ROBOTICS · MICROCONTROLLERS · COMPUTER CONTROL · LASERS

Nuts & Volts

THE PREFERRED MAGAZINE OF THE ELECTRONICS HOBBYIST/INDUSTRY

December 2001
Vol. 22 No.12

FONDEST WISHES FOR A JOYOUS HOLIDAY SEASON FROM ALL OF US AT NUTS & VOLTS

Take your PIC ...
Atoms, Stamps, AVRs,
PICs ... whatever microcontroller
you prefer, we've got you covered
in this month's line-up.

U.S. $4.50 CANADA $6.50

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www.nutsvolts.com

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The items below can be found in the "Specials" area of our on-line shopping pages at www.halted.com...check them out and use our secure site to place your order for the holidays!

Rechargeable 12VDC Battery
40 AH, lead/acid, Yuasa NPX-150R
HSC# 18917 **$29.50**

Server Cabinet, ATX rack mount, with Power Supply, White color
HSC# 80541 **New Price!** **$179.95**

Battery charger, NiMH
HSC# 19151 **$17.50**

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HSC# 18218 **New Price!** **$9.95**

SCSI Controller, Adaptec 1505, ISA Bus
HSC# 17995 **New Price!** **$7.50**

Mouse, 2-button
HSC# 18731 **$3.95**

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HSC# 80539 **$4.95**

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200W, "Mini-Tower"-style
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HSC# 18964 **New Price!** **$24.50**

Motherboard, Baby AT, 486 VLB
HSC# 19003 **$9.95**

Multimeter, analog, VOM
HSC# 18260 **$9.95**

Multimeter, DMM, with transistor check
HSC# 80370 **$14.95**

Multimeter, DMM, tilt-up display, nice!
HSC# 80504 **$39.95**

Computer Joystick, "FX2000"
HSC# 18772 **New Price!** **$3.00**

Distribution Amplifier, 50MHz to 1 GHz
HSC# 18897 **New Price!** **$19.95**

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- 'Videotronics' Model No. VHS-10S player deck
- Dual power option! - 110VAC or 12VDC!
- Perfect for entertaining the kids in the van!
- Many other uses...home, business, camping...
- Standard NTSC VHS format, full front-panel controls, soft-touch buttons with LED's
- Remote control sensor on front panel - remote NOT included...may work with generic remotes?
- Removed from working service, 90-day HSC warranty

HSC# 19048 **$19.95!**

External CD-R/W!

- Hewlett-Packard Model 7200 Series CD-R/W
- Use just like a floppy! Shares printer port!
- Drag & drop up to 650MB on a single CD!
- 2X write on CD-R/W, up to 6X read on CD-R
- 1X R/W: 150KB/sec, 2X R/W:300KB/sec
- 6X Read: 900KB/sec -- drivers avail. at HP website
- EIDE-(ATAPI) interface w/MMC, front tray load
- 74 min. on 120mm disk, 21 min. with 80mm disk
- Power supply not included (pinout provided)
- Refurbished, 90-day HSC warranty

HSC# 19036 **$49.50**

VHS for even less!

- Magnavox Model No VR9100AT01 video player
- Standard 'F' type connectors for inline connection
- Rear panel switch selects Ch. 3 or Ch. 4 output
- RCA jacks for line level video/audio connect
- Pulled from working service. Units have slight markings from removed infared transmit element covering front panel infared detector. Remote NOT included.
- For 110VAC, 60Hz operation
- Removed from working service, 90-day HSC warranty

HSC# 19152 **$17.50!**

Lab Bench Supply!

- Model No. AEEC-350, 0-50VDC @3 Amp
- 110VAC, 60Hz - 150VA -- small footprint!
- Dual digital meters for voltage and current
- Short-circuit protected, grounded line cord
- New, IEC power cord, manual, 90-day warranty

HSC# 80606 **$139.00**

3-Com Superstack II!

- Plug 'n Play switch offers smooth migration to Fast Ethernet!
- 12 autosensing 10/100 Ethernet ports, one matrix port, one expansion port
- For 10/100BASE-TX/RJ-45
- Optional 100BASE-FX/SC, 1000BASE-T/RJ-45, 1000BASE-SX/SC, 1000BASE-FX, or 100BASE-LX/SC
- Features store-and-forward, full/half duplex auto-negotiation, port-trunking, 802.1Q VLAN support, 802.1p traffic prioritization
- Embedded web-server for direct management
- 2.8"H x 17.3"W x 12"D
- New, boxed w/accessories, 90-day warranty

HSC# 19062 **$199.00**

Disk Drive Deals!

- Seagate ST15150N 4.3 GB "Barracuda" SCSI
- 7,200 RPM, 8.0/9.0 ms avg. seek time
- 21 Hds, 11 Disks, 3,711 Cyl.
- Standard 50-pin SCSI
- 3.5" size, half-height (1.5" tall)
- Refurbs, 90-day warranty

HSC# 18412 **$32.50**

- Seagate ST19171WC, Ultra-SCSI Wide ASA2
- Formatted capacity: 9.1GB
- Spindle speed: 7200 RPM, 3.5" size, half-height (1.5" tall)
- 80-124 mbits/sec internal transfer rate
- Average Access (read/write): 9.7-10.7 mS

HSC# 18753 **$ 39.95**

Special!...buy this drive & get a 50-pin (#SCA23700) or 68-pin (#SCA23720) Adapter for $10.00! Normally a $20 - 30 value!

Wireless Music for 4!

- Special Package Deal!!
- You get one transmitter and four mini receivers!!
- Tuneable 900 MHz transmitter has standard mini-stereo plug
- Connects to your CD, Tape, PC sound card...etc.
- Range: 100 ft. + (depends on height, obstructions...etc)
- 12VDC power pack included (for transmitter)
- Mini 900 MHz tuneable receivers have belt clip
- Standard mini-stereo headphone jack, off/on & volume control- unit is the size of a pager!
- Receivers run on two AA batteries (not included)
- Brand new units! Limited quantities!!
- OEM packed, 90-day warranty

HSC# 19150 **$39.50**

EASY NETWORK!

Multi-PC Web Access...
Save Money!
Up to 4 PC's on one phone line!

Perfect for homes/small businesses
Share printers, send faxes, backup-files
Proxy server for multi-PC internet access!
Only one phone line needed for ISP connection
Includes 4-port hub/56K modem & 1 network card
If you want more than two PC's networked, you will need more network cards (HSC# 18493 $4.95)
50 ft network cable, driver/installation manual CD
OEM package, new, 90-day warranty

HSC# 80599 **$29.95**

- ...or, you can just buy the modem/net-hub card!
- Comes with installation software CD
- You can connect your own 10-BaseT network PC's (up to three) to its hub and save!
- OEM package, new, 90-day warranty

HSC# 18942 **$17.50**

PCMCIA Ethernet!

- EPSON Ethernet PCMCIA interface card
- Both 10Base2 and 10BaseT cables included!
- Compatible with notebooks/PCs with Type II slots
- Hot card insertion and removal - no power down
- No jumpers or switches - Two LED status lights
- New, boxed, diskette & manual, 90-day warranty

HSC# 19125 **$9.95**

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For over 35 years, HSC has been your best source for high-tech goodies from Silicon Valley ! Haven't visited us yet? You owe it to yourself to come see our constantly-changing, mind-boggling array of electronic parts, equipment, computers, and scientific gear! Find out why knowledgeable engineers, technicians and hobbyists make HSC their first stop for all their techno-shopping needs!

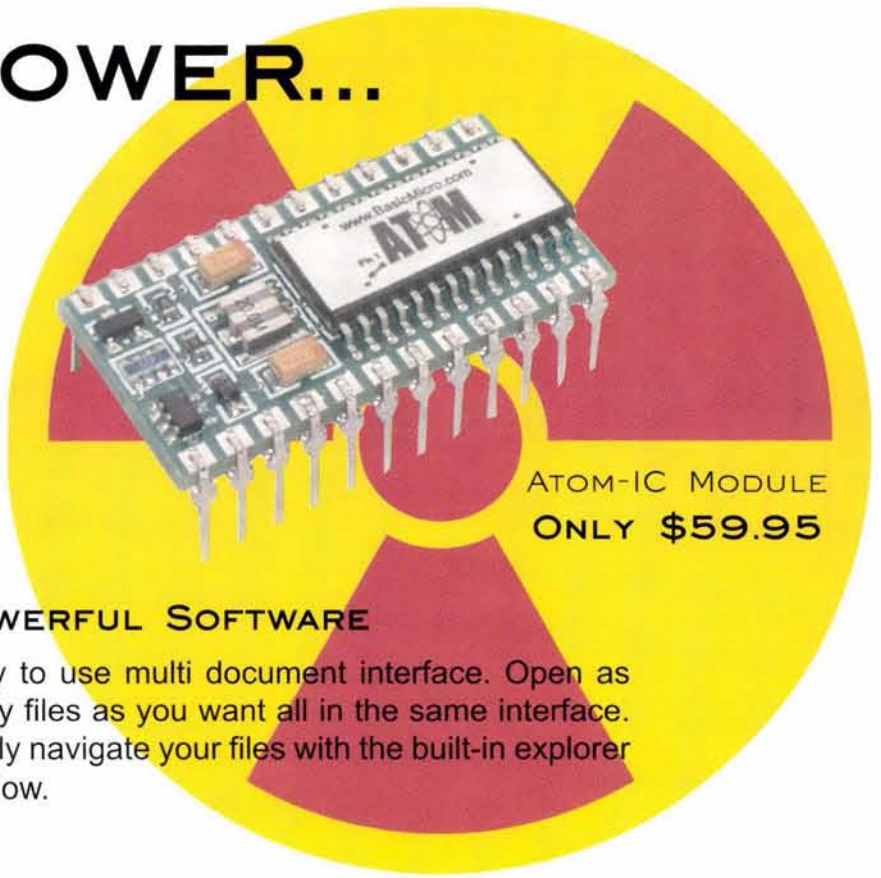
Terms: Some quantities limited; all items are subject to prior sale. **Minimum order: $10.00 plus shipping.** Orders under $20.00 subject to $2.00 handling fee, in addition to shipping. All orders shipped FOB Santa Clara, CA (this means you pay freight!) by UPS Surface (no P.O. Boxes) unless otherwise specified, in which case prevailing carrier rate plus $5.00 handling fee may apply. Prepaid orders that don't include shipping charges will be shipped freight COD. There is a $6.00 UPS charge added to shipping charges for COD shipments. If you have questions about your order, please call Customer Service at (408) 732-1854 M-F 9AM to 5PM PST.

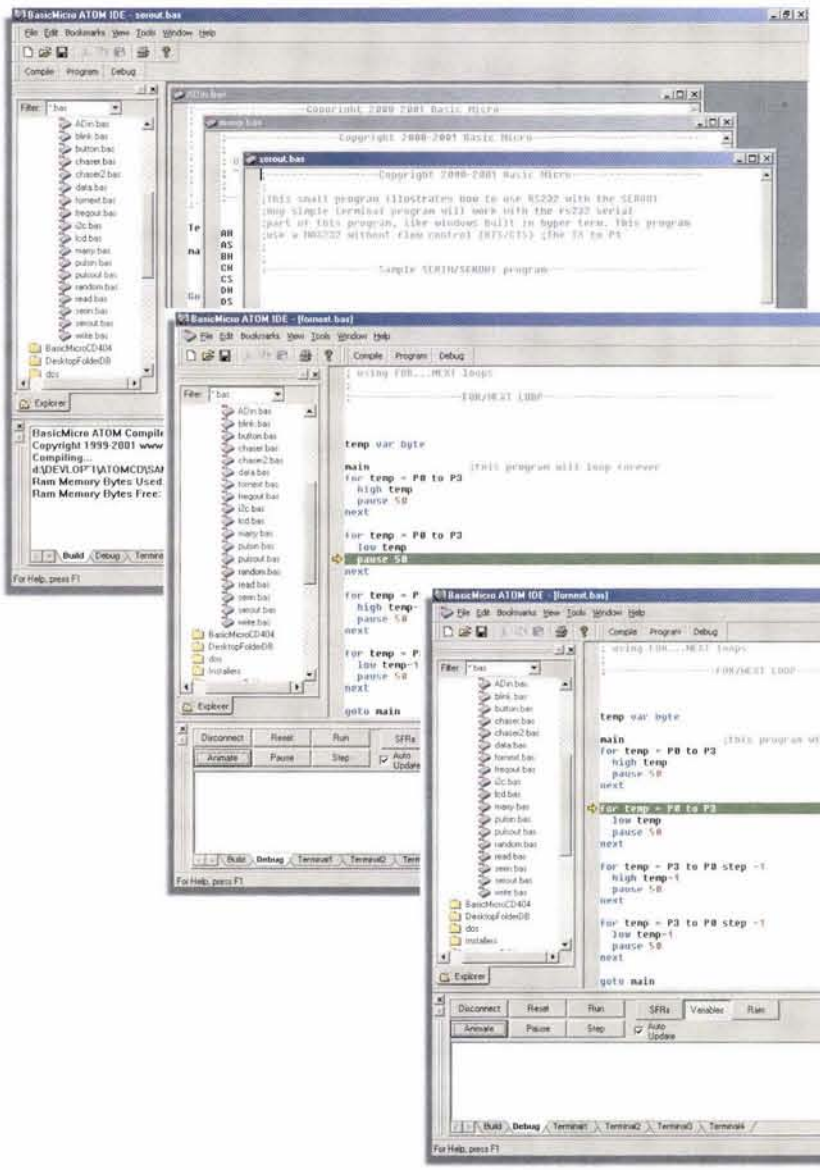
Circle #53 on the Reader Service Card.

More Power...

The New Basic Micro Atom, offers more in the same package you are already familiar with. Built-in features like upgradeable firmware, Analog to Digital, Hardware Serial, In Circuit Debugging, 32 Bit Math, 32 Bit Floating Point Math and more !

The Atom includes powerful expanded BS2p syntax compatible software with commands such as; OWout, OWin, ADin, LCDwrite, If..Then..Elseif..Else..Endif, LCDread, HPWM, Hserout, Hserin, Do..While, Repeat..Until and more !





Powerful Software

Easy to use multi document interface. Open as many files as you want all in the same interface. Easily navigate your files with the built-in explorer window.

In Circuit Debugging

Watch your program run step-by-step as the Atom executes each line of code. Easily debug your code. Bring your programs to life quicker than you ever thought possible !

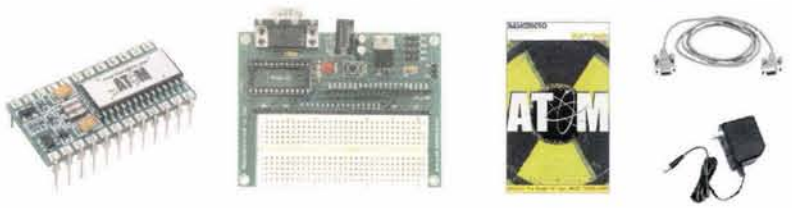
Watch it Come to Life

No more strategically placing debug statements throughout your program! Not only can you watch your program execute live, you can keep an eye on every variable and ram location as they are affected by your program. Each program variable is displayed in binary, hexadecimal and its real values.

Features

- Graphical Debugging (ICD)
- More Software Commands
- 32 Bit Integer Math
- 32 Bit Floating Point Math
- BS2p Compatible Syntax
- Expanded BASIC library
- Firmware upgradeable
- Unlimited Support
- Free Software Updates
- Plus More!
- Over 300 Bytes of RAM
- 256 Bytes of Data EEPROM
- External & Internal Interrupts
- 3 10 bit A/D Converters
- 2 Capture and Compare
- Internal Adjustable Vref
- + / - External Vref
- 3 Timers, 2 PWM
- UARTS, I2C, SPI
- Plus More!

Development Kits



Kit Includes: Development Board, Atom, Manual, Cable and power supply

Only $129.95

BASIC MICRO INC
Microcontrollers Made Easy™

To order visit **www.basicmicro.com** or call us at 734-425-1744 M-F 10 AM to 6 PM

The Atom is a registered trademark of Basic Micro Inc.

***Take your PIC* ... Atoms, Stamps, AVRs, PICs ... whatever microcontroller you prefer, we've got you covered in this month's line-up.**

A PIC Of A Power Supply

If you're serious about experimenting with PIC microcontrollers and their applications, then you need a serious power supply. This bench instrument will power all your PIC needs – present and future.

Page 10 *by TJ Byers*

RVK-BASIC: Fast, Affordable Code for AVR Microcontrollers

Discover a new language that executes millions of lines of Basic per second for use with low-cost chips and can be downloaded free from the *Nuts & Volts* website.

Page 33 *by Bob Vun Kannon*

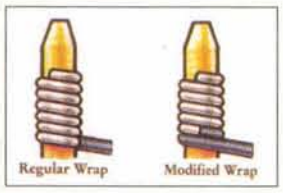
Digital Utility Meter

Looking for a low-end frequency counter that can be integrated with a breadboard system? Check out this project using a new microcontroller – the Atom.

Page 48 *by Michael Simpson*

Also this month ...

Wire Wrap is Alive and Well



The PC board fabrication process can sometimes be a daunting task for the new hobbyist. However, PC board fabrication may not necessarily be the only alternative to assembling circuit boards.

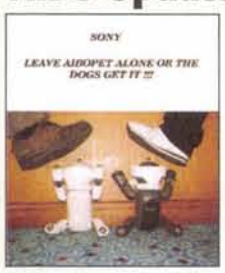
Page 37 *by Russ Shumaker*

Strap on Some High Frequency Performance

You wanted quick band changing, good efficiency on lower bands, rapid deployment from one vehicle to another without leaving scratches or holes, and a variety of whip configurations ... well, you got it!

Page 44 *by Gordon West*

Aibo Update – Part 3



The Aibopet website – THE premiere source of info and freeware – has been shut down by Sony. Find out the ramifications within the Aibo community and get a look at the new Aibo models.

Page 75 *by Jeff Mazur*

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Nuts & Volts

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Just in time for the holidays ... Kit-Bashing with the Velleman Christmas Tree

Make three unusual holiday ornaments by modifying the same kit.

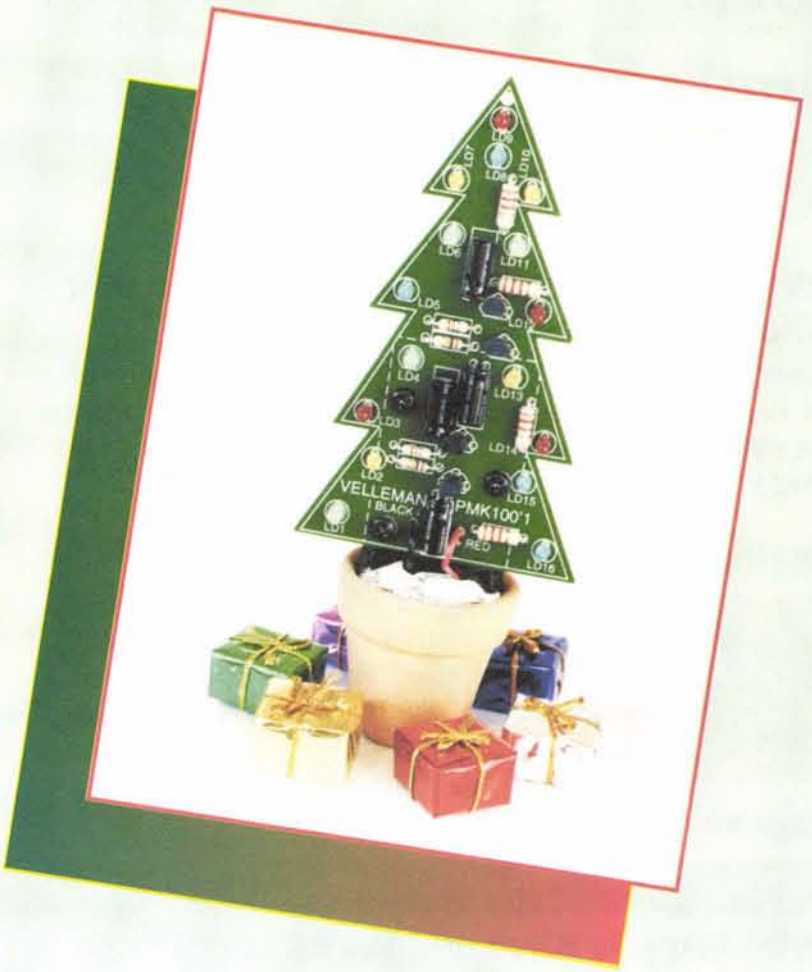
Page 6 *by J. Ronald Eyton*

Columns ...

Departments ...

KIT-BASHING WITH THE VELLEMAN CHRISTMAS TREE

by J. Ronald Eyton



PROJECT #1

This Velleman tree was 'planted' in a small terra cotta pot and surrounded by small Christmas packages; both the pot and the packages were obtained at a crafts store. The red LEDs that came with the kit were replaced with red, green, yellow, and blue T1 LEDs that are sold in a pack of four from Electronic Goldmine (www.goldmine-elec.com) as Rainbow of Colors LED Assortment G4256 ($1.00). Four packages (16 LEDs in total) are needed to replace the Velleman LEDs.

PROJECT #2

An unaltered Velleman tree was sewn to a red/green Christmas-colored tie through holes drilled at the edges (at the tips of the branches) of the printed circuit board. Light gauge wire was soldered to a nine-volt battery connector and threaded through the back of the tie. The other end of the wire was soldered to the battery connections on the circuit board before sewing the tree to the tie. Tie the tie as usual and place the battery in a shirt pocket.

Kit-bashing is something model railroad enthusiasts do to a conventional rolling stock kit or building/structure kit that produces an outcome different than intended from the original design of the kit. The model builder chooses a kit that will serve as the foundation for producing a unique piece of rolling stock or a unique building/structure that, for example, may have existed in real life for a specific region in the world, but is not available in kit form.

This process was used to produce variations of one of my favorite kits, the Velleman Christmas Tree With Blinking LEDs — Minikit MK100 (contact Velleman Kit at www.velleman-kit.com for a list of retailers). Although the kit was designed to be hung as a decoration, several other incarnations are possible.

The projects are listed here, and details for what little construction is involved are given as part of the photo captions.

Project #1: Create a traditional look by 'potting' the Velleman tree and adding multicolored lights. Makes a great table ornament.

Project #2: Use the Velleman tree with the blinking red LEDs and sew it to a tie with a hidden wire attached to a nine-volt battery placed in a shirt pocket. Wear it to your Christmas party.

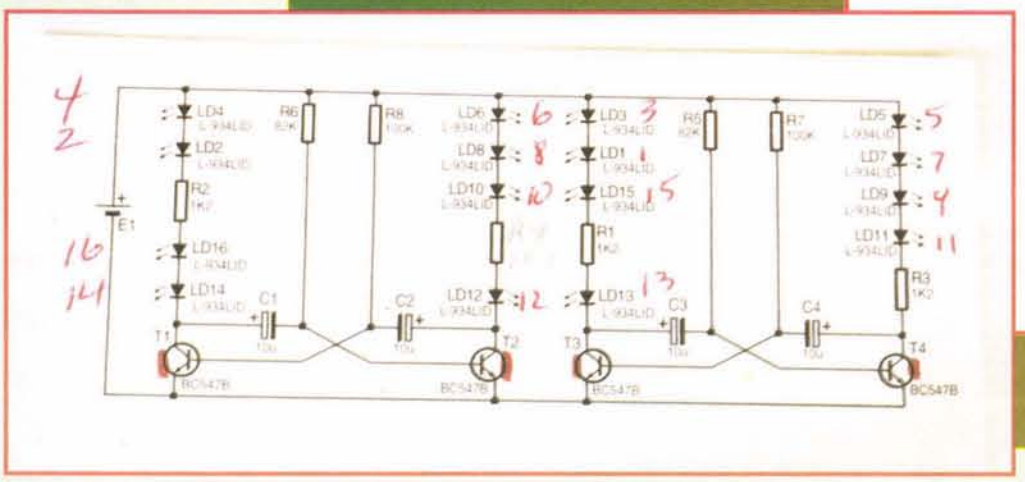
Project #3: Make a 'real' electronic Christmas tree. Hardwire the circuit exactly as shown in the schematic diagram using parts from the kit but not the printed circuit board — decorations are optional.

MERRY CHRISTMAS! **NV**

Make three unusual Christmas ornaments by modifying the same kit.

The electronic 'tree' shown in the top photo is a hardwired replication of the Velleman Christmas tree schematic diagram shown in the bottom photo. The positive bus wire and negative bus wire were made from straight pieces of coat-hangers (lacquer removed with sandpaper) that were bent, embedded, and epoxied into two rubber spacers (or feet) that kept the assembly rigid and electrically separated. An enlarged copy of the schematic diagram was used as a template for the bus wires and for the final wiring of parts. An alligator clip wired to the positive side of the battery and connected to the positive bus wire was used as the on/off switch.

PROJECT #3



TechKnowledgey 2001

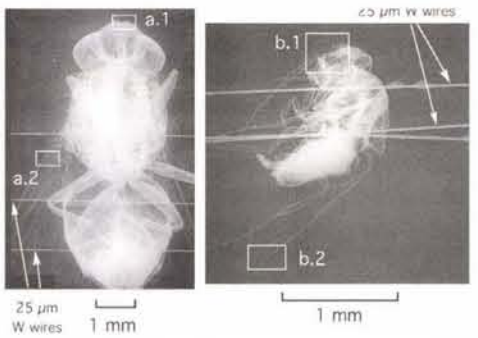
Events, Advances, and News From the Electronics World

by Jeff Eckert

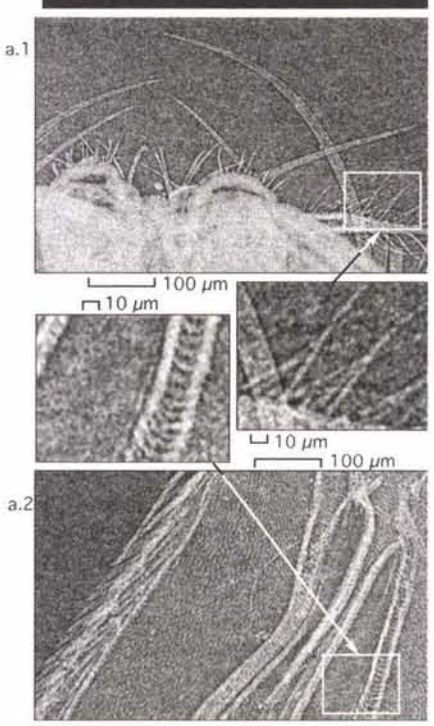
Advanced Technologies

High-Resolution X-Ray Imaging

For several years, Cornell University **(www.cornell.edu)** has been working with Sandia National Laboratories **(www.sandia.gov)** in the development of an x-ray inertial confinement system for hydrogen fusion. This has resulted in Sandia's "Z machine," which generates a high-power x-ray pulse to create temperatures in the range of millions of degrees, producing the fusion of hydrogen fuel. In an interesting offshoot, scientists in Cornell's Laboratory of Plasma Studies have discovered a new way to create high-resolution images of objects as small as fly parts (see figure) and the filaments that keep dandelion seeds floating in air.



Radiographs of a common housefly made with X-pinch imaging. Boxes a.1 and a.2 show enlarged parts of the fly. Copyright Cornell University, reproduced with permission.



Enlarged parts of the housefly image corresponding to boxes a.1 and a.2 in the first image. Copyright Cornell University, reproduced with permission.

In operation, the machine runs a powerful electrical current through a vacuum chamber that contains a pair of very fine, crossed wires. The current causes the wires to explode, which forms a plasma (a dense gas that is so hot that the atoms within it break down) known as "X-pinch."

The plasma created by the exploding crossed wires lasts for less than one microsecond, during which time it implodes and forms one or two plasma points, with temperatures as high as 10 million degrees Celsius, that last for less than a billionth of a second. The high-density plasma generates bursts of x-rays that can produce extremely high-resolution radiographs (x-ray photographs) of very small objects.

Because the detail shown in a radiograph is determined by the size of the x-ray source, microscopic details can be shown at very high resolution. In fact, the plasma points that emit the x-rays are so small that their size is still unknown. The Cornell plasma lab soon will begin collaboration with scientists in the Cornell College of Veterinary Medicine to determine whether this new imaging technology could have important applications for medicine or biology.

Inexpensive Sensor Has Food, Medical Applications

A simple, inexpensive sensor has been developed by Johnson Matthey **(www.matthey.com)** that can detect gases and micro-organisms. It basically exhibits a color change or develops fluorescence when exposed to certain low-molecular-weight gases (e.g., sulphur, nitrogen, phosphorus, carbonyl, and amines), including by-products of chemical degradation or microbial growth.

For those who are interested in the technical details, the sensor consists of a metal (e.g., palladium) that has been complexed with a chromophore or fluorophore (that is, a chemical that gives rise to color or fluorescence in a molecule). In the presence of the gases we wish to detect, a "ligand exchange reaction" occurs, and the metal reacts preferentially to the gas. As the chromophore or fluorophore is released, a color change or fluorescence occurs. The reaction can be tailored to a particular application.

Because the fluorescing material can be printed onto a label or incorporated in packaging, you may eventually see it included in packaged food to detect product decomposition (thus replacing expiration dates on the package). It also may be useful in detecting packaging that has been tampered with, in both the food and pharmaceutical industries. The technology has not been incorporated in any commercial products at this time, but it is available for licensing (contact Johnson Matthey for details).

Computers and Networking

Terascale Computing System Available to You (Maybe)

The Terascale Computing System (TCS) — presently the most powerful system in the world available for unclassified research — was recently installed at the Pittsburgh Supercomputing Center (PSC, www.psc.edu/) in collaboration with Compaq Computer Corp. and with funding from the National Science Foundation. The system is available for use by scientists and engineers nationwide for research in areas such as earthquake modeling, storm-scale weather forecasting, global climate change, and protein genomics modeling (integral to the development of new drug therapies).

The system employs 3,000 Compaq Alpha EV68 microprocessors, housed in 750 four-processor AlphaServer systems running Tru64 UNIX. The EV68 has peak floating-point capability of two gigaflops (two billion calculations per second). Along with six teraflops of total processing power, the TCS features 3.0 terabytes of memory; high-bandwidth, low-latency interconnections; and extraordinary capabilities for large-scale data handling, including the ability to write its entire memory to disk in less than 40 seconds. This extremely short system-write time is critical to preserving research data in the event of component failure.

Even if you could afford the $36 million price tag, you probably would not want the TCS in your own office. Total TCS floor space is roughly that of a basketball court. It uses 14 miles of high-bandwidth interconnect cable to maintain communication among its 3,000 processors. Another seven miles of serial, copper cable and a mile of fiber-optic cable provide for data handling. And the unit is not easy on power consumption. Reportedly, the TCS draws 664 kW of power and produces heat equivalent to burning 169 pounds of coal an hour. To cool the computer room, more than 600 feet of eight-inch cooling pipe, weighing 12 tons, circulate up to 900 gallons of water per minute, and 12 30-ton air-handling units provide cooling capacity equivalent to 375 room air conditioners.

The good news is that you can apply for access to the TCS (or the center's Cray T3E machine) through the National Science Foundation's Partnerships for Advanced Computational Infrastructure program. The bad news is that you have to have a legitimate need for it. For information, visit **www.psc.edu/grants/paci.html**.

M-Systems' DiskOnKey™ storage device allows machine-to-machine data transfer of up to 128 MB. Courtesy of M-Systems.

Key-Size Storage Device

This month's "why didn't I think of that?" product is the DiskOnKey™ storage product from M-Systems. If you have more than one computer, but haven't linked them up via a high-speed network, this could be the next best thing. The key-sized flash memory device operates just like a hard disk, but requires no power supply or batteries (power is provided via the USB connection) or cables.

You simply plug it into the USB port of your computer and use it the same way you would use any external

hard drive. The data transfer rate is a respectable 12 Mbits/s, and it is rated for an operating life of one million read/write operations. The devices, which measure less than 100 mm in length including the protective cap, are available with capacities ranging from 8 MB ($30.00) to 128 MB ($130.00) and are PC and Mac compatible. Details are available at **www.diskonkey.com**.

Sophisticated Graphics Pad, Cheap

If you have always wanted a pen-and-mouse graphics pad for your computer but didn't want to shell out several hundred dollars for it, it may be time to look at Wacom's Graphire2® device. The unit, which lists for $99.95, can be used for drawing, photo retouching, and other graphic functions. The mechanical portion of the products includes a cordless, no-ball scrolling mouse, a pressure-sensitive pen, and a 4 x 5 active drawing pad. The cordless, battery-free pen draws with one end and erases with the other, and it can sense 512 levels of pressure to determine the width or darkness of a line.

Wacom's Graphire2® graphics pad features a cordless mouse and a programmable pressure-sensitive drawing pen. Courtesy of Wacom Technology Corp.

A double-sided switch on the side of the pen incorporates two buttons that can be programmed to perform a variety of functions. The mouse has a resolution of 1015 lines per inch, which is better than that of standard and optical mice.

The Graphire2 comes with Adobe Photoshop 5.0 LE and Corel's Painter Classic. It can be used on your PC (requires Windows 98, 2000, Millennium, or XP) or Macintosh (requires OS 8.5 or later). In either case, you will also need a USB port, CD-ROM driver, and color monitor. For more details, visit **www.wacom.com/graphire/index.cfm**.

Circuits and Devices

New Three-Axis Magnetic Sensor

The Honeywell Solid-State Electronics Center (**www.magneticsensors.com**) has introduced a miniature three-axis magnetic sensing solution for next-generation applications. To complement the existing HMC1052 two-axis sensor, Honeywell designed the HMC1051Z single-axis sensor. When the two are used together, they offer a miniature, low-power, low-field, three-axis magnetic sensing solution.

