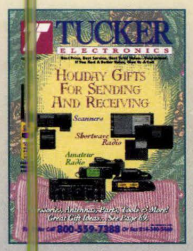
NUTS & VOLTS
MAGAZINE

OUR 16th YEAR

$3.50
VOL. 16 NO. 12
DECEMBER 1995

Exploring Electronics And Technology For The Hobbyist And Professional



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Weller WLC100

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On/off switch with "power-on" indicator light; Variable power control produces 5-40 W; Quality lightweight pencil iron; Cushioned foam grip with replaceable heating element; Ideal for hobbyists, DIYers and students; Safety guard iron holder; Natural sponge tip cleaning pad; ST3 iron plated copper tip

Xcelite Y99SPC

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- Contains 13 anti-static chip tools, protects chips from ESD damage
- Tools fit securely in a convenient roll-up pouch

Weller 921ZX

Soldering Station $119

The Weller 921ZX offers electronically controlled - zero cross circuitry; spike free - ESD safe; ceramic heater rated for exceptionally long life; variable control - fully adjustable 550° - 850°; external fuse and calibration access; cool and lightweight handpiece. Over 19 tips including SMT tips are available.

Optoelectronics Scout 40

Frequency Scout

$399

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: 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speed .0001 second gate; 9 digit LCD display; An LCD display for best visibility and longer battery life, unlike the outdated LED counters that aren't visible in sunlight and drain the power right out of the counter; 1 MHz - 250 MHz direct count capability for high resolution; 1 MHz -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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...wishes you the best for the Holidays and the coming New Year...
To show our appreciation, we lowered prices on several items below!

Multimedia Kit Deal #1

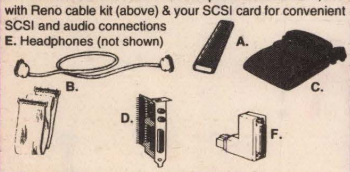
- Mediavision *Reno* External CD ROM/Audio CD Drive:
  - Consists of new external Reno CD/ROM drive, docking bay with SCSI2 port, AC Adapter
  - Double-speed 180mS drive is lightning fast!
  - Drive detaches from docking bay, use with headphones as a portable personal audio CD player
  - Great for Mac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

Mediavision Reno Kit HSC#15586 **$89.95**

Reno detaches from SCSI2 Docking Bay for Complete Portability!

- **Mediavision *Reno* Kit HSC#15586 includes:**

A. Rechargeable Battery Pack
B. Reno Cable Kit (SCSI2 - DB25 cable, 50p. ribbon cable, internal & external audio patch cables)
C. Padded Travel Pouch
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
E. Headphones (not shown)



- ***Reno* Accessory Available Separately:**

F. Macintosh Powerbook SCSI Adapter (HDI-30 to 25-pin D connector) **HSC#15704 $12.50** if purchased alone, or with purchase of Reno Kit, **$5.00**

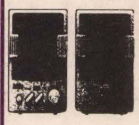
Multimedia Sound Card!

- 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.



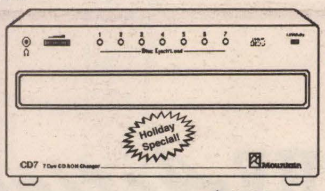
MSS-1000 HSC# 15127 Pair/ **$6.95**

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

Dealer Inquiries Invited...
Quantity Discounts Available!

Seven Disk CD-ROM Changer

- Mountain Network Solutions **CD7** 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 Changer HSC# 15641 **$149.00**

1200 dpi Color Scanner!

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

Holiday Special!

HSC#15572 **$199.95**

High Power AA NiCads!

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- Regular AA NiCads are only 300mAh
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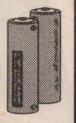
- Sorry, no quantity discounts



HSC# 15281 **$2.99 / pr.**

Network Card Bargain!

- Racal Interlan 16-Bit Ethernet Cards
- High Quality US Product, 10-Base-T or AUI
- Manual, Software included
- NE2100 Compatible, NI6510 Compatible
- Handy 5-pack contains 5 cards, 1 Manual and 2-disk software pack)

HSC# 15364 **$99.95 / 5pk.**

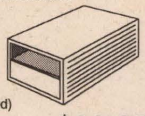
SCSI Hard Drive Deal!

- Rodime RO3259T SCSI Interface Hard Drive
- 210 Megabytes, 9 heads, 1216 cylinders,
- 18 mS access time
- 3.5" Half-height form-factor
- Removed from unused sytems
- Tested Good, 90 Day Warranty

HSC# 15698 **$59.00**

SCSI Drive Case #1

- Bargain case for 5.25" drives, brand new!
- 7" x 4.5" x 10.5" overall size
- 50-pin SCSI connectors
- SCSI ID switch
- 65W Power Supply
- Fan-cooled, uses standard IEC Power cord (not included)



HSC# 15715 5.25" SCSI Drive Case **$39.95**

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)

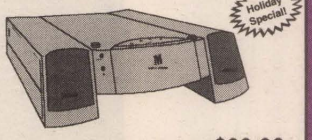
Sony CDU-31 1X-Drive HSC# 15650 **$35.00**

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 above). 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 **$99.00**

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**

SCSI Drive Case #2

- 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**

PCMCIA SCSI Card

- Mediavision PCMCIA SCSI II Card for Laptops
- Use with CD/ROM Drives, WORM Drives, Hard Drives, Scanners, any SCSI I or II device
- Bundled with Corel SCSI (ver. 2.04) software
- Cable, installation software, manual included
- Would make excellent laptop connection to *Reno*, above
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R10 INTERCEPTOR

If searching out RF signals is your thing, then the R10 Interceptor is the answer. The R10 searches out nearfeild signals and locks on in 8ms. It provides a shield of protection that no RF signal can penetrate without being detected. Unlike scanners and receivers that must be tuned to a specific frequency or scanned through a fixed frequency range, the INTERCEPTOR will provide an exciting new dimension in recreational monitoring with near instant response to strong signals. Communications monitoring hobbyists will be able to take the R10 on cruise ships, to military bases, theme parks, zoos, airports, to space shuttle launches, parades, sporting events, car races and anywhere two way FM communications is used. **•Check Deviation with 10K or 100K range •Check Relative signal strength •Continuous 30MHz-2GHz coverage in less than 1 second •Built in Speaker •Thumb wheel volume and squelch control •Supplied with telescoping whip antenna, Internal NiCad battery pack, and an AC charger**

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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

Dear Nuts & Volts:

Regarding Question 9956, drive belts. The answer printed October 1995 doesn't help much. My items' belts are too small to substitute O-rings for. They are about 1/16" x 2-1/2" diameter. Please keep that question as to where to get those drive belts open as it is a continuing problem, and shows planned obsolescence and perfidy, and also contempt for the consumer. I hate to junk an item because of a 10¢ drive belt. The choice is to get it repaired @ $100.00 or buy a new one @ $29.95.

Joseph A. Dickerson
Baltimore, MD

Dear Nuts & Volts:

(In response to Jan Zaluda November issue)

More Starlight information for Jan Zaluda:

The Vietman era tubes don't contain the microchannel plate, but they do have the fiber optic face plates on the front and rear sections making coupling a simple matter. The photo response of the input is matched in design to the green output of the viewing area and each tube can be used singularly or stacked, with a output to input gain with each new tube. There is no loss of signal gain due to color response, except that which is intended by the manufacturer. This is a design factor to lower the gain so they don't become too sensitive and see things like vegetation rotting. When using two tubes with a CCD pickup, you simply rotate the CCD pickup, upside down to invert the image. You can also use a simple eye piece off of any binocular or telescope, or a single lens, for inverting images when not using a CCD as a pickup.

I've used the later versions of the starlight scopes both in the 25 and 40 mm size (American not Russian), and I was not impressed at all with their gain factor or resolution. The only good points that I saw with these units were the small length size, automatic gain circuitry and less chance of blowing them up from bright lights such as headlights panning across your path.

The method of stacking multiple tubes into a single unit is very simple and will result in a very high-gain unit with little or no flaws. The three tubes are set-up parallel to each other on an insulated work bench and powered up without lenses or eye pieces in a very dark room. A small light source is produced in the direction of the inputs and the tubes are marked according to their brightness of the output screen. The brightest tube is used as the input tube and the least brightest as the final tube. This way, the most sensitive tube is used as a pickup and once the light is amplified the lesser units work on a higher light source than the first and still add gain to the whole. Depending on the quality of your tubes this can make a 25%, or more, difference in the sensitivity.

When comparing LEDs to laser diodes I find the analogy of comparing golf balls to beach balls a little closer. There is no comparison. Even when I pulse visual or infrared LEDs with 1/2 amp to 1-1/2 amps. Nanosecond pulses at 10,000 to 30,000 cycles the LED is very impressive, but no cigar. The unit is good for short distances, but doesn't even come close to a laser diode working at the lower threshold limits. In short, you can't compare coherent light to non-coherent light. Have you ever seen a 5 MW light bulb shine five miles? Power for power, the laser wins hands down every time even when considering the 60 to 80 mA draw as apposed to the LEDs 20 to 30 mA. The power draw factor for a laser may be three to six times, but the light output of the laser is in the thousands.

Stacked starlight tube assemblies don't require anywhere near 2 MW/sq. meter to illuminate even the darkest object. At one tenth of those levels damage will occur to the unit.

If you couple a telescope and eyepiece to the starlight scope with a 300X power equivalent, an object at a half mile away (880 yards) will not be equal to 2.9 yards away, or approximately 9 feet.

A 600X will make it 4-1/2 feet away. Ambient light being the same here as it is a half a mile away makes the job for the starlight scope a very easy task. It is approximately equal to a 50 mm lens set at F16 or less and looking at an object (the ant in question) 9 feet away from the lens with only ambient light as the source. This is clearly a flood light situation. These starlight scopes work well below the 1/000 LUX range depending on the quality of each tube and if you get three perfect tubes you will find them too sensitive for the average person to use anywhere but in absolute darkness.

Chris
Belber, CA

Dear Nuts & Volts:

Good News! The programming software that accompanied "The PIC16C84 Programmer" article in the Oct. '95 issue of Nuts & Volts Magazine has been updated to support the entire family of Microchip's mid-range processors (the PIC16C6x/7x/8x series). This software is freely available for downloading at the ITU Technologies' FTP site (URL: ftp://itutech.com) in the support directory. An 80286 or above processor in your PC is required to

Continued on page 137

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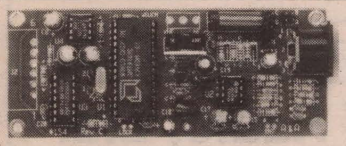

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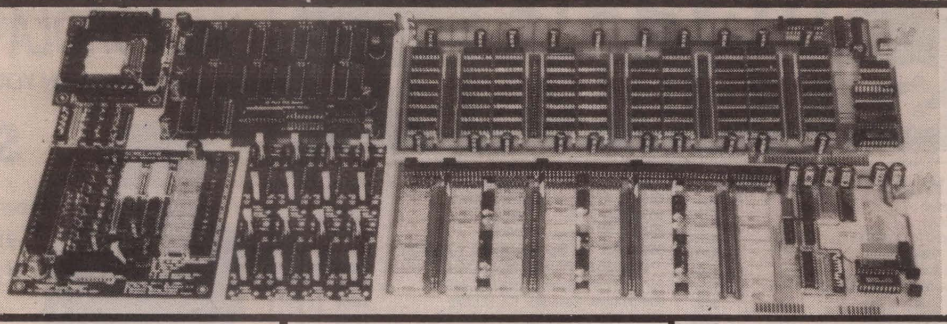

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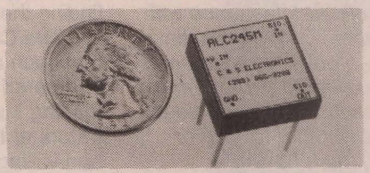

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If Cellular Clones Are Outlawed,
Only Outlaws Will Have Cellular Clones

by Bob Keller

A Critical Review of the FCC Prohibition on Modification of Cellular Unit Electronic Serial Numbers

Among the many rule changes and amendments included in the Federal Communications Commission's recent "re-write" of Part 22 of its Regulations (the section of the FCC rules governing common carrier mobile radio services, e.g., paging, cellular, etc.), is a new Section 22.919 of the Rules. The new regulation, which became effective on January 2, 1995, provides that every cellular telephone must have a unique electronic serial number (ESN) which may not be modified by any person for any reason after the unit leaves the factory. (See side bar article for the full text of Section 22.919 of the FCC Rules.)

The stated purpose of the rule is to prevent or reduce fraud that results from "cloning" (programming a legitimate ESN into a fraudulent unit in order to illegally access a cellular system). But the scope of the regulation goes further and has thus engendered much controversy. No one argues with the proposition that it ought to be illegal to clone cellular phones for the purpose of stealing service or fraudulently accessing cellular accounts. As written, however, Section 22.919 also precludes clearly non-fraudulent uses. It is a violation of Section 22.919, for example, to clone your ESN into a second unit to serve as an "extension" phone, even though you have no intention of using both units at the same time and are willing to pay all usage costs generated by both units. It is also a violation for your own cellular carrier to program the ESN of your broken phone into a loaner unit while repairs are made.

Even cellular equipment manufacturers are concerned that the regulation is so narrowly drawn that many design features built into cellular phones are arguably in technical violation.

It is not always easy to compose statutes or regulations that include the targeted conduct or situation without also unwittingly encompassing other matters that have nothing to do with the matter at hand. Such problems are frequently addressed after the fact by "interpretation" of the law. The meaning of a proscription can often be viewed in terms of its underlying purpose. Such use of legislative or regulatory history, in effect, imputes a certain intent to the authors of the law. Should this process not be applied to Section 22.919? Would it not be reasonable to assume that, because the purpose of Section 22.919 is to prevent cellular fraud, the Commission certainly could not have intended by it to proscribe non-fraudulent cloning?

Well, there is good news and there is bad news. The good news is we don't have to guess at the FCC's intention. All the right questions were put to and answered by the Commission before the regulation was adopted. The bad news is the FCC's answers to those questions make very little common sense.

ESN modification and cellular cloning was a hot issue during the rule making proceeding in which the current version of Section 22.919 was adopted. There was no argument with the need to adopt legitimate regulatory measures to address cellular fraud, and there was no objection to rules that prohibited the cloning of cellular phones or the modification of ESNs for fraudulent purposes. But commenters specifically urged the FCC not to draw the rule so narrowly that it precluded either modification or "emulation" of ESNs in order to create non-fraudulent "extension" phones. The Commission considered and squarely rejected these arguments, stating:

"[T]he ESN rule will not prevent a consumer from having two cellular telephones with the same telephone number . . . We note that Commission rules do not prohibit assignment of the same telephone number to two or more cellular telephones. It is technically possible to have the same telephone number for two or more cellular telephones, each having a unique ESN. If a cellular carrier wishes to provide this service, it may."

Thus, with the stroke of a pen the Commission gave the cellular carriers an effective monopoly on the provision of cellular extension phones.

The third party programmers of extension units, outlawed by Section 22.919, typically charge a flat fee to program the second phone. With the adoption of Section 22.919, however, many cellular carriers have started to offer two or more phones on the same number — but they are reimposing monthly fees in the $17.00 to $30.00 range for this optional service. At those rates, many users may decide it is better to simply buy a second cellular account — and the critics say that is exactly what the cellular carriers intend.

The Commission also expressly considered and rejected suggestions that the scope of Section 22.919 be narrowed to permit ESN modification by manufacturers and authorized repair centers. The Commission responded to such suggestions as follows:

"[C]omputer software to change ESNs, which is intended to be used only by authorized service personnel, might become available to unauthorized persons through privately operated computer "bulletin boards." We have no knowledge that it is now possible to prevent unauthorized use of such software for fraudulent purposes."

That shows how far wide off the mark is the Commission's thinking on this whole issue. Can the FCC — the agency attributed with the expertise in electronic telecommunications matters — actually believe that by making it unlawful to modify ESNs they will prevent thieves from acquiring the means to do so? Are they really ignorant of how relatively simple (not necessarily inexpensive, but simple) it is to clone an ESN?

There is an entire underworld industry for the laundering of stolen ESNs. The foot soldiers set up their sniffing monitors at airports, convention centers, busy highway interchanges, etc., and collect thousands of ESNs off the air from unwitting cellular users. The numbers are programmed into cellular phones and put on the street through a black market network. The units are frequently recognized as fraudulent and deactivated within days or even hours of their deployment, but not before many hours cellular airtime and long distance usage (potentially including extensive international long distance) has been misappropriated. Canceling the fraudulent account is easy — finding the fraudulent unit and its user is not.

The Commission certainly cannot believe that such a lucrative operation is going to be hampered in the least by an FCC regulation making it unlawful to modify ESNs. The perpetrators of these cloning schemes knowingly and willingly assume the risk of violating many criminal statutes with potential penalties far more serious than non-compliance with an FCC policy.

Section 22.919 cannot rationally be expected to have any significant effect on cellular fraud. It does, however, preclude totally non-fraudulent uses by honest members of the public. It also gives the cellular carriers a monopoly on the provision of cellular "extension" phones. This is a curious ruling for an agency that recently has been using "competition" as a mantra. Over the past few decades, the FCC has consistently struck down telephone company tariff provisions that preclude uses of the telephone service that are privately beneficial to the subscriber without being harmful to the network or other users. Arguably, Section 22.919 fails under that test!

The final chapter has not yet been written.

47 C.F.R. Section 22.919

22.919 Electronic serial numbers. The Electronic Serial Number (ESN) is a 32-bit binary number that uniquely identifies a cellular mobile transmitter to any cellular system.

(a) Each mobile transmitter in service must have a unique ESN.

(b) The ESN host component must be permanently attached to a main circuit board of the mobile transmitter and the integrity of the unit's operating software must not be alterable. The ESN must be isolated from fraudulent contact and tampering. If the ESN host component does not contain other information, that component must not be removable, and its electrical connections must not be accessible. If the ESN host component contains other information, the ESN must be encoded using one or more of the following techniques:

(1) Multiplication or division by a polynomial;
(2) Cyclic coding;
(3) The spreading of ESN bits over various non-sequential memory locations.

(c) Cellular mobile equipment must be designed such that any attempt to remove, tamper with, or change the ESN chip, its logic system, or firmware originally programmed by the manufacturer, will render the mobile transmitter inoperative.

(d) The ESN must be factory set and must not be alterable, transferable, removable, or otherwise able to be manipulated in the field. Cellular equipment must be designed such that any attempt to remove, tamper with, or change the ESN chip, its logic system, or firmware originally programmed by the manufacturer, will render the mobile transmitter inoperative.

Additional Comments

Section 22.919 in all of its technical detail was adopted only last year and did not officially become effective until January of 1995. The FCC has had a policy prohibiting ESN modification, however, since the earliest incarnation of its cellular regulations.

Here is the full text of an FCC Public Notice explaining the policy as it existed prior to adoption of Section 22.919.

PUBLIC NOTICE
FEDERAL COMMUNICATIONS COMMISSION
COMMON CARRIER PUBLIC MOBILE SERVICES INFORMATION

October 2, 1991
Report No. CL-92-3

CHANGING ELECTRONIC SERIAL NUMBERS ON CELLULAR PHONES IS A VIOLATION OF THE COMMISSION'S RULES

It has come to the attention of the Mobile Services Division that individuals and companies may be altering the Electronic Serial Number (ESN) on cellular phones. Paragraph 2.3.2 in OST Bulletin No. 53 (Cellular System Mobile Station — Land Station Compatibility Specification, July,1983) states that "[a]ttempts to change the serial number circuitry should render the mobile station inoperative." The 1981 edition of these compatibility specifications (which contains the same wording) was included as Appendix D in CC Docket 79-318 and is incorporated into section 22.915 of the Commission's rules.

Phones with altered ESNs do not comply with the Commission's rules, and any individual or company operating such phones or performing such alterations is in violation of Section 22.915 of the Commission's rules, and could be subject to appropriate enforcement action.

Questions concerning this Public Notice should be addressed to Steve Markendorff at 202-653-5560 or Andrew Nachby at 202-632-6450.

The Commission received several petitions for reconsideration and clarification of Section 22.919. The matter is still under consideration and, at last report, a ruling was anticipated by the end of the year. If the FCC does not adopt significant modifications to the rule, an appeal to federal court may be mounted by some industry players.

In the meantime, the regulation remains on the books — an obstacle to honest users, but an entirely insignificant, if even noticed, "finger shaking" at the crooks. **NV**

About the Author

Bob Keller (who, in real life, is KY3R) is a Washington, DC, attorney specializing in federal telecommunications law, with particular concentration in the areas of wireless telecommunications, and new and emerging technologies.

Mr. Keller, a member of The District of Columbia Bar and of the Federal Communications Bar Association, established a solo law practice in April, 1994. Prior to that he was a partner in a Washington, DC, firm that specializes in communications and public utility regulation, corporate and securities law, and commercial litigation. He has over 15 years experience representing companies that are subject to or affected by Federal Communications Commission regulations and policies, including cellular, paging, SMR, and other mobile radio system operators, telephone companies, long distance carriers, competitive local access providers, electronic and communications equipment vendors and manufacturers, microwave and satellite system operators, broadcast licensees, internet service providers, etc. Mr. Keller has also served as special communications counsel to banking and investment firms in financial and securities transactions involving such regulated companies. Mr. Keller practices primarily before the FCC and federal courts, and has also participated in telecommunications proceedings before several state public utility regulatory agencies.

Mr. Keller took both his undergraduate and law degrees at the Catholic University of America in Washington, DC, and is also a member of the adjunct faculty at Catholic University's Institute for Communications Law Studies, where he teaches a course on the regulation of wireless telecommunications services.

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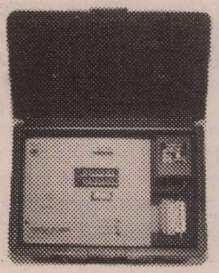

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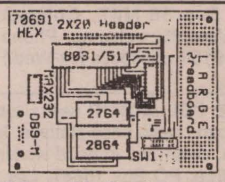

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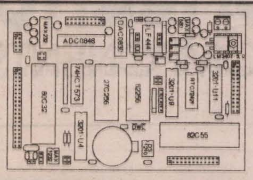

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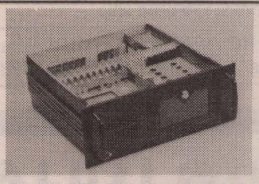

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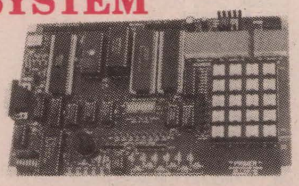

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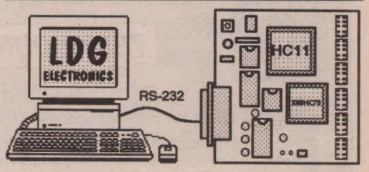

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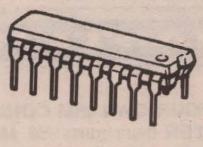

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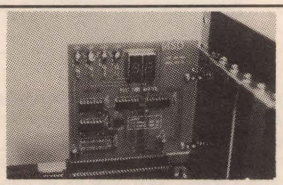

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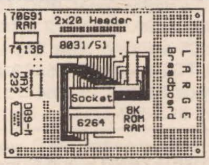

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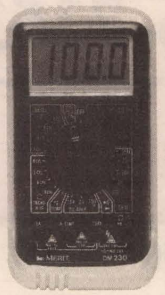
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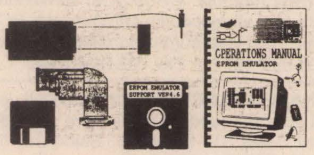

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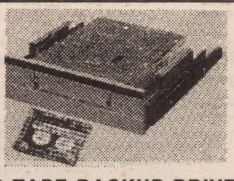

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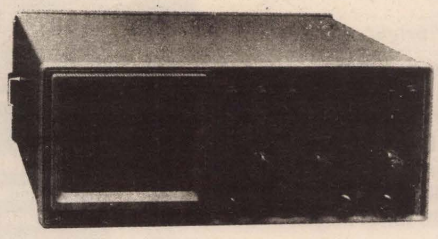

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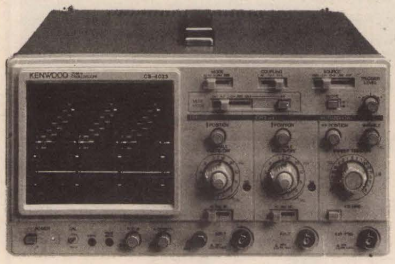

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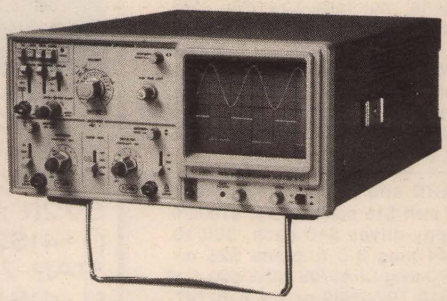

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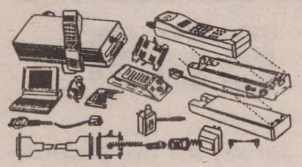

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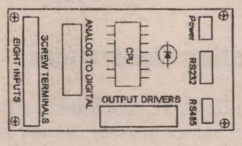

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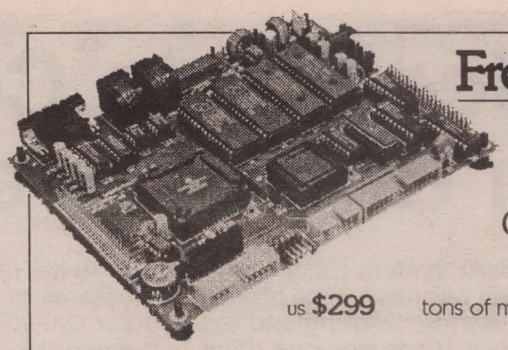

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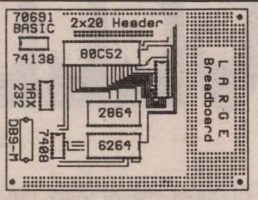

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Secret Service Busts Cellular Bandits with Undercover BBS

In January of this year, a computer Bulletin Board System (BBS) was brought to life in New Jersey for the purpose of discussing the "use and enhancement of cell phones." Like other BBS systems of its nature, it contained message bases dedicated to subjects like keypad reprogramming and the popular Oki-900 handheld cellular phone.

Aside from the files and messages left by users, there was one thing that made this system truly unique. This was a system with an undercover mission. A secret that would not be revealed until after its modems mysteriously stopped answering the phone lines, leaving callers with little more than the sound of endless ringing.

Once the BBS was down, it didn't take long for the secret to become known. The story first appeared in the *Wall Street Journal* and *New York Times*, and within minutes was propagating across the high-speed backbone of the Internet. The big news was that New Jersey's Celco51 BBS had actually been set up by the Secret Service as a sting operation to catch cellular bandits.

And it worked.

THE CELLULAR STING

THE CELLULAR STING

by Damien Thorn

Chronology of a Trap

It is a difficult task to report a story in reverse, giving away the end before explaining the beginning, but it is necessary in this case. What we're about to unfold here is a fascinating look at intrigue, criminal activity, and federal law enforcement at work undercover.

This is also a story that touches me personally, as I was contacted more than 15 times over a nine-month period about the BBS system by someone who seemed to be a somewhat illiterate hacker who wanted to run a system with a cellular theme. In the end, this person has turned out to be an agent or informant with the Secret Service who pretty much attempted to use me as an unwitting accomplice to the operation. As such, this article is a blend of fact and personal opinion.

Although the Celco51 BBS didn't become operational until January, it was first brought to my attention on Nov. 15, '94 though an E-Mail message originating from "pmf@cyberspace.com" signed with the name "Paul." Paul claimed that his friend was thinking of starting a cellular-oriented BBS. In a series of three messages that day, Paul invited me to maintain a forum or discussion area on the forthcoming system, and asked for the Phoenix Rising Communications online system phone number so he could look through the file archives.

The last message was an attempt to see if I had any illegal or pirated software that I could give to him. Although nothing illegal is mentioned in his message, he was fully aware from previous correspondence that Phoenix Rising does not knowingly carry material that would constitute a copyright or other legal violation.

This is what his messages said:

Date: Tuesday, November 15, 1994
From: pmf@cyberspace.com
To: Damien Thorn
Re: BBS

My friend is [possibly] starting a BBS for the use and enhancement of cell phones and utilities, etc. for that subject. If you would be interested in maintaining a forum or message base there, please let me know . . . thanks . . . Paul.

Can I get the number of your BBS? I would love to look thru that stuff and compare it to the library we are collating. Thanks a lot. Paul . . .

Oh, and the system will probably be underground . . . let me know what u have u might be able to share we can put up, that u can't! (wink!) I'll have to confirm with him whats up, but I'd like to see what u have anyway! (Am I too nosey or what?) he he . . . later.

By mentioning that his system would be underground, then asking for material that he can put online that we can't, the inescapable conclusion is that he was openly soliciting traffic in illegal software.

Although it was not difficult to brush him off that cold November evening, "pmf" continued to haunt my E-Mail box with his short, bothersome questions that ranged from wanting to know how to set up MajorBBS software to asking how to find *Nuts & Volts Magazine*. In the process, he also mentioned that he had recently arrived from England.

Although Paul's mail was annoying because of its poor grammar and the mutated spelling of common words, I tried to answer his questions as patiently as possible. As an author, receiving strange letters was nothing new, and at least his weren't as bad as the ones that look like they were typed by a five-year-old with an affinity for pressing the 'shift' key many times in mid-sentence.

On May 3, '95, Paul sent a message explaining that the system phone number was (201) 772-4715 and that I should log on with the handle "Dr. Damien" and a password of "nutz." He also said, *"Please let me check ur system out . . . leave me e-mail on mine, please note I think the people on mine probably post sum stuff u wouldn't allow on urs (!) . . ."*

Not being particularly interested in systems that blatantly advertise an illegal content, I promptly forgot about his invitation. On June 12, '95 Paul once again popped up electronically to ask if I would be using the account he had set up for me. I requested that he resend the access information, which he did on June 20, '95. At that time, he also commented, *"Ok! On condition none of the material found that breaks any law is mentioned anywhere . . . feel free to mention me in nutz and voltz though . . . and send me a copy . . . heheheheh ok (oh, and let me take a look on yer BBS)."*

Operation Cybersnare

On Sept. 11, '95, the US Attorney for the District of New Jersey issued a press release documenting the undercover Secret Service investigation dubbed "Operation Cybersnare." The press release itself is pretty dry, and composed of too many run-on sentences to reprint here verbatim. Instead, here's a summary of the operation compiled from the press release and a number of articles appearing in newspapers such as *The New York Times, Wall Street Journal,* and *Los Angeles Times.* Some of the details were provided by former callers to Celco51.

In early '95, the US Secret Service set up a bulletin board system (BBS) in an apartment building located in Bergen County, NJ. Special Agent Stacey Bauerschmidt presided over the system using the handle "Carder One," and was reported to have been assisted by an un-named informant with experience as a computer hacker. The system, running Major BBS software from Galacticomm, had multiple phone lines, including a toll-free number at one point.

Press reports indicate that an undercover Secret Service agent then posted messages to hacking-related newsgroups on the Internet, inviting people to call the system. Several people who frequent these newsgroups and use Internet Relay Chat (IRC) indicate that the individual named Paul was continually trying to get people to call the system. Sometimes he said the system belonged to a friend, as in the above-quoted electronic mail. At other times, he claimed to be the system operator.

Although no field of dreams, the principle of "build it and they will come" certainly applied here. Many people began to frequent the Celco51 BBS, uploading files, exchanging messages, and in some cases, posting illegal information. News reports indicate that the Secret Service advertised the system on the Internet as catering "to those involved into breaking into computers and in cellular phone and credit card fraud."

Although much of the system's file content and messages were not of an illegal nature, and consisted of files and topics of discussion that can be found all over the Internet and other bulletin board systems, some of the users were interested in more than experimenting with cellular phones.

When the operation came to a close in early September, the Secret Service arrested six cyber-criminals who are alleged to have traded millions of dollars worth of illegally obtained credit card numbers and cellular ESN/MIN pairs. The online criminals, from New York, California, Texas, Arizona, and Michigan, are alleged to have sold tens of thousands of numbers and pairs to the undercover Secret Service agents in exchange for cash. Most of the transactions took place online, with agents sending money through a wire service.

The operation has been equated to a high-tech version of a standard law enforcement tool known as a "fence" or a "swag shop." Traditionally, a fence is a person who buys stolen property. Officials will occasionally set up an undercover officer to purchase stolen property, later arresting those who offered the goods. Although a standard gambit for catching those who sell stolen property, Celco51 is the first such operation to take place online.

"We created a thieves' den and invited them in," said Peter A. Cavicchia, Secret Service Special Agent. "They can't hide anymore. The same computers and technology they use to commit crime are now coming back to bite them."

"If they are selling the stuff in cyberspace, law enforcement has to be willing to go there. The way to do that is to have a fence in cyberspace," said Assistant US Attorney Donna Krappa.

Two of the men arrested are accused of conspiring to break into computer systems operated by a major cellular carrier in Oregon. Others are charged with possessing and trafficing in hardware used to obtain unauthorized access to communications services, or trafficing in access devices.

Online Response

The majority of callers to the Celco51 BBS were not involved in criminal activity, and expressed shock and disbelief at the arrests and revelation that the system has been a sting operation.

"I think the whole deal about Celco51 really reeks," says a former caller from Texas. "Especially since Paul of Celco51 was constantly begging people to call his board. He used to hang around on the cellular IRC channel and that's how I became familiar with his board. In the beginning, I thought it was a little weird that he was so demanding and insistent that he have a voice number that he could (reach us at)."

"While I'm not an attorney, it seems very much like entrapment," he continues. "I considered Celco51 a plethora of knowledge, in that most of its callers were inquisitive individuals, most of all wanting to obtain a greater understanding of how the cellular network and phones work. I suppose this is only the beginning of the federal government intrusion. First our guns, then our 800 MHz radio equipment, then encryption, finally free speech."

A claim of entrapment is usually the first defense to arise when people are caught in a sting operation. In reviewing buffers of the message bases maintained on Celco51 through June, '95, there were no public messages from Carder One that would substantiate such claims. Considering the past conduct of the Secret Service in conducting bulletin board raids such as the infamous "Operation Sundevil," one would believe that they have learned from their mistakes in terms of breaking the law to catch lawbreakers.

Here's a sample of a message apparently posted by Special Agent Bauerschmidt using the Carder One alias:

Date: Friday, February 10, 1995
Msg #490
From: Carder-one
*To: ** ALL **
Re: Phone

Hi, I am looking to buy any small portable phone that has been modified to be reprogrammed thru the keypad. PMF has told me that the Oki can be modified to do this, but I will be interested in any kind of phone that will fit in my pocket. PLease get back to me if you can supply me. I have cash waiting 8))
Carder-one

Conclusion

Operation Cybersnare generated a good deal of publicity within the mainstream news media. It also caused a significant uproar on the Internet and among cellular experimenters. Despite the surge of attention, the operation was simply a classic sting updated for implementation online. Although many people feel that simply providing and promoting an online haven for the exchange of underground information constitutes entrapment, let's be honest with ourselves.

Someone with an existing desire to sell ESN/MIN pairs or credit card numbers would fall neatly into the trap set by the Secret Service. Those with no criminal intent would simply enjoy the knowledge and files available from the system, blissfully unaware that credit card numbers were being sold in the electronic equivalent of a back room.

While it all seems "different" because it occurred online, there really isn't much difference from a stolen property sting in the real world. Assume you met someone whom you discovered bought stolen cars and disassembled them to sell the pieces. If you were a car thief, you might sell this undercover operative a few stolen vehicles before being arrested. If you were a law-abiding individual, you certainly wouldn't go out and begin stealing cars simply because you had a convenient place to dispose of them.

The same principle applies to Operation Cybersnare. Considering how far and wide the Secret Service and their apparent informant cast the net across the Internet, the fact that only six people were arrested out of what must have been hundreds of callers speaks well for the integrity of both cellular hobbyists and their undercover operation.

Some people will be disappointed to note that I'm sticking up for the Secret Service after a fashion, but until there is documented evidence of entrapment or abuses such as those that occurred with the many "fishing expeditions" of Operation Sundevil, it would be wrong to condemn a standard law enforcement activity simply because it moved online.

The conduct of Paul, the apparent Secret Service informant, is another story altogether. On a personal level, I was offended to learn that his persistent efforts and unsolicited E-Mail were all designed to involve me in a sting. Many of the people who called Celco51 did so only after being pestered a number of times by Paul.

So who is Paul? That question remains unanswered. Several people have stepped forward to discuss their knowledge of him, and made statements about his behavior at the SummerCon convention earlier this year. None of the information has been substantiated, so it won't be repeated. When contacted for this article, Paul declined the opportunity to tell his side of the story.

His response of Sept. 13, '95 to my inquiry was to write, *"There could be a nice book out of this."* When asked whether he was an informant or an agent with the Secret Service, his E-Mailed response was, "I am not with an agency in any shape or form. As I said (before), I can't comment on my involvement."

"I am not allowed to talk about anything because I am a witness," he later wrote. "But it does sound like an interesting article. I bet you won't be the only one (writing an article). Emmanuel Goldstein (editor of *2600 Magazine)* is going mental over this..."

In summary, Operation Cybersnare was about catching high-tech criminals using the same type of computer systems and networks that have long been employed to disseminate the information sold by these individuals. The six people arrested face from 5 to 15 years in prison and fines of $250,000.00 each upon conviction.

Can we expect to see similar operations as law enforcement officials make the logical move online as the rest of us are doing? You bet. "Online Sting Just the Beginning" reads a headline in the *Los Angeles Times.*

These types of crimes are not a "harmless thing done for kicks by kids and geeks," says Agent Cavicchia in the article. "A crook is a crook. This is not a victimless crime. If these guys get ahold of your information, it wrecks your credit rating for years and leaves you with a huge mess to clean up . . ."

Special Agent Cavicchia declined to discuss what shape future online investigations may take, or what tactics might be employed online by law enforcement officials.

"Macy's would never tell Gimbels, would they?" he quipped. **NV**

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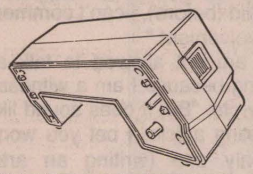

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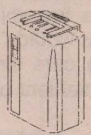

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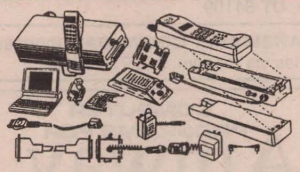

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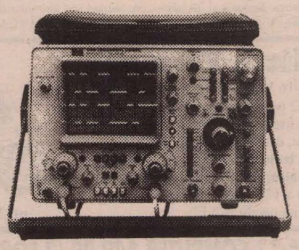


Xmas Special $500.00

Hewlett-Packard 8753A

Network Analyzer, 300 kHz to 3 GHz, integrated 1 Hz resolution synthesized source, time domain analysis, 100 dB dynamic range, accuracy enhancement.

$14750.00

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.

$369.00 Special

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.

$975.00

Hewlett-Packard 5340A

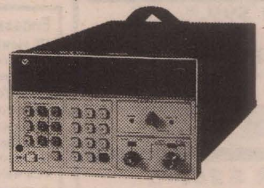
Frequency Counter, 10 Hz to 18 GHz, automatic amplitude discrimination, high sensitivity -35 dBm.

$1000.00

Hewlett-Packard 5342A

Microwave Frequency Counter, 500 MHz to 18 GHz, 11 digit LED display, sensitivity to -25 dBm.

$2500.00



Hewlett-Packard 8569B

Spectrum Analyzer, 0.01 to 22 GHz with internal mixer, extendable, internal preselection, 1.7 to 22 GHz, 100 Hz to 3 MHz resolution range.

$9200.00

Hewlett-Packard 8565A

Spectrum Analyzer, 0.01 to 22 GHz with internal mixer, 1 kHz to 3 MHz resolution range, easy to use.

$5000.00

WANTED USED TEST EQUIPMENT!

Tektronix 492 Opt 01, 02

Spectrum Analyzer, 50 kHz to 21 GHz, 80 dB dynamic range, amplitude comparison in 0.25 dB steps, opt 01 internal preselection & opt 02 digital storage.

$7500.00

Tek 492 opt 01, 02 , 03

Spectrum Analyzer see above. Opt 03 adds frequency stabilization/ 100 Hz resolution.

$8250.00

Tektronix 2754P

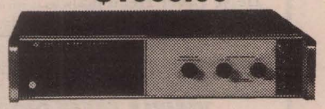
Programmable Spectrum Analyzer, 10 kHz to 21 GHz, -117 to +30 dBm, resolution 1 kHz to 3 MHz.

Special $9900.00

Hewlett-Packard 8444A

Tracking Generator, 500 kHz to 1250 MHz, 90 dynamic range, 1 kHz frequency.

$1000.00



Hewlett-Packard 141T System with 8552B/ 8553B

Spectrum Analyzer includes 141T mainframe that provides variable persistence and storage. Covers from 1 kHz to 110 MHz, 10 Hz resolution bw, high sensitivity -140 dBm.

$1750.00 Special

Hewlett-Packard 141T System with 8552B/ 8555A

Spectrum Analyzer includes 141T mainframe that provides variable persistence and storage. Covers 10 MHz to 18 GHz, absolute amplitude calibration capabilities from +10 dBm to -125 dBm.

$1975.00

Hewlett-Packard 141T System with 8552B/ 8554B

Above mainframe, covers 100 kHz to 1250 MHz, high resolution to 100 Hz, high sensitivity -122 dBm.

$1900.00 Special

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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

VIRD-1™ VISUAL IR DETECTION SYSTEM

Communication Security Inc., introduces the Visual IR Detection System, model VIRD-1™.

The sophisticated binocular system utilizes patent pending technology to visually detect and locate infrared (IR) eavesdropping devices and attacks.

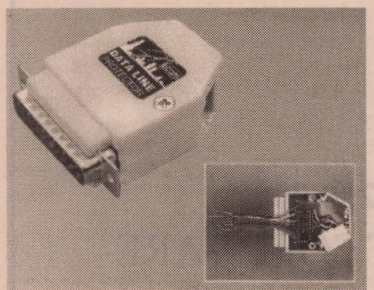
The model VIRD-1 is a lightweight portable unit which is simple to operate, day or night. This straightforward detection system enables users to reliably detect and locate invisible light transmitters and laser attacks within seconds.

Advanced performance features include: visual panoramic display, allows user to see invisible light; light intensification, amplifies invisible light to detect even the weakest of signals; provides greatly enhanced detection capabilities over existing equipment; superior sensitivity; no specialized operator training or experience necessary; and locates the source of invisible IR and laser radiation.

For more information, contact:

COMMUNICATION SECURITY, INC.
P.O. BOX 1815, DEPT. NV
BAY CITY, TX 77404
409-245-8545

MODULAR ADAPTORS



For the first time modular adaptor kits are offered with all RJ45 or RJ11 lines fully protected against the possibility of damage due to line surges.

The high-speed transients diverting ability makes these adaptors ideal choices for protecting system applications. Each adaptor features the traditional six or eight "crimp and poke" terminated wires to be programmed and final assembled per your needs.

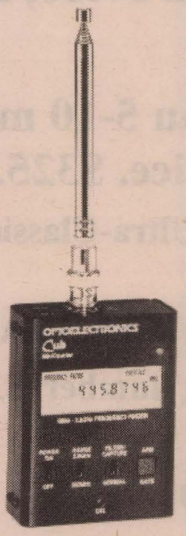
New, compact design allows the inclusion of six or eight Avalanche diodes to be placed on each of the RJ12 or RJ45 lines. They are rated at 500 watts and have 27-volt clamping. Four basic types are offered: male or female DB25 (RS232) with either RJ12 or RJ45 modular end.

This is L-com's TDHS series, priced at only $27.95 and $29.95.

For more information, contact:

L-COM, INC.
1755 OSGOOD ST., DEPT. NV
NORTH ANDOVER, MA 01845
508-682-6936 FAX: 508-689-9484
1-800-343-1455

CUB POCKET SIZED FREQUENCY COUNTER



Optoelectronics, Inc., announces the latest in their line of handheld frequency counters. The new CUB pocket sized frequency counter at 7.5 oz., 3.7" x 2.75" x 1.2" improves on the model 3300 MiniCounter. The CUB frequency counter is ideal for communications, surveillance, and recreational applications.

The following are some of the features that have been added to the CUB over the 3300 MiniCounter: Digital filter reduces false counts; auto capture acts like an intelligent auto hold button; 10 hour battery life, works all day like you do; eight selectable gate times; high speed .0001 second gate; and nine digit LCD display.

The CUB also incorporates all of the other standard features of the 3300 MiniCounter. 1 MHz-250 MHz direct count capability for high resolution. Selectable gate times. Maximized sensitivity for picking up radio transmissions. Direct and prescaled ranges. 10 MHz timebase. Frequency range 1 MHz to 2.8 GHz.

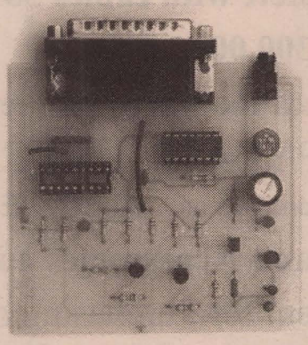
With the new CAPTURE mode, gone are the days of writing down the frequency with a pen and paper before it disappears. The CAPTURE mode allows for a frequency to remain displayed as long as you so desire, with no chance of being overridden by surrounding RF.

The CUB is designed for use in the more traditional lab settings, as well as field service, counter surveillance, police and military situations, private investigations, two-way radio, ham radio, frequency detection, monitoring, and any other situation that warrants the desire to know frequencies. The CUB was designed to fit into any situation, from the novice to the most experienced service technician. The CUB is simple to operate with all switches at a fingers touch, yet it has the sophistication and accuracy that experienced service and field technicians demand. Priced at $149.00. For test and measurement applications, the Optoelectronics P30 counter/oscilloscope probe may be used to directly connect to circuitry test points.

For additional information, contact:

OPTOELECTRONICS, INC.
5821 N.E. 14TH AVE., DEPT. NV
FT. LAUDERDALE, FL 33334
305-771-2050 FAX: 305 771-2052
1-800-327-5912

PIC PROGRAMMER



ITU Technologies introduces the new ITU PIC Programmer Model PIC-1, the first truly low-cost and versatile programmer for the Microchip Family of PIC microcontrollers.

This programmer is designed for programming Microchip's PIC16C6x/7x/8x family of microcontrollers from an IBM PC-compatible host. An 18-pin socket is provided on board for programming 18-pin PIC devices, and 28/40 pin adapters will also be available. An expansion header is provided for adapters and in-system programming of EEPROM-based PIC's.

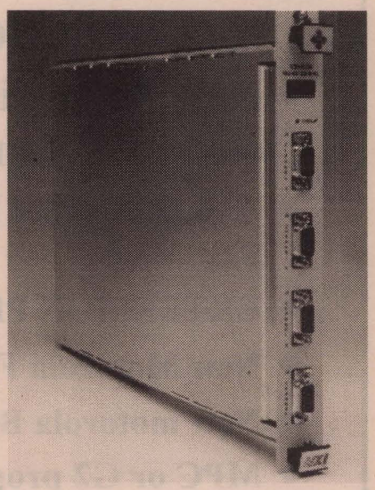
The programmer includes everything needed to get started programming and is ideal for students, hobbyists, and novice programmers. The PIC-1 programmer is supplied with a cable to interface to the PC's parallel port, a power supply, programming software for the PC, and a user's manual.

The PIC-1 is available in both a kit and assembled/tested form. The kit includes a high-quality printed circuit board and an easy-to-follow assembly manual. The kit is available for $29.00 and the assembled/tested version for $49.00.

For more information, contact:

ITU TECHNOLOGIES
3477 WESTPORT CT., DEPT. NV
CINCINNATI, OH 45248-3026
513-574-7523
E-MAIL: ITUTec@aol.com

ASYNCHRONOUS SERIAL COMMUNICATION MODULE



ICS Electronics announces a new VXI Module that provides asynchronous serial communication formats for VXIbus test systems.

The new Model VXI-5534 features four high-speed independent serial channels with programmable RS-232, RS-422, and RS-485 interfaces. The VXI-5534 uses separate VXIbus addresses for each channel, thereby reducing the number of data bytes that have to be sent across the VXIbus backplane per message.

The Model VXI-5534 is a message-based module with four logical VXI devices, one for each serial channel. Each serial channel operates in full-or half-duplex mode with baud rates up to 115.2 Kbaud.

The VXI-5534 transfers data transparently without the need to embed the data in command messages. Outgoing data can be transmitted immediately or stored and transmitted upon receipt of a VXIbus trigger. Received data is buffered and transferred to the slot 0 con-

New Product News

troller as a complete message or when the buffer is full.

Programmable channel configuration parameters include character formats, baud rate, interface signals, internal or external clock, and handshake selection. All configuration parameters can be saved in non-volatile memory for later recall. All configuration parameters are software controlled by SCPI commands and can be examined or changed without having to remove the unit from the VXI chassis.

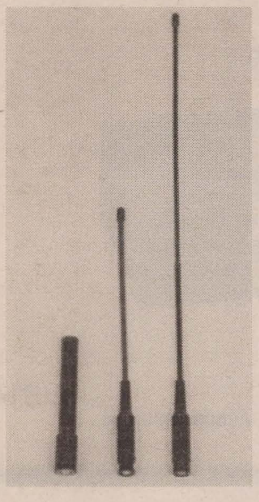
The VXI-5534 is a single slot wide, C-size module with separate nine-pin connectors on the front panel for each channel. When RS-232 signals are chosen, the signal pinouts match those of a PC COM port. A unique alpha-numeric display shows the user the addressed channel and module status. Although the VXI-5534's standard firmware only supports asynchronous formats, custom firmware can be added to the VXI-5534 to handle synchronous bit and byte protocols.

The VXI-5534 complies with revision 1.4 of the VXI specification and the IEEE-488.2 standard. The VXI-5534 is available now at $2,400.00 each.

For more information, contact:

ICS ELECTRONICS, CORP.
473 LOS COCHES ST., DEPT. NV
MILPITAS, CA 95035-5422
408-263-5500 FAX: 408-263-5896

MFJ-1717 DUAL BAND "FLEXIBLE" DUCK



The MFJ-1717 is a high gain dual band 144/400 MHz "flexible" duck antenna for handhelds and is only $19.95.

When other rubber ducks just give you noise and quacks, turn to the MFJ-1717 "flexible" duck. Only 15-3/4 inches, it's a halfwave on 440 MHz that will give you a 2.15 dBi high gain!

On the two meter side, you'll get an efficient full-size 1/4 wave antenna for full-size performance. The MFJ-1717 will come precisely-tuned from the factory for a low SWR. A high Q low-loss construction gives you the maximum radiated power needed and a BNC connector.

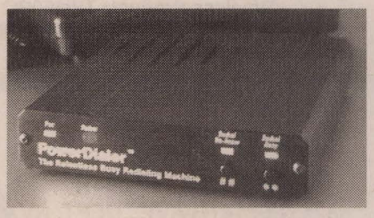
The MFJ-1717 will take all the bending, twisting, flexing, and tugging that you can dish out, but will keep on going! The radiator is protected by a durable, synthetic rubber compound and has a hard protective safety tip. A strong rigid base protects the matching network from flexing and changing frequency.

The MFJ-1716 is similar to its big brother, but has an 8-3/4 inch length and 1/4 wave on 440 and efficient loaded 1/4 wave on two meters and is priced at $16.95. The youngest duck, the MFJ-1718 is similar to its bigger brothers. Add this strong, flexible "shorty" duck at 4-1/4 inches to a two-meter handheld and fascinate at the outstanding signals! It has a high-Q helical wound radiator that is specially impedance matched to handhelds for maximum gain. It has a special low price at $12.95.

For more information, contact:

MFJ ENTERPRISES, INC.
P.O. BOX 494, DEPT. NV
MISSISSIPPI STATE, MS 39762
601-323-5869 FAX: 601-323-6551
1-800-647-1800

POWERDIALER™



Technology Arts announces the release of PowerDialer™, the fastest way to automatically redial busy numbers.

PowerDialer repeatedly dials busy telephone numbers as quickly as the telephone company can process the calls — as fast as 25 times per minute. When busy signals or "all circuits are busy" recordings are encountered, PowerDialer immediately hangs up and tries again. When PowerDialer encounters either a ringback or speech, meaning that the call has gone through, an alarm sounds to signal a successfully connected call.

PowerDialer was specifically designed to redial telephone numbers that seem to be constantly busy, such as ticket order lines for concerts, theater, or sporting events; radio contest lines; golf tee-off and tennis court reservation numbers; technical support lines; computer online services and bulletin boards, etc.

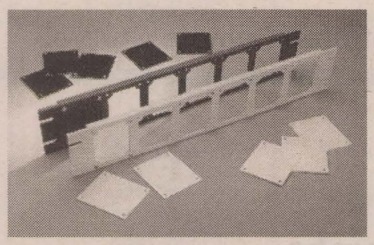
PowerDialer can also be set to periodically retry unanswered phone numbers. Other features include the ability to store numbers in memory, advanced tone detection, and a built-in speaker for hands-free monitoring.

PowerDialer is available for $249.00.

For more information, contact:

TECHNOLOGY ARTS, INC.
150 BEAR HILL RD., DEPT. NV
WALTHAM, MA 02154
1-800-600-1778
FAX: 617-736-1499

19" PATCH PANEL



L-com now makes it easy for anyone to fabricate their own custom patch panels. The panel kit includes a basic 3-1/2" x 19" rack panel with six prepunched rectangular openings that accept mating sub-panels. A choice of six plastic or anodized aluminum sub-panels, each equipped with mounting hardware to complete the assembly.

Customizing of the sub-panels is simplified because working with plastic or aluminum is easier to do than with steel. Another choice is the color of the basic universal rack panel, either black or bone. A good idea is to keep several kits on hand, considering the low price of only $45.50 per set.

L-com also makes available over a hundred different types of preassembled sub-panels which contain varied options such as, coaxials, D-subs, switch boxes, etc., all with plug-in options, front and back, so as to eliminate any tooling or soldering.

For more information, contact:

L-COM, INC.
1755 OSGOOD ST., DEPT. NV
NORTH ANDOVER, MA 01845
508-682-6936 FAX: 508-689-9484
1-800-343-1455

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DeoxIT by Caig Laboratories, Inc., is a fast-acting deoxidizing solution that cleans, preserves, lubricates, and improves conductivity on all metal connector and contact surfaces. DeoxIT improves the performance and reliability of electrical components and equipment.

DeoxIT contains improved deoxidizers, preservatives, conductivity enhancers, anti-tarnishing compounds, arcing, and RFI inhibitors and provides extended temperature range (-34°C to 200°C).

DeoxIT also prevents dissolved oxides and contaminants from reattaching to metal surfaces, providing longer lasting protection. Available in spray, liquid, wipes, and pen applicators.

Use on switches, potentiometers, relays, PCB edge connectors, batteries, faders, interconnecting cables, plugs, jacks, etc.

For more information, contact:

CAIG LABORATORIES, INC.
16744 WEST BERNARDO DR.
DEPT. NV
RANCHO BERNARDO, CA 92127
619-451-1799 FAX: 619-451-2799

PEAK VIP POWER METER

The peak VIP power meter is an electronic instrument used to measure parameters associated with power consumption by an electrical load that is normally operated from a 50, 60, or 400 hertz power line. The peak VIP power meter measures true RMS voltage and current; true power, and peak voltage, current and power.

This meter also calculates crest-factor for current and voltage, and calculates volt-amps and power-factor. The VIP also includes a peak-hold function for all peak measurements.

Connections to the VIP are via a rear panel terminal strip, whereby measurements are possible to a limit of 30 amps (25 amps continuous) and 280 volts. Alternately, a load may be plugged into a front panel 120 volt outlet if the power input is nominally 120 volts and the load current is less than 15 amps. Current is sensed by an internal .005 ohm shunt resistor. Power is supplied to the VIP measuring electronics via a permanent power cord exiting the rear panel.

A dual line, 20 character per line, LCD provides a visual output to the operator. A single front-panel pushbutton allows sequencing through one of four different displays of values. All measurements and calculations are updated at five-second intervals.

Usage of the VIP meter capabili-

Continued on page 140

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- Favorite Channel Memory
- Parental Lockout
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- Channel 2/3 Switchable
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Timeless Products TPI550PC with all new G7 Tri-Mode decoder installed. This brand new one piece system is a real crowd pleaser. Easy to install and operate.

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- Manual Fine Tuning

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	QTY 10	QTY 20
STEALTH 1000-P 5 x 4 Plastic Case w/Toggle	$49	$45
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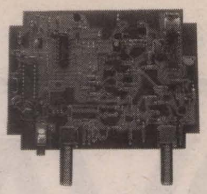
TVT-3G 6 x 9 Metal Case	$42	$39
MINI-TVT 3 x 6 Metal Case	$42	$39
GOLD 3 x 6 Plastic Case	$42	$39
APOLLO-J 3 x 6 Metal Case Replaces Purple & SIP	$49	$45
FTB-3 6 x 9 Metal Case	$43	$39
G7 4 x 4 Board Only	$39	$35



	QTY 10	QTY 20
PIO-6300 6 x 9 Metal Case w/Toggle	$69	$59
PIO+/TNT 6 x 9 Metal Case w/Toggle	$69	$59
PIO RED 3 x 6 Metal Case Replaces Green & Apollo-P	$69	$59
STEALTH 80-P 5 x 4 Plastic Case w/Toggle	$55	$49
M-80 6 x 9 Metal Case w/Toggle	$65	$59
S-BLUE	$65	$59

Converters

Stargate Elite — QTY 10 $59 — QTY 20 $55

- Last Channel Recall
- Favorite Channel Memory
- Parental Lockout
- STD/HRC Switchable
- Infrared Remote

Stargate 550XL — $99 — $89

- Volume Control
- Sleep Timer
- Last Channel Recall
- Favorite Channel Memory
- STD/HRC Switchable
- Channel 2/3 Switchable
- Infrared Remote Control

Panasonic TZPC1453G2 — $79 — $69

- Sleep Timer
- Last Channel Recall
- Favorite Channel Memory
- Parental Lockout
- STD/HRC Switchable
- Infrared Remote Control

TPI 550 — QTY 10 $60 — QTY 20 $57

- Last Channel Recall
- Favorite Channel Memory
- Parental Lockout
- Infrared Remote Control

Centurion — $65 — $61

- Sleep Timer
- Last Channel Recall
- Favorite Channel Memory
- STD/HRC Switchable
- Infrared Remote Control
- 100 Channel Capability
- Fine Tuning

Millennium^3 — $69 — $59

- Sleep Timer
- Last Channel Recall
- Favorite Channel Memory
- Parental Lockout
- STD/HRC Switchable
- Infrared Remote Control
- 100 Channel Capability

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Centurion

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- parental control
- switched AC outlet
- sleep timer
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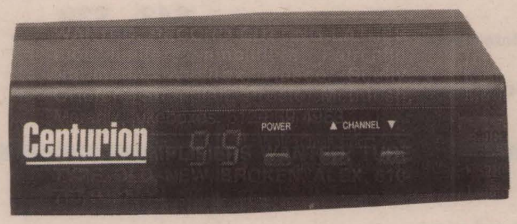
- auto/manual fine-tune
- favorite channel memory
- batteries included
- jumper cable included
- illustrated user manual
- LED display

Introductory Offer! For a limited time only, 10-lot price is only: **only $65**

place your orders soon—demand for the Centurion is high!



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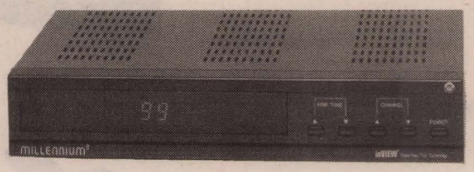

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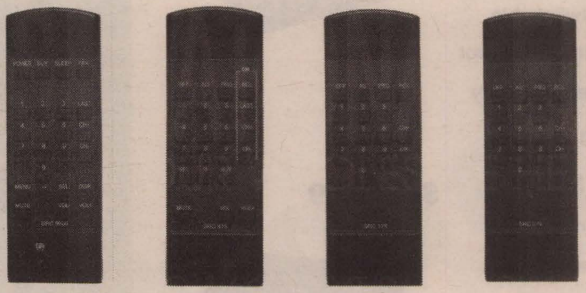

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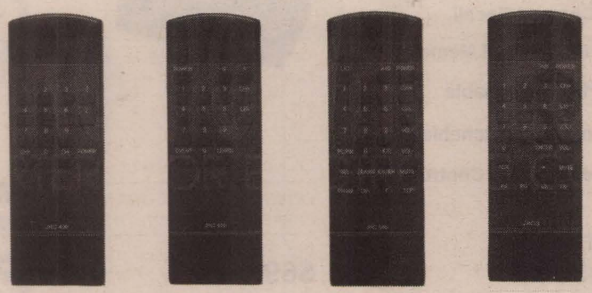

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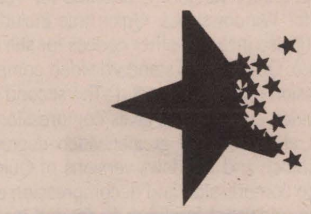

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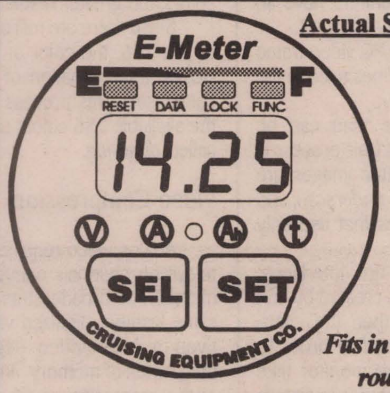

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SOFTWARE WIZARDRY

Working with Digital Video

Some have predicted that PCs will eventually "merge" with television sets, and that in the near future you won't buy just a PC or just a television; instead, you'll buy a "PCTV" that's a combination of both. I don't buy that prediction myself, but I do believe that tomorrow's PCs will be far more "video capable" than today's systems. All types of software in the future will use plenty of video, and a good working knowledge of how video is stored and manipulated on a PC will be essential for any software developer. That's why this month's column is about computer video.

Video Basics

While PCs store and process video in digital form, video is still displayed on monitors much like ordinary television sets. To understand digital video, we have to begin with analog video. While there are many similarities between broadcast television video and PC video, there are some important differences you need to be aware of.

The basic unit of video is called a *frame*, and a frame is one complete image. Each frame is "scanned" on the monitor as a series of horizontal lines. A new frame is produced every 1/30 of a second by a fast-moving electron beam. The electron beam strikes phosphors on the television or monitor tube screen, and these phosphors glow red, green, or blue when struck by the electron beam. Magnets inside the display tube are used to steer the electron beam to desired areas of the phosphor screen. By rapidly scanning several frames each second, moving images can be created. Monitors have an aspect ratio (horizontal to vertical ratio) of about 4:3.

Sound a lot like television? Yes, but a PC video frame only has 480 lines, in contrast to the 525 lines used in the NTSC color television broadcast standard.

In broadcast video, a larger image than can be accommodated on the screen is broadcast (this process is called *overscan*). By contrast, PC monitor images are smaller than the screen area. This is called *underscan*, and it means that PC monitors display images that use only 360 of the available 480 lines.

Unlike NTSC video, PC video is not interlaced. Interlacing is a process whereby a frame is created by first scanning the odd-numbered lines and then the even-numbered lines. PC video is not interlaced in order to reduce "flicker" when sitting close to the monitor (like most of us do). NTSC video signals are composite signals made by combining red, blue, and green colors into a single signal. PC video signals are known as component signals, meaning there are separate signals for the red, blue, and green colors. As a result, PC video colors are "purer" and more accurate renditions of the true colors of a scene or image than those found in NTSC video. However, this means there will often be visible differences in the colors found in the same image when displayed on NTSC and PC monitors.

On PC monitors, images are made up of *pixels*. Pixels are the "atoms" of digital video, and represent the smallest element of an image you see on a PC monitor. As the electron beams scans across the display, different pixels are "turned on" and their color set by the color information in the electron beam. Pixels are square (that is, they have a 1:1 aspect ratio) and can represent various color combinations depending on the video hardware and software of the PC. The most common standard is for PC displays to be able to represent 256 different colors. The resolution of PC monitors is expressed in pixels. A very common monitor resolution is "640x480." This means the monitor has 640 pixels per line horizontally and that there are 480 pixels vertically in each "line" running down the screen. The *de facto* standard for PC video is 256 colors and 640x480 resolution. This is known as the VGA (video graphics array) standard. While many high-end PCs can display more colors or a greater screen resolution, you should always develop for the VGA standard unless you know that the user PCs can support more colors and greater resolution.

Since there are millions of colors in the world instead of just 256, the color of many pixels must be set to the closest approximation of the actual color instead of the color itself. This process of finding the closest match in the available 256 colors and setting a pixel to that color is called *dithering*.

Video Compression

Analog video requires a lot of bandwidth. That's why television channels occupy 4 MHz of space while commercial FM broadcasters require only 200 KHz. In the same fashion, digitized video occupies a lot of memory. Even a brief video segment can easily fill several megabytes of memory, and those large video files eat a lot of the processing power available on the PC. This is why several compression/decompression standards have been developed for handling video on PCs. Compression and decompression is done by a software algorithm known as a *codec*.

You don't get high levels of compression and decompression without paying a price. In order to achieve high levels of compression (like 5 to 1), you have to accept the outright loss of some of the video data you compress. Such compression schemes are called "lossy," and they drop video information considered not important (per the codec) to the overall image. The greater the degree of compression, the more data that is dropped. The result is that compressed video data is inevitably of lower quality than the original video source or television video. However, improvements in PC hardware and software are rapidly closing this gap.

Most PC video codecs are *asymmetric*, meaning that video compression may take a relatively long time, but video decompression is rapid. Since we are concerned with decompression (playback) speed in end-user applications, this is an acceptable approach.

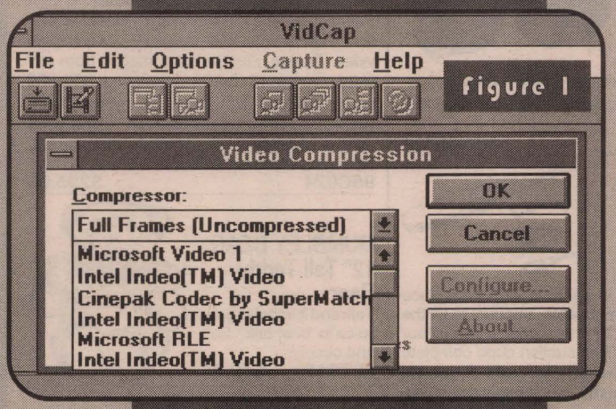
The first widespread PC video standard was Apple Computer's QuickTime. It was originally developed for the Macintosh, and a later version, QuickTime for Windows, was released for Windows PCs. QuickTime includes two video codecs (it also includes other codecs for still images and animations). QuickTime's standard video compressor gives compression ratios of up to 8:1. The second codec, the compact video compressor, gives compression ratios of up to 25:1 at the cost of greater video degradation. Both the Macintosh and Windows versions of QuickTime handle all video compression and decompression entirely in software; no additional hardware is needed inside the PC. To use QuickTime files on Windows PCs, a Windows software driver is required. The necessary drivers and QuickTime player files are distributed with the Windows application, usually in a separate folder labeled "qtw."

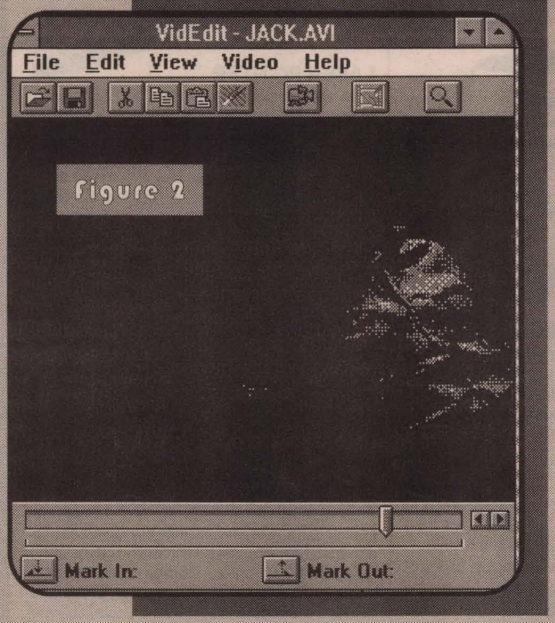
One of the great strengths of QuickTime is that video files created on a Macintosh can be easily ported to Windows PCs using QuickTime for Windows. The file extension for QuickTime for Windows is .mov. However, there are some differences between Macintosh and Windows video hardware. As a result, QuickTime video often shows differences in resolution, color intensity and purity, and brightness between the two systems. For this reason, there is a growing trend to use QuickTime strictly for Macintosh applications and use a Windows-only tool for Windows applications. However, if you are developing video for both Macintosh and Windows PCs and cost is a consideration, then QuickTime is the way to go.

But QuickTime shares a problem with most widely used PC video codecs: acceptable full-screen video is not possible. If you try to show a QuickTime video file on the full monitor screen, the video quality is substantially degraded and several frames will be dropped. The result is a grainy, "washed out" look that more closely resembles a rapid sequence of still images than it does video. Acceptable image quality is possible only with images substantially smaller than the full screen. This is not the fault of QuickTime or other tools, but instead is due to limitations of existing hardware (especially microprocessor capacity, the transfer rates from CD-ROM drives, and the video digitization boards used to convert analog video to digital form).

Another PC video standard that was introduced shortly after QuickTime made its debut is DVI (digital video interleaved). This was a joint effort between IBM and Intel to develop a digital video system with quality comparable to broadcast television. While technically impressive when first introduced, DVI required special proprietary ICs developed by Intel and IBM. For this reason, DVI never made a big impact, and its use has mainly been restricted to high-end video disc products for the corporate training and education markets. The big advantage of DVI is that it delivers full screen images of good quality.

