Sound Activated Christmas Tree light up for the holiday season. **NV**

The complete Sound Activated Christmas Tree kit is available from:

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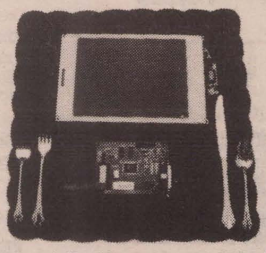
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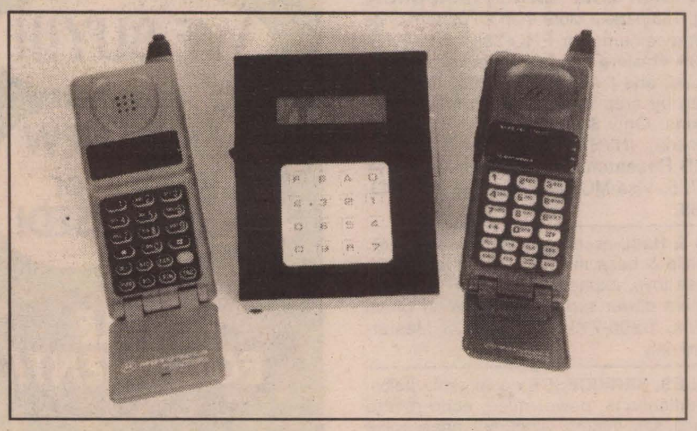
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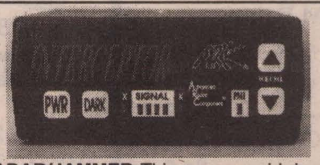
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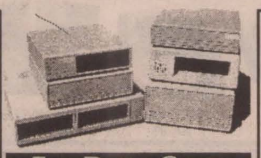


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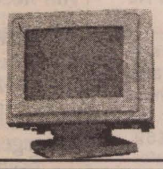
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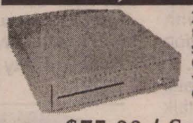


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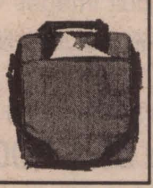
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SOFTWARE WIZARDRY

by Harry Helms

Using Digital Audio

PC software is no longer quiet. Speech, music, and sound effects aren't restricted to multimedia titles anymore, and are now being including in E-Mail, word processing documents, and even database records. The majority of new desktop PCs sold today are equipped with a sound card and speakers, and I personally feel that within the very near future all new PCs (desktops to notebook models) will come "sound ready" from the factory. If you're developing software commercially, this means you need to start including sound in your products.

There's a tendency among some programmers, especially veterans of the "good old days" of DOS prompts, to dismiss sound as a gimmick. Sound can be gimmicky, but it can also be extraordinarily useful in many situations. For example, sound can be used to alert users about certain actions and their consequences, like deleting a file or saving work before exiting an application. Text-based message boxes are used for such purposes now, but they can be overlooked or misread (admit it: you've lost a file or two because you didn't read a message box or misunderstood it!). A voice warning or announcement is much harder to ignore or misinterpret.

Adding sound to your software products is remarkably easy. Both Windows 3.1 and Windows95 include tools for digitizing audio input, editing and processing it, and using sound in applications. Even if you're not a software developer, you'll be interested at how creative you can be with sound on a Windows PC. Processing and editing sound on a PC is much more convenient and cost-effective for many purposes than conventional sound editing techniques, even for non-PC applications. For example, a Pentium-powered PC with a large hard drive can be a terrific tool for mastering audio CDs!

How Sound is Digitized

In analog recording (such as with a cassette tape), audio is converted to a continuous electrical waveform. This waveform can be used to produce a varying magnetic field pattern on magnetic recording tape or to drive an audio amplifier, radio transmitter, etc. However, computers can only handle data in binary form. To convert the continuous analog waveform into an equivalent stream of binary pulses would use too much memory and require too much computing horsepower to be practical. Instead, the analog waveform is sampled to produce a digital equivalent.

Sampling means that we measure the analog waveform at discrete intervals and assign a digital value to the signal amplitude. For example, a digital value of 0000 would mean the value of the analog waveform is zero. As the analog waveform increases in amplitude, values such as 0001, 0010, 0011, 0100, 0101, etc., could be assigned to each sample taken. If the analog waveform is sampled at its peak value, 1111 would be used to represent that peak.

The sampling rate means the number of samples of an analog waveform taken in a second, and is expressed in kilohertz (KHz). Sampling rates used for PC audio are usually 11, 22, and 44 KHz. The higher the sampling rate, the higher the audio quality of the digitized sound and the resulting .wav file is also larger.

The sample size is the number of bits used to represent each sample taken. The two sampling rates used with PCs are 8- and 16-bits. A 16-bit sample can represent a greater range of possible analog waveform levels than an 8-bit sample, and thus gives better audio quality. However, 16-bit .wav files are larger than 8-bit files. Sound files can be recorded in stereo or mono, and stereo .wav files are also larger than mono ones. The one sure rule for digitizing sound is that the higher the audio quality (the higher the sampling rate and sample size plus being in stereo), the larger the amount of memory the resulting .wav file will occupy. A good rule of thumb for estimating the size of a .wav file is that one minute of mono audio sampled at 11 KHz and 8-bits will require one megabyte of storage space. Doubling the sample size or sampling frequency will more than double the memory required to store the file.

The *de facto* standard PC sound capture and playback hardware is a sound card that is equivalent to the SoundBlaster sound card.

Sound cards come in 8-bit and 16-bit varieties. A 16-bit sound card can play both 8-bit and 16-bit .wav files, but an 8-bit sound card (which is common on many older and entry-level PCs) generally lacks the ability to play 16-bit .wav files. Thus, unless you know that your application will be used exclusively on PCs with 16-bit sound cards, you should only use 8-bit .wav files. Last Christmas, the Walt Disney Company got into big trouble with its *The Lion King* CD-ROM by using only 16-bit .wav files in it. Quite a few kids (and their parents!) were bitterly disappointed when they loaded the CD-ROM into their new multimedia PC and were greeted by error messages instead of Simba and his pals! The other hardware you will need are the usual microphones, tape decks, and patch cords used for any other audio work. For voice narration using 8-bits at 11 KHz in mono, I've found a standard cassette deck to be an acceptable source of audio.

You'll need a "developer quality" PC for anything but simple, short sound captures. I recommend at least a 486 processor running at 66 MHz or faster, at least 8 megabytes of RAM, and at least 100 megabytes of free hard disk space. Handling sound files gets easier and faster with increased processing power and memory. I recently upgraded to a 100 MHz Pentium PC with 16 megs of RAM and a gigabyte hard drive, and the savings in time over my previous 486 PC when processing sound files is remarkable, especially with files containing over one minute of audio.

Using Sound Recorder

Windows 3.1 introduced a handy sound capturing tool called Sound Recorder. To be honest, this is a relatively crude tool compared to other available sound capturing tools. However, it is a great place to start learning about PC audio. If your sounds needs are restricted to short segments of voice or music and your audio source materials are of high quality, Sound Recorder may be the only sound capturing tool you'll ever need.

Figure 1 shows the display you see on your PC monitor when Sound Recorder is in operation. In fact, this shows a segment of an actual sound file I captured for a project I was working on (a CD-ROM based accounting tutorial; the file name of aeintro.wav stands for "accounting equation introduction"). As the analog input signal is digitized, you'll see the analog waveform displayed. This is handy, since it's easier (at least for me) to judge the level of the audio input from a visual waveform display than from a VU meter or a set of "idiot lights." The control "buttons" on the Sound Recorder window are similar to those on many tape recorders, allowing you to start recording, stop recording, and navigate to different sections of the .wav file.



Figure 1

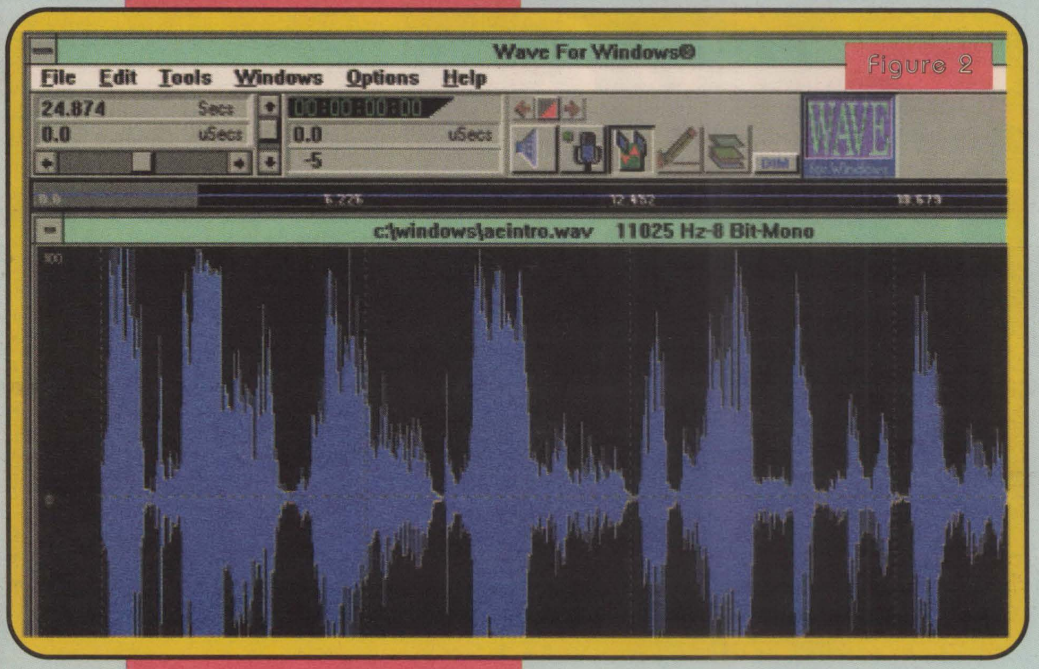


Figure 2

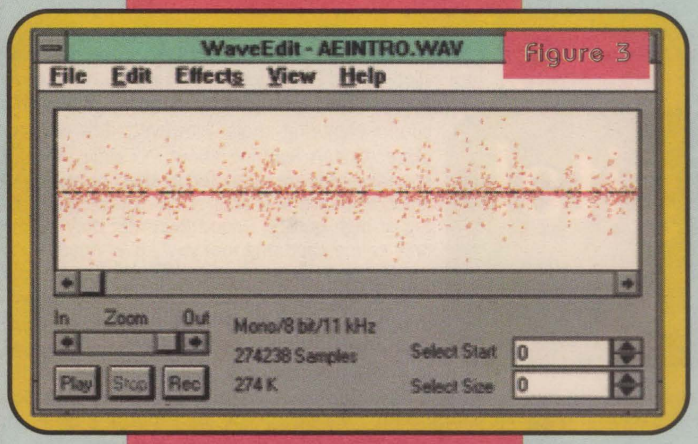


Figure 3

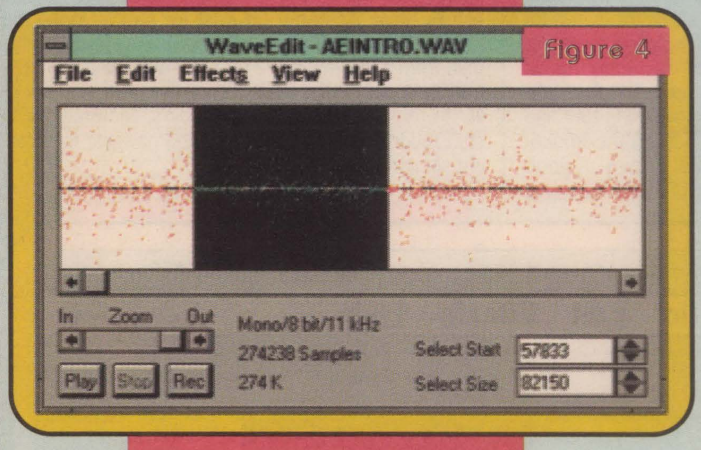


Figure 4

There are many additional sound digitization software packages for Windows that are more versatile than Sound Recorder. My personal favorite for lengthy voice narrations and simple sound effects is Wave For Windows from Turtle Beach Systems. Figure 2 shows the same aeintro.wav file as recorded using Wave For Windows. The waveform display is larger, and Wave For Windows can easily handle recordings longer than one minute. Wave For Windows is also useful for audio processing and editing, which is our next topic.

There are more powerful (but complicated) sound capture and recording tools available for Windows PCs. In particular, a whole new generation of sound tools is becoming available for Windows95, and some are supplied with Windows95 PCs. For example, my new Windows95 PC came supplied with the Audio Works set of sound tools from Midisoft Corporation. This set permits you to do things like mix multiple audio sources to create an entirely new .wav file. I haven't used Audio Works much yet, but it looks like it has great potential.

Recording with both Sound Recorder and Wave for Windows is simple and intuitive, much like using a conventional tape recorder. Sound Recorder's buttons shown in Figure 1 and Wave for Windows's control box buttons (not shown) operate just like those on tape decks. Audio is fed into your PC's sound card via its microphone or line input jack.

You can set the sampling size, sampling rate, and whether the file will be in mono or stereo before you digitize the audio. I generally record with 16-bits and a higher sampling rate (like 22 KHz) even if I only plan to include 8-bit, 11 KHz files in my applications. As we'll see in the next section, I can "scale down" 16-bit, 22 KHz files to 8-bit, 11 KHz files using sound file processing software. In most cases, I find files converted from 16-bit, 22 KHz originals have better audio fidelity than those originally recorded as 8-bit, 11 KHz files. Unless you are recording files to be included on an audio CD, you'll usually have no reason to use a 44 KHz sampling rate. The sound cards and speakers in most PCs are inadequate to let you fully take advantage of that sampling rate. However, the 44 KHz sampling rate (along with 16-bits and stereo) is used if you plan to place the resulting sound files on audio CDs.

Editing Sound Files

For most developers, the most interesting part of audio on PCs is how easily the audio can be edited and altered. Does a speaker have an irritating habit of going "uhhmm" without realizing it or taking an audible breath before each sentence? It's easy to remove such segments from a digitized sound file. Did someone misspeak, such as saying "debit" when they should've said "credit?" It's easy to go into another sound file that has the correct word and then "copy and paste" the correct word into the sound file where the wrong word appears.

Special effects, like echo and distortion, can be easily added. And if the original audio source material is noisy, it's possible to perform audio filtering to improve the signal-to-noise ratio and eliminate frequency-specific noise sources (like a steady 1,000 KHz tone).

The most common sound editing tool in Windows 3.1 is Wave Edit. This is supplied with many multimedia and presentation tool software packages, and is often part of sound card software. Wave Edit is simple to use, but is limited in its capabilities. Figure 3 shows the aeintro.wav file displayed by Wave Edit.

Wave Edit allows you to cut, copy, and paste portions of sound files. Figure 4 shows how a portion of the aeintro.wav sound file can be selected for cutting or copying. The action is much like the cut and paste actions familiar to any user of Windows or Macintosh PCs; you simply place the mouse pointer on the segment of the audio file where you want to start, click and drag over the segment you wish to cut or copy, and release the mouse button at the end of the segment. To insert a cut or copied segment, just click on the spot where you want to insert the segment and select "Paste" from the Wave Edit edit menu.

Another use for this selection capability is to play a segment of a .wav file. If the "Play" button at the lower left is clicked, the section of aeintro.wav selected in Figure 4 would be played. This is a handy feature when editing.

The horizontal slider bar labeled "Zoom" at the left side of the Wave Edit box lets you take a closer look at the displayed waveform; the long slider bar underneath the displayed waveform is for scrolling through the waveform. With a little practice, you'll start recognizing the waveform patterns for entire words and even common single sounds (like the "s" at the end of a plural noun). The patterns for noises and other sounds (like those "uhhmm" sounds mentioned earlier) will also quickly become familiar.

Unfortunately, Wave Edit's editing features are largely limited to cutting, copying, and pasting segments of a .wav file. However, Wave Edit can do one thing more quickly and simply than some other sounding editing software: it can easily convert between different sampling formats. Figure 5 shows the "Change Audio Format" box displayed when selected from the "Effects" menu. Of course, Wave Edit cannot "re-sample" a .wav file and magically convert a 11 KHz sample into a higher quality 44 KHz sample. What Wave Edit does do is convert formats; the 11 KHz sample pattern is "repeated" to produce a 44 KHz sample. The audio quality is the same as the original 11 KHz sample, but the resulting 44 KHz sample is in the same format as

an original 44 KHz sample. Wave Edit could also take a 44 KHz sample and convert it into an 11 KHz sample. Audio quality would be sacrificed, but the resulting 11 KHz files would also be much smaller. Wave Edit can do similar conversions from 16-bits to 8-bits and mono to stereo (and vice-versa). If a file is converted from mono to stereo, the same signal appears on both channels.

Other sound processing software offers more powerful sound editing tools. Wave for Windows has an impressive set; Figure 6 shows the menu for them. Among the editing effects possible are low- and high-pass filtering, replacing segment of a sound file with silence, adding echo, reverb, and selected distortion, "speeding up" and "slowing down" segments of a sound file, and equalization of a sound file. Such capabilities often allow you to pull usable audio from source materials that seem at "first listen" to be worthless.

Desktop Audio CD Production

You might be skeptical that it's possible to master an audio CD on a PC. But it's true – I know, because I recently did it. The one catch is that you will need a CD recorder (CD-R) capable of producing Red Book standard CDs. The Red Book standard calls for files to be recorded in stereo with 16-bits at a 44 KHz sampling rate. As we've seen, tools like Wave Edit can produce files meeting this standard even if the original file is recorded using a different standard. CD-R units that can produce audio CDs – I used a Toshiba to produce my master audio CD – come with software that can take ordinary .wav files and write them to a CD in audio CD format.

The audio CD I produced is included with a new book, *Pirate Radio* by Andrew Yoder, which has just been published by HighText Publications. (Copies are $29.95 plus $4.00 shipping by calling 1-800-247-6553.) The audio CD contains 14 tracks of audio segments from various pirate radio stations. To produce each track, I took recordings of various pirate radio stations from a cassette tape. The output from my cassette deck was taken from a "line out" output and fed to the microphone input of my PC's sound card. The audio was digitized, processed, and edited using Wave for Windows. Most of the audio consisted of off-the-air recordings of pirate stations, and I made extensive use of that software's high-pass filter capabilities to clean up the audio.

Each "track" (.wav file) was placed in a separate Windows folder. There were numerous audio segments that simply consisted of a station identification, and I "pasted" several of these together to create a single track. At the Red Book standard, the audio files were huge – over 10 megabytes per minute! I used a separate 500 megabyte hard drive to store the audio files. The CD-R unit produced a "gold master," which is the CD used by the duplicator to create the "glass master" to produce all additional copies of the CD.

If there's enough interest, I could devote a future column to more details on producing audio CDs on a PC. Suffice to say, doing it on a PC was a lot faster and cheaper than the quotes I received from recording and audio engineering services. Just as computer-based graphic arts services have wiped out many conventional graphics arts houses, I'm convinced that computer-based audio services are going to do the same to tape-based audio houses.

Even if doing a CD isn't in your plans, I suggest getting familiar with the audio tools in your Windows PC. Given that sound cards are now standard equipment on most PCs, something tells me that your software customers won't be content with "silent software" much longer! NV

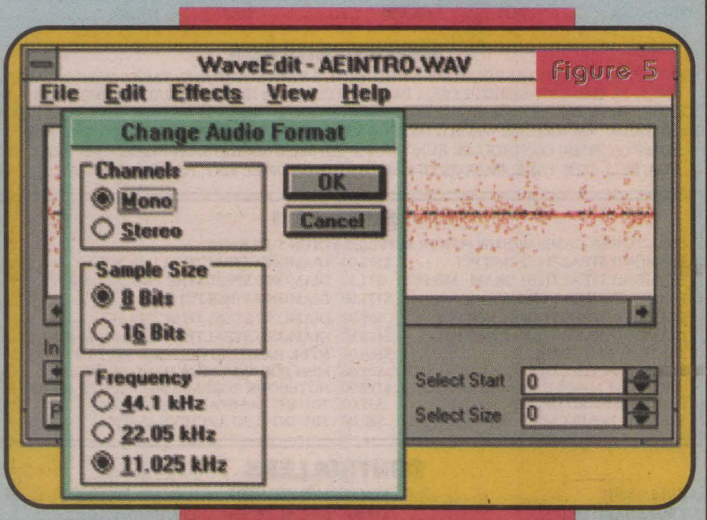


Figure 5

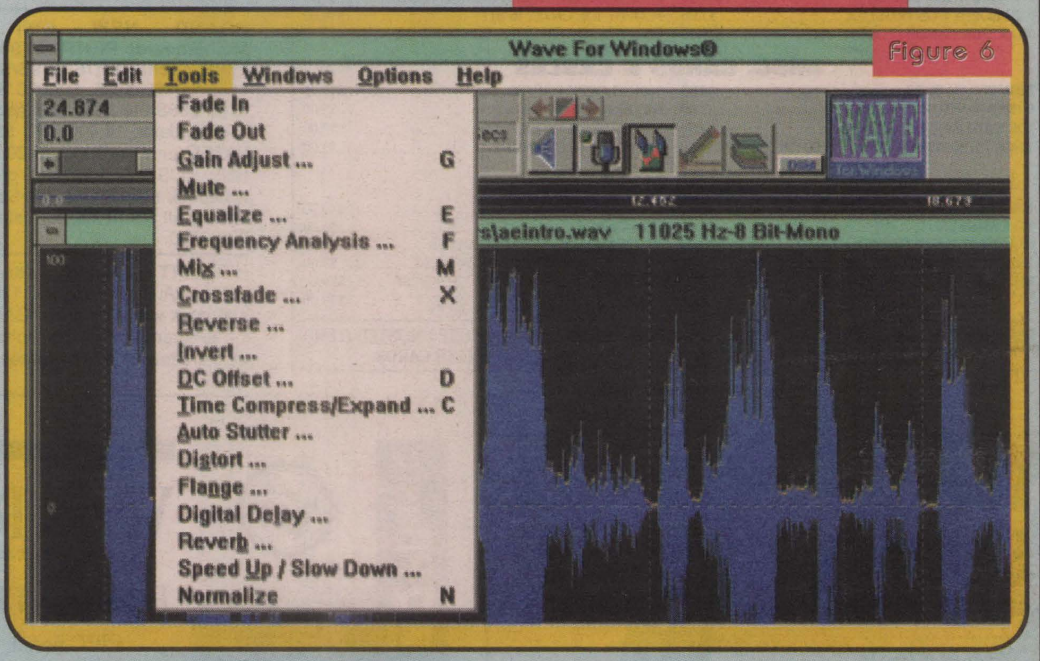


Figure 6

Operating System News

On the day Windows95 was finally introduced, IBM caved in and announced they have licensed it for bundling with their PCs. IBM has also announced they are re-positioning OS/2 as an operating system for business computing environments, largely in conjunction with the widely-used Lotus Notes "groupware" (IBM acquired Lotus earlier this year). In effect, IBM will be using Notes to gain acceptance of OS/2 in business. This is something of a return to IBM's original strategy for OS/2. When the project (originally known as "TopView") was launched a decade ago, it was intended to be a common user interface for everything from desktop PCs to "dumb" terminals attached to mainframes. While IBM is still shipping single-user consumer PCs with OS/2 installed, it has been mum on whether it will continue to support or upgrade the system for non-network users.

Meanwhile, the joint efforts of IBM and Apple to develop an alternative to the Intel/Windows stranglehold on the PC market – the Taligent and Kaleida ventures – seem to be on the verge of collapse. Apple's original plan was to stop upgrades of the Mac OS with System 7 and then use the new joint OS, but 1996 will see the release of a "System 8" (or whatever the name will be). Meanwhile, IBM is making Windows NT available for its Power PC units and, as noted above, is pushing OS/2 into networked business computing.

If you've upgraded to Windows95 from Windows 3.1, you've probably discovered that some Windows 3.1 development tools refuse to function under Windows95. One that I find particularly irritating is that the "Screen Capture" utility from Video for Windows cannot be used in Windows95. I have often used this utility to capture a sequence of operations displayed on my monitor (such as how to use certain software features) and store them as .avi files; using other Video for Windows tools, I could then add voice narration, music, etc., to the .avi file and play it like a movie. Microsoft promises an upgraded set of video tools for Windows95 "soon." In the meantime, I am one disgruntled puppy!

Intel's successor to the Pentium, the P6, will carry the name "Pentium Pro." Advance word is that Pentium Pro PCs will show only marginal improvement over plain vanilla Pentium PCs when running Windows95. The Pentium Pro really begins to shine when it runs Windows NT, and that will apparently be the initial thrust of the Pentium Pro marketing effort. Pentium Pro/Windows NT PCs will be aimed at the lower end of the workstation market where companies like Silicon Graphics now dominate.

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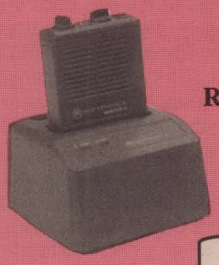
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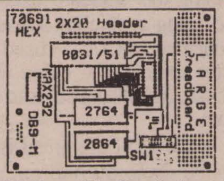
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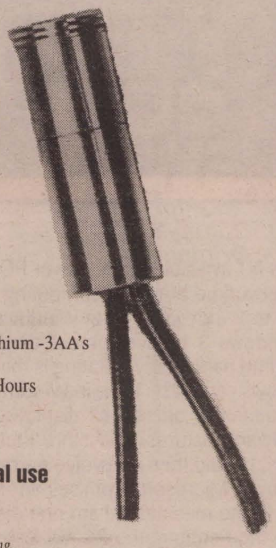
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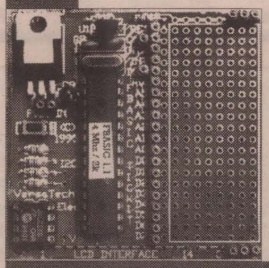
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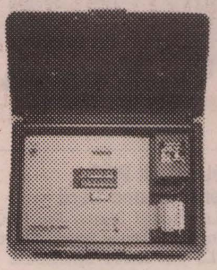
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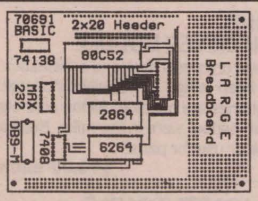
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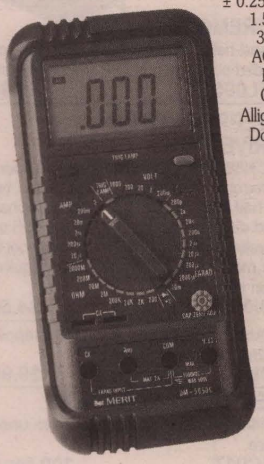
"BEST BUY" Wholesalers, systems, peripherals. Addresses, FAX, toll free numbers. Domestic and foreign. Hundreds of tips/diagrams on building, repairing, upgrading and configuring computers. Two good reference/diagnostic programs. On 1.44 disk. $3 postpaid. Satisfaction guaranteed. For two additional 1.44 disks chock full of diagnostic and reference programs add $3. Southern Oregon Computer Supply, Box 1349N, Jacksonville, OR 97530.

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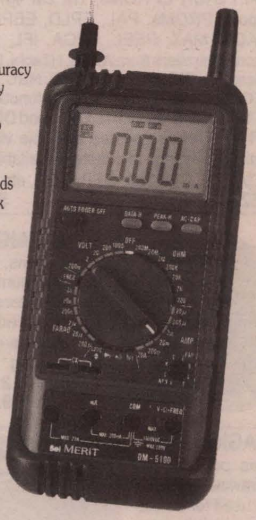
DM5050C, 42 Range
DMM + CAPACITANCE METER
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- Capacitance Meter, Extended Range
  - Up to **20,000**µF (**9** Range)
  - Zero Adjust Knob
  - Test Leads and Bukit-in Socket
  - Check Motor Starting & Running Capacitance
- Triggering Lamp

DM5100, 45 Range
WIDE RANGE, ELEVEN FUNCTION
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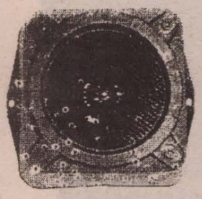
VU METER

0 to 250 µA at full scale. Meter resistance 1000 Ohms. Black face with VU scale in white and red, marked from -20 to +3. 1.625" sq. x 1.125" deep.
95U011 $2.00 each

• Same as above, except 1.75" sq. x 1.25" deep.
95U012 $2.50 each

SUPERPRO II

40-pin universal programmer for PALs, GALs, FLASH, E(E)PROMs, and Microcontrollers. 24/28/32/40 pin E(E)PROMs, CMOS EPROMs and FLASH EPROMs, 1M 2M 4M & 8Mbit. Bipolar PROMs. PAL, EPLD, EEPLD, GAL, MACH, MAX, PEEL, FPGA, IFL, FPL, etc. Microcontrollers from Atmel, Hitachi, Intel 87*nn*, Microchip PIC, Motorola, NEC, NSC, Signetics 87C*nnn*, WSI, Zilog, etc. Also functions as an IC tester for CMOS/TTL Logic and DIP DRAM/SRAM. Device updates available via BBS or mail. Wide range of adapters available for DIP, PGA, PLCC, SOIC, QFP, SOP, etc.
95Z018 $ 449.00



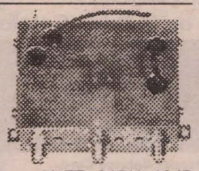
SPEAKER SET

4 Ohms, 30 Watts maximum. Each 4" diameter speaker is mounted in a wedge-shaped housing.
95V012 $9.95/Pair

MAGIC LIGHT



This pocket-sized ultraviolet light may be used for detecting invisible inks, minerals in rocks, etc. It's the same approximate size as a pocket pager and even has a belt clip to keep it handy. Runs on two "AA" batteries (not included). 3¼"W x 1¾"H x 1"D.
95L007 $7.95 each

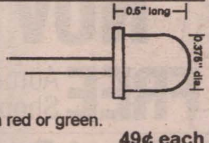


VHF RF PREAMP AND SPLITTER

Contains two transistors with FT of 4GHz 10dB gain, 3dB NF. Soup up that VHF receiver, scanner, FM tuner, VHF-TV reception or whatever. Actually has two preamps in one case. Runs on 12VDC. Schematics included and hints for broadband use.
92A026 $7.95 each

COMPUTER RFI ELIMINATION KIT

Stop that radio frequency interference with these split ferrite core kits. Each kit includes two pairs of split ferrite cores, designed to be installed on each end of your computer's cables (video, serial, parallel, etc.). These are easy to install and each kit comes with instructions. Buy one kit for each cable!
95P002 $1.99 per Kit



JUMBO LEDs

Draw 15mA @ 2VDC. Available in red or green.
95L008 - Red 49¢ each
95L009 - Green 49¢ each

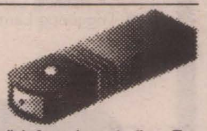


BRAND "X" LENS

Eyepiece-type magnifier. Focal length = 50mm, f3:2. Approx. dimensions: D=38mm, L=43mm. Excellent hand magnifier at approx. two power.
93L009 $9.95 each

CD-ROM JEWEL CASES

Use for CD-ROMs sold without a case or as a replacement for a broken one. These have been salvaged from unsold, obsolete software.
95U004 Three for $1.00



IR REMOTE

Hand-held "encoder" infrared controller. Encoded pulse train is DIP switch selectable.
95L005 $1.95 each

STEPPER MOTOR DRIVER IC

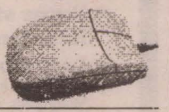
UCN5804-B. Drives a unipolar stepper in one of three operating modes: single phase, two phase or half step. Up to 12.5 Amps per phase. Step and direction input. Drive with a 555 oscillator, parallel port, etc. Build your own robot turntable for model trains, anything that requires precision positioning.
93I002 $4.50 each

• Above, packaged with 5V stepper motor (92M010) and schematics.
93I003 $9.95 each

RECYCLED DISKETTES!

1.44MB, 3½", bulk erased. From unsold software.
95C017 100 for $25.00

PC-COMPATIBLE MOUSE



400 DPI, 3 buttons. Drivers included.
MUS4B $7.95



HAND-HELD TRACKBALL

PS/2 and Microsoft compatible. Two keys, 200 DPI.
MUHTB $9.95



COPY HOLDER

Clip holds standard 8½" x 11" sheet of paper next to monitor for easier text entry. Swings out of way when not in use.
CH-6 $2.95 each

HALL EFFECT SENSOR

Mounted within a hollow stud. Stud is 0.875" long with ¼-28 threads. Overall length is 2.625" incl. connector.
95Z016 $2.00 each

DUKE'S DELIGHT

Five pounds of assorted electronic hardware - fasteners, nuts, bolts, screws, brackets, springs, standoffs, arms, gears, pulleys, and indescribable metal stuff scrounged from Silicon Valley's surplus to complement your hardware hoard.
92Z009 5 Lbs for $4.95

"AA" NICADS

Used, mixed manufacturers.
94E017 49¢ each - 10 for $3.99



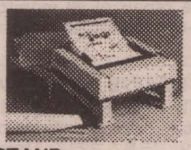
SOUND FX PRO Stereo Sound Card

AdLib, Sound Blaster Pro II, Covox Speech Thing and Disney Sound Source compatible. OPL3 FM stereo synthesizer generates 20 voices using 4 operators. 4-44.1 KHz sample rate. Software selectable IRQ and DMA, and enable/disable game port. 8-bit DAC. Dynamic adaptve filtering. Built-in MIDI interface. AT-Bus CD-ROM interface. Four Watts out. Includes external speakers, drivers and application software.
95C019 $39.95 each

SOUND GALAXY 16-Bit Business Audio Board

Microsoft Windows Sound System compatible. OPL3 FM stereo synthesizer, 5.5-44.1 KHz sample rate. Dynamic filtering. AT-Bus CD-ROM interface. Includes headphones, drivers and application software.
95C020 $29.95 each

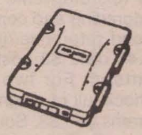
Call our BBS for List of Mac Stuff!



PRINTER STAND

Fully adjustable. Saves space. Paper tray. Non-slip rubber feet. Free paper trimmer included. Limited lifetime warranty.
PL-2 $4.95 each

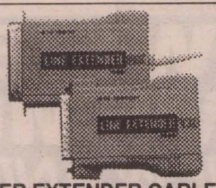
PRINTER SWITCHES



2-to-1 parallel auto switch. DB-25F cable connectors. Manual switch or software switchable.
AS21P $22.00 each

4-to-1 parallel auto switch, same as above.
AS41P $29.95 each

6-to-2 parallel auto switch, same as above.
AS62P $49.00 each



PRINTER EXTENDER CABLE

Connect your PC or compatible to a printer up to 1200 feet away with this transmitter/receiver connected by two- or four-wire modular telephone cable. No external power needed.
PCE-11 $25.00 each

POWER CENTER



Individually lighted control switches. Lighted master on/off switch. Five heavy duty grounded power outlets controlled individually by front panel switches (Computer, Monitor, Printer, Aux1, Aux2). 15A circuit breaker.
94C006 $14.95 each



BOOM MIKE

Electret condenser type. This versatile microphone may be wired for Handy-Talkie, telephone, base station, aircraft radio, CB radio, motorcycle intercom, etc. An earphone or miniature speaker may be installed in either or both muffs. The microphone unit can be easily removed and installed on another headset or helmet.
92A001 $4.95 each

MINIATURE SPEAKER

Great for use in Boom Mike (92A001). Applications include model railroad sound systems, radios, test equipment and more. Only 0.9" dia. by 0.2" thick. 40 Ohm coil, rated at 20 mW has 6" wire leads.
92A007 $1.49 each

CRYSTAL MICROPHONE



Monaural 1/8" phono plug on approx. 30" cable.
95V011 $2.49

MINIATURE C-BAND LNB

Low-noise block converter. Better than 40°K noise temperature. Spec sheet included.
94G001 $49.95 each

40-CHANNEL CB TRANSCEIVER MODULE

These are new units with book and schematics. They have been tested to be fully functional. The microphones are missing. All the controls and channel readout were in the mike. Build a remote base or use for parts.
95A001 $10.00 each

STEREO ADAPTER CABLE

Five feet long, 1/8" stereo plug to two RCA male.
95W017 $1.49 each



SCOPE PROBE #1

Attenuation: X1 @ 15 MHz, 60 pF or X10 @ 60 MHz, 12 pF. Working voltage: 60VDC (including AC peak). Working temperature range: -13 deg. F (-25 deg. C) to 158 deg. F (70 deg. C). Compensation range: 15pF to 50pF. Avex model # 510-SW60S.
94Z001 $19.50 each

SCOPE PROBE #2

Attenuation: X1 @ 10 MHz, 75pF, X10 @ 100 MHz, 11pF. Working voltage: 600 VDC (including AC peak). Compensation range: 15-50 pF. Include 6" ground lead, spring hook, BNC adapter, I.C. tip, insulating tip, and trimmer tool. Avex model #510-SW-1.
94Z002 $24.50 each

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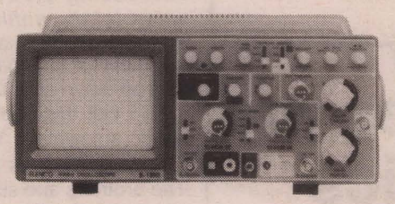
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ELENCO OSCILLOSCOPES





STANDARD SERIES
S-1325 25MHz $325
S-1340 40MHz $489
S-1365 60MHz $795

Features:
- High Luminance 6" CRT
- TV Sync
- 1mV Sensitivity
- 2 - x1, x10 Probes
- X-Y Operation
- Complete Schematic
- Voltage, Time, + Frequency differences displayed on CRT thru the use of cursors (S-1365 only)
- Plus much, much more

DELUXE SERIES
S-1330 25MHz $439
S-1345 40MHz $569
S-1360 60MHz $759

Features:
- Delayed Sweep
- Automatic Beam Finder
- Z Axis Modulation
- Built-in Component Test
- Dual time base
- Illuminated internal gradicule
- Plus all the features of the "affordable" series

Hitachi Compact Series Scopes

V-252 - 20MHz, Dual Trace	$449
V-555 - 50MHz, Cursors	$1,095
V-552 - 50MHz, DC Offset	$949
V-422 - 40MHz, DC Offset	$849
V-222 - 20MHz, DC Offset	$695
V-665A - 60MHz, DT, w/cursor	$1,449
V-1560 - 100MHz, Dual Trace	$1,595
V-1065A - 100MHz, DT, w/cursor	$1,695
V-1585 - 100MHz, QT, w/cursor	$2,095

B&K OSCILLOSCOPES

2120 - 20MHz Dual Trace	$389
2125 - 20MHz Delayed Sweep	$539
1541B - 40MHz Dual Trace	$749
2160 - 60MHz Dual Trace, Delayed Sweep, Dual Time Base	$949
2190 - 100MHz Three Trace Dual Time Base, Delayed Sweep	$1,379
2522A - 20MHz / 20MS/s Storage	$869



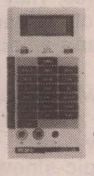
Digital Multimeter
EDM-83B
$175.00
Almost every feature available Bargain of the decade



Elenco LCR + DMM
LCM-1950
$79
12 Functions
Freq to 4MHz
Inductance
Capacitance



Digital Capacitance Meter
CM-1555
$49.95
- Measures capacitors from .1pf to 20,000µf
- 3-1/2 Digit LCD readout with unit indicator



Digital LCR Meter
LCR-680
$79.95
- 3-1/2 Digit LCD Display
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- Resistance .1Ω to 20MΩ
- Capacitance .1pf to 200µF



Function Generator
GF-8026
$225
Int/Ext Operation
Sine, Square, Triangle, Pulse Ramp, .2 to 2MHz, Freq. Ctr.



3-3/4 Digit Multimeter
BK-390
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- Auto/manual ranging
- 4,000 count LCD display
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- Temperature probe



Digital Multimeter Kit with Training Course
By Elenco
M-2665K
$49.95
- Full function 34 Ranges
- Extra large display • Ideal school project

M-2661 (Assembled) $55.00



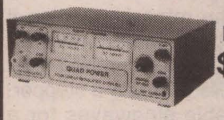
Frequency Counter
F-1225
$225.00
- 8 Digit LED display
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- High sensitivity
- Data hold function
- Input impedance 1MΩ or 50Ω
- 10:1 Input attenuation function

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Model 93	$1,225.00	Model 70II	$69.95
Model 95	$1,549.00	Model 77II	$149.00
Model 97	$1,795.00	Model 79II	$175.00
10 Series		**80 Series**	
Model 10	$62.95	Model 87	$289.00
Model 12	$84.95		



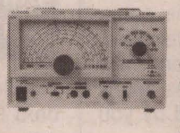
Triple Power Supply
XP-620
By Elenco
$75.00
3 fully regulated supplies; 1.5-15V @ 1A, -1.5 to -15V @ 1A or (3-30V @ 1A) and 5V @ 3A **Kit XP-620K $49.95**



Quad Power Supply
XP-581
By Elenco
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Four supplies in one unit; 2-20V @2.5A, 5V @ 3A, -5V @ .5A and 12V @ 1A. All regulated and short protected



High Current DC Power Supply
BK-1686
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- 3 to 14 VDC Output
- 12A @ 13.8V (less current at lower voltages
- For servicing high power car stereos, camcorders, ham radios, etc.
- Connect 2 or more in parallel or series



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SG-9500 150MHz built-in counter **$235**

Telephone Kit
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$14.95
Available Assembled PT-223 $15.95



Function Generator Blox
#9600
By Elenco
$29.95
Kit $26.95
Sine, Triangle, Square wave



Learn to Build and Program Computers with this Kit



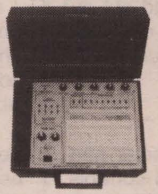
MM-8000
By Elenco
$129.00
From scratch you build a complete system. Our Micro-Master trainer teaches you to write into RAMs, ROMs and run a 8085 microprocessor, which uses similar machine language as IBM PC.

Electronic Tool Kit
TK-1000
$39.95



A professional organizer tool kit at affordable prices. Includes 25 high quality tools in a high impact carrying case which includes a pocket for meter.

Digital/Analog Trainer
Complete Mini-Lab For Building, Testing, Prototyping Analog and Digital Circuits



XK-525
$159.95
Kit XK-525K
$129.95

Elenco's trainer is designed for school projects, with 5 built-in power supplies. Includes a function generator with continuously variable, sine, triangular, square wave forms. All power supplies are regulated and protected against shorts.

The case can include a full line of tools and meter of your choice.

Transistor Radio Kits
with Training Course

AM/FM Radio
Model AM/FM-108 $29.95
AM Radio Kit
Model AM-550 $19.95

Telephone Line Analyzer



Kit TT-400K $19.95
Assembled TT-400 $26.95

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Don Lancaster's

RESOURCE BIN

number forty-six

New Opportunities in Power Electronics

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 daytime 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.

Power Electronics

This month, I thought we'd take a look at a few new power electronics resources. All of a sudden, this rather staid and arcane field is exploding. Mostly thanks to several brand new tools, devices, and techniques. Many of which are easily explored by you individuals and tech start-ups.

So, there are now lots of brand new opportunities here.

Let us first look at a few exciting new developments you could directly profit from. Then we'll round out our survey with a look at those older and more traditional power resources.

Magic Sinewaves

Electric cars, off-grid solar panels, induction motor speed controls, and home energy efficiency improvers all share a common problem: cheaply, simply, and efficiently generate low-distortion power sinewaves. Waves of carefully controlled amplitude and of a precisely controlled frequency.

Usually, you will start off with a four-switch beastie called an *H-Bridge Drive*. The object of the game is to flip your four switches just so, creating a sinewave output. For best efficiency, you'll want to flip the switches as *few* times as possible per cycle. And you'd also like to consistently flip only *half* of the switches at once, for a further efficiency doubling.

There is a brand new game in town I like to call *Magic Sinewaves*. Magic sinewaves are very long sequences of carefully selected repeating ones and zeros. They easily give you bunches of high-quality sinewaves of most any amplitude and frequency.

Magic sinewaves whose harmonics can be forced to *zero*. Or else held to amazingly low values.

To use your magic sinewave, you simply stash a listing of them in a dollar PIC or another cheap micro. For level #85, you grab sequence #85 and shove it out one or more ports. Your delay between bits sets the frequency. Single, two, or three phase. Per your choice. It's all that easy.

NEXT MONTH:
Don looks at several odd-ball and unusual phone and communication resources.

Compared to the industry standard PWM (pulse width modulation) way of doing things, the magic sinewaves offer far less high-frequency losses. Ridiculously so. As much as a 25:1 or higher improvement!

Heatsinks can be much smaller and all your power drivers much cheaper. The integration, offsets, nonlinearities, and noise totally vanish.

Magic sinewaves seem brand new because they've traditionally been so excruciatingly hard to find. At least before some brand new tools became available. A typical magic sinewave is 384 bits long. There are more magic sinewaves than there are atoms in the solar system. So, finding them used to be worse than finding a needle in a multi-dimensional universe chock full of humongous haystacks.

A ferinstance: Hex $1006 070E 1F87 FE3F FF7F FFFF is one quadrant of a 384-bit magic sinewave. This outputs 97.8% of your supply voltage. With a reasonable filter, your *total* harmonic distortion 3-17 is an astounding 0.031 percent! Even when *totally unfiltered*, the same sequence offers a negligible third harmonic of only 0.0065% and a fifth way on down at 0.0261%.

I'll call this one the mother of all magic sinewaves. Well, at least this week. Better ones are arriving daily. The brothers and sisters in this series will give you 128 or more uniformly spaced amplitudes from zero to your full supply voltage.

I will be happy to mail you a free tutorial on magic sinewaves.

My *GEnie* PSRT is the center of the universe for magic sinewave concept development. By myself, from math genius Jim Fitzsimons, and by other leading edge researchers. Start with that MAGSINT.PDF tutorial, then go on to the dozens of other files. Just search under "magic."

Custom consulting, a co-developer program, sine analysis & synthesis, source code, and ready-to-run chips are all available. Call or write me for more info on this multi-million dollar opportunity. Or use my E-Mail address from the end blurb.

Car Alternator Steppers

The price of power stepper motors is dropping. There certainly are lots of bargains right here in *Nuts & Volts*. But scant few people realize that a car alternator can be converted into a fair to middlin' power stepper at very low cost, and local availability.

That very same alternator can also become a switched reluctance motor or a servo. Generally what you do is DC power the rotor, converting it into a "permanent" magnet. You will then sequence your stator coils to create a stepper. Or apply suitable sinewaves for a switched reluctance drive.

Uh, a "three phase" stepper motor may seem a little weird, compared to those usual two-phase and four-phase ones.

But it works like a champ.

You will get best results by using a current drive scheme. Details on this in most stepper drive ap notes.

John Rees markets an outstanding self-produced video on converting car alternators into power steppers. He also takes you step-by-step through building a humongous programmable sign router using car alternators for three axis control.

Additional details on car alternator steppers are shown in NUTS34.PDF, HACK47.PDF, and EMERGOP3.PDF.

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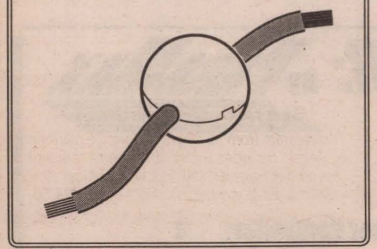
with knowing exactly how much AC power gets used for what. But measuring the main and branch AC currents can end up a horrible mess, involving safety regulations, electricians, and rewiring.

Here's a little gadget that I've got an in-house research project going on. I like to call it the . . .

The isopod snaps onto one of your incoming power lines right at your weatherhead. This is basically a self-powered current transformer and a short range transmitter.

The simplest version transmits a digital signal burst every now and then. One that identifies the Isopod, your current zero crossing, and how much current is being consumed.

ISOPOD ENERGY REPORTER



A nearby receiver gathers in the digital current burst and routes it to a microcontroller, modem, or personal computer. A local line reference gives the voltage. By comparing the phase angle of your current zero crossings against the voltage, both the real and reactive power can be found.

Other isopods can be snapped onto branch circuits or even made part of individual appliances. One place they should be super handy is for fixing air conditioning intermittents. A fancier unit could include a receiver, so they speak only when spoken to.

For full home energy management, dozens of isopods could be spotted in appropriate places. Leading to greatly reduced home electric bills.

More on isopods in NUTS34.PDF, HACK47.PDF, and EMERGOP3.PDF on *GEnie* PSRT. Hard copy reprints and custom consulting is also available.

PostScript Robotics

I sure get an amazing number of helpline callers wanting to build their own two-axis or three-axis robotic systems. For everything from printed circuit drills to milling machines, to embroidery set-ups, animation stages, and silk screen cutters.

Regardless of what these do, I like to call them *flutterwumpers*. Well, a flutterwumper moves something that chomps or spits against a piece being worked. Under computer control.

As I may have mentioned once or thrice before, there is this general purpose computer language known as *PostScript*. PostScript is *absolutely ideal* for *all* flutterwumpers. Because of the ease with which it can handle graceful curves and typography.

Usually, you'll apply a two-step process. You use a PostScript printer or GhostScript shareware on a PC to generate your artwork and curves or such. Bring the full power of all the world's fonts, Illustrator, Acrobat, Photoshop, scads of CD-ROM clip art, and lots more to the table.

Your printer or your program then generates an output text file in a very simple control language. One which ridiculously minimizes all the smarts needed by your actual flutterwumper. While you could use *Gerber* format or the HPGL graphics language for the output, all you'll often really need is simple serial commands. Such as "U" for up and "D" for down. Or "N" for north and "S" for south.

All of which lets you reduce your flutterwumper intelligence down to a one dollar microcontroller. That new *Basic Stamp* from *Parallax* is ideal for this sort of thing. For higher speed and performance, you can step up to those *Scott Edwards PIC Tools*. Or use any of the fine applications info from *MicroChip Technology*.

Fundamentals of PostScript appear in STARTUP.PDF and SPEEDUP.PDF. For more info on flutterwumpers, see FLUTWUMP.PDF, FLUTOOLS.PDF, or else NUTS19.PDF.

New Integrated Circuits

Prices of power semiconductors are dropping dramatically. We are also seeing the low level circuits combined on-chip with the power output stages for further economics.

Newer power MOS transistors are now cheap to buy and easy to use. They are vastly easier to drive than an older bipolars or Darlington. Besides being less likely to blow up.

One neat trick with some power MOSFETs: It's a simple matter to put 10,000 identical MOS transistors on the same chip. You use 9,999 of these for your main load circuit. And then take the last one and sense your current through it. This current will be 100 microamps *per amp* of load current. All of which can give you a "lossless" current sensor. One which requires nothing in series with the bulk of the main load current.

National Semiconductor has free samples of their LMD18245 H-Bridge Driver. Besides their lossless current sensing, this includes a current drive (for higher speeds and more power), and the ability to power down to one of 16 levels. Forward or reverse. Easily driven from any micro.

Full details on this low-cost power stepper driver in MUSE93.PDF.

Texas Instruments also has several interesting *Power+Arrays* chips. These work well as drivers or predrivers for alternator steppers.

Other places to search for power electronic solutions do include *Maxim, Linear Technology, Siliconix, Motorola, Analog Devices, Allegro, SGS, Harris, and International Rectifier.*

The really big power semis (such as those used for locomotives) are made by supply houses that keep changing their names. For instance, that old Westinghouse operation is now called *Powerex*. Check out their *Applications and Technical Data Book* on their new *Intellimod* power modules.

Surplus Bargains

I recently discovered *Jim DuBois,* an incredibly great new source for lots of stepper motors, rotary tables, gantrys, drivers, precision stages, and such. Apparently Jim visits the failing New England aerospace firms, scooping up these gems when and as found.

An example: a complete X-Y table including steppers for around $100.00. A tiny fraction of the initial cost. Jim has a free flyer available on request.

Needless to say, you should also be on a first paw basis with your local junkyard dog. Share a bowl of Purina every now and then. Or maybe even a rawhide chew.

And tune yourself into both the local and statewide auction scene.

My favorite older surplus source for big mutha iron is *C & H Sales*. AC and DC motors, steppers, hydraulics, pneumatics, and the bits and pieces needed to put it all together. Most at very good prices.

Other sources for the heavy stuff do include *Burden's Surplus Center* and *Northern Hydraulics*.

Two other lighter favorites are *Fair Radio Sales* for military electronics, and *American Science & Surplus* for lots of oddball smaller items.

Rounding out the surplus scene is *Edmund Scientific, Herbach & Rademan, Surplus Traders, Radio Research,* and the rather pricey *AST Servo Sales.*

Much more on surplus sources in NUTS06.PDF on *GEnie* PSRT.

RESOURCE BIN

Grainger and Galco

The most obvious source for nearly anything electrical is *W.W. Grainger* who has outlets in most larger cities. Grainger is especially big on electric motors and pumps. Plus a stunning variety of light bulbs and fixtures. A large catalog is available.

For more info on lamp and lighting resources, see MUSE95.PDF.

The leading distributor of old line power electronics components is the little known supplier by the name of *Galco*. They do publish a free *Galco Gazette*, besides offering a fat catalog to potential volume customers.

Two other firms anyone in power electronics has to know about: *Small Parts* has everything your hardware store has never heard of. They sell in small quantities at reasonable prices. They are the greatest robotics source anytime ever. They'll also custom cut metal and plastics for you.

Good old *McMaster-Carr* is sort of a universal industrial hardware source. Their distinctive yellow catalogs can be found industry wide.

PCIM

The leading power electronics trade journal seems to be *PCIM*, formerly *Power Control and Intelligent Motion*. It is free to qualified subscribers. Their competitors are *Motion* and *Motion Control*. Also try *MotorTechniques* and *PowerTechniques*. But these two may have recently folded.

Meanwhile, Penton has just come up with the brand new and somewhat misnamed *Power Transmission Design* magazine. This one also centers itself on motion control subjects. Your two finest classic mechanical design trade journals, of course, remain *Machine Design* and *Design News*.

The IEEE has scads of publications that at least touch upon power. Their *IEEE Transactions on Power Electronics* is the biggie. But other Transactions to check are Automatic Control, Energy Conversion, the Industrial Electronics, Power Devices, Industry Aps, Robots & Automation, and Vehicular Tech.

Two other organizations to check are the *Electric Power Research Institute* and *SAE*. The car folks.

There's lots of other trade journals I have found rather useful for power electronics. *Appliance* and *Appliance Manufacturer*, ferinstance. Or, at the other end of the problem, *Sensors* or *Measurement & Control*.

I didn't get much of a chance to check those power electronics online resources by column deadline time. Mostly because magic sinewaves are so obsessive, I've been spending as much as 20 hours a day on them. Just barely squeaking by on column deadlines. But *Gopher* and the usual CD directory search services can lead you to useful sites.

As usual, you can find out anything about anything by using the *Dialog Information Service*. Found on *GEnie*, elsewhere on line, or by way of your local library. Your best info source for insider magazines is *Ulrichs*.

Home Power

Of the hobby or newsstand mags, *Home Power* is really coming on strong with homebrew power electronics. Particularly for alternate energy, solar & wind power, and especially home-built electric cars.

And, of course, you'll start seeing more and more higher power projects right here in our *Nuts & Volts*. Also be sure to check out *Electronics Now* and *Circuit Cellar*.

This Month's Contest

For our contest this month, just tell me about any new or unusual power electronics resource which I do not already know about. Especially tune me into any useful online sites.

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

Let's hear from you. **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*

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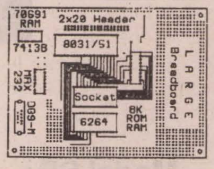
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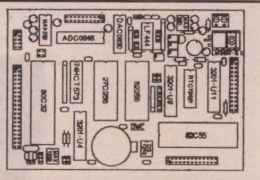
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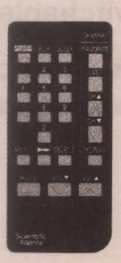
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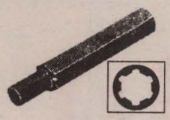


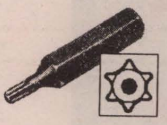


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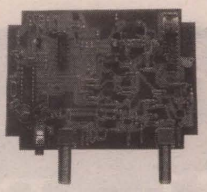
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Fun with the New Family Radio Service

Get set for the birth of a new type of radio service that has long been overdue for short-range communications.

by Gordon West

It will be on UHF FM, offer 14 low-power channels, micro-handheld-type equipment, and advanced signaling features similar to what ham radios have for group call, cell call, digital selective calling, and the common CTCSS for quiet channel monitoring.

So, where in the world did we come up with 14 channels that weren't being used on the UHF band for this proposed family radio service? To explain that, a little history about citizens band, the general mobile radio service, and the whole concept of staying in touch in-close is in order.

Back Then

Fifty years ago, a *Life Magazine* article entitled "Phone Me by Air," written by FCC Commissioner E.K. Jett, opened the imagination of millions of Americans to be able to stay in touch with each other over two-way radio phones, without having to take a licensing test. This would be a radio service available for all citizens of the United States, and would aptly be called "citizens band."

Two years later, the Federal Communications Commission opened up a several-MHz block of UHF frequencies near 460 MHz for a Class A citizens band.

This writer was issued one of those early 11W call sign authorizations, and got on the air on UHF CB using a Vocaline FM transceiver where frequency tuning was accomplished by squeezing or separating two parallel capacitive plates close together or far apart. By pushing and tugging on the plates with a non-metallic instrument, you might be able to find someone else to communicate with.

As envisioned, the Class A citizens band would be for non-superfluous communication — in other words, radio communications to serve a need. It was not intended to be a yak-yak band or a ham radio band.

Soon after little excitement, the frequencies were reassigned to the business radio band needs, and ultimately scaled down to the present eight pairs of UHF frequencies — eight for base stations and mobile talk-around, and eight channels for mobile uplink to repeaters.

The new name of the original Class A citizens band was general mobile radio service. And just like Class A citizens band, its start-up was relatively slow and soon became a quasi-business band where companies could set-up a repeater and dispatch their trucks over a large community.

As the UHF CB radio band began to grow with business-type users, as well as family members wishing to stay in touch with their spouses, the FCC came out with Class D citizens band in 1957. This was located down on 27 MHz where the FCC miscalculated the problem and the hobby associated with skywaves.

For the next 10 years, Class A GMRS UHF CB would grow slowly in an orderly fashion, and Class D 27 MHz CB began to become a "cult radio system," and in 1975 soon became the most important radio to have in your vehicle to stay in touch with everyone else around you to find out where "smokie" was and to find out about which gas station still had fuel left.

The frequencies were so full by over 30 million operators that the Federal Communications Commission expanded the band from 23 channels to 40 channels. The volume of operators coming up on

Class D citizens band was so overwhelming in numbers that the Federal Communications Commission finally abandoned formal licensing, tried self-licensing, and most recently have given up altogether in monitoring the 40 channels for rule violators transmitting beyond what is spelled out in Part 95, Subpart D. Class D citizens band still continues to be a popular radio service for anyone wishing to stay in touch with anyone else, and public service organizations like REACT still continue to do their best in guarding CB Channel 9 for emergencies and traveler's aid assistance.

A Class D CB transceiver can provide hours of enjoyment while motoring from one part of the country to the other. It's also good for safety because of the large number of mobile monitoring enthusiasts staying in touch on the band.

Over on the UHF GMRS channels, the service continued to steadily grow in a disciplined UHF repeater band where licensing was a precise requirement. Eight channels for mobile and eight additional pair channels for base and mobile are available:

Designator	Base and Mobile Freq. MHz	Mobile Freq. MHz
550	462.550	467.550
575	462.575	467.575
600	462.600	467.600
625 (Blk dot)	462.625	467.625
650	462.650	467.650
675 (Orange dot, REACT traveler's aid)	462.675	467.675
700	462.700	467.700
725	462.725	467.725

Repeater stations in the GMRS dramatically improve the range between mobile and portable units, and between mobile/portable units and their control station. The repeater receives on the upper frequency, and simultaneously transmits on the lower frequency. The frequency separation is 5 MHz.

The Federal Communications Commission would usually assign only one or two channel pairs to a GMRS licensee. As of December 31, 1993, simplex will be allowed only on the 462 MHz channels to prevent the accidental triggering of another licensee's repeater station. The FCC also redefined the family use aspect of GMRS, and no longer will routinely grant business radio users GMRS channels. Their 1989 decision now allows for only individual persons to be eligible for a new GMRS license; however, business communications between licensed individuals is permitted.

REACT also uses GMRS to stay in touch with other monitoring stations, and also give out traffic and weather information. Their guard of UHF GMRS Channel "675" provides motorists with GMRS equipment a quick way to call REACT in an emergency or for traveler's assistance. For more information about REACT, contact REACT International, 242 Cleveland, Wichita, KS 67214; (316) 263-2100.

Getting a license on GMRS requires FCC Form 574, and plenty of patience. One of the biggest organizers of the proper use of GMRS and how to get a license is the Personal Radio Steering Group (PRSG), P.O. Box 2851, Ann Arbor, MI 48106. This is an all-volunteer, not-for-profit corporation created in 1980 by licensees in GMRS to provide services to, and to service and advocate for, the GMRS personal-use community. They offer a $30.00 a year newsletter that is excellent for those contemplating obtaining a license and a GMRS repeater system.

A couple of years ago, the Federal Communications Commission opened up seven additional GMRS frequencies for licensed users. These are called interstitial channels, and are located in between assigned GMRS base/mobile input channels:

Channel 1	462.5625
Channel 2	462.5875
Channel 3	462.6125
Channel 4	462.6375
Channel 5	462.6625
Channel 6	462.6875
Channel 7	462.7125

FCC Rule 95.29(2)(f) indicates that a mobile station or a small base station may operate simplex over these interstitial channels, only for voice, and with a power output no more than fives watts effective radiated power.

But to gain access to these low-power interstitial channels, you needed to first obtain a regular GMRS

New Family Radio Service

license. What if you just wanted low-power interstitial use without a full-fledged system — like why go through all the licensing for this type of operation?

That was a question raised by many manufacturers who were coming out with low-power interstitial channel transceivers.

Family Radio Service Proposed

Bob Miller AA5FL, an active amateur radio operator and personal radio proponent, suggested a family radio service based on Part 95 personal radio service rules, made up of the seven existing interstitial channels, but also the other seven interstitial channels on the up side of the frequency assignments for GMRS:

Channel 8	467.5625
Channel 9	467.5875
Channel 10	467.6125
Channel 11	467.6375
Channel 12	467.6625
Channel 13	467.6875
Channel 14	467.7125

Comments from Tandy Corporation also expressed that public interest might be well served by permitting family radio service users to access GMRS emergency and traveler's aid frequency 462.675/467.675. This would lead to a 15-channel radio — 14 channels for interstitial low-power use, and one additional channel for emergency and traveler's aid repeater use.

In August of this year, the Federal Communications Commission issued a Notice of Proposed Rulemaking with some very positive comments like the following . . .

"We (FCC) believe that this service would provide most small groups, such as family, friends, and associates, with good quality voice communications over a range of a few city blocks . . . useful to hunters, campers, hikers, bicyclists . . . many millions of small groups around the country . . . line-of-sight propagation characteristic of frequencies in the UHF domain . . ."

Family radio service equipment would need to adhere to tight technical standards. FM would be the type of modulation with authorized bandwidths less than 12.5 KHz. Maximum power output would be one-half watt, and the antenna will be an integral part of the transmitter precluding a family radio service operator setting up a base station with a huge beam antenna. Not allowed as the FCC envisions this new service.

Handheld transceivers will probably be less than $100.00, and could contain such exciting features as digital selective calling, paging, page alert, scanning, group call, all call, and any other type of acceptable tone signaling system. CTCSS would allow subaudible EIA-sanctioned tones to keep one's receiver absolutely quiet until the same tone is received by another unit.

There was some concern among GMRS users that these low-power handhelds could interfere with their transmission or reception range on legitimate repeater channels. These frequencies are interstitial to authorized GMRS repeater channels, but at the one-half watt output level and only small antennas affixed to the unit, experts feel that these 14 frequencies can co-exist between the presently assigned GMRS channels. The little half-watt handhelds would be no match for causing interference to 50-watt signals on either side!

But don't be surprised as to how far you might be able to talk on one-half watt on UHF. Two hikers on two mountain tops could communicate up to 50 or 70 miles away. Out on a lake, three to five mile communications are indeed possible. In downtown areas, UHF signals become highly reflective, and you could achieve communication range over 5 to 10 blocks in just the right position.

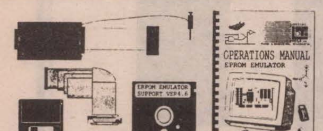
The rules still aren't clear on licensing, call signs, and exactly who can use it and who cannot. The Federal Communications Commission is right now studying the closing comments.

Bob Miller of Radio Shack envisions a huge need for short-range personal communications. He sees community watch programs on FRS, kids staying in touch with their parents in a shopping mall on FRS, FRS for emergencies, FRS for traveler's assistance, and family radio service equipment that will certainly talk to others with the same type of equipment to help out in an important or emergency situation.

If you have a scanner, start tuning the presently authorized interstitial frequencies now and see what you hear. Get set for the family radio service to soon become a very popular reality over the UHF airwaves. One-half watt will go a lot further than you think on UHF! **NV**

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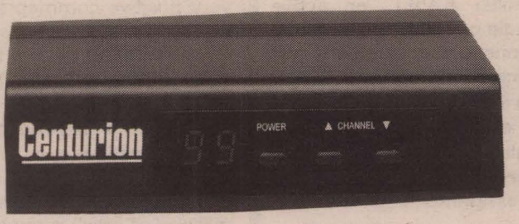
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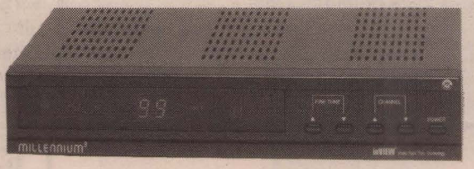
NOVAVISION

Watch one channel and record another any quantity **$199**



MILLENNIUM

Configure the various option packages to suit your needs 10-lot: **$62**



Panasonic TZPC 145 Converter
SA 8511-300 Converter

Units sold with wireless remote control & batteries
Features include: parental control (Panasonic only), last channel recall, favorite channel memory, sleep timer, channel 2 or 3 available.
In quantities of 10 or more, **$65**

Also: Panasonic TZ - PC 175 Series Converter w/volume. Topcases for Panasonic, SA and Jerrold (all models) also available. Call for pricing and availability.