Both the HMC1051Z and the HMC1052 have a sensitivity of 1mV/V/Gauss, a wide field range up to ±6 Gauss, resolution of 120 microgauss, and a required supply voltage as low as 1.8V. Patented on-chip set/reset straps eliminate the effects of temperature drift and stray magnetic fields for improved accuracy and reliability. The devices come in a small eight-pin SIP or a 10-pin MSOP (3mm x 3mm x 1mm) package.

For compassing and position sensing applications requiring small size and low power drain, the HMC1052 can be used alone. The HMC1052 is designed for handheld wireless appliance applications such as location-based services in mobile phones, compasses, and global positioning system (GPS) applications in personal digital assistants, walkie-talkies, watches, and GPS receivers. According to Honeywell, it provides accurate orthogonal two-axis sensing. With the HMC1051Z, the capabilities can be extended to three axes.

Fingerprint Sensor Introduced

Fujitsu Microelectronics, Inc. (FMI, **www.fmi.fujitsu.com**), has introduced a solid-state fingerprint-sensor product designed for embedded mobile computing systems and physical-access authentication systems. The MBF110 fingerprint sensor features a 300 x 300 pixel sensor array that produces 500 dpi resolution fingerprint images. Sensor area is approximately 1.5 cm square, which allows single-touch fingerprint authentication. The sensor also features a patented scratch-proof protective coating, an integrated eight-bit flash A/D converter, and an eight-bit microprocessor interface.

Honeywell's 1051Z single-axis magnetic sensor combines with the CMC1052 for three-axis position sensing applications. Courtesy of Honeywell Solid-State Electronics Center.

Sensor operating voltage range is from 3.3V to 5V, and it draws operating and standby currents of only 170 mW and 250 µw, respectively. The sensor is a CMOS device, available in an 80-pin LQFP and an 80-pin VSPA package. The VSPA version employs an integrated stainless steel ground ring that provides electrostatic discharge protection and ultra-stiff package pins that result in a rugged sensor package suitable for heavy-use outdoor access or automotive applications. The price is about $80.00 for samples and drops to $40.00 in quantities of 1,000.

Industry and the Profession

No Recession at Microsoft

For the quarter ended Sept. 30, Microsoft Corp. (**www.microsoft.com**) reported revenues of $6.13 billion, a six percent increase over the same period a year ago. Net income was $1.28 billion including a $1.24 billion after-tax charge related to some losses in securities. Earnings were $0.23 per share. According to John Connors, chief financial officer, the positive financial picture was created by strong demand for Windows® 2000 and NET Enterprise Server product families coupled with cost-control efforts.

In particular, the Windows 2000 Server family showed growth of better than 20 percent. For the full fiscal year that will end June 30, 2002, Microsoft is predicting revenues in the range of $28.4 to $29.1 billion, including operating income of $12.0 to $12.4 billion, and diluted earnings of $1.61 to $1.66 per share.

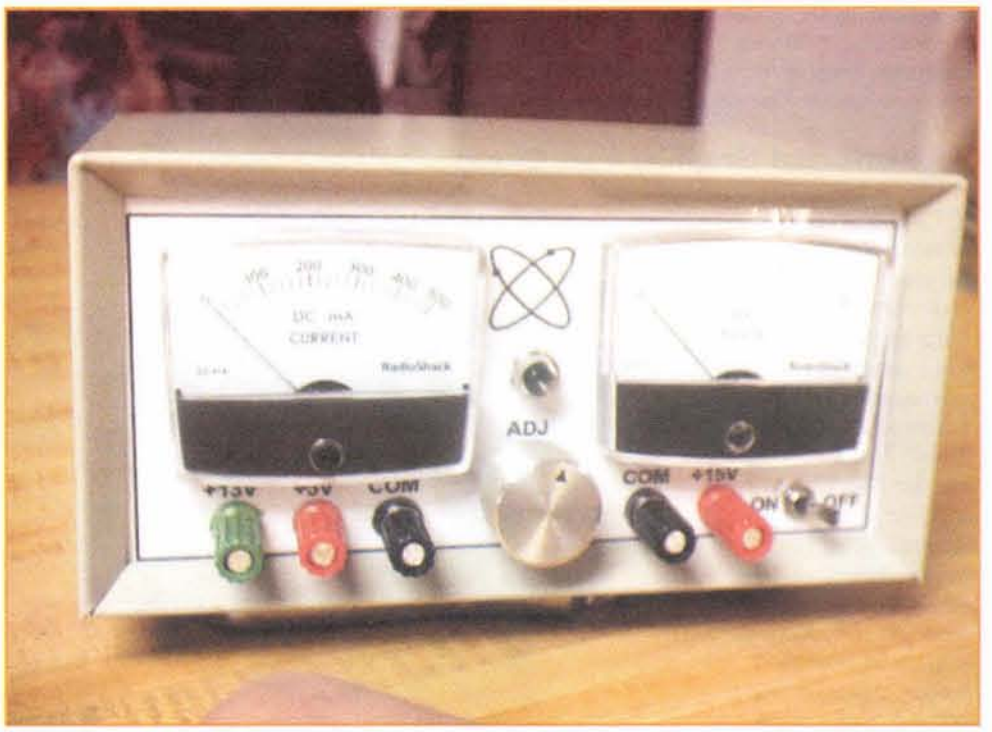
Egghead Gives Up

In spite of some last-minute efforts to put Humpty-Dumpty back together again, Egghead.com, Inc. (www.egghead.com/), has ceased operations. The company had been operating under Chapter 11 bankruptcy protection while it attempted to find a buyer, but its only immediate suitor, Fry's Electronics, Inc., withdrew from the deal because of Egghead's failure to provide required financial documents. According to the company, orders processed and confirmed before October 25th will be fulfilled, but others will be cancelled. **NV**

A PIC of A Power Supply

by TJ Byers

If you are serious about experimenting with PIC microcontrollers and their applications, then you need a serious power supply. This bench instrument will power all your PIC needs — present and future — and well beyond.



The PIC is fast becoming the microcontroller of choice among hobbyists and experimenters. Although the Parallax BASIC Stamp modules are popular with our readers, many hobbyists are discovering that the family of Microchip PIC single-chip microcontrollers offers a cost-effective solution for many state-of-the-art embedded applications. Why is the PIC becoming the microcontroller of choice? In a word, flexibility. As the technologies change, you'll find a PIC that's in step.

But as technology changes, so do the power requirements. As expected, the PIC is — and forever will be — compatible with existing five-volt technology. But did you know it's also capable of supporting the new 2.7- and 3.3-volt technologies? A whole new world just waiting to be explored.

In this article, I show you how to build a power supply that focuses on the specific requirements of the PIC and its impact on future technologies. With this bench instrument, there is no PIC experiment too complex or power-hungry that this power supply can't handle.

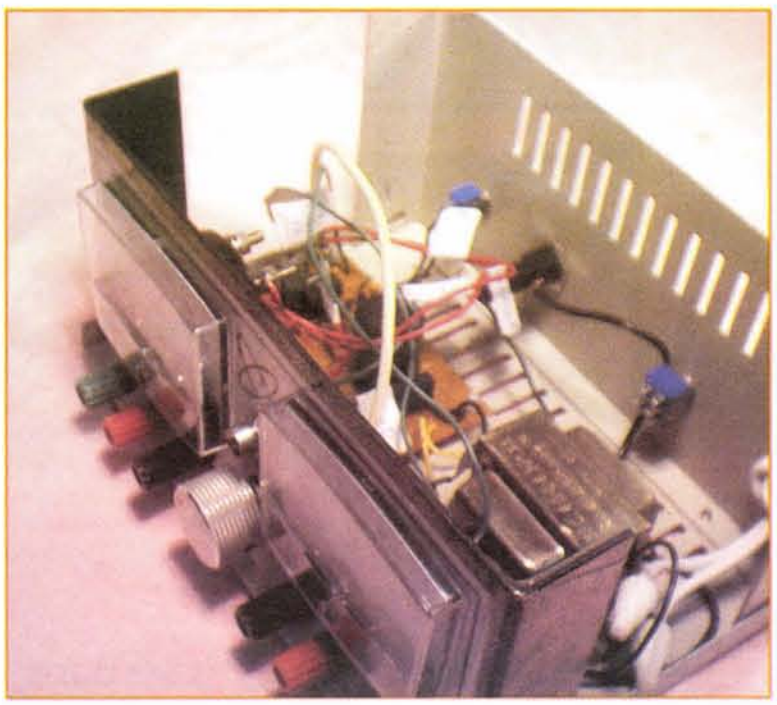
About The PIC Power Supply

The bench power supply described in this article provides the voltages and currents needed to power the most complex PIC designs, including attached peripherals, displays, and glue chips. First and foremost is a five-volt output that delivers a robust one amp that's the primary voltage source for the PIC — and most other support chips, like op amps, A/D converters, and interface chips (level translators, line drivers, etc.).

For those applications that need high-current voltages other than five volts — like stepper motors — there is a variable 0 to 15 volts output with a hefty 1.0 amps. While I say zero volts for the sake of this discussion, that's not the case. The lowest voltage the LM317 can attain is 1.2 volts.

However, I can't think of a reason why you'd ever want to dip below 2.0 volts — the lower limit for PIC operation — which also makes this output perfectly suited for 2.7-volt experiments at currents up to 1.0 amps. If you want to push it, you can pump out 1.5 amps for periods of up to five minutes (the transformer is the limiting factor, not the LM317 regulator). If you do push the envelope, allow a 10-minute cooling-off period between sessions.

There is a third voltage output, too — actually four, if you're counting. Most of the time, the 16F84 hums along nicely on just five volts. When it comes time to program the chip, though, an additional 13-voltage-source is required. This is where the third output comes into play. It provides 18 volts at 100 mA that most PIC programmers use as their primary power source. But like I said, the 13 volts is only needed for a short burst while programming the chip. After the 16F84 is programmed, the 18-volt source isn't needed or even wanted. It seems a shame to let an output go unused, but there's not a lot of call for 18 volts at a tawdry 100 mA. An auxiliary 12-volt output, on the other hand, would be most useful to power devices like sensors, disk drives, and voltage inverters — or a BASIC Stamp module. Well, guess what? Yep, this output is switchable between 12 and 18 volts.



Looking inside the prototype. The perfboard has since been replaced with the printed circuit board shown in Figure 2.

PIC Power Supply Specifications

Outputs

Voltage	Current
+5V	1A
0-15V	1A
+12V	100 mA
+18V	100 mA

How It Works

Operation of the power supply is pretty straightforward, but there are a couple of design twists that make it unique. Starting at the wall plug (Figure 1), the voltage is transformed via T1 to 18 VAC and rectified by D1, a full-wave bridge rectifier, and filtered by C1 to generate about 25 volts DC with no load. This is split three ways and routed to each of the output regulators.

The top regulator (7805) supplies the +5-volt output. It also powers the unlabeled "power on" LED (D2) indicator. C2 and C3 are used to improve transient response time and smooth out any residual ripple. The regulator is both thermally and current protected; if the chip gets too hot or exceeds maximum output current, the regulator shuts down. Which is why the output isn't fused. A short on the output simply turns off the regulator until

the short is removed.

The 0 to 15 volt output is controlled by the LM317 regulator. Basically, the LM317 is a variable voltage version of the 7805 described above. The output voltage is determined by the ratio of R4 and R6 using the formula

Vo = 1.25 (1 + R6/R4)

However, notice that R6 is paralleled by R2, which adds a variable factor to this ratio. Consequently, the actual resistance of R6 changes from 2.8k to 0 ohms (R = R2 x R6/ R2 + R6) as you twist the ADJ knob. Again C4 and C5 fine-tune the regulator's response characteristics. Meters M1 and M2 monitor this output's current and voltage, respectively.

The 18-volt output is the most interesting because of the way the dual output voltages are achieved. The internal structure of the 78L12 regulator is identical to that of the 7805, including temperature and over-current protection. The difference is that the output current is limited to 0.1 amp, or 100 mA.

Normally this regulator puts out 12.0 volts

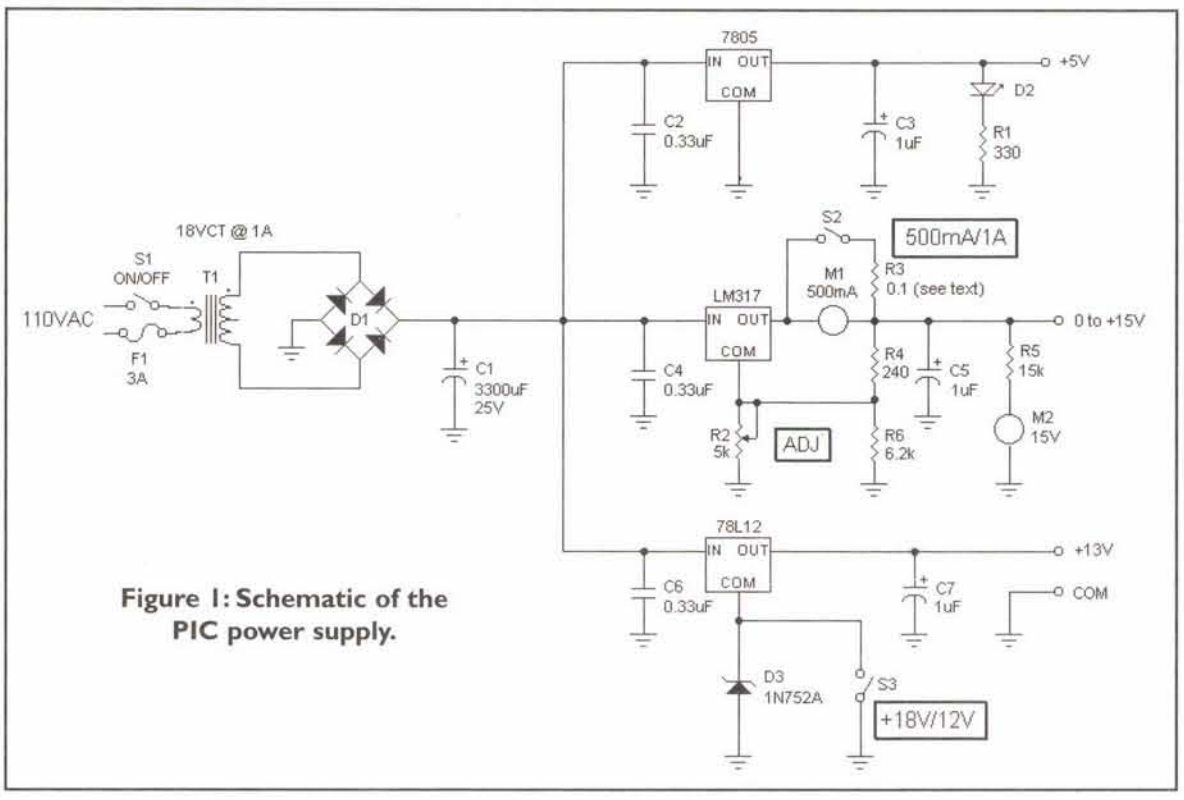


Figure 1: Schematic of the PIC power supply.

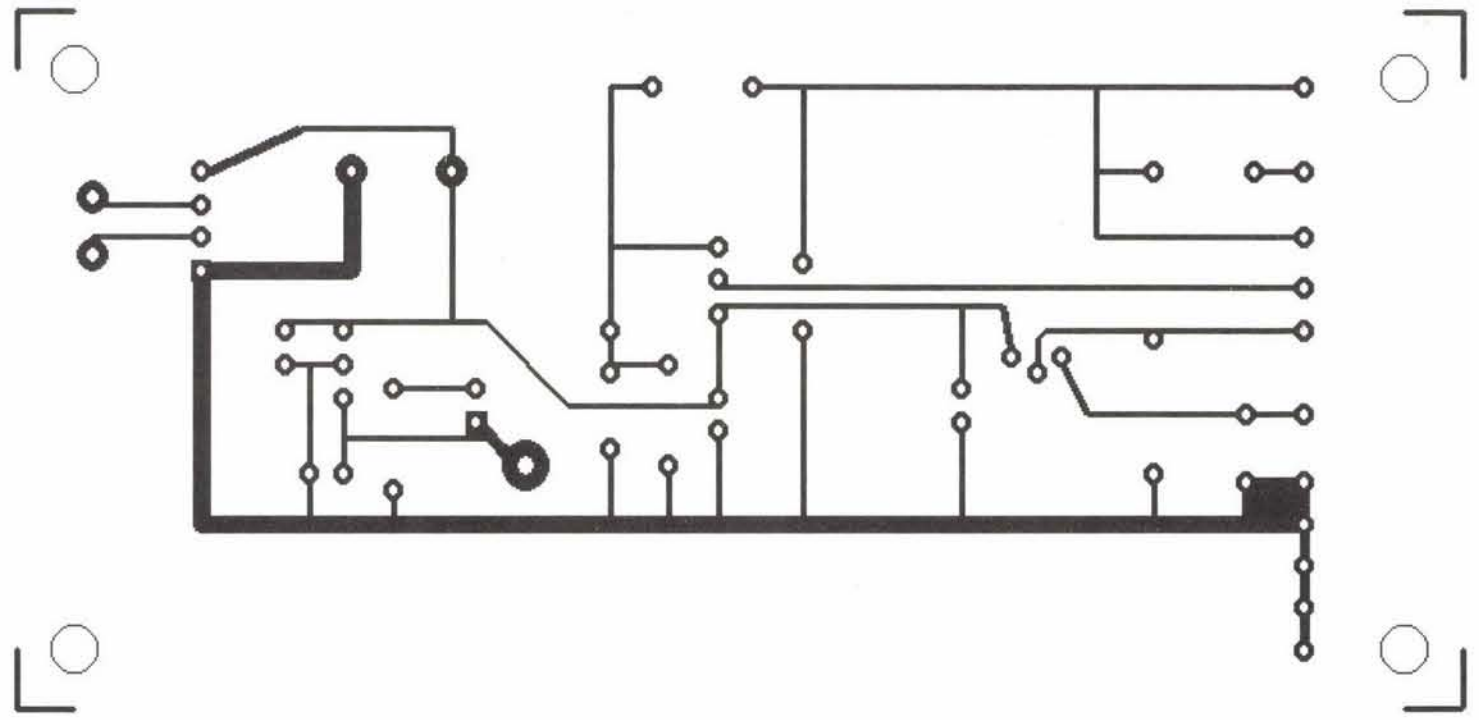


Figure 2: Foil pattern of the PIC power supply.

using ground (GND) as its reference. However, by raising the COM pin above ground, we can boost the output voltage by an amount equal to the offset voltage. In this design, a 1N752A diode (D3) creates a 6.2-volt offset, resulting in a 18.2-volt output. When this diode is shorted out via S3, the COM pin is again referenced to ground and the output returns to 12 volts.

Construction

Duplicating this power supply is easy using parts you can buy from Jameco and RadioShack. In fact, RadioShack is the sole source for these meters at an affordable price. Layout isn't critical, with the exception of a few critical capacitors, and can be constructed using any method you wish. The prototype shown in Photo 1 was built on a RadioShack perfboard. It wasn't until later, after extensive testing, that I committed it to an etched printed circuit board.

Figure 2 shows the foil pattern for the circuit board and Figure 3 shows the parts layout. As you can see, the regulator compensation capacitors (C2 through C7) are placed VERY close to their respective regulator — in fact, as close as possible. If you decide not to use the published circuit board, the same rule applies: Keep them close.

For the enclosure I didn't want something that would take over my entire workbench (which still has limited room in the garage even after we moved the car to the curb), yet a box sturdy enough to endure the rigors of everyday use. I decided on a 4" by 8" by 6" cabinet that I bought from Alltronics (see their ad on page 33). A major reason I chose this cabinet is because the front panel has to be large enough to accommodate both meters and the other front panel gadgets — like

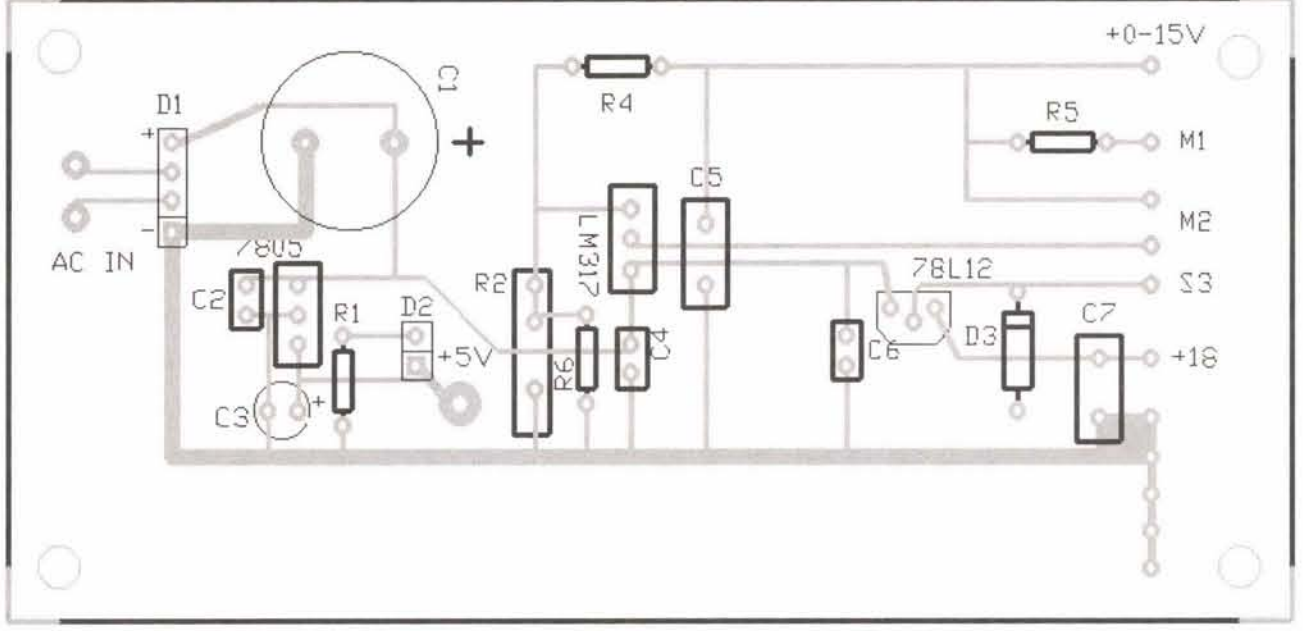


Figure 3: Parts layout for the PIC power supply.

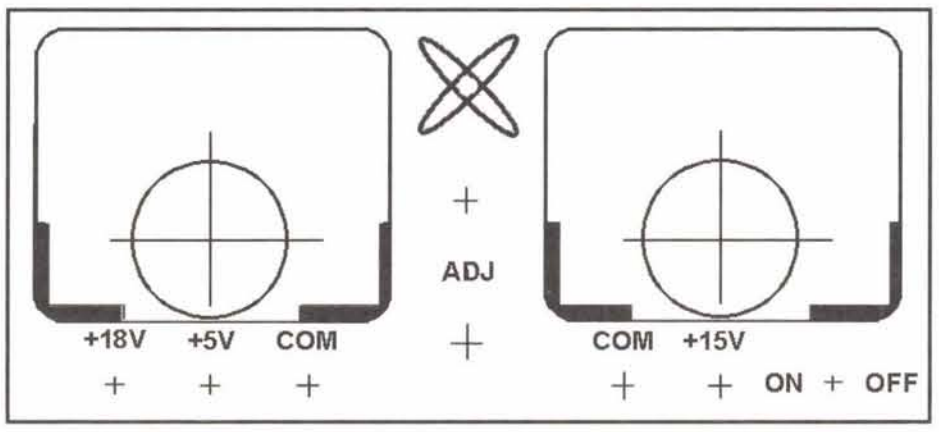


Figure 4: A drill template of the front panel for the PIC power supply. What I did was print this out and pasted it on the front panel of the enclosure that you see in the photo, then applied transparent shipping tape over the printout to protect the paper and create a glossy look.

Note - This template was reduced to 65%. Copy at 154% to return to original size, or, a full size copy can be found on our web site at www.nutsvolts.com

those pesky adjustment knobs, switches, and output jacks. During initial layout of this project, I soon discovered that you can't crowd this crowd onto a front panel that's smaller than four inches by eight inches (Figure 4). But any suitable enclosure will work — just make sure it has adequate ventilation for the heat generated by the linear regulators.

Ventilation? Yes, linear regulators are like resistors or light bulbs in that they dissipate all wasted power in the form of heat — power needed for the job at hand, but expendable like pawns in a chess game. For example, if the input voltage to the five-volt (7805) regulator is 20 volts (typical) and the output current is one amp, then the chip will need to "waste" 15 watts of heat — about that generated by a pair of night lights. No, that's not a lot, but when bottled up in a sealed enclosure, it becomes an oven (how many of you remember Barbie's Bake With Me oven, where kids could bake cakes using a 100-watt light bulb?). So, keep it cool.

Off the circuit board are S2 and R3. When I started this project, I wanted to use inexpensive off-the-shelf analog meters like those from RadioShack. Unfortunately, the only meter that comes close to the specs has a full-scale range of 500 mA. So to keep the meter from boinging itself to death, I installed a switch on the back panel (S3) that shorts the meter out.

Now the meter (M1) will still indicate a reading — just not one that represents anything that's on the dial. If you wish to calibrate this current to align with marks on the meter, you can adjust R3 using different lengths of wire between the switch and meter or whatever resistance you discover that works.

Three, Two, One ... PIC Power On

Are you done putting all the parts in place? No blue plumes of smoke? Cool! Then let's cut to the chase and see what you have.

Just because the specs say that both the +5V and 0 to 15V outputs boast one amp blasts, moderation is closer to the truth. Like all power supply ratings, the maximum power is the cumulative rating of all the outputs — let's call it wattage. Starting with the transformer, the best it can deliver is 18 VA (volt-amps) — roughly 18 watts.

There is no way both outputs can be outputting one amp at the same time. The transformer simply can't handle that (at least not for long). Split the output loads into 750 mA and 250 mA, which is more likely the situation, and there's no problem. All commercial power supplies are rated this way.

What I like best about this power supply, and the reason I created it, is that it replaces a handful of clip-leads and wobbly breadboard components. Moreover, it gives me the power I need to play with the next generation of low-voltage ICs. Isn't it time you jumped on the new technology bandwagon, too? **NV**

PARTS LIST

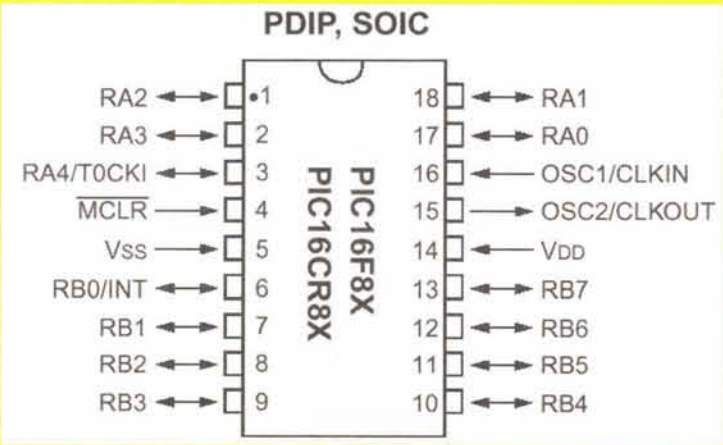
Resistors
R1 -- 330 ohms
R2 -- 5k potentiometer
R3 -- see text
R4 -- 240 ohms
R5 -- 15k (comes with M2)
R6 -- 6.2k

Capacitors
C1 -- 3300uF, 25V
C2 -- 0.33uF
C3 -- 1uF
C4 -- 0.33uF
C5 -- 1uF
C6 -- 0.33uF
C7 -- 1uF

Semiconductors
D1 -- 50V, 4A bridge rectifier (276-1146)
D2 -- LED with holder (276-069)
D3 -- 1N752A
7805
78L12
LM317

Misc.
M1 -- 0-500 mA panel meter (22-414)
M2 -- 0-15 VDC panel meter (22-410)
S1-S3 -- SPST (275-634)
T1 -- 18VCT @ 1A
Fuse holder
Heatsink (276-1363)
Knob
Nylon five-way jack
Enclosure

The most popular hobbyist PIC in use today is the 16F84, an eight-bit processor that sells for about $6.00. This 18-pin chip sports 1K of flash memory and clips along at clock speeds of up to 10 MHz. The 16F84 operates over a wide voltage range of 2.0 to 6.0 volts and typically draws 2 mA at 5 volts; less than 1 uA in the standby mode.



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reader FeedBack

Dear Nuts & Volts:

I'd like to start out by telling you how much I enjoy your magazine. I'm relatively new to electronics as a hobby and look forward to each new issue. However, I feel that I must comment on the article on "Gravity, Inertia, and the Electromagnetic Spectrum — Part 1."

I would ask that Part 2 of this series provide a more balanced approach on the current state of ZPE research (or physics research for that matter). From reading the article, you would get the impression that the ZPE theories put forward by Dr. Harold Puthoff have been universally accepted. However, I have been unable to find the support in the mainstream physics literature for these theories. I anxiously await the names of the peer review magazines that this research has been published in so that I can update my electromagnetic spectrum chart to include Inertia waves (WHAT????) and participate in the FCC auctions for spectrum at the gravity wavelengths.

Hey guys, we have not successfully DETECTED gravitational waves, their existence is IMPLIED. Perhaps this was a mislabeled science fiction short? As I stated above, I am new to *Nuts & Volts*, but I get the impression that your readers are down-to-earth, skeptical, engineering types. If that's the case, here's a few things you might want to know about the article's major source of information, Dr. Harold Puthoff. In addition to ZPE, Dr. Puthoff has also been involved in several other dubious activities over the years; headed remote viewing experiments in 1970 (psychically viewing Russian military installations), claimed Uri Geller had genuine Telekinetic powers, believes that UFOs regularly visit the earth, and often reviews books on this topic. He's a regular smorgasbord of pseudoscience.

I would ask that your readers make up their own minds on this subject, but be aware that all is not as it seems. The internet is full of intelligent people pushing crackpot ideas that have little foundation in reality. I don't have a PhD, but I do have a B.S. in Engineering Physics. Something smells.

M.A. Curtis, Loganville, GA

Dear Nuts & Volts:

In the AVR microcontroller article in the August 2001 issue, the STK200 starter kit is listed as being available from Digi-Key. As of this writing, I am told this development system is obsolete and the STK500 is replacing it.

Dan P. via Internet

Editor's Note

In the November 2001 issue, the Figure 1 schematic in Don Powrie's article on USB-Microcontrollers For The Masses was inadvertently altered during our production process and is unusable in its printed form.

A replacement file of the diagram is available on our website for download at www.nutsvolts.com. We apologize for any inconvenience this may have caused.

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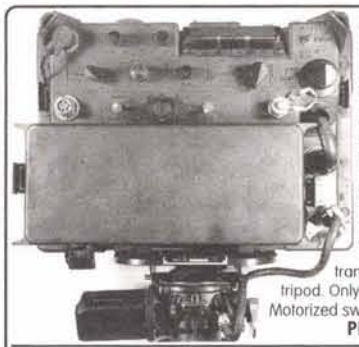

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High performance auto iris lens, 12mm, f1.2...$199ea.

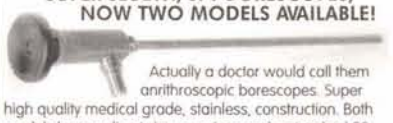
ULTRA RESOLUTION & HIGH SENSITIVITY, SCIENTIFIC QUALITY for demanding applications.

Type GM-6000, offers 410K pixels, 570 Lines resolution, < 0.1 LUX sensitivity. >45db s/N with AGC off. Access all operating parameters, outside the camera! C or CS mount. Adjustable shutter speed from 1/60 to 1/100,000sec, BLC on/off, AGC on/off, gain auto/off., Auto iris selectable, DC/Video with level control, external/internal sync. 24VAC powered, adapter included. Video out on BNC. Industrial quality metal housing.Just the thing for scientific or low light. **SPECIAL, GM6000.....$199ea.**

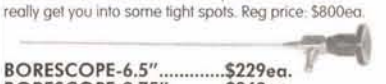
DAYLIGHT/LOW LIGHT MINI CAM & A/I LENS,

For dawn 'till dusk applications. Rugged alum. housing, dual mtg. sockets. 1/3" CCD, 420 lines res., 0.1 Lux sens., AGC, 12VDC @120mA. Take full advantage of camera sensitivity with super, 4mm, f1.4, 78° FOV Auto Iris lens included. BNC video out. 50mm sq. X 65mmL. With pwr. adapt. **GM-510A/I...$179 or 2/$349**

SUPER SLUETH, SPY BORESCOPES, NOW TWO MODELS AVAILABLE!



Actually a doctor would call them anrithroscopic borescopes. Super high quality medical grade, stainless, construction. Both models have a direct view eyepiece and a standard 90 degree external light port. The unit pictured above is constructed with a 6.5" long X 7.5mm diameter tube with the objective end optic angled at a 30 degrees for easy viewing of surrounding area. The second style, shown below offers a 9.75" long tube with an amazingly small, 2.2mm in diameter with a flat objective end. That could really get you into some tight spots. Reg price: $800ea.



BORESCOPE-6.5".....$229ea.
BORESCOPE-9.75".....$249ea.
BOREPAIR-6.5"+ 9.75".....$450 per set.

TECH SPEC" R/A PRISM.

New in the box. Edmund Optical P/N 32536. A very nice, BK7 prism in a size large enough for display of demonstration purposes. Angle accuracy ± 5 Arc min., Reg price, $135ea. Limited Quantity.

SPECIAL, PRISM-32536....$35

NEW! WEATHERPROOF B&W mini TUBE CAMERA Industrial strength, solid machined housing.