SOFTWARE WIZARDRY





A PC video standard that is going to be very big in the future is MPEG. "MPEG" stands for "motion picture experts group," and reflects the fact that MPEG was developed by international groups of software, video, and hardware specialists. If you've witnessed an MPEG-capable PC in action, you've been impressed; over 70 minutes of full screen video is possible from a CD-ROM drive! MPEG compression ratios are typically between 50:1 and 200:1, and noticeable picture degradation does not happen until the upper ranges of compression. Decompression takes place in real time.

As you probably expect, this level of performance requires some heavy duty hardware and software. MPEG compression boards have dropped in price recently, but you can still expect to pay a few hundreds dollars for one. Until recently, MPEG decoding required a separate board or dedicated chips on the PC's motherboard. With the introduction of the Pentium microprocessor and improved graphics cards, it became possible to do MPEG decoding entirely in software. However, the decoding is not as complete as when dedicated hardware is used. On a 90 MHz Pentium, up to 24 frames per second of MPEG video can be decoded. On a 133 MHz system, full 30 frames per second decoding is possible. Given these trends, we can probably expect to see software MPEG decoding standard on most PCs within the next three years.

There's much more to MPEG, and it will be the subject of a future column. The point for now is that high-quality, full-screen video is soon going to be common on PCs.

Video for Windows

The first successful video software for the Windows PC market was Microsoft's Video for Windows. While MPEG is clearly the wave of the future, Video for Windows is the best current choice for Windows PCs. Video files produced by Video for Windows carry the .avi extension. These files can be played on any Windows PC through the built-in multimedia extensions of Windows.

Video for Windows contains all the basic software tools you'll need to edit video files and "capture" monitor displays and store them as video files. If you want to use video from an external source like a camcorder or VCR, you'll need a video digitizing (or capture) board for your PC. These boards vary greatly in cost and their capabilities; the cheaper boards may not be able to capture 30 frames per second video or may only be able to produce an image that occupies a small portion of the monitor display. Video digitizing boards include connectors for camcorders and VCRs, and often a separate audio input. (There are also boards from companies such as Video Toaster that can produce analog video output from a digitized video file.)

Video for Windows includes video capture and editing routines, much like the sound tools discussed in last month's column. Figure 1 shows the VidCap box. As you can see, Video for Windows supports several different codecs (all produce .avi files). Among the most commonly used codecs are Indeo (developed by Intel) and Cinepak (developed by Radius). These various codecs produce files that vary in image quality and memory space used, and you can select the appropriate codec based upon those attributes. VideoCap works much like Window's Sound Recorder tool. After selecting the desired codec, you can digitize a video signal from a camcorder, VCR, etc., and save it as an .avi file. The video file consists of two separate parts, or *tracks*; one is for video, the other is for the accompanying audio.

.avi files can be edited using the VidEdit tool. Figure 2 shows an .avi file being displayed in the VidEdit box. VidEdit lets you edit frame-by-frame; you can cut, paste, and insert individual frames anywhere in the video file. You can also select sequences of frames and cut, paste, and insert them like text in a word processing program. The accompanying audio for each video file can be edited and even replaced. For example, for a recent multimedia CD-ROM project, I replaced the existing audio narration on a video file with a new narration I wrote. My new narration was recorded by a professional announcer, and I digitized and stored it as a .wav file. Using VidEdit, I was able to strip out the original narration track and replace it with my new narration track. By making using of VidEdit's ability to edit individual frames, I was able to precisely synchronize the narration and video tracks.

There are other video editing tools available. One I like is Digital Video Producer from Asymetrix. This tool allows you to add visual effects like dissolves, fades, inverted colors, and "rippling" to a video file. You can also superimpose titles and captions on any segment of the video file, as well as combine frames from two different files to create a new video file. Advanced video editing software gives even more capabilities.

The Bottleneck: CD-ROM Drives

There's one element of PC video that you, as a software developer, can't do anything about. That's the CD-ROM drive in the user's PC. If your application will end up on a CD-ROM, you'll have to make allowances for the transfer rate of data from the CD-ROM.

There's a good reason why "4X" or "quad speed" CD-ROM drives are becoming so popular in PCs; anything slower will probably lose a few frames when playing a video file. Video from "2X" or "twin speed" drives will usually be a little "jerky" or uneven, while video from "single speed" drives will be noticeably impaired.

As 4X CD-ROM drives become standard on Pentium-class machines, such problems will eventually vanish. Until that time, however, don't push the limit on video – especially if image quality is an issue – unless you know the user will have a 4X speed drive. NV

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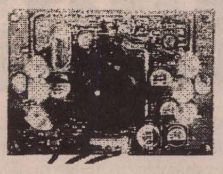

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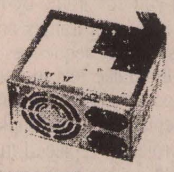

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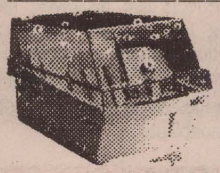

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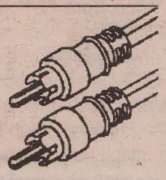

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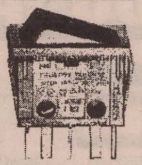
95Z017 **$4.95 each**

DPST ROCKER SWITCH



Will fit panel cutout measuring 1.1875" x 0.875". Light brown color.

95B011 **99¢ each**

HIGH SPEED SCOPE PROBE

Hewlett-Packard 10017A. 275 MHz, 9-14 pF. Includes tip accessories, adjustment tool and spec sheets.

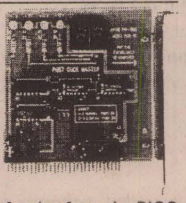
95Z020 **$59.95 each**

MAGIC LIGHT

This pocket-sized longwave 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**

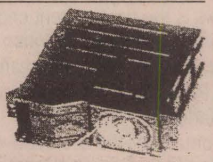
POST CODE MASTER



Captures and displays the POST codes (power-on self-test) generated by the BIOS in most '286, '386 and '486 PC's and compatibles. Complete description of codes for major BIOS manufacturers included.

95C022 **$59.00 each**

MINIATURE FOLDED HORN SPEAKERS



8 Ohms impedance without amplification. Baffled box for better bass. Frequency response ±6dB, 120 Hz to 14 KHz. Use two in parallel for for sound enhancement. Applications include multimedia (plugs into PC sound card), ham radio (visor mount), etc. Measures only 3½" x 4½ x 1½". Incredibly good sound for such small speakers!

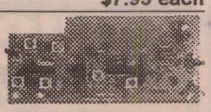
95V017 **$1.49 each**

BINOCULAR GLASSES

These sporty-glasses are actually 3x30 binoculars with focus independently adjustable for each eye. Quality lightweight construction includes two sets of inner lenses: clear and tinted. At outdoor sporting events on sunny days or while surveying a snowy landscape the dark lenses can be switched in. *Voilà!* Binocular sunglasses.

92Z034 **$7.95 each**

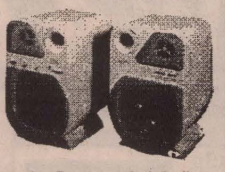
6 METER FSK BOARD



Crystal controlled on 50.675 receive frequency. Super het with 10.7MHz IF. Three ICs and one transistor. Not a kit! New, with schematics and spec sheet for major components.

92A067 **$9.95 each**

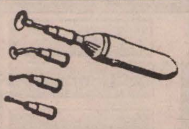
100 WATT POWERED SPEAKERS



Magnetically-shielded. Two-channel stereo amplifier. Bass/Treble/Volume controls. Power switch/indicator and cables. Measures 9" tall x 5" wide x 7" deep.

95V014 **$59.95/Pair**

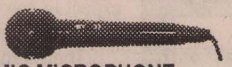
SURFACE MOUNT TOOL



The Handi-Vac® is used to remove/replace surface mount components. Vacuum to lift the part is generated by the squeeze bulb. Four metal probes and four suction cups complete the ensemble for handling all types of delicate components. Of course, everything is anti-static.

HV-Kit **$9.95 each**

DYNAMIC MICROPHONE



Use with tape recorder, multimedia computers. 600 Ohms. Includes on/off switch and 8-ft. cord with 3.5mm plug.

95V002 **$4.95 each**

MINIATURE MULTIMEDIA MIKE

Electret condenser type microphone is only 1¼" by 2". Has pocket/lapel clip and comes with hanger to fasten to computer or whatever. Can be hooked to ham radio through foot switch for hands-free applications.

95V016 **$1.99 each**

STEPPER MOTOR DRIVER IC

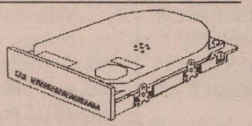
UCN5804-B. Drives a unipolar stepper in one of three operating modes: single phase, two phase or half step. Up to 12.5 Amps per phase. Step and direction input. Drive with a 555 oscillator, parallel port, etc. Build your own robot, turntable for model trains, anything that requires precision positioning.

93I002 **$4.50 each**

Above, packaged with 5V stepper motor (92M010) and schematics.

93I003 **$9.95 each**

RECYCLED HARD DRIVES



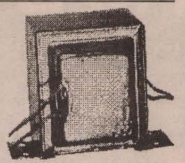
Seagate ST-225, 20MB MFM 5¼" half height.

94C033 **$19.95 each**

Quantum Q540 - 36 Meg MFM 5¼" full-height.

94C025 **$24.95 each**

36V, 3A POWER TRANSFORMER



110VAC input. P/N 199-40020.

92N021 **$6.95**

WATCH TV ON YOUR PC!

VideoHighway TV200

PC TV! PC FM! PCFrame Grabber!

Full-motion video in a movable, sizeable window from broadcast or cable TV or composite video. Freeze, store or load images from any video source. 1248x1024 interlaced, 800x600 non-interlaced, high color. No system RAM limitations. No memory address, interrupt or DMA setting required. 2 x 2W stereo audio out. No sound card required!

95C024 **$295.00**

MUMBLEY BEAR 12" Tall Teddy Bear

Talk and it imitates your voice in "bear talk." Soft and cuddly.

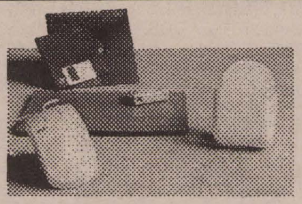
92T015 **$19.95**

LASER POINTER

This solid-state laser emits a red light up to 5mW at 670nM that will produce a spot on objects up to 100 ft. away. Use as a pointer/instructional aide, tease your cat, or use as a sight for your peashooter. Buy two so you and a friend can have lightsaber battles on foggy nights. Runs on two AAA cells and comes in a hard, protective case. Batteries included.

94L007 **$49.95 each**

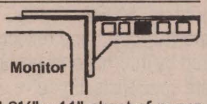
SUPER MOUSE



This mouse comes with its own house - a pocket to hang on the side of your computer for storage. Three buttons with hi-res microswitch type click switches. Comes with its own mousepad, DB9 to DB25 adapter, DOS and Windows compatible software on both 3.5" and 5.25" disks.

MUSGD **All for $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.

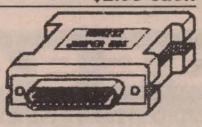
CH-6 **$2.95 each**

VGA MONITOR CABLE

Six feet long with high-density 15-pin male and female connectors.

HGA-6 **$2.95 each**

RS-232 JUMPER BOX



Use this to create a loop-back, null-modem, or to interface two devices with incompatible pinouts. Includes wire jumpers which you solder in to your requirements.

95C021 **$2.90 each**

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Write in 52 on Reader Service Card.

#70 COMPUTER EQUIPMENT WANTED *cont.*

DID YOU KNOW that old personal computers, monitors, modems, electronic cash registers, and even old calculators contain valuable IC chips that are plated with pure gold! My "Big Color Photo" (8" x 10") shows over 25 of the most common gold plated IC Chips and the price I will pay for them. Chips are shown actual size. The price of gold keeps climbing higher and higher and is making it worthwhile to tear apart old equipment. To order "The Big Photo" send $15 to Jim Sciuto, Box 128, Methuen, MA 01844.

SYNERTEK KEYBOARDS wanted. Model KTMZ, Model no. 800008. Key Technology, 1-800-456-2161 ext. 246.

KAYPRO PIGGYBANK CP/M RAM disk board wanted. Doug Margolis, 153 East 57th St., #8-G, New York, NY 10022.

WANTED: DAMAGED laptop computers (must be color). Also non-working Rolex and Accutron watches and Motorola flip phones. Call, 302-836-5504.

SHARP JX9500 laser printer memory expansion board wanted. **COMPUDYNE 386SXL/25** laptop parts/accessories such as memory expansion boards, internal modem, docking station, etc. **CALL 718-965-3442** after 6PM EST.

HP CALCULATORS with LED display wanted for private collection. Will pay up to $200 for model 10, 37E, 46, 70, 81, 91, 92, 97S, others. Bob Morrow, 317-855-2348, rkmorrow@aol.com

WANTED: TERMINALS + PRINTERS: DEC, Wyse, IBM, ADDS, Okidata, Data South, Epson, C.ITOH, etc. Call for quote on any surplus computer equipment. Call Jeremy, 603-673-8077.

WANTED: POSTSCRIPT and 25-in-one cartridges for HP LaserJet II. Stoicheff, POB 1022, Laurel, MD 20725-1022. FAX/answg mach: 301-498-8915.

LCD COLOR PANELS/PROJECTORS WANTED working or not. Fax description and price to 610-935-7666 or call 610-983-0100 ask for Neil.

WANTED: MFM hard drives: NEC D-3142; Maxtor XT-1085, XT-1140, XT-2190; Seagate ST-125, ST-138, ST-251, ST-1100; Toshiba MK134FA. Call 714-542-1037 or Fax 714-835-1575.

DEC EQUIPMENT WANTED!!! We are buying DEC systems, boards, terminals, drives and peripherals. Also Scientific Micro Systems (SMS), DSD, Datability, Dilog, other DEC compatibles, and Computer Output Microfilm (COM) units. Please call for a quote or fax us your equipment list. We buy, sell, and trade. **KEYWAYS, INC.,** 513-847-2300 OR fax 513-847-2350.

RAINBOW 100 computer from digital requires special format floppy to boot DOS. Who has disk? Swap/buy. Mike, 414-785-4278.

WANTED: COMPUTER memory, 30 & 72 pin SIMMs, CPUs, cache chips, call 508-532-2323, Fax 508-532-1040. BNFE, 119 Foster St., Peabody, MA 01960.

MEMORY WANTED: On or off boards, working or non-working, used and new. Call for a bid. 603-672-0218.

WANTED: COMPUTER BASED ON VME/680X0. ALSO, WANT OPERATING SYSTEM SOFTWARE, COMPILERS, APPLICATIONS, THAT WILL RUN ON VME/680X0. ALSO NEED VME CHASSIS, VME MODULES, VME FLOPPY AND/OR HARD DRIVE SUBSYSTEMS AND DOCUMENTATION. JIM, 469 JAYSON AVENUE, PITTSBURGH, PA 15228. 412-531-7619.

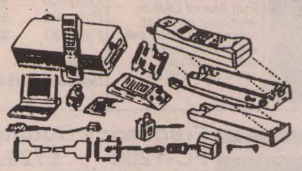
PRINTHEADS WANTED. We buy all quantities of dot matrix printheads for hundreds of printer model types. Working or dead units acceptable. Call Mike Anderson @ 1-800-969-0009.

WANTED: GOOD used VGA of SVGA color monitor repair manuals and schematics. Send make, model and price to: **TOP CAT COMPUTER, 6814 TEXAS RD., FORT SMITH, AR 72903.** PH 501-646-4773, FAX 501-646-0238.

WANTED: DICONIX working PC printer 619-394-4275.

TEST EQUIPMENT 80

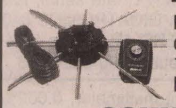
LAMBDA LES-F-02-OV Power supply, 0-18VDC, 0-48A, CVCC, digital read-out $250. **Gelman HV Power Supply,** 0-500 VDC, 125mA, dual meters, $100. **Power Designs 2K20**. Power supply, 0-2000VDC, 20mA. $225 **HP 6516A** power supply, 0-3000VDC, 0-6mA $200. **HP 6220B** power supply 0-50VDC 2 0.5A or 0-25VDC @ 1.0A, CVCC, $125. **Tektronix TM503** Three slot mainframe. $135. **Tektronix TM504** Four slot mainframe. $150. 30-day warranty. **Lehman Scientific** 717-252-4211, fax 717-252-4266, Visa/MC.



UJ'S©, EMULATOR-TEST INSTRUMENT. (REFURBISHED-DEACTIVATED-MODIFIED, CELLULAR PHONE) EFFORTLESS 5 STEP, 5 MINUTE PROGRAMMING (FOR COMMERCIAL USE) MOTOROLA'S FIRMWARES FROM 9122 TO 94XX. EMULATOR-TEST SET, AUTOMATICALLY ADJUSTS FOR MODEL, FIRMWARE, ETC., BEING PROGRAMMED, EXTENDS MOST POPULAR AMPS SOFTWARE 9122 BELOW) TO PROGRAM FIRMWARES TO 94XX, ALSO REPAIRS 0000FFFF. COMPLETE **UJME-94XX**. EMULATOR PROGRAMMING SYSTEM WITH PORTABLE PC, FITS DEEP ATTACHE CASE, OPERATES ON 12VDC, 117VAC. **UJME-99XX** ASSEMBLED, TESTED, READY TO OPERATE, INCLUDES PROGRAMMING HANDSET, EMULATOR 4 MODE CONTROL BOX, 3 FT. INTERFACE CABLE, SOFTWARE MAMPS-1E: (AMPS 9122 BELOW, MAMPS, ETAC & AMPS G2E PROGRAMS) POWER ADAPTER, INSTRUCTIONS, MODEL **UJME-94XX, $369.95 COMBINATION OFFER A: $669.95** (SAVE $40) **INCLUDES EMULATOR MODEL UJME-94XX WITH 3 SETS MOTOROLA COMPATIBLE, PHONE-EMULATOR-COMPUTER, INTERFACE CABLE HARDWARE SETS:** 5 PC SFPE FLIP/POCKET PHONES $119.95 4 PCS-689UCE BRICK/UC PHONES $129.95 AND 3 PCS-BPE FOR BAG PHONES ($89.95) PLUS BONUS PARALLEL FOUR WAY DATA TRANSFER SWITCH BOX. ($29.95 VALUE) INCLUDED. PRICES INDICATED, LESS COMPUTER. S&H $16 PER ORDER, UPS COD 2ND DAY AIR. **ELITE INTERFACE CABLE-HARDWARE SET 5 PCS-EFPE $129.95.** FREE CATALOG ORDERS, ETC., TELEPHONE 702-642-0325. **LESS BUSTER'S ELECTRONICS**, 2039 CIVIC CENTER DRIVE #176, NORTH LAS VEGAS, NV 89030.

PLEASE CHECK for current items available at http://www.fmci.com// on INTERNET. **BARTEK ELECTRONICS**, 1-800-960-8378.

FM STEREO ANTENNA



REMBRANDT MODEL 5000, omni-directional 8-element antenna is electronically rotated with remote control unit. 20"L elements; 47" dia assembled. Fits 1.25" dia mast. Includes 50 ft. 4-cond wire & control; 7 lbs. sh.
NEW **$25.00**

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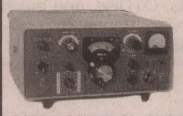
TA-1 TELEPHONE requires 2-conductor wire connected to another TA-1 for voice commnications without batteries. Palm-operated generator "buzz" signals other phone; with plastic case. Useful where radio communications is not practical. 8.5x3.5x3.5, 4 lbs.
USED-CHECKED ..... **$35.00 each; 2 for $60.00**

TA-312 FIELD PHONE, requires two D-batteries (not sound-powered); replaces old EE-8 phones. With canvas case; 12x7x4, 12 lbs. sh. **USED-CHECKED** ..... **$65.00 each**

COLLINS S-LINE RADIO



Military-surplus "winged" emblem HF Ham-band equipment; 45 lbs. each.
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KWM-2A TRANSCEIVER ..... **$425** With PM-2 supply..... **$495**
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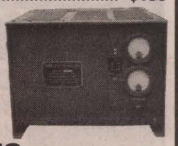
516F2 AC SUPPLY for KWM-2A/30L1 ..... **$135**
312B4 CONTROL-SPEAKER w/directional coupler **$150**

28 VDC 50 AMP SUPPLY



PP-4763A/GRC power supply produces 28 VDC 50 amps from 115/230 VAC 22/11 amp 47-63 Hz input; +/-0.5% regulation. Has meters 0-50 VDC and 0-80 amps DC; 13.5x19.5x15, 145 lbs. (Shipped UPS)
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2A3 Penta-USA (but looks Chinese-made) **$14.00**
2K25 X-band Klystron, Raytheon blue **$40.00**

3BP1 CRT	**$15.00, 2/$25.00**	**4D32 Raytheon**	**$35.00**
4CX300A Eimac	**$85.00**	**5R4WGB Cetron**	**$3.50**
1625 NU	**$4.50**	**5751 ECG-Phil**	**$4.00**
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TZPC1453G2	$65-	$62-	$59-
TZPC1003	$62-	$59-	$56-
CENTURY	$58-	$55-	$53-
WAVEMASTER	$58-	$55-	$53-

SALES REPRESENTATIVE AVAILABLE
8:30 A.M. EST–5:00 P.M. EST/MON.-FRI.
PLEASE ASK FOR GAYLE

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.

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.

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.

TEKTRONIX 492 SPECTRUM ANALYZER: 21GHz, PLOT CAPABILITY, late serial, low hours. Mixers available. GIGATRONICS 840 FREQUENCY DOUBLERS; 26-40GHz LEVELED, AMPLIFIED output. 1-800-862-8983.

FLUKE 8400A 5.5 digit multimeter, 0.002% accuracy good working condition $59. 415-244-9254.

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

SELL: WAVETEK 907A 7-12.4 GHz sig. gen., $900; Wavetek 907, 7-11 GHz sig. gen., $700; Wavetek 5100 2MHz synthesizer, $300;Tektronix 432 25MHz storage scope, $450; HP 3586C, $1,200; Hekiman Labs HLI 3701 communications test system, $400. Send for test equipment sales list. A-Comm Electronics, 7198 S. Quince St., Englewood, CO 80112. 303-290-8012.

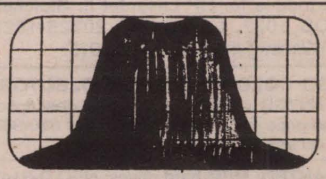
WANTED: TEST equipment in working condition. TEK, HP, FLUKE and others! DEXIS. Fax list to 612-942-9712 or voice at 612-944-7670.

FLUKE 97 ScopeMeter 50MHz DSO, less than 200 hours of actual use, perfect condition, all accessories included, $1,750. Leave voice message at, 618-256-3282.

TEST EQUIPMENT Sale: O'scopes: Tek 475, 200MHz, $500; Tek 466 DM44, 100MHz, storage, $700: Tek 475A, 250MHz, $750; Tek 465, 100MHz, $450; Tek 454A, 150MHz, $400; Tek 453, 50MHz $125; Tek 422, $85; Tek 2213, 60MHz, $450; Tek R7603, $175; Tek 7633, 100MHz, storage, $200; Tek 7623, 100MHz, storage $200; Tek 7603N, 60MHz, $300; Tek 7704, 200MHz, $175; Tek 7904, 500MHz, $350; Nicolet 4094B, 4175, F-43 with cart $1,750; Kikusui 6100, 100MHz, $450, HP 1725A, 275MHz, DMM $650; HP 1741A, 100MHz $400; HP 181, 50MHz, $250; Spec. Analyzers: Tek 491, $550, with mixers $900; HP 141T 8555A/8552B $1,500; HP 141S 8553B/8552B, $1,250. Offers accepted on multiple items. Phone or FAX 520-432-1229.

FACTORY BOXED, NEW, Struthers inline, **RF directional wattmeter.** (502-120-G1) uses 3 plug-in elements included with manual. Operates from 0 to 5,000 watts at frequencies 2-1000 MHz. Factory new, carrying/storage case w/rubberized inserts also included, $200, **free shipping** CONUS. Limited quantities. **PSITECH PLUS,** (WA1HFN), 531 Gordon Ct. Room A, Benicia, CA 94510. 707-745-4804, fax 707-747-5277.

SPECTRUM ANALYZERS FOR AUDIO, BROADCAST, VIDEO: Tek 7L5/L3 spectrum analyzer, 20Hz-5MHz, digital storage $1,400; with tracking generator $1,900. **HP 3580A** spectrum analyzer, 5HZ through 50KHz, 1HZ resolution bandwidth, digital storage, adaptive sweep, tracking generator $1,195 to $1,695. **Anritsu MS420B** powerful spectrum/network analyzer, 10Hz through 30MHz, 3Hz resolution bandwidth, digital storage, tracking generator $2,500. All in excellent condition. All with warranty. Pepper Systems, 214-353-0257.



A WIDE 3.1KHz FILTER is used for signal searching with the **RYCOM 6040** selective level meter. A 50 hertz filter, along with an AFC circuit, allows exact tuning (even with a drifting signal). Level measurements can be made with .2dB accuracy in the 300Hz to 3.5MHz range with one hertz frequency accuracy. Why pay the big boys $2,500 when I can ship you one ready for action now for $995! Gary, N6ZD. 408-385-0301, FAX 408-385-0261. GARYN6ZD@AOL.COM.

TEST EQUIPMENT sale. Hamfest prices everyday! Tek 7000 series packages starting at $350. HP 5315A counter $250. Fluke 8050A DMM $150. HP 5300 series counters starting from $50. Tektronix portables, 465 $400, 475 $450, 464 $400, 466 $450, 468 $650. Bartek Electronics, Charlotte, NC, 1-800-960-8378. 704-588-5991 FAX 24hr. Now accepting Visa and MasterCard. Please check for current items available at http://www.fmci.com// on INTERNET.

SALE, COMPLETE 8 channel recorder system with paper, manual, etc. HP 7418A $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.

IMPEDANCE MEASURING SYSTEM, Electro Scientific Industries Model 291B, consisting of 840 DC generator detector, 860 AC generator detector & 290A impedance bridge, with manual and accessories $500. **PSITECH PLUS,** 707-745-4804, fax 707-747-5277.

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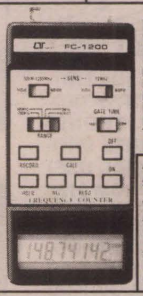

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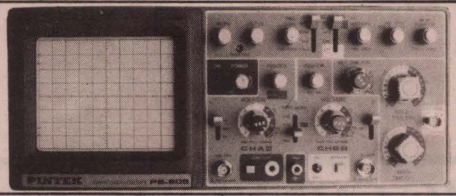

20 MHz Oscilloscope with Delay Sweep PS-205 $429.95
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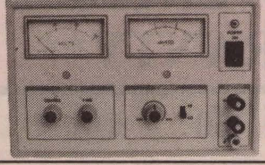

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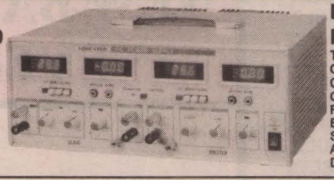

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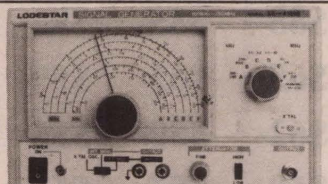

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RF Output 100mVrms to 35 MHz
Internal 1kHz, External 50Hz-20kHz AM modulation
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Sensitivity <50mV

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Synchronization: ±3% of oscillation frequency per Vrms
Output distortion:
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Sensitivity <50mV

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CUSHMAN CE-5 service monitor with VHF-RF preselector card and o'scope preselector card in working order with manuals. Call 616-839-5244 or write John Bivens, 7897 West Morristown Road, Manton, MI 49663. Sell or trade.

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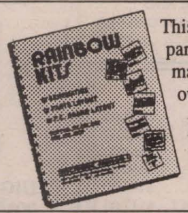

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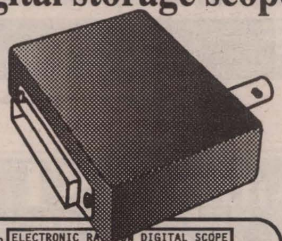

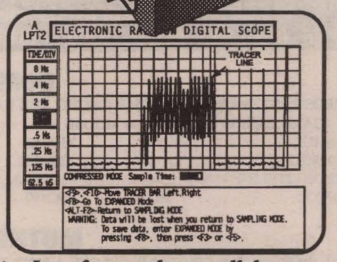

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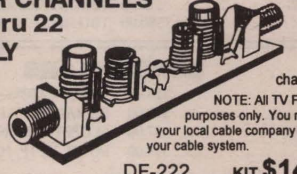

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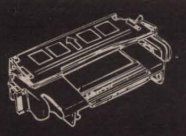

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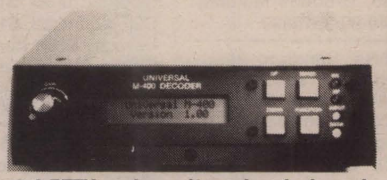

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- ■ ASCII
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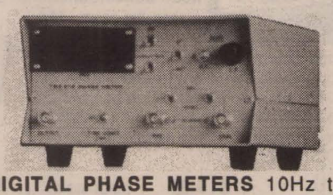

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FS73 "SIGNAL Cube RF field strength meter. Calibrated 1-100 MHz. Relative readings to GHz range. Dipole antenna for consistent readings. NYE Engineering, Inc. 4020 Galt Ocean Dr., Suite 606, Fort Lauderdale, FL 33308. Tel. 305-566-3997, FAX 305-537-3534,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

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THE LASER EXPERIMENTER

Conducted by
Anthony Charlton

Welcome! Last month, we took a look at the beginning of our Laser Video Project, which will enable us to transmit video (TV) pictures to a TV set through a VCR after they are recorded. Central to the project is a power supply of sufficient quality so the video won't be distorted.

Two power supplies are presented in Figures 1 and 2. The first is a rechargeable battery supply, and the second operates off the AC line.

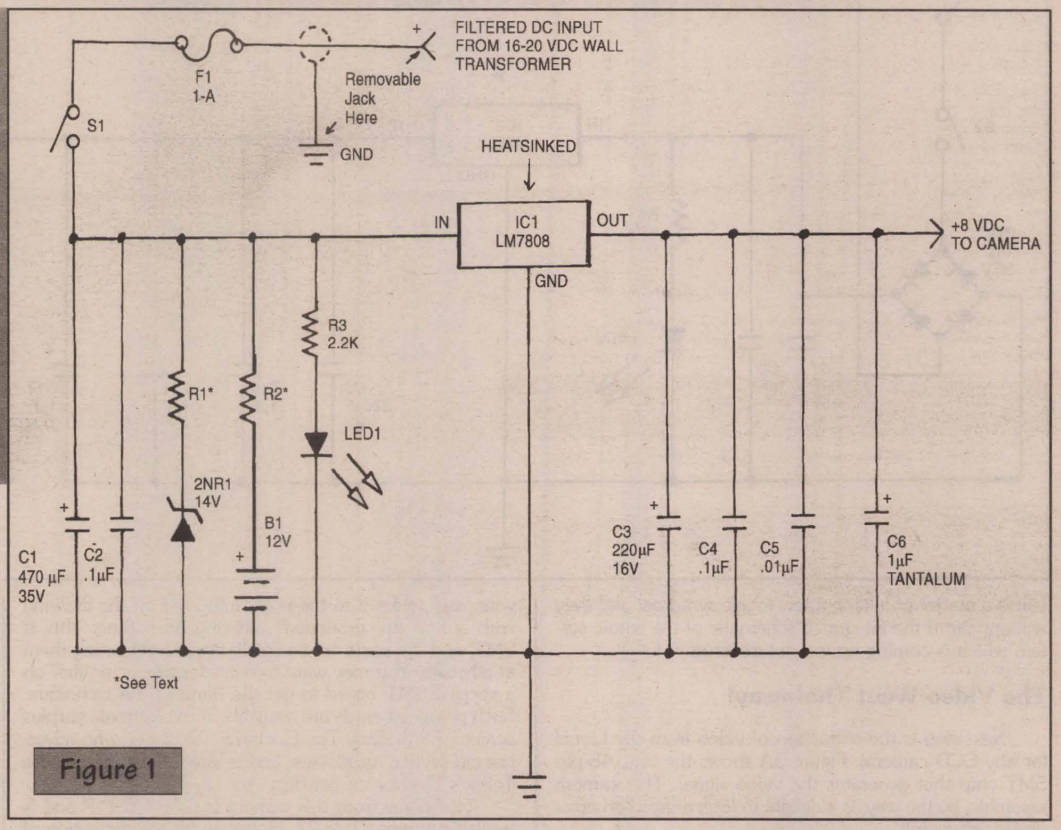

Figure 1

With the first schematic, the camera and recharge circuit for the battery are powered by a filtered DC source of 16 VDC-20 VDC supplied by a DC-output wall transformer. This can be a very modest transformer, just 100 mA of output or even less, as it is designed to trickle-charge the 12-volt lead-acid battery, B1. A fast charge circuit would be considerably more involved, and if that is what your application requires, it is suggested to purchase a battery charger that is matched to your battery. A jack is connected between the power pack and the charger transformer so you can just remove it and pick up and go wherever you want.

Note the existence of several bypass capacitors, and the fact they are of several different values. This is to insure that we get clean video input to the laser we're going to modulate by filtering and bypassing the circuit well. Note that with both circuits (which are very similar in design), there is an eight- volt IC regulator that supplies the current for the camera.

The camera's current consumption is quite high at 350 mA @ 8 VDC (regulated), so this regulator must be heatsinked. If the regulator isn't adequately heatsinked, there is a good possibility it will oscillate if it gets hot enough. Those oscillations could quite likely destroy the camera's circuitry, so be sure and use a heatsink with enough area. I find that if I bolt two dual 10-watt TO-220 heatsinks back-to-back, this makes a very useful cooler for power devices, and also it's cheap (68 cents). Model #HS114-ND was used for the prototype and is available from Digi-Key. Use plenty of heatsink grease in joining the two together, and on the back of the voltage regulator. Wipe the excess grease off after the unit is assembled.

Select a 12-volt lead-acid or gel-cell battery that will give you adequate time for your experiments. This can be figured by the formula:

T = 0.7 * (B{Ah}/0.350) * 60 where:

T is the time of operation in minutes;
B{Ah} is the amp-hour capacity of the battery;
0.350 is the amperes of consumption of the camera.

In real life, you don't want to fully discharge a battery each time or you will substantially shorten its useable lifetime. Ergo, the 0.7 multiplier factor which leaves 30% of capacity left (approximately). You can either time this interval out or design a simple supervisory circuit. That can be as easy as a comparator, which at one input uses a voltage reference IC or zener diode, and at the other a voltage divider that senses the battery's voltage relative to the reference.

Then when the monitored battery's voltage drops below a certain point (which you will have to determine experimentally), the comparator will trip to an opposite polarity state. Then it will set off whatever warning device, like say a piezo beeper, you have attached to it.

Since many people will be building this circuit and probably with all different types of batteries, the choice of reference and voltage divider is left to the builder if he or she wishes to incorporate this feature. One excellent precision voltage reference diode is the #LM385Z-2.5-ND (Digi-Key) which sells for $1.79 each. Tailor your resistive divider to input a voltage to the comparator according to your battery discharge observations. I personally choose not to let a "12-volt" lead-acid cell drop below 11.8 volts while in operation to prolong its service lifetime. The resistive divider can be adjusted if using the above specified part so that when the battery drops to 11.8 volts (or whatever you choose), the input to the comparator drops below 2.5 volts, and the warning alarm is tripped.

All rechargeable batteries require a means to recharge them, eh? The simplest means is to use a series resistor (R2 in Figure 1) in the circuit between the charger and the battery, and a 14-volt zener diode (ZNR1) as a clamp so the battery does not go over 14 volts of charge. If it does, the electrolyte will boil off and the battery will be rapidly ruined.

A good 14-volt zener of 1/2 watt dissipation is sold by whom I call "The Experimenter's Supplier Friend," — Digi-Key — and their number is 1N5244BCT-ND. It is priced at just 22 cents. Digi-Key is mentioned a lot in our work in print, and the reason is they seem to be the best supplier of many thousands of different components for the scratch builder.

Every zener diode requires a current limiting resistor at its cathode to limit the power run through the device once it begins regulating. Exceeding that power can ruin the device, resulting in overcharging the battery. This resistor is labelled R1 in Figure 1. Power dissipation of ZNR1 is calculated from the formula:

P{mW} = (V{in}-V{znr} / ZZT + R{s}) * 1000 where:

P{mw}	is the dissipated power in milliwatts;
V{in}	is the RMS (averaged) voltage to the circuit;
V{znr}	is the zener breakdown voltage (its rating);
ZZT	is the dynamic impedence of the zener in ohms;
R{s}	is the series resistance to the zener diode (R1 in our case);
1000	is the multiplier to get the equation's result in milliAmps.

Direct Video to TV: No Laser, Just Camera

This particular system uses the Lionel Railscope CCD camera, described in the last issue. The system consists of a camera module and an RF receiver module that produces an RF signal suitable for direct connection to the antenna terminals of your TV set. The system is now distributed by Images Company (see "Sources"). If you wish to bypass the laser aspect of the CCD camera and modulate the receiver board that is supplied with the camera, then you will have to compensate by adding the 150 mA the receiver board consumes to the first equation. It is a fun idea to configure the system so you can use it for both modulating the laser, and for the already available feature of RF transmission, which can bring in a picture at the antenna terminals of your TV on channel 3 or 4. Channel selection is directed by the switch on the receiver board. Switching the laser in and out of the cir-

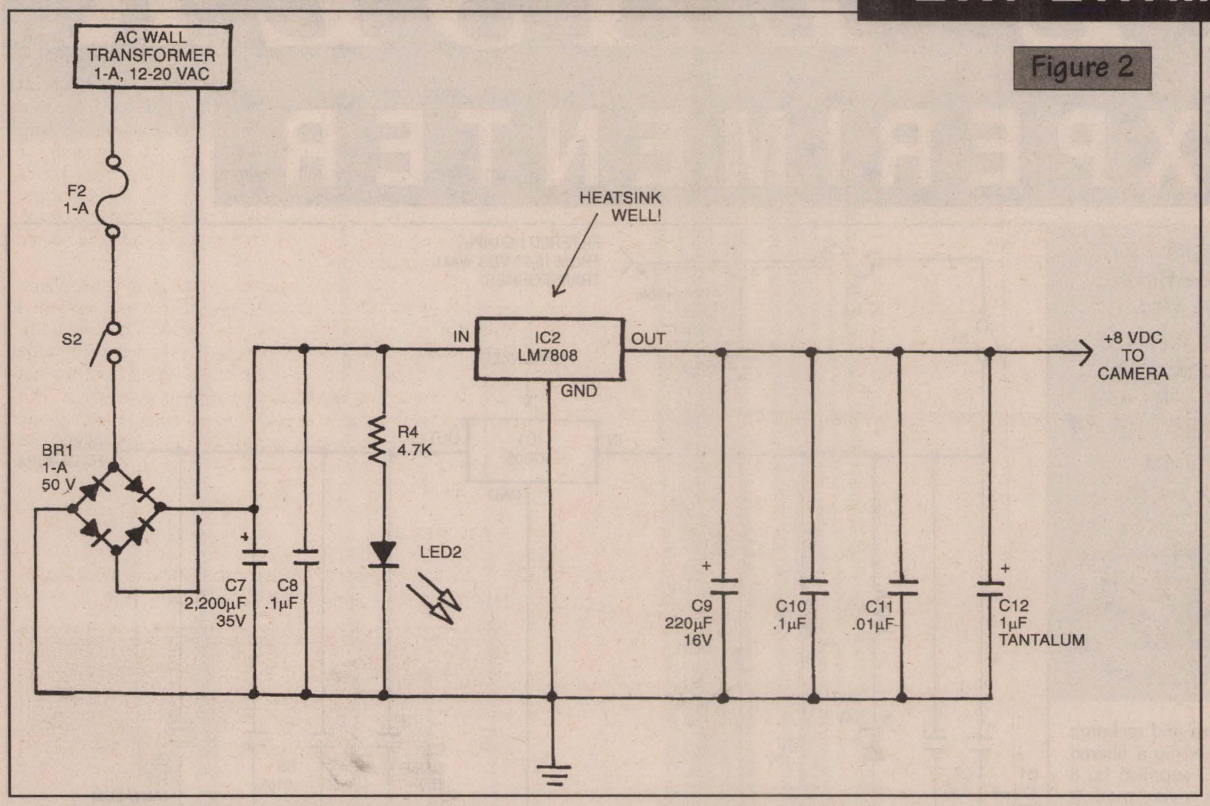

Figure 2

cuit is a matter of adding a few toggle switches, and they will appear in the integrated schematic of the whole system which is coming up in a future issue.

The Video Went Thataway!

Next stop is the extraction of video from the Lionel (or any CCD camera). Figure 3A shows the tiny, 48-pin SMT chip that generates the video signal. This camera assembly, by the way, is a delight to look at from an engineer's viewpoint.

Precise circuit layout and SMT ICs impress one's mind with the elegance of modern technology. In order to locate the video, we used a probe tied to an oscilloscope, in conjunction with directions sent in by one of our faithful readers (thank you!) and found a video signal at the location depicted in Figure 3B. This will be tapped in order to drive the laser modulation circuitry.

If you wish to tap this signal now, be EXTREMELY CAREFUL to make sure you don't short one part against the other, or to a ground. Use a fine gauge connecting wire, and solder it to the point indicated on the drawing with a fine tip, grounded soldering iron. Since this is SMT, and the parts are so small, avoid overheating them at all costs. You may want to consider practicing first on a surplus SMT board to get the hang of the technique. Such practice boards are available from electronic surplus dealers, particularly The Electronic Goldmine who advertises in several magazines, and is listed as a source in the Today's Electronics' articles.

The signal from this camera is 0.5 volts P-P and is available at pins 21 or 22. However, for the protection of the IC, the video should be extracted from the isolating capacitor, C53 as shown in the figure. Persons wishing a more powerful video signal can implement an amplifier to increase its P-P swing. Such an amplifier among several is the MAX4112, available from Maxim. Call them at (800) 998-8800 for instructions as how to get a sample.

Reader Questions Answered

Here, I would like to solicit your input again about any items that you would like to see in print, or that we can develop here in Connecticut at our modest lab. Send such info to our P.O. box here, as if you send it to *Nuts & Volts*, the reply cycle will be long, as they are very busy publishing a fine magazine and technical questions must be forwarded as time permits to the L-E P.O. Box.

One intelligent fellow asked whether we'll be running construction-type articles about high-power lasers. Such "build-it-yourself" articles have appeared in past days in science publications, most noteably *Scientific American*, and they are masterpieces of amateur technology. But in most cases, it is not responsible to give out specific details of construction about any device that may cause harm to a magazine audience that enjoys among its readership, the ambitious young student. With those few projects that could be a possible source of trouble, this experimenter has made a substantial effort to give proper safety guidelines to avoid any potential problems. I don't want anyone getting hurt. But we don't want to get bored either!

One project I have going is the proposed Moon Bounce experiment whereby a ruby laser is fired at the Moon, and the pulse returned by the retroreflector array placed there by one of the Apollo missions. The return pulse would be analyzed as to propagation time. That way, the distance between the Earth and the Moon can be determined down to just miles by utilizing a high-speed digital counter that is activated upon firing of the laser and deactivated once the pulse is returned. Such measurements are done routinely by observatories. Not bad considering the mean (average) distance between the two heavenly bodies is 238,000 miles! This is a long-term commitment, and we shall see if it all works out, and if so, publish it. The apparatus required is not inexpensive, necessitating the purchase of a moderate-sized amateur telescope plus the cost of the high-power supply used to activate the ruby rod. But we felt you might be interested in the project, ergo its mention again. The ruby laser is anticipated as generating about 5,000 watts of peak power.

High Power Laser Caution

Speaking of lasers that could cause harm, I'm notic-

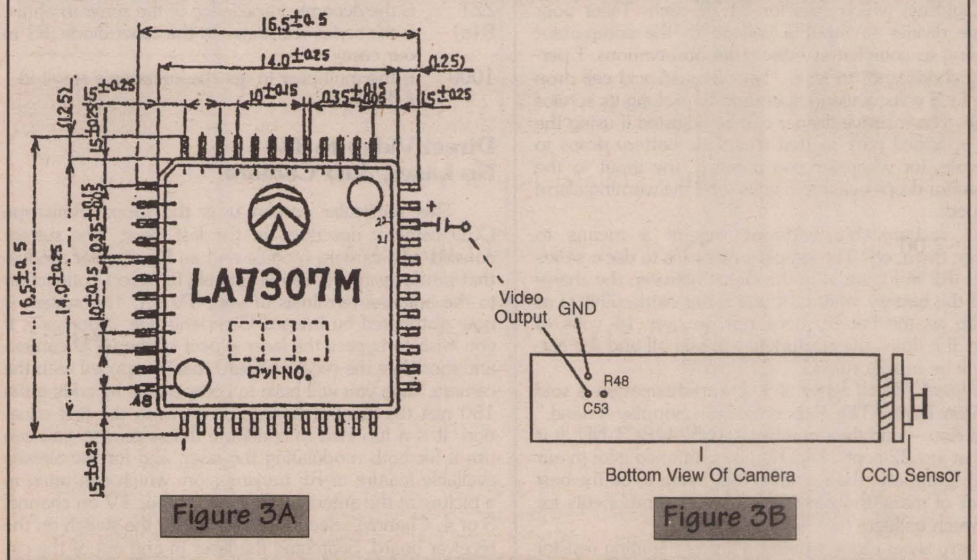

Figure 3A

Figure 3B

Parts List

IC1, IC2 — AN7808, LM7808 or #LM2940T-8.0-ND 8-volt, 1-amp volt regulator
ZNR-1 — #1N5244BCT-ND, 14-volt zener diode
LED1, LED2 — Indicator lamps to suit
BR1 — #DB101-ND 1-A, 50 PIV bridge rectifier or similar

C1 — 470 uF, 35 WVDC aluminum electrolytic capacitor
C2, C4, C8, C10 — 0.1 uF ceramic disc capacitor
C3, C9 — 220 uF, 16 WVDC aluminum electrolytic capacitor
C5, C11 — 0.01 uF ceramic disc capacitor
C6, C12 — 1 uF solid tantalum capacitor
C7 — 2,200 uF, 35 WVDC aluminum electrolytic capacitor

R1, R2 — See text
R3 — 2,200-ohms, 1/4 watt, carbon film resistor
R4 — 4,700-ohms, 1/4 watt, carbon film resistor

B1 — 12-volt rechargeable battery to suit
S1, S2 — Switch to suit
F1, F2 — 1-amp fast blow fuse

Misc — 1-amp wall transformer, heatsinks, jacks to suit, enclosure

Note: Part numbers prefixed with a pound (#) sign are Digi-Key part numbers.

THE LASER EXPERIMENTER

SOURCES

Amateur TV Quarterly, 1545 Lee Street, Des Plaines, IL 60018. Voice: (708) 298-2269, FAX: (708) 803-8994. Publisher of a magazine and several books geared to Amateur TV. Mentioned here because of the general interest to experimenters and the parallel to our Laser Video endeavor. Contact them for the current pricing of a sample issue and brochure.

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.

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

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

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

Imaging Concepts Bulletin Board Service, A free scientific bulletin board that contains, among other topics, laser information. Georgia area code. Parameters: 9600 baud, N81. Accessible 24 hours a day by calling (404) 466-3932.

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

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

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

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

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

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.

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

ing more and more high-powered devices that are available on the surplus market that may cause harm indeed. Laser experimentation is safe at the one-to-five milliwatt level if one does not stare into the beam (by into, that means looking down the barrel of the laser into its light generating area, even if for a fraction of a second), or catch strong reflections of laser light in the eye. That's why we have always focussed on these low-power lasers, and one doesn't need to be afraid of them if you have followed our guidelines in previous columns, and the advice of an informed supplier.

Protective laser eyewear is available from suppliers, like MWK Industries, listed in the "Sources" section. I personally use green oxyacetylene welder's glasses without trouble, and they're much cheaper, yet cannot be trusted to look directly into the beam, since they are not as efficient as the carefully filtered laser eyewear is. But be aware that, like experimenting with high-voltage devices, the safety of the experimenter must be foremost in mind, so investment in and use of such eyewear is a very good idea.

Conclusion

Until next month, when we shall include more exploration into laser projects and laser theory. **NV**

CLOSING QUOTE:
"What Art was to the ancient world, Science is to the modern."
— Benjamin Disraeli (1804-1881)

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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#80 TEST EQUIPMENT *cont.*

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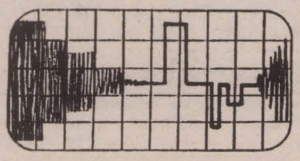

FREQUENCY COUNTERS: HP 5381A $95, HP 5383A $245, HP 5328A $245, HP 5328A/096 $495. HP 5328A/098 $545. **METERS:** HP 3490A $395, Rycom 6040 $995. HP 3406A $795. **SCOPES:** Tek 453 $245. Tek 455 & battery $495, Tek 465M $495, Tek 475 $595, HP 1725A $595, HP 1741A $595. **GENERATORS:** HP 204C $125, HP 652 $295, HP 8005B $495. HP 8660A mainframe $495, Wavetek 3000-200 $745. **ANALYZERS:** HP 334A $395. Rycom 6040 $995. Gary N6ZD. 408-385-0301, FAX 408-385-0261. GARYN6ZD@AOL.COM.

TEKTRONIX 465-DM44 scope $345 works good, perfect CRT. **ACDC Electronics electronic load** EL750 60V, 200A. Static or dynamic loading. $450. **Esterline Angus MRL multipoint recorder-logger.** 24 point, volts, resistance. T/C RTD, thermister inputs $950. Four Designs Co. VISA, M/C, AMEX, DISC. 360-887-1555.

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.

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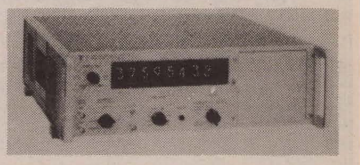
TEST EQUIPMENT Sale: Fluke 710B Impedance Bridge $250; Cohu 351 DC Std. $200; Gen-Rad 1409-L Cap. Std. $150; Gen-Rad 1482-M Ind. Std. $200; TV-7B like new $50; Fluke 730A transfer Std. $300; Tek 7000 Series Plug-ins 7A18 $65; 7A26 $100; 7A13 $150; 7A22 $150; 7A19 $150; 7B53 $150; 7D15 $200; HP 1727A, 275MHz, storage, $750; Tek 324 O'scope $150; Tek RM 529 waveform monitor, $150; Tek SC 502 O'scope $225; Tek 7B15, Time Base, $300; Tek PG 501, Pulse Generator, $175; Tek 7A11 $100; Tek AM 502 $350; Wavetek 2002, $850; Wavetek 2001 $750; Fluke 8522, DMM $450; Racal Dana 1992, Freq. counter $365; HP 5315A, Freq Counter $350; Wavetek 145, Function Gen. $350. Phone/Fax 520-432-1229.



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FOR SALE: Tek scope 7904. 2 7A26, 1 7B92, 1 7B53A, $650. Tek cart model 3 $2,900. Wanted: Tek scope 453 & Fluke digital meter 6000A. Andy Bagatta, PO Box 1036, Marlboro, NY 12542. 914-236-4773.

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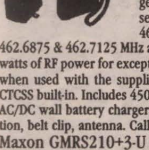

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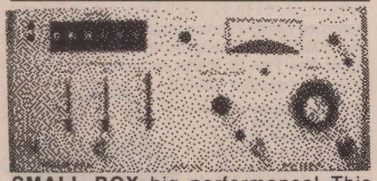

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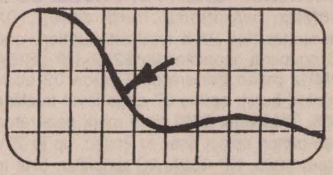

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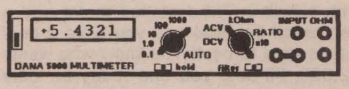

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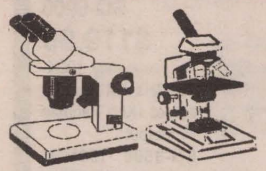

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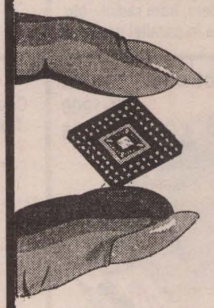

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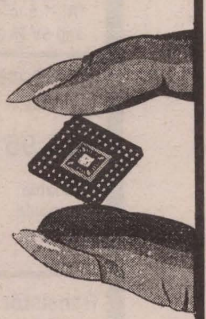

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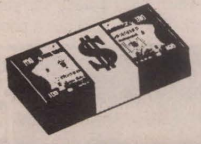

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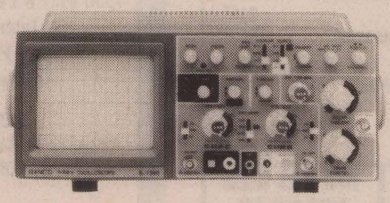

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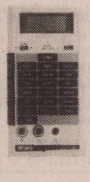

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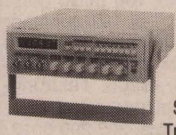

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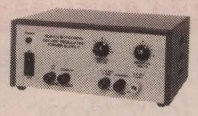

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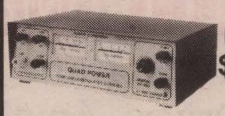

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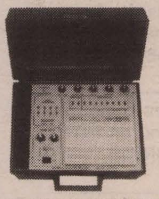

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Stamp Applications:

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

by Scott Edwards

This month's column will show you how to use an off-the-shelf LED driver chip to add an LED display to your Stamp projects with a minimum of hardware and software overhead. And since so many of you have asked, I'm beginning a new feature this month — a column within a column — introducing the fundamentals of BASIC programming.

Put Your Data Up in Lights Using an LED Display Chip

Interfacing the MAX7219 LED Driver and Part 1 of an Introduction to BASIC

Although most consumer-electronic gear uses liquid-crystal displays (LCDs), military and industrial users are still in love with light-emitting-diode (LED) readouts. Balanced against LED's brutally high-current draw and poor contrast under bright lighting are their toughness, broad viewing angle, and wide operating temperature range. These are significant advantages that the goop-under-glass construction of LCDs cannot match.

Of course, you might prefer LEDs just for their snazzy appearance.

Meet the Max

The Maxim MAX7219 LED display driver is the key to creating a Stamp-friendly LED display. The chip's features include:

- Drives up to eight seven-segment (plus decimal point) LED displays, or 64 discrete LEDs.
- Multiplexes display at high speed (more than 1200 Hz) to prevent visible flicker.
- Decodes binary-coded decimal (BCD) digits into patterns of LED segments.
- Controls current to the LEDs and provides software control over brightness.
- Permits software configuration of the display width from one to eight digits.

The figure and listing show how the hardware and software go together. Before you run off to build a display based on them, let's discuss some operating principles of multiplexed LED displays.

Multiplexing Makes the Most of the Max

The MAX7219 uses a technique called multiplexing to drive 64 LEDs with just 16 output lines. How? Look at the figure. All of the display's individual segment anodes (the + connections of the LEDs) are connected in parallel. Within each display, all of the LED cathodes (the — connections) are tied together. This is called a "common cathode" configuration.

Imagine that the *a* segment line is connected to +5 volts, but only one display's common-cathode line is grounded. The top bar (segment *a*) of that one display would light up. The other displays would remain dark, lacking a complete path from +5 to ground.

Now, if you grounded a different display's common-cathode line, its segment *a* would light.

And if you switched the ground connection from one display to another 30 or more times a second, it would appear that all of the display's *a* segments were lit at once.

It's not much of a stretch to see that a fast controller could create the impression of lighting all of the displays with different patterns of lights by rapidly switching the segment lines and scanning the digit lines. That's called *multiplexing*, and it's what the MAX7219 does.

In addition to multiplexing the displays, the MAX7219 incorporates tables that correlate the numbers 0 to 9 to their corresponding patterns of LEDs. For example, the number 3 is represented by lighting LED segments *a*, *b*, *c*, *d*, and *g*. It's normally the program's responsibility to convert digits into LED segments. However, the MAX7219 can perform this conversion for you, depending on a configuration setting. This feature saves at least a dozen bytes of PBASIC program memory in applications that use numeric displays.

Synchronous Serial Communication

The MAX7219 uses a three-wire synchronous-serial interface. We've seen these before with such peripherals as the LTC1298 analog-to-digital converter, DS1620 digital thermometer, and many others. This type of interface sends one bit at a time, just like RS-232 asynchronous serial. It differs in that it requires a separate clock pulse to tell the receiver when to grab the next data bit.

The listing shows how this process works on a BS1-type controller in the code labeled Max_out. The new BS2 controllers have a command called Shiftout that handles the whole process. In the BS2 version of the program (included with the AppKit; see Sources), the code within the For/Next loop is reduced to:

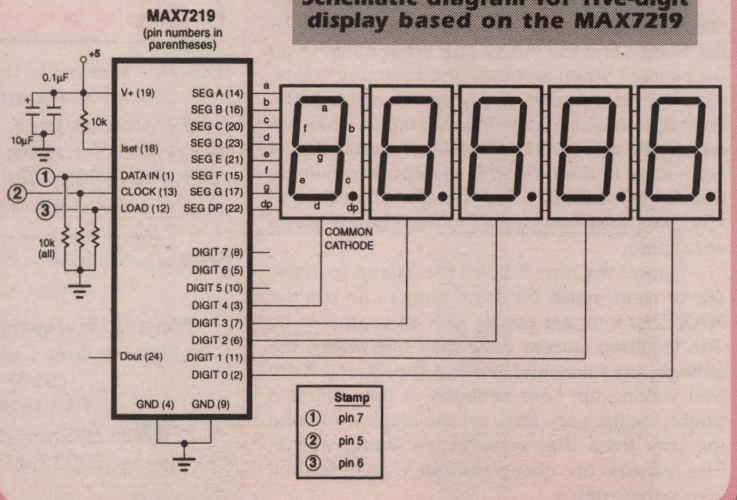
```
shiftout, Data_n,CLK,msbfirst,[temp]
```

. . . where temp is the variable containing data to be sent to the MAX7219.

Final Hardware Notes

As I mentioned at the beginning of the article, one of the reasons for preferring LCDs to LEDs is current draw. The MAX7219 provides a means of setting the segment current of the LEDs through the Iset pin. The smaller this resistor, the greater the current through each LED segment. The value shown in the schematic — 10K — sets the maximum segment current of 40 mA. If all eight segments of a particular display are lit, the current draw is 8 x 40 = 320 mA. I mention this because the voltage regulators on the Stamp products are limited to 50 mA; the Counterfeits to 100 mA. You can increase the value of the Iset resistor, but the display won't be as bright. At 60K, the segment current will be approximately 10 mA, and combined maximum draw will drop to 80 mA. Depending on the LED displays you choose, this

Schematic diagram for five-digit display based on the MAX7219



```
' Program Listing: MAX7219.BAS (Using the LED Display Driver with BS1)
' This program controls the MAX7219 LED display driver. It demonstrates
' the basics of communicating with the 7219, and shows a convenient
' method for storing set-up data in tables. To demonstrate practical
' application of the 7219, the program drives a 5-digit display to
' show the current value of a 16-bit counter (0-65535). The subroutines
' are not specialized for counting; they can display _any_ 16-bit
' value on the LCDs. (A specialized counting routine would be faster,
' since it would only update the digits necessary to maintain the
' count; however, it wouldn't be usable for displaying arbitrary
' 16-bit values, like the results of Pot, Pulsin, or an A-to-D
' conversion.)

' Hardware interface with the 7219:
SYMBOL DATA_n   = 7      ' Bits are shifted out this pin # to 7219.
SYMBOL DATA_p   = pin7   '  "   "   "     "     "
SYMBOL CLK      = 5      ' Data valid on rising edge of this clock pin.
SYMBOL Load     = 6      ' Tells 7219 to transfer data to LEDs.

' Register addresses for the MAX7219. To control a given attribute
' of the display, for instance, its brightness or the number shown
' in a particular digit, you write the register address followed
' by the data. For example, to set the brightness, you'd send
' 'brite' followed by a number from 0 (off) to 15 (100% bright).
SYMBOL dcd      = 9      ' Decode register; a 1 turns on BCD decoding.
SYMBOL brite    = 10     '  "     "   " intensity register.
SYMBOL scan     = 11     '  "     "   " scan-limit register.
SYMBOL switch   = 12     '  "     "   " on/off register.
SYMBOL test     = 15     ' Activates test mode (all digits on, 100% bright)

' Variables used in the program.
SYMBOL max_dat  = b11    ' Byte to be sent to MAX7219.
SYMBOL index    = b2     ' Index into setup table.
SYMBOL nonZ     = bit1   ' Flag used in blanking leading zeros.
SYMBOL clocks   = b3     ' Bit counter used in Max_out.
SYMBOL dispVal  = w2     ' Value to be displayed on the LEDs.
SYMBOL decade   = w3     ' Power-of-10 divisor used to get decimal digits.
SYMBOL counter  = w4     ' The value to be displayed by the demo.

' The program begins by setting up all pins to output low, matching
' the state established by the pulldown resistors.
let port = $FF00  ' Dirs = $FF (all outputs) and Pins = 0 (low).

' Next, it initializes the MAX7219. A look-up table is a convenient way
' to organize the set-up data; each register address is paired with
' its setting data. The table sets the scan limit to 4 (5 digits,
' numbered 0-4); brightness to 3; BCD decoding to the lower 5 digits
' (the only ones we're displaying), and switches the display on. The
' MAX7219 expects data in 16-bit packets, but our look-up table holds
' a series of 8-bit values. That's why the loop below is designed to
' pulse the Load line _every_other_ byte transmitted.
for index = 0 to 7              ' Retrieve 8 items from table.
  lookup index,(scan,4,brite,3,dcd,$1F,switch,1),max_dat
  gosub Max_out
  let bit0 = index & 1          ' Look at lowest bit of index.
  if bit0 = 0  then noLoad
  pulsout Load,1                ' If it's 1, pulse Load line.
NoLoad:                         ' Else, don't pulse.
next                            ' Get next item from table.

' ========== MAIN PROGRAM LOOP ==========
' Now that the MAX7219 is properly initialized, we're ready to send it
' data. The loop below increments a 16-bit counter and displays it on
' the LEDs connected to the MAX. Subroutines below handle the details
' of converting binary values to binary-coded decimal (BCD) digits and
' sending them to the MAX.
Loop:
  let dispVal = counter
  gosub MaxDisplay
  let counter = counter+1
goto loop

' ========== SUBROUTINES ==========
' The MAX7219 won't accept a number like "2742" and display it on
' the LEDs. Instead, it expects the program to send it individual
' digits preceded by their position on the display. For example,
' "2742" on a five-digit display would be expressed as:
' "digit 5: blank; digit 4: 2; digit 3: 7; digit 2: 4; digit 1: 2"
' The routine MaxDisplay below does just that, separating a value
' into individual digits and sending them to the MAX7219. If the
' lefthand digits are zero (as in a number like "102") the
' routine sends blanks, not zeros until it encounters the first
' non-zero digit. This is called "leading-zero blanking."
MaxDisplay:
let decade = 10000                  ' Start with highest digit first.
let nonZ = 0                        ' Reset non-zero digit flag.
for index = 5 to 1 step -1          ' Work from digit 5 to digit 1.
  let max_dat = index               ' Send the digit address.
  gosub Max_out
  let max_dat = dispVal/decade      ' Get the digit value (0-9).
  if max_dat = 0 then skip          ' If digit <> 0 then nonZ = 1.
  let nonZ = 1                      ' If a non-zero digit has already
skip:                               ' ..come, or the current digit is not
  if nonZ = 1 OR max_dat <> 0 OR index = 1 then skip2   '..0, or the
  let max_dat = 15                  '..._only_ digit is 0, send the digit,
skip2:                              '..else send a blank.
  gosub Max_out                     ' Send the data in max_dat and
  pulsout Load,1                    ' ..pulse the Load line.
  let dispVal = dispVal//decade     ' Get the remainder of value/decade.
  let decade = decade/10            ' And go to the next smaller digit.
 next                               ' Continue for all 5 digits.
return                              ' Done? Return.

' Here's the code responsible for sending data to the MAX7219. It
' sends one byte at a time of the 16 bits that the MAX expects. The
' program that uses this routine is responsible for pulsing the
' Load line when all 16 bits have been sent. To talk to the MAX7219,
' Max_out places the high bit (msb) of max_dat on DATA_p, the data pin,
' then pulses the clock line. It shifts the next bit into position by
' multiplying max_dat by 2. It repeats this process eight times.
' In order to avoid hogging the bit-addressable space of w0, the
' routine uses a roundabout way to read the high bit of max_dat: if
' max_dat < $80 (%10000000) then the high bit must be 0, so a 0
' appears on DATA_p. If max_dat >= to $80, then a 1 appears on DATA_p.
Max_out:
for clocks = 1 to 8                 ' Send eight bits.
  let DATA_p = 0                    ' If msb of max_dat = 1, then let
  IF max_dat < $80 then skip3       '..DATA_p = 1, else DATA_p = 0.
  let DATA_p = 1
skip3:
  pulsout CLK,1                     ' Pulse the clock line.
  let max_dat = max_dat * 2         ' Shift max_dat one bit to the left.
next                                ' Continue for eight bits.
return                              ' Done? Return.
```

may be bright enough.

Finally, you may be wondering about the 10K pulldown resistors on the interface between the Stamp and the MAX7219. What purpose do they serve? When a Stamp or Counterfeit resets, either when you first apply power or push the reset button, its pins are in input mode. They are effectively disconnected, so any digital inputs connected to them float. Such inputs frequently float high (logical 1, as though connected to +5V), but noise can cause them to change states at random.

During the time it takes the Stamp to come out of reset, noise on these inputs can put the MAX7219 into test mode, with all segments lit. The resulting current draw may overwhelm the voltage regulator, and prevent the Stamp from ever waking up. Less seriously, it may cause a bright, momentary flash on the display, making the user think that something's wrong with it. The resistors are cheap insurance against such embarrassments.

Sources

For more information on the BASIC Stamp, contact:

Parallax, Inc.
3805 Atherton Road, #102, Rocklin, CA 95765
(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:

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964 Cactus Wren Lane, Sierra Vista, AZ 85635
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FAX **(520) 459-0623**
E-Mail (CompuServe) at **72037,2612**
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 BS1 Stamps) is $69.00 and includes a 150-page manual, downloading cable kit, Parallax software, and one Counterfeit controller kit.

The MAX7219 AppKit includes complete documentation, source code for Stamps I and II and PIC microcontrollers on disk, and one MAX7219 chip for $25.00.

Visa, MasterCard, and American Express accepted for phone/fax orders. POs accepted on approved credit. Personal checks and money orders are welcome for mail orders.

If it's So *BASIC*, How Come I Don't Understand it?

I've received calls and E-Mail recently from folks who read this column regularly and are intrigued by the applications they see here, but don't know anything about programming. They're eager to get started with the Stamp or Counterfeit, but unsure about learning BASIC.

This was news to me, because BASIC has been universally available and very popular since the dawn of the personal-computer era. Most of the early "home computers" had BASIC stored in read-only memory (ROM) right on the machine. Some form of BASIC has been bundled with every version of DOS, and it's starting to show up as a macro language for programs like spreadsheets and word processors.

On the other hand, bookstore shelves are no longer full to bursting with books on BASIC, and the popularity of programming as a leisure activity for computer users has fallen *waaay* behind *Doom* and Internet flame wars. And many schools are no longer teaching BASIC as an introduction to computing. Ivory-tower types have convinced them that anything as understandable as BASIC must cause irreparable damage to the mind. The bizarre C language — the "C" is for "cryptic" — is much more effective at convincing people to leave programming to professionals.

So it's time for a running tutorial on BASIC. From now on, the final section of this column will contain hints and information on programming for newbies. Next issue will kick things off with a discussion of what a program is, and how to set about writing one. Thereafter, we'll look at topics like memory, math, logic, decisions, loops, and subroutines in detail. Naturally, since this column is about the Stamp and workalikes (the Counterfeit), we'll concentrate on PBASIC, but a lot of the concepts will apply to other BASICs, and to programming in general.