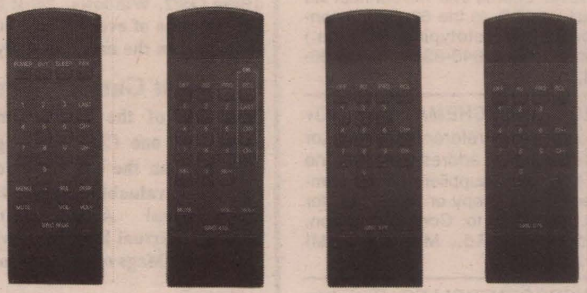


Panasonic TZPC 145 $ 65
channel 2 or 3; 10-lot prices

SA 8511 channel 3 8-lot: $ 65



Quality SA-Compatible Remotes



Also available: Tocom, Hamlin, Pioneer, and Panasonic compatibles; all prices quoted in this ad are:

10-lot prices

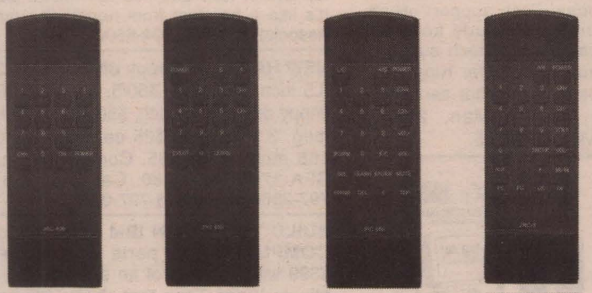
SRC 8600A
Operates 8600 on-screen programming converters
$6.25

SRC 475A (w/volume)
Operates 8540 & 8590 series volume-control converters
$6.25

SRC 175A
Operates 8500-8590 series non-volume converters
$5.75

SRC 075A
Operates all beige 8500 series converters
$5.75

Full Line of Jerrold-Compatibles



JRC 400A
Operates Jerrold DRX 400 series converters
$5.75

JRC 450A
Operates Jerrold DRZ 450 series converters
$5.75

JRC 550A (w/volume)
Operates DP, DPBB, DPV, DQN 5&7, Starcom VI, & DL4 series converters
$5.75

ZRC 3 (Zenith)
Operates all Zenith PM, PZ, ST series
$6.00

Dozens of other items in stock!

Jerrold- & SA-compatible topcases with lenses	from	$3.25
Torx Bits & Drivers (all brands)	from	3.95
Capacitors (every voltage) at 1000-lot prices	from	.06

Call for quantity discounts!

Kester Solder 44 Coresize	from	$8.45/roll
Jumper cables (1, 3 & 6 ft.)	from	.60
Jerrold- & SA-compatible bezels & lenses	from	.95

Call for your free catalog! **NO DESCRAMBLER SALES!**

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Call Toll-Free 8am-6pm PST 800-644-6682

Novaplex, Inc. 8818 Bradley Ave, Sun Valley CA 91352
FAX: 818/504-6522 COD, MasterCard, Visa, Credit Terms

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Write in 102 on Reader Service Card.

An Exclusive Reception

A sneak preview featuring the Novaplex 1996 product line...

Presenting *NovaLink*—the new interactive platform for the Novavision converter!

CES Winter Show, Las Vegas Nevada
Saturday, January 6, 1996, from 2 p.m. to 5 p.m.
Aladdin Hotel, Imperial Room #6

WINTERCES® 1996

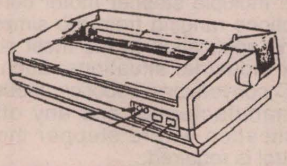
from your friends at NOVAPLEX

Must R.S.V.P. to attend. Please call for details and guest list reservations.
Private VIP party to follow—admission by invitation only.
For details contact Novaplex Marketing Department at 800-644-6682.

Write in 101 on Reader Service Card.

#50 COMPUTER HARDWARE *cont.*

DOS 6/6.1 $25/15, Windows for Workgroups $25. ACT for Windows best contact management software $45. OS/2 $20. COREL SCSI $45. Hard drives from 65 meg to 9 gigabytes SCSI and IDEs. Cordless mouse $30. CCI, 714-778-0450.



QUME PRINTERS 10 x 135, daisy wheel LQ serial interface, new in box, wide carriage. W/cable + cartridge $25/ea. Take all 50+ pcs. offer. Atco, Corp. 617-933-9909, fax 617-938-1299.

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DEC 486DX33PC pizza box workstation DEC bare bones closeout special case, PS, 2 meg VRAM SVGA, 2S, 1P, & MP, IDE, H&F cont. Token Ring, ext. SCSI-2 P. You supply: CPU 486 SX to DX2-66, monitor mag 15" or equal, 1 or 4 meg SIMMs mem., 1.44M FD, notebook HD, keyboard, mouse, for a $4,999.95 system. New bulk packed with manual, cables & software. Size: 15" x 15" x 2.5" use as a portable or workstation. Over 300 sold. Only $149, 20" SVGA 1280x1024 .31dp, WS monitors for above systems $349. Motherboards & parts available to complete fantastic systems! OEM accounts welcome. Our 31st year. Call/faxback catalog 508-532-2323. BNF, 119 Foster St., Peabody, MA 01960, 508-532-2323.

COMPLETE SINGLEBOARD COMPUTER WITH BACKPLANE. Made in the USA, Intel 386DX-33 CPU, max. 32MB RAM, IDE & floppy controllers on-board, two serial ports, one parallel port. 8-slot ISA passive backplane with keyboard and power connectors is **INCLUDED**. These are new, excess inventory, limited quantity. $159 with 0K RAM, $215 with 2MB installed, etc. **10% off for ten or more**. Going fast. 1-800-505-0019.

TOWER CASES! Baby AT desk top cases! New mid tower with 3 5-1/4 bays, 2 3-1/2 inch bays digital display 200 watt $40, $375/10 black mini tower with 145/200 watt supplies $27/$33 baby AT case 230 watt only $35 each! Call Under The Wire Electronics, 818-797-2569 or FAX, 818-797-0384. Quantity shipping discounts available!

DATA ACQUISITION hardware is wanted. Inexpensive for T/C type (K) & Transducers (mA & mV), to drive solenoids & relays. With books & software (if possible). (For senior project) Angel, 209-237-6248.

HP 85 computer with plug-in modules. HP 86. HP 7041A plotter. All work. What are they worth? Make any offer. Evenings. Atlanta, GA. 770-424-9962, FAX 770-427-3807.

HARD DISK Technical reference on Disk. This disk is a complete technical reference for all major hard drives & controllers. Provides all the info and parameters you need to install, set up, and troubleshoot most mfg. hard drives and controllers. If you work on IBM compatible computers, this is a must have. To receive yours, send check or money order for $7.95 to: Stewart & Associates, 244 Mid Rivers Centre, St. Peters, MO 63376.

386DX COMPUTER: includes VGA color monitor, 4MB RAM, 80MB HD, 1.44 & 1.2 FD. 101 keyboard, I/O ports complete system warranted, only $399. IBM XT with color monitor $125, 286 computer with color monitor from $175. Many other computers, printers and PC parts to choose from, great prices and service. All products warranted. Call: **ADVANCED PRODUCTS, 813-935-3614.**

BUYING & Selling IBM computer parts. Repairing most IBM compatibles, C-64, Timex, and other classic machines. SASE for info. Computer Classics, RT-1, Box 117, Cabool, MO 65689. 417-469-4571. FAX 417-467-4571.

ETHERNET/IEEE 802.3 FX-4000 Quad port fiber optic transceivers by Canary. New in original cartons. $195 ea. $419 value). Direct fiber optic link between up to 8 Ethernet stations. 206-881-2797.

COMPUTER PARTS at discount Mini Tower $33, IDE w/IO $11, 486DX2-80 MB $175, Keyboard $15, 1.44 Floppy $29, 14,400 Modem $55 486SLC-33 MB w/CPU $64, 420 HD $149, MultiMedia Kit $175, Call for other items motherboards, memory, hard drives, CD ROMs. MasterCard & Visa, accepted. Menifee Computer 909-679-2142.

16-BIT MEMORY 0K installed) NEW! Holds up to 3 meg. of DRAM (41256 chips). Add memory @ $25/meg. memory card that uses SIMMs also available up to 12 meg. Call UTWE, 818-797-2569 for details.

HP 7475A plotters $150 ea., PS2: HD controllers, memory adapter cards, FD adapters, 286 & 386 systems (also: Tektronic CAD System). Very reasonable. Mike's PC Repair. Kansas City, MO. 816-353-3605.

THE RF CONNECTION

The RF Connection
213 North Frederick Ave.
Suite 11NV
Gaithersburg, MD USA
20877

Complete Selection of MIL-Spec Coax, RF Connectors and Relays

UG-21B/U N Male for RG-213/214 ..... $5.00
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N Connectors for 9913/Flexi4XL/9096

UG-21B/9913.....$5.75 **Pins Only**..... $1.50
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Amphenol 83-1SP-1050 PL-259 ..... $0.90
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UG-175/U Reducer RG-58/58A. .25 or 5/$1.00
J&I Silver Teflon PL-259 MIL-Spec ..... $1.25 or 10/$10.00

MIL-Spec Coax Available (Teflon, PVC 11A) Certified CQ Flexi 4XL811A (Flexible 9913)

New Product: International's 9096-2A Low Loss RG-8 Size, Stranded Center Conductor Same Specs As 9913..... .70/ft or $59.00/100ft

Also New: RG-8X Clear w/UV Jacket 98% Cu **Intro Price** $14.00/100ft

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8 Pin Mike Female..... $2.00
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13 Pin DIN for Kenwood..... $2.75
8 Pin DIN for Icom..... $1.00
8 Pin DIN for Kenwood..... $1.50

Prices Do Not Include Shipping

Orders 800/783-2666
Info 301/840-5477
FAX 301/869-3680

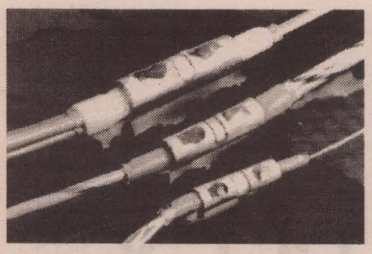
Write in 100 on Reader Service Card.

New Product News

Our readers are always looking for new and interesting electronic items. Showcase your NEW PRODUCTS here to help stimulate your product's success. Submit all news releases, product information, and/or photos to:

NUTS & VOLTS MAGAZINE
NEW PRODUCT EDITOR,
430 PRINCELAND CT., CORONA, CA 91719

SOLDER SPLICE



A new solder splice that connects, insulates, and seals multiple wires in one step using a standard heat gun is introduced by Nelco Products, Inc.

Nelco solder splices are a fast, one-step system for soldering, insulating, and sealing multiple wires using a standard heat gun. Simple to use, just insert the wires (which will lock in place by internal wire tabs) and apply heat to melt the solder disk and connect the wires. The thermoplastic dams will melt and flow to create a moisture-tight seal and the Kynar® sleeve will shrink.

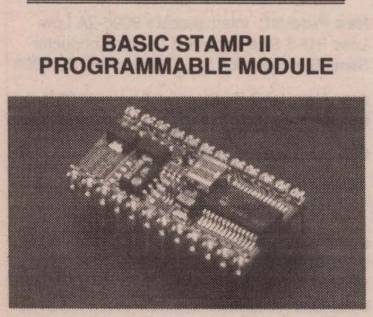
Eliminating the need for crimp tools and heat shrinkable tubing, Nelco solder splices provide a fast way to splice or "pigtail" wires. Available in three color-coded sizes: red for 22-14 AWG, blue for 20-10 AWG, and yellow for 16-8 AWG; each will reliably splice and environmentally seal several wires within a size range.

Nelco solder splices are priced according to size and quantity.

For more information, contact:

NELCO PRODUCTS, INC.
77 ACCORD PARK DR., DEPT. NV
NORWELL, MA 02061
1-800-346-3526 617-871-3115
FAX: 617-871-3117

BASIC STAMP II PROGRAMMABLE MODULE



The Stamp II is a complete BASIC-programmable computer in a 24-pin DIP package. It has 16 I/O lines, 2K of non-volatile memory, and a clock speed of 20 MHz.

The Stamp II's I/O lines are used to connect the Stamp to the outside world. Most I/O functions are digital, and include serial communications, pulse measurement, button input, transition counting, etc. A few functions are pseudo-analog, such as resistance measurement and PWM. The Stamp II even has functions for transmitting X-10 powerline control signals, as well as for generating accurate audio frequencies (including DTMF tones for telephone dialing).

An eight-pin EEPROM provides 2K of non-volatile memory. This memory is used for both program and data storage. Each BASIC instruction takes 3-4 bytes of space, so the memory can store about 600 program instructions (assuming no space is taken for non-volatile data storage).

A fast operating speed of 20 MHz yields many benefits, including fast serial I/O (up to 50K baud) and accurate pulse measurements (2 µs resolution). It also results in fast program execution (about 6,000 instructions per second).

All of these features are easy to access, even for people with little experience. This is due to the Stamp II's simple "PBASIC" language. The language includes all familiar BASIC instructions, such as FOR...NEXT, IF...THEN, and GOTO, as well as special instructions for the I/O functions mentioned above.

Stamp II modules are available for $49.00 in single quantities.

For more information, contact:

PARALLAX, INC.
3805 Atherton Rd., #102
DEPT. NV
ROCKLIN, CA 95765
916-624-8333
FAX: 916-624-8003
BBS: 916-624-7101
E-MAIL:
info@parallaxinc.com

NEW CABLE ASSEMBLIES

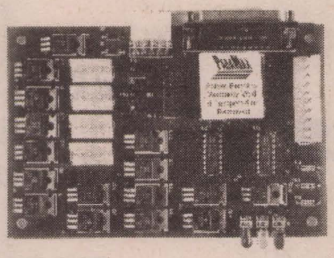


RF Industries introduces a new line of high-quality cost-effective cable assemblies. Currently, both standard and special cable assemblies are being produced using RG-142, double or single shielded RF-58 and RG-316. Cable assemblies can be constructed to any length.

For more information, contact:

RF INDUSTRIES, LTD.
7610 MIRAMAR RD., DEPT. NV
SAN DIEGO, CA 92126-4202
619-549-6340 FAX: 619-549-6345
1-800-233-1728

PC ADDRESSABLE STEPPER MOTOR CONTROLLER



ParaMax introduces the arrival of the JWP1X-1A, PC parallel printer port based addressable stepper motor controller with eight digital inputs. The ParaMax stepper motor controller is the answer to a problem that has plagued most home and industrial PC users with the desire to control or operate stepper motors via a PC system. Currently, all of the PC serial or parallel based stepper motor controllers are limited to two to four stepper motors per PC port and generally do not allow for any inputs.

The ParaMax stepper motor controller supports up to four stepper motors per controller with eight digital inputs. Utilizing any standard PC system with a parallel printer port allows you to simultaneously connect and control up to 256 ParaMax stepper motor controllers per each parallel printer port. Each stepper motor controller is given a unique user selectable address (0..255) which allows the PC to communicate with any given stepper motor controller through a single PC parallel printer port.

The ParaMax stepper motor controller is capable of controlling virtually any type of stepper motor that contains five, six, and eight wires, from around 5V to 12V at up to 2 amps per motor winding.

A major advantage of the ParaMax stepper motor controller is the ability to determine the drive method for the stepper motors currently attached to the controller. This gives you the ability to connect and operate stepper motors when not much is known about the operational specifications of the stepper motors. This feature allows you to purchase your stepper motors at a greatly reduced cost from the vast surplus stepper motor market. Usually, when one buys a surplus stepper motor, no data or operational specifications are available other than voltage, current, and degree per step, which would normally pose a problem due to the fact that you would not have access to the wiring configuration. With the ParaMax stepper motor controller, that missing information is no longer required. All that is needed to know, is which wire(s) are common, the rest of the wires can be placed into any order. The provided utility software will allow you to figure out the appropriate drive method for your current wiring configuration.

Inputs are an important feature in any control or robotic function where feedback is necessary, the ParaMax stepper motor controller contains eight digital inputs which are TTL or CMOS compatible. These inputs can be tied to virtually any type of external device, such as A/D converters, switches, relays, and any variety of sensor apparatus. The data transfer rate for these inputs are as high as 500 KB per second on a standard parallel printer port, much faster data transfer rates can be obtained when utilizing a high-speed parallel printer port.

The software required to operate the ParaMax stepper motor controller is fairly simplistic and can be written in any language under any operating system available to a PC system. Included with the ParaMax stepper motor controller kit is a wide variety of utility software for both DOS and Windows along with libraries for C++, Pascal, Delphi, BASIC, and source code examples with application notes.

The ParaMax stepper motor controller is perfectly suited to perform multiple stepper motor control functions ranging from the simplest home application to the most complex industrial situations, such as CNC conversions, robotics, industrial manufacturing, and any other application where stepper motor control is required.

For additional information, contact:

PARAMAX
714-739-7156 FAX: 714-739-5669

AERONAUTICAL FREQUENCY DIRECTORY

The *Aeronautical Frequency Directory,* 420 page frequency directory covering high frequency, very high frequency, UHF 225-400 MHz military, 450 MHz-470 MHz, and 800-900 MHz frequencies are now available. An ideal reference for the scanner users and the professional monitor.

The community format lists frequencies by state, city, airport, service, license, airport code, call sign, frequencies, and comments. Included in this section are civilian and military airports with VHF and UHF frequencies with over 28,500 frequencies. Airport designators

have been expanded in this section.

Major air carrier business licenses have been included to provide a complete reference source for the aeronautical monitor.

FAA coverage includes separate center listings with both VHF and UHF frequencies, flight service stations, and enroute flight advisory service. ARINC coverage includes major VHF network map and 800 MHz airport channels and the new ACARS system.

Civil air patrol coverage updated to include new primary and secondary regional frequencies, and new VHF channels. Coverage of air-to-air refueling, includes a refueling track and anchor map and the new air force command control network frequencies. Also fleet area control and surveillance facilities frequencies are included. International aircraft markings are shown to assist in plane identification.

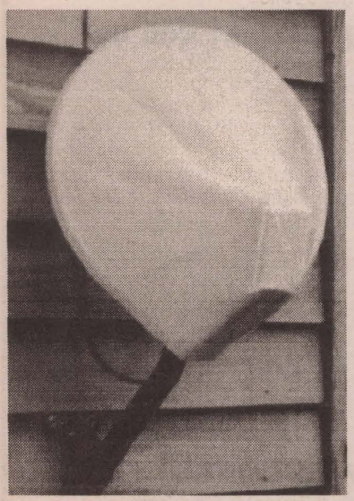
High-frequency coverage has been expanded with international enroute frequencies and long distance operational control frequencies and now includes rainbow radio.

The retail price is $21.95 plus $4.05 shipping and handling.

For additional information, contact:

OFFICIAL SCANNER GUIDE
P.O. BOX 712, DEPT. NV
LONDONDERRY, NH 03053
603-432-2615 FAX: 603-425-2253

SAT-COVER™



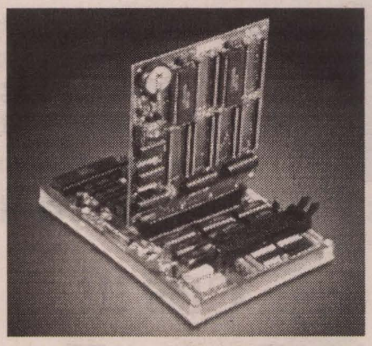
SAT-COVER™, who has been making satellite dish covers for 11 years, introduces a new cover for the 18-inch DSS dish with a patent pending. The "Mouse" cover embodies the entire dish and collection of snow and ice on the dish surface and LNB which can otherwise block signals and cause freeze frames or loss of picture. The covers also protect against dust and other debris that may get into the electronics. For people in restricted areas, SAT-COVER can be used as a disguise to cover the dish.

The drawstring back provides easy installation and removal of the cover. The covers are rot- and mildew-resistant and come in a wide range of colors.

For more information, contact:

SAT-COVER™
1-800-642-2907

MICRO UNIVERSAL ROM/RAM EMULATION SYSTEM



A new PC based, low-cost, high-capacity, high-speed ROM emulator from ABI aids development of ROM based programs and embedded solutions such as control code for commercial and consumer applications. The emulator is used during development of programs before the code is committed to ROM or CD. The combination of speed and capacity make the µU-REM (Micro Universal ROM/RAM Emulation) System well suited for these applications.

The µU-REM includes software, an eight-bit ISA interface card (XT or better), a desktop unit with portable plug-in memory card, and adapters for 8- and 16-bit ROM devices. The software provides instantaneous viewing and editing of any address range or individual bytes, modification and monitoring of I/O lines, verification of data during downloads and uploads, and automatic splitting of 16/32/64 bit files. µU-REM supports 8- and 16-bit data widths (2716, 27C512, 27C800, 27C4096 . . .) with capacity to 8 MBytes.

Two memory card types are available: The basic card comes with 256 KBytes of RAM and can be expanded in 256 KByte increments to 2 MBytes, the higher capacity card comes with 1 MBytes of RAM and can be expanded in 1 MByte increments to 8 MBytes. The µU-REM can be configured for demanding high-end applications, as well as smaller emulation requirements.

The major differentiators of the µU-REM are capacity, download time, and expendability. It takes less than two seconds to download a 1 MByte program through a dedicated interface card rather than the slower printer ports used by other low-cost emulators. When the need for larger emulation space arises, simply add additional memory to the existing memory card, an additional memory card, or combine multiple units.

The µU-REM is aimed at a broad range of ROM-based programs and data including video games, BIOS, printer drivers, postscript interpreters, character font libraries, and other ROM-based drivers. The µU-REM is inexpensive enough for computer engineering labs and student projects.

The base unit's introductory price is $195.00 with 256 KBytes and $35.00 per 256 KByte increment to 2 MBytes.

The higher capacity unit is priced at $495.00 (introductory) with 1 MBytes and $300.00 per 1 MByte increment to a maximum of 8 MBytes.

Introductory prices range from $195.00 for 256 KBytes to $2,595.00 for 8 MBytes; additional memory cards and target adapters are also currently available.

µU-REM carries a 30-day money-back guarantee and a full year limited warranty.

For more information, contact:

ABI
233 E. WEDDELL DR., UNIT G
DEPT. NV
SUNNYVALE, CA 94089
408-946-8710
FAX: 408-743-3323
E-MAIL: abiusa@aol.com

LOW-COST DMM



Fieldpiece Instruments has introduced the LT6 handheld digital multimeter. This unique meter measures volts (AC & DC), ohms, amps (AC & DC); indicates continuity with a beep; tests power semiconductors for catastrophic failure.

This meter is different from other low-cost meters because it works with all the accessory heads and other accessories offered by Fieldpiece for their Heavy Duty line of meters. The optional deluxe test leads (model ADL2) fit the LT6. Use these leads to connect the accessory heads to the meter. Currently available accessory heads include converters for AC current, DC micro-amps, relative humidity, and dual temperature.

The meter has both 200 mVAC and 200 mVDC ranges. This means that for any Fieldpiece accessory the meter can display parameters to one-tenth resolution. This is especially important when trying to measure a value low in the scale, such as 5 amps using an AC current clamp accessory. While still within the accuracy specification, the LT6 will display between 4.7 to 5.3 for an actual of 5 amps. Meters without an mVAC range will display from .003 to .007. The user must multiply by 1,000 to get a number as low as 3 and as high as 7 for an actual of 5.

The case is made out of tough ABS plastic. To further improve ruggedness, a rubber holster is available (model ARB1LT). The model LT6 is priced at $39.00.

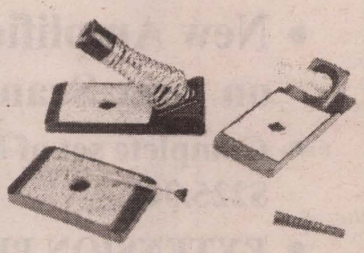
The LT6 is also available as an LT6VA which includes a 300A current clamp, deluxe test leads, all in a vinyl carrying case. The list price is $69.00.

The meter measures volts up to 600V AC and DC; amps up to 2A AC and DC, and up to 300A AC using the optional current clamp; ohms up to 20 megohms.

For more information, contact:

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

SOLDERING IRON STANDS



A line of soldering iron stands that are designed for users with occasional to full-production soldering requirements is available from M.M. Newman Corporation.

Antex Soldering Iron Stands are made from noncharring thermoset plastic and each have a tray with a sponge for tip wiping and a center hole to collect excess dross. The model SP-1 is a simple sponge tray and the model ST-4 has a spring holder that accepts all miniature soldering irons and rapidly dissipates heat.

For electronic assembly operations, the Antex ST-5 Soldering Iron Stand features a spring holder with two bezels that fit most popular production soldering irons and has a heavy metal base for added stability. This holder design eliminates contact between the tip and spring to reduce heat loss and conforms to DOD-STD-2000-1B.

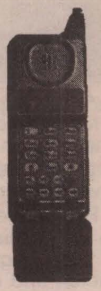
Antex Soldering Iron Stands are priced according to model.

For more information, contact:

M.M. NEWMAN CORPORATION
24 TIOGA WAY/P.O. BOX 615
DEPT. NV
MARBLEHEAD, MA 01945
617-631-7100 FAX: 617-631-8887



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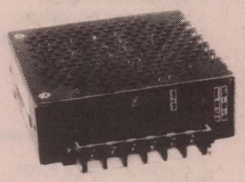
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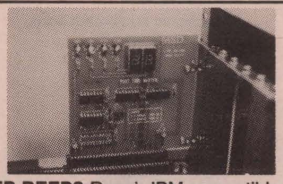
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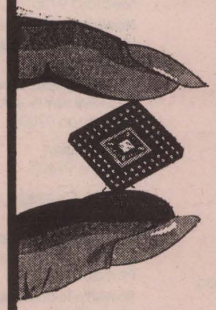
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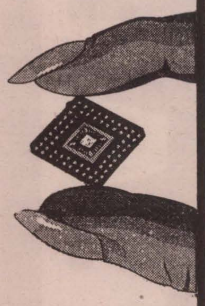
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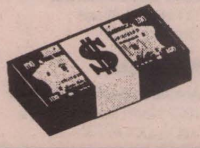


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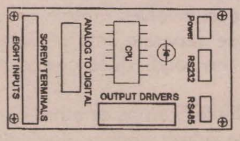
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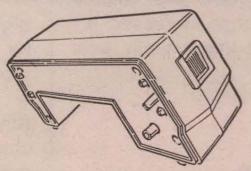
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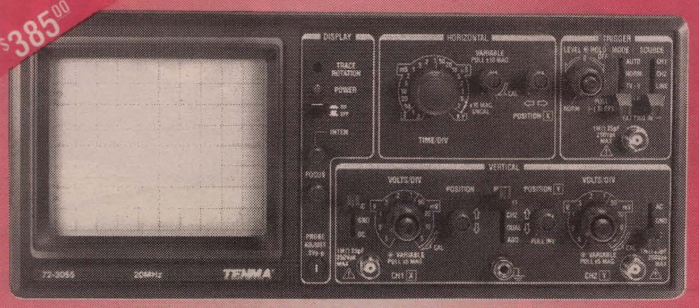


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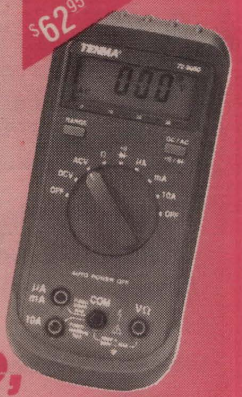
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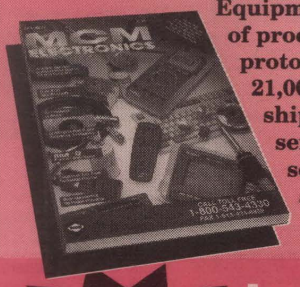


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Stamp Applications:

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

by Scott Edwards

The Stamp is so easy to use and program that I sometimes forget what a complex little computer it is. Fortunately, I have you, the readers of this column, to remind me. This month, I'll present an assortment of bug fixes, explanations, hints, and tips based on questions and comments I've received by E-Mail.

Exterminating Common Bugs with Little-Known Stamp Info

Miscellaneous Tips and Techniques

Programs without END

In Figure 1, an LED is wired so that it lights when a low (0) appears on pin 0. Suppose you wrote a program that consisted of just the following line:

```
LOW 0        ' Light the LED.
```

What would happen? When the Stamp first turned on, all pins would be in input mode, and the LED would be dark. A fraction of a second later, the LOW instruction would execute, changing pin 0 to output/low. The LED would light.

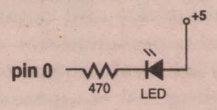


Figure 1. An implicit END instruction makes the LED blink.

After that, there are no more instructions for the Stamp to execute. With its work complete, the Stamp does the only sensible thing; it executes an END instruction and goes to sleep. During sleep, the LED stays on, but every 2.3 seconds it blinks off for a fraction of a second.

The Stamp resets every 2.3 seconds during sleep, and its pins go into input mode during reset. This reset takes about 18 milliseconds — long enough for you to see a visible blink in the LED.

This behavior can affect other devices as well. Suppose the Stamp were connected to a serial device. Every 2.3 seconds it would lose control of the pin being used for output. The glitch could cause "garbage characters" to appear at the serial receiver.

Problems caused by the implicit END instruction are rare in finished programs, since most are loops. But during casual testing it's quite common to type in a few lines to see what happens. If you want to avoid letting the Stamp execute that unwritten END, try this:

```
        LOW 0        ' Light the LED.
stop:   GOTO stop    ' Freeze here.
```

Mighty Frustratin' Power Dangers

While we're on the subject of resets, let's talk about unwanted resets caused by an inadequate power supply.

The Stamp and Counterfeit both come with nine-volt battery clips. A built-in voltage regulator drops this input voltage to a steady five-volt supply for the rest of the electronics.

The regulators are quite efficient. They only require an input of slightly over 5 volts in order to maintain regulated 5 volts out. However, if the input voltage falls below their *dropout voltage* — the voltage at which they can no longer regulate the output — all bets are off.

This can happen more often than you might think, even with a battery that measures well over 5 volts. Although a battery is shown as a single component in schematic diagrams, it acts like two components: a voltage source and a series resistance. As the battery wears out, the voltage decreases and the series resistance increases. It's the increased series resistance that usually gets you.

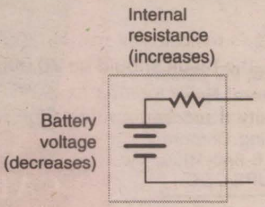


Figure 2. As a battery wears out, its internal resistance increases.

When a nine-volt battery is down to 7 volts, it's still well above the voltage regulator's dropout voltage, which may be as low as 5.1 volts. But the battery's internal resistance has increased to, say, 50 ohms. If your circuit draws a total of 50 mA, the voltage drop across that internal resistance becomes 0.05 x 50 = 2.5 volts. (Ohm's Law — current in amperes times resistance = voltage.) The battery delivers just 7 — 2.5 = 4.5 volts to the regulator's input. The result is that the supply is no longer in regulation, and a reset can occur.

I saw a particularly acute example of this in a recent on-line help message. A user had connected a radio-control servo (positioning motor with built-in electronics) to the Stamp, and was powering both from the same four-pack of AA penlight cells. The circuit was totally erratic. The cause was fairly obvious — whenever the batteries (only 6 volts total) tried to deliver large currents to move the servos, the large voltage drop across their internal resistance caused a brownout to the Stamp, which re-set itself.

This problem is more severe with newer Stamps, which have a "brownout reset" IC on board. These reset the processor any time the regulated supply falls below 4 volts. Older Stamps had no such circuit, and could continue to operate at 2.5 volts or less. This sometimes caused problems, because different parts of the circuit shut down at different voltages, causing a kind of temporary insanity. (The Counterfeit also has a brownout circuit, which kicks in at approximately 3.4 volts.)

Here are some hints for tracking and fixing power-supply related problems:

- If a circuit behaves erratically and you suspect that varying loads are to blame, try removing those loads and rerunning the program. If it works okay without the load, you need to beef up the power supply, or use a separate supply.
- Don't draw more than 50 mA from the Stamp's built-in five-volt supply, or 100 mA from the Counterfeit's supply.
- If your application involves motors or other high-current loads, use separate sets of batteries for the Stamp and the load. Just connect the grounds together.
- If you have multiple Stamps or other circuits running from a single power supply, don't daisy-chain the wiring; wire each module back to the power supply terminals separately.

Divide and Conquer

PBASIC can perform simple arithmetic on 16-bit positive integers. A 16-bit variable can range from 0 to 65535. What if your application involves calculations that generate numbers larger than 65535?

I recently answered an E-Mail help request that illustrates the problem and a way to solve it. Dan DiLuzio was building a pH meter, a device that measures the acidity or alkalinity of a solution on a scale of 0 to 14. He had a pH probe and some analog circuitry that converted the pH to a 0- to 5-volt output, where 0 volts represented a pH of 14 and 5 volts a pH of 0.

An LTC1298 analog-to-digital converter

```
' Program: RJ_DEMO.BS2 (Right-justified printing with Stamp 2)
' This program demonstrates how to print numbers on the LCD Serial
' Backpack with right justification. This means that the ones place
' is always in the same location on the screen regardless of the
' number of digits in the number. This program uses a Lookdown table
' as a function that returns the number of decimal digits in a given
' 16-bit value.

I           con     254     ' Instruction toggle command.
ClrLCD      con     1       ' Clear-LCD instruction.
prn_at      con     140     ' Display RAM, address 13 (128+12).
j           var     word    ' 16-bit counter variable.
pos         var     byte    ' Cursor position to print at.
numDig      var     nib     ' Number of digits of number.
N96N        con     $4054   ' 9600 baud, inverted, no parity.

low 0                       ' Make the serial output low.
pause 1000                  ' Let the LCD wake up.
serout 0,N96N,[I,ClrLCD,I]  ' Clear the LCD.
serout 0,N96N,["Number: "]  ' Print the fixed label.

' The loop below counts from 0 to 20,000 and displays the current count
' on the LCD Serial Backpack. The Lookdown table determines how many
' digits are in the current value of the count in order to position
' the printout aligned on the rightmost digit. It works by determining
' whether a given number is less than 10 (one digit); between 10 and 100
' (two digits), etc. The table is good for values from 0 to 65534.

Loop:
 for j = 0 to 20000                 ' Count to 20,000.
  lookdown j,< [0,10,100,1000,10000,65535],numDig       ' Get # of digits.
  pos = prn_at - numDig             ' Adjust the screen position.

  serout 0,N96N,[I,pos,I,DEC j,"  "] ' Print j at adjusted screen pos.
  pause 50                          ' Slow the count a little.
 next                               ' Keep going to 20,000.
goto Loop                           ' Do it again.
```

(ADC) (described in Stamp Applications No. 4, June '95) allowed the Stamp to read in the 0- to 5-volt signal as a 12-bit number from 0 to 4095. To convert this number to a pH reading, Dan needed to use the following formula:

pH = 14000 D — (ADC_result * 14000/4095)

This formula uses the number 14,000 to represent the full-scale reading of 14. Just moving the decimal point three places to the left (14.000) would scale the readings to real pH units. The trouble is that when the pH is 0 the ADC reads 4095, and the calculation ADC_result * 14000 equals 57,330,000. That's beyond PBASIC's maximum integer of 65,535.

Dan was starting to think that he'd have to abandon some of the precision offered by the 12-bit ADC, and content himself with readings of 0 to 14 or 0.0 to 14.0 at best. But I showed him how to chop the problem up into smaller pieces by factoring, preserve precision, *and* stay within the bounds of 16-bit math.

I started by factoring the constants 14,000 and 4095 into smaller integers. Since 4095 is close to 4096 (212) I cheated and changed it to the more convenient value. Here are the factors:

14,000 = 7*5*5*5*2*2*2*2
4096 = 2*2*2*2*2*2*2*2*2*2*2*2

I then rearranged Dan's formula into a series of smaller alternating multiplications and divisions. I eliminated cases in which the number would be multiplied by 2 then divided by 2, since these have no net effect. I wound up with:

ADC_result * 7 / 4 * 5 / 4 * 5 / 4 * 5 / 4

Trying this with the troublesome maximum value of 4095, I got an answer of 13,995 — within a fraction of a percent of the correct answer of 14,000. And no calculation exceeded PBASIC's limit. I passed this information to Dan, along with the suggestion that he use a correction factor or calibrate the analog circuitry to eliminate the small bias introduced by fudging 4095 to 4096 and by the lost fractions due to integer arithmetic. He reported back: problem solved!

Timing NOT to Set Your Watch By

On the BS1-series Stamps, you can generate or measure pulses with 10-microsecond (µS) resolution. On the BS2, pulse resolution is 2 µS. This fine timing precision leads some users to believe that the Stamps are also very accurate. They're not, and the discussion that follows should interest both Stamp users and folks who never quite grasped the distinction between *precision* and *accuracy*.

First, you must understand that all Stamp timing is referenced to an internal oscillator whose frequency is set by a ceramic resonator. Resonators are similar in properties to quartz crystals, but are built to withstand rough treatment like shock and vibration. The tradeoff is that a mediocre crystal's actual frequency is usually within ±0.005 percent [50 parts per million (ppm)] of its nominal or rated frequency, while a good ceramic resonator may be within ±1 percent.

Putting that into perspective, a clock controlled by a 50-ppm crystal might be off by four seconds a day; with a one percent resonator the error could be close to 15 *minutes* a day!

On the BS1, the nominal 4 MHz resonator can operate at 3.96 to 4.04 MHz. A BS2's 20-MHz resonator can range from 19.8 to 20.2 MHz. (These ranges are based on the hypothetical one percent tolerance; some resonators are as sloppy as three percent.)

If a BS1 is used to measure a 200-millisecond (ms) pulse, the result should be 20,000 units of 10 µS apiece. But if the resonator is off by one percent, the actual reading could range from 19,800 to 20,200.

This resulted in a Stamp user calling me for help. He was trying to use a BS1 to produce pulses that were measured by a BS2 in order to simulate his final application involving motor-speed measurement. The two Stamp clocks were not only off frequency, but may have been off in opposite directions (above and below nominal), resulting in an error of close to two percent, and hundreds of pulse-timing units.

He was shocked, having expected that the fine *precision* of the pulse commands (units of 10 and 2 µS) also meant high *accuracy*, with results within a few units of right on the money. Nope; accuracy can't be any better than the timing reference, which is only good to ±1 percent. Bear this in mind when designing any time-critical application.

Bowlegs, Brackets, and Bugs with the BS2

If you bought one of the early BS2s, you received the "preliminary documentation," a dump of just the essential information required to get started with the new Stamp. Because of some major improvements in PBASIC's structure, the BS2 dialect is not backwardly compatible with the BS1.

One change that's causing headaches for users who are accustomed to the BS1 is the new role of parentheses (like the ones surrounding this text). On the BS1, bowlegs enclose lists, such as data items for Serout, Lookup, Lookdown, and Sound. The BS1 does not support the use of parentheses to change the order of math and logic operations. The BS2 does.

As a result, Parallax had to find a new way to enclose lists of data items, which might include expressions enclosed in bowlegs, and it chose square brackets [like these].

The change is sufficiently subtle that I didn't notice it on first reading of the new docs, but the host software brought it to my attention several times when I wrote my first BS2 program! I'm hoping this explanation will help you remember when to use bowlegs and when to use brackets.

Here are more tips for BS2 users:

• The serial commands now require baud rate expressed in terms of microseconds - 20. To convert a desired baud rate, divide it into 1, multiply the result by 1 million and round off, then subtract 20. Try 9600 baud: 1/9600 = 104.167 x 10^{-6}. Multiply by a million and round off: 104. Finally, subtract 20: 104 - 20 = 84. That's your baud-rate timing. For other baud-mode options (expressed as hex numbers in the documentation), just add them to the calculated timing value. For example, to invert the serial output at 9600 baud, use $4000 + 84.

• If you're planning to use the new X-10 remote control command Xout, or the synchronous-serial instructions Shiftin and Shiftout, make sure to get the new application notes from Parallax. And get the whole notes, not just the source code. The accompanying text and illustrations are probably more important than the programs to really understanding how these new features work.

• Having trouble downloading programs to a BS2? The problem may be that the host software can't figure out which serial port the BS2 is connected to. You can specify the port when you boot the software by adding the switch /1 for com 1 or /2 for com 2. For example:

STAMP2 /1

launches the host program for com port 1.

• The new BS2 method of reading and writing the I/O pins seems to be puzzling some people. It's probably because you no longer have predefined variables called "pin0, pin1 . . . pin7." Under the new PBASIC, you have a pair of 16-bit variables called INS and OUTS which hold the input and output states of the pins.

To use the individual bits of these registers, you need to define bit variables, like so:

```
in_pin1 var INS.bit1 ' Pin 1 input.
```

Stamp Applications:

This may take some getting used to, but in the long run you'll appreciate the flexibility of the new approach.

• If you're using the BS2 to display data on the LCD Serial Backpack, there's a neat trick you should know. By using the new comparison feature of Lookdown and the decimal-digit function Dig, you can right-align a numeric display. See the listing for an example.

Back Issues of Stamp Applications

One of the biggest headaches associated with writing a monthly column is handling requests for reprints of previous installments. On one hand, it's flattering that readers who see a sample of the column want more. On the other, more practical hand, it's brutally expensive to make and mail paper copies.

Here's an information-age alternative: I have posted an electronic copy of the first seven Stamp Applications columns (March through September '95) to locations on CompuServe and the Internet. You can download, read, and print these copies using your PC (under Windows) or Mac computer and free Adobe Acrobat software (version 2.0 or higher).

The file is called "ST_APPS1.PDF." It's roughly 250KB in size and contains the equivalent of 34 letter-sized pages, including all text, drawings, and photos that appeared here in *Nuts & Volts*. On CompuServe, it's located in the Hobby Electronics library of the Consumer Electronics Forum. On the Internet, it's on the Parallax ftp site, ftp.parallaxinc.com

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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

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: on the Internet 72037.2612 @ compuserve.com

Scott offers Stamp-related kits, including:

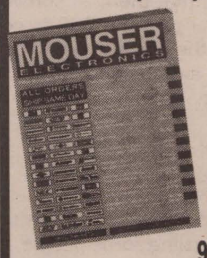
The Counterfeit controller, a kit alternative to the BASIC Stamp, is $29.00. Double and quad-speed options are $2.00 and $4.00, respectively. The Counterfeit Development System, required to program Counterfeits (also for programming original BASIC Stamps, like the BS1-IC) is $69.00 and includes 150-page manual, downloading cable kit, Parallax software, and one Counterfeit controller kit.

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 Backpack is $29.00; with a 16 x 1 LCD, $40.00.

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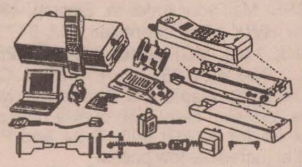


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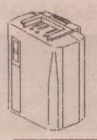
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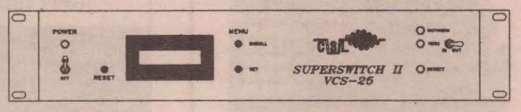
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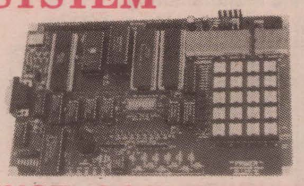
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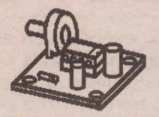


Circuit designed around a recently developed IC. Circuit utilizes PIR detector, & a light dependent resistor to provide a optimized circuit that will detect motion in the 3-4 meter range. Operates on 9-12 VDC

L: 3" **W:** 2" **H:** 1-1/4" **WT:** .1

STOCK #	DESCRIPTION	PRICE
6030-KT	PIR Motion Kit	$34.95

1 WATT AMPLIFIER KIT



Circuit designed around a single TDA7052 IC. Ideal part for larger projects. Drives 8 ohm speaker (not supplied) Ideal for battery powered circuits, Operates on 3-15 VDC solder pads for all connections.

L: 1-1/4" **W:** 1-1/8" **H:** 7/8" **WT:** .05

STOCK #	DESCRIPTION	PRICE
6027-KTN	1W Amp Kit	$7.95

POWER SUPPLY KIT

Featured in "Electronics Now"



Basic circuit designed around 2 fixed TO-220 regulators. Provides fixed output of +5V & a variable from +5 to 2V under the input voltage. Terminal strip output, solder pads & 3.5mm mini phone jack for input. 7-30V DC or 7-20V AC input.

L: 3-1/8" **W:** 2" **H:** 1" **WT:** .22

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

ULTRASONIC MOTION DETECTOR KIT



2 boards; one with Matched pair of Ultrasonic transducers to detect motion from 4-7m away. 2nd board contains Xtal controlled osc. & all circuits. Switchable latch, red LED indicator. Solder pad output to drive external relay or circuits. Runs on 9V battery. Main Board: 2-3/4" X 2" X 3/4" Transducer Board: 2-3/4" X 5/8" X 7/8"

WT: .1

STOCK #	DESCRIPTION	PRICE
6020-KTN	Motion Detector	$29.95

LCD TEMPERATURE METER KIT (CELSIUS ONLY)

Featured in "Electronics Now"



Designed using a single IC that contains Analog & Digital sections to provide a simple yet versatile LCD meter. Other components convert the basic meter to read Temperature (degrees "C"). With power switch. Runs on 9V battery.

L: 3-3/4" **W:** 2-1/4" **H:** 3/4" **WT:** .3

STOCK #	DESCRIPTION	PRICE
6002-KTN	Temp. Meter Kit	$29.95

SWITCHING POWER SUPPLY KIT

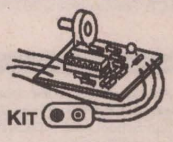


Basic step-up switching supply circuit designed around single IC. Selectable 1.5 or 3 VDC input. Provides a fixed output of 9V @ 18mA from a 1.5 V "AA" cell. Solder pads for input & output. 1 cell & 2 cell "AA" holders supplied.

L: 1-5/8" **W:** 3/4" **H:** 1/2" **WT:** .08

STOCK #	DESCRIPTION	PRICE
6035-KTN	Switching P/S	$8.95

OP-AMP FUNCTION GENERATOR KIT



Circuit designed around a Quad Op-Amp connected as oscillator & wave shapers. Oscillator generates a Square Wave over 6Hz to 6KHz. range. The other amps then produce the Triangle & pseudo Sine outputs. Solder pad outputs. Runs on 9V battery.

L: 1-7/8" **W:** 1-5/8" **H:** 7/8" **WT:** .07

STOCK #	DESCRIPTION	PRICE
6023-KTN	Function Gen.	$8.95

TELEPHONE TRANSMITTER KIT



Phone line powered & activated when handset is lifted. Uses phone wires for antenna. Transmitts over short distance (<100ft) to the lower part of FM broadcast band (90-95 MHz). Circuit does require the ability to "Tweak" RF circuits.

L: 1-7/8" **W:** 5/8" **H:** 3/8" **WT:** .06

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 require the ability to "Tweak" RF circuits by stretching/compressing coils. Operates on 6V DC, 4 cell "AA" battery holder supplied.

L: 2-1/2" **W:** 1-1/2" **H:** 5/8" **WT:** .09

STOCK #	DESCRIPTION	PRICE
6028-KTN	FM VOX Xmitter	$12.95

LOW VOLTAGE AMPLIFIER KIT



Circuit designed around the National LM386 IC. The LM386 is a variable gain audio amp. Use this kit as a building block for other projects. Operates on 4-12 VDC. Solder pads for all connections.

L: 1-1/4" **W:** 1-1/4" **H:** 3/4" **WT:** .06

STOCK #	DESCRIPTION	PRICE
6017-KTN	Amplifier Kit	$6.95

TAPE RECORDER VOX SWITCH KIT



When sound is detected, kit will turn on cassette recorder or other low voltage load. 6 second turn-off delay allows for pauses in conversation. Requires recorder with "REMOTE" control jack. An external relay (not supplied) can be added to handle heavier or line loads.

L: 4-5/8" **W:** 3/4" **H:** 1/2" **WT:** .1

STOCK #	DESCRIPTION	PRICE
6013-KTN	Tape VOX	$12.95

3VDC FM TRANSMITTER KIT

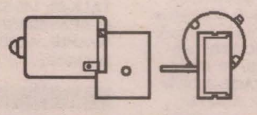


Small FM Xmitter teaches basic construction & set up of tuned circuits. Transmits over 100 Meters in building & over 500 M outside. Circuit requires the ability to "Tweak" RF circuits by stretching/compressing coils. Operates on 3-9V DC, Holder for 2 "AA" cells supplied.

L: 1-3/4" **W:** 3/4" **H:** 1/2" **WT:** .1

STOCK #	DESCRIPTION	PRICE
6007-KTN	3V FM Xmitter	$9.95

6V DC GEARHEAD MOTOR



Reversable 6-12V DC gear motor. 100RPM @ 6VDC, 3mm dia. X 19mm long shaft with slight serriations. Plastic gears. Solder terminals

L: 2-1/4" **W:** 1-1/2" **H:** 1-1/8" **WT:** .21

STOCK #	DESCRIPTION	PRICE
7280-MDN	6V Gear Motor	$6.95

12V DC GEARHEAD MOTOR



Hi-torque, reversable 12-24V DC gear motor. 30 RPM @ 12VDC. 4.5mm dia. X 15mm long shaft with 20 tooth plastic gear held by steel pin. 5 stage reduction using plastic & metal gears. Solder terminals with 4-3/8" leads

WT: .42

STOCK #	DESCRIPTION	PRICE
7300-MDN	6V Gear Motor	$8.95

18V DC GEARHEAD MOTOR



Hi-torque, Buehler reversable 18V DC gear motor. 22 RPM @ 18VDC. 3mm dia. X 10mm long shaft. 8 stage reduction using plastic & metal gears. Solder terminals

L: 2-1/8" **W:** 1-1/2" **H:** 1-1/8" **WT:** .3

STOCK #	DESCRIPTION	PRICE
7302-MDN	18V Gear Motor	$9.95

4A 13.8VDC REGULATED BENCH SUPPLY

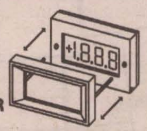


Short Circuit & Overload Protected. 110/120VAC Input. With Metal Case, Power Cord, Line Fuse and Switch For Cellular Phones, Auto Accessories, Test Equipment. Binding post & Cigarette plug socket for output.

L: 9-1/2" **W:** 5-1/4" **H:** 3-1/2" **WT:** 5.5

STOCK #	DESCRIPTION	PRICE
5383-PSN	4A Bench P/S	$19.95

DIGITAL PANEL METER

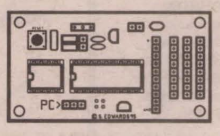


Compact 3-1/2 Digit LCD DPM with black plastic bezel & face plate. 1/2" character height, 200mV DC input, adj. decimal point, auto polarity, >100Mohm input imp. 2 readings/sec., 9 VDC powered, .5% accuracy. Through panel mounting. Holes on board to add scale resistors

W: 2-5/8" **H:** 1-3/4" **D:** 3/8" **WT:** .1

STOCK #	DESCRIPTION	PRICE
6929-MEN	LCD Meter	$9.95

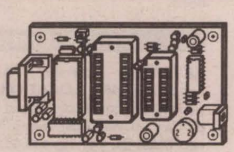
"COUNTERFIT STAMP" KIT FROM SCOTT EDWARDS



SCOTT EDWARDS ELECTRONICS introduces a 100% "BASIC STAMP" compatable micro controller IN KIT FORM! Features: 4MHz clock CPU & 256 Byte serial EEPROM, 32 instructions including GOTO, FOR, NEXT, IF...THEN, as well as Special commands; SERIN (Serial In), SEROUT (Serial Out), PWM (Pulse Width Modulation out). 8 Programmable I/O lines.
Turbo Options allow 2X or 4X speed-up Development Kit allows you Edit, debug, & down load programs to Stamps. Requires PC with 3.5" Drive, 128K Ram & a Parallel Port.
Development Kit includes 1 Counterfit Stamp (Standard Speed); Parallax Programming Software; Interface cable Kit & 150pg. Manual with Application Notes.
First time buyers should purchase the Development Kit

STOCK #	DESCRIPTION	PRICE
7270-SEN	Counter Stamp	$29.00
7271-SEN	Stamp 2X Turbo	$30.95
7272-SEN	Stamp 4X Turbo	$32.95
7273-SEN	Development Kit	$69.00

PROFESSIONAL PIC™ CONTROLLER & 93CX6 EEPROMS PROGRAMMER

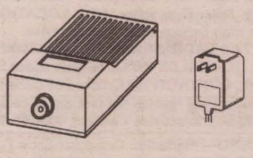


Full featured, Newfound Electronics PP1 programmer that you use to Read, Blank check, Program & Verify Microchip PIC16CXX ™ (including 61,64, 74& 84) micro-controllers and 93CX6 serial EEPROMs. All 18 Pin & 28 pin PIC chips are supported. ZIF sockets for easy insertion of your IC. Verifys at 4.5 & 5.5V. OPT. file to set Fuses, Auto Serial number support. Newfound Electronics's Visual Interface software makes programming easy. Requires a PC compatable with a RS232 COM port, DOS 3.3 or higher, & a 1.44 floppy. A EGA & Hard disc is recommended. DB-9S connector connects to COM port. Requires 9-12VDC @ 300-500mA and a 9 pin serial cable. Knowlege of PIC Programming & language required.

L: 4.5" **W:** 2.75" **D:** .75" **WT:** .23

STOCK #	DESCRIPTION	PRICE
7305-MIN	PIC Programmer	$249.00

SECURITY CAMERA & POWER SUPPLY



Element: 1/3" silicon CCD sensor
Lens: Fixed
Scanning: EIA 525 lines- 60 fields
Electronic Iris/shutter: Auto; 1/60-1/10,000
Resolution: 400 H X 504 V
Illumination: Ambient light
Sensitivity: 1 lux. @ F: 1.2
Video output: EIA std. 2/I interlace 1.0V P/P composite video
Connections: RCA jack for Video & 1/8" phone jack for Power
Power: Plug transformer supplied
Mounting: Standard 1/4-20 threaded insert in bottom.
New Mini surveillance camera package. Mini camera comes in a white plastic case

L: 4.5" **W:** 2.675" **T:** 1.675" **WT:** .8

STOCK #	DESCRIPTION	PRICE
6936-STN	Security Camera	$110.00

THERMOELECTRIC MODULE

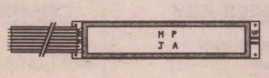


Peltier Effect cooling module with 71 Pairs of couples. When powered one side gets cold while the other is hot. With proper heat sink & insulation will cool below 0 C°. 3.4A max, 8.0V max, 59 C° Max temp. Differential, 18W heat pumped (~55 BTU). Similar to Melcor CP-1.4-71-10L

Dimn: 1-3/16"Sq. **T:** .18" **WT:** .03

STOCK #	DESCRIPTION	PRICE
7075-PMN	Peltier Module	$16.95

40 CHAR. X 2 LINE INTELLIGENT LCD DISPLAY



Optrex DMC40218, 5 X 8 X .21" char. ht. dot matrix display, on-board CPU, RAM & ASCII char. generator IC, C-MOS/TTL signal level, 11 instructions, +5 VDC for logic & -12 (Max) VDC for contrast adj., 14 I/O/power pins. 8" flat cable leads, Data

L: 7-3/16" **W:** 1-5/16" **T:** 3/8" **WT:** .2

STOCK #	DESCRIPTION	PRICE
5120-OPN	2X40 Display	$9.95

Events

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 Princeland Court
Corona, CA 91719
Phone 909-371-8497
Fax 909-371-3052
CompuServe 74262,3664
Internet
74262,3664@compuserve.com

WESTERN REGION

NOVEMBER 4

CA - RESEDA — Computer Marketplace. **SPONSOR:** National Productions. **LOCATION:** Sherman Square Entertainment Center. **HOURS:** 10am-5pm. **ADMISSION:** $5. **CONTACT:** National Productions, 408-778-5200 or 1-800-800-5600. FAX 408-779-1374.

CA - SANTEE — Ham Radio, Computer & Electronics Swap Meet. **SPONSOR:** ARC of El Cajon. **LOCATION:** Santee Drive-In, 10990 N. Woodside. **HOURS:** 6:30am-? **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 - VENTURA — MarketPro Computer Show & Sale. **LOCATION:** Ventura Fairgrounds. **HOURS:** 10am-5pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

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

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-? **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 - 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-? **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-?. **ADMISSION:** X$1 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-? **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-? **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.

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-? **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.

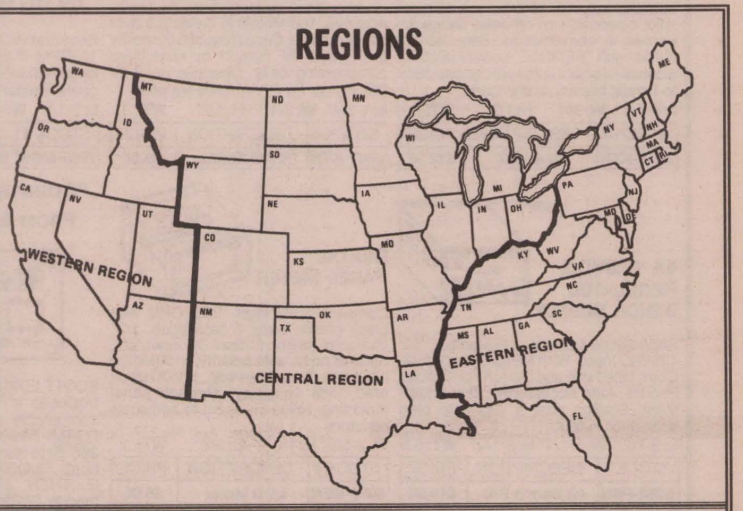
JANUARY 7

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.

JANUARY 13

AZ - PHOENIX — WestFest. **SPONSOR:** Amateur Radio Council of Arizona & Thunderbird ARC. **LOCATION:** Glendale Community College, North lot, 6000 W Olive (Dunlap & 59th Ave). **HOURS:** 6am-4pm. **ADMISSION:** Free, parking $2. **TALK-IN:** 146.76-600, 162.2 PL. **FEATURES:** CB - F/R - RV-S. **DEALER INFO:** Tailgaters $5. **CONTACT:** Morgan N7DLW, 602-938-4356, Mark N7KKQ, 602-843-0960.

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-? **ADMISSION:** Free. **FEATURES:** E



FEATURES KEY

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

COMPUTER SHOW PROMOTER INFO

AGI Computer Fair — 317-299-8827
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

- 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, 685-7694.

JANUARY 28

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.

CENTRAL REGION

NOVEMBER 3-4-5

TX - KATY — South Texas Section Convention. **SPONSOR:** Gulf Coast Ham Conv. Comm. **CONTACT:** Darrell Glueck KK5LG, 1523 Earl of Dunmore, Katy TX 77449-3024. 713-544-4829.

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.

MI - TAYLOR — Computer Trade Show. **LOCATION:** Democratic Club Hall, 23400 Wick Rd, 4 blocks E of Telegraph, 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.

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

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 Show 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 - ANN ARBOR — Computer Trade Show. **LOCATION:** Crowne Plaza, 610 Hilton Blvd, I-94 @ State St, Exit #177, by Briarwood Mall. **HOURS:** 10am-4pm. **ADMISSION:** Adults $4; seniors & students w/ID $3; under 12 free w/adult. **FEATURES:** C - DP. **CONTACT:** Computers & You, 313-283-1754.

MI - FLINT — Computer 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 Rd. **HOURS:** 8am-? **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.

MI - SOUTHFIELD — ARRL Hamfest. **SPONSOR:** Oak Park ARC & Spirit of '76 ARK. **CONTACT:** Andy Penn N8JVA, 28771 Fairfax, Southfield MI 48076. 810-559-2442.

OH - MASSILLON — Auctionfest '95 Hamfest. **SPONSOR:** Massillon ARC. **LOCATION:** Knights of Columbus Hall, 988 Cherry Rd NW. **HOURS:** 8am-?. **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-? **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:** Lamoine 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.*

MI - MADISON HEIGHTS — Computer Trade Show. **LOCATION:** UFE&CW Hall, 876 Horace Brown Dr, 1 block E of I-75, 1 block 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.

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

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.

MO - WARRENSBURG — ARRL Hamfest. **SPONSOR:** Warrensburg Area ARC. **CONTACT:** Keith Haye WE0G, 612 Foster Ln, Warrensburg MO 64093. 816-492-5909.

NM - SOCORRO — ARRL Hamfest. **SPONSOR:** Socorro ARA. **CONTACT:** Monte Bateman WB5RZX, Box 522, Socorro NM 87801. 505-835-4782.

NOVEMBER 18-19

IL - ST. CHARLES — Chicagoland Antique Ad, Slot Machine & Jukebox Show. **SPONSOR:** R & S Promotions. **LOCATION:** Pheasant Run Resort, Rt 64, North Ave: 2-1/2 mi W of Rte 59. **HOURS:** Sat 10am-6pm, Sun 11am-4pm. **ADMISSION:** $5. **CONTACT:** Dealers: Beverly 713-527-8960, Gen'l: Steve 708-381-1234.

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 - FP - F/R - All indoors. **CONTACT:** 24-hour Hotline 708-974-3123.

MI - MIDLAND — Five Star Productions Computer Shows. **SPONSOR:** Five Star Productions. **LOCATION:** Holiday Inn, US-10 at Eastman Rd exit. **HOURS:** 10am-4pm. **ADMISSION:** $4. **FEATURES:** C - DP - FP. **DEALER INFO:** $35 tables. **CONTACT:** Five Star Productions, 810-239-3640.

MI - MADISON HEIGHTS — Computer Show. **LOCATION:** UFE&CW 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 — 9th Annual Central Illinois Amateur Television Banquet. **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 25-26

XMI - LANSING — Computer Trade Show. **LOCATION:** Holiday Inn South Convention Center, 6820 S Cedar St, Exit #104 off I-96. **HOURS:** 10am-4pm. **ADMISSION:** Adults $4; seniors & students w/ID $3; under 12 free w/adult. **FEATURES:** C - DP - S. **CONTACT:** Computers & You, 313-283-1754.

NOVEMBER 26

CO - GOLDEN — Annual Hamfest & ARRL Section Convention. **SPONSOR:** Denver Radio Club. **LOCATION:** Jefferson County Fairgrounds, 15200 W 6th Ave. **HOURS:** 8am-2pm. **ADMISSION:** $3. **TALK-IN:** 147.33. **FEATURES:** CB - DP - F - F/R - S. **CONTACT:** Bruce Kirkpatrick, 303-450-0076.

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.

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. **CONTACT:** Five Star Productions, 810-239-3640.

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 Dr, Dover AR 72837. 501-967-4372.

DECEMBER 2

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.

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.

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-?. **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 9

IN - INDIANAPOLIS — Indianapolis Computer Fair. **LOCATION:** Indiana State Fairground. **HOURS:** 10am-3pm. **ADMISSION:** $4, under 12 free. **FEATURES:** C - DP. **CONTACT:** Ben Yanto, AGI Computer Fairs.*

DECEMBER 16

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 - FP - 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. **CONTACT:** Five Star Productions, 810-239-3640.

DECEMBER 23

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. **CONTACT:** Five Star Productions, 810-239-3640.

Continued on page 139

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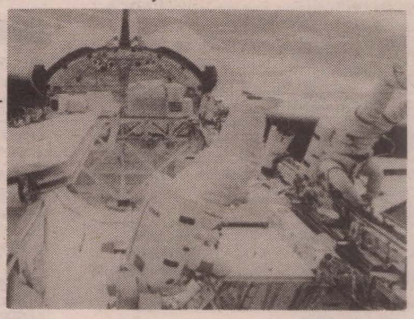


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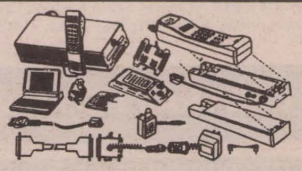
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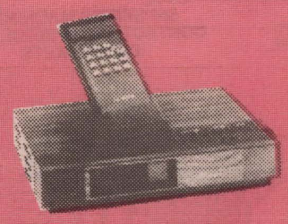
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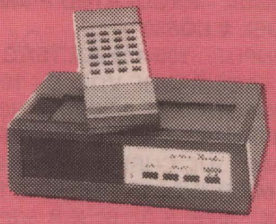
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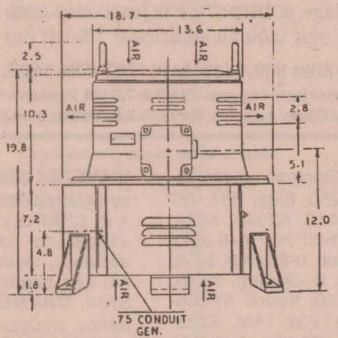
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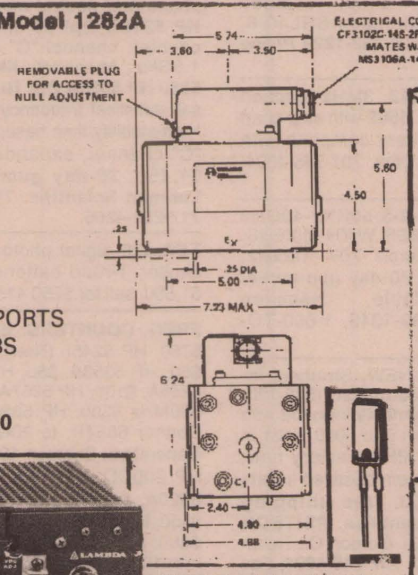


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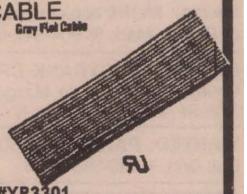
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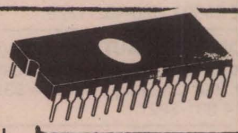


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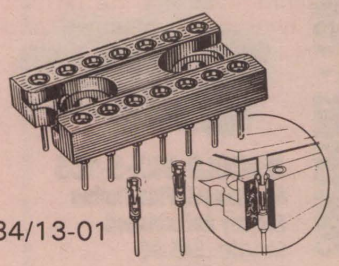
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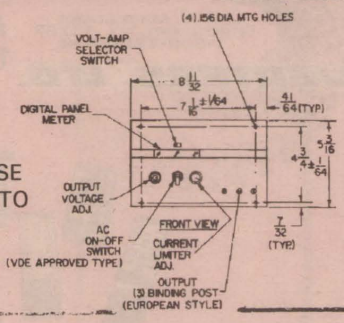


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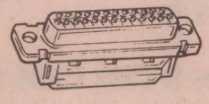
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How Big (Long, Hot) is It? A Bit about Measurements

Open Channel

by Joseph J. Carr
K4IPV

British physicist Lord Kelvin once remarked something to the effect that one doesn't really understand a thing until one can measure it and assign numbers to it. Electronics is intimately related to the science of measurement, both in its own right and as an adjunct to other sciences and technologies. It is therefore useful for electronics people to explore what is meant by this thing called "measurement."

Measurement is the assignment of numerals to represent the attributes or properties of something, according to a standard rule that gives the numbers some ordered meaning. Measurements are made to fulfill any or all of several different goals:

- Obtain information about a phenomenon.
- Assign a value to some fundamental constant.
- Record trends in, or control some process.
- Correlate behavior of a phenomenon with other parameters in order to obtain insight into their relationships.

Measurement is an act designed to "derive quantitative information about . . ." some phenomenon ". . . by comparison to a reference . . ." or standard. The physical quantity being measured is called the measurand or factor.

Measurement Data Classes

The data that results from measurements can be divided into two major classes, and those classes are each divided into two sub-classes. The major divisions include qualitative data and quantitative data.

Qualitative Data

This type of data is non-numerical or categorical in nature. It includes things like the presence or non-presence of some factor, good or bad, defective or not defective, gender, race, and so forth.

Qualitative data doesn't inherently result in numbers, so is sometimes held in less esteem than quantitative data. This attitude is a mistake unless there is some inherent need for numbers in a particular case.

Qualitative data can be further broken into two subgroups: nominal data and ordinal data.

Nominal data is qualitative data that has no inherent ordering or rank. Examples include lists of names, labels, groupings, and so forth.

Ordinal data allows ranking, but differences between data points are either non-existent or meaningless.