Sleek black anodized, BRASS, housing is O-Ring sealed & WATERPROOF. Adjustabe mount included. Specs: 1/3" CCD, 400 Lines resolution, 0.05 Lux sensitivity, AGC, Auto Shutter. Operates on 12VDC @200mA, 4mm, 78° FOV lens, A real glass lens. NTSC video out. Superior construction. SENSITIVE to IR. Ultra small Size only: 1.25" diam. X 2" long. With 60 ft. cable. Great for outdoor use too.

NEW, GM300K-N.....$99

COLOR, UNDERWATER, CCD CAMERA, (down to 60 ft.) Now with 12, Built-in SUPER, WHITE LIGHT LED'S,

Sleek black anodized, BRASS, housing. O-Ring sealed & WATERPROOF. Adjustabe mount incl. Specs: 1/4" CCD, 350 Lines res., 0.5 Lux sensitivity, AGC, Auto Shutter. 12VDC @220mA, 4mm, 78° FOV Lens, A real glass lens. NTSC video out. Superior construction. Ultra small Size only: 1.25"diam. X 2" long. With 60 ft. cable. Perfect as a COLOR remote area inspection camera. Now with TWELVE, super bright, white LED'S! BRAND NEW,

GM400K-12 with LEDs.....$229ea.
or GM400K-N without LEDs..$199ea.

NEW! UNITEK, REFLOW SOLDERING POWER SUPPLY, type PHASEMASTER IV,

A single phase, resistance heating control with a time-at-temperature feature. The system is used for reflow soldering as well as resistance brazing and other heating processes which can be monitored via a thermocouple. Presettable parameters include: proportionally controlled heating current, temperature set point, at temperature period, auto release of air actuated reflow head, (head not included) preset release temperature. System is microprocessor controlled offering several modes of operation. Operation is via a 20 key keyboard with readout via a 2 x 40 LCD display. Maximum output current is 15Amps with 50% duty cycle. System is new in the box. Includes Unipulse X5 transformer as well. This is a lucky find. Only one. **UNITEK-PM4.....$950**

SPECIAL, PRICE BUSTER, PANASONIC, M-A100-PJ, COLOR, CCD CAMERA, ALL ACCESSORIES SUPPLIED!

Originally destined as the video camera, in a major brand conferencing system. Now available for a fraction of its' original price. Great looking styling. Camera has a very stable, manually adjustable pan and tilit base. Front panel LED power indicator. Excellent video performance packaged in a sturdy 2.9"W x 2.9"H x 4.8"L, 11 oz. package. Simply connect camera to any "Video Input." with the RCA cable supplied. Camera has 5.6mm lens with fixed focus from 18" to infnity. No adjustment required! Power is 12VDC from power adapter also included. 1/3" CCD, 330Lines resolution 37% better than standard VHS! Auto white balance. Externally adjustable sensitivity. Perfect for any general purpose video application. Brand new, in original sealed boxes.

NEW, COLOR CAMERA, 100PJ-CCD...$59ea. 3 for $149

NEW, TRIPLE OUTPUT, 60W, POWER SUPPLY

Astec model: SA40-1313, outputs of +12VDC @ 3Amps, +5V @ 5Amps and -12V @ 350mA. 110VAC input. Very compact size: 3"W x 5"L x 1.3"H Perfect for many hobby applications as well as an external disk drive power supply. **ASTECPS,...$4ea. or 6 / $20**

UNUSUAL, DUAL ROTARY MOTION TABLE offers 2 independent drives with 0.02° per step!

A heavy duty, 23"L x 15.25"W x 5/8" thick, black anodized alum. panel serves as the base for two concentrically aligned, rotary motion units. The outer, "platter" is 13" d x 0.1" thick blk. anodized alum. Drive is via a toothed belt & direct coupled 3.2" toothed pulley, driven by a stepper mounted 1/2"diam. pulley. Stepper is: 2.2" d, size 23, 1.8° / step, 5V@1Amp, 4 wire. The inner "platter" sits 2.7" above the 13" platter. Its' outer diameter is 4". An additional raised center section of 2" diam. elevated 1" above the 4" diam. can act as a "hub" The inner platter drive is via a toothed belt & direct coupled 3." toothed pulley, driven by a stepper mounted 1/2"diam pulley. Stepper is: 1.5" sq., 1.8° /step, 4V@1Amp, 4 wire. Steppers are fully independent allowing. The large base provides the perfect area to "breadboard" your mechanical marvel. Removed from new equipment.

SPECIAL, DUAL PLATTER....$49ea.

Circle #42 on the Reader Service Card.

NEW, 470 LINE "DSP COLOR Micro CAM" The HIGHEST PERFORMANCE available. MICRO SIZED PACKAGE too!

Yes 470 lines with a 60db S/N ratio to back it up! That's 16X better than a typical 46dB standard camera! The GM-4500, CCD camera with its' DSP technology provides high speed white balance with no color rolling. Auto shutter speed of 1/60 to 1/120,000 second. Truly state of the art. Sleek cast aluminum housing protects the 18mm x 26mm pc board inside.Mounting bracket & 18" cable with BNC video and DC pwr. jack for, no sweat hook up. requires only 12VDC@ 65mA. Optional mirror function available. Why fool around with an open P.C. board? This camera has it all. • 1/4" CCD • 1 Lux • AGC • Auto Shutter • 270k pixels • Std. 3.7 mm, 68° FOV lens • Focus:10mm to infinity • 3<ounce! • Size (mm): 33W x 29H x 30D

GM-4500-STD, SPECIAL...$99ea.

WEATHER RESISTANT Camera Enclosure, Solid, extruded aircraft aluminum. Glass window.Strain reliefs for cables. Size: 3.5"w x 3.7"h x14"L, New. Perfect for our new "Night vision cameras" **ENCL-B.....$55ea.**

Adjustable Heavy Duty Mount.....$19ea.

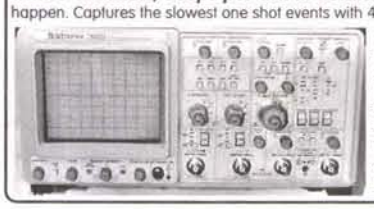
A NICE ASSORTMENT OF CO_2 and YAG OPTICS TO MAKE YOUR LIFE EASIER! All NEW and factory boxed first quality, BK-7 glass or ZnSe.

ITEM #	NAME	DESCRIPTION	MISC.
RP10-02	RISLEY PRISM	1deg. AR @1064 & 540 to 650nm	Aligninment/multi wavelength path.
RP10-03	RISLEY PRISM	1deg. AR @450 to 650nm	Aligninment/multi wavelength path.
BS10-01	BEAM SPLITTER	AR @45deg. for 1064nm	YAG or CO_2 High Power
BS01-02	BEAM SPLITTER	AR @45deg. for 1064nm	YAG or CO_2
DUAL-01	MIRROR/HT-HR	HT @45deg. for 532nm, HR for 1064nm	High Power
PLCV-01	DUAL FREQ LENS	HT for 1064 and 6328nm >98.5%, 113mm	Focus C02 & HeNe ZnSe

Order by Item Number. All models priced at $19ea. or 2 for $35

SPECIAL PRICE, 350MHz, TEKTRONIX 2467, MICRO CHANNEL PLATE CRT! with 4 Channels, 500ps per div. in normal room light.

Displays intermittent variations as they happen. Captures the slowest one shot events with 4ns per division a 100 fold increase in the visual writing rate over conventional CRT. Features: 1 ns rise time, 500ps/Div time base, 2mV/Div. vertical sensitivity at 350MHz, 20ps time interval resolution, 1Mohm / 50-ohm input, 500Mhz trigger bandwidth, four channels. On-screen waveform cursors provide vertical & horizontal scale factors, trigger level, voltage, time, freq., phase, ratio values and mode indication. With 2 probes, pouch and manual. EX. cond. 90 day warranty.



New..$12K Now SALE, TEK 2467.....$2295.

AAEON, 486-DX-4-100MHz, HALF SIZE CPU CARD.

SBC-455, HALF SIZE CPU CARD. Perfect for EMBEDDED APPLICATIONS

Brand new and in their original manufacturers boxes. Each package includes five 3.5" floppies with VGA and LCD drivers. A set of interface cables for the keyboard, mouse, serial and parallel ports. A comprehensive 88 page manual.The SBC-455 is an industry standard half size PC/AT compatible ISA-Bus card. Our configuration includes an Intel 486-DX4-100 CPU and 2MB of DRAM. The on-board PCI-bus, flat panel/CRT SVGA controller uses the CHIPS 65548 chipset. High speed local bus IDE controller for mode 3 or 4 hard disks. Compatible with CD-ROM, tape and other IDE devices. (Up to four) On-board features include two high speed RS-232 ports with 16C550 UARTs, one bidirectional SPP/EPP/ECP parallel port and a floppy controller. (up to two) In addition to the 486's 16KB of on-chip cache, the SBC-455 includes an extra 128KB of on board cache. Two 72 pin simm sockets for up to 64MB of DRAM. AMI flash bios. Daughter board available from the manufacturer for various flat panel displays. Watchdog timer on board. Connectors for PC/104 modules. "Green " power management support. Clear CMOS function.

SALE SPECIAL, SBC455.....$69ea.

SONY, ROBOTIC COLOR CAMERA, 450Line, 8X ZOOM, NTSC & S-VIDEO OUT, Serial Control of Pan, Tilt and Zoom, Auto Iris and Auto Focus!

Five user presets alow one click "go-to" scenes with pan, tilt and zoom for each in memory. (Under software control) Like having your own R2D2. Intended for use in fortune 500 board rooms. The video performance is stunning. Superior to almost anything we have seen. Camera and lens is an integral assembly. Excellent condition. Rugged black ABS enclosure. 8 pin mini-DIN & Std. SVHS jack. Size: 8"Dx6.5"H. With software and serial cable for remote control. Reg price over $4K. Limited quantity **PICTEL-4K....$399ea.**

NEW! 0.01 Lux, COLOR NIGHT VISION CAMERA! FANTASTIC LOW LIGHT PERFORMANCE. Exclusive ON SCREEN, menu driven setup of all camera parameters. NEW, STATE of the ART, GMV-35KOSD,

Perfect for covert, military & scientific applications that must be color. Unbelievable 0.01Lux @ f1.2 performance is enhanced through low speed electronic shuttering, digital frame integration & advanced DSP. Auto sensitivity mode starts as it becomes dark. 24 hour surveillance is possible with the optional f1.2 lens shown below. Specs: Shutter speed auto or manual, 1/60 to 1/120,000, 60dB S/N ratio!, 154dB Smear rejection!, AGC gain 0 dB to 18 dB. Digital gain 0dB to 12dB. Digital zoom continuous from up to 2X in 0.1X steps. Masking mode allows hiding 4 programmable zones for privacy protection. Camera on screen name. Choose you own name for the camera and display it on monitor for easy identification.) White balance modes: Auto tracking, one push or selection from 3200k, 4800k, 5600k, 7800k, and "double white balance" independent white balance circuit for both bright and dark zone, maintains correct white balance even with combined indoor and outdoor lighting. Programmable 48 zone back light compensation mode for difficult lighting situation. Negative mode for negative film reading. Mirror image and up/down selection for rear view and camera mounted upside down. Seven Gain/Shutter modes are user selectable. Normal, X2, X4, X8, X16, X24, X32, X64. These provide frame rates of 60, 30, 15, 8, 4, 3, 2, and 1 per second. Alum. housing, dual 1/4x20 mtg. Specs: 1/2" CCD, 811(H) X 508(V), with 412K pixels, 470 Lines, 12VDC ±1V@250mA, Std. video out on BNC. Std S-Video out on 4Pin connector. Size: 2"H x 2"W x 4.5" long. Regulated power adapter included. C-mount lens not included.

SALE, GMV-35KOSD.....$399ea.

High performance lens, 12mm, f1.2...$69ea.

UNITED WE STAND

A VIDEO MICROSCOPE in the PALM of your HAND! NEW, MAGCAM, VIDEO INSPECTOR, OFFERS HIGH POWER and LOW COST. Two optical magnifications at the flick of a lever. Choose either 40X or 140X.

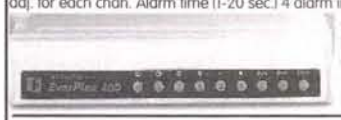
A high quality, digital, color CCD camera, with dual optical magnification settings and built in object illumination via two ultra bright, white LED's. Entire system is fully integrated into a rugged and ergonomically designed, hand held unit only 2.7"W x 3"H x and 1.8"D Video output is standard NTSC via a RCA jack. 12VDC powered. CCD provides 380 lines of resolution and 0.8lux sensitivity .. Complete with power supply and 3 foot RCA cable. A fantastic and useful device for inspection, diagnostics and observation of small objects. Perfect for SMT inspection.

SPECIAL, GM- MAGCAM....$199ea.

NEW, DAY/NIGHT TECHNOLOGY, OPTIMIZED COLOR / IR OPTICS DSP technology and 10 Automatic LED's. Weather Tight GM450K-IR Makes it Happen

Features include: Interactive infrared illuminator with 10 high power, wide angle LEDs @ 880nm . See objects 60 feet away during total darkness. A super quality 5 element, glass lens, specially coated with a 100 layer optical coating. For perfect focus with white light and a crisp image under infrared. Normally impossible due to the different focal point for IR and visible light. Solid state infrared optical switch provides day time IR cut filter for excellent color. At night infrared filter will turn off to allow infrared to pass. Also, night time IR LEDs will gradually turn on with proper amount of illumination. You can also see color images such as lights and signs at night. Fog free cover glass. Specs: 0.5 lux color sensitivity. 60dB S/n ratio typical. 12" I/O cable with BNC video and DC barrel jack. 120 dB smear rejection ratio. Adjustable mount and C power adapter included. **GM450K-IR.....$199ea.**

B&W QUAD PROCESOR, The GM4-BQ is an unbeatable value. Four camera inputs with loop through. Full screen image, REAL TIME display, high resolution: 960 x480, brightness adj. for each chan. Alarm time (1-20 sec.) 4 alarm inputs. Auto Sequencing mode with adj. dwell:1-4 sec. Quality video processing. Specs: •4 video inputs. •1 monitor out and VCR in/out, •4 alarm inputs •Buzzer •2 Alarm Out •Dim: 239 x166 x55 mm.



GM4-BQ QUAD.....$169

MOTORIZED, INDOOR PAN & TILT with CONTROLLER NEW, PT100-C provides dependable motion control.

SPECIFICATIONS:
Movement range: 350° Pan, +/–60° Tilt
Pan:4° /sec., Tilt: 3°/sec Load rating:
Pan: 7kg, 15lbs., Tilt: 4kg, 8lbs.
Pan: continuous, Tilt: intermittent
Cable req'd.: 6-conductor, unshielded
Input voltage: 117VAC@ 0.02A, 6 watts Operating temperature: -25°C to +60°C
Construction: aluminum and plastic
Dimensions: 184H x 115mm diam. Weight: 1.9kg

SPECIAL.....$289 set

NEW, LINEAR BALL SLIDES from DCI, Three models available: The large is 6"L x 2.6"W x 1"H with 4" of travel. The medium is 5"L x 2.6"W x 1"H with 3" of travel. The small is 1.75"W x 1.75"L x 0.75"H with 1" of travel with a removable spring return for use against a micrometer or similar. Features common to all include: Solid machined aluminum with anodized construction, hardened steel ways. Slides are usable in any position and can carry heavy loads. Over 100lbs for the large and medium and 25lbs for the small. Straight line accuracy of 0.00008"/inch of travel. All are new. Limited quantity.

DCI-LONG.....$79ea.
DCI-MEDIUM.....$69ea.
DCI-SHORT.....$45ea.

ORDERS. 800.810.4070
Tech 603.668.2499

RESOURCES UN-LTD.

Fax 603.644.7825, All CCards, COD,
300 Bedford St. Manchester, NH 03101
WWW.RESUNLTD4U.COM

NEW, MINI LASER PATTERN PROJECTOR and IT'S PORTABLE TOO!

PRODUCT FEATURES:
• Built-in microprocessor control. • Approximately 40 patterns. • Spinning and geometric laser displays • Pattern modes: Auto, Manual, & sound control. • Wireless remote control. • Laser patterns can be easily projected in any direction. • Battery or AC powered. • 4 x "AA" batteries & AC adapter incl. • 635nm Class II laser for excellent visibility. • Laser patterns change rhythmically to sound input. • External sensitivity control for sound mode. • Dimension: 16.0cm(L) x 15.0cm(W) x 9.0cm(H) • Weight: 600Grams. (Incl. batteries.) • Range: 12meters • Approximately 4 hours run time from batteries.• Warranty 1 year.

LASER SHOW-2 SPECIAL.....$79ea.

FREE, NEW! HELIUM NEON LASER TUBE! DON'T WAIT and be DISSAPPOINTED! FREE! with a $50 purchase! This month only!

Output Pwr Typ.	1.0 mW	Max.Starting Voltage	10 kV dc
Wavelength	633 nm	Typ. Operating Lifetime	15,000 hours
Beam Diam.	0.63 mm	Overall Length	9.6 inches
Beam Div.	1.3 mrad	Diameter	1.0 inches
Voltage (±100)	1000 Vdc	Note: We do not have power supplies.	
Current (±0.1)	4.1 mA		

ASK for HENE-1MW

END FIELD of VIEW GUESSWORK! 3.5 to 8mm VARI-FOCAL LENS

Brand New, super f1.8 lens allows you to smoothly adjust from a 97 ° FOV @ 3.5mm to a 44° FOV @ 8mm. Now you can frame your area of interest just the way you want it! Standard CS-Mount with adjustable focus and iris. **SPECIAL.....$79ea. or 2 for $150**

LCD, 128 X 64, GRAPHIC PANEL

Varitronix, MGLS128-64T-G-HT-HV, 128 x 64 pixel module. Std. Toshiba T6963 driver, 8 bit parallel interface. Module size: 78mmW x 70mmH x 10mmD, Viewing area: 62mmW x 44mm H. Dot size: 0.39mm x 0.55mm, Dot pitch: 0.44mm x 0.60mm, with data. Removed from new equipment.

LCDMGLS128..$24ea. 3/$69

QUAD FIBER OPTIC LIGHT PIPE UNIT

A unique experimenters find. High quality, glass, super flexible light pipes. Four 15" long, steel armored "fingers" are terminated and polished on one end as a 0.46"OD x 0.036" ID bundle. At the opposite end bare fibers from each bundle ar fanned to provide a straight line output which is 9" long x 0.032" thick. Terminated at a convenient alum. plate. Assembly is 21" in length overall. Excellent condition. Removed from equipment. Ltd. Qty.

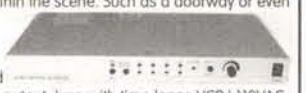
LIGHT-PIPE-4.....$29ea. or 2 for $49

SALE on ALL TYPES of COVERT CAMERAS, all available with audio,

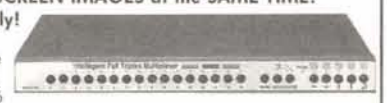
Specification for all models include: 1/3" CCD, 410 Lines Res., 0.3 Lux sensitivity, Power from 9 to 12VDC @100mA, 90° FOV lens except dome and PIR which are 80° , All focus from 2 ft. to infinity. Standard NTSC video out. SENSITIVE to IR. note: Smoke & Motion detectors not functional, Clock & Exit operate normally. Don't see what you want? We can put a camera in anything you desire.

Smoke Det., Motion Det. or Clock Camera, Special...$69ea.
Exit Sign, Special.....$79ea. Please add $10 for audio. (any model)

BRAND NEW, VIDEO MOTION SENSOR. The model VM-10 connect to any standard video signal and you've got an electronic "watchman" diligently watching the entire scene. Or any adjustable sized area within the scene. Such as a doorway or even a drawer or cabinet. A state of the art security aid. The unit will close a contact when it senses a change. Auto or manual reset. Internal buzzer with volume control and adjustable on time. VCR record and VCR stop output. (use with time lapse VCR.) 110VAC powered. Adjustable sensitivity. Video loop through. **NEW, VM10.....$179ea.**



NEW! TRIPLEX, COLOR or B&W, DIGITAL VIDEO MULTIPLEXER, OUTPUTS up to 16 FULL SCREEN IMAGES at the SAME TIME! Records ALL Simultaneously!



The GMUX-16 is a feature rich Triplex multiplexer. Triplex gives the ability to Watch, Record or Replay, all at the same time! The GMUX-16 offers stunning performance and flexibility in a feature packed piece of industrial strength video equipment. The self contained unit is compact and can handle up to 16 channels in color or black and white. Both of which can be freely mixed. It's high performance allows you to dispense with two 8 way quads or multiplexers at a stroke, simply leave the unwanted channels unplugged until expansion is required. Simple On-Screen, menu driven set up. 720 X 240 pixels at a refresh rate of 30 fps in full screen mode and 2 fps in complex or 16 way mode from its 60MHz processors. Alarm management is comprehensive with day/night options, up to 100 log entries, and that's for each camera! Dual monitor outputs, dual VCR input/output. Standard composite and S-Video I/O for VCRs, N.C/N.O. Relay alarm outputs. 16 channels of alarm input. Time and date. Front panel mounted switches are tactile and easy to operate. Don't miss this one.

NEW, GMUX-16.....$829ea.

Circle #42 on the Reader Service Card.

News Bytes

Local Builders Host Robot Rumble

The Northeast Robotics Club is sponsoring a Combat Robot competition to be held on Saturday, March 23 and Sunday, March 24, 2002, between 10:00am and 6:00pm, at the East Coast Hobby Show, located at the Fort Washington Expo Center in Philadelphia, PA.

Upwards of 30 robots built by people from all over the country will be entered in this competition, which promises to deliver a thrill a minute as these metal monsters clash in the club's two-ton custom-built combat arena. This 16x16 foot behemoth is capable of safely containing anything the robots can dish out.

Robots will be on display for the public to view, and many builders can be witnessed repairing their 'bots between fights. Time permitting, members of the press will be invited to take the controls and put several of the 'bots through their paces.

The NERC is a rapidly growing group of robot builders with a membership centered on the Philadelphia region. You may have seen similar robots on shows such as Battlebots™ or Robot Wars™. While they may be smaller, rest assured that these 'bots are no less destructive than their bigger cousins.

For more information, contact: Ed McCarron @ 610-583-6136 or email: emccarron@robotconflict.com.

Newest Robot Store Catalog Unleashes New Robot Pets, Bugs, and Smart Toys for Smarter Kids!

It used to be if the box received more playtime than the toy, that toy failed. With today's "smart toys," if the toy does more learning than the child, that toy also fails. And the loss goes far beyond the price of the toy. RobotStore.com stocks a multitude of great robot-related products that expose curious minds of all ages to a wide range of really cool topics.

Fifteen-year-old Mondo-tronics, Inc. — home of the biggest selection of hobby robot kits, books, toys, and more — has released their new Robot Store catalog, which includes a fascinating array of interactive robots such as the new B.I.O. Bugs, the unstoppable Desktop Rover, life-like Kinetic Dragonflies, new species of butterflies, and a pet shop's worth of robot dogs.

Desktop Rover — Tiny R/C Tank

Go forth and conquer! Inspired by NASA Planetary Exploration Missions, the Desktop Rover lets you explore "alien" landscapes remotely. Independent left and right tracks let you spin and maneuver in all directions. With plenty of torque, you can climb over obstacles with ease! Also includes a built-in "laser tag" game for two or more Desktop Rovers. Hide behind the soda cans and pop out for a surprise attack! Available in four different channels, so up to four Rovers can battle it out for desktop dominance all in the safety of your own home. Pocket-sized for easy transport to new worlds.

New Home for Sony's AIBO

Robot Store now offers Sony's amazing AIBO ERS-210 Entertainment Robot. It grows, learns, responds to voice commands, shapes, and images, and much more. Robot Store offers the entire line of AIBO ERS-210 products, and has an extensive set of information on line. For a good laugh and an example of the limitless fun to be had with AIBO, check out Cliff and

Tony Thompson's AIBO home movie called "K-9 vs. Thunder Lizard" at http://homepage.mac.com/tonitt/iMovieTheater.html.

AIBO also responds to over 50 spoken commands like "stand," "kick the ball," "dance," and "karate chop." AIBO learns from its experiences, positive and negative reinforcement, and develops a unique personality. Please download our AIBO.PDF file for tons of additional information and accessories. We want to be your AIBO source and our low prices prove it!

i-Cybie Arrives!

If your budget draws you toward other robot pets, there's an alternative robot dog — i-Cybie! The hot and long-awaited i-Cybie includes 16 motors for a wide range of amazing motions, plus a sophisticated artificial intelligence system that lets your i-Cybie develop its own unique personality.

Voice recognition software that actually responds to your verbal commands! Plus sound and light effects, interactive and remote control modes, and much more.

Robot Insects Swarm!

New breeds of robotic life forms from B.E.A.M. creator and robotic pioneer, Mark Tilden, have also newly emerged. Rambunctious, noisy, and aggressive, they're a "Revolution in Evolution." Each Bug contains "nervous network" circuitry that reacts to the world much like a living insect. They actually walk on their four legs, exploring and interacting with their environments. Plus you can take control via the included remote unit. Like all living creatures, they want to "eat" — they "feed" off the signal from the remote, as well as anything else that emits infrared — like the TV control or even fluorescent lights!

The four different species of Bugs have different behaviors and levels of aggression, and they can recognize and react to each other. Bugs of different species will actually fight for dominance, scoring points on each other, and even calling for help from their teammates!

Silent Life-Like Bugs!

The new Kinetic Dragonflies move with incredible realism due to the Flexinol™ Muscle Wires® a unique motorless way to create silent, life-like motion. Plus, we're offering three new styles of Kinetic Butterflies, "Ulysses," "Urania," and "Meridion" join the two styles of dragonfly, "Blue Dragonlet" and "Halloween Skimmer." Muscle Wires also made their way to Mars aboard the Pathfinder/Sojourner mission in July 1997 to help measure dust build-up on the surface of the rover.

Mondo-tronics just celebrated its 15th anniversary of bringing innovative, education and fun products to curious minds of all ages. The new Robot Store Catalog #22 can also be downloaded as a .PDF file from the RobotStore.com website.

For additional information, to request a free catalog, or place an order, please visit Mondo-tronics' website at www.RobotStore.com, or call toll free at 800-374-5764 from 9am-5pm, Pacific.

Chicago Tech Companies Launch Emergency Asset Management System to Support NY Disaster Relief Efforts

2Xchange, a Chicago software company specializing in web-based asset management and redeployment technologies, has launched the Emergency Asset Management System (EAMS), in conjunction with divine, Inc., and DaVinci Software, Inc., Chicago-based technology companies and co-sponsors of the initiative.

EAMS, a web-based system (www.eams.org) that makes it easy for businesses to contribute to relief efforts while helping agencies in need to quickly and efficiently secure the goods and services they require, has been launched to aid the ongoing disaster relief efforts in New York.

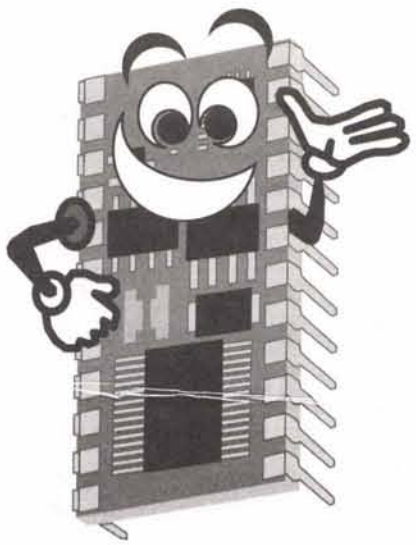
It is estimated the recovery efforts will take as long as 18 months. That means there is an ongoing need for donated goods and services.

The web-based EAMS platform, powered by software developed and implemented by 2Xchange, allows corporations to post listings of assets that they are donating to the relief effort on the EAMS web site. New York City and State agencies and the Federal Emergency Management Agency (FEMA) are able to source goods and services when needed directly from the EAMS site. The EAMS system streamlines the current paper-based methods of tracking, monitoring, taking inventory, warehousing, and distributing donated goods and services, helping to ensure that donated items get to the agencies and individuals when they most need them.

"We are excited about the opportunity to utilize the EAMS. This will give the 300-plus affiliated Chambers of Commerce another opportunity to participate directly in the disaster efforts. Additionally, using the EAMS will give us the ability to efficiently make available the contributions to the over 10,000 affected businesses," said Nancy Ploeger, Executive Director of the Manhattan Chamber of Commerce.

"Certainly, as we have seen, there's no shortage of generosity as individuals and corporations in America have consistently reached out

Continued on page 66



by Jon Williams

Stamp Applications

SECURITY CONCERNS

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

Security concerns have hit me, personally, twice in the last two days. Yesterday, I got an email from a guy who wanted to know how to use the Stamp to talk to a GPS unit so he could control the steering vanes on a large rocket. A rocket ... or a guided missile intended to do harm? Since it's impossible to tell via email, I politely declined his request for help. I love helping Stamp customers with their applications, but this one just made me too nervous about the possible negative consequences of his success.

Then, just this morning, it dawned on me that the airline ticket my friend purchased for me is in my stage name, not my legal name (there are too many guys in the business named Jon Williams, so I go by Jon McPhalen as an actor). I called the airline and will have to make a special trip to the airport this afternoon to "fix" the ticket. I have all the legal documentation required by the airline (I own my stage name), but FAA security specialists at the airport might not take the same point of view.

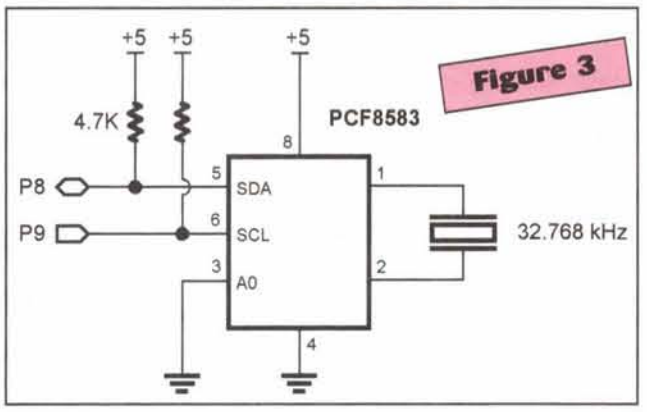
So, security is, indeed, a concern. My friend Chuck pointed this out and how he'd heard from Stamp users interested in building their own security systems. Our project this month is just that – the beginnings of a very simple security system. Please keep in mind that my job here is to teach you Stamp programming and interfacing and that many of the applications I present are only suitable for training purposes. If you decide to build your own security system, proceed with extreme caution – as if you decided to build your own car. Your security is at stake.

Okay, enough serious stuff. Let's have some fun and build a project.

Lots O' Pins On The -40

I've made it pretty clear that my favorite Stamp is the BS2p; it's fast, has great features, and even comes in a 40-pin variant. Since most of my projects are fairly small, I never needed the 40-pin package – until now. The BS2p-40 has 16 additional I/O pins. They're addressed somewhat differently than you might expect, although the scheme makes sense in context to the BASIC Stamp.

In the past, I was always a bit of a jokey guy when starting this column. It's not that I've lost my ability to laugh and have fun, it's just that recent events have caused me — and many — to be a bit more serious and cautious in our approach to life.



The first 16 pins are known as the main I/O pin group. The additional 16 pins are known as the auxiliary I/O group. Since the Stamp uses 16-bit variables, we will still deal with pins 0-15. What we need to do, then, is tell the Stamp which group of pins we're working with.

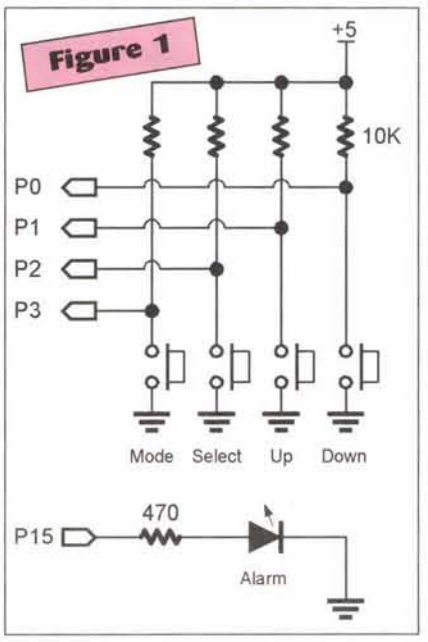
The main group is accessed with the keyword MAINIO. Any reference to I/O pins after this command will refer to the lower (main) group. The auxiliary group is accessed with the keyword AUXIO. After this command, I/O pin references will be to the upper (auxiliary) group.

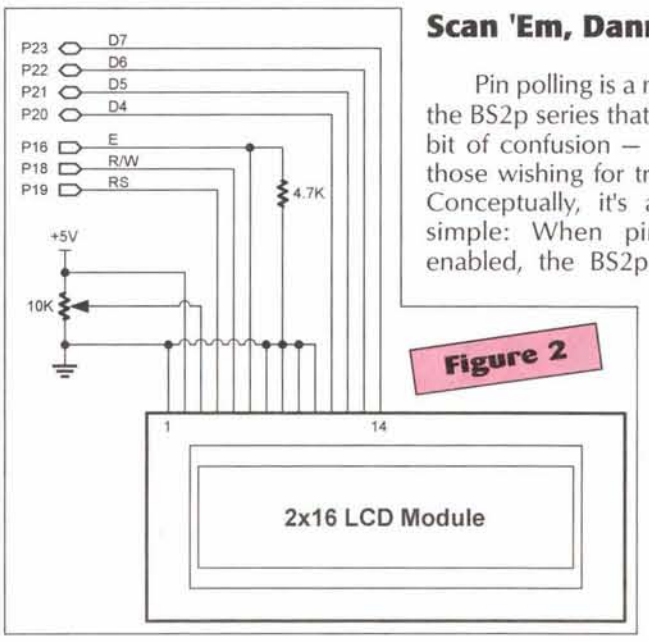
There is one more command used by the BS2p-40: IOTERM. This command requires a parameter that specifies which I/O group to use (0 = main, 1 = auxiliary). IOTERM is useful for general-purpose subroutines like this:

```
Set_Pin_High:
  IOTERM (pinNum / 16)
  HIGH (pinNum // 16)
  RETURN
```

With this subroutine, you could set pinNum to any value between 0-31 and the Stamp would set the physical pin high.