A final thought . . . most programmers agree that there are really only two effective methods for learning to program: looking at someone else's programs and writing your own. So if you have QBASIC on your DOS machine, or own one of those old built-in-BASIC dinosaurs, fire it up and play around with programming. Many of the old manuals contain great tutorials; try 'em out. If you like it (and you will), take the plunge with a Stamp or Counterfeit. We learn by doing. **NV**

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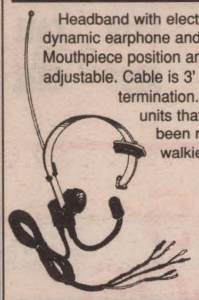

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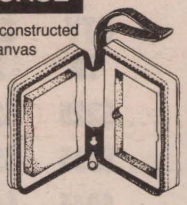

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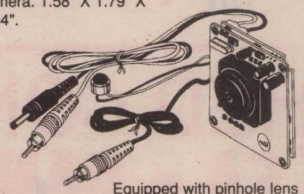

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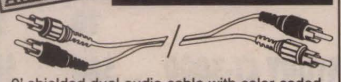

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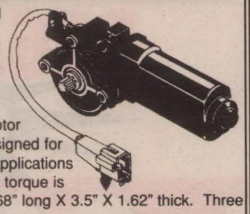

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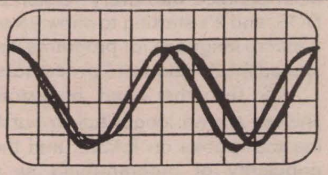

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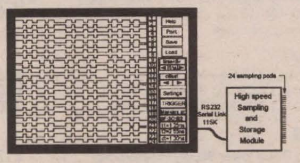

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TEK DC5004 Programmable 100 MHz/100nS $475.00
Counter/Timer, TM5000 series
TEK DC5009-opt.01 Programmable 135 MHz Univ. $750.00
Counter/Timer, TCXO, TM5000
TEK DC5010 350 MHz/3.125 nS Univ. Counter, TM5000 series $1,200.00
TEK DC503A 125 MHz Universal Counter/Timer, TM500 series $500.00
TEK DC509 135 MHz High Resolution $700.00
Universal Counter/Timer, TM500
TEK DC510 350 MHz/3.125 nS Universal Counter, TM500 series $900.00

FREQUENCY COUNTERS

EIP 545-opt.05,08 18 GHz Frequency $1,875.00
Counter, OCXO and GPIB
FLUKE 7220A-opt.111 1.3 GHz Communications $650.00
Counter, TCXO option
HP 5305B/5300B-001 1.3 GHz Counter Package $450.00
w/TCXO ref., high res. audio
HP 5340A-001,011 18 GHz Frequency Counter, ... $1,900.00
OCXO reference, HPIB
HP 5340A-005,011 23 GHz Frequency Counter, HPIB $2,000.00
HP 5342A 18 GHz Frequency Counter $2,350.00
HP 5342A-001,011 18 GHz Frequency Counter, OCXO, HPIB $2,750.00
HP 5342A-003,011 18 GHz Freq.Counter, ... $2,750.00
+22 dBm,-20 dBm dynamic range,HPIB
HP 5342A-01,04,05,11 24 GHz Frequency Counter, ... $3,900.00
OCXO, DAC, and HPIB
HP 5361A-006 20 GHz Pulsed/CW Frequency Counter, ... $6,750.00
10 Watt protection
HP 5382A 225 MHz Frequency Counter $200.00
SYSTRON-DONNER 6054B 24 GHz Frequency Counter $1,875.00
SYSTRON-DONNER 6245A-opt.12 18 GHz $1,500.00
Frequency Counter, OCXO option
TEK 7D14 525 MHz Frequency Counter, 7000 series $175.00
TEK DC504 80 MHz Frequency Counter $125.00

STANDARDS

HP 5087A-031 Distribution Amp., ... $1,800.00
0.1/1.0/5.0 MHz x 4 channels each
HP 5359A Time Synthesizer, pulse $2,000.00
width 5 nS-160 mS, jitter<200pS

AUDIO & BASEBAND

SPECTRUM ANALYZERS

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, ... $550.00
-60 dB, auto nulling
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 $1,500.00
Analyzer, 0.0025% THD, w/frame

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RMS VOLTMETERS

FLUKE 8920A True RMS Voltmeter, 180 uV-700 V, 10 Hz-20 MHz $700.00
HP 3400A RMS Voltmeter, 10 Hz-10 MHz $250.00
HP 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., 5 Hz-500 kHz, 70 dB step atten.,TM500 ..... $350.00
TEK SG505-OPT.01 Low Distortion Osc., 10 Hz-100 kHz, IMD test $1,000.00

MISCELLANEOUS

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

RF & MICROWAVE

SPECTRUM ANALYZERS

EATON/AILTECH NM-17/27A Measurement Receiver, 10 kHz-30 MHz, 0.1/1/10/50 kHz BW $3,250.00
HP 11970A WR28 Harmonic Mixer, 26.5-40 GHz $1,100.00
HP 11970K WR42 Harmonic Mixer, 18.0-26.5 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, 0.5-1500 MHz, for 8554,8568,etc. $1,500.00
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, 100 kHz-1250 MHz, 100 Hz resolution $2,000.00
HP 8555A RF Section, 0.01-18 GHz $950.00
HP 8555A/8552B/141T Spectrum Analyzer System, 10 MHz-18 GHz, 100 Hz res. $2,250.00
HP 8555A/8552B/8445/141 As above,w/1.8-18 GHz Preselector, opt.003 freq.display $3,000.00
HP 8558B/181TR Spectrum Analyzer, 0.1-1500 MHz, 1 kHz res., w/display $2,250.00
HP 85711A CATV Measurements Personality, for 8590 series $375.00
TEK 496P Spectrum Analyzer, 10 kHz-1.8 GHz, 30 Hz res., GPIB $5,500.00
TEK 7L12/7613 Spectrum An.,1 00 kHz-1.8 GHz, 300 Hz min.res.,w/display $1,875.00
TEK 7L18/7603 Spectrum Analyzer, 1.5-18.0 GHz, 30 Hz res., w/display $3,400.00
TEK TR503 Tracking Generator, 0.1-1800 MHz, for 492/4/5/6 ..... $1,750.00

NETWORK ANALYZERS

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

SIGNAL GENERATORS

FLUKE 6060A/AN Synthesized Signal Gen., 10 kHz-520 MHz, 10 Hz res,GPIB $2,000.00
FLUKE 6060B-488 Synth. Signal Gen., 10 kHz-1050 MHz, 10 Hz res., GPIB $3,750.00
GIGATRONICS 605/0.01-8.0, opt.3 Synthesized Source, 10 MHz-8 GHz, 1 kHz res. $3,000.00
GIGATRONICS 605/10-18, opt.3 Synthesized Source, 10-18 GHz, 1 kHz res. $3,000.00
GIGATRONICS 875/50 Levelled Multiplier, x4, 50.0-75.0 GHz output, -3 dBm $3,500.00
GIGATRONICS 875/86 Levelled Multiplier, 26.5-40.0 & 50.0-75.0 GHz outputs $7,000.00
GIGATRONICS 910/12-18,opt6,14,16 Synthesized Source/Sweeper, 12-18 GHz, 1 Hz res., OCXO $3,500.00
HP 85100V Frequency Mult., 10-15 GHz in / 50-75 GHz out >0 dBm $4,250.00
HP 8640B-001,002,003 Signal Gen., 0.5-1024 MHz, AM, FM, var. audio osc. $2,750.00
HP 8654A Signal Generator, 10-520 MHz, calibrated AM & uncal. FM $625.00
HP 8660C/86602B/86633B Synthesized Signal Generator, 1-1300 MHz, AM, FM $2,750.00
HP 8660C/86603A/86633B Synth. Sig. Gen., 1-2600 MHz, AM, FM, digital sweep $4,500.00
HP 8683B Signal Generator, 2.3-6.5 GHz, AM, WBFM, Pulse $5,000.00
HP 8684B Signal Generator, 5.4-12.5 GHz, AM, WBFM, Pulse $5,000.00
WILTRON 6742A Synthesizer/Sweep Generator, 18.0-26.5 & 26.5-40.0 GHz $9,000.00

SWEEP GENERATORS

GIGATRONICS 900/0.05-12, opt.3 Synthesized Sweep/Sig. Gen., 50 MHz-12 GHz, 1 kHz res. $4,500.00
HP 8350A/86290B-H08 Programmable Sweep System, 2.0-22.0 GHz, +4 dBm lvl'd $5,500.00
HP 8601A Generator/Sweeper, 0.1-110 MHz, +20 dBm levelled $500.00
HP 8620C Sweep Oscillator Frame $550.00
HP 8620C-011 Sweep Oscillator Frame, 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, crystal markers, 0-70 dB atten $1,950.00
HP 86230B RF Plug-in, 1.8-4.2 GHz, +10 dBm unlevelled $675.00
HP 86240A RF Plug-in, 2.0-8.4 GHz, +16 dBm levelled $1,000.00
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, 1-400 MHz, +10 dBm, 75 ohms $500.00
WAVETEK 2002A Signal/Sweep Generator, 1-2500 MHz, +10 dBm levelled $1,650.00
WAVETEK 907 Sweep/Signal Generator, 7.0-11.0 GHz, 0 dBm levelled $1,000.00
WAVETEK 954 Signal/Sweep Generator, 3.7-7.6 GHz, +7 dBm unlevelled $1,750.00
WAVETEK 962 Sweep Generator, 1.0-4.0 GHz, markers, +12 dBm unlvld. $2,000.00
WILTRON 6619A-003 Prog. Sweep Gen., 2.0-8.0 GHz, +10 dBm levelled, GPIB $1,900.00

POWER METERS

BOONTON 4200-01B/-4G Power Meter w/sensor, 1 MHz-26.5 GHz,-60 to +10 dBm,GPIB $1,500.00
BOONTON 42B/41-4E Analog Power Meter, with 1 MHz-18 GHz sensor $650.00
BOONTON 42B/42A-S3 Analog Power Meter, with 1 MHz-8.4 GHz N(f) sensor $375.00
GENERAL MICROWAVE 476/4240A Power Meter & Sensor, 0.01-18 GHz, -35 to +10 dBm $375.00
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 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/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, 10 kHz-1.2 GHz, 1 mV-30 V $375.00
RACAL 9303 TRMS Level Meter, 10 kHz-2 GHz, -77 to +23 dBm, GPIB $875.00

AMPLIFIERS, MISCELLANEOUS

AILTECH 7616 Noise Source, 1.0-12.4 GHz, N(m), 15 dB ENR $375.00
AILTECH 7618E Noise Source, 10 MHz-18 GHz, SMA(m), 15 dB ENR $500.00
AMPLIFIER RESEARCH 1W1000 Amplifier, 30 dB gain, 1-1000 MHz, 1 Watt output $650.00
BOONTON 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 A300 Amplifier, 55 dB, 0.3-35.0 MHz, 300 Watts $3,500.00
HP 11720A Pulse Modulator, 2-18 GHz, >80 dB on/off ratio $950.00
HP 8447A-001 Dual Amplifier, 0.1-400 MHz $500.00
HP 8901B-001,003 Modulation Analyzer, 150 kHz-1300 MHz $9,000.00
HP 8970A Noise Figure Meter, 10-1600 MHz, 0.1 dB accuracy $7,000.00
HUGHES 1177H01F000 TWT Amplifier, 30 dB, 2-4 GHz, 10 Watts $1,750.00
HUGHES 1177H02R000 TWT Amplifier, 30 dB, 4-8 GHz, 10 Watts $1,750.00
M.P.D. LAB2-1020-2A Amplifier, 34 dB, 1.0-2.0 GHz, 2 Watts $1,000.00
M.P.D. LAB2-714-3A Amplifier, 34 dB, 0.7-1.4 GHz, 3 Watts $1,000.00
MARCONI TF2304 AM/FM Modulation Meter, 18-1000 MHz, FM dev.1.5-150 kHz $500.00
MICROWAVE SEMI.CORP. MC5112 Noise Source, 25.5 dB ENR, 1.0-12.4 GHz, N(m), +28 VDC $325.00

COAXIAL & WAVEGUIDE

AEROWAVE 15-3000/10 WR15 Directional Coupler, 10 dB, 50-75 GHz $400.00
AEROWAVE 22-3000/10 WR22 Directional Coupler, 10 dB, 33-50 GHz $400.00
AMERICAN NUCLEONICS AM-432 Cavity Backed Spiral Antenna,LHC, 2-18 GHz,TNC(f) *NEW* $95.00
ANZAC MDC-171 Mixer, RF/LO=4-18 GHz, LO +7 dBm, IF=DC-4 GHz, SMA $135.00
AVANTEK 290116P3-5 Amplifier, 35 dB gain, 8-18 GHz, +20 dBm Po, 17V 600mA $275.00
BIRD 8325-30 30 dB Attenuator, 500 Watts, DC-500 MHz $325.00
FXR/MICROLAB S3-02N Triple Stub Tuner, 200-1000 MHz, 100 Watts max., N(m/f) $90.00
GR 874-LTL Constant Impedance Trombone Line, 0-44 cm, DC-2 GHz $450.00
GR 900-LB Precision Slotted Line, 0.3-8.5 GHz, 50 Ohms 0.1% tol. $450.00
GR 900-Q GR900 14mm 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 11742A DC Blocking Capacitor, 0.01-26.5 GHz, APC3.5(m/f) $135.00
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 Directional Coupler, 10 dB, 33-50 GHz $875.00
KRYTAR 202020016 Directional Det., 2-20 GHz, SMA(f/m)/SMC(f), 10 uV/uW $200.00
M/A-COM 3-19-300/10 WR19 Directional Coupler, 10 dB, 40-60 GHz $450.00
MAURY MW. 2640D Slide Screw Tuner, 1.8-18.0 GHz, APC7 ..... $375.00
MAURY MW. J320-series WR22 Calibrated Mismatch, VSWR values 1.1-2.0 ..... $375.00
MICA T-317S Isolator, 15 dB, 17.0-24.5 GHz, SMA $200.00
MILLIWAVE S91-1777B Amplifier, 2.7 dB, 18.0-26.5 GHz, +19 dBm Po, SMA(f) $150.00
NARDA 26298 20 dB Attenuator, 150 Watts, DC-1 GHz, N(f/f) $200.00
NARDA 3000-SERIES Directional Couplers $150.00
NARDA 3022 Bi-Directional Coupler, 20 dB, 1-4 GHz $350.00
NARDA 3024 Bi-Directional Coupler, 20 dB, 4-8 GHz $300.00
NARDA 3090-SERIES Precision High Directivity Couplers $225.00
NARDA 4000-SERIES SMA Miniature Directional Couplers $75.00
NARDA 4203-6 Directional Coupler, 6 dB, 2-18 GHz, SMA(f/f/f) $225.00
NARDA 4246B-10 Directional Coupler, 10 dB, 6-18 GHz, SMA(f) $100.00
NARDA 5070-SERIES Precision Reflectometer Couplers $300.00
NARDA 792FF Variable Attenuator, 0-20 dB, 2.0-12.4 GHz $375.00
OMNI-SPECTRA 2082-5810-02 Adj.Phase Trimmer, 8-18 GHz, 10 deg./GHz range,SMA(m/f) $50.00
PRD N233A/232 Slotted Line, 3-12 GHz, N(m/f), w/carriage & detector $175.00
SPACEK LABS DQ-1 WR22 Flat Broadband Detector, 33-50 GHz $550.00
TRG V510 WR15 Precision Rotary Vane Atten., 0-50 dB, 50-75 GHz $1,000.00
TRG V551 WR15 Frequency Meter, 50.0-75.0 GHz $600.00
TRG V559-10 WR15 Directional Coupler, 10 dB, 50-75 GHz $400.00
TRG W510 WR10 Precision Rotary Vane Atten., 0-50 dB, 75-110 GHz $1,000.00
TRG W559-10 WR10 Directional Coupler, 10 dB, 75-110 GHz $475.00
WAVELINE 808 WR42 Var.Phase Shifter, 0-180 deg.,gage read, 18-26.5GHz $375.00
WEINSCHEL 1515 Power Divider, DC-18 GHz, SMA(f/f/f) $125.00
WEINSCHEL 3200-1 Programmable Step Atten., 0-127 dB, DC-2 GHz, SMA *NEW* $200.00
WILTRON 60A50-opt.1 SWR Bridge, 5-2000 MHz, APC7 test port, 46 dB dir. $550.00
WILTRON 60N50 SWR Bridge, 5-2000 MHz, N(m) test port, 40 dB dir. $475.00
WILTRON 87A50 VSWR Bridge, 2-18 GHz, 35 dB dir., APC7 test port $950.00
HP 5005A Signature Multimeter $350.00

LOGIC

HP 8170A-002 Logic Pattern Generator, 2 MB/s, address driver option $1,400.00
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
TEK 1410R-opt.04 NTSC Test Signal Gen. w/SPG2,TSG1,TSP1,TSG3,TSG5,TSG6 ..... $2,750.00
TEK 1411R-opt.04 PAL Test Gen. w/SPG12,TSG11,TSP11,TSG13,TSG15,TSG16 ..... $2,750.00
TEK 144 NTSC Test Signal Generator $675.00
TEK 147A NTSC Test Signal Generator, with noise test signal $950.00
TEK 1485R Dual Standard Waveform Monitor, NTSC & PAL $1,850.00
TEK 520A NTSC Vectorscope $1,250.00
HP 59307A HPIB VHF Switch $200.00
P.A.R. 5205-94,95,96,98 Lock-In Amp, 20 Hz-20 kHz, int. osc., lin/log, GPIB $2,750.00
P.A.R. 5206 Two-Phase Lock-In Amplifier, 2 Hz-200 kHz $3,000.00
TEK TM5006 5000-series 6-slot Programmable Power Module $600.00
TEK TM503 500-series 3-slot Power Module $175.00
TEK TM504 500-series 4-slot Power Module $175.00
TEK TM506 500-series 6-slot Power Module $250.00
TEK TM515 500-series 5-slot Traveller Power Module $275.00

TEST EQUIPMENT SALES

HP 1650B	$3995	TEK 7104	$3495
HP 1650A	$2195	TEK 7904	$450
HP 1630G	$1095	TEK 7A26	$125
HP 8012B	$695	TEK 7A22	$325
HP 8444A	$1295	TEK 7A29	$650
DATRON 1065	$695	TEK 7B10	$395
KEITHLEY 224	$1195	TEK 7B15	$395
TEK 475	$625	FLUKE 5100B	$5695
TEK FG504	$575	FLUKE 5200A	$2195
TEK P6201	$295	FLUKE 732A	$2195
TEK 7B92A	$295	FLUKE 752A	$2950
TEK 7A42	$995	FLUKE 5440A	$2895

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#80 TEST EQUIPMENT *cont.*

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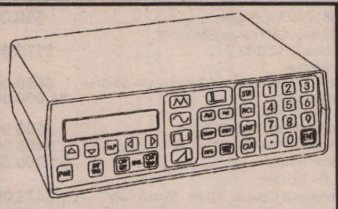

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THE ULTIMATE IN TOUCHTONE CONTROL

by Raymond Buck

Remote control devices have become a fact of life in today's world. It seems as if all electronic equipment has some type of remote control unit associated with it. One common piece of equipment that is often overlooked as a control device is the standard touch-tone telephone. It is available everywhere and is ideally suited for remote control purposes. You can have the ability to call from anywhere, and activate or de-activate equipment in your home. All that is needed is some type of interface box between your telephone line and the equipment you are trying to control. The Control Plus 16 was designed to perform this task.

The Control Plus 16 works in conjunction with any of the AC power-line control boxes that are on the market. These boxes are all referred to as being BSR compatible. They are available under several different brand names from major stores such as Sears and Radio Shack.

They control AC modules that plug into standard 117-volt outlets. The equipment to be controlled is then plugged into the module. Each module is assigned a house code and a device code. There is also an all-lights-on and all-lights-off command. However, the Control Plus 16 will not make use of these two commands.

The specific box I used is the one available at Radio Shack. It is not stocked by the stores. You go to the nearest Radio Shack store, order the unit, and it will be shipped to you from their Home Consumer Center. It only takes three or four days to receive the unit.

An alernate source for the unit is shown in the parts list. This is the same unit for less money, but takes slightly longer to receive depending on where you live since it has to come out of California. Radio Shack stocks the AC wall modules in all of their stores.

With the Control Plus 16, you are able to call into your home and control or check the status of any equipment attached to the box. Although the unit was designed to be used with the AC control boxes mentioned above, it is not limited to just this application. There are 16 relay outputs available that you can connect to any equipment. These are low-current reed relay contacts.

If you are going to be controlling any equipment that draws more than 1/2 amp, or if the equipment is connected to the 117-volt power line, you should let the built-in relays control another relay to switch the high power load. Diodes should be connected across the reed relay contacts as shown in Figure 4 to prevent contact damage.

If you are not using the PC board layouts that are available from me you do not have to use reed relays. The ULN2803 can sink 500 mA per section so it is possible to directly drive relays that can switch several amperes of current. However, be sure and watch the total power supply current rating and remember that the 7812 regulator can only handle one amp. Also, a larger heatsink will be required on the 7812 if you use more than a couple of large relays.

To use the Control Plus, you must enter a security code when accessing the unit. This code is determined during the initial set-up and can be changed at any time.

When you are connected to the Control Plus, you have several options. You can turn any relay on or off. When turning a relay on, you have the option of either a two second closure or a permanent closure. There is also a two second option followed by either a two second ON command or a two second OFF command.

These last two options are used to control the AC command center boxes. By entering the correct touchtone digits, it is possible to check the last command that was issued to any relay. The Control Plus responds with a series of beeps to indicate different relay conditions.

The Control Plus can be accessed either locally or remotely. You connect the unit between the telephone line and your telephones. If you have an answering machine, it will require a separate connection to the unit. You may pick up any telephone in the home for local access. When the unit is accessed locally, it will disconnect the telephone line from all telephones in the home. However, it will leave the answering machine connected for incoming calls. When the unit disconnects, it restores everything to normal.

For remote access, the unit will answer the ringing telephone line after the number of rings that you preset. This number can be changed at any time via touchtone control. If you have an answering

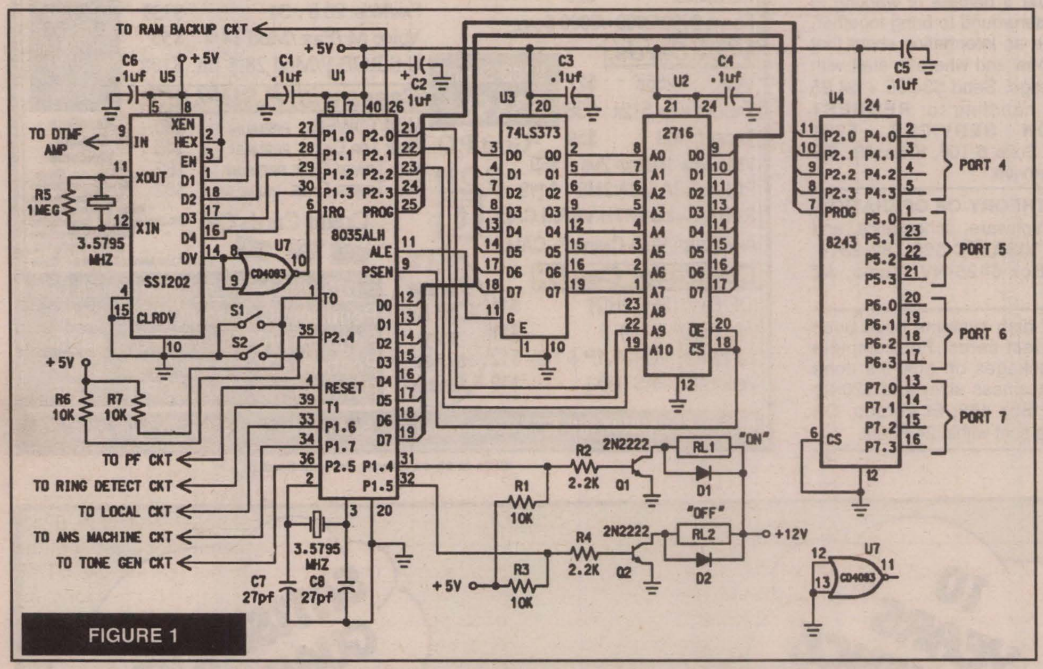


FIGURE 1

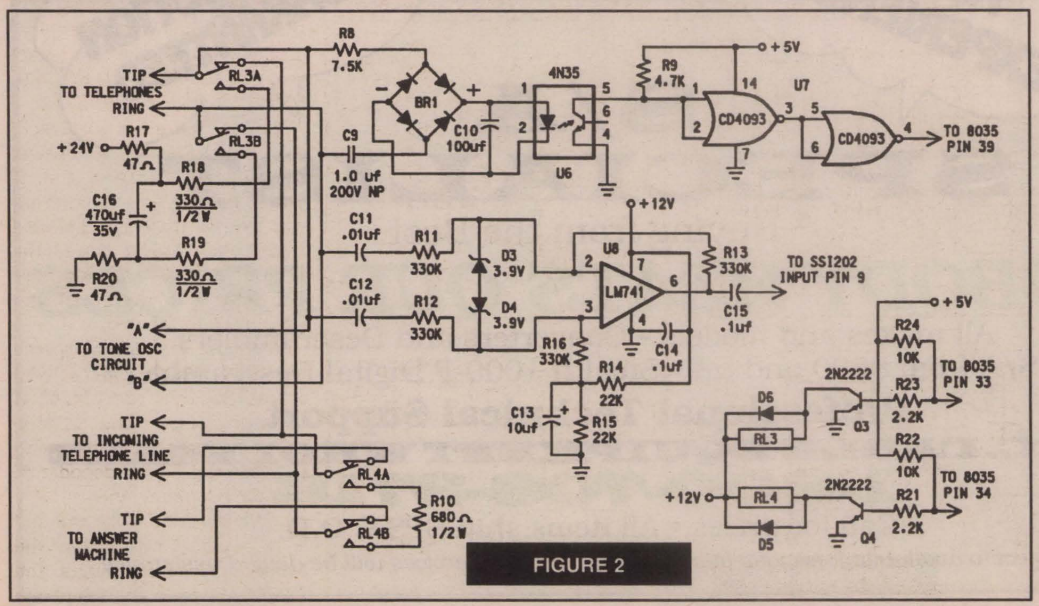
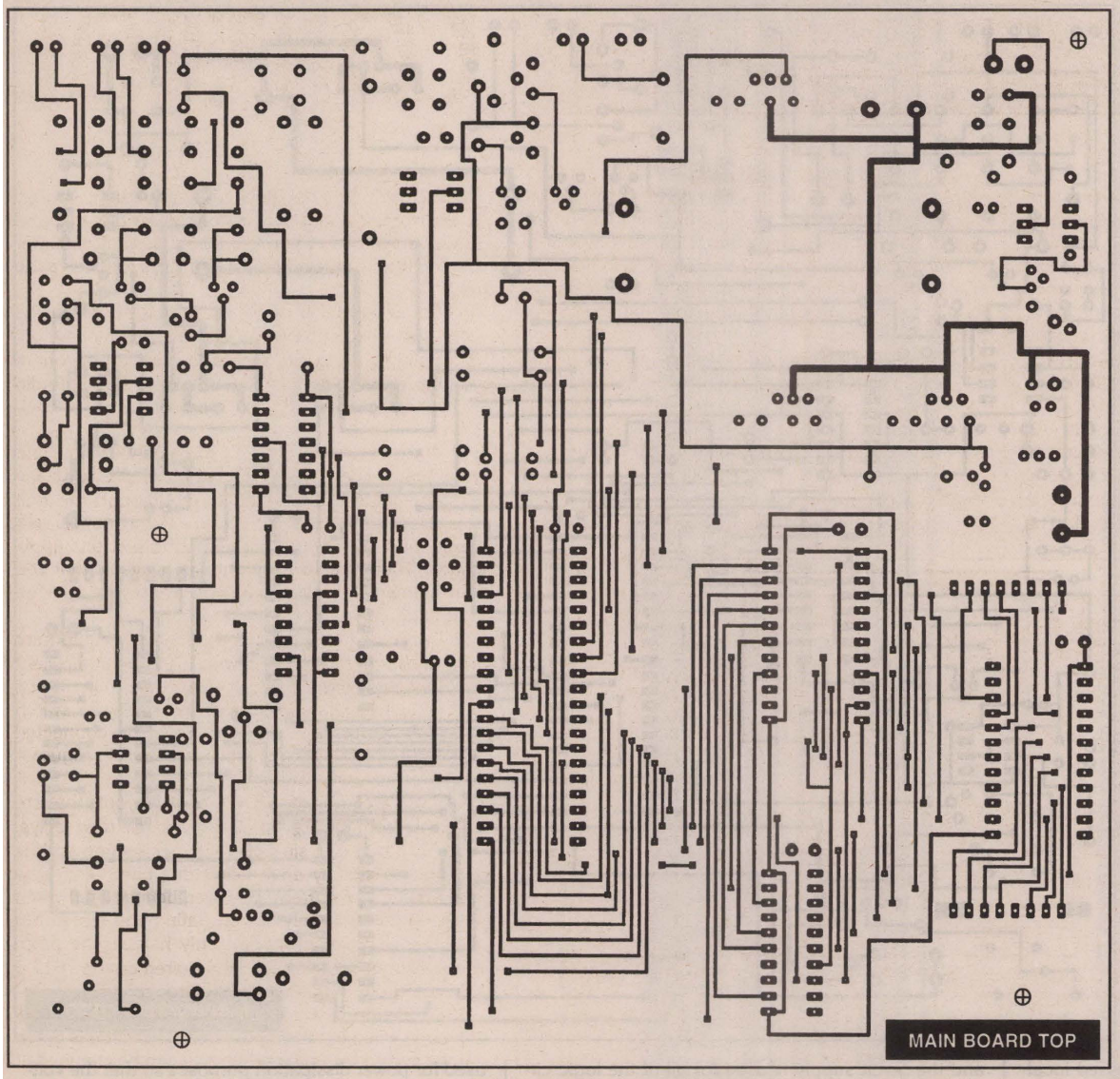


FIGURE 2



machine, you would let it answer in the normal manner. This allows your machine to still be able to take messages as if the control box were not present. When you access the Control Plus, it will disconnect the answering machine. A switch inside the unit determines whether the answering machine or the Control Plus is to answer the line. Again, when the unit disconnects, everything returns to normal.

Several things will cause the unit to disconnect. If no valid security code is entered within 15 seconds, the unit will disconnect. If a valid code is entered, the unit beeps two times to confirm that you are in the control mode. Three incorrect security code entries will also disconnect the unit. If more than 30 seconds elapse with no DTMF (touch-tone) signals being received, the Control Plus will disconnect. This 30-second timer is used as a back-up disconnect in case your telephone connection is lost before you enter a manual disconnect command.

The Control Plus has built-in battery back-up for the system RAM in cases of power outages. When power is restored, the unit will automatically return all relays to the state that they were in prior to the power outage. The last command that was issued to each relay will be re-issued. Also, since the BSR compatible modules are sometimes affected by power-line glitches that result in false ON or OFF conditions, the unit updates all relays every 10 minutes. When the unit is accessed for any reason, all relays

Depending on which commands have been issued to the relays, this update could take as long as 90 seconds. Anytime the unit is in the process of updating the relays, you will be unable to access it for control purposes. This applies to both local and remote access.

Now that you have an overview of the Control Plus 16's features, we can look at the circuit in detail and begin construction.

The heart of the unit is the 8035 microprocessor. Although this is an older processor, it is well suited for this job. It has 64 bytes of on-board RAM (all 64 bytes are used) and two built-in eight bit I/O ports. When purchasing the 8035, be sure and obtain the 8035AHL part. The AHL suffix indicates the part can be powered down and retain RAM contents. This is necessary for the automatic restoration of the relays on power up.

Since the 8035 does not provide enough I/O lines by itself, an 8243 I/O expander is added to provide an additional 16 I/O lines. These 16 lines are used to control the relays while the 8035 I/O ports are used for other control functions. Program memory is stored in a 2716 EPROM. Almost all of the available 16K of EPROM space is used.

You can obtain a copy of the source code to program the 2716 yourself or purchase a pre-programmed EPROM. See the parts list for details.

Figure 1 shows the main processing portion of the controller. The 8035, 8243, and 2716 interconnections are on the right side of the drawing. On the left are the DTMF decoder IC, option switches, and connections for other parts of the circuit. RL1 and RL2 at the bottom right are the ON and OFF relays, respectively. Figure 2 is the circuitry for interfacing to the incoming telephone line, answering machine, and telephones. The ring detect circuitry consists of R8, C9, BR1, C10, R9, U6, and U7.

If S2 in Figure 1 is not closed, the Control Plus will not answer the ringing telephone line. If you have an answering machine on the line, S2 should be left open. If S2 is closed, the Control Plus will answer after the number of rings that you program into the unit.

The unit answers by operating RL4 which places R20 across the line. The LM741 is used to isolate and provide proper impedance matching between the DTMF decoder IC and the telephone line.

RL3 operates when the unit is accessed from within the home. This disconnects the telephones from the telephone

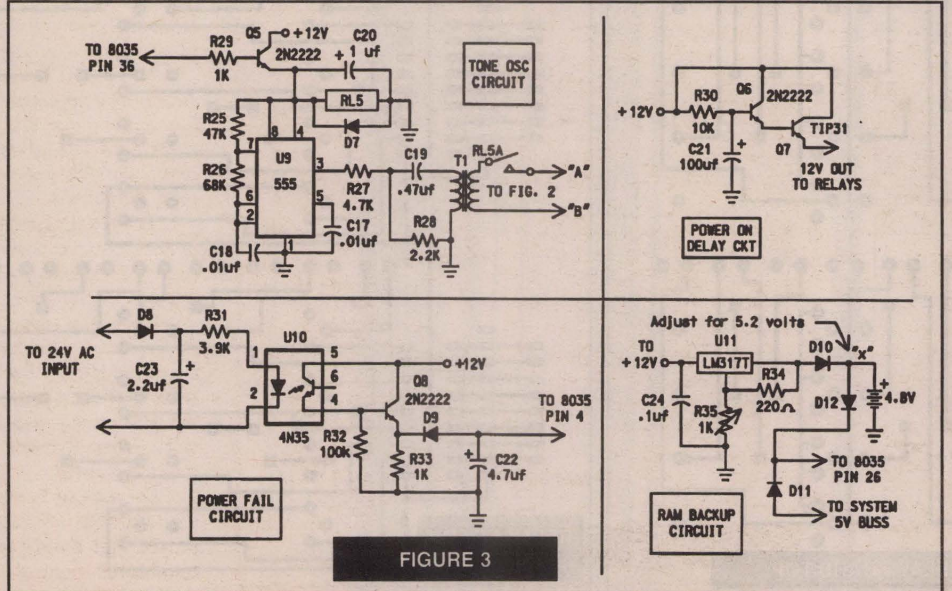


FIGURE 3

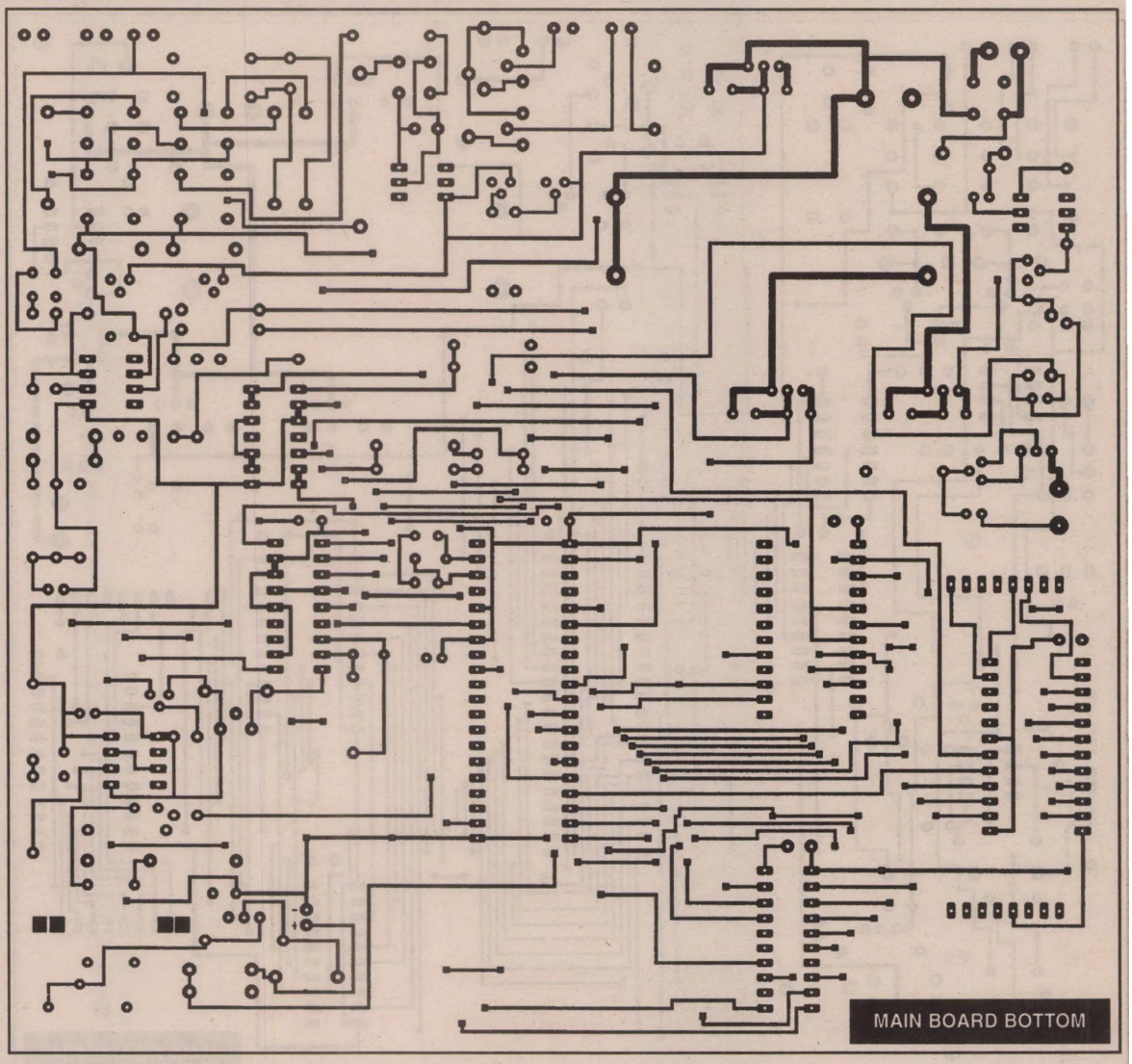
line and connects them to a talk supply voltage derived from R17, R18, R19, R20, and C16. The answering machine remains connected to the line through the contacts of RL4.

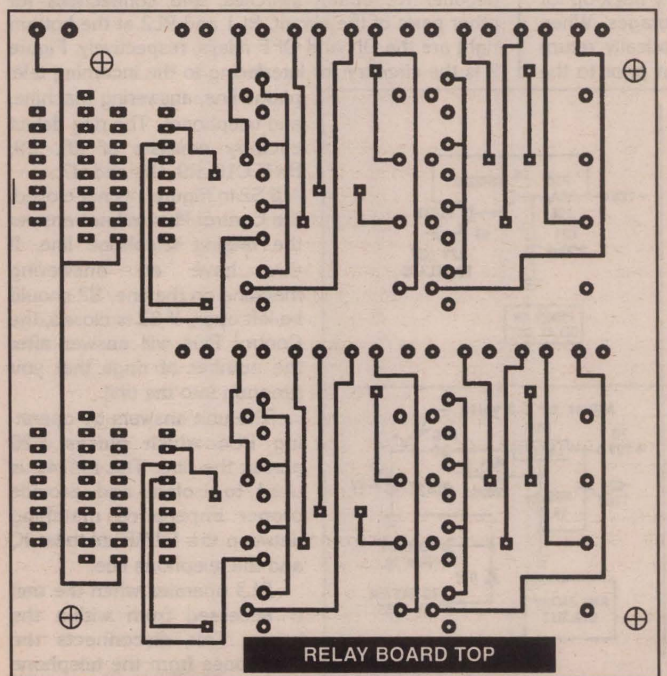
Four different circuits are shown in Figure 3. The tone oscillator circuit uses a 555 to generate the tones that are heard when accessing the unit. Different numbers of tones indicate different status conditions for the unit. The power on delay circuit is used to prevent voltage from being applied to the relays until the 8035 has had time to stabilize when first powered up. Otherwise, all relays would operate momentarily on power up.

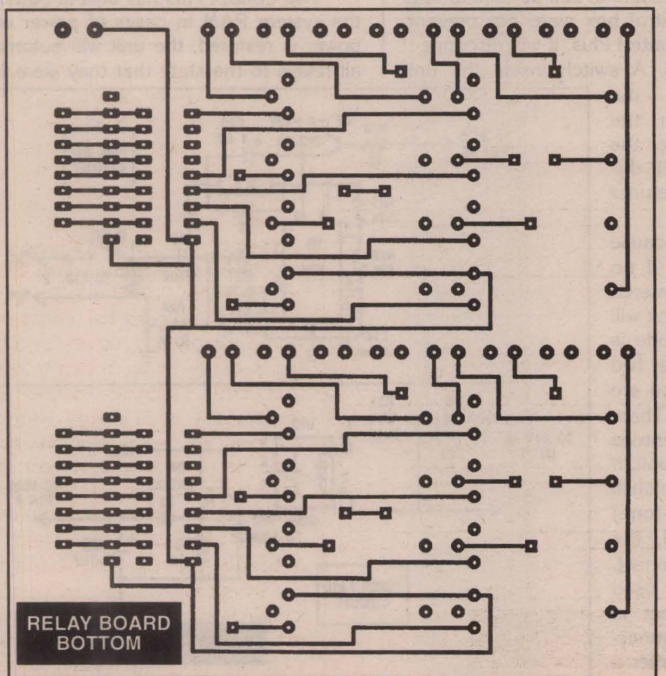
The power fail circuit is used to detect a power failure and ground the reset pin of the 8035 before the five-volt power supply drops completely out. This prevents the internal RAM data from being corrupted as the power supply falls out of tolerence.

The RAM back-up circuit is used to maintain RAM data during power outages. The 4.8-volt battery pack is made up of four 1.5-volt AA ni-cad rechargeable batteries. A trickle charge circuit consisting of U11 and D10 insures that the batteries are always fully charged. The LM317T may seem like overkill. However, if the batteries are fully discharged, they will draw about 145 mA from the charging circuit when it is first powered up. This would overheat a LM317L low power device. The trickle charge current is less than 2 mA when the batteries are fully charged.

Figure 4 shows the system power supply and relay interfacing circuitry. The power supply consists of three voltage regulators that provide 5, 12, and 24 volts for the unit. The 24-volt supply is used to provide talk battery for the telephones when the control unit is accessed locally. The 12-volt supply provides power to the relays and the 5-volt supply is used for all of the logic circuitry. The 10-watt resistors at R36 and R37 are used for power dissipation purposes so that the voltage regulators do not have to dissipate a lot of heat. This means that smaller heatsinks can be used on the regulators.

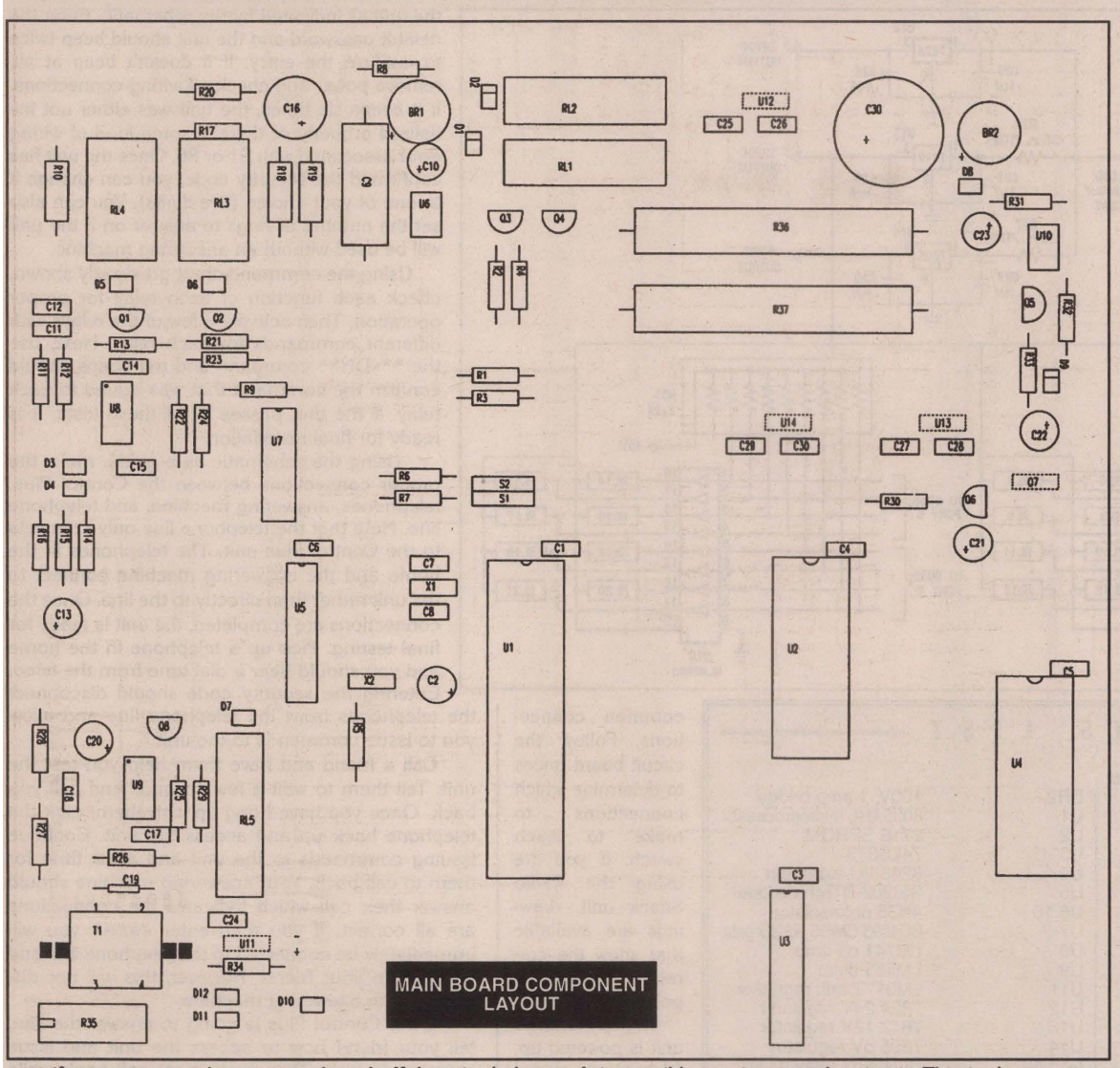

MAIN BOARD BOTTOM


RELAY BOARD TOP


RELAY BOARD BOTTOM

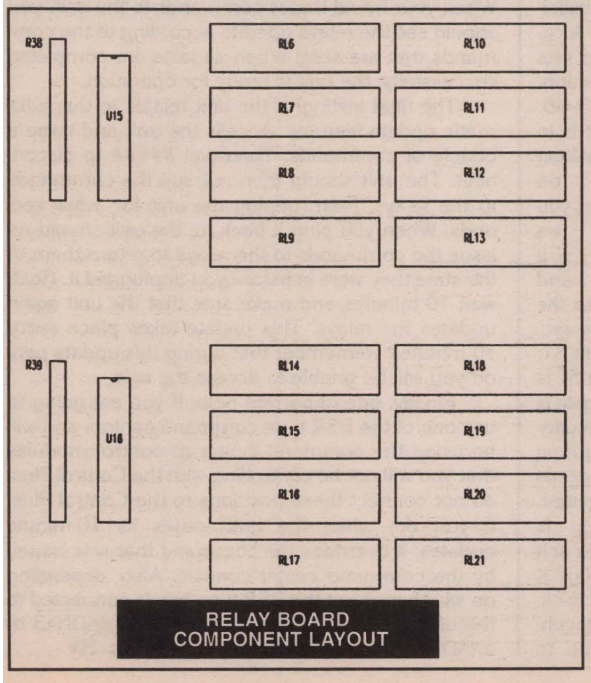
The relay circuitry contains two ULN2803 driver ICs that are driven from the four ports of the 8243. The ULN2803s have built-in spike protection diodes so that no diodes are required across the relay coils. They also provide voltage level shifting between the 5-volt logic circuits and the 12-volt relays.

I have not had printed circuit boards produced for the Control Plus unit so they are not available as a purchase item. However, you can obtain the board lay-



MAIN BOARD COMPONENT LAYOUT

outs if you want to make your own boards. If there is enough interest from readers wishing to purchase boards, I will consider having them made by a board house. It is possible to wire-wrap the circuit. This is the way the original unit was made. However, due to the large number of connections, this takes a long time and is also subject to wiring errors.



RELAY BOARD COMPONENT LAYOUT

You can also obtain the software listing if you would like to have it for possible modification. An assembler was not used to generate the software. It was all hand coded so there is some fragmentation of code. However, it is well commented and should be fairly easy to understand. If you have any specific questions, you can reach me via telephone and I will try and help you with any modifications you are trying to make.

The operation of the Control Plus is fairly simple. To access the unit from within the home, simply pick up any telephone and dial the security code. You will hear two beeps that confirm the security code was correct. If the security code is entered incorrectly, you will hear six beeps. You will be given three chances to enter the correct security code. After three incorrect entries, you will be disconnected. All correct data entries are confirmed with two beeps and all incorrect entries are acknowledged with six beeps.

To access the unit remotely, dial the telephone number that the unit is connected to. If S2 is closed, the unit will answer after the number of rings that have been programmed. If S2 is open, wait for the answering machine to answer and then enter your security code. This will disconnect the answering machine and leave the Control Plus connected to the line. You may then proceed with entering the desired commands.

The commands to control the unit are as follows:

##<DN>1 Two second relay closure
##<DN>2 Permanent relay closure
##<DN>3 Release relay permanent closure
##<DN># Two second relay closure, one second pause, two second closure of the ON relay
##<DN>* Two second relay closure, one second pause, two second closure of the OFF relay
**<DN>* Identifies last command that was issued to a relay

In all cases, <DN> refers to the device number (relay) that is being addressed. The relays are numbered 01-09 and 10-16. In the case of the **<DN>* command, the last command issued to the relay is determined by the following number of beeps:

One beep — Last command was a two second closure

Two beeps — Last command was a permanent closure

Three beeps — Last command was to release a permanent closure

Four beeps — Last command was a two second closure followed by a two second closure of the ON relay

Five beeps — Last command was a two second closure followed by a two second closure of the OFF relay

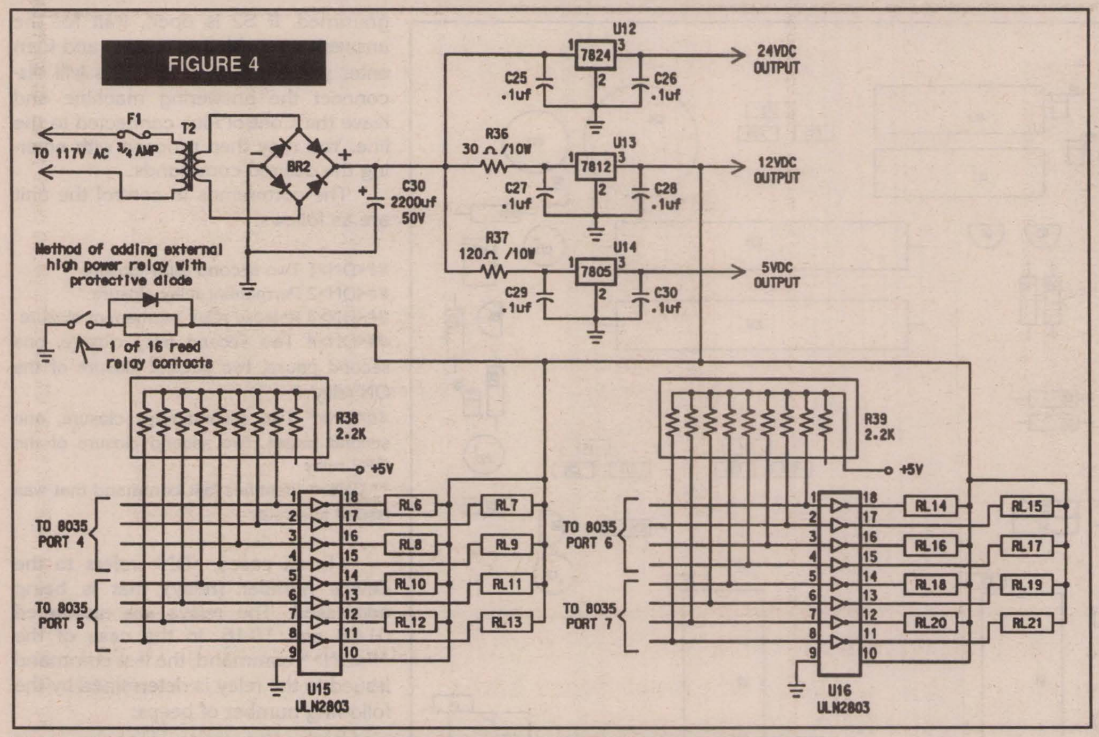
There are three additional commands as follows:

###** — Security code change
***** — Sets number of rings unit will answer on
— Immediately disconnects the unit

The security code is a five digit entry. Any number of digits less than five will be rejected. The number of rings is a two digit entry from 01 to 99.

Construct the unit according to the schematics. It is highly recommended that an IC socket be used for the 8035 and 2716. Complete the assembly, but do not install any of the ICs. Power the unit up and check the three power supply voltages. Using Figure 3 as a guide, temporarily connect a 470-ohm resistor between point "x" and ground. Adjust R35 so that 5.2 volts are present at point "x." The unit will not operate properly until this voltage is set. Once it is set, you can remove the resistor and replace it with the ni-cad battery pack. Also, make sure that five volts are present on the correct pin numbers of all ICs. If these voltages check out okay, remove power from the unit and install all of the ICs.

If the Control Plus is to be used in conjunction with one of the BSR compatible units, make the connections between the relay contacts and the switch contacts on the BSR box. The BSR switches are multiplexed and therefore several switches share



PARTS LIST

All resistors are 1/4 watt, 5% unless otherwise indicated.

R1,3,6,7,22,24,30	10K
R2,4,21,23,28	2.2K
R5	1 meg
R8	7.5K
R9,27	4.7K
R10	680 ohm, 1/2 watt
R11,12,13,16	330K
R14,15	22K
R17,20	47 ohm
R18,19	330 ohm, 1/2 watt
R25	47K
R26	68K
R29,33	1K
R31	3.9K
R32	100K
R34	220 ohm
R36	10 ohm, 10 watt
R37	30 ohm, 10 watt
R35	1K, 15 turn trimpot
R38,39	2.2K, 9 resistor SIP

Capacitors

C1,2,3,4,5,6,14, 15,24,25,26,27, 28,29,30	.1 uF monolithic or disc ceramic
C7,8	27 pF disc ceramic
C9	1.0 uF, 200V non-polarized
C10	100 uF, 16V electrolytic
C11,12,17,18	.01 uF disc ceramic
C13	10 uF, 16V electrolytic
C16	470 uF, 35V electrolytic
C19	.47 uF mono ceramic
C20	1 uF, 16V electrolytic
C21	100 uF, 16V electrolytic
C22	4.7 uF, 16V electrolytic
C23	2.2 uF, 50V electrolytic
C30	2200 uF, 50V electrolytic

Semiconductors

Q1,2,3,4,5,6,8	2N2222
Q7	TIP31
D1,2,5,6,7,8, 9,10,11,1	1N4002
D3,4	3.9V zener, 1/2 watt
BR1	200V, 1/2 amp bridge
BR2	100V, 1 amp bridge
U1	8035AHL microprocessor
U2	2716 EPROM
U3	74LS373
U4	8243 I/O expander
U5	SSI202 DTMF decoder
U6,10	4N35 optoisolator
U7	CD4093 CMOS NAND gate
U8	LM741 op amp
U9	LM555 timer
U11	LM317T adj. regulator
U12	7824 24V regulator
U13	7812 12V regulator
U14	7805 5V regulator
U15,16	ULN2803 relay driver

Misc. components

RL1,2,5-21	12V reed relay Radio Shack part #275-233
RL3,4	12V DPDT relay Radio Shack part #275-249
T1	600 ohm to 600 ohm Mouser part #42TM016
T2	24V 1 amp pwr xfmr
F1	3/4 amp fast blow
BT1	4 AA ni-cad batteries & four position holder

An alternate source for the 16-position BSR type control unit is: **Home Control Concepts**, 9520-108 Padgett St., San Diego, CA 92126 **(800) 266-8765.**

Their part number for the unit is HCC-2549.

The following is available from **ATC Electronics**, P.O. Box 14091, Scottsdale, AZ 85260.

PC board layouts	$1.00 *
Source code	$1.50 *
Connection sheet for Radio Shack console	$1.00 *
Source code and PC layouts	$2.00 *
All three above	$2.25 *

* includes mailing cost

Preprogrammed EPROM $5.00 + $2.00 S & H.

common connections. Follow the circuit board traces to determine which connections to make to each switch. If you are using the Radio Shack unit, drawings are available that show the correct connection points.

The first time the unit is powered up, S1 has to be closed and the back-up batteries have to be installed. S1 initializes all RAM locations to 0 and sets the default security code to 1-2-3-4-5. Make sure S2 is in the correct position (depending on whether or not you are using an answering machine) and apply power to the unit. Wait five seconds and open S1. The only time S1 is ever closed again is in case the security code is forgotten and the unit needs to be reinitialized. Anytime S1 is closed and the unit is powered up, it will reinitialize itself.

Connect a touch-tone telephone to the unit as indicated by the schematic. Enter the default password and the unit should beep twice to confirm the entry. If it doesn't beep at all, remove power and check all wiring connections. If it beeps six times, the unit was either not initialized properly or there is some kind of wiring error associated with S1 or R6. Once the unit has confirmed the security code, you can change it to one of your choice (five digits). You can also set the number of rings to answer on if the unit will be used without an answering machine.

Using the command chart previously shown, check each function of each relay for proper operation. Then activate a few of the relays with different commands for each relay. Next, use the **<DN>* command and the beeps should confirm the command that was issued to each relay. If the unit passes all of these tests, it is ready for final installation.

Using the schematic as a guide, make the proper connections between the Control Plus, telephones, answering machine, and telephone line. Note that the telephone line only connects to the Control Plus unit. The telephones in the home and the answering machine connect to the unit rather than directly to the line. Once the connections are completed, the unit is ready for final testing. Pick up a telephone in the home and you should hear a dial tone from the telco. Entering the security code should disconnect the telephones from the telephone line and allow you to issue commands to the unit.

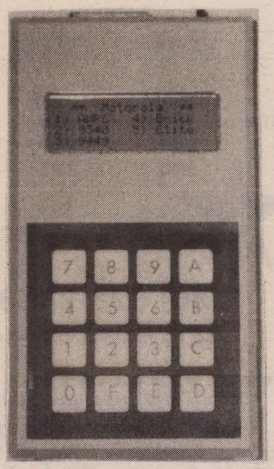
Call a friend and have them help you test the unit. Tell them to wait a few seconds and call you back. Once you have hung up with them, pick the telephone back up and access the unit. Continue issuing commands to the unit and allow time for them to call back. Your answering machine should answer their call which indicates the connections are all correct. If you then enter ##### you will immediately be connected to the telephone line and can talk to your friend. However, this will not disconnect the answering machine.

If the Control Plus is going to answer the line, tell your friend how to access the unit and issue commands to it. Then have them call back while you watch the unit for proper operation. It should answer the call after the proper number of rings. When your friend issues commands to the unit, you should see the relays operate according to the commands that are sent. When all tests are completed successfully, the unit is ready for operation.

The final testing of the unit relates to the automatic update features. Access the unit and issue a couple of commands. Then dial ##### to disconnect. The unit should then re-issue the commands to the relays. Next, unplug the unit for a few seconds. When you plug it back in, the unit should re-issue the commands to the relays to return them to the state they were in before you unplugged it. Next, wait 10 minutes and make sure that the unit again updates the relays. This update takes place every 10 minutes. Remember that during this update period you will be unable to access the unit.

Finally, one important note: If you are going to use one of the BSR type command centers and will be using the command center to control modules that you will not be controlling with the Control Plus, do not connect these positions to the Control Plus. If you do, when the unit issues its 10-minute updates, it overrides the command that was issued by the command center console. Also, depending on whether or not the BSR-type box is connected to the unit, it is a good idea to issue the ##<DN>3 or ##<DN>* to all unused device locations. **NV**

THE KOPY CAT



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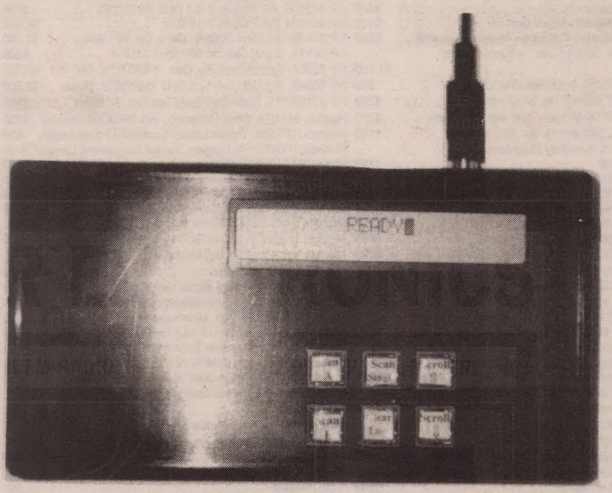

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AMATEUR ROBOTICS

by Karl Lunt

I now have my all-terrain robot (ATR) up and running. I've named the machine BYRD, for Back Yard Research Drone. BYRD will serve as the core to several upcoming articles, and you can build your own BYRD for about $200.00, depending on your junk box and access to tools.

Much of the following descriptions will refer to robot sub-assemblies discussed in previous *Nuts & Volts* columns. Consult the accompanying index, in case you need to order back issues.

I built BYRD around a Rubbermaid wheeled, beer-cooler, purchased from a local hardware store. Regularly $80.00, I waited for a big sale and picked one up for considerably less.

The cooler is quite light, but very rugged and nearly waterproof. The molded plastic construction leaves lots of places to fasten robo-thingies, and you can easily hot-glue, bolt, or foam-tape your add-ons wherever you need.

Besides being perfectly designed for robot retro-fit, this cooler really looks, well, cool. The body is bright green, the top is grey, and it has a large, purple plastic handle for pulling; the handle folds down onto the top and locks in place when not needed.

The cooler stands about 22" tall, and sports four 7" hollow plastic wheels. The front wheels are actually independent casters, which means one of the hardest aspects of robot frame design is already done for you. The original back wheels are free-spinning, mounted onto a single axle that clips into a groove along the back of the cooler.

Dan Mauch, one of the Seattle Robotics Society's top machinists, pulled the back axle off, then mounted a motor support beam along the cooler's underside. This beam holds a pair of Dayton 2L011 12 VDC gearhead motors. I fastened two 7" diameter lawn-mower wheels onto 1/2" motor shaft adapters, then fastened the shaft adapters onto the two motor shafts.

The finished frame tilts forward at a rakish angle, giving it a devil-may-care profile.

Once I had the motors and wheels mounted, I was ready to start on the interior. The cooler has a huge cavity, large enough to hold ice and a couple of six-packs. Mine now holds a pile of electronics. Refer to the accompanying system block diagram.

A portrait of BYRD.

Electrical System

I started with a pair of 6 VDC, 10 AHr gel-cell batteries, wired in series to give 12 VDC. The wiring harness mates to the batteries using standard female spade lug connections. I used 18 AWG stranded wire for all high-current wiring.

The ground connection runs to a single large lug, which serves as a common-ground return for all electronics. A common-ground point plays an important part in keeping down electrical noise within the robot. This ground point appears in the system diagram as a single large ground symbol. Note how all subassemblies have their grounds returned to this one point.

The battery's positive lead runs directly to a SPDT charging jack, mounted inside the robot's cavity. The charging jack passes power to the rest of the system until I plug in a battery charger. Then, the jack disconnects all the other electrical systems, and routes the charging power to the battery.

I used a Radio Shack 274-1565 DC power jack, covering the wire connections with heatshrink. I didn't bother mounting the charging jack onto the robot's frame; instead, I just let it flop around inside the cavity. There are no exposed voltages, and I don't mind lifting the hood to plug in the charger. The battery voltage from the charging jack next runs to a key switch, mounted in a metal chassis on the outside top of the robot. This key switch, a Radio Shack 49-515, sports a weatherproof spring-loaded cover. The key switch lets me securely turn off all power to the robot, so I can let it sit unattended without worrying that someone might start it up on their own.

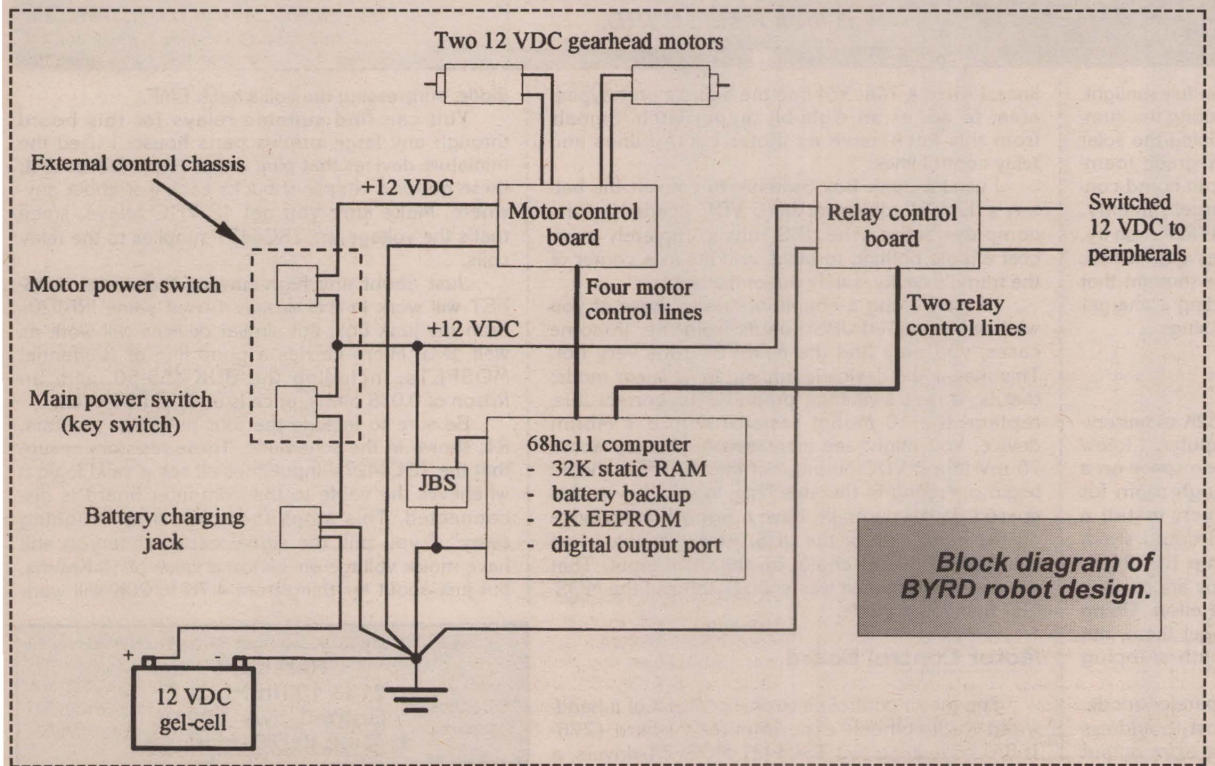
I also mounted a red LED and a 1.2 Kohm dropping resistor in the control chassis, wired to the switched side of the key switch. This gives me a visual clue when main power is turned on. I ran an 18 AWG wire from the switched side of the key switch back to the main electronics. All electronics except the motor control board get 12 VDC whenever the key switch is turned on.

I also mounted a large SPST toggle switch in the control chassis, wired into the switched side of the key switch. The other lug of this switch provides power to the motor control board, via an 18 AWG wire. This toggle switch acts as a "panic" switch, allowing anyone to quickly shut off motor power should BYRD suddenly lose control.

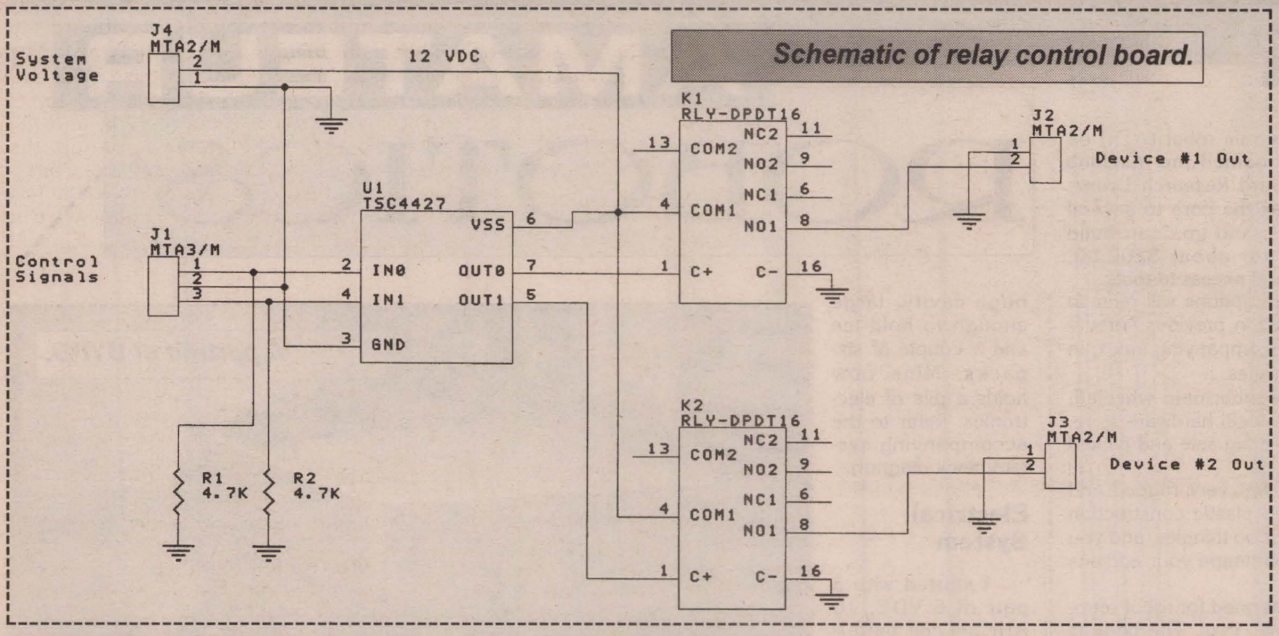
I also installed a red LED and dropping resistor in the motor voltage line, so I can tell when the motor voltage is on.

I use two battery chargers with BYRD. One is a standard wall-wart unit, based on a LM317 circuit from an earlier column. This device can recharge BYRD overnight, and I usually let BYRD trickle-charge when I'm not using it.