Qualitative data can sometimes be given a numerical flavor by correct collection techniques. For example, because much of this data is binary in nature (i.e., has only two possible results), one can assign the digits 0 and 1 (e.g., 1 for "yes" and 0 for "no"). Another popular method is to assign some arbitrary, but consistent, scale indicating depth of feeling, preferences, and so forth. For example, a five point scale (Figure 1) is often used to assign numerals to questions that are largely qualitative value judgements.

Quantitative Data

Quantitative data is that which naturally results in some number to represent the factor. Examples include: amount of money, length, temperature, number of defects per unit, total number of defective units, voltage, pressure, weight, etc.

Quantitative data can be further divided into two sub-classes: interval data and ratio data.

Interval data allows for a meaningful comparison of differences, but not the relative values of two or more factors. Such measurements are made relative to an arbitrarily selected standard zero point. For example, in the West we assign calendar dates according to the birth date of Christ. In other cultures, the zero point is some other fixed historical event.

Another example of an interval measure is temperature, as measured on the Celcius (centigrade) and Fahrenheit temperature scales (°C and °F, respectively). The Celcius scale sets the zero degree point at the freezing point of water. Another arbitrary (but convenient) reference point on the Celcius scale is the 100° C point: i.e., the boiling point of water.

Why are these points used to define the Celcius scale? Aren't they somewhat arbitrary? The reason these points are used is that they are easy to replicate wherever anyone wants to calibrate a Celcius thermometer. In other words, one doesn't need a high quality metrology laboratory to do a reasonably good job of calibrating an electronic thermometer.

The Celcius scale is also sometimes called "centigrade" because there are one hundred (centi) equal divisions between the arbitrarily set 0° C and 100° C points. The zero point on the Fahrenheit scale is equally arbitrary, but its selection seems to us a bit irrational (water freezes at 32° F).

Why are the 0° C and 100° C points on the Celcius scale arbitrary? Because there is no particular reason to select these points, except for calibration convenience. After all, there are temperatures colder than 0° C and hotter than 100° C.

The selection of zero points on the temperature scale illustrates the properties of interval data; we can make meaningful statements about differences of temperature, but differences cannot be scaled up, i.e., 40° C is NOT twice as much temperature as 20° C (see Figure 2).

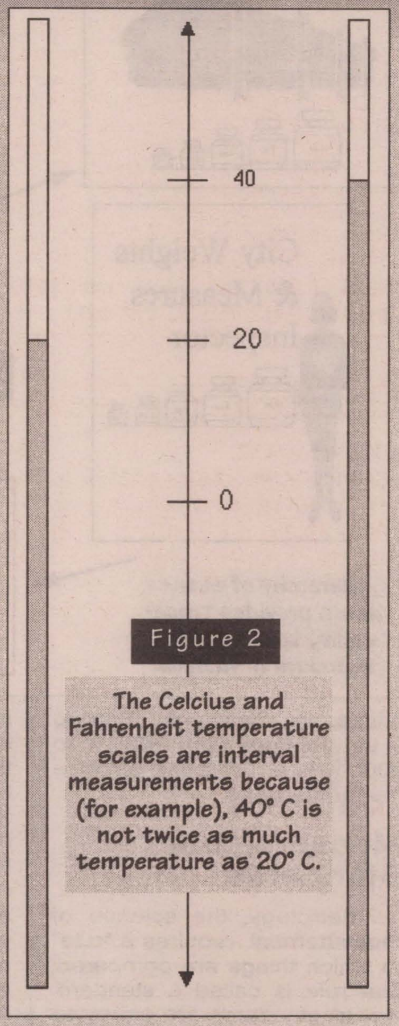


Figure 2

The Celcius and Fahrenheit temperature scales are interval measurements because (for example), 40° C is not twice as much temperature as 20° C.

Ratio data are based on some fixed or natural zero point, e.g., weights, pressures, and temperatures such as the Kelvin scale. Retaining our temperature scale example, the Kelvin scale uses degrees of the same size as the Celcius scale (a change of 1° C is the same as a change of 1° K), but the zero reference point is what physicists call "absolute zero," i.e., the temperature at which all molecular motion ceases (0° K is about -273.16° C). Thus, 0° K represents a natural zero point.

A consequence of having a natural zero reference point is that ratios, as well as differ-

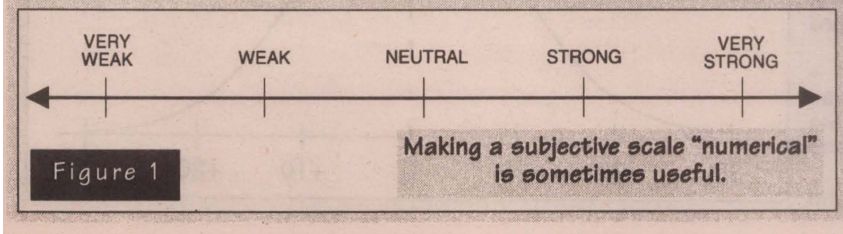


Figure 1

Making a subjective scale "numerical" is sometimes useful.

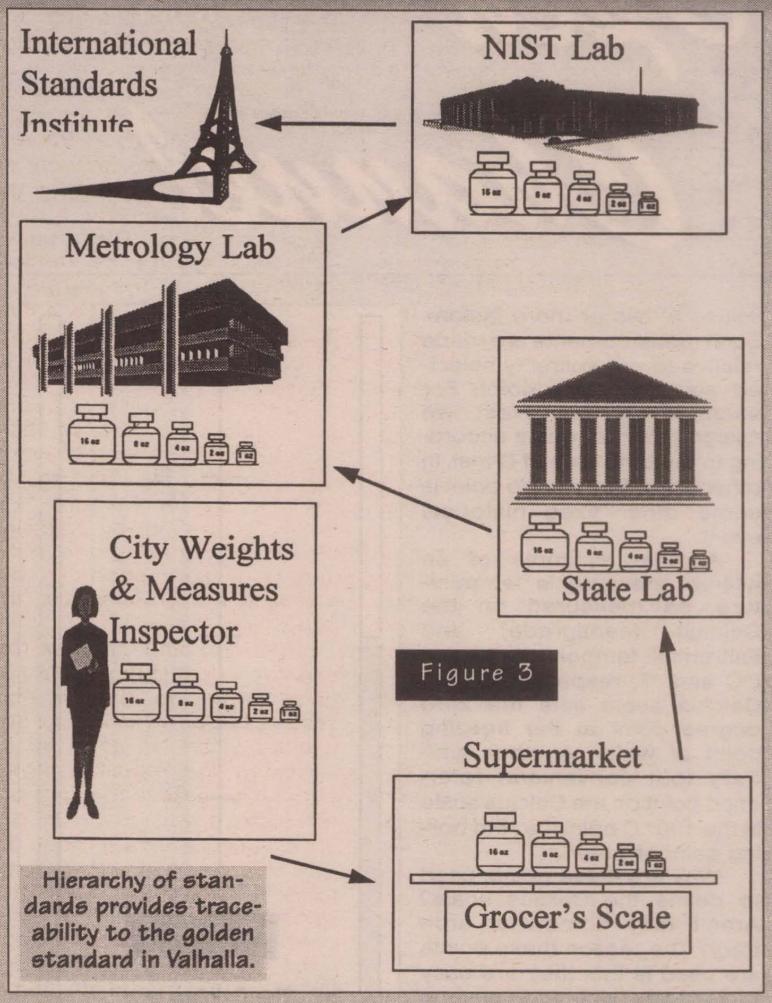


Figure 3

Hierarchy of standards provides traceability to the golden standard in Valhalla.

ences, are meaningful. Raising a temperature from 100° K to 200° K is an increase of twice the temperature.

Measurement Standards

Metrology, the science of measurement, requires a "rule" to which things are compared; that rule is called a standard. Not all standards are equal, so there is a hierarchy of standards (Figure 3): International reference standards, primary standards, transfer standards, working standards, and shop-level standards.

International Reference Standards – These standards are those agreed upon by an international standards organization. For years, the reference standard for the meter was a platinum bar, 1.0000 meters long, stored in a vault in Paris, France, maintained by the International Standards Institute. Other international standards are kept by various authorities around the world.

Primary Standards – These are the principal standards maintained at a national level in the various countries. In the US, these standards are maintained by the National Institutes of Standards and Technology (NIST), formerly, named the National Bureau of Standards (NBS). Some primary standards are periodically taken to Paris, where they are compared with an international reference standard maintained by the International Standards Institute.

Transfer Standards – These standards are second level, and are periodically compared with the primary standard. They are used to calibrate lower order standards used in the country so that wear and tear on the primary standard is reduced.

Working Standards – The working standard is compared with the transfer standard in a nationally certified laboratory, or at NIST. Such standards are said to be "NIST traceable."

Secondary Standards – These standards are used locally (e.g., in the plant) to calibrate instruments and gauges (see below).

Gauges/Instruments – The lowest order of standards, these are the devices actually used to make measurements and collect data on the objects being measured. Gauges and instruments are compared with either working standards or secondary standards.

Examples of these standards can be seen in the hierarchical chain leading from the grocery checkout counter at the local supermarket (see again Figure 3), all the way back to NIST. The scale used to weigh the product that they sell by the pound is a gauge or instrument standard. In the state where I live, a local (county or city) "weights and measures inspector" calls on the stores and checks the calibration of the produce scales at each checkout counter to make sure that consumers are not ripped off.

The inspector is equipped with a set of standard weights that can be placed on the scale. These are a secondary standard. Once every six months, the inspector must take the secondary standard to a laboratory at the state capital and compare the secondary standard weight set to a master set kept at the lab, i.e., the working standard. Once a year, the lab's weight set is taken to either NIST or a designated metrology laboratory for comparison to a transfer standard. That transfer standard is, in turn, compared with the primary standard on a periodic basis.

Measurement Variation and Error

All measurements are subject to a certain amount of variation caused by small random errors in the measurement process, and by actual variation in the measured parameter. In this context, the idea of "error" does not mean "mistake," but rather a normal random variation due to inherent limitations of the measurement system (i.e., the instrument and its operator).

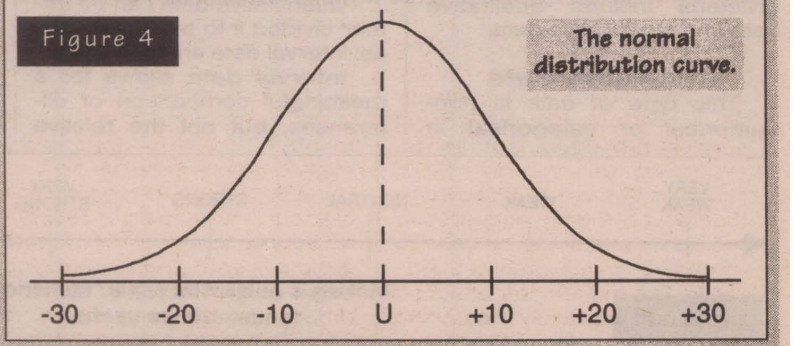
There are many different causes of random variation. Some errors are dependent on the particular type of measurement being made (and are a function of the type of instrument being used), while other error is due to inherent variation in the process being measured. Still others are due to problems in using the instrument or making the measurement, i.e., people problems.

Consider an ordinary ruler (such as a yard stick) as an analogy for random error. It is divided into 36 large divisions of 1" each, and 288 smaller divisions of 1/8" each. Or is it? In truth, the distance from 0 to 36 inches is not exactly 36.0000 in., but rather will be 36 ± e in., where e is some small error. In addition, the spaces between small divisions (either 1/4" or 1/8") are not all exactly the same size, but vary somewhat from mark to mark. As a result, when you measure the size of some object there will be some inherent error due to the limitations of the particular ruler selected.

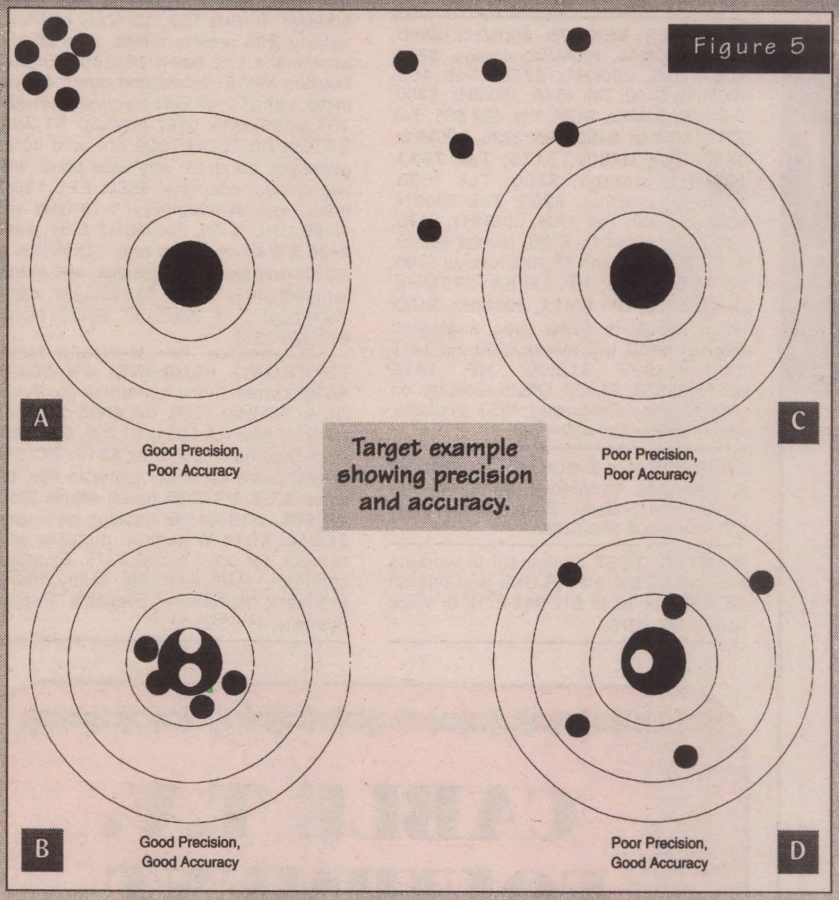
An example of people problems with the ruler is old guys like me who can't see as well as we once did. Without a heavy piece of shaped plastic in front of my eyes, everything up close is fuzzy and distorted. Even with the glasses on, there will be some small variation in where I reckon a point on the ruler lines up with the thing being measured.

Random variation causes the data obtained when making measurements to disperse. Many (but not all) processes disperse according to the normal distribution curve shown in Figure 4. If the process is truly random, then the value that one would report in making the measurement is the mean value, μ. But it is also necessary to specify either the variance (Ó2) or standard deviation (Ó). We know that any particular measurement may or may not

Figure 4



The normal distribution curve.



be μ. We also know that 68.27% of all values lay between ±1Ó; 98.45% between ±2Ó, and 99.73% between ±3Ó.

Categories of Measurement

There are three general categories of measurement: direct, indirect, and null. The direct measurement is made when you can directly compare what's being measured with the standard. For example, you can measure a length of coaxial cable to 12' by comparing it to a tape measure, and then whacking off the lot from 0 to 12'.

An indirect measurement is made when the actual measurement is too hard, too inconvenient, or too dangerous. One example of an indirect measurement is the blood pressure cuff. Your doctor could insert a manometer (pressure meter) into your artery, and measure blood pressure directly. But that surgical procedure is unnecessarily dangerous. In 1905, Nicholas Korotkoff discovered that an occluding cuff around the upper arm could be used to "measure" blood pressure indirectly. The manometer attached to the cuff is actually measuring the pressure in the cuff, not your blood pressure. But by noting the onset and cessation of certain turbulence sounds, and correlating them with the cuff pressure as it falls, the systolic and diastolic pressures are obtained.

There was once a minicomputer manufacturer who used an indirect temperature measurement to ease the job of their service technicians. They created a small hole at the top of the rack mounted cabinet where the temperature would be less than or equal to 39° C when the temperature on the electronic circuit boards down in the bowels of the rack-mount cabinet was within specification limits. They used this method for two reasons: A: the measurement point was available to the outside world, and thus did not require any disassembly; and B) the service technician could use an ordinary household medical fever thermometer (30° C to 42° C) as the measurement instrument. No special laboratory thermometers were needed.

Null measurements are made by comparing a calibrated source to an unknown measurand, and then adjusting either one or the other until the difference between them is zero. This is the approach taken when we use the zero-beat method to measure frequency. When two frequencies (F1 and F2) are mixed together in a nonlinear circuit, they "heterodyne" (fancy word for "mix," eh?) together. One of the products created is the difference produce, F1-F2. By comparing a signal to a standard, and adjusting for zero beat (F = F1 - F2 = 0).

For example, to calibrate a 100 KHz crystal oscillator, one would listen for its harmonics beating with the signals of standard frequency stations WWV or WWVH (say, at 10 MHz). The 100 KHz oscillator can be trimmed to the lowest pitch difference between the two signals. By ear, one can get to within 30 Hz or so using zero beating.

Some circuits are also used to measure the frequency or phase difference between the two signals. Guitar players and piano tuners use the zero-beat method to tune their instruments.

Accuracy vs. Precision

Two terms that are often used as if they are the same are "precision" and "accuracy." For sake of example, let's assume that the distribution of the data dispersion is normal, i.e., it has the bell shaped curve. This would be the case if the data dispersion is due solely to random effects. Accuracy refers to how far the mean (peak value in bell shaped curve) is from the correct value. For example, if a voltage is 2.5000 volts (unchanging), and the mean of many repeated measurements with your rusty (or is that "trusty") old VOM is 2.7 volts, then the error is 2.7-2.5 volts, or 0.2 volts. The size of the error is a measure of the accuracy.

The precision of the measurement is determined by the dispersion of the measurements, again assuming an unchanging 2.5000 volt potential, and a collection of measurements with a mean of 2.7 volts. We note that, in over a hundred measurements, that the low was 2.45 volts and the high was 2.95 volts. The range of measurements is 2.95-2.45, or 0.5 volts (which means that ol' VOM must be more rusty than trusty). The standard deviation (Ó) is a good measure of the precision of a measurement.

Target shooting is a good analogy for precision and accuracy. Good shooting instructors know that it's better to work on precision first, i.e., getting the cluster smaller (called "grouping" in shooting). That's analogous to reducing the random variation in a measurement process. Some of the clustering is due to the mechanics of the gun, but most of it happens to be due to the shooter.

Once the shooter (or worker) is consistently shooting tight clusters, then it's time to worry about moving the impact point (i.e., moving the average). How is this done? Not by adjusting the person making the measurement (i.e., shooter), but adjusting the process (i.e., the gun).

The gun and shooter that shot the target in Figure 5A has good precision (i.e., a tight group), but poor accuracy. The accuracy can be obtained by adjusting the movable sights about two clicks to the right and two clicks down.

A mistake often made by novice shooters, and poor measurers, is to adjust the sights with too few shots on the paper. Enough shots (data points) must be collected to truly see the clustering before any meaningful change can be made. I have observed shooters firing two shots and then adjusting the sights; firing two more shots and adjust; fire two more shots and adjust; fire . . . They wonder why the gun never seems to come into regulation. They blame the gun, the ammunition, and the lighting on the range . . . but never their methods.

The target in Figure 5B has good accuracy and good precision (I wish I could shoot like that!): the group is tight and on the center of the target. The target in Figure 5C shows poor precision and poor accuracy, while that in Figure 5D (which is about how I shoot) shows poor precision and good accuracy (it's centered on the bullseye, but dispersed all over the place). One chap tells me less coffee and I'd shoot like Figure 5B!

More on this topic will be found in my book *The Art of Science* (HighText Publications, Inc., P.O. Box 1489, Solana Beach, CA 92075; $19.95). We will also deal with measurement instruments in this column several times in the future. **NV**

#80 TEST EQUIPMENT *cont.*

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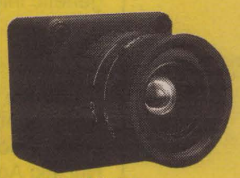
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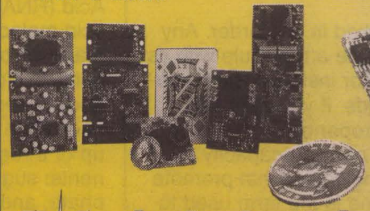


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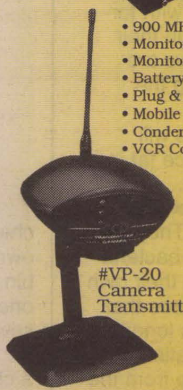
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Recombinant DNA Experiment

by John Iovine

Gene manipulation is a relatively new science. Companies are pursuing genetic engineering to develop medicines and vaccines that are safer and more effective than conventional products. As an example, genetically engineered bacteria have produced human life-saving proteins like insulin and interferon.

Biotechnology has passed the stage of just using bacteria to produce human proteins. British researchers are using cows, endowed with foreign DNA to produce pharmaceuticals in their milk. These genetically engineered cows are capable of reproducing and transmitting the genetic code to their offspring.

New advances in growth hormones will increase milk production in cows, reduce fat in pigs, and bring poultry to market faster.

Plants that produce fruits and vegetables also benefit from genetic engineering. They can be made more resistant to attack from bacteria and insects. In some cases, producing their own pesticide. Other benefits include tomatoes that have been engineered to take twice as long to ripen. As a result of this gene manipulation, the tomatoes will stay fresh on the long trip from the farm to market. The US government on May 27, 1992 approved these and other genetically altered plants to be safe for marketing and human consumption.



Human Genome Project

It has been estimated that it will cost three billion dollars and 15 years to map and identify the 100,000 genes within the 46 human chromosones. This is equivalent to mapping approximately three billion base pairs of DNA. Gathering this information will help scientists to diagnose and treat inherited disorders. In addition, it will provide inroads to curing diseases such as cancer and AIDS.

Biotechnology 101

Before we begin manipulating genetic information for ourselves, let's review some basic biology.

Protein molecules are made up of sub-units called amino acids. Two linked amino acids are called a peptide. Larger amino acid molecules are called polypeptides. A protein is a polypeptide molecule.

Amino acids are built from atoms of carbon, hydrogen, oxygen, nitrogen, and occasionally sulfur. There are 20 types of amino acids.

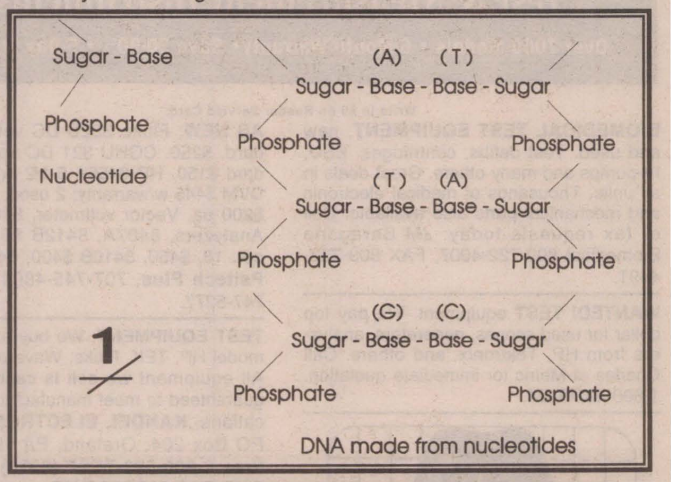
Amino Acid	Abbreviation
Glycine	GLY
Arginine	ARG
Alanine	ALA
Asparagine	ASN
Valine	VAL
Glutamine	GLN
Leucine	LEU
Cystine	CYS
Isoleucine	ILE
Methionine	MET
Serine	SER
Phenylalanine	PHE
Threonine	THR
Tyrosine	TYR
Aspartic Acid	ASP
Tryptophan	TRP
Glutamic Acid	GLU
Histidine	HIS
Lysine	LYS
Proline	PRO

Amino acids can be linked in any order. Any change in the order will create a molecule with its own individual properties. For instance, hemoglobin contains 539 amino acids. If you alter just one amino acid out of its proper order it would severely effect the oxygen carrying capacity.

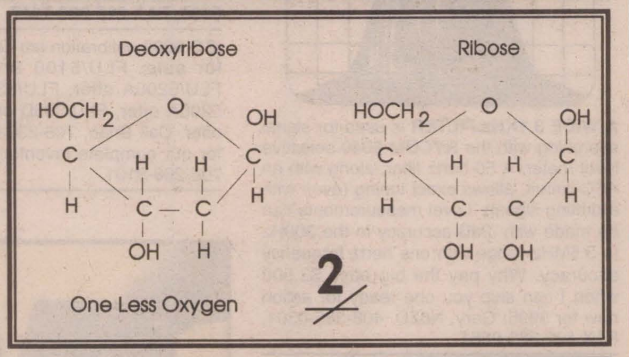
Enzymes are protein molecules that promote a chemical reaction. Enzyme is the term used to describe any biological catalyst associated with living tissue. Enzymes control all chemical reactions in the cell. Enzymes like physical catalysts are unchanged by the reaction they promote and can be reused. Enzymes are employed to take apart or put together molecules.

Genes

For many years, it was believed that proteins communicated the genetic information from generation to generation. Although DNA had been looked at as a possible messenger, it was dismissed as being too simple in structure, being composed of just four nucleic acids, to relay the complex biological messages. Proteins, on the other hand, use 20 different amino acids. So it was felt that the 20 amino acids provided a more diverse and complex chemical language to transfer genetic information.



DNA made from nucleotides



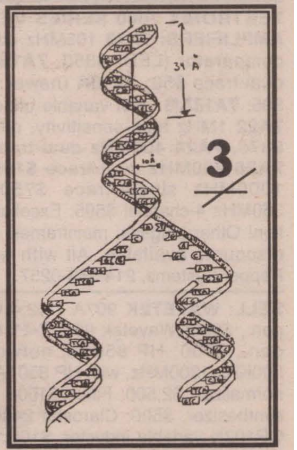
One Less Oxygen

This assumption turned out to be wrong. The simpler nucleic acids in DNA transmits genetic information.

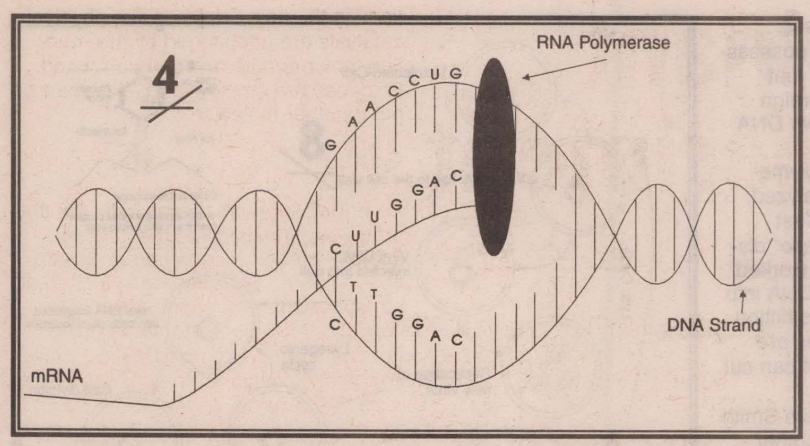
Nucleic Acids

There are two types of nucleic acids: Deoxyribose Nucleic Acid (DNA) and Ribose Nucleic Acid (RNA). Nucleic acid molecules are made up of simpler units called nucleotides. A nucleotide is made up of three components: sugar, phosphate, and a base (see Figure 1).

There is one



DNA Double Helix
When DNA replicates, the double helix unzips. Complementary strands build up of new DNA, Adenine (A) always pairs with Thymine (T), Cytosine (C) always pairs with Guanine (G).



4

type of phosphate, two types of sugar (ribose and deoxyribose see Figure 2), and five types of bases.

Base	Abbreviation
Adenine	A
Thymine	T Found exclusively in DNA.
Guanine	G
Cytosine	C
Uracil	U Found exclusively in RNA.

Nucleic acids — whether it's DNA or RNA — are made up of just four nucleotides linked together into long chains. In addition, only one type of sugar molecule is used in each particular acid; ribose is used exclusively in RNA and deoxyribose in DNA.

Double Helix

In the early 1950s, Rosalind Frankin took a sharp x-ray diffraction photograph of the DNA molecule. The diffraction pattern suggested a helical molecule with a repeat pattern of 34 A and a width of 20 A.

James Watson and Francis Crick used this information to work out the structure of the DNA molecule in 1953. The structure of the DNA molecule is a double helix — it looks like a twisted ladder or spiral staircase (see Figure 3). To extend the twisted ladder analogy, the sugar and phosphate of each nucleotide form the legs, with the bases forming the cross bars.

There is a complementary relationship between the nucleotides. Adenine (A) always pairs with Thymine (T), and Cytosine (C) always pairs with Guanine (G).

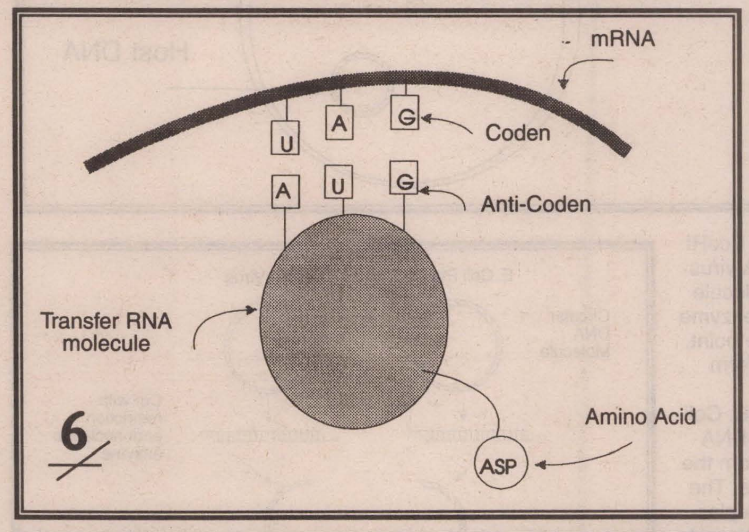
The structure of DNA explains how DNA replicates itself during cell division. The hydrogen bonds between the nucleotides break, unzipping the DNA ladder. Each complementary half serves as a template for reconstructing the other half. The results are two identical DNA molecules.

Second Base

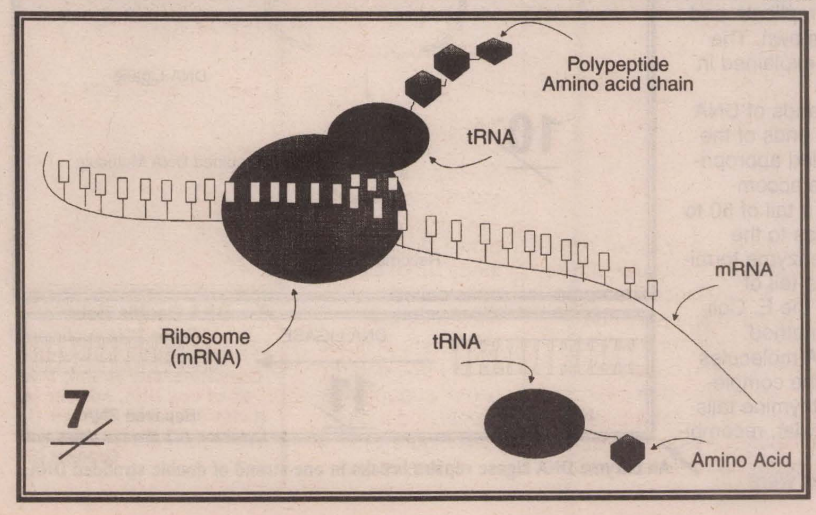
First Base	U	C	A	G	Third Base
U	UUU, UUC PHE; UUA, UUG LEU	UCU, UCC, UCA, UCG SER	UAU, UAC TYR; UAA, UAG STOP	UGU, UGC CYS; UGA STOP; UGG TRP	U C A G
C	CUU, CUC, CUA, CUG LEU	CCU, CCC, CCA, CCG PRO	CAU, CAC HIS; CAA, CAG GLN	CGU, CGC, CGA, CGG ARG	U C A G
A	AUU, AUC, AVA ILE; AVG Meta	ACU, ACC, ACA, ACG THR	AAU, AAC ASN; AAA, AAG LYS	AGU, AGC SER; AGA, AGG ARG	U C A G
G	GUU, GUC, GUA, GUG VAL	GCU, GCC, GCA, GCG AUA	GAU, GAC ASP; GAA, GAG GLU	GGU, GGC, GGA, GGG GLY	U C A G

5 Genetic Code

*Start Signal for protein synthesis



6



7

Protein Synthesis

We are still left with the question of how the four nucleotides in DNA direct the synthesis of 20 amino acid to build proteins and enzymes.

Researchers found that triplet groups of nucleotides are used to identify the different amino acids. Nucleotides can follow one another in any order. In other words, any one of the four nucleotides can be in the first, second, or third position, regardless of what nucleotide came before or goes after it. This means there are 4 x 4 x 4, or 64 possible triplet combinations.

Obviously, there are more triplet combinations (64) than there are amino acids (20). Well, nature decided to build redundancy into the code; there can be two or three different triplets that identify the same amino acid.

DNA material is held within the nucleus of the cell while the site of protein synthesis — the ribosome — is outside the nucleus in the cytoplasm. How does DNA transmit this information outside the nucleus?

RNA molecules were found to be involved in the flow of genetic information from inside to outside the nucleus. DNA molecules produce a complementary RNA molecule, called messenger RNA (mRNA).

The process of producing the mRNA is called transcription. An enzyme — RNA polymerase — unzips a small region of DNA. It travels down the strand of DNA, using the DNA as a template to synthesize mRNA (see Figure 4). Notice in the illustration that the nucleotide uracil replaces thymine in the mRNA molecule. Both of these nucleotides, uracil and thymine, are similar chemically and both are complementary to adenine.

The synthesized messenger RNA (mRNA) is single stranded and much shorter (50-1000 nucleotides) than the DNA (million nucleotides) molecule. This smaller size allows the mRNA to pass through the nucleus membrane into the cytoplasm. It is mRNA that brings the DNA information outside the nucleus for protein synthesis.

The Genetic Code

As stated, the mRNA brings the information outside the nucleus for protein synthesis. We now need to know how that information is coded and synthesized. The triplet nucleotides that code specific amino acids are called codons. The codons are abbreviated using the first letter of the base in the particular nucleotide. So, the codon AUG for example represents the bases adenine-uracil-guanine. The task to find which triplet identified which amino acid became known as cracking the genetic code.

The first break in the code happened in 1961. Researchers Nirenberg and Matther found that a synthetic mRNA molecule consisting only of uracil (making codons UUU-UUU-UUU-UUU...) produce a polypeptide consisting of the amino acid phenylalanine.

Soon all codon combinations were produced creating a genetic dictionary.

Most proteins begin with the amino acid methionine, its codon is AUG. This codon also represents the start signal for protein synthesis. Three codons UAA, UAG, and UGA do not represent any amino acid, rather they are stop signals that terminate a protein synthesis.

Of all the amino acids just two — methionine and tryptophan — are specified by a single codon. All other amino acids are specified by two or more codons. For example, the amino acid glycine is identified by any codon that begins with GG, regardless of the nucleotide in the third position. Figure 5 illustrates the entire genetic code.

Transfer RNA (tRNA)

Transfer RNA (tRNA) molecules perform the

actual translation. The tRNA has three unpaired bases called the anti-codon on one end of the molecule. These bases are the complementary to the codon bases. When the anti-codon on the tRNA matches the codon on the mRNA, it binds with the codon on the mRNA strand. On the opposite end of the tRNA molecule is a site that can attach a single amino acid specified by the codon (see Figure 6). For each tRNA, there is a specific amino acid that can bind to its site.

Ribosomal RNA (rRNA)

The ribosome (ribosomal RNA) travels down the mRNA strand, linking the amino acids attached to the tRNA. As each amino acid is linked, the empty tRNA is released (see Figure 7). The released tRNA is able to pick up an amino acid and again bind to a site on the mRNA strand.

The ribosome begins protein synthesis by attaching itself to the codon AUG which, as stated before, is the codon for methionine and also the start message for protein synthesis. It continues linking amino acids together until it reaches one of the stop codons UAA, UAG, or UGA which terminates synthesis. The completed protein is released to perform its function.

Clones

Bacteria that reproduce through asexual reproduction are *clones*. The identical genetic information (DNA) from the parent cell is replicated and passed onto the daughter cells. Successive generations of cells, in turn, divide and quickly give rise to a population of genetically identical clones, all the cells being derived from a single ancestral cell.

The idea of cloning a human from the DNA in one of its cells is possible, and makes for a good science fiction plot, but it is still a number of years away from being practical.

Escherichia Coli is a favorite bacteria used in genetic engineering. It is part of the normal bacterial fauna that inhabits the human colon. Under ideal conditions, E. Coli replicates itself once every 22 minutes. In just 11 hours, one cell can go through 30 generations and create more than one billion cells.

Genetic Manipulation by Viruses

Viruses can attack cells and use either the cell's machinery to produce new viruses or incorporate its own genetic material into the host cell's DNA (see Figure 8). Understanding this explains why it is so difficult to cure viral infections (i.e., AIDS).

In genetic engineering, we may use bacteria that reproduce asexually to manufacture proteins. Genetic engineering is accomplished by a means similar to those used by viruses. We insert a gene of interest into the cell's genetic information. As the host cell reproduces, so does the gene of interest. When the cell goes about its normal life synthesizing proteins it needs to survive, it is also producing the proteins from the inserted genes.

These proteins could be insulin, growth hormones, interferon, or any genetic information we can splice into the cell DNA successfully.

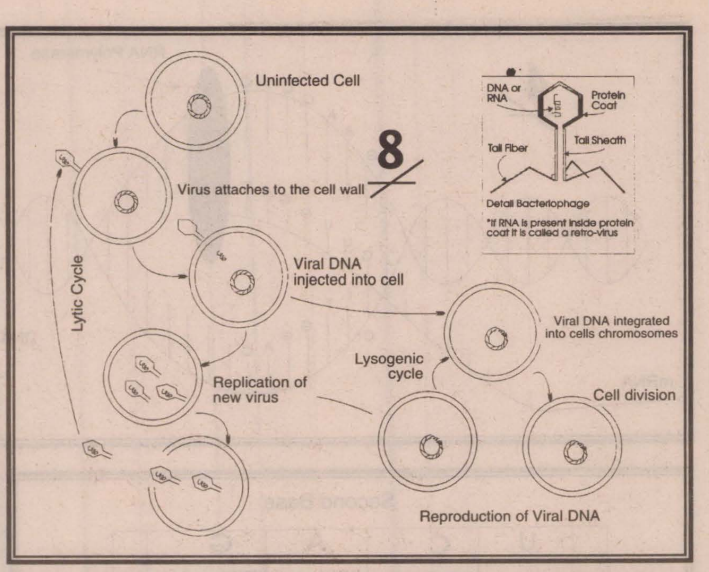
First Step Toward Genetic Engineering

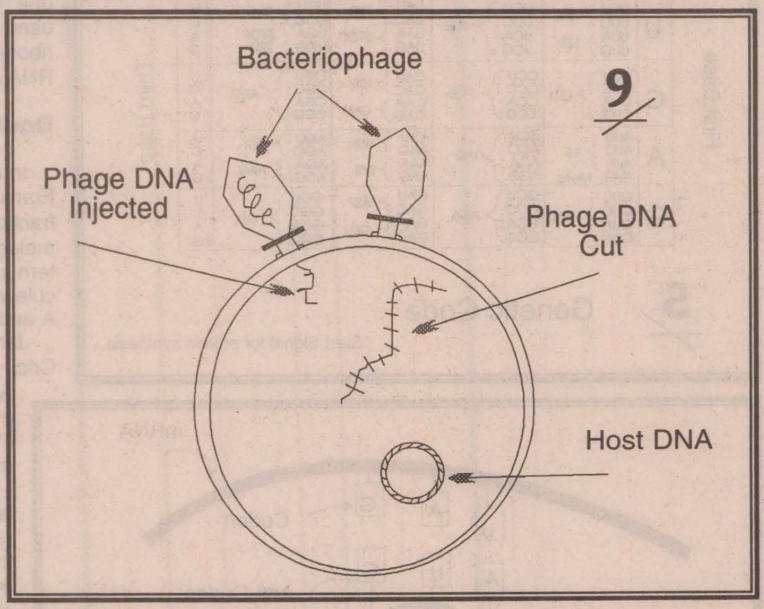
In the 1950s, it was found that a certain strain of E. Coli could protect themselves from foreign introduced DNA. These cells had a primitive immune system (see Figure 9). The E. Coli possesses an enzyme system that selectively destroys foreign DNA, but leaves its own DNA intact.

This protective enzyme was extracted and analyzed. This enzyme was the first "restriction endonuclease" discovered. The enzyme worked by cutting the foreign DNA into pieces. In essence, restriction endonuclease enzymes are molecular scalpels that can cut DNA.

In 1970, researchers Smith and Wilcox isolated another restriction endonuclease enzyme from Haemophilus influenza. The enzyme was named HindII. The advantage of this new enzyme is that it cut DNA at predictable points, within a recognition sequence of nucleotides. This is in contrast to the other enzymes that cut the DNA pretty much at random points.

Daniel Nathans used the HindII enzyme to cut the DNA of a small virus that infects monkeys, called simian virus 40 or SV40 for short. Doing so, he created a restriction map of the virus that shows where the enzyme cut the DNA.





Recombinant DNA

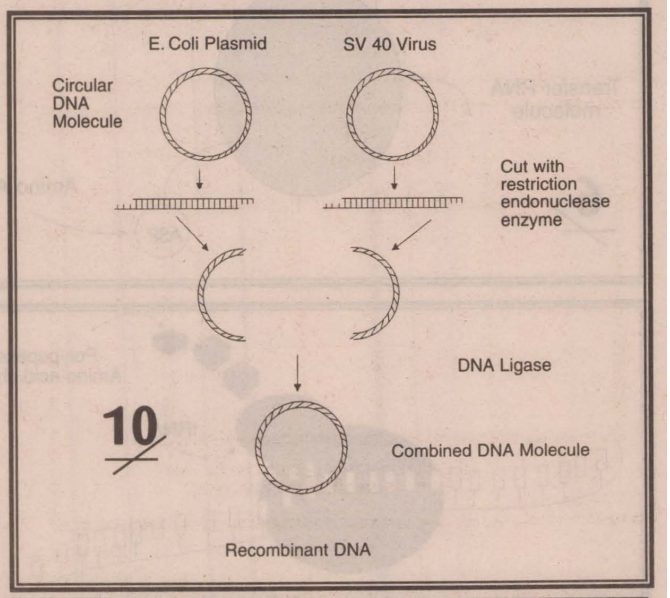
In 1972, Paul Berg worked out a method of joining DNA molecules. Using the restriction enzyme EcoRI he cut the circular SV40 DNA virus and a small circular DNA molecule from E. Coli. The restriction enzyme cut each molecule at a single point, opening the circular DNA to form strands (see Figure 10).

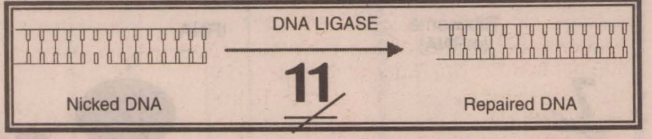
The DNA molecule from E. Coli is particularly important. The DNA molecule used exists apart from the bacteria's main chromosomes. The small DNA molecule, called a plasmid, has the ability to replicate and produce proteins on its own. The plasmid vector will be explained in greater detail later on.

To join the two strands of DNA together, he made the ends of the DNA strand sticky, called appropriately "Sticky Ends." He accomplished this by adding a tail of 50 to 100 adenine nucleotides to the SV40 virus using the enzyme terminal transferase. Next, a tail of thymine was added to the E. Coli DNA using the same method.

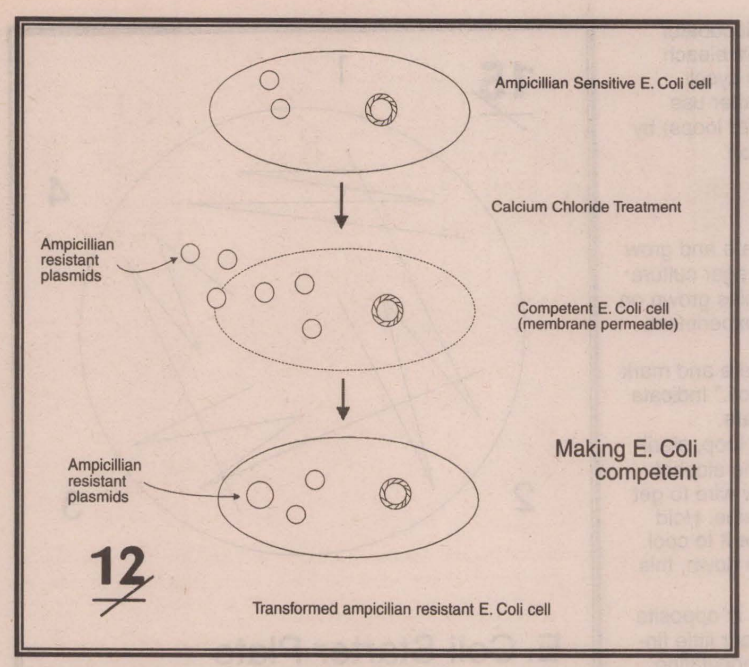
When the two DNA molecules were mixed together, the complementary adenine and thymine tails paired to form one circular, recombinant DNA molecule.

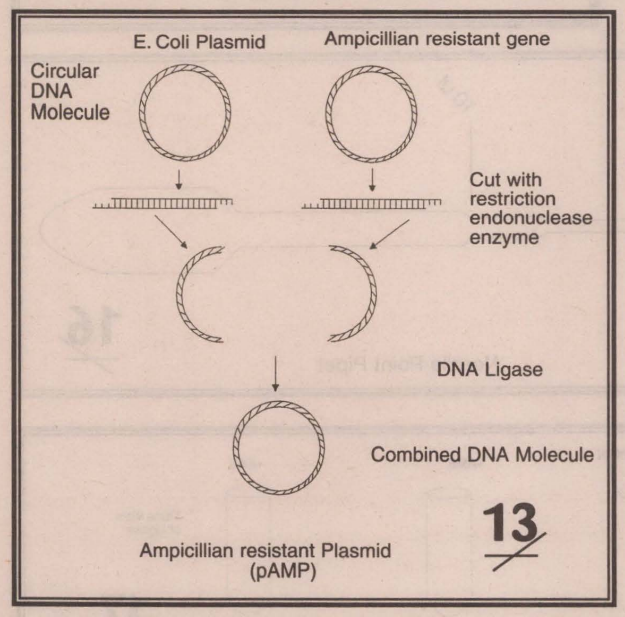
Two other enzymes were

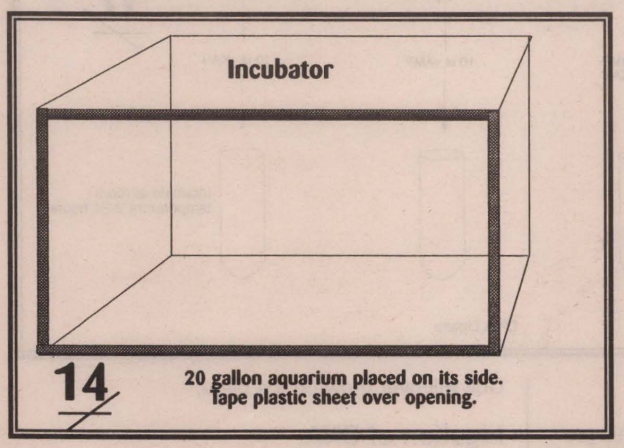




An enzyme DNA Ligase repairs breaks in one strand of double stranded DNA.







employed to finish the job. DNA polymerase filled any single stranded gaps and DNA ligase sealed the junction points (see Figure 11). (Later it was found out that EcoRI produced its own sticky ends, eliminating the need to add tails to the DNA strands.)

Paul Berg's experiment illustrated that a restriction enzyme could be used to cut DNA in a predictable and controlled manner and that the DNA fragments from different organisms could be joined together.

Putting Recombinant DNA to Work

In 1973, Stanley Cohen and Annie Chang brought Berg's experiment further. They inserted the recombinant plasmid back into the E. Coli bacteria where it was maintained and replicated itself along with the cell.

Restriction Endonuclease Enzymes

There are three major classes of restriction endonuclease. Types I and III cut DNA at sites a distance away from their recognition sequences. ATP must be provided to provide energy for these enzymes to work.

The enzyme used most often is the Type II. These enzymes cut DNA in a predictable manner on or adjacent to the recognition site. The energy required is supplied by a simple magnesium ion (Mg ++). Currently there are over 1,200 Type II restriction endonuclease enzymes.

The names of these enzymes are coded as follows.

1) The first letter is usually the initial letter of the organism from where the enzyme is collected.
2) Second and third letters are usually the organism's species name.
3) The fourth letter, if any, indicates the strain.
4) The roman numeral usually indicates the order of discovery.

So EcoRI breaks downs as follows:

E = genus Escherichia
co = species coli
R = Strain RY13
I = First endonuclease isolated

HindIII breaks down to:

H = genus Haemophilus
in = species influenza
d = strain RD
III = Third endonuclease isolated

Making E. Coli Competent

Competent is a term used to describe cells brought into the proper physiological state, so that they will absorb molecules of foreign DNA from the environment. In 1970, Mandel and Higg found that E. Coli becomes competent when the cells are suspended in a cold calcium chloride solution and subjected to a brief heat shock at 42° C (see Figure 12).

The precise mechanism of DNA uptake by competent E. Coli cells is at the moment unknown. However, this is the method that we shall use for our DNA experiment.

Plasmid Vector

In standard medical terminology, a vector is an organism that carries a disease from one host organism to another. In genetic engineering, a vector is a DNA molecule that carries an inserted gene into a host cell.

The plasmid vector we shall use is from E. Coli. Plasmid vectors range in size from 1,000 to 200,000 base pairs (bp). It is a circular or looped DNA molecule. The advantage to using a plasmid DNA is that it exists separately from E. Coli's main chromosome. In addition, it has the ability to replicate itself within the cell, synthesize proteins, and propagate through successive bacterial generations.

The plasmid structure within the host cell carries out protein synthesis. And, as in our case, it will also synthesize the protein from the gene (DNA) instructions we inserted into it.

The making of a pAMP plasmid vector is illustrated in Figure 13. Although the regents are available for splicing our own plasmids and inserting a gene, it is easier to purchase a kit with plasmid vectors and antibiotic genes ready to be joined together and inserted into a bacterial cell.

Gene Splicing Experiment

A word of caution is in order before we start. Although the materials in the kit are safe, it is important for you to follow simple procedures to keep the experiment controlled and nonthreatening.

We are working with Escherichia Coli bacteria, a favorite of gene splicers everywhere. It is not a pathogenic bacteria, in fact it is part of the normal bacteria fauna that exists in your colon. It is rarely associated with any disease, but you should follow sterile procedures at all times.

Overview

In this experiment we will construct three types of vector plasmids. One plasmid will contain an antibiotic resistance gene for ampicillin called pAMP. The second will contain a gene for the resistance of the antibiotic kanamycin called pKAN. The third will contain the genes of both called pAMP/pKAN.

The E. Coli plasmid fractions, along with the antibiotic DNA, are mixed with DNA ligase to form stable recombinant DNA. Next, we use the calcium chloride procedure to inject the plasmids and transform the E. Coli bacteria with the recombinant DNA. To test the bacteria for uptake of the recombinant DNA, we culture the bacteria on specific agar plates. One plate has ampicillin, another has kanamycin, the third has both ampicillin and kanamycin, and the fourth is plain nutrient agar.

Only the bacteria that has been transformed can grow on the antibiotic treated agar. Our control E. Coli group that remains untransformed will not grow on any of the anti-biotically treated plates. But our transformed bacteria will.

You can purchase all the materials necessary separately to do this and other DNA experiments, or purchase a kit. I strongly advise to purchase the kit, see suppliers index.

The kit includes:

Vial Plasmid pAMP
12 needle point pipets
Vial plasmid pKAN
18 1-ml sterile transfer pipets
3 vials ligase/ligation

4 15-ml sterile culture tubes
Culture E. Coli
5 sterile inoculating loops
Vial Calcium Chloride
Glass cell spreader
3 agar plates
Manual
2 AMP agar plates
2 KAN agar plates
2 AMP/KAN agar plates

The kit supplies all the tubes, pipets, plates, cultures, and regents needed for this experiment.

When you receive the kit in the mail, refrigerate the culture plates (upside down) along with the vials of plasmid pAMP, pKAN, and calcium chloride. Freeze the vial of ligase/ligate buffer/ATP. The other materials can be stored at room temperature.

In addition to the materials provided in the kit, you also need: 70-95% ethanol alcohol; a small quantity of distilled water; a marker for labeling culture plates and tubes; beaker or dish; 98.6° F incubator; 106° F water bath; crushed ice; a small quantity of household bleach; alcohol lamp or bunsen burner.

98.6° F Incubator

Since E. Coli inhabits the human colon, it is not surprising that the optimum temperature for its growth is human body temperature 98.6° F. You can use any enclosed space for an incubator. If you don't have such an area, a 20 gallon glass aquarium will suffice nicely. Place the aquarium on its side with the open end facing you. Tape a piece of plastic to the top of the aquarium, so that the plastic drapes down, covering the open end of the aquarium (see drawing). Secure the plastic to just the top of the aquarium. In order to work inside, you will need to lift the plastic up and out of the way.

To heat the incubator to 98.6° F, use a standard incandescent lamp enclosed in a can or small pail. I needed a 75 watt bulb to warm the incubator to 92° F. This is lower than the optimum temperature recommended, but it works fine. Start out using a low wattage 40 watt bulb and measure the temperature after 12-24 hours. Increase wattage if necessary. If the incubator becomes hotter than 98.6° F, reduce the wattage of the bulb. If it is impossible to adjust the temperature by just changing the wattage of the bulb, insert a light dimmer control to the bulb. Use the light dimmer to adjust the power to the lamp and consequently the temperature. It is better to keep the temperature a little lower than 98.6° F than above.

It's a good idea to set up your incubator before the kit arrives, this way you can start on it right away.

107.6° F Water Bath

You only need the water bath once for 90 seconds to heat shock the bacteria. You can use an aquarium heater to bring the water to this temperature. In a pinch, just run tap water adjusting the temperature with a thermometer to 107 degrees.

Adjust and keep the water running into a small container. Use water in the container to heat shock the bacteria.

Simple Procedures

Always follow these procedures:

• Wash your hands with an anti-bacterial soap before and after working with the materials.

• Keep work space and incubator spotless. Wipe area with 10% bleach solution or a disinfectant like Lysol.

• Disinfect all materials after use (such as tubes, pipets transfer loops) by placing in 10% bleach solution.

Starter Plate

Our first step is to incubate and grow E. Coli strain bacteria on an agar culture plate. We will need the colonies grown on this plate for the rest of the experiment.

1) Take one plain LB agar plate and mark the bottom of the plate "E. Coli." Indicate the date you streaked the plate.
2) Using the wire inoculating loop, sterilize the loop in the flame of the alcohol lamp or bunsen burner. Allow wire to get red hot, then remove from flame. Hold the loop for a few seconds for it to cool. Do not place inoculating loop down, this would contaminate it.
3) Hold vial of E. Coli culture in opposite hand and remove cap with your little finger of the hand holding the inoculating loop. With cap removed, pass mouth of vial through flame to sterilize it.
4) Push inoculating loop into the side of agar to cool loop. Then drag the loop a few times across the area of E. Coli culture. Remove the loop, pass the mouth of the vial through the flame again, and recap it.
5) Lift top of agar plate, marked "E. Coli" just enough to perform streaking (see Figure 15).

a) Drag loop back and forth across the agar surface. Do not stab loop into the agar. Make a few streaks across the top as in Figure 15. Replace lid between streaks.

b) Turn agar plate 1/4 turn. Reflame loop, cool loop by stabbing it into the agar plate away from first streak. Pass loop once through first streak and continue in zig-zag pattern.

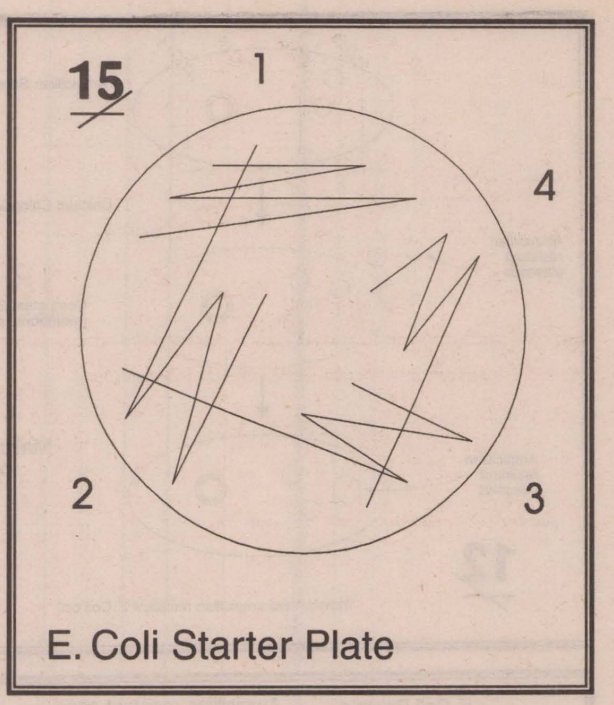
c) Turn agar plate 1/4 turn. Reflame loop and proceed as before, except draw loop once through secondary streak.

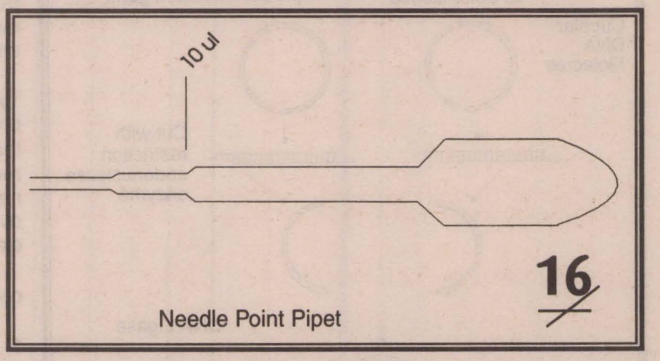
d) Turn agar plate 1/4 turn. Reflame loop and proceed as before, except draw loop once through third streak, and make a final zig-zag pattern.

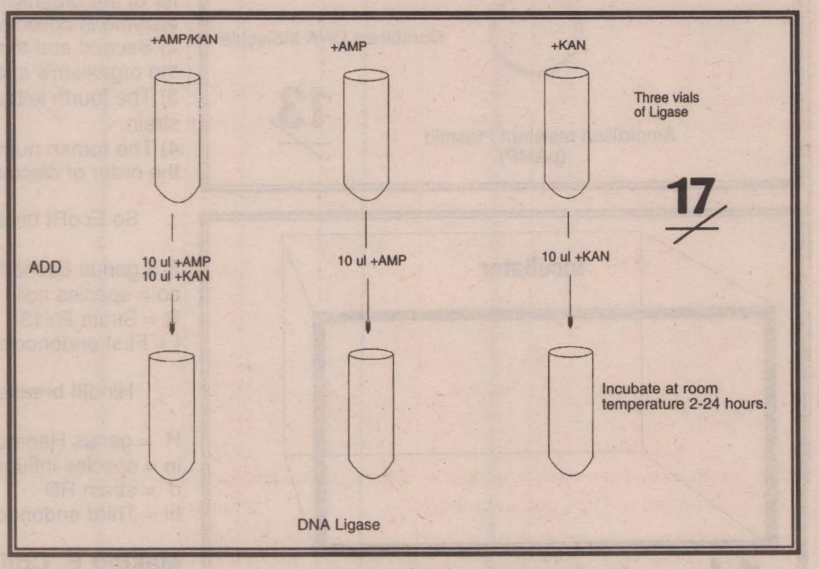
e) Replace lid on culture plate.

6) Reflame loop before putting it down. This prevents contaminating work space. Make this a habit.
7) Place plate upside down in incubator. This prevents condensation, that may collect on the lid from falling into the agar and smearing the E. Coli colonies. Incubate plate from 12-24 hours.
8) After initial incubation, remove from incubator and allow colonies to grow 1-2 days at room temperature.

Do not over incubate the culture or the E. Coli will over grow on the plate.

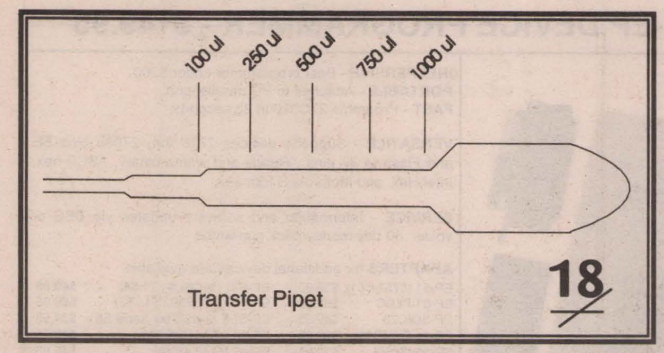






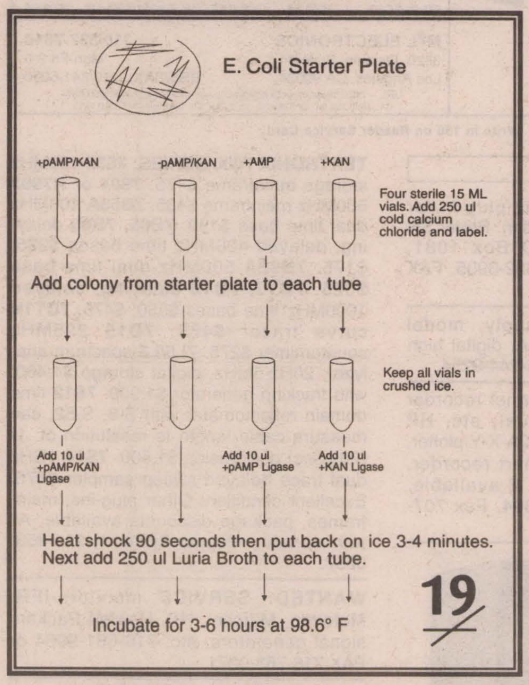
Ligation of DNA

In this procedure, we are linking the fragmented DNA molecules together with E. Coli plasmids. The regents labeled pAMP and pKAN have the plasmid DNA strands from E. Coli bacteria, as well as the antibiotic DNA fragments. The ligase links the two DNA molecules via the formation of a phosphodiester bond. The ATP in the ligation solution provides the energy for the reaction joining the nucleotides together. See

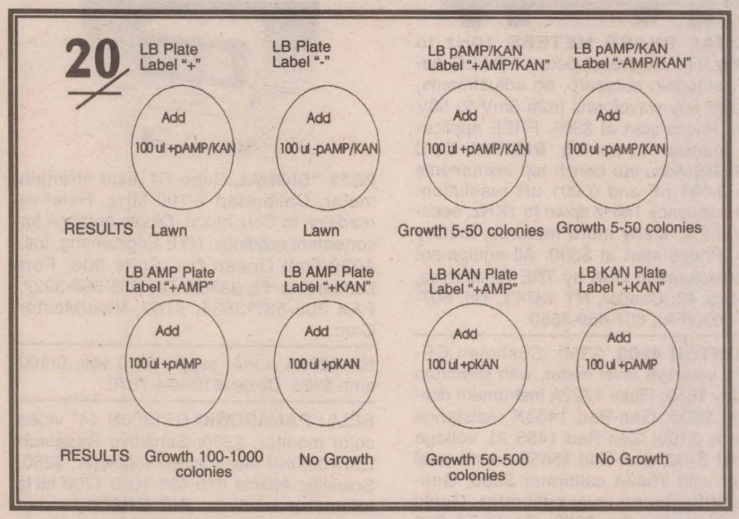


Transfer Pipet

18



19



simple structure of DNA molecule under nucleotides.

It is interesting to note that this procedure forms many different types of hybrid molecules, such as plasmids composed of more than two fragments. However, only those that form properly will be maintained and expressed in the cell.

1) You will need the three vials containing 20 ul of ligation buffer ATP/ligase. Label one tube +pAMP/KAN, label another +pAMP, and the last tube +pKAN.
2) To measure quantities, use a sterile needle-nose pipet (see Figure 16). Use a fresh needle-nose for each regent.
a) To the +pAMP/KAN tube, add 10 ul of pAMP and 10 ul of pKAN.
b) To the +pAMP tube, add 10 ul of pAMP and 10 ul of distilled water.
c) To the +pKAN tube add, 10 ul of pKAN and 10 ul of distilled water.
3) Close tube tops and gently tap tube bottoms on the table to mix regents.
4) Incubate tubes at room temperature for 2-24 hours (see Figure 17).

Transform E. Coli with Recombinant DNA

In this procedure, we are making the E. Coli cells competent which allows the cells to uptake the recombinant DNA we made in the preceding procedure.

1) Get four sterile 15 ml tubes. Label one "+pAMP/KAN," label the second "-pAMP/KAN," the third "+pAMP," and the fourth "+pKAN." Using a sterile transfer pipet (see Figure 18), add 250 ul of cold calcium chloride to each tube. Place four tubes into beaker or dish with crushed ice.
2) Using a sterile plastic inoculating loop, transfer one or two colonies of E. Coli from the starter plate to the +pAMP/KAN tube. Be careful not to transfer any agar from the plate along with the cell colonies.
a) Immerse the loop into the calcium chloride solution. Tap against the side of the tube to dislodge the cell mass.
b) Suspend cells in the solution by repeatedly pipeting in and out with a sterile transfer pipet. Return +pAMP/KAN tube to ice.
3) Transfer cell colony to -pAMP/KAN tube using the same procedure as describe in step 2. Return -pAMP/KAN tube to the ice.
4) Transfer cell colony to +pAMP tube using the same procedure as described in step 2. Return +pAMP tube to the ice.
5) Transfer cell colony to +pKAN tube using the same procedure as described in step 2. Return +pKAN tube to the ice.
6) Using a fresh needle-nose pipet for each transfer:
a) Transfer 10 ul of ligated +pAMP/KAN to +pAMP/KAN culture tube.
b) Transfer 10 ul of ligated +pAMP to +pAMP culture tube.
c) Transfer 10 ul of ligated +pKAN to +pKAN culture tube.
d) *Do not* transfer any material into -pAMP/KAN culture tube.
7) Place all tubes back in ice and let them incubate for 15 minutes.
8) Following the 15-minute ice incubation, it's time to heat shock the E. Coli cells to make them competent. Remove all the tubes from the ice and immediately immerse them in the 107° F water bath for 90 seconds. Then return all the tubes directly into the ice again. Keep tubes on ice for 3-4 minutes.
9) Using a sterile transfer pipet, add 250 ul of luria broth (LB) to each tube. Gently tap tube with finger to mix broth and place tubes in incubator, at 98.6° F for 3-6 hours, (see Figure 19).

Plating the Results

In this procedure, we will check to see if we have successfully incorporated our recombinant DNA into the E. Coli bacteria.

The culture plates supplied with the kit are marked showing the agar medium.