Since the BS2p-40 has a second set of I/O pins, it also has a second Dirs register, Outs register, and Ins register. These are accessed by using AUXIO or IOTERM, as I've described above.





Scan 'Em, Danno

Pin polling is a new feature in the BS2p series that has caused a bit of confusion – especially for those wishing for true interrupts. Conceptually, it's actually fairly simple: When pin polling is enabled, the BS2p will look at specified input pins between each PBASIC instruction and can take some action. Here's what you can have the Stamp do:

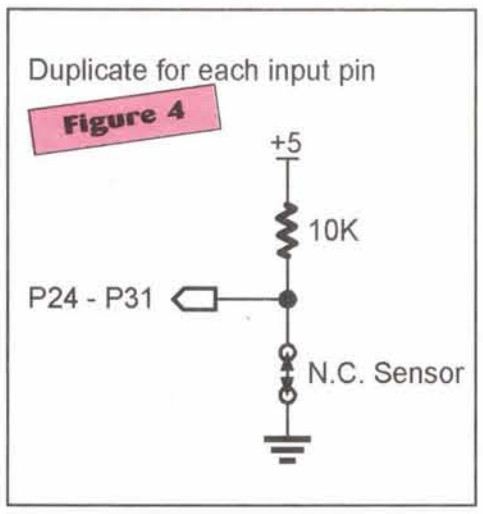


Figure 4

1. Nothing
2. Set an output pin to specified state
3. Run another program
4. Wait (pause program) until interrupt condition occurs
5. Any combination of 2, 3, and 4

In our particular project, we're going to use the upper eight pins on the auxilary I/O port for our alarm inputs. What this means is we'll have to use the AUXIO command when defining our polled input pins. Once defined and enabled, we don't have to worry about which I/O set is active, pin polling looks at all physical pins meaning that our auxiliary input pins are still active for polling, even when we have the main I/O group selected.

Can I See A Menu Please?

Since most alarm systems are menu driven we should probably follow suit. This program will use a multi-tiered menu system like we built back in June 2000. The user interface will consist of four buttons and a two-line LCD. If you decide to improve the project with a larger keyboard, there are enough pins open to scan a 4x4 matrix.

Our menu, then, will look like this:

- Alarm On
- Alarm Off
- View Alarms
- Clear Alarms
- Set Clock

Within the Set Clock menu we will be able to set the hours, minutes, and day. **NV**

Resources:

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3718 Valley View Lane, #3040
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(972) 659-9090
jonwms@aol.com

Parallax
599 Menlo Drive, Suite 100
Rocklin, CA 95756
(888) 512-1024
www.parallaxinc.com

```
' -----[ Title ]-----------------------------------------------------------------
'
' File..... ALARM.BSP
' Purpose... Simple Alarm System Using The BS2p-40
' Author.... Jon Williams
' E-mail.... jonwms@aol.com
' Started... 28 OCT 2001
' Updated... 06 NOV 2001

' { $STAMP BS2p }


' -----[ Program Description
'
' This program uses a BS2p-40 to demonstrate polled pins and the use of the
' BS2p-40's extended I/O pins.  It is also a good demonstration of an LCD-based
' HMI (human machine interface) for Stamp projects.
'
' NOTE: THIS PROGRAM IS FOR EDUCATIONAL PURPOSES ONLY.
'       USE TO PROTECT PROPERTY AT YOUR OWN RISK.
'
' General connections:
' -- Main 0 - 8          User keys (keyboard, etc.)
' -- Main 9 - 15         I2C bus, alarm LED, misc I/O (future)
' -- Aux  0 - 8          LCD output
' -- Aux  9 - 15         Alarm inputs (pulled up, NC to ground, 1 = alarm)


' -----[ Revision History ]-------------------------------------------------
'


' -----[ I/O Definitions ]--------------------------------------------------
'
AlarmIns        VAR     InH             ' AUX  - high byte
LCDpin          CON     16              ' AUX  - low byte
AlarmLED        CON     15              ' MAIN - pin 15
I2Cpin          CON     8               ' MAIN - pins 8 & 9
Buttons         VAR     InA             ' MAIN - low nib


' -----[ Constants ]-------------------------------------------------------
'
M_Status        CON     0               ' mode values
M_Clear         CON     1
M_System        CON     2
M_Clock         CON     3

Modes           CON     4               ' menu modes
TimeOut         CON     150             ' mode timer (loop iterations)

NoCmd           CON     $00             ' No command in LCDOUT
ClrLCD          CON     $01             ' clear the LCD
CrsrHm          CON     $02             ' move cursor to home position
CrsrLf          CON     $10             ' move cursor left
CrsrRt          CON     $14             ' move cursor right
DispLf          CON     $18             ' shift displayed chars left
DispRt          CON     $1C             ' shift displayed chars right
DDRam           CON     $80             ' Display Data RAM control
CGRam           CON     $40             ' Custom character RAM
Line1           CON     $80             ' DDRAM address of line 1
Line2           CON     $C0             ' DDRAM address of line 2

UpAr            CON     0               ' up arrow char number
DnAr            CON     1

Wr8583          CON     %10100000       ' write to RTC
Rd8583          CON     %10100001       ' read from RTC

' -----[ Variables ]-------------------------------------------------------
'
hours           VAR     Byte
minutes         VAR     Byte
day             VAR     Nib             ' 0 = Sunday, 6 = Saturday

rtcCtrl         VAR     Byte            ' [0] control/status
rtcHuns         VAR     Byte            ' [1] hundredths (bcd)
rtcSecs         VAR     Byte            ' [2] seconds (bcd)
rtcMins         VAR     Byte            ' [3] minutes (bcd)
rtcHrs          VAR     Byte            ' [4] hours (bcd)
rtcYrDate       VAR     Byte            ' [5] year & date (bcd+)
rtcMoDay        VAR     Byte            ' [6] day & month (bcd+)

mode            VAR     Nib             ' main menu level
modeTimer       VAR     Byte            ' auto time-out to Status mode
level           VAR     Nib             ' sub menu level

btns            VAR     Nib             ' button input
btnMode         VAR     btns.Bit3
btnSelect       VAR     btns.Bit2
btnUp           VAR     btns.Bit1
btnDn           VAR     btns.Bit0

alarmStatus     VAR     Bit             ' 0 = Off, 1 = On
blink           VAR     Bit             ' cursor blink control

temp1           VAR     Byte            ' general purpose vars
temp2           VAR     Byte

' -----[ EEPROM Data ]-----------------------------------------------------
-
'
UpArrow         DATA    $00,$00,$04,$0E,$1F,$00,$00,$00
DnArrow         DATA    $00,$00,$00,$1F,$0E,$04,$00,$00

Su              DATA    "SUN",0         ' day names
Mo              DATA    "MON",0
Tu              DATA    "TUE",0
We              DATA    "WED",0
Th              DATA    "THU",0
Fr              DATA    "FRI",0
Sa              DATA    "SAT",0

' -----[ Initialization ]-------------- ------------------------------------
'
Initialize:
  ' setup alarm input pins
  AUXIO                                 ' point to auxilliary i/o pins
  POLLMODE 0                            ' clear and disable polling
  POLLIN  8, 1                          ' inputs look for high
  POLLIN  9, 1
  POLLIN 10, 1
  POLLIN 11, 1
  POLLIN 12, 1
  POLLIN 13, 1
  POLLIN 14, 1
  POLLIN 15, 1

  ' setup LCD
  PAUSE 500                                     ' let the LCD settle
  IOTERM (LCDpin / 16)                          ' point to LCD I/O  bank
```

```
  LCDCMD (LCDpin // 16), %00110000 : PAUSE 5        ' 8-bit mode
  LCDCMD (LCDpin // 16), %00110000 : PAUSE 0
  LCDCMD (LCDpin // 16), %00110000 : PAUSE 0
  LCDCMD (LCDpin // 16), %00100000 : PAUSE 0        ' 4-bit mode
  LCDCMD (LCDpin // 16), %00101000 : PAUSE 0        ' 2-line mode
  LCDCMD (LCDpin // 16), %00001100 : PAUSE 0        ' no crsr, no blink
  LCDCMD (LCDpin // 16), %00000110                  ' inc crsr, no disp shift
  LCDCMD (LCDpin // 16), ClrLCD

  LCDCMD (LCDpin // 16), CGRam                      ' prepare to write CG data
  FOR temp2 = UpArrow TO (DnArrow + 7)              ' build 2 custom chars
    READ temp2, temp1                               ' get byte from EEPROM
    LCDOUT (LCDpin // 16), NoCmd, [temp1]           ' put into LCD CGRAM
  NEXT

  ' setup alarm output pin
  MAINIO                                            ' point to main i/o pins
  POLLOUT AlarmLED, 1

  ' setup keyboard
  MAINIO                                            ' point to lower group
  DirA = %0000                                      ' make pins input


' -----[ Main Code ]-------------------------------------------------------
'
Main:
  GOSUB Scan_Buttons                                ' get button inputs
  mode = mode + btnMode // Modes                    ' update current mode

Check_Mode_Timer:
  modeTimer = (modeTimer + 1) * (1 - btnMode)       ' inc if Mode button not
pressed
  IF (modeTimer < TimeOut) THEN Run_Mode            ' if not expried, run mode
  mode = M_Status                                   ' - otherwise, set to Status
  modeTimer = 0

Run_Mode:
  BRANCH mode, [Show_Status, Clear_Alarms, Set_System, Clock_Set]

Loop_Pad:                                           ' pad loop for button
presses
  PAUSE 150
  GOTO Main
  END


' -----[ Main Menu Fuctions ]----------------------------------------------
'
' -- called with BRANCH
' -- should end with GOTO Loop_Pad

' *************
' System Status
' *************

Show_Status:
  level = 0                                 ' reset sub-menu level
  GOSUB Get_Clock                           ' get and display current clock
  IOTERM (LCDpin / 16)
  LCDCMD (LCDpin // 16),%00001100           ' no crsr, no blink
  LCDOUT (LCDpin // 16), Line1, [HEX2 rtcHrs,":",HEX2 rtcMins,":",HEX2 rtcSecs]
  LCDOUT (LCDpin // 16), NoCmd, ["      "]

  LOOKUP day, [Su,Mo,Tu,We,Th,Fr,Sa], temp2         ' point to day name
  GOSUB Print_Str                                   ' print it on LCD
  BRANCH alarmStatus, [Is_Off,Is_On]                ' show system status

Is_Off:
  LCDOUT (LCDpin // 16), Line2, [" * SYSTEM OFF * "]
  GOTO Show_Status_Done

Is_On:
  GET 131, temp2                                    ' grab alarm bits
  IF (temp2 > 0) THEN Show_Alarm_Bits
  LCDOUT (LCDpin // 16), Line2, ["   All Clear    "]
  GOTO Show_Status_Done

Show_Alarm_Bits:
  ' alternate between latched event and current inputs every other second
  BRANCH rtcSecs.Bit0, [Show_Latched,Show_Current]

Show_Latched:
  LCDOUT (LCDpin // 16), Line2, ["Alarms  ",BIN8 temp2]
  GOTO Show_Status_Done

Show_Current:
  AUXIO
  LCDOUT (LCDpin // 16), Line2, ["Now     ",BIN8 AlarmIns]

Show_Status_Done:
  PAUSE (200 * btnMode)                     ' extra delay if first entry
  GOTO Loop_Pad


' ***************************
' Clear Alarm
' -- will clear if Up pressed
' ***************************

Clear_Alarms:
  GET 131, temp2                            ' read latched alarm bits
  IF (temp2 > 0) THEN Check_Clear           ' alarms enabled and active?
  mode = M_System                           ' skip to system set if no alarms
  GOTO Set_System

Check_Clear:
  IOTERM (LCDpin / 16)
  LCDOUT (LCDpin // 16), Line1, ["Clear Alarms?   "]
  LCDOUT (LCDpin // 16), Line2, ["  ",UpAr," Yes    ",DnAr," No  "]

No_Clear:
  IF (btnDn = 0) THEN Yes_Clear             ' is Dn pressed?
  mode = M_Status                           ' - return to Status mode
  GOTO Clear_Alarm_Done

Yes_Clear:
  IF (btnUp = 0) THEN Clear_Alarm_Done      ' is Up pressed?
  LCDOUT (LCDpin // 16), Line1, ["Clearing Alarms "]
  LCDOUT (LCDpin // 16), Line2, [REP " "\16]

  POLLMODE 9                                ' clear polling, save setup
  PAUSE 1000                                ' pause to show message
  POLLMODE (alarmStatus + 9)                ' reset if alarms = On
  mode = M_Status                           ' return to Status mode

Clear_Alarm_Done:
  PAUSE (200 * btnMode)                     ' extra delay if first entry
  GOTO Loop_Pad


' ****************************************
' Set System (enable alarms)
' -- Up = System On
' -- Dn = System Off
' -- will reset alarm if Up or Dn pressed
' ****************************************

Set_System:
  IOTERM (LCDpin / 16)
  LCDOUT (LCDpin // 16), Line2, ["  ",UpAr," On    ",DnAr," Off "]
  LCDOUT (LCDpin // 16), Line1, ["Set System "]
  BRANCH alarmStatus, [System_Off,System_On]

System_Off:
  LCDOUT (LCDpin // 16), NoCmd, ["(OFF)"]
  GOTO Check_System_Set

System_On:
  LCDOUT (LCDpin // 16), NoCmd, [" (ON)"]
```

```
Check_System_Set:
  IF ((btns & %11) = 0) THEN Set_System_Done        ' skip if not Up or Dn
  alarmStatus = btnUp                               ' set new status
  POLLMODE (alarmStatus + 9)                        ' set latching POLLMODE
  mode = M_Status                                   ' back to Status mode
Set_System_Done:
  PAUSE (100 * btnMode)                             ' extra delay if first entry
  GOTO Loop_Pad


' *********
' Set Clock
' *********

Clock_Set:
  IOTERM (LCDpin / 16)
  LCDCMD (LCDpin // 16), %00001100                  ' no cursor
  LCDOUT (LCDpin // 16), Line1, ["Set Clock       "]
  LCDOUT (LCDpin // 16), Line2, ["    ", DEC2 hours,":",DEC2 minutes,"  "]

  LOOKUP day, [Su,Mo,Tu,We,Th,Fr,Sa], temp2
  GOSUB Print_Str
  LCDOUT (LCDpin // 16), NoCmd, ["    "]

  IF ((btns & %0111) = 0) THEN Check_Level          ' check for press
  modeTimer = 0                                     ' clear mode timer if
press

Check_Level:
  level = level + btnSelect // 3                    ' update level selection
  BRANCH level, [Hrs_Set,Mins_Set,Day_Set]          ' branch to sub-menu
code
  GOTO Clock_Set_Done

Hrs_Set:
  LCDCMD (LCDpin // 16), Line2 + 4          ' move to hours position
  GOSUB Blink_Cursor
  BRANCH btnUp, [Check_Hrs_Down]
  hours = hours + 1 // 24
  GOSUB Put_Clock                           ' update RTC
  GOTO Clock_Set_Done

Check_Hrs_Down:
  BRANCH btnDn, [Clock_Set_Done]
  hours = hours + 23 // 24
  GOSUB Put_Clock
  GOTO Clock_Set_Done

Mins_Set:
  LCDCMD (LCDpin // 16), Line2 + 7          ' move to minutes position
  GOSUB Blink_Cursor
  BRANCH btnUp, [Check_Mins_Down]
  minutes = minutes + 1 // 60
  GOSUB Put_Clock
  GOTO Clock_Set_Done

Check_Mins_Down:
  BRANCH btnDn, [Clock_Set_Done]
  minutes = minutes + 59 // 60
  GOSUB Put_Clock
  GOTO Clock_Set_Done

Day_Set:
  LCDCMD (LCDpin // 16), Line2 + 12         ' move to day position
  GOSUB Blink_Cursor
  BRANCH btnUp, [Check_Day_Down]
  day = day + 1 // 7
  GOSUB Put_Clock
  GOTO Clock_Set_Done

Check_Day_Down:
  BRANCH btnDn, [Clock_Set_Done]
  day = day + 6 // 7
  GOSUB Put_Clock

Clock_Set_Done:
  PAUSE (200 * btnMode)                     ' extra delay if first entry
  GOTO Loop_Pad


' -----[ Subroutines ]-----------------------------------------------------
-
'
Scan_Buttons:                               ' debounce four buttons
  MAINIO                                    ' keys are connected to main I/O
  btns = %1111                              ' assume pressed
  FOR temp2 = 1 TO 5                        ' scan 5 times
    btns = btns & ~Buttons                  ' check for press
    PAUSE 10                                ' debounce delay
  NEXT
  RETURN


Put_Clock:                                  ' send data to RTC
  rtcSecs = 0
  rtcMins.HighNib = minutes / 10            ' convert regs to BCD
  rtcMins.LowNib = minutes // 10
  rtcHrs.HighNib = hours / 10
  rtcHrs.LowNib = hours // 10
  rtcMoDay = 1 | (day << 5)                 ' pack weekday in
  IOTERM (I2Cpin / 16)                      ' point to I2C bus I/O bank
  I2COUT (I2Cpin // 16), Wr8583, 2, [STR rtcSecs\5]
  RETURN


Get_Clock:                                  ' read data from RTC
  IOTERM (I2Cpin / 16)
  I2CIN (I2Cpin // 16), Rd8583, 0, [STR rtcCtrl\7]
  minutes = (rtcMins.HighNib * 10) + rtcMins.LowNib
  hours = (rtcHrs.HighNib * 10) + rtcHrs.LowNib
  day = rtcMoDay >> 5
  RETURN


Print_Str:                                  ' print zero-terminated string
  READ temp2, temp1                         ' read a character
  IF (temp1 = 0) THEN Print_Done            ' done?
  IOTERM (LCDpin / 16)
  LCDOUT LCDpin, NoCmd, [temp1]             ' print the character
  temp2 = temp2 + 1                         ' point to next
  GOTO Print_Str:                           ' go get it
Print_Done:
  RETURN


Blink_Cursor:                               ' blink every other loop
  temp2 = %00001100                         ' no cursor
  temp2.Bit1 = blink
  IOTERM (LCDpin / 16)
  LCDCMD (LCDpin // 16), temp2
  blink = ~blink                            ' invert blink control
  RETURN
```

HP 85044B 75 Ohm Transmission/ Reflection Test Unit, 300 kHz-2 GHz $1250.00
HP 85054A Type N Calibration Kit, for HP 8510 series $1800.00
HP 8717A Transistor Bias Supply $500.00
HP 8751A-001,002 Network Analyzer, 5 Hz-500 MHz $12500.00
HP 8756A Scalar Network Analyzer, HPIB $1375.00

SIGNAL GENERATORS

FLUKE 6060B/AK Signal Generator, 0.1-1050 MHz, 10 Hz res. $1250.00
FLUKE 6060B-130,830 Signal Generator, 0.1-1050 MHz, 10 Hz res., GPIB $1600.00
GIGATRONICS 1018 Signal/Sweep Gen., 0.05-18 GHz, 1 kHz res., +8 dBm $5000.00
GIGATRONICS 600/ 6-12 Synthesized Source, 6-12 GHz, 1 MHz res., GPIB $1500.00
GIGATRONICS 6000/ 8-16 Synthesized Source, 8-16 GHz, 1MHz res., GPIB $2250.00
GIGATRONICS 6061A-830 Signal Generator, 0.1-1050 MHz, 10 Hz res., AM, FM, GPIB $1900.00
GIGATRONICS 900/2-8 Signal/ Sweep Generator, 2-8 GHz, 1 MHz res., GPIB $1750.00
HP 11707A Test Plug-in, for HP 8660 series $400.00
HP 11720A Pulse Modulator, 2-18 GHz, 80 dB on/off ratio $450.00
HP 8642M Signal Generator, 0.1-2100 MHz, 1 Hz res., HPIB $3750.00
HP 8656B-001 Signal Generator, 0.1-990 MHz, 10 Hz res., HPIB, OCXO $2750.00
HP 8657A Signal Generator, 0.1-1040 MHz, 10 Hz res., AM, FM, HPIB $3000.00
HP 8660C/603A/633B Signal Generator, 1-2600 MHz, 1 or 2 Hz res., AM, FM$3250.00
HP 8660D/86603A-002 Signal Generator, 1-2600 MHz, 1 or 2 Hz res., phase modulation $6000.00
HP 8672A Signal Generator, 2-18 GHz, 1-3 kHz res., AM, FM, +3 dBm $4500.00
HP 8672A-008 Signal Generator, 2-18 GHz, 1-3 kHz res., AM, FM, +8 dBm $5000.00
HP 8673H-212 Signal Generator, 2.0-12.4 GHz, 1 kHz res., AM, FM, +8 dBm $8500.00
HP 8673M Signal Generator, 2-18 GHz, 1 kHz res., AM, FM, +8 dBm $9500.00
HP 8683B Signal Generator, 2.3-6.5 GHz, cavity tuned, AM/ WBFM/ Pulse $2250.00
HP 8683D Signal Generator, 2.3-13.0 GHz, cavity tuned, AM/ WBFM/ Pulse $3750.00
HP 8684B Signal Generator, 5.4-12.5 GHz, cavity tuned, AM/ WBFM/ Pulse $2250.00
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MARCONI 2019 Signal Generator, 80 kHz-1040 MHz, 10 or 20 Hz res $850.00
WAVETEK 952 Signal Generator, 1-4 GHz, +10 dBm, AM, FM $750.00
WAVETEK 955 Signal Generator, 7.5-12.4 GHz, +7 dBm, AM, FM $750.00
WAVETEK 957 Signal Generator, 12-18 GHz, +7 dBm, AM, FM $750.00

SWEEP GENERATORS

HP 8350B/ 83522A Sweep Oscillator, 10-2400 MHz, +13 dBm levelled $3750.00
HP 8350B/ 83525A Sweep Oscillator, 10 MHz-8.4 GHz, +13 dBm levelled $5000.00
HP 8350B/ 83540A-002 Sweep Oscillator, 2.0-8.4 GHz, 70 dB step atten. $3250.00
HP 8350B/ 83545A-002 Sweep Oscillator, 5.9-12.4 GHz, 70 dB step atten. $3750.00
HP 8350B/ 83570A Sweep Oscillator, 18.0-26.5 GHz, +10 dBm levelled $7000.00
HP 8350B/ 83592A Sweep Generator, 10 MHz-20 GHz, +10 dBm levelled $9000.00
HP 8350B/83570A-H22 Sweep Oscillator, 17-24 GHz, +10 dBm levelled $5000.00
HP 8620C Sweep Oscillator Frame $500.00
HP 86222B-002 RF Plug-in, 10-2400 MHz, +13 dBm, 70 dB step atten. $1250.00
HP 86222B-E69/8620C Sweep Osc. & frame, 0.01-2 GHz & 2-4 GHz bands $1200.00
HP 86241A RF Plug-in, 3.2-6.5 GHz, +8 dBm levelled $300.00
HP 86245A RF Plug-in, 5.9-12.4 GHz, +16 dBm unlevelled $350.00
HP 86251A RF Plug-in, 7.5-18.6 GHz, +10 dBm levelled $500.00
HP 86260A RF Plug-in, 12-18 GHz, +10 dBm unlevelled $400.00
HP 86260A-H04 RF Plug-in, 10-15 GHz, +10 dBm unlevelled $400.00
HP 86290A RF Plug-in, 2-18 GHz, +7 dBm levelled $1200.00
HP 86290B RF Plug-in, 2.0-18.6 GHz, +10 dBm levelled $1650.00
HP 86290C RF Plug-in, 2.0-18.6 GHz, +13 dBm levelled $1850.00
WAVETEK 2001 Sweep Generator, 1-1400 MHz, +10 dBm, 70 dB atten. $750.00
WAVETEK 2002B Sweep Generator, 1-2500 MHz, +13 dBm, GPIB $1750.00
WILTRON 6647M Sweep Generator, 10 MHz-20 GHz, +10 dBm, GPIB $4500.00
WILTRON 6717B-20 Synthesizer/ Sweeper, 10 MHz-8.4 GHz, +13 dBm,GPIB $6000.00

POWER METERS

BOONTON 42B/ 41-4E Analog Power Meter, with 1 MHz-18 GHz sensor $400.00
HP 435B/8481A Power Meter, -30 to +20 dBm, 10 MHz-18 GHz $900.00
HP 436A-022/ 8481A Power Meter, -30 to +20 dBm, 10 MHz-18 GHz, HPIB $1200.00
HP 436A-022/ 8482A Power Meter, -30 to +20 dBm, 100 kHz-4.2 GHz, HPIB $1200.00
HP 436A-022/ 8484A Power Meter, -70 to -20 dBm, 10 MHz-18 GHz, HPIB $1200.00
HP 436A-022/ 8485A Power Meter, -30 to +20 dBm, 50 MHz-26.5 GHz, HPIB $1500.00
HP 436A-022/ 8485D Power Meter, -70 to -20 dBm, 50 MHz-26.5 GHz, HPIB $1700.00
HP 438A Dual Channel Power Meter $3000.00
HP 8477A Power Meter Calibtator, for HP 432 series $400.00
HP 8900D/84811A Peak Power Meter, 0.1-18 GHz, 0-20 dBm peak $2500.00
HP Q8486A Power Sensor, 33-50 GHz, -30 to +20 dBm, for 435/6/7/8 ..... $1500.00
HP R8486A Power Sensor, 26.5-40 GHz, -30 to +20 dBm, for 435/6/7/8 ..... $1500.00

RF MILLIVOLTMETERS

BOONTON 92C RF Millivoltmeter, 3 mV-3 V f.s., 10 kHz-1.2 GHz $500.00
RACAL-DANA 9303 RF Millivoltmeter, -70 to +20 dBm, 10 kHz-2 GHz, GPIB $750.00

AMPLIFIERS, MISCELLANEOUS

AMPLIFIER RESEARCH 4W1000 Amplifier, 40 dB gain, 4 Watts, 1-1000 MHz $950.00
BOONTON 82AD Modulation Meter, AM/ FM, 10-1200 MHz $500.00
C.P.I. VZC6961K1 TWT Amplifier, 35 dB gain, 4-8 GHz, 20 Watts $3500.00
ENI 525LA Amplifier, 50 dB gain, 1-500 MHz, 25 Watts $3250.00
HP 11713A Switch / Attenuator Driver, HPIB $800.00
HP 11729B-003 Carrier Noise Test Set, 5 MHz-3.2 GHz $1900.00
HP 3730B/3738B Downconverter, 5.9-8.9 GHz & 8.7-11.7 GHz $1200.00
HP 415E SWR Meter $200.00
HP 8403A-002 Pulse Modulator, 0.8-2.4 GHz, 80 dB dynamic range $450.00
HP 8406A Comb Generator, 1/ 10/ 100 MHz increments, to 5GHz $500.00
HP 8447E Amplifier, 22 dB, 0.1-1300 MHz, +13 dBm output $650.00
HP 8447F-H64 Dual Amp., 0.01-50 MHz 28 dB & 0.1-1300 MHz 25 dB $900.00
HP 8673D Signal Generator, 50 MHz-26.5 GHz, 1-4 kHz res., HPIB $18500.00
HP 8901A Modulation Analyzer, 150 kHz-1300 MHz, HPIB $1500.00
HP 8970A Noise Figure Meter, 10-1600 MHz, HPIB $3750.00
HUGHES 8010H13F000 TWT Amplifier, >30 dB gain, 3-8 GHz, 10 Watts $2500.00
RACAL 9009 Modulation Meter, 30-1500 MHz, AM, 1.5-100 kHz pk FM $350.00
RF POWER LABS ML50 Amplifier, 2-30 MHz, 47 dB gain, 50 Watts, metered, 28 V $200.00
ROHDE&SCHWARZ ESH2 Test Receiver, 9 kHz-30 MHz $3250.00

COAXIAL & WAVEGUIDE

AEROWAVE 28-3000/10 WR28 Directional Coupler, 10 dB, 26.5-40 GHz $300.00
AMERICAN NUC. AM-432 Cavity Backed Spiral Antenna, LHC, 2-18 GHz, TNC(f) *NEW* $95.00
AVANTEK AMT-400X2 WR28 Active Doubler, +10 dBm in & out $450.00
BIRD 8201 500 Watt Oil Dielectric Load, DC-2.5 GHz $350.00
FXR/MICROLAB SL-03N Stub Stretcher, 0.3-6.0 GHz, 100 Watts max., N(m/f) $75.00
GENERAL RADIO 874-LTL Constant Impedance Trombone Line, 0-44 cm, DC-2 GHz $400.00
HP 11590A-001 Bias Network, 1.0-18.0 GHz, APC7 ..... $450.00
HP 11691D Directional Coupler, 22 dB, 2-18 GHz, N connectors $450.00
HP 11692D Dual Directional Coupler, 22 dB, 2-18 GHz $800.00
HP 33327L-006 Prog. Step Attenuator, 0-70 dB, DC-40 GHz, 2.9mm $1000.00
HP 778D-011 Dual Dir. Coupler, 20 dB, 0.1-2.0 GHz, APC7 ..... $450.00
HP 87300C-020 Directional Coupler, 20 dB, 1.0-26.5 GHz, 3.5mm $475.00
HP K422A WR42 Flat Broadband Detector, 18.0-26.5 GHz $350.00
HP K532A WR42 Frequency Meter, 18.0-26.5 GHz $450.00
HP K752A WR42 Directional Coupler, 3 dB, 18.0-26.5 GHz $450.00
HP K752C WR42 Directional Coupler, 10 dB, 18.0-26.5 GHz $450.00
HP K752D WR42 Directional Coupler, 20 dB, 18.0-26.5 GHz $450.00
HP K870A WR42 Slide Screw Tuner, 18.0-26.5 GHz $275.00
HP K914B WR42 Moving Load, 18.0-26.5 GHz $250.00
HP Q752D WR22 Directional Coupler, 20 dB, 33-50 GHz $650.00
HP R422A WR28 Crystal Detector, 26.5-40 GHz $400.00
HP R752A WR28 Directional Coupler, 3 dB, 26.5-40 GHz $450.00
HP R752D WR28 Directional Coupler, 20 dB, 26.5-40 GHz $450.00
HP R914B WR28 Moving Load, 26.5-40 GHz $250.00
HP V365A WR15 Isolator, 25 dB, 50-75 GHz $750.00
HP V752D WR15 Directional Coupler, 20 dB, 50-75 GHz $650.00
HP X870A WR90 Slide Screw Tuner $150.00
HUGHES 45322H-1110/1120 WR22 Directional Couplers, 10 or 20 dB, 33-50 GHz $350.00
HUGHES 45712H-1000 WR22 Frequency Meter, 33-50 GHz $750.00
HUGHES 45714H-1000 WR15 Frequency Meter, 50-75 GHz $900.00
HUGHES 45721H-2000 WR28 Direct Reading Attenuator, 0-50 dB, 26.5-40 G $1000.00
HUGHES 45722H-1000 WR22 Direct Reading Attenuator, 0-50 dB, 33-50 GHz $1000.00
HUGHES 45724H-1000 WR15 Direct Reading Attenuator, 0-50 dB, 50-75 GHz $1000.00
HUGHES 45732H-1200 WR22 Level Set Attenuator, 0-25 dB, 33-50 GHz $250.00
HUGHES 45752H-1000 WR22 Direct Reading Phase Shifter, 0-360, 33-50 GHz $1400.00
HUGHES 45772H-1100 WR22 Thermistor Mount, -20 to +10 dBm, 33-50 GHz $400.00
HUGHES 47316H-1111 WR10 Tunable Detector, 75-110 GHz, pos. polarity $600.00
HUGHES 47741H-2310 WR28 Phase Locked Gunn Osc., 32 GHz, +18 dBm $2000.00
HUGHES 47742H-1210 WR22 Phase Locked Gunn Osc., 42 GHz, +18 dBm $2750.00
KRYTAR 201020010 Directional Detector, 1-20 GHz, SMA(f/f)/SMC $200.00
KRYTAR 2616S Directional Detector, 1.7-26.5 GHz, K(f/m)/SMC $200.00
M/A-COM 3-19-300/10 WR19 Directional Coupler, 10 dB, 40-60 GHz $450.00
NARDA 3000-series Octave Band Directional Couplers, N connectors $150.00
NARDA 3020A Bi-Directional Coupler, 50-1000 MHz $500.00
NARDA 3022 Bi-Directional Coupler, 20 dB, 1-4 GHz $450.00
NARDA 3024 Bi-Directional Coupler, 20 dB, 4-8 GHz $375.00
NARDA 3090 Precision High Directivity Couplers $225.00
NARDA 368BNM Coaxial Hih Power Load, 500 Watts, 2-18 GHz, N(m) $500.00
NARDA 3752 Coaxial Phase Shifter, 0-180 deg./GHz, 1-5 GHz $900.00
NARDA 3753B Coaxial Phase Shifter, 0-55 deg./GHz, 3.5-12.4 GHz $950.00
NARDA 4000-series Octave Band Directional Couplers, SMA connectors $75.00
NARDA 4247-20 Directional Coupler, 20 dB, 6.0-26.5 GHz, 3.5mm(f) $200.00
NARDA 5070-series Precision Reflectometer Couplers $300.00
NARDA 562 DC Block, 10 MHz-12.4 GHz, 100 V max., N(m/f) $65.00
NARDA 765-10 10 dB Attenuator, 50 Watts, DC-5 GHz, N(m/f) $165.00
NARDA 791FM Variable Attenuator, 0-37 dB, 2.0-12.4 GHz $500.00
NARDA 792FF Variable Attenuator, 0-20 dB, 2.0-12.4 GHz $375.00
NARDA 793FM Direct Reading Variable Attenuator, 0-20 dB,4-8GHz $225.00
NARDA 794FM Direct Reading Variable Attenuator, 0-40 dB,4-8GHz $375.00
OMNI-SPECTRA 2085-6010-00 Crystal Detector, 1-18 GHz, neg. polarity, SMA m/f $50.00
PAMTECH KYG1014 WR42 Junction Circulator, 18.0-26.5 GHz $250.00
SONOMA SCI. 21A3 WR42 Circulator, 20 dB, 20.6-24.8 GHz $75.00
TEKTRONIX 2701 Step Attenuator, 0-79 dB, DC-1 GHz $150.00
TRG B510 WR22 Direct Reading Attenuator, 0-50 dB, 33-50 GHz $900.00
TRG V551 WR15 Frequency Meter, 50-75 GHz $600.00
TRG W510 WR10 Direct Reading Attenuator, 0-50 dB, 75-110 GHz $1000.00
TRG W551 WR10 Frequency Meter, 75-110 GHz $750.00
WAVELINE 100080 WR28 Terminated Crossguide Coupler, 30 dB $200.00
WEINSCHEL 150-110 Programmable Step Atten., DC-18 GHz, SMA $450.00
WEINSCHEL DS109 Double Stub Tuner, 1-13 GHz, N(m/f) $150.00
WEINSCHEL DS109LL Double Stub Tuner, 0.2-2.0 GHz, N(m/f) $150.00

COMMUNICATIONS

HP 37204A-003 HPIB Extender, fiber-optic connection *unused* $250.00
HP 59401A HPIB Bus Analyzer $375.00
TAMPA MW. LAB BUC1W-02W-CST Ku band Upconverter, 1 Watt 14.0-14.5 GHz WR75 *NEW* $150.00
TEKTRONIX 1411R-opt.04 PAL Test Gen.,w/ SPG12,TSG11.TSP11,TSG13,15,16 ..... $1400.00
TEKTRONIX 147A NTSC Test Signal Generator, with noise test signal $800.00

MISCELLANEOUS

EG&G/ P.A.R. 5302 / 5316 Lock-in Amplifier, 100 mHz-1 MHz, GPIB / RS232C $2250.00
FLUKE 2180A RTD Digital Thermometer $500.00
HP 59307A HPIB VHF Switch $200.00
P.A.R. 5206-95.98 Two-Phase Lock-in Amp., 2 Hz-100 kHz, GPIB $1250.00
TEKTRONIX TM5003 TM5000-series 3-slot Programmable Power Module $450.00
TEKTRONIX TM5006 TM5000-series 6-slot Programmable Power Module $500.00
TEKTRONIX TM503 TM500-series 3-slot Power Module $150.00
TEKTRONIX TM504 TM500-series 4-slot Power Module $175.00
TEKTRONIX TM506 TM500-series 6-slot Power Module $250.00
TEKTRONIX TM515 TM500-series 5-slot Portable Power Module $250.00

Laser Insight

by Stanley York

Laser Diodes

This month, we will be taking a look at another type of laser that I have mentioned many times in previous articles, but so far have not gone into any details about — the diode laser.