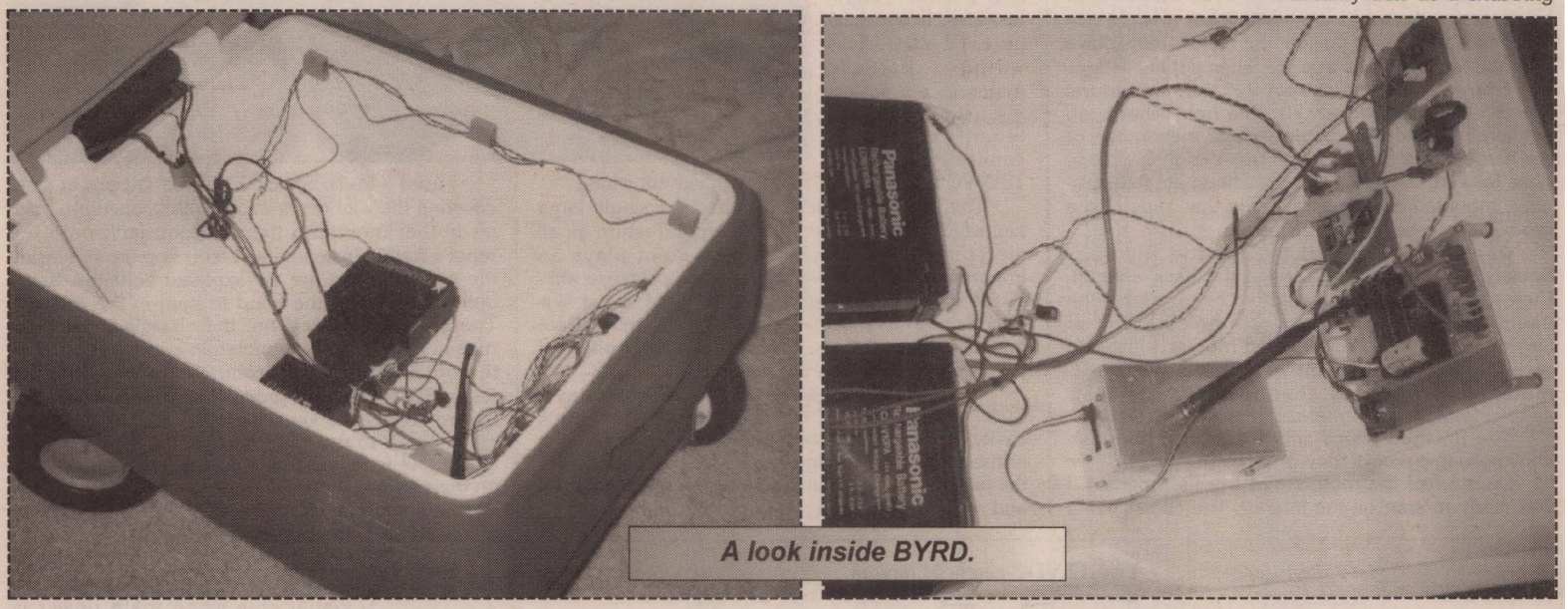
The second charger uses a large solar panel that I had laying around



Block diagram of BYRD robot design.



Schematic of relay control board.



A look inside BYRD.

from somewhere. It provides 18 VDC in full sunlight, and I can use this charger outdoors during the summer. I built the solar charger by hot-gluing the solar panel onto a large piece of industrial-grade foamcore, then connecting it to a small circuit board containing my usual LM317 battery charger circuitry. The whole panel fits neatly inside BYRD's cavity, ready to use whenever the sun comes out. Which, living in Seattle, isn't often, but it's the thought that counts. Actually, I'd be better off building a charger around a waterwheel or a treadmill for slugs . . .

Main Computer

BYRD uses a 68hc11 board with 32K of battery-backed static RAM as its main computer. I knew from the beginning that the limited code space on a BOTBoard was not going to be enough room for my planned projects. I did, however, install a 68hc811e2 MCU in the board, so I could stash some special code in the 2K on-chip EEPROM; more about this later. The '811e2 chips are proving tough to find, but they are worth the effort. Going price is about $20.00 when you can get them, but many places are quoting multi-month shipping delays.

This board uses the '811e2 in expanded mode, so most of the MCU's I/O lines are lost to address and data busses. Since I needed some extra output lines, I wired a 74hc574 into the board's prototyping area, to act as an eight-bit output latch. Signals from this latch serve as motor control lines and relay control lines.

I used a Junk Box Switcher to convert the battery's 12 VDC down to the 5 VDC needed by the computer board. The JBS runs completely cool, cost almost nothing to build, and fits in a corner of the frame's cavity, safely out of the way.

I'll pass along a couple of tips to those of you who have ordered JBS boards from me. In some cases, you may find the MOSFET runs very hot. This means the device is running in its linear mode; that is, it isn't switching properly. To correct this, replace the 10 Mohm resistor with a 1 Mohm device. You might see increased ripple, say about 75 mV in a 5 VDC output, but the MOSFET should begin operating in the switching mode. If even this doesn't do it, you might have too much inductance on the input side of the JBS. At one point, I had installed a 500 uH choke on the JBS' input. That increased inductance was enough to send the MOSFET into linear mode.

Motor Control Board

The motor control electronics consist of a hand-wired Radio Shack experimenter's board (276-168A) containing two TSC4427 MOSFET drivers, a pair of 12 VDC DPDT relays, two N-channel power MOSFETs, and assorted passives. The relays are good for about 2 amps each, more than enough for the selected motors.

You can get the TSC4427, or its equivalent, through Digi-Key or other large mail-order houses. The eight-pin IC uses digital level inputs to control higher voltage devices such as power MOSFETs. It sports two switches, controlled by signals IN0 and IN1; a high on an input connects VSS to the corresponding output.

I have used the TSC4427 before in several circuits. It is cheap, easy to get, and nearly bullet-proof. The chip is rated to 600 mA, far more than a relay coil will draw, and the TSC4427's internal circuitry acts as a snubbing diode, surpressing the coil's back EMF.

You can find suitable relays for this board through any large surplus parts house. I used the miniature devices that plug into a 16-pin DIP socket; these go for a couple of bucks each just about anywhere. Make sure you get 12 VDC relays, since that's the voltage the TSC4427 supplies to the relay coils.

Just about any high-current N-channel MOSFET will work in this design; I used some IRF520s from my junk box, but similar devices will work as well. B.G. Micro carries a good line of N-channel MOSFETs, including the BUK-455-50, with an Rdson of 0.038 ohms; price is under $1.00 each.

Be sure to include the four pulldown resistors, R1, shown in the schematic. These resistors ensure that the TSC4427s' input lines all see a valid logic 0 whenever the cable to the computer board is disconnected. This stops the robot from "running away" if you pull the signal cable while you still have motor voltage on. I show a value of 10 Kohms, but just about anything from 4.7K to 20K will work

As always, you can reach me at:
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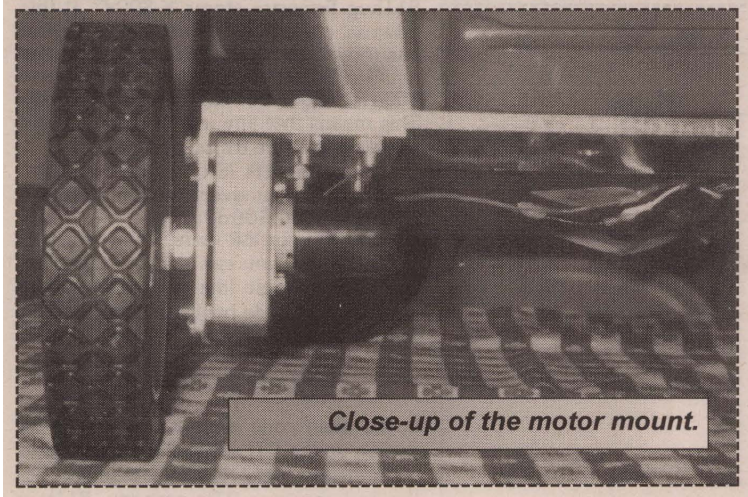

Close-up of the motor mount.

as well.

Relay Control Board

The relay control board is a simplified version of the motor control board. It lets the 68hc11 turn 12 VDC peripheral devices on and off, using digital output lines. This comes in handy when you want to control a video camera, a tape recorder, floodlights, a siren, or other actuators.

A single relay control board provides two switched 12 VDC output lines. The lines are switched on or off by two relays, similar to those used in the motor control board. These relays are, in turn, controlled by the output lines from a single TSC4427 MOSFET driver.

The two output connections on the relay control board are open-circuit if the corresponding TSC4427 input line is low; an output goes to 12 VDC if the input line goes high.

Note that I have only wired up half of each relay in this circuit. You could easily wire up the second half of a relay, if you needed to switch two different devices at exactly the same time.

Serial Communications

I designed BYRD as a tele-operated robot; it exchanges signals with the operator via the 68hc11 serial port. While you could run a long wire between your host computer and BYRD, I chose instead to connect the two using a pair of 9600 baud RF spread-spectrum modems.

I discussed these modems in an earlier column. The original modems, made by Proxim, are no longer available, but you can probably find similar RF modems by searching through the mail-order houses.

BYRD's RF link makes a huge difference in ease of use; no more fussing with serial cables whenever I need to reload BYRD's software. I don't need to pull the electronics out of the chassis; I don't even need BYRD in the same room or the same building. I just fire up my comm program and press a key; if BYRD is powered up and within 500 feet, it responds.

Part of this power comes from the firmware I've loaded into the 2K EEPROM onboard the 68hc811e2 on BYRD's computer board. The firmware, which I call 811bug, includes a full S19 loader, compatible with the Motorola S19 object records generated by SBasic, tiny4th, and the Motorola assemblers. Following power-up, the 68hc811e2 jumps to 811bug and waits for a character from the serial port. If it sees an 'S' as the first character of a new text line, 811bug assumes that

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INDEX

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

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

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

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

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

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

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

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

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

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

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

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

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

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

November 1993 — Review of the CGN 1101 68hc11 MCU module; using a 68hc11 MCU in expanded mode; the 68hc11 reset problem; introduction to Forth.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

February 1995 — CBE-1, an older robot; building Dancer, a new wire-frame robot; line-following pitfalls; the Leatherman's Super-Tool.

March 1995 — Simple vision systems; building a three-element robot eye; cheap development systems, based on the Practical Peripherals external modems; hacking the 8051 PP external modem.

April 1995 — More hacking on the 8051 PP external modem; driving 74hc595 serial latches from an 8051; building an IR serial link.

May 1995 — Review of *Sensors for Mobile Robots* by H.R. Everett; an introduction to 68hc11 SBasic.

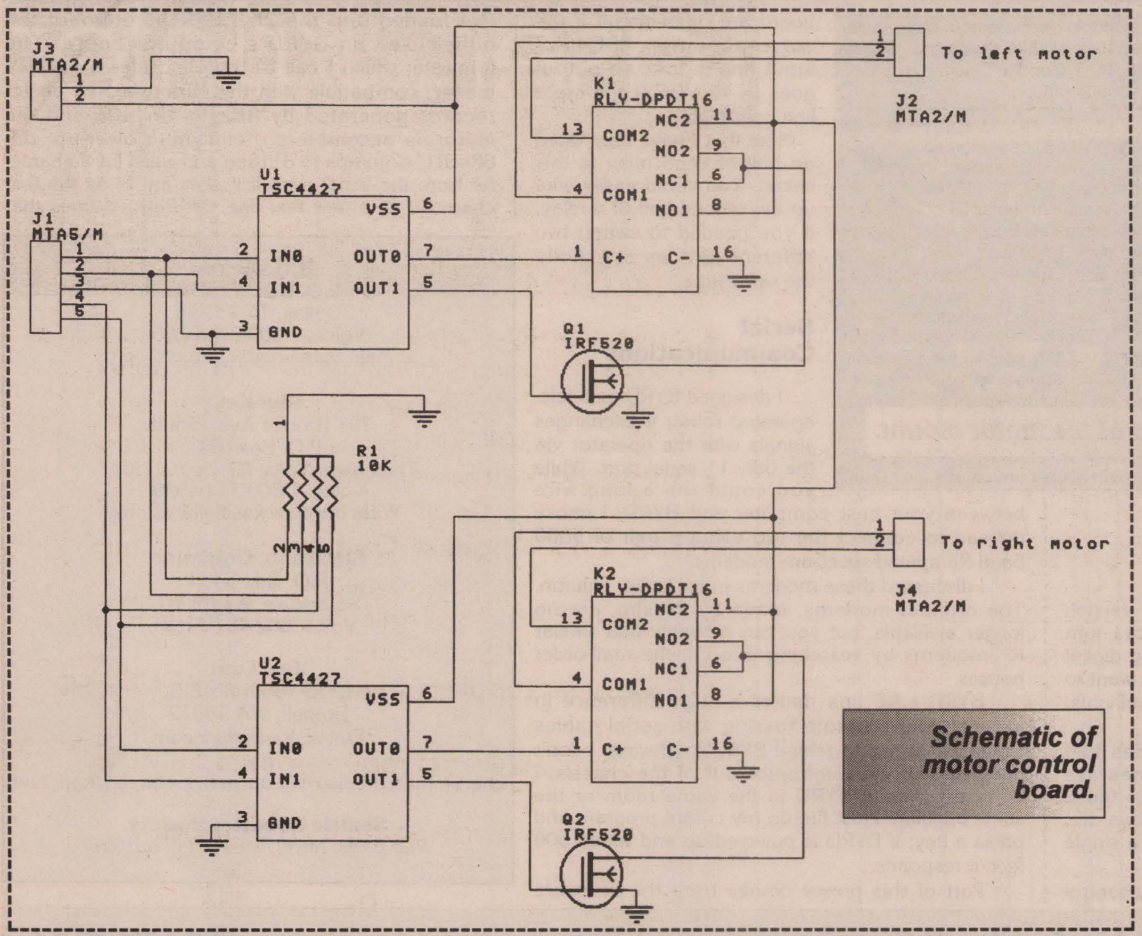
June 1995 — More on my SBasic compiler; a sample SBasic program; FREEWARE on the Web; using the Mosaic Web browser; hacking the 68302 PP external modem; review of Stanley and Krantz' *68000 Assembly Language* book.

July 1995 — More hacking on the 68302 PP external modem; making the 68302 modem board battery-powered and robot-ready; the Tangoes brain-teaser.

August 1995 — More hacking on the 68302 PP external modem; surplus in San Diego; a visit to the Monterey Bay Aquarium Research Institute (MBARI); deep-water submersible robots; review of *Star Trek Creator* by David Alexander.

September 1995 — Building the Junk Box Switcher (JBS) power supply; testing the JBS; 5th GEAR; Meccano construction set; the *Robotics Practitioner* magazine.

October 1995 — Building Artist, a drawing robot; a typical SRS meeting; Robothon '95, a club competition; SBasic code for Artist.



Schematic of motor control board.

the entire line contains an S-record of some kind.

811bug's S19 loader handles the three most common S-records in an object file. It ignores the S0 header records. It processes S1 records by storing the supplied bytes in the appropriate memory addresses. Finally, it saves the execution address in an S9 record for later use. This means that downloading a new program to BYRD is as simple as sending an ASCII file from my comm program. I don't even need to enter any kind of "load" command; I just start the file on its way, and the S19 loader handles the rest.

After I have loaded a complete S19 object file into BYRD, I send the character 'x' to BYRD to start execution. 811bug uses this character to signal a jump to the execution address contained in the most recent S9 object record.

Since 811bug resides from addresses $f800 to $ffff, it takes over the 68hc11 vector area. Therefore, I included a jump mechanism that routes almost all 68hc11 vectors through a dedicated area of on-chip RAM. This means that you have to modify your software if you want to use interrupts in programs downloaded with 811bug. Specifically, most vectors automatically jump through dedicated addresses in the range $b0 to $ec. Each RAM vector becomes a three-byte sequence of the form:

JMP START

where START is the address of the 811bug firmware.

To use the RAM vectors in your program, simply overwrite the 16-bit value of START at the appropriate spot in RAM with the address of your interrupt service routine (ISR). Do NOT overwrite the JMP opcode, or your program will die when the first interrupt occurs. For example, the real-time interrupt (RTI) vector normally resides at $fff0. The 811bug firmware stores a $00d7 at this address, since the RAM vector for the RTI has moved to $00d7. 811bug then stores a JMP START sequence at address $00d7, before it loads any S19 records. This means that any unexpected RTIs will simply restart the 811bug firmware.

To use an RTI ISR in your program, your code must overwrite the value in $00d8 (NOT $00d7!) to contain the address of your ISR code. If you are writing in SBasic, you can perform this function with a single line of code. Assume your RTI ISR code begins at label RTIISR. Simply include the line:

POKE $00d8, addr(RTIISR)

in the main code of your program. After setting up the RTI sub-system and turning on interrupts, your RTI ISR will begin fielding and servicing RTIs properly. 811bug does not treat all interrupts this way. In particular, the Illegal Opcode and COP Failure interrupts are hardwired to jump back to the start of 811bug. These two vectors serve as insurance; should your code go completely bananas, there is still a chance that 811bug can recover control.

I will post the source for the latest version of 811bug on my ftp site as 811bug.zxx, where the xx indicates the revision number. This will be a .zip file, not a .ZOO file! I wrote 811bug to assemble with the Motorola asmhc11 FREEWARE assembler; you can get a copy of this assembler by downloading either tiny4th or SBasic (in the file beta.zxx) from the same site.

Feel free to modify the source file and reassemble as needed. I have included a few lines of assembly that are specific to my version of BYRD; you will likely need to doctor 811bug for your platform.

811bug includes a few features and options beyond those discussed above. I have added plenty of comments and documentation within the source file, so you shouldn't have too much trouble figuring out how 811bug works and where to add your own enhancements.

I will save a discussion of BYRD's operating software for next month. I will say that to date, the entire control program is written solely in SBasic; it contains not a single line of assembly language. This, despite using multiple interrupts and PWM speed control of the drive motors.

My thanks to Dan Mauch, Marvin Green, and Keith Payea for their help in building this prototype BYRD robot; had a lot of fun, guys. NV

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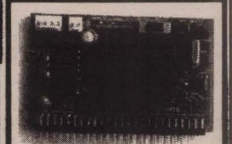

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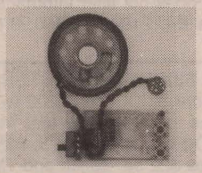

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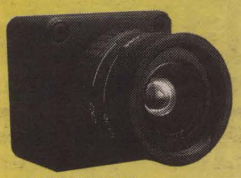

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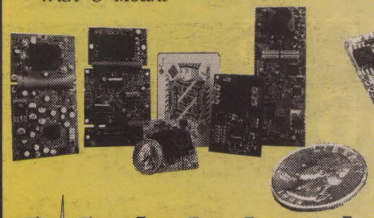

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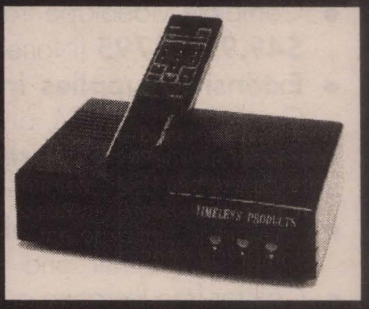

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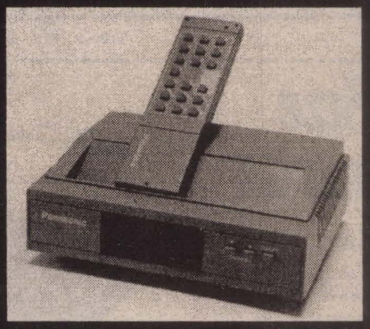

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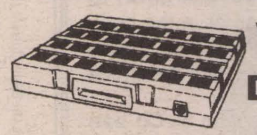

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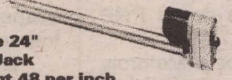

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by Anthony Charlton

Build a Ni-Cd Battery Charger

We chose this as a useful project that many people can benefit from. Ni-Cd batteries are everywhere, and are used in a variety of applications that benefit from their recharge capability. There are even tiny button Ni-Cds that fit into watches and calculators, which is a very handy idea since non-rechargeable batteries always seem to run down when you are miles from a store that sells replacements! Although Ni-Cd button cells don't seem to be as popular in the USA, I have seen many manufacturers that offer them in trade magazines from Asia.

This project is based around the MAX713 Ni-Cd Fast Charge Battery Controller IC. This is truly a "Today's Electronic's" type of part, as it boasts internal intelligence that regulates the charging of 1 to 16 cells, of virtually any size, and can charge them at any reasonable rate.

I debated whether to do this as another SMT project or to use DIP technology, and chose to stay with DIP plus the option of SMT since the chips are available from Digi-Key as DIPs and from Maxim's distributors as SMT when anyone wants to go that way. (The Parts List contains the exact part numbers for both suppliers and package styles.)

Figure 1-A shows the schematic of a simple circuit designed to charge two 800 mAh (slightly smaller than a "C" cell) Ni-Cd batteries. It can also charge Nickel-Metal-Hydride (NiMH) cells with some modifications to the component values.

This article serves as an introduction to this versatile chip and, in a future issue, we'll explore the full gamut of programmable features the chip has.

The MAX713 can be used either in a linear or a switch-mode power control configuration. That means it can either sense the charge on a battery and adjust a constant charging current, or it can charge in bursts of controlled, pulsed current such as the circuit does that is shown in Figure 1A. This circuit can supply up to 4 amps to a battery pack (in this case, two cells, of course).

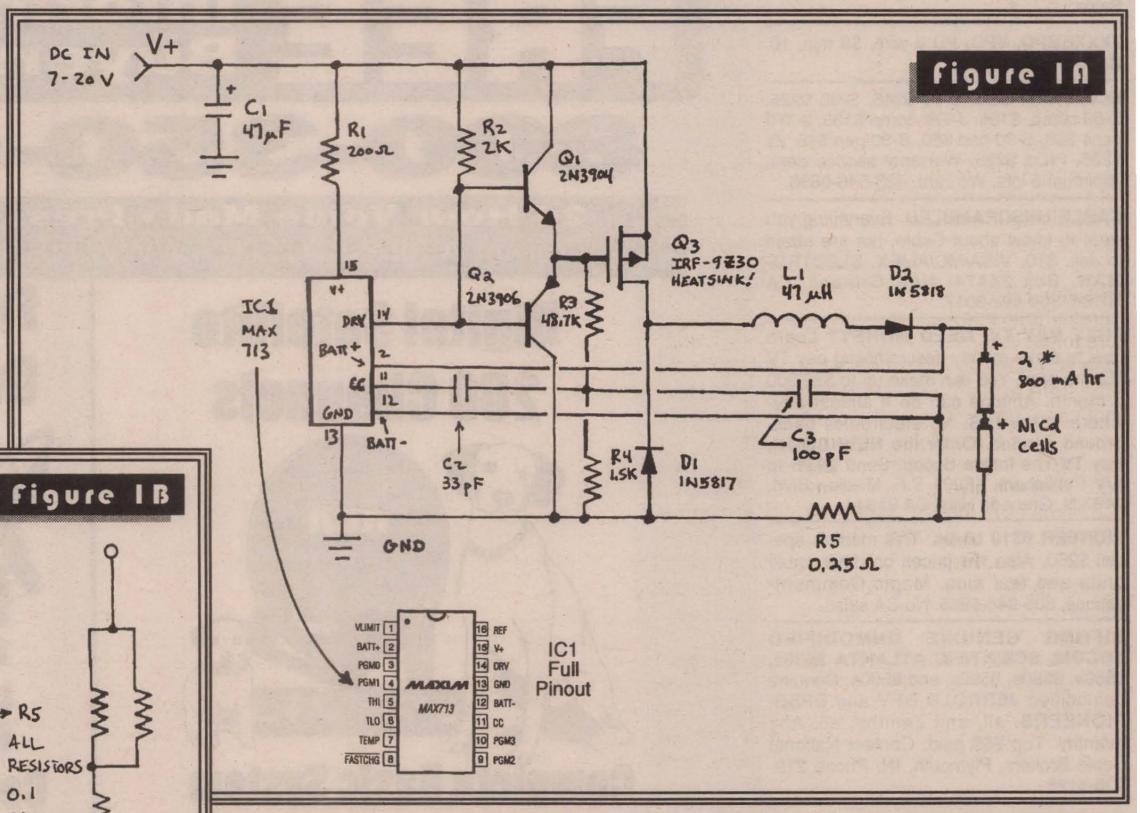
Note the two complementary transistors, Q1 and Q2, that are switched by the DRV pin, #14, from the IC. These, in turn, drive a power PNP MOSFET, Q3.

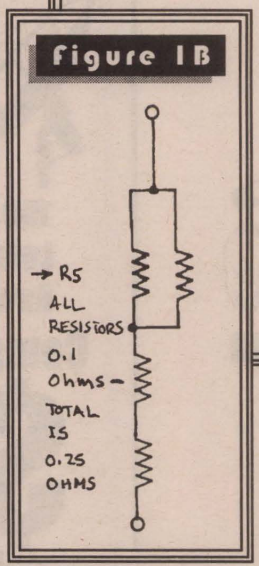
The original schematic called for a Motorola device p/n #MTP12P05, but that was changed by us to a #IRF9Z30-ND, a Hexfet readily available, so that procurement is easier. This part should be heatsinked, and since it is heftier than the Motorola part, actually should perform better under all conditions. A standard TO-220 "dual" heatsink is adequate unless the project is operated under high-ambient temperature conditions, in which case, you will have to go to a larger area heatsink. Neither switching transistors Q1 or Q2 seem to need heatsinking as they supply just a relatively small current to switch the Hexfet, which requires a very limited drive current of just a few mA.

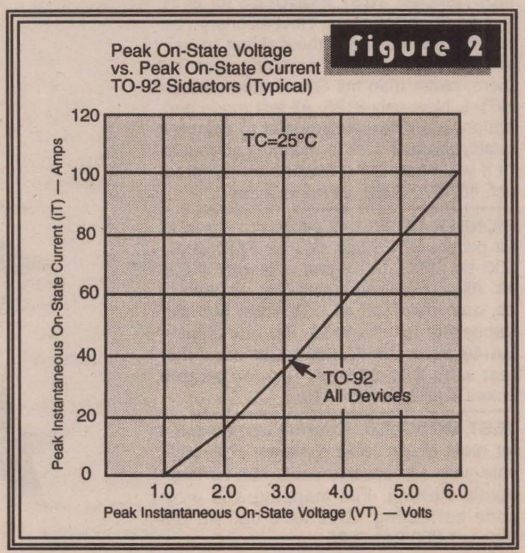
The rest of the circuit is very straightforward. Schottky barrier diodes D1 and D2 are both 1-amp (continuous) devices, and respectively rated at 20 volts and 30 volts PIV. They are used to respectively block the negative component of the AC switching waveform generated by the circuitry in conjunction with the inductor, L1. (This insures that just positive current is fed into the battery. We don't want the circuit discharging the battery we wish to charge!) Diode D2 is used to insure no current will flow out of the battery into the switching transistor and possibly back into the MAX713 when the circuit is either turned off or in the positive half of the squarewave switch cycle. I also suspect D2 is a "safety valve" to protect the circuit from a self-destruct in case Q3 fails.

Given our latest experiences with Ni-Cd battery packs in the application of electrically powered model airplanes (alluded to in other articles), we have learned that Ni-Cds can generate some AWFULLY high peak currents under error conditions — on the order of 100 amps or so — adequate enough to toast the associated circuitry and blow up the batteries!

People will wonder why just 1-amp diodes are used, but the reason is that they can withstand up to 4-amps charging current without failure since they operate in a pulse mode. Constant current would toast these components because of the thermal overheating effect upon their semiconductor junctions. But the pulse mode makes the difference in the peak amperage range capability of







such devices and for that matter, all semiconductors, because they can be driven at a higher current if it's not of continuous duty.

Layout of this circuit is a little critical. Breadboarding is NOT suggested. Putting it together on a Radio Shack experimenter board or similar is fine, provided you electrically connect two or more traces in ALL the heavy current-carrying paths to insure that adequate current is delivered to the batteries under charge. Avoid long lead lengths in all parts of the circuit. Since this is operating in a switch mode, possible oscillation or interference to other electrical devices may result. 0.1 uF bypass capacitors are suggested along the power supply rails, which serve the purpose of decoupling the transients and possible oscillations to the ground rail of the power supply.

The DC input of the circuit, ranging from 7 to 20 volts, should be well-filtered and overbuilt in terms of the capacity of the transformer used to supply power to the circuit. It is an excellent idea to add a safety margin to any power supply component, or any component that may be subject to possible overheating. So, if your application requires 3 amps of current, why not add an amp or two extra to the front end of the circuit to safeguard against failures? That way, a sudden overload or operation in a higher-than-usual ambient temperature condition will guard against frustrating failures. Same principle as carrying a spare tire in your car.

Select the 47 uH inductor to allow a peak current of 4-amps to flow through it. There are several available in the Digi-Key catalog that will work. The DC resistance should be less than 0.1 ohm. A continuous rating of 1-amp should be ample. Resistor R5 is a little hard to come by. You can parallel four one-half or one-watt, one-ohm resistors to get the 0.25-ohm value suggested. Another idea is: I have a bunch of 0.1-ohm resistors available here at the Today's Electronic's P.O. Box. In that case, one would use two 0.1-ohm resistors in series, plus a paralleled assembly of two 0.1-ohm resistors attached to this assembly (see Figure 1B). That will give you 0.1 ohms * 2 which equals 0.2 ohms plus the 0.05-ohm value of the two 0.1-ohm resistors in parallel. The total value is equal to 0.25 ohms. Free resistors are available here, if you write the Today's Electronic's P.O. Box listed elsewhere. Don't be shy; we give them away for the asking.

The type of Ni-Cd batteries that should be used with this circuit are the "High Rate Discharge and Rapid Charge (R/P) Type," the "Rapid Charge (R) Type," or the "Super High Capacity and Rapid Charge (S) Type." All are available from Digi-Key Corp.

An Overvoltage Protection Device — The Sidactor

A SIDACTOR™ is a device that allows current to flow in either direction once it has been tripped by an overvoltage. It is quite similar to two back-to-back SCRs wired for opposite polarity. Except that a Sidactor will trip itself in less than 1 nanosecond (1 nS = one billionth of a second) if confronted with an overvoltage, whereas an SCR is much slower. Therefore, the Sidactor is far more effective protecting sensitive electronics from transients than any SCR. But power MUST be turned off once the device is tripped to stop it, and we say that again shortly in the description of the electrical specifications to follow.

Note the graph in Figure 2. This shows the relationship between the peak instantaneous on-state voltage of a Sidactor device vs. its peak instantaneous current in amps. This little TO-92-sized plastic package can shunt 50 amps for a short time! The graph shows that the On-State Voltage, V(t) increases as the peak current does too. That is a natural effect of most semiconductors. Most all semiconductors INCREASE in resistance as more and more current is passed through them. There are a few types though (Tunnel Diodes for instance, and a few of the Sidactor devices as well), whose resistance DECREASES as the current through them INCREASES.

Figure 3A shows the characteristics of the test pulse waveform applied. It is from this waveform that the specifications are developed.

Figure 3B shows the property called HOLDING CURRENT which, like all SCR-type devices, decreases with increasing temperature. The reason being the atomic/electron efficiency grows more energetic with increasing temperature, and hence less current is required to keep the device on. In the untriggered mode, less than 10 microamps of standby current is used by the device.

Figures 4A and 4B show a Sidactor's switching characteristics. Both a negative resistance device (first figure) and a positive resistance device (second figure) are shown. The terms appearing on those figures are explained as follows:

V(bo) — The breakover voltage or point at which the Sidactor trips. Keep in mind this isn't an exact spec — for instance, one device is rated a minimum of 135 volts and a maximum of 165 volts.

V(drm) — Specified minimum blocking voltage: the rating at which the device is guaranteed not to trip until this rating is exceeded apparently regardless of the signal conditions (like exceedingly fast rise time which would trip an SCR).

I(h) — The minimum holding current once the device is tripped. Below this value, the device turns itself off. IMPORTANT! Power must be interrupted to the circuit once a Sidactor's been tripped for the device to turn off, and the voltage upon restoration must be less than the V(bo) value!

I(drm) — The leakage current.

V(t) — Voltage drop at a specified current.

V(peak) — The maximum voltage the device can withstand at a specified current. Exceeding this value will result in device destruction.

In essence, a Sidactor is an advanced and inexpensive device for protecting electrical equipment from overvoltage transients with fast rise times and short duration. The nature of the destructive error signal can be single or repetitive. They may also be used to generate signals in an R-C-Sidactor circuit with narrow pulse durations and with exceedingly fast rise times.

Examples of such circuits include pulse generating networks and quite possibly, drivers for single heterostructure laser diodes, whose characteristics demand a fast risetime pulse of short duration and relatively high current, typically in the tens of amperes. Finally, Digi-Key has Sidactors in various volt-

SUPPLIER LIST

PRB Line, P.O. Box 176, Whitewater, WI 53190. Ph: (800) 533-9654, FAX: (800) 635-8101. Carries the ChipQuik SMC removal kit.

Circuit Board Express, 2 Avco Road, Haverhill, MA 01835. Ph: (508) 521-9288, FAX: (508) 521-9388, Modem: (508) 373-9272, E-Mail: fastpwb@tiac.net Time crucial manufacturer for industry. Produces prototype circuit boards in 24 to 48 hours. Not a hobbyist supplier.

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Datak Corporation, 55 Freeport Blvd, Unit #23, Sparks, NV 89431. Ph: (702) 359-7474, FAX: (702) 359-7494. Dry transfers for PWB fabrication, chemicals, Circuit-Fix™ products. Free catalog.

Digi-Key Corporation, 701 Brooks Avenue South, P.O. Box 677, Thief River Falls, MN 56701-0677. Ph: (800) 344-4539, FAX: (218) 681-3380. Top-of-the-line supplier of SMT components; features a large selection. Free catalog.

Dyna-Art Designs, 3535 Stillmeadow Lane, Lancaster, CA 93536-6624. Ph: (805) 943-4746. Provider of and seller (through distributors as well) of the Toner Transfer System (TTS) method of PCB fabrication. Also sells a desk-top integrated package for small OEM and prototype PCB fabrication.

Electronic Goldmine, P.O. Box 5408, Scottsdale, AZ 85261. Ph: (602) 451-7454, FAX: (602) 451-9495. SMT surplus PWBs and SMT components. Some great values here. Free catalog.

ESP Solder Plus, 14 Blackstone Valley Place, Lincoln, RI 02865-1145. Ph: (401) 333-3800, FAX: (401) 333-4954. Small manufacturer, educational and industry SMT repair kits and solder cream. **Garrett/IEU, Inc.,** 3130 Skyway Drive #104, Santa Maria, CA 93455. Ph: (805) 922-0594, FAX: (805) 922-3643. Small and bulk quantities of surface mountable components.

Hobby Lobby International, Inc., 5614 Franklin Pike Circle, Brentwood, TN 37027. Ph: (615) 373-1444, FAX: (615) 377-6948. Supplier of all kinds of hobby kits and supplies; mentioned here because of their large selection of instant-setting glues and some tools that are useful to any precision endeavor such as with electronics. Catalog $2.50.

Maxim Integrated Products, Inc., 120 San Gabriel Drive, Sunnyvale, CA 94086. Ph: (408) 737-7600, FAX: (408) 737-7194. Specialty analog and digital integrated circuits of amazing diversity and use. Call for nearest distributor, or sales rep (in the case of OEMs). Will give out free information and samples to qualified companies.

Micro-Mark, 340 Snyder Avenue, Code 340-1892, Berkeley Heights, NJ 07922-1595. Ph: (800) 225-1066, FAX: (908) 665-9383. This company calls itself "The Small Tool Specialists" and indeed they are. Listed here because of the many precison hand and power tools they offer that are useful in SMT and other electronic work. Also carries hard-to-find supplies for model making. Full-color catalog $1.00.

Pace Inc., 9893 Brewers Court, Laurel, MD 20723-1990. Ph: (301) 490-9860, FAX: (301) 498-3252. Manufacturer of SMT soldering/desoldering equipment and workstations.

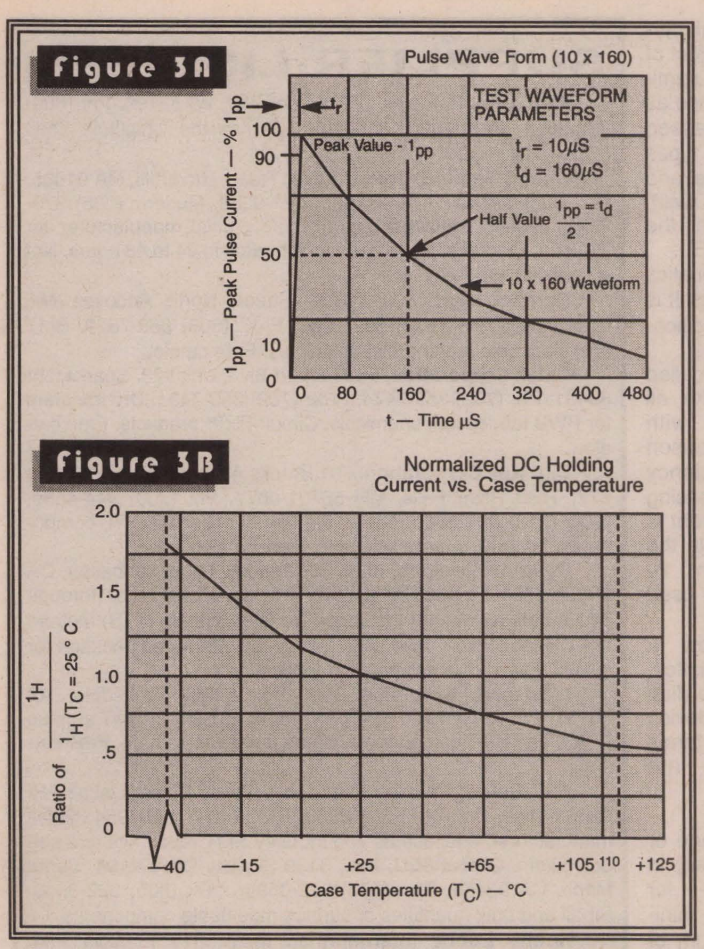
Techni-Tool, 5 Apollo Road, P.O. Box 368, Plymouth Meeting, PA 19462. Ph: (215) 941-2400, FAX: (215) 828-5623. Soldering/desoldering equipment and electronic tools of all types.

All Electronics Corporation, P.O. Box 567, Van Nuys, CA 91408-0567. Ph: (800) 826-5432, FAX: (818) 781-2653. Some SMT parts and occasional surplus SMT boards useful for parts salvage and experimentation. Free catalog.

Capital Advanced Technologies Inc., 309-A Village Drive, Carol Stream, IL 60188. Ph: (708) 690-1696, FAX: (708) 690-2498. Manufacturer of the Surfboard™ breadboarding medium for SMT, sells mostly through distributors such as Digi-Key. OEM's can contact Capital directly for large quantity pricing.

Carolina Biological Supply Company, 2700 York Road, Burlington, NC 27215. Ph: (919) 584-0381, FAX: (503) 656-4208. Laboratory supplies including test tubes, plastic and glass vials handy for use categorizing SMCs. Contact for current price of their 30,000 item, full-color catalog.

Be sure to mention Nuts & Volts when you contact the above suppliers so they can process your requests properly.



age, peak amperage handling capabilities and case styles, including SMT.

ChipQuik

As SMT grows in popularity amongst the prototyping, hobby, and experimenter people, sundries that help the process of assembly and repair of circuits using this miniaturized technology are a particularly great enjoyment. Manufacturers and job shops will benefit as well from a relatively new product called ChipQuik. This patented product is the brain child of Marvin S. Cohen, CET. Marvin is the technician/owner of CTS Electronics in Framingham MA, and has been for 35 years. I had the opportunity to speak to Marvin about his patented product. A condensation of our talks and the nature of the ChipQuik product follows.

Previous SMT removal techniques can be nasty, in the sense that they used to require expensive and specialized tools, and significant skills on the part of the repair person. (Or for that matter, us experimenter-type fellows who just want to get our feet wet in this technology.)

Marvin came up with a plan to use a very low melting temperature alloy along with a special flux whose combined effect would blend with the existing solder alloy of the part that wants to be removed. The result is that the heat required to remove any component (it doesn't have to be SMT either) is greatly reduced. Which means, the damage to the PC board and repair or new part are minimal.

The usual 60/40 solder alloy of tin and lead melts at 360° F. And soldering irons usually operate in the 600° F. range, unless they're temperature controlled. By adding ChipQuik to the existing solder alloy on a PWB, the temperature at which the solder blend melts is reduced to 200° F.

I find it amazing that the technique involved can actually desolder a joint at the temperature of boiling water! (Needless to say though, water and electronics don't mix.) Using ChipQuik is a snap. All you have to do is use the special flux provided, and first apply it to all the leads of the component(s). Then melt the ChipQuik alloy on all the leads, doing this job quickly so as to minimize the heating of the component. Allow the component to cool between solder passes if you think this is needed. Next, the alloy you just made is removed by heating and then using the de-soldering braid provided to wick up the solder off the pins.

Alternately, you can use a solder sucker type of rubber bulb to do this. I find that heating the pins of the component and then rapping the PWB against the workbench causes the solder to fly off nicely. Tape a protective layer of aluminum foil over the PWB below the joint(s) you are removing to prevent the solder from shorting out other components. Also, wear protective glasses as the solder can splash with this technique. The component(s) are easily picked off at this point using a dental tweezer. Carolina Biological (in "Sources") carries a wonderful assortment of precision instruments of this type at a very modest cost, compared to other suppliers.

After the de-soldering process is completed, the manufacturer suggests using some more flux and a Q-Tip along with your soldering iron to remove the residual combined solder alloy after heating. Then the new components are soldered in.

I would suggest, however, carefully tinning the area after the removal process with a very good grade of solder, or a tin/lead/silver alloy such as used with SMT components. Such alloys contain typically 2% silver in addition to the lead and tin, whose presence seems to add both strength and solderability to any soldered joint. It is interesting to note that in all cases, there is an alloy blending between the component, PWB, and solder material where the molecular interface of each intermingles with the metal used to join all.

Unlike an adhesive bond which, if not using a solvent glue, is an adhesive-to-part bond only. So, soldering is a bit akin to welding, where the metals of the parts being joined along with the welding rod all intermingle, and that forms the strongest possible joining. Both high-quality solder and SMT solder paste containing a bit of silver are availble from Digi-Key.

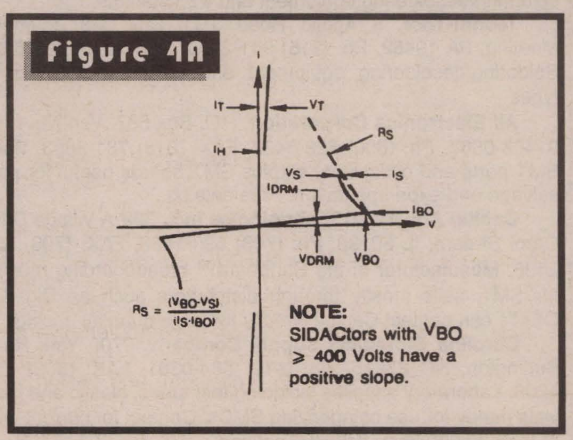
The ChipQuik kit comes with the special alloy, de-soldering braid, flux, and simple instructions. Enough material is supplied to remove 8-10 large SMT ICs. The current price at the time of this writing (Nov. '95) is $14.95 from PRB Line, listed in "Sources."

Silver Plate

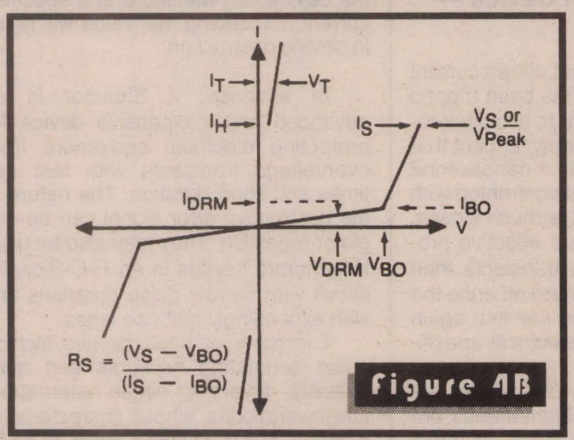
Dyna-Art Designs has come out with yet another innovative product to help the hobbyist, experimenter, or small manufacturer. This is a kit that plates silver — yes silver, not tin — on a PC board. Silver is by far a better conductor than tin or solder plating. It is easily soldered to, and protects the copper traces of a board from oxidation for years. What makes this kit unique is its simplicity of application. Usual methods of silver plating may involve several processes. One is electroplating. This is a process whereby DC current is passed through a chemical solution of a silver salt, and one pole of the current source is immersed in the chemical solution, and that pole is silver metal. The other pole is the copper traces of a PC board (or other metal object) you want to silverplate. This is an untidy process for the small-volume manufacturer and just a plain nuisance for the hobbyist and experimenter unless one wants to make a science project out of it.

Enter the "Silver Lining" Kit. Packaged in a clear plastic box are the four components of the kit. They are: 1) a sponge with a scrubber pad attached to it on one side; 2) a small towel-like applicator that appears to be made of a synthetic fiber; 3) rubber gloves; and 4) the central component of the kit, which is a silverizing powder. In order to achieve the silver coating, the following steps are recommended by Dyna-Art Designs:

A) Clean the area to be plated. Please do this thoroughly, as the quality of the plating is adversely



V-1 Characteristics of Sidac and SIDACtor Device with Negative Resistance



V-1 Characteristics of Sidac and SIDACtor Device with Positive Switching Slope

affected by an oxidized, dirty, or greasy surface. One uses the green, abrasive side of the sponge and a mild dish soap or liquid solution. I probably would want to avoid using a soap product that had perfume or other chemicals in it. Ivory soap is a logical choice.

B) Rinse thoroughly. Here, I have had better results rinsing with de-ionized, distilled water. It is available at any drug store for about $2.00 a gallon, and is a good thing to have on hand for anyone using chemicals anyway, because you won't have to contend with any chemical reactions if using city (chlorinated) or spring water (which is frequently full of minerals as a result of having run through rocks on its way to the spring). A gallon goes a long way if you are careful.

C) Put on the rubber gloves. Dampen a corner of the green towel, or any clean towel for that matter, that doesn't contain a soapy residue or anti-static product residue, and put a corner into the silverizing powder. The powder will stick to the moisture. Now you are ready to silverplate! Rub the product over the area to be plated, and in a minute or two, you'll see the copper change to a silver color. This is a little subtle, just give the product four or five minutes to do its job, and your job will then be fully silverized. Applying too much of the powder won't result in a thicker silver plating, it'll just waste the product. Only electroplating can give you thicker coats, but as we mentioned, that is an involved process.

A little of the powder goes a long way. The literature says the one ounce tub of powder will plate 375 square inches of copper. That would be a 2.6 foot square piece of solid copper PC board. I should estimate the contents of the kit would actually silverplate twice that if one does not waste material. Consider that a PC board is say, 30% (or less usually) copper area after etching, this kit is rather economical. It is priced at $29.00, so is within the range of most hobbyist budgets. I have only one suggestion for improvement, and that is to have the powder contained in a wide-mouth, miniature plastic specimen jar with a screw cap. These jars are used in the biological sciences community to contain protozoan cultures, and the screw cap would be more childproof than the snap-lid container supplied.

After the plating process is completed to your satisfaction, wash the PC board with a mild detergent soap and use the soft side of the sponge to remove powder residue. It is important to remember that the coating is extremely thin, and will be removed by abrasives and steel wool.

How Safe are the Chemicals?

We obtained a Material Safety Data Sheet for the product, and found the formulation contains Silver Chloride, which is an irritant. This chemical does not give off fumes, is not flammable, and does not release any known hazardous decomposition products. However, you will want to wear the plastic gloves while using it. Don't breathe any of it, get it in your eyes, or ingest any. Contact with skin or eyes should be taken care of by washing with large amounts of water and followed up by medical attention if irritation persists. Accidently breathing the material (which would be difficult to accomplish because it isn't prone to forming a dust in the air) should be followed by getting fresh air and medical attention if irritation presists.

The MSDS advises immediately contacting a Poison Control Center if the powder is eaten. Logical enough. If you keep this chemical out of the reach of children and wear your gloves, there shouldn't ever be any hazard under normal circumstances. The gloves can be rinsed, dried, and re-used many times before discarding.

Conductive Silver Pen

Dyna-Art also offers an intriguing conductive drawing pen which contains micro-sized silver particles suspended in an evaporative liquid. This product is extremely useful for making jumpers, repairing defective traces, creating shielding, or for "quickie" circuits. So you can make simple circuits without the bother of making a PCB. Silver has a very low resistance, and the traces you generate will measure in the fraction of an ohm range. The pen's tip has a little valve in it that opens when you press it against a surface, and closes when the tip is removed, so there are no spills. The pressure on the flexible pen barrel regulates how much product is dispensed. Lines down to 1/32" in width can be drawn with precision. Within 30 minutes, the liquid has dried and the traces are useable. The silver traces do have a tendency to scratch off, so where mechanical conditions require some durability, I suggest two or three applications over the required trace, allowing an hour between applications for drying. Then overcoat with several coats of a clear conformal coating, allowing each one to dry so the traces don't run (solvents can re-dissolve the evaporated binder).

This product should not be used for purposes such as making edge-card fingers because it doesn't have that extra durability to withstand socket insertion. However, it can be soldered, if you are careful. But for $13.00, the manifold uses for anyone in electronics are enough to warrant purchasing the Conductive Pen. There are two precautions to observe with this product. One is: Its evaporative carrier is Butyl Acetate, which is flammable and must be used in a ventilated area. So practice safety just like you would with say, plastic model cement, and don't "hang" over the product while it dries. Second precaution is: Make sure you wipe the tip after each use or it'll clog in short order. The product has a six-month shelf life after opening and an 18-month life if kept unopened after manufacture. Storing the Conductive Pen in a cool area like a cellar will undoubtably improve its useable life. Again, keep this product away from children, and contact a Poison Control Center (listed in your phone book) for instructions IMMEDIATELY if it is swallowed.

Conclusion

Today's Electronics welcomes innovative products to review. A hands-on sample or one that we can borrow is requested so that we may do a fair and unbiased review. If you have a product (or are aware of one which our readers will find helpful), please contact us at the Today's Electronics Reader Helpline listed elsewhere in this article.

We hope you have found this installment useful, and welcome suggestions from anyone regarding the content of these articles and/or what you would like to see in print. We would also be interested in hearing whether you would like reading about one medium-level project or one advanced tutorial plus projects, or for that matter both! A simple note at our Helpline would be greatly appreciated, and the proposal follows:

The medium-level project is a general-purpose DVM with a 0000-1.999 reading capability (2,000 counts) that uses a single chip and may be configured for LED or LCD display, by choosing one or another sister chip. Their maximum input level without a voltage divider resistor ladder is 200 mV, which would give a resolution down to one-tenth of a millivolt. This project is useful for many applications such as interfacing sensors (temperature, humidity, explosive gas, carbon monoxide, G-force acceleration, blood pressure, etc.), and getting out a quantification of what's happening to the sensor. It's also cheap — the whole tamale being less than $30.00, if you aren't into fancy enclosures which cost a lot.

The advanced project would be a course on how the GUTS of a microprocessor (MPU) works, and would include the instruction set of the MPU's brain, so you can learn about what's happening inside its gray matter. Then proceed to build a simple, commercially available kitted-up microcontroller with peripheral interfaces and program that to turn lights on and off, play musical tones, toggle relays, and whatever else your imagination desires. Many people know how to operate a computer with very much greater adriotness (skill) than I can possibly muster, but do you know what's going on INSIDE the microprocesser and its various peripheral circuits? If you want to hear about this, we'll do it, including some real-life storytelling about the "dinosaur days" of PCs when they were just becoming available to computer/experimenter type people who at that point, had to solder in the chips themselves, test them, and design various peripheral circuits. And in those days, 4K of RAM was a big deal — not like today's times of 4 Megabytes and more!

Until the next installment, when we shall continue to explore some of the terrific new ICs available for your build-it-yourself projects. **NV**

PARTS LIST

IC1 — #MAX713CPE-ND (DIP version available from Digi-Key) or - MAX713CSE (SOIC package in SMT available from Maxim distributors)
Q1 — 2N3904 NPN transistor
Q2 — 2N3906 PNP transistor
Q3 — #IRF9Z30-ND, P-channel Hexfet
D1 — #1N5817CT-ND, 1 amp, 20 PIV Schottky barrier rectifier
D2 — #1N5818CT-ND, 1 amp, 30 PIV Schottky barrier rectifier

R1 — 200-ohms, 1/4 watt, 5% carbon film resistor
R2 — 2,000-ohms, 1/4 watt, 5% carbon film resistor
R3 — 48,700-ohm, 1/4 watt, 1% metal film resistor
R4 — 1,500-ohm, 1/4 watt, 1% metal film resistor
R5 — 0.25-ohm carbon film resistor (see text)

C1 — 47 uF, 35 WVDC or higher aluminum electrolytic capacitor
C2 — 33 pF ceramic disc capacitor
C3 — 100 pF ceramic disc capacitor

L1 — 47 Microhenry inductor (or choke)

Misc. — Heatsink, Ni-Cd batteries, enclosure to suit, DC power supply for the circuit

Note: *Numbers prefixed by the pound (#) sign are Digi-Key part numbers.*

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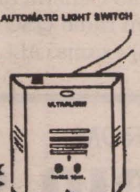

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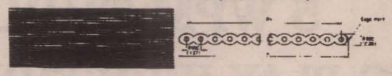

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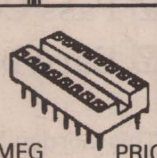

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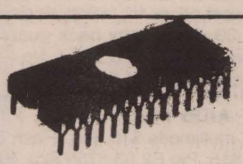

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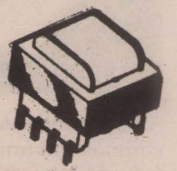

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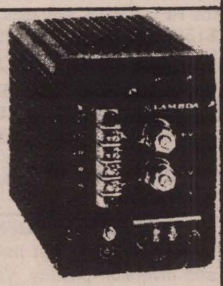

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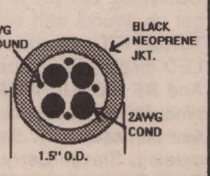

Write in 81 on Reader Service Card.

Don Lancaster's

RESOURCE BIN

number forty-seven

A look at telecommunications resources.

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.

Telephone Electronics

This month, I thought we'd take a look at some lesser known resources involving telephone comm.

Happily, the statute of limitations is long expired on the phone phreaking secrets I am about to reveal here. In print for the first time ever.

Back before they had phone freaks, they had me. In those times, things sure were a lot simpler. To get a free local phone call, you simply shoved a pin through the handset cable on a pay phone. You then grounded it to the coin slot. Briefly.

A free long distance call was a tad trickier. The worst part was that you had to borrow enough change to start your actual call. One minute into your conversation, you inserted a special "W" shaped coat hanger into the coin return and flipped the mechanism.

Free phone calls were essential to a starving college student in the early 60s. Especially since they kept all the females locked up 40 miles away at Cedar Chest College.

Winos would also stuff paper up the coin returns of pay phones at bus stations and such. People in a hurry usually would not complain. A route of several dozen phones sometimes yielded a marginal income.

The more astute of you might note that pay phones these days seem to include an armored cable and a coin return hopper or reverse flipper.

Ever wonder why?

Some Basics

Your phone line consists of a +48 volt DC source having an impedance of roughly 600 ohms. The green wire is normally positive and called the *tip*. The red wire is normally negative and called the *ring*. The names date from when real phone jacks got used.

In its *on-hook* state, *only* the bell of your telephone gets connected to your line through a DC blocking capacitor. The capacitor value and inductance of a traditional bell winding resonate at a 40 Hertz low audio frequency.

NEXT MONTH:
Don looks at recent developments in solar power and alternate energy.

To ring the phone, a very high AC voltage of 100 volts or so is applied at a frequency of 40 Hertz. At one time long ago, different ring frequencies were used to selectively isolate party line phones. In more modern phones, a series resonant circuit extracts the ring information.

Picking the phone up *off hook* loads the line, dropping its DC voltage to 8 volts. One way you can tell if a modem or extension phone is active is to simply measure the DC line voltage.

Details in HACK41.PDF

Dialing is done in one of two ways. That *pulse* method used a mechanical dial. It *broke* the line connection equal to the number of counts desired. For a zero, you got 10 counts.

The *Touch Tone* scheme generates a pair of audio tones using a *two-of-eight* code selected from four *low-band* tones and four *high-band* tones.

The rest of your phone is mostly a microphone or other voice *transmitter,* and a headphone or some other voice *receiver.* These two interact through a nearly balanced *hybrid* transformer.

The main purpose of the hybrid is to allow full duplex conversations. By letting your transmitted audio go out over the phone line and the incoming audio go to the receiver.

A slight unbalance is created in the hybrid to let a little of the transmitted energy appear in the receiver. This is called the *sidetone* and lets you hear yourself. It is just enough to keep you from shouting.

The normal telephone signal levels are somewhere below 0 dBm. Or one milliwatt into 600 ohms. Equal to an AC voltage under one-volt RMS.

The only real differences between voice, fax, and modem is that fax and modem send out specific tones used for digital data comm. Unless special steps are taken (involving digitized audio), you can *not* simultaneously send voice and high-speed data over the same phone channel.

Current Topics

Some of the phone stuff that seems to interest a lot of people these days: Part 68 interfaces, line recording, ring detection, call progress monitoring, touchtone encoding and/or decoding, PostScript fax, and Caller ID.

Two sets of highly restrictive FCC rules apply when you connect to the phone line. Part 15, which is plain old "thou shalt not transmit interference." And Part 68, covering the specifics of phone-line interconnect.

More Part 68 interface details are in HACK07.PDF and HACK61.PDF.

In general, all you'll really need to meet FCC Part 68 is a transformer and some clipping diodes to restrict max amplitude. But extensive certification testing is involved. Gruesomely so. In particular, the lateral balance spec is a real bear to meet.

Carefully selected capacitors could replace a fancy transformer. But it is extremely tricky to do so.

The FCC regs appear in several blue and white volumes that are part of chapter 47 of the CFR. Or otherwise called the *Code of Federal Regulations.* These are found in any large library that has a government docs section. You can also buy them directly from the *US Government Bookstore.*

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umes needed for the full set of FCC specs.

Because meeting the Part 68 specs are so gruesome, most users will opt for a "pass through" certification. Where you buy a certified interface and then call it your own. Several *Nuts & Volts* advertisers offer low-cost kits here. *Circuitwerkes* is one hobby source. Two commercial sources here include *Cermetek* and *Dallas*.

More on getting your own Part 68 certification appears in the *Compliance Engineering* trade journal. More on FCC specs in HACK45.PDF.

A telephone recorder is basically a simplified Part 68 interface. A typical circuit appeared in HACK07.PDF. And also available in the *Hardware Hacker* reprints. Ring detection is often done by use of a zener-LED-photodetector lash-up. Custom ring detector ICs also exist. With *Texas Instruments* being a leading supplier. More details once again in HACK07.PDF.

Call-progress detectors get involved if a modem has to determine whether a busy signal arrived or if a call has gone through. *Teltone* is the leading supplier for these low cost chips. A circuit appears in HACK17.PDF.

The touch tones are a two-of-eight selection of a group of low- and high-audio tones. These could be useful for telephone signalling, for ham repeater control, and some alarm and coding applications.

But their baud rate is horribly low for anything else. These chips come from *Teltone* and similar sources. The *Basic Stamp* from *Parallax* has a totally hassle-free touch-tone generator built into its unique firmware. *PostScript FAX* is a new system that completely, totally, and utterly blows away grubby old FAX. This gives you precise *camera-ready* art much faster and cheaper. Even when sent to an ordinary FAX machine, the quality is ridiculously higher. More on this new technology is found in ATN5011.PDF, ATN5128.PDF, ATN5135.PDF, and in FAXPRINT.TXT.

Ah yes, Caller ID. By far, number one in file popularity on PSRT. Start with HACK40.PDF for a tutorial. Next, you search under "caller" for the dozens of additional files and circuits.

Basically, a short data burst is sent between your first and second rings. Even though it is transmitted at 1200 baud, this burst is *not* receivable by an ordinary modem. Because of the odd format and framing used.

Bellcore

The horse's whatever source for all telephone standards is *Bellcore*. Very pricey, but they do have a free catalog on all their specs and guidelines.

Nearly all of the technical details of the phone system are covered.

Other sources for some telephone specs include *The Information Store* and *Global Engineering Documents*.

Telecom Books

The best phone book store I have found so far appears to be *Telecom Books*. They have several free catalogs available. Including one centered on computer telephony. Many hundreds of new titles are available. Probably the best starter book is *Understanding Telephone Electronics* by Stephen Bigelow. Another one is *Basic Telephone Installation*. This one is in the *TeleTraining Pocket Guides*.

One good third party Caller ID book is the *Principles of Party Line Station Identification*. Telecom also resells a *Computer Telephony Starter Kit*.

This five book collection includes *Newton's Telecom Dictionary, Computer Based Fax Processing, PC Telephony, Client Server Computer Telephony*, and *Telephony for Computer Professionals*.

By the way, I finally did find out what "client-server" means. The term means the same as "lemon-scented."

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At (800) HI-HELLO, they have to be one of the easiest remembered phone numbers of all time. Free catalogs.

The Mart

This one is by far the best magazine for most telephone bargains. Over 200 pages per month. It's pretty much an "ads-only" tabloid classified shopper. But does have tech tutorials.

Their ads list everything from pay phones to recycled PBX units on up to headsets and handsets. Repairs and site services, too.

Be sure to check out those sister publications of *The Mart* as well. Their *Comp-U-Mart* utterly blows *Computer Shopper* away. And their *Printer's Mart* is right up there with *HorseTrader* and *Printer's Hot Line* for printshop and desktop publishing bargains.

Surplus Traders

A great source for just about any surplus telecomm is Marvin Birnbom at *Surplus Traders*. He maintains hot daily buy-sell FAX sheets.

Telecom Sources

The real phone bargains come from the Far East. *Telecom Sources* is one of a group of fat and slick trade journals distributed by *Asian Sources*. A recent issue focused upon cordless phones, home fax machines, telecom chipsets, private paging systems, and modems. A good mix of tech info is combined with hundreds of ads.

Telecom Sources is intended mainly for the large quantity buyer. But the technical information is useful for just about anybody.

Subscriptions are a tad pricey at $65.00 per year. But if you can find *any* copy of *any* magazine in the series, there is a mail-in coupon to get a sample of any other mag offered.

The other magazines in the series include *Electronics, Timepieces, Gifts & Home Products, Electronic Components, Computer Products, Fashion Accessories*, and *Hardwares*. By "Hardwares" they mean things like drill presses.

These magazines are probably *the* best way to find far eastern contacts. A free finder service is offered.

Other Trade Journals

As with any field, there are zillions of trade journals. All you have to do is pin them down. Most are free. While I may have mentioned this a time or three before, *Ulrichs Periodicals Dictionary* is *the* place to go to get a list of all mags everywhere. Either on the reference shelf of your local library, or online through *GEnie*.

By far the most important historical pub, of course, is the old *Bell System Technical Journal*. The bible of phone phreaks everywhere. Those innermost secrets of the phone company all laid bare. This one has apparently ceased publication. But it remains available in larger technical libraries.

I have posted a listing of comm resources as HACK64.PDF.

A few random samples . . .

Computer Telephony calls itself

RESOURCE BIN

"The magazine for computer and telephone integration." Sister magazines include *Teleconnect* and *Call Center.* The latter is a support mag for customer service help desks and such.

Lots of publications seem to have "communications" in the title. Some of the more interesting include . . .

All in Communications
Communications
Communications News
Communications Technology
Communications Week
Data Communications
Global Communications
Telecommunications

Network Computing also has some useful phone stuff in it.

Cellular Business is about marketing and distribution of the cellular phones and services. One of their competitors is *Cellular Marketing.* Pagers and such appear in *Mobile Radio Technology.* An insider trucker mag is *Land Line.*

Fiber optic comm is well covered in both *Fiber Optic System Design* and in *LightWave.* One of the best of the new wireless mags is *Wireless Design and Development.* A second source is *RCR Wireless Communication.*

Last and least, that *TeleProfessional* teaches you how to make obnoxious and annoying phone calls.

When the Chips are Down

The two most interesting telecomm chip houses are *Teltone* and *MX-COM.* Teltone is big on their call progress detectors. Plus touchtone encoders and decoders. MX-COM has all sorts of neat stuff. Including scrambling and privacy circuits. Bunches of mobile comm selective calling. And a brand new Caller ID chip.

Your best older source for Caller ID chips is *Sierra Semiconductor.* With *Exar* and *Motorola* being the also rans. *Mitel* has a lot in the way of PBX and crossbar semiconductors.

Uh, for some strange reason *AT&T* seems to want to sell telephone chips. As does *Signetics* and *SGS.* One source for ring detectors is *Texas Instruments.*

Power supply chips that rob phone line power are sold by *Maxim.* They do offer free samples.

A Network Interface

I just picked up a great heaping bunch of *Northern Telecomm* type 2960 network interface devices. These are an epoxy module which goes between you and your phone line. If there is any problem, their 2960 will *remotely* disconnect you. Running some simple telco tests then finds out whether the problem is your fault or theirs.

All easily handled from their front office. Without a field service call!

Note that the phone line polarity is sometimes *reversed* when they are using maintenence diagnostics.

For this reason, all direct network interfaces *must* include a full-wave DC bridge to keep the right polarity. Of course, the phone company only fixes their own problems. Never yours.

Much more on this useful beastie in MUSE96.PDF. You can easily modify these dual bilateral analog switches into all sorts of non-phone aps. From pulse generators to LED flashers to antique radio test generators.

You basically have an isolated pair of bilateral analog switches. These snap on when their terminal voltage exceeds 17 volts.

They snap back off whenever the current through them reverses or else drops under three mils. There's also several tantalum caps and zeners and such in the module.

Let me know if you want some of these to play with. Yeah, I've also got full specs available.

This Month's Contest

Let's have three different contests this month. Tell me about some telco resource I don't know about. Or find a new ap for the 2960.

Or find me a buyer for the three cubic yards of *Northern Telecomm* 2960 network interfaces currently piled up in my driveway. These are clean and unused 1988 production. Sadly, there are not quite enough of them to glue together to make a carport.

Pretty close, though.

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.

By the way, I have just posted the insider secrets to winning just about any trade contest to CONTEST.PDF.

Even more by the way, I have just bought an *entire* community college electronics department at auction. So, I've got some really great one-time buys. Especially Tektronix. You can write, call, or E-Mail for a current list.

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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REMOTE CONTROL VIDEO A/B SWITCHES, controlled by **any** remote! $39.95, Visa & MasterCard. Dealer inquiries welcome. 1-800-831-0184.

CABLE CONVERTER diagnostic and test modules for sale. Internal and external. Call John 1-800-879-9657.

CBTV DESCRAMBLERS. Make your own! For under $10, 7 easy steps, instructions show you how! All parts are available at Radio Shack. Plans including S&H only $7. Send to: Information Wholesale, PO Box 9359, Toledo, OH 43697.

2700+ REVERSE engineered schematics for sale. Latest cable draws: three digital music decoders, CFT-2014/V5S8 box. Coming soon: Primestar DSS system. Send $5 (refundable with order) and specify **TELEVISION CATALOG** or call for info. **BOMARC SERVICES,** Box 1113, Casper, WY 82602. 307-234-3488 (no Canada).

CABLE TV descrambler. "You wanted, we got it." 1-800-973-9278.

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CBTV CONVERTERS: RX-400-DIC, R2-450-DIC, $50; Pio BA-5XXX $140; BA-61XX $175; 63XX $200; Stealth-1000-P $49; M-80 $69; FTB-3 $45. We carry most pan-cake, call for low-cost 60-channel plain converter only $29. Tel: 405-634-3338, FAX: 405-631-0644.

BUYING SCIENTIFIC Atlanta 8600, 8580, 8550, 8500. Software available. SA, Pioneer. Will program your 8550, 8500 EPROMS for $7.50. Cable security key gets passed collars $25. Add $5 shipping. No TX sales. Send postal money order to: K. Perry, PO Box 816, Leander, TX 78646-0816. Phone: 512-259-4770.

X-MAS SPECIAL, Super stable wireless activator FSK kits $75, works on all 2r, vpd, and bbvpd boxes. Limited time offer. Sloppy Joe's, 707-778-7488.

ZENITH TEST kits (2L3) 1-5/$9.95 each — 6-20/$7.50 — 21 and up call. MVR, 1-800-436-8630. No FL Sales.

CABLE DESCRAMBLERS BBPD $295, 5503 8600 $295. ST 1000, ST 1600, REW. Call, 717-788-5939.

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FOR SALE: factory fresh. Pioneer 3130, 2120, 10 lot, $25. Zenith ST 100, 10 lot $65 ep. All units raw unmodified. Call 1-800-500-9825.

DECEMBER SPECIALS: multimode 2R/5V kits $10. Scientific Atlanta 8600, 8580-6 quickboards 2 for $25. SA 40 pin microprocessors $15. Pioneer 5xxx to 67xx $15, (4-wire no switch $20). Zenith ZL1, T3055, T7055, D5 kits $4. COD only. $50 minimum order. We will beat any price. Leave message; 1-800-950-5148.

CABLE HACKERS BIBLE Volume 2. Covers: Tri-Mode, DI, DIC, 400, Sig. 3, SB-3. Fixes, theory, CM/CCM, bullet, software for 5503/7 VIP, and more! $46.95. Catalog $3. **VISA/MC** 520-782-2316, **FAX** 520-343-2141. **TELECODE,** Box 6426-NV, Yuma, AZ 85366-6426.

DEALERS ONLY: New Multi-Mode test kit for M1 converters model PV-7, and Baseband. Available also is **Scientific Atlanta Quickboard** any models. **Zenith, Pioneer.** Please call for volume price quotation. To order call **1-800-483-6447.** Bulk purchase only! **(Hrs 9:30am-6:30pm EST.)** No Delaware sale.

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$11.95 each for Epson MX/FX-100/286e, LQ1000/1050, LQ2500/2550/EX800/1000/LQ860, AP3250/LQ100 Star NX1020/2400/2410/2415/2420, Panasonic KX-P 2180/2123/2124/1624/1524, Toshiba P321/351/1340. **$5.95** each for Okidata 82/92/83/93, Gemini 10X/15X.