1) Using the plates supplied in the kit label them as follows:
a) Label one LB plate "+"
Label one LB plate "-"
Label one LB/AMP/KAN plate "+pAMP/KAN"
Label one LB/AMP/KAN plate "-pAMP/KAN"
Label one LB/AMP plate "+pAMP"
Label one LB/AMP plate "+pKAN"
Label one LB/KAN plate "+pKAN"
Label one LB/KAN plate "+pAMP"
2) Using a sterile transfer pipet, add 100 ul of the cell suspension from the -pAMP/KAN culture tube on the -LB/AMP/KAN plate and another 100 ul on the -LB plate. Spread cells over the surface of the agar using the following procedure.
a) Dip glass spreader in the ethanol alcohol, and ignite the alcohol using the bunsen burner or alcohol lamp. After the alcohol burns off the spreader, it is sterile for use. Use spreader to evenly distribute cells over the agar.
3) Using another sterile transfer pipet, add 100 ul of the cell suspension from the +pAMP/KAN culture tube to the +LB/AMP/KAN plate and another 100 ul on the +LB plate. Spread cell suspension as outlined in 2a.
4) Using another sterile transfer pipet, add 100 ul of the cell suspension from the +pAMP culture tube to the +pAMP plate, and another 100 ul to the +pKAN plate. Spread cell suspension as outlined in 2a.
5) Using another sterile transfer pipet, add 100 ul of cell suspension from the +pKAN culture tube to the +pAMP plate and another 100 ul to the +pKAN plate. Spread cell suspension as outlined in 2a.

Allow plates to set up for 10 minutes, then wrap together with tape. Place plates upside down in 98.6° F incubator. Incubate plates for 12-24 hours.

Results

Figure 20 illustrates the results of the experiment. If the E. Coli growth is too dense to count, record lawn.
1) The LB plates labeled "+" and "-" show that both the transformed E. Coli and natural E. Coli are viable and grow equally well.
2) The LB plates that contain ampicillin and kanamycin labeled "+AMP/KAN" and "-AMP/KAN" show that only the E. Coli that have been transformed with both antibiotic resistant genes can grow. The natural E. Coli fails to grow in this medium.
3) The LB plates that contain the ampicillin illustrate that the gene for pKAN does not contain a resistant gene for ampicillin.
4) The LB plates that contain kanamycin illustrate that the gene for pAMP does not contain a resistant gene for kanamycin.

By measuring the growth of the colonies, we can determine that ligation of two genes pAMP and pKAN is more rigorous (5-50 colonies) than either single ligation. Further that ligation of the pKAN gene is more rigorous (50-500 colonies) than ligation of pAMP gene (100-1000 colonies). **NV**

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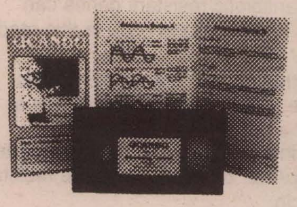
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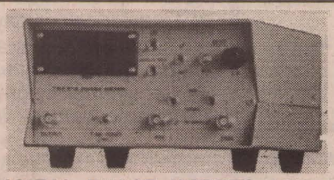
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#80 TEST EQUIPMENT *cont.*

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.

LAMBDA lab power supply, model LESF030V. 0-32VDC, 0-24A, digital high accuracy readout. $350. 415-244-9254.

SALE. COMPLETE 8 channel recorder system with paper manual, etc. HP 7418A/8821A $350. HP 9862A X-Y plotter, $150. **Chessell** 301 D chart recorder, complete w/paper $150, 2 available. **Psitech Plus**, 707-745-4804, Fax 707-747-5277.



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BOONTON 4200, $350; Cushman CE-70/71 selective level meter, with spectrum display $650; Fluke 1722A instrument controller $500; Gen-Rad 1433X resistance decade $100; Gen-Rad 1455 AL voltage divider $100; Gen-Rad 1565B sound level meter with 1562A calibrater $350; Gen-Rad 1982 sound level calibrater, Gould 220 chart recorder $225; Gould TA 260 easy graf chart recorder $500; HP 334A distortion analyzer $275; HP 333A distortion analyzer $300; HP 4328A milliohmmeter $250; HP 432B-H05 to 100 watts $450; HP 478 thermister $125; HP 5182A waveform recorder, digitizer, $850; HP 4925A bit error test set $350; HP 5359A time interval analyzer, $750; HP 740B DC Calibrator, $250; HP 745/746 (New) AC Calibrator $650; HP 8900B peak power meter $150; Krohn-hite 3750R $250; North Atlantic phase angle voltmeter 212C $300; RFL 829G AC/DC calibration standard $600; Sencore LC-53, $350; Singer-Stoddart NM-37/57 field strength meter $350; Tek 6042, current probe $200. 520-432-1365, Phone/Fax.

TEKTRONIX 7000 SERIES: 7633 100MHz storage mainframe $475. **7904** or **R7903** 500MHz mainframe $435. **7B53A** 100MHz dual time base $190. **7B85, 7B80** delaying, delayed 400MHz time bases $225, $175. **7B92A** 500MHz dual time base $325. **7B15, 7B10** delaying, delayed 1000MHz time bases $550, $475. **7CT1N** curve tracer $475. **7D15** 225MHz counter/timer $275. **7L5/L3** spectrum analyzer, 20Hz-5MHz, digital storage $1,400; with tracking generator $1,900. **7S12** time domain reflectometer with S-6, S-52, can measure cable length to resolution of .1" (20 psec) per division $1,500. **7S14** 1GHz dual trace delayed sweep sampler $675. Excellent condition! Other plug-ins, mainframes, package discounts available. All with warranty. Pepper Systems, 214-353-0257.

WANTED: SERVICE monitors-IFR, Motorola, Marconi, HP, Hewlett Packard signal generators, etc. 716-661-9964 or FAX 716-763-0371.



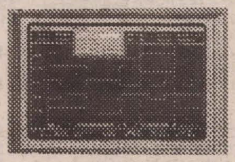
FS73 "SIGNAL Cube RF field strength meter. Calibrated 1-100 MHz. Relative readings to GHz range. Dipole antenna for consistent readings. NYE Engineering, Inc. 4020 Galt Ocean Dr., Suite 606, Fort Lauderdale, FL 33308. Tel. 305-566-3997, FAX 305-537-3534, $169. Visa/Master Card.

HP 6260A power supply 0-10 volt, 0-100 amp $325. Dexis, 612-944-7670.

SELL: PANASONIC BT1300N 14" video color monitor, $300; Sensitive Research ESH 0-60KV electrostatic voltmeter, $250; Scientific Atlanta 410-428 1660-1700 MHz telemetry receiver; JVC CR600U video recorder, $600; JVC CR850U editing cassette video recorder, $900; JVC KM-1200U special effects generator, $300; JVC SAT400U time base corrector, $250; HP 5004A signature ana, $200. A-Comm Electronics, 303-290-8012.

LOGIC ANALYZERS: Biomation K100D, $450; HP 1600A, with pods, $400; HP 1607A, $150; HP 10254 serial to parallel convertor, $150; HP 1611A, Z80 module, $200; Tek 7D01/DF-2 with probes and grabbers $650. Digital Meters: Fluke 8000A $65; 8012A, $125; 8050A, $150; 8810A, $150; 8840AF, $650; 8502A, $350; HP 3437A, $175; HP 3465A $150, 3435A, $150; 3455A, $350; Dana Labs 5100, $50. 520-432-1229, phone or Fax.

GR TEST Equipment: GR1142A frequency discriminator, $75; GR1216A, IF unit, $75; GR1360A, microwave oscillator 1.7-4.1 GHz, $150; GR1432J, decade resistor, $100; GR1432M, $100; GR1432P, $100; GR1421B graphic level recorder, $300; GR1522 DC recorder, $350; GR1606A RF bridge, $400; GR1650A RLC bridge, $250; GR1925 multifilter, $500, GR222 precision condenser, 1500 PF, $150; GR546-C, audio microvoltmeter, $150; GR722-D precision variable cap, $200; GR874-D50; 50CM stub, $50; GR874-F500L 500MHz low pass filter, $60; GR916AL RF bridge, $250; A-Comm Electronics, 303-290-8012, 303-290-8133 FAX.



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AIRCRAFT TEST equipment, TIC VOR Ramp $50, MEC 140 $450, TIC T12, $150, more. Microwatch SWR $25, Box antique radio stuff from 1928 on, as is, unopened. $150. Dave Graves, 3106 W. Osborne, Tampa, FL 33614. 813-879-2545.

HEWLETT PACKARD 5245L counter, DC to 50MHz, $69. **1MHz** oscillator assembly, $35. **Readout cards** with nixies, $15. Misc. parts, covers. **Ed Matsuda,** PO Box 390613 San Diego, CA 92149. 619-479-0225.

HP 6264B power supply 0-20V, 0-20A, $450. Dexis 612-944-7670.

FEITEK PROVIDES repair, calibration and certification on many makes of test equipment. We also have a large selection of used equipment. Send large SASE envelope for list. VISA and MasterCard accepted. Feitek Inc., 2752 Walton Road, St. Louis, MO 63114, 314-423-1770.

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PORTABLE SCOPES Tek 465B/DM44 (100MHz) $625. **Tek 475** (200MHz) $595. **Tek 475** (200MHz) $595. **Tek 475/DM44** (200MHz) $660. **Tek 475A** (250MHz) $695.**Tek 475A/DM44** (250MHz) $760. **Tek 485** (350MHz) $790. **HP 1727A** (275MHz storage) $925. **Tek 466** (100MHz storage) $825. **Tek 2465 & 2465DVS** (300MHz) call. All with BRIGHT CRTs, excellent condition, warranty. Pepper Systems, 214-353-0257.

EQUIPMENT MANUALS we have 1000's of service and operators manuals for all types of test and measurement equipment from 1950 to present. All test equipment manufacturers are represented. Call, write, or fax your want list. Please include mfg.'s manual P/N unit serial no's if known. **Manuals Plus,** Box 937, Spanaway, WA 98387. 206-531-8031 or FAX 206-536-1121.

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INSTRUMENTATION: TEK 7912AD programmable digitizer $3,995; Tek 7834 storage osc. $1,590; HP 6259B DC power supply 0-10V 0-50A $425; Western Graphtec WR3101 12 channel recorder with 12 AZ3101 amplifiers $4,995; HP 6621 programmable dual power supply 0-20V $2,295; Fluke 2205A switch controller with RS-232 $1,795; many Tek 7 Series plug-ins. 206-881-2797.

CLARKE-HESS 255 volt amp watt meter $475/offer. Dexis, 612-944-7670.

SPECTRUM ANALYZERS Tek 7L12 0.1-1800MHz $1,100, Tek portable 1401/324 1-500MHz w/access $650, 7B92 $120, 7A19 $130, P6109 $40, ICOM H16 VHF portable $325, all VG to Exell. Jeff, 503-690-8904.

HP 5363B time interval probe $295/offer. Dexis, 612-944-7670.

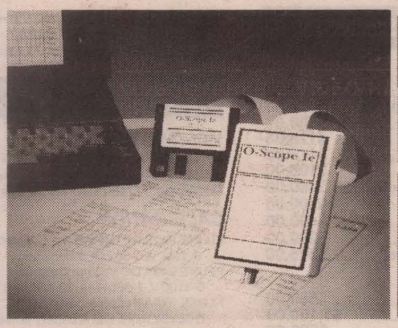
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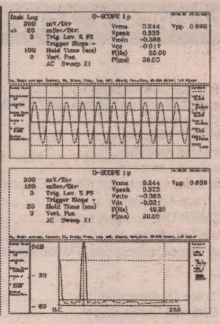
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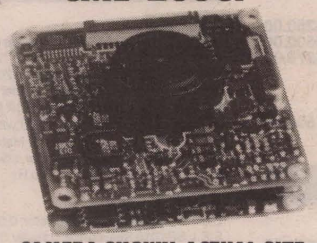
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GR 1432-U 4-Decade Resistor, 0-111.10 ohms, 0.01 ohm resolution $175.00
GR 1433-X 6-Decade Resistor, to 111,111.0 ohms, 0.1 ohm res. $550.00
GR 1434-G 7-Decade Resistor, 0-1,111,111.0 ohms, 0.1 ohm res. $500.00

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
VALHALLA 4150-ATC 4-1/2 digit Ohmmeter, 20 milliohms-2 kilohms, 4-wire $1,000.00

CURVE TRACERS

TEK 577D1/177 Storage Curve Tracer, with standard test fixture $2,250.00
TEK 577D2/177 Curve Tracer, with standard test fixture $1,950.00
TEK 7CT1N 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

POWER SUPPLIES

SINGLE OUTPUT

GLASSMAN PS/EG-05R06 5kV CV/CL Power Supply, to 6mA $500.00
HP 6023A Autoranging 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 6439B 60 V at 15 A CV/CC Power Supply $550.00
KEITHLEY 240A HV Power Supply, 0-1200 V, 0-10 mA, CV/CL $250.00
SORENSON DCR 110-45T 110 V at 45 A CV/CC Power Supply $2,200.00
SORENSON DCR 300-6B 300 V at 6 A CV/CC Power Supply; 120 VAC line $1,000.00
SORENSON DCR 300-8A 300 V at 8 A CV/CC Power Supply; 208/230 VAC line $950.00
SORENSON SRL 60-8 60 V at 8 A CV/CC Power Supply, low noise $950.00

MULTIPLE OUTPUT

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

MISCELLANEOUS

HP 59501A HPIB Isolated DAC/Power Supply Programmer $175.00
HP 6824A Bipolar Power Supply/Amplifier, to 50 V, 1 A $400.00
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

TIME & FREQUENCY

UNIVERSAL COUNTERS

HP 5314A 100 MHz/100 nS Universal Counter $225.00
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-ch $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

FREQUENCY COUNTERS

EIP 545-opt.05,08 18 GHz Frequency Counter, OCXO and GPIB $1,875.00
FLUKE 7220A-opt.111 1.3 GHz Communications Counter, TCXO option $650.00
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-003,011 18 GHz Freq.Counter, +22 dBm,-20 dBm dynamic range,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., 0.1/1.0/5.0 MHz x 4 channels each $1,800.00
HP 5359A Time Synthesizer, pulse width 5 nS-160 mS, jitter<200pS $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 DA4084 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

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MasterCard AMERICAN EXPRESS

HP 400FL AC Voltmeter, 100 uV-300 V f.s., 20 Hz-4 MHz $200.00

OSCILLATORS

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
TEK SG502 Sine/Square Osc., ... $350.00
5 Hz-500 kHz, 70 dB step atten.,TM500
TEK SG505 Low Distortion Oscillator, 10 Hz-100 kHz $850.00

FILTERS, MISCELLANEOUS

HP 3575A-002 Phase-Gain Meter, 1 Hz-13 MHz, dual display $900.00
KROHN-HITE 3202 Dual High-Pass/Low-Pass $600.00
Filter, 20 Hz-2 MHz, 24 dB/oct
KROHN-HITE 3342 Dual HP/LP Filter, ... $1,100.00
0.001 Hz-99.9 kHz, 48 dB/octave
KROHN-HITE 3343 Dual HP/LP Filter, ... $950.00
0.01 Hz-99.9 kHz, 48 dB/octave
TEK AM502 Differential Amplifier, 0.1 Hz-1 MHz, TM500 series $575.00

RF & MICROWAVE

SPECTRUM ANALYZERS

EATON/AILTECH NM-17/27A $3,250.00
Measurement Receiver, 10 kHz-30 MHz, 0.1/1/10/50 kHz BW
HP 11970A WR28 Harmonic Mixer, 26.5-40 GHz $1,100.00
HP 11970Q 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, 1/10/100 MHz increments, to 5 GHz $450.00
HP 8443A 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, ... $1,500.00
0.5-1500 MHz, for 8554,8568,etc.
HP 8445B Preselector, 1.8-18.0 GHz, for HP 8555A $800.00
HP 8552B IF Section $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, ... $2,000.00
100 kHz-1250 MHz, 100 Hz resolution
HP 8555A RF Section, 0.01-18 GHz $950.00
HP 8555A/8552B/141T Spectrum Analyzer $2,250.00
System, 10 MHz-18 GHz, 100 Hz res.
HP 8555A/8552B/8445/141 As above,w/1.8-18 GHz $3,000.00
Preselector, opt.003 freq.display
HP 8558B/181TR Spectrum Analyzer, ... $2,250.00
0.1-1500 MHz, 1 kHz res., w/display
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 7L18/7603 Spectrum Analyzer, ... $3,400.00
1.5-18.0 GHz, 30 Hz res., w/display
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, ... $1,250.00
100 kHz-110 MHz, with sweep generator
HP 85021A Directional Bridge, ... $1,200.00
0.01-18.0 GHz, APC7, for 8755/6/7
HP 85027E Directional Bridge, ... $2,000.00
10 MHz-26.5 GHz, for 8757 series
HP 85050D APC7 Calibration Kit, for 8510 series $1,100.00
HP 8505A-005/8503A Network An., ... $6,000.00
0.5-1300 MHz, w/S-Parameter & phase lock
HP 8755C/(3)11664A/181T Scalar Network $1,750.00
An. w/3 detectors, 10 MHz-18 GHz & frame
HP 8756A/(3)11664A Scalar Network Analyzer, ... $3,750.00
w/(3) detectors, 0.01-18 GHz
NARDA 7000A/7202/7206 Microwave Multimeter $1,950.00
System: scalar analysis 0.1-18 GHz
WILTRON 560/ 3x-7S50 Scalar Network $2,000.00
Analyzer, w/3 detectors, 0.01-18.5 GHz
WILTRON 640/G50/E(2)/7B50(2) Network An., ... $1,675.00
w/1-1500 MHz source, (2) log amp, (2) det.

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., ... $3,500.00
100 kHz-1040 MHz, 100 Hz res., GPIB
FLUKE 6060A/AN Synthesized Signal Gen., ... $2,000.00
10 kHz-520 MHz, 10 Hz res,GPIB
FLUKE 6071A-830,870 Synthesized Signal Gen., ... $4,000.00
0.2-1040 MHz, 1 Hz res., GPIB

SWEEP GENERATORS

GIGATRONICS 605/0.01-8.0, opt.3 Synthesized Source, ... $3,000.00
10 MHz-8 GHz, 1 kHz res.
GIGATRONICS 605/10-18, opt.3 Synthesized Source, ... $3,000.00
10-18 GHz, 1 kHz res.
GIGATRONICS 605/6-12, opt.3 Synthesized $3,000.00
Source, 6-12 GHz, 1 kHz res.
GIGATRONICS 875/50 Levelled Multiplier, x4, ... $3,500.00
50.0-75.0 GHz output, -3 dBm
GIGATRONICS 875/86 Levelled Multiplier, ... $7,000.00
26.5-40.0 & 50.0-75.0 GHz outputs
HP 85100V Frequency Mult., ... $4,250.00
10-15 GHz in / 50-75 GHz out >0 dBm
HP 8640B-001,002,003 Signal Gen., ... $2,750.00
0.5-1024 MHz, AM, FM, var. audio osc.
HP 8654A Signal Generator, 10-520 MHz, ... $625.00
calibrated AM & uncal. FM
HP 8660C/86602B/86633B Synthesized $2,750.00
Signal Generator, 1-1300 MHz, AM, FM
HP 8660C/86603A/86633B Synth. Sig. Gen., ... $4,500.00
1-2600 MHz, AM, FM, digital sweep
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, ... $9,000.00
18.0-26.5 & 26.5-40.0 GHz
GIGATRONICS 900/0.05-12, opt.3 Synthesized $4,500.00
Sweep/Sig. Gen., 50 MHz-12 GHz, 1 kHz res.
HP 8350A/86290B-H08 Programmable Sweep $5,500.00
System, 2.0-22.0 GHz, +4 dBm lvl'd
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, HPIB 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, ... $1,950.00
crystal markers, 0-70 dB atten
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
HP 86290C RF Plug-in, 2.0-18.6 GHz, +13 dBm levelled $2,500.00
WAVETEK 1001A Sweep Generator, 0.5-300 MHz $350.00
WAVETEK 1067 Sweep Generator, ... $500.00
1-400 MHz, +10 dBm, 75 ohms
WAVETEK 2002A Signal/Sweep Generator, ... $1,650.00
1-2500 MHz, +10 dBm levelled
WAVETEK 907 Sweep/Signal Generator, ... $1,000.00
7.0-11.0 GHz, 0 dBm levelled
WAVETEK 954 Signal/Sweep Generator, ... $1,750.00
3.7-7.6 GHz, +7 dBm unlevelled
WAVETEK 962 Sweep Generator, ... $2,000.00
1.0-4.0 GHz, markers, +12 dBm unlvld.
WILTRON 6619A-003 Prog. Sweep Gen., ... $1,900.00
2.0-8.0 GHz, +10 dBm levelled, GPIB

POWER METERS

BOONTON 4200-01B/-4G Power Meter w/sensor, ... $1,500.00
1 MHz-26.5 GHz,-60 to +10 dBm,GPIB
BOONTON 42B/41-4E Analog Power Meter, ... $650.00
with 1 MHz-18 GHz sensor
BOONTON 42B/42A-S3 Analog Power Meter, ... $375.00
with 1 MHz-8.4 GHz N(f) sensor
GENERAL MICROWAVE 476/4240A Power $375.00
Meter & Sensor, 0.01-18 GHz, -35 to +10 dBm
HP 11683A Range Calibrator, for HP 435/6/7/8 ..... $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 Autoranging 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 K486A WR42 Thermistor Mount, 18.0-26.5 GHz, for 432 series $400.00
HP Q8486A Power Sensor, 33.0-50.0 GHz, WR22 waveguide $1,500.00
HP R486A WR28 Thermistor Mount, 26.5-40.0 GHz, for 432 series $400.00

RF MILLIVOLTMETERS

MILLIVAC MV-723BBRS RF Millivoltmeter, ... $375.00
10 kHz-1.2 GHz, 1 mV-30 V
RACAL 9303 TRMS Level Meter, ... $875.00
10 kHz-2 GHz, -77 to +23 dBm, GPIB

AMPLIFIERS, MISCELLANEOUS

AILTECH 7616 Noise Source, 1.0-12.4 GHz, N(m), 15 dB ENR $375.00
AILTECH 7618E Noise Source, ... $500.00
10 MHz-18 GHz, SMA(m), 15 dB ENR
AMPLIFIER RESEARCH 1W1000 Amplifier, ... $650.00
30 dB gain, 1-1000 MHz, 1 Watt output
BOONTON 82AD 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 A300 Amplifier, 55 dB, 0.3-35.0 MHz, 300 Watts $3,500.00
HP 8970A Noise Figure Meter, 0.01-1.5 GHz, HPIB $7,000.00
HUGHES 1177H01F000 TWT Amplifier, ... $1,750.00
30 dB, 2-4 GHz, 10 Watts
HUGHES 1177H02R000 TWT Amplifier, ... $1,750.00
30 dB, 4-8 GHz, 10 Watts
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, ... $500.00
18-1000 MHz, FM dev.1.5-150 kHz
MICROWAVE SEMI.CORP. MC5112 N(m), +28 VDC $325.00
Noise Source, 25.5 dB ENR, 1.0-12.4 GHz,

COAXIAL & WAVEGUIDE

AEROWAVE 15-3000/10 WR15 Directional z $400.00
Coupler, 10 dB, 50-75 GH
AEROWAVE 22-3000/10 WR22 Directional Coupler, ... $400.00
10 dB, 33-50 GHz
AMERICAN NUCLEONICS AM-432 Cavity $95.00
Backed Spiral Antenna,LHC, 2-18 GHz,TNC(f) *NEW*
ANZAC MDC-171 Mixer, RF/LO=4-18 GHz, ... $135.00
LO +7 dBm, IF=DC-4 GHz, SMA
AVANTEK YO83-4037 YIG Tuned Osc., ... $100.00
5.4-10 GHz,+15/-5 V, TUNE & FM coils,NEW
BIRD 8201 500 Watt Coaxial Load, DC-2.5 GHz, N(f) $375.00
FXR/MICROLAB S3-02N Triple Stub Tuner, ... $90.00
200-1000 MHz, 100 Watts max., N(m/f)
GR 874-LTL Constant Impedance $450.00
Trombone Line, 0-44 cm, DC-2 GHz
GR 900-LB Precision Slotted Line, 0.3-8.5 GHz, 50 Ohms 0.1% tol. $450.00
GR 900-Q GR900 14mm Interseries 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 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 $875.00
Directional Coupler, 10 dB, 33-50 GHz
KRYTAR 202020016 Directional Det., 2-20 GHz, ... $200.00
SMA(f/m)/SMC(f), 10 uV/uW
M/A-COM 3-19-300/10 WR19 Directional Coupler, ... $450.00
10 dB, 40-60 GHz
MAURY MW. 2640D Slide Screw Tuner, 1.8-18.0 GHz, APC7 ..... $375.00
MAURY MW. J320-series WR22 ..... $375.00
Calibrated Mismatch, VSWR values 1.1-2.0
MICA T-317S Isolator, 15 dB, 17.0-24.5 GHz, SMA $200.00
MILLIWAVE S91-1777B Amplifier, 2.7 dB, ... $150.00
18.0-26.5 GHz, +19 dBm Po, SMA(f)
MINI-CIRCUITS ZHL-1042J Amplifier, 25 dB, ... $325.00
10-4200 MHz, +20 dBm Po
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 $50.00
Trimmer, 8-18 GHz, 10 deg./GHz range,SMA(m/f)
PRD N233A/232 Slotted Line, 3-12 GHz, ... $175.00
N(m/f), w/carriage & detector
SPACEK LABS DQ-1 WR22 Flat Broadband $550.00
Detector, 33-50 GHz
TRG V510 WR15 Precision Rotary $1,000.00
Vane Atten., 0-50 dB, 50-75 GHz
TRG V551 WR15 Frequency Meter, 50.0-75.0 GHz $600.00
TRG/ALPHA V559-10 WR15 Directional $400.00
Coupler, 10 dB, 50-75 GHz
WAVELINE 808 WR42 Var.Phase Shifter, ... $375.00
0-180 deg.,gage read, 18-26.5GHz
WEINSCHEL 1515 Power Divider, DC-18 GHz, SMA(f/f/f) $125.00
WEINSCHEL 1579 Power Divider, DC-26.5 GHz, ... $275.00
APC3.5(f/f/f) *NEW*
WEINSCHEL 3200-1 Programmable Step Atten., ... $200.00
0-127 dB, DC-2 GHz, SMA *NEW*
WILTRON 60A50-opt.1 SWR Bridge, 5-2000 MHz, ... $550.00
APC7 test port, 46 dB dir.
WILTRON 60N50 SWR Bridge, ... $475.00
5-2000 MHz, N(m) test port, 40 dB dir.
WILTRON 87A50 VSWR Bridge, 2-18 GHz, ... $950.00
35 dB dir., APC7 test port

LOGIC

HP 5005A Signature Multimeter $350.00
HP 8170A-002 Logic Pattern Generator, ... $1,400.00
2 MB/s, address driver option
TEK 1240 Logic Analyzer, w/(36) 50 MHz channels $1,500.00

COMMUNICATIONS

HP 3551A Transmission Test Set $800.00
HP 4935A Transmission Test Set, 20 Hz-110 kHz $1,675.00
HP 59401A HPIB Bus Analyzer $700.00
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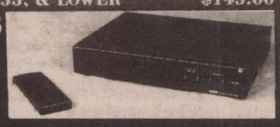
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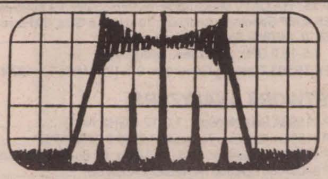
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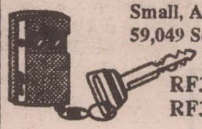
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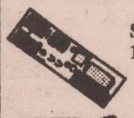
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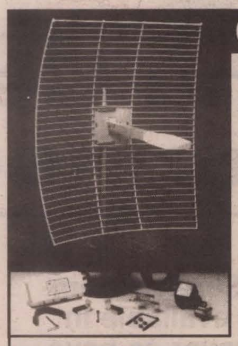
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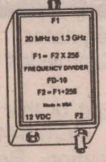
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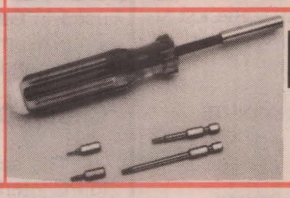
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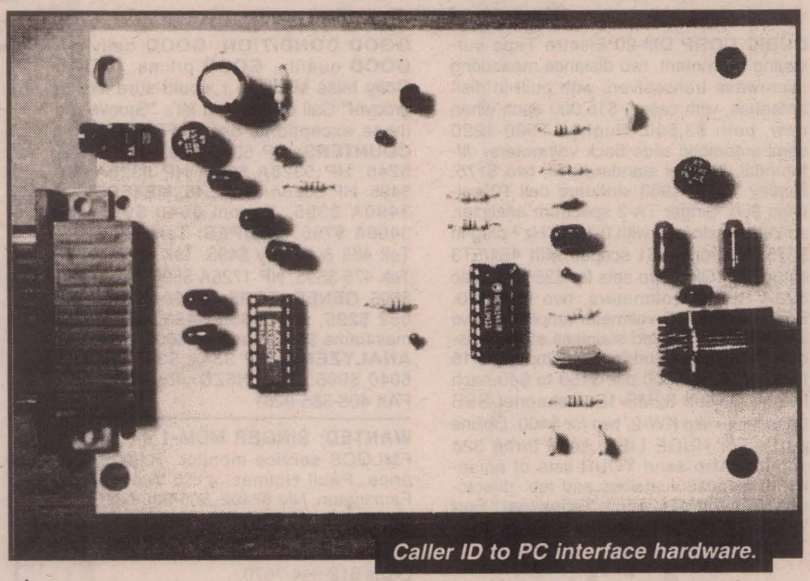
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Making the Caller ID to PC Connection

by Chris Sakkas

Let your computer know who is calling!

The Caller Number Identification Service, commonly known as Caller ID, has been available in most regions for several years. However, to have your personal computer receive the Caller ID information has involved the addition of an expensive modem that features Caller ID support. This article details the construction of an inexpensive and simple-to-build Caller ID receiver that interfaces to the serial port of your PC. We will also discuss the software required to decode the Caller ID format and how to integrate Caller ID into your own applications.



Caller ID to PC interface hardware.

Message Formats

Once you are a subscriber to the Caller ID service with your phone company, the Caller ID information will be sent over the telephone as a burst of data between the first and second ring. This data is sent to conform to the Bell 202 standard which calls for data to be encoded as an analog phase-coherent frequency shift keyed (FSK) serial transmission at 1200 bits per second.

Currently, two types of Caller ID message formats are used by the phone system. The single data message format transmits only the date and time of the call and the caller's number. The multiple data message format incorporates the ability for the phone company to include multiple messages in the data sent. The caller's name is usually sent using this method.

Figure 1 shows the arrangement of the message formats. The single data message format consists of: a Message Type byte used to identify the message format (single data, in this case); a Message Length byte containing the number of bytes in the message following this byte and excluding the error-detection byte; eight bytes with ASCII data providing the month, day, hour, and minute of the call; the ASCII data of the caller's number; and finally a Checksum byte formed by taking the 2's compliment of the modulo 256 sum of the data bytes. The checksum byte can be used to detect the integrity of the data by adding the received checksum byte to the sum of the other bytes received and checking to see if the modulo 256 of this value equals 0.

The multiple message data format consists of: a Message Type byte used to identify the message format; a Message Length byte containing the number of bytes in the message following this byte and excluding the error-detection byte; a series of Parameters that hold the data; and a Checksum byte as described above.

The Parameters consist of a Parameter Type, the Parameter Length, and the Parameter Data. Examples of Parameters that are used in Caller ID include Date and Time, Number, Name, Absence of Name, and Absence of Number.

Caller ID Message Formats

Single Data Message Format

MESSAGE IN ASCII

TYPE	LENGTH	MONTH	DAY	HOUR	MINUTE	NUMBER	CHECKSUM
= 04h	1 byte	2 bytes	2 bytes	2 bytes	2 bytes	data	1 byte

LENGTH = Total number of bytes in message

NUMBER = ASCII bytes of number or "O" for Out of Area or "P" for Private

CHECKSUM = 2's compliment of modulo 256 sum of the message data bytes

Multiple Data Message Format

PARAMETER

TYPE	LENGTH	PAR. TYPE	PAR. LENGTH	DATA	...more parameters...	CHECKSUM
= 80h	1 byte	1 byte	1 byte	ASCII data		1 byte

PARAMETERS:

Date and Time:	PAR.TYPE	PAR. LENGTH	MONTH	DAY	HOUR	MINUTE
	= 01h	1 byte	2 bytes	2 bytes	2 bytes	2 bytes
Number:	PAR.TYPE	PAR. LENGTH	Digit 1, 2, 3, ..., 10			
	= 02h	1 byte	ASCII DATA			
Absence of Name:	PAR. TYPE	PAR. LENGTH	"O" OR "P"			
	= 08h	1 byte	"O" = out of area, "P" = Private			
Absence of Number:	PAR. TYPE	PAR. LENGTH	"O" OR "P"			
	= 04h	1 byte	"O" = out of area, "P" = Private			

FIGURE 1. Caller ID message formats. The single data message format and the multiple data format structures are shown.

Circuit Description

The schematic for the Caller ID to PC interface is shown in Figure 2. Power is supplied to the circuit via a wall transformer in the 6-12 volt AC range connected to jack J1. Full-wave bridge rectifier D1 is used along with capacitor C1 to convert the voltage to DC. LED D2 indicates that power has been applied. Voltage regulator U3, a LM78L05ACZ, provides a steady +5 volt supply.

At the heart of this interface is the Motorola MC145447P Calling Line Identification Receiver IC, labeled U1. This chip is designed to demodulate Bell 202 data and is optimized for this application with its addition of on-chip ring detect. The telephone is connected to the interface unit via standard RJ-11 jack JP1, and bridge rectifier D3 is used along with an attenuation network to provide the proper ring detect signals to U2. U2 demodulates the data it receives from the tip and ring signals of the telephone line and outputs the processed data on pin 15. The Carrier Detect pin output of U2 is also used to supply a carrier detect to the RS-232 port.

The Maxim MAX202CPE IC, labeled U1, is used to drive the RS-232 inputs to the computer. This chip is readily available, inexpensive, and offers the two RS-232 drivers needed in this application using a single +5 volt source. The transmitter outputs are connected to DB-25 connector pins associated with the RS-232 Port's Receive Data (RxD) and Data Carrier Detect (DCD) signals. Also, the RS-232 port signals Data Terminal Ready (DTR) and Data Set Ready (DSR)

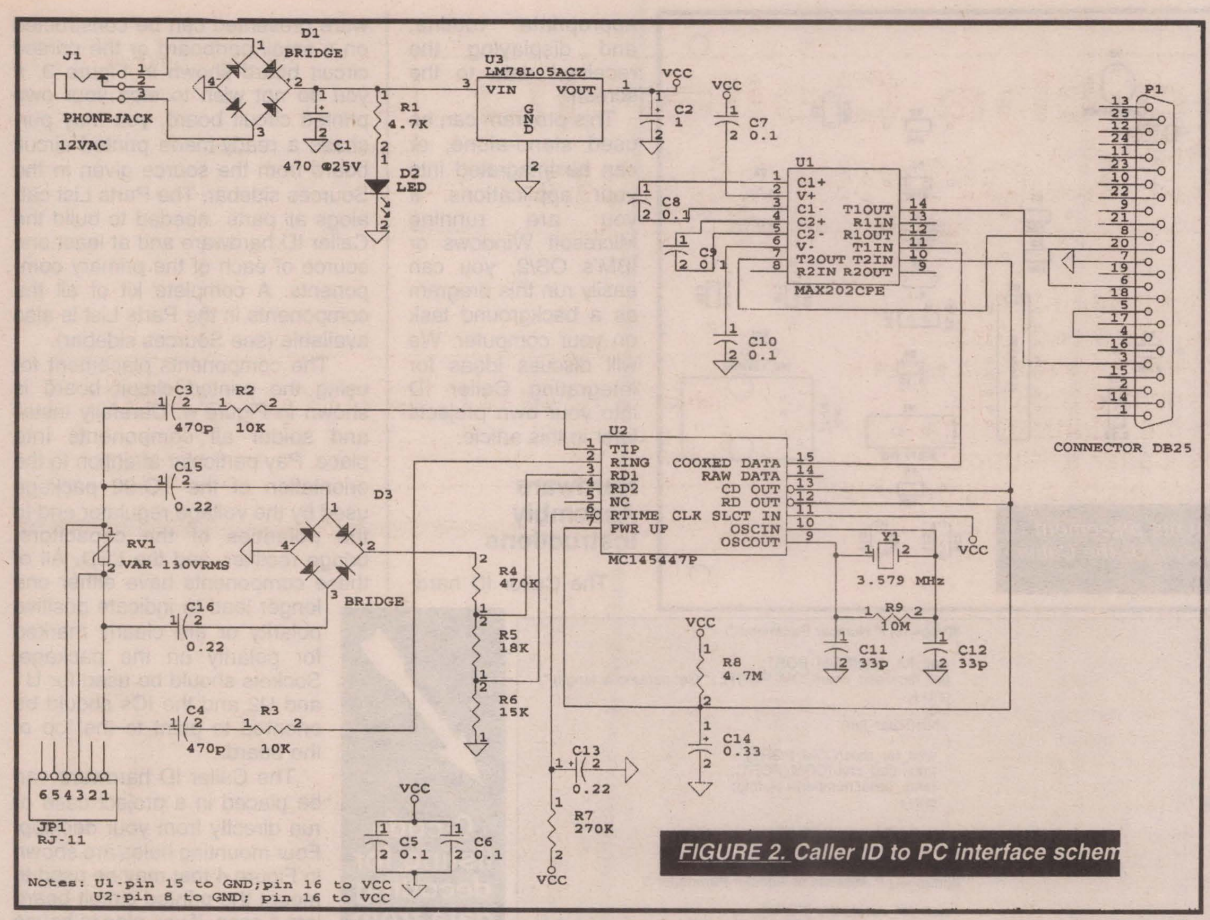


FIGURE 2. Caller ID to PC interface schem

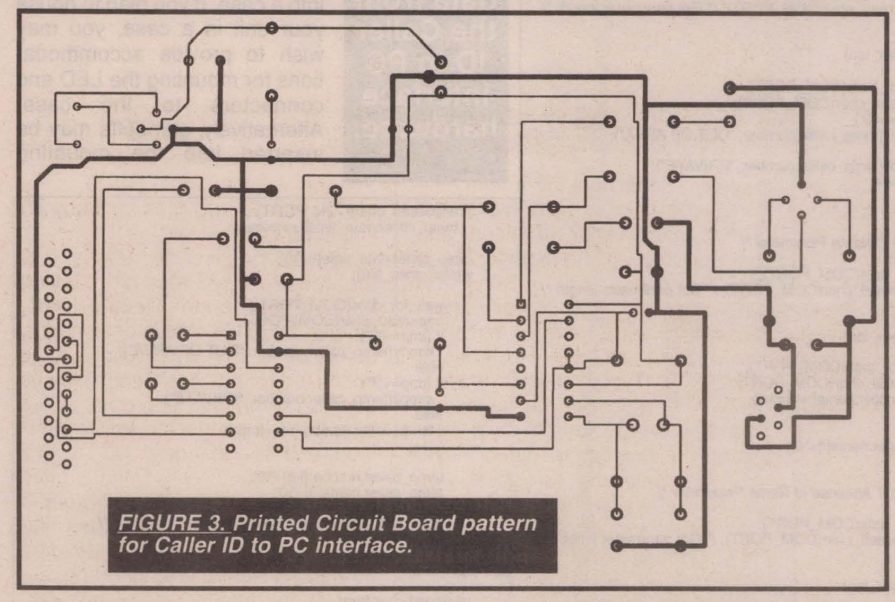


FIGURE 3. Printed Circuit Board pattern for Caller ID to PC interface.

are connected together, as well as the Request to Send (RTS), and Clear to Send (CTS) signals. A simple straight cable (DB-25M to DB-25F) can be used to connect the interface board to the PC's RS-232 serial port or a generic adapter may be required if your PC uses a DB-9 connector.

Software

Software must now be created to read the incoming data from the RS-232 serial port and decode it for proper use. The serial port must first be initialized to a 1200 baud rate, no parity, eight bits, and one stop bit. When this is done, the serial port can be read when data is available and the Caller ID format may be decoded as mentioned above.

Listing 1 shows a simple C program, compiled using Borland C++ v3.1 for IBM PC-compatible computers, that can be used to receive and display Caller ID messages. In this program, the PC's ROM BIOS is used to handle communications with the serial port. Although this may not be the most efficient method of programming for the PC's communication ports (particularly at higher baud rates), it serves well for our example and for limited applications.

The BIOS software interrupt 14h contains the basic routines needed for communications with the serial port. The functions (what is passed in the AH register to the interrupt routine) 00h, 02h, and 03h perform port initialization, read characters from the port, and return the status of the port, respectively. For more information on how these interrupt routines function, how to call and interpret the returned parameters, consult a PC reference book such as *The Programmer's Guide to the IBM PC* by Peter Norton.

The program in Listing 1 is straightforward and easy to follow. The init_port, read_char, and read_status functions are simply routines used to call the software interrupts discussed above. The wait_for_data functions is used to continually poll the serial port to see if new data has arrived. The functions stuff_mdmf and stuff_sdmf are used to read the Multiple Data Message Format and the Single Data Message Format, respectively, from the incoming data and fill the cnid_format data structure, which is returned by the function. The cnid_format structure consists of the members date_time, number, and name that are simply string variables corresponding to the time of the received call, the telephone number of the caller, and the name of the caller. The main function performs the task of calling the port initialization routine, detecting if data has been received and which message format it is in, calling the

Parts List

Semiconductors
U1 - Maxim MAX202CPE RS-232 Driver/Receiver IC, 16-pin Package (Digi-Key MAX202CPE)
U2 - Motorola MC145447P CNID IC, 16-pin Package (ITU Technologies)
U3 - LM78L05ACZ 5 Volt 0.1 Amp Regulator, TO-92 Package (Digi-Key LM78L05ACZ)

D1 - Bridge Rectifier (Digi-Key RB151)
D2 - 2.54 mm LED (Digi-Key P363)
D3 - Bridge Rectifier 200V@1.5A (Digi-Key RB153)

Resistors
All resistors 1/4 watt, 5% tolerance unless otherwise stated
R1 - 4.7K ohm
R2, R3 - 10K ohm
R4 - 470K ohm
R5 - 18K ohm
R6 - 15K ohm
R7 - 270K ohm
R8 - 4.7M ohm
R9 - 10M ohm

RV1 - Varistor 130 V RMS (Digi-Key P7188)

Capacitors
C1 - 470 uF, 25 V radial electrolytic (Digi-Key P5630A)
C2 - 1 uF, 35 V tantalum (Digi-Key P2059)
C3, C4 - 470 pF, 500 V ceramic disc (Digi-Key P4108A)
C5, C6, C7, C8, C9, C10 - 0.1 uF Poly (Digi-Key P4593)
C11, C12 - 33 pF ceramic disc (Digi-Key P4018A)
C13 - 0.22 uF, 35 V tantalum (Digi-Key P2055)
C14 - 0.33 uF, 35 V tantalum (Digi-Key P2056)
C15, C16 - 0.22 uF, 250 V Poly (Digi-Key EF2224)

Miscellaneous
J1 - 3.5 mm Phonejack (Mouser 161-3505)
JP1 - Modular Telephone Jack (Digi-Key A9048)
P1 - DB25 Female right angle PC mount (Digi-Key 425F)
T1 - Wall transformer 12 VAC, 150 mA (JDR Microdevices TR12-500)
Y1 - 3.579 MHz crystal (Digi-Key X049)

Two 16-pin sockets, DB-25 male to DB-25 female cable or DB-9 adapter, case or other mounting hardware
See Sources sidebar for supplier information.

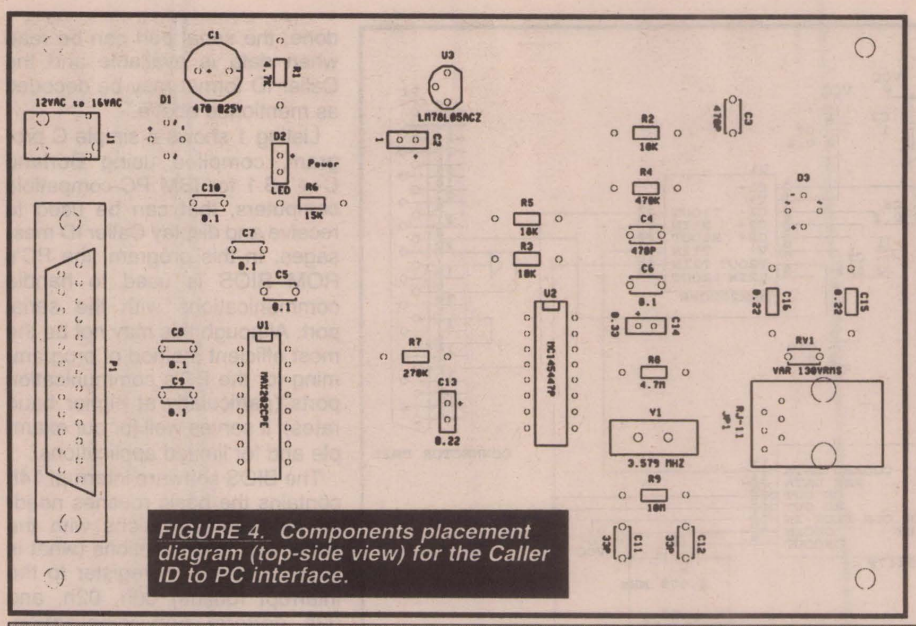


FIGURE 4. Components placement diagram (top-side view) for the Caller ID to PC interface.

appropriate routine, and displaying the received data to the screen.

This program can be used stand-alone, or can be integrated into your applications. If you are running Microsoft Windows or IBM's OS/2, you can easily run this program as a background task on your computer. We will discuss ideas for integrating Caller ID into your own projects later in this article.

Hardware Assembly Instructions

The Caller ID hardware presented 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 Caller ID hardware and at least one source of each of the primary components. A complete kit of all the components in the Parts List is also available (see Sources sidebar).

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 package used by the voltage regulator and to the polarities of the capacitors, bridge rectifier, and the LED. 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 U1 and U2 and the ICs should be oriented to point to the top of the board.

The Caller ID hardware can be placed in a project case or run directly from your desktop. Four mounting holes are shown in Figure 4 that may be used to mount the printed circuit board into a case. If you plan to house your unit in a case, you may wish to provide accommodations for mounting the LED and connectors to the case. Alternatively, standoffs may be inserted into the mounting

C code listing for decoding data from the Caller ID to PC interface hardware.

```
/*      Caller ID to PC
        by Chris B. Sakkas
        (C)opyright 1995 ITU Technologies
        Compiled using Borland C++ v3.1
*/

#include <stdio.h>
#include <DOS.H>
#include <CONIO.H>
#include <STRING.H>

#define COM_PORT 0 /* 0 for COM1, 1 for COM2 */

struct cnid_format
{
        char date_time[15], number[15], name[25];
};

void init_port(unsigned char Port)
/* init COM port number Port to 1200 baud, 1 stop, no parity,8 bits */
{
        struct REGPACK reg;
        reg.r_dx = Port;
        reg.r_ax = 0x0083;
        intr(0x14, &reg);
}
char read_char(unsigned char Port)
/* read character from port */
{
        struct REGPACK reg;
        reg.r_dx = Port;
        reg.r_ax = 0x0200;
        intr(0x14, &reg);
        return (reg.r_ax & 0x00FF);
}
unsigned int read_status(unsigned char Port) /* read status of port */
{
        struct REGPACK reg;
          reg.r_dx = Port;
          reg.r_ax = 0x0300;
          intr(0x14, &reg);
          return reg.r_ax;
}
void wait_for_data(unsigned char Port)
/* wait for data ready from port */
{
        struct REGPACK reg;
        do
        {
          reg.r_dx = Port;
          reg.r_ax = 0x0300;
          intr(0x14, &reg);
        }while (!( (reg.r_ax & 0x0100)>>8 ));
}
struct cnid_format stuff_mdmf(void)
/* read MDMF data and returns a structure */
{
        unsigned char tmp;
        unsigned char mes_len,par_len;
        unsigned char cnt;
        unsigned char i;
        struct cnid_format temp_caller;
          cnt=0;
          wait_for_data(COM_PORT);
          mes_len=read_char(COM_PORT); /* Get message length */
          while(cnt<mes_len) /* get message */
          {
            wait_for_data(COM_PORT);
            tmp=read_char(COM_PORT); /* Get parameter type */
            cnt++;
            if(tmp==1) /* Date and Time Parameter */
            {
              wait_for_data(COM_PORT);
              par_len=read_char(COM_PORT); /* Get parameter length */
              cnt++;
              i=0;
              while(i<par_len)
              {
                wait_for_data(COM_PORT);
                tmp=read_char(COM_PORT);
                temp_caller.date_time[i++]=tmp;
                cnt++;
              }
              temp_caller.date_time[i]='\0';
            }
            if(tmp==2) /* Number Parameter */
            {
              wait_for_data(COM_PORT);
              par_len=read_char(COM_PORT); /* Get parameter length */
              cnt++;
              i=0;
              while(i<par_len)
              {
                wait_for_data(COM_PORT);
                tmp=read_char(COM_PORT);
                temp_caller.number[i++]=tmp;
                cnt++;
              }
              temp_caller.number[i]='\0';
            }
            else
            if(tmp==4) /* Absense of Number Parameter */
            {
              wait_for_data(COM_PORT);
              par_len=read_char(COM_PORT); /* Get parameter length */
              cnt++;
              i=0;
              while(i<par_len)
              {
                wait_for_data(COM_PORT);
                tmp=read_char(COM_PORT);
                if (tmp=='O')
                  strcpy(temp_caller.number, "OUT OF AREA");
                else
                  strcpy(temp_caller.number, "PRIVATE");
                cnt++;i++;
              }
            }
            else
            if(tmp==7) /* Name Parameter */
            {
              wait_for_data(COM_PORT);
              par_len=read_char(COM_PORT); /* Get parameter length */
              cnt++;
              i=0;
              while(i<par_len)
              {
                wait_for_data(COM_PORT);
                tmp=read_char(COM_PORT);
                temp_caller.name[i++]=tmp;
                cnt++;
              }
              temp_caller.name[i]='\0';
            }
            else
            if(tmp==8) /* Absense of Name Parameter */
            {
              wait_for_data(COM_PORT);
              par_len=read_char(COM_PORT); /* Get parameter length */
              cnt++;
              i=0;
              while(i<par_len)
              {
                wait_for_data(COM_PORT);
                tmp=read_char(COM_PORT);
                if (tmp=='O')
                  strcpy(temp_caller.name, "OUT OF AREA");
                else
                  strcpy(temp_caller.name, "PRIVATE");
                cnt++;i++;
              }
            }
          }
          wait_for_data(COM_PORT);
          tmp=read_char(COM_PORT); /* read checksum */
          return temp_caller;
}
struct cnid_format stuff_sdmf(void)
/* reads SDMF data and returns a structure */
{
        unsigned char tmp;
        unsigned char mes_len;
        unsigned char i;
        struct cnid_format temp_caller;
          wait_for_data(COM_PORT);
          mes_len=read_char(COM_PORT); /* Get message length */
          i=0;
          while (i<8)  /* get date and time information */
          {
            wait_for_data(COM_PORT);
            tmp=read_char(COM_PORT);
            temp_caller.date_time[i++]=tmp;
          }
          temp_caller.date_time[i]='\0';
          while(i<mes_len)
          {
            wait_for_data(COM_PORT);
            tmp=read_char(COM_PORT);
            if (tmp=='O')
              strcpy(temp_caller.number, "OUT OF AREA");
            else
            if (tmp=='P')
              strcpy(temp_caller.number, "PRIVATE");
            else
              temp_caller.number[i-8]=tmp;
              i++;
            }
            temp_caller.number[i-8]='\0';
            temp_caller.name[0]='\0';
            wait_for_data(COM_PORT);
            tmp=read_char(COM_PORT); /* read checksum */
            return temp_caller;
}
void main(void)
{
        unsigned char tmp;
        unsigned int status_word;
        struct cnid_format caller;
        init_port(COM_PORT);
        while(!kbhit())
        {
          status_word=read_status(COM_PORT);
          if ( ((status_word&0x0100)>>8) ) /* data ready! */
          {
            tmp=read_char(COM_PORT);
            if(tmp==0x80)           /* MDMF format */
            {
            caller=stuff_mdmf();
            printf("%s\n%s\n%s\n\n",caller.name,caller.number,caller.date_time);
            }
            else
            if(tmp==4)              /* SDMF format */
            {
            caller=stuff_sdmf();
            printf("%s\n%s\n%s\n\n",caller.name,caller.number,caller.date_time);
            }
          }
        }
}
```

Listing 1.

holes or rubber feet may be used to prevent the solder side of the printed circuit board from touching the desktop. If your PC has a DB-25 connector for the serial port you plan to use, or if you are not using the supplied PCB design and have modified it for use with a DB-9 connector, the Caller ID hardware may be attached directly to the serial port of your PC instead of using a cable.

Testing and Troubleshooting

To test the Caller ID hardware, simply connect the completed circuit to the serial port of the PC and apply power to the hardware. The LED should immediately light, indicating power. You may now choose to run the compiled software given in Listing 1 on your PC or use a communications program such as ProComm or Telix to see if the Caller ID data is being decoded by the hardware. You must now set up your terminal to use the proper communications port and the parameters to 1200 baud, no parity, and one stop bit.

Now arrange for another party to call your telephone number or call your number from another telephone. If you are using the program in Listing 1, you should see at minimum the number of the calling party and the time of day.

A terminal program will also display this information, but will include the other data (message type, checksum, etc.) that may appear as garbage on your screen.

If you do not receive any data from the call, first double check your communications parameters. If you are still unable to get any response from the hardware, begin to look over your construction techniques.

You should carefully inspect your work to insure that all solder joints are good and that all components are placed properly. You may also want to use a voltmeter to verify the output of the voltage regulator and an oscilloscope to look at the waveforms out of U1 and U2.

Implementation Ideas

Now the fun begins! As we mentioned earlier, so many applications exist for Caller ID. With the aid of a sound card and a little software, you can announce the name of the caller instead of using a traditional telephone ring — and even block out some callers or all unknown callers! If you operate a business, you can have your database open up your customers' business records before you even answer the phone. Or, use the hardware to provide security by only allowing a known caller access to your modem or voice mail system. See the Sources sidebar for more software information, and try your hand at writing some applications that utilize Caller ID! **NV**

Sources

Software
The source code and a compiled version of the software presented in this article is freely available for downloading from the ITU Technologies' FTP site. Our full URL for this directory is: ftp://iglou.com/members/ITU/support/cnid

Enhanced Software — $5.00 Includes example programs, with source code, and integration techniques. Requires an IBM-PC compatible computer running DOS or Windows. Some examples require Windows 3.1 or greater.

Hardware
MC145447P Caller ID IC — $8.00.
MAX202CPE RS-232 Driver/Receiver IC — $4.00.

Printed Circuit Board — $8.00. A quality PCB with top side silkscreened for easy assembly.

Packs and Kits — Chips and PCB Pack $19.00.
MC145447P Caller ID IC, MAX202CPE IC, and Printed Circuit Board.

Complete Caller ID to PC interface kit — $35.00 (include $5.00 shipping). Includes all parts in parts list (minus wall transformer and cable), Printed Circuit Board and enhanced software.

Accessories Pack — $6.00 (include $5.00 shipping if ordered without above kit). Includes wall transformer and your choice of DB-25 Male to DB-25 Female or DB-25 Male to DB-9 Female cable.

Your personal check or money order can be sent to the address below. Please specify 3 1/2" or 5 1/4" floppy disk format. All prices include shipping unless noted. COD orders are also accepted with an additional $5.00 charge.

ITU Technologies
3477 Westport Ct.
Cincinnati, OH 45248-3026

Your questions can be answered or COD orders may be placed via phone or E-Mail.
E-Mail: ITUTec@aol.com
Phone: (513) 574-7523 (9 AM to 5 PM Eastern)

Please call or write if you would like to receive our catalog of other electronic products.

See our World-Wide-Web page and ftp site for more Caller ID and electronics information!

WWW URL: http://www.iglou.com/ITU
FTP URL: ftp://iglou.com/members/ITU

Other Parts Sources
(as mentioned in Parts List)

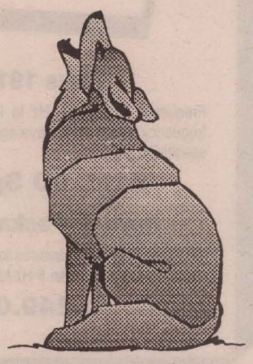
Digi-Key
701 Brooks Ave. South
P.O. Box 677
Thief River Falls, MN 56701-0677
1-800-344-4539

Mouser Electronics
2401 Highway 287 North
Mansfield, TX 76063-4827
1-800-346-6873

JDR Microdevices
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San Jose, CA 95112-9941
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#80 TEST EQUIPMENT *cont.*

TEACHER NEEDS equipment: Tektronix 2225 oscilloscope, Krohn-Hite 1400 function generator, Simpson 260-8P VOM, logic probe OK-PRB50, resistor substitution box Ohmite Ohm-Ranger 3420, capacitor substitution box Ohmite 3430, or equivalents, reasonable. Call 203-482-7946.

POOR MAN'S Spectrum Analyzer/Monitor Receiver Kit. 2 to 1,700 MHz. Basic kit only $78. Now available with switched resolution filters, tracking generator and direct digital frequency readout. Works with ANY scope or IBM compatible computer. Send stamped envelope for details. Science Workshop, Box 310B, Bethpage, NY 11714.

HP PLOTTERS: HP 7044A, XY with sweep, $400; 7045A, $400; 7045B, $400, HP 7225A XY HPIB, $150, 7225A, RS232, $150; HP 7225B, HPIB, $150; HP 7470A 6 pen with HPIB, $200; 7470A RS232 $200; 7440A, RS232 8 pen, $200; HP 7475A 6 pen plotter RS232, $200; HP 7475A, HPIB, $250; HP 9872A 4 pen plotter, $250; 9872S, $300. A-Comm Electronics, 303-290-8012, 303-290-8133 FAX.

WEINSCHEL ENGINEERING RF plug-in 2-4 GHz model 432AP-1. $400 Aptec, PO Box 101, El Segundo, CA 90245-0101. 310-640-7262.

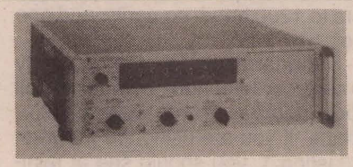
HP 3551A transmission test set. Battery, AC, operation. Adaptors, cables, power cord included. $435. Bob Morgan, test equipment sales. Ph/Fx 717-842-1534.

LOGIC ANALYZERS: HP 1630D logic analyzer (100MHz timing, 25MHz state) $950. **Pods** for HP 1600A $25 each. **Tek 7DO1/DF1** logic analyzer plug-in (to 100MHz) $225. **Tek DAS 9129** color systems, up to 660MHz, lower prices. Analyzers sold with pods, warranty. Pepper Systems, 214-353-0257.

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

WANTED! TEST equipment. We pay top dollar for used scopes, generators, analyzers from HP, Tektronix, and others. Call Charles at Metric for immediate quotation. 1-800-432-3424.

KEITHLEY 616 digital electrometer $275, Keithley 6162 isolated output/control $100, Brown & Sharp 990 $100, HP 8151A optical pulse power meter $500, HP 5180A waveform recorder $367, HP 400EL AC voltmeter $100, HP 1610A, 1610B logic state analyzer $75, HP 6940B multiprogrammer $100, HP 8410A network analyzer $100, HP 8412B phase-mag display $175, Tek 7844 400MHz oscilloscope $300, HP 3500 attenuator set $100, HP 431A power meter $60, HP 350B attenuator set $50, HP 34702A multimeter $100, Fluke 1953AE counter timer $200, Fluke 8000 digital multimeter $25, Tek 7B71 $100, Tek P6452 data acquisition $40, HP 85 $50, HP 7475A plotter $125, HP 7550A plotter $175, JDR Instrument oscilloscope 2000 $300, General Radio 1432-KDECADE resistor $50, HPIB 37203A extender $100, signal conditioner MODD33 series Unholtz-Dickie $100, Infrared Industries , Inc. 803 modulation control $100, Fluke 2204A scanner $100, function generator Exact Electronic, Inc. $100, Harrison regulated power supply 809A V=40V, I=10A $100, regulated power supply Deltron SH36=6 V=50, I=10 $100, Beckman pH meter G $50, signal source 1208A selectable rate TV test pattern generator $175, pulse instruments 451A-16 $125. Call 714-827-7345.



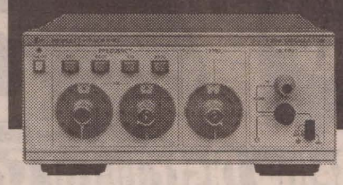
HEWLETT PACKARD 5245L COUNTERS are all gone, but **WE NOW HAVE 500MHz PLUG-INS (HP 5253B) AVAILABLE, $35 + $7.50 SHIPPING.** Pretested repair parts are still available: Readout with Nixie, $9.95 A17 card, $9.95. Other cards $7.50. Nixies $6.50. Xtal oven assy, $39. Add $5 shipping. Send stamped addressed envelope for quote on any other part. Check/MO plus part number/description to: **TURCOTRONIX,** 1000 E. 14th, Suite 429A, Plano, TX 75074.

DC TO GHz: Fluke: 720A volt divider primary standard $1,250, 332B DC calibrator $850, 382A current/volt source $1,100. C41 transfer standards shunt kit (12 A40/A40A 0-20 KHz shunts, 20mA-20 amp) $2,500. Guildline 9152-1 standard cell/enclosure $90. ESI 230 resistance bridge $110. Tektronix R140 NTSC test signal generator $180. Hughes 105A memoscope with 6 assorted plug-ins $140. Keithley 242A 300-350 VDC source $185. GR 1601A VHF bridge $110. Military SP-2 1-3.2 GHz 120VAC receiver $120. Superb cream-color Singer panoramic SSB-3B spectrum analyzer system, also TMI-1A and TMI-4/120 telemetering indicators, and TMC-505 simultaneous five point calibrator, all 4 $950. For HUGE LIST, send three 32¢ stamps. Also send YOUR lists of equipment, manuals, catalogs, and manufacturer directories. Art Klinger, 4601 Yellowleaf, Fort Worth, TX 76133. Home 817-370-2575.

HP 3586B selective level meter opt 1 $600, HP 8410A network analyzer with 8413A phase gain indicator $150, HP 493A microwave amplifier $200. HP 214A pulse generator, $175. Ty Miller, Southcoast Surplus, 714-830-9170. Fax, 714-454-9841.

TIRED OF paying high prices to get Tektronix, Hewlett Packard, Wavetek, IFR, etc., repaired, calibrated, certified? Give us a call. Free estimates, fast service. We also sell and rent test equipment. For information: Feitek, 2752 Walton, St. Louis, MO 63114. 314-423-1770.

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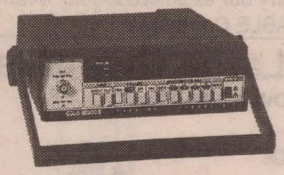
Digital Multimeter, 4.5 Digit LED, .02% accuracy, 5 functions.

$159.00

Fluke 1900A

Multifunction Counter, 5 Hz to 80 MHz, provides frequency, period, period averaging and totalize measurements, 6 digit display.

$189.00 Special



Fluke 1911A

Frequency Counter, 5 Hz to 250 MHz, measures frequency period, period average and totalize. 15 mV sensitivity, 7 digit display.

$199.00 Special

Hewlett-Packard 332A

Distortion Analyzer measures total distortion down to 0.1% full scale between 5 Hz to 600 kHz.

$249.00

Hewlett-Packard 3586B Selective Level Meter

Makes carrier measurements to 32.5 MHz, voice channel measurements from 50 Hz to 100 kHz, can use the 3336B Level Generator as an automatic tracking generator. Includes options 004. Like new.

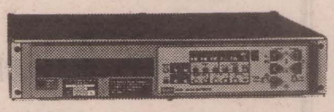
$850.00

Hewlett-Packard 3336B Synthesizer/ Level Generator

Frequency coverage is from 10 Hz to 21 MHz, making the 3336B useful for telephone circuit loop testing on most FDM systems. Includes Opt 005, Like new.

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Fluke 8520A



Digital Multimeter, 5.5 digit, ac/dc volts, 2 and 4 wire ohms, conductance, 20 ppm basic dc accuracy, burst memory and math capabilities.

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Tektronix 475A DM44

250 MHz Oscilloscope,dual channel, 5 mV/div sensitivity, 1 nS/div sweep rate. Has differential-time/ DMM option. Includes 2 probes.

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Hewlett-Packard 8553B

Spectrum Analyzer RF Section, 1 kHz to 110 MHz, resolution bw range from 300 kHz to 10 Hz, signal levels as low as -140 dBm can be measured using the 10 Hz bw.

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Anritsu MS 420B

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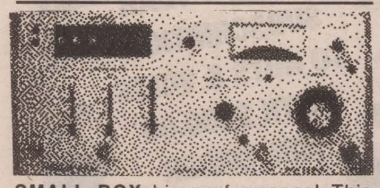
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TEST EQUIPMENT Sale: HP 580A D/A converter, $125; Tektronix 2235A, $900; HP 675A .1-32 MHz sweeper, $300; HP 394A variable attenuator 1-2 GHz, $200; HP 3400A, $250; HP 3403C, true RMS DVM, $250; HP 3330B, $500; HP 3762A clock data generator, $500; HP 415E, $200; HP 8620A, $300; Noise Comm NC6101 noise gen. 10Hz-20KHz, $150; Shiba Soku AS953B TV sound multiplexer, $350; HP 4944A TIMS, $700; Tektronix PG501 50MHz pulse gen., $200; HP 1600A logic state ana. with probes, $200; HP 10783A numeric display, $100; HP 59308A timing gen., $150; Ballintine 1066B, 20MHz dual channel scope, $150; Antritsu ME645A microwave test set display unit, $150. A-Comm Electronics, 303-290-8012.



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HP 4815A Z-METERs: Sandford Associates is your source for repair of the Probe and Main Frame. Former HP 4815A tech/supv., with factory expertise, specs, parts, special tooling, restores & warrantees probes to HP/QA specs. many other HP 4815A factory parts available. Tel/write: Sandford Associates, 110 Highview Terr., Hackettstown, NJ 07840. 908-852-7989, CIS: 72540,1345.

RACAL-DANA 61/2 digit DMM $300. Wavetek 154 10MHz generator $225. 714-895-8897.