Diode lasers have a few characteristics in common with LEDs and, in fact, they are closely related in terms of their construction.

Comparison of an LED vs. Laser Diode

The two most common construction methods for making LEDs and laser diodes are as edge emitters and surface emitters. Edge emitters are somewhat older technology and are less efficient than the newer surface emitters.

As the name implies, edge emitters are constructed in such a way that the light emitted by the diode always exits from the edge of the crystal. This construction method has a serious drawback though, because of the tendency of the crystal to absorb a fairly large proportion of the radiation that is generated.

This is because the light has to travel through the length of the semiconductor material before it leaves the crystal surface. Because a lot of the light is absorbed in this manner, the overall gain of the laser medium is very low and consequently, the light output from these devices is limited to very low powers.

In the surface emitter, the mechanism of light generation is essentially the same, but the construction and layout of the active elements is slightly different.

In these devices, the light is emitted through a surface layer of semiconductor a few microns thick before reaching and exiting the surface. Thus for a given power input, the surface emitter puts out a lot more light than an edge-emitting counterpart.

Figure 7-1 shows how the two edge-emitting devices compare. On the left is a simplified drawing of the construction of an edge-emitting LED, and on the right a drawing of an edge-emitting laser diode. You'll see from the drawings that the two are very similar in construction.

In the LED, there is a multilayer sandwich of P and N type semiconductor material. On the top and bottom of the stack, there are metal layers that form the contact points for power.

In the laser diode, there are two main layers, with a third diffused layer between them (the active region). In the laser diode, the ends of the crystal are cleaved during manufacturing to produce two flat, square, and parallel faces.

These crystal faces are highly polished by the cleaving process. The output surface of the crystal is partially transmitting at the laser wavelength, and the rear surface is usually broadband coated to reflect all light. They form the two mirrors of the laser resonator. Since they are cleaved from a single crystal, the two faces are intimately aligned and consequently, perfectly set up for optimum laser feedback within the crystal.

Recent developments in laser diode manufacturing have resulted in the production of the newer and more efficient surface emitting diodes. Figure 7-2 shows how this device differs from the edge emitters. The drawing shows a simple illustration of a vertical-cavity surface-emitting laser (VCSEL).

The VCSEL has created a lot of excitement in the laser field since its development. The operating efficiency of these devices is better than 50% compared to the earlier edge emitters (<20%). Most of the laser diodes produced now follow this surface-emitting construction style. In the VCSEL, the thin layer of semiconductor on top of the stack forms the output window of the laser. Being thin, it doesn't absorb nearly as much light as its predecessor, making the VCSEL a far more efficient device.

Common colors for laser diodes lie mainly in the red end of the spectrum, but there are now some devices available in the green region. At the time of this writing, I checked in my Edmund Scientific catalog, and the green laser diode pointers advertised were about four times the price of the red ones.

The pointers that Edmund sells are a pretty good buy though, and are adequate for any experiments you may wish to try. The beam quality is not as good as the more expensive diode lasers they sell, but should be good enough for most purposes. If you want to improve the beam quality, try some of the improvements I have mentioned in an earlier column. You'll lose a little power, but the beam quality will improve.

If you recently won the state lotto, and feel like making a big buy, a decent quality high power green diode laser goes for about $2,000-$6,000, depending on how much power you need!

Edmund Scientific also sells beam expanders, spatial filters, and precision mounts. With careful selection, you should be able to improve the beam quality of even the cheapest diode pointer.

So, you may be asking yourself, how can such a small resonant cavity in a laser diode emit the same output power, same color light as the much larger HeNe laser? Well remember what I said in my first column? The size of the resonant cavity really doesn't matter. The length of the cavity does not determine the frequency of the emitted light, it is the nature of the lasing medium and the reflecting coatings on the mirrors that determine the output color (or wavelength).

In the red laser diodes, the active material is usually one of the Aluminum-Gallium-Arsenide alloys (AlGaAs), whereas in a green laser, the active material is AlGaAs with a trace of Indium (In).

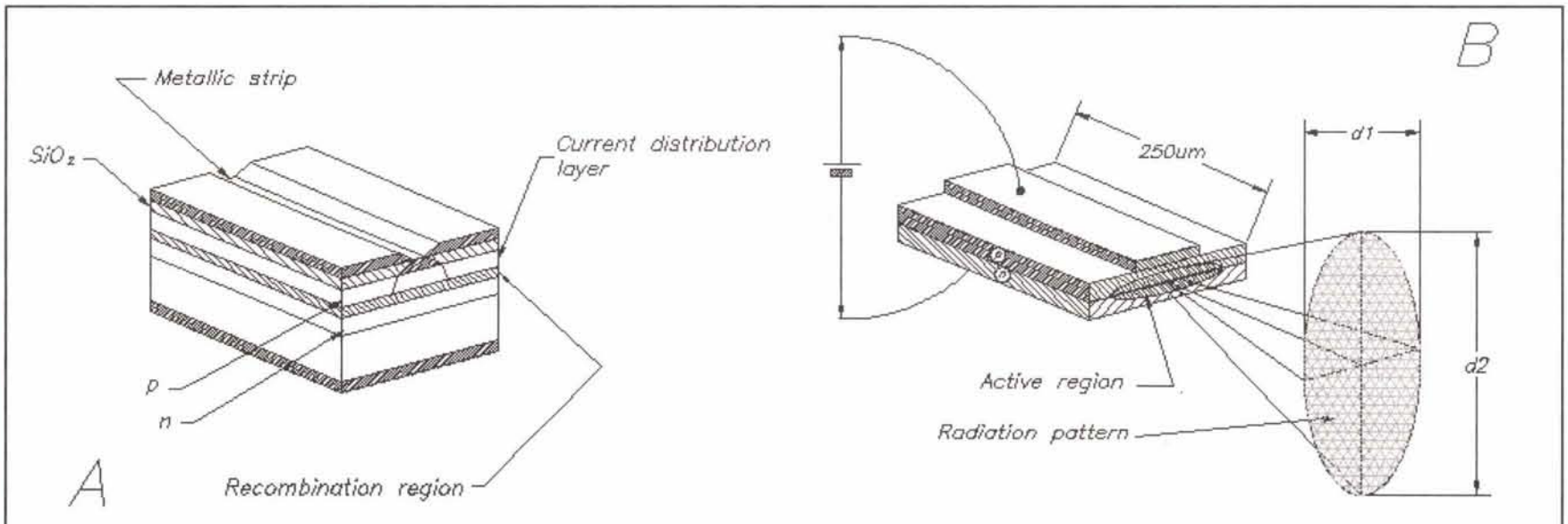

Figure 7-1 — Comparison of an edge-emitting LED (A) and an edge-emitting laser diode (B).

Communications Using Laser Diodes

Because of the very small size of the die making up the laser diode, these devices are capable of switching extremely fast. This particular characteristic allows the use of laser diodes in high-volume, high-speed communications over fiberoptics, and explains why so many new telephone and television cable hook-ups are switching over to optical fibers for transmission and distribution to homes all over the country.

The available bandwidth in a single optical transmission line is truly mind boggling when one considers the carrier frequency. A beam of laser light at 632nM (approximately at the HeNe wavelength) is in the red end and therefore, at the long wave end of the visible spectrum (akin to the longwave end of the AM radio spectrum). I am comparing the modulation means to AM because, for now, most optical data transmission is done either as a simple on/off type (digital) modulation or as some form of optical intensity modulation. There are ways of shifting or modulating the frequency of a light wave (similar to FM), but we'll not get into that here.

Since the wavelength (lambda) is 632nM, the frequency of the wave is equal to the velocity divided by the wavelength, i.e., f = c/lambda, where lambda is the wavelength, and c is the velocity of light. We know the velocity of light is 300,000kM/second. So the frequency c/lambda = 300,000,000/632 x 10-9

= 4.746 x 1014Hz

That's 470,000 GHz! If you allow each speech channel a bandwidth of 10kHz (a telephone speech channel is about 4-5kHz, but I am a generous sort), this gives us a whopping 4.7 x 10^10 channels on a single beam! That's 47 billion speech channels on a single laser beam.

Amazing, isn't it? These facts illustrate what a tremendous impact laser diodes have had on communications. Perhaps now you understand why everyone wants to get on the fiberoptic bandwagon, and why Time/Warner's Roadrunner™ Internet service is so fast and so popular.

But, I digress. I'm guessing a whole lot of readers out there are already familiar with that particular service. I know myself that download speeds are phenomenal when compared to dial-up connections.

The wavelength chosen in the example above (632nM) is at the long wavelength end of the visible spectrum, and lies about in the middle of the red portion of the band. Look around now and see how many colors are available in present day lasers. Some of these lasers are in the blue and ultraviolet end of the spectrum (making the wavelength about half of the previous example, and therefore twice the frequency) and can carry twice as many speech channels as a red laser. This gives us tremendous bandwidth.

Industrial Applications

Turning now to the industrial applications of laser diodes, we find that there are some very high-power diodes available. Commercial lasers that use diodes come in two basic flavors; in one type, laser diodes are used directly to produce a beam powerful enough to do useful work. These lasers are typically found in the laser printers, laser lithography systems, and laser microwelding systems. The other type consists of rows or bars of laser diodes (Figure 7-3) that are used to increase the output power and further pump an Nd:YAG rod, or perhaps a dye laser.

The output power of a diode array such as depicted may easily reach several tens of watts per array. One of the systems advertised in the new Edmund Scientific catalog is of this latter type. The device uses the bars of diodes to pump an Nd:YVO4 (Neodymium-doped Vanadate) laser rod (similar in appearance to an Nd:YAG rod) and produce a fairly high power (50mW) beam of intense green light at 532nM, and is the one I referred to earlier (when I talked about winning the lotto).

You may be wondering why there are so many different types of lasers, at so many different wavelengths, and with so many different power levels. In industrial applications, the reason for so many variations is because of overall efficiency of the laser, and application specific parameters surrounding the task the laser is intended to process.

For best performance, and best return on investment, it's obvious that you want the best laser for a particular task. I have briefly covered some of the application details of a selection of industrial type lasers, but there are many factors that have to be considered before a laser is settled on as being the right one for the job.

Until quite recently, a medium power laser using an arclamp pump source would come with a heavy, awkward power supply. With the advent of the laser diode, the same output power can now be produced by a laser a fraction of the size previously available. This allows a laser to be used where it would have been impossible before, simply because of the sheer size of the laser head or power supply.

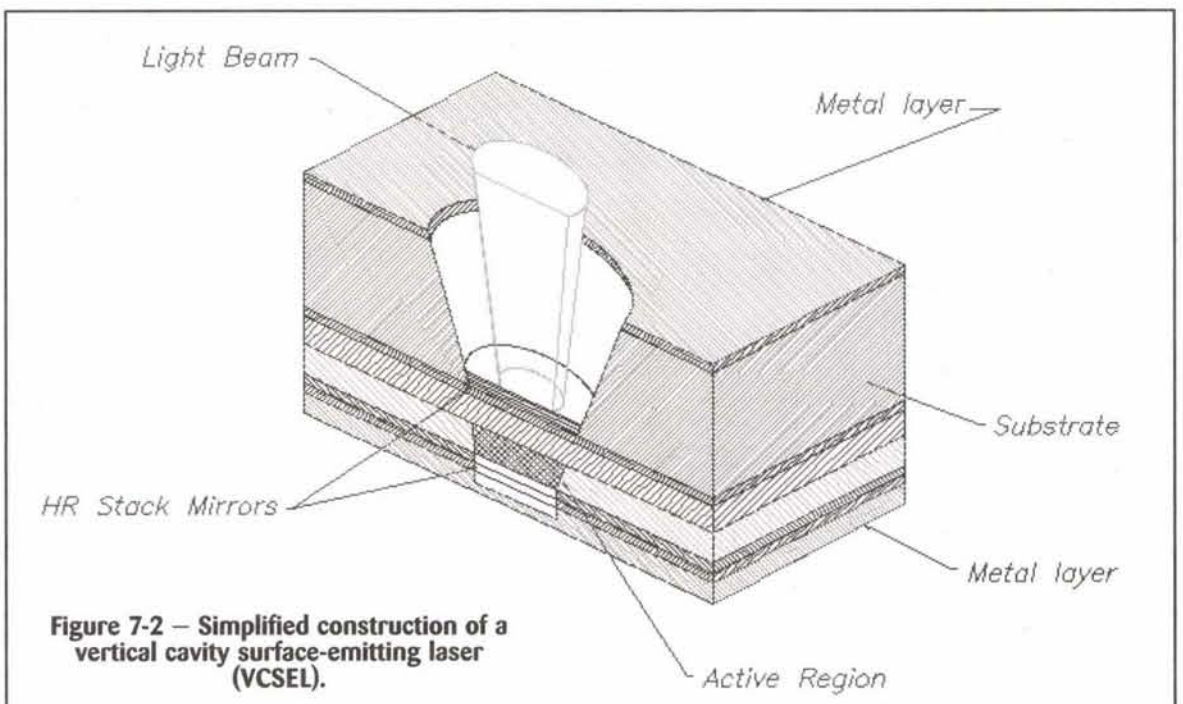

Figure 7-2 – Simplified construction of a vertical cavity surface-emitting laser (VCSEL).

Limitations of Diode Lasers

The laser diode has certainly changed the way communications work, and a large number of industrial applications rely on the laser diode because of its relatively small size. But the laser diode is not without its disadvantages.

Looking at Figure 7-1 again, you'll notice that I have drawn in what is generally regarded as a typical beam pattern emitted from an edge-emitting laser diode.

Although I have tried to illustrate the laser diode chip in three dimensions, when the laser diode is energized, the light pattern projected onto a surface perpendicular to the light beam would appear more football shaped than round.

The dimension of the beam in one direction is D1, while the beam measures D2 in a direction perpendicular to D1. The reason for the elongated pattern is simple to understand. The shape of the active region where the laser action takes place is very small and narrow. The width of the laser chip is on the order of 100uM, while the thickness is only about 2-3uM, and the length is about 300uM.

With such a small geometry, there is very little guidance for the laser beam as it bounces back and forth within the crystal. A lot of light is able to escape at a broad angle relative to the faces of the chip, creating a wide divergence. The laser beam leaving the chip has an aspect ratio of about 2:1.

As the beam gets further from the diode, the aspect ratio increases because the divergence angle of the

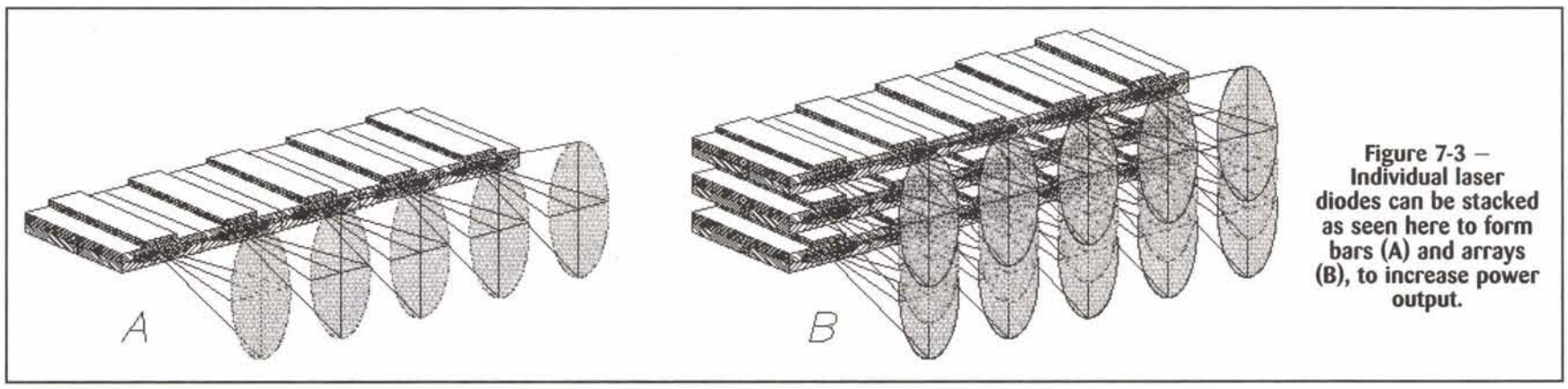

Figure 7-3 – Individual laser diodes can be stacked as seen here to form bars (A) and arrays (B), to increase power output.

beam is different for the two axes (Figure 7-1, D1-D2).

Manufacturers of laser diodes are aware of this problem, and normally put corrective optics into the laser diode package to compensate for this drawback. These optics are usually fixed, but not always, and the user may be able to adjust the output lens to arrive at a beam shape suitable for the task at hand.

The shape of the output beam is, of course, a function of the shape of the die, and is not something easily overcome.

Because of this important shortcoming of laser diodes, it is hard to imagine that they will be useful in holographic applications. To make a hologram (here I will only touch lightly on the subject, we'll discuss holography later) it is crucial that the laser beam be many things at one time:

- It must be stable.
- It must have a narrow line width.
- It must operate in a low order mode.
- And it must not be noisy.

Unfortunately, present laser diodes do not stack up too well for this application. The best holograms are made with fast-pulsed visible lasers. So far in this series, we have not talked about pulsed lasers. But these systems do produce the best holograms, and I will be discussing these and, in particular, the Cr:Ruby laser in a later column.

Next month, I am presenting another construction project for you. We're going to build a tachometer using a pen-type laser diode, and you'll find it useful for working on your car, model aircraft, electric motors, anything in fact, that involves rotating or reciprocating motion.

I'd like to say thank you to everyone who has taken the trouble to write to me with ideas and suggestions for this column. There are some good ideas out there, and I will look into the possibilities of doing something with them.

So stay tuned, your idea may be a feature article some time. **NV**

Events

CALENDAR

The Events Calendar is a free service for publicizing electronic events such as amateur radio hamfests, flea markets, etc. If your organization is sponsoring an event and would like a free listing, contact us at least 60 days in advance. 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.

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Phone 909-371-8497
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E-mail events@nutsvolts.com

DECEMBER 2001

December 1

AZ - MESA - Hamfest. Superstition ARC, Ed Cole KB7RMO, 520-468-9015. Email: colej@cybertrails.com
LA - MINDEN - Hamfest. Minden ARA, Jimmy White KB5SUE, 318-377-2501. Email: kb5sue@microgear.net Web: http:www.bayou.com/~k5dlh/fest.html

December 1-2

FL - PALMETTO (TAMPA) - Hamfest. Manatee County Convention and Civic Center, One Haben Blvd. at US 301. Sat: 8am-5pm, Sun: 9am-2pm. VEC exams. Talkin: 145.430- and 442.950+. The Florida Gulf Coast ARC, Fred Hendershot N3BUL, 813-671-9556. Email: fgcarc@fgcarc.org Web: http://www.fgcarc.org

December 2

MI - HARRISON TOWNSHIP - Hamfest. L'Anse Creuse ARC, Gregg Crump KC8PXJ, 810-463-0729. Email: grcrump@home.com Web: www.ameritech.net/users/lc_arc/index.html

December 8

SC - UNION - Hamfest. National Guard Armory, Industrial Park Dr. 8am-2pm. VE testing. WCARS, Roger Gregory, 864-427-1462, email: rgregory@carol.net

December 9

IN - GREENFIELD - Hamfest. Greenfield Central High School Pavilion, 810 N. Broadway St. 8am-2pm. VE testing. Talkin: 145.330-. Hancock ARC, email: kb9vzl@excite.com Web: www.w9atg.org

JANUARY 2002

January 5

WI - WAUKESHA - Hamfest. Waukesha Co. Expo Center Forum. 8am-2pm. VE testing. West Allis RAC, Phil Gural W9NAW, 414-425-3649. Email: janphil@execpc.com

January 11-12

FL - FT. MYERS - Hamfest. Shady Oaks Community Center, 3280 Marion St. Fri: 1pm-9pm, Sat: 9am-3pm. Ft. Myers ARC, Earl Spencer K4FQU, 941-332-1503. Email: k4fqu@juno.com

January 12

MO - SPRINGFIELD - Hamfest. 145.49 Repeater Group, Michael Blake N0NQW, 417-742-3955. Email: n0nqw@arrl.net Web: http://www.qsl.net/49ers
NY - MARATHON - Hamfest. Skyline ARC, Patrick Dunn KC2BQZ, 315-488-3499. Email: patdunn@dreamscape.com Web: http://www.dreamscape.com/sarc

January 13

IN - SOUTH BEND - Hamfest. Michiana Valley Hamfest Assn., Bob Denniston KA9WNR, 219-291-0252 (7-11pm EST).

January 19

LA - HAMMOND - Hamfest. SELARC, Bill Borstel KB5SKW, 225-695-6414. Email: wborstel@hotmail.com Web: http://www.selarc.org
MI - FLUSHING - Hamfest. Amateur Radio & Youth Club, Clay Hewitt KF8UI, 810-233-7889. Email: clay@iavbbs.com Web: http://www.qsl.net/aray
MO - ST. JOSEPH - Hamfest. MO Valley ARC & Ray-Clay ARC, Carlene Makawski KA0IKS, 816-279-3406. Email: nem3238@ultra.ccp.com
TN - GALLATIN - Hamfest. Sumner County ARA, 615-451-0213. Email: hamfest@scara.net Web: http://www.scara.net

January 20

MI - HAZEL PARK - Hamfest. Hazel Park High School, 23400 Hughes St. 8am-2pm. Talkin: 146.64-. Hazel Park ARC, Jeff Albrecht N8WR, 248-642-3608. Email: n8wr@arrl.net Web: http://www.qsl.net/w8hp
NY - NORTH BABYLON - Convention. Great South Bay ARC, Diane Ortiz K2DO, 631-286-7562. Email: k2do@aol.com Web: http://www.arrlhudson.org/nli
OH - NELSONVILLE - Hamfest. Sunday Creek AR Federation, Russ Ellis N8MWK, 740-767-2226. Email: n8mwk@arrl.net Web: http://www.hfradio.org/kc8aav/

January 26

AL - TROY - Hamfest. Troy RC & Butler County RACES, Thomas Johnston KC4FIG, 334-566-1373. Email: kc4fig@arrl.net
FL - ARCADIA - Hamfest. DeSoto ARC, Doug Christ KN4YT, 863-494-5070. Email: kn4yt@arrl.net
NY - LOCKPORT - Hamfest. Eagles Hall, 6614 Lincoln Ave. Talkin: 146.820- 107.2 PL. Lockport Amateur Radio Assn., Duane Robinson W2DLR, 716-791-4096. Email: w2dlrham@aol.com Web: http://lara.hamgate.net

January 27

IL - STICKNEY - Hamfest. Wheaton Community Radio Amateurs, 630-545-9950. Email: info@wheatonhamfest.org Web: http://www.wheatonhamfest.org
MD - ODENTON - Hamfest. Odenton Vol. Fire Dept. Hall, 1524 Annapolis Rd., Rt. 175. 8am-1pm. MMARC, Gary Johney, 410-437-4285, email: w3cu@arrl.net/
OH - DOVER - Hamfest. OH National Guard Armory, 2800 N. Wooster Ave. 8am-1pm. Talkin: 146.730-. Tusco ARC, Gary Green KB8WFN, 740-922-4454. Email: kb8wfn@tusco.net

FEBRUARY 2002

February 1-2

MS - JACKSON - State Convention. Jackson ARC, Ron Brown AB5WF, 601-956-1448. Email: ab5wf@arrl.net Web: http://www.jxnarc.org

February 2

KS - LACYGNE - Hamfest. Mine Creek ARC, Ron Cowan KB0DTI, 913-757-4455. Email: kb0dti@arrl.net
SC - NORTH CHARLESTON - Hamfest. Stall High School. Talkin: 146.79, 145.25, and 147.45. Charleston ARS, Jenny Myers WA4NGV, 843-747-2324. Email: brycemyers@aol.com Web: www.qsl.net/wa4usn/index.html

February 2-3

FL - MIAMI - Tropical Hamboree. Dade Radio Club of Miami, Evelyn Gauzens W4WYR, 305-642-4139. Email: w4wyr@arrl.org

February 3

OH - LORAIN - Hamfest. Gargus Hall, 1965 N. Ridge Rd. 8am-1pm. Talkin: 146.700- and 444.800+. NOARS, John Schaaf K8JWS, 216-696-5709. Email: noars@qsl.net

February 8-9-10

FL - ORLANDO - Convention. Orlando ARC, Harold Prosser KK1B, 321-235-7513 (days) or 407-365-2444 (eves). Email: hal@mpinet.net Web: http://www.oarc.org/hamcat.html

February 9

COMPUTER SHOWS

AGI Shows, 317-299-8827
E-Mail: info@agishows.com
http://www.agishows.com

Blue Star Productions
612-788-1901
http://www.supercomputersale.com

Computers And You, 734-283-1754
www.a1-supercomputersales.com

Computer Central Shows
630-782-4625 Fax 630-834-2594
E-Mail: cc@gats.com
www.computercentralshows.com

Computer Country Expo
847-662-0811 Web: www.ccxpo.com

Five Star Productions
810-379-3333 E-Mail: jeff@fivestar
www.fivestarshows.com

Gibraltar Trade Center, Inc.
734-287-2000 Taylor, MI.
E-Mail: taylor@gibraltartrade.com
www.gibraltartrade.com

Gibraltar Trade Center, Inc.
810-465-6440 Mt. Clemens, MI.
E-Mail: mtclemens@gibraltartrade.com
www.gibraltartrade.com

KGP Productions
1-800-631-0062, 732-297-2526
E-Mail: kgp@mail.com

MarketPro, Inc., 201-825-2229
http://www.marketpro.com

MarketPro, Inc., 301-984-0880
E-Mail: md@marketpro.com
http://marketpro.com

ComputerShow
770-663-0983
E-Mail: narisaam@aol.com
Web: http://www.shownsale.com

Northern Computer Shows
978-744-8440
E-Mail: inquiries@ncshows.com
Web: ncshows.com

Peter Trapp Computer Shows
603-272-5008
Web: www.petertrapp.com

ME - CHELSEA - Hamfest. Augusta ARA, Tom Clay KD1KE, 207-382-6000. Email: kd1ke@uninets.net
MN - ST. CLOUD - Hamfest. St. Cloud ARC, L. Scott Hall KA0DAQ, 320-252-4498. Email: lscotth@aol.com Web: http://www.w0sv.org

February 10

OH - MANSFIELD - Hamfest. InterCity ARC & MASER, Scott Yonally N8SY, 419-522-9893. Email: n8sy@arrl.net Web: http://www.maser.org
VA - RICHMOND - State Convention. Richmond Amateur Telecommunications Society, Pat Wilson W4PW, 804-932-9424. Email: w4pw@arrl.net Web: http://www.frostfest.com

February 16

MA - MARLBOROUGH - Hamfest. Algonquin ARC, Ann Weldon KA1PON, 508-481-4988 before 9pm.

February 23

GA - DALTON - Hamfest. Dalton ARC, Harold Jones N4BD, email: n4bd@ocsonline.com
ND - BISMARCK - Hamfest. Central Dakota ARC, Kurt Carufel KB0KDG, 701-222-0938. Email: carufel@home.com
NY - HORSEHEADS - Hamfest. The National Guard Armory. 8am-3pm. Talkin: 146.700-, 444.20. ARAST, Randy 607-738-6857. Email: n2syt@arast.org Web: http://www.arast.org
VT - MILTON - State Convention. Radio Amateurs of Northern VT, Mitch Stern W1SJ, 802-879-6589. Email: w1sj@arrl.net Web: http://www.ranv.org

February 24

FL - ZEPHRYHILLS - Hamfest. Zephyrhills Area ARC, Ron Russell N8VFE, 813-782-1602. Email: ron301@aol.com
NC - ELKIN - Hamfest. Briarpatch & Foothills ARCs, Pat Hill AE4HK, 540-236-6747. Email: Craig Patton @ kg4fla@hotmail.com
NY - HICKSVILLE - Hamfest. Long Island Mobile ARC, Ed Muro K2EPM, 516-520-9311. Email: hamfest@limarc.org Web: http://www.limarc.org
NY - WILLIAMSVILLE - Hamfest.

Lancaster ARC, Luke Calianno N2GDU, 716-634-4667. Email: luke@towncountryflorist.com
Web: http://gbhamfest.hamgate.net

MARCH 2002

March 2

FL - NEW PORT RICHEY - Hamfest. Gulf Coast ARC, Rick Brown AG4JN, 727-934-8741. Email: ag4jn@arrl.net Web: http://www.gulfcoastarc.org/
NJ - PARSIPPANY - Hamfest. Splitrock ARA, Maria Turner KB2VKP, 888-511-SARA. Email: hamfest@splitrockara.org Web: http://www.splitrockara.org
OK - ELK CITY - Hamfest. West OK ARC, Earl Bottom N5NEB, 580-821-0633. Email: n5neb@logixonline.net

March 3

NY - LINDENHURST - Hamfest. GSBARC & SCRC, Walter Wenzel KA2RGI, 631-957-0218. Email: info@gsbarc.org
Web: http://www.gsbarc.org
VA - ANNANDALE - Hamfest. Vienna Wireless Society, Jim Parsons W4JTP, 703-392-0150. Email: w4jtp@aol.com Web: http://winterfest.home.att.net

March 9

AR - HARRISON - Hamfest. North AR ARS, Bill Rose N5VKF, 870-741-7074. Email: billrose@cswnet.com Web: http://www.qsl.net/naars/hamfest/index.html
FL - PORT CHARLOTTE - Hamfest. EARS & PRRA, Larry Brown KD4KVE, 941-625-0830. Email: kd4kve@aol.com
WA - PUYALLUP - Hamfest. Mike and Key ARC, Michael Dinkelman N7WA, 425-867-4797 days or 253-631-3756 eves. Email: mwdink@eskimo.com Web: http://www.mikeandkey.com

March 9-10

LA - RAYNE - Hamfest. Rayne Civic Center, 300 Frog Festival Dr. VE testing. Talkin: 146.820- 600, 147.030+ 600 PL. LCARC, web: http://www.w5ddl.org
NC - CHARLOTTE - Hamfest. Mecklenburg ARS, Tom Hunt KA3VVJ, 704-948-7373. Email: hamfest@w4bfb.org Web: http://www.w4bfb.org

March 15-16

OK - CLAREMORE - Hamfest. Green Country Hamfest Committee, David Jackson KE4OPA, 918-622-2277. Email: info@greencountryhamfest.org Web: http://www.greencountryhamfest.org

March 16

CT - POMFRET - Hamfest. Eastern CT ARA, Paul Rollinson KE1LI, 860-928-2456. Email: ke1li@arrl.net
NJ - CLINTON - Hamfest. North Hunterdon Regional High School, Rt. 31. VE testing. Talkin: 147.375. Cherryville Repeater Assocation II, 908-788-4080. Web: www.qsl.net/w2cra

March 17

OH - MAUMEE - Hamfest. Toledo Mobile Radio Assn., Paul Hanslik N8XDB, 419-385-5056. Email: kb8iup@arrl.net Web: http://tmrahamradio.org

March 23

FL - PLANTATION - Cy Harris W4MAQ Memorial Free Flea. Robin Terrill N4HHP, 954-583-3625. Email: kg4chw@arrl.net http://www.geocities.com/bcepn/freeflea.html

March 23-24

PA - PHILADELPHIA - Robot Combat. East Coast Hobby Show, Ft. Washington Expo Center. Sat: 9am-6pm, Sun: 10am-5pm. Northeast Robotics Club, Ed McCarron, 610-583-6136 eves. Email: emccarron@robotconflict.com Web: www.robotconflict.com

March 30

TX - BRENHAM - Hamfest. Brenham ARC, Dan Lakenmacher N5UNU, 979-836-8739.