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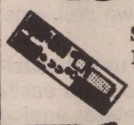

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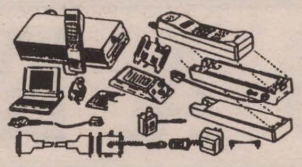

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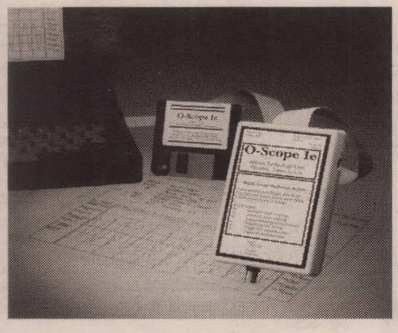
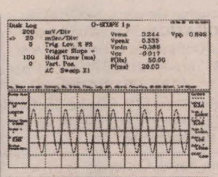
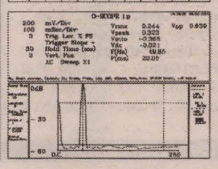




Screen Capture of Sine Wave



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PB8	12v @ 850 mAh	49.00
PB-13	7.2v @ 750 mAh	37.00
PB-14	12v @ 800 mAh	49.00
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7S	13.2v @ 1400 mAh	$53.00
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BP82, BP83A		
BP84	7.2v@1200 mAh 3"	$39.00
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FNB-2	10.8v	600 mAh	$19.00
FNB-4	12v	750 mAh	39.00
FNB-4A	12v	1000 mAh	55.00
FNB-17	7.2v	600 mAh	30.00
FNB-10S	7.2v	1200 mah	39.00
FNB-12S	12v	600 mAh	40.00
FNB-25	7.2v	600 mAh	35.00
FNB-26	7.2v	1200 mAh	44.00
FNB-26S	7.2v	1500 mAh	49.00
FNB-27S	12v	800 mAh	49.00

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EPB-10N	7.2v @	700 mAh	$36.00
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EPB-20N	7.2v @	800 mAh	$34.00
EPB-20NX	7.2v @	1600 mAh	44.00
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FNB-31	4.8v	@ 600 mAh
FNB-33(S)	4.8v	@ 1500 mAh
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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:
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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

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:** $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.

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

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.*

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 9-10

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

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

DECEMBER 10

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

DECEMBER 16

CA - BAKERSFIELD — MarketPro Computer Show & Sale. **LOCATION:** Holidy 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.

DECEMBER 16-17

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

DECEMBER 17

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

DECEMBER 23

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

JANUARY 6

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 6-7

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.*

JANUARY 7

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

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 - 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.

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

JANUARY 14

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

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

JANUARY 20

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

CA - SANTEE — Ham Radio, Computer & Electronics Swap Meet. **SPONSOR:** ARC of El Cajon. **LOCATION:** Santee Drive-In, 10990 N. Woodside. **HOURS:** 6:30am-? **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.

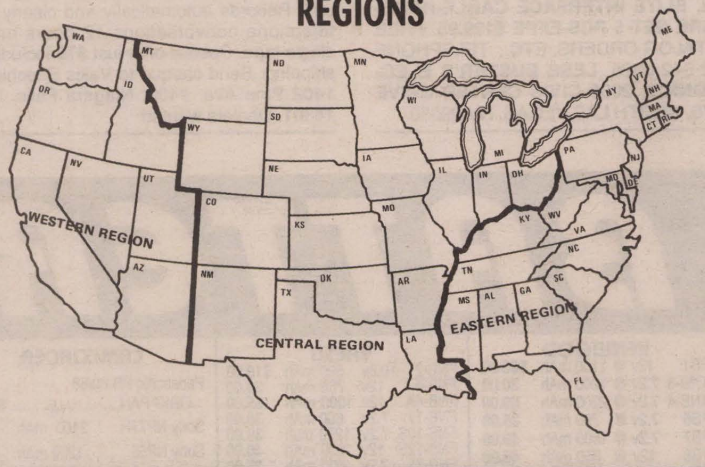
JANUARY 21-21

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

JANUARY 27-28

CA - SACRAMENTO — MarketPro Computer Show & Sale. **LOCATION:** Cal Expo. **HOURS:** 10am-5pm.

REGIONS



FEATURES KEY

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

COMPUTER SHOW PROMOTER INFO

AGI Computer Fair — 317-299-8827
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

ADMISSION: $6, free w/membership. **FEATURES:** C. **CONTACT:** MarketPro Computer Shows.*

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

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.

JANUARY 30-31-FEBRUARY 1

CA - SANTA CLARA — SoftExpo '96. **SPONSOR:** Webcom Communication Corp. **LOCATION:** Santa Clara Convention Center. **CONTACT:** Webcom Communication, 303-745-5711.

FEBRUARY 3

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.

FEBRUARY 4

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.

FEBRUARY 10

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, 685-7694.

FEBRUARY 17

AZ - TUCSON — Fest West '96. **SPONSOR:** SouthWest Ninety Niners User Group. **LOCATION:** Quality Inn, University. **HOURS:** 9am-6pm. **ADMISSION:** $4, under 15 free w/adult. **FEATURES:** C. **CONTACT:** Tom Wills, 520-886-2460, twills@inderect.com, or twills@pima.gov.

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.

OR - RICKREAL — ARRL Hamfest. **SPONSOR:** Oregon Coast Emergency Rptr. Assn. & Salem Rptr. Assn. **CONTACT:** Evan Burroughs N7IFJ, PO Box 784, Salem OR 97308. 503-585-5924.

FEBRUARY 24

CA - MONTEREY — ARRL Hamfest. **SPONSOR:** Naval Postgraduate School ARC. **CONTACT:** Max Cornell K0MC, 199 Linde Cir, Marina CA 93933-2206. 408-883-0491.

CENTRAL REGION

DECEMBER 1-2

AR - LITTLE ROCK — Arkansas DX Convention. **CONTACT:** Dennis Schaefer W5RZ, 181 Schaefer Dr, Dover AR 72837. 501-967-4372.

DECEMBER 2

IL - JACKSONVILLE — Central Illinois Winter Superfest. **SPONSOR:** Illinois Valley ARC & Jacksonville ARS. **LOCATION:** Turner Junior High School, 664 S Lincoln Ave, one blk N of Wal-Mart. **HOURS:** 8am-2pm. **ADMISSION:** $3 or 2 for $5, under 16 free. **TALK-IN:** 146.775-, 444.675+. **FEATURES:** C - EX - FM - FP - F/R - H. **DEALER INFO:** Tables $10 + admission, set-up 6am. Rich Tavender KB9IXO, 721 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

IN - GREENFIELD — 11th Annual Hamfest. **SPONSOR:** Hancock ARC. **LOCATION:** Hancock County Fairgrounds. **HOURS:** 8am-? **ADMISSION:** $5, under 12 free. **TALK-IN:** 145.330. **FEATURES:** DP - FM. **DEALER INFO:** Commercial space $20, flea market table $12.50. **CONTACT:** Hamfest Committee, PO Box 335, Greenfield IN 46140.

MI - FLINT — Super Computer Sale. **LOCATION:** Holiday Inn, 5353 Gateway Centre, Exit at Hill Rd from US-23 or I-475. **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 - 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.*

MI - JACKSON — Super Computer Sale. **LOCATION:** Jackson Co. Fairgrounds Rollatorium, 200 West Ganson St, Exit #139 off of I-94 (Cooper St) go S approx 1.5 mi to Ganson St. **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.

DECEMBER 10

MI - MADISON HEIGHTS — Super Computer Sale. **LOCATION:** UF&CW Hall, 876 Horace Brown Dr, 1 blk E of I-75, 1 blk S of 13 Mile Road. **HOURS:** 10am-4pm. **ADMISSION:** Adults $4; seniors & students w/ID $3; under 12 free w/adult. **FEATURES:** C - DP. **CONTACT:** Computers & You, 313-283-1754.

DECEMBER 16

MI - FARMINGTON HILLS — Super Computer Sale. **LOCATION:** Farmington Activity Center, 28600 Eleven Mile Road, 3 blks E of Middlebelt. **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.

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 - DEARBORN — Super Computer Sale. **LOCATION:** Dearborn Civic Center, 15801 Michigan Ave, corner of Greenfield. **HOURS:** 10am-4pm. **ADMISSION:** Adults $4; seniors & students w/ID $3; under 12 free w/adult. **FEATURES:** C - DP. **CONTACT:** Computers & You, 313-283-1754.

MI - FLINT — Five Star 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.

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.

OH - CINCINNATI — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Cincinnati Gardens. **HOURS:** 9:30am-4pm. **ADMISSION:** $6. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

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

IN - FT. WAYNE — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Allen County Fairgrounds. **HOURS:** 9:30am-4pm. **ADMISSION:** $6. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

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

LA - SPRINGFIELD — Hammond Hamfest. **SPONSOR:** Southeast Louisiana ARC. **LOCATION:** Southeastern Louisiana University, upper level of the SLU "University Center." **HOURS:** 8am-?. **ADMISSION:** Free. **TALK-IN:** 147.000-. **FEATURES:** C - DP - EX - F - FP - H. **DEALER INFO:** Tables $15, swap space $8. **CONTACT:** SELARC, POB 442, Springfield LA 70462.

MI - FLINT — 4th Annual Swap & Swap. **SPONSOR:** Amateur Radio and Youth (ARAY) & Southwestern Academy Radio Club. **LOCATION:** Southwestern Academy, I-69 @ Hammerburg Rd. **HOURS:** 8am-1pm. **ADMISSION:** $4. **ADMISSION:** 147.26, 145.29, 224.18. **FEATURES:** C - CB - F/R - H. **CONTACT:** Keith N8QNA, 810-635-4123.

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.

OH - DAYTON — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Montgomery County Fairgrounds. **HOURS:** 9:30am-4pm. **ADMISSION:** $6. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

JANUARY 20-21

OH - DAYTON — Computer Fair. **SPONSOR:** Trade Show Promotions. **LOCATION:** Dayton Convention Center. **HOURS:** Sat 10am-5pm, Sun 10am-3pm. **ADMISSION:** $5. **CONTACT:** Mark Hanslip, 143 Schloss Ln, Dayton OH 45418.

JANUARY 21

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

OH - COLUMBUS — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Ohio Expositions Center. **HOURS:** 9:30am-4pm. **ADMISSION:** $6. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

OH - NELSONVILLE — ARRL Hamfest. **SPONSOR:** Sunday Creek AR Federation. **CONTACT:** Allan Withem KC8VR, Old St Rte 78, Glouster OH 45732. 614-767-2766.

JANUARY 27

IN - INDIANAPOLIS — Indianapolis Computer Fair. **LOCATION:** Beech Crest Center, 3655 E Raymond St, corner Sherman, E of I-65 Exit 109. **HOURS:** 10am-4pm. **ADMISSION:** $6, under 12 free. **FEATURES:** C - DP. **CONTACT:** Ben Yanto, AGI Computer Fairs.*

JANUARY 28

IL - VILLA PARK — ARRL Hamfest. **SPONSOR:** Wheaton Community Radio Amateurs, WCRA, PO Box QSL, Wheaton IL 60189. 708-545-9950.

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

FEBRUARY 10

MN - BLAINE — Midwinter Madness. **SPONSOR:** Robbinsdale ARC. **LOCATION:** National Sports Center, N of Minneapolis/St Paul. **HOURS:** 7:30am-2:30pm. **ADMISSION:** $7. **FEATURES:** C - CB - FM - H. **CONTACT:** RARC, POB 22613, Robbinsdale MN 55422. 612-537-1722.

FEBRUARY 11

OH - MANSFIELD — Mid-Winter Hamfest/Computer Show. **SPONSOR:** InterCity ARC. **LOCATION:** Richland County Fairgrounds. **HOURS:** 7am-?. **ADMISSION:** Adv $4, door $5. **TALK-IN:** 146.34/94. **FEATURES:** C - DP - FM - H. **DEALER INFO:** Tables adv $9, door $12. **CONTACT:** Pat Ackerman N8YOB, 63 N Illinois Ave, Mansfield OH 44905. 419-589-7133.

FEBRUARY 17

IN - INDIANAPOLIS — Indianapolis Computer Fair. **LOCATION:** Beech Crest Center, 3655 E Raymond St, corner Sherman, E of I-65 Exit 109. **HOURS:** 10am-4pm. **ADMISSION:** $6, under 12 free. **FEATURES:** C - DP. **CONTACT:** Ben Yanto, AGI Computer Fairs.*

TX - SMITHVILLE — ARRL Hamfest. **CONTACT:** Bastrop County ARC. **CONTACT:** Charlie Claiborne N5JWP, PO Box 556, Smithville TX 78957. 512-237-3817.

FEBRUARY 18

IL - ROCK ISLAND — 25th Annual Davenport Hamfest. **SPONSOR:** Davenport RAC. **LOCATION:** QCCA Expo Center, 2621 4th Ave. **HOURS:** 7:30am-3:30pm. **ADMISSION:** Adv $5, door $6, under 14 free. **TALK-IN:** 146.28 -88. **FEATURES:** CB - DP - EX - FP - H. **DEALER INFO:** Tables $12, commercial booth $20, set-up Sat noon-6pm & Sun @ 6am. **CONTACT:** Kent Williams K9UQI, 309-796-0718, 4245 10th St, East Moline IL 61244-4154.

MI - FLINT — Five Star Productions Computer Shows. **SPONSOR:** Five Star Productions. **LOCATION:** Holiday Inn-Gateway Centre, US-23 at Hill Rd Exit. **HOURS:** 10am-4pm. **ADMISSION:** $4. **FEA-**

Continued on page 138

COMPUTER PARTS - SCSI DRIVE ACCESSORIES - SURPLUS ELECTRONICS

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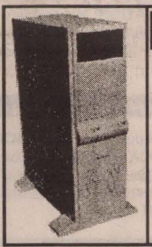

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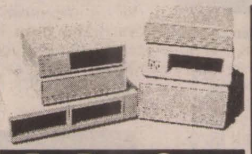

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- LED's & Rst
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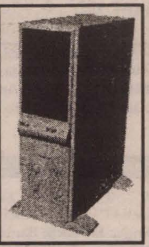

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CD ROM Drives

Sanyo 2x External w/ctrl'r....$99.00
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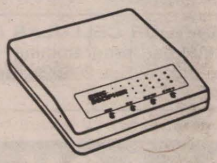

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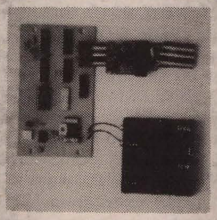

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Sales to qualified buyers ONLY. Prepaid orders, C.O.D.s, and the American Express Card are gladly accepted.

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Assembled & Tested: $99.95
Enclosure: $10.00
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It is not the intent of B.E.S.W. to defraud any pay television operator and we will not assist any company or individual in doing the same.
*Refer to sales personnel for specifications.

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"COPY CATS" "X-MAS CLOSE OUT" THESE PRICES ARE ONLY AVAILABLE THROUGH THE END OF '95 WHILE SUPPLIES LAST. SO HAVE AT IT. We purchase (used Copy Cats), **and provide 951C-9545 upgrades for Copy Cats. Call for details.** 1 way Motorola device/**$1,595,** was $3,000; 2 in 1 Motorola, NEC device **$2,400,** was $4,500; 5 in 1 Motorola, Audiovox, NEC, Sony, General Electric (Ericsson), **$3,700,** was $6,595; 4 in 1 **(INCLUDES NEW 951C through 9545 SOFTWARE FOR MOTOROLA,** NEC, Sony, General Electric, Sony (Ericsson) **$4,400,** was $5,995. **BEST VALUE:** 7 in 1 **INCLUDES NEW 951C-THROUGH 9545 SOFTWARE FOR MOTOROLA,** Audiovox, NEC, General Electric (Ericsson), Mitsubishi, Sony, Panasonic device ONLY **$5,000,** was $7,995. **Complete** Uniden boxes are available, but can not be combined with any other boxes, **$3,700. Dealers: Ask about our volume discounts. NOTE: CODED DEVICES ARE ALSO AVAILABLE UPON REQUEST. WARNING: TELECOMMUNICATION THEFT AND FRAUD IS A LOCAL AND FEDERAL CRIME TITLE 18-1029. THECK TALLK,** Telephone: 1-800-588-2979.

$79-$129. MOTOROLA CELLULAR PHONES, REFURBISHED, WITH ACCESSORIES, GUARANTEED. ECONOMY MODELS, IDEAL FOR BUDGET CELLULAR SERVICE USER'S PROGRAMS, SUCH AS BILL WATCH, PREPAID METERED, NON-CONTRACTED, MINIMUM DEPOSIT & OR NO CREDIT CHECK. ULTRA CLASSIC II (THIN LINE) $139.95, ULTRA CLASSIC (THIN-LINE) $109.95 AND 8000 BRICK (THICK) PHONE $79.95. NEW! FLIP PHONES, MICRO TAC MODEL DPC-550, WITH EXTENDED BATTERY, WEIGHT IS LESS THAN 10 OZS., $295.95. PHONES, PRICES INDICATED INCLUDE BATTERY, LEATHER CARRY CASE, HOME, CAR (AC-DC) BATTERY CHARGER, OPERATORS MANUAL & 90 DAY DEFECTIVE PRODUCT EXCHANGE. DEALER QUANTITY DISCOUNTS AVAILABLE. ORDER/INFORMATION: TELEPHONE 702-642-3559 S&H CHARGES PER ORDER $11.95, VIA UPS, COD, CASH, TELEPHONE, MAIL ORDER ONLY. **LESS BUSTER'S ELECTRONICS,** 2039 CIVIC CENTER DRIVE #176C N. LAS VEGAS, NV 89030.

ATM HACKERS BLACK BOOK: Amazing hacking methods exposed! Covers everything on the vulnerabilities of automatic teller machines. Includes: Pin compromise, service codes, card counterfeiting, crimes, magnetic stripes, jackpotting, security, signal interception, spoofing, pulse, vibration, tapping, and more! Protect yourself! $18. **SPECTRE PRESS,** PO Box 5112, N. Muskegon, MI 49445.

PARTY-LINE Phoneline Simulator Kit. Provides six extensions, caller-ID signal, distinctive ringing, authentic dial tone, busy signal, and real 20Hz ringing. Featured in Jan '96 Electronics Now Magazine. Use it to test or demonstrate your telephone devices. Kit includes very high quality circuit board, all electronic parts, technical manual. $199 plus $8 for USA shipping. CA residents include local tax. MasterCard, Visa, Discover, Amex. Digital Products Company, 134 Windstar Cir., Folsom, CA 95630. 24 hr. voice 916-985-7219, Fax 916-985-8460, E-Mail DigProd@aol.com

HANDHELD CELLULAR PROGRAMMER: The Pro-1 will program an ESN on Motorola (including Elite), NEC, Sony, GE-Ericcson, Audiovox, and Diamondtel. The Pro-1 allows activation of the programmer phone menus simply by entering passwords Activate 1 or more menus to begin with, and add other menus later, all without the delay, risk, and cost of sending your valued programmer by mail. **PROGRAMMERS ARE GUARANTEED.** Call 1-800-690-3431 for more info. (Se habla español.)

TURN ON YOUR CELLULAR PHONE through key-pad programming. Manual $22. Cabletronics, Box 30502N, Bethesda, MD 20824.

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HACKERS SECRETS: New book with software on hacking, cracking and phreaking. Information resources, boxes, password cracking, fakemail, FTP sites for hackers, LASS codes, magnetic stripe encoders, ringback numbers, suppliers. Includes: IBM-AT software covering: Using computer as DTMF signaler/generator/coin tone signalling, keytrap program, several war dialer/code cracker programs, and more. $36.45. **VISA/MC** 520-782-2316. **TELECODE,** Box 6426-NV, Yuma, AZ 85366-6426.

FREE PAGERS! Call 1-800-724-3637, use gift certificate #3337510. Get a standard beep/vibrate pager free! Activation required at time of redemption. Also, need people looking to make $$$ giving away free pagers! Info: BerlCo, Box 370463, West Hartford, CT 06137-0463.

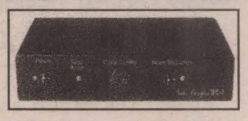
UNIDEN CP-1700 bag phone $50. Call 1-800-804-8655.

PHONE BOX BIBLE. 35 plus plans and articles on phone boxes. Covers: Red, beige, and 22 other boxes. Includes the new "QUARTER" box plans. For educational use only! $46.45. **VISA/MC** 520-782-2316. **TELECODE,** Box 6426-NV, Yuma, AZ 85366-6426.

BLACK FEATHER ELECTRONICS

VIDEO CLARIFIER

ELIMINATES ADVERSE EFFECTS OF VIDEO COPY-GUARDS!



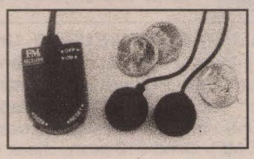
State-of-the-art circuitry restores original (master) quality to all video tapes. Allows for flawless viewing of all prerecorded video's whether rented, purchased or produced at home (even copy-protected tapes),for your personal home use. Unique auto Sync Boost feature eliminates horizontal instability and restores tapes to broadcast quality. Noise Reduction Circuit filters out the "snow" and other annoying interference. Compatible with all VCRs and T.V.s. Includes AC adapter.

SALE

CAT #VC-1 **$49.95 each**

ULTRA-MINI FM RADIO

WOW! SOUNDS GREAT!

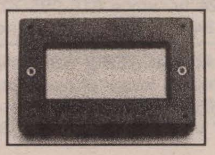


Fit an entire orchestra in the palm of your hand and still have room for the concert tickets with this Mini FM Radio that has an incredible sound. Features on/off button, seek button and reset button. Includes battery. If this isn't the world's smallest, it's close to it. But the sharp, clear sound that comes out will make you think you have a jam box. Black.

SALE

CAT #FM-1 **$10.95 each**

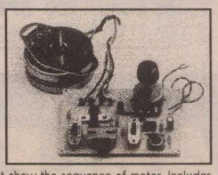
3 1/2 DIGIT PANEL METER



This meter has many useful applications such as Voltmeter, Thermometer, Db Meter, Watt Meter, Current Meter, Capacitance Meter, Lux Meter and LCR Meter. Features include: 200mV full scale input sensitivity, single 9VDC operation and decimal point selectable. In addition, it has 13mm figure height, automatic polarity indication, guaranteed zero reading for 0 volt input and high input impedance (>100M ohms). Specifications: Max input 199.9mV DC-Max. Display: 1999 counts (3-1/2 digits). Measuring method: Dual slope integration A-D converter system, plus many other features.

CAT #PM-1 **$9.95 each**

STEPPER MOTOR CONTROLLER KIT



This kit allows you to adjust the speed and direction of a stepper motor. You can move the motor in one step increments or rotate it at a constant speed. There are a set of visual indicators that show the sequence of motor. Includes stepper motor, pc board, parts and instructions.

(12Vdc power source not includ.)

CAT #SMK-1 **$25.00 each**

LASER POINTER

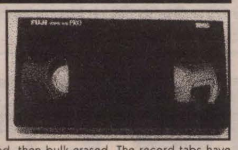
5mW LASER POINTER!

Make a point with your laser pointer. Pointers are the most effective way to demonstrate your drawings, schematics, presentation, and charts. Just press and point! The beam shoots out across the room and puts a red dot on the wall up to 350 feet away. Operates on 2AAA batteries (included). wt. 2.3oz, wavelength 670nm/5mW output. Measures: .5" diameter x 5.75" L

CAT #LP-1 **$39.99 each**

SUPER VHS VIDEO TAPES

SUPER VHS PRO VIDEO TAPES

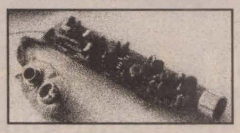


Name brand S-VHS tapes, T-120. These tapes were used for a brief period, then bulk erased. The record tabs have been broken out, so you will need to cover the notch with a bit of tape, but they are a great deal at a fraction of the "New" price!

CAT #S-VHS **$3.00 each - 10 for 28.00**

FM WIRELESS MIKE KIT

POWERFUL



2 stage, wireless mike kit transmits over .5 mile (up to 1 Km in the open) Tunable to the upper part of FM broadcast band. Circuit does require the ability to "Tweak" RF circuits by stretching or compressing coils. With mike and 9V battery clip. Operates from 6-12V DC. 2.75" x .625" x .5" WT .06

CAT #FM-32 **$10.95 each**

9V DC FM TRANSMITTER KIT

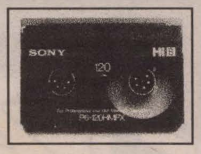
POWERFUL

FM transmitter. Transmits over 100 meters in building and over 500 meters outside using .25 or .5 wavelength of wire. Transmits to the upper part of FM broadcast band (100-108MHz). Circuit requires the ability to "Tweak" RF circuits. Operates on 9V DC. 1.75" x .75" x .375" WT .05

CAT #FM-18 **$9.95 each**

CAMCORDER VIDEO TAPES

HI-8 120 MINUTE VIDEO CASSETTE TAPES (used)



They were recorded on once and played only a few times. Made by a major brand name manufacturer. Professional series metal tapes. Includes plastic jewel box.

NOTE: Other tapes available.

CAT #CCT-1 **$3.00 each**

10 or more - 2.80 each

EMERGENCY LIGHT

THE AMAZING EMERGENCY LIGHT!

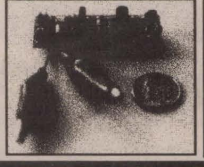
Never ever needs batteries! This waterproof unit is powered by pumping the handle-this action moves a flywheel which activates a dynamo. The dynamo produces a DC voltage and current that powers the light. Great for the car, home and boat. Never be without a light when the power goes out due to earthquakes, floods or other disasters. Operates when completely submerged in water. The dynamo can be stripped out for experimentation.

CAT # EL-1 **$7.95 each**

TELEPHONE TRANSMITTER KIT

JUST LIFT THE HANDSET!

Phone line powered and activated when handset is lifted. Uses phone wires for antenna. Transmits over short distance (100ft) to the lower part of FM broadcast band (90-95MHz). Circuit does not require the ability to "Tweak" RF circuits. WT .06



CAT #FM-16 **$9.95 each**

STROBE KIT

This kit allows you to vary the rate of strobe flashes 60 to 120 flashes per minute. Operating voltage is adjustable depending on how you wire the kit. It will work on 4.5, 6 and 12 VDC. Includes pc board, parts and instructions.

CAT #SLK-1 **$7.50 each**

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TEST CLIPS. No need to remove soldered ICs. Clips onto chip, plugs into programmer to read or write. Available: 8, 14, 16, 20, 24, 28, and 40 DIP. $39.95 each. ALL 7 for $239.95 ppd. **TELECODE**, Box 6426-NV, Yuma, AZ 85366-6426.

PRIVACY AT LAST. Amazing new module gives you total privacy on your telephone conversations. Send $29 to V. Eftechiou, 1402 Pine Ave., Niagara Falls, NY 14301.

CELLULAR SCANNER: Decode cellular data, monitor channels, decode DTMF and more. Use as stand-alone unit or with optional computer interface. For immediate fax info call 714-647-7236 or call 818-425-2243 for orders.

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CELLULAR EXTENSIONS for all Motorola bag and flip phones. Will program yours for $100 or purchase a phone already on your current service. Call Bullseye Services, 803-934-2464.

MINIATURE JACKFIELDS. Telephone industry type 19" rack mount jackfields with bantam jacks. Several styles available. Connectorized. $40/unit. More info? Phone 415-665-5606 or FAX: 415-665-0616.

ESN READER connects between AR3000 scanner and personal computer, reads and logs to disk. Scanner and computer not included. $995 US postal money order to Keith Perry, PO Box 816, Leander, TX 78646-0816. SASE for info. 512-259-4770.

FOR SALE TIE MODEL 2260 TELEPHONE SYSTEM 40 phones, power supply, back-up boards, $500. Takes all. STC Corp. Call Les or Mike 616-849-1800.

9.9 CTS/MIN. offpeak personal LD. 17.5 cts/min non-surcharge calling card. Personal 800# and low cost business rates 800# and outgoing. Info/opp — SASE to: JHK, 2189 Wist Marne Ave., Glendale, WI 53209-4355.

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PRINTED CIRCUT BOARD TRANSFER FILM

For LASER PRINTERS and PHOTOCOPIERS

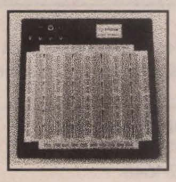
Eliminate darkroom, photochemical, negatives, and copy cameras! Make printed circuit boards using a laser printer or photocopier, direct from CAD software or magazines.

Only four easy steps: 1. Print or copy; 2. Iron-on; 3. Peel-off; 4. Etch!

CAT #TEK-1 **$10.95 each package of 5**

BREAD BOARDS

DESIGN YOUR OWN CIRCUITS QUICKLY !!! NO SOLDERING NECESSARY...

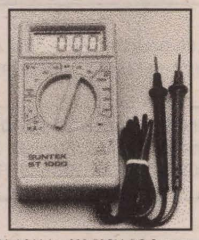


Breadboards allow you to design and prototype circuits quickly. It lets you position components on the board without soldering. Great for the experimenter, student and hobbyist! This breadboard is a large size board with enough room to design major projects. It measures: 7" x 9" mounted on an aluminum back plate.

CAT #BB-2 **$30.00 each**

DIGITAL POCKET MULTIMETER

- **3 1/2 Digit LCD Display**
- **AC & DC Volts**
- **DC Current**



This little gem comes with many fancy features considering its compact size! Light weight and hand held, this unit also tests batteries and diodes. Great for the technician, student and hobbyist alike! SPECIFICATIONS: DC Volts: 2-50OV, AC Volts: 200-50OV, DC Current: 2OOmA, Resistance: 2K-OHMS-2MEG.OHMS, Diode Test: 3.2V Max 1=1mA (Diode), Battery Test: 1.5V AA (4OmA) - 9V (24mA)

CAT #DMM-01 **$19.95 each**

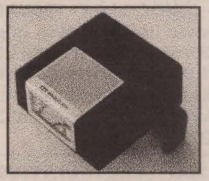
BNC CONNECTOR

BNC Connector Panel Mount Applications
(isolated) BNC-JACK
CAT #BNC-1
$1.00 each 10 for $8.50

BNC-TEE ADAPTER
2-JACKS / 1 PLUG (UG-274B/U)
CAT #BNC-T
$1.50 each
10 for $12.50

CAMERA FLASH

ITT MAGIC FLASH

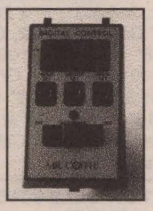


Manufactured for Polaroid OneStep and Pronto cameras. This flash has many uses, and is great for lighting and special effects. The flash can be triggered by external 3Vdc pulse. Operates on 6 Vdc with 4 AA batteries (not included). It also contains a 600uf 330v photo flash capacitor. This valuable cap is worth the asking price alone!

CAT #FSH-1 **$2.75 each**

"MR. COFFEE" TIMER

YOU CAN AUTOMATICALLY TURN ON APPLIANCES, LIGHTS AND GADGETS.



This timer was removed from electric coffee makers due to design changes. It works on 120Vac and is capable of handling a Max of 10 Amps. Because they were used in coffee makers they automatically turn off after two hours. Some have a few blemishes, but are guaranteed to work. Measures 4.9" x 2.45" x 1.1"

CAT #MCT-1 **$4.75 each or 2 for 9.00**

SWITCHES

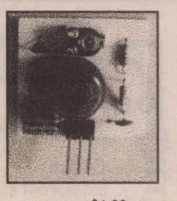
MINIATURE TOGGLE
They all have 5A-125 VAC rating with BAT-HANDLE style & solder terminals.
1/4-40 threaded bushing.

MTS-1 thru 4

MTS-1 S.P.D.T. ON-ON
$1.00 each 10 for $9.00
MTS-2 S.P.D.T. ON-OFF-ON
$1.00 each 10 for $9.00
MTS-3 D.P.D.T. ON-ON
$1.25 each 10 for $10.50
MTS-4 D.P.D.T. ON-OFF-ON
$1.60 each 10 for $13.00

SOUND ACTIVATED SWITCH

SOUND TURNS THE CIRCUIT ON!

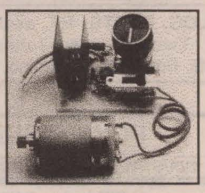


High-pitched sound turns circuit on. Trigger relays, motors, lights or other devices. Must be reset after triggered. Operates on 6Vdc. has sensitivity adjustment.

CAT #SAW-1 **$1.00 each**

DC MOTOR SPEED CONTROLLER KIT

Easy To Build!



This kit allows you to control the speed and direction of a 6 to 12 volt motor. It is easy to build and includes pc board, motor, parts and instructions.

CAT #MSC-1 **$15.00 each**

REGULAR CAMCORDER TAPE

120 MINUTE VIDEO CASSETTE TAPE

Major brand name manufacturer, recorded on once and played only a few times.

Excellent condition!

These will play on a regular camcorder, where the HI-8 tapes don't. If you have a regular camcorder machine then this is the tape for you. If you have a HI-8 machine, you may enjoy the higher quality provided by the HI-8 tapes.

CAT #CCT-2 **$2.50 each**
Includes plastic jewel box. **10 or more - 2.30 each**

FUSE HOLDER

3AG FUSE HOLDER PANEL MOUNT WITH A SCREW CAP

CAT #FHPM-1
.75 cents each

RCA JACK PANEL MOUNT

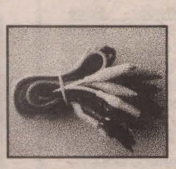
SINGLE HOLE PANEL MOUNT RCA JACK with threads form the back.
CAT #RJPM

1-9 pcs	**.40 cents**
10-99 pcs	**.35 cents**
100+	**.25 cents**

MINI JUMPERS

MINI JUMPERS
10 TEST LEAD JUMPERS
with 1" ALLIGATOR CLIPS
2 each of 5 colors

CAT #MTL-1
$2.50 per set



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PANASONIC, SOUTHWESTERN BELL phones and professional security equipment catalog. Send $2 to: HES Electronics, PO Box 183, Brick, NJ 08723.

WANTED: A reasonably priced Caller ID blocker to block your number when calling 800 numbers. W. Guri, 145-28 Ave., Brooklyn, NY 11214-6885.

TELECODE™

CELLULAR PROGRAMMERS PACKAGE OFFER!!! Volumes 1 & 2 of the cellular hacker's bibles, cellular programmer's Bible (updated 7-15-1995. Now with over 400 instructions sets!), bag phone video bible and cloning cellular telephones video. Includes software to program Motorola bag, flip, brick (ALL PHONE plus Amps-G2) NEC, Panasonic, and Nokia, $179. We pay postage within USA! **VISA/MC** 520-782-2316 or **FAX:** 520-343-2141. **TELECODE**, Box 6426-NV, Yuma, AZ 85366-6426.

FIVE ESN/NAM modification installed in your OKI 900 for $250. Chip only $150. Phone with chip $600. Other OKI stuff, too. Call Keith at 512-259-4770.

CELL PHONE cloning for the guy who has (two of) everything. Must have current service contract. Motorola, Tandy. For more info, call Keith, 512-259-4770.

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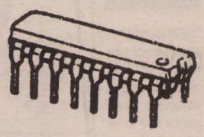

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Collecting Data the Mechanical Way

Open Channel

by Joseph J. Carr
K4IPV

The most popular columns that I have written thus far have been those on radio astronomy, and those related topics that I call "radio science observing." These activities can be done by nearly all owners of receivers and simple antennas, on frequencies ranging from the low VLF (near 20 KHz) to the low microwave (1-2 GHz). Receivers for these frequencies are easily obtained, and can also be built.

Data collection is another thing, however. While observing can be done with the ears (sort of), the real test of your radio science observing comes when you collect actual data. There are several ways to do this trick.

One of them is to tie up a computer equipped with an analog-to-digital converter (ADC). The purpose of the ADC is to convert the analog signals from the receiver output to a binary word that makes sense to a digital computer. Now that a lot of MS-DOS-only machines are on the market for $50.00 to $150.00 (or, as my wife discovered when her employer dumped old machines, as low as $10.00 or carry 'em away), this approach is reasonable . . . if you can get a cheapie ADC.

The ADC problem is less than it used to be . . . by a long shot. When I was doing scientific and medical instrumentation work at the dawn of the microcomputer age, an eight-bit ADC could cost $600.00. Today, you can build your own for a few bucks and buy a ready-built for a few score bucks. The latter comes in models that will interface with your computer through either the serial communications port, or through the Centronics parallel printer port.

Uhhh . . . "parallel printer port, did you say? Isn't that an output?" Yep, it's surely and truly an output port, but it is equipped with four handshaking lines that are each effectively one-bit bidirectional lines. Clever design and software make it possible to read the data four bits at a time. That means doing a double-clutch to get eight-bit data, and a triple-clutch for 12-bit data, but that's not usually a problem with the low data rates used in radio science observing (1 Hz being typical).

The other way to collect data is to use a mechanical paper chart recorder. I've owned several over the years, starting with a cast-off vacuum tube electrocardiograph (ECG) machine that I bid $25.00 for at a Veterans Administration hospital auction.

Let's discuss these machines . . . an awful lot of radio science observers use surplus, cast off, or otherwise obtained mechanical paper recorders to collect their data. Today, I've got a Gulton 190 1-mA full-scale recorder, and a multi-speed recorder that was once used in a hospital. I also have an old Heathkit servo-mechanism recorder, but it doesn't work terribly well (and parts are no longer available), so I don't count it.

If you look into the mail order market where radio science observers and radio astronomers dwell, you will discover occasional advertisements for new, used, and "old, but never used," strip chart recorders of one sort or another. You might also want to keep an eye on the classified ads in this publication . . . you never know what pops up!

The Care and Feeding of Mechanical Paper Recorders

The term "mechanical recorders" refers to a broad class of devices that make a permanent paper record of analog waveforms using a pen or stylus. To the analog data system, the recorder serves the same function as a printer in a personal computer system. That is, it creates a permanent record "hardcopy" of the data output produced by the instrument. For some modern pin-driven analog recorders (which are actually digitally-based), the analogy to a computer printer (at least the 24-pin dot matrix type) is more than merely metaphorical.

Several different categories of analog recorders are used in medicine: strip chart, X-Y servo-recorders, and plotters are among the most common. We also now have analog-digital dot matrix printing mechanisms for analog recorders. The strip chart recorder uses paper that is continuous on either a roll (like adding machine paper) or in a Z-fold pack (like personal computer printer paper). The X-Y servo-recorder uses a single sheet of paper and an analog pen. The plotter is actually a sophisticated, digitally controlled version of the analog X-Y recorder. Of these, the strip chart recorder is by far the most commonly used in medicine (especially on emergency equipment), and long duration scientific recordings; other scientific recordings will use the X-Y or Y-Time servo-recorder. We will look at the strip chart recorder version in this column.

But first, we must examine the principal means for writing in the strip chart recorder: the *permanent magnet moving coil* (PMMC) galvanometer mechanism.

PMMC Galvanometer Movements

The heart of any standard strip chart recorder is a device called a permanent magnet moving coil (PMMC) galvanometer, or "galvie" as it is called in the trade (see Figure 1). The moving coil consists of a bobbin on jeweled bearings, with a lightweight coil of wire wound over it. When an electric current is applied to the coil, a weak magnetic field is set up around the coil. The signal being recorded is applied to the coil so that it causes a current to flow in the coil. Thus, the magnetic field surrounding the coil is proportional to the amplitude of the signal applied to the coil.

The permanent magnet applies a strong magnetic field across the space occupied by the moving coil. The magnetic field of the moving coil therefore interacts with the field of the permanent magnet. Recall the standard rules for magnetic field interaction: opposite poles attract and like fields repel. The reaction of the coil will be to move when a current flows. The jeweled bearings allow rotational motion only. By attaching a pen or stylus (of which, more later) to the coil's pivot point, we produce an angular deflection proportional to the applied signal amplitude.

If this arrangement looks a bit like a D'Arsonval or taut-band analog meter movement, with the pointer replaced by a stylus or pen, then you're right . . . it's the same thing.

The pen tip is positioned over a strip of chart paper that is pulled under the pen tip at a constant speed, thereby establishing a time base. Deflection of the pen across the paper reproduces the waveshape of the signal applied to the coil.

A PMMC galvanometer with a short pen arc will write in a curved manner, i.e., the pen will scribe an arc at its tip instead of a straight line because the bobbin is cylindrical. In some applications this may be tolerable, and the user mere-

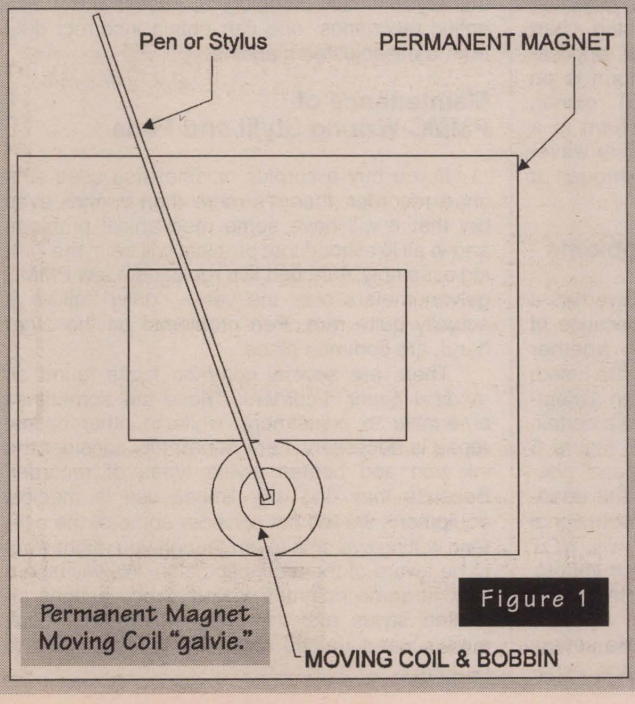


Figure 1

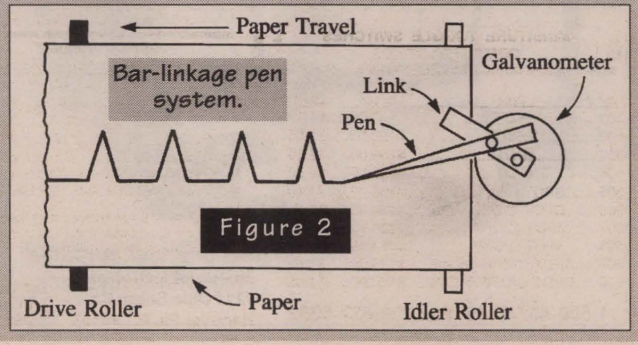


Figure 2

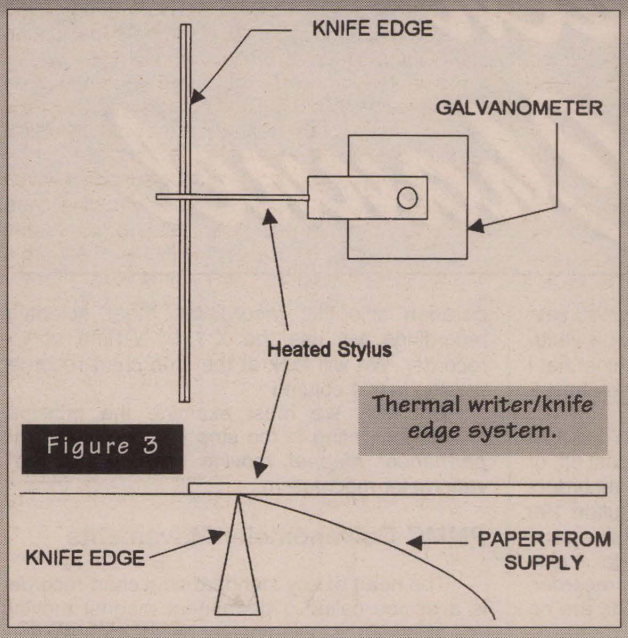


Figure 3
Thermal writer/knife edge system.

ly records on a paper that has a semi-circular grid marked on it. In most applications, however, it is of limited use. In such cases, the amount of deflection (e.g., a temperature) is more important than the shape of the wave. Thus, this type of pen is almost useless for recording waveforms.

A solution to the problem of curvilinear recording is shown in Figure 2. The PMMC mechanism is not connected directly to the pen, but through a mechanical linkage that translates the curvilinear motion of the PMMC coil bobbin to a rectilinear (fancy word for "straight line") motion needed at the pen tip. This type of system is used by most ink pen type of writers. This type of mechanism is used extensively, and is gaining, but is still not as extensively used as the knife-edge method discussed later.

A pseudorectilinear technique is also sometimes used. In that type of assembly, the pen or stylus is very long compared with the arc that it must scribe (and also the chart paper width). The pen tip, therefore, travels in an arc that is very small compared with its radius, i.e., the pen length. The trace, then, is nearly linear. Some curvature will exist, however, so this method is only used on some non-critical applications where some distortion of the waveform is permitted.

The thermal stylus/knife-edge writing system is shown in Figure 3. The "pen" is a hollow stylus that contains an electrical resistance wire heater inside. The tip still travels in a curvilinear method (which allows the simplest form of linkless PMMC pen mechanism), but the trace is very nearly linear because the knife edge is straight. This technique works in both thermal writing and direct pressure systems (as opposed to ink) because the heated stylus can write anywhere along its own length — not just at the tip. By keeping a straight knife edge in a fixed position beneath the stylus, and allowing the stylus' point of contact with the heat or pressure sensitive paper to vary, we obtain a rectilinear recording. It is the straightness of the knife edge that creates the rectilinear operation. Special paraffin coated paper is used with the heated stylus.

Another knife-edge system is the direct contact type of system. The direct method uses specially treated paper similar to the "carbonless" multi-copy form paper marketed by companies such as NCR paper for commercial purposes. The stylus is designed to tap the paper, leaving a small dot at the point where the "pen" struck the paper. A small stepper or slow-speed motor advances the paper between taps. The 1-mA Gulton recorder contains a timing cam that causes a tap to occur once every second as the paper moves very, very slowly under it. This type of recorder has been popular with radio solar/VLF SID hunters.

Recorders come in a variety of different configurations. One of the most useful is the sort-of portable form shown in Figure 4. This particular model is a two-channel strip chart recorder used in medical applications. The left-hand waveform is an electrocardiograph (ECG) signal, while the right-hand waveform is a tracing of the arterial pressure waveform (which is obtained through a strain gauge transducer).

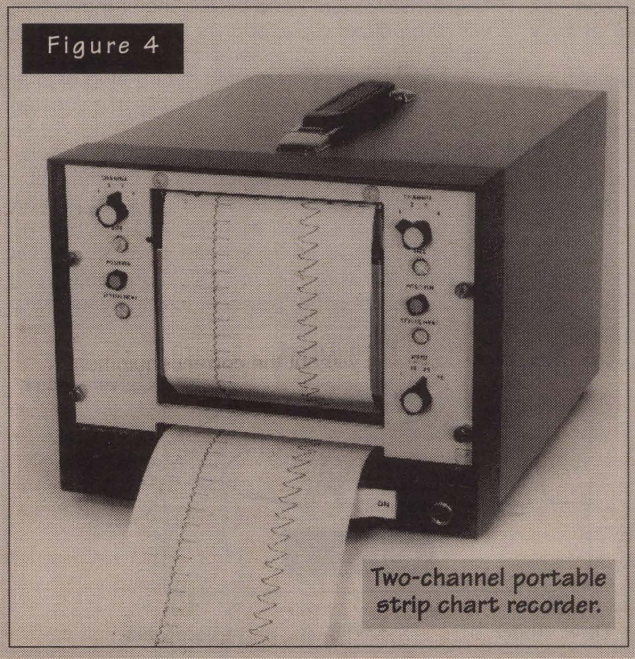


Figure 4
Two-channel portable strip chart recorder.

Solving Recorder Problems

The pen assembly always has a certain amount of inertia because of its mass, regardless of whether PMMC or servo systems are used. Because of its mass, the pen assembly will not start moving until a certain minimum signal is applied. Figure 5 shows this so-called "deadband" phenomena. The definition of the deadband is "the largest amplitude signal to which the instrument will NOT respond." In most quality instruments, the deadband is not more than 0.05 to 0.1 percent of full-scale.

The deadband can cause severe distortion of the recorded trace, especially on low-amplitude signals whose level approximates the deadband itself. The solution to the problem of deadband is to slew the signal through the deadband as rapidly as possible.

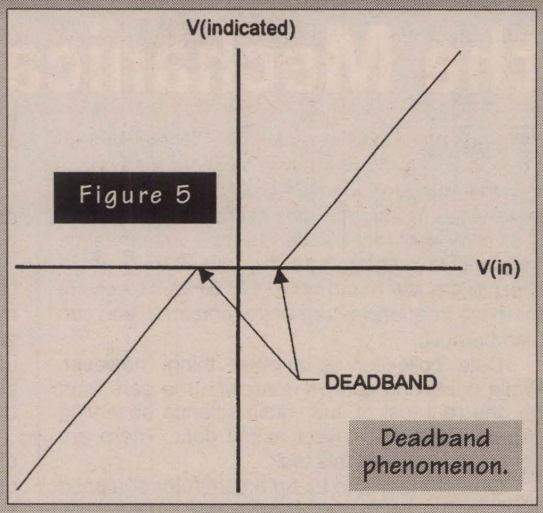


Figure 5
Deadband phenomenon.

Another problem is overshoot or undershoot of the pen in response to a step function (e.g., squarewave). This problem also affects both forms of mechanical writer. Figure 6 shows three different responses. In a properly dampled recorder, the pen will rise to the correct position with very little rounding of the trace. This situation is called "critical damping."

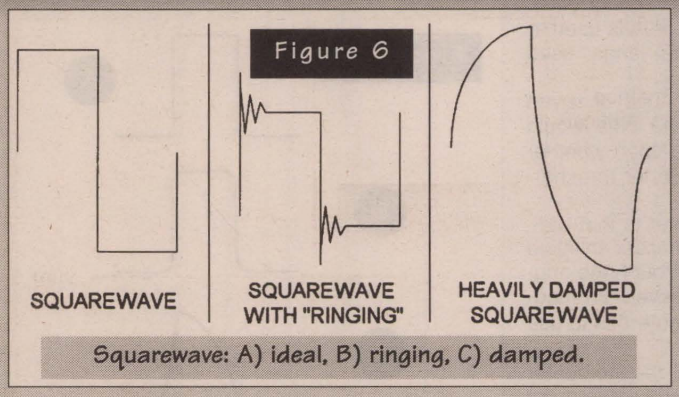
A subcritically damped signal will overshoot the correct position, and then hunt back and forth across the correct position for a few cycles before it settles on the correct point. If a squarewave is applied to such a system, then the recording will appear to be "ringing" (i.e., oscillations at the top and bottom of the squarewave).

An overcritically damped system (the more common) approaches the final value very sluggishly. The pen in that type of system will appear to be very sluggish. A squarewave applied to such a system will have rounded edges. Damping is an important parameter in medical recorders because it can distort the resultant traces and thereby mimmick pathological traces, and in scientific recordings, one can obtain incorrect data from a misadjusted machine.

Maintenance of PMMC Writing Stylii and Pens

If you buy a surplus or otherwise used strip chart recorder, then it's more than a odds-even bet that it will have some mechanical problem, and in all likelihood that problem will be in the writing assembly. Although I've replaced a few PMMC galvanometers over the years, "galvi" failure is actually quite rare. Pen problems, on the other hand, are common place.

There are several common faults found on medical paper recorders. These are sometimes amenable to adjustment, while in other cases, repair is necessary. Let's separately consider the ink pen and heated stylus types of recorder. Because they find only limited use in medical equipment, we will not consider some of the esoteric writing systems (even though you might want to be aware of them conceptually). We will take a look at some common maintainance actions on heated stylus and ink pens writers that don't always need trained engineering technicians to perform.



Squarewave: A) ideal, B) ringing, C) damped.

Figure 7 shows how to remove an ink blockage from an ink pen recorder that's been allowed to stand too long without being used. As a general rule, such recorders should be run for about five minutes or so once a week when not in regular service. Otherwise, the ink will dry up at the tip and prevent the recorder from writing. Fill a 3- to 10-cc syringe with water (or acetone if certain types of ink are used), and insert the needle end into the ink inlet on the rear end of the pen assembly. On most recorders, the pen will have to be removed from the machine for this operation. The needle should be inserted up to the Luer lock hub in order to make a good fluid seal. Quickly, and with a single sharp motion, drive the plunger "home" so that a high-pressure jet of water or acetone is forced into the pen. The ink clot should be forced under high pressure out the other end.

This procedure usually works quite well. Some precautions are in order, however. First, always wear protective goggles over your eyes when doing this operation. Also, wear protective clothing, as ink/water will splatter everywhere. Second, make sure that the pen tip is aimed downward into a sink (there is still a laboratory at George Washington University Medical Center with a blue spot on the ceiling tiles over the sink . . . where the author failed to observe this precaution). Finally, as always when dealing with needles, be careful not to stick yourself.

Syringes are controlled devices because of the drug problems seen in this country for the past few decades. However, one can still salvage insulin syringes from diabetics if they are properly cleaned (DON'T REUSE THEM FOR MEDICAL PURPOSES, HOWEVER). Also, there are syringe-like devices used for oiling fine machinery or spreading glue. If properly cleaned, these devices should also work well.

Also, for goodness sake, keep in mind that the thick, high viscosity ink used in these machines permanently stains everything it touches . . . and is the virtual dickens to clean.

Ink pen tips are designed to operate parallel to the paper surface (see inset in Figure 8). If the pen is worn, or when a new pen is installed, it is necessary to "lap" the tip in order to re-establish the parallelism. The symptom that lapping is needed will be either (or both) of the following: *a*) a "blob" of ink when the machine first starts recording a waveform, or *b*) a too-thick trace.

In most such machines, the ink should be dry before the paper leaves the paper platform at the drive roller end of the surface. If it is not dry, then lapping may be needed. To lap the pen, place a piece of very fine emery cloth (a sandpaper-like material available at any hardware store) under the tip. The pen tip is worked back and forth 5 to 10 times to "sand" the tip parallel to the paper.

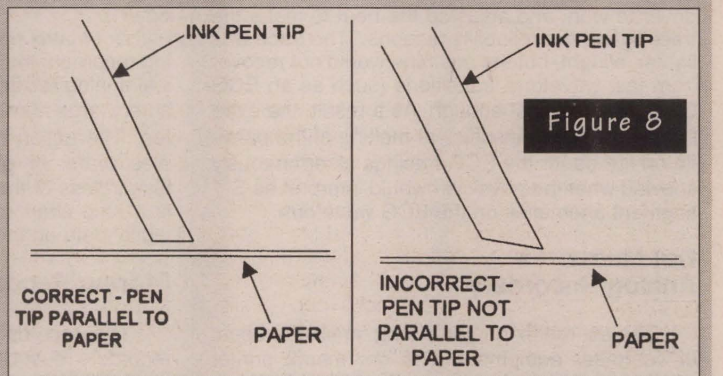
The pressure of the stylus or pen is also important. If the pressure is not correct, then the waveform may be distorted. On medical equipment, it is possible to make a normally healthy ECG signal look like it has either a heart block or a recent myocardial infarction because of improperly adjusted stylus pressure. The manufacturer will specify a pressure in grams. These numbers vary from 1 to 10 grams, depending upon the machine model (and its year of manufacture — older model machines tended to use heavier stylus pressures).

A stylus pressure gauge (see Figure 9) is used to lift the pen or stylus from the paper as the machine is running until the trace just disappears. The pressure reading is then made from the barrel of the gauge. Suitable stylus pressure gauges can be purchased from strip-chart recorder and ECG machine manufacturer's service or parts departments.

Alternatively, the stylus pressure gauge used for old-fashioned record player "tone arms" is also useful if the specified pressure is within their relatively limited range (usually 0 to 4 grams). The stylus pressure adjustment is made using a screw that is usually located on the rear of the stylus (or pen), or the assembly that holds it in place.

Figure 10 shows several different one millivolt calibration pulses from an ECG machine, and although from a medical application, illustrates what happens to the calibration pulse of all forms of strip chart recorder when misadjusted.

These traces can be made by pressing the "1-MV" or "CAL" button on the front panel of the machine. The ideal shape is perfectly square, as shown in Figure 10A. But this ideal is almost never achieved in practical machines because of the inertia of the pen or stylus assembly. Usually we see the slightly rounded features of the pulse shown in Figure 10B. This waveform is usually acceptable. What is not acceptable, however, are the overdamped and underdamped waveforms of Figures 10C and 10D, respectively.



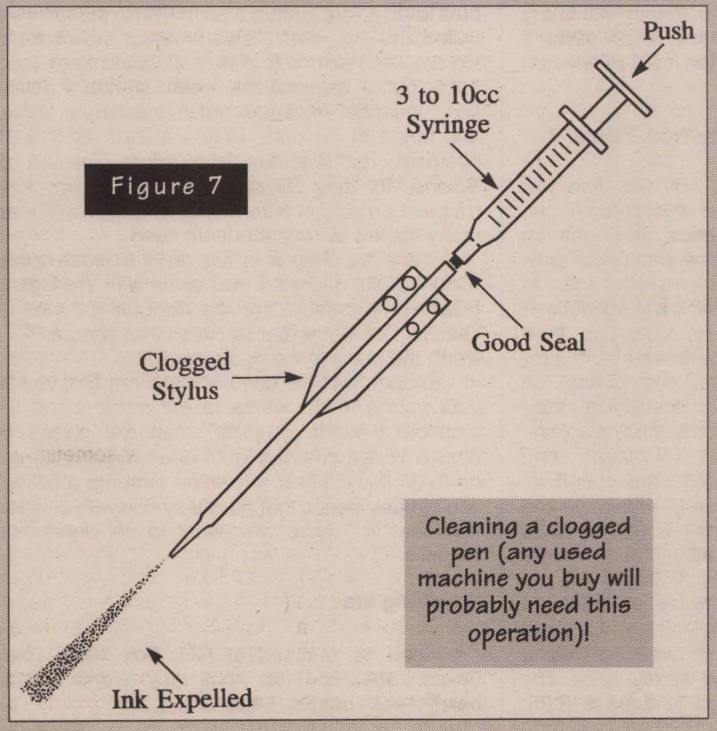
Correct and incorrect way pen should ride on paper.

On all recorders, there may be a damping control available for adjustment by a properly trained technician. This control is adjusted (usually internally to the machine) in order to compensate for problems. On ink pen machines, the stylus pressure can affect the waveshape, especially if it is set to too high a value (it produces the overdamped waveform). On heated stylus machines, both the stylus pressure and the heat can affect the waveform.

On some heated stylus machines, the standard procedure is to set the pressure to a specified value, set the voltage applied to the stylus heating element to a specified value (usually either 5.00 or 7.00 volts), and then adjust the internal damping control to produce the waveform of Figure 10B in response to either a squarewave input or successive presses of the "1-MV CAL" button.

If the manufacturer of the machine did not provide a knob on the stylus heat control, then don't adjust it without the correct equipment (usually stylus pressure gauge and voltmeter) AND the manufacturer's service manual! The author remembers a time when the director of the emergency room called me and snorted that he didn't really believe that the last 40 patients — only one of which had a cardiac complaint — all had recent myocardial infarctions.

The problem was that an ambitious medical student (who also held an electrical engineering degree) thought he knew how to adjust the heat . . . but did not. He brought a small screw-



Cleaning a clogged pen (any used machine you buy will probably need this operation)!

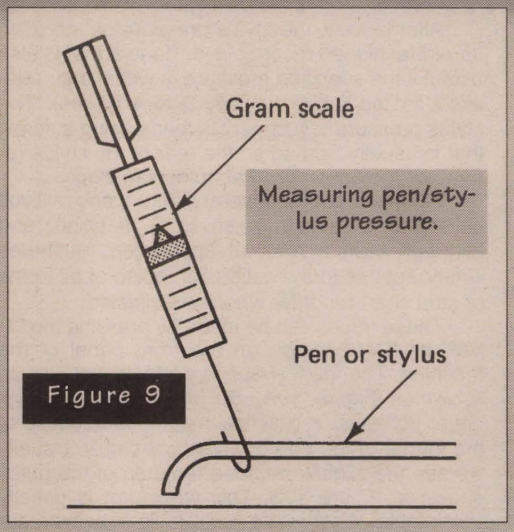


Figure 9

driver to work and adjusted the heat to make the trace lighter "for reliability reasons." The trace was lighter, allright, but the machine would not recover from fast waveform transitions (such as an ECG QRS complex) fast enough. As a result, the extra inertia caused by insufficient melting of the paraffin on the paper the ECG tracings all erroneously showed what the physician would interpret as S-T segment anomalies on the ECG waveform.

Dot Matrix Analog Recorders

The dot matrix printer is long familiar to users of computer equipment. The dot matrix printer was developed in response to the high cost of traditional computer printers. At the time that they became popular, the dot matrix printer cost about one-fifth to one-third the cost of daisy wheel, flying print head, or similar printer mechanisms. The original dot matrix printers (mid-1970s) used a 5 x 7 matrix of dots to form alphanumeric characters.

The dot matrix machine used a print head to cause the correct dot elements to be energized to make a mark on the paper. Two different methods were once popular, although one has since faded almost to obscurity.

Some of the earliest machines were thermally based. The dots were thermally connected to heating coils, and could be heated when needed. Special temperature sensitive paper was used to receive the text. This method is no longer used widely.

The second method used an array of seven print hammers (actually pins). The pins would either extend or retract depending upon whether or not that particular dot was active for the character being printed.

An advantage of the pin method is that ordinary paper can be used. The pins impact an inked ribbon to leave the impression. Although the original low resolution printers were seven-pin models, the current standard for pin printers is to use 24-pin (or more) print heads.

It was rapidly discovered in the computer world that clever programmers could make a dot matrix print head do graphics, as well as alphanumerics. The spate of newsletters, church and school bulletins, and other low-cost (but often creatively done) publications are a testimony to the graphics capability of modern dot matrix technology.

Dot matrix printing can be used to make analog recorders that outperform most older mechanical analog recorders. A dot matrix print head with a very large number of pins is arrayed over a platten. The action depends upon whether thermal, electro-arc, or plain strip chart paper is used. Regardless of the particulars, however, the result is a strip chart recording that mixes analog and digital data on the same chart.

Storing Recordings

The records produced by strip-chart paper recorders must be handled properly. For example, a pen and ink recording should not be touched on the tracing for some time after it is made, or ink will smear (and stain whatever touched it!). Even after it's dry, however, dirt and oils from your hands will smudge the recording.

Thermal and direct contact paper is a special problem. Avoid handling it as much as possible. My practice is to place a recording that I wish to keep in one of those plastic page protectors that you can obtain from office supplies or stationary stores. Also, keep thermal paper in a cool place. If the temperature is elevated, then it will slowly turn brown or black.

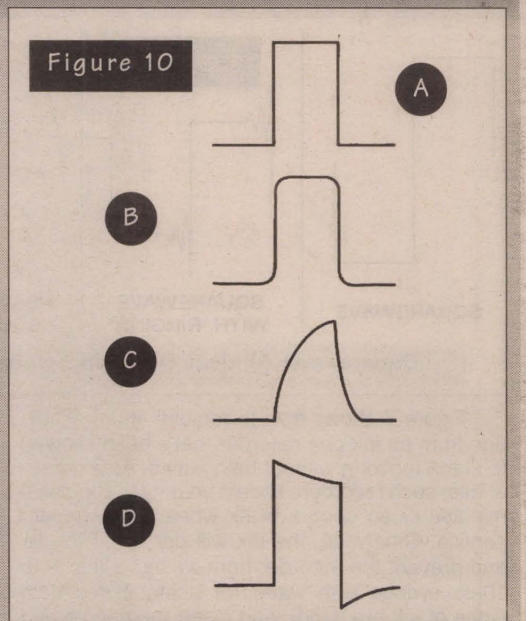


Figure 10

Calibration pulses: a) ideal; b) what is normally seen when machine is properly adjusted; c) heavily damped; d) with some overshoot, due to being too light.

Science Fairs

By the time you read this column, the science fair season will be well under way. Students who plan to enter their school will be finishing up their experiments and projects, and getting on with preparing their reports and displays. In February and March, the round of school, regional, and state science fairs takes place every year. If someone you know is planning to enter the fair, you might want to take a look at my book *The Art of Science* ($19.95, HighText Publications, Inc., P.O. Box 1489, Solana Beach, CA 92075; 1-800-247-6553 for credit card orders). The chapter on winning science fairs is gleaned from more than a decade of judging science fairs, and could make the difference.

If your young friend (or yourself if you are that young friend) doesn't do as well as expected, then that chapter might hold a clue as to "why" . . . and better prepare them for next year.

One of the things that a tremendous number of science fair entrants get wrong, even at the 11-12th grade levels, is the matter of statistics, i.e., handling their data. *The Art of Science* tells them how to do it. I've written a bit of Windows software called StuStats that allows amateur scientists to log data and store it to disk, and it calculates (and prints out, if desired) the mean, standard deviation, variance, minimum value, maximum value, and range of the data. I sell StuStats for $19.95 postpaid, but teachers who adopt *The Art of Science* for their classes can have a copy free (request on school letterhead), and may make as many copies as their students need.

There is a chapter in *The Art of Science* called "Counterfeits of Truth," and deals with the logical fallacies. A reviewer for the National Council of Teachers of Mathematics called that chapter ". . . worth the price of the book alone."

Enough with the commercial already. If you or your young friend wants to get some ideas for technology-based projects, then the pages of *Nuts & Volts* contains a lot of ideas. When I signed on to do this column, the editor sent me a collection of back issues that positively drip with science fair ideas for those who want to do electronics projects.

Reaching Me . . .

I can be reached at P.O. Box 1099, Falls Church, VA 22041 for snail mail users, and at **carrjj@aol.com** for E-Mail users. **NV**

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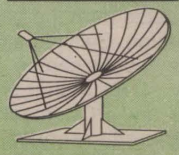

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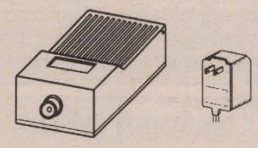
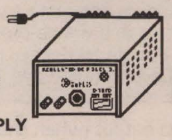


Element: 1/3" silicon CCD sensor
Lens: Fixed
Scanning: EIA 525 lines- 60 fields
Electronic Iris/shutter: Auto; 1/60-1/10,000
Resolution: 400 H X 504 V
Illumination: Ambient light
Sensitivity: 1 lux. @ F: 1.2
Video output: EIA std. 2/I interlace 1.0V P/P composite video
Connections: RCA jack for Video & 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

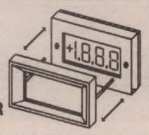
4A 13.8VDC REGULATED BENCH SUPPLY



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

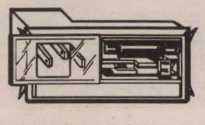
DIGITAL PANEL METER



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

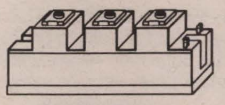
POWER INPUT MODULE



Potter 7100-0002, snap-in power inlet. Rated: 6A @ 250VAC. Standard male 3 blade IEC cord connector, 6A line filter, fuse holder & input voltage programming card (used to select power transformer taps). UL/CSA listed
W: 2-3/4" **H:** 1-1/8" **D:** 1-3/4" **WT:** .17

STOCK #	DESCRIPTION	PRICE
7313-FHN	IEC Module	$3.50

50A BIPOLAR MOTOR DRIVER MODULE



Fuji 2DI-50A-120A Hi-Current NPN 1/2 bridge module. Rated: I_C= 50A, V_{CE}=1200V. V_{BE} = 10. Base Current 3A. 2.5KV Isolation. For motor control, inverters etc.
L: 4-1/4" **W:** 1-1/4" **H:** 1-3/8" **WT:** .6

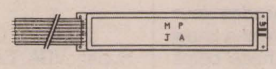
STOCK #	DESCRIPTION	PRICE
7307-QTN	Fuji 50A Driver	$29.95

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

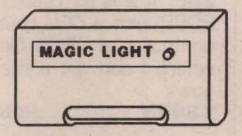
40 CHAR. X 2 LINE INTELLIGENT LCD DISPLAY



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

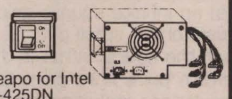
STOCK #	DESCRIPTION	PRICE
5120-OPN	2X40 Display	$9.95

POCKET" BLACK LIGHT"



Pocket sized "Black Light" used to detect fluorescent inks, paints etc. Unit runs off 2 "AA" cells. With belt clip & Push button switch for convience in use.
L: 3-1/8" **W:** 1-3/4" **T:** 1" **WT:** .1

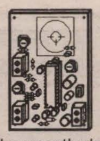
STOCK #	DESCRIPTION	PRICE
7231-MIN	"Black Light"	$3.95



MFG: Teapo for Intel
P/N: TP-425DN
Input: 110/220 VAC 50-60Hz
Output #1: +5V @ 23A **#2:** +12V @ 8A **#3:** -5V @ .5A **#4:** -12 @ .5A
220W Switching supply for "AT" P.C. systems. Standard IEC input power connector, power switch, Female IEC power connector for monitor. P-1 & P-2 mother board connectors & 4 molex 4 pin connectors for drives etc. Internal fan. UL/CSA /VDE Listed.
L: 9-3/8" **W:** 6" **H:** 5-7/8" **WT:** 7.1

STOCK #	DESCRIPTION	PRICE
7349-PSN	P.C. Supply	$29.95

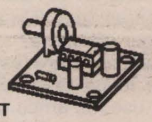
PIR MOTION DETECTOR KIT



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-KTN	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

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

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

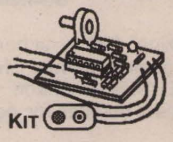
STOCK #	DESCRIPTION	PRICE
6002-KTN	Temp. Meter Kit	$29.95

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

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

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

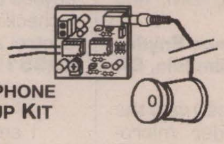
STOCK #	DESCRIPTION	PRICE
6013-KTN	Tape VOX	$12.95

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

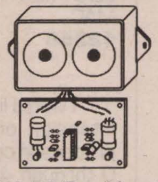
TELEPHONE PICKUP KIT



Kit features a suction cup pick-up coil and sensitive amplifier. Cup attaches to phone handset to pick up your phone conversations. Use as speaker phone so all in room can hear. Runs on 4 "AA" cells. Pick-up coil, speaker, & "AA" holder supplied.
L: 4-1/2" **W:** 2-1/8" **T:** 1-1/4" **WT:** .26

STOCK #	DESCRIPTION	PRICE
6055-KTN	Phone Pickup	$15.95

SIREN KIT



Kit produces a 108-110dB wail from 2 piezo tranducers. Uses 556 dual timer to generate the tones required. Board fits in the back of the piezo transducer case. Runs on 6-12VDC.
L: 4-1/2" **W:** 2-1/8" **T:** 1-1/4" **WT:** .26

STOCK #	DESCRIPTION	PRICE
6015-KTN	"Screamer"	$16.95

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4529-TYN	7.5" Ty-wrap	$2.80	$20.00
4530-TYN	11" Ty-wrap	$5.00	$39.00

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

I have been playing with a problem for over 40 years. I even wrote to Martin Gardner, but got no reply. Perhaps one of your readers can supply the missing stroke of genius.