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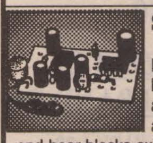
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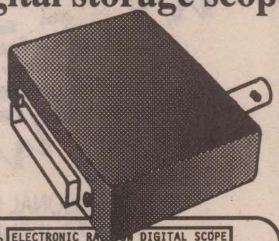


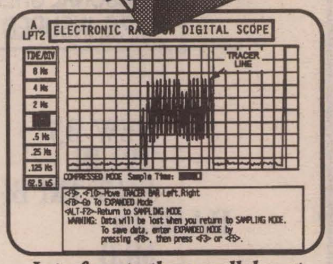
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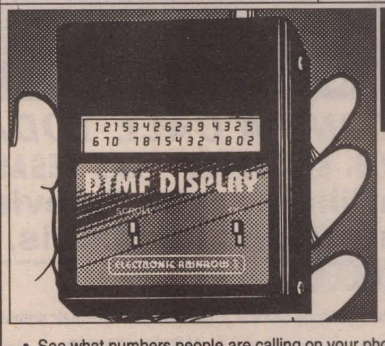




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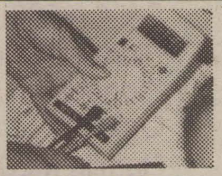
TEST EQUIPMENT Sale: Halycon 803B Datalink ana, $300; Guildline 9936 voltage calibration system, $1,000; Weksler 0811PU 7-day vacuum circular chart recorder, 0-30" $150; Wayne Kerr B221, Q221 Z bridge, $150; video research AN/TNH-21 reel-to-reel tape recorder, $200, digital VR160 color monitor, $150 (for digital equipment). A-Comm Electronics, 7198 S. Quince St., Englewood, CO 80112. 303-290-8012, 303-290-8133 FAX.

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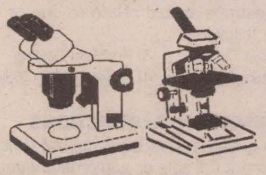
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HPIB CABLES: HP 10833A 3.3 ft, $15 ea.; 10833B 6.6 ft, $25; HP 10833D, $10. A-Comm Electronics, 303-290-8012.

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

NI-CD BATTERY analyzers: charge, discharge, cycle and test. PC controlled using serial port and DOS software. $289. PO Box 672, London, ON N6A 4Y4. Lamantia Products, 519-472-5566, FAX 519-472-1702.

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STEREO MICROSCOPES for surface mount work at 10X and PC inspection at 30X. Top and bottom illumination, 2-year warranty, delivery to 48 states $365. Student microscopes from $150. Used stereos, micro-optics available. Seabird Technical, Box 2438, Menlo Park, CA 94026-2438. Phone 415-367-8320, Fax 415-365-5845 Visa/MC.

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HP 8620C Sweep generator, with HP 86222B plug-in .01 to 2.4GHz. $1,895. HP 3581C selective voltmeter $495. All clean, working. **Technologies West,** 503-267-6064.

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TEST EQUIPMENT check-out and repair. Low rate. TWK Engineering. 714-895-8897.

TEST EQUIPMENT: HP 5326B, counter DVM, $200; HP 5327B, $250; HP 8412A, $200; HP 8414A, $200; HP 4260A universal bridge, $200; Tektronix TM506, $200; HP 8750A storage normalizer, $200; HP 3710A, HP 3702A, 3705A, $1,500; Boonton 92A-S2, $150; NewPort research 820 laser power meter, $100; MIL/Taffet Electronics ZM-4B/resistance bridge unused with manual; $60 ea., 15 available. Send for test equipment sales list. A-Comm Electronics, 7198 S. Quince St., Englewood, CO 80112. Phone 303-290-8012, Fax 303-290-8133.

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HP 3320B frequency synthesizer opt 4 $365. Dexis, 612-944-7670.

HEWLETT PACKARD 5335A high performance 200MHz/2-ns universal counter, opt 020 (DVM), opt 040 (expanded HP-IB), excellent, $1,095. 334A distortion analyzer, looks new $345. Many other HP and Tektronix. Allen Fulmer, 2538 Sweetgum Way West, Clearwater, FL 34621. 813-796-3424.

FTS 4050 CESIUM standard with 1991 tube, inquire. FTS 1200 1x10^{-10}/day quartz oscillator $325, HP 10544A hi stability quartz $175, HP 10544 (no suffix) $125, Cesium and Rubidium standards wanted, any condition. Repairs with free estimates. Coming soon, replacement digital clock kits for HP 5061A and HP 5065A. Put one into your standard! Corby Dawson, 805-736-0288.

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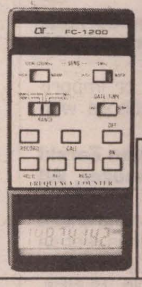
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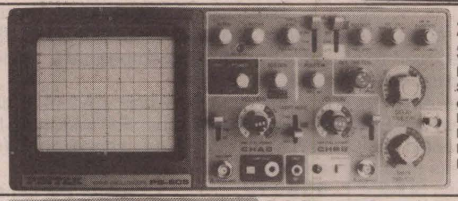


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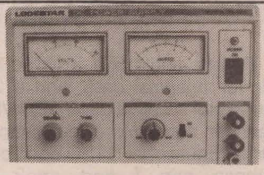


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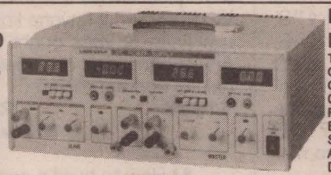
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Scope Probe: 60MHz x1, x10 $13, 100MHz x1, x10 $22

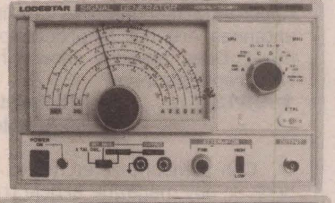
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RF SIGNAL GENERATOR SG-4160B $119.00
100 kHz-150MHz sinewave in 6 ranges
RF Output 100mVrms to 35 MHz
Internal 1kHz, External 50Hz-20kHz AM modulation
Audio output 1 kHz, 1 Vrms



RF SIGNAL GEN./COUNTER SG-4162 AD $229.95
Generates RF signal same as SG-4160B
Frequency counter 1Hz - 150 MHz for internal and external source
Sensitivity <50mV

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Output: 0-8Vrms sinewave
0-10Vp-p squarewave
Synchronization: ±3% of oscillation frequency per Vrms
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0.05% 500Hz - 50kHz
0.5 % 50Hz - 500kHz
Output impedance: 600 ohm

AUDIO GEN./COUNTER AG-2603AD $229.95
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Frequency counter 1Hz-150MHz for internal and external sources
Sensitivity <50mV

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Sine, square, triangle, pulse and ramp
Output: 5mV-20Vp-p
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VCF: 0-10V control frequency to 1000:1

FUNCTION GEN/COUNTER FG-2102AD $229.95
Generates signal same as FG-2100A
Frequency counter 4 digits
Feature TTL and CMOS output

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Sweep: Linear 10:1/Log 10:1 20ms to 2s
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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

Need to know how to procure an electronic transmitting signal set at a particular frequency that could neutralize or interfere with a chemical's natural emitting frequency. Example: what electronic frequency signal could disrupt the normal operating frequency of the element potassium? If a chart could be drawn up on how to achieve this for each chemical in the periodical table of the elements would be very useful in my research.

11951 **Don Dreis**
Bloomington, IN

I need information on how to activate a DMX/Digital Music Terminal Model #DM2000X.

11952 **Joe Cornado**
Sacramento, CA

Is anyone still making, or importing, 365 PF variable capacitors with 1/4" shafts?

11953 **Bogdan Zarski**
Milwaukee, WI

Where can I find good references that report any and all precious metals components in old PCs — gold, silver, platinum group metals (old 8086s, 8088s, 286s, apples, etc.)? Publication of this info would encourage recycling of these components, and therefore improve our environment by lowering our mining efforts!

11954 **Gerry LaBorde**
Gretna, LA

1) How can terminals (Telex 179, Memorex 1192, Memorex 14G, IBM3179, others) be converted to PC monitors? What would they be compatible to (EGA, VGA)? Does anyone have schematics for terminals? **2)** What hard/software do I need to network some XTs?

11955 **H. Otters**
Fredericksburg, TX

I have a Mitsubishi VCR Model HS-U34 which will play tapes recorded in the LP or SLP modes, but tapes recorded in the SP mode show nothing but diagonal hash marks. Manual tracking adjustment does not correct it. Has anyone else had this problem? Any solution?

11956 **T. R. Miller**
Long Beach, CA

I am accumulating a quantity of 110-volt power cords such as the ones that come with computers, computer monitors, and printers. They have a standard two or three prong male plug on one end, the end that plugs into the wall socket. On the other end they have a three prong female plug.

Does anybody make adapters which will enable one to connect these cords, one to the next, and then an adapter which would terminate the last cord with an ordinary female receptacle. If so, I will never have to buy an extension cord again.

11957 **Chuck Lynn**
Overland Park, KS

I have a Macom satellite TV feedhorn servo motor I would like to fix, but cannot find the M51660L IC. Can someone describe how a chaparral polarotor one-type servo motor circuit works, with an accompanying schematic. I cannot get a schematic nor find a broken chaparral motor locally. I was hoping to adapt the chaparral circuit to my Macom.

11958 **Steven Garren**
Winder, GA

I'm trying to find: **1)** Transceiver using FM for interference rejection. **2)** 49 or 900 MHz band as long as no license is required. (Or . . . ANY other frequency as long as it's legal and can transmit about 500 to 1000 ft.). **3)** Transmitter capable of 16 different dip switch selectable frequencies. **4)** Receiver capable of scanning these frequencies at about 5 Hz.

I want to transmit a string of DTMF tones from one transceiver to the other at the highest typical telephone rate. I'd like to use an already proven RF subsystem. I believe the RF subsystem I'm describing could be HACKED right out of a cordless phone and I just KNOW this is existing SOMEWHERE! And if anyone knows of it, I figure *Nuts & Volts* ought to know of it! Any suggestions or suppliers would be helpful and appreciated!

11959 **Randy Palmer**
Broken Arrow, OK

1) How to build a negative ion generator which uses radio-waves instead of charged plates. **2)** How to build an ozone generator.

119510 **M. Meyers**
Bothell, WA

I need a circuit to decode composite NTSC video into R-G-B and sync signals. I plan to use an old RGB monitor with a VCR.

119511 **Ernest C. Land**

I am a student at California State University Fresno, majoring in Industrial Control Electronics. I'm searching for material to develop my senior project. My project proposes to design and implement a household solar heating and, if possible, cooling system.

A high temperature solar generator system should be able to supply hot water all year round, house heating during the winter season and, perhaps, cooling during the hot summer. Some regular solar collectors would act as a pre-heater, while a satellite dish, covered with mirrors, would act as the main heat generator. This paraboloidal solar concentrator dish will concentrate sunlight in its focal area. A heat pipe then will transfer heat from the focal area of the solar concentrator to a fluid which will be stored for thermal applications. The stored fluid should be capable of driving an absorption refrigeration cycle, ammonia and/or water. A relatively high temperature source of heat must be available, in the range of 300°F to 450°F. I understand it is a very ambitious endeavor; however, I really believe that with the right design and materials, this project can be accomplished. I am certainly going to need guidance in many areas.

I would be grateful if you could answer the following questions, or any other information that you consider to be helpful in the achievement of my goal:

Are you aware of any effective studies on solar absorption systems which might help in my research process?

Materials & equipment: Thermal energy storage, insulation and fluid medium for high-temperature applications.

Sun trackers and control + data acquisition systems. For instance, I/O cards for T/C and transducers (mV and mA).

119512 **Angel Fernandez**
Fresno, CA

1) Where can I find a Lotus FM receiver for financial data, and a 30-inch Equatorial satellite dish? **2)** What is the proper name for a four-channel card for an Equatorial 5150 controller and where can I find one? **3)** Apparently the Equatorial satellite dish antennas are not in production anymore. Does anybody know why and what replaces them?

119513 **Richard Ponti**
Los Angeles, CA

Can someone refer me to a textbook or any magazine article that discusses writing data access and reduction programs used with laboratory equipment or scientific applications such as pH meter readout, gas or liquid chromatography?

There are "canned" commercial programs available, but I would like to be able to program and personalize my own. Are there any public domain programs already written?

Also, there are several shareware programs for statistical analysis, but I've never seen any that apply to statistical process control where inputed data is generated into control charts. Do they exist?

119514 **Bob D. Graham**
Buena Park, CA

I need specific interfacing and software information on the Control-L protocol which Sony originated (and I understand has now abandoned) to control and monitor video equipment. I have the 1986 edition of the Sony data on this system, but I need current info on control codes used in the data stream and especially software to

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 3) Problem Solving
2) Electronic Theory 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.

allow PC control and monitoring of VCRs (SLV 757) and camcorders (Ricoh R18H). Most Sony people I have talked with have never heard of the system.

119515 **Robert M. Harkey**
Charlotte, NC

ANSWERS

ANSWER TO #109517 - OCT. 1995

The easiest method I've found for capturing caller ID numbers, is to use a caller ID capable modem connected to a PC. Models from Supra and ZyXEL come to mind. A few commands to the modem will enable it to output caller ID information to your terminal program where they can be stored to a file or printed.

Doug Smith

ANSWER TO #109521 - OCT. 1995

The IBM PS2 Model 25 computer's system board came with an integrated jumper (J4) on the motherboard known as the MCGA (Multicolor Graphics Array) which can display 256 colors out of 262,144 possible colors, and 64 shades of gray. The MCGA is a subset of VGA and does not support color in high resolution mode. This jumper connected to the 12" analog display which housed the entire computer and all the I/O in one unit. This particular model has analog output and will not support digital display monitors. The Model 8525-XX1 used the monochrome display, while 82525-XX4 used the color monitor @ .38 mm dot pitch. Because of the built-in integrated functions of this computer, many graphics adapters might and will conflict with what's located on the motherboard.

Arthur Hazboun
Harbor City, CA

ANSWER TO #109516 - OCT. 1995

Yes, there are much smaller vacuum tubes based in silicon! These microscopic, modern devices appeared in the literature a few years ago and quickly disappeared from sight. They featured etched grids and resembled integrated circuits more than electron tubes. I don't know why they disappeared. I'll bet they would have superb radiation hardness.

Charles Wenzel
Austin, TX

ANSWER TO #109511 - OCT. 1995

If you mean offset as are the small DSS dishes (LNB closer to the edge of the dish), you can't. The dish you have is perfect (in theory) parabola, which has an exact focal point located above the center of the dish. You would have to deform your dish to re-focus it.

Breck Ricketts
Lenexa, KS

ANSWER TO #10953 - OCT. 1995

George Terry, your friend who told you not to try to upgrade your IBM Model PS/2 was pretty close. To be sure, one can purchase a set of components from various *Nuts & Volts* advertisers and make a system that'll run WINDOWS much cheaper and more satisfactorily than with the PS/2 30. You didn't indicate it was a 30-286 or just a 30 although it wouldn't matter much. The problem is the non-standard motherboard setup and the limited (three) expansion slots. About the only salvageable is the SIMM memory, the drives are too small, floppies are 720 and the hard is miniscule. Maybe with an adaptor one can use the keyboard.

Travis Brackeen
St. Louis, MO

ANSWER TO #109523 - OCT. 1995

What you need is called a scanner. It reads serial ASCII data from a car on-board computer, and displays the result on a small screen. A software implementation for PC compatibles, including laptops, is available from Rinda Technology, Inc. in Chicago.

The scanner is not hard to construct if you have documentation describing the content of the data packets sent by the on-board computer. There is something called Equipment Tool Institute, a group of rather rude and arrogant individuals, which tries to sell this essentially public domain information for a five digit fee. It may be worthwhile to start an internet news group to start posting this documentation, and not purchase a new car, unless the salesman provides this information for the car.

Jan Zaluda
Mountain View, CA

ANSWER TO #10956 - OCT. 1995

PH, Nitrate and Ammonium probes are available from Omega (1-800-TC-OMEGA). They are rather expensive ($200.00 each), and finicky. They need to be kept clean, which is going to be hard to do in an aquarium environment. They also might contaminate the water, which would not be a good thing for your critters. PH probes are slightly less expensive, and are available in non-contaminating types, but they are just as finicky. All in all, you are probably better sticking with the standard chemical test kit, unless you have lots of money and time to throw at this project. (I looked at doing this myself several years ago, and gave up due to the expense involved.)

Robert Zusman

ANSWER TO #109522 - OCT. 1995

PCMCIA cards are very much like IDE or ATA disk drives. These may be considered connected in parallel, and not daisy chained. Each card needs to be addressed individually to access its card information structure so that it may be recognized by the system it is installed in.

Jan Zaluda
Mountain View, CA

Editors Note

Since this question pertains to a topic that has drawn much debate, we are printing several answers, not all of which are in accord.

ANSWERS TO #10957 - OCT. 1995:

#1 First of all, V = IR, regardless of V or I! What everyone has been missing in this debate is POWER, or VI. The reason that low-voltage lines need to be so heavy, is that for a given power, the current is much higher than at a higher voltage (e.g., 120 W at 12 V = 10 A, while 120 W at 120 V = 1 A), therefore the power loss in the cables is much more significant for low-voltage systems. As far as your application is concerned, .1% regulation is needlessly tight, 1% is fine. This implies a maximum voltage drop of 5 V-(5*.99) = .05 V. Since you want to transmit 5 A of current over 10 feet (round trip), the cable resistance can't exceed R = V/I or R = .05/5 or .01 ohm. My handy Pocket Ref says that 10-gauge wire has 980 feet per ohm or .0102 ohm in 10 feet. So use 10-gauge wire and you should be fine. Watch out for the resistance in your connectors! (This is why unregulated power supplies with LOCAL voltage regulators are usually used to transmit power over several feet — or sense lines are run back to the power supply, so that it can put the cable resistance in its feedback loop.)

Robert Zusman

#2 You indicated in your question all the answers to why one needs bigger wire for lower voltage systems. The line drop, I x R1 as a percentage of the source voltage tells the story. A volt dropped at 120 V is no big deal, but starting with six, you're down to only five. Shari tried to say that in her letter. Amps are amps when you are interested in the wire not fusing, but volts count when you need all you can get. By the way, it's true with speaker cables for the same reason.

Travis Brackeen
St. Louis, MO

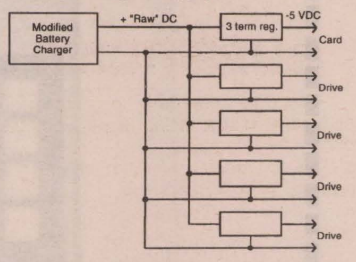
#3 Amperes are amperes at any voltage. Current carrying capability of wire depends only on current, and not on voltage. However, in many applications voltage drop across the wire is of concern, and gauge larger than necessary is used.

If you require 0.1% drop at 5 V, at 5 A, and length five ft., you need gauge 10 wire. The 0.1% is probably a mistake, since logic only requires 5% tolerance at 5 V.

Jan Zaluda
Mountain View, CA

#4 I hate to break the news to you, but you are on the losing side of the wire gauge argument. The amperage rating is the same regardless of the voltage (except in extreme cases where skin effect might be pronounced). The reason a six-volt car needs a heavier gauge wire is that more current is required to do the same amount of work (work = power, not current). The power is the current multiplied by the voltage. Power companies "go to such high-voltage lines to transfer power" because it takes less current and consequently less wire to transmit the same amount of power (not current). If a 10-amp load is connected to an ideal 12-volt power supply, then only one amp will flow in the 120-volt line cord (10 x 12 = 1 x 120). The current heats the wire (I^2R losses) and the voltage drop from one end of the wire to the other is simply IR where R is the resistance of the wire.

If your application requires voltages held to 0.1% (seems unlikely), then proceed with caution. A car battery charger has no regulation so a precision voltage regulator must be added. I would recommend either placing the regulator near the drives or using separate "sense lines" to avoid the worry about the wire losses. Sense lines allow a voltage regulator to measure the voltage at the load using separate wires that do not carry current and therefore do not have any voltage drop. The only requirement of the power handling wires is that they do not overheat and they do not drop so much voltage that the regulator cannot overcome the losses. A simpler approach to your problem is to place a three-terminal regulator at each drive and the card all connected to the "raw" battery charger supply:



Add a large capacitor (several thousand uF) to the battery charger output and place 1 uF capacitors from the input and output of each regulator to ground near the regulator's package (not show in the schematic). A little voltage drop in the wires delivering power to the regulators will not matter. For example, 18-gauge wire will have about 0.06 ohms for a five-foot run and will drop about 0.3 volts which is fine if the regulators are placed at the drive end or if remote sense lines are used. But to drop only 15 mV (0.1% power drop) at 5 amps would require the use of about 5-gauge wire! That is totally unnecessary brute force!

Charles Wenzel
Austin, TX

#5 Reader Lambert is correct. The reason power companies use high-voltage for long-haul runs is to reduce resistance losses. Total power transferred (wattage) is the product of the voltage and the amperage. Resistance loss is proportional to current (amps), so raising the voltage reduces these losses.

As to his question of what gauge wire is needed to have less than .1% voltage drop on a five-volt circuit over a five-foot run, this is pretty easy to figure out. .1% of five volts is .005 volts. Voltage drop is equal to the current times the resistance: E = IR. Solving for R gives R = E/I or R = .005/5 = .001 ohms of total wire resistance.

Dividing this by five feet gives a wire resistance of .0002 ohms/foot or .2 ohms/1,000 ft. Checking a wire chart, we can see that three-gauge wire has a resistance of .1971 ohms/1,000 ft. Pretty hefty stuff!

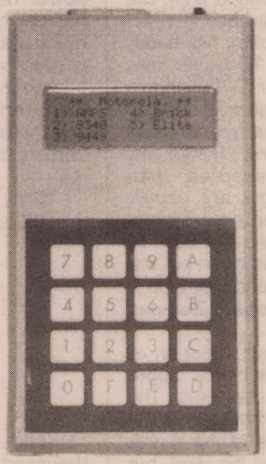
Having said this, I'd think a drop of less than .1 volt would actually satisfy the requirement, which would translate to a wire size of about 16 gauge.

George R. Scott
Alexandria, VA

#6 The correct wire size to carry 5 amps five feet and allow only .1% drop is calculated as follows: Total length is 10 feet. (Remember that current flows in a loop, both to the load and a return path.) Total wire resistance can allow only .005 volts of drop, maximum. R = .005 V/ 5 Amp = .001 ohms! (in a 10 foot run). Since wire and cable are nor-

Continued on page 141

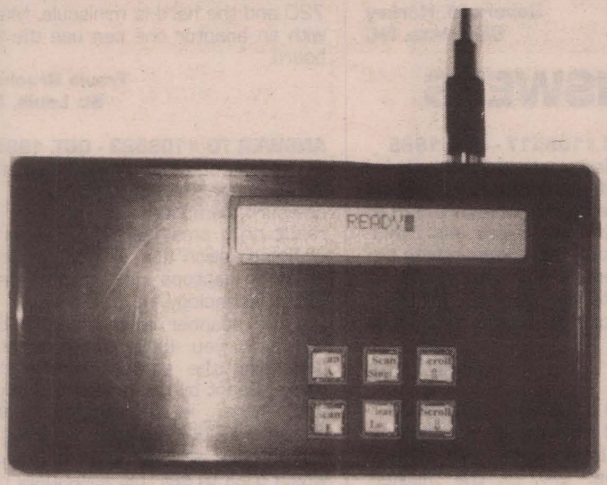
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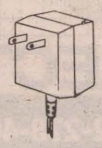
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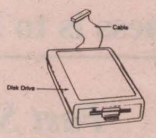
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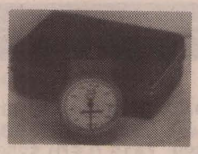
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SELL: HP 8690A sweeper frame, $200; HP 8690B, $250; HP 8699B, 100MHz-4GHz plug-in, $400; HP 8698B, $350; HP 8694A $200; HP 8695A, $200; HP 8693B, $200, HP 8691A, $150; HP 8693B, $200, Tektronix C30A camera and back, $100; HP 197A, $100, Tektronix DC503, $150 Tektronix 106 pulse gen., $200; Tek 109, $100; Tek 191 constant amp. sig. gen., $200; Tektronix 7603 scope frame, $250; Tektronix 1474 NTSC color sync. generator, $200, Tektronix 067050201 scope amplitude cal. fixture, $200. A-Comm Electronics, 303-290-8012, Fax: 303-290-8133.

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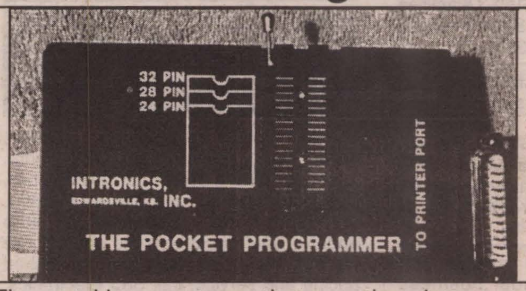
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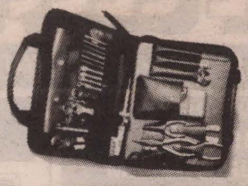
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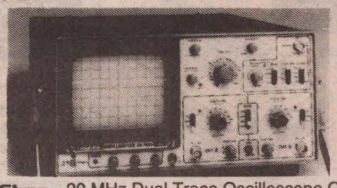
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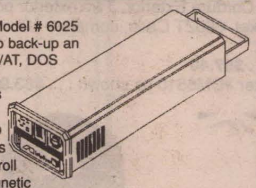
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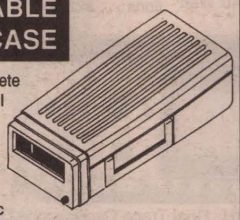
Interdyne Model # 6025 Designed to back-up an IBM PC/XT/AT, DOS 2.0 or later. These units were designed to do back-ups on a small roll of 1/4" magnetic tape. The units are 14.6" x 4.75" x 2.9" and weigh 10 lbs. The heavy-gauge metal chassis box contains a tape drive, power supply with fan and other components. Also includes IEC power cord, data cable and 2 rolls of back-up tape. Although these are new units, we do not wish to represent these as useable units.

We are selling them "AS-IS" for parts and experimentation.

CAT# TBS-2

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PORTABLE SCSI CASE



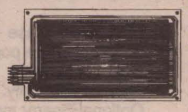
Nearly complete case for SCSI device. Includes 40 watt power supply (5 Vdc @ 3 amps, 12 Vdc @ 2 amps) with cooling fan, power switch, fuse holder, LED socket, power input receptacle, two standard 50 pin SCSI interface jacks, molex-type power connectors, interior cable with 50 pin socket connector and interior mounting rails. Front face plate is an aftermarket piece that doesn't quite go with the box but serves the purpose pretty well. Absent from the case is the switch in back which specifies the device's position in the chain. This can be easily bypassed with a few 0.1" shorting jumpers (our CAT# SJ-1). Also not included is a standard IEC power cord (our CAT# LCAC-60). Off-white case is 14.25" X 7.38" X 3.26" and has a folding handle for easy carrying.

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CAT# FSR-1

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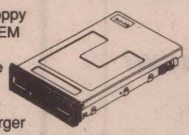


SPST mercury tilt switch. Glass bulb is 0.25 "dia. X 0.67" long. Circuit is closed in vertical position. Rated 750 ma.

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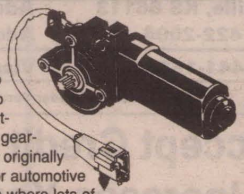
CAT# MPF-11SF

$14.00 each

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INSTALLATION KIT for MPF-11SF allows for installation into 5.25" drive bays. Simply cut and remove three plastic gussets to install. **CAT# FDD-3.5** $3.50 each

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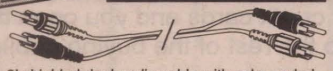


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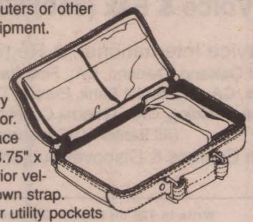
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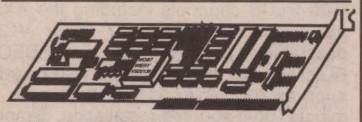
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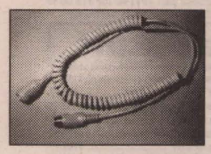
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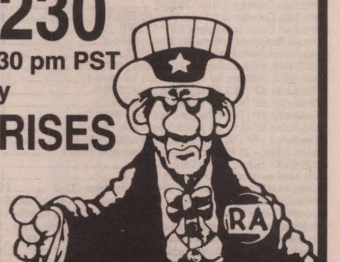
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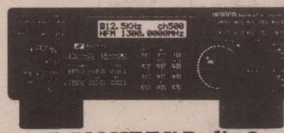
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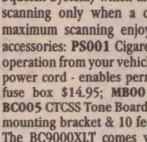
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VHF Transceiver

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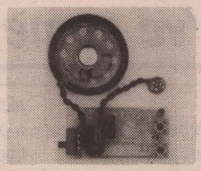
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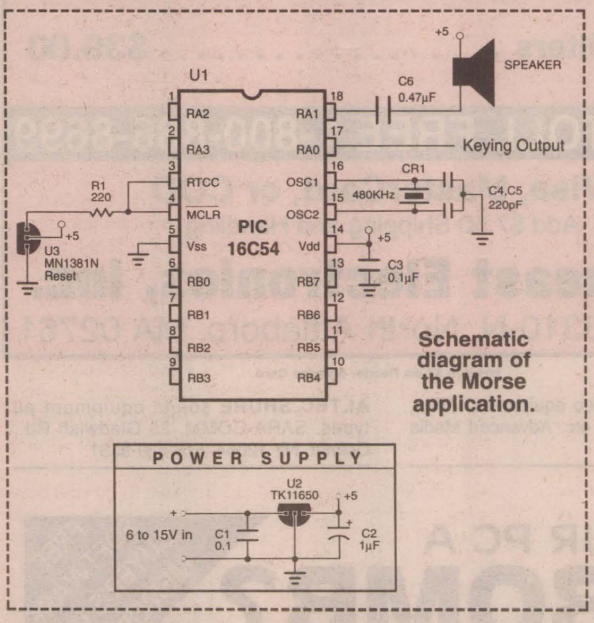
You've come to the right place.

by Scott Edwards

This article will walk you through the process of converting an application originally written in BASIC into a single-chip PIC project that you can use as-is, or modify to your heart's content.

If you have been hesitant to get into programming PICs in assembly language because it seemed too hard, or because beginner-level information has been hard to find, wait no longer. Read this article and plunge in!

(For introductory information on PICs and the PIC programming tools used to create this application, see *Getting Started with PIC Microcontrollers, Nuts & Volts Dec. '94.)*



Schematic diagram of the Morse application.

The Project

Although Morse code is declining as a primary means of communication, it's more popular than ever for automatic identification of radios, electronic tagging of balloons, and propagation beacons, and as a target signal for radio direction-finding activities called *foxhunts*. The ham radio operators out there know exactly what I'm talking about; the rest of you have to take my word.

Generating Morse is a piece of cake. It requires orchestrating a series of short and long tones or switch closures (*dits* and *dahs;* collectively known as the *elements* of a Morse character) into a sequence that a trained Morse operator or computer program can recognize. In the past, Morse has been generated with clever assemblages of gates, timers, counters, flip-flops, and EPROMS or diode arrays to store the message. Going back further, Morse was sometimes sent mechanically by bizarre clockwork arrangements.

Our project will create a chip that can be used as a Morse beacon, a device that sends a preprogrammed message at regular intervals. We'll use an inexpensive ($4.00) PIC microcontroller for hardware. For software, we'll adapt a BASIC Stamp application note. (The Stamp is a single-board computer that can be programmed in BASIC from a host PC. At approximately $40.00, it's overkill for this simple application, but the sheer flexibility of the Stamp approach often justifies the additional cost. See Sources for more information.)

The first step in developing any circuit application is to define, in precise terms, how it should work. This is often the most difficult part of the process, in part because of a human tendency to say, "I'll know what I want when I see it." When you hear about projects that are delayed and over budget, there's a good chance that this effect is at least partly responsible. We'll spare ourselves this problem by choosing to adapt a ready-made idea from Stamp Application note number 8, *Sending Morse Code* (Sources). That application can be described as follows:

At intervals of approximately 60 seconds, send a brief (1 to 100-character) message in Morse code. The code will be keyed as both a logic level and as a tone of approximately 500 Hz to an attached speaker.

Listing 1 shows the BASIC Stamp program. I'll pare this down to the bare essentials of hardware, then translate the firmware (software that lives in the 'hard' confines of a chip) to create our PIC keyer.

Although I have neatly separated the design into hardware and firmware, it's not that simple in real life. Decisions about one affect the other. The design process seesaws back and forth and settles into a rough balance between competing factors: battery life versus performance; cost versus reliability; hardware minimization versus software complexity; wishful thinking versus engineering reality.

Hardware

Unlike microprocessors, which generally require external memory, clock sources and interface chips in order to operate at all, PIC microcontrollers are starkly self sufficient. All they require is a regulated (or just reasonably stable) power supply, and a timing element for the internal clock oscillator. The timing element can be a quartz crystal or ceramic resonator and a pair of capacitors, a ceramic resonator with built-in capacitors, or a resistor and capacitor.

Our first design hurdle is to select an appropriate five-volt power supply. The PIC microcontroller draws very little current; about 200 microamps (µA) at this project's clock speed of 480 KHz. We want a five-volt regulator that draws as little additional current as possible. (Note that we could go for even greater battery endurance by taking advantage of the PICs sleep mode, but at the expense of either very sloppy interval timing or greatly increased program complexity. See the firmware section for more details.)

A scan of a few catalogs and data books turns up three voltage-regulator candidates: the ultracheap 78L05, the mid-range TK11650, and the expensive LM2936. (Note that there are scads of other small linear regulators out there; I picked three representative units for this discussion.) Table 1 compares their characteristics.

Although the 78L05 is attractively priced, its relative-

Table 1.
Comparison of Selected Five-volt Regulators

	Cost	Quiescent Current	Dropout Voltage	Load Current
78L05	$0.38	2 mA	6.7 volts	100 mA
TK11650	$1.13	400 µA	5.5 volts	100 mA
LM2936	$3.27	15 µA	5.2 volts	50 mA

Table 2.
Comparison of Crystals, Resonators, and RC Oscillators

	Cost	Tolerance	Durability	Size
Crystal plus caps	$1.30+	±0.005%	fragile	large
Resonator w/caps	$0.86	±1%	tough	medium
RC	$0.05	±50%	very tough	small

Table 3.
PBASIC Instructions Used in Morse Application

Instruction	Remarks
Output	Use 'tristate' data- irection register.
For/Next	Use assembly language compare-and-jumps.
Lookup	Copy-fill in table with Morse patterns.
Gosub	Use assembly language Call instruction.
Pause	Copy-modify for 480 KHz operation.
IF/Then	Use assembly language compare and jumps.
Let, logical AND	Use assembly language AND.
Let, multiply by 2	Use assembly language rotate left.
High and Low	Use assembly language setb and clrb.
Sound	Copy-modify for single output pin; set pitch high to compensate for slow clock.

Listing 1.
BASIC Stamp Program Listing

```
' Program MORSE.BAS
' This program sends a short message
' in Morse code every minute.
Symbol          Tone = 100
Symbol          Quiet = 0
Symbol          Dit_length = 7
Symbol          Dah_length = 21
Symbol          Wrd_length = 42
Symbol          Character = b0
Symbol          Index1 = b6
Symbol          Index2 = b2
Symbol          Elements = b4

Identify:
output 0: output 1
for Index1 = 0 to 7
' Send the word "PARALLAX" in Morse:
    lookup Index1,(100,66,67,66,68,68,66,148),Character
    gosub Morse
next
pause 60000
goto Identify

Morse:
let Elements = Character & %00000111
if Elements = 7 then Adjust1
if Elements = 6 then Adjust2
Bang_Key:
for Index2 = 1 to Elements
    if Character >= 128 then Dah
    goto Dit
Reenter:
    let Character = Character * 2
next
gosub char_sp
return

Adjust1:
Elements = 6
goto Bang_Key

Adjust2:
Character = Character & %11111011
goto Bang_Key
end

Dit:
high 0
sound 1,(Tone,Dit_length)
low 0
sound 1,(Quiet,Dit_length)
goto Reenter

Dah:
high 0
sound 1,(Tone,Dah_length)
low 0
sound 1,(Quiet,Dit_length)
goto Reenter

Char_sp:
sound 1,(Quiet,Dah_length)
return
```

```
; ========================
; SUBROUTINES
; ========================

; This is the Source Book Pause routine, modified to work at 480 KHz.
; Upon entry, variables hiB and lowB hold the MSB and LSB of the
; number of milliseconds (1 to 65535) to delay.

Pause   NOT     hiB                     ; Take twos complement
                NEG     lowB            ; of the 16-bit counter
                snz                     ; If zero, lowB overflowed,
                inc     hiB             ; so carry into hiB.
:load   mov     temp,#28                ; Set up for 1-ms loop.
:loop   nop                             ; Do nothing.
                djnz    temp,:loop      ; Do more nothing.
                inc     lowB            ; lowB = lowB+1.
                snz                     ; Overflow in lowB?
                incsz   hiB             ; Yes: hiB=hiB+1, overflow?
                jmp     :load           ; No overflow: do it all again.
                ret                     ; Overflow. Return to caller.

; Lookup table containing the dit/dah patterns for "NUTS AND VOLTS."
Lookup jmp      pc+w
                retw    130,35,129,3,0,66,130,131,0,20,227,68,129,3

; Sound routine from the PIC Source Book, modified to always point to ra.1,
; the speaker output for this application. The modification saves a few
; lines of code by eliminating the need to specify port and pin each
; time Sound is used. It also frees up one level of the PIC's return
; stack, since Sound no longer has to call the table of pins.

Sound
                mov     fsr,#ra         ; Point to port ra,
                mov     pin,#2          ; ..pin 1.
                NEG     duratn          ; Convert to two's complement.
                mov     f_copy,freq     ; Use copy so freq value is saved.
                snz                     ; If freq is 0, clear pin to
                clr     pin             ; produce a silent delay.
:loop           mov     w,pin           ; f_copy=f_copy+1: IF f_copy<=255
                incsz   f_copy          ; THEN w=pin ELSE w=0
                clr     w               ; (makes a silent delay if freq = 0)
                XOR     indirect,w      ; indirect=indirect XOR w
                mov     w,f_copy        ; If f_copy has rolled over to 0,
                snz                     ; reload it with the value of freq.
                mov     w,freq
                mov     f_copy,w
                inc     temp            ; Increment LSB of duratn counter.
                snz                     ; Overflow? Yes: Increment duratn and
                incsz   duratn          ; if it overflows, return. Else loop.
                jmp     :loop
                ret
```

mon pin arrangement and similar bypass-capacitor requirements, perhaps the decision can be made on the basis of the final application. If absolute maximum battery life is the goal, spend the extra money and use the LM2936. If battery life is less important than cost, or the ability to use the regulator to run another circuit requiring more than 50 mA, then the TK11650 wins out.

Next we must choose appropriate timing components. The choice basically boils down to the factors shown in Table 2.

The timing components set the speed at which the PIC will process instructions. In our Morse application, this will affect the rate at which the characters are sent and the pitch of the tone output. Looking at the choices in Table 2, we can dismiss the inexpensive RC oscillator as a bit too sloppy. Large variations in sending speed and sidetone pitch would be obvious and annoying to the user. The super-accurate crystal is overkill in light of its cost, fragility, and size. The resonator offers a nice balance of accuracy, durability, and size. So our design will incorporate a ceramic resonator.

The selection of clock speed goes hand-in-glove with the type of oscillator. In general, it's smart to run the PIC as slowly as possible, since current draw increases with speed. The BASIC Stamp runs at 4 MHz, but it's saddled with the responsibility of fetching instruction from an EEPROM and interpreting them. The program for our Morse application will be constructed from modules that work like the Stamp instructions, but are written in lean, fast assembly language. We can therefore slow down the clock considerably.

The next hardware issue is the speaker output. We use a series capacitor to block direct current from flowing through the speaker's voice coil, and to limit the average current of the pulsating DC of our output tone. I'd like to tell you that the capacitor value was carefully selected based on a yard-long formula, but it was just a case of TLAR design. TLAR is the term coined by Dick Rutan, builder of the round-the-world Voyager aircraft, for design decisions made on the basis of "That Looks About Right."

The keying output is next. It is simply a logic-level output that switches between 0 volts (key up) and +5 volts (key down). It is capable, like any PIC I/O pin, of sinking 25 mA or sourcing 20 mA. This output can drive TTL logic, a switching transistor, a relay through a switching transistor, an opto-isolator, etc. The *Radio Amateur's Handbook* has information on interfacing logic to transmitter keying inputs.

Our final design considerations have to do with how to handle the various pins that aren't used in this application. First on the list is the MCLR pin. When this pin is low (grounded), the PIC is forced into an inactive state with all I/O pins set to input. When MCLR is high, the PIC runs the program stored in its EPROM, beginning with the instruction specified in the program's reset directive.

Other chips have similar reset pins, and most require an external resistor-capacitor circuit to hold reset low during power up. The PIC has built-in power-up delay circuitry, making the external R and C unnecessary. However, the PIC is vulnerable to the effects of

ly high quiescent current (the current it draws for internal purposes under little or no load) is high. An unwritten design goal of every application should be to conserve battery power. It does little good to throttle the PIC down to 200 µA of current while allowing the voltage regulator to waste nearly 10 times that amount. The 78L05's relatively high dropout voltage – the input voltage below which it will no longer regulate its output – also reduces effective battery life. There may be considerable energy left in a nine-volt battery even after its output drops below 6.7 volts.

Now we have a runoff between the TK11650 and the LM2936. Since the two devices have a com-

Parts List

Semiconductors

U1 – PIC16C54 microcontroller programmed with code from Listing 2. (Purchase blanks from Parallax or Digi-Key.)
U2 – TK11650 low-dropout five-volt regulator (Digi-Key TK11650CT-ND).
U3 –MN1381 reset circuit (Digi-Key MN1381-N-ND).
CR1 – 2-terminal 480 KHz ceramic resonator (Integrity Tech ZTB 480k or Digi-Key P9943-ND).

Capacitors

C1,C3 – 0.1 µF 50 WVDC ceramic
C2 – 1 µF 16 WVDC tantalum
C4,C5 – 220 pF 50 WVDC ceramic
C6 – 0.047 µF 50 WVDC ceramic

Miscellaneous

R1 – 220 ohms, 1/4 or 1/8 watt speaker – miniature 8-ohm (or higher). May substitute earphone or other sounding device.
Battery or power supply; breadboard or circuit board; enclosure; etc.

Table 4. ASCII Characters with Morse and Binary Morse Equivalents

Character	ASCII	Morse	Binary Encoding	Decimal Encoding	Remarks
<space>	32		00000000	0	7 dits of silence
!	33		00000000	0	sent as <space>
"	34	•–••–•	01001110	78	
#	35	•••–•–	00010111	23	Morse $\overline{SK}$
%	36	•••–••–	00000000	0	sent as <space>
$	37		00000000	0	sent as <space>
&	38		110011111	207	sent as comma
'	39	•––––•	01111110	126	
(	40	–•––•	10110101	181	
)	41	–•––•–	10110111	183	
*	42		00000000	0	sent as <space>
+	43	•–•–•	01010101	85	Morse $\overline{AR}$
,	44	––••––	110011111	207	
-	45	–••••–	10000111	135	
.	46	•–•–•–	01010111	87	
/	47	–••–•	10010101	149	
0	48	–––––	11111101	253	
1	49	•––––	01111101	125	
2	50	••–––	00111101	61	
3	51	•••––	00011101	29	
4	52	••••–	00001101	13	
5	53	•••••	00000101	5	
6	54	–••••	10000101	133	
7	55	––•••	11000101	197	
8	56	–––••	11100101	229	
9	57	––––•	11110101	245	
:	58	–––•••	11100110	230	
;	59	–•–•–•	10101110	174	
<	60		00000000	0	sent as <space>
=	61	–•••–	10001101	141	Morse $\overline{BT}$
>	62		00000000	0	sent as <space>
?	63	••––••	00110110	54	
@	64		00000000	0	sent as <space>
A	65	•–	01000010	66	
B	66	–•••	10000100	132	
C	67	–•–•	10100100	164	
D	68	–••	10000011	131	
E	69	•	00000001	1	
F	70	••–•	00100100	36	
G	71	––•	11000011	195	
H	72	••••	00000100	4	
I	73	••	00000010	2	
J	74	•–––	01110100	116	
K	75	–•–	10100011	163	
L	76	•–••	01000100	68	
M	77	––	11000010	194	
N	78	–•	10000010	130	
O	79	–––	11100011	227	
P	80	•––•	01100100	100	
Q	81	––•–	11010100	212	
R	82	•–•	01000011	67	
S	83	•••	00000011	3	
T	84	–	10000001	129	
U	85	••–	00100011	35	
V	86	•••–	00010100	20	
W	87	•––	01100011	99	
X	88	–••–	10010100	148	
Y	89	–•––	10110100	180	
Z	90	––••	11000100	196	

Listing 2.
PIC Assembly Language Program (Parallax dialect)

```
; PROGRAM: Morse.src
; This program demonstrates how to use routines from The PIC Source Book
; to generate a periodic Morse-code identification message. The Source
; Book routines have been modified to work at 480 KHz instead of the usual
; 4 MHz. This helps conserve battery power.

        org     8
pin     ds      1       ; Pin to use as output for Sound.
freq    ds      1       ; Frequency of note (Sound).
duratn  ds      1       ; Duration of note (Sound).
f_copy  ds      1       ; Copy of freq variable.
temp    ds      1       ; Variable to stretch duratn to 16 bits.

char    ds      1       ; Character to send.
index1  ds      1       ; Index of characters to be sent.
index2  ds      1       ; Index of elements (dits and dahs).
elments ds      1       ; Number of elements in a character.

hiB     ds      1       ; MSB of Pause time.
lowB    ds      1       ; LSB of Pause time.

tone    =       250     ; Pitch of Morse dits and dahs.
quiet   =       0       ; No tone for a freq of 0.
dit_len =       3       ; Duration of a dit.
dah_len =       9       ; Duration of a dah.
Wrd_len =       16      ; Duration of an inter-word pause.
msg_len =       14      ; Number of characters in message.

delay   =       60000   ; Delay in milliseconds between xmissions.

; Device data and reset vector
        device          pic16c55,xt_osc,wdt_off,protect_off
        reset           start
        org             0
```

brownouts, temporary dips in supply voltage below the minimum required for operation. Different portions of the chip shut down at different times, causing all kinds of unpredictable behavior.

Further, the MCLR and RTCC (digital counter input) pins seem to be susceptible to *latchup*, a response to voltage spikes that causes the chip to create an internal short circuit path between +5 volts and ground. When latchup occurs, the chip is locked up until the power is switched off, then back on. That's *if* the batteries and the chip survive the experience!

To prevent brownout problems, our circuit uses a low-voltage detector. The MN1381 responds to a brownout by putting the PIC into reset when the supply falls below a threshold voltage. It keeps the PIC in reset until the supply climbs to 300 millivolts (mV) above that threshold. That 300-mV difference between the into-reset and out-of-reset voltages is called *hysteresis*, and it prevents the voltage detector's output from chattering on and off in response to noise at the threshold voltage.

We've added a series resistor between the voltage detector output and MCLR to limit maximum current. This will help prevent latchup, which starts with a large gulp of current (50 mA or more) into or out of the pin.

Sources

Scott Edwards Electronics offers the source code for this project free with the purchase of *The PIC Source Book*, a book/disk package of more than 35 assembly language routines and demonstration programs for PIC 16C5x microcontrollers. Price is $39.00 for users of Parallax PIC programming tools, $69.00 for others (e.g., PICStart 16B owners) who will need the Parallax assembler.

Scott also carries the Counterfeit, a single-board computer kit based on Parallax' BASIC Stamp controller chip, for $29.00. You can program the Counterfeit from your PC using either the Parallax Stamp Programming Package, or the Counterfeit Development System ($69.00). The Counterfeit Development System includes one Counterfeit controller, so it's ready to assemble and go.

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Manufacturer of the BASIC Stamp microcomputer and PIC programming tools.

Finally, we've tied the RTCC input to MCLR, simply because it needs to go somewhere, and the two are neighbors on the PIC package.

As for the other unused pins, the general-purpose I/Os of port RA and RB, we've left them unconnected. In the program, we'll set them to output-in effect internally tying them to the power-supply rails. We could also program them as inputs, and physically tie them to the supply rails with anti-latchup resistors, but why waste components?

That concludes our tour of the hardware. The resulting circuit (minus the speaker) represents a fairly typical starting point for almost any PIC application.

Firmware

Listing 2 is the assembly-language program that runs our Morse-keyer PIC. I wrote it with the help of routines from my *PIC Source Book*. This book (Sources) presents a series of assembly-language subroutines that work like BASIC Stamp instructions. It comes with source code on disk that you can cut and paste into your own programs.

The *Source Book* routines and Listing 2 are written in the Parallax dialect of PIC assembly. If you're just getting started with the PIC, or if you have experience with other micros that you would like to apply to the PIC, this is the language for you. The Parallax assembler is free with the purchase of Parallax programming hardware, and available as an extra-cost option with The *PIC Source Book*. See the Sources box.

My first step in writing the program was to make a list of BASIC instructions used in the original program, and deciding how they might have to be modified to fit my final application. Table 3 is my list.

The program is a hybrid of prefabricated code (Lookup, Pause, and Sound), and assembly language equivalents of PBASIC commands.

Let's start our firmware discussion by taking a look at the format used to encode the Morse dots and dashes (short and long tones; also known as dits and dahs).

Table 4 shows the encoding scheme used in this program. A single byte represents a Morse character. The highest five bits of the byte represent the dots (0s) and dashes (1s), while the lower three bits represent the number of elements in the character. For example, the letter F is dot dot dash dot, so it is encoded 0010x100, where x is a don't-care bit.

Since Morse characters can contain up to six elements, we have to handle the exceptions. There is some excess capacity in the number-of-elements portion of the byte, which can represent numbers up to seven. So we assign a six-element character ending in a dot the number six, while a six-element character ending in a dash gets the number seven.

To play back one of these Morse-encoded bytes, we use this sequence:

1. Put the lowest three bits of the Character byte into a variable called Elements.

If Elements is less than 6, do nothing.

If Elements is equal to 6, make bit 2 of the character (the sixth element of the Morse sequence) a 1, which will play as a dash.

If Elements is equal to 7, make Elements = 6. Leave bit 2 of the character equal to 0 so it will play as a dot.

2. If bit 7 of Character is 1, play a dash, else play a dot.

Shift the bits of Character to the left so that bit 6 is now in bit 7, bit 5 in bit 6, and so on.

Let Elements = Elements - 1.

If Elements is not 0, go back to step 2, else continue.

3. Produce a silent delay equal to the desired space between characters.

Listing 1, the section labeled "Morse" shows how this is phrased in PBASIC; the same labeled portion of Listing 2 shows it in assembly language. Note that in assembly language, decisions can be made on the basis of the state of a specified bit, as in the skip-if-not-bit (snb) instruction. In PBASIC, only certain bits are directly addressable. Examining other bits requires either a comparison or a logic operation and a comparison. In this instance, we want to look at bit 7, which has a value of 128. The PBASIC program uses the fact that any value with bit 7 set (equal to 1), must be greater than or equal to 128.

The bottom line is that it's generally easier to perform bit manipulations in assembly language than in BASIC!

That's how an individual Morse character is played back. I deliberately glossed over the process of generating the individual dots and dashes because it's as simple in assembly language as it is in PBASIC; just pass the desired tone and duration data to a subroutine called Sound.

Now that we can play a Morse character, let's play a sequence of 'em to produce a message. The logic goes like this:

1. Make Index equal to 0.
2. Look up the Morse character corresponding to Index from a list of characters to send.
3. Send the Morse character by the process described above.
4. Let Index = Index + 1.
5. If Index is less than the number of characters in the message, go to step 2, else continue to step 6.
6. Pause 60 seconds.
7. Go back to step 1.

That's it, the whole process of programming the simple Morse IDer. The code in Listing 2 has not been optimized to reduce the amount of program or data memory it requires, yet it still uses only 25 percent of the PIC 16C54's program memory. The extra capacity can be used to add capabilities, like much larger messages; user selection of sending speed, sidetone pitch and other parameters; or even data-to-Morse conversion as the basis of a Morse telemetry unit.

Conclusion

Programming PICs in assembly language is fun and rewarding. It can also be quite a challenge, especially to a novice without previous programming or digital electronics experience. Small projects like this one are a great way to get started. NV

```
; ==========================
; MAIN PROGRAM
; ==========================

; Starting point of the program. Sets ra to output for speaker and key,
; clears temp variable used by the Sound subroutine.
start           mov     !ra, #0         ; Output for speaker.
                mov     !rb, #0         ; Unused pins to output.
                clr     temp            ; Clear LSB of duratn counter.

; The loop that plays the message stored in the Lookup table above.
Identify
        clr     index1                  ; Start w/ item 0 in the table.
:loop   mov     w,index1                ; Look up next table entry.
        call    lookup
        mov     char,w                  ; Put the table item into char.
        jmp     morse                   ; Play the dits and dahs.
:next   inc     index1                  ; Point to next item in the table.
        cjne    index1,#msg_len,:loop   ; End of message?
        mov     hiB,#delay<             ; Load delay constant in hi and low bytes.
        mov     lowB,#delay>
        call    pause                   ; Pause.
        jmp     start                   ; Do it again.


; Routine that unrolls the encoded Morse character stored in char to
; play a sequence of dits and dahs.
Morse           mov     w,char          ; Check for a 0 (representing a word space).
                jnz     :not_sp         ; Not a space? Play dits and dahs.
                mov     freq,#quiet     ; A space: Set for silence.
                mov     duratn,#wrd_len; Long pause between words.
                call    Sound           ; Do it.
                jmp     identify:next   ; Get the next character of the message.
:not_sp AND w,#00000111b                ; Get the lowest three bits (number of elements).
                mov     elments,w       ; Put it into the variable elments.
                cjb     elments,#6,:key; If less than six elements, get on with it.
                cjne    elments,#7,:six ; Handle case in which elments = 6.
                dec     elments         ; Elments = 7, adjust to be 6.
                jmp     :key            ; Begin keying.
:six            AND     char,#11111011b; Elements = 6, adjust last element to "dit."
:key            snb     char.7          ; Keying: if bit=1 then dah.
                jmp     Dah
                sb      char.7          ; Keying: if bit=0 then dit.
                jmp     Dit
:nextEl rl      char                    ; Rotate bits of char left to get next element.
                djnz    elments,:key    ; All elements played? If not, key next.
                mov     freq,#quiet     ; Done: play post-character silence.
                mov     duratn,#dah_len; Medium pause after characters.
                call    Sound           ; Do it.
                jmp     identify:next   ; Send the next character in the message.

; Plays a short dit tone. Change duration by changing the value of
; the constant 'dit_len' at the beginning of the program.
Dit             setb    ra.0            ; High pin 0 of port ra (key down).
                mov     freq,#tone      ; Set pitch.
                mov     duratn,#dit_len ; Set length of dit.
                call    Sound           ; Do it.
                clrb    ra.0            ; Low pin 0 of port ra (key up).
                mov     freq,#quiet     ; Set silent pause
                mov     duratn,#dit_len ; Set length of post-dit pause.
                call    Sound
                jmp     Morse:nextEl

; Plays a longer dah tone. Change duration by changing the value of
; the constant 'dah_len' at the beginning of the program.
Dah             setb    ra.0            ;High pin 0 of port ra (key down).
                mov     freq,#tone      ; Set pitch.
                mov     duratn,#dah_len; Set length of dah.
                call    Sound           ; Do it.
                clrb    ra.0            ; Low pin 0 of port ra (key up).
                mov     freq,#quiet     ; Set silent pause.
                mov     duratn,#dit_len ; Set length of post-dah pause.
                call    Sound
                jmp     Morse:nextEl
```

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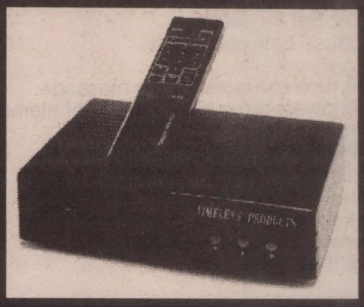
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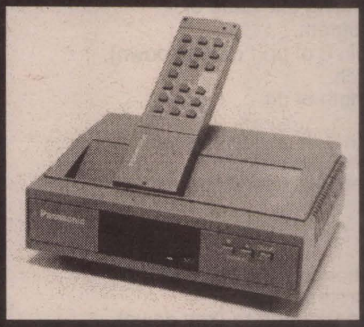


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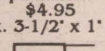
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- PS-10 ADJUSTABLE 0 TO 20 VDC
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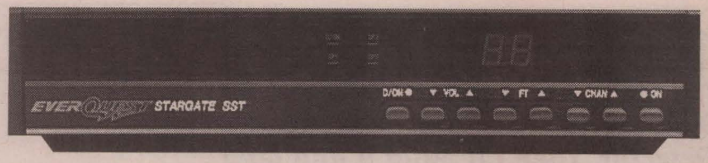
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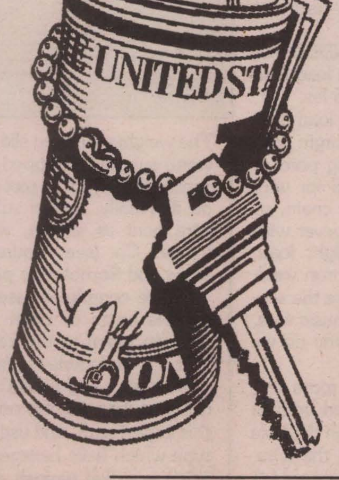
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THE LASER EXPERIMENTER

Conducted by
Anthony Charlton

Welcome! This month, we'll first look at an on-paper improvement to our experimental Laser Gravity Detector. Then I'll build it and let you know the results in a future column. This subject has been covered in the previous two columns, and in case you missed it, here's a brief re-cap:

Every mass in the universe from sub-atomic particles to entire clusters of galaxies have mutual gravitational attraction. While this attraction is by far the weakest force in nature, when enough mass is concentrated in a central spot, the force becomes quickly measurable. Try dropping a pencil from your spot right now, and you will see in action the force of gravity generated by the mass of the earth. Our project over the last several columns revolves around whether we can make a reliable device for detecting and possibly quantifying mutual attraction between two small masses.

Sensor Set-up Improvement

I became disenchanted with the previous experimental design, whereby a mass is held aloft by a piece of music wire; an extremely strong and flexible steel. The idea is to approach the gravity detector with another mass (such as a person) and the sensor mass will become attracted slightly to the approaching mass, bend on its supporting wire slightly, and thus cause interferometric results with a laser beam. The interferometer approach can detect movement on the order of fractions of a millionth of an inch, if all is set up properly. (For more information, see the prior two columns and the one on Interferometry; this subject is treated in Laser Experimenter Jan. '94.)

However, this approach had its problems. First, the wire was not strong enough to support the 15+ lb. sensor mass without the danger of bending awry, and it did several times, ruining it, and necessitating rebuilding the assembly. So, as far as practicality was concerned, this was OUT. So then I began to think of another way to incorporate both the sensor mass, and the flexibility of the music wire, plus the necessary vibration dampening, which, if not incorporated, interferes with the clarity of the results.

The result is Figure 1, showing a SUSPENDED and much heavier mass of 100 pounds. Based on a load limit table for 1/4" wire rope, whose safe load is 675 lbs. {1}, the stronger 1/8" music wire would have a safe load of at least 168.75 lbs., giving us plenty of safety margin with the 100 lb. load in this example. The breaking point is supposedly seven times the safe working load for wire rope, and four times the safe working load for chain, so I don't think there will be any problem whatsoever with the 1/8" music wire under this relatively light load. However, if you substitute brass rod or drawn iron welding rod, one would significantly have to downsize the sensor load mass. Mail order hobby suppliers sell music wire, in case you have difficulty finding it locally. Why do we need so much weight, you ask?

Well, the idea is the heavier the mass, the more sensitive the gravity detection. The wire is secured both at the top and the bottom by first guiding it through the hole drilled in the lower steel plates, heat-bending the wire, and then soldering it to the plates using acid core solder.

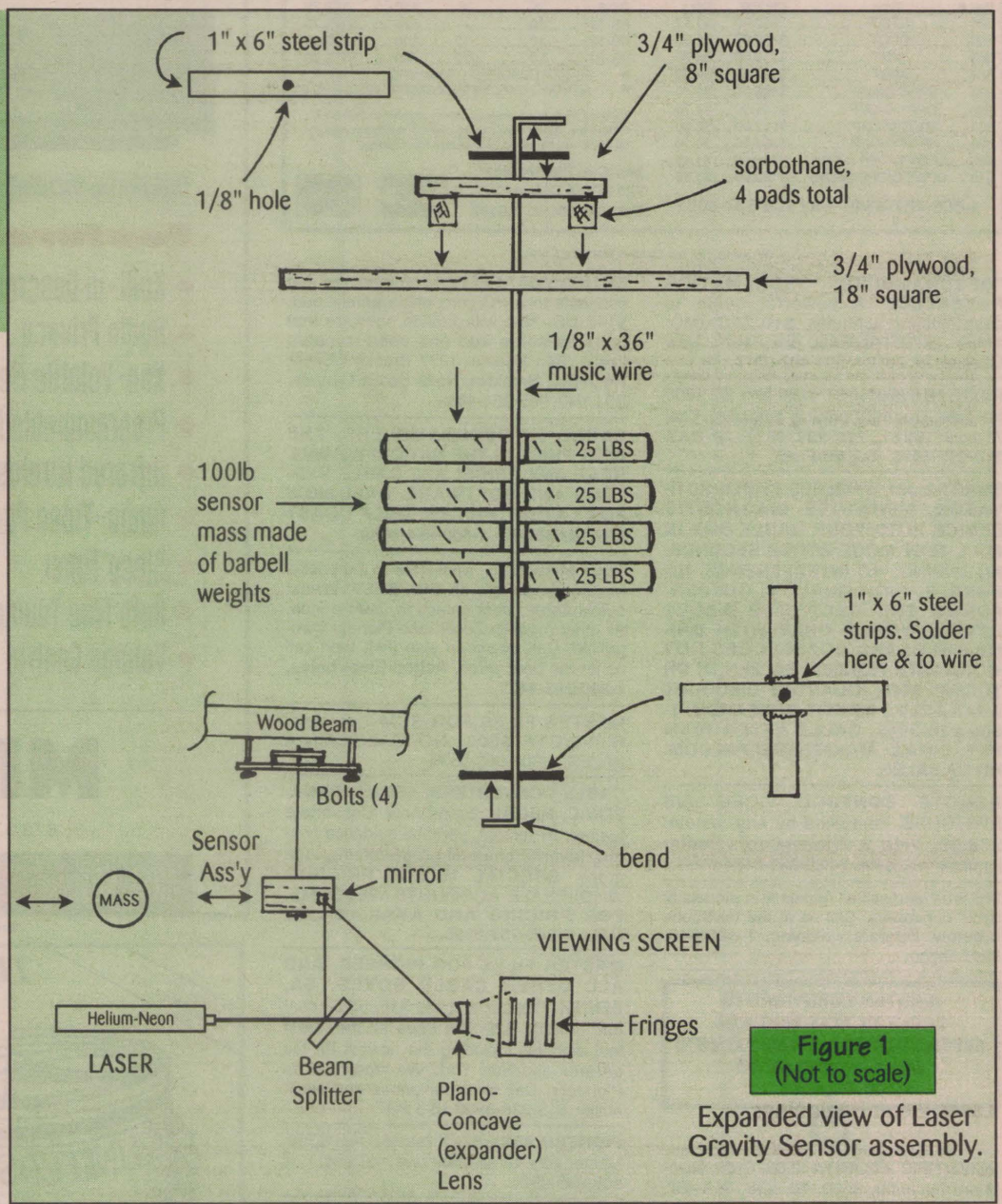


Figure 1
(Not to scale)

Expanded view of Laser Gravity Sensor assembly.

The weights are then slid over the wire. Next, the top plywood support is slipped down over the wire. After that, comes the plywood piece with the four Sorbothane pads on it. Finally, a steel strip is slipped over the wire, the wire bent as shown, and soldered to the steel strip. Images Co. (see "Sources") carries both suitable steel strips and Sorbothane pads.

The completed assembly will then be screwed to a suitable beam or other support. I plan to use a large wooden beam in the cellar of my house as a support. Wood is preferable to metal, as metal conducts vibration more easily, and doesn't "dampen out" like wood does. Support the assembly on a secure scaffold when installing this experiment, and use long, heavy screws of the "Lag" type which have hexagon heads, and can be screwed in using a socket wrench. You don't want 100 pounds of weights crashing down from the ceiling!

The assembly will float on the Sorbothane pads, and the music wire will allow free movement of the sensor mass. Set up your laser as shown, and give the experiment plenty of time to settle (about 20-30 minutes) before trying it out. The reason is to allow any micro-movement of the mass to settle out. Also, turn off anything electric or mechanical that could cause vibration. For this reason, the experiment probably won't work on windy days, as the wind load on your building will likely cause enough vibration to obscure the results. We only wish to get the influence of gravity upon this experiment.

You should be able to see fringes where the two

{1} *Pocket Ref*, Sequoia Publishing, Inc, Littleton, CO, c. 1989, 1992 by Thomas J. Glover

CAUTION: Static Sensitive Device. Handle Boards By Edges Only.

Figure 2 Miniature Video Camera Circuit Board, With TV Modulator Receiver Board

CAMERA CIRCUIT BOARD

Picture	Black & White (CCD)
Output to RX Via Cable	4MHZ, FM
Band Width	2 MHZ
Resolution	162 x 120 Pixels
Viewing Angle	30 Degrees Horizontal x 22.5 Degrees Vertical
Focus	4 Inches to Infinity
Required Light	40 LUX thru Sunlight
Irising	Electronic
Power	7.0 Vdc - 9.0 Vdc @ 350 mA
Power Connector	Radio Battery Clip
Size	Approx. 1"Hx1.25"Wx7"L

RECEIVER CIRCUIT BOARD

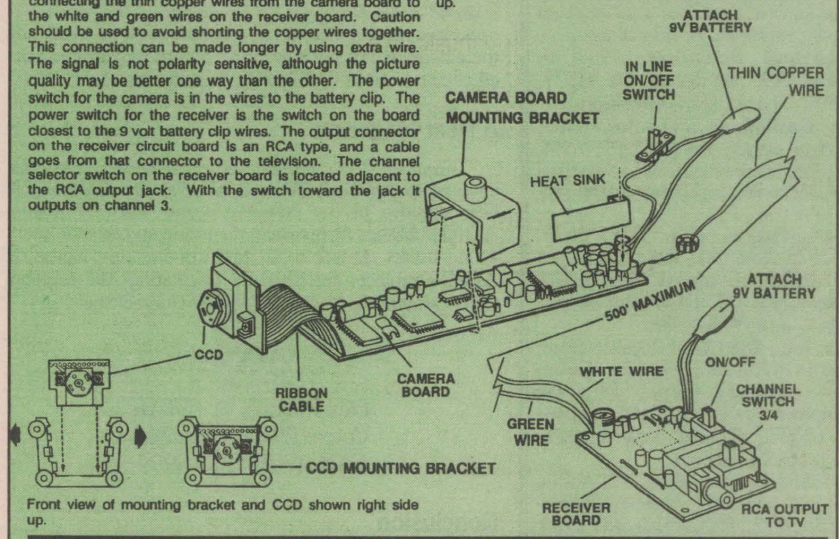
Output Frequency	TV Channel 3 or 4 Switch Selectable
Distance Thru Cable	Approx. 500' Maximum
Distance Thru Air	Will Not Operate Thru Air
Output Connection	RCA Approx..75Ω (With 300Ω Matching Transformer)
Power	7.0 Vdc - 9.0 Vdc @ 150mA
Power Connector	Radio Battery Clip
Size	Approx. 1"Hx2.5"Wx3.5"L

CAUTION: Static Sensitive Device

CONNECTION AND OPERATION

Connection from the camera to the receiver is made by connecting the thin copper wires from the camera board to the white and green wires on the receiver board. Caution should be used to avoid shorting the copper wires together. This connection can be made longer by using extra wire. The signal is not polarity sensitive, although the picture quality may be better one way than the other. The power switch for the camera is in the wires to the battery clip. The power switch for the receiver is the switch on the board closest to the 9 volt battery clip wires. The output connector on the receiver circuit board is an RCA type, and a cable goes from that connector to the television. The channel selector switch on the receiver board is located adjacent to the RCA output jack. With the switch toward the jack it outputs on channel 3.