Email: briang@comwerx.net Web: http://www.alpha1.net/~barc

APRIL 2002

April 6

MN - ST. PAUL - Hamfest. Robbinsdale ARC, Jerry Dorf N0FWG, 763-537-1722. Email: k0ltc@visi.com Web: http://www.visi.com/~k0ltc

April 6-7

MD - TIMONIUM - Greater Baltimore Hamboree. Timonium Fairgrounds. Sat: 6am-5pm, Sun: 6am-3pm. Baltimore ARC, James Green WB3DJU, 410-426-3378. Email: w3ft@juno.com Web: http://gbhc.org

WA - YAKIMA - State Convention. Yakima ARC, Jack Wrenn N7KNO, 509-249-0897. Email: n7kno@arrl.net Web: http://eagle.ykm.com/~w7aq/hamfest.html

April 14

NC - RALEIGH - State Convention. Raleigh ARS, Chuck Littlewood K4HF, 919-872-6555. Email: k4hf@arrl.net Web: http://www.rars.org/hamfest

WI - STOUGHTON - Hamfest. Madison Area Repeater Assn., Paul Toussaint N9VWH, 608-245-8890. Email: n9vwh@arrl.net Web: http://www.qsl.net/mara

April 20-21

CA - PALO CEDRO - EMCOMM Convention. Sacramento Valley Section ARES, Jerry Boyd K6BZ, 530-396-2256. Email: k6bz@arrl.org Web: http://www.qsl.net/k6soj/

MAY 2002

May 3-4

MO - LEBANON - State Convention. Lebanon ARC, Bill Wheeler K0DEW, 417-532-4642. Email: bwheeler@advertisnet.com

May 5

PA - WRIGHTSTOWN (BUCKS COUNTY) - Hamfest. Warminster ARC, Bill Strunk K3ZMA, 215-822-0749. Email: k3zma@aol.com Web: http://www.k3dn.org

May 11

WA - STANWOOD - Hamfest. Stanwood-Camano ARC, John McCann N7MZ, 360-629-2921. Email: huppert@whidbey.net

JUNE 2002

June 2

VA - MANASSAS - Hamfest. Ole Virginia Hams ARC, Jack McDermott N4YIC, 703-335-9139. Email: n4yic@arrl.net Web: http://www.qsl.net/olevahams

June 8

PA - BLOOMSBURG - State Convention. Columbia Montour ARC, George Law N3KYZ, 570-784-2299. Email: n3kyz@jlink.net Web: http://www.qsl.net/cm-arc

June 9

IL - WHEATON - Hamfest. Six Meter Club of Chicago, James Novak WA9FIH, 708-442-4961. Email: wa9fih@arrl.net Web: http://cyberconnect.com/orion/hamfest.htm

JULY 2002

July 7

PA - WILKES-BARRE - Hamfest. Murgas ARC, Frank Karcheski N3WPG, 570-824-7579. Email: n3wpg@juno.com Web: http://www.qsl.net/k3ytl

AUGUST 2002

August 3

OH - COLUMBUS - Hamfest. Voice of Aladdin ARC, James Morton KB8KPJ, 614-846-7790. Email: kb8kpj@cs.com

August 25

MI - LAPEER - Hamfest. Lapeer Center Bldg., 425 County Center Dr. 8am-1pm. LCARA, email: w8lap@arrl.net Web: www.w8lap.com

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!

Don't forget to check out the new online electronics forums at the *Nuts & Volts* website. There are currently boards for discussing Robotics, Microcontrollers, Radio, Computers, CNC, and a General forum for discussing any electronic topic at all. We'll even add new dedicated boards for hot topics. Just let us know!

Want to get a jump on things before the magazine arrives? The Tech Forum questions are posted on our website on or before the first of each month. Unanswered questions from recent issues are there also.

Send all material to **Nuts & Volts Magazine**, 430 Princeland Court, Corona, CA 92879, OR fax to (909) 371-3052, OR E-Mail to **forum@nutsvolts.com**

QUESTIONS

I have several clocks that set themselves from NIST (National Institute of Standards and Technology) atomic clock radio signal. The signal is so weak where I live that only the one in the attic can get this signal.

Is there a repeater that can retransmit the signal to the rest of the house? Or, is there possibly a transmitter I can connect to a PC, because it can get the correct time from the internet. I can build one if someone can provide a schematic.

12011 **Jay Masuda**
via Internet

I need to find a certain PC-to-plotter cable. [An RS-232 to IEEE-488 – 24-pin male ... looks like a shortened 36-pinner – cable to interface a standard RS-232/LPT to an HP-plotter. (HP-IB, back of an HP 7550A)]. Any help would be appreciated.

12012 **Brian Tussing**
via Internet

Using a potentiometer, I want to vary the speed of a 130V, 18A conventional DC motor (commutator, brushes, permanent magnet field).

Would pulse width modulation be the best method, maybe starting with a simple 555 oscillator?

What "gate" components would be best: bipolar transistors, FETs, or what? Would an H-bridge be necessary?

Total possible speed range is 0 to 6800 RPM. Service: drive a fan. Accuracy and stability not important.

12013 **Richard Herman**
Costa Mesa, CA

I've spent many hours on the phone to garage door opener manufacturers trying to obtain schematics for the receiver operator circuit of garage door openers that use a safety reversing infrared eye. It seems that it is top secret. They won't sell me one. They say they don't have them.

I am trying to find out what signal or voltage change comes from the infrared eye.

When the door is going down and the beam is broken, a green LED on the eye goes out and stays out until the beam is unbroken. Checking the voltage to these is confusing. They are connected in parallel. One screw on the opener says 24 volts. One wire from the infrared eye is connected to that screw, the other is connected to another screw for the eye.

Checking the voltage across these two wires with an analog meter, you get 5VDC, switch the meter to AC and it reads 12 volts AC. Break the beam and the AC voltage goes up only about about .2 volts. DC goes up even less. The output must change and stay changed while the beam is broken because the LED stays out until the beam is unbroken.

Does anyone have a schematic or can someone tell me what is happening at the output of the eye itself? Do all the door openers with this feature have the same output from the infrared eye?

12014 **Dan Zielinski**
Port St. Lucie, FL

About a year ago, I purchased a kit from Parallax, to program the Scenix SX28AC/DP microcontroller.

I've read over the online documentation, finding especially interesting the Ubicom SX family user manual, but I want to use the b pins as wake-up inputs and I can't figure out how.

Could someone submit a program that would react to a push button on b1 by turning on an LED at a1, or a push button at b2 by turning on an LED at a2, and going to sleep after either case, only to wake up and react again to either of those buttons being pushed?

12015 **Greg Moran**
Riverside, CA

I am thinking of trying to integrate a Piezo Gyroscope – like the ones for RC helicopters and planes – into my home-robotics project for dead-reckoning navigation. How does something like the Cirrus MPG-10 Micro Piezo Gyro work? Would it be possible to use one in such an application?

12016 **Rich K.**
via Internet

I have an old wall telephone (two external bells, wall-mounted mouthpiece and hand crank) made by Julius Andrae and Sons.

Does anyone know how to convert it to operation on modern phone lines?

12017 **Carl Jespersen**
via Internet

I like to listen to a local AM radio station that operates on 1510 KHz.

The power supply of my computer puts out a signal that is about on top of the local station. All the power supplies of computers do this.

Driving around town with the radio tuned to this station picks up this interference as one drives past businesses that use computers.

I would like to find or build a filter that could be attached to the power supply of my computer to eliminate this interference.

12018 **Jess Talley**
Post Falls, ID

I can't find details anywhere on how my Chamberlin garage door safety eye-beam works? It is approximately 10 ft. between trans. and rcvr. units. There are three wires total used; one (the common) goes to each unit. I have a hunch that this is what I have in mind for a burglar-alarm system that would activate a switch closure. Any ideas?

12019 **Roger Hamel**
via Internet

I have been trying to find something for my work place. I would like to put a sensor at each of my 20 air conditioning units and somehow wire them back to a panel in the shop, so I can just look and see if they are running by what tempera-

ANSWER INFO

- Include the question number that appears directly below the question you are responding to.
- Payment of $25.00 will be sent if your answer is printed. Be sure to include your mailing address if responding by E-Mail or we can not send payment.
- Your name, city, and state, will be printed in the magazine, unless you notify us otherwise. If you want your email address printed also, indicate to that effect.
- The question number and a short summary of the original question will be printed above the answer.
- Unanswered questions from a past issue may still be responded to.
- Comments regarding answers printed in this column may be printed in the Reader Feedback section if space allows.

QUESTION INFO

TO BE CONSIDERED

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, Phone Number, and email. Only your name, city, and state will be published with the question, but we may need to contact you.

ture the air is.

What I would like is a small digital display with a wire going to the sensor (longest run would be about 900 ft.).

I have looked everywhere I can think of, I hope you can point me in the right direction whether it be something already available or something I have to build.

120110 **Chris Salter**
via Internet

ANSWERS

ANSWER TO 11011 - NOV. 2001

What is the easiest (and least expensive) way to obtain a hard copy of a waveform on a PC printer? Is it necessary to have a GPIB controller?

The oscilloscope I am using is a Tektronix 7603 with the 7D20 digitizer plug-in. Ideally, I would like to print the entire magnified record across the continuous pages of a dot-matrix printer.

The easiest way to obtain a hardcopy from a storage oscilloscope is through a Centronics hardcopy module.

The 7603 is a 100 MHz mainframe and on most recent Tektronix equipment you may be able to get Centronics, RS232 and GPIB (sometimes all three, sometimes a combination). Just check out the advertisers in *Nuts & Volts* dealing with used test equipment, what is available and don't forget the software if it is required. The internet is also a good source.

I personally use the Velleman PCS32, which is an older version of the PCS64 just recently reviewed in *Nuts & Volts*. The PCS64 comes with all the necessary software for all kinds of OSs, connects through a printer port to a PC, is only about $400.00 and includes FFT. It generates a TIFF file, which can be inserted in MS Word, PowerPoint, Publisher, and other documents.

Walter J. Heissenberger
Hancock, NH

ANSWER TO 11015 - NOV. 2001

I recently acquired a Philips PM3310 digital storage scope. It ran for about 20 minutes, then quit.

I have isolated the problem to the power-supply board and would hate to throw this unit out when it appears to be a fairly simple fix.

Could anybody point me in a direction for repair information, parts list, suppliers, etc.?

There is a site in GB — Bird Equipment Data (**www.telford-electronics.com**) and they have a Phillips PM3310, which is a 50 MHz DSO 2 Channel for sale. They may be able to get you a copy of the manual. My experience with older test equipment power supplies is, that the power semiconductors (rectifiers, switching and series transistors, voltage regulators) and the electrolytic capacitors go first, since they are the stressed components. Cold solder spots and connectors are another sore point.

I typically replace all those components (except connectors, most cold solder spots get fixed in the process), since they are worth only a few bucks and get then a good life out of the equipment. Good parts sources are Jameco, Digi-Key, Philips ECG, and Mouser.

Walter Heissenberger
Hancock, NH

ANSWER TO 10016 - OCT. 2001

I would like to build a circuit to control 40-50 LEDs with a numeric-touch pad. If I wanted the LED in the number 3 position to go on, I would just press "03" on the touch pad. If I want the LED in the number 3 position to go off, I'd press "03" to extinguish the LED.

If this can be accomplished with a wireless circuit that would be ideal, but a ribbon cable connection is just as good.

Can someone draw me a diagram with required parts?

Over a dozen microprocessor (uP) families can do this job for under $7.00 with MIPS to spare and the wireless section in particular has gone from a serious headache to a $24.00 receiver (Rx) and a $12.00 transmitter (Tx). This is not a trivial project, but it sure has gotten easier and cheaper in the past couple years.

First, pick a microprocessor family. If a 3 x 4 keypad is used (seven I/O lines to scan) and 49 LEDs (multiplexed as 7 x 7 using 14 I/O lines) then the ribbon cable design needs 21 I/O lines and very little processing power.

The wireless version will use two small processors. One will need seven I/O lines to scan the keyboard plus resources to handle the serial communication to the Tx module (300 baud would be

enough, but 1,200 would allow for some expansions I'll suggest at the end). The receiver will need 14 I/O lines plus the same serial resources to interface to the Rx module.

Use any uP family you choose: AVR, BASIC Stamp, 8051, 68HC705/11/12, PIC, RABBIT, SX – you name it. *A source list is provided at the end.* This sounds as though it might be your first microprocessor-based project. Spend some time looking at each of the web sites listed below and thinking about the future. Once you have spent a couple hundred dollars (or more) to buy a programmer and/or a development kit, as well as bought a compiler and chosen an IDE in which to run all the software you will probably want to use that uP family and that financial investment for your next few projects. The list of uP families is by no way complete and some of these processors are certainly overkill for this project. Still, that same uP might be just right for the next couple ideas you have stirring in the back of your mind.

I am not a fanatic about any particular processor family, but some people are so I'm not going to add to the discord in the world by choosing a microprocessor for anyone. Also there are people who live and die by GNU and the open-source movement who will be quick to point out that there are hundreds of assemblers and compilers available for free on the internet and that is absolutely true. You still need a programmer, but you might not have to spend a dime for your software tools.

With all those disclaimers out of the way your second step is to pick a language. Reading a keypad and lighting LEDs (even with a wireless serial link) is a low MIPS task so almost any language will do the job. You will probably settle on Assembler, some form of BASIC, or C, but here too pick a language that you like and one that has the features and power to run some future projects.

Also whatever language you decide to use buy a book on how to program and do your part to rid the world of rambling, non-structured "spaghetti" code. I'm partial to Ed Yourdon's books, but there are dozens of good texts and even free tutorials available on the net. The rule of thumb at my company was spend 40% of your time planning your program, 20% actually writing code and 40% testing. Good programming technique makes debugging much easier and solves scores of problems before they even occur.

Remember to break this project down into small bites. Scan the keyboard, send a byte to the Tx module, receive the bite, decode it, turn on the lamp drivers, etc. Debug each section as you go. Even the pyramids were built one block at a time.

So now you have picked a processor and you have picked a language.

For interfacing the LEDs take a look at Fred Blechman's Scrolling Clock *(N&V July '01 pg. 78)* for ideas. You may or may not want some latches, drivers, or glue chips to interface with your microprocessor. If you decide to use glue chips then you have the opportunity to use optoisolators or solid-state relays and regular incandescent light bulbs or Christmas lights or even flood lamps! Do you want this display to be visible across the room, across the gymnasium, or across town?

Abacom, Lemos International, and Linx all provide excellent Tx and Rx modules. Check their websites for application notes showing how to use them.

They are inexpensive and work great, but as with any RF device there are some esoteric considerations to keep in mind.

Continued on page 64

ANSWERS TO 110110 - NOV. 2001

I am looking for a hard drive that is made entirely from memory modules, specifically, 256MB SDRAM modules. This drive would contain 10 or more said modules to produce a 2.56GB IDE logical drive. A box with a 40-pin IDE spigot that contains no moving parts (no platter or heads) just sockets for memory modules, a lithium battery to refresh the modules when power is removed, and the IDE controller.

This box could easily fit into a 5.25 drive slot, memory and all.

Since SDRAM is so cheap now, this would be a viable alternative to magnetic media.

This drive would offer superior boot time, as well as access time. It would be used in place of a hard drive.

Boot time would be reduced to 10n seconds or less, a boon to those who do financials or serious engineering/scientific/graphic work, as well as reduced time to load applications.

#1 In regards to your question about making a memory-only hard drive, I do have some points that you should be aware of.

In terms of cost: A mechanical unit of 20 gig costs roughly $99.00. A memory-based one of 2.5 gig would cost at today's prices $285.00.

Your idea about the battery-powered refresh isn't quite complete. While a battery will hold the contents of dynamic RAM for some time, something still has to refresh (re-write) the contents of the cells every once in a while. So, in order to use SDRAM, you have to add on a processor to do the refresh. Or you can use static RAM, which eliminates the refresh requirement. This is how products like USBdriveStor and the ThumbDrive work. Either way, the cost goes up.

What about backup? Bits get twiddled all the time on modern PCs, and batteries do die. You'd still have to have a mechanical drive to mirror all the data. This will use processor time, which will slow things down.

Having said all that, what you want has been accomplished by both high-level techno-geeks and by several companies. The key is to do a web search for "solid-state drives." For your needs, I would check out: **www.imperialtech.com/products_megaram35.htm**, which is designed to be interchangeable with standard 3.5 inch SCSI/LVD drives.

Alan Sheets
via Internet

#2 The type of drive you are looking for is know as a solid-state disk drive. And so are Flash, EPROM, and ROM. A disk drive that used RAM modules use to be made only for the commodore C64/C128. Flash, EPROM, and ROM based drives seem to be the most popular. The following is a list of companies that sell SCSI and/or IDE flash disks.

www.tri-m.com.

www.advantech.com/products/PCD-350A.asp

www.kingston.com/pccard/default.asp

www.web-tronics.com/solstatdisss.html

www.sandisk.com/oem/flashdrive.asp

www.peak-uk.com/index.htm including isa and cf

Dan Hockey
Des Moines, IA

RVK-BASIC: Fast, Affordable Code for AVR Microcontrollers

by Bob Vun Kannon

The choice of which kind of computer to purchase has long been dominated by the software available. The overall availability of software for the IBM-style personal computer was the largest factor in allowing it to win the market place over the Apple computers.

In choosing a microcontroller, there are many good families of chips available and the cost of the chips themselves is generally very low. One popular option in the microcontroller arena is the BASIC Stamp®. A primary reason for the Stamp's popularity is the ease of writing code for it. The reason code is easy to write is that it is programmed in Basic.

But what if there was another line of options, which were just as easy to program in a very similar Basic language? What if that language was designed for real-time controls, and what if the compiler could be downloaded for free over the Internet? What if this language offered execution speeds of millions of lines of Basic per second? What if the chips cost dollars instead of tens of dollars? Now, let's go one step further. What if the source code for the compiler itself was written in Basic and was also available for free?

Today, I am happy to inform you that all of the above is true. The playing field has now changed. Now you can download the RVK-Basic compiler for free from the *Nuts & Volts* website (www.nutsvolts.com/tbd/). This compiler is written in Power Basic and the source code is included.

If you don't like it, you can change it. You are the master of your own fate. It compiles code for the Atmel AVR line of microcontrollers, which are very inexpensive and widely available. You can purchase a development board for programming this line for about $80.00 or you can build your own programming cable (instructions are included in RBP.TXT with the compiler).

When running byte operations on a slow chip (4 MHz), you will be executing over one million lines of Basic source code per second using this compiler. Simple microcontrollers in this line are available at speeds up to 12 MHz and, if you're really brave, there is the FPSLIC line that will run up to 30 MHz. Just how much speed do you really need?

The RVK-Basic language currently consists of 189 types of statements. I say "currently" because the very nature of an open-source project is change. This language started out two years ago to be very simple with a few dozen types of statements. Now it can be fairly described as suffering from rampant feature-itis.

About open-source projects: I wrote this compiler all by myself. I own it. It's my property. I am making it available at no charge for personal use to encourage hobbyists and engineers worldwide to enjoy it and enter the world of embedded micro-

controllers. If you should choose to use this compiler for a product for any commercial purpose, please contact me for license details. The royalty will be quite modest.

Another advantage of making this an open-source project is that we will all gain the benefits of improvements from many other people. I have put into this compiler everything I can think of that I will need. Now others can add their contributions and we will all gain. I do have one request in this regard. If and when you modify the compiler, please share it with me so that I can publish a new version for all persons to use. I can be reached at rvkbob@att.net.

Concerning the language itself, the rest of this article will give a summary of the RVK-Basic language. This article will not go into the fine detail of each instruction type. That information is contained in the RB.TXT file you receive when you download the compiler.

This compiler is a DOS compiler. It has been successfully used under MSDOS, PCDOS, PTDOS (Russian DOS), and under the command prompts of WIN95, WIN98, WINNT, and WIN2000. It will probably also run under WINME, as well as LINUX/XDOS. In order to use the output of the compiler to program a chip, instructions and software are provided for programming through the parallel port under MSDOS. If you are using any windowed operating system, you will probably need to purchase a programming system (I recommend the STK-500 from Atmel for about $80.00).

RVK-Basic currently supports the following Atmel AVR processors: 1200, 1200A, 2313, 2323, 2333, 2343, 4414, 4433, 4434, 8515, 8535, MEGA103 (untested), MEGA161 (untested), and the MEGA603 (untested).

RVK-Basic differs from classic forms of Basic in that it allows only one statement per line. While this eases the job of parsing the source code by the compiler, it also keeps the code more readable. Comments are generally allowed at the beginning or end of any line and are separated by a single quote or apostrophe.

There are five basic types of variables in RVK-Basic (hereafter, referred to as RB for brevity). Variable types are identified by the last character of the name of the variable. They default to unsigned byte variables in registers. For all of the processors which contain RAM, unsigned byte variables stored in RAM may also be specified by suffixing a tilde (~) to the variable name. Unsigned integer variables may be specified (in chips with RAM) by suffixing the variable name with %.

For example, X% is an integer while Y is a byte. Note: Because of the fact that there are only 32 registers in an AVR processor, you may not use more than 28 byte variables in registers in any program. (four registers are reserved for system operations.) You may use as many byte variables in RAM as you have space for. The variables in registers can be manipulated extremely quickly. In practical experience, 28 register variables are usually sufficient for most programs where speed is critical.

An array of bytes is named by suffixing the name with "@," e.g., TEST@ is a byte array. (See DIM, READ, STORE below.) Arrays are stored in RAM. An individual byte in an array is referenced by enclosing the index to that byte within square brackets.

A string may be defined in RB by suffixing the variable name with a "$." Strings are stored in EEPROM. There is also an EEPROM statement for explicitly storing numeric data in EEPROM.

A Summary of Variable Types:

x	byte variable in a register (fastest access)
x~	byte variable in static ram (slower access)
x%	integer variable in static ram (2 bytes, unsigned)
x$	string variable in EEPROM
x@[]	an array of bytes in static RAM

Equations in RB are similar to but different from classic BASIC programming languages. All operations are strictly performed from left to right. For example,

```
Y = 2 + 3 * 5
```

will give a result of 25, not 17.

Algebraic operations supported in equations are:

+	addition
-	subtraction
*	multiplication (integer = byte * byte)
/	division (byte = byte / byte)

The divide operation is an unsigned byte divide with no remainder.

The following logical and arithmetic operators may be used in equations and must be delineated by spaces or tabs on both ends of the operator.

AND	logical and
OR	logical or

XOR logical exclusive or.
MOD a MOD b returns the remainder of a/b. Both a and b must be bytes.

Constants may be freely used in place of variables on the right-hand side of an equation. All of the following are legal examples.

```
y7 = x + 5 and &H0F
     y7 = 5 + x + y~
     p123 = a and b
     p123 = &H17 and charlie
     Y = -X
     a@[7] = a@[1] XOR a@[i] AND 7
```

Constants are understood as decimal numbers unless otherwise indicated; "&H" prefixes a hexadecimal number. "&B" prefixes a binary number.

In equations, byte variables, constants, and integers may be intermixed provided that the destination variable is at least as big as the largest operand. For example, an integer may be specified as the result of an operation with bytes, integers, or bytes and integers.

A byte or an integer may be specified as the result of an operation with bytes (other than multiplication). You may also assign an integer to a byte for the purpose of moving the lower byte of the integer into the byte.

Four relational operators are used in IF THEN ELSE END IF constructs. These operators are the following.

> greater than
< less than
= equal to
| not equal to

RB allows the following 29 flow control statements: **BEGINCASE, CASE, CASE ELSE, ENDCASE, DO, EXITDO, LOOP, WHILE, EXITWHILE, WEND, FOR, EXITFOR, NEXT, CONTINUE, IF, ELSE, ENDIF, GOSUB, RETURN, INTERRUPT, END INTERRUPT, GOTO, RUN, END, CALL, SUB, ENDSUB, EXITSUB**, and **SHARED**.

RB allows the following 17 types of arithmetic and logical operations: **ADD16, CLR, COMPARE16, SET, TEST, DECR, FILTER, FLIP, INCR, MAKEINT, SHIFT, SHIFT16R, SHIFT32, SUB16, ROTATE, SWAP**, and **EQUATIONS**. The FILTER statement deserves special comment, since this may be the only form of BASIC to incorporate this feature. This statement performs a sliding-average filter on incoming data. It is rather useful for quieting down noisy data. The **FLIP** statement is unusual: it performs a mirror bit-image of a variable (bit 7 swaps with bit 0, etc.).

RB provides the following five configuration and port control operations: **DIRPORT, MAKEOUT, MAKEIN, REVERSE,** and **XMEM**. The **XMEM** statement allows external memory usage for those processors that support this option.

RB provides the following 22 I/O and data operations: **A2D, ANALOG, CLRBIT, INPORT, INBIT, OUTPORT, SETBIT, TOGGLE, PULSE, EDGE, DEBOUNCE, BYTES, NIBBLES, DIM, READ, STORE, PWM INIT, PWM OFF, PWM THRESHOLD, PWM2 INIT, PWM2 OFF**, and **PWM2 THRESHOLD**. The **BYTES** statement swaps the bytes in an integer. The **NIBBLES** statement swaps the nibbles of a byte.

RB supports the following 30 time and serial communications statements: **PAUSE, SERIN, SEROUT, SPI, DOGCLR, DOGOFF, DOGON, RECV INIT, RECV OFF, RECV IN, RECV INTERRUPT, RECV2 INIT, RECV2 OFF, RECV2 IN, RECV2 INTERRUPT, TIMER0 ON, TIMER0 OFF, TIMER0 READ, TIMER1 ON, TIMER1 OFF, TIMER1 READ, TIMER2 ON, TIMER2 OFF, TIMER2 READ, XMIT INIT, XMIT OFF, XMIT OUT, XMIT2 INIT, XMIT2 OFF**, and **XMIT2 OUT**. Of these, the **SPI** statement allows easy interface to serial hardware devices while the **RECV** and **XMIT** statements control the UARTS and the DOG statements control the watchdog timer.

RB supports the following 18 miscellaneous statements: **ASM, DEVICE, EEDATA, EQU, EXTINT, POPFLAGS, POPREG, PUSHFLAGS, PUSREG, REGPOP, REGPUSH, REM, RESETSP, REVISION, SLEEP, STACK, VARPUSH**, and **VARPOP**. While these are largely low-level operations, note that the **ASM** does allow directly embedded assembler statements.

For more details on any of these statements or on the use of the compiler itself, download the compiler and read RB.TXT. For details on how to program through your parallel port, read RBP.TXT. For examples of code written and compiled by this compiler, go to www.rvkbob.com. There are free routines there that you can download which have been written and tested in RVK-Basic. As you develop generally useful routines yourself, please feel free to send them to me so that *Nuts & Volts* and I can post them on the web site.

Happy computing! **NV**

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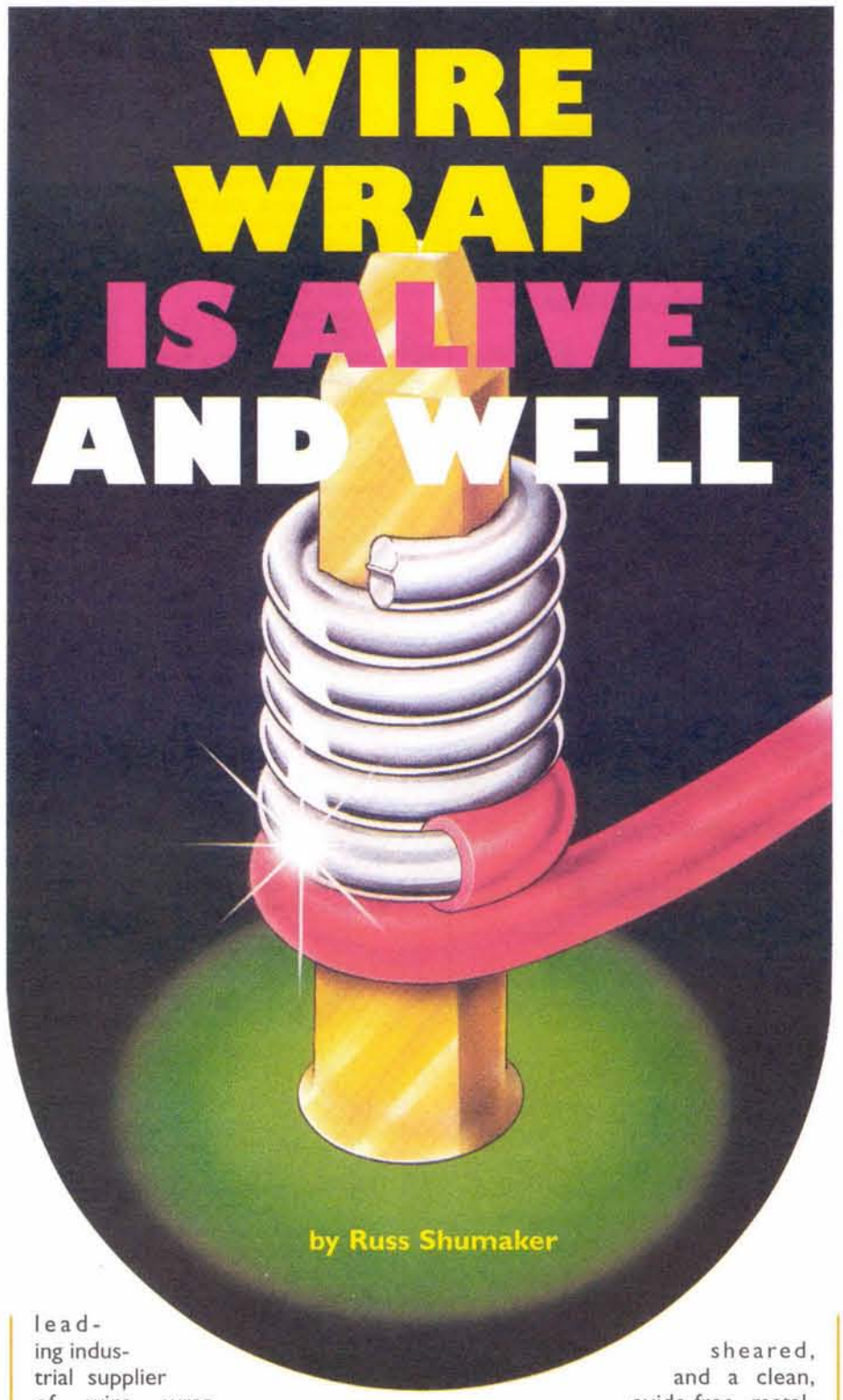


by Russ Shumaker

Electronics hobbyists evolve through a series of circuit-building techniques, starting with the simplest of the simple, such as wire nuts or twisting component leads together, to designing, fabricating, and assembling their own printed circuit boards.

After successfully building a few simple circuits on perf board, and perhaps a small kit or two, confidence rises. They find it's time to move on to bigger and better circuits.

The neophyte soon finds out that assembling a more complex circuit onto perf board is an exercise in futility. Part way into the project, too many connections too close together turn it into an unmanageable mess.

Construction articles found in electronics magazines use printed circuit boards for all but the simplest circuits, so investing time and money into the PC board fabrication process seems to be the next logical step, albeit a bit daunting for the new hobbyist. PC board fabrication is not necessarily the next step.

There is another alternative ... wire wrap.

It is relatively fast, reliable, simple, solderless, inexpensive, and easy to learn. Wire wrap has been successfully used for decades by the telecom/datacom and controls industries. It is ideal for complex one-of-a-kind circuits and systems. Nimble-fingered production assemblers, armed with pneumatic wire wrap guns, an assortment of prestripped wires, and computer printouts of wiring charts, are amazingly fast and accurate. A system back plane with thousands of wire terminations is typically completed in a few days.

WHAT IS WIRE WRAP, ANYWAY?

Simple; it's a wire connection system that uses a special tool to tightly wrap a small gauge solid wire around the sharp corners of a connection post. Bell Telephone Laboratories developed the system, and OK Industries, which was founded in 1946, pioneered the process.

Wire wrap has been around a long time. Today, OK Industries is the leading industrial supplier of wire wrap tools and supplies.

RELIABILITY

See Figure 1. By bending the wire around the sharp corners of a square post, the oxidation on both the wire and the terminal is crushed or sheared, and a clean, oxide-free metal-to-metal electrical connection is obtained.

The contact point between the wire and the post is gas-tight. This means the contact is tight enough to prevent the intrusion of air, and thus eliminating the possibility of any oxidation occurring between the contact surfaces.

Wire wrap is also very stable when exposed to temperature changes, corrosive atmospheres, humidity, and vibration. It is stronger than a solder connection. It is less easily stripped from the terminal, and is less subject to breakage. The connection can be removed quickly and easily, with no damage to the terminal.