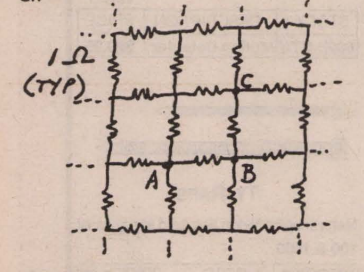
There exists (at least in our imaginations) an infinite square grid of one-ohm resistors, a small part of which is shown in the figure. What is the resistance from point A to point C? I have run simulations including from one-by-one to 13-by-13 squares, with results as follows:

No. of squares:	Value of R(A,C)
1x1	1 ohm
3x3	5/7 = .7142857
5x5	.6686868687
7x7	.6542157535
9x9	.6477616222
11x11	.6443137946
13x13	.6422536563

The results seem to be converging to somewhere around .63 or .64 ohms, although who can be sure as the number of squares approaches infinity?

As background information, the resistance from A to B is easily figured as follows: Insert a one-amp current into the grid at A. By symmetry, the current in R(A,B) is 1/4 amp. Remove that current, and draw one amp out of B. Again by symmetry, the current in R(A,B) is 1/4 amp, also from A to B. Now connect a single current source from A to B, with current entering the network at A. Superposition (it's a linear system) says that the current in R(A,B) will be 1/2 amp. The voltage across R(A,B) will be a drop from A to B of 1/2 volt. The resistance from A to B will then be 1/2 volt divided by one amp, or 1/2 ohm.

Can someone provide a similar non-numerical solution for R(A,C)? Obviously, the value must be less than the 13 x 13 result, for the resistance is decreasing as the network gets larger.



12951 **R. W. Thorpe**
San Luis Obispo, CA

I need a MS-DOS program called Move-It from Woolf Software Systems, Canoga Park, CA. It is a communications program like Lap Link or Hooker to hook two computers together. Telephone information shows no listing, so they must be out of business. I would very much like to find a legal copy of the MS-DOS program.

12952 **Bert Balch**
Seattle, WA

I once saw a CPU called "Make-it 286." It was for replacing the 8086 or 8088 with a CPU that upgrades your computer to a 286. Does anyone know where I can get some of these chips now?

12953 **Robert W. Ritchey**
Vandalia, IL

Please let me know if there is any kind of portable equipment I can use/buy to prevent the use of a cellular phone within 210 yards around me.

12954 **Jack Chee**
Sybang Saya, Malaysia

I am looking for manuals, repair and/or operating for a Wang Laser Printer Model LPS-12 or Zerox 2700-11 Laser printer.

12955 **Steve Vantine**
Denver, CO

I need any information on Circle-X Antenna Corp. and Circle-X antennas manufactured in the 1950s.

12956 **Gene Sky**
Chandler, AZ

Can someone tell me the formulas and procedure of how to put a 25" CRT in the place of a 19" CRT, but keep the same component board and modify it to accommodate the 25" CRT. Both CRTs and component boards are for color.

12957 **Jason Beck**
Frackville, PA

I'm planning to have two web servers at my home both hooked to Internet for incoming access. Is there a "Smart Serial Switch" or other device to channel incoming accesses to the least busy server for maximum efficiency? I have US Robotics dual standard V.34 Modem (28.8), IBM, and MAC.

12958 **Vance Snyder**
Palmdale, CA

I would like to continuously vary the intensity of an LED under microprocessor control. 12 bit digital, values 0 through 4096, will be sent to a 12 bit D/A converter, which will be configured to give an analog output ranging between 0 and +10 VDC. It is at this point that I do not know what analog circuitry I will need to convert this varying analog voltage to a variable current output to drive the LED. This circuit should let me calibrate both the maximum current to output (when the D/A converter receives digital input of 4096), and the amplification ratio of Vin to Iout, so that the LED operates over the greatest range of digital input values. I would like to use this as the basis for a device that would write an image directly to photographic film.

12959 **Greg Aiken**
Del Mar, CA

I have a Criterion Graphics Genie Super VGA Card with an ALI/Quatel chipset. I need a driver for Windows 95 for this chipset or a compatible one.

129510 **R. O'Neill**
Dumont, NJ

Help! I need a test chart for GC36.540 tube tester.

129511 **L. R. Deede**
Las Vegas, NV

1. What are the proper procedures of connecting an equalizer, synthesizer, and receiver to a VCR and TV set, and two larger speakers?

2. I have blown speakers (tweeters and bass). Fuse found to have incorrect amperage, used 2 amps instead of 1/2 amp. Can I correct this?

129512 **S. N. Palaski**
Crestline, CA

How do I make lasting AC and DC high voltage (10KV-20KV) low and high power switches?

129513 **M. Meyers**
Bothell, WA

I am looking for a schematic and/or a repair manual for a Compudyne KD-1450 monitor, or at the least, the part number for component Q901.

129514 **Nick Mattera**
Cranston, RI

I have a Zenith laptop computer #ZFL-181-93, it no longer dims the screen after it sits for a while without being used. The brightness control no longer adjusts brightness either. Can anyone tell me which circuit is at fault? I checked the pot on the brightness control and it is okay.

129515 **Robert W. Ritchey**
Vandalia, IL

I am looking for a way to control small clay figures via computer. These figures resemble human dolls and range in height from 6 to 12 inches. I need some method of moving the head, eyes, mouth, legs, arms, and even fingers. I am very familiar with motion control software, microcontrollers, etc., and therefore, don't require any information along those lines. What I need is some type of electro-mechanical device that is extremely compact (capable of being installed inside the figures) and is microprocessor-controllable. I know that there are numerous means of controlling motion, including motors, solenoids, actuators, etc. However, the unusually small size of the figures make these methods unfeasible. I once saw an ad for a device known as a "muscle wire." Maybe someone can suggest if this might be a viable method and tell me who sells this device.

129516 **K. A. Delahoussaye**
Titusville, FL

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

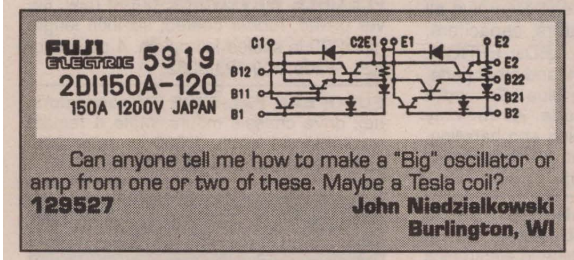
INFORMATION/RESTRICTIONS

- 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.

TECH FORUM



Can anyone tell me how to make a "Big" oscillator or amp from one or two of these. Maybe a Tesla coil?

129527 **John Niedzialkowski**
Burlington, WI

I have two memory boards for the IBM compatible computers. They are marked: MAGITRONIC (615) AB208. Each board has 10 rows for 9 DRAM and two sets of DIP switches. One 6 switch and one 8 switch. They are 16-bit boards. Can anyone let me know where to get software and information on the DIP switches? I DO NOT USE ON-LINE SERVICES; so PLEASE do not refer me to that way.

129517 **Robert W. Ritchey**
Vandalia, IL

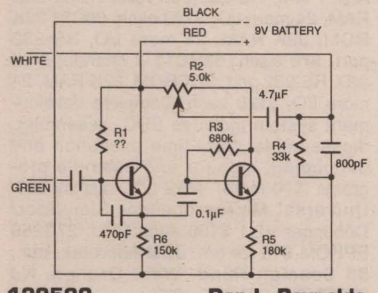
Can anyone give me the audio/video pinouts for Sega Genesis and Nintendo video game systems (the DIN jacks). Also, how (if?) you can take the output of the TV or VCR and convert that signal to the same type as the video game output (NTSC to RGB converter?).

129518 **Steve Burgess**
Pinetops, NC

I need help in identifying a component from the power supply board of a Sharp fax machine. The component is marked Q1 on the circut board. This is a TO220 case style with component markings of 56 on the top line and C3317 on the bottom line. The fax machine model number is FO-3100. Maybe someone has a schematic.

129519 **Gary Gretzinger**
Salem, OR

What is the value of R-1 (presumed to be 5KW)? The NPN transistors are presumed to be both 2N3904 NPNs. This is an audio (microphone) preamp.



129520 **Don L. Reynolds**
Lexington, OK

I need a circut, or schematic to make a spike protector. Would like to install in a wall outlet to protect what is plugged into it.

129521 **Ray Marshall**
Fairhaven, MA

Without being painfully blunt, I need to get an education or get assistance developing software patches to replace program hardware locks. (Dongles to the uninitiated.) I'm aware that many good programmer/hackers have the skills to read the EPROMS and redirect the parallel port calls, and I need help. This business of removing the device from the parallel port before I go home every night is getting very old. Are there any papers or books on the subject? Anybody willing to speak up?

129522 **R. Bacon**
E-Mail: rbacon@tx.direct.net

I recently acquired a used Kodak Diconix inkjet printer, Model 701. I understand that Kodak discontinued this model and actually replaced them with new models. However, mine works just fine, but I need the following: Either a new ink cartridge or an old one that I can have refilled, and an owners manual. The ink cartridge is most important. Kodak says that neither are available. Anyone have a cartridge or manual? Even a copy of a manual would be fine.

129523 **Dave Lee**

I'd like to find some way to enhance cell phone service between my home in Mexico, and the closest US cell site in Yuma, AZ. I do get service, but erratically, usually at night or early morning, although on occasion I'll get service during the day.

Yuma is 200 miles away, mostly over water (Sea of Cortez). My home is very remote and the closest Mexican cell site is also 200 miles away. Others have tried YAGI antennas, but results don't seem to be any better than mine. I suspect they lose as much as they gain in the coax run to their antennas. I know I could pre-amplify the incoming signal and amplify my outgoing signal without too much trouble, but I suspect also that I need to achieve a line-of-site path between my geographical location and the Yuma cell.

Because of the isolation, I could probably operate a transceiver without trouble from the authorities, and there are mountains of at least 2,000 feet rising immediately behind my beach. I would power it with a couple of solar panels charging a couple of batteries. Ideally, this transceiver would then pick up my cell phone signal and relay it to the Yuma cell.

My questions: Is this a goal worth pursuing, or should I just wait for the satellite phones (which were due this year)? Is anybody already doing this in some remote US (or other location)? What is this going to cost? Is there surplus equipment available? Who has it?

I'm presently using a Motorola digital flip phone. I've tried a three-watt bag phone without any better results. It seems the signal is either there or it's not, leading me to believe it's a problem of propagation and not power.

129524 **John Shepard**
Corona, CA

I am interested in using the following IBM equipment with my IBM compatible XT and/or AT. I would appreciate it if you could inform me how this might be accomplished.

The Monitor: IBM 3179, KVA 0.15, NFDA Type II. Listed, EDP equip, 167G, LR47817, ID No. 3179 74496. PART No. 5954160, Date 11/84, Mod 00, PLT 88. The Keyboard: Part no. 1389160, PLT No F1, Model M.

I also have a SAKATA SC100 RGB monitor that I would like to utilize with my XT and/or AT. It has the following markings. TAK8320, FCC ID CJ69XAFC148C317, 23989265.

129525 **Edwin Jaeger**
Far Rockaway, NY

Help! I was referred to you by American Science Surplus to help me out with something that I have been told is an impossibility. I refuse to believe this.

I need to communicate with someone that has vast amounts of knowledge on motion picture cameras. Not, I repeat NOT, video camcorders (anathema to true cinematographers), but 16 mm and Super-8 movie cameras.

The cameras I own are a CP16A (not to be confused with the more expensive "R" or reflex version), a Canon 1014 and Bolex 551 Super 8. I also own another camera (Super 8) that has the similar, through the lens (TTL) reflex system.

Here's my problem. I want to build a cheap, portable black & white video assist for these cameras, so that I can take the same advantages of systems like the Steadicam, Jr. or Jimmy Jib crane system.

I would also like to make my CP16A with its AV30 lens (side reflex viewfinder), orientable.

No shops in Los Angeles including Angenieux, CP, Super 8 Sound and, others too numerous to name, can help me. I work on a non-existant budget. Please help. I know it can be done! And done cheaply!

I was one told by a director friend of mine that a cinematographer he once worked with converted an Auricon Pro 600 to reflex viewing. Since my director friend and this cinematographer had personal disagreements and therefore no longer communicate, I couldn't find out how this was done. If a mirror shutter could be placed in the CP16A, and the present viewfinder moved from lens to camera body and be made 180° (or at least 90°) orientable, and video tape accessible and this done at a reasonable (under $500.00) cost, my dream would be a reality!

C'mon guys, surely there's somebody out there who can take up a good challenge!

129526 **Marty Hamrick**
Jacksonville, FL

ANSWERS

ANSWER TO #109512 - OCT. 1995

Many Federal, state, and local government agencies monitor the RF spectrum from receivers located throughout the US. The information received on these channels is recorded on multi-track logging recorders, made by companies such as Dictaphone and Stancil. Precise time is recorded on tracks synchronized to the audio. The monitoring is all done on individual frequencies used for police, fire, and government communications systems.

This type of monitoring was probably not what you were thinking of when you asked the question. While the US Government undoubtedly has the ability to monitor communications systems from space based platforms; there is just too much spectrum out there to record everything. The microwave "data pipe" from the satellites back to ground stations is just too small to fit everything though. Specific frequencies or bands of interest must be targeted. In addition, since VHF, UHF, and microwave signals usually only travel a short distance, the spy

Continued on page 130

ANSWER TO #109528 - OCT. 1995

To enable your IBM PC to talk to your DEC LA50 printer via the serial interface, construct the following serial cable:

Function	PC	<—>	LA50
Prot. Gnd	-		1
Xmit	2		3
Rcv	3		2
Rdy/Busy	6		11
DTR	5		20
Signal Com	7		7
RTS	8		4

If you use a shielded multiconductor cable, use the shield for the LA50 pin 1 connection. Since both DB25s are females, mark which end goes to the printer. Also, I suggest using a right-angle connector at the printer so the cable dresses under the paper feed.

You'll also have to match the RS 232 baud rates at both ends, and set the LA50 for the correct data format and protocol. Set the LA50 switch positions as follows (O=open, C=closed):

	1	2	3	4	5	6	7	8
SW1	O	O	O	O	O	C	C	O
SW2	O	O	O	O	O	O	C	O

This sets the LA50 for its fastest speed of 4800 bps, 8 bits, no parity, and ready/busy protocol with busy=low. Now add these two lines to your AUTOEXEC.BAT file to make printer output appear at the COM1 port:

```
MODE COM1:4800,N,8,1
MODE LPT1:=COM1:
```

This gives you a nice draft-quality printer. You'll need the manual to get the escape codes to access any of the LA50's advanced printing capabilities.

John Bau
Santa Fe, NM

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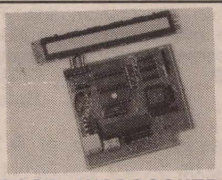

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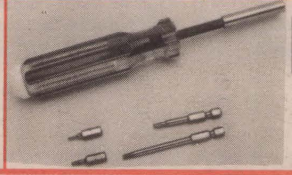

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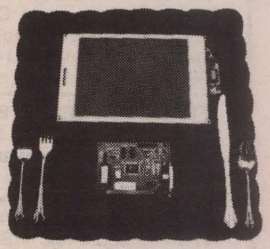

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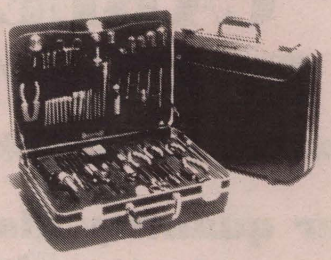

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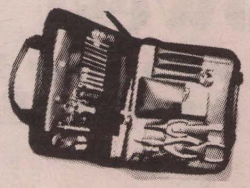

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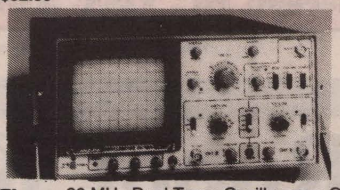

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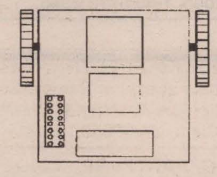

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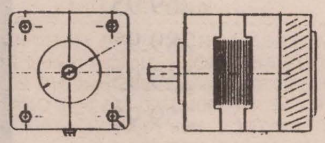

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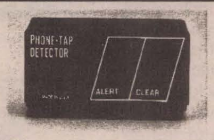

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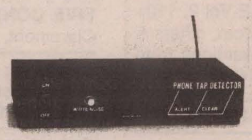

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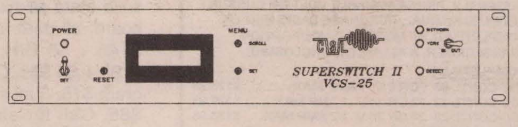

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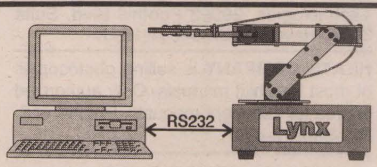

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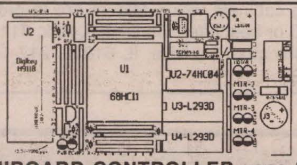

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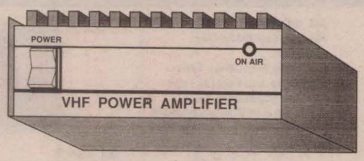

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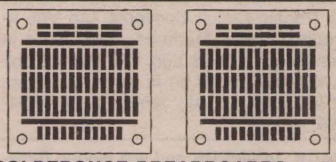

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by Gordon West

Weather Radio FAX Stays on the Air — For Free

Capturing weather facsimile broadcasts over the free radiowave bands is relatively easy if you have the right equipment, and you know where to tune in. Weather facsimile images are provided by the National Weather Service, as well as other countries in the world, free for the taking. Some images are bounced off the ionosphere and are received on worldwide shortwave receivers. Others come direct from polar-orbiting satellites that can be tuned in with a modified scanner. Yet others can be received directly from geostationary satellites, and with the right equipment weather facsimile charts are as close as your radio receiver and simple computer set-up.

Shortwave Weather Fax Remains on the Air

You probably heard that the National Weather Service was going to stop sending shortwave weather facsimile images as of September 30th of this year. This was a Federal budget proposal for the next fiscal year due to reductions in the National Weather Service funding. It was proposed that weather charts produced by the National Weather Service would no longer be broadcast on worldwide high frequency and be made available only to private weather information services.

In the Congress, a bill was introduced (HR1450) proposing similar budget cuts looking toward eliminating government broadcast of marine facsimile charts and preparation of offshore and high seas marine weather forecasts.

This was a surprise to boat owners who rely heavily on shortwave weather facsimile broadcasts to predict their weather when far out at sea. The US Coast Guard and the National Weather Service both agree to increase marine weather facsimile products broadcast from US Coast Guard Communications Station Boston on August 1st of this year. Now turn everything off? The Coast Guard also plans to begin marine weather facsimile broadcasts from US Coast Guard Communications Station New Orleans, beginning October 1st.

At the same time, the US Navy was curtailing high frequency weather broadcasts since their ships were installing satellite high-speed fleet broadcast receiving equipment. But the Navy was also premature in their thoughts to turn off the weather FAX, so their stations will continue on the air until at least 1997.

The US Coast Guard broadcasts worldwide weather facsimile imagery from Coast Guard stations NMF in Marshfield, MA; NMC in Point Reyes, CA; and NOJ in Kodiak, AK. The FAA broadcasts weather facsimile from Honolulu, HI; and private marine stations WLO in Mobile, AL; and WLC in Rogers City, MI.

So what looks like weather facsimile reception on the worldwide bands remains on the air for now, according to John Hoot, President of Software Systems Consulting in San Clemente, CA (714-498-5784).

"Mariners and shortwave weather facsimile users throughout the country made enough noise to stall the efforts to shut down high frequency FAX broadcasts," comments Hoot. "The three hurricanes that hit the East Coast unexpectedly also had an impact on whether or not the government can just shut off a radio facsimile service that thousands of lives depend on for accurate weather reports," adds Hoot. John Hoot is considered by the weather facsimile equipment industry as being the number one "mover and shaker" when it comes to keeping everyone informed on what's happening with weather facsimile signals coming in from the airwaves and from outer space.

It takes a shortwave receiver with single-sideband capabilities to tune in worldwide weather facsimile signals on the shortwave bands. A ham radio-type shortwave receiver is best, but even the West Marine "Yachtboy" receiver for under $200.00 will do the trick nicely on the following frequencies:

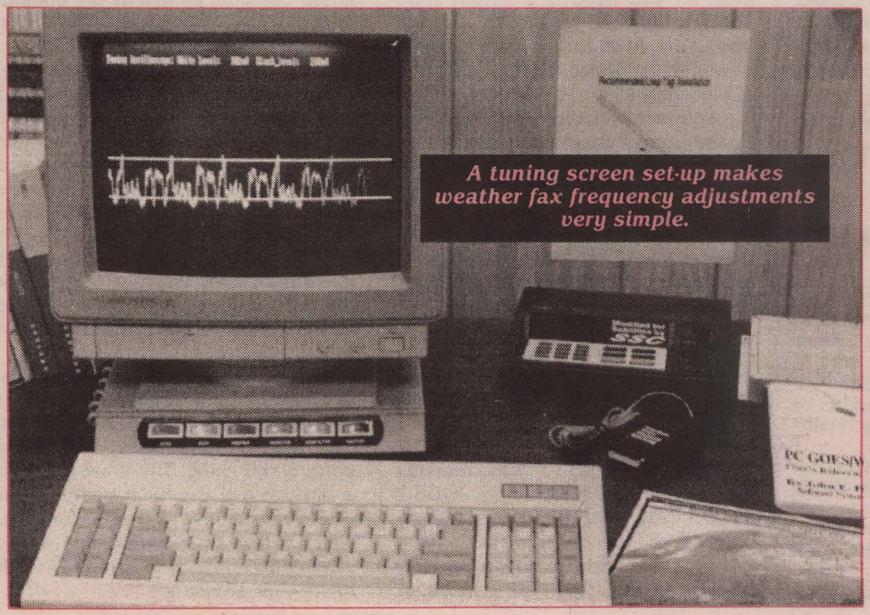
Weather fax receiver and printer (left) on a ship's radio station.

Frequencies USB in KHz	Region
4,344.1	Pacific Coast
8,680.1	Pacific Coast
12,728.1	Pacific Coast
11,088.1	Pacific/Hawaii
16,133.1	Pacific/Hawaii
9,980.1	Pacific/Hawaii
10,863.1	Atlantic Coast
12,748.1	Atlantic Coast
6,850.1	Gulf Coast
9,155.6	Gulf Coast
8,078.1	North Atlantic
15,957.1	North Atlantic

What you will be tuning into is "radio facsimile," a term meaning sending pictures and weather charts over shortwave radio frequencies to be displayed or printed on a computer or dedicated weather facsimile system. Back in the old days, it took a $1,500.00 weather facsimile receiver to display or print out weather charts, spitting out a new 8 1/2" x 11" weather chart every 10 minutes. On worldwide, it takes a whopping 10 minutes to receive a single weather chart.

Nowadays you don't need a dedicated weather facsimile machine and chart recorder. All you need is a simple shortwave receiver for worldwide weather facsimile charts, and a hook-up to your existing lap-top or home computer, along with a $99.00 software program from Software Systems Consulting or another popular program from AEA out of the Pacific Northwest available from many ham radio dealers. I like the Software Systems' program the best because it installed easily in my computer with no additional hardware required on the inside, and it took only a few moments to get the program up and running and ready to digest the sounds coming out of my shortwave receiver.

The sound you hear on high-frequency upper sideband is a rhythmical, twice-a-second, warbling tone whose audio characteristics represent shades of gray, white, and black. The audio output of any type of shortwave receiver tuned into a transmitting weather facsimile signal is fed into a RS-232-type plug that contains an analog-to-digital converter built into the plug assembly, and the plug simply pushes onto any one of the spare COMM ports on your computer. Run the program, and there is no hardware to mess with. Slowly, the weather facsimile system will paint a picture on your computer screen, or on your LCD black-and-white or color



A tuning screen set-up makes weather fax frequency adjustments very simple.

lap-top, and you can save it for later retrieval or even print it out on your computer's printer. And here's what you get:

- Satellite imagery.
- Surface weather analysis and pressure systems.
- Surface weather prognosis for 24 and 36 hours.
- Extended surface prognosis up to five days.
- Ocean wave analysis, including height and direction.
- Ocean wave prognosis.
- Sea surface thermal analysis.
- Storm front analysis and hurricanes.
- Storm track analysis.

But it takes 10 minutes for each shot. This is lengthy compared to some of the other radio weather FAX systems because worldwide signals may only occupy a small bandwidth; and when you are restricted to bandwidth, you must send the imagery ever so slowly over the worldwide airwaves.

The best part of receiving weather facsimile from worldwide frequencies is each station regularly sends four to six new charts every couple of hours, and the broadcasts are relatively strong enough to be received with almost any kind of a shortwave set capable of upper sideband reception. Sorry, an inexpensive AM-only shortwave receiver won't work — you must have either USB, or a BFO, or a ham set/shortwave receiver capable of single sideband reception.

Antenna requirements are also minimal — and 20 or 30 feet of wire will do nicely. Most important, however, is that the antenna is located as far away from the computer as possible. Trying to run a shortwave portable set right next to a computer won't work. The computer will generate so much hash that it will cover up incoming shortwave weather facsimile signals.

You will need to use an external antenna connection on your portable shortwave set in order to make weather facsimile reception readable. And all you need to do is dial in these frequencies and take a listen — and then turn on the computer. If the computer doesn't wipe out reception, you are all set. Get the $99.00 program from John Hoot's Software Systems Consulting, take the audio from your shortwave set and plug it into the special jack, plug the jack into the COMM port, run the program, and get set for weather facsimile reception.

Another nice thing about worldwide radio facsimile reception is all of the great National Weather Service markings on the charts that show you exactly what's happening out there in the weather world. You can see exactly where the storms are, where they may be going, hurricanes, and everything else. If you are new to weather facsimile reception, get started on worldwide weather FAX. It looks like we still have another year or two without Congress trying to figure out a way how they can charge us for it beyond what we're already paying in taxes to keep this valuable service going!

***Additional Weather FAX companies:**

- **A.E.A., Lynwood, WA (206) 774-5554**
- **M.F.J., Mississippi State, MS (800) 647-1800**
- **MultiFAX, Peachland, NC (704) 272-9028**
- **Kantronics, Lawrence, KS (913) 842-7745**
- **OFS Weather FAX, Raleigh, NC (919) 847-4545**

Polar-Orbiting FAX

A second way to tune into satellite weather-photo imagery, both visible as well as infrared, is to tune into the four to eight broadcasts a day from United States and Russian polar-orbiting satellites. These satellites offer the ultimate in ground and weather feature resolution in real time. Features as small as one kilometer can be resolved in Russian satellite images.

Polar-orbiting satellites can be received from virtually anywhere in the world with a simple scanner and a vertical antenna system. If the National Weather Service had discontinued shortwave weather facsimile transmissions, a polar-orbiter receiving set-up will provide real-time imagery of higher quality than what is now obtained from shortwave transmissions.

If you are into fishing, the polar-orbiting satellites can resolve different color temperature variations of the ocean — giving you a clue on what the exact temperature is of your fishing grounds, and where to go to find the right fish at the right temperature.

The antenna is called a "quadrifilar helix" and works well from a moving platform since it does not require accurate pointing. You can run your polar-orbiting weather facsimile station from a car, RV, boat, or even portable.

The images come in on the 137 MHz band, tuned in by a wideband modified scanner. Try 137.500 MHz on a regular scanner, and several times a day you will hear the incoming tones of polar-orbiting satellites beaming down weather facsimile satellite imagery. Sorry, no Weather Bureau charts — just the real thing!

The polar-orbiting system is more expensive than picking the weather out of the shortwaves. The software runs about $250.00 from Software Systems Consulting, the scanning receiver specifically modified for satellite reception at an additional $150.00, and the deluxe quadrifilar antenna for another $150.00 — for a total package of about $500.00-plus. But this is everything — the only thing that you will need at your end of the circuit is a lap-top or home/office computer and capabilities to route some coax cable outdoors.

Beaming the Geos

Geostationary satellites also transmit satellite imagery, and they do it continuously for a view of the world from a collection of one-hour old shots from many satellites. The geostationary weather satellites don't broadcast on high frequency single sideband. They don't broadcast on 137.5 MHz VHF. They broadcast on the S-band in the microwave spectrum at 1691 MHz, and a satellite image is transmitted every five minutes.

To receive these microwave signals, all you need is a simple loop Yagi, a downconverter to change 1691 MHz down to 137.5 MHz, and a modified scanner that feeds the audio output into your home or lap-top computer. The images sent down by the "geos" are enhanced with borders and latitude and longitude lines, just like worldwide FAX. The images you receive are also relay images from other orbiting satellites, and there are presently five satellites in geosynchronous orbits active around the world:

GOES 7	135 degrees west
GOES 8	75 degrees west
METEOSAT 3	70 degrees west
METEOSAT 5	0 degrees
GMS-4	135 degrees east

A new GOES 9 was recently launched, and it is replacing GOES 2 at 135 west, providing extraordinary signals of the Pacific and West Central United States. So, for those of us here in the USA, you can either beam Pacific West and Central Coast coverage, or beam to the other satellite that will give you all USA. coverage plus the Atlantic. And since we get relays from other satellites, you ultimately end up with the entire world on your computer screen with a new picture unfolding every five minutes.

The GOES system is the most expensive, with a downconverter from Quorum at $575.00, the loop or dish at about $150.00, and that $150 .00 scanning scanner that has been modified for wide-band satellite reception.

Quorum Communications (8304 Esters Boulevard, Suite 850, Irving, TX 75063; 800-982-9614) is another leader in weather facsimile equipment, and their SDC-1691C downconverter is considered the finest in the industry and is the same unit that John Hoot sells. Quorum also has a weather FAX software and hardware system where the receiver is actually built onto a board on the inside of your computer. Just connect to an appropriate antenna or audio signal, and that is all that is needed to begin reception. Call Quorum in Texas for their weather FAX "Explorer" catalog and some additional high-tech notes on weather facsimile receivers and antennas.

Which Way To Go?

Since shortwave weather facsimile has been given another year as a minimum to stay on the air, and because John Hoot indicates it will be many years before they ever think about turning it off again, I recommend you start with worldwide shortwave weather facsimile reception using your existing computer and a relatively simple portable or fixed ham set or shortwave receiver capable of 3-30 MHz single sideband reception.

Think about a simple dipole antenna fed with coax to keep the antenna as far away from the computer noise as possible. Contact John Hoot at 714-498-5784 and get his $99.00 weather facsimile program including a demonstration audio cassette, as well as the analog-to-digital converter that is built into the COMM port plug.

You will NOT need to put anything inside the computer — just add audio to the analog-to-digital converter plug, tune in weather facsimile sounds, push the capture menu, and get set to watch a weather facsimile chart unfold in front of your eyes in 10 minutes. Save the disk, or save it on the hard drive, or dump it, or print it. Your option. You can even walk away from your set-up and have the whole thing happen automatically, too.

There are also worldwide weather facsimile transmitting stations that let you tune into shortwave frequencies and see the weather in other parts of the globe. These are found in a directory in the back of the John Hoot instruction manual. Tune in, watch the weather unfold, and enjoy. The high-frequency weather FAX still has a year or two left. NV

Why Cut HF FAX?

The following is what the National Weather Service based its decision on to possibly shut down high frequency weather facsimile. *"Competition with private sector."*

The National Weather Service shall not compete, or assist other entities to compete, with the private sector when a service is currently provided or can be provided by commercial enterprises, unless (1) private sector is unwilling or unable to provide the service, (2) service provides vital weather warnings and forecasts for the protection of lives and property of the general public . . ." and it was the second (2) where mariners acting on an alert from John Hoot of Software Systems Consulting made a clear showing that no one in the private sector would be willing to send out free weather information, because there is no way to charge someone for what is being received over HF. Also, turning off the HF weather facsimile by the National Weather Service could put thousands of lives in jeopardy where mariners have no other means of accurately receiving long range weather warnings.

Care to guess how much money would be saved by the National Weather Service no longer providing the US Coast Guard with weather facsimile imagery? Would you believe less than $500,000.00? For a complete text of the *National Oceanic & Atmospheric Administration Authorization Act of 1995*, contact your elected Senator and ask for the June 13, 1995, bill details.

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ROBOT - CNC LOW COST QUAD AXIS CONTROLLER. This 4-stepper motor controller receives step and direction pulses from your PC parallel port. The kit includes circuit board and components to build a complete electronic controller plus four stepper motors. Stepper motors larger than the size 17's supplied may be easily plugged into the circuit board which have drive requirements of 2 amps per phase or less. The controller and stepper motors supplied are designed to utilize your computer's power supply for easy lowest cost experimental developments. Wiring diagrams and documentation supplied with guide you to greater power requirements. The L-R design is improved upon by giving you the option and flexibility to determine if you want to power enable three motors using computer control, or pulse width modulate the stepper power for greater torque output requirements and run all four motors. Demonstration software is available in the kit. The QUAD-4-ROBOT kit is $125 unassembled and includes shipping handling and sales tax. ADD $45 for assembled and tested kits. Send US check/MO to: IMAGINET, 3943 Ellesford Ave., West Covina, CA 91792. TEL: 818-810-0033 after 6:30pm Pacific Standard Time.

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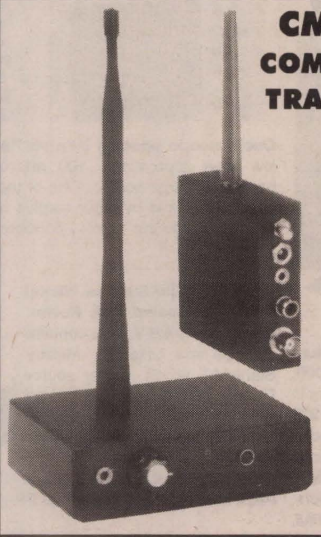

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CME-200PC 1/3" CCD COLOR PINHOLE CAMERA (1-5/8" SQUARE)	495

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CME-CASE3 PLASTIC CASE for CME-200SCP	15

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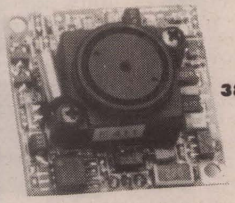

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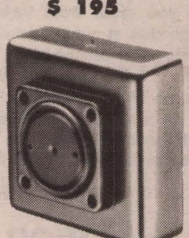

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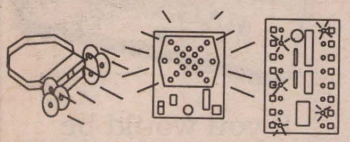

HOT KITS! Build microcontrolled kits: Seventeen function remote controlled robot kit $99. Eight function mini-light show kit $59. Twelve function electronic game kit $79. Perfect for school projects or just learning about microcontrollers. Call or write for free info. Silicon Sound, PO Box 371694-NV, Reseda, CA 91337-1694. Phone 818-996-5073.

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OAK SIGMA, schematics, master files, equipment. Call 719-661-1659 for free Sigma catalog.

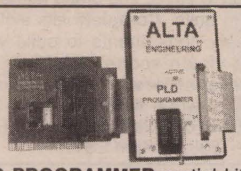
PIC-1 PROGRAMMER programs Microchip's PIC16C6x/7x/8x family of microcontrollers. Connects to parallel port of IBM-compatible PC running DOS or Windows 95. Programming software, cable and power supply included. Includes 18 pin DIP socket and expansion header for adapters and in-system programming. Step-by-step construction manual for easy assembly. Kit $29, assembled/tested $49. **PIC-n-GO Package** includes PIC-1 Programmer and one PIC16C84-04/P EEPROM-based microcontroller with data sheet. Kit $39, assembled/tested $59. **28/40 pin DIP adapters** $25. Add $5 S/H per order. **ITU Technologies**, 3477 Westport Ct., Cincinnati, OH 45248. 513-574-7523.

AUDIO ANNUNCIATOR SYSTEM Based on a PIC microcontroller & an ISD-1000A Speech Chip (available at Radio Shack), this system allows you to digitally record and play 4 different alarms of 5 seconds duration each. An interval timer repeats all active alarms every 30 seconds. Any change of input status (new alarm or alarm reset) immediately reannounces all active alarms. Send $25 money order for preprogrammed PIC, plans, & ceramic resonator ppd. Send a SASE & $2 for plans including PCB layout. Shepard Engineering Concepts, 817 Quailridge Drive #39, Bakersfield, CA 93309.

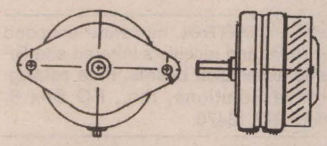
COGENERATION GIVES free electricity using induction generator. How to get up to $1 worth of electric for each $1 worth heating fuel and get full heating value also. Detailed information, $5. Power, PO Box 308, Caledonia, MI 49316.

MINIBOARD 68HC11. See the ad in 145 (ROBOTICS).

NI-CAD ZAPPER can rejuvenate those unrechargeable NI-CAD batteries. Instructions, schematic and parts list to construct NI-CAD ZAPPER: $5 **TENTRONIX**, 3605 Broken Arrow, Coeur d'Alene, ID 83814.



PLD PROGRAMMER partial kits start at $40. Alta Engineering, 58 Cedar Lane, New Hartford, CT 06057-2905, 860-489-8003 (voice/FAX back) VISA/MC.



E-Z STEPPER is a 7.5 degree unipolar stepper motor and driver electronics in one compact unit. Just apply 6 volts DC @ 1 amp max. and TTL inputs for motor inhibit, direction, step input, and 1/2 step to the 16 pin DIP socket on rear of motor unit and you're ready to go. Has internal thermal shutdown circuitry, detent torque 19 grams, holding torque 200 grams, motor dia. 2.23 x 1.75 tall, shaft 0.25 dia. x 0.64 long, mounting holes 2.60 center to center. Weight 0.75 lbs., with data. Part # EZST1, introductory priced at price $49.95 plus $5.50 shipping to: Future-Bot Components, 106 Commerce Way, Suite A8, Jupiter, FL 33458. 407-575-1487. CHK, MO, COD.

MAGPRO-11 KIT: HCX11 EEPROM PROGRAMMER/MINI-DEVELOPMENT SYSTEM. Download S19 files from computer to EEPROM via RS-232 or program EEPROM direct with built-in line assembler. For more details see article in November/December 1995 Micro-Computer Journal. Step-by-Step instructions makes it all simple. Includes PC compatible software disk with 68HC11 cross-assembler. Specify disk size. Easy-to-build **MagKit** PRICE: **$45.** Part No. **MagPro-11kit.** HC11s not included. 1/2K EEPROM MC68HC11A1FN $10 each, 2K EEPROM MC68HC811E2FN $22 each (maximum 2). Include $3 S&H. Send check or money order to: **Magicland,** Dept. A1, 4380 S. Gordon, Fremont, MI 49412. 616-652-2368 between 8am and noon, Eastern.

MINIATURE TRANSMITTERS! All types! Low to high power! Also voice activated switches! Telephone recording switches! 16 level voice changer plus complete plans on RF power amplifiers! Send $2 for information, refundable on first order. **PARSEC Electronics**, PO Box 34594, Phoenix, AZ 85067-4594.

MANUALS — SCHEMATICS WANTED 155

WANTED: TEST EQUIPMENT SERVICE MANUALS! For late model Hewlett-Packard, Tektronix, Fluke, Wavetek, ESI test equipment. Pepper Systems: 214-353-0257; 214-902-9511 FAX.

WANTED: SECRET CB Books, 405-447-5689, 405-360-6817.

Another *Cold War Surplus* unbelievable deal! Helium Compressor (Cryogenic Source) Original cost $50,000, yours for $149.00! originally used to cool Infra-red detectors in the M1 tank. Does not include head unit or connecting lines. **230 Volts AC 60HZ.** Possible uses include vacuum traps, detector cooling, "freezie" mausoleum, physics, biological experiments. Size is 20" H, 16W, 28 D. Mfr CTI Cryogenics Waltham MA, model 350R. Shipping weight 150 lbs, contains compressors, motors, pumps, fans, radiator, guages. Construction is beautiful, greatest fun thing since WW2.....**$149.00 freight collect.**

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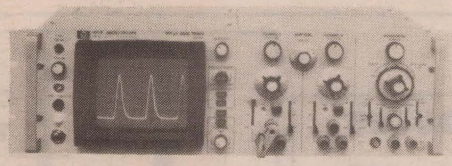
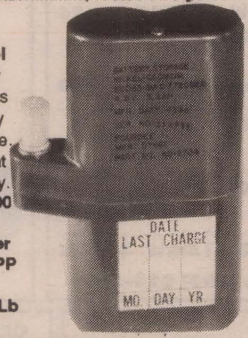


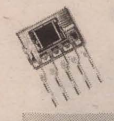
Oscilloscope Special! Hewlett Packard 1200B for audio and low level applications. **100 microvolt sensitivity, 500KHz** bandwidth, large screen. One of the best scopes for low levels ever made. Sold by other surplus houses at several times our price. Checked out, in ex++ condition.....**$175.00 Postpaid.**



New! Cold War Surplus. Nickel Cadmium Sealed Cell Power Pack 3.2 AH 4.8 V. This contains 4 D type cells. Originally Military Starlight scope power source. Please note that most discount store cells are only 1AH capacity. Unused...**$6.00 PP. 10 for $45.00**

Quantum 4 cell AA size Power Pack 800 Ma-H....4 for $10.00 PP

30AH Aircraft Nicad $7.00 3Lb



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17" Sony (Hewlett Packard 98789A) Monitor. Never before at checked out, good bright tube. RGB inputs (BNC) with sync on green. Not compatible with IBM unless modified. Compatible with Mac when retuned. Suggest you buy this only if you are familiar with monitors, or wish to experiment **40 Lbs...$150.00**
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BOOKS

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Spread Spectra Communications Simon, Omura,Et al 3Volumes 1985 .....$35.00
Digital Processing of Signals Gold and Radner Wiley 1969 269 pages $8.00
Communication System Engineering Hamsher McGraw 1967 800 pages.$10.00
Digital Signal Processing Openheim and Shafer 1975 585 pages.....$15.00
Spread Spectrum Systems Dixon 1976 Wiley 297 pages.....$8.00
Reference Data for Radio Engineers 5 Ed ITT 1968 750 pages $8.00
The Visual +isplay of Quantitive Information Tufts 1983 199 pages.....$11.00
Searching and sorting Knuth 1973 Addison -Wesley 721 pages...V1.....$10.00
Seminumerical Algorithms Knuth 1973 Addison-Wesley 688pages...V2.....$8.00
Fundamental Algorithms Knuth 1973 Addison-Wesley 634 pages....V3.....9.00
Structured Programming Dahl Dijkstra, Hoare 972 Academic 220 pages.....9.00
Radar Handbook Skolnik 1970 McGraw Hill 900 pages.....$12.00
A Primer on Pascal Cinway, Gries, Zimmerman Winthrop 1981 paperb.....$5.00
Principles of Communications Engineering Wozencraft 1965 718p.....$9.00

If there is great interest in books, I will try to catalog them, and get them on-line or printout. Many books on cold war subjects, as this is a local think-tank. Titles like *The Red Army, Soviet Strategy, Soviet Space, Soviet Aviation.*

Write in 103 on Reader Service Card.

WANTED: COLLINS Radio Company literature. Jim Stitzinger, 805-259-2011, FAX 805-259-3830.

MILITARY COMPONENTS wanted. Capacitors, resistors, diodes, transistors, semiconductors, ICs. Electronic Material Industries, 818-842-5953, FAX: 818-845-3613.

WANTED: MANUAL for Trygon power supply model C-36-30. Call Greg 305-261-0929, Fax 305-266-4300.

CANON VR-E10A portable video recorder. Need pinouts or schematic defining "camera" and "adapter" connectors. Also looking for user manual. Will pay mail/copy cost. PO Box 106, Annapolis Junction, MD 20701. 1-800-253-7202 (Access #525).

WANTED: MANUAL, instructions, for military tube tester, model TV-2C/U. Al Wudel, 1209 N. 7th, Estherville, IA 51334. 712-362-4119.

MANUALS WANTED for amateur, audio, test equipment, TV, VCR. A.G. Tannenbaum, Box 386, Ambler, PA 19002. 215-540-8055, FAX 215-540-8327.

NEED: SERVICE information for NCR PC class 3390 model 1305. Peters, PO Box 806, Sidney, NE 69162.

NEED SERVICE manual for Sharp Model VC6846UB, VCR. Will pay $15 for manual. Ernie, 603-774-4254.

MISCELLANEOUS ELECTRONICS FOR SALE 160

SOLAR KING'S many million dollars of solar panels in stock. Solar panels: 12" x 12" 15V. 3W, .25A, $17.95, $150/10, $700/58, $1350/100, 6" x 12" 15V, @ .125A, 1.5W, $13.95, $120/10, $1,100/100, $1,000/100, 6" x 6" 7.2V, @ .065A, .75W, $4.95, $39/10 $350/100, $2,980/1000. Wholesale, retail, mail order. Material running low. New solar material coming in all the time. Many other solar items available. Our 22nd yr. Call cat'l, 508-532-2323. BNF, 119 Foster St., Peabody, MA 01960. 508-532-2323.

FOR SALE items list here. Big discount from suggested retail price. Telephones, recording answering machine, color TV, coaxial cable assemblies, modular telephone, connectors, and accessories. Slot machines, quality, cleaned, refurbished. Watches, computers, OEM 14" VGA monitor, OEM 9" color SVGA monitor. Nema Keyboards, Microsoft mice and industrial rat-trak. Alex Mastin (Ent), PO Box 8802, Canton, OH 44711-8802.

SOLAR-POWERED FAN HAT. Baseball type hat with solar powered fan. Great for sports fans, golfers, etc. Available in red or blue. $19 plus $2.00 shipping. CA residents add 7.75% sales tax. Visa/MC/Disc/Amex OK. H.T. Orr Computer Supplies, 249 Juanita Way, Placentia, CA 92670. 714-528-9822, 1-800-377-2023, FAX 714-993-6216.

SCRAP TIME AGAIN. We have loads of used and obsolete gadgets, R&D scrap, and other interesting junk to unload. To avoid waste and associated costs we are offering our surplus to today's gadgeteers. We ask $10 per box lot to cover shipping and handling. Please send requests to Special Economies, 3 Margit Street, Wilington, DE 19810.

ELECTRONIC ASSEMBLY MACHINERY. We buy and sell assembly machinery including solder machines and board cleaners, insertion machines and lead formers. Petlock Inc., Rialto, CA. 909-877-8900, FAX 909-877-8902.

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

LOW-COST AUTOMATIC wire & tubing measure/cut machine, the Model PMC-110 by Red Line Mfg., Co. 314-831-3014. FAX 314-831-3927.

$1,000,000 ELECTRONICS Distributor Inventory! Industrial and commercial parts. Semiconductors, receiving tubes, loads of connectors, and much more. Call/Fax for immediate quotes. C&H Distributing, 215 S. George St., York, PA 17403. Phone 717-843-7881/Fax 717-843-3875.

NICADS 125 AH SAFT HIP-14, test as good as new, 10 cells (12V) put out 1180W usable power, will ship anywhere, $275. Strong's, 25 Pine St., Ellsworth, ME 04605. 207-667-7020.

ELECTRON TUBE SPECIALISTS. Extensive inventory of all types. Scottco Electronics, 3390 Commercial Ave., Northbrook, IL 60062. 708-498-2352, FAX: 708-564-3008.

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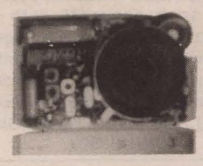
RADAR LASER JAMMER COMBO PHAZER jams all police radar. No more tickets or they're paid for! 3-yr warranty. 30-day money back guarantee, Christmas Special $185 complete. MO/Visa/MC/COD. Kortesis Marketing, Box 460543, Aurora, CO 80046. 303-548-3995.



CHEAP RECEIVERS! Motorola tone/voice pager boards. Complete, less case. Experiment, use for radio control, etc. Choice of 35MHz, 43MHz, 152MHz, or 450MHz. Order part #NZ525, Wt 3 oz., $6 ea., 5 for $25 + UPS. MDM Radio, Ltd., 7112 W. Roosevelt Rd., Oak Park, IL 60304. Tel. 708-848-4210.

CRT RESTORER/analyzers. (BK-490) test-performed: emission, leakage tracking, short removal, gun cleaning, balancing and cathode rejuvenation. $350. Hung, 408-274-9163.

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80387SX-20	$19.95	8749H	$6.50
80387SX-25	$22.95	8751	$8.95
80387DX-20	$17.95	8751H	$9.95
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USED ULTRASTOR EISA HIGH PERFORMANCE SCSI/2 CONTROLLER BOARD

Pulled from working equipment tested with 30-day warranty. Board supports two floppies and up to seven SCSI devices. Note: No manual or software suppiled with card.

UltraStor U24F-10F ..... $79.95 Ea.

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4 ft. coil cord with PS/2 type 6 PIN MINI DIN connector. AT and XT DIP switch selectable

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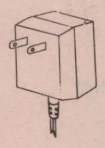

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Brand New True 256 Gray Scale Hand Scanner. Resolution: 25-400 DPI. Scan Width: 4.2 In. Scan Length: 11 In. Interface: 16 Bit high speed (ISA) card, 64K SRAM. System Requirements: 286/386/486 PC Compatible (16MHz). Available 16-Bit Interface slot, Windows 3.1, 4 Meg RAM, 10 Meg of Available HD space (Min.), Mouse or Other pointing device.

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This board was made for DEC's line of PCs by ATI. It is the ATI wonder ISA bus with three button mouse included. (Plugs into the back of the video board.) 640x480/256 color: 800x600: 1024 x 768/16C. Note: Software included with board and bus mouse.

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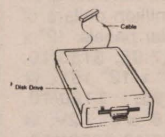

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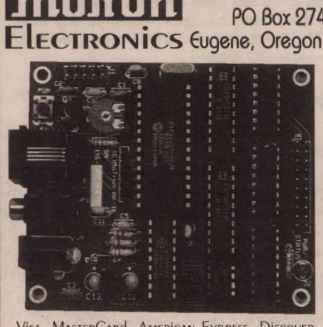

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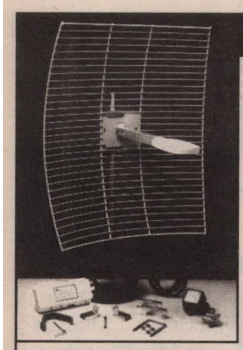

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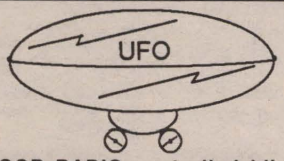

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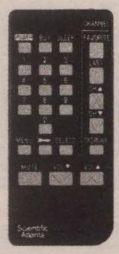

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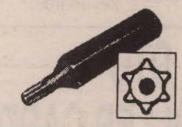

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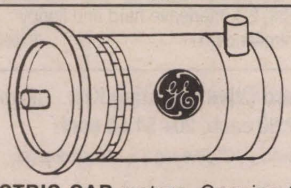

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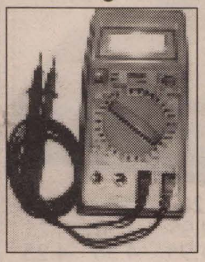

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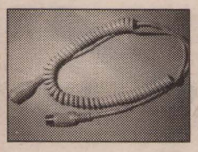

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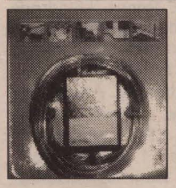

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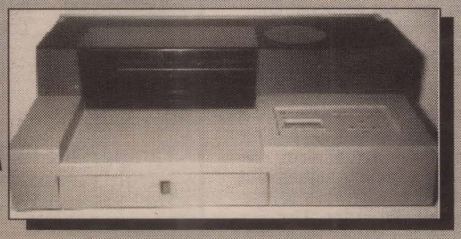

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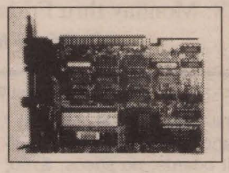

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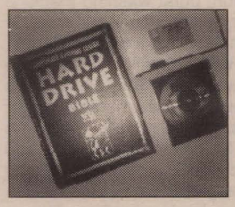

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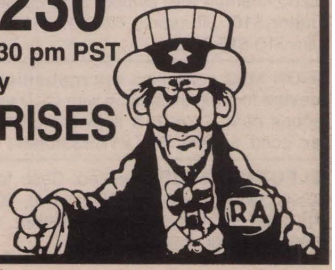

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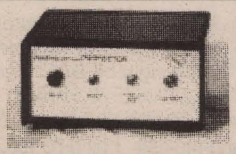

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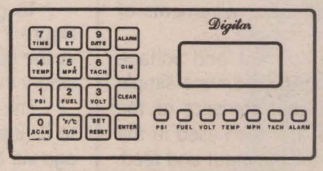

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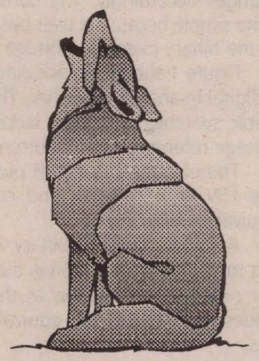

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THE SOLDERLESS BREADBOX

by Donald Wilcher

What the Heck are DACs?

Every electronic magazine you pick up, the three letter words of DAC are plastered on the advertisement pages. Trade publications show DACs with information related to resolution, volts per step, and accuracy. Values such as 8-bit, 10-bit, and 12-bit DACs are used to describe DACs.

Just what are DACs anyway and how can they be used in electronic projects? Well, in this month's column, those questions and more will be answered. The electronic characteristics of these unique components will be investigated along with the usual hands-on circuits and examples for a true hardwiring experience.

Understanding these ICs is important because computers use them to do internal signal conversion for number crunching and I/O (input/output) processing.

Electronic instrumentation and test gear cannot function without DACs because so many of them are being used, not only to monitor static and dynamic signals, but they control servo and stepper actuated devices. Examples of this would be XY plotters and chart recorders.

Industrial equipment such as linear motion and speed controllers are quite heavy into using DACs for mechanical activation and control. Tachometers used to display the number of RPMs use DACs for controlling the needle movement on the automotive display gauge. So, as you can see, DACs have been around for quite some time. Now, most of you are saying, "that's fine, but what the heck is a DAC?" Well, a DAC is . . .

What Are DACs?

DACs are known as *Digital-to-Analog Converters* that have digital inputs and a single analog output. The digital inputs are combinations of logic 1s and 0s that form a binary number. Inputs are compatible with logic levels that are generated by TTL circuits. The analog output provided by a DAC is a voltage or current that is continuously variable between an upper and lower limit.

DACs are very fast ICs when it comes to converting the applied digital value into the corresponding voltage output. The conversion speed is within a microsecond. There is no other control required; you simply apply the binary bits, and the voltage output of the converter changes accordingly. The construction of the DAC is quite simple because it uses basic electronic circuits due to the binary-to-analog voltage conversion.

Figure 1 shows a block diagram of what's inside of a digital-to-analog converter. The DAC consists of electronic switches, a resistor ladder network, a precision voltage reference, and a current-to-voltage converter.

The electronic switches provide a means of taking the +5V and 0V levels and converting them into an equivalent binary value.

A +5V signal has a binary value of 1 and 0V equating to 0. This information is then sent to a resistor ladder network which looks at the 1 and 0 combination values and creates the equivalent analog current values.

The current-to-voltage converter changes the current values into equivalent voltages. An operational amplifier such as the 741 or LM318 can be used to provide the necessary current-to-voltage conversion.

The precision voltage reference establishes what maximum output voltage the DAC will produce. This reference voltage is maintained by using a simple carbon resistor and an external voltage. In order for the 1408 DAC to maintain an output voltage of 5V, a 1 Kilohm resistor and a +5V source is used in regulating this constant signal. An equation that is used to determined the output voltage of the DAC is

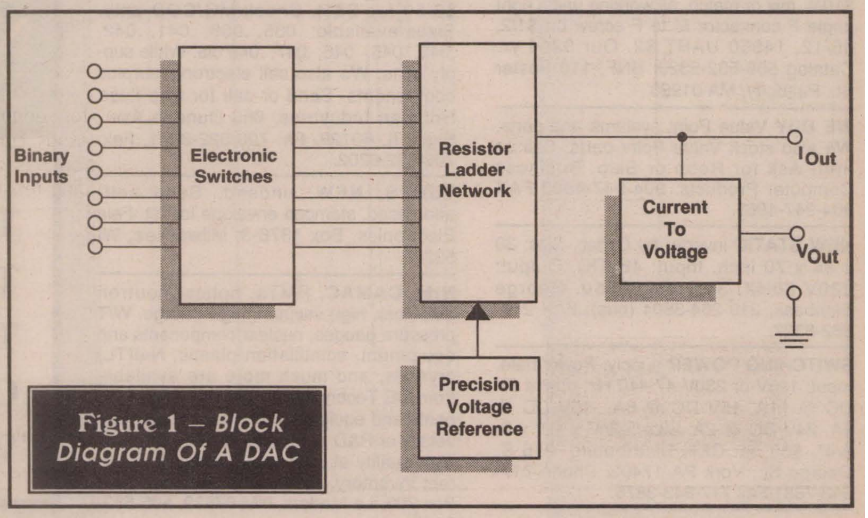

Figure 1 – *Block Diagram Of A DAC*

$$Vout = (Iout \times Rl) \times [(R2/R1) + 1]$$

where Vout is the Output Voltage
Iout is the Output Current
Rl is the load resistor connected to the output of the DAC

R2 /R1 are the feedback and input resistors of the op-amp current-to-voltage circuit. Using this equation will give the electronics experimenter a tool in design and analysis of the current-to-voltage converter circuit of the DAC. When it comes to load driver capability, this equation allows the electronics user to determine the output current and voltage requirements of the DAC.

To illustrate how important current and voltage requirements are, let's use the DAC to drive a simple light bulb. Current and resistor characteristics of the light bulb would be determined, and then used in the equation to calculate the values for the input and feedback resistors of the current-to-voltage converter circuit. Once these values have been found, the output current and voltage requirements of the DAC will be met by the resistor values calculated from the use of the equation.

One important piece of information before we move on to circuit applications of the DAC – that is voltage weights and resolution. An eight-bit DAC has 256 output voltage steps associated with it. To determine the output voltage at any one particular step, the diagram in Table 1 shows the DAC's output voltage at the eight major steps of the binary input value applied to the chip. All of these values are based on using five volts as the fullscale (fs) quantities of the chip. Resolution relates to how close the chip's output voltage is from its design "intent" value at fullscale. For a fullscale value of 10V for an eight-bit DAC, it has a % resolution of 0.39 (10 x 0.0390625=0.390625).

To determine the % resolution using a fullscale value of 5V, take 5V and multiple it by 0.0390625. The % resolution equals 0.195. Table 2 shows the voltage resolution of several DACs.

Well, we are now ready to explore how the DAC does its binary-to-analog magic by breadboarding some circuits.

DAC Circuit Applications

To gain some experience in the use of the DAC, Figure 2 should be wired on a breadboard. As shown in the diagram, all the components illustrated are necessary in order for the DAC chip to work properly.

The 1408 chip will take the binary value supplied to its input and convert it to an equivalent analog voltage via the op-amp current to voltage circuit.

Once this circuit has been built, it can be verified

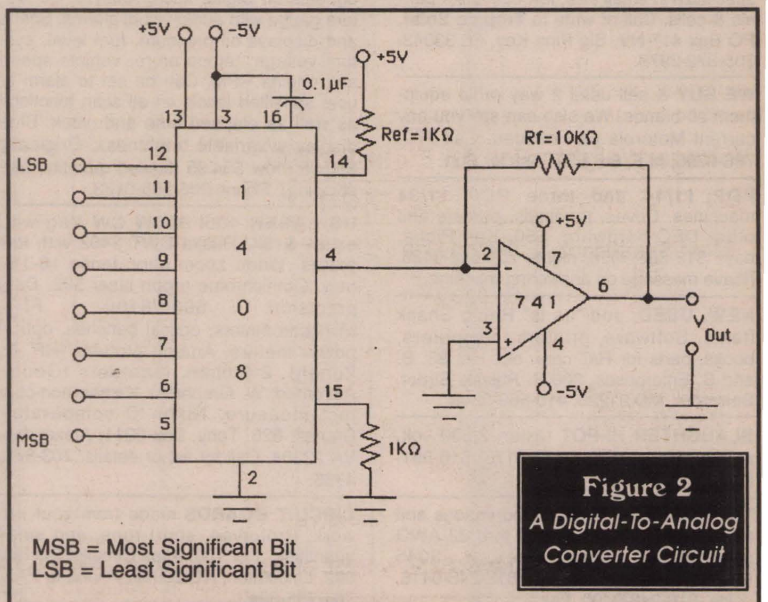

Figure 2
A Digital-To-Analog Converter Circuit

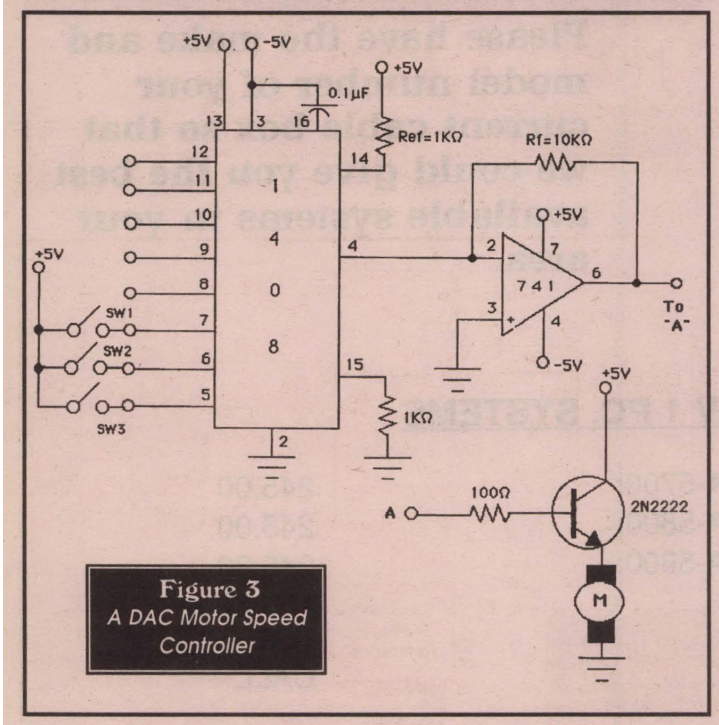

Figure 3
A DAC Motor Speed Controller

by using Table 1. An analog or digital voltmeter is connected to the output pin of the op-amp to measure the voltage. By turning on the appropriate switches, the Table 1 voltages should be monitored on the voltmeter. If these values are not being measured on the voltmeter, recheck your wiring for errors. The power supply voltage, if changed, will effect the fullscale value as discussed earlier in this column.

Try changing the voltage source from 5V to 10V and measure the range voltages via the input binary value applied to the DAC. Make a table like that of Table 1. This information will be quite valuable for future DAC projects and experiments. Also, experiment with the reference resistor and see what affect it has on the operation of the DAC. Record this value as well.

With the DAC circuit built and data collected, what else is there to do with it? Well, for starters, a motor speed controller can be constructed using the experimental DAC circuit as the main element for this project.

Figure 3 shows a DC motor driver circuit that can be wired to the DAC for speed control. The 2N2222 general purpose NPN transistor is wired as an emitter follower circuit. The DC motor is the load under control by the transistor switch. The circuit works by the input voltages applied to the base of the transistor via the 100-ohm resistor. The current that flows through the emitter into the motor windings varies in magnitude based on the output voltage generated by the DAC.

Voltage Weights For An Eight-Bit DAC

BIT POSITIONS	VOLTAGE
Most Significant Bit	5.00000000 = 1/2 of FS
	2.50000000 = 1/4 of FS
	1.25000000 = 1/8 of FS
	0.62500000 = 1/16 of FS
	0.31250000 = 1/32 of FS
	0.15625000 = 1/64 of FS
	0.07812500 = 1/128 of FS
Least Significant Bit	0.03906250 = 1/256 of FS

Table 1

The transistor driver circuit will control the motor at the currents produced by the resistance winding of the electromechanical device. The more current that flows through the motor, the faster the shaft of the motor will rotate.

Table 3 shows the input switch combination for generating the various current values. These values are based on a motor having a winding resistance of 2.3 ohms. Your current values will be based on the resistance of the motor winding you experimenters used for this project.

As seen in Table 3, the combination of switches 1, 2, and 3 establish the speed of the motor. The binary values for low, medium, and high speed and their decimal equivalents are 011 (3), 101 (5), and 111 (7), respectively. In addition to using Table 3, Table 1 can be used to generate other speed control patterns for the DC motor as well. As always, record your results for future DAC applications.

The motor in Figure 3 can be replaced with a small light bulb, thereby creating a dimmer circuit. Tables 1 through 3 can be used in testing and analyzing the function of the circuit. If the circuit is wired correctly, the intensity of the bulb should decrease as the fullscale voltage is reduced by the appropriate input binary value. The equation discussed earlier will be quite valuable in designing the appropriate transistor driver circuit. Depending on the current requirements of the bulb, the selection of transistor is very important. So analyze your results very carefully.

Voltage Resolution Of Various DAC

CONVERTER	MAX. FULLSCALE*	RESOLUTION	%RESOLUTION
8 BIT	9.9609375 volts	0.0390625 volts	0.39
10 BIT	9.9902344 volts	0.0097656 volts	0.1
12 BIT	9.9975588 volts	0.0024412 volts	0.024

*10V FS Converter

Table 2

Further Thoughts and Experimentation

Well, I hope the question "What the heck are DACs?" has been answered. Now that you experimenters have information on functionality, construction, and application, you can see how versatile this chip is in terms of digital-to-analog conversion and control for computers, automotive, and industrial machines.

If you have a data book on microcontrollers, take a look at the construction block diagram of the chip. You should see a block with D/A or DAC shown on the diagram. The data book should explain how the DAC works in conjunction with the rest of the chip.

What makes this integration feature so appealing is the DAC can be programmed with the I/O ports of the microcontroller. The DAC, in this case, can be used to do PWM (pulse width modulation) or waveform generation application.

Oh, by the way, if you haven't guessed it, the DAC is an excellent chip for computer interfacing. Your local university's engineering/science library is an excellent source for books on computer interfacing and control. My *Oct/Nov '95* columns have information relating to Mac I/O interfacing.

Also, I'm thinking about starting a special interest newsletter on Mac I/O projects. Based on the amount of E-Mail I've been receiving on my Oct/Nov columns on this topic, I thought this publication will help those Mac Users on how to interface their machines to the real world. In addition to interfacing techniques, science topics will be discussed as well, which leads me into DAC projects and science.

The discussion on how to substitute the motor with a light bulb brings up an interesting project with light detection measurements. This technique of using the DAC as a "programmable" dimmer makes an excellent instrument for testing light detection sensors and systems. By using a light meter, an optical bench, and this DAC dimmer circuit, a pretty descent electo-optics lab can be constructed. If the interest is there via E-Mail responses, I will present in a future article some circuits and test procedures for evaluating light detectors, sensors, and systems.

Science and engineering are very important areas that our society is involved with daily. Some aspects of hobbyists electronics also focus on the science and engineering fields. To get the most out of this circuit and future "Solderless BreadBox" columns, the Society of Amateur Scientists folks are a good source of experimenter science/engineering stuff!

Shawn Carlson, the Executive Director, has been quite busy in running this organization devoted to promoting the sciences via the contributions of amateur scientists.

Forrest Mims, the famed author of several Radio Shack books on electronics, is a frequent speaker on the electronic forum. Yours truly is also an active participant of this forum as well. Membership is $35.00 per year and it includes the quarterly newsletter, *The Amateur Scientist Bulletin* and access to the electronic forum. For more info on the SAS, contact Shawn Carlson at (619) 239-8807. You'll be glad that you did.

Well enuf said, see ya next month in the breadbox!

E-Mail address: **t6790dw@infoctr.chrysler.com** **NV**

Motor Speed Table

Table 3

SWITCHES 1	2	3	OUTPUT VOLTAGE	MOTOR CURRENT	
0	0	0	0	0	
0	0	1	625 mV	7.30 µA	
0	1	0	1.25 V	19.20 µA	
0	1	1	1.88 V	46.20 µA	LOW
1	0	0	2.50 V	73.80 µA	
1	0	1	3.12 V	101 mA	MED
1	1	0	3.75 V	129 mA	
1	1	1	4.38 V	157 mA	HIGH

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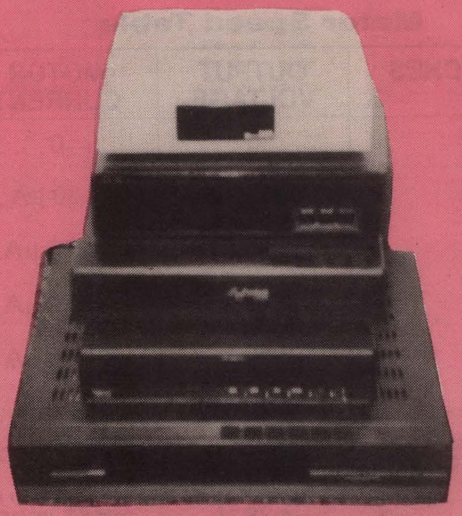

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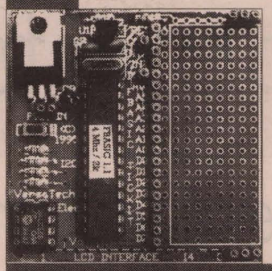

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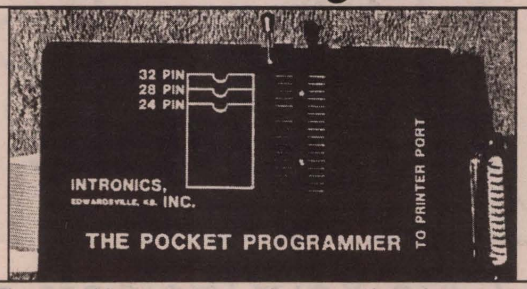

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Military Spinoff Now Available to Hobbyists

Give Your Projects a Sense of Direction With a New, High-Tech Electronic Compass

by Scott Edwards

Compasses haven't changed much since ancient mariners floated magnetized needles in a bowl of water to find North. More recently, electronics experimenters have lashed together all sorts of pseudo-compasses, whose drawbacks made them nearly unusable:

- Flux gate magnetometers (high-current draw, expensive, low resolution).
- Hall-Effect sensors (terrible drift, poor sensitivity).
- Instrumented conventional compasses (fragile, low resolution, and just plain ridiculous; like measuring temperature by pointing a video camera at a thermometer!).