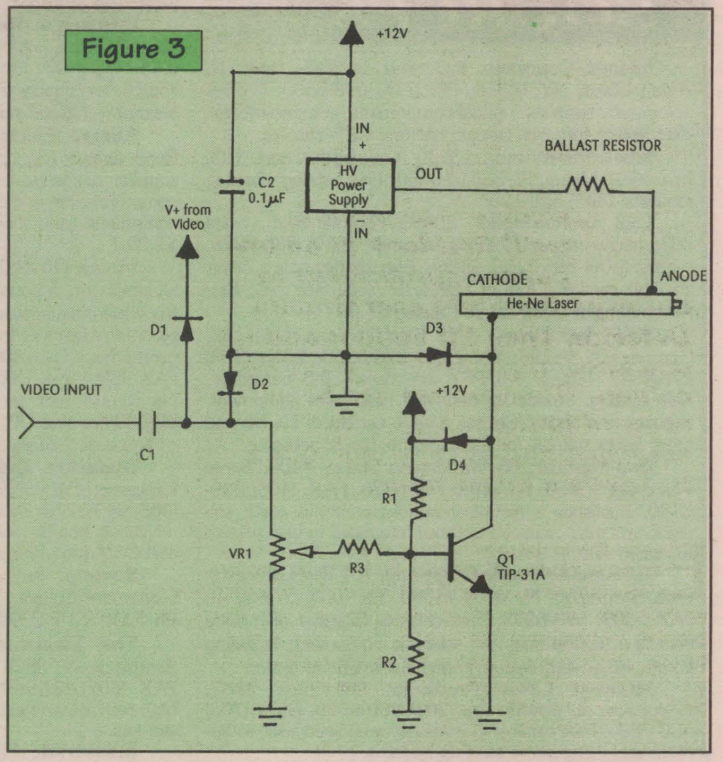
NOTE: Underside view of the camera board is shown for clarity. Camera board and CCD must be mounted right side up.



Front view of mounting bracket and CCD shown right side up.

CAUTION: Static Sensitive Device

Figure 3



beams combine. If not, tinker with the position of the laser, beamsplitter, and mirror until you see them. When you approach the experiment, you should be able to see the fringes move, because of your body mass and the sensor's mass attracting one another.

I would very much like to hear of any of your results with this or similar experiments, and I'll continue to work with it and publish my results in the near future.

Laser Video Beginnings

Either a diode or a helium-neon laser may be used to carry video-modulated laser information to a receiver. This information may be transmitted either through the air, or over an optical fiber. What we shall do over the next few columns is explain theory, test both types of lasers, get the circuit working, and then see how we can improve the circuit to get the best picture.

A black-and-white CCD (Charge Coupled Device) camera is used to modulate the laser. Only the video part of the signal will be used. Using experimenter-grade circuits, the laser is incapable of being modulated at the RF frequencies that a TV receiver will require. Just as an example, Channel 4 is assigned the frequency of 60-66 MHz, a high frequency indeed to modulate a laser with. But no means as high a frequency possible in TV technology, since the highest frequency used in non-satellite, non-cable broadcast bands that I'm aware of is UHF Channel 83, and tops out at 890 MHz!

The bandwidth of a black and white TV is 4.2 MHz. I believe we can get 1+ MHz out of a He-Ne laser and better than that with a diode laser. The bandwidth of the camera is 2 MHz, and the resolution is 162 x 120 pixels. So an acceptable picture will be produced @ 1 MHz and one that is equal to the camera's best picture transmitted if we can get a 2+ MHz bandwidth out of a diode.

Figure 2 shows the data on the camera. It is only 1" H x 1.25" W x 7" L. Amazing! Super Circuits (see Sources) has cameras that are actually substantially smaller than the one shown. But the price of this camera is low (about $60.00 plus shipping) and that makes it financially a good deal to experiment with. Images Co. (see "Sources") is now handling distribution of this camera.

By all means, use it for non-laser experiments if you like. It is also sensitive to infrared, and thus can record near IR diodes and pulsed IR diodes. I hook mine up to a VCR to record experiments done with IR lasers, whose beams are invisible to the unaided eye, of course. Note the TV RF modulator circuit board included with the camera. This enables you to directly connect the camera to the RF terminals of your TV set.

To modulate a helium-neon laser, a circuit such as sketched in Figure 2 is used. Prior columns have carried do-it-yourself articles on how to modulate and recover AUDIO information. In case you missed these, they appeared in Laser Experimenter July '93, Aug. '93, Sept. '93, and Feb. '94.

Here's how it works: Q1 is biased in such a manner by R1 and R2 that the cathode current of the tube, just 4 or 5 milliamps, normally flows through it easily. Since the cathode is near ground potential, the transistor does not have to be a high-voltage type. If it were in the ANODE, it certainly would be, and placing it in the anode will destroy it instantly. Incoming video signals at Q1's base vary the collector-to-emitter resistance of the transistor. The video signals are isolated from the laser circuit by a capacitor, C1. This is necessary, as the pulses used to start the laser may destroy the integrated circuits and other components of the video circuit if a static charge is built up.

A "high" signal causes the transistor to conduct more heavily, and the laser receives a better ground through it and more current flows. Thus, a "high" makes the beam brighter. A "low" signal has just the opposite effect, since the transistor now conducts less current. The bias resistors control the transistor's current flow in the absence of a signal, keeping it on, or "simmering" so that the laser doesn't cut off.

VR1 and series resistor R3 control the amount of video signal that the transistor receives. Note the protection diodes D1-D4. These are tiny but ultrafast switching diodes that shunt transients to the power supply rails, instead of allowing them to ring about and possibly degrade or destroy the video circuit. When we go on to build the circuit, which we'll do after more introduction, the exact values of the components will be given out.

The power supply is a 12 VDC type "epoxy block" module that puts out 1300 VDC @ 4.0 mA with an 8 KV starting pulse. A power supply for the experiment doesn't have to be equal in 'specs, but it does have to be

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.

Mike DeMetz is looking for specifications for an RCA 60285 pulsed laser diode that has an 11 watt output and requires 35 amps from the driver circuit. He is building the Pulsed Laser Diode Driver circuit from the June '95 issue, and would like to obtain the 'specs so that he can properly select the series resistor for that particular laser. He is also looking for a source for a Sharp IR3C02 laser diode controller IC. Any help would be appreciated, and you can send your material to this P.O. Box, and we'll forward the information to Mr. DeMetz.

THE LASER EXPERIMENTER

SOURCES

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, CCD camera.

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.

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 00807-1380. 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.

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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 and data acquisition kits, plans, specialized equipment, and 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) SNAP-FAX [(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 and 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: scarlson@sas.org

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.

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.

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

a DC supply. I have found there is too much ripple in a 60 Hz AC supply, and this introduces distortion in the video signal. The high-frequency output of the DC supply, plus the filtering effect of the capacitive multiplier contained within it, allows a smooth voltage to the laser tube and thus minimal noise output to the receiver. The internal capacitance of the laser tube and the regulating effect of the helium-neon gas mixture within further reduces the ripple that is impressed upon the beam. (Remember that among the first voltage regulators ever used are gas-filled vacuum tubes which still are used sometimes to regulate the high voltages in tube circuits.)

Epoxy block power supply modules are available from such dealers as MWK Industries, listed in "Sources." They run anywhere from $20.00 up, depending whether they are surplus or new, and the size of the laser tube they are capable of operating.

Speaking of high voltage, it is advisable to separate the laser and its power supply from the video circuit's supply by several feet. Reason being is the possible build-up of static charges which could destroy the ICs in the video camera. A common ground is essential, and it must be a utility ground to prevent that same build-up. Another precaution is to spray the video camera (not on the lens, please!) with a clear conformal coating. Such coatings are available from electronic tool suppliers and do the job of neatly covering a circuit with a voltage-resistant coating without affecting circuit operation. Potentiometers and mechanical components like switches have to be covered with masking tape before application. Mechanical protection of the delicate camera is important, too. I used a thick-walled rigid PVC pipe, and have mounted the camera in it using Silicone RTV glue, thus protecting the whole assembly.

Of course, we need a receiver/amplifier for the modulated beam. The receiver must have the following properties:

- Adequate sensitivity.
- Adequate selectivity, or the ability to respond preferentially to the wavelength of the laser light used, and filter out unwanted wavelengths (to a degree, no filter is perfect).
- High-speed response. This is essential since the higher the speed response, the better the quality of the amplified video.
- Low distortion. This is required so that the video is received and
  amplified in good condition so as not to degrade picture quality.
- Readily available and inexpensive parts.

This last item was a bit of a stumper until I started to check out some integrated circuits MANUFACTURED by Maxim and sold by Digi-Key. I have a design breadboarded and will release the schematic of that once it is optimized. In the meantime, you may want to check out the extensive (but not expensive) line of Maxim integrated circuits carried by Digi-Key. It is awesome!

A Neat Magazine

Amateur TV Quarterly is a fascinating magazine devoted to Amateur TV, and we are recommending it here because of the parallels to our video endeavor. *ATVQ* publishes its quarterly magazine and several interesting books related to TV projects and tips. Some of *ATVQ's* projects are REALLY fascinating, like sending CCD cameras up in model rockets! Contact them at:

ATVQ
1545 Lee St.
Des Plaines, IL 60018
Voice: (708) 298-2269
FAX: (708) 803-8994

Conclusion

We would like to get your opinion here at the headquarters of The Laser Experimenter. (Sounds official, eh? but our "Headquarters" is rather modest.) Opinions about whether you like to see projects developed over several columns, indicating our successes, shortcomings — and yes — occasional failures. Or, whether you like to see projects finished, working flawlessly, and done. And encapsulated in one, or possibly two or three consecutive issues, depending upon the complexity of the project.

This question is important, as all science is a process of taking an idea, developing a theory from that idea, and producing an experiment (or device) which yields consistent results time after time to prove the theory correct or wrong. Many times, the theory or experiment has to be modified (like this month's improvement — so far on paper — of the Laser Gravity Detector) so the TRUTH of what the scientist(s) are searching for comes out as it really is. So, a postcard indicating whether you like "Finished" or "Developing" projects would be very helpful. Just write either of these two words and any of your comments and send them to the Laser Experimenter's P.O. Box, listed elsewhere.

We hope you have enjoyed this installment. Next month, we continue with our video project and shall describe some more light-wave theory which we hope you'll find interesting. NV

CLOSING QUOTE:
"Experience is the universal mother of Science." — Cervantes (1547-1616)

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.

Anthony Charlton is an active electronics and science "do-it-yourself" project designer, does custom R & D, and writes technical articles. Previous work experiences include design of hardware & software for microprocessor-based process control systems and electronic design. His hobbies include lasers, gardening, target shooting, and model rocketry.

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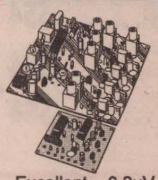
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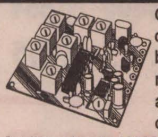


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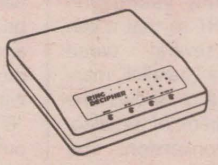
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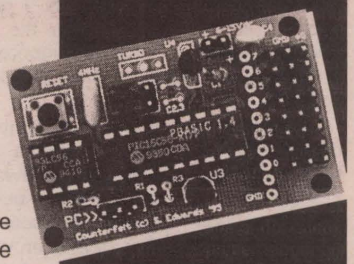
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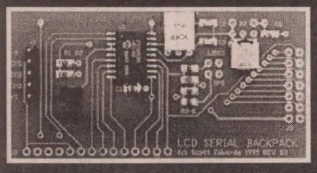
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```
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```

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THE SOLDERLESS BREADBOX

by Donald Wilcher

Serial I/O Control

I hope last month's column sparked some hard core computer control projects. I have been knee-deep in experimentation with the Mac serial I/O board in terms of circuit design/construction, programming, and documenting while preparing for this column.

The idea of being able to control "real world" devices with the Mac is quite an accomplishment because of the software and hardware products for PCs (personal computers) being publicized in electronic/computer magazines and books.

Tons of applications have been written regarding PC interfacing using the serial or printer ports of these machines for I/O control that most users know exist for the PC, but not for the Mac. Although Mac users are aware of computer control, this information is not published in books and magazines.

But this article should not be taken as a slap to PC users. The intent behind this column is to illustrate easy-to-use circuits and software code that will allow your machine to be in "control" of its environment. The purpose behind using the Mac as the programming instrument is to give hope to the small band of users who are looking for challenges in computer interfacing and programming.

As a side note, I would like to thank everybody for the wonderful E-Mail regarding my discussion on strain gauges/instrumentation amplifiers and the TMP01 IC. I will respond to those individuals when time permits. I appreciate your patience in this matter.

Now, let's get this show on the road by discussing the make-up of the serial I/O board for the Mac.

The Mac Serial I/O Board

Figure 1 shows the layout of the serial I/O board for Mac interfacing. The connection to this board is made by using a nine-pin DIN serial cable. As discussed in last month's column, the wiring for the male and female connectors should be one-to-one. Pin 1 on the male should tie into pin 1 on the female end, pin 2 male to pin 2 female, etc. Making the connection to the Mac is done by a serial cable mated to the printer or modem port of the machine. I used the modem port because the software I wrote configures this port for input/output communications. The serial I/O monitor program that accompanies this board will allow you to see the proper communications established between the two units via the 1s and 0s displayed on the screen. If x's are viewed on the input/output windows, check the cable for proper point-to-point wiring. By re-splicing this cable, the proper communications to the board from the Mac will exist.

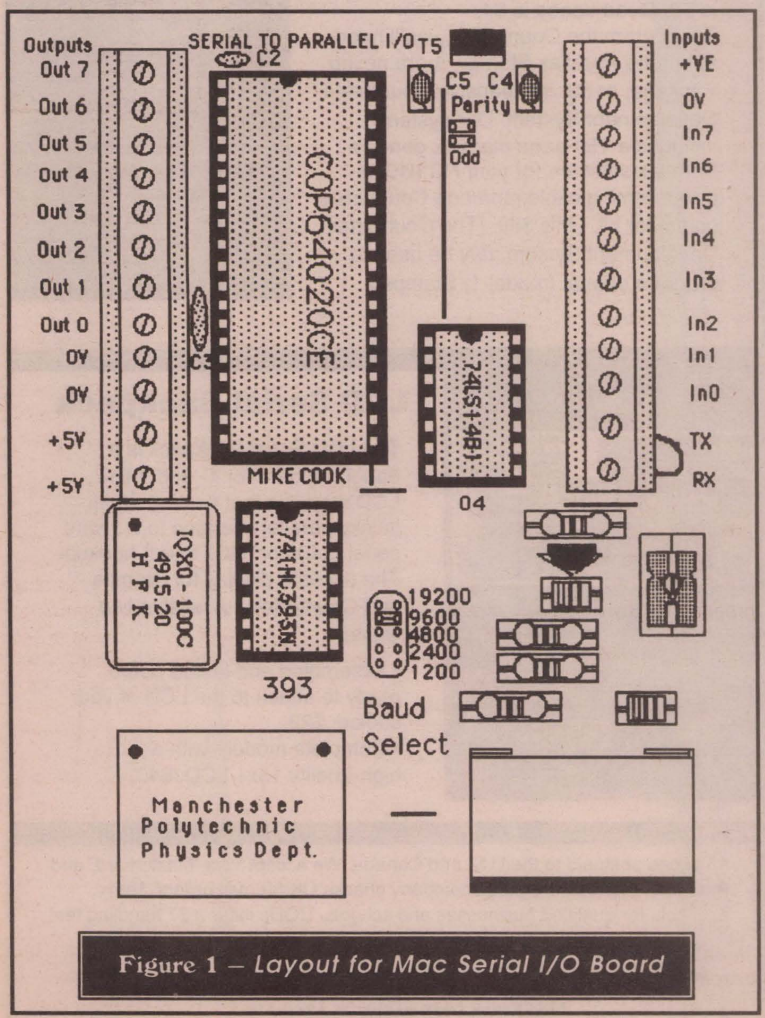


Figure 1 – *Layout for Mac Serial I/O Board*

As seen in Figure 1, there are a lot of electronic goodies on this board. The important chip that allows control/monitoring of electronic devices is the component identifed with the number "COP64020CE." This chip is known as a UART. UART stands for Universal Asynchronous Receiver Transmitter and it's a very useful device for doing external communications between devices.

The UART is basically a serial-to-parallel converter that allows the input data string generated by the machine (PC or Mac) to transmit this information to the UART so that it can control several wired devices in a "parallel" manner. Figure 2 shows the basic diagram of serial-to-parallel conversion. The transmit and receive lines are wired together so that the UART can transmit and receive data serially from the Mac.

The 74LS14B chip is a hex inverter. It is used to allow the transmit and receive lines of the UART to be at the correct logic level (+5V or 0V). The 74HC393 is a four-bit counter responsible for shifting the data into the UART in a serial manner. The crystal (HFK) establishes the appropriate frequency for the Mac's external communication transmit/receive baud rates. Connections to the outside world are made via the terminal strips. A +5V regulated supply is necessary for proper board operation. If a supply voltage greater than +5V is available, not to worry! This serial I/O board has a voltage regulator chip that will maintain the proper voltage level throughout the board. To make this connection requires using the +VE and 0V inputs on the input terminal strip. The software that comes with the board allows the user to check out proper communications between the board and the Mac. Also, it allows you to start doing computer interfacing immediately. (See last month's column on communication check-out procedures and I/O interfacing example[s].) With an explanation of the board, let's investigate how to use it for real world control!

A Mac Serial I/O Interface Example

Here is an example on how to use this board for "real" I/O control. What we would like to accomplish is to turn a motor on/off via the keyboard of the Mac. The screen of the machine will allow the user to make a selection of turning on or off the motor depending on a key depression. The board will then send this information to output terminal "zero" allowing the motor to respond to the user's request. Sounds simple! Well, it is once you know the steps involved in making this interface circuit work.

The first step of this project is to design a circuit that will switch the motor on and off. As shown in Figure 3, a transistor motor driver circuit will do the job. The TIP32C is a power PNP transistor that can handle small loads such as DC motors and lamps directly. This transistor can be powered up to a maximum of 100 VDC and can handle currents up to 3 amps. The motor that I used allowed 78 mA of current to flow with a supply voltage of 5 volts. A 10K-ohm resistor is used to reduce the amount of current flowing through the base. The circuit works by applying 0V at the base of the transistor. This will turn on the three terminal switching device, thereby allowing current to flow through the collector-emitter junction. The current flowing through the emitter lead also flows through the windings of the motor allowing the shaft of the component to rotate.

To test out the operation of the circuit, wire a switch as shown in Figure 3B. The method I used in wiring this circuit is the traditional solderless breadboard. With the switch closed, the motor turns on, and with it open, the motor is off. Now that the motor driver circuit has been checked out, it can be wired to the serial I/O board. Output terminal strip "0" is used for controlling the board, but any of the output terminals can be used as well. A 5V power supply is then wired into the board using the 5V and 0V inputs on the output terminal strip.

To check for serial board to motor driver communication, load the Serial I/O Monitor program. Set the "OUTPUT" 0 bit to 0 and notice the motor turns on. Click the same box and the motor should turn off. If this doesn't work, check to see that the circuit is wired to the right terminal strip output and make sure prop-

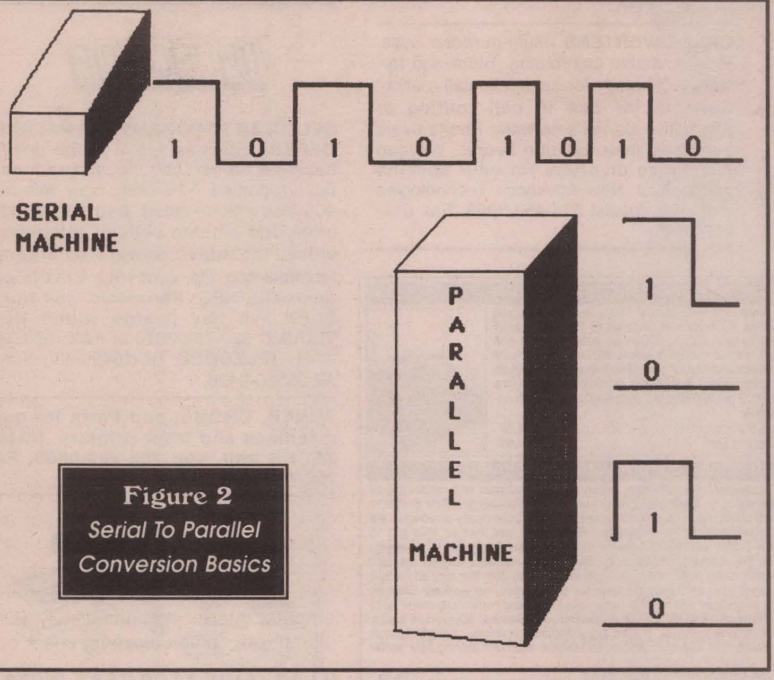


Figure 2
Serial To Parallel Conversion Basics

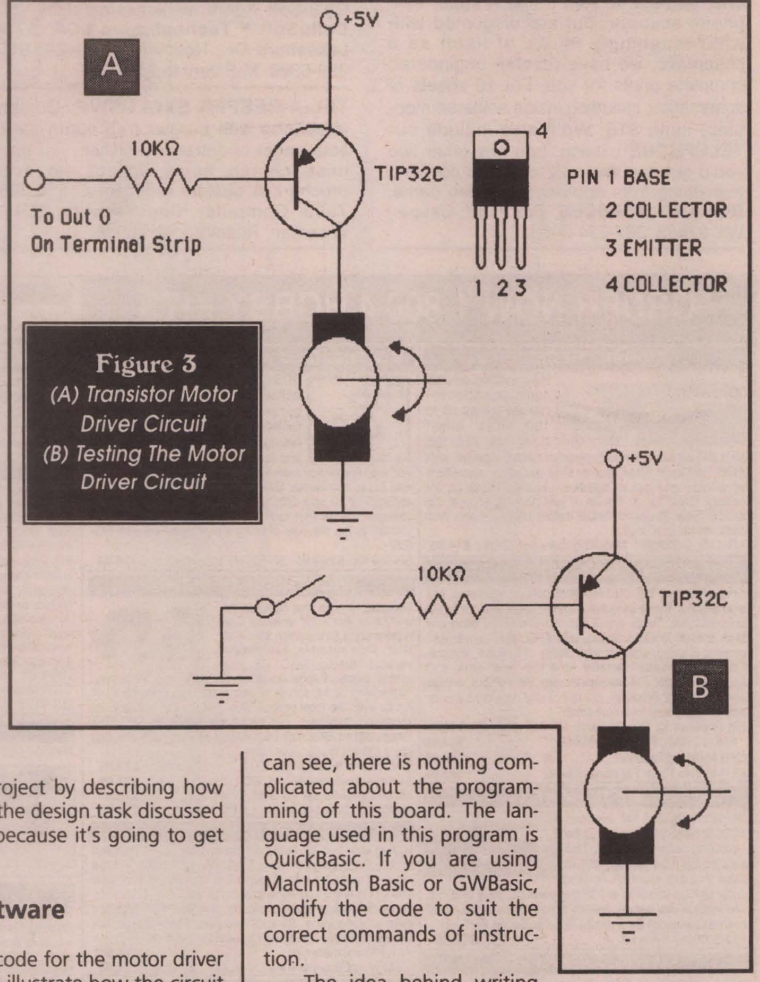


Figure 3
(A) Transistor Motor Driver Circuit
(B) Testing The Motor Driver Circuit

er communication between the Mac and the board has been established.

One activity I found to be useful in planning and designing this circuit is to use the board layout as a worksheet. This will allow management of the project as it relates to the circuit design and can provide a means of troubleshooting the circuit I/O configuration.

Well, congratulations are in order! You have successfully interfaced your Mac with the outside world. I know by now the wheels are turning and your mind is imagining all kinds of neat stuff to control with this system. Jot your ideas down on a piece a paper and put it aside. This list will be valuable after reading the rest of the article. So just be patient, the best is yet to come!

We will complete our project by describing how to develop code for meeting the design task discussed earlier. Hang onto your hat because it's going to get mighty windy, partner!

DC Motor Control Software

This first step in writing code for the motor driver is to draw a diagram that will illustrate how the circuit is to be controlled. Figure 4 shows a flow chart for our DC motor controller. The flowchart shows what decisions are needed in order for the software to take action on the motor.

Flowcharts also allow code to be written directly, because the chart will show what data is required, how it will be processed, and in what form it will be used to control outputs. As shown on the flowchart, the serial or modem port must be configured for an output mode. If this line is not added to the code, the Mac will not be able to transmit the right code to the board for proper I/O control configuration.

The diamonds "flag" the software that a decision will be made depending on the right key being depressed. If key "1" is depressed, the motor will turn on. If key "2" is depressed, the motor will turn off. If no key is depressed, the program will keep scanning until a key selection has been made.

The code that was developed from this flowchart is shown in Listing 1. As you can see, there is nothing complicated about the programming of this board. The language used in this program is QuickBasic. If you are using MacIntosh Basic or GWBasic, modify the code to suit the correct commands of instruction.

The idea behind writing code is to keep it simple and to have fun in developing it. That's where you can learn a lot and enjoy what you're doing as opposed to cursing and screaming at your machine. Remember, the computer will only do what you tell it to.

```
OPEN"COM1:9600,N,8,1
"FOR OUTPUT AS#1
CLS
LOOP:
PRINT"MOTOR ON - KEY[1]"
PRINT"MOTOR OFF-
KEY[2]"
INPUT X
IF X=1 THEN PRINT#1,
CHR$(1);GOTO LOOP
IF X=2 THEN PRINT#1,
CHR$(0);GOTO LOOP
GOTO LOOP
```

LISTING 1

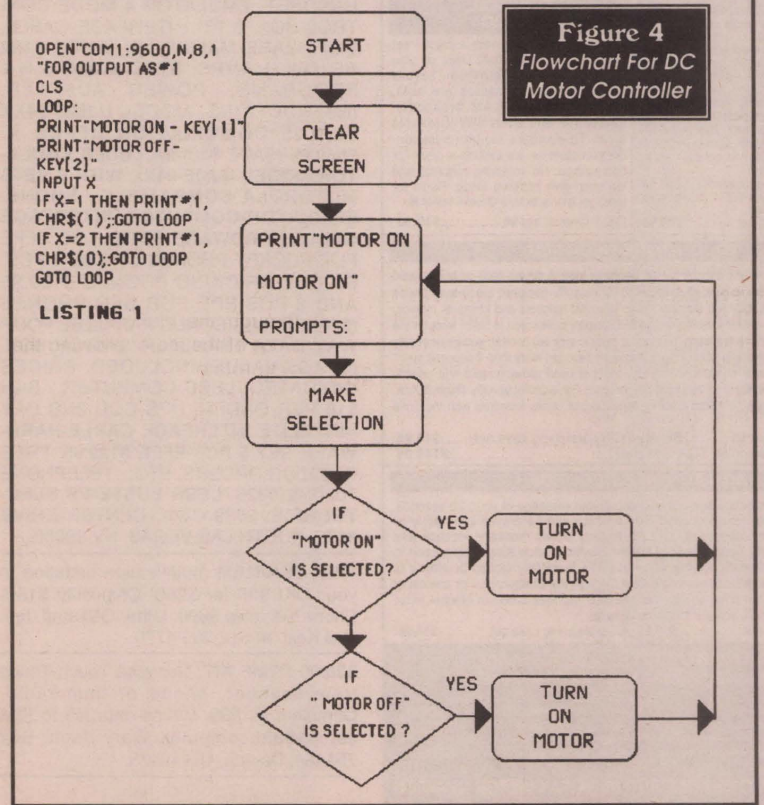


Figure 4
Flowchart For DC Motor Controller

Further Thoughts and Experimentation

The mystery of computer interfacing on the Mac has now been unveiled. With this inexpensive board and parts available from your junk box, Mac users now have the ability to control motors, relays, lamps, and other external devices wired to this wonderful machine.

Other projects that can be created with this board are IC testers, function generators, computerized timers, switch testers, semiconductor testers, and programmable counters. A project that can be played with using the circuit and code discussed, is to have the Mac pulse the motor at some predetermined switch rate. Take the code discussed in the previous paragraphs and modify it to pulse the motor. I will provide my solution to this experiment in next month's column.

Another investigation I'm looking into is to generate speed-torque curves for an erector set motor that is being used as the test sample for the data collection/analysis project. The reason for pursuing this activity is to be able to reproduce data that is depicted in electric rotating machinery books. This method will allow me to characterize small motors, thereby having data that will be vital for robotic or small automation design projects. This information will be provided in a future installment of this column. Well enuf said, see ya in the breadbox!!! **NV**

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SYNTHESIZED AUDIO GENERATOR



DDS (Direct Digital Synthesis) technology brings you a terrific audio generator at a fantastic price! Generates from 0. 01 Hz to 50 KHz with five digit LED display of frequency. Sine and square wave output adjustable 0-5 volt p-p. Frequency selected by direct keyboard entry and with handy continuous tune tuning knob. Crystal controlled accuracy of 10 ppm and two memories for rapid frequency changes. Retire that jury-rigged old generator and treat yourself to the pleasure of using a new state-of-the-art SG-550!

SG-550 Kit ..**$199.95** SG-550WT assembled **$269.95**

SHORTWAVE RECEIVER



Fantastic receiver that captures the world with just a 12" antenna! Can receive any 2 MHz portion from 4-11 MHz. True superhet, has smooth varactor tuning. AGC, RF gain control, plenty of speaker volume and runs on a 9V battery. Fascinating Scout, school or club project, provides hours of fun for even the most serious DXer. For the car, consider our shortwave converter. Two switchable bands (in 3-22 MHz range), each 1 MHz wide—tunable on your car radio dial. Add some interest to your drive home!

Shortwave receiver kit, SR1..... **$29.95**
Shortwave converter kit, SC1 ..... **$27.95**
Matching case set for SR1, CSR **$14.95**
Matching case set for SCI, CSC **$14.95**

AM TRANSMITTER

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

AM-1 Transmitter kit..... **$24.95**
CAM Matching case set **$14.95**

SCANNER CONVERTER



Tune in on the 800-950 MHz 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**
SCN Matching case set..... **$14.95**
SCN-1WT Assembled SCN-1 and case..... **$89.95**

SURROUND-SOUND/REVERB

Add concert hall realism to your stereo, TV or even 2-way radio! Easily sythesize a stereo effect from mono sources or richly enliven regular music. Add a big-voice reverb to your radio voice that others will envy! Our reverb/surround sound kit uses a Bucket Brigade IC Device for reliable solid-state performance. Adjustable reverb, delay and mix controls to customize your sound. Easily connected to radios, stereos, CB's and TV's. Plently of audio to drive a small speaker for stand-alone operation too. Experierence the fun and realism that surround sound provides - without spending hundreds! Add our case set for a neat, pro look.

RV-1 Surround Sound/Reverb kit..... **$59.95** CRV Matching case set..... **$14.95**
RV-1WT Assembled RV- 1 and case..... **$99.95**

TOUCH-TONE REMOTE CONTROL

Control virtually anything by Touch-Tone remote control. The URC-1 has 16 switched outputs, 4 adjustable voltage outputs (20 mV steps 0 to 5 VDC), two 10K digital pots (for volume, squelch, etc.) and 3 timers adjustable from 10 mS to 40 hours! Two level password control allows secure control and multi-level access. Six digit LED display shows currently entered codes and a crystal controlled touch-tone decoder provides reliable operation. There's nothing else like this unit, be in complete control of remote radios, thermostats, hi-fi's, homes or even factories with the URC-1. Add our matching case set for a handsome finish.

URC-1 Remote control kit..... **$129.95** CURC Matching case set..... **$14.95**
URC-1WT Fully assembled URC-1 and case..... **$189.95**

FM SUBCARRIER DECODER

Tap into the world of commercial-free music and data that is carried over many standard FM broadcast radio stations. Decoder hooks to the demodulator of FM radio and tunes the 50-100 KHz SCA subcarrier band. Many radios have a demod output, but if your radio doesn't, it's easy to locate, or use our FR-1 FM receiver kit which is a complete FM radio with a demod jack built-in. These "hidden" subcarriers carry lots of neat programming - from stock quotes to news to music, from rock to easy listening - all commercial free. Hear what you've been missing with the SCA-1.

SCA-1 Decoder kit..... **$27.95** CSCA Matching case set..... **$14.95**
FR-1 FM receiver kit..... **$24.95** CFR Matching case for FR-1 ..... **$14.95**

L-C METER

Measure inductors from 10 uH-10mH and capacitors from 2 pF-2uF with high accuracy by connecting the LC-1 to any digital multimeter. Two pushbutton ranges for high resolution readings and we even give you calibration components to assure proper accuracy of your kit! Active filters and switching supplies require critical values, no one should be without an accurate LC meter. For a pro look, add our matching case set.

LC-1 LC meter kit ..... **$34.95** CLC case set..... **$14.95**

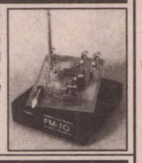
MOTOR CONTROLLER

Control the speed and direction of any motor. Use our SMD-1 for those nice steppers you see surplus, and our MSC-1 for DC motors. The stepper driver features variable speed, half step rotation, direction and power down mode, can drive most any stepper motor. Our DC driver features pulse width modulation control allowing full motor torque even at low speeds and can drive motors up to 50 VDC @ 10 Amps! Add our case set for a professional assembly.



SMD-1 Stepper kit ..... **$24.95** MSC-1 DC motor kit..... **$24.95**
CSMD SMD-1 case ..... **$14.95** CMSC MSC-1 case..... **$14.95**

STEREO FM TRANSMITTER



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

FM-10A Stereo transmitter kit **$34.95**
CFM Case,whip ant set **$14.95**

DR. NI-CAD CONDITIONER/FAST CHARGER

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

DN-1 Dr. Ni-Cad conditioner/fast charger kit..... **$49.95**
CDN Matching case set..... **$14.95**
DN-1WT Fully assembled Dr. Ni-Cad with case **$89.95**

SPEED RADAR

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



SG-7 Complete kit..... **$99.95**

STEREO PEAK HOLD BARGRAPH

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

PH-14 Dual Linear bargraph kit..... **$39.95** PH-15 Dual Log bargraph kit ..**$39.95**
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SS-70WT Assembled SS-70 and case set **$79.95**

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

TG-1 Tone Grabber kit..... **$99.95** CTG Matching case set..... **$14.95**
TG-1WT Fully assembled TG-1 and case..... **$149.95**

DIGITAL VOICE RECORDER

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

CB-1 Voice recorder kit..... **$59.95** CCB Matching case set **$14.95**

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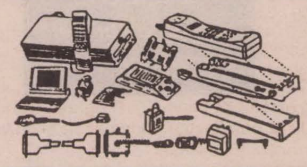
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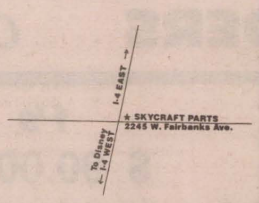
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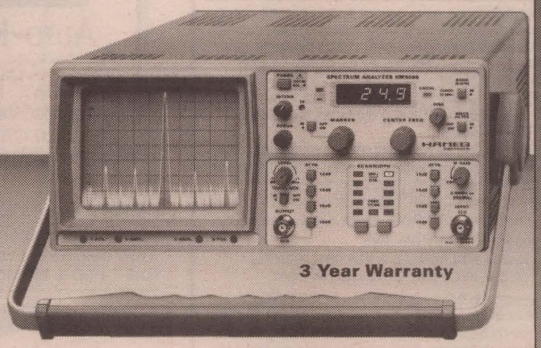


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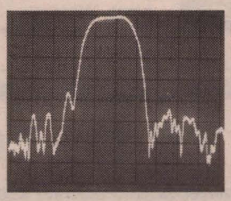
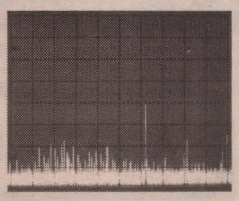


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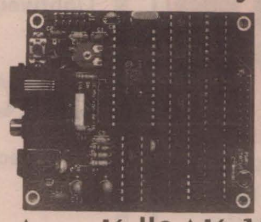
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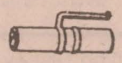
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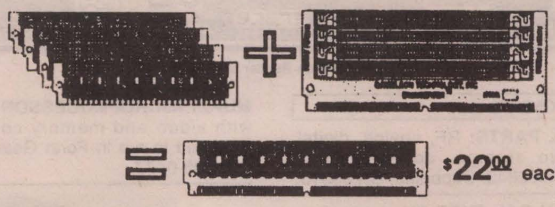
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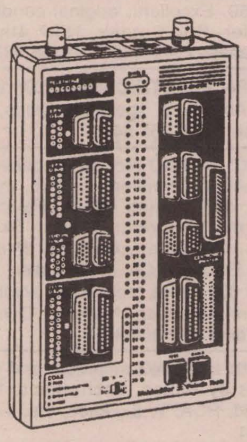


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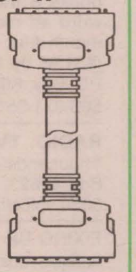
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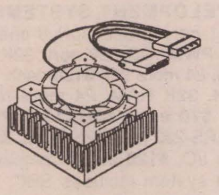
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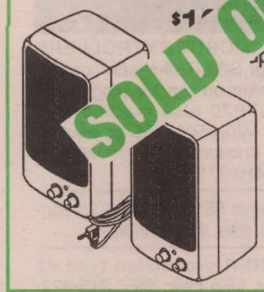
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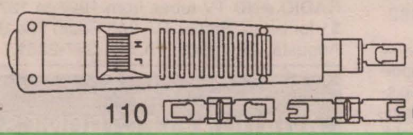
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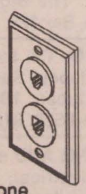


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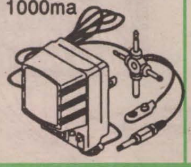
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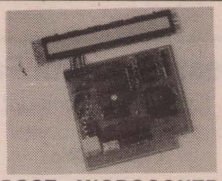
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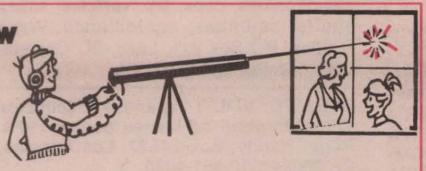
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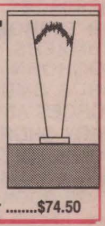
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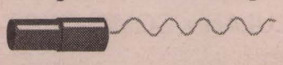
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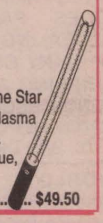
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FULL DUPLEX COMMUNICATION

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.

PROGRAMMING EPROMS

As consumer electronic devices become smaller and more complex, much of what was once analog circuitry has been replaced by digital logic. Where digital circuitry may once have been a collection of discrete logic circuits comprised of many integrated circuits, the common implementation today involves a microprocessor following a small set of software instructions residing in a non-volatile storage device such as an erasable programmable read-only memory (EPROM) integrated circuit.

These types of circuits can be found in everything from business telephone systems, cellular phones, set-top cable television boxes, and video cassette recorders. Even some of the toys used by your kids have microprocessors tucked away inside.

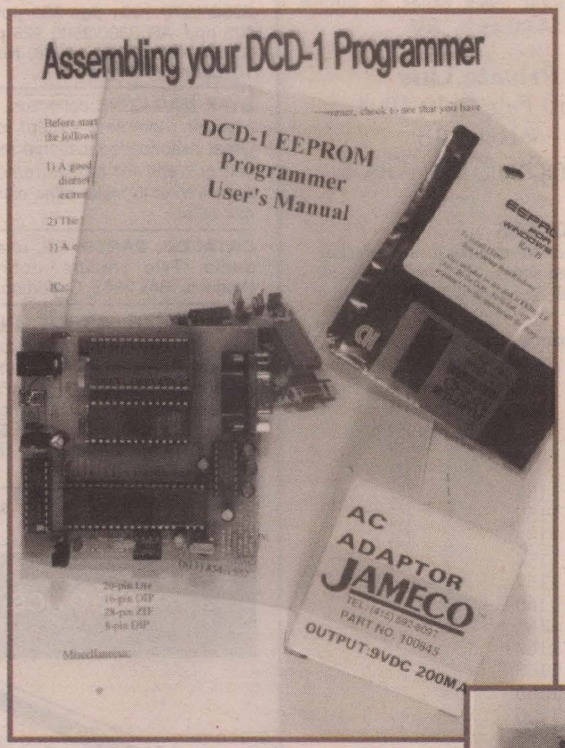
Technicians who work on such units have not only faced a bit of a learning curve as technology marched along, but the high cost of the "burners" that allow the data stored in these EPROMs to be read, altered, and reprogrammed. If programming chips is a fundamental part of one's business, spending from several hundred to several thousand dollars on a programming unit is easy to justify. This has not been the case for hobbyists, however.

Hobbyists who have wished they could afford to take the plunge and start learning how data is stored, arranged, and programmed in these devices are now in luck. Over a year ago, Serbu Specialties introduced what is arguably the least expensive PROM burner in existence. Priced at less than $50.00, the DCD-1 EEPROM Programmer is a complete kit of hardware and computer software that reads and programs a large variety of memory devices, including many of the small eight-pin DIP serial EEPROMs. A fully assembled version of the programmer is also available.

While I certainly didn't expect much for the price, the DCD-1 I received some time back was of high quality, and included a ZIFF socket for repeated chip insertions and removal. The assembled kit and the programmer itself are depicted in the photos shown. All you need is a serial cable and a PC running Windows 3.1 to get rolling. Being inquisitive by nature, I wondered what the "DCD" in the model number stood for. In fine print on the back of the instruction manual, I finally found the answer: "Dirt Cheap Development."

For ordering information and a list of supported devices, send a SASE to:

Serbu Specialties
11410 Zenith Circle
Tampa, Florida 33653



NEW AREA CODES

For those that haven't noticed, the structure of what we call "area codes" is changing. An area code is officially known as a Numbering Plan Area (NPA) within the telecommunications industry, and their creation and distribution has always been one of the many tasks of Bellcore, which is the research, development, and standards setting arm of what was once the Bell System monopoly.

Not too long ago, an NPA followed a specific format in that the middle digit of these three-digit numbers was always a 1 or 0, and an office code (or phone number prefix) would never use either of these two digits in that position. This year, all that has changed. The middle number of an area code (NPA) can now consist of any number between 2 and 9. All of the combinations of digits using a 0 or 1 in the middle position have been used up. Allowing these other digits to be used as the center digit for an NPA provides the phone companies with an additional 640 new area codes.

These are the new area codes that have been or will be implemented within the next year:

281	Houston, Texas
334	Alabama
352	North Florida
360	Washington
423	Tennessee
441	Bermuda
520	Arizona
540	Virginia
541	Oregon
562	Southern California
630	Chicago, Illinois
770	Atlanta, Georgia
860	Connecticut
864	South Carolina
941	Tampa, Florida
954	Miami, Florida
970	Colorado

Obviously, these new area codes will pose a bit of a problem for older, mechanical PBX equipment and toll-restriction devices that have a hard-coded method of determining whether digits dialed are an NPA based on the 1 or 0 in the middle digit position. Newer equipment that is software controlled can be upgraded to recognize new area codes with a simple software (or firmware) update.

Pacific Bell had initially proposed to add NPA 562 in a fashion they called an "overlay area code" within the current 310 service area. Since the 310 NPA was running out of prefix (office code) possibilities, new service within the 310 area code would have been given the 562 NPA.

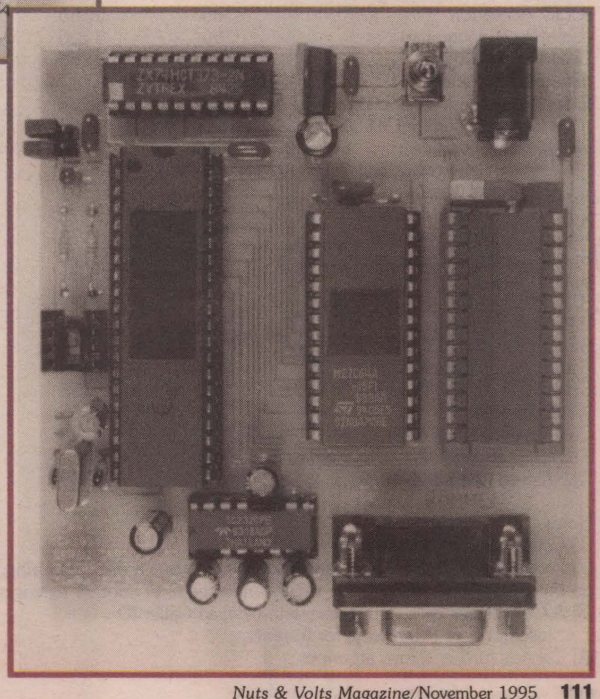
This would have meant that next door neighbors could have each had a different area code, thus requiring the dialing of ten digits to reach a phone less than 100 feet away. While it may have been a novelty to have two lines in the same house, each with a different area code, some people were less amused by the prospect.

Based on a complaints that were filed to oppose this plan, the California Public Utilities Commission has ordered Pacific Bell to split the 310 area code along a geographic boundary instead, as has been the norm for area code "splits." Public hearings were scheduled before the commission last month to determine the exact nature of the split, and Pacific Bell states that the 562 NPA will be implemented no later than February 1, 1997.

TELCO FEATURE ACTIVATION CODES

While we're on the subject of telephone companies, this might be a good time to address some questions regarding feature codes. Although they no doubt have a more official name, these are the digits that activate certain features within the telco's switch when dialed. As an example, call forwarding is usually initiated from a touch tone phone by dialing 72#. You hear a "stutter dial tone" and can then dial the number to which you would like your calls forwarded.

The chart on the next page lists most of the know codes to activate and deactivate the various features offered by different telephone companies. Although the "standard" codes are supposedly designated by Bellcore, it seems that some telcos do not adhere to



the standard. Hopefully this will satisfy some of the thirst for information as to what all these odd *xx or xx# digit combinations are used for.

ACCESSING PRIVATE LINE

In my last article, I mentioned Private Line Magazine and quoted some material from an article on the Digital Telephony Bill appearing in the May/June 1995 issue. While I fully intended to mention the contact address for Private Line, I neglected to do so.

Basically, Private Line is a magazine that is dedicated to exploring the complex array of hardware that comprises the telephone network. Previous issues have explained how to obtain copies of patents, and the wealth of technical information nd diagrams that are contained within them. Detailed explanations of pay phone operation and even the cellular system have also appeared.

The July / August issue covered outside plant and contains over 30 photos of terminal boxes, slice cases and an underground AT&T 5ESS remote switch. The slick cover of the 'zine is graced with an eerie photo of a central office cable vault.

Private Line runs between 30-40 pages in length each issue, and is pretty much a labor of love by it's creator, Tom Farley. Tom and I have become friends since we first met, and I saw an early issue of the magazine. In my opinion, this is such a great resource for those of us that want to learn about the technical meat of the telephone company, that I happily volunteer my time once in awhile to do things like drive around the countryside with Tom and take pictures of things like old open wire phone lines and splice enclosures.

Since I receive no money for my contributions to the magazine (not that Tom could afford to pay me anyway), my endorsement is from the heart. If you like the mysteries of the phone company, you'll love Private Line. With a circulation of only about 1,500 copies per issue, it's a diamond in the rough, waiting to be discovered.

An annual subscription runs $27.00 and is shipped via first class mail in a large envelope. Back issues or sample copies are $4.00 each. **NV**

Private Line
5150 Fair Oaks Blvd.
#101-348
Carmichael, CA 95608

CUSTOM CALLING FEATURE CODES

The following is a composite list of the "feature codes" that are present in the switches of various telephone and cellular switches within the united states. This list was adapted from the "alt.2600" newsgroup FAQ maintained by Will Spencer (will@gnu.mit.edu) on the Internet.

Service	DTMF	Rotary	Notes
Assistance/Police	*12		[1]
Cancel forwarding	*30		[1]
Automatic Forwarding	*31		[1]
Notify	*32		[1]
Enable Voice Dialing	*44		[1]
Intercom Ring 1 (..)	*51	1151	[2]
Intercom Ring 2 (.._)	*52	1152	[2]
Intercom Ring 3 (._.)	*53	1153	[2]
Extension Hold	*54	1154	[2]
Call Trace	*57	1157	
Selective Call Screen	*60	1160	
Selective Distinct Alert	*61	1161	
Selective Call Acceptance	*62	1162	
Selective Call Forwarding	*63	1163	
ICLID Activation	*65	1165	
Call Return (outgoing)	*66	1166	
Busy Number Redial	*66	1166	
Caller ID Blocking	*67	1167	
Computer Access Restriction	*68	1168	
Call Return (incoming)	*69	1169	
Call Waiting — disable	*70	1170	
No-Answer Call Forwarding	*71	1171	
Per-Call Three-way calling	*71	1171	
Call Forwarding — initiate	*72 or 72#	1172	
Call Forwardin g — cancel	*73 or 73#	1173	
Speed Calling (8 numbers)	*74 or 74#	1174	
Speed Calling (30 numbers)	*75 or 75#	1175	
CID Blocked Rejection — activate	*77	1177	[3]
Call Screen Disable	*80	1160	
Selective Distinct Disable	*81	1161	
Select. Acceptance Disable	*82	1162	
Select. Forwarding Disable	*83	1163	
ICLID Disable	*85	1165	
Call Return (cancel out)	*86	1186	[4]
CID Blocked Rejection — cancel	*87	1187	[3]
Call Return (cancel in)	*89	1189	[4]

Notes:
[1] Cellular System — selected carriers.
[2] Found in Pac Bell territory; Intercom Ring causes a distinctive ring to be generated on the current line; Hold keeps a call connected until another extension is picked up.
[3] A.C.R. blocks calls from those who blocked Caller ID (used in C & P territory, for instance).
[4] Cancels further return attempts.

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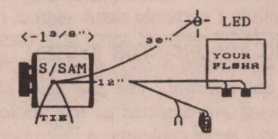
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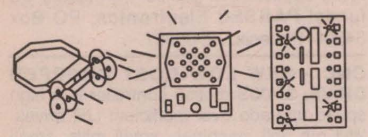
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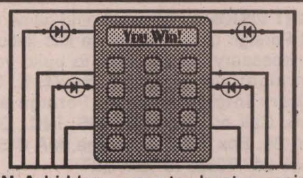
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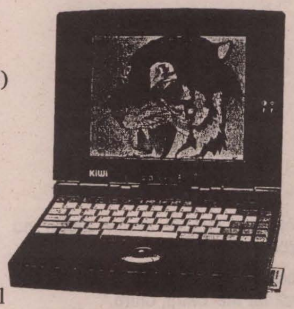
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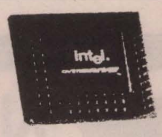
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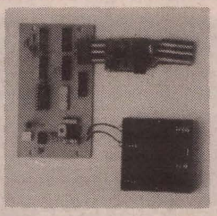
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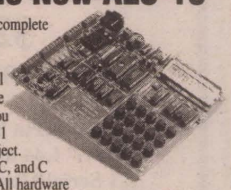
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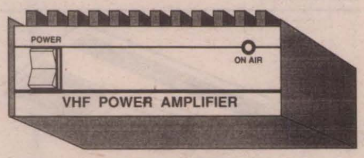
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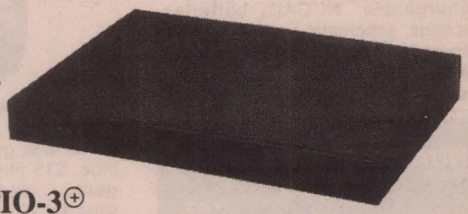
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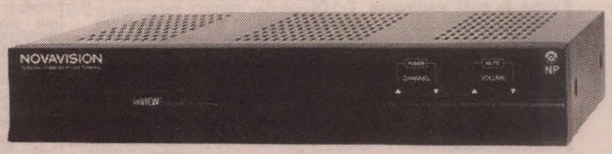
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AMATEUR ROBOTICS

by Karl Lunt

I usually use modified Futaba S148 RC servo motors for my little robots, such as Huey and Arnold. The servos are easy to use, but mounting a wheel onto one of the servo motor's control horns has always seemed more painful than necessary.

I like using the Dave Brown Lite Flite wheels, available at most hobby stores. These wheels have a wide, soft foam tire on them, with a two-piece hard plastic hub. But the hub has five evenly spaced radial ridges on it, which make aligning the hub and the servo's control horn difficult.

Plus, I used to insist on using two #2 sheet-metal screws to hold the hub to the control horn. The uneven hub surface guaranteed that the wheel would mount crookedly, giving the finished robot a bow-legged gait.

My latest technique results in a clean, solid coupling between the wheel and control horn, without using screws or machining. It only takes about five minutes per wheel, and gives a quality-looking finish.

The technique relies on two of my favorite tools: a hot-glue gun and a roll of double-sided foam tape. Refer to the accompanying diagram of the mounting technique.

Begin by selecting a control horn of the proper size. The Futaba servo package, available from Tower Hobbies, usually includes three different control horns. You want to use a round control horn that is at least 1/4" smaller than the diameter of the wheel's hub.

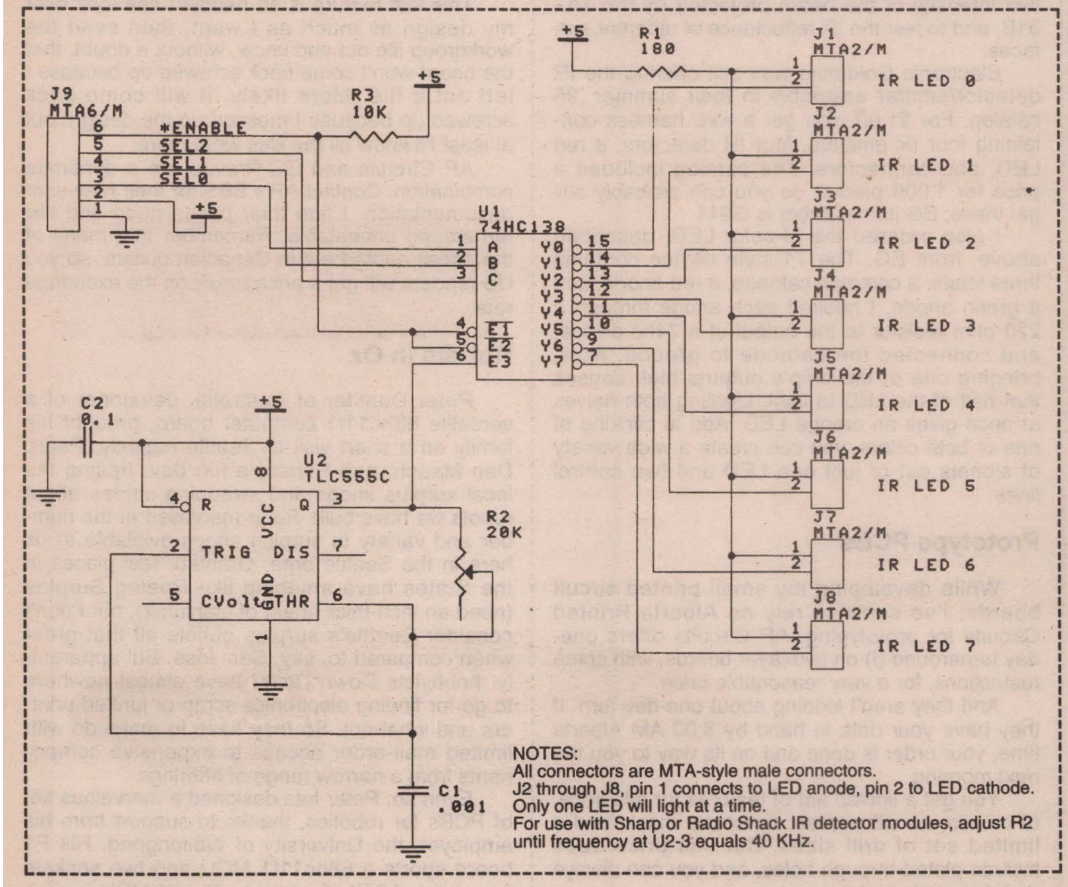
For example, I used a control horn 1-3/8" in diameter with a 3-1/4" wheel. Since the hub for this wheel measures 1-5/8", I had exactly 1/4" of hub overlap to use.

Begin by cutting two pieces of foam tape, each slightly longer than the diameter of the control horn. Stick the tape down onto the wheel hub, covering as much of the hub as you can. Use an X-ACTO® knife to trim the foam tape away, exposing 1/4" of hub. Use the knife to punch a hole in the tape at the center of the hub, where the axle was designed to go.

Next, put the control horn mounting screw into the control horn, with the threaded end of the screw sticking out through the mounting rim of the horn. Peel the protective paper from the foam tape, then carefully position the control horn onto the foam tape. Take care to align the control horn properly; you should see an even band of hub around the horn's rim. Make sure the tip of the mounting screw still sticks up above the mounting rim. Press the control horn firmly in place, then run a bead of hot glue completely around the circumference of the control horn. Use plenty of glue, and make sure you get a thick, smooth bead that touches both the wheel hub and the control horn in all places.

That's it! The whole process takes about five minutes, with no tricky alignment. Makes for a good-looking product, and my robots are starting to drive straighter lines. I've already built up a bin of wheels, ready to mount onto whatever robot needs them.

A variation of this technique lets you use the four- and six-point control horns, also shipped with the Futaba servos. Just cut a single, smaller piece of foam tape, and put it over the center hole of the hub. The tape should be only about 3/4" square. This will leave plenty of exposed hub when the control horn is pressed onto the tape. Now, run a bead of hot glue around each arm of the horn, making sure the glue flows into the gaps between the arm and the wheel hub. You can use this tape-and-glue technique for wheels other than the Dave Brown units. In fact, you can probably tape-and-glue a control horn to just about anything. Just remember to leave a hole in the middle of the mounting surface, and be sure you insert a mounting screw into the control horn before taping the horn in place.



NOTES:
All connectors are MTA-style male connectors.
J2 through J8, pin 1 connects to LED anode, pin 2 to LED cathode.
Only one LED will light at a time.
For use with Sharp or Radio Shack IR detector modules, adjust R2 until frequency at U2-3 equals 40 KHz.

More IR

Regular readers of this column should be familiar with using a modulated beam of IR light as an object detection system. I won't go into all of the gory details, but instead refer you to past columns, and to the bible of amateur robotics, *Mobile Robots*.

I recently started a robot that needs to use multiple IR object detectors. I quickly realized I would need at least three IR LEDs, each emitting a 40 KHz signal on demand.

I could have built up a second 74hc04 circuit from the *Mobile Robots* book, but frankly, I wanted a more general solution to the problem of multiple IR sources.

My solution uses two ICs — a CMOS 555 and a 74hc138 — to provide up to eight 40 KHz IR sources. Refer to the accompanying schematic for details.

U2, a CMOS 555, generates a constant frequency squarewave at pin 3. Trimpot R2 sets the output frequency, and as shown spans a range of just a few kilohertz to well above one megahertz.

The output squarewave runs at exactly 50% duty cycle; that is, pin 3 stays high for exactly the same amount of time as it stays low for each cycle of the signal.

This 50% duty cycle is crucial to reliable operation of any IR object detection system using the Radio Shack IR detector modules. If the duty cycle gets too far above or below 50%, the system's performance is severely degraded.

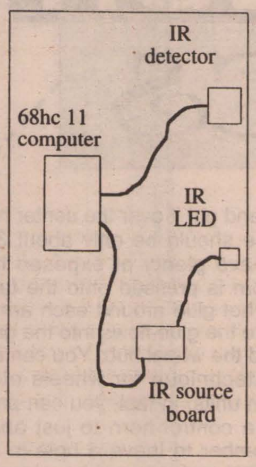
Note that R2 only controls the frequency of the 555's output; it has no impact on the duty cycle.

The circuitry shown for U2 will not work with an NMOS device, and it will not work with a Motorola 1455 CMOS timer. I have used a Texas Instruments chip (TLC555C) successfully, and a National LMC555 device will work also.

The output from U2 is routed to the enable line, pin 6 of U1, which is a 74hc138 demultiplexer. I have wired the 74hc138 to function as a selectable data router. If pins 4 and 5 of U1 are both pulled low, the device is enabled. If these lines are pulled high, the device is disabled, and all outputs remain high.

When enabled, the '138 uses its three address lines — pins 1, 2, and 3 — to determine which of eight output lines will carry the inverse of the signal on pin 6. For example, if pin 1 is high and pins 2 and 3 are low, then output Y1 (pin 14) will show the inverted state of pin 6.

Since I've routed the 40 KHz signal to pin 6,



Set-up of IR test platform

any enabled output line will show a 40 KHz signal and the disabled output lines will remain high.

The enabled output line will provide a current path from +5 VDC, through limiting resistor R1 and the connected LED. The enabled LED will turn on when its associated output line goes low, and will turn off when that line goes high.

The current through any LED is limited by R1. You can select any value you like, but you should limit current to no more than 20 mA, to stay within specs on the 74hc138.

Your computer controls this circuit using the signals on the six-pin MTA connector J9. Select lines SEL0, SEL1, and SEL2 determine which LED lights, while a low on *ENABLE is required to enable the circuit.

In my prototype, I hard-wired *ENABLE to ground right on the IR source board, and used just a five-pin cable back to the host computer. This means that one output on the board is always supplying a 40 KHz signal. I also installed a red LED as IR LED 7, wiring the LED directly onto the circuit board. My software writes 111 to the three select lines by default, which means that this red LED is normally lit at half-brightness.

This default condition lets me know that I have power on the IR source board, and that the computer select lines are controlled.

If the computer needs to turn on a different LED, perhaps to test for an object's presence, it briefly selects the proper LED, performs the test, then selects LED 7 again.

I have created a 1.5" x 2" blank etched and drilled PCB for this circuit, available by mail order for $6.95 each. To order, send $6.95 per board to my address listed elsewhere. Refer to part number RPB-02 in your order.

Be sure to include $1.50 per order (NOT per board!) for shipping and handling. All orders must be accompanied with a check or money order in US funds only; sorry, but I don't take plastic and I don't do COD. Washington state residents, please add 8.5% sales tax.

Still more IR

After building the prototype circuit for the above IR source board, I started rooting through my junk box, looking for suitable IR LEDs. I had always used some surplus detector/emitter units, purchased from a local store, but my stash of those was empty. I did find a large wired assembly of LEDs and IR detectors, purchased some time ago from Electronic Goldmine. Just for grins, I pulled one of the LEDs off the assembly and plugged it into LED port 0 of my circuit board. I wrote a little SBasic code for a 68hc11 board, connected up the IR source board, and set up a test platform.

I started by taping one of the LEDs to the edge of my work table, with the LED's lens pointed out away from the table. I also taped an IR detector module to the table's edge, placed about five inches from the LED, also placed with the sensor facing out away from the table.

The program causes the LED to broadcast a continuous stream of 40 KHz IR. The code then samples the IR detector's output every half-second, and lights a bi-color LED, based on the detector's signal.

Normally, the bi-color LED remains red, signalling that no 40 KHz IR has reached the detector. If, however, I place a suitable object in front of the emitter/detector arrangement, the reflected IR pulses will register in the detector's output and the code will turn the bi-color LED green.

The IR LED from Electronic Goldmine, a TIL-31B, gave a dependable signal out to a distance of 19", in contrast to the 9" of the unit I used to use. For this test, I used a white sheet of paper, positioned perpendicular to the LED's beam, as a target.

This test platform has proven valuable in studying the performance of IR object detection. I was easily able to determine the angle and relative intensity of the beam projected by the TIL-31B, and to test the IR reflectance of different surfaces.

Electronic Goldmine was still offering the IR detector/emitter assembly in their summer '95 catalog. For $1.00, you get a wire harness containing four IR emitters, four IR detectors, a red LED, and connectors. The catalog included a price for 1,000 pieces, so you can probably still get these; EG item number is G911.

I also ordered the bi-color LED, described above, from EG. The T1-style device contains three leads: a common cathode, a red anode, and a green anode. I hooked each anode through a 220 ohm resistor to the output of a 74hc device, and connected the cathode to ground. Now, bringing one of the chip's outputs high causes that half of the LED to light. Lighting both halves at once gives an orange LED. Add in blinking of one or both colors, you can create a wide variety of signals out of just one LED and two control lines.

Prototype PCBs

While developing my small printed circuit boards, I've come to rely on Alberta Printed Circuits for prototyping. AP Circuits offers one-day turnaround (!) on two-layer boards, with some restrictions, for a very reasonable price.

And they aren't kidding about one-day turn. If they have your data in hand by 8:00 AM Alberta time, your order is done and on its way to you the next morning.

You get a limited set of features for this price, of course; no silk screen, no solder mask, and a limited set of drill sizes. But this price does include plated-through holes, and you can always do information text in copper.

AP Circuits wants your board files in Gerber format, and I have settled on the Protel Autotrax board layout package for my work. The Seattle Robotics Society made a group purchase of the Protel package some time ago, and it has become a sort of standard for us.

I have not yet been able to substantiate a rumor that Protel has placed the final version of this package on their BBS, free for downloading. I do know that Protel stopped selling the package shortly after the SRS made their buy.

AP Circuits moves the data through the process so quickly that you had better be darn sure you have everything right before you pull the trigger; you won't have much chance to stop them after they start.

To help verify your design before you ship it, AP Circuits provides a very cool tool, called GC-Prevue, downloadable from the AP BBS.

GC-Prevue lets you load in all the drill files and Gerber plot files for the various layers of your board, then view the PCB that would result from those files. It shows all drill holes in true diameter and placement, and all traces are shown true width. You can zoom in and out on your design, move from place to place, and even use the mouse to measure actual distances between points on your circuit board.

It took me a little time to get the hang of GC-Prevue's user interface; I've seen more intuitive designs. But after reading the skimpy and poorly written docs and running a couple of sessions, I finally got up to speed. It helped having access to Dan Mauch, the club's CNC expert, to answer some of my questions. GC-Prevue can even save all of your PCB files into a single, larger file called a workgroup file. Later, you can run GC-Prevue and restore this single file, and your entire design is restored, just as you left it. Even better, AP Circuits accepts this single file as your design set. This reduces those awful errors in which you send all but one crucial file to the fab shop, then get back a whole run of boards you can't use.

This last feature is so handy! I can look over my design as much as I want, then send the workgroup file out and know, without a doubt, that the board won't come back screwed up because I left out a file. More likely, it will come back screwed up because I messed up the design, but at least I'll know all the files were there.