TYPES OF WRAP

See Figure 2. The regular wrap coils only the stripped portion of the wire around the post. This style is quite adequate for most applications.

The modified wrap coils a portion of the insulation around the post, as well as the stripped section. This gives better vibration protection, as well as provides an extra bit of wire if the connection needs to be moved to another post during troubleshooting or circuit revision.

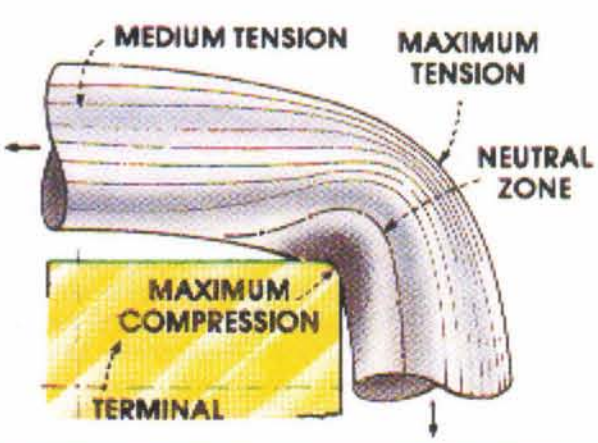
TOOLS

Hobby Hand Wrap/Unwrap Tools. See Figure 3. This is the best place to start. OK Industries' tool WSU-30 (regular wrap) is shown. The WSU-30M (modified wrap) tool looks almost identical. The wrap and unwrap bits are installed on opposite ends of the handle, and a 30 AWG wire stripper is built into the center of the handle. The two tools are readily available from several distributors, including Digi-Key and Allied, for around $20.00.

RadioShack also has a wrap/unwrap tool — part no. 276-1570 — that works quite acceptably. A stripper is furnished with the tool, but it is separate, and small enough to be easily misplaced. It is normally stored inside the tool handle. This tool uses the same bit for wrap and unwrap.

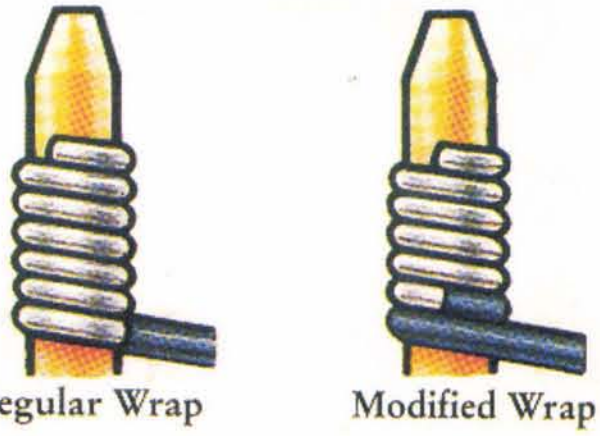
Powered and Manual Wrapping Tools. See Figure 4. The unit shown is an OK Industries' 115 VAC tool. Several models and options are available There are also battery-powered tools available, as well as a manual tool with a squeeze-ratchet mechanism that spins the bit. The battery-operated and squeeze tools are very often used by field service people who don't always have con-

Figure 1 — MECHANICS OF A WIRE WRAP



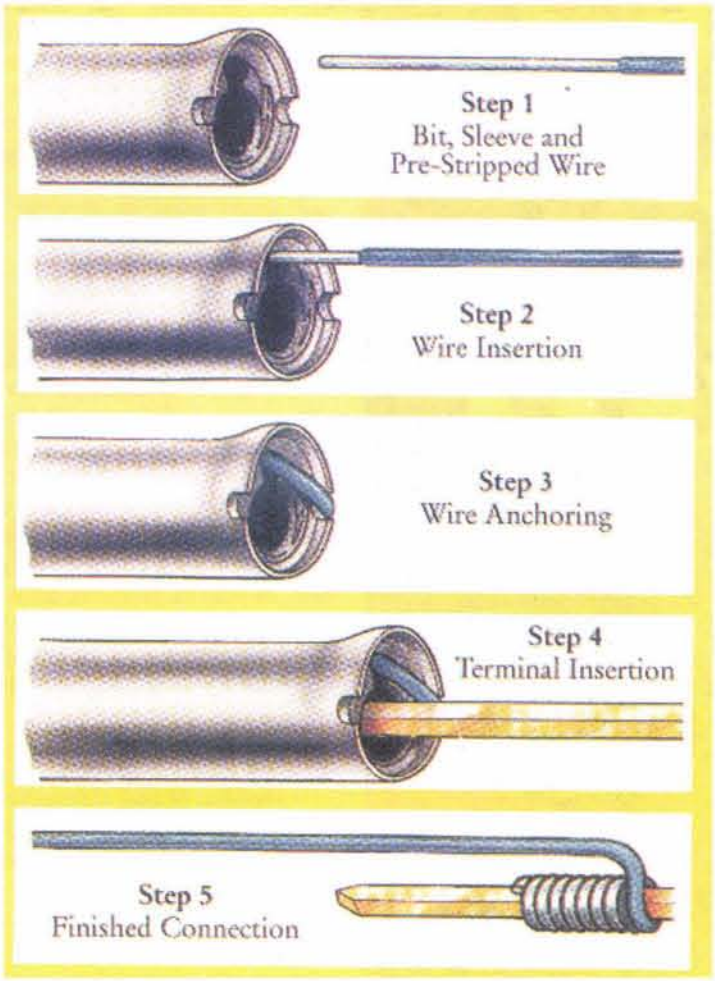
This enlarged cross-section of a wire wrap connection shows the maximum force occurs where the wire is wrapped around the sharp corner, which crushes and shears the oxide layers, thus creating a clean, gas-tight metal-to-metal contact.

Figure 2 — TYPES OF WRAP



A "regular" bit wraps the bare wire only around the post. A "modified" bit wraps a portion of the insulation around the post in addition to the bare wire. This greatly increases the ability to withstand vibration.

Figure 6 — MAKING THE CONNECTION



The wrapping bit shown is on a power tool. A hand tool is very similar, except it doesn't have the two notches on the outside lip of the sleeve. It's a simple procedure that takes a few seconds per connection.

Figure 3 — HOBBY HAND WRAP/UNWRAP TOOLS

The tool on the left is an OK Industries #WSU-30; the wrap and unwrap bits are on each end, and the wire stripper is attached in the center of the handle. The tool on the right is a RadioShack #276-1570. The same bit is used for wrapping and unwrapping. The cap is shown removed. The wire stripper that is stored inside the handle is shown on the extreme right.

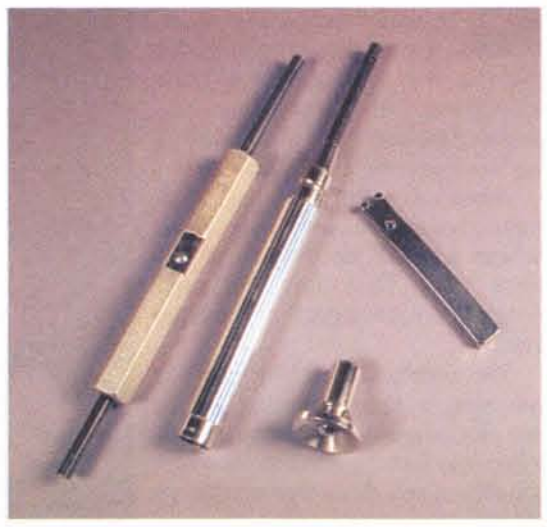
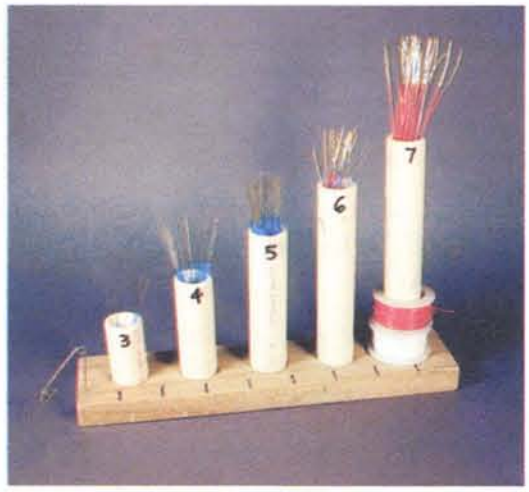


Figure 4 — WIRE WRAP GUN

This is an OK Industries wire wrap gun that is powered by 115 VAC. The bit and sleeve are held on by a hand-tightened chuck, and are quickly and easily replaced for different types of wrap and different gauges of wire.

Figure 5 — PIPE ORGAN

This is a homemade bench top holder for pre-cut/pre-stripped wires. It's made from lengths of plastic water pipe glued into counterbored holes in a piece of wood. Inch marks on the wood help to measure spooled wire, which is conveniently stored on the end pipe. The safety pin is used to straighten "unwraps."



venient access to plug-in power at a job site. The bits and bit sleeves are sold separately for different types of wraps and different gauges wire. These tools require a small investment, so the hand tools should definitely be tried first to determine if wire wrap is the way to go.

Wire Strippers. Chances are that a regular old toolbox stripper won't work. Wire wrap requires 30 AWG solid wire with a special thin insulation. A universal V-notch stripper will nick and weaken or break the wire, and better strippers rarely strip wire that small. There are dedicated wire wrap strippers for industrial applications, but they're rather expensive, and most are not readily available through consumer distributors. The best bet is the stripper that comes with, or is built into, the hand wrap/unwrap tools or wire dispensers.

WIRE

Wire wrap wire is 30 AWG solid wire, with a special thin insulation, usually Kyner™ or Tefzel™. It is sold by the roll, or by pre-stripped lengths, or in an OK Industries dispenser that cuts and strips rolled wire in one operation. The wire comes in an assortment of colors, and is carried by most distributors, including RadioShack. Wire sizes other that 30 AWG are not available from most consumer distributors, and are usually special-order items for industrial applications.

Pre-cut lengths of wire wrap wire with 1" stripped ends are available from Digi-Key. These cost a bit more, but they cut about a third or more off the assembly wiring time. See Figure 5 for a do-it-yourself wire holder.

MAKING THE CONNECTION

See Figure 6. A wire wrap connection requires a 1" long stripped end of wire.

The execution of a wire wrap connection is pretty much the same for a hand tool as it is for an electrically- or manually-powered tool. The difference is that a with a hand tool, the wrapping bit is twirled by hand, and with a power or manual tool, the bit is spun by a motor, or a mechanical squeeze-ratchet mechanism.

There are two holes in the end of a wrapping bit. Insert the stripped end of the wire into the hole that is closest to the outside diameter of the bit. This is the smaller of the two holes. When the inserted wire bottoms in the hole, bend it outward, and place the larger center hole over the wire wrap post.

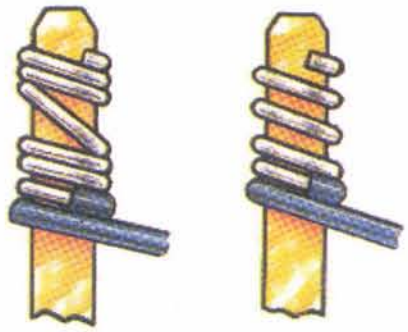
Hand Tool. Hold the free end of the wire so it doesn't turn when the

Figure 7a — OVERWRAP PROBLEM

Overwrap

Usually done with a power tool by applying too much downward pressure. Let the tool do the work. Just guide it.

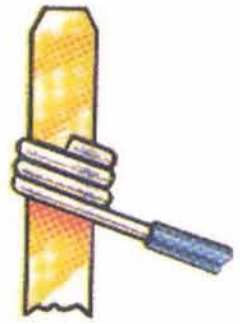
Figure 7b — OPEN WRAP & SPIRAL WRAP PROBLEMS



Open Wrap Spiral Wrap

Caused by removing the power tool before the wrap is completed. Leave the tool in place a bit longer.

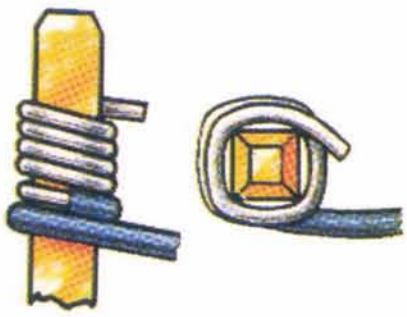
Figure 7c — INSUFFICIENT TURNS PROBLEM



Insufficient Turns

Caused by not inserting the stripped end of the wire far enough into the wrapping bit.

Figure 7d — LOOSE WRAP/PIGTAIL PROBLEM



Pigtail

Wire wrapping is a precision technique, and the wrong tooling cannot do the job. If bits and sleeves or hand tools do not agree with the wire size, a multitude of problems can occur.

bit is turned. Twirl the tool clockwise with the fingers, and when turning resistance is no longer felt, the wrap is complete. Lift off the tool.

Power Tool. After inserting the stripped wire into the bit, anchor the free wire end by bending it back through one of the two notches on the lip of the sleeve. Place the bit over the post, and against the board. This will anchor the wire and keep it from turning when the bit turns. If the connection is higher on the post and away from the board, the free end of the wire will have to be held to keep it from turning. Press the trigger for about a second or so until the wrap is complete. Let the power tool do the work. There is no need to press down. Just guide it.

Learning to wire wrap is no more difficult than learning to solder properly. A few practice connections will probably be necessary to get the feel of the tool, and to develop "the knack." Again, like soldering, dexterity and speed increases with experience.

GOOFS AND PROBABLE CAUSES

Overwrap. See Figure 7a. Too much downward pressure on a power tool during wrapping usually causes this. Again, let the tool do the work. Many OK Industries power tools have a feature to help prevent this, and it is indicated by a "BF" (backforce) suffix in the part number. It costs a little more, but is recommended.

Open Wrap/Spiral Wrap. See Figure 7b. This is another power tool problem, and is caused by removing the tool before the wrap is complete. Leave it on the post a wee bit longer. Don't remove the tool before the motor stops.

Insufficient Turns. See Figure 7c. Caused by not inserting the stripped end of the wire into the bit all the way.

Loose Wrap/Pigtail. See Figure 7d. Usually caused by a mismatch between the wire size and the tool bit. Hobby hand tools are for 30 AWG wire only. Power tools require a different bit and sleeve for each size wire used.

FIXING GOOFS AND WIRING ERRORS

The easiest fix is to snip the wire off close to the post, and leave it there. Re-strip and re-install the snipped end of the wire, or toss it, and install a new wire.

Unwrapping a wire from a post is simple, fast, and easy. Simply place the "unwrap" bit over the post, and slowly turn counterclockwise. A slight downward pressure on the tool may be required to get it to "grab." Continue to turn until the wrapped wire "lets go." Lift off the tool; the wire may or may not come with it. If it doesn't, the wire will be loose enough to lift off the post, without further unwrapping.

The stripped end of an unwrapped wire can be straightened and re-used, with a little care and a trick or two.

After a successful unwrap, and with the wire free of the tool, the stripped end of the wire will be a tiny formed coil. The first tendency is to straighten it with a thumbnail. This will most likely kink and break it. Instead, insert the pointed end of a large pin into the coil, and then pull it straight (one of Aunt Fannie's hat pins, or a large safety pin will do). See Figure 8. The straightening can now be completed with a thumbnail, or by drawing it over a rounded edge. After straightening, snip about 1/16" from the end. There will be a tiny, almost invisible hook on the tip, which will make it difficult to re-insert into the wrapping bit.

The unwrapped end can now be re-wrapped. A hand tool re-wrap is usually most successful. Be gentle.

If the wire is still inside the tool after unwrapping, insert the pin into the unwrap bit center hole, and jiggle the tool a little (like a toilet handle) and lightly tug on the wire. The coil should come out of the tool intact, and still be on the pin. Straighten the wire and clip the tip as described above.

SO, WHAT'S TO WRAP?

Most wire wrapping is done on connectors. Industrial system back planes that were mentioned previously consist mostly of PC board edge connectors — quite often hundreds of them. These connectors are wired together configuring the system, and dedicated-function PC boards are plugged into the connectors, completing the circuitry.

Hobbyists use mostly DIP (dual in-line package) integrated circuit sockets. See Figure 9. This does not, however, limit one to using ICs only. There are many components that are available in DIP packages. Read on!

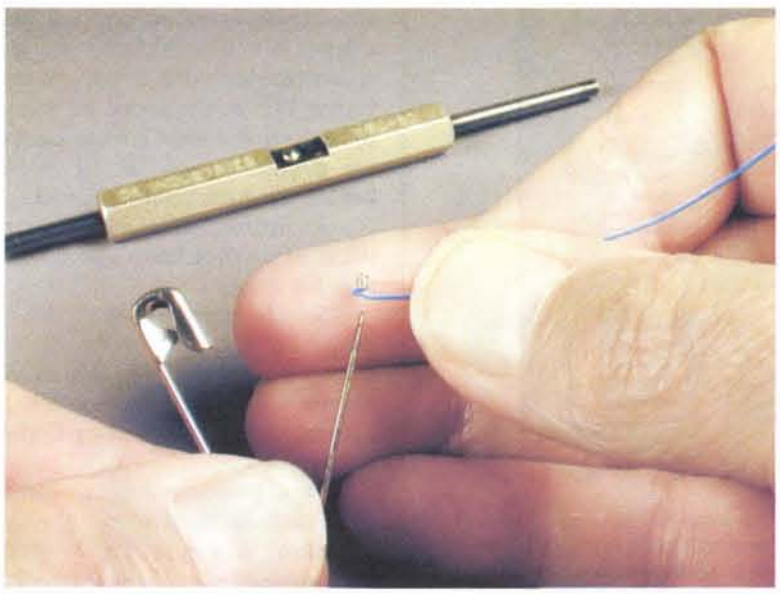
Wire wrap sockets are quite often specified as two or three level. See Figure 10. This simply means that the wire wrap posts can hold a maximum of either two or three wire wrap connections; the three level is a longer post (about 1/2"). The three level gives a little more versatility when routing and wiring the circuit.

Other wire-wrappable connectors include male pin headers. SIP (single in-line package) connectors are also available. Individual wire wrap pins (RadioShack part no. 276-1987) can be pressed into a project or perf board in any desired configuration.

THE ANATOMY OF A WIRE WRAP PROJECT

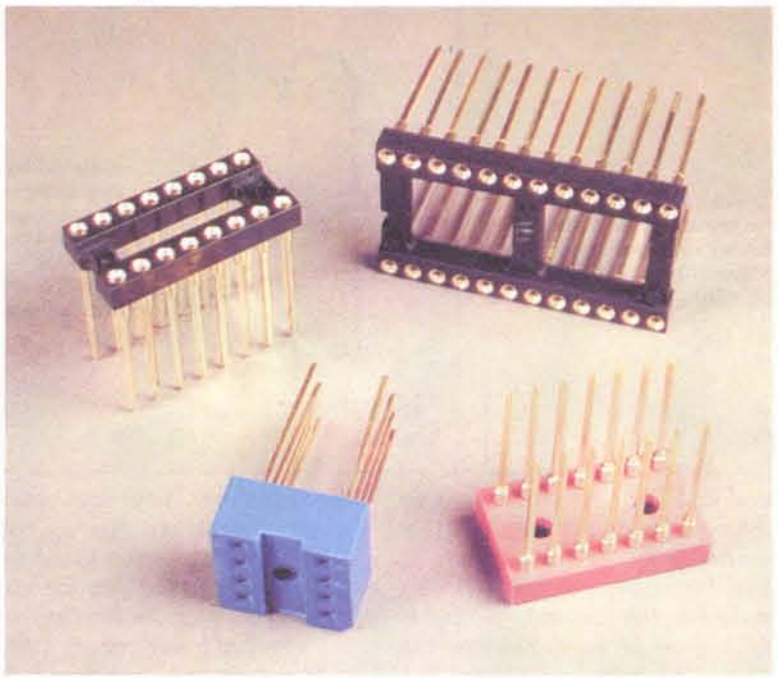
Most of the wire-wrappables used by the hobbyist will be 8, 14, and 16-pin DIP IC connectors as previ-

Figure 8 — RE-USING AN UNWRAPPED WIRE



An unwrapped wire is a small coil. Insert a pin into the coil and pull it straight; straighten it further with a thumbnail, or roll it over the side of the pin. Snip about 1/16" from the tip to make it easier to insert the wire into the wrapping bit. Re-wrap as required.

Figure 9 — WIRE WRAP DIP SOCKETS

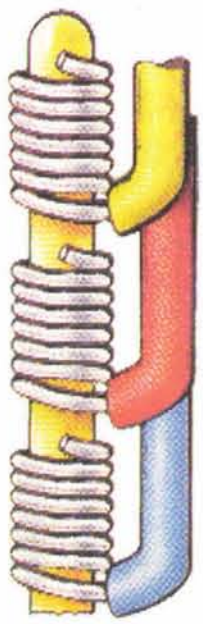


Typical integrated circuit wire wrap sockets available from most electronics distributors. Wire wrap connectors also include SIP sockets and male pin headers.

ously shown in Figure 9. An occasional SIP socket and male pin header may also be used. This does not mean, however, that one is limited to using mostly DIP ICs. Since these sockets have become electronics standards, there are now many components other than ICs that use DIP and SIP sockets. They include:

- Resistor Arrays
- LED Seven-Segment Displays
- Transistor Arrays
- Electro-Mechanical Relays
- Crystals and Oscillators
- Solid-State Relays
- Opto-Isolators
- Reed Relays
- LED Light Bars

Figure 10 — WIRE WRAP SOCKET LEVELS



Wire wrap sockets are defined as two or three level. A three level is shown above, and simply means the posts are long enough for three wire wrap connections. A two level post is a little shorter, and can only support two connections.

- Diode Bridges
- Trim Pots
- Switches
- Ribbon Cables With DIP or Header Connectors

Of course, any electronics home hobbyist worth his (or her) salt will first head for the primary parts source ... the junk box under the workbench. Chances of finding components in DIP packages here (other than ICs) are probably bleak. With a little adaptation and ingenuity, those radial and axial lead components, including big clunky capacitors, as well as semiconductors, can be wire wrapped.

Wire wrap sockets can, of course, be mounted onto any perf board having 0.1" hole spacing. A better choice, however, would be project board. A project board is similar to perf board, except it has printed circuit foil pads around each hole. This allows the sockets to be tack-soldered and secured to the board before connecting any wires. Wiring is much easier if the parts aren't wobbling and falling out of the board. DIP sockets can be secured by tacking the four corner posts to the project board. Gluing in place before wiring is another option.

RadioShack has a large assortment of project board sizes at reasonable prices.

Small components can be mounted on plug-in headers, as shown in Figure 11. These are manufactured by Aries Electronics, and others, and are supplied by Digi-Key and Jameco.

Larger components can be mounted as shown by the blue capacitor in Figure 12. Insert the component leads through the project board, and tack-solder in place. Don't clip the leads off flush, but rather leave about 1/4" or more protruding. Make the wire wrap connections to these component lead extensions. Hand-wrapping seems to work better with round leads. Since wire wrap is designed for posts with sharp corners, and the component leads are round, secure the wire wrap connection with a drop of solder for added reliability.

The wiring side of a completed wire wrap project is shown in Figure 13. Push the routed wires down against the board to make a neater looking project. The eraser end of a new wooden pencil makes the ideal tool to push the wires down between the IC socket pins.

A completed wire wrap board can be mounted into a chassis or a case any number of ways, as long as the wire wrap posts projecting from the back side aren't crushed or shorted. Standoff mounting as shown in Figure 14 is as good a way as any. RadioShack standoffs — part no. 276-195 — work quite well.

The board can also be mounted on spacers, angle brackets, or long screws and nuts. Some project cases have built-in card guide slots, which allow the project board to be mounted on edge.

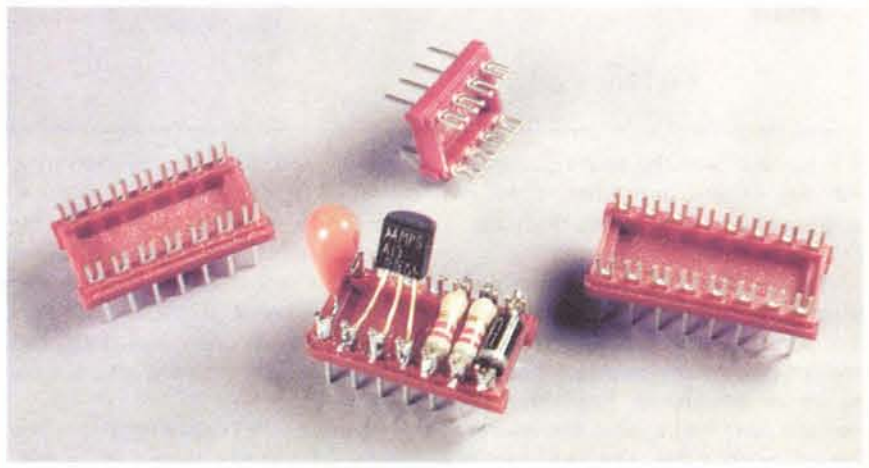
RULES OF THUMB

- Avoid stringing wires "banjo string tight." This puts an undue strain on the wires, connections, and posts. It is unreliable.
- Leave enough slack in each wire to allow for a re-strip and re-wrap if the circuit needs modifying. It may save a little work later.
- If a pre-stripped length of wire looks like it will be just long enough, it won't be. Use the next longer size.
- Route the longest wires first, and the shortest last. The short wires will hold the longer wires down against the board, making a neater looking assembly.

CONCLUSIONS

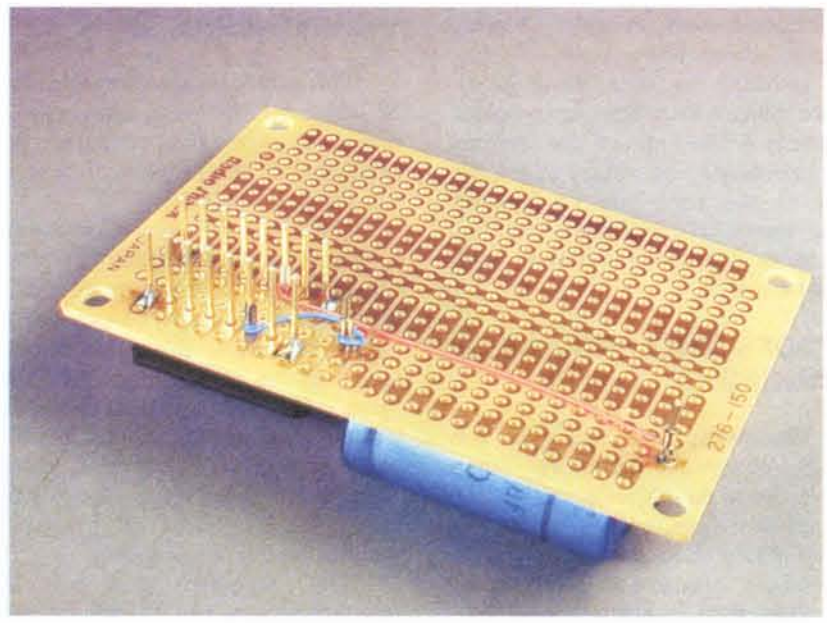
Wire wrap is not a replacement for soldering, or for PC boards. It

Figure 11 — PLUG-IN HEADERS



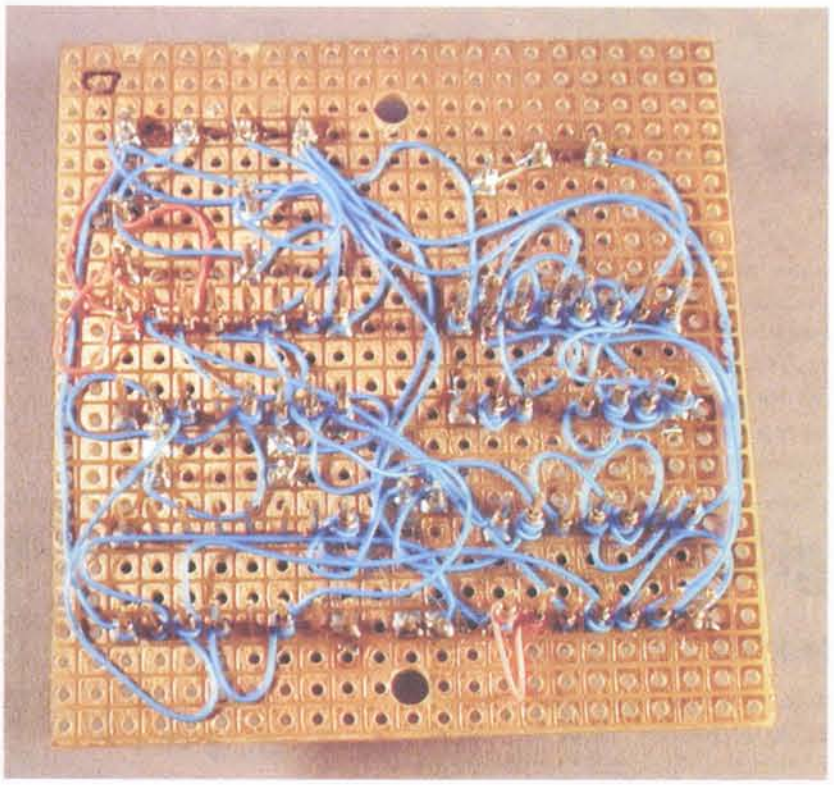
These are ideal for mounting small components; they are available in many pin configurations, and plug into standard DIP sockets. Snap-on covers for the headers are also available.

Figure 12 — MOUNTING LARGE COMPONENTS



Components such as the blue capacitor above can be installed by inserting the leads through holes in the project board, and soldering to the PC foil pads around the holes. Leave the component leads on the foil side of the board about 1/4" long. Wire wrap to these leads, and tack with a drop of solder.

Figure 13 — COMPLETED WIRE WRAP BOARD



The wiring lies neatly against the board and is routed with sufficient slack. The six top connections are a feed-thru terminal block, and are soldered, not wire wrapped.

simply makes point-to-point wiring manageable.

Occasional solder joints will always be necessary.

Although a short run of 30 AWG wire can carry up to an amp, higher currents will require a heavier gauge wire soldered in place. A wire wrap onto a round component lead will also require a drop of solder for reliability.

Printed circuit boards, of course, are ideal for making multiple identical circuits, but are a lot of work for one circuit assembly. Granted, they do make a more "professional" looking assembly, but most of the time, the circuit is mounted inside a case or chassis anyway.

Wire wrapping is an assembly technique that has long been overlooked by the home hobbyist.

A little practice and a nominal investment will allow the hobbyist to add this new tool to the old "bag o' tricks." **NV**

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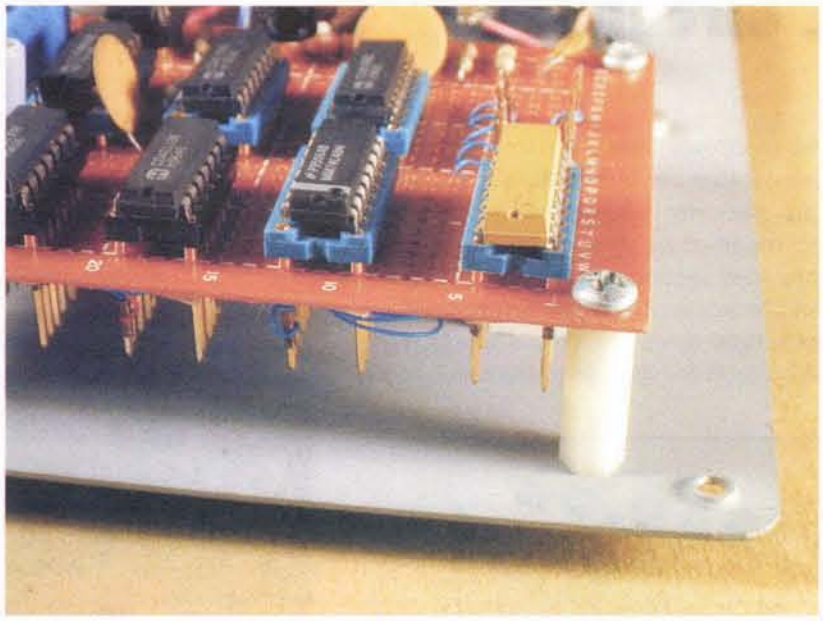
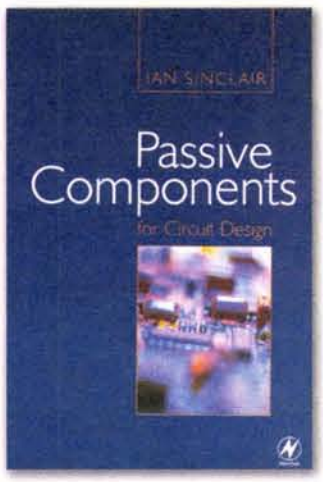
Figure 14 — WIRE WRAP BOARD MOUNTING



Circuit boards can be mounted in chassis or case any number of ways. It is not critical. The method shown above uses standoffs that are long enough to provide clearance between the wire wrap posts and the chassis; 5/8" or longer will give clearance to a level three connector.

New Books



Passive Components for Circuit Design

by Ian Sinclair

Passive Components for Circuit Design is a unique introduction to this key area of analog electronics designed for technicians, engineers, and anyone involved in circuit design. The coverage encompasses all component types capable of power amplification: resistors, capacitors, transformers, solenoids, motors, and transducers. The behavior of the components is explored along with the different types available and the principles of circuit design. Tolerances, stability, variation with temperature, reliability, and manufacturing standards are all covered.