Then a high-tech start-up met the US Army, and a new electronic compass technology was born: the magneto-inductive compass. This technology has been trickling down through high-buck applications, like military and maritime navigation, oceanographic research, automotive compasses, virtual-reality sensors, and pricey gizmos for Yuppie campers. Now the developer, Precision Navigation, Inc., has set its sights on a new market — electronics hobbyists — with its $50.00 Vector 2X electronic compass module.

In this article, we'll look at how the Vector 2X works and how to hook it up. From there, it's up to your imagination to apply the Vector 2X to projects like:

- Robot navigation systems.
- Stationary heading indicators to supplement Global Positioning System (GPS) receivers.
- Head-direction sensors for virtual reality systems, avant garde musical instruments, aids for the disabled, etc.
- Direction and distance loggers to record the movements of a vehicle or person.

Basic Compass Concepts

The earth has a magnetic field that runs more or less between the North and South poles. Figure 1 shows the relative positions of magnetic and geographic, or *true* North. Map makers use true North as their reference, but also provide a correction factor called *declination* that lets you reckon true North in terms of magnetic North.

The earth's magnetic field is constant, but can be distorted by solar activity. This distortion amounts to less than one degree, and is fairly predictable, since solar activity varies in relatively consistent cycles spanning years.

On a more local level, nearby magnetic materials like iron and steel (especially *magnetized* iron and steel) can distort the magnetic field and throw off a compass by *dozens* of degrees. This means that a perfectly good handheld compass may be nearly useless in a car or onboard a ship. Fortunately, compasses designed for vehicular use, including the electronic Vector 2X, allow the user to recalibrate the compass for its magnetic environment.

The Vector 2X Compass Module

Although the earth's magnetic field is easy to detect with a free-pivoting piece of magnetized steel, it has proven difficult to measure electronically. Or at least with reasonably priced, portable electronics.

Until recently, the flux-gate magnetometer was the primary electronic technology for compass applications. Flux gates consist of a pair of coils wound on a specially made core. One coil, the *drive* coil, is driven with alternating current (AC), which induces an AC voltage in the second, *sense* coil. Magnetic influences, like the earth's magnetic field, change the characteristics of this transformer, and cause a second harmonic proportional to the strength of the magnetic field to be

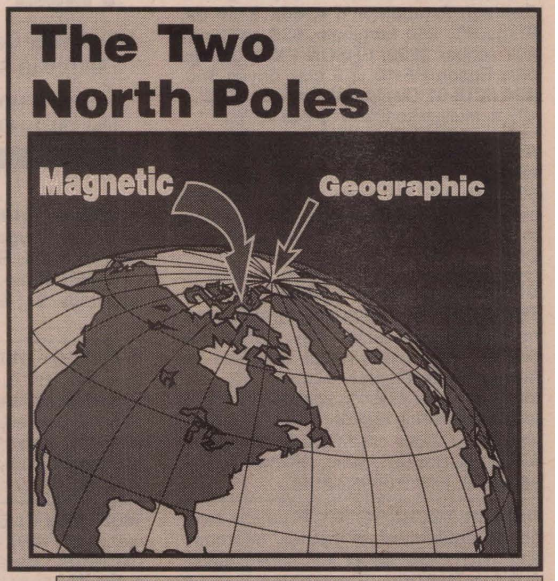

FIGURE 1. Magnetic North is not quite the same as geographic North, but it's been the basis of navigation for centuries.

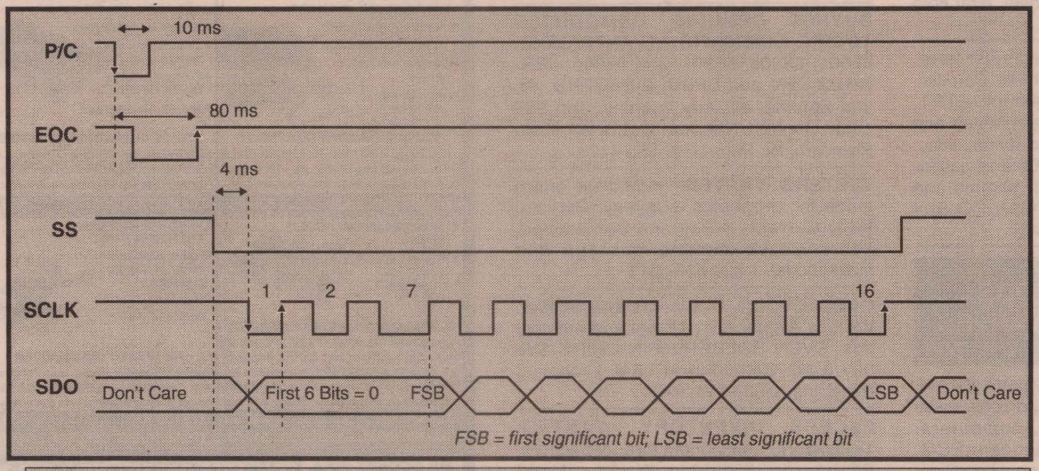

FIGURE 2. Timing diagram for the slave-mode interface (typical microcontroller connection).

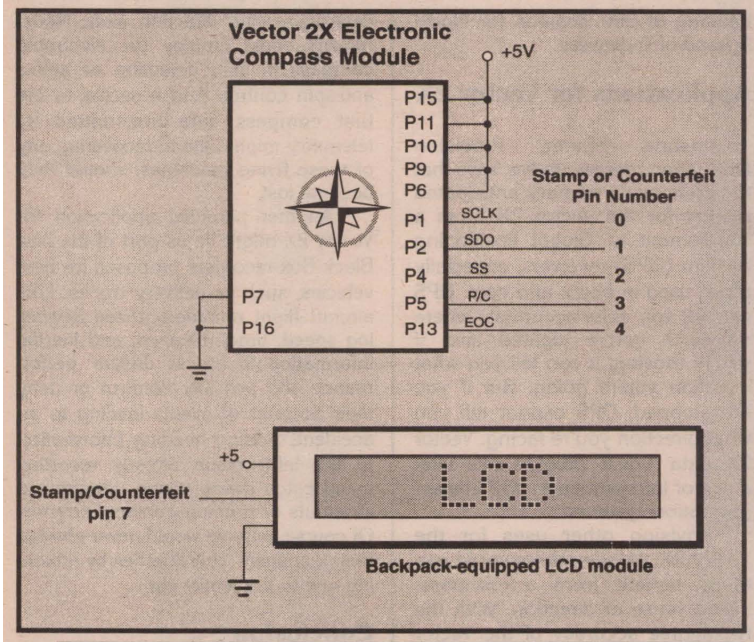

FIGURE 3. Schematic diagram of the test/demo set-up.

Pinout of the Vector 2X Compass Module

Pin	Name	Description	Active State
P1	SCLK	Serial Clock Input	Rising edge
P2	SDO	Serial Data Output	
P3	SDI	Serial Data Input	
P4	SS	Slave Select	Low
P5	P/C	Poll/Continuous	Low = Continuous
P6	CAL	Calibrate Select	Low
P7	5/10	5 or 10 Hz Update Select	Low = 5 Hz
P8	M/S	Master/Slave Mode Select	Low = Master
P9	BCD/Bin	BCD/Binary Data	Low = BCD
P10	YFlip	Flip Y Axis Direction	Low = Flip
P11	XFlip	Flip X Axis Direction	Low = Flip
P12	CI	Calibrate indicator signal	Low
P13	EOC	End-of-Conversion signal	Done on Rising Edge
P14	RAW	Raw Data Mode Select	Low = Raw
P15	VCC	Five-volt Power Input	
P16	GND	Power Supply Ground	

```
' PROGRAM LISTING: Vector1.BAS
' This program interfaces the BS1/Counterfeit to the
' Vector 2X digital compass. The program gets the data in binary form
' from the Vector, then displays it on an LCD Serial Backpack-equipped
' LCD module.

SYMBOL SCLK_n = 0                ' Pin 0 is serial clock output.
SYMBOL DATA_n = 1                ' Pin 1 is serial data output from Vector 2X.
SYMBOL DATA_p = pin1             ' Pin 1 " " " " " "
SYMBOL SS_n = 2                  ' Pin 2 is slave select.
SYMBOL P_C_n = 3                 ' Pin 3 is poll/continuous output.
SYMBOL EOC_p = pin4              ' Pin 4 is end-of-conversion signal input.
SYMBOL bits = b2                 ' Bit counter.
SYMBOL heading = w0              ' Data from Vector 2X.
SYMBOL display = b3              ' Current display indication.

high SCLK_n                      ' Starting position for clock.
high SS_n                        ' Deselect initially.
high P_C_n                       ' Start in poll mode.

pause 1000
' Define degree symbol in CG RAM.
serout 7,n2400,(254,64,254)
serout 7,n2400,(8,20,8,0,0,0,0,0)
serout 7,n2400,(254,1,254)       ' Clear LCD screen.
pause 100
serout 7,n2400,("HEADING: ")     ' Print the fixed label.

' Here's the loop that gets data from the Vector 2X then displays it on
' the Backpack screen.
Vector:
 pause 500                       ' A half-second pause.
 pulsout P_C_n,1200              ' Start conversion with 12ms pulse.
 wait:                           ' Wait for end of conversion.
 if EOC_p = 0 then wait
 low SS_n                        ' Start communication.
 pause 4                         ' Wait 4ms before first clock pulse.

 for bits = 1 to 16              ' Loop 16 times.
  let heading = heading*2        ' Shift variable left.
  low SCLK_n                     ' Drop the clock line.
  let bit0 = DATA_p              ' Get the bit.
  high SCLK_n                    ' Raise the clock.
 next                            ' Repeat.
 high SS_n                       ' End comm with Vector 2X.

 serout 7,n2400,(254,137,254)    ' Position cursor to character 9.
' Now print the heading, the custom degree symbol, and some blanks
' to erase old data.
 serout 7,n2400,(#heading,0," ")
goto Vector                      ' Do it again.
```

developed in the sense coil. Set up two such sensors and appropriate electronics to detect the magnetic-field-proportional harmonic, and you've got a compass.

In practice, this is as cumbersome as it sounds. A further, hidden problem is that the most efficient flux-gate circuits require a battery-sapping 50 to 60 milliamperes to operate.

The breakthrough that made the inexpensive and precise Vector 2X module possible was the development of a magnetometer sensor whose properties could be measured with simple hardware. The Vector 2X uses a pair of proprietary magneto-inductive sensors, which the manufacturer patented in 1989. These are coils wound on a special core whose properties vary with the strength of a DC magnetic field. So, the magnetic field strength changes the inductance of the coil, and the inductance of the coil controls the frequency of an oscillator. A microprocessor-based frequency counter circuit can determine field strength.

To find North, the microprocessor acquires the field strength from two magneto-inductive coils mounted at right angles to one another. It then performs a trigonometric calculation — a rectangular-to-polar coordinate conversion — and bingo! there's the compass direction.

The benefits of this approach as implemented in the Vector 2X are many: low cost, one-degree precision; ± two-degree accuracy; rapid (20/second) direction updates; and low (average 1 mA) current draw. In addition, the use of a microprocessor in the module allows the Vector 2X to offer a variety of configuration, calibration, and communication options.

Interfacing the Vector 2X

The Vector 2X is designed to interface to a microprocessor or microcontroller through a five-wire serial connection (slave mode). It can also generate a clock signal and talk to "dumb" logic like shift registers to directly drive simple displays (master mode). We're going to concentrate on the slave-mode microcontroller interface, since it's the more interesting and versatile of the two.

The table lists the Vector 2X pins and their functions, while Figure 2 shows the signals that appear on the communication pins when a controller reads data from the compass module. The listing contains a PBASIC program that generates these signals and timing relationships. This program runs on BASIC Stamp and Counterfeit microcontroller boards (Sources).

Those of you with some microcontroller experience will recognize this interface for what it is: a variation on the serial peripheral interface (SPI) and variants promoted by Motorola, National Semiconductor, and others. It offers a relatively fast way for micros to communicate with peripheral devices without the space required for a full parallel bus.

If you're accustomed to other SPI devices, you may be surprised by the relatively long delays between the time the controller brings the P/C line low to start a conversion and the availability of the first bit on the SDO line — a total of close to 90 milliseconds or almost a tenth of a second. This time is required for the Vector 2X's onboard controller to wake from sleep, and then to perform the dual-magnetometer measurement. Once

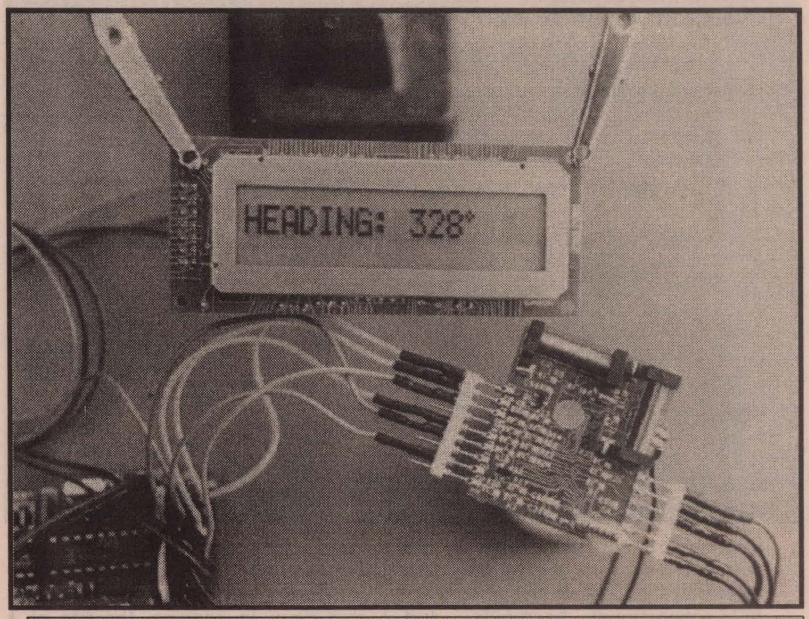

FIGURE 4. Vector 2X compass module connected to test hardware. Note magnetometer coils.

this is done, the data is placed in a shift register, and may be clocked out by pulsing the SCLK line at speeds of over one million bits per second.

Controllers that are blessed with interrupts don't have to hang around waiting for the compass module to finish its measurement as shown in the PBASIC listing; they may pulse P/C to kick things off, set the interrupt to trigger on the rising edge of EOC, then go about other business. When the EOC interrupt triggers, the controller can then gather up the compass data.

The manufacturer, Precision Navigation, provides a small booklet of application notes showing how the Vector 2X may be connected to popular Motorola and Intel processors, and how to reduce I/O pin requirements to just three (SS, SCLK, and SDO) in some cases. For the sake of this demonstration, I used an interface that conforms to the timing diagram and suggested hookup; see Figure 3.

Figure 4 is a photo of my test setup. I soldered header posts to the shoulders of the component-style pins of the Vector 2X and used header-socket jumpers to wire it to a Counterfeit controller (Sources). An alphanumeric LCD module equipped with a serial Backpack interface (Sources) served as the display.

Despite the Vector being a preproduction beta test unit, I found that everything worked as advertised. The beta glitches, which should be eliminated before any of you get your hands on a Vector 2X, turned out to be minor stuff, like occasionally displaying a heading of 360 degrees for North instead of 0 degrees.

Applications for Vector 2X

Christine Sherer, Precision Navigation representative, says that the company's primary anticipated market for the Vector 2X is as a supplement to Global Positioning System (GPS) receivers, especially those used in boats and cars. GPS can tell you quite accurately where on earth you're located and, if you're moving, it can tell you what direction you're going. But if you are stopped, GPS cannot tell you what direction you're facing. Vector 2X data would provide this vital piece of information for GPS-based navigation systems.

I envision other uses for the Vector 2X. Mobile robots could certainly benefit from a compass-based sense of direction. With the two-degree accuracy of the Vector 2X, a robot would need some supplemental navigational assistance in order to locate a small target like a docking/charging station. Still, knowing what room it's in and what direction it's facing would be a vast improvement over the navigational blindness of the majority of mobile robots.

Sail planes and experimental/weather balloons could benefit from Vector 2X compasses to help them determine wind direction aloft. Model rockets could employ the electronic compass in spin detection or active anti-spin control. And it seems to me that compass data transmitted by telemetry might help in recovering any of these flying machines, should they become lost.

Another potential application for Vector 2X might be as part of the new Black Box recorders proposed for fleet vehicles, such as delivery trucks. Like aircraft flight recorders, these devices log speed, time, distance, and inertial information to assess drivers' performance and possibly confirm or deny their account of events leading to an accident. Adding heading information to the information already recorded could catch drivers using unapproved shortcuts or running personal errands. Of course, parents would never abridge their teenagers' civil liberties by attaching one to the family car . . .

Conclusion

The Vector 2X brings military electronic-compass technology within reach of average hobbyists and basement inventors. It is inexpensive, precise, and simple to use. Once the initial wave of compass-with-an-electronic-display products passes, I'll bet that we'll see a host of interesting new products combining the Vector 2X and the fertile imaginations of *Nuts & Volts* readers. **NV**

Sources

The Vector 2X compass module is manufactured by Precision Navigation, Inc. (PNI), 1235 Pear Avenue, Suite 111, Mountain View, CA 94043; phone (415) 962-8777; FAX (415) 962-8776. At the time of this writing, PNI was making arrangements to distribute the Vector 2X through Jameco Electronic Components, 1355 Shoreway Road, Belmont, CA 94002-4100; phone 1-800-831-4242. Price was not set at press time.

The controller and display hardware used in the example application are available from Scott Edwards Electronics, 964 Cactus Wren Lane, Sierra Vista, AZ 85635; phone (520) 459-4802; FAX (520) 459-0623; E-Mail (CompuServe) at 72037,2612; Internet 72037.2612@compuserve.com

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. All Counterfeit hardware and software is 100-percent compatible with the BS1 and original BASIC Stamp.

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

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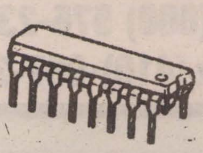

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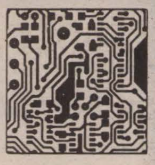

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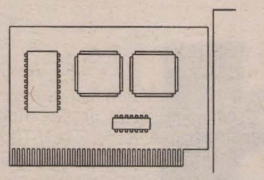

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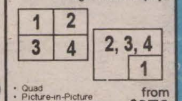

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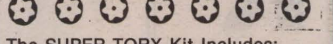

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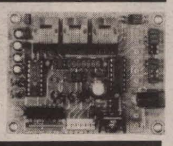

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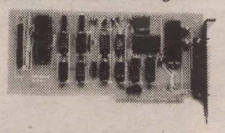

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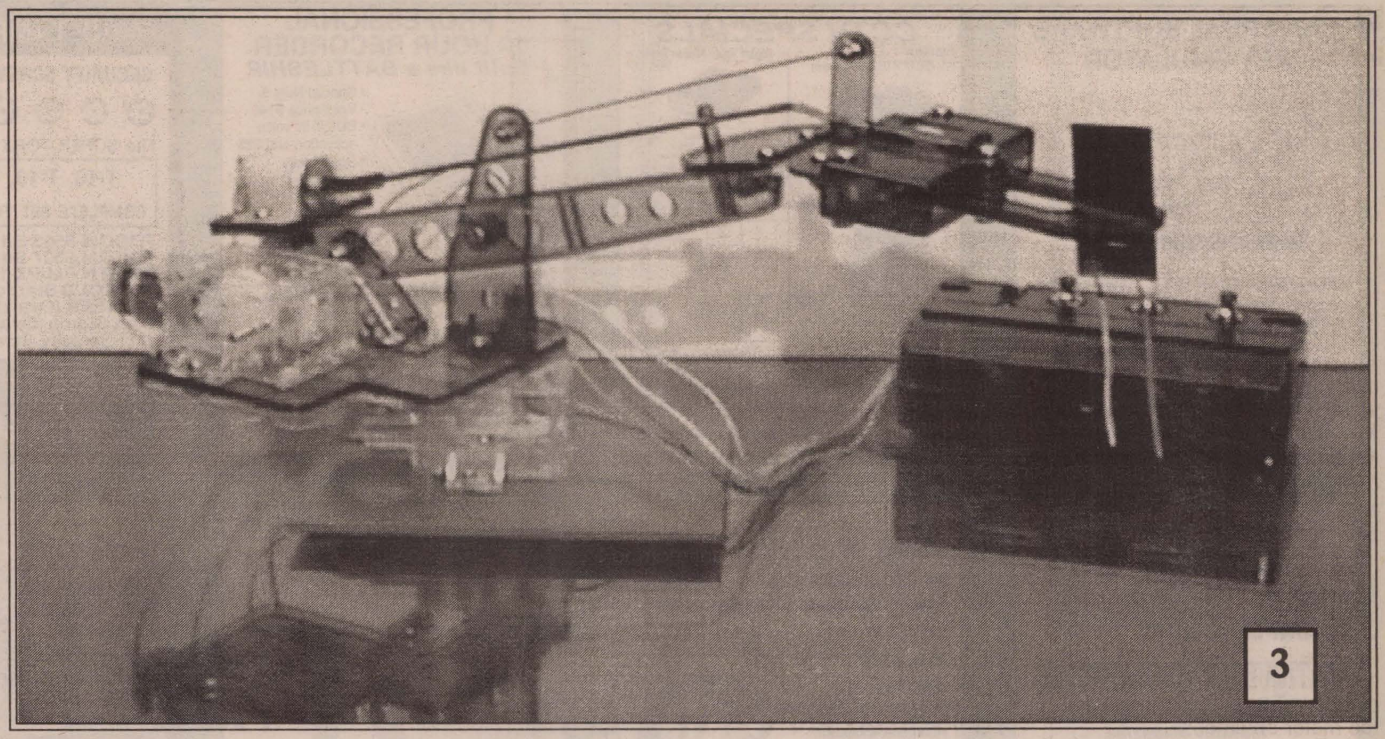


by John Iovine

The robotic arm we will interface to the IBM is a kit. We will interface to a standard IBM style printer (parallel) port. The robotic arm provides an excellent introduction into the world of robotics. While most readers of this magazine are familiar with electronic components, few are experienced with motors, gears, hardware, and motion control. This kit provides an introduction to the mechanics of robotics and motion.

The arm can move freely within two axes of motion. It can move vertically (up or down), and rotate clockwise or counterclockwise. The gripper portion of the robotic arm can grasp and release small objects.

The arm may at first glance appear to be a simpler version of the Armatron robotic arm sold (usually around Christmas) at Radio Shack. The Radio Shack arm has more features than the robotic arm we shall use. For instance, the Radio Shack arm can rotate the gripper portion of the arm clockwise or counterclockwise. In addition, each motion incorporates two speeds depending upon the amount of movement one uses on the control sticks. However, the Radio Shack arm achieves its motion with a single motor and an ingenious concoction of gears and controls.

The gearing controls make interfacing the Radio Shack robotic arm to a computer too complex. The robotic arm outlined here uses three small DC motors and a "wire" control. The wire control makes it possible to easily interface the robotic arm to the IBM printer port. Once connected to the printer port, the arm may be programmed to perform a sequence of motions. The motion sequence may be used to perform repetitive action.

The robotic arm is lightweight. Most of the stress bearing parts are made of plastic. The three DC motors used in the arm are small. The motors only provide low torque. The arm uses two gear boxes to generate enough torque from the motors to move the arm vertically and rotationally. Even with the gear boxes, the robotic arm is not capable of lifting or moving much weight. Regardless of this fact, it provides an opportunity for the experimenter to learn first hand the integrated structure of a simple robotic arm — how it works and how it may be programmed. The information obtained from this project can be utilized to build other robotic arms with greater capabilities.

Robotic Arm Assembly

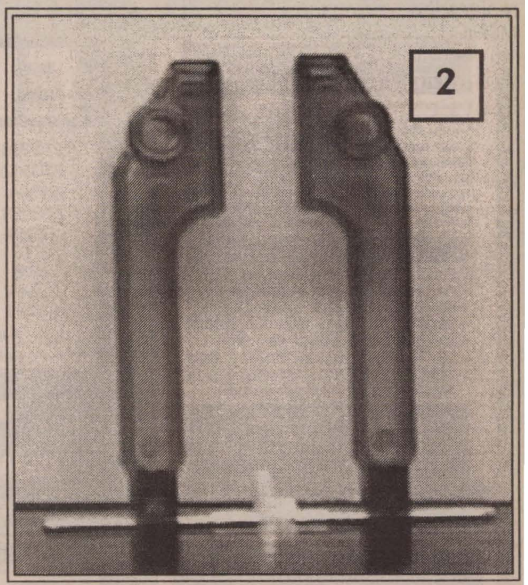
The robotic arm kit has been thoughtfully laid out. The components are packaged in individual transparent plastic bags that are identified with an alpha numeric number (see Figure 1). By carefully following the directions enclosed with the robotic arm, the construction proceeds smoothly (see Figure 2). A few hours later you have an operational robotic arm (see Figure 3).

Test IBM Interface

The stock robotic arm uses a single three-volt power supply. To achieve reverse motion, one must toggle a switch that reverses the current flow to the small DC motors.

The first step in interfacing the arm to the computer is to replace the standard three-volt power supply with a bi-polar three-volt power supply. Each one of the three DC motors are controlled by two NPN Darlington transistors (see Figure 4). If neither transistor is turned on, the motor is off. Only one transistor (per motor) should be turned on at a time. If two transistors to the same motor are accidently turned on together, it will create a short circuit.

Each NPN Darlington transistor controls the current flow to the motor, but in opposite directions. Figure 4 is a test circuit that I recommend you build before interfacing the robotic arm. Use the test Basic program to run a single motor, see Basic listing DC Motor Control Test. This program turns the motor on clockwise (CW) for a second or so, turns it off, then turns it on in a counterclock-



wise (CCW) direction.

Second IBM Interface

Before we go further into the robotic arm interface, there is one chip I'd like to examine. I have read about using a TC4427 MOSFET driver as an H bridge to drive small DC motors. The results were not as good as I had hoped.

It is possible to use a TC4427 MOSFET driver to control each motor on the arm. This, of course, simplifies construction (see Figure 5). However, to use the TC4427 MOSFET I had to increase the voltage to 12 volts before the three-volt motors would perform reliably. The reason being that the internal resistance of the TC4427 is much greater than the resistance of the DC motors used in the arm. The TC4427 resistance load reduces the power delivered to the DC motors.

Another problem this created was heat. The MOSFET driver got real hot, real fast. The heat dissipating capacity of the IC is small. Therefore, I could only run the motors intermittently to prevent overheating the integrate circuit. I'm sure heatsinks can be placed on the ICs to increase the motor on time.

The electric motors used in the robotic arm are inexpensive, low-efficiency type. High-efficiency motors may work with the TC4427 ICs better.

The Basic programs will work without modification if you decide to switch out the NPN Darlington transistor and replace them using the TC4427 MOSFET drivers.

Running the Second Test Program

It is important to build the test circuit and run the test program. There are so many different IBM style computers out there that it becomes important to first determine how fast the computer runs through the Basic program. The timing loop in the main program determines how long a motor stays on.

You want to find a timing loop number that turns on the motor for one second. With this determined, you can use multiples and fractions

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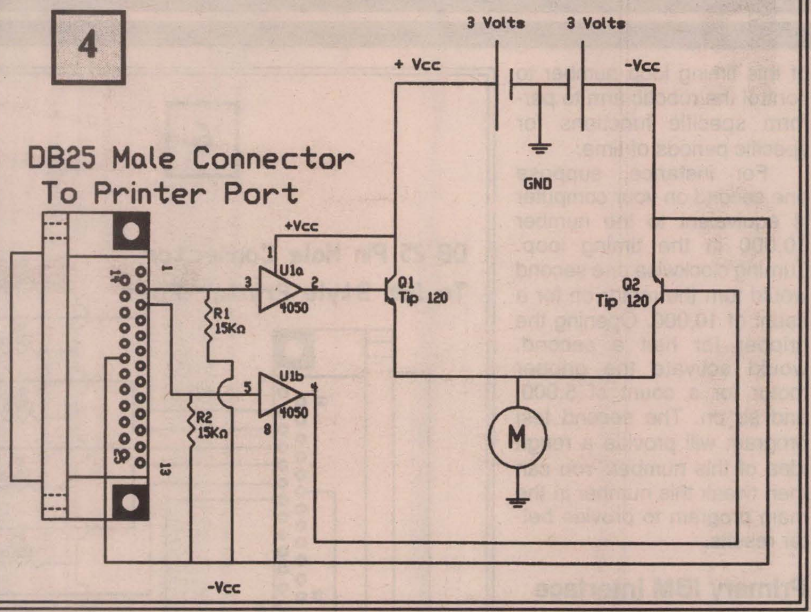

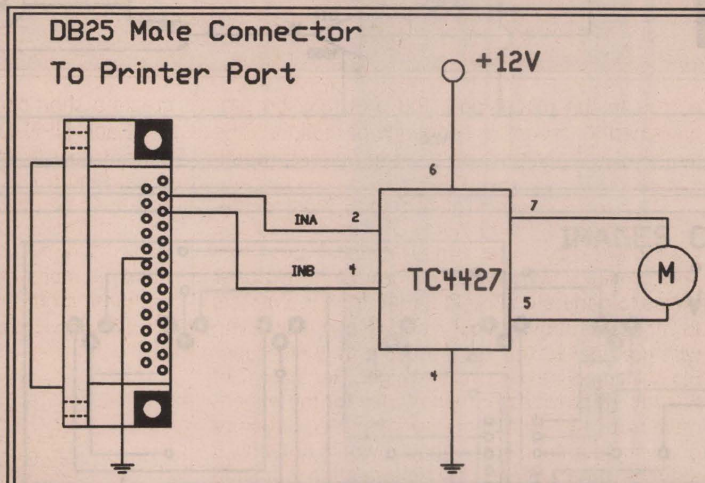

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Truth Table TC4427		
INA	INB	Function
L	L	Motor Off
H	L	Motor On CW
L	H	Motor On CCW
H	H	Motor Off

```
10 REM Use Timer to determine 1 second loop
20 ON TIMER(1) GOSUB 100
25 TIMER ON
30 FOR x = 1 TO 30000
40 NEXT x
100 BEEP
110 PRINT x

5 REM DC Motor Control Test
10 REM John Iovine 10-10-95
15 REM First find the Printer Port Address
20 DEF SEG = 0
25 a = (PEEK(1032) + 256 * PEEK(1033))
30 OUT a, 1: REM turn clockwise for awhile
35 GOSUB 200
40 OUT a, 0: REM stop for awhile
45 GOSUB 200
50 OUT a, 2: REM turn counterclockwise for awhile
55 GOSUB 200
60 OUT a, 0: REM STOP everything
65 END
200 FOR t = 1 TO 25000: NEXT t: RETURN

5 REM Robotic Arm Controller
10 REM John Iovine 10-10-95
15 REM First find the Printer Port Address
20 DEF SEG = 0
25 a = (PEEK(1032) + 256 * PEEK(1033))
30 DIM dr$(100), tr(100): REM direction and time
35 REM commands left, right, up, down, grip, release
40 REM grip = 16:release = 32:up = 8:down = 4:right = 2:left =
   1:stop = 0
45 REM To Program Robotic Arm enter direction and time in data
   statements
50 REM 16,000 = 1 second
55 FOR x = 1 TO 9: REM x equals number of data statements
60 READ dr$(x), tr(x)
65 c = tr(x): REM Set timing loop counter
75 IF dr$(x) = "right" THEN dr = 2
80 IF dr$(x) = "left" THEN dr = 1
85 IF dr$(x) = "up" THEN dr = 8
90 IF dr$(x) = "down" THEN dr = 4
95 IF dr$(x) = "grip" THEN dr = 16
100 IF dr$(x) = "release" THEN dr = 32
105 FOR i = 1 TO c
110 OUT a, dr: NEXT i
115 NEXT: REM next data statement
120 OUT a, 0
125 REM for repetitive action add following lines by removing REM
   statements
130 REM rp = 2: REM RP = number of repetitive sequences
135 REM RESTORE: REM Reset DATA pointer
140 REM rep = rep + 1: IF rep >= rp THEN 150
145 REM GOTO 55
150 rep = 0: END

236 DATA right,16000 : REM turn right for 1 second
237 DATA left, 16000 : REM turn left for 1 second
238 DATA up, 8000  : REM up for 1/2 second
239 DATA down,16000  : REM down for 1 second
240 REM      CONDENSE DATA STATEMENTS
242 DATA up, 16000, down, 16000, up, 8000, grip, 8000, release,
   8000
```

of this timing loop number to control the robotic arm to perform specific functions for specific periods of time.

For instance, suppose one second on your computer is equivalent to the number 10,000 in the timing loop. Turning clockwise one second would turn the motor on for a count of 10,000. Opening the gripper for half a second, would activate the gripper motor for a count of 5,000, and so on. The second test program will provide a rough idea of this number. You can then tweak this number in the main program to provide better results.

Primary IBM Interface

The complete robotic arm interface schematic is shown in Figure 6. The PCB pattern for the circuit is illustrated in Figure 7, and parts placement on the board is shown in Figure 8.

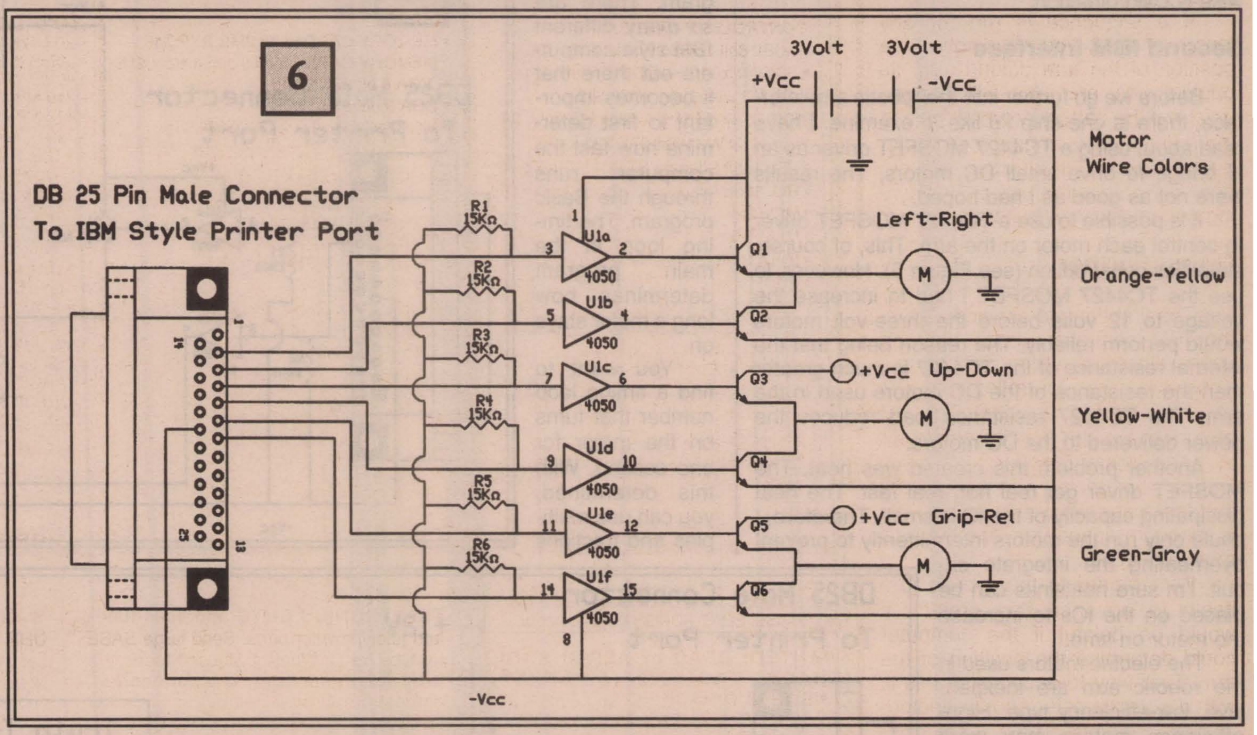
On the right hand side of the board, by the letters GND, there are six holes in a straight vertical line. This is where the motor wires from the arm are connected. Rather than solder the wires to the board, solder PC board wire terminals. This will allow you to remove the robotic arm for other projects with little hassle.

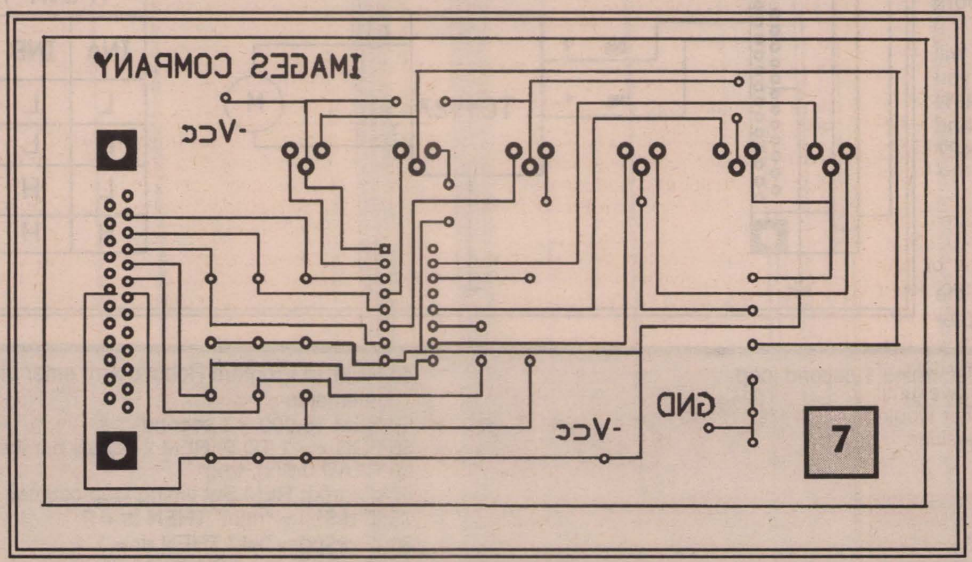
To achieve the same results from the program, you must wire the motors to the circuit in the same sequence as I have. Starting from the top, the PC terminal closest to Q5, the wire colors are green, yellow, orange, brown, white, and gray. The last three wires (brown, white, and gray) may be put into any sequence since they all are connected to the circuit ground.

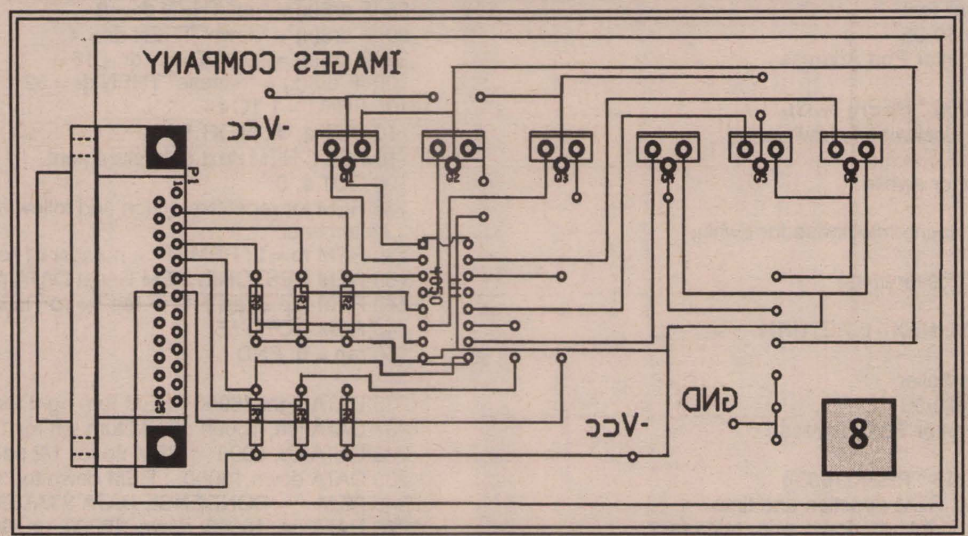
The bi-polar power supply may be made from two, three-volt D cell battery holders. For longer lasting power, make a three-volt bi-polar power supply from a six-volt one-amp transformer with a center tap.

Programming the Robotic Arm

The main robotic arm program illustrates the programming of each robotic arm function. Each command is associated with a number that is ported to the printer port. For instance, to turn the arm left, the number 1 is sent to the printer port. This brings U1a high, which turns on transistor Q1, that activates the DC motor. Each command works in a similar manner.







If you read through the program, you will notice only single function commands are given. It is possible to program two functions at a time, like move up (dr = 8) and turn left (dr = 1), by adding their dr numbers together and output it to the port (OUT a,9). These commands will increase the load on your power supply. If the power supply can't handle the load, or slows down, it will not move the full distance as dictated by the timing loop. This becomes more important, for repetitive operations you would use for animatronics.

Animatronics

You can program a sequence of movements into the robotic arm and let them repeat. This is a quick introduction into animatronics. The Main program already contains the code to perform repetitive functions. The REM statements from lines 130-145 are removed. The number assigned to variable rp determines how many times the robotic arm will perform the sequence of movements. In the program, it's only two times, but could very easily be 1,000 times or 10,000 times, or even unlimited. To program for an unlimited amount of repetitions, put the REM statements back in line 140. Now the program will continue the sequence indefinitely. To stop the program, hit the CTRL and

Break keys.

If a sequence is run for any length of time, you may notice the position of the arm drifting from its original position. This will happen quickly if the battery power supply to the robotic arm is or becomes inadequate. The most effective way to deal with this is the use of positioning controls or limit switches.

Going Further

The first thing to consider is that the IBM controller circuit may be used with most hobby DC motors. Therefore, the controller may be used to control a variety of DC motors which can then be employed in animatronic creations. A quick look at the printer port informs us that there are two unused pins. This is enough space for another DC motor controller.

With regard to the robotic arm itself: to advance this project, it would be helpful if the computer could determine the position of the arm. One way to accomplish this is with a potentiometer and an analog-to-digital converter (A/D). A small linear pot may be placed on the gripper section to determine closure. A similar unit may be placed on the arm to determine the up and down position of the arm. A rotary pot may be used to determine sweep position as long as the arm is restricted to the travel of the rotary pot.

A simpler procedure may be used to determine absolute positioning. This would be a series of limit switches (momentary contact lever switches) that close when the arm reaches its limit of travel in that direction. To reset the arm, have it proceed in the direction of travel until switch closure. The computer would then know the absolute position of the arm. **NV**

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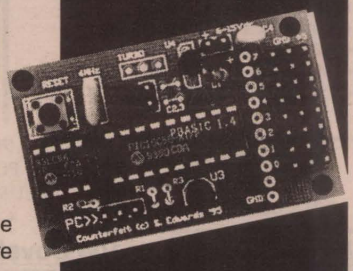

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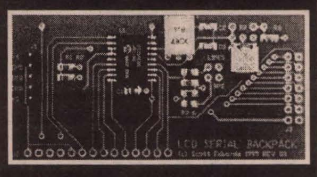
To program the Counterfeit, you'll need either the Parallax Stamp Programming Package, or our inexpensive Counterfeit Development System. Our system includes a 150-page manual, genuine Parallax software for your PC (DOS), programming cable, and one Counterfeit controller kit. Only $69. [The Counterfeit Development System may be used to program orignal (model 1) Stamps.]

The Counterfeit is easy to build, with its new, high-quality double-sided circuit board. It's also easy to program, thanks to genuine Parallax BASIC.