AP Circuits and GC-Prevue are a dynamite combination. Contact AP's BBS for their new-user documentation. I find their prices good and the turnaround unbeatable. Remember that many of the prices quoted are in Canadian dollars, so you US readers will get a price break on the exchange rate.

Robots in Oz

Peter Dunster of Australia, developer of a versatile 68hc11f1 computer board, brought his family on a short visit to Seattle recently. Peter, Dan Mauch, and I spent a fun day, trolling the local surplus shops and swapping stories about robots we have built. Peter marvelled at the number and variety of surplus shops available to us here in the Seattle area. Granted, few places in the States have anything like Boeing Surplus (need an inch-thick sheet of titanium?), but I don't consider Seattle's surplus outlets all that great when compared to, say, San Jose. But apparently, hobbyists Down Under have almost nowhere to go for finding electronics scrap or junked printers and what-not. So they have to make do with limited mail-order access to expensive components from a narrow range of offerings.

Even so, Peter has designed a marvelous set of PCBs for robotics, thanks to support from his employer, the University of Wollongong. His F1 board sports a 68hc11f1 MCU and two sockets for a total of 64K of memory. The 'f1 MCU is similar to the standard 'a1 chip, but it has extra I/O lines and some cool programmable chip select lines.

Peter also offers an add-on PCB called the

As always, you can reach me at:
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Bothell, WA 98012
E-Mail: karl@mav.com

motor-driver board. You can plug this board directly onto the expansion connector of an F1 board, then hook motors to the driver board. The motor-driver board controls about any type of motor you can imagine; servos, steppers, and DC gearheads.

And you can download the Protel .PCB files for a number of other add-on boards, such as a 64-line digital I/O board. Peter has made the designs of these add-ons available on his ftp site, free for the taking.

I encourage anyone looking for a high-powered, well-designed robot controller to check out Peter's work. You can contact Peter by sending E-Mail to: pdunster@uow.edu.au

You can also find Peter's designs in an ftp site on MIT's cherupahka. Check in the site ftp::/cherupahka.media.mit.edu/pub/incoming/F1

Remember that cherupahka wants your name as a password, NOT your login name or your E-Mail address.

By the way, Dan Mauch serves as the US distributor for Peter's F1 board and motor-driver board, along with other goodies Peter offers. Contact Dan for prices of the various boards by sending E-Mail to:

dmauch@dmauch.seanet.com

What language?

I get so many letters and E-Mail asking me what language to use for programming robots that I thought I'd address the question publicly. The answer is: It depends.

It depends on the size of your robot's memory. If you are using an unexpanded 68hc11a1, you only have 512 bytes of memory. Therefore, the size of the executable program becomes paramount, and you may be limited to using languages you don't understand or don't use easily. If, however, you have 32K or 64K of memory available, you have more freedom on your language choice, and can go with one you enjoy using, even if it creates larger code than other languages might. It also depends on the execution speed your final program will require. If your code needs to position multiple stepper motors, sample A/D ports, and scan an array of switches, you may have to pass up some languages as being too slow for the job.

And it depends on your wallet. If you have bucks to spare, you can pick up a commercial development package, with cool de-bug support and extensive libraries of developed code. Most hobbyists, however, must stay with cheap or free software, which can limit choices.

Finally, it depends on your own skill level. Guys who write software for a living usually are fluent in one or more languages, and have more choices available. If you have never written software before, you will have to deal with the learning curve problem, and some languages are easier to learn than others.

Given all of those depends, I'll provide a list of recommendations. I'm sure that some readers will disagree with some of my ideas, and that's okay, but this is my column and these are my recommendations. In all cases, these assume you are using a 68hc11 MCU in your robot brain. For robots with 512 bytes or less of code space, I suggest 68hc11 assembly language or SBasic. Assembly language is way more complicated and difficult to learn than SBasic, but experienced programmers will create much smaller code with assembly than with SBasic.

For assembly language, you can pick up a copy of Motorola's free 68hc11 assembler, asmhc11. I use this assembler exclusively, and even distribute copies of it with my SBasic and tiny4th systems. You can download your own copy from Motorola's ftp site or from the Motorola BBS.

Note that the documents with asmhc11 are rudimentary at best; they assume you know assembly language already. If you don't, check the comp.robotics.misc FAQ for pointers to books on 68hc11 assembly language.

If you're just starting out, begin with SBasic; you will get your programs running sooner with SBasic. Also, SBasic code runs about half as fast as well-crafted assembly language, which is usually plenty fast for most robot software.

For robots with 512 to 2K bytes of code space, you can choose between the above two languages, as well as a couple of C compilers or tiny4th. icc11 is ImageCraft's $49.00 68hc11 C compiler. Those in the SRS who have used icc11 like it a lot, and it comes highly recommended.

Another C compiler that gets a lot of positive press in comp.robotics.misc. is Dave Dunfield's Micro-C. This package costs $100.00, and Dave has created an extensive suite of support software and tools.

I have not used either icc11 or Micro-C, but am passing along both because I have heard lots of good things about them, and nothing bad.

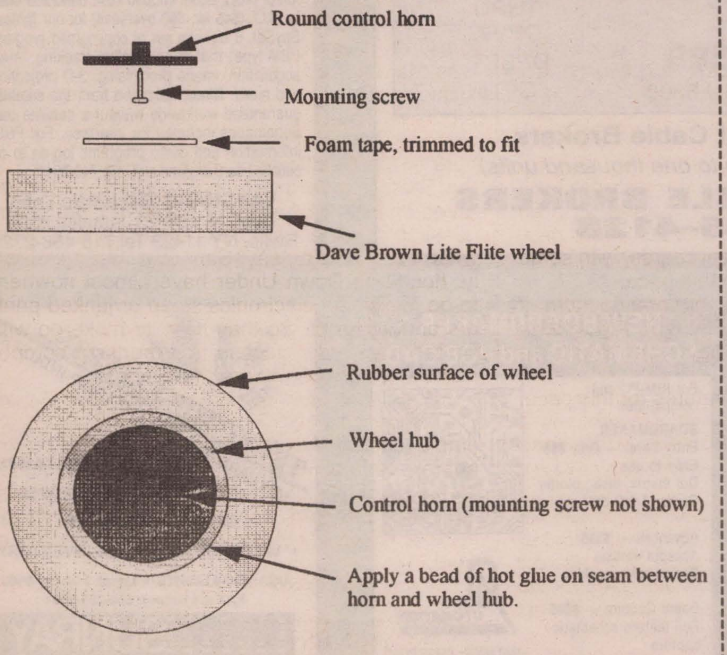
I wrote tiny4th a couple of years ago, and distribute it free from my ftp site: cherupahka.media.mit.edu/pub/incoming/karl_lunt tiny4th translates programs written in a subset of the Fourth language into tokenized assembly language, which is then assembled by the Motorola asmhc11 assembler. If you know or want to learn Fourth, tiny4th makes a great way to get up to speed. Note that tiny4th's programs run about six times slower than assembly language, due to the tokenizing.

For robots with 2K to 64K of code space, you can use nearly anything.

All of the above options will work, plus you can try MIT's Interactive C or IC. As its name implies, IC is interactive. You can run it on your robot's computer, and enter C statements from your keyboard. The statements are executed immediately, giving you instant feedback on your system. For a more complete discussion of IC, check your copy of *Mobile Robots*. You can download the latest version of IC from the appropriate directory on cherupahka.

Those are my recommendations, along with one more. You cannot write robot code if you don't try. Start with something simple, such as SBasic, and write a program. Keep it simple, maybe just flashing an LED. If that works, move on to something more complex. If that doesn't work, or when you start writing code that doesn't work, don't be discouraged. Software may be the most difficult aspect of robotics, but it can also be the most rewarding. Keep trying, and use E-Mail and the Internet news groups as a source of help and guidance.

Software is a necessary evil when it comes to amateur robotics, and I say this as someone who earns his living writing software. I've seen more than one promising hobbyist stopped in his tracks by the need to write software; don't let it stop you.



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And Finally . . .

There is more to life than building robots. When it's time to set aside my soldering iron or keyboard, I usually reach for a good book, and that book doesn't even have to be about robots. Beryl Markham's autobiography, *West with the Night*, is, as Ernest Hemingway wrote, "really a bloody wonderful book." Beryl grew up in British East Africa in the early 1900s, and went on to become a celebrated aviatrix, horse trainer, and adventurer. More than that, she writes like an angel, of a life beyond anything most of us could dream about, let alone experience. The stories of her childhood, spent hunting in the African plains with only a spear or raising a new-born Abyssinian colt, are marvelous reading. And her beautiful prose haunts you long after you finish the book. Highly recommended. **NV**

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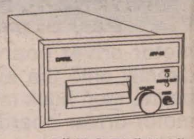
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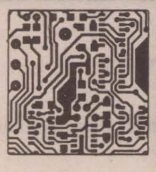
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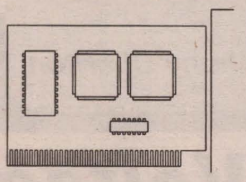
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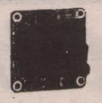
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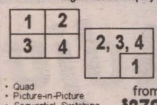
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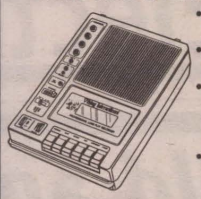
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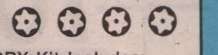
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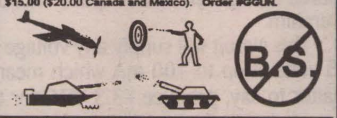
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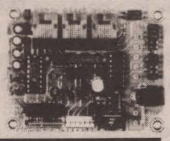
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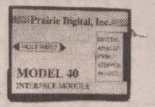
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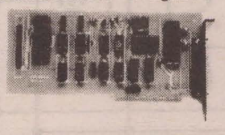
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Today's Electronics

by Anthony Charlton

Build an Adjustable Voltage Power Supply

To continue our look at Surface Mount Technology (SMT), we have chosen a handy project to go over in detail, and we hope you may find it useful to build. Also, we have included a handful of circuit applications which we can develop in detail in future articles, if you find any of them interesting. As always, your comments and suggestions are welcome at the Today's Electronics Reader Helpline listed elsewhere.

The Adjustable Positive Voltage Power Supply is very simple to build, and seeing how the whole assembly is hardly bigger than a postage stamp, you can use it anywhere a low-current adjustable voltage source is required where space and/or weight is at a premium.

This circuit will supply any voltage between 1.2 to 25 volts at up to 100 mA which means, it's a simple matter to say, produce +3.3 VDC for those new integrated circuits from a standard 9-volt battery or 12-volt supply. (By the way, we'll be looking at some 3.3 volt circuits in a future article.)

By carefully setting potentiometer VR1 using your DMM and applying a tiny spot of glue to mechanically retain the pot at its setting, the voltage will remain the same with very little drift.

We have chose to use a standard non-SMT trimpot, as SMT trimpots have a very short adjustment cycling lifespan, and we wanted to allow you to adjust VR1 many times before it wears out.

The IC comes in two versions: one is in a transistor case and the other a SO-8 integrated circuit package. It is the latter type that we'll be using. Its pinout is given in Figure 1. Note there are four pins labelled Vout. These are electrically common, and each of these must be soldered, as they function as heatsinking pins where some of the heat generated internally by the IC is dissipated on the printed circuit board it's soldered to.

Sometimes we lose sight of what's going on INSIDE these integrated circuits, even a simple one like this. It always is a little surprising to look at the complexity of the components within the "little black box," so we have reprinted the internal schematic in Figure 2.

Operating Parameters and a Tip

Here are three precautions to observe before using this tiny little IC:

First the input voltage should be at least 3 volts higher than the desired output voltage. This is called DIFFERENTIAL VOLTAGE. To be on the safe side, I'd recommend five volts or more because of the nature of the voltage regulator involved, and its transient response characteristics to a sudden repetitive load.

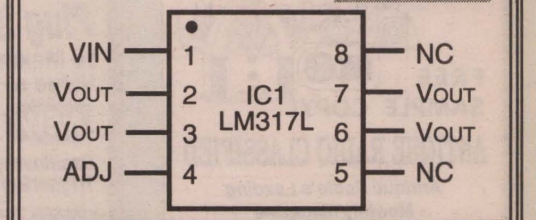
Another requirement is you should use an additional 250 to 470 microfarads of supply filtering on the input of the circuit if the power that is applied to the project is produced from an AC stepdown transformer and its associated bridge rectifier. If a regulated power supply of higher voltage or a battery is used, no additional filtering is required.

Lastly, if your input voltage is close to the maximum rating of the IC, and the output current is close to its maximum, you will definitely need a heatsink. Why? Because the greater the differential voltage and the current draw, the more heat is generated, and the more that has to be DISSIPATED.

You may find ambient temperature is an important factor in current delivery; high temperatures will lower the current delivery capabilities of the IC and the dissipation efficiency of the heatsink. In either case, I'd suggest making a heatsink from copper roof flashing available at your local hardware store. Then double-check it to see if it makes flat contact with the upper surface of the IC package.

Once this is verified, apply a small amount of heatsink grease to the IC, and secure the heatsink to the IC by working a small drop of Krazy Glue™ or other cyanoacrylate (CA) glue at the interface of the edges of the IC and the bottom of the heatsink.

Figure 1



Here's a tip: From my model airplane experiences, to which I returned after a long sabbatical (see last article), I discovered they have done wonderful things with CA glue in the interim such as: making very fast, medium, or slow setting types, in various viscosities and even a filler material that when used with CA can repair or MAKE parts!

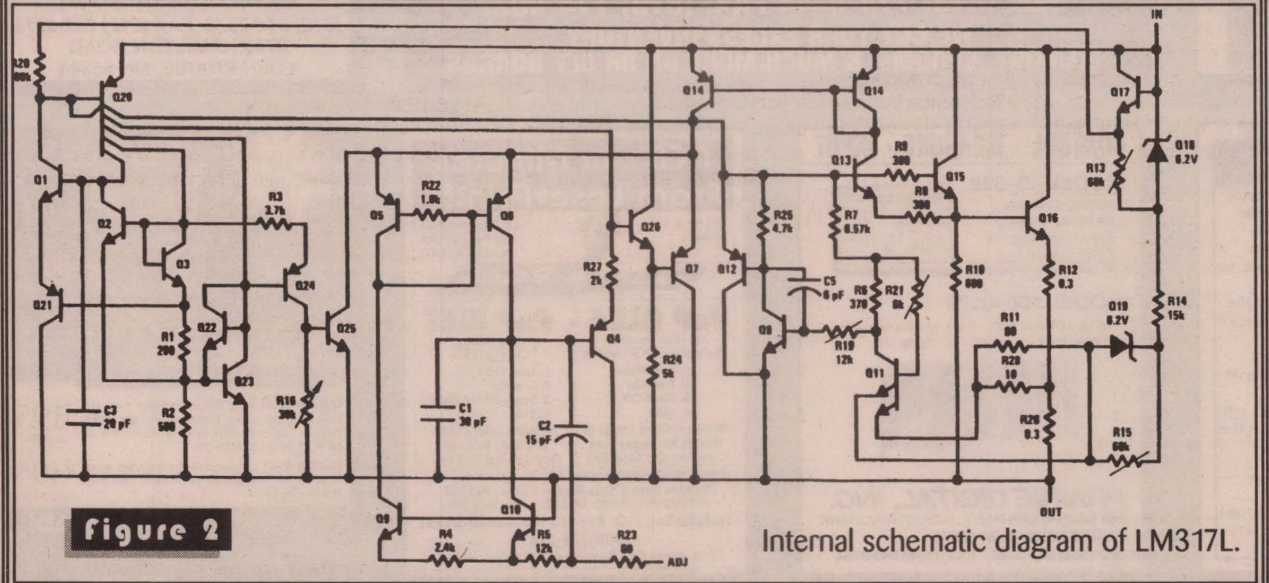
Another such wonderment is an ACCELERATOR – a fine mist spray in a perfume-like bottle that when spritzed on any CA glue, sets it solid INSTANTLY. Neat, eh? So you glue the part in question with slow-setting CA, hold them together with one hand, spritz it with the other, and – ZAP! – you have an instant bond. Hobby Lobby among other sellers, carry these products, and anyone in the electronics field who does any type of gluing and is unaware of these glues, are suggested to contact them (see "Sources").

Describing the operating parameters of the IC is fairly easy once you get the hang of reading a data sheet (see the July '95 article in *Nuts & Volts* by Ron Reis entitled "Conquering Data Sheet Block, It's As Easy As ABC"). In this vein, you will find the graphical parts of the data sheet reprinted in Figure 3. Although not as exciting as the circuit and/or its applications, it is presented so that you can get an idea of the "real-life" working of the IC, and apply this knowledge to other ICs we'll be working with down the road.

Reading from the upper left to right,, here's what these parameters mean:

• **Load Regulation** – The deviation from the setpoint of the IC under a stable output voltage and continuous current vs. the ambient temperature. Expressed as a percentage of the output

Figure 2



Internal schematic diagram of LM317L.

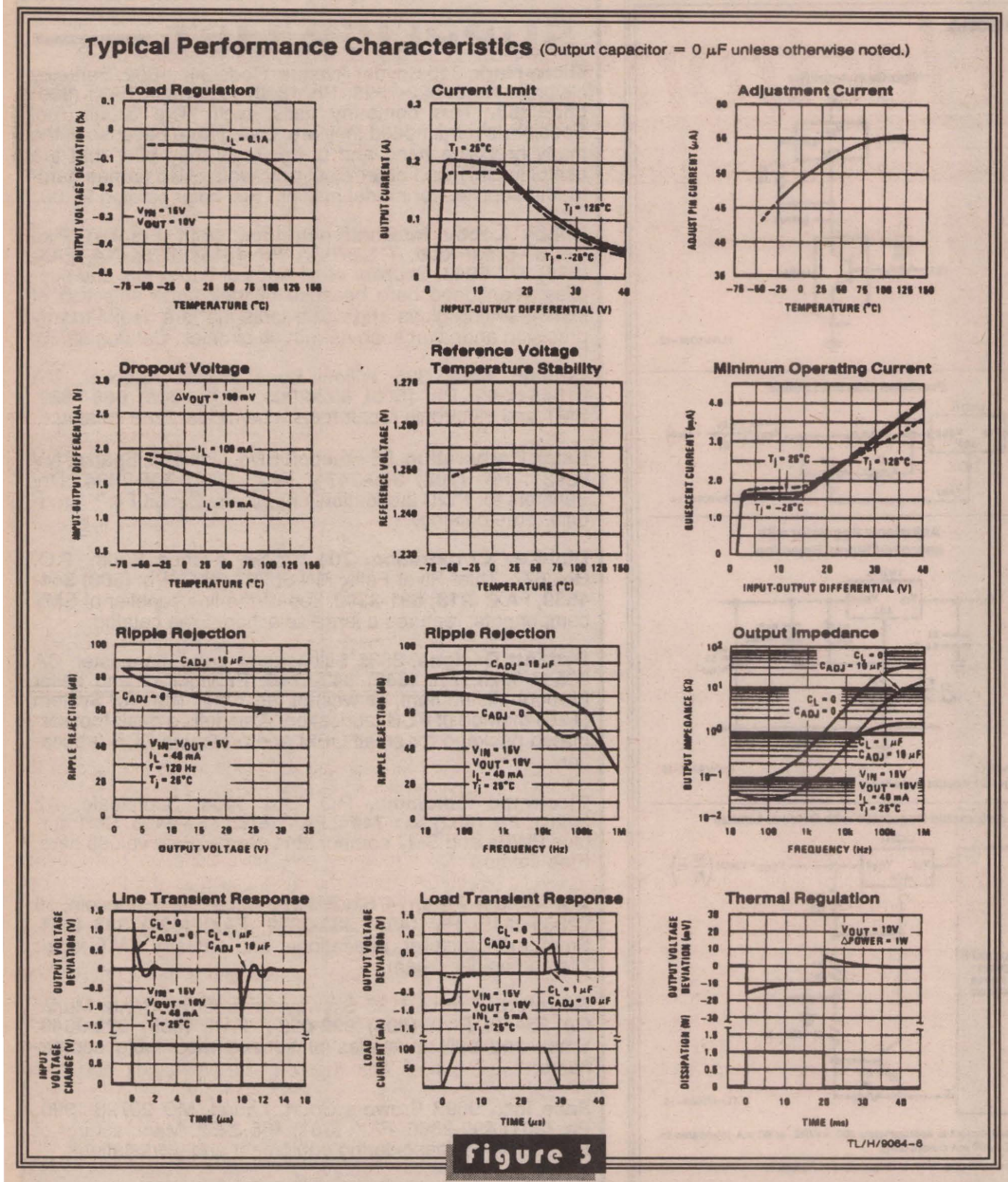


Figure 3

voltage.

• **Current Limit** – The amount of current that can be expected at one or more temperatures with varying input-output voltage differentials. Note the fact that as we mentioned, the higher the differential, the less current available due to heating of the chip.

• **Adjustment Current** – The amount of current required at the voltage adjustment pin (#4) vs. ambient temperature changes.

• **Dropout Voltage** – The voltage at which the IC will no longer properly regulate the input voltage to the load under different temperature conditions. Note this is two volts or less, but we suggested three to five volts of input/output differential previously so you would not have any conceivable failures with this parameter. Some integrated circuits greatly dislike anything but a perfectly smooth voltage at their power consumption pins, hence the conservative suggestion that we provided.

• **Reference Voltage Temperature Stability** – The stability of the on-chip voltage reference vs. temperature. That reference is instrumental in controlling and maintaining the setpoint of the voltage output of the chip, and this characteristic would be handy for engineers calculating the ultimate voltage stability vs. temperature of the chip and its associated external components.

• **Minimum Operating Current** – What the IC consumes without any load vs. the in-out voltage differential, and plotted at different temperatures.

• **Ripple Rejection (versus Output Voltage)** – The value, measured in deciBels, of the noise generated by the IC vs. the capacitance at the adjustment pin (#4).

• **Ripple Rejection (versus DC Input Frequency)** – The value, again measured in decibels, of ripple at the output vs. the input frequency to the IC considered for two values of capacitance (1 uF and 10 uF).

• **Output Impedance** - The impedance, or what the output of the IC would look like if it was considered a pure resistance, vs. the capacitance at the adjustment pin (#4) and the load capacitance at the output versus the ripple DC input frequency at the input. (It is actually more complex than this folks, but this has been abbreviated for readability.)

• **Line Transient Response** – The deviation of the IC's voltage output to a load vs. a sudden change in the input voltage. This can be a single event or repetitive.

• **Load Transient Response** – The response from a sudden load on the output of the IC, either transient or repetitive vs. the values for the capacitors on the adjustment pin (#4) and output pins (#2,3,6, and 7). Note the improvement of this parameter as the two capacitors in the circuit are increased in value.

• **Thermal Regulation** – The variance in the IC's voltage output vs. a sudden, heavy load which has an immediate heating influence upon the chip's internal circuitry.

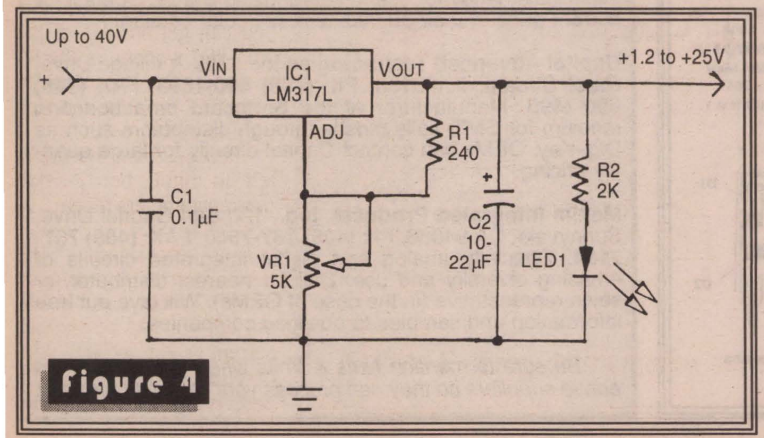


Figure 4

PARTS LIST

All parts SMC type unless otherwise noted

C1 - 0.1 uF ceramic capacitor
C2 - 0-22 uF electrolytic capacitor, 10 WVDC or higher
R1 - 240-ohm resistor
R2 - 2,000-ohm resistor
VR1 - 5,000-ohm laydown potentiometer, Digi-Key #K4A53-ND (Non-SMT)
IC1 - Positive Adjustable Voltage Regulator, Digi-Key #LM317LM-ND
LED1 Green Panasonic Super Bright Chip LED (Chimled), Digi-Key #P504CT-ND (or LED to suit)
PWB - Surfboard, Digi-Key #9081CA-ND

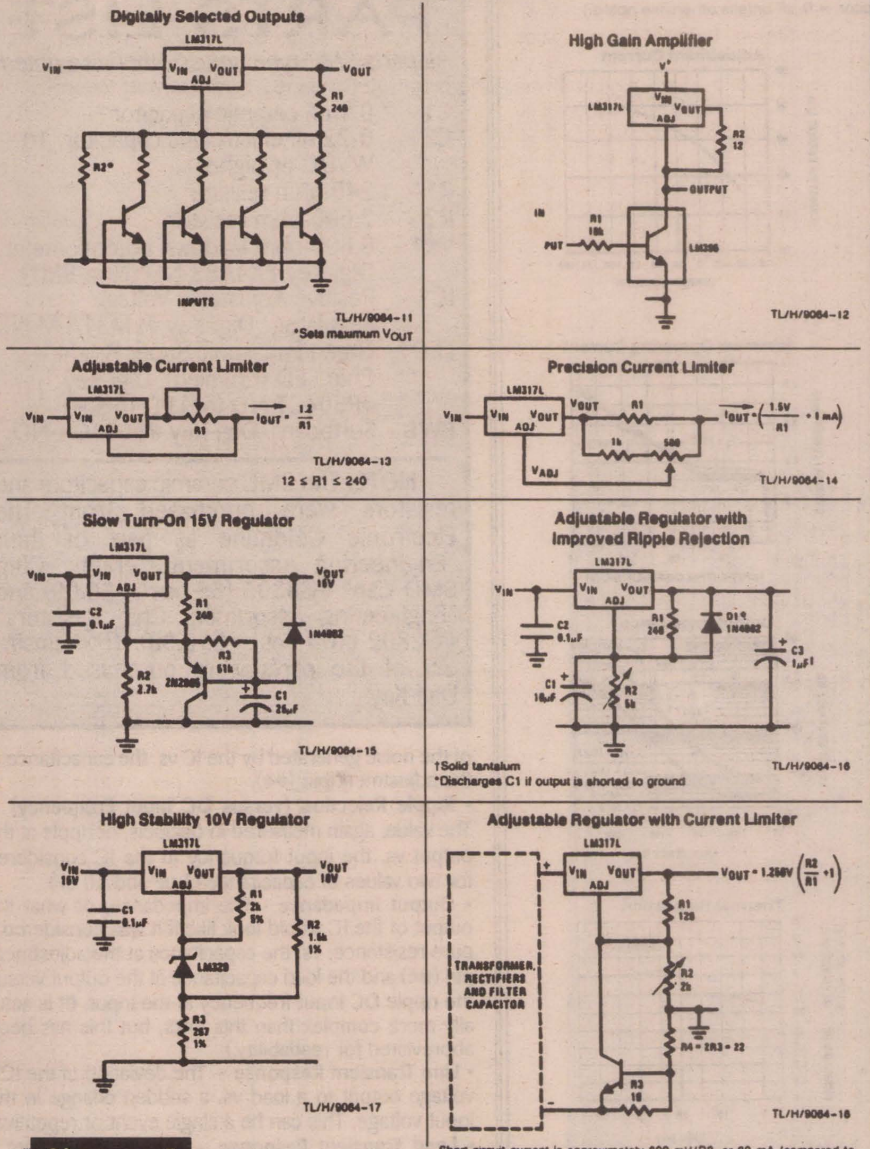
NOTE: The SMC ceramic capacitors and resistors were purchased from The Electronic Goldmine as part of their "Engineering Assortment Ceramic Chip SMD Cap" #G3305 (55 pcs – $5.00) and "Engineering Assortment Chip Resistors" #G2802 (100 pcs – $10.00). The remainder of the parts were purchased from Digi-Key.

Assembly Techniques

As in the previous SMT assembly articles that have appeared here, construction proceeds on a Surfboard™ SMT breadboarding medium. This is model #9081 available from Digi-Key and the exact part number appears in the Parts List. Assemble the components carefully, using a low-wattage, fine-tipped soldering iron. Component placement can be to your liking; there aren't any critical parameters of this circuit that dictate exact components placement EXCEPT the position of the IC on its intended eight solder pads. If your input power source is more than 6" away, it is recommended to add a couple of 0.1 uF bypass capacitors spaced evenly along the input line to avoid problems such as spurious oscillations. These 'caps can be either SMT or small-sized conventional disc capacitors, but disc caps will be easier to use in this case.

Note: Most parts are polarity sensitive. The IC, LED, and electrolytic capacitor must be positioned

Typical Applications



Short circuit current is approximately 600 mV/R3, or 60 mA (compared to LM317LZ's 200 mA current limit).

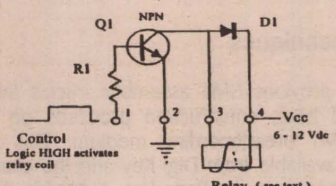
At 25 mA output only 3/4V of drop occurs in R3 and R4.

Figure 5

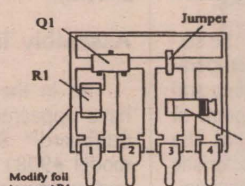
BUILD THESE USEFUL SURFACE MOUNT
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Figure 6

RELAY DRIVER CIRCUIT PLUGS IN WHERE NEEDED WHEN BREADBOARDING



Basic circuit



Surfboard based version
MODEL 6004

Easy to build relay interface circuit requires only one foil modification. Logic high turns on relay. Select relay that does not exceed transistor current capacity. Experiment with component values to tailor circuit for your application.

Part list / Description

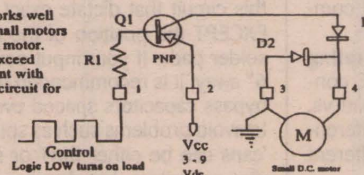
SURFBOARD -	6004
Q1 - 2N2222	SOT-23
D1 - 1N4148	Mini Melf
R1 - 1-K	1206
RELAY	(see text)

INTERFACE CIRCUIT CONTROLS SMALL MOTORS FROM LOGIC SIGNAL

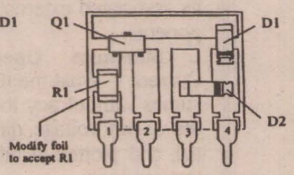
This simple interface circuit works well with inductive loads such as small motors and relays. Logic low activates motor. When selecting motor do not exceed current rating of Q1. Experiment with component values to optimize circuit for your application.

Part list / Description

SURFBOARD -	6004
Q1 - 2N2907	SOT-23
D1,D2 - 1N4148	Mini Melf
R1 - 1-K	1206
MOTOR	(see text)



Basic circuit



Surfboard based version
MODEL 6004

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correctly to avoid their destruction once current is applied. Polarity is marked on the schematic, which appears in Figure 4.

Testing and Operation

After you've checked your job for shorts, opens, and bridged traces, and are happy the circuit has gone together well, apply power to the assembly.

Measure the output with a voltmeter or multimeter. The LED should light instantly upon application of input power. It is not supposed to be bright. To conserve input power, the series resistor is large in value, but you should be able to see the LED all right under normal light. It will change in intensity as the VR1 is varied. Mount it in a shady spot of your enclosure if needed, or reduce the value of the series resistor until it shines brightly enough for your taste.

Other Uses for the LM 317L

This versatile integrated circuit is not limited to just simple voltage regulation uses! In Figure 5, we have shown several circuit applications that somebody may find handy. To repeat, These can be described in more detail in a future article if any of the readers show an interest – just drop us a note or postcard at our dedicated P.O. Box, and we'll build the circuit and supply the tutorial.

Another Practical Capital Advanced Technologies Project

Capital has again provided the author of these articles more data on "build-it-yourself" SMT projects. Figure 6 shows the circuit schematic and layout for a simple Relay and Motor Interface Circuit using one of their Surfboard SMT breadboards. I like these two circuits because they allow you to adapt a relay or small motor to any kind of project in need of same. The project is assembled on a style #6004 Surfboard, which Digi-Key currently sells for $1.49 in single quantities. Their number is 6004CA-ND.

One cut has to be made in the leftmost foil trace to allow R1 to be correctly installed (see figure). Cut through the foil using a razor (X-Acto® knife) allowing enough foil for solder bonding of R1. Then, heat the center of the cut with a soldering iron, and pull the foil away from the PWB using the tip of your razor/knife. Further details of these interesting two projects appear in the figure.

Conclusion

We'll be checking out a fascinating product called ChipQuik™ in the next article. This is an amazing product for successfully removing SMCs from a PC board using a minimum of tools and effort. This innovative product has earned a patent!

The repair technique involves a process whereby a secret low-temperature alloy is applied to a PWB solder joint along with a special flux, and the connection heated. The metals and flux intermix and make the existing solder alloy of the IC or component/PWB bonding interface melt at only about 200° F! So the thermal and mechanical damage to the PWB (and the removed component, if it tests out okay, and wants to be re-soldered) is at a minimum.

With any electronic assembly, especially SMT, it is a good idea to remember this equation: Pressure + Heat = Damage. We'll check out the ChipQuik samples provided, give a write-up, and pass along any tips observed in the evaluation process.

Also, we'll be doing another SMT project in the next installment, which we think you'll enjoy, plus, begin looking at new types of semiconductors in non-SMT packages that perform some very basic and useful functions such as transient surge absorption, and also latching a circuit in case of an overvoltage condition – which, Voila! – will prevent damage to any circuit desiring such protection. NV

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Includes: • 20 character dot matrix display with full alpha-numeric capability • keypanel with full alpha-numeric entry • separate 7.5 VDC/0.5 Amp power supply • standard telephone interface extension cord • lithium battery and flat-cone speaker.
HP bar code wand (HBCS 2300).....$35.00

POWER SUPPLIES

73 WATT SWITCHING $15.00 or 2 @ $25.00, (2) 4 pin power connectors attached • 115/230 Volt, Dim: 8.5" L x 4.5" W x 2" H • Output: +5V @ 2-9.75 A, +12V @ 0-1.5 A, -5V @ 0-0.4 A, -12V @ 0-0.5 A
68 WATT SWITCHING $12.00 or 2 for $20.00, 115/230 Volt, Dim: 5.5" L x 3.2" W x 1.7" H • Output: 5V @ 4 A, 12V @ 4A

MISCELLANEOUS

ADAPTEC 4070A (RLL) OR 4000A (MFM) SCSI Controller, your choice $25.00
IBM 370 option XT and AT emulation boards $50.00

MONITORS

Non-Enclosed TTL
Comes with pinout. 12V at 1.4 Amp input • Horizontal frequency 15Khz. • Ability to do 40 and 80 column.

5 inch Amber	$35.00
7 inch Amber	$39.00
9 inch Amber or Green	$29.95

5" COLOR MONITOR $49.00
• Flat Faceplate • 320 x 200 Dot Resolution • CGA & Hercules Compatible • 12 VDC Operation • 15.75 KHz Horiz. Freq. • 60 Hz Vert. Sync. Freq. • Open Frame Construction • Standard Interface Connector • Degaussing Coil included • *Mfr. Samtron*
2 for $89.00

CHARGE COUPLED DEVICES

"The Spy In The Sky" $29.00 MATRIX TYPE
Sony CCD Imager - designed for black and white composite video cameras. Picture elements: 384 (H) x 491 (V)
Chip size 10.7 (H) x 9.3 (V) mm² • Unit cell size 23.0 (H) x 13.4 (V) um². Ceramic 24 pin DIP package • Mfr: Sony, Part# 016AL

4096 element CCD $29.00
1024 element CCD $15.00
LINEAR TYPE
2048 element CCD $15.00 • 1728 element CCD $15.00

HACKER CORNER

CELL SITE TRANSCEIVER $99.00
These transceivers were designed for operation in an AMPS (Advanced Mobile Phone Service) cell site. The 20 MHz bandwidth of the transceiver allows it to operate on all 666 channels allocated. The transmit channels are 870.030-889.980 MHz with the receive channels 45 HMz below those frequencies. A digital synthesizer is utilized to generate the selected frequency. Each unit contains two independent receivers to demodulate voice and data with a Receive Signal Strength Indicator (RSSI) circuit to select the one with the best signal strength. The transmitter provides a 1.5 watt modulated signal to drive an external power amplifier. channel selection is accomplished with a 10 bit binary input via a connector on the back panel. Other interface requirements for operation are 26 VDC (unregulated) and an 18.990 MHz reference frequency for the digital synthesizer. The units contain independent boards for receivers, exciter, synthesizer, tunable front end, and interface assembly (which includes power supplies and voltage-controlled oscillator). Service manual, schematics and circuit descriptions included.

Encased Black & White Composite CCD Camera with Adapter
IR viewing to 1000 nm 7 ½ L x 2 ¾ W x 1 ¾ H
Comes complete with CCD camera, mounting nut on bottom of casing, 12VDC power supply. Excellent low light capability, standard RCA NTSC video out. **$89.00**
Great for: entryway security/remote monitoring, video conferencing/desktop video conferencing **2 for $159.00**
This miniature camera is perfect for multimedia computer applications as well as security and surveillance. NTSC output allows use with all popular video digitizing boards for Apple Macintosh and Microsoft video for Windows. Connects directly to any composite monitor or VCR with "video" input. Its razor-sharp wide-angle lens focuses from two inches to infinity and its state-of-the-art CCD technology accurately captures 16 level grayscale images for Quick Time movies and still pictures. Records at 30 frames per second and 260 lines resolution with excellent low light capability. Uses 12VDC (adapter supplied) and standard RCA cable.

Portable Micro Terminal
Flip up LCD display (9-16 VDC) • Can communicate with any computer having RS 232 port • Can communicate with another Microterminal • Use by itself as electronic notebook • Onboard microprocessor, data RAM (32K) and Video RAM (64K) • Complex built in diagnostics and set up capabilities. • Original intention for POS applications. • display size 40x16 (256 x 128 pixels.) Dimensions: 6.3" W, 11"L, 2"H. (With LCD up height is 7.1")
$99.00 or 2 for $149.00

BAREBONES 286-12 COMPUTER $49.00 (2 FOR $79.00)
Slimline desktop case, 100 watt supply, math co-processor support. On board IDE, & Floppy controllers. 2 COM ports and 1 parallel port with software setup. Supports up to 8 Megs using standard 30 PIN SIMMs. Internal room for (1) 3 1/2 inch IDE hard drive and (2) 3 1/2 inch floppies. Four 16 BIT ISA slots, accepts full length AT size cards. Keyboard can be set to no test at boot. Case size is 15.5"W x 16"D x 4"H.
(Motherboard can be purchased separately: $29.00 or 2 for $49.00)

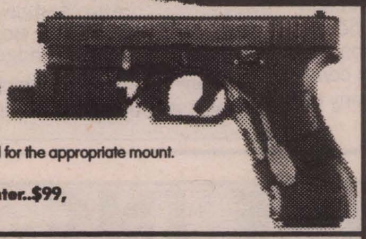
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Order desk only: **USA: (800) 872-8878 CA: (800) 223-9977**
L.A. & Technical Info: **(310) 784-5488** Fax: **(310) 784-7590**
OEM INQUIRIES WELCOME

Minimum Order: $20.00. Minimum shipping and handling charge $5.00. We accept cashiers checks, MC or VISA. No personal checks or COD's. CA residents add 8.25% sales tax. We are not responsible for typographical errors. All merchandise subject to prior sale. Phone orders welcome. Foreign orders require special handling. Prices subject to change without notice. 20% restocking fee for returned orders.



SEASONAL SPECIALS for the SERIOUS SEARCHER

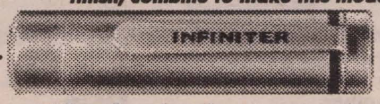
LASERSIGHTS,



Rugged & Dependable.
Windage and Elevation are easily adjustable using internal adjustment screws. Custom mount, Lithium battery and remote switch included.
Simply specify your make and model for the appropriate mount.
One year warranty!
670nm...$79, 650nm, 5X brighter..$99,
635nm, 10X brighter..$139

NEW LASER POINTER MODEL,

Super 650nm Intensity, Sophisticated styling, and a Luxurious finish, combine to make this model tops!

A. 

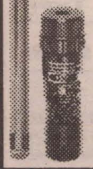
SHOWN ACTUAL SIZE! 2.3"L x 0.6" Diam.

B. 

We continually search the market for the best laser pointers available. We have tested them all. We offer only models selected for the best reliability, power and style.
(A.) 5X BRIGHTER than 670nm and we think it's the nicest laser pointer on the market. Machined from solid brass, then hard nickel plated with a beautiful satin finish. This is the laser pen that perfofms as well as it looks. No plastic parts. Built to last. One Year Warranty. New compact size for easy handling. Operates from three SR-44 Button cells. (included)
(B.) NOW with PULSE MODE! Black anodized body has a substantial feel. Weighs only 2 ounces. Super tough aluminum extrusion. Brass inserts for battery cap and grippers on the side. You could stand on it! Looks very HI -TECH. A real pushbutton switch (with dual action flashing or steady modes) at the beam end allows for stable operation. Two AAA cells that don't rattle, provide power. Batteries, and 1 year Mfr.'s Warranty. You will be amazed! Don,t buy a pointer you can crumble in your hand like a soda can!
MODEL (A.).....$69ea. MODEL (B.).....$49ea.

Don't get "BURNED" Super Bright, 635nm LASERS

COMMERCIAL QUALITY at "HOME MADE" PRICES.
The Choice is Yours?



We offer 24K GOLD for less than their PC board!
Our lab models are priced even lower. 24K Gold plated, laser pen, operates from 2 AAA cells. Lab style has internal X/Y adjustment screws. The wide input voltage laser module has internal SMT pwr supply! All provide 800 Yard range and 1.5mrad divergence. performance you can afford. *•SPECIAL PRICES THIS MONTH•*
PEN/$139, LAB STYLE/$139, LDM/$99

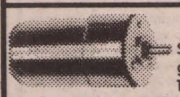
Easy to use, WIDE Input 5mW, LASER with 3V to 6VDC power!



670nm, $39.00
650nm, $49.00
635nm, $99.00

SPECIFICATIONS: DC Power, 3 - 6Vdc, @65mA Power out, 5mw max. Range, 100-800 Meters Glass Collimator (fixed @ inf.) Size, 0.41"diam. x 0.7"L
Through a large volume purchase we can now offer absolutely the best value and best quality available on our commercially made, 670nm, 650nm and 635nm subminiature, laser diode modules. A glass collimating lens provides adjustment free <1.5mRad performance. (comparable to HeNe lasers.) NEW wide input range, internal surface mount power supply operates from 3 to 6 Volts DC. The package is machined brass for excellent thermal characteristics. These are THE quality laser modules.

ESCAP SWISS GEARMOTOR



Superior quality **brand new** motors. Both the motor and 64:1 gearbox are ball bearing. Able to deliver over 14oz/in of torque @ 112RPM, 6VDC @100mA! Can be operated from 1.5VDC to 12VDC. Stainless steel case. Size: 58mmL x 23.8mm diam. With 3mm diam. shaft. Perfect as a drive motor for our linear slides or for robotics. **theirs $200ea. ours $15.95ea. 3/$45**

TEST EQUIPMENT SPECIALS

TEK 7633, 100 MHz Storage with 2/7A18 D/T vert., 7B53 T/B.....$895
TEK 7834, 400 MHz Storage with 2/7A18 D/T vert., 7B53 T/B.....$895
TEK 7844, 400MHz Dual Beam, with 2/7A19 vert., 7B92 T/B.....$895
TEK 7854, 400MHz Digital, GPIB w/ 7A24 & 7A26 vert., 7B92 T/B no keybd.....$1195
TEK 7904, 500MHz with 7A24, 7A26 D/T vert., 7B80/7B85 T/B.....$895
TEK 475, 200 MHz portable, Dual trace, Delayed sweep.....$649
TEK 475A, 250 MHz portable, Dual trace, Delayed sweep.....$729
TEK 485, 350 MHz portable, Dual trace, Delayed sweep.....$995
ALL PORTABLE SCOPES INCLUDE PROBE MANUAL and COVER. ALL TEST EQUIPMENT CALIBRATED WITH 90 DAY WARRANTY

LASER ACCESSORIES (see photos below description)

A. ***MIRROR GALVOS, Closed Loop, X/Y*** with 40mm square, first surface mirrors. Galvos are General scanning model Z1483. Both are pre mounted on a black anodized aluminum plate and pre aligned for operation. Screw terminal stips provide easy connection. Very limited quantity.....**$249**

B. ***SPATIAL FILTER*** Rugged machined aluminum construction with pinhole adjustment screws. Removed from Argon laser system. Very good condition. No other specs.....**$69ea.**

C. ***EG&G DETECTOR with CUBE BEAM SPLITTER, includes signal conditioner board.*** The assembly includes an EG&G type SGD 100A detector mounted at the approx. 7% split output of a 13mm cube beam splitter. Transmission is about 85% straight through. The signal conditioner board operates from +- 15 VDC. All optical components are mounted on a anodized adjustable mount. Removed from Argon laser system in very good condition. Very limited quantity.....**$59ea.**

C. ***ACOUSTO-OPTIC MODULATORS*** with RF AMP. Isomet type RFA 1108, They were used with 488nm Argon lasers. BNC connectors on amp and crystal. Very limited quantity.....**$149ea.**

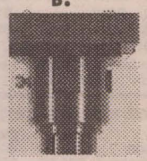
D. ***NEWPORT XYZ MOUNT,*** model 462M with 25mm travel micrometers. Like new condition. All stainless steel construction. Ultra precision. **Catalog price.....$1150 OUR PRICE.....$695**

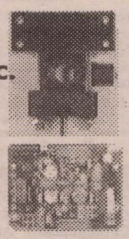
E. ***LINEAR SLIDE, NEAT Model SC300,*** All anodized aluminum, industrial quality construction. Ball bearing with 50 pound capacity. Smooth as silk. Like new, but some have a scratch in the edge where a dummy used a utility knife to open the boxes. Their blemish is your gain! Very rugged. Size: 1.75"Wx4"Lx.75"H with 3.4" travel: Use two or three for a fabulous x-y or xyz set-up. Their solid proportions make them excellent for z axis alone as well. Very limited qty. Use our Swiss gearmotor for drive & HP encoder for feedback! **Reg.....$86ea. Our Price.....$34 or 3/$85**

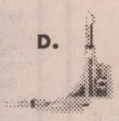
F. ***NEWPORT MOTORIZED ROTARY STAGE,*** model 495A, NEW. Bidirectional 360° continuous rotation with 0.001° resolution. Integral DC motor and precision encoder. Load independent velocity servo. Can be mounted in any orientation. Load capacity: 55lbs. Size: 4.75"x5"x1.35" With 2" clear aperture. **Newport price....$2141 Our Price.....$895**

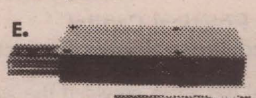
H. ***CUBE BEAM SPLITTER, 25mm*** Two precision BK-7 right angle prisms, flat to two waves, bonded with an hypotenuse interference coating. Their fancy price $115 .....**$24ea.**

A. 

B. 

C. 

D. 

E. 

F. 

G. 

H. 

NEW! COLOR PINHOLE CAMERA,



remote head, 0.5 lux. 330 lines, 1/3" CCD, 3mm, 110° FOV lens, 12VDC @150mA, auto shutter and AGC, Size: Head, 1.37" x 1.57", Proc., 1.96" x 3.93", weight, 2.3 0z.
PRICE..$289ea.

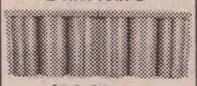
"MOTION DETECTOR" CCD CAMERA,



Now, place video cameras almost anywhere! 0.3 lux. 380 lines, ⅓" CCD, 4mm, f1.8, 78° FOV lens, 9VDC @100mA, auto shutter and AGC, smoked lexan face makes camera almost invisible! New
PRICE..$159ea.

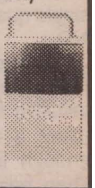
12V@8AH GATES GEL CELL PACK,

BRAND NEW! Arrainged as a 1X6 cell pack. SIZE: 2"Wx4"Hx11"L



$10.00ea.
Metal box of four, 12V packs...$29

STEP DOWN TRANSFORMER 220/240 to 120VAC



1.5 KVA Heavy Duty Brand New, Boxed.
Size:11"Lx7"Wx6"D
Weight: 41lbs.
NEMA 3 BOX.
Single Phase
List price $185
PRICE..$29ea.

The REAL SUPER MAGNET!



The most powerful magnets you have ever experienced. Other magnets are "Kids Stuff" compared to these. Each module consists of two magnets bonded to a steel base. Size: 2.5"Lx1.1"Wx.67"H. The actual magnets are only .82Lx.78Wx.32H. Yet they can pull 50 pounds. YES FIFTY! Not suitable for children. Can cause personal injury. Brand new. **Two modules..$10.95 10 modules..$49.95**

OSCILLOSCOPE PROBES, 100MHz w/READOUT!



If you have a TEK scope with an auto switching attenuator display, you need a probe with the readout option. Don't be fooled by cheap, low priced low bandwidth probes without readout. This one works the way your scope was intended. Complete with all accessories. **New.....$39ea.**
or without readout.....$34ea.

HP OPTICAL ENCODER, HEDS-7500,

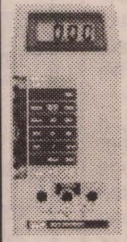


NEW, 1000 count quadrature, TTL compatable, A & B output for count and direction, 5VDC @20mA power. With Data. Perfect for do it yourself motion control. Size : 1.13"diam x 87"d ***2 for $25***

QUADRATURE CLOCK CONVERTER IC for use with OPTICAL ENCODERS, TYPE GM7082,

NEW, X1, X2 and X4 mode selection. 16MHz Output clock frequency. INDEX I/O, UP/DN indicator, On-chip filtering of inputs. TTL and CMOS compatible. Perfect for do it yourself motion control. Standard 14 pin dip. With data.....**$4.95ea, 10+ $3.95**

FLUKE 8022B DIGITAL MULTIMETER



Previously owned by a Fortune 100 electronics manufacturer. We were fortunate to obtain them in time for this ad. The FLUKE name is synonymous with quality. Perfect for the experimenter or technician. Measures AC/DC Volts, Ohms, and AC/DC Amps. With audible continuity test and diode check function. 3 1/2 digit LCD display. Fuse protected. All in very good condition. Includes test leads and battery.
Our Price Price.....$49ea.

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Write in 119 on Reader Service Card.

WISHING all our FRIENDS a HAPPY and HIGH TECH HOLIDAY





PACKAGE INCLUDES:
SNAPPY HARDWARE WITH
FAUVE MATISSE &
GRYPHON MORPH S/W
CHINON VCC-062 CCD
12VDC ADAPTER
VIDEO CABLES AND MANUAL
$489.95

Worlds Highest Res Video Grabber 1500x1125 @ 16.8 Million Colors!

CAPTURE FULL COLOR DIGITAL IMAGES to your PC in MINUTES with our SNAPPY with CHINON COLOR CCD CAMERA PACKAGE

Specifications	
Image Resolutions:	1500 X 1125, 640 X 480, 320 X 240
Colors:	16.8 million (24-bit)
Freq. Response:	more than 12.5MHz
Capture Modes:	Field, Frame or Multi-Frame
Video Input:	Any NTSC video source
Dimensions:	2.5" W x 4.9" L x .85"H
Connectors:	RCA Video, DB25 PC

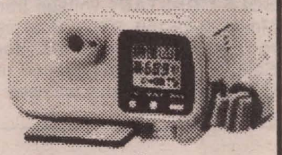
- No tools required
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- No slots used
- Just Click to grab
- Powerful, award winning, Windows, Image editing and morphing s/w included. A $300 VALUE!

Grab From Any Source
VCR,Camcorder, TV Tuner,Cable Box, Laserdisc Player, Satellite Tuner, Nintendo, Sega, Atari, 3DO, CD1, Mavica or Xapshot still video camera Security System



CHINON DIGITAL CAMERA

- True Color, 24 Bit, 16.8 million colors
- 3X Power Zoom Lens with Macro
- 3 Selectable Resolutions up to 640x480
- Multi - Auto Focus/Auto Flash
- 1MB Built - In Picture Memory
- Flash Memory (up to 16MB avail.)
- f2.5, 7-21mm Zoom Lens
- Shutter Speeds from 1/16 to 1/500
- Up to 40 Pictures on Internal Memory
- Up to 689 Pictures with Optional PCMCIA card
- Ideal for Desk Top Publishing, School Reports, Internet Home Page Graphics or Instant T-shirts.
- PC (Windows) and MAC Software Supplied.
- Perfect for "Sensitive" Photos you Don't Want Commercially Developed.
- Powered by 4 "AA" Batteries





NO OTHER DIGITAL COLOR CAMERA OFFERS ALL THE SOPHISTICATED FEATURES OF THE CHINON ES-3000.

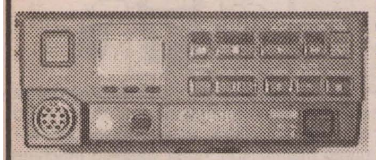
PC and MAC COMPATIBLE,
You'll get everything you need for quick and easy installations, including serial cables and software for both PC and Macintosh use. For the PC, a Windows compatible image acquisition and camera control program plus a TWAIN compatible utility for aquiring images within your favorite graphics program are included. You'll also get a Macintosh compatible image acquisition and camera control utility and a plug-in module for Adobe Photoshop.

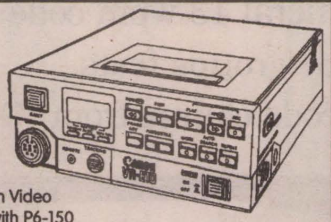
ES3000, digital color camera.....$939.00
Flash Memory, 2Mb.....$299, 4Mb.....$379, 8Mb.....$779

CANON VR-E10, 8mm, Portable Video Recorder, NEW!

Compact design perfect for covert "briefcase recording" and mobile applications. Complete package includes:

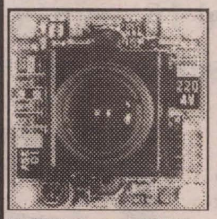
Recorder, Regulated AC power supply/ charger, 12V, 1100mAH NiCad battery, Charging Connector, RCA A/V cable and 10 Pin DIN to RCA A/V input cable. Wired remote control pendant with 6M cable included. (duplicates front panel operation) Size: 2.25"H x 6.4"W x 7.5" D, weight 3.2lbs. less battery. Uses standard 8mm Video Cassettes. Up to 150 min. record time with P6-150 Cassette, LCD displays for tape counter, index and battery state. FM quality sound, provides 30Hz to 14kHz freq. response. With operating manuals. Limited quantity.





Our price.....$399ea.

ACTUAL SIZE



1.25" Sq. x .99"D

CCD MICRO CAMERA, Chinon model

060. Black and White, 1/3" CCD, with a full 250,000 PIXELS!, 380 Lines Resolution. Sens. 0.3 LUX. AGC and Electronic Shutter. Low Power 9VDC @100mA ALL lensesincl. pinhole, can be focused! FOV,4mm, 78°, 3mm 110°, Pinhole 91°, 10mm to infinity) A real glass lens! You get what you pay for. A little more, for a lot more quality. Standard video out. 1/2 once! IR SENSITIVE! A brand name camera. Mating Connector w/ cable included.

with 3 or 4mm.Lens.....$139ea.
with PINHOLE lens.....$149ea.

Mini Camera Housing,
Black,textured ABS. 1"x1.5"x2".....$15.95

NEW! SCIENTIFIC 1/2" COLOR CCD CAMERA with YC/SVHS out Achieves Superior Picture Quality. 380K Pixels with 460 Lines Resolution, 1.5 Lux Sensitivity

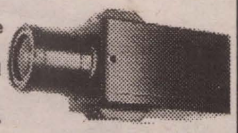


All operating parameters are adjustable from outside the camera! Perfect for microscopy and inspection as well as image capture and surveillance. The GM-470C camera, features internal or external sync. Interlaced or Non-Interlaced operation. Adjustable shutter speeds of 1/60 to 1/10000 Sec. Auto White balance selector with three steps. Auto iris output. C or CS mount lens mount. Manual or auto gain as well as external variable gain. Video out on BNC, 12VDC @ 250mA input through standard barrel jack. Truly this camera has it all. Super for use with our SNAPPY frame grabber as well. Rugged aluminum housing. Size: 50.5mm W x 50.5mm H x 145mm L. New, boxed.

less lens.....$549ea.
with 16mm, f1.6,.....$569ea.
with 8mm, f1.3,.....$589ea.

GM600 HIGH RES. B/W 1/2" CCD

425K pixels, 600 Lines resolution, 0.02LUX sensitivity. Access all operating parameters from outside the camera! 12VDC pwr. Dual mounts. Sony CCD! Scientific quality



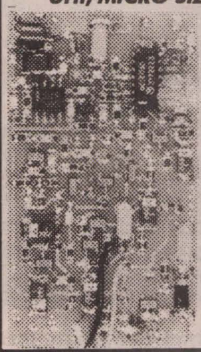
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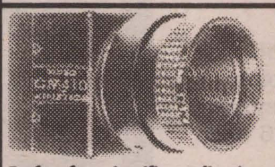
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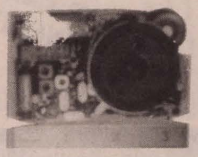
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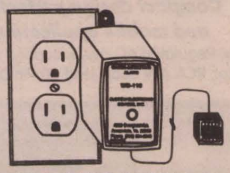
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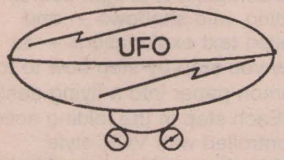
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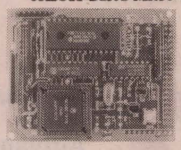
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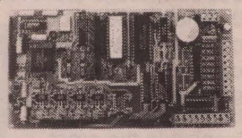
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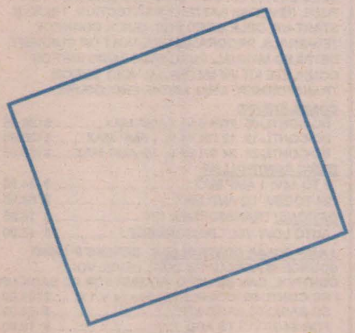
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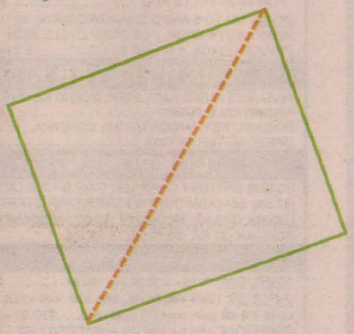
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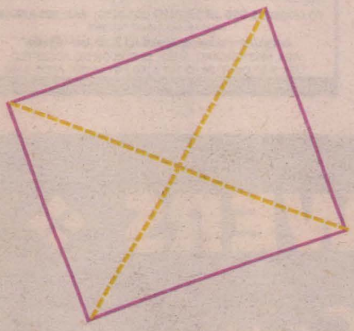
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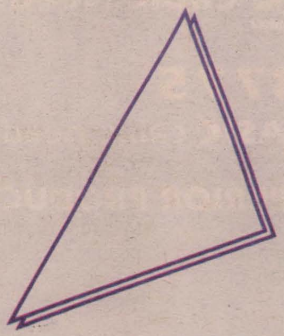
The Greatest Paper Airplanes

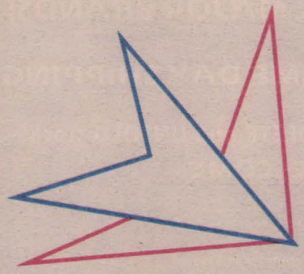
by Fred Blechman











The Greatest Paper Airplanes is an IBM PC Windows or Mac program that shows you, using step-by-step animation, how to fold standard sheets of paper into 25 different paper airplane designs that actually fly, some including aerobatics.

Although intended as "hobbyware" or "toyware," this software is creative fun that helps get indoor computer addicts up out of their chairs to go gliding, diving, barrel-rolling, and looping in the great outdoors — or maybe the office atrium!

Using a unique "notebook" approach, the numerous screens feature some simple flying instructions, the history of paper, basic folding skills — and some safety tips for wrong-way paper flyers.

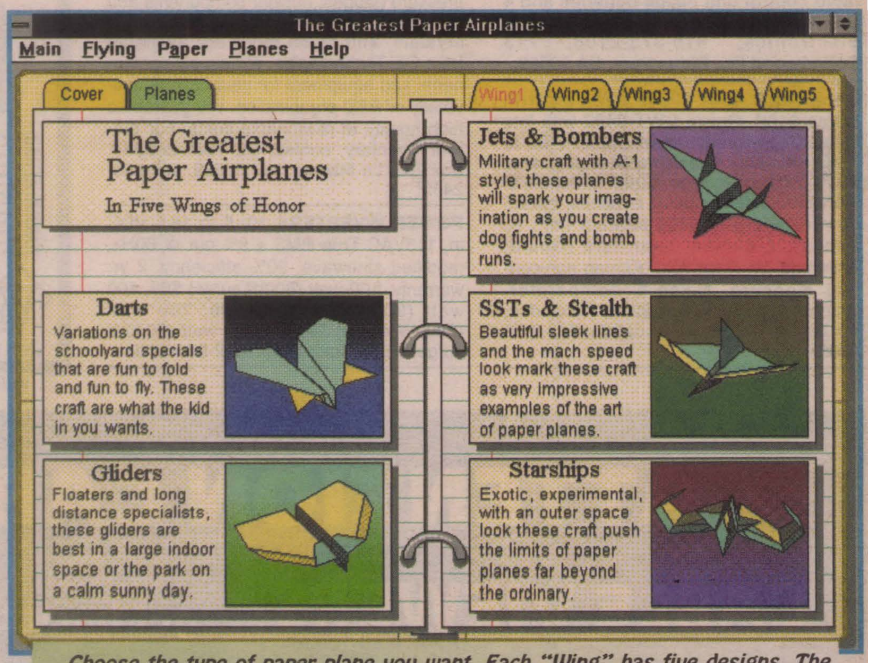
Origami, the ancient Japanese art of folding single sheets of paper into realistic animal forms (usually without the aid of scissors or paste) has metamorphosed into the computer age. Instead of animals, the folded objects are weird paper airplanes that actually fly. And instead of printed drawings showing construction steps, "The Greatest Paper Airplanes" programs your computer screen to animate the assembly in color one step at a time, as quickly or slowly as you desire.

Great ideas abound in the computer world, but frequently end up with poor implementation. Such is not the case here. Not only was Paper Airplanes original in conception, but the implementation is deserving of a special award. It features simple screens that resemble a three-ring notebook, packed with information and fun for all ages, with index tabs that ensure effortless program navigation.

Click on colored words and you are launched into special animations of that subject. Just point, click — and listen to some clever sounds, as well. The operation of the program is so intuitive that only a Quick Reference Card is supplied. No manual is provided or needed!

Features

Available for both the IBM PC or the Macintosh, and either on disks or CD-ROM, all versions are the same price ($29.95) and have the same features. This review is of the IBM PC versions.



Choose the type of paper plane you want. Each "Wing" has five designs. The disk version offers five Wings, the CD-ROM version has 10 Wings.

Using standard 8-1/2" x 11" paper, Windows users now can have the "Wright stuff" by simply folding and flying. Three-dimensional animations and tutorials, complete with sound effects, teach the history and principles of flight, from Leonardo da Vinci and Chinese Kites, to ailerons and elevators — and how they apply to paper airplanes.

The fleet of 25 airplane designs (50 if you get the CD-ROM version!) is arranged in five "wings" (Darts, Gliders, Jets & Bombers, SSTs & Stealth, and Starships) that range from fairly simple (none are REALLY simple) to totally weird. The simple arrow-shaped paper glider that we've all made is not included; too simple.

No tape, paste, or glue is required, and no rubber bands or propellers are needed; thrust is provided by YOU when you hand-launch your folded creation.

Modeled after CAD/CAM (Computer Aided Design/Computer Aided Manufacturing) software, The Greatest Paper Airplanes uses smooth three-dimensional animations complete with light source, shading, and shadows — and detailed text explanations — to show you step-by-step how to fold common paper into a flying design.

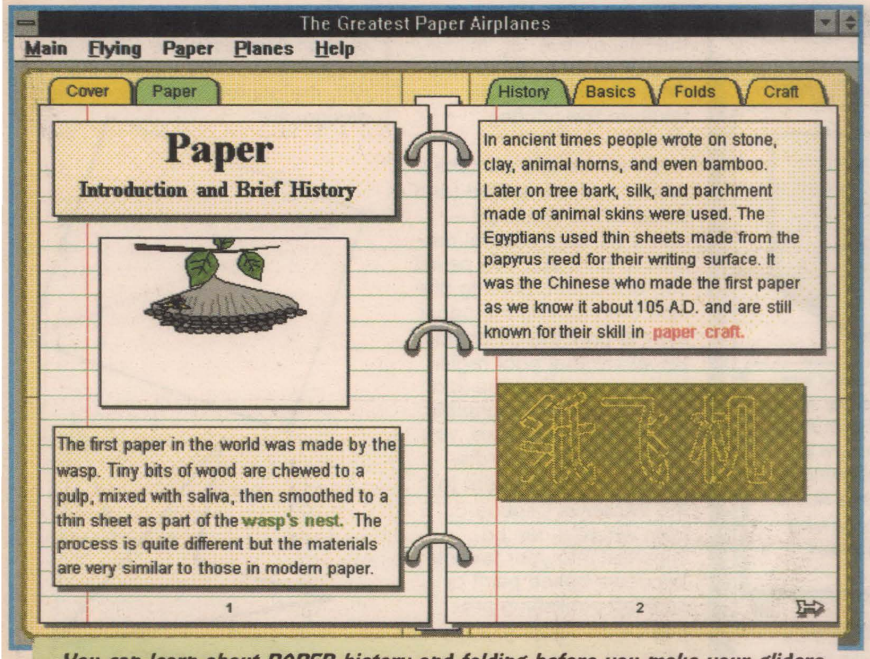
Each step in the folding action is controlled with VCR-style play/stop/forward/backward buttons, which allow "instant replays" if you miss a step. You can also zoom and rotate the emerging airplane for a better look as you make each fold.

The software supports black and white or color printing. You can also copy designs to other Windows applications, in color and complete with artistic or military decorations.