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```
SEROUT 0,N2400,(#w1)
```

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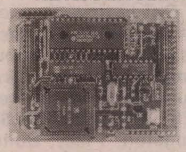

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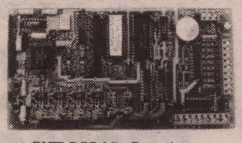

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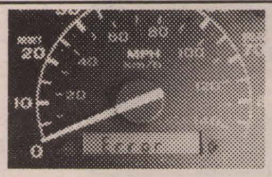

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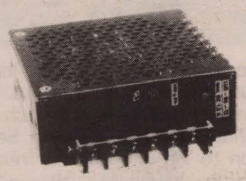

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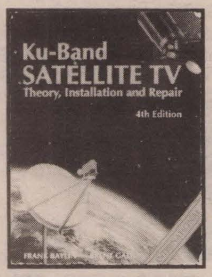

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Continued from page 97

TECH FORUM

satellites must be carefully positioned, and their antennas directed to the geographic area of interest. The US National Security Agency (NSA), which has responsibility for this type of monitoring, is theorectically prohibited from aiming its spy satellites at domestic targets. The traffic from various world hot-spots is undoubtedly of greater interest to our government.

If an electromagnetic pulse (EMP) was present between 9 to 9:05 AM on April 19, 1995 in Oklahoma City, it would have almost certainly affected numerous communications systems. This would include normal broadcast TV receivers which use AM video transmission that is highly susceptible to electromagnetic interference.

J. Gilbert
Lake Zurich, IL

ANSWER TO #109527 - OCT. 1995

If the monitor has TTL inputs, it can be directly connected to a VGA card by a VGA-to-BNC cable, available at bigger computer stores for about $30.00. The inputs can be identified with the monitor turned on, using a voltmeter. Unconnected TTL inputs will about 1.5V. Use the IN inputs. There is probably a switch next to each connector that reads HiZ/75 ohm. Set termination to 75 ohms. Scan frequencies are probably about 60 Hz and 65 KHz, 1280 x 1024. Many VGA cards include drivers for use with DOS and Windows.

Jan Zaluda
Mountain View, CA

ANSWER TO #109513 - OCT. 1995

Vacuum tubes work better with DC filament current. Add a bridge rectifier to the 25.2 VAC transformer, and replace the ballast tube with a LM317 voltage regulator. Leave the other tubes in series as before, connected to the output of the regulator. Filter capacitors are optional. Adjust the regulator output with a voltmeter to the sum of the two filament voltages. Use a DC voltmeter for the adjustment. The receiver will probably be more stable than ever before.

Jan Zaluda
Mountain View, CA

ANSWER TO #109530 - OCT. 1995

To measure pH, you need a pH electrode, and a high impedance millivoltmeter. These are available from many chemical suppliers, including Lazar Research, 1-800-824-2066. Electrodes are about $50.00 and up depending on durability. Output of the millivoltmeter may be digitized with an A/D converter, which can be connected to a bus, or a port of a computer.

Jan Zaluda
Mountain View, CA

ANSWER TO #109520 - OCT. 1995

The simplest way to solve this problem is to purchase a standard on/on light switch from the hardware store. It has one input and two outputs. The switch only allows one output at a time which will alternate between the normal position of down being for example, the heater is on and the disposal off, then when switched, the other way will cut off the heater while the disposal is being used. The cost of these switches are under five bucks. The ground fault detector won't be affected as this is attached to the positive feed.

Part two, is solved with a solid-state switch with multiple outlets and the input from the solid-state switch, on/off, goes to a light sensor (photo trans or CAD cell) that can be attached to the TV's power on light, TV screen, or any other light source that the TV puts out when on. Under $10.00.

Chris
Beiber, CA

ANSWER TO #10954 - OCT. 1995

Your 101EE (the question had 100EE listed, but I don't believe Yaesu made a model 100 series) appears to be going into parasitic oscillation. There are several things that could be aggravating this.

To troubleshoot the rig, operate it into a proper dummy load to present a proper load. Make certain the plate control is pointing to the center of the band being used, and turn the load control to approximately four. This will give you a ballpark tuning point.

The rig must be properly neutralized and have proper bias. The bias is

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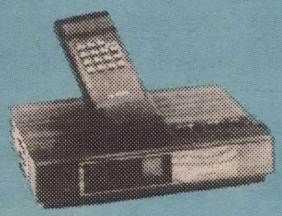

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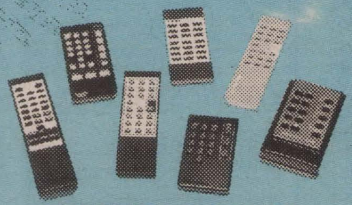

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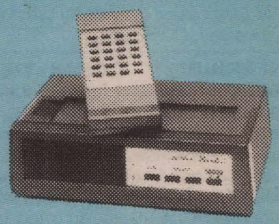

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TECH FORUM

checked in the upper or lower sideband mode. Key the rig with no mike connected or the mike gain control set to zero. Place the meter switch on IC and adjust the bias adjustment so that 50-60 mA of final tube current is indicated.

To neutralize the rig, the neutralization capacitor in the final tube compartment is adjusted so that at 29 MHz and 100 mA of plate current, as the plate control is rocked back and forth, it has equal effect on both sides of peak output. Use a non-metallic tool to adjust the capacitor; it has 600 volts applied to it! There is a complete procedure for adjusting the bias and neutralization in the 101 manual.

You must use Toshiba final output tubes for proper neutralization. Most other brands had different inter-electrode capacitance, which won't allow the neutralization capacitor enough range to adjust neutralization. The driver isn't as difficult. Most brands of 12BY7 will work. The Yaesu Maintenance Manual suggests that if you use a GE 12BY7, change C-123 to 3 pF. If you use an RCA, change it to 5 pF.

If these aren't the problem, you might want to check the voltages on the tubes to see which direction to go. Using a VTVM or at least a high impedance voltmeter (10 M ohm or greater) the tubes should have the following:

	12BY7		6JS6 (both)	
	RX	TX	RX	TX
pin 2	-20.0	-3.6	0	.03
pin 3			160	160
pin 5			-63	-50
pin 7	340	270		
pin 8	260	220		
pin 9			-63	-50
pin 11			160	160
plate cap			650	570

Frank W. Denk, Jr.
Romeoville, IL

ANSWER TO #109510 - OCT. 1995

The Everex laptop battery can be removed by pushing back on the levers behind the LCD screen. The battery voltage is nominally 12 volts, about 14.5 volts when fully charged. A new AC adaptor is available from PBM Systems (NY, 1-800-645-1655) for about $150.00! A simpler and much less expensive solution is to carefully solder some flat wire or copper tape to the two battery terminals and bring it out to a "flying lead" connector. Connecting a 12 VDC 1-amp supply to the added connector will not only charge the battery, but will also allow it to run while being charged. Make sure that the open circuit voltage from your adapter is less than about 15 volts to avoid overcharging the battery. One minor inconvenience — the "low battery" or "charging" light above the keyboard will probably not work.

Larry Supremo
Catonsville, MD

ANSWER TO #11951 - NOV. 1995

You will probably have to be more specific in your question. Elements such as potassium don't emit anything unless they are excited in some way or are made to be radioactive. If the electrons in an atom are excited to a higher than normal energy level, they will emit electromagnetic radiation as they fall back to their normal energy state. This electromagnetic emission is unique to the material and is called its emission spectra. Conversely, the electromagnetic frequencies that the substance absorbs to get into an excited state is called its absorption spectra. Or perhaps you are thinking of what happens when electromagnetic energy bombards a substance such as what happens in a microwave oven. Everything has a resonant frequency associated with it. This is the frequency at which a substance absorbs energy most efficiently. When atoms or molecules absorb energy in this way, they vibrate or move around faster, or in other words, get hotter.

Michael Young
Newville, AL

ANSWER TO #11954 - NOV. 1995

Your question is a good one. I don't know of any single source that has compiled all the data you want. Basically, there are a couple of ways I can suggest to find out the precious metal content of ICs. One is to contact the manufacturer of each chip and try to find out from them. The other is to

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Powell's Technical Bookstore
33 NW Park
Portland 97209

Tower Books
1307 NE 102nd Avenue
Portland 97220

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Red Lion 17356

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2310 A Walnut Street
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Tower Books
425 South Street
Philadelphia 19147

PUERTO RICO

Marval Security Equipment
Calle 6 #13, Ext. San Agustin
Rio Piedras 00926

TEXAS

Tanner Electronics
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Carrollton 75006

The Communication Source
2713 Galleria Drive
Arlington 76011

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Omega Electronics
1500 North 150 West
Provo 84604

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Riley's Distributing
1045 Edom Road
Harrisonburg 22801

Satellite Headquarters
9310 Timberlake Road
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Fairfax 22033

WASHINGTON

A-B-C Communications, Inc.
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Seattle 98155

Amateur Radio Supply Co.
5963 Corson Avenue S. #140
Seattle 98108

Supertronix
18650 68th Avenue South
Kent 98032

Tower Books
10635 NE 8th Street
Bellevue 98004

20 Mercer Street
Seattle 98109

WEST VIRGINIA

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Morgantown 26505

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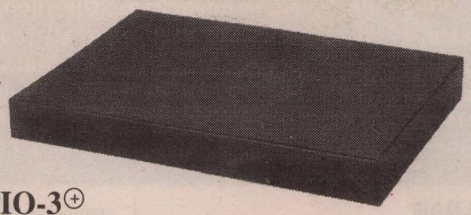

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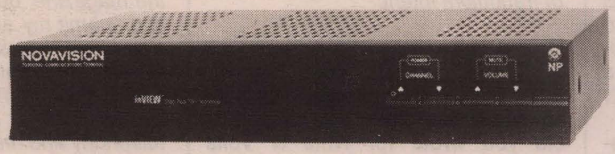

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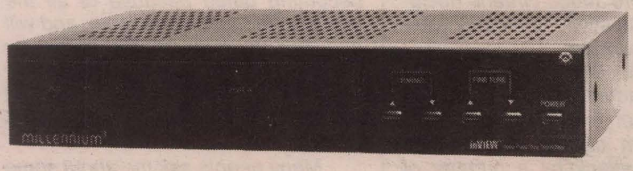
- Ch 3/4 switch



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 at Damien@prcomm.com via the Internet. Names will not be published if anonymity is requested.

MAILBAG

Dear Damien:

I have been a regular reader of your magazine, and I find it one of the most informative sources of electronic information around. My question to your staff is: I have cellular service provided by a major cellular provider. I recently purchased another handheld phone to compliment the one in my auto. I wanted the same phone number assigned to the handheld and was told that they couldn't clone another phone, I must purchase another contract.

This seems a little odd to me, because I already have active service. Is there a way that I can clone the new phone myself? What equipment would I need to do it? I have some experience in electronic and telecommunications. Any help would be greatly appreciated.

Errol via CompuServe

Errol:

Thanks for sharing your common concern with adding an extension phone to your cellular service. This has been an ongoing issue discussed in this column over the years, and two articles in this issue will shed some light on the subject. Unfortunately, there is no absolute correct answer.

Here's the legal situation in a nutshell. Federal law prohibits the theft of communications services. Some carriers have argued that depriving them of the monthly revenue generated by each service agreement constitutes theft. This would be a stretch, however, and is equivalent to the old Bell System claiming phone fraud because you plugged in an extension phone without paying a fee for that extension. I'm sure most of us are old enough to remember those draconian days before Judge Greene decided such a nationwide monopoly wasn't fair to consumers.

The other law existing on the books that addresses this issue is part 22.919 of the FCC rules. This prohibition on cloning phones has been under attack by a number of firms who are involved in an appeal process known as a "petition for reconsideration." Even the Advocacy arm of the Small Business Administration is supporting the firms who want this rule overturned. The logic is that the FCC is supposed to promote competition, not offer cellular carriers a monopoly on a silver platter. It looks like the FCC forgot about serving the public interest, and forgot that the airwaves licensed by cellular carriers actually belong to us.

While I am hopeful that the Commission will recognize its error and modify the rule to allow extension cellular phones to be provided by firms other than the carriers themselves, at this point use of an extension phone is a technical violation of 47 CFR 22.919.

Since you didn't mention what brand and model of phones you own, I can't offer much in the way of technical information to explain what you would need to create an extension. Over time it has become apparent that it is not cost-effective to purchase software or hardware to reprogram a single phone. While we do not advocate anyone violating the FCC rules, those who are determined to have an extension phone would probably be better off sending their phone to a company that specializes in ESN reprogramming.

While most readers of this magazine are of a do-it-yourself persuasion, most readers would not buy a $900.00 oscilloscope for the sole purpose of repairing a $149.00 television. The same principle applies to reprogramming the ESN within newer, handheld cellular phones. Companies that provide these services have usually invested thousands of dollars to purchase dedicated reprogramming hardware for a variety of phones.

Hacked computer software is becoming dated because of all the new phone models available, and will one day be remembered fondly by old timers much as former cutting-edge software such as VisiCalc and the CP/M operating system is regarded today.

Many people ask me about some of the cellular advertisers in this and other magazines. With firms coming and going at a rapid pace, I know very little about most of them first hand. Although Nuts & Volts as a publication does not endorse any of the firms that advertise herein, as an individual columnist I'm able to offer my personal opinions.

There are two people who operate cellular-related businesses with whom I've had numerous conversations over the last couple of years. Based upon the length they've been in business, the positive comments I've received from readers, and my interaction with them, I have no qualms about referring you to either of them.

The first is Keith Perry. Keith can be reached at 512-259-4770. The second is Greg of California Grapevine Communications. Greg can be reached at 714-581-2121, or via an automated FAX back system at 714-581-7460.

Since a number of people have been taken by fly-by-night companies that suddenly go out of business, the only other recommendation I can offer to those seeking a reputable programming company is to call the Independent Cellular Services Association (ICSA). This is an informal trade association representing extension phone programmers, and spearheading the fight for consumer rights before the FCC. Although the ICSA discourages "mail order" programming, they can probably refer you to a firm near you. Write the ICSA at Box 2171, Gaithersburg, MD 20886. My helpful contact there has been Mike Heavener of MT Communications.

My final comment to anyone considering a cellular extension is that you should be prepared to document both your identity and the fact that you have a valid cellular service agreement. Legitimate aftermarket programmers absolutely will not offer you services if there is any indication of fraudulent intent.

Dear Damien:

I read an old post [on the Internet] about modifying Motorola phones which was based on an article you wrote for *Nuts & Volts Magazine*. Well, I'm not going to bother you for specific instructions on how to do that — I'm quite sure you're tired of explaining that. I would like to subscribe to *Nuts & Volts* though, and don't know their address, or how to do it. Can you help me out?

Also, I have my scanner hooked up to a computer and would like to know how I can capture the forward voice channel digital information or control channel digital information [from the cellular datastream]. I prefer not to go the DDI box route, as that thing is very expensive, and it just seems that there must be some other software out there that can do the same thing. Any suggestions? Or, perhaps there is a way to hook the output of the modified Motorola phone into a computer?

Anonymous E-Mail
from New York

This letter was received some time back and answered personally, but not in print. It raises some points that would be good to clarify. First, I encourage everyone to subscribe, and why not order a gift subscription for a buddy while you're at it. One of those holiday gifts that lasts all year, and is a bargain at $19.00. The information required to subscribe is right below the table of contents at the front of the magazine.

In some ways it seems kind of dumb to talk about subscribing to a magazine that you're now holding in your hands, but many people just stumble across a copy in a store, or receive a sample issue. The subject of subscribing has become more important to me since I've checked the advertising rates charged by other electronic and computer magazines for my business. In some ways, I've taken this magazine for granted, never realizing what a valuable resource it is to so many individuals and small companies looking to buy and sell things.

To be honest, I was shocked to discover that a full page ad in Nuts & Volts would cost me about the same as a little dinky one in another national magazine. Since this didn't make sense to me, I asked about this and basically learned that Nuts & Volts is published by a family-owned corporation and not a big publishing conglomerate, and they want to keep their ad rates low enough so that all of us can afford to participate in the virtual electronic swap meet that takes place in the classified ads every month.

Since I'm a staunch advocate of assisting the "little guy" in helping himself, I really appreciate this attitude. As you can probably tell, I get a bit evangelical about having people subscribe and turn on friends to the magazine. Cynics may think that I get on my soap box because I write for the magazine, but the reality is that I can submit my articles to any magazine I like. Nuts & Volts is my "home" because this just happens to be . . . well, a cool neighborhood.

Think about it if you like cellular telephony and read other magazines. Where do you read the low-down on what is really going on in the cellular world, and where do you read nothing but regurgitated press releases from cellular companies? I rest my case, and thus end my impromptu sermon and annual one-man subscription drive. Many neat things are going to happen in 1996, and I'd hate for you to miss any of the action.

Getting back to the second part of the letter, at this point I'm not aware of any existing products that are capable of decoding the data transmitted over cellular data channels other than the digital data interpreter product (marketed as the Cellular Surveillance Interface or "CSI" by a Canadian firm), or the interface that is available for the Oki 900 and related phones. I've tested both products and didn't think either one was very expensive in terms of

capabilities. Perhaps cost is simply relative.

The CSI has become more sophisticated and feature-rich since originally reviewed here quite some time ago. Perhaps we can arrange to take a look at the current iteration of this test device in a future issue.

Next Year

As usual, I have a hard time believing that another year has passed. It's been a busy one, that's for sure. In addition to the standard cellular coverage, there are several things on my plate that I'll be covering in '96. In the review department, we'll be taking a look at two of the latest products from OptoElectronics. I don't mind telling you ahead of time as a scanner hobbyist that the "Scout" is one of the neatest and useful tools I've used besides my scanners themselves. While the Scout looks like a tiny frequency counter, it does what would have taken a small rack of equipment and a computer to accomplish a few years ago.

Letting my inquisitive nature run free, you'll also get to join me as I explore the world of cable television and mysterious government transmitter facilities. We'll finally figure out what a "pan" refers to, and why there seems to be more than one abandoned bomb-proof structure sitting in the middle of very large HF antenna farms in at least two states. Since research on the transmission facilities has been ongoing since July, and involves numerous requests and appeals under the Freedom of Information Act, you'll discover how that whole process works and see exactly how a journalistic investigation proceeds.

We'll also be exploring the resources of the Internet and demonstrating that it is not quite the unfriendly mess that some people believe. The key is to simply get your feet wet. Next thing you know, you're suddenly swimming in data and will wonder how you ever managed to get along without being jacked into the 'net.

If you're already accessing the Internet, in next month's column, we'll explain how you can help GTE Mobilenet solve a security problem. It seems that a phone phreak of some sort has managed to infiltrate a cellular switch. He's leaving behind little notes that are signed "HackerX" and GTE Mobilenet has them online for you to view. According to their site on the World-Wide Web, they'll even reward the person who unravels this mystery.

Enjoy your holidays, and have a safe new year. Oh yeah, if you can't wait until next month to learn more about HackerX and his threats to bring down the phone service in a certain city, you can point your WWW browser at GTE's URL: **NV**

http://wireless-gte.com/gte/hackerx.html

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TECH FORUM

Continued from page 131

extract the gold (or other metals) yourself and from experience learn which components contain the most. Generally, individual ICs don't contain much gold. The most productive sources of gold are circuit card edges, connectors with gold contacts, switches, relays, etc. Any place an electronic connection is made usually contains gold. If you can see the gold, it's worth getting. In 1992, over 53,396 KG (117,738 lbs) of gold was recovered from scrap products. A good source of this kind of information can be found in the *Minerals Yearbook*, published by the US Departmnt of Interior, Bureau of Mines. This is available at most of the larger libraries. The best publication I know that describes how to recover scrap gold is my own book, *Extraction, Recovery and Refining of Gold From Scrap Electronics*, $35.00, P.O. Box 145, Newville, AL 36353. Contact me and I will send you a complimentary copy.

Michael Young
Newville, AL

ANSWER TO #11953 - NOV. 1995

365 pF (approximately) variable capacitors with 1/4" shafts are still sold by Fair Radio Sales, 1016 E. Eureka St., Lima, OH 45802. Call 419-223-2196 for a catalog.

Mike Smith
Florence, AL

ANSWER TO #11957 - NOV. 1995

Yes, there is an adaptor cable capable of converting your "business machine" power cables into extension cords. They are normally used to connect a monitor that does not have a removable cord to the output of a computer's power supply so that both can be switched on by the computer's power switch. They are one foot in length and are available through any number of computer suppliers for about $3.00. Alltronics had these in their last catalog as part number 94W002. Give them a call at 408-943-9773.

Tim Naami
Cary, IL

ANSWER TO #11958 - NOV. 1995

My company carries the M51660L IC you require. They are in stock at $4.89 each. LJ Enterprises, 4353 Summit Bridge Rd., Middletown, DE 19709. Tel 302-378-3334, FAX 302-378-3558.

Lee S. Jacobs
Middletown, DE

ANSWER TO #119511 - NOV. 1995

A wealth of data sheets for RGB/NSTC converter ICs and related products can be found using the Search Engine on the World Wide Web at http://www.analog.com Click over to the Search Engine (http://www.analog.com/adibin/wais_search) and ask for a search on NTSC. The files are in Adobe Acrobat format, a reader for which can be found at most Web sites that use that format.

L. Supremo
Baltimore, MD

ANSWER TO #119513 - NOV. 1995

Oregon Manufacturing Services (address below) has parts, provides service, repair, and sales of re-manufactured equipment from Equatorial. Oregon Manufacturing Services, 1773 Avalon Way, Klamath Falls, OR 97603. 503-882-8464 (V), 503-883-4609 (F).

Warren L. Wilson
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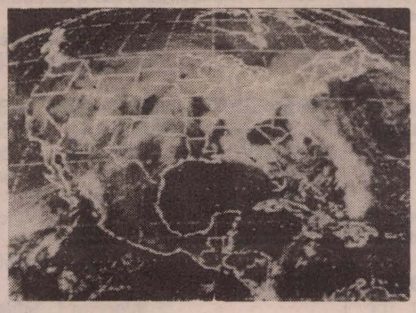

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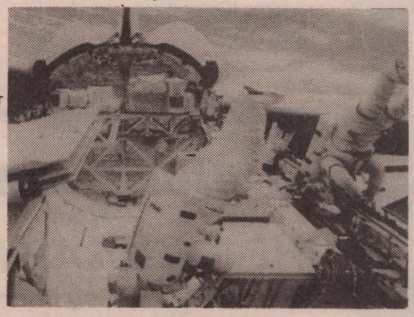

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ANSWER TO #10951 - OCT. 1995

The speaker connection in the original IBM PC came from a 75475 interface driver IC, using a series 33 ohm resistor. See Figure 1.

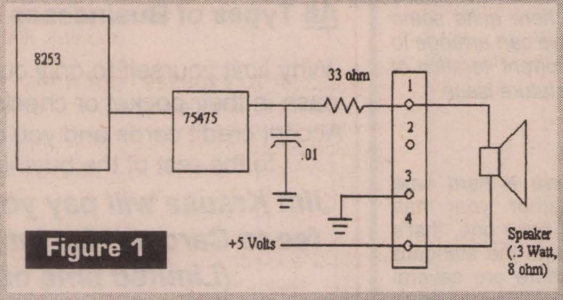

Figure 1

I believe that the 75475 is an open collector-type interface circuit, though I can't find an old enough data book with the data sheet. The rating that is stamped on the speaker currently installed in your PC means it has an impedance near 8 ohms, and can handle up to .3 watts of power. Exceeding the power rating for long periods of time may damage the speaker, and certainly cause terrible distortion! You need not worry about damage, because this circuit can't produce enough power to harm your speaker. Also, since the output wave form is mostly a squarewave, it probably sounds quite distorted compared to a sinewave!

Your desire to replace the speaker with a better one will probably not give much improvement in sound quality or volume. You can replace it with a more efficient speaker for more volume, or you can build a small enclosure (like your stereo system's speakers) to improve efficiency. Lastly, a simple volume control can be made by placing a small potentiometer (variable resistor) in series with the speaker as shown in Figure 2.

Robert Kelly
Poway, CA

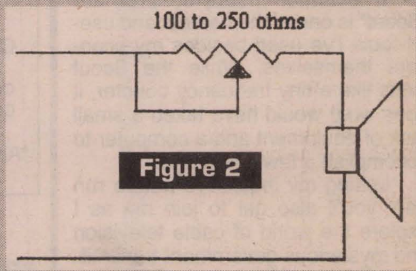

Figure 2

ANSWER TO #109524 - OCT. 1995

On the surface it appears simple to modify a TACs cell phone to operate on the AMPS system. But this is not the case! Let me contrast the two systems and then explain the challenge.

The table above contrasts some fundamental differences in the two systems. Aside from different RF bands of operation, the channel spacing is different, and there are differences in the system level protocol and channel assignments. In a nutshell, changing a phone from one system to another involves replacing many of the RF components and changing the operating software in a Read Only Memory (ROM).

Here are some detailed issues in changing standards on a cellular phone: {It does not represent a complete list, only some of the areas of concern to highlight the complexity of undertaking this project.}

1. Channel spacing is slightly different on the two systems, and probably can be changed by loading the correct binary numbers into the Phase Lock Loop (PLL) frequency synthesizers.

2. The Voltage Controlled Oscillator (VCO) associated with each PLL would also need to be replaced, as they are usually designed to cover the correct frequency band only.

3. Both cellular phone systems are full duplex. This means they receive and transmit at the same time, on two frequencies separated by 45 MHz. Since the same antenna is used for both receive and transmit, there is a special filter network which separates the receive and transmit frequencies. This special filter, called a duplexer, would also need to be replaced.

4. There are other filters in the radios that will need to be replaced. These are usually Surface Acoustic Wave (SAW) devices. You probably have at least one in the transmit path and one in the receive path to replace.

After all of this is accomplished, then you need to change some of the system protocol software. One small help is that most of the chip sets to support cellular supported both standards. Usually there are some initialization values in software that need to be set properly to enable the other standard. Tracking down these registers and knowing the correct values to load is a major task, even if you have all the documentation!

Now you have modified an ETACS radio for the EAMPS standard. There is a very good chance at this point, the set is ruined, because some of the circuitry is very easily damaged. To confirm the phone is still operational, you will need access to some expensive test equipment. Marconi makes a cell phone test set that will confirm that the modifications produced a phone that still meets most of the requirements to function in the existing system.

I hope by this point, you are convinced to go out and buy a low-cost AMPS cellular phone and avoid ruining a good ETACS handset!

Robert Kelly
Poway, CA

	EAMPS (USA)	ETACS (Europe)
Channel Spacing	30 KHz	25 KHz
Mobile Transmit Band	824 MHz - > 849 MHz	872 MHz - > 905 MHz
Mobile Receive Band	869 MHz - > 894 MHz	917 MHz - > 950 MHz

Write In 161 on Reader Service Card.

TECH FORUM

ANSWER #109519 - OCT. 1995

According to the parts guide that I have concerning Compaq systems, all of the 900 series of the Presario computers contain a 185 watt power supply that follows the standard pin out for IBM style compatible PCs. They are as follows:

Connector P1
Pin 1 = Power Good
Pin 2 = +5V
Pin 3 = +12
Pin 4 = –12V
Pin 5 = Ground
Pin 6 = Ground

Connector P2
Pin 1 = Ground
Pin 2 = Ground
Pin 3 = –5V
Pin 4 = +5V
Pin 5 = +5V
Pin 6 = +5V

Marschell D. Ray
Wallkill, NY

ANSWER TO #109526 - OCT. 1995

Almost any defective component within the color circuit can cause the color to fail. An improper or low voltage from the power supply might produce weak or no color. Check voltage and scope, each color pin itself contains chips. If it contains transistors, check each one for leakage or low voltage. Trace the circuit outward making sure each component is properly operating and all connections secure.

Mike Clemente
Eggharbor Township, NJ

ANSWER TO #109514 - OCT. 1995

The switch settings for the serial Okidata Microline 184 turbo are as follows:

Switch Bank 1

sw1: on - odd parity
off - even parity
sw2: on - no parity
off - parity enabled
sw3: on - 8 bit data
off - 7 bit data
sw4: on - ready/busy
off - Xon/Xoff
sw5: on - diagnostic circuit test
off - diagnostic monitor mode
sw6: on - normal print mode
off - diagnostic mode

Busy Line

	DTR–	RTS–	SSD–	SSD+
sw7:	on	on	off	off
sw8:	on	off	on	off

Switch Bank 2

Baud	19.2	9.6	4.8	2.4	1.2	600	300	110
sw1:	on	off	on	off	on	off	on	off
sw2:	on	on	off	off	on	on	off	off
sw3:	on	on	on	on	off	off	off	off

sw4: on - DSR - active
off - DSR - inactive
sw5: on - Buffer threshold - 32 bytes
off - Buffer threshold - 256 bytes
sw6: on - Busy signal timing - 200 ms
off Busy signal timing - 1 sec
sw7: on - DTR high when power on
off - DTR high when selected
sw8: not used (off)

This information can be obtained from Okidata's bulletin board system at 609-234-5344, and you can reach their technical support at 1-800-654-3282.

Michael Young
Newville, AL

reader FeedBack

Continued from page 6

program the non-EEPROM devices.

We recommend the following changes be made to the programmer to increase robustness in programming non-EEPROM PIC microcontrollers.

1) A 10 uF tantalum capacitor should be substituted for component C3.

2) A 14-pin socket with a 0.1 uF decoupling capacitor should be used to hold U3's 74LS06 IC.

3) A ground strap should be connected from the shell of the DB-25 connector to ground of the circuit.

Although the above changes may not be necessary, we have found these changes bring increased reliability when using most PIC and PC combinations.

All kits and packages sold by ITU Technologies since the article's appearance have included the new programming software and the changes noted above with no price changes. Adapters for 28/40 pin DIP packages are also available. If you would like more information or have any questions about these changes please contact ITU Technologies at 513-574-7523 or E-Mail support@itutech.com

Chris B. Sakkas
Cincinnati, OH

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1000s of PBXs are hacked to the tune of about $8 Billion/yr! While our "VOICE MAIL HACKING" (below) details how VMSs are hacked for "phun" and profit - including VMS methods for hacking PBXs themselves - "PBX HACKING" addresses all other Issues relating to PBX hacking, including countermeasures. Can your business or agency afford a $90,000 phone fraud loss (average loss due to hacked PBXs)? As described in Forbes Magazine article. $29.

VOICE MAIL HACKING
How Voice Mail Box (VMB) systems are used and the specific ways they are hacked. Includes ASPEN, MESSAGE CENTER, BIX, GENESIS, RSVP, CENTAGRAM, EZ, AUDIX, SYDNEY, PHONE MAIL, CINDY, SPERRY LINK, etc. An absolute must for all users, sysops and security personnel! $29.

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How answering machines are hacked to listen to - even erase - messages, and to convert them into mini-VMBs. And countermeasures - protect yourself from snoops, stalkers, burglars and pranksters! $29.

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Details on how they work and dozens of effective ways of defeating Caller ID, ANI, *69, *57, Call Blocking and *67. Also describes Caller ID, Orange, Beige, Cheese and CF Boxes, ESS, SS7, E-911, various CLASS services, CNA, NON PUB DA, CAMA, DNR, 800-ECR, Diverters, LD Extenders, Centrex - more. $29.

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Dozen phone color boxes described - many circuits. Plus Call Forwarding, Conferencing, Phreak History, Glossary, Diverters, Extenders, Loops, REMOBS, Bridging Heads & Cans, Optocom, 3rd Party and many other non-box methods - more. $39.

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The most comprehensive, hard-hitting, hi-tech survival book ever written! Topics include electronic, computer, commo, chemistry, energy, weaponry, cryptography, concealment, revenge, alarm, disguise & ID change, etc designs, tactics and strategies to survive an increasingly dangerous and brutal world. Field-expedient use of technology in various threat and conflict environments and scenarios. Comprehensive. $49.

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Events CALENDAR

Continued from page 85

TURES: C - DP - FP. **DEALER INFO:** $35 tables negotiable. **CONTACT:** Five Star Productions, 810-239-3640.

FEBRUARY 24

IN - LAPORTE — Mid-Winter "Cabin Fever" Hamfest. **SPONSOR:** LaPorte ARC. **LOCATION:** LaPorte Civic Auditorium. **HOURS:** 8am-1pm. **TALK-IN:** 146.610, 131.8 PL. **CONTACT:** LaPorte ARC, POB 30, LaPorte IN 46350.

FEBRUARY 24-25

OH - CINCINNATI — ARRL Great Lakes Division 1996. **LOCATION:** Cincinnati Gardens Exhibition Center, 2250 Seymour Ave @ Langdon Farm Rd. **HOURS:** 8:20am-5pm. **ADMISSION:** Adv $6, door $8. **FEATURES:** CB - DP - EX - F - FP. **CONTACT:** Stan Cohen WD8QDQ, 513-531-1011, 2301 Royal Oak Ct, Cincinnati OH 45237.

FEBRUARY 25

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 - DEARBORN — 26th Annual Swap 'N Shop. **SPONSOR:** Livonia ARC. **LOCATION:** Dearborn Civic Center, 15801 Michigan Ave. **HOURS:** 8am-3pm. **ADMISSION:** $5. **TALK-IN:** 145.350, 146.52. **FEATURES:** DP - EX. **DEALER INFO:** Tables $15 + $ adm. **CONTACT:** Neil Coffin WA8GWL, Livonia ARC, POB 2111, Livonia MI 48151, 313-261-5486.

OH - CUYAHOGA FALLS — 42nd Annual Hamfest, Computer Show & Flea Market. **SPONSOR:** Cuyahoga Falls ARC. **LOCATION:** Emidio & Sons, 48 Bath Rd. **ADMISSION:** Adv $4, door $5. **FEATURES:** C - DP - FM - H. **DEALER INFO:** Tables $8, adv only. **CONTACT:** Carl N8JLQ, 216-497-7047.

EASTERN REGION

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:** C - E - FM - FP - F/R - H - RV-S - T. **CONTACT:** Mario N4TSV, 904-245-9514.

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.

NJ - WAYNE — Computer Show. **LOCATION:** William Paterson College, Recreation Center, near I-80, Rte 23 and Rte 46 on Pompton Rd. **HOURS:** 10am-4pm. **FEATURES:** C. **DEALER INFO:** 400+ tables. **CONTACT:**KGP Computer Shows.*

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.*

NH - SALEM — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Rockingham Park Race Track, I-93 Exit 1. **HOURS:** 10am-3:30pm. **ADMISSION:** $7, under 14 free w/adult. **FEATURES:** C. **DEALER INFO:** Set-up 8am. **CONTACT:** Northern 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.*

NJ - EDISON — Computer Show. **LOCATION:** Raritan Center Exposition Hall, NJ Tpke Exit #10. **HOURS:** 9:30am-4pm. **FEATURES:** C. **DEALER INFO:** 1000+ tables. **CONTACT:**KGP 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.*

NH - MANCHESTER — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Center of NH Expo Complex @ Holiday Inn, I-293 Exit 5 or 6. **HOURS:** 10am-3:30pm. **ADMISSION:** $7, under 14 free w/adult. **FEATURES:** C - FP. **DEALER INFO:** Set-up 8am. **CONTACT:** Northern Computer Shows.*

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.*

MA - MARLBOROUGH — Computer Show. **LOCATION:** Royal Plaza Trade Center, take MA Tpke to I-495 N, Exit #24-B. **HOURS:** 10am-4pm. **FEATURES:** C. **DEALER INFO:** 500+ tables. **CONTACT:**KGP 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.*

NY - TROY — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Troy Armory. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

DECEMBER 16-17

KY - LOUISVILLE — Computer Fair South. **SPONSOR:** MEKA Enterprises, Inc. **LOCATION:** Kentucky Army National Guard, 2729 Crittenden Drive. **HOURS:** Sat: 9:30am-4:30pm, Sun: 10am-3pm. **CONTACT:** William Ibarra, Meka Enterprises, 2656 E 2nd St, Bloomington IN 47401. 812-333-4484, FAX: 812-333-4650.

PA - ALLENTOWN — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Allentown Fairgrounds. **HOURS:** 9:30am-4pm. **ADMISSION:** $6. **FEATURES:** C - FP. **CONTACT:** MarketPro 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.*

ME - PORTLAND — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Verrillo's Conv. Ctr. @ Howard Johnson Motor Lodge, I-95 Exit 8. **HOURS:** 10am-3:30pm. **ADMISSION:** $7, under 14 free w/adult. **FEATURES:** C. **DEALER INFO:** Set-up 8am. **CONTACT:** Northern Computer Shows.*

NJ - EAST RUTHERFORD — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Sheraton Meadowlands. **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:** 9:30am-4pm. **ADMISSION:** $6. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

DECEMBER 23

NH - NASHUA — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Sheraton Tara Hotel, Rte 3 Exit 1. **HOURS:** 10am-3:30pm. **ADMISSION:** $7, under 14 free w/adult. **FEATURES:** C. **DEALER INFO:** Set-up 8am. **CONTACT:** Northern Computer Shows.*

DECEMBER 30

MA - TAUNTON — Computer Shows & Sales. **SPONSOR:** Northern Computer Shows. **LOCATION:** Taunton Holiday Inn, Exit 9 off I-495, between Rte 24 & I-95. **HOURS:** 10am-3:30pm. **ADMISSION:** $7, under 14 free w/adult. **FEATURES:** C. **DEALER INFO:** Set-up 8am. **CONTACT:** Northern Computer Shows.*

NJ - WESTFIELD — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Westfield Armory. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

JANUARY 6

MA - WEST SPRINGFIELD — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Eastern States Expostion. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

MD - BALTIMORE — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Martin's West. **HOURS:** 9:30am-4pm. **ADMISSION:** $6. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

PA - NEWTOWN — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Bucks County Community College. **HOURS:** 9:30am-4pm. **ADMISSION:** $6. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

TN - MORRISTOWN — Hamfest & Computer Show. **SPONSOR:** Lakeway ARC. **LOCATION:** Talley Ward Recreation Center. **HOURS:** 8am-3pm. **ADMISSION:** $4. **TALK-IN:** 147.030+. **DEALER INFO:** Tables $7.50. **CONTACT:** Dealers: Perry Hensley KS4QK, 423-828-4848. Gen'l Info: Ken Bowie KC4YDQ, 423-581-1258.

JANUARY 6-7

FL - FORT 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.

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 Shows.*

JANUARY 7

CT - WATERBURY — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Waterbury Sheraton. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

DE - NEWARK — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** University of Delaware. **HOURS:** 9:30am-4pm. **ADMISSION:** $6. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

VA - VIRGINIA BEACH— Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Virginia Beach Pavilion. **HOURS:** 9:30am-4pm. **ADMISSION:** $6. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

JANUARY 13

NJ - SOMERSET — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Garden State Exposition Center. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

NY - MARATHON — ARRL Hamfest. **SPONSOR:** Skyline ARC. **CONTACT:** Barb Mudge KB2TIK, 3364 Rte. 221 W., Marathon NY 13045. 607-849-6751.

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.

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.*

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.

MA - MARLBOROUGH — Computer Show. **LOCATION:** Royal Plaza Trade Center, take MA Tpke to I-495 Exit #24-B. **HOURS:** Sat: 10am-4pm, Sun: 10am-3pm. **FEATURES:** C. **DEALER INFO:** 500+ tables. **CONTACT:**KGP Computer Shows.*

PA - ALLENTOWN — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Allentown Fairgrounds. **HOURS:** 9:30am-4pm. **ADMISSION:** $6. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

JANUARY 14

MD - GREENBELT — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Martin's Crosswinds. **HOURS:** 9:30am-4pm. **ADMISSION:** $6. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

NJ - PARSIPPANY — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Parsippany Hilton. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

VA - HAMPTON — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Hampton Coliseum. **HOURS:** 9:30am-4pm. **ADMISSION:** $6. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

JANUARY 20

VA - RICHMOND — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** The Showplace. **HOURS:** 9:30am-4pm. **ADMISSION:** $6. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

JANUARY 20-21

NJ - HACKENSACK — Computer Show. **LOCATION:** FDU/Rothman Center, near Geo. Wash. Bridge to NYC, Rte 4 to Hackensack Ave South, left on Temple Ave. **HOURS:** Sat: 10am-4pm, Sun: 10am-4pm. **FEATURES:** C. **DEALER INFO:** 600+

Events CALENDAR

tables. **CONTACT:**KGP Computer Shows.*

NY - STONY BROOK — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** SUNY Stony Brook. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

PA - KING OF PRUSSIA — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Valley Forge Convention Center. **HOURS:** 9:30am-4pm. **ADMISSION:** $6. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

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

AL - GREENVILLE — Hamfest '96. **SPONSOR:** Butler County & Pike County RACES. **LOCATION:** Butler County Fairgrounds. **HOURS:** 8am-3pm. **ADMISSION:** $2. **TALK-IN:** 146.07-.67. **FEATURES:** F/R. **DEALER INFO:** Tables $10, tailgate space $5, set-up Fri 4pm-8pm & Sat 6:30am. **CONTACT:** Randolph Walters KW4B, 334-382-3496 between 2pm-6pm.

FL - FORT LAUDERDALE — Narisaam Computer Fair. **LOCATION:** Holiday Inn-West, 5100 N State Road 7. **HOURS:** 10am-4pm. **ADMISSION:** $5, $4 with this ad, under 12 free. **FEATURES:** AC - C -FP. **CONTACT:** Fred Ahmadi, Narisaam Computer Shows.*

NY - WHITE PLAINS — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Westchester County Center. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

TN - GALLATIN — Hamfest/Computer Show. **SPONSOR:** Tennessee Valley ARN. **LOCATION:** Civic Center, off Hwy 31E on N side of town. **HOURS:** 8am-4pm. **ADMISSION:** $5, XYLs & under 16 free. **FEATURES:** EX. **DEALER INFO:** Tables $10, set-up Fri 4pm-9pm, Sat 5am-8am. **CONTACT:** Gen'l Info: Bill Ferrell, 1032 Hidden Woods Tr, Gallatin TN 37066, 615-452-7246. VE Exams: Ronnie Gilley, 510 Hillside Dr, Gallatin TN 37066.

JANUARY 27-28

MD - GAITHERSBURG— Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Montgomery County Fairgrounds. **HOURS:** 9:30am-4pm. **ADMISSION:** $6. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

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.

PA - MONROEVILLE — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Pittsburgh Expo Mart. **HOURS:** 9:30am-4pm. **ADMISSION:** $6. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

JANUARY 28

FL - WEST PALM BEACH — Narisaam Computer Fair. **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.*

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.

NY - POUGHKEEPSIE — Computer Show & Sale. **SPONSOR:** MarketPro. **LOCATION:** Mid-Hudson Civic Center. **HOURS:** 9:30am-4pm. **ADMISSION:** $6, under 12 free w/adult. **FEATURES:** C - FP. **CONTACT:** MarketPro Computer Shows.*

FEBRUARY 3

TN - KNOXVILLE — Kerbela Hamfest. **SPONSOR:** The Shriners of Kerbela AR Service. **LOCATION:** Kerbela Shrine Temple. **HOURS:** 8am-4pm. **ADMISSION:** $4. **TALK-IN:** 144.83/145.43. **FEATURES:** EX - T. **DEALER INFO:** Tables $8 + admission, tailgate space $3 + adm. Set-up Fri 4pm-9pm, Sat 5am-8am. **CONTACT:** Paul Baird KY4A, 1500 Coulter Shoals Cir, Lenoir City TN 37772. 423-986-9562. FCC Exams: Ray Adams N4BAQ, 423-688-7771.

FEBRUARY 3-4

FL - MIAMI — 36th Tropical Hamboree. **SPONSOR:** Dade Radio Club of Miami. **LOCATION:** Dade County Youth Fair & Exposition Center, SW 112 Ave & Coral Way (SW 24 St). **ADMISSION:** Adv $5, door $7. **TALK-IN:** 146.925. **FEATURES:** Swap tables: $25, elec $10 per user. **CONTACT:** Evelyn Gauzens W4WYR, 2780 NW 3 St, Miami FL 33125-5059, 305-642-4139.

FEBRUARY 10

FL - PENSACOLA — ARRL Hamfest. **SPONSOR:** Pensacola Area Hamfest Association. **CONTACT:** Bill Behrends WA4YRN, 1050 W Carlton Rd, Pensacola FL 32534-1130. 904-476-8537.

SC - CHARLESTON — 23rd Annual Charleston Hamfest & Computer Show. **SPONSOR:** Charleston ARS. **LOCATION:** Stall High School. **HOURS:** 8:30am-4pm. **ADMISSION:** $5, under 12 free. **FEATURES:** C - DP - EX - F/R - H - T. **DEALER INFO:** Tables $8, set-up Fri after 5pm. **CONTACT:** Jenny Myers WA4NGV, 2630 Dellwood Ave, Charleston SC 29405-6814, 803-747-2324.

FEBRUARY 10-11

MA - WILMINGTON — Computer Show. **LOCATION:** Shriner's, N of Boston at I-93, Exit #39. **HOURS:** Sat: 10am-4pm, Sun: 10am-3pm. **FEATURES:** C. **DEALER INFO:** 500+ tables. **CONTACT:**KGP Computer Shows.*

FEBRUARY 11

PA - LATROBE — Winterfest. **SPONSOR:** Chestnut Ridge ARC. **LOCATION:** Latrobe American Legion, 1811 Ligonier St. **HOURS:** 8am-3pm. **ADMISSION:** $2. **TALK-IN:** 145.150-. **FEATURES:** DP - F/R. **DEALER INFO:** Tables $10. **CONTACT:** CRARC, POB 175, Loyalhanna PA 15661-0175. Chris Weiss, 412-537-6068.

FEBRUARY 16-17-18

FL - ORLANDO — Florida State Convention. **CONTACT:** John Lenkerd W4DNU, 1046 Turner Rd, Winter Park FL 32789. 407-645-2026.

FEBRUARY 17-18-19

NJ - EDISON — Computer Show. **LOCATION:** Raritan Center Exposition Hall (NJ Convention Center), NJ Tpke Exit #10. **HOURS:** Sat: 9:30am-4pm, Sun & Mon: 10am-4pm. **FEATURES:** C. **DEALER INFO:** 500+ tables. **CONTACT:**KGP Computer Shows.*

FEBRUARY 18

NC - ELKIN — ARRL Hamfest. **SPONSOR:** Briarpatch & Foothills ARCs. **CONTACT:** Dave Nicholson N4VMB, PO Box 162, Cana VA 24317-0317. 703-755-4669.

EVENTS CALENDAR Month at a Glance

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/Hamfest
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
NJ - Wayne - KGP Computer Show*

DECEMBER 2-3

GA - Atlanta - MarketPro Computer Show*
VA - Chantilly - MarketPro Computer Show*

DECEMBER 3

CA - Fresno - MarketPro Computer Show*
CA - Livermore - Swap Meet
CA - San Diego - MarketPro Computer Show*
IN - Greenfield - 11th Annual Hamfest
MA - Fitchburg - MarketPro Computer Show*
MI - Flint - Computers & You Computer Show
MI - Hazel Park - 30th Annual Swap & Shop
NH - Salem - Northern Computer Show*

DECEMBER 3-4-5-6

CA - San Fransisco - Software National Conference

DECEMBER 9

CA - Fontana - Amateur Radio/Elect. Swap Meet
FL - Lake City - Tailgate/Hamfest
IN - Indianapolis - AGI Computer Fair*
MD - Towson - MarketPro Computer Show*
MI - Jackson - Computers & You Computer Show
NJ - Edison - KGP Computer Show*
SC - Union - Swap-fest

DECEMBER 9-10

CA - Sacramento - MarketPro Computer Show*
CA - Ventura - MarketPro Computer Show*
GA - Perry - Middle Georgia Computer Show
PA - King of Prussia - MarketPro Computer Show*

DECEMBER 10

CA - Santa Rosa - MarketPro Computer Show*
IL - Des Plaines - Computer Show & Sale
MD - Baltimore - MarketPro Computer Show*
MI - Madison Heights - Computers & You Show
NH - Manchester - Northern Computer Show*
NY - Stony Brook - MarketPro Computer Show*

DECEMBER 16

CA - Bakersfield - MarketPro Computer Show*
CA - Santee - Ham/Computer/Electronic Swap Meet
FL - Fort Lauderdale - Narisaam Computer Show*
MA - Marlborough - KGP Computer Show*
MD - Upper Marlboro - MarketPro Computer Show*
MI - Farmington Hills - Computers & You Show
MI - Westland - Great Lakes Computer Expo & Sale
NY - Troy - MarketPro Computer Show*

DECEMBER 16-17

CA - Vallejo - MarketPro Computer Show*
KY - Louisville - Computer Fair South
PA - Allentown - MarketPro Computer Show*
PA - Monroeville - MarketPro Computer Show*

DECEMBER 17

CA - Lancaster - MarketPro Computer Show*
FL - West Palm Beach - Narisaam Computer Show*
IL - Orland Park - Orland Park Computer Show
ME - Portland - Northern Computer Show*
MI - Dearborn - Computers & You Computer Show
MI - Flint - Five Star Productions Computer Show
NJ - East Rutherford - MarketPro Computer Show*
VA - Annandale - MarketPro Computer Show*

DECEMBER 23

CA - Stockton - MarketPro Computer Show*
MD - Gaithersburg - MarketPro Computer Show*
MI - Flint - Five Star Production Computer Show
NH - Nashua - Northern Computer Show*
PA - Lebanon - MarketPro Computer Show*

DECEMBER 26

MD - Gaithersburg - MarketPro Computer Show*

DECEMBER 30

MA - Tauton - Northern Computer Show*
NJ - Westfield - MarketPro Computer Show*
PA - Wilkes Barre - MarketPro Computer Show*

JANUARY 1996

JANUARY 6

CA - Santee - Ham/Computer/Electronic Swapmeet
MA - West Springfield - MarketPro Computer Show*
MD - Maryland - MarketPro Computer Show*
OH - Cincinnati - MarketPro Computer Show*
PA - Newtown - MarketPro Computer Show*
TN - Morristown - Hamfest & Computer Show

JANUARY 6-7

CA - San Diego - MarketPro Computer Show*
FL - Ft Meyers - Southwest Florida Hamfest
MI - Detroit - Computer & Hi Tech Electronic Show
NJ - Pennsauken - KGP Computer Show*

JANUARY 7

CA - Lancaster - MarketPro Computer Show*
CA - Livermore - Swapmeet
CT - Waterbury - MarketPro Computer Show*
DE - Newark - MarketPro Computer Show*
IN - South Bend - 19th Annual Hamfest
OH - Cincinnati - MarketPro Computer Show*
VA - Virginia Beach - MarketPro Computer Show*

JANUARY 13

AZ - Phoenix - WestFest
CA - Fontana - Amateur Radio/Electronics Swapmeet
CA - Sacramento - MarketPro Computer Show*
CO - Loveland - Winter Superfest
NJ - Somerset - MarketPro Computer Show*
NY - Marathon - ARRL Hamfest
PA - Allentown - MarketPro Computer Show*
PA - Harrisburg - Hamfest
VA - Annandale - MarketPro Computer Show*

JANUARY 13-14

FL - Sarasota - Annual Hamfest & Computer Show
MA - Marlborough - KGP Computer Show*

JANUARY 14

CA - Oxnard - MarketPro Computer Show*
CA - Santa Rosa - MarketPro Computer Show*
IL - Des Plaines - Computer Show & Sale
IN - Ft Wayne - MarketPro Computer Show*
MD - Greenbelt - MarketPro Computer Show*
NJ - Parsippany - MarketPro Computer Show*
OH - Dover - Hamfest
PA - Allentown - MarketPro Computer Show*
VA - Hampton - MarketPro Computer Show*
WI - Waukesha - 24th Annual Midwinter Swapfest

JANUARY 20

CA - Bakersfield - MarketPro Computer Show*
CA - Santee - Ham/Computer/Electronic Swapmeet
LA - Springfield - Hammond Hamfest
MI - Flint - 4th Annual Swap & Shop
MO - St Joseph - Winter Hamfest
OH - Dayton - MarketPro Computer Show*
PA - King of Prussia - MarketPro Computer Show*
VA - Richmond - MarketPro Computer Show*

JANUARY 20-21

CA - Vallejo - MarketPro Computer Show*
NJ - Hackensack - KGP Computer Show*
NY - Stony Brook - MarketPro Computer Show*
OH - Dayton - Computer Fair

JANUARY 21

IL - Glen Ellyn - Computer Central Computer Show
NY - Yonkers - Giant Electronic Swapmeet
OH - Columbus - MarketPro Computer Show*
OH - Nelsonville - ARRL Hamfest
PA - King of Prussia - MarketPro Computer Show*

JANUARY 27

AL - Greenville - Hamfest '96
FL - Ft Lauderdale - Narisaam Computer Show*
IN - Indianapolis - AGI Computer Fair*
MD - Gaithersburg - MarketPro Computer Show*
NY - White Plains - MarketPro Computer Show*
PA - Monroeville - MarketPro Computer Show*
TN - Gallatin - Hamfest/Computer Show

JANUARY 27-28

CA - Sacramento - MarketPro Computer Show*
CA - Ventura - MarketPro Computer Show*

JANUARY 28

CA - Santa Ana - ACP Swapmeet
FL - West Palm Beach - Narisaam Computer Show*
IL - Villa Park - ARRL Hamfest
MD - Gaithersburg - MarketPro Computer Show*
MD - Odenton - Post Holiday Swapfest & Flea Market
MI - Midland - Five Star Computer Show
NY - Poughkeepsie - MarketPro Computer Show*
PA - Monroeville - MarketPro Computer Show*

JANUARY 30-31-FEBRUARY 1

CA - Santa Clara - SoftExpo '96

FEBRUARY 1996

FEBRUARY 3

CA - Santee - Ham/Computer/Electronic Swapmeet
TN - Knoxville - Kerbela Hamfest

FEBRUARY 3-4

FL - Miami - 36th Tropical Hamboree

FEBRUARY 4

CA - Livermore - Swapmeet

FEBRUARY 10

CA - Fontana - Amateur Radio/Electronics Swapmeet
FL - Pensacola - ARRL Hamfest
MN - Blaine - Midwinter Madness
SC - Charleston - Hamfest & Computer Show

FEBRUARY 10-11

MA - Wilmington - KGP Computer Show*

FEBRUARY 11

IL - Des Plaines - Computer Show & Sale
OH - Mansfield - Mid-Winter Hamfest/Computer Show
PA - Latrobe - Winterfest

FEBRUARY 16-17-18

FL - Orlando - ARRL State Convention

FEBRUARY 17

AZ - Tucson - Fest West '96
CA - Santee - Ham/Computer/Electronic Swapmeet
IN - Indianapolis - AGI Computer Fair*
OR - Rickreal - ARRL Hamfest
TX - Smithville - ARRL Hamfest

FEBRUARY 17-18-19

NJ - Edison - KGP Computer Show*

FEBRUARY 18

IL - Rock Island - 25th Annual Davenport Hamfest
MI - Flint - Five Star Computer Show
NC - Elkin - ARRL Hamfest

FEBRUARY 24

CA - Monterey - ARRL Hamfest
FL - Brooksville - ARRL Hamfest
IN - LaPorte - Mid-Winter "Cabin Fever" Hamfest

FEBRUARY 24 - 25

OH - Cincinnati - ARRL Great Lakes Division 1996

FEBRUARY 25

IL - Glen Ellyn - Computer Central Computer Show
MI - Dearborn - 26th Annual Swap N Shop
OH - Cuyahoga Falls - Ham/Computer/Flea Market

See Computer Show Promoter Info Box

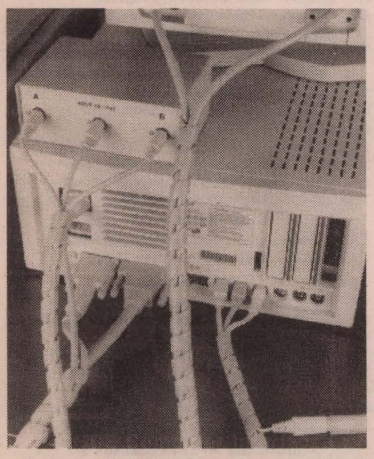
ties range from sizing equipment for uninterruptible power supplies, to troubleshooting problems related to excessive peak currents or voltages, to measuring values for engineering purposes.

The peak VIP power meter is priced at $947.00.

For more information, contact:

ELECTRONIC PRODUCT DESIGN, INC.
6963 BLUEBELLE WAY, DEPT. NV
SPRINGFIELD, OR 97478
1-800-616-5521

SPIRALLY CUT CABLE WRAP



A line of spirally cut wrap that applies like tape to neatly bundle computer cabling, especially in open offices where they would otherwise be messy and exposed, is introduced by M.M. Newman Corporation.

Heli-Tube® spirally cut cable wrap applies like tape, without tools, to neatly bundle and organize all of the different cables at computer workstations. Allowing routing in any direction, the cables can be easily re-routed when a new peripheral is added.

Available in a variety of colors to complement any decor, and sizes from 1/8" to 1" OD for bundling many different cables, Heli-Tube spirally cut cable wrap is extruded from polyethylene.

Heli-Tube spirally cut cable wrap sells for $3.95 in 1/2" OD size by 10 ft. long and comes in a poly-bag with a header card. Private labeling and bulk packaging are available (distributor and dealer inquiries are invited).

For more information, contact:

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

CODEBOY

Radio Adventures Corp. announces the immediate availability of the CodeBoy model A1 advanced CMOS electronic keyer. The CodeBoy features a speed range of 10 to 40 wpm, calibrated speed control, Iambic A or B style operation, space and weight compensation, paddle and straight key or bug input, autospace on straight key or bug, debouncing of key inputs, and MOSFET keying transistor output.

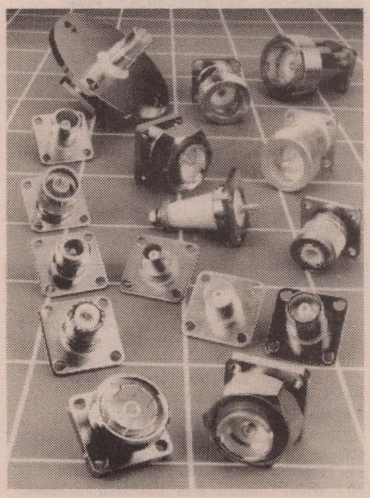
The CodeBoy is powered by a built-in battery and is based on the company's C1 Iambic keyer/controller chip. It is housed in an all aluminum case painted dark brown and eggshell white. Case dimensions are 1-3/16H x 3-1/8W x 2-7/8D and the completed unit weighs 3 1/2 oz.

In addition to the complete kit which includes the battery, available under stock number A1K for $37.95, a wired and tested unit is available as stock number A1W for $54.95, and a printed circuit board kit without the case is available as stock number BK-167 for $24.95. Shipping is $3.75 extra.

For more information, contact:

RADIO ADVENTURES CORP.
MAIN ST., P.O. BOX 339, DEPT. NV
SENECA, PA 16346
814-677-7221 FAX: 814-677-6456
E-MAIL: rac@usa.net

WATTMETER RF CONNECTORS



An expanded line of quick-change RF connectors that are direct replacements for Bird, Coaxial Dynamics, and other multipower level wattmeter manufacturers is being introduced by Tru-Connector Corporation.

Tru-Connector's quick-change wattmeter RF connectors include the following types: European 7/16, BNC, C, HN, LC, LC-HV,LC-HV POL, LC-large, LT, N, QDS, SC, SMA, TNC, UHF, Mini-UHF, GR-874, 7/8", 1-5/8" EIA, and open terminal. Available from stock in male and female styles, they can be modified to customer specifications.

Developed for use with high-power testing and monitoring equipment, Tru-Connector's quick-change wattmeter RF connectors are constructed with a nickel-plated brass body, beryllium-copper center conductors, silver-plated contacts, and Teflon® insulators. Adapter blocks and complete DC cable assemblies can be provided.

Tru-Connector's quick-change wattmeter RF connectors are priced according to type, style, and quantity.

For more information, contact:

TRU-CONNECTOR CORP.
245 LYNNFIELD ST., DEPT. NV
PEABODY, MA 01960
508-532-0775 FAX: 508-531-6993

MFJ-66 DIP METER ADAPTER

Now, with the purchase of the MFJ-66 dip meter adapter, priced at $19.95, you can turn your MFJ SWR analyzer into a sensitive and accurate bandswitch dip meter; just by plugging in a dip meter coupling coil!

With the MFJ-66, you'll be able to determine resonant frequencies of tuned circuits and measure the Q of coils.

Two coils will cover 1.8-170 MHz, depending on your MFJ SWR analyzer. The MFJ-66 dip meter adapter comes with MFJ's full one-year unconditional guarantee.

For more information, contact:

MFJ ENTERPRISES, INC.
P.O. BOX 494, DEPT. NV
MISSISSIPPI STATE, MS 39762
601-323-5869 FAX: 601-323-6551
1-800-647-1800

TCL AND TK POCKET REFERENCES

Specialized Systems Consultants, Inc. (SSC), announces the publication of the Tcl Pocket Reference and the Tk Pocket Reference. Tcl (Tool command language) is an embeddable, extensible scripting language. Tk is a toolkit for the X Window System.

When Tcl and Tk are used together, the Tcl/Tk programming system can be used to rapidly build X front-ends to applications.

Sections of the Tk card focus on the wm command (to communicate with the window manager); images, buttons, menus, containers, interaction, bind, options, geometry, canvas, actions, text, winfo, and information.

The Tcl Pocket Reference covers substitution, control and evaluation, procedures, variables, list manipulation, regular expressions, formatting, file manipulation, interpreter state, and string commands.

The Tcl and Tk Reference are sold individually for $3.00 each or together as a package for $4.50.

For more information, contact:

SPECIALIZED SYSTEMS CONSULTANTS, INC.
P.O. BOX 55549, DEPT. NV
SEATTLE, WA 98155-0549
206-782-7733 FAX: 206-782-7191
E-MAIL: sales@ssc.com
WEB: http://www.ssc.com/

DIGITAL MULTISYSTEM VIDEO CONVERTER

Ten-Lab's newest product, the TR-10, is a digital multisystem video converter that accommodates inputs standards of NTSC, PAL and SECAM and converts to NTSC or PAL outputs.

Featuring a built-in TBC (Time Base Corrector), advance digital line and field video processor/converter, 2 megabyte field memory, automatic gain control (AGC), and auto detecting system mode. The TR-10 delivers high-quality pictures comparable with professional and broadcast equipment several times more expensive.

The built-in TBC assures excellent signal synchronization, ideal for people who have any PAL or SECAM video source, as a PAL satellite signal, PAL camcorder, PAL VCR, etc., and need to playback on a regular US TV set. The auto detect mode makes set-up and operation of the unit very easy.

Used in conjunction with a PAL player-recorder enables playback of foreign tapes on a regular US monitor, copy of PAL tapes into NTSC, or dubbing of US tapes into PAL (to be sent abroad).

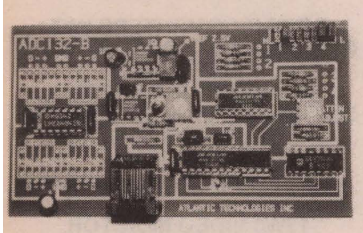
Ten-Lab also offers a wide line of special video products with unique features, such as a 61" big screen TV worldwide compatible and several TVs and VCRs with multisystem capabilities. Special

units are made upon request.

For more information, contact:

TEN-LAB
2217 MALCOLM AVE., DEPT. NV
LOS ANGELES, CA 90064
310-474-6909 FAX: 310-441-1807

THE OCTA-PORT SYSTEM



The Octa-Port system allows eight different I/O boards to be controlled from a PC, DSP, or microcontroller. The available boards include an 18-bit A/D converter, an opto-isolated relay system, digital input and output boards, etc. Most boards are priced at less than $100.00.

A unique feature of the system is that digital modules, as well as analog modules can be operated as watch-dog comparators to immediately signal the host computer of any problems, thereby eliminating the need to continuously poll these functions.

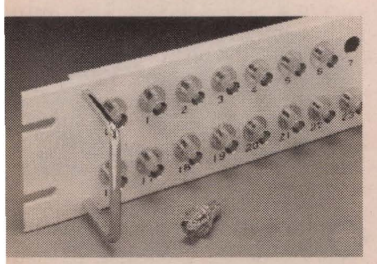
The Octa-Port boards can be located 50 feet from the host computer. Communication is conducted through LAN cables by means of a synchronous serial protocol common to most DSPs. Source code for DOS and WINDOWS software programs are provided. Even portable PCs can be used at remote locations.

Several of the boards contain differential amplifiers for translating sensor signals. Consequently, the Octa-Port system is ideally suited to custom and educational applications, as well as to standard industrial applications.

For more information, contact:

ATLANTIC TECHNOLOGIES, INC.
P.O. BOX 26, DEPT. NV
NEWTOWN SQUARE, PA 19073
610-356-1070

SELF-TERMINATING BNC COUPLERS



Rack panels are now available from L-com equipped with unique couplers that automatically terminate to ground when the coaxial cable is disconnected. Use of line terminators are highly recommended to maintain constant impedance on an active line.

Self-terminating couplers eliminate the nuisance factor associated with using discrete terminators. The individual couplers have a 75-ohm impedance, and are available at only $6.95. They fit into a standard 0.5" diameter hole and are easy to install in pre-punched panels. L-com also provides the completed 19" rack assemblies equipped with choice of 16 or 32 couplers, priced at $131.50 (16) and $268.00 (32).

For further technical details, contact:

L-COM, INC.
1755 OSGOOD ST., DEPT. NV
NORTH ANDOVER, MA 01845
508-682-6936 FAX: 508-689-9484
1-800-343-1455

HYPERLINK 24

HyperLink 24's multiple user-selectable channels can be used to increase the aggregate throughput of 2 megabit per second wireless LANs to as high as 10 megabits per second. By segmenting the wireless network into as many as five independent 2 megabit per second channels at 2.4 GHz, HyperLink 24 achieves five times the usable bandwidth and significantly reduces packet "collisions" which are typically associated with CSMA/CA LANs.

HyperLink 24 allows existing 900 MHz wireless Ethernet equipment to operate at 2.4 GHz. Consisting of a frequency "upconverter," a "downconverter," and a high-speed switching circuit, HyperLink 24 can operate with just about any 900 MHz wireless Ethernet card on the market.

Eliminate signal losses typically associated with high-frequency wireless systems. Even the finest antenna cable is "lossy" at 2.4 GHz. HyperLinks 24's remote mounted design permits the use of low-cost cable and connectors since only the lower frequency 900 MHz signals travel through the antenna cable. And since HyperLink 24 contains integral transmit and receive amplification, maximum signal strength is maintained regardless of cable length.

HyperLink 24 is ideal for: multipoint building-to-building LANs and MANs, spread spectrum serial data modems, multi-frequency wireless LAN repeaters, and military communications projects.

Standard US and European models available with power levels from 100 MW to 1 watt.

Custom military and export frequencies and high power models available.

For more information, contact:

HYPERLINK
TECHNOLOGIES, INC.
6600 WEST ROGERS CIR., STE. 6
DEPT. NV
BOCA RATON, FL 33487
407-995-2256 FAX: 407-995-2432

SCOUT REACTION TUNE

Optoelectronics announces that the Scout™ will now Reaction Tune™ and Memory Tune™ the following receivers: ICOM R7000, R7100 and R9000, AOR AR2700 and AR8000, and the Radio Shack models Pro-2005/2006 (equipped with an OS456) and the Pro-2035 (equipped with the new OS535).

The Scout performs the patented reaction tune when in "capture" mode and connected to any of the above receivers with a mono cable. When the Scout captures a frequency it automatically tunes the receiver for monitoring. For memory tuning, a recorded frequency may also be recalled from any one of the 400 memories in the Scout to tune the receiver.

With a frequency range of 10 MHz to 1.4 GHz, the Scout distinguishes itself from a frequency counter by being able to differentiate between random noise and coherent RF transmissions. These features are called digital filter and auto capture. An embedded microprocessor evaluates each measurement to determine when an actual RF frequency is dominant. This is the digital signal processing which makes auto capture and recording possible.

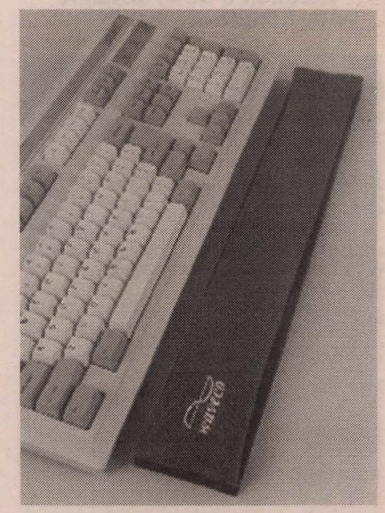
The Scout is a single range operating counter. A distinctive double beep informs you that a new frequency has been recorded, and a single beep indicates an already stored frequency has been hit again. The Scout is also equipped with a pager style vibrator to inform you when a frequency has been recorded. When in "recall" mode, you can scroll through and view all of your 400 frequencies and hits stored in memory.

The Scout's powerhouse performance continues on throughout the day and night with its equipped 10 hour discharge rapid charge NiCads, but when you go to sleep so does the Scout. The "sleep" mode allows the data in the Scout to be saved into its non-volatile memory. The Scout also features a custom 10 digit LCD display, as well as an (EL) backlight for night operation. A 16-segment signal strength bargraph is built-in to the LCD display, providing an indication of RF signal strength. The suggested list price of the Scout is $449.00.

For additional information, contact:

OPTOELECTRONICS
5821 N.E. 14TH AVE., DEPT. NV
FT. LAUDERDALE, FL 33334
305-771-2050 FAX: 305-771-2052

WATERBED FOR YOUR WRISTS



To address the growing concern of keyboard ergonomics, Waveco has invented a revolutionary new type of wrist rest that utilizes a gel to provide the most comfortable, non-fatiguing support for the wrists. The device, named the Waterbed For Your Wrists, has been approved for patent rights.

The gel filled Waterbed For Your Wrists addresses several key ergonomic factors. First, the gel-filled cushion provides improved comfort for the wrists of keyboard operators thereby reducing pain and fatigue. Second, the wrists are supported at a height that allows use of the device while typing. Many conventional wrist rests are used only as a resting platform during periods of inactivity between keyboard oper-

ations. Third, since the gel conforms precisely to the contour of the wrists and palms, perfect contact is maintained with the wrist rest regardless of the orientation of the users arms and hands. This prevents the wrist from ever contacting a "corner," which can result in pressure lines across the underside of the wrists.

Fluids and gels have vibration and shock absorbing properties used in numerous industrial applications. Vibration has been shown to be an important risk factor for Carpal Tunnel Syndrome according to the Centers For Disease Control.

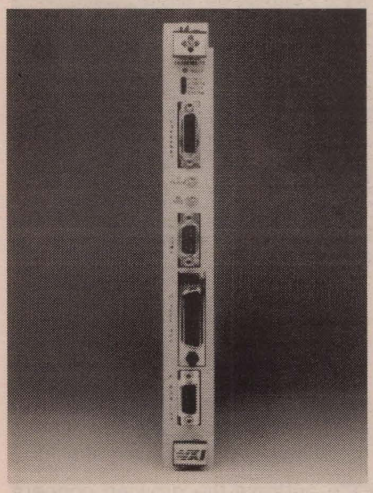
The Waterbed For Your Wrists can also be refrigerated to provide cold therapy for aching wrists. To top it off, the Waterbed For Your Wrists has a removable, machine washable fabric cover. This feature not only keeps the wrist clean and odor free, but also allows the user to replace covers if permanently stained or damaged.

The price is $19.75 plus shipping and handing.

For more information, contact:

WAVECO
P.O. BOX 1331, DEPT. NV
PALMETTO, FL 34220
813-723-2229

VXI SLOT 0 CONTROLLER WITH ETHERNET INTERFACE



ICS Electronics announces a new VXI Slot 0 controller and embedded computer with the capability to control VXI systems over a network. The new model VXI-5543E features an Ethernet interface and firmware for direct connection to an Ethernet network using TCP/IP or VXI-11 protocols. The VXI-5543E provides an alternative means for intelligent control of remote VXI chassis via a network.

The VXI-5543E is a complete embedded AT style computer with software that allows it to operate in a variety of configurations. At power turn-on, the VXI-5543E runs its resource manager program and then is ready to execute commands received via its Ethernet, GPIB, or serial ports. Alternately, the VXI-5543E can execute programs stored on its solid-state drive or download programs from a remote host computer. Test data can be sent back to the remote host via the network connection.

The VXI-5543E's Ethernet interface is a standard IEEE-802.3 compatible 15-pin AUI connector with extra 10Base-T signals. External transceivers can be used to adapt the VXI-5543E to a 10Base2 coaxial system. The VXI-5543E includes a LAN control program that allows it to execute commands received from the network and drivers for operation with TCP/IP, ODI, and NDIS network protocols. The LAN control program operates with VXI-5 compatible commands and the new VXI-11 specification for VXI TCP/IP instrument protocol.

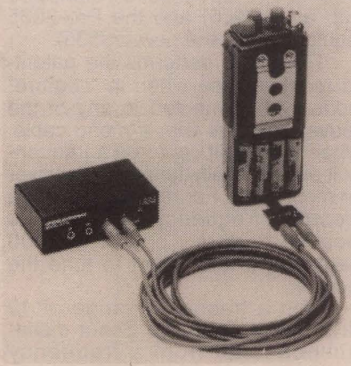
The VXI-5543E is a single slot wide, C-size module that has been optimized for remote control of VXI, GPIB, and serial instruments. Its rugged construction and solid-state drive allow it to be used in portable applications and other harsh environments. Uses include running factory test systems, remote test sites, and portable data acquisition systems. Its Ethernet interface provides a high-speed data link to the remote host over an IEEE 802.3 compatible network.

The VXI-5543E is available with 1 or 2 Mbytes of disk storage and includes the LAN control program and network drivers. Pricing starts at $3,660.00 each.

For more information, contact:

ICS ELECTRONICS CORP.
473 LOS COCHES ST., DEPT. NV
MILPITAS, CA 95035-5422
408-263-5500 FAX: 408-263-5896

COMPUTER CONTROL INTERFACE



Optoelectronics announces the CX12AR Computer Control Interface for the AOR AR8000, and CI-V receivers (Icom R7000 and R7100). The CX12AR not only allows CI-V to RS-232C conversion, but it provides complete interfacing for computer control of the Icom R7000 and R7100, which Icom's CT17 will not.

The CX12AR is the only converter with two operating modes, which are switch selectable between full duplex and half duplex. The dedicated squelch status input is wired for high-speed scanning and a software controlled tape recorder control output is also provided on the unit.

The CX12AR converts TTL serial interface signal levels compatible with most personal computers, while allowing up to four different Optoelectronics devices equipped with serial ports to be connected to one computer port in a star network configuration.

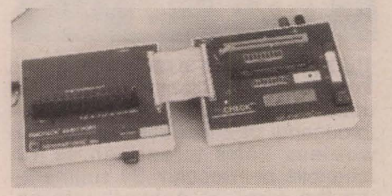
The CX12AR can be used to download memory from the Scout to a PC. After downloading those frequencies, check them against the Spectrum CD-ROM FCC database (optional). Switched in RS-232 mode, the CX12AR can be used as a datalogging device for the popular M1 frequency counter. The CX12AR also has a software controlled tape recorder output.

Scanstar software is compatible for use with the OptoScan456/535, Icom R7000 computer control, and the AOR 8000. A demo version of Scanstar is included with all CX12AR purchases. The suggested retail price of the CX12AR is $99.00.

For additional information, contact:

OPTOELECTRONICS
5821 N.E. 14TH AVE., DEPT. NV
FT. LAUDERDALE, FL 33334
305-771-2050 FAX: 305-771-2052

SIMCHECK PLUS



Aristo Computers Inc., announces a new memory test equipment package — Simcheck Plus.

Simcheck Plus combines Simcheck and the 40-bit port adapter in a single packaged deal, providing more test power at a reduced cost. Together, they provide a total testing solution for both 30-pin and 72-pin SIMMs. The package also includes the universal power supply, which now can be plugged directly into Simcheck or into the 40-bit port.

Simcheck Plus is available now and retails for $1,490.00 compared to the separate component's price of $1,790.00, a savings of $300.00!

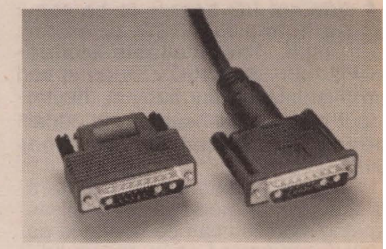
The basic Simcheck tests all standard SIMM and SIP memory modules with eight or nine bits of 64K, 256K, 1M, 4M, and 16M memory. The Simcheck 40-bit port enhances Simcheck's capabilities to test 72-pin SIMM modules that have a data bus with up to 40 bits and with a maximum capacity of 128 megabytes.

In addition to the Simcheck Plus's testing capability, the Simcheck line of optional adapters offers complete coverage for testing of DRAM memory chips, as well as many non-standard SIMM and SIP modules. All products come with a 30-day money back guarantee and a one-year warranty.

For more information, contact:

ARISTO COMPUTERS INC.
6700 S.W. 105TH AVE., STE. 300
DEPT. NV
BEAVERTON, OR 97008
503-626-6333 FAX: 503-626-6492
1-800-3ARISTO

13W3 VIDEO MONITOR CABLES & ADAPTOR



L-com now offers a complete line of 13W3 cables for use not only with Sun workstations, but also with other compatibles or non-compatibles when used with the adaptor.

These are super-superior designed and built for long distance and trouble-free use. Each cable features a built-in ferrite in close proximity to the 13W3 connector. 100% shielding is guaranteed by use of a steel enclosure over the wiring, fully solder sealed, and over molded for an enhanced appearance.

Cable lengths from 4 to 50 feet are available with prices starting at $69.95. The 13W3 male to HD15 female adaptor is priced at only $39.95.

For additional details, contact:

L-COM, INC.
1755 OSGOOD ST., DEPT. NV
NORTH ANDOVER, MA 01845
508-682-6936 FAX: 508-689-9484
1-800-343-1455

OPTOSCAN535

Optoelectronics announces the new OptoScan535 add-on computer control interface board for the Radio Shack model Pro-2035 Scanner.

New Product News

The OptoScan535 provides optimum control in scanning with the ability to tune the receiver from the computer while increasing the scanning speed. The Pro-2035 equipped with the OS535 scans faster than the Icom R7100, AOR 8000, or any other scanner using computer control. When combined with a computer, the OptoScan535 makes using the Pro-2035 easier and much less confusing. Even when away from the scanner, the computer can continue to search out those frequencies you want to monitor and record them into virtually unlimited numbers of memory locations. The unit also comes with two built-in CI-V interface converter jacks, eliminating the need for an external converter box.

One of the most exciting features of the OptoScan535 is that it can be used with the Scout™ for the Optoelectronics Patented Reaction Tuning™. The Scout will automatically tune the Pro-2035, equipped with an OptoScan535, to the frequency recorded. The frequencies may also be recalled from any one of the 400 memories in the Scout to tune the receiver by Memory Tune™.

The OptoScan535 provides signal decoding of CTCSS tones, DCS codes, and DTMF (Touch Tone®) characters.

The OptoScan535 is supported by such software programs as Probe, Scanstar, Scancat, Scanner Ware for Windows, Radio Manager for Windows, and Wave for Mac. The suggested list price of the OptoScan535 is $299.00.

For additional information, contact:

OPTOELECTRONICS
5821 N.E. 14TH AVE., DEPT. NV
FT. LAUDERDALE, FL 33334
305-771-2050 FAX: 305-771-2052

CES-1000 CELLULAR SYSTEM ACTIVITY MONITOR

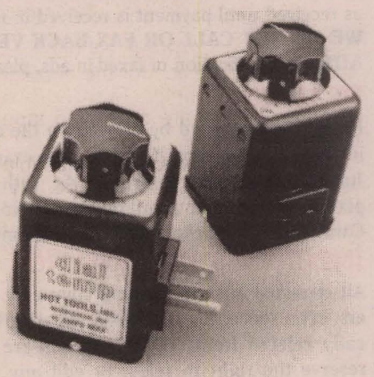
Cellular Evaluation Systems (C.E.S.), introduces the CES-1000 cellular system activity monitor.

The CES-1000 features real-time status indicators displayed and updated by overhead message information. The CES-1000 is a serial data interface used to communicate between a computer's nine-pin serial port to an OKI (900, 910, 1145, or 1150), or AT&T (3710, 3730, or 3760) cellular phone. This is accomplished by utilizing Cellular Evaluation Systems customized software package. This software package requires an IBM PC or compatible computer with a nine-pin serial port and an OKI (900 or 1150) series or AT&T equivalent cellular phone.

For more information, contact:

CELLULAR EVALUATION SYSTEMS
P.O. BOX 1872, DEPT. NV
UNION CITY, CA 94587
510-504-5150 FAX: 510-791-8757

SOLDERING IRON CONTROLLER



A low-cost controller that converts any soldering iron into a variable temperature tool for working with sensitive electronic components or other applications requiring lower tip temperatures is available from Hot Tools.

The Dial-Temp Soldering Iron Controller is compatible with any soldering iron ranging from 15 to 1600 watts and easily adjusts tip temperatures from 150°F to full heat. Featuring a grounded wall plug and receptacle, just plug the soldering iron into the controller and dial select the desired working tip temperature.

Developed to moderate fixed temperature soldering irons used with heat sensitive electronic components, the Dial-Temp Soldering Iron Controller eliminates the need for costly temperature control soldering stations in many applications. Providing a 15 amp capacity, it can also moderate hot plate temperatures.

The Dial-Temp Soldering Iron Controller sells for $39.95 (list).

For more information, contact:

HOT TOOLS
24 TIOGA WAY, P.O. BOX 615
DEPT. NV
MARBLEHEAD, MA 01945
617-639-1000 FAX: 617-631-8887

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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.

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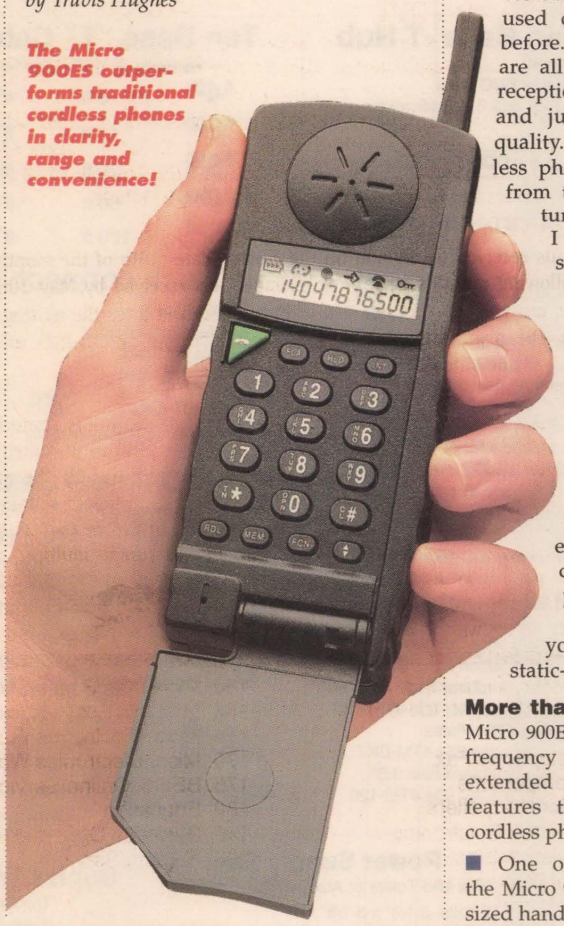
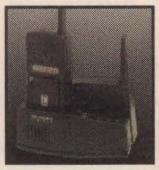
Now you can get far greater range and networking features in a 900 MHz phone!

Introducing the Micro 900ES cordless phone that operates on the 900 MHz frequency for clean, crisp sound and greatly extended range. Its superior range and unique lightweight, pocket-sized handset make it the ultimate in home or small office communications systems!

by Travis Hughes

The Micro 900ES outperforms traditional cordless phones in clarity, range and convenience!





We have all seen and used cordless phones before. The complaints are all the same—bad reception, short range and just poor sound quality. I have a cordless phone that will only work 10 feet from the base unit. And every time I turn my head in a certain direction, I either get static or I can hear someone else's conversation.

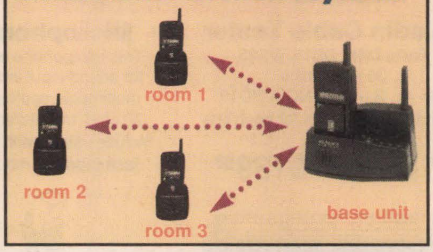
Now there is a cordless phone, the Micro 900ES, that uses 900 MHz technology to give you the mobility of a cordless phone, but without the complaints. Not only will you get far greater range and incredible sound quality, you can create a home office environment by adding up to three remote handsets and charger bases to each base model. You can transfer calls between these phones with music on hold, and with 40-channel auto-scanning you will be assured of crystal-clear static-free conversations!

More than just a cordless phone. The Micro 900ES system operates on the 900 MHz frequency for clean, crisp sound and greatly extended range. It also has many more features that make it more than just a cordless phone.

- One of the smallest in the industry, the Micro 900ES offers a lightweight, pocket-sized handset.
- The MultiLink™ feature is a multi-handset capability that lets you add up to three additional handsets and chargers to each Micro 900ES phone base—without the need for additional phone jacks.
- The two-way paging/intercom lets you page between baseset to handsets and handsets to baseset.
- 40-channel Auto-Scanning automatically chooses the clearest of 40 channels for clarity and static-free conversations.
- Direct Call Receiving allows you to receive incoming calls even with the flip cover closed by pressing the line engage/disengage key.
- Auto-Talk feature enables the line to automatically engage to receive incoming calls when the handset is removed from the baseset.
- QuickDial™ provides one-touch dialing for a pre-programmed number for each handset.

Additional features. The Micro 900ES system has 65,000 digital security codes to prevent unauthorized long distance charges. It has a Call Timer Display that activates after a call is received or dialed. And if you want an office telephone system, you can call transfer between handsets with music on hold. There is also privacy—no eavesdropping on transferred calls.

Create a home or office communications network system



Have you ever wanted to put a phone in your garage or have additional phones for your small business, but didn't have enough phone jacks? The Micro 900ES lets you add up to three additional handsets and chargers to each Micro 900ES phone base—with only one phone jack!

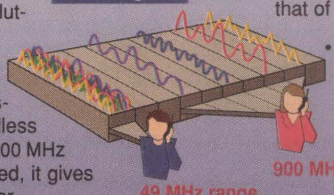
Risk-free. The Micro 900ES system is backed by our risk-free home trial. If you are not satisfied, return it within 90 days for a full "No Questions Asked" refund. It is backed by a one-year manufacturer's limited warranty.

The future of cordless products can be found in 900 MHz technology...

900 MHz technology

The FCC recently allocated a band of frequencies, from 903-926 MHz, specifically for cordless products. Most other cordless products use 49 MHz technology, from 46-49 MHz. Interference and shortened range are common side effects of this cluttered frequency range, which is shared by garage door openers, remote controls, home security systems and many other cordless phones. But because the 900 MHz range is still virtually unused, it gives clarity and long-range power.

The 900 MHz advantage



Extended range. Range depends upon many factors, including frequency. Because the Micro 900ES phone system uses the uncluttered 900 MHz frequency range, you get clarity and range not available from other cordless phones. In fact, with Micro 900ES you can expect a range *two to three times* that of ordinary cordless phones.

The Micro 900ES system operates in the newly-approved frequency range, from 903-926 MHz. You get incredible sound quality and long-range power!

Micro 900ES phone.....$279 $19 S&H

Additional handset and charger base .....$179 $9.50 S&H

Please mention promo code **1242-NV-5820.**

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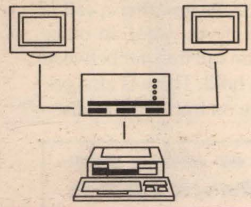

SimmVerter™
Allows 30 Pin memory to be used on 72 Pin mother Board

- Ideal for all service/repair and upgrade business
- Left and right sided version to allow use of all available slots

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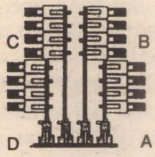
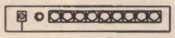
CA-MEM-D CA-MEM-A



Ten Base -T Hub
- 8 port
- AUI or BNC input
- I-EEE 802.3 Specifications



#TM-TBT-HUB $139.00

Ten Base "T" Cables
Category 5 / PVC Jacket

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$6.00	12 ft	#TE-128-L5
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$14.00	50 ft	#TE-508-L5
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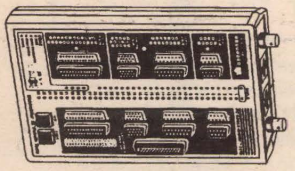
Paladin Cable Tester
Tests DB9, DB15, DB25
36 centronics
RJ-45, RJ-11, BNC & HD15
36 Individual L.E.D's for each line

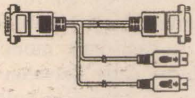
#TM-157 $139.00



Microphones
This microphone is ideal for sound input into your multimedia applications
7ft cord 1/8" stereo jack
Includes stand with double face tape for mounting

#TM-MIC-2 $3.00

MIDI Cables
Musical Interface
Soundblaster compatible
6' DB15 male-female
2 - 5 pin DIN male



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Power "Y" for speed display 12/5vDC **50¢** #TM-WRE
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- Double shielded
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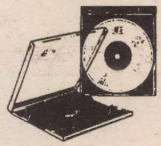
CD Jewel Case



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Dual 25¢ more will hold 2-CD's in one case

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Tests DB9, DB15, DB25
36 centronics
RJ-45, RJ-11, BNC & HD15
36 Individual L.E.D's for each line

#TM-157 $139.00

Microphones
This microphone is ideal for sound input into your multimedia applications
7ft cord 1/8" stereo jack
Includes stand with double face tape for mounting

#TM-MIC-2 $3.00

MIDI Cables
Musical Interface
Soundblaster compatible
6' DB15 male-female
2 - 5 pin DIN male

#CC-155 $15.00

SCSI II Adapter
HD 50 male to DB25 female

#CA-016 $21.00

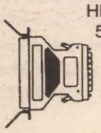
Motorized CD Cleaner

#TM-CDC $8.50
MFG by Discwasher
Includes Fluid and Pads
3v DC adaptor or batteries not included

Anti-Static Strap
Adjustable velcro strap
10 feet grounding cord

#TM-STP $5.00

SCSI II Adapter
HD 50 male to 50 Centronics female



#CA-015 $17.00

SCSI I and SCSI II
3' SCSI I to SCSI II
$18.00 **#CC-679**
6' SCSI I to SCSI II
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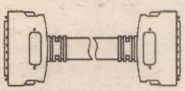
3' SCSI II to SCSI II
$24.00 **#CC-678**



SCSI III also available

Power Supply Fan
For Mid-Tower or Auxiliary fan, 7 blades
12 volts 3 1/8" x 3 1/8" x 1"

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Duplex Wall Plate
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Beige Color
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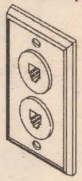

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(RJ-11)

Other phone accessories available
Blow Out!! 30¢

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Universal Multi-voltage 1.5v - 12v DC 6 Different Connectors Polarity Switch

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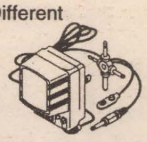

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For Sound Cards or Compact Disc
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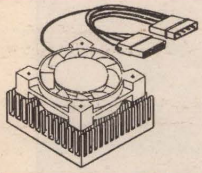

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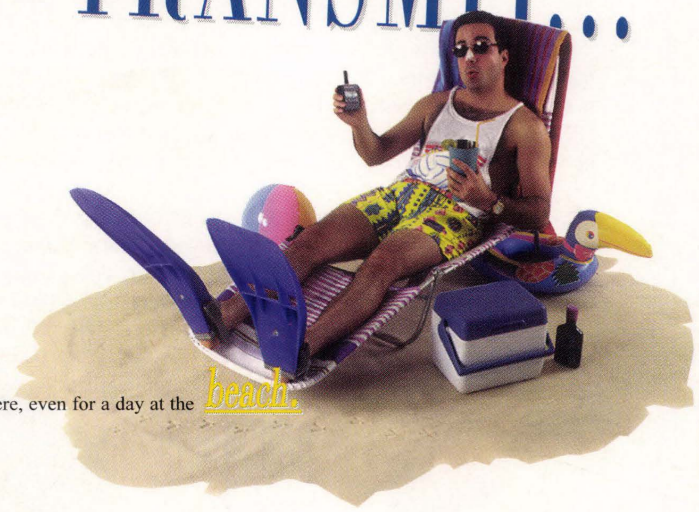
Relax. There's no need to get uptight about missing that important frequency. With Scout Reaction Tune, capturing frequencies is like a day at the beach. Pure bliss! Interface the Scout to the AOR AR8000 and the Scout will not only show you which frequency is being transmitted, but you'll be able to instantly hear the conversation from the AR8000 as well. The Scout can record 400 frequencies into memory, with up to 255 hits per frequency (From 10MHz - 1.4GHz). The Scout distinctively beeps indicating frequency hits, or switch to a pager style vibrator for discreet recording. Built-in rapid charge NiCads provide a full ten hour discharge time.

Portability, functionality and the hand-held size of the Scout make it great for mobile operations. Take it anywhere, even for a day at the beach.



BUT WITH SCOUT® REACTION TUNE™...

YOU'RE DEFINITELY GONNA CATCH IT.

Scout shown with AOR AR8000, Scanner not included

Minor modification to the AR8000 required

Scanners not sold by Optoelectronics

·Specifications·

- 16 segment RF signal strength bargraph.
- 10 digit LCD display w/ EL backlighting.
- Reaction Tune™ the AOR AR8000/2700, ICOM R7000 R7100, and R9000 and Realistic Pro 2005/6 w/OS456 Pro 2035 w/OS535 *Scanners not sold by Optoelectronics.*
- Download frequencies into PC using optional CX12AR.
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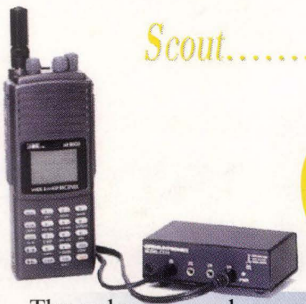
- Full on screen function annunicators.
- Memory Tune - Scroll through Scout memory to tune receiver.

Scout..... $449.00



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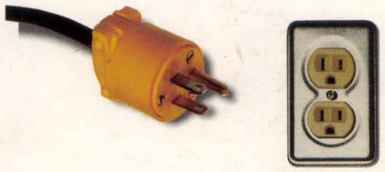
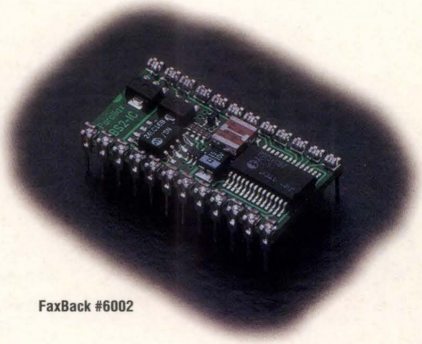
DTMFOUT *

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.



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COUNT *

Counts cycles on an I/O pin. Makes tachometer and other count/time programs simple.

BASIC Stamp II Module (BS2-IC)

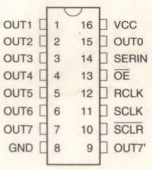
16 general-purpose I/O lines
2048-byte program space (600 instructions)
20-MHz clock (38400 baud serial, etc.)
$49, $69 with optional carrier board

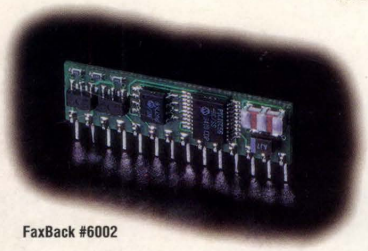
** Only available on the Stamp II.*

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

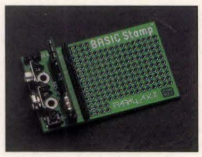




FaxBack #6002

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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