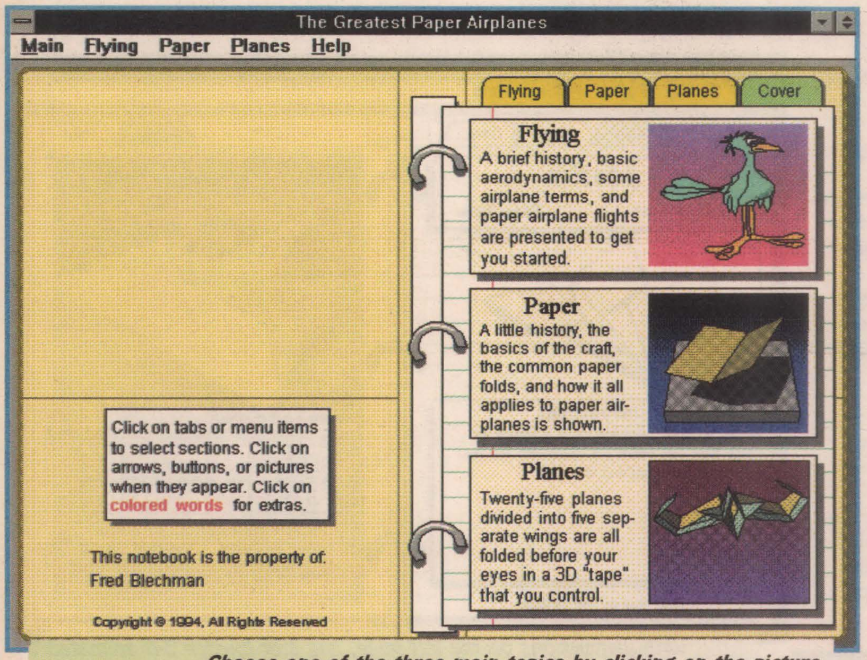
Although no manual is provided, the disk version of The Greatest Paper Airplanes comes with a 50-sheet paper pad that consists of two copies of each airplane design, printed on both sides of each sheet.

Each copy features different markings, decorations, and paint schemes, complete with fold lines to guide users as they follow instructions in the software. But trust me, without the software, the lines alone will not allow you to fold the design properly.

For non-stop recreation, the software also includes a "folding



You can learn about PAPER history and folding before you make your gliders.



Choose one of the three main topics by clicking on the picture.

airplanes" screen saver. Instead of the default flying Windows or twisting and turning geometric designs provided with Windows, if you choose you can have 12 progressive panels appear on screen sequentially (left to right, top to bottom) through the folding steps of one of the designs. When all 12 panels of this array are used, the folding sequence continues starting at the top left panel. Fascinating (and almost hypnotic) to watch; a guaranteed time sink!

Equipment Required

While you don't need a barn-burner computer to run Paper Airplanes, it won't run on an obsolete machine; an 80386SX 20 MHz or higher microprocessor is required. A math coprocessor is not required, but speeds up some actions.

For the disk version of Paper Airplanes, you'll need at least MS-DOS 3.2 with Windows 3.1 or better, and at least 2 MB of RAM (with 4 MB a lot better). You'll need a mouse or compatible pointing device. Sound and color are optional. If you want them, you'll need a Windows-compatible sound board and a printer installed into Windows.

You'll need a hard drive. Considering the enormous number of screens embedded in this program, it's surprising that it takes up only about 4 MB of hard drive space.

Installation and Operation

Initial installation of the disk version could hardly be easier, since you simply run the SETUP program provided on two 3.5" 1.44 MB floppies (5.25" 1.2 MB disks are available for $3.00 from the program publisher). It takes about five minutes.

As is often the case with the myriad of hardware configurations cluttering the computer scene, some adjustments may be necessary to get the program to run in your particular computer software environment. After telling the program I wanted to use the Paper Airplanes screen saver, it left Windows and crashed.

The typical ALT-CTRL-DEL key combination "warm boot" reset did not do it — the computer hung up after memory checking. I found it necessary to use the RESET key on my computer "cold boot" to get things in order. In some extreme cases, you might have to turn the computer off and then on again after about 10 seconds.

Using the program is a pleasure. Just double-click on the program icon in Windows and, after an animated/sound introduction with a paper glider cavorting about, you are presented with the cover of a tabbed three-ring notebook screen.

Select "Flying" and you'll be able to go through a sequence of screens that take you through a brief history of flight, some very basic aerodynamics, and simple airplane terminology. Click on the "Paper" tab and you'll learn about the history of paper and basic paper folding.

The "Planes" tab takes you to the screens where you select the group and then the plane you want to construct. You can progress forward and backward through the notebook pages at your own speed.

Folding the Plane

Once you've selected a plane to construct, the fun really begins. Most of the right-hand page is

Technical Notes

The Greatest Paper Airplanes was developed using Microsoft Visual C++ Professional Edition, version 1.0. Microsoft Foundation Classes were used wherever possible in an effort to make the application more "Windows friendly." Native C++ code was used in developing the folding geometry engine. No assembly code programming was found necessary.

The constraints established for the design included the following:

Must be completely resizable and work in all screen resolutions.
Must show smooth animation and convincing interactive 3-D.
Must execute on a 386/16 with 2 MB RAM.

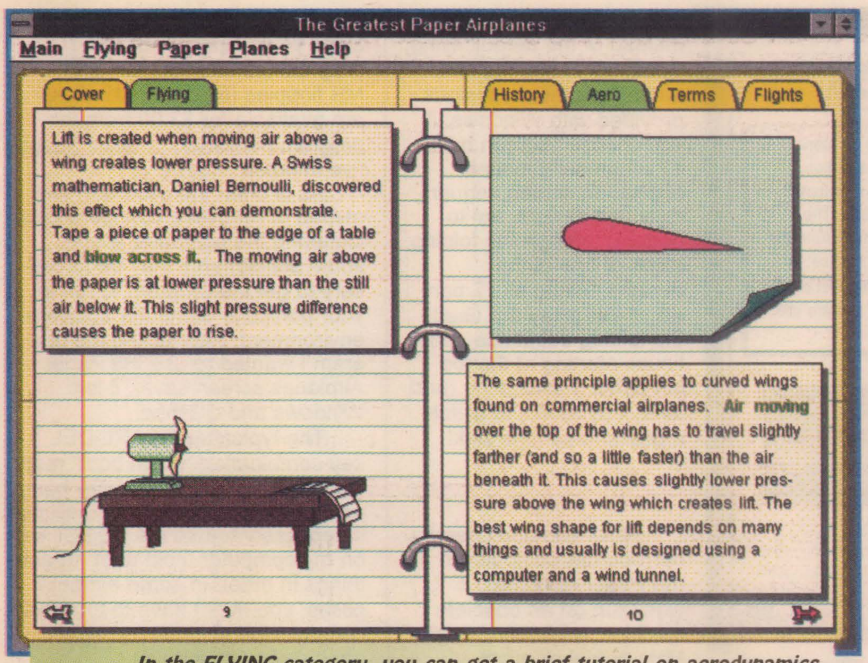
A search for libraries and authoring tools was undertaken for the animations and the 3-D work. None were found that satisfied the constraints so three tool kits were developed in-house.

The first was an animation tool kit which provided routines to do vector based animation in any Windows defined region. It was used for all animated controls, display animations, and the 3-D animations as well. Included in the kit were programs to generate, manage, and integrate the animations into the application framework. Since all animations were vector based, the resizing/resolution constraint was automatically satisfied.

The second tool kit addressed the generation and management of the paper folding animations. Included in the kit were programs to capture/generate the folding data, choreograph the folding "video," and interact with the user controls. The choreography section of this tool kit was critical to achieving convincing interactive 3-D. It gave the ability to manage light sources, camera angles, and object orientation in order to assemble a coherent and convincing animation sequence.

The third tool kit was a more traditional 3-D library which had to be optimized for the representation of an object which undergoes large changes in shape. Two libraries were generated and optimized for different hardware, one with floating point emulation and one with true in-line x87 instructions.

The application attempts to run the animations at a maximum 18 frames/sec. The animation rate in a specific system depends primarily on its video update speed and the size and complexity of the animated object. While the application executes on the minimum system above as required, animation rates of 3-5 frames/sec are not uncommon on these systems.



In the FLYING category, you can get a brief tutorial on aerodynamics.

devoted to an animated sequence showing the actual folds, one at a time, together with instructional text on the left-hand page.

Thirteen "buttons" and two selection boxes give you total control of how the sequence progresses (forward or backward) and in what manner (single step or automatic). With each step, the three-dimensional folding image automatically twists and turns as required to show the fold you should make. You can zoom in and rotate the image manually as well. Amazing!

Four panels of the six-panel 8.5" x 4.75" Quick Reference Card provide you with all the installation and operation instructions you'll need.

Read this first, especially when you get to actually folding up an airplane, since the purpose of each screen button is explained. You'll be comfortable in no time.

Do They Really Fly?

Yes, Virginia, these paper models really fly, provided you pay attention to three things:

- You must make the folds sharp and symmetrical.
- You must launch appropriately — that is, don't try to launch an aerobatic model for a slow glide, or vise versa.
- And you'll probably have to "trim" the elevator, rudder, and aileron surfaces for proper flight.

Printing the Lines

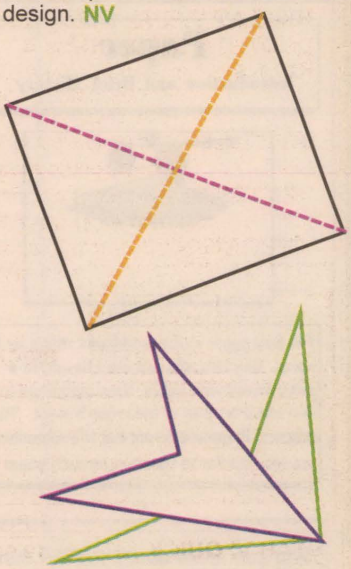
Actually, since the supplied pad shows all the 25 designs of the disk version of Paper Airplanes, there is hardly any reason to take the time to print out the folding lines of a particular design. You can just photocopy the pad design.

However, you might want the "decorative" or "military" design in color. Select the Print tab and you'll be taken to the printing screen.

Be aware this will take a printer that is installed (and selected) in Windows — and it will take several minutes to print out. You select Top or Bottom, printing one side then turning the paper over to print the other side. Be aware that poor registration may offset the fold lines on two-sided printing.

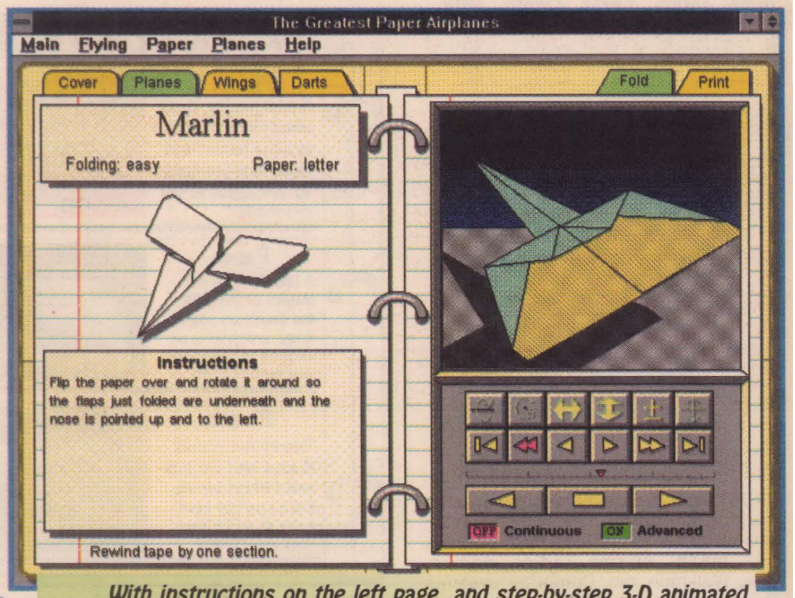
Should you desire, you can also COPY the displayed printing pattern to the Windows Clipboard, from where it can be imported into your favorite Windows-based paint or desktop publishing program.

pared to the 4 MB used by the disk version. However, the CD-ROM version does NOT include the pad with the printed fold lines for each design. NV

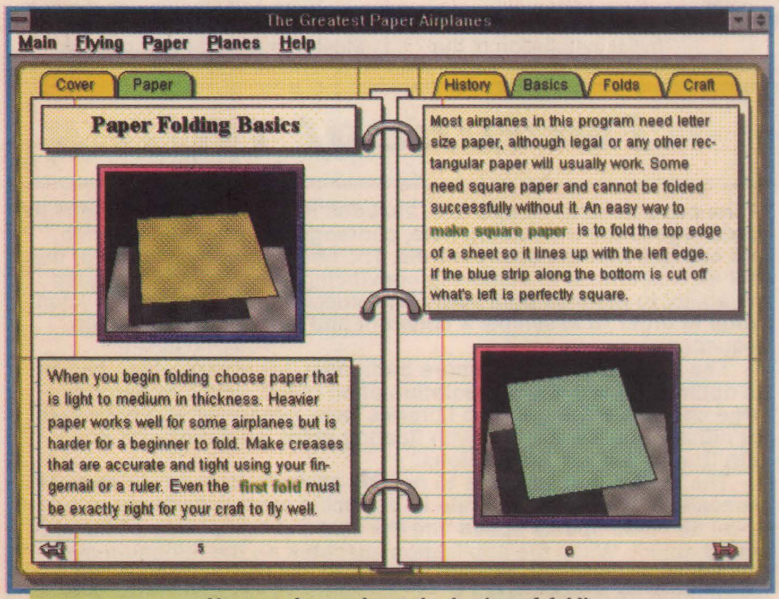


OOPS!

It happened to me, so it could



With instructions on the left page, and step-by-step 3-D animated paper folding on the right page, you can't go wrong. Various "controls" let you manipulate the view – rotate, move, zoom, and more.



You can learn about the basics of folding paper.

happen to you. I ran Paper Airplanes on my 386DX 60 MHz 8 MB RAM machine — and it ran out of "resources" at one point after I had jumped all around the program. Fortunately, you can resize the Paper Airplanes screen so it is smaller than the entire Window, and still operate it normally — and you'll be far less likely to run out of memory.

CD-ROM Version

If folding 25 planes is not enough for you, how about the 50 planes offered in the CD-ROM version by Mindscape, for the same price? Installation takes only a minute or so, and less hard drive space (about 3 MB) is used com-

Since 1961, Fred Blechman, a former US Navy fighter pilot, has written over 700 magazine articles and five books about electronics, microcomputers, and flying.

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PERSISTANCE: " PERSISTANCE PREVAILS WHEN ALL ELSE FAILS "

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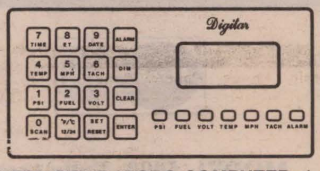
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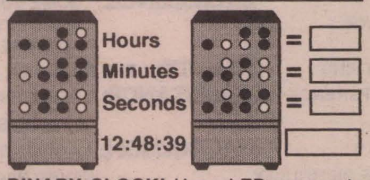
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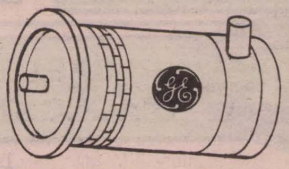
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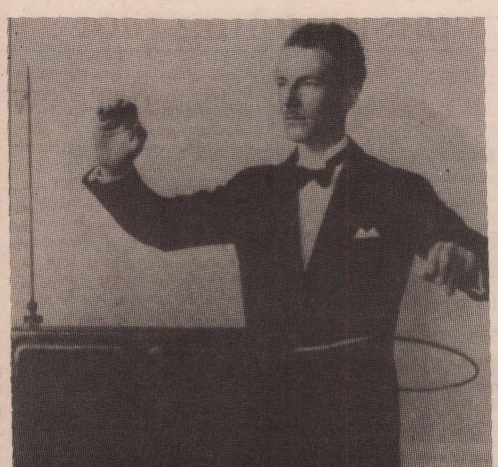
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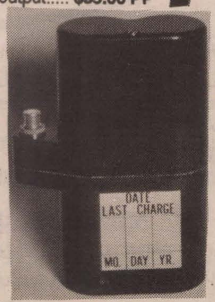
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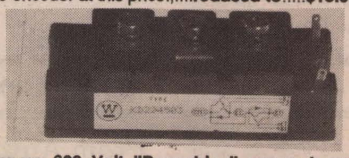


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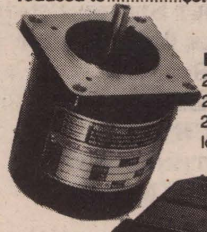
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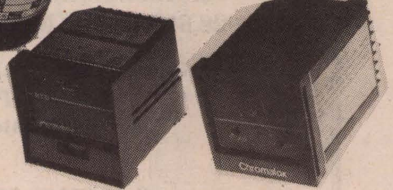
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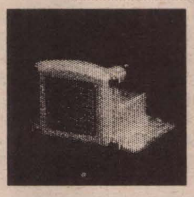
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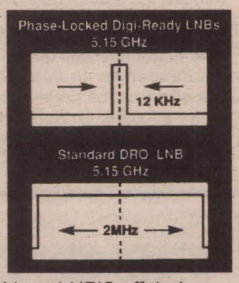
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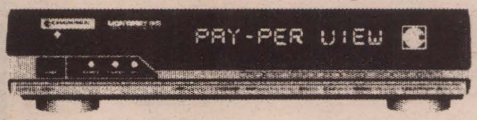
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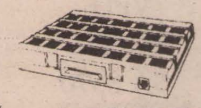


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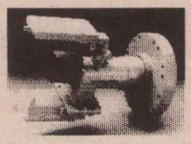
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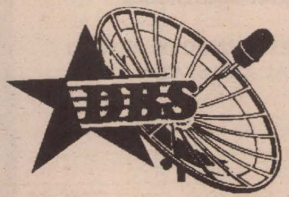
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Events CALENDAR

Continued from page 47

JANUARY 6-7

MI - DETROIT — Computer & Hi Tech Electronics Show. **SPONSOR:** Target Productions. **LOCATION:** Michigan State Fairgrounds, Coliseum Bldg. **ADMISSION:** $7, under 12 free. **FEATURES:** C - DP - E - F/R. **DEALER INFO:** Space $45, set-up Fri 4pm-8pm, Sat 6am-8am. **CONTACT:** Target Productions, POB 1634, Monroe MI 48160.

JANUARY 7

IN - SOUTH BEND — 19th Annual South Bend Hamfest & Computer Expo. **SPONSOR:** Michiana Valley Hamfest Assn. **LOCATION:** Century Center, US 33 N @ Jefferson Blvd. **HOURS:** 8am-3pm. **ADMISSION:** Adv $4, door $5. **FEATURES:** C - DP - FM - H. **DEALER INFO:** Tables $5-$20, set-up 6am. **CONTACT:** Denny KA9WNR, 219-291-0252 eves. MVHA, 21970 Kern Rd, South Bend IN 46614.

JANUARY 13

CO - LOVELAND — Winter Superfest Swapmeet. **SPONSOR:** Northern Colorado ARC. **LOCATION:** Larimer County Fairgrounds, 700 S Railroad. **HOURS:** 9am-3pm. **ADMISSION:** $3. **FEATURES:** C - CB - DP - E - EX - FP - F/R - H. **DEALER INFO:** Tables $8. **CONTACT:** Jeanene Gage N0YHY, 970-351-7327 for tables, Michael Robinson AA0UB, 970-282-1167 chairman.

JANUARY 14

OH - DOVER — Hamfest. **SPONSOR:** Tusco ARC. **LOCATION:** Ohio National Guard Armory, 2800 N Wooster Ave. **HOURS:** 8am-? **ADMISSION:** $2. **FEATURES:** F - F/R - H. **DEALER INFO:** Tables $8, set-up 6am. **CONTACT:** Howard Blind KD8KF, 6288 Echo Lake Rd NE, New Philadelphia OH 44663. 216-364-5258.

WI - WAUKESHA — 24th Annual Midwinter Swapfest. **SPONSOR:** West Allis RAC. **LOCATION:** Waukesha County Expo Center Forum. **HOURS:** 8am-2pm. **ADMISSION:** Adv $3, Door $4. **FEATURES:** C - E - EX - H. **DEALER INFO:** 4' tables: adv $4, door $5, elec $8. **CONTACT:** WARAC Swapfest, POB 1072, Milwaukee WI 53201.

JANUARY 20

MO - ST. JOSEPH — Northwest Missouri Winter Hamfest. **SPONSOR:** Missouri Valley, Green Hills & Ray-Clay ARCs. **LOCATION:** Ramada Inn, I-29 Exit 47, Frederick Ave exit. **HOURS:** 9am-4pm. **ADMISSION:** Adv $2, door $3. **TALK-IN:** 146.85, 444.925. **FEATURES:** CB - DP - EX - FM - FP. **DEALER INFO:** Tables: $8 ea for first two, $20 table #3 & above. **CONTACT:** NMWH, POB 182, Cameron MO 64429.

JANUARY 20-21

OH - DAYTON — Computer Fair. **SPONSOR:** Trade Show Promotions. **LOCATION:** Daton Convention Center. **HOURS:** Sat 10am-5pm, Sun 10am-3pm. **ADMISSION:** $5. **CONTACT:** Mark Hanslip, 143 Schloss Ln, Dayton OH 45418.

EASTERN REGION

NOVEMBER 4

AL - MOBILE — ARRL Hamfest. **SPONSOR:** Mobile ARC. **CONTACT:** Richard Ireland KD4TTD, 10341 Hwy 188, Grand Bay AL 36541. 334-824-2749.

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, Tavares FL 32778. Tony Summelin: 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.

NY - STONY BROOK — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** SUNY, 495 Exit 62, Nicholls Rd N 9 miles. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

PA - YORK — Computer Show & Sale. **SPONSOR:** 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

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 WD8SAS, 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 - LAGRANGE — Mt. Beacon Hamfest. **LOCATION:** Arlington Senior High School North Campus, Lagrange/Poughkeepsie, Dutchess County. **HOURS:** 8am-1pm. **ADMISSION:** $5, spouses/kids free. **TALK-IN:** 146.97-. **FEATURES:** C - E - EX - FP - F/R - H. **DEALER INFO:** Tables: adv $8, gate $10, tailgating $6, set-up 6am. **CONTACT:** Ken Akasofu KL7JCQ, 316 Titusville Rd #4, Poughkeepsie NY 12603. 914-485-9617.

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.

NY - WESTBURY — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** SUNY, W side of Rte 107 approx 1/2 mi N of Jericho Turnpike. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

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:** 146.24/84. **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 — Narissaam 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:**

Events CALENDAR

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:** Table $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.

VA - VIRGINIA BEACH — Computer Show & Sale. **SPONSOR:** HAV Productions. **LOCATION:** Virginia Beach Pavilion. **HOURS:** 10am-4pm. **ADMISSION:** $6. **FEATURES:** C - DP - F - FP - F/R -S. **CONTACT:** HAV Productions, POB 4127, Hampton VA 23664. 1-800-859-4428.

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-?. **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.

CT - PUTNAM — ARRL Hamfest. **SPONSOR:** Eastern CT ARA. **CONTACT:** Mike Therrien N1OPZ, 476 River Rd, Putnam CT 06260. 203-928-7151.

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-195. **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

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.

RI - SMITHFIELD — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Bryant College, Rte 295, Exit 8B. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

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, I-4 & US 301. **HOURS:** Sat: 8am-6pm, Sun: 8am-4pm. **ADMISSION:** Adv $6, door $7, under 12 free. **TALK-IN:** 146.94, 223.98. **FEATURES:** EX - F - FP - F/R - T. **DEALER INFO:** Swap table: $20, good both days. Tailgating: $5 per day. **CONTACT:** FGCARC, 1556 56th Ave N, St. Petersburg FL 33703. Jean: 813-525-5178, eves.

MA - WILMINGTON — Computer Show. **LOCATION:** Shriner's, 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

CT - WATERBURY — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Sheraton Inn, I-84 E Exit 25A. Left off exit. Right at light. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **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-?. **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 - BINGHAMTOM — 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 - HOUSTON — 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.*

MA - STURBRIDGE — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Sturbridge Host Hotel, Exit 9 off MA Pike (I-90) to Rte 20 W. **HOURS:** 9:30am-2:30pm. **ADMISSION:** $7, under 14 free w/adult. **FEATURES:** C. **DEALER INFO:** Set-up 8am. **CONTACT:** Northern 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:** $6 all 3 days, $5 Sat-Sun only days, $4 Sun. only. **FEATURES:** AC - C - DP - FP - F/R. **DEALER INFO:** 8' tables $50. **CONTACT:** Computer Show, POB 295, Riverdale GA 30274. 770-907-6225.

NOVEMBER 25

MA - TAUNTON — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Taunton Holiday Inn, Exit 9 off I-495, between Rte 24 & 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.*

MD - BALTIMORE — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Martin's Eastwind. **HOURS:** 10am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

NY - BUFFALO — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Hamburg Fairgrounds, 5600 McKinley Parkway. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C - FP. **CONTACT:** 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, I-65 & 264 Freedom Way at the Fairgrounds. **HOURS:** 10am-3pm. **CONTACT:** William Ibarra, Meka Enterprises, 2656 E 2nd St, Bloomington IN 47401. 812-333-4484, FAX: 812-333-4650.

NH - PORTSMOUTH — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Frank Jones Center, I-95 Exit 5 to Rte 1, Bypass Southbound behind U-Haul. **HOURS:** 10am-3:30pm. **ADMISSION:** $7, under 14 free w/adult. **FEATURES:** C. **DEALER INFO:** Set-up 8am. **CONTACT:** Northern Computer Shows.*

VA - RICHMOND — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** The Showplace. **HOURS:** 10am-4pm. **ADMISSION:** $6. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

DECEMBER 2

MA - WALTHAM — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Hillcrest, I-95, Exit 26, bear right off exit. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

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.*

NC - GREENSBORO — 15th Annual Hamfest & Computer Show. **SPONSOR:** 76 Group. **LOCATION:** Greensboro Coliseum Special Events Center, Exhibit Hall A. **CONTACT:** 910-299-2525 (enter 0076) or 910-852-9244.

DECEMBER 2-3

GA - ATLANTA — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Gwinnet Civic Center. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, free w/membership. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

VA - CHANTILLY — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Capital Expo Center. **HOURS:** 9:30am-4pm. **ADMISSION:** $6. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

DECEMBER 3

MA - FITCHBURG — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Royal Plaza Trade Center, 190 N to Rte 2 W to Rte 31. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

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 WA5RKR, POB 1649, Lake City FL 32056, 904-755-7969.

MD - TOWSON — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Towson State University. **HOURS:** 9:30am-4pm. **ADMISSION:** $6. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

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.

PA - KING OF PRUSSIA — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Valley Forge Convention Center. **HOURS:** 9:30am-4pm. **ADMISSION:** $6.50. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

DECEMBER 10

MD - BALTIMORE — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** BWI Airport Marriott. **HOURS:** 9:30am-4pm. **ADMISSION:** $6. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

NY - STONY BROOK — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** SUNY, 495 Exit 62, Nicholls Rd N 9 miles. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

DECEMBER 16

FL - FORT LAUDERDALE — Narisaam Computer Show. **LOCATION:** Holidy 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.*

MD - UPPER MARLBORO — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** The Show Place Arena. **HOURS:** 9:30am-4pm. **ADMISSION:** $6. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

NJ - FAIRFIELD — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Radisson Hotel Fairfield, Rte 46 E, just W of Willowbrook Mall. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

DECEMBER 16-17

PA - ALLENTOWN — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Allentown Fairgrounds. **HOURS:** 9:30am-4pm. **ADMISSION:** $6. **FEATURES:** C - FP. **CONTACT:** MarketPro

Events CALENDAR

Computer Shows.*

PA - MONROEVILLE — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Pittsburgh Expo Mart. **HOURS:** 9:30am-4pm. **ADMISSION:** $6. **FEATURES:** C - FP. **CONTACT:** MarketPro 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.*

VA - ANNANDALE — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Northern Virginia Community College. **HOURS:** 9:30am-4pm. **ADMISSION:** $6. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

DECEMBER 26

MD - GAITHERSBURG — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Montgomery County Fairgrounds. **HOURS:** 9:30am-4pm. **ADMISSION:** $6. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

JANUARY 6-7

FL - FT. MEYERS — Southwest Florida Hamfest. **SPONSOR:** Fort Meyers ARC. **LOCATION:** Araba Shrine Temple, 2010 Hanson St., 1 blk E of US 41. **HOURS:** Sat 9am-5pm, Sun 9am-3pm. **ADMISSION:** Adv $5, Door $6, good both days. **TALK-IN:** 147.345+. **DEALER INFO:** 8' tables $15, elec $2. Set-up: Fri 6pm-9pm, Sat 7am. **CONTACT:** Jackie Kampfert KR4MZ, 941-542-6675. Southwest Florida Hamfest '96, POB 61183, Ft Meyers FL 33906.

JANUARY 13

PA - HARRISBURG — Hamfest. **SPONSOR:** Harrisburg RAC. **LOCATION:** Oberlin FC Social Hall, Exit #1 I-283, follow PA #441 N 1 mi to site. **HOURS:** 8am-noon. **ADMISSION:** $2. **TALK-IN:** 146.76, 146.52/52. **FEATURES:** F/R - H - T. **DEALER INFO:** Tables $8, tailgating $1, WX permitting, Tom Hall WU3X, Box 418, Halifax PA 17032. **CONTACT:** 717-232-6087.

JANUARY 13-14

FL - SARASOTA — 17th Annual Sarasota Hamfest & Computer Show. **LOCATION:** Sarasota fairgrounds, Robarts Sports Arena, 3000 Ringling Bl. **HOURS:** Sat 9am-5pm, Sun 9am-3pm. **ADMISSION:** Adv $5, door $7. **TALK-IN:** 146.31/91, 444.925. **FEATURES:** DP - EX - F - FP - F/R - RV-H - T. **DEALER INFO:** Tables $20-$25 + admission, tailgating space $10 (includes 1 admission). **CONTACT:** Sam Everts KE4BXF, 941-927-8999.

JANUARY 21

NY - YONKERS — Giant Electronic Flea Market. **SPONSOR:** Metro 70cm Network. **LOCATION:** Lincoln High School, Kneeland Ave. **HOURS:** 9am-3pm. **ADMISSION:** $6, under 12 free. **TALK-IN:** 440.425 MHZ PL 156.7, 223.760 MHZ PL 67.0. **FEATURES:** DP - EX - F/M - FP - F/R. **DEALER INFO:** Table setup 7am. Call for prices. **CONTACT:** Otto Supliski WB2SLQ, 914-969-1053.

JANUARY 27-28

NC - CHARLOTTE — Charlotte Area Computer Show. **LOCATION:** Metrolina Expo Center, 7100 North Statesville Rd, I-77 N to Exit 16A, first exit N of I-85/I-77 intersection. **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.

JANUARY 28

MD - ODENTON — Post Holiday Swapfest & Flea Market. **SPONSOR:** Maryland Mobileers ARC. **LOCATION:** Volunteer Fire Dept. Hall, 1425 Annapolis Rd, Rte 175, 9 mi E of I-95. **HOURS:** 8am-2pm. **ADMISSION:** $3. **TALK-IN:** 146.205/805. **FEATURES:** EX - FM - FP - F/R. **DEALER INFO:** Tables $7. **CONTACT:** Tom Wilkison KA3OMU, 592 Eason Dr, Severn MD 21144, 410-969-2639 eves.

EVENTS CALENDAR Month at a Glance

NOVEMBER 1995

NOVEMBER 3-4-5
TX - Katy - ARRL South Texas Section Convention

NOVEMBER 4
AL - Mobile - ARRL Hamfest
CA - Reseda - Computer Marketplace
CA - Santee - Ham, Computer, Electronic Swap Meet
CA - Ventura - MarketPro Computer Show*
FL - Eustis - Lake County Hamfest/Electronics Expo
FL - West Palm Beach - Free Flea
IL - Godfrey - Midwest Amateur Radio Expo
MI - Taylor - Computers & You Computer Show
NC - Sanford - CCARS Fall Festival
NY - Stony Brook - MarketPro Computer Show*
OK - Enid - Hamfest
PA - York - Computer Show & Sale
VA - Manassas - MarketPro Computer Show*
WA - Payallup - MarketPro Computer Show*
WI - Milwaukee - Friendlyfest '95

NOVEMBER 4-5
CA - Sacramento - MarketPro Computer Show*
GA - Stone Mountain - Hamfest '95 & Computer Expo
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
MD - Greenbelt - MarketPro Computer Show*
MI - Ann Arbor - Computers & You Computer Show
MI - Flint - Computer Show
MI - Lathrup - 1995 Swap & Shop
MI - Southfield - ARRL Hamfest
NC - Concord - Hamfest/Swap Meet
NH - Nashua - Northern Computer Show*
NY - Lagrange - Mt. Beacon Hamfest
NY - Melville - Ham Expo '95
NY - Westbury - MarketPro Computer Show*
OH - Massillon - Auctionfest '95
PA - Ft Washington - Photographic Swap/Shop Show
WI - Kaukauna - Hamfest

NOVEMBER 11
AL - Montgomery - Annual Hamfest/Computer Show
CA - Fontana - Amateur Radio/Electronics Swap
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
VA - Virginia Beach - Computer Show & Sale

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
CT - Putnam - ARRL Hamfest
DE - Newark - MarketPro Computer Show*
FL - West Palm Beach - Narisaam Computer Show*
IL - Macomb - ARRL Hamfest
IN - Ft Wayne - MarketPro Computer Show*
MA - Swansea - Northern Computer Show*
MI - Madison Heights - 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, Electronic Swap Meet
CA - Stockton - MarketPro Computer Show*
MI - Livonia - Computers & You Computer Show
MI - Westland - Great Lakes Computer Expo & Sale
MO - Warrensburg - ARRL Hamfest
NM - Socorro - ARRL Hamfest
PA - Scranton - Computer Show & Sale
RI - Smithfield - MarketPro Computer Show*
VA - Annandale - MarketPro Computer Show*

NOVEMBER 18-19
CA - Pomona - Computer Marketplace
FL - Tampa - Radio/Computer & ARRL State Conv.
IL - St Charles - Antique Ad, Slots, Jukebox Show
IN - Ft Wayne - Ham/Comp. Expo & 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
CT - Waterbury - MarketPro Computer Show*
IL - Chicago - Ham Auction
IL - Orland Park - Orland Park Computer Show
MD - Bowie - MarketPro Computer Show*
MI - Flint - Five Star Productions Computer Show
MI - Madison Heights - Computer Show
MI - Waterford - Computers & You Computer Show
NC - Benson - Jarsfest '95
NY - Binghampton - Computer Show & Sale
OH - Akron - Computer Show & Sale
PA - Washington - Tri-State Hamfest & Computer Fair

NOVEMBER 24
MA - Sturbridge - Northern Computer Show*
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
IL - Litchfield - Amateur T.V. Banquet
IN - Evansville - 3rd Annual Winter Hamfest
IN - Indianapolis - AGI Computer Fair*
LA - Chalmette - 1995 Greater New Orleans Hamfest
MA - Tauton - Northern Computer Show*
MD - Baltimore - MarketPro Computer Show*
NY - Buffalo - MarketPro Computer Show*
PA - Harrisburg - Computer Show & Sale

NOVEMBER 25-26
MI - Lansing - Computers & You Computer Show
NJ - Pennsauken - KGP Computer Show*

NOVEMBER 26
CA - Santa Ana - ACP's Computer Show
CO - Golden - Hamfest & ARRL Section Convention
IL - Glen Ellyn - Computer Central
KY - Louisville - Computer Fair South
MI - Flint - Five Star Production Computer Show
NH - Portsmouth - Northern Computer Show*
OH - Columbus - MarketPro Computer Show*
VA - Richmond - MarketPro Computer Show*

DECEMBER 1995

DECEMBER 1-2
AR - Little Rock - ARRL Arkansas DX Convention

DECEMBER 2
AZ - Mesa - Superstition Hamfest
CA - Santee - Ham, Computer, Electronic Swap Meet
FL - Ocala - Marion County Tailgate/Hamfet
IL - Jacksonville - Central Illinois Winter Superfest
LA - Minden - ARRL Hamfest
MA - Rockland - Northern Computer Show*
MA - Waltham - MarketPro Computer Show*
MN - Fairbault - Winter Hamfest
NC - Greensboro - Annual Hamfest /Computer Show

DECEMBER 2-3
GA - Atlanta - MarketPro Computer Show*
VA - Chantilly - MarketPro Computer Show*

DECEMBER 3
CA - Livermore - Swap Meet
MA - Fitchburg - MarketPro Computer Show*
MI - Hazel Park - 30th Annual Swap & Shop

DECEMBER 3-4-5-6
CA - San Fransisco - Software Support National Conf.

DECEMBER 9
CA - Fontana - Amateur Radio/Electronics Swap
FL - Lake City - Tailgate/Hamfest
IN - Indianapolis - AGI Computer Fair*
MD - Towson - MarketPro Computer Show*
SC - Union - Swapfest

DECEMBER 9-10
GA - Perry - Middle Georgia Computer Show
PA - King of Prussia - MarketPro Computer Show*

DECEMBER 10
MD - Baltimore - MarketPro Computer Show*
NY - Stony Brook - MarketPro Computer Show*

DECEMBER 16
CA - Santee - Ham, Computer, Electronic Swap Meet
FL - Fort Lauderdale - Narisaam Computer Show*
MD - Upper Marlboro - MarketPro Computer Show*
MI - Westland - Great Lakes Computer Expo & Sale
NJ - Fairfield - MarketPro Computer Show*

DECEMBER 16-17
PA - Allentown - MarketPro Computer Show*
PA - Monroeville - MarketPro Computer Show*

DECEMBER 17
FL - West Palm Beach - Narisaam Computer Show*
IL - Orland Park - Orland Park Computer Show
MI - Flint - Five Star Productions Computer Show
VA - Annandale - MarketPro Computer Show*

DECEMBER 23
MI - Flint - Five Star Production Computer Show

DECEMBER 26
MD - Gaithersburg - MarketPro Computer Show*

JANUARY 1995

JANUARY 6-7
FL - Ft Meyers - Southwest Florida Hamfest
MI - Detroit - Computer & Hi Tech Electronic Show

JANUARY 7
CA - Livermore - Swapmeet
IN - South Bend - 19th Annual Hamfest

JANUARY 13
AZ - Phoenix - WestFest
CA - Fontana - Amateur Radio/Electronics Swapmeet
CO - Loveland - Winter Superfest
PA - Harrisburg - Hamfest

JANUARY 13-14
FL - Sarasota - Annual Hamfest & Computer Show

JANUARY 14
OH - Dover - Hamfest
WI - Waukesha - 24th Annual Midwinter Swapfest

JANUARY 20
MO - St Joseph - Winter Hamfest

JANUARY 20-21
OH - Dayton - Computer Fair

JANUARY 21
NY - Yonkers - Giant Electronic Swapmeet

JANUARY 28
CA - Santa Ana - ACP Swapmeet
MD - Odenton - Post Holiday Swapfest & Flea Market

See Computer Show Promoter Info Box

TECH FORUM

Continued from page 79

mally specified in ohms/1000 feet, convert the .001 ohms/10 feet by multiplying by 100: .1 ohms/1,000 feet allowed resistance.

Consult your handy wire and cable catalogs to find that even an exotic 6 gauge (AWG) still has four times the resistance that was requested! Clearly, something is wrong!

The requested drop through the cable is way too stringent! Remember that the electronics on the other end probably will work just fine with supply voltages ±5% or even ±10%. So, using a worst case drop of 2%, this allows a maximum cable resistance of .02*5 V/5A = .02 ohms. (This is 2 ohms per 1,000 feet.) Several types of 12-gauge AWG stranded wire can meet this criteria.

One other thing to consider is that usually hard disk drives only use their rated current at start up. Once the platters are up to speed, the needed current drops. Your letter didn't specify type of drive, but if they are floppies, you are even in better shape. Most controllers only spin the floppy drive when they are being accessed. If this is the case, only one drive can be on at a time! Now the maximum current drops to say 2 amps, and you can use 16-gauge AWG stranded wire!

Robert Kelly
Poway, CA

ANSWER TO #10952 - OCT. 1995

The best circuit to play these files back is a computer. If you have some ROMs with WAV or AU files stored in them, your best bet to play them back is to transfer the data to a PC, using a ROM reader, then play them back there. WAV is the standard Windows sound format. Several public domain utilities exist to convert AU format files, a common Unix workstation format, to WAV.

A circuit to do the playback would consist of a microprocesser, RAM, ROM, and a D/A converter. Effectively, a special purpose computer.

If you want a stand-alone device to play back stored sounds, I suggest abandoning WAV or AU as a file storage format in ROM. It's not very efficient. Seven seconds of sound can require 30K bytes of storage (for mono). A better approach is to use one of the several analog voice storage modules or chips. Radio Shack stocks a voice storage module (10 seconds of storage) and a chip (20 seconds of storage) that are both very easy to use. Stock numbers are 276-1324 and 1325.

George R. Scott
Alexandria, VA

ANSWER TO #109529 - OCT. 1995

Conductive rubber seldom loses conductivity. Usually the metal traces which it shorts become oxidized, and no longer make contact. Metal cleaner or abrasive may be used to clean these.

Plastic cases which are not meant to be opened are often ultrasonically welded. This is a much cheaper method than hidden latches. There is no easy way to open such cases without some damage.

Jan Zaluda
Mountain View, CA

Continued from page 6

included the necessary technical details. This was never intended to be a "Build a Fax Scanner" article.

Fred Blechman

Dear Nuts & Volts:

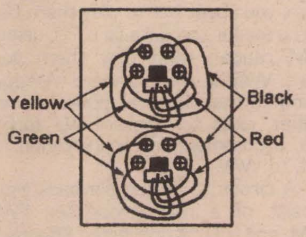
In your Sept. '95 issue, you ran an article entitled "Using Your Fax as a Computer Scanner/Printer." The faxSCANNER product used to make the link between the fax and the computer is shown as a $49.95 item. There is a much cheaper way.

Several months ago, the Technology column in *Business Week* pondered the same question. I responded to them with the first of the enclosed letters. When the editor objected that some fax machines need a dial tone, I sent the second letter.

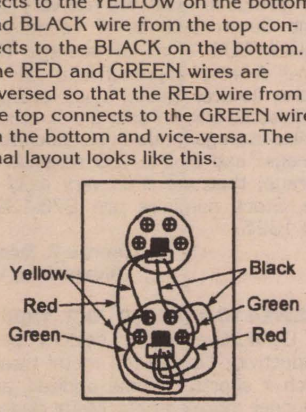
FAX TO FAX IMAGES

Regarding your column in the November 28th issue of *Business Week*, I've been using my stand-alone fax machine as a scanner for over a year without the need of two phone lines by using a distinctly low-tech approach.

Initially, I did use two phone lines to prove the concept. However, I then realized that I could connect the machines directly without going through the telephone network. I purchased a DUAL MODULAR WALL PLATE from Radio Shack (Cat. No. 279-350) for $5.99, This is simply a two-jack telephone outlet plate. Seen from the back, the plate comes wired as shown:



I disconnected the top socket's wires at the screws and reconnected them to the bottom sockets screws. The YELLOW wire from the top connects to the YELLOW on the bottom and BLACK wire from the top connects to the BLACK on the bottom. The RED and GREEN wires are reversed so that the RED wire from the top connects to the GREEN wire on the bottom and vice-versa. The final layout looks like this.



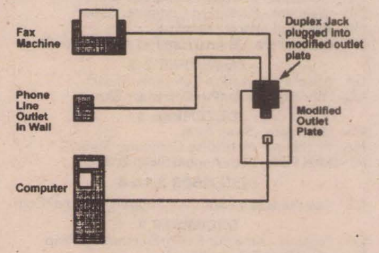
I plugged the fax machine into one outlet and my fax/modem into the other. On the computer, using the fax modem software, I initiate the background fax receive program. I set up the fax machine to dial a fake phone number consisting of a single digit and press "START." On the computer, I then use the software's hot-key combination to force the fax/modem into immediate receive mode. The two machines happily exchange IDs and act as if they are actually connected over the telephone network. Once the fax is received and stored, it is a simple matter to convert it into PCX format.

Fortunately, I purchased a good quality fax with a 32-shade gray scale photo setting. This has given me all the benefits of a good page scanner in addition to having the fax machine.

FAX TO FAX IMAGES — Part II

Thanks for your response. I wasn't aware that some fax machines won't dial without hearing a dial tone. Once again, though, there is a much more cost-effective solution than the $75.00 device you mentioned. You can easily use the phone company's line to provide a dial tone.

Go back to your friendly neighborhood Radio Shack and buy a MODULAR DUPLEX JACK (Cat. No. 279-357) for $3.99. This is an adapter that allows you to plug two phones or other devices into a single outlet. Then hook everything up like this.



Now your fax machine will "hear" the dial tone on the phone line. When you dial a fake number, which doesn't have to be any more than one digit, the dial tone will stop. Then, unplug the phone line from the duplex jack and initiate the receive mode in your fax software. Although this raises the cost of my solution from $6.00 to $10.00, it still beats $75.00.

I suppose that some fax software may not have the manual receive mode, but the two I have both do. These are two popular packages (Quick Link II and WinFax Lite) which are included with many of the fax-modems on the market.

I can't argue with you that uncabling and recabling can be a hassle, but if you need the capability frequently, and still don't want to go to the expense of a scanner, phone line switch boxes can be incorporated into the set-up.

By the way, I thoroughly enjoy your column. You provide good, concise discussions of technical issues appropriate to readership of *Business Week*.

John Soltesz
Citrus Heights, CA

Dear Nuts & Volts:

The July and September issues of *Nuts & Volts* carry letters in which Shari Prange, Robert Tiffany, and Peter Skye all explain and dispute which wire gauge is appropriate for 6 volt versus 12 volt automotive use.

Shari Prange has the correct answer, although she has not been able to offer an engineering explanation as to why she is correct.

Shari claims that even when both systems are operated at the same 20 amp current level, a 6-volt system should be provided with a heavier gauge wire than the wire provided for a 12-volt system.

This is true, and the reason is that an electric vehicle runs off of the very limited energy resource of its batteries. Every watt-hour is precious. A power cable must be designed so as to waste a bare minimum of battery energy.

The analysis of this energy wasting in the power cable is as follows:

$$\text{energy efficiency of the cable} = \frac{\text{energy delivered to the motor}}{\text{energy drawn from the batteries}}$$

This can also be expressed as:

$$\text{energy efficiency of the cable} = \frac{(\text{energy drawn from the batteries}) - (\text{energy wasted in the cable})}{\text{energy drawn from the batteries}}$$

In these expressions, and energy efficiency of one represents a perfect cable with zero resistance. The cable's efficiency is 100% at zero resistance. Using Peter Skye's figures, if you pass 20 amps through 30 feet of AWG #10, then the loss is .74 volts. 20 amps times .74 volts equals a loss of 14.8 watts.

A six-volt motor drawing 20 amps is using 120 watts. Meanwhile, its connecting cable (30 feet of AWG #10) is wasting 14.8 watts as heat. Therefore:

$$\frac{120W - 14.8W}{120W} = \frac{105.2W}{120W} = .88 = 88\%$$

This cable is passing 88% of the power on to the motor, and is wasting 12% of the power as heat.

A 12-volt motor drawing 20 amps is using 240 watts. Meanwhile, its connecting cable is wasting 14.8 watts as heat:

$$\frac{240W - 14.8W}{240W} = \frac{225.2W}{240W} = .94 = 94\%$$

This cable is passing 94% of the battery's power on to the motor. The other 6% is wasted as heat.

As you can see from the preceeding examples, the cable that you use needs to go to heavier and heavier gauges as you change your system to operate with lower and lower battery and motor voltages.

An extreme example will demonstrate this fact: Use the same 30 feet of #10 AWG carrying 20 amps, but now run a one-volt motor off of a one-volt battery. The .74 volt loss in the cable is now 74% of the entire voltage supplied by the battery.

Obviously, with a one-volt battery running a one-volt motor, cable far heavier than #10 AWG is necessary when the cable's run is 30 feet.

Chuck Johnson
Chalfont, PA

Dear Nuts & Volts:

I read Jan Zaluda's response to my letter in the October issue and would be happy to inform the readers about multiple stage tube assembly starlight scopes. To say that there are not off-the-shelf multiple stage starlight tube assemblies is totally incorrect. Had he been doing his homework as long as I have, he would have been able to assemble a three stage tube assembly as far back as 1985, when I bought my first off-the-shelf assembly from Meredith Instruments, for a total cost of $450.00. Enclosed with this letter is the original (copy) pamphlet that Meredith Instruments supplied me when I bought my first unit, showing the three stages together and how the gain is achieved. The units are still available from various dealers in and out of the country, for a lot less than the original price that I paid.

A 5 mw IR laser diode with a fully adjustable collimator lens and vernier adjustment, is a practical illuminator for the assembly at distances up to 500 yards with a 200 to 500 mm lens assembly, as long as you can focus the laser beam spread to illuminate the object to the exact size required by your main lens assembly input on the starlight scope.

If you couple the tube assembly to a Celestron C90 telescope (APX1000mm x f11) you can easily see an object at distances of a half a mile to as far as a mile, clearly, and see the objects in reasonably fine detail, as long as your collimating lens can focus to a dot at these distances, which will be about 10 yards across or larger. This will still be too bright for the starlight scope to handle at full voltage. The scope must be powered to a lower voltage in order to not destroy and scar the unit. At distances of 200 yards and less, the 5 mw IR Laser, even when reflecting off of low reflective objects such as trees, is still far too bright for the unit to handle and the voltage must be set very low to avoid permanent damage. The resolution of these scopes are far superior to the later versions with around 800 lines per inch which is more than a modern TV set has totally, despite its screen size.

The name Starlight Scope was derived from the expression that the stars were the only light source needed to illuminate the object. Early units were too sensitive and could see the infrared source of rotting vegetation in the jungles. The view from the eye piece would show a faint glow covering almost everything in sight on the jungle floor, when in a rain forest. The gain from these units were altered and lowered to exclude these problems. Anything more powerful than a 5 mw laser is overkill and only threatens to damage the tube assemblies.

As mentioned before, I can clearly spot the laser dot at a distance of over 10 miles, but at these distances I would need a very large telescope of around 4,000 to 5,000 mm to see what I had illuminated.

The South Korean Army had these units installed on their borders many years ago and could easily spot troop movements at distances of 10 miles or more. With a telescope, three tubes, and a eye piece; the assembly is too impractical for handheld use. But with a 50 to 100 mm lens, 2-1/2" PVC tubing as a case, and a good eye piece, the assembly can be very light and useful as a handheld unit being about a foot long and 2-1/2" in diameter and weighing in at about two pounds, depending on batteries and power assembly. (DC 15 KV single power supply).

A manufacturer's note states that these units should not be subjected to any ambient light when even in the off position due to the nature of the tube assembly and the coating used.

I hope this information will encourage readers to believe that there really is such a thing as a "Starlight Scope," and that experimen-

tation with these units is very interesting and affordable.

NOTE: To Jan

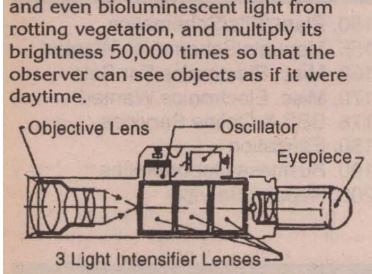
There are silicon units, CCD, that rival even the best starlight scopes, but for now they are too expensive. They go into the 1/000 LUX to 1/4000 LUX range and better. See the ads in Photonics Spectra.

The Vietnam era tubes can be stacked past three, both the light/noise factor goes bad unless the units are defective and only then is it practical to stack more than three, with a controllable voltage supply. Each unit positive to negative has to be insulated from the preceding unit because of the short distance and high voltage involved. A current limiter resistor has to be installed to each supply wire to stop arcing and tube damage. 50 megohm or more depending on the supply current from the power supply unit.

If you couple two stack tubes to a modern CCD assembly, you have a very impressive unit that has a real gain in the 20,000 to 30,000 range due to the low lux input of modern CCD units equaling a gain factor. Also do not glue tubes together as suggested by the seller as this makes it hard to repair when you damage a single unit from exposure to bright light.

STARLIGHT SCOPE

It was during the Vietnam War when see-in-the-dark devices based upon light intensification came into being. After spending $20 million, the US Army's Night Vision Laboratory developed the Starlight Scope. This device has the ability to take low intensity, barely visible light such as that emitted from stars, the moon shining through clouds, distant street lights, and even bioluminescent light from rotting vegetation, and multiply its brightness 50,000 times so that the observer can see objects as if it were daytime.



The first-generation viewers consisted of an objective lens, three light intensifier tubes, an eyepiece, and a power source. Like the IR image tube, the light intensifier tube contains a cathode on which has been deposited a layer of cesium, antimony, sodium, and potassium. Electrons are emitted when light strikes the cathode, accelerate through a focusing component, and strike the phosphor coating of a fiber optic lens which traps the light and amplifies it 30 to 50 times the original intensity. The focused image from the fiber optic lens is projected onto the cathode of the second light intensifier tube where another 30 to 50 fold increase in brightness occurs. This is repeated a third time so that light has been intensified 50,000 times the level which it entered the scope. The final image is focused onto the human eye.

The Starlight Scope presents many advantages over the IR viewer. It does not require a source of artificial illumination so that the complete unit weighs much less than a Sniperscope.

Chris Bieber, CA

Jan Zaluda's Response

I have never tested a multiple tube night vision scope, therefore, I have no way of comparing its performance. But I can tell you that a surplus TVS4, a pricey device with dozens of little intricate mechanical parts, although it has more gain and considerably less noise that Russian gen-2 scopes, is a far cry from a true starlight scope performance.

Stacking of tubes dates back to before microchannel plate era. However, not every tube will perform well in a stacked configuration scope. Specifically, recent vintage tubes use a red sensitive photocathode, with spectral response extending from yellow to near IR, but have little sensitivity to green light. This is a problem since most tubes use a green phosphor display. To couple tubes, either a fiber-optic plate or a lens is needed. Also, to obtain an upright image, an odd number of tubes is needed.

Comparision of LEDs and laser diodes is an apples to apples comparison. After all, a laser diode is basically an LED with a resonant cavity. For a given light, output laser diodes need only half as much electricity as LEDs and therefore would be more efficient light sources, except that FDA administrators request contribution to their payroll fund by anybody selling products containing laser diodes. Therefore, commercial illuminators use LEDs, often operated near melting point, to get enough light. Outputs range from 15 to 35 mW, at 750 to 850 nm.

Based on actual tests, I have found that single first-generation tube scopes with f/1.8 lens, need 2 mW per square meter illumination at 820 nm for satisfactory operation. To illuminate an object 10 M in size, which means 100 square meters area, requires 200 mW of light. You will not get that out of a 5 mW laser diode. Red light diodes do not have to be as powerful, but the light is visible, a drawback in night vision applications. To tell someone that he will see a black ant half mile away on a pitch black night, is an unrealisitc expectation. Even a true starlight scope cannot do that in real time.

As far as a reasonably priced true starlight performance night vision scope, I am confident that a scope with a daylight spectral response photocathode, two 90% active area $3.00 microchannel plates, in a $50.00 tube, with plastic light-weight compound lenses can be sold for $300.00. The technology exists, and only needs to be commercialized. The Russians will not do this and neither will ITT, and Litton owned US military night vision manufacturers. This is an opportunity for private investor groups. Serious investors will get much better return on a modest, under $1M investment, than in commercial real estate.

Jan Zaluda

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The ad rate for **current PAID subscribers** is **30¢** per word. All others pay **60¢** per word. These rates apply to the first 150 words of your ad. From 151-200 words, the rate per word doubles to 60¢ and $1.20 respectively. We do not accept ads over 200 words. There is a **$4.50 minimum** charge per ad per insertion.

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A photo or drawing may be run at the top of your classified ad for an additional **$10.00** (1" depth max.) for camera-ready art. No wording is allowed in this area. Add a one-time charge of **$5.00** to enlarge, reduce or duplicate line art, or **$8.00** for halftone of photographs. To **BOX** your ad, include an additional **$25.00** for copy-only ads, or **$50.00** for ads with artwork or photos.

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You may fax in ad copy or changes before the closing date (5:00pm on the 10th) at 909-371-3052 using MasterCard or Visa. Be sure to include the credit card expiration date, the name that appears on the card, a daytime phone number, and your *Nuts & Volts* account number. Ads faxed in without credit card information will not be listed as received until payment is received in full. Due to the large number of ads received, **WE DO NOT CALL OR FAX BACK VERIFICATION OR QUOTES OF FAXED-IN ADS.** For verification of faxed-in ads, please call 909-371-8497.

DEADLINE

Prepaid ads received by 5:00pm on the closing date (10th of the month) will appear in the following month's issue. For example, ads received by May 10th will run in June. Ads postmarked through the 10th, but received after the closing date, will be placed in the next available issue. No cancellations or changes after the 10th. Cancellations and changes must be submitted in writing.

IMPORTANT INFORMATION

All classified ads are running copy only. No special positioning, centering, dot leaders, extra space, etc. is allowed. All advertising in *Nuts & Volts* is limited to **electronically related items ONLY**. All ads are subject to approval by the publisher. We reserve the right to reject or edit any ad submitted. We do not take ad copy or changes over the phone. The magazine is mailed on or before the 1st of the month. We do not bill for classified ads. Repeat ads or ads run in multiple classifications within the same issue are allowed. Paid subscribers may run ads at the 30¢ rate only through their subscription expiration date. **NO REFUNDS**. Credit only. No credit for typesetting errors will be issued unless you *clearly* print or type your copy.

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Select the appropriate classification for your ad(s) to appear in and mark it in the space provided below. If no classification is indicated, the ad(s) will be placed in the Misc. Section or wherever we deem most suitable. Available classifications to choose from are:

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Virtual Reality technology creates the world's first portable big-screen television

Breakthrough portable TV from Virtual Image Displays, Inc. creates a virtual image that simulates a 60" big-screen image at a distance of six to 15 feet away.

by Timothy B. Arnett





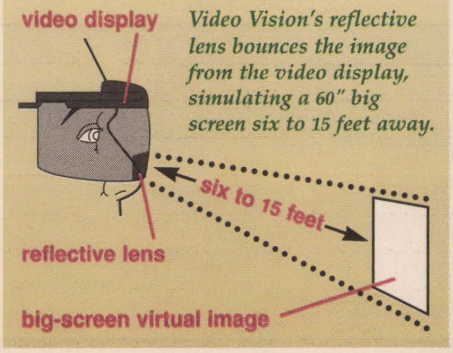
VIRTUAL TECHNOLOGY

How does Virtual Vision Sport create a virtual image that floats in space? Within the eyeware is a miniature video display and a sophisticated reflective optical system. Part of the optical system is a small, specially-engineered reflective lens which is mounted slightly below your normal field of vision on your dominant-eye side. (Your brain gives priority to whatever image is viewed by your dominant eye, so the image will seem to appear in both of your eyes. See the inset box at the right to determine which eye is your dominant eye.) The lens bounces the video image from the video display so that it appears to be focused a comfortable distance (about six to 15 feet) in front of you.





The Sport eyeware is easy to wear, and it lets you see your environment as well as the TV image.



Video Vision's reflective lens bounces the image from the video display, simulating a 60" big screen six to 15 feet away.

Virtual reality. We've all heard about it. But if you're like me, you figure you'll never get the opportunity to experience it in your lifetime. Think again! The Virtual Vision Sport 200 is a breakthrough invention that uses virtual reality (VR) technology to bring big-screen virtual images to a portable TV.

Virtual Vision Sport is the ultimate portable television. You can wear it on the beach, in the gym, wherever you want. And because the TV image is part of the eyeware, *it moves with you.* With the Sport, you can maintain your active lifestyle without missing your favorite shows!

How it works. The Sport's portable battery-operated tuner picks up TV signals from the airwaves and transmits images to a miniature LCD video display in the eyeware. The image is reflected to your dominant eye, resulting in a floating virtual image that appears to be a comfortable distance away. The farther away you focus your vision, the larger the image appears. Special color optics provide projection TV-style imagery. The eyeware contains a pair of high-fidelity earphones. It also comes with an AC adapter for indoor use!

Monocular technology. The Sport uses monocular technology to create the virtual image. While your retinas are presented with different images, they are not so different that the brain can't fuse them together. The process of fusing two slightly different retinal images into a single picture with depth, called *stereopsis*, is the way most of us see the world around us.

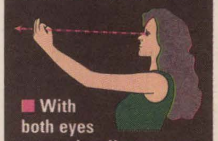
VR, only better. Ordinary VR equipment is cumbersome and uncomfortable. Plus, the dual video displays used in VR can confuse the visual system, resulting in eyestrain and *binocular dysphoria*, a defect in depth perception that can last for hours.

The Sport is different. Weighing a mere five ounces, you will forget you're wearing it. And because you see your environment *and* the virtual image, eyestrain is minimized and depth perception is unaffected.

More than TV. You can connect the Sport to a camcorder, video game system or VCR. Watch a movie from your VCR in bed without disturbing your spouse. Plug the Sport into your video game system to battle life-size virtual characters. Used with a camcorder, the Sport serves as the ultimate viewfinder—no more missing any action. The Sport is also great for training and education—students can watch a training video while working. You can even use the Sport to impress your clients with a personalized multimedia presentation!

DETERMINING YOUR EYE DOMINANCE...

- Extend your arm out as far as you can.
- Bring your index finger and thumb together to form a circle.



- With both eyes open, visually center a small, distant object (like a light switch or door knob) within the center of the circle.



- Without moving your head or arm, close one eye at a time. *The eye that keeps the object centered in the circle of your fingers is your dominant eye.*

Risk-free. The Sport is backed by our risk-free home trial. If you're not satisfied, return it within 90 days for a refund, "No Questions Asked." The manufacturer provides a 90-day labor and one-year parts warranty. Most orders processed within 72 hours and shipped UPS.

Virtual Vision Sport 200 . . . . . **$499** $19 S&H
PLEASE SPECIFY RIGHT- OR LEFT-EYE DOMINANCE.

Please mention promotional code **1171-NV-5819.**

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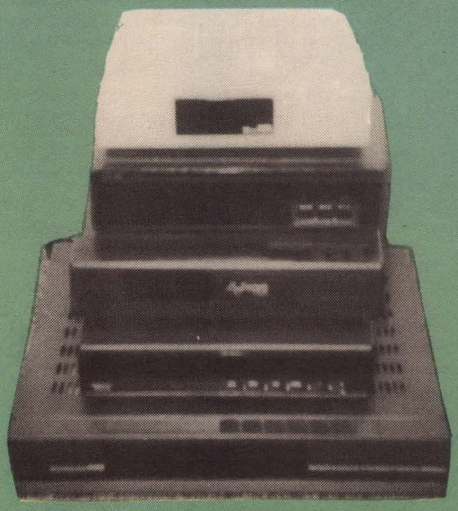
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PIO-DECODER:	95.00
DIGITAL J-COMBO	150.00
DIGITAL J-DECODER	85.00
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OAK DECODER	70.00

SOME BRANDS NOT LISTED

(ALL COMBOS CONSIST OF TUNER, REMOTE, AND DECODER + PATCH CORD)

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(1 PC. UNITS CONSIST OF A CONVERTER WITH BUILT IN DESCRAMBLER & REMOTE)

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• ANY COMBO WITH PANASONIC CONVERTER ADD 10.00 PER UNIT
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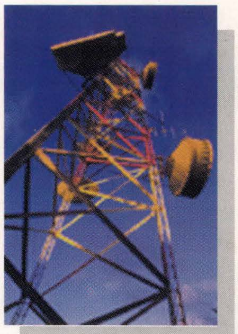
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Write in 150 on Reader Service Card.







Are You Listening?

CATCH THE Action WITH an INTERCEPTOR!

R10 INTERCEPTOR

f searching out RF signals is your thing, then the R10 Interceptor is the answer. The .10 searches out nearfeild signals and locks on in 8ms. It provides a shield of protection hat no RF signal can penetrate without being detected. Unlike scanners and receivers hat must be tuned to a specific frequency or scanned through a fixed frequency range, he INTERCEPTOR will provide an exciting new dimension in recreational monitoring vith near instant response to strong signals. Communications monitoring hobbyists will e able to take the R10 on cruise ships, to military bases, theme parks, zoos, airports, to pace shuttle launches, parades, sporting events, car races and anywhere two way FM ommunications is used. **•Check Deviation with 10K or 100K range •Check Relative ignal strength •Continuous 30MHz-2GHz coverage in less than 1 second Built in Speaker •Thumb wheel volume and squelch control •Supplied with elescoping whip antenna, Internal NiCad battery pack, and an AC charger**

R20 INTERCEPTOR

he R20 is a compact RF signal strength detector with a 10 segment bargraph isplay. There is also an audio output from the detector for monitoring AM communi- ations. The audio output is useful for room sweeps where in close proximity to a ansmitter a quieting effect can be heard due to detector saturation.
The 10 segment LED bargraph responds to all RF signals with nominal 3dB ncrements •Pocket sized with built in telescoping whip antenna •9 volt attery operation •Monitor Aircraft, CB, AM Broadcast transmissions •Check Microwave oven leakage •Wide .5MHz-2.5GHz range

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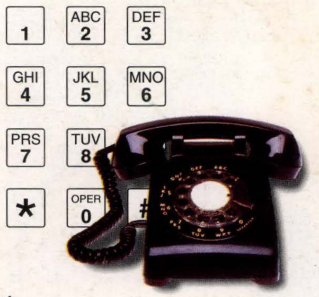
Write in 146 on Reader Service Card.

BASIC STAMP® MODULES

Stamp II has many useful new instructions

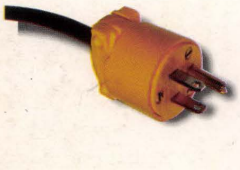
BASIC Stamps are perfect for many applications, from controlling model trains to monitoring factory sensors. They have 8 or 16 I/O lines, which can be used for a variety of digital and analog purposes. And to keep life simple, they're programmed in BASIC. Our special "PBASIC" language includes familiar 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.



DTMFOUT *

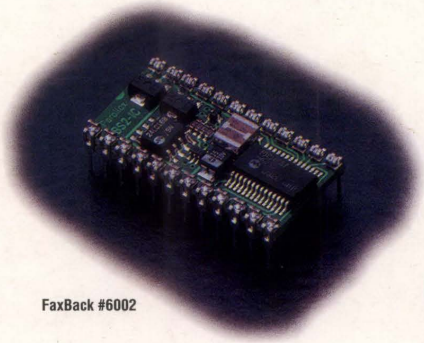
Generates DTMF tones with just one I/O pin, two capacitors, and a speaker. Another related instruction, **FREQOUT**, generates one or two tones simultaneously. Each tone is programmable in 1-Hz increments from 0-Hz to 32767-Hz.



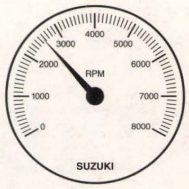


XOUT *

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.



FaxBack #6002



COUNT *

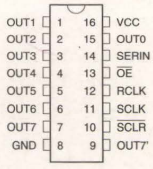
Counts cycles on an I/O pin. Makes tachometer and other count/time programs simple.

** Only available on the Stamp II.*

SHIFTOUT *

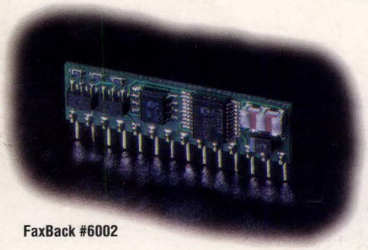
Uses two I/O pins to control common serial-to-parallel shift registers. Can be used as a means of controlling many devices without using too many of the Stamp's I/O pins.

74HC595



BASIC Stamp II Module (BS2-IC)

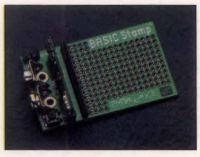
16 general-purpose I/O lines
2048-byte program space (600 instructions)
20-MHz clock (38400 baud serial, etc.)
$49, $69 with optional carrier board



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





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