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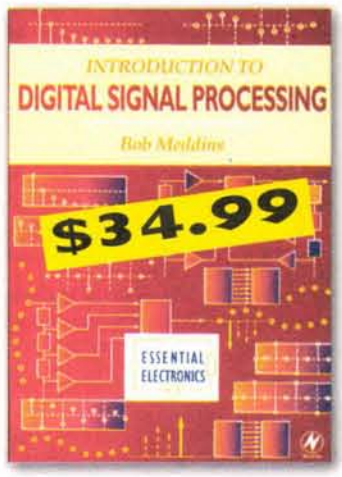
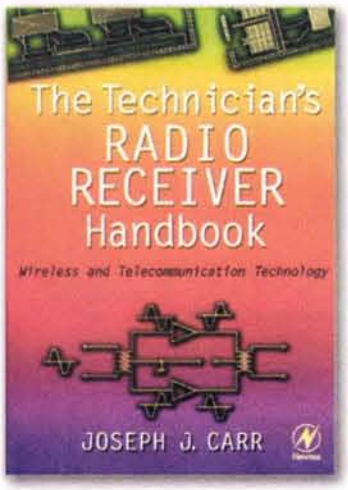
Introduction to Digital Signal Processing by Robert Meddins



Introduction to Digital Signal Processing covers the basic theory and practice of digital signal processing (DSP) at an introductory level. As with all volumes in the Essential Electronics Series, this book retains the unique formula of minimal mathematics and straightforward explanations. The author has included examples throughout of the standard software design package, MATLAB and screen dumps are used widely throughout to illustrate the text.



by Joseph J. Carr

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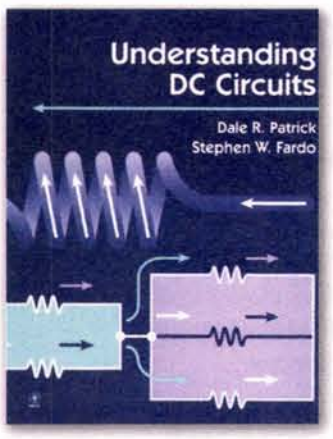

Understanding DC Circuits

by Dale Patrick & Stephen Fardo

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Understanding AC Circuits

by Dale Patrick & Stephen Fardo

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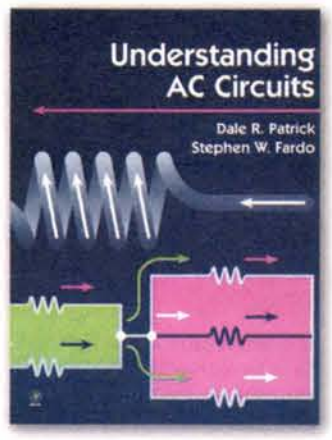
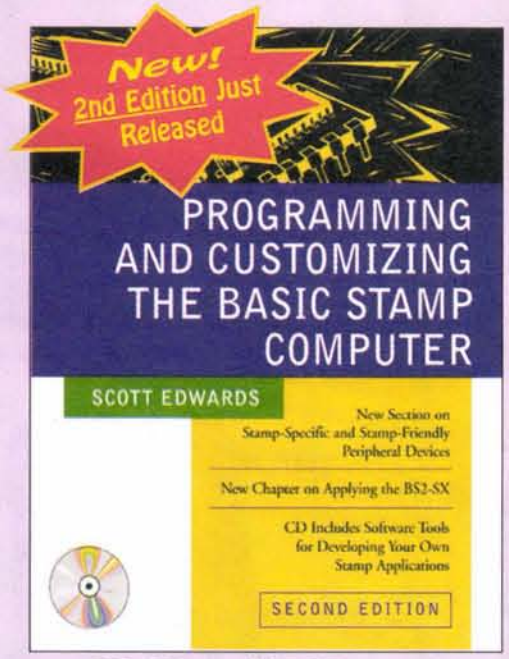


Understanding AC Circuits fully covers dozens of topics including single-phase and three-phase AC electronics; electrical generator basics; how to use a multimeter and oscilloscope in AC electronics; troubleshooting and testing circuits; tools and equipment; resistive circuits; inductive circuits; capacitive circuits; vector diagrams; series circuits; transformers; filter circuits; resonant circuits; decibels; waveshaping control; electronic symbols; soldering techniques; plus much more.



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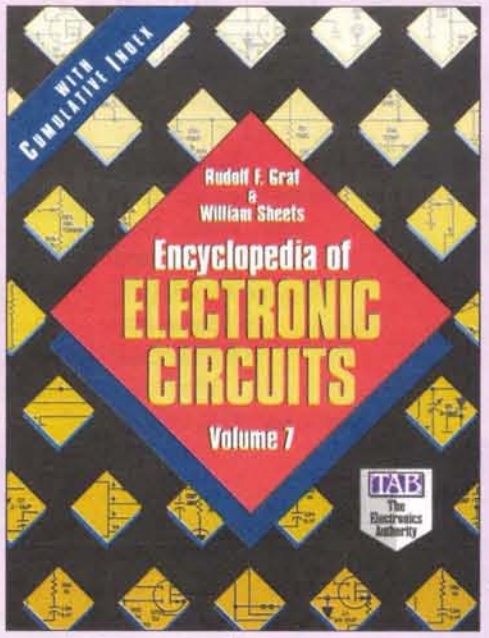

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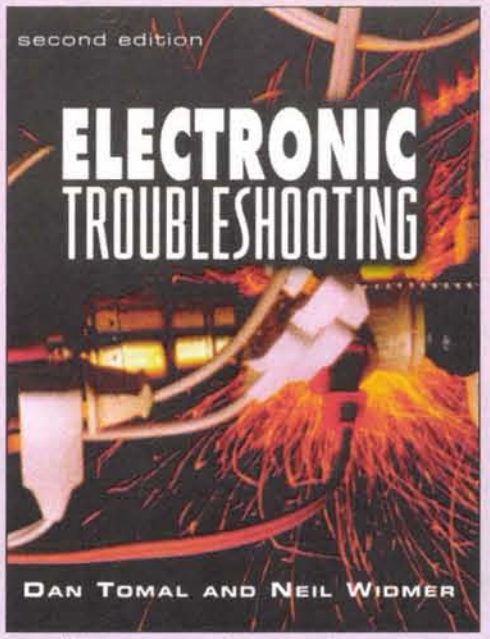

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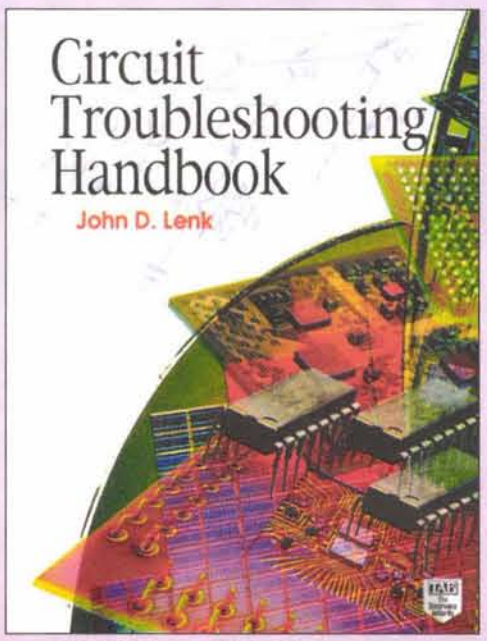

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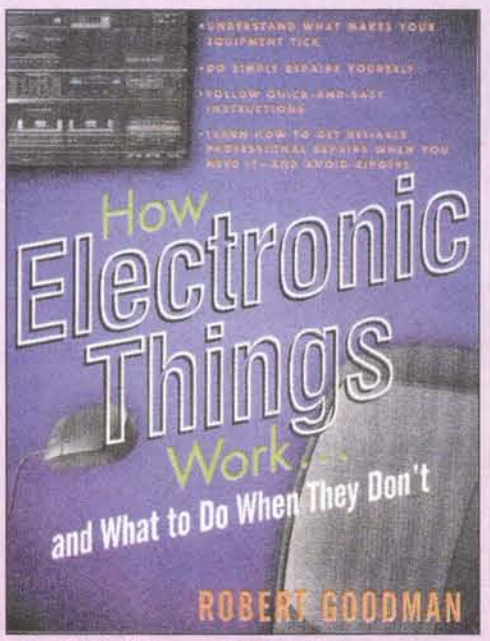

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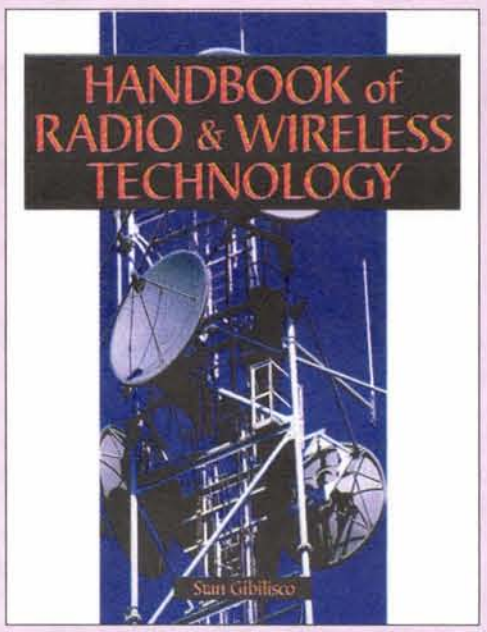

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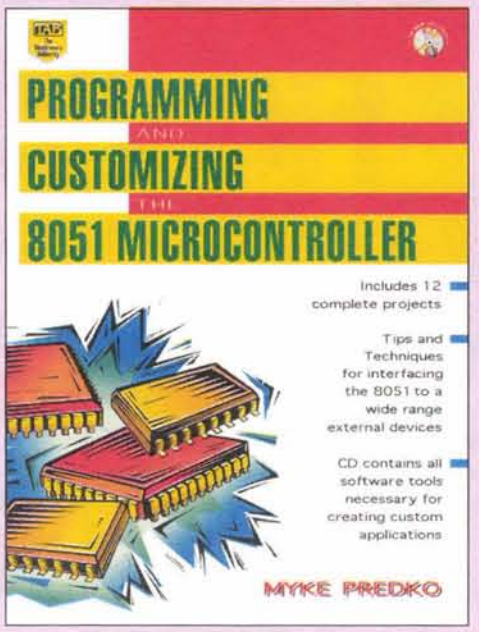

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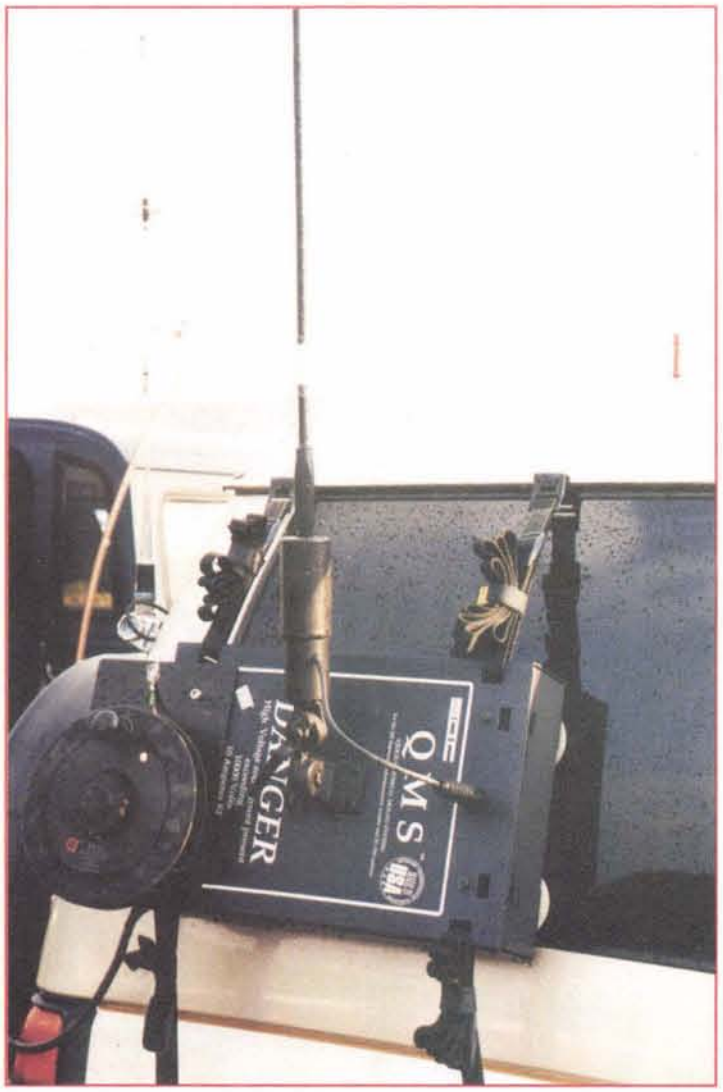


"If you pull on the base of the antenna and the car moves without the QMS moving on the car, then the straps are tight enough, otherwise readjust them," suggests SGC.

Another neat mounting of the larger SGC QMS antenna system.

by Gordon West

STRAP ON SOME HIGH-FREQUENCY PERFORMANCE

In the last two issues of *Nuts & Volts*, my review of mobile, high-frequency 3/8 x 24 thread antennas has generated some excellent points and questions from avid high-frequency mobile radio operators. Everyone seems to agree that no little tiny loaded high-frequency whip will have near the performance as a mobile whip dramatically longer and larger. There is no fooling Mother Nature when it comes to the radiation characteristics of a very tall whip versus a very small whip.

But many readers wanted to know more about getting on the air with a high-frequency antenna system that was both transportable quickly from one vehicle to another, and one that could be retuned to any new band without having to stop the vehicle and fiddle with resonance schemes.

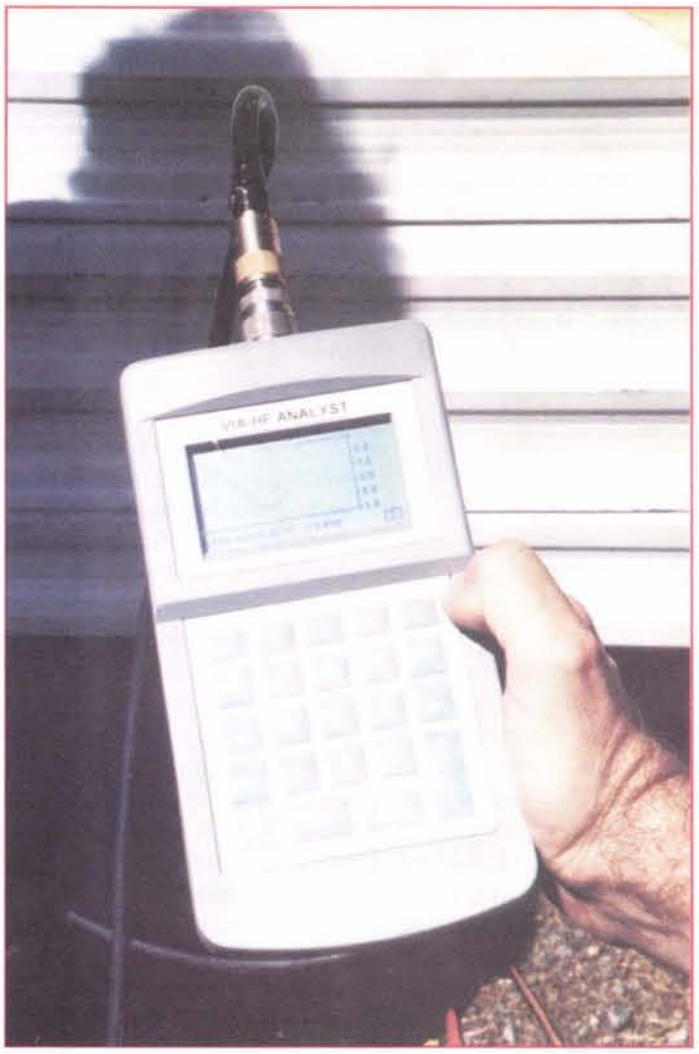
You wanted quick band changing, good efficiency on lower bands, rapid deployment from one vehicle to another without leaving scratches or holes, and a variety of whip configurations that could be real tall for "mobile at rest" installations, but relatively short for "mobile in motion" traveling.

One of the whip systems we tested meets these requirements precisely, so I went ahead and repeated the on-vehicle trials just to make sure it was everything that everyone seemed to have wanted, and the SGC Quick-Mount System (QMS) has some distinct advantages over any of the other whips I tried on our communications van.

SGC (Bellevue, WA; www.sgcworld.com) is well known for its marine, aviation, ham, and military automatic antenna tuner systems. Their automatic antenna tuners are available as five distinct models, all handling at least 100 watts of voice power output and covering 1.5 MHz through 30 MHz, and even one tuner including the six-meter, 50 MHz band, too.

The SGC founder and owner, Pierre Goral — an avid ham operator — quickly saw the many different applications of his automatic tuners and the need for both the military, as well as the avid radio operator to get the tuner up and running within five minutes on any type of vehicle. His answer to this challenge was the Quick-Mount System, a strap-on metal black box with capabilities to work with four of his most popular, fully automatic, high-power tuners.

Sometimes professionals call these automatic tuner systems "couplers," and maybe the military calls them ARUs, but it's all the same thing — a remote-mounted black box that will pass applied high-frequency RF power through a detector system, then through the active relay coupler tuning array, consisting of capacitors and inductors, then through an impedance detector and VSWR detector and



Testing the SGC with the AEA antenna scope, showing good tune on 40 meters with the AEA portable analyst.

phase detector all monitored by a central processing unit (CPU) proprietary chip, and an output that normally provides the most efficiency to a proprietary SGC helical-wound, black fiberglass whip.

In simple terms, you say the word "FFFOOOUUURRR" in the mike, and the tuner goes WWWHHHRRRRR, and you watch your SWR indicator drop to minimum while simultaneously watching power output on your transceiver go to maximum. This takes about three seconds on a cold first-time tune-up, and less than one second on an automatically memorized retune on your favorite frequency with the same electrical connections. Of course, the resultant output signal relies on a big surface area ground and the very tallest whip or wire you can get up into the sky.

The SGC QMS system has been around for several years. I must honestly admit that the first time I saw a vehicle with one of these units strapped on the side corner panel, I thought it looked terribly hokey, and who in the world would ever run with this type of installation as opposed to a more permanent type of mount. I soon found out that this particular tuner would constantly go on different vehicles in the fleet, and it took only five minutes to get back on the air after a vehicle switch.

I also saw some military installations with the QMS firmly attached to the side of some rather impressive armored vehicles, and this tells me that the equipment stays put even when the tall SGC whip is taking a pounding from low branches over the highway.

The actual tuning assembly is exactly the same as the normal line-up of SGC tuners, but mounted securely inside the QMS black box. The mounting box carries four large suction cups to keep the tuner in place without skidding around on glass or metal. And the suction cups work well — I nearly pulled the glass off of our communications van's back window when I gave it a tug to see how strongly it was holding on!

The black box also carries the 3/8 x 24 threaded receiver for any number of SGC helical-wound-type whips. You could also use a common stainless steel CB-type whip, but we found increased performance with the tuner working into a capacitive loaded helical-wound whip. When we added an intermediate capacitive loading hat, the tuner retuned to a new setting, and the receiving station over 1,000 miles away could actually hear the slight increase in signal strength.

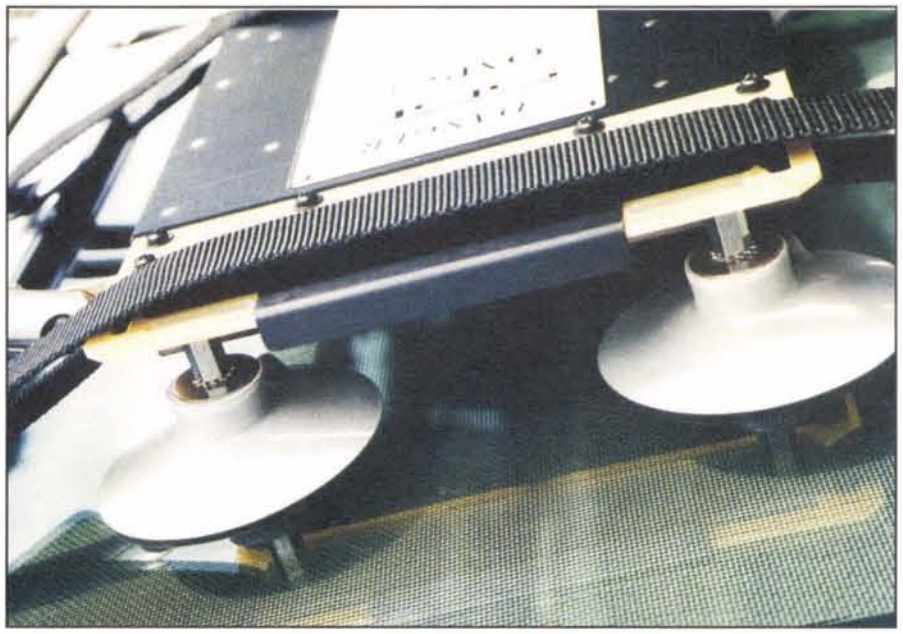
The SGC QMS box holds on with suction cups and the two required nylon straps. The nylon straps have two hooks at the top, and two hooks at the bottom to hang securely on the top edge and bottom edge of most vehicles. The straps are long enough to accommodate almost any type of gutter or lip you plan to hook into with the metal strap hangers. The metal hangers are rubber-coated so as not to scratch the finish of your vehicle.

The tuner box also has an adjustable whip receiver that may rotate at almost any angle in order to accommodate almost any type of box mounting. Just be sure to get the box mounted so that the whip receiver is not coming out the bottom!

The straps may be removed from the box and run through the QMS assembly in a different way in order to accommodate almost any type of mounting. But if you do remove the straps, be sure to note how they were originally passed through the QMS so you can reduplicate the same mounting scheme. The strong strap self-locking tighteners allow you to dog-down the straps to keep the tuner firmly in place, resting on its four rubber suction cup feet.

If you have an extremely long strap run, the SGC QMS also comes with four rubber black spacers, specifically to tighten up on the strap's hold. I did not need them for

> ... You wanted quick band changing, good efficiency on lower bands, rapid deployment from one vehicle to another without leaving scratches or holes, and a variety of whip configurations ...



The suction cups on the SGC QMS box keep the base from sliding around.

our van installation, but I suppose they might come in handy in certain installations.

The nice thing about the SGC QMS box and the straps is the capability to try different locations, and see which one provides the best stability for the antenna system. I usually mount it on the left side of a vehicle in order to minimize encounters with overhead branches.

The QMS system comes with coax cable and the 12-volt DC line already attached at the tuner end, so there is no need to disassemble anything to rapidly get on the air. With other manufacturer automatic couplers, not only do they have the neat way of external vehicle mounting, but none of the cables are attached. This means you must spend several hours just making the watertight seal, and getting things wired up on the inside. With SGC, all of the tuners are pre-wired.

The coax cable goes to the high-frequency transceiver. If it's not long enough, a barrel connection and an extension is all you need. Below 30 MHz, line loss is minimal. The 12-volt red and black wires go to a switched 12-volt source at your operating station. Most high-frequency transceivers output 12 volts that is switched on after turning on the equipment; and while the output 12 volts DC is rated below one amp of current capability, this is plenty of current to work an SGC autocoupler that typically draws less than 300 miliamps. But you do want the SGC to power down when you turn off the equipment in order to not accidentally drain your battery if the vehicle is not operated with the tuner in place for several weeks.

The tuner must be grounded with the supplied silver-tinned ground flexible braid. The braid supplied was long enough to easily go to the chassis of our vehicle for a good secure mount. The tuner must be grounded with this strap, and the ground point must be within a few feet of the tuner for everything to work properly. If you don't ground the strap, you will lose major amounts of signal in the tuning elements.

Now it comes time to choose what type of whip you're going to screw into the tuner. The SGC whip features helical loading, and most important, a big rubber-covered spring assembly to take out the shock of the whip hitting branches. SGC stresses the importance of their relatively expensive helical whip as being the only one to go into the 3/8 x 24 threads, and I do agree that their whip versus an equal length stainless steel whip does achieve different relay settings and an increase in output current. Distant stations said they could hear a slight increase when using the SGC whip over a stainless steel whip.

But when I started playing around with capacity hats halfway up my own style whip, the tuner immediately reacted to a different

The SGC QMS system is fully waterproof for vehicle mounting on the roof.

center-loading and top-loading scheme, and distant stations indicated that my signal began to build. The more wire I could hang on the whip, and the more capacitive loading I could stick up at the tip of the whip, the better my apparent signal strength.

Certainly the SGC helical-loaded whips were most aerodynamic for the automatic coupler QMS system, but if you stop the vehicle and start attaching your own type whips with capacitive top loading, you could very well outdo the more expensive SGC-designed whip. And that's the beauty of the SGC automatic coupler — play around with your antenna radiators, and see what you can do to improve field strength and better signal reports from distant stations. And, if you're really looking for a great signal on 75 meters, attach some wire to the end of any whip, and get the wire up and away from the tuner into a nearby tree, and stand by for excitement! Our signal on 75 meters continued to get stronger and stronger as we added more and more wire to the end of our simple CB-type stainless steel whip.

So, the SGC QMS system is indeed a great performer as advertised; and once you get accustomed to that strange-looking box hanging onto your vehicle, and explain to everyone else what in the world it is, you'll have the capability to be whizzing down the road and instantly go from 10 meters to 75 meters, 75 meters to 40 meters, and then maybe work a little sporadic-E DX on six meters with one coupler that goes all the way up to 60 MHz.

When working other mobile and base stations on 75 meters, most operators gave me equal signal reports to other mobile stations around me running pre-tuned, center-loaded, very-narrow-resonant antenna system. But I had the capability of going from the bottom of the band to the top of the band, always in resonance, without needing to stop the vehicle and do any whip-tip adjustments. Just a quick few syllables in the mike, and presto, I am on a new frequency with a decent low SWR reading.

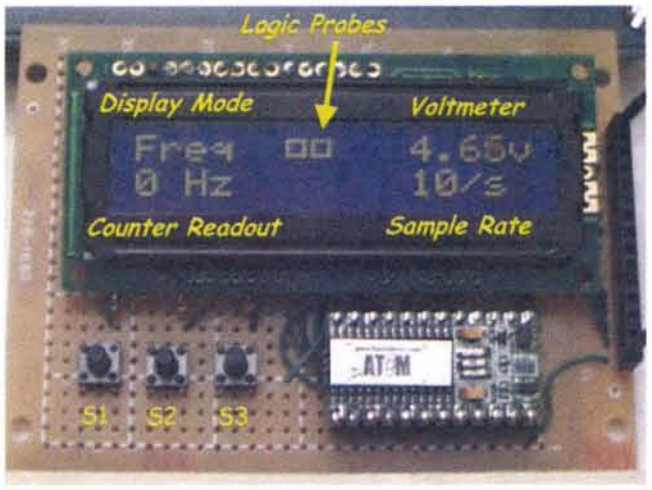
Log onto the SGC website and download a huge amount of information that they have put on their system for those of you who want to read a highly technical analysis of how each tuner goes about selecting hundreds of combinations of L and C. If you have questions, just ask, and SGC is not so large a company that you won't get a personal answer back within a day or so. They indeed know what it takes to keep their customers technically satisfied.

So check it out — we have tried it on our communications van, and while the SGC QMS system looks strange, it gives us capabilities of band hopping without ever having to stop the vehicle. **NV**

The SGC straps firmly hold the QMS in place at driving speeds.

Digital Utility Meter

by Michael Simpson



I have been building robotic projects for years, and while I own several oscilloscopes, digital voltmeters, and a slew of logic probes, most of my frequency counters are rated for 50MHz and above. What I really needed was a low-end frequency counter that could be integrated with my breadboard system.

Then it came to me. I would build one based on a microcontroller. The question is which one? I had recently received a new controller called Atom™. I decided to check out the specs to see if it would work for me.

The Atom has 32-bit variables and 32-bit floating point math functions, 8K of program space, and 368 bytes of RAM for variable storage. The main feature that caught my interest was the additional built-in hardware. The Atom boasted three built-in analog-to-digital ports, hardware interrupts, timers, and a PWM signal generator. It also processes 33,000 instructions per second and it will all work with my existing BASIC Stamp® carrier boards.

I decided to check out the Atom's commands and language syntax. I found that I could port any code over because the syntax was almost identical to that of the BASIC Stamp® II and IIp. In the cases where there were differences, the Atom seemed to have more flexibility. For instance, let's look at a few commands:

If Then Else

```
Myvarb var long
If myvarb = 204345 then
   Serout 5,i9600,["That's a big number.",10,13]
Else
   Serout 5,i9600,["That one is not so big.",10,13]
Endif
```

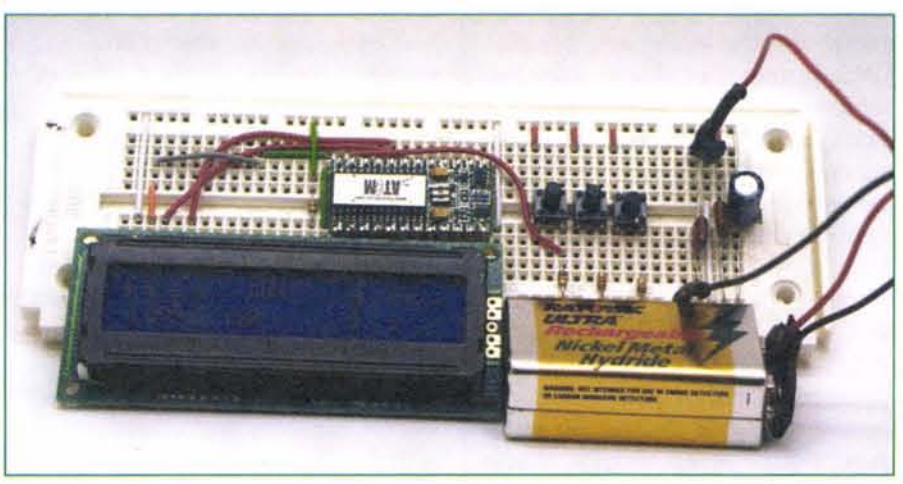
No more single line if/then statements with wild spaghetti goto's. Let's take a look at another command.

Analog Input

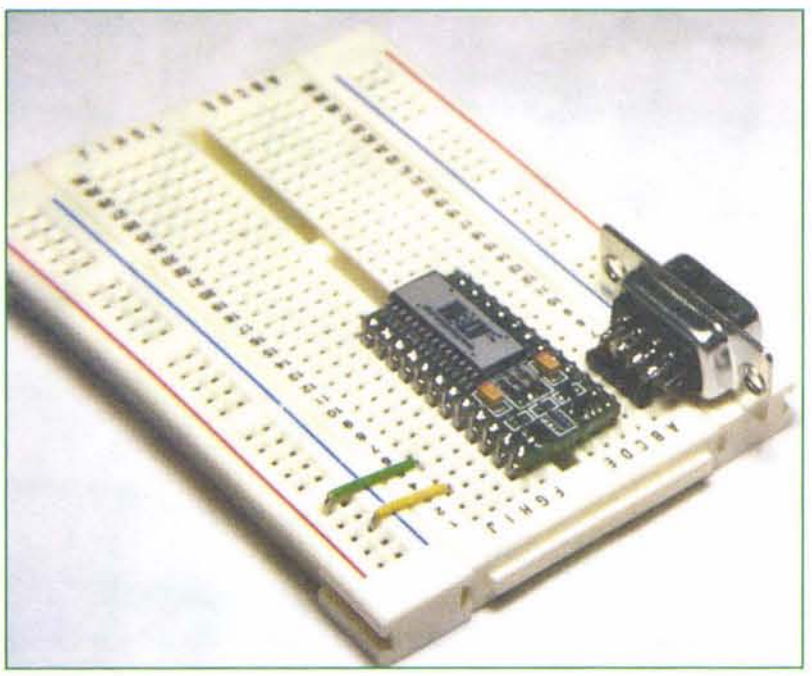
```
Adin AX0,3,AD_RON,adval
```

Very simple syntax. Read analog input 0 (there are three). Use a clk value of 3 (takes at most 72uS per conversion). Place the right justified result into the adval variable. These seemed to be the most common settings. This had got me a bit excited; later we will get into some interrupts and background tasks as we examine the code for this project.

I now have my hardware platform. It's time to look at the actual features I want to include in my meter. We will start off with a 1-100KHz frequency counter and a 5-100KHz signal generator. Throw in a voltmeter, two logic probes, and a duty cycle meter. And, finally, one can't truly work on robots without a RPM meter. You've got to know how fast those little buggers are scooting across the floor.



I built my first prototype on a breadboard so that I could test and change the circuit around a bit. The circuit went together like a dream. The Atom tends to take a bit longer to upload a program than the BASIC Stamp does. This seems to have something to do with the 8K of program space and the fact that the Atom does a verify after each upload.



Meter Operation

Voltmeter

The voltage on AX0 will be displayed constantly in the background independently of the modes the meter is in.

First and most important, remember to never exceed +5V at the voltmeter input. If you want to measure 12 volts, make sure you use a resistor to drop the voltage. Also make sure you filter the input if you are going to measure AC. While experimenting with measuring 12V DC, I accidentally shorted the dropping resistor and fried the Atom.

Frequency Counter

The meter will display the frequency on pin 11 in Hz while in this mode.

The longer the sample time, the more accurate the meter. If you need to measure down to the Hz, use a one per second sample. This will slow down the meter so only use it when necessary. You can change the sample rate by hitting the S2 button while in this mode. Also, as the frequency gets up between 50KHz and 100KHz, don't expect 1% precision: the higher the frequency, the more room for error. I found this quite acceptable, as when you are measuring in those ranges you don't need to measure down to the Hz.

Duty Cycle Meter

The period of the high pulse and low pulse, as well as the duty cycle at pin 11 will be displayed while in this mode. Again, as the frequency gets up above 50KHz, the accuracy will start to drop. In any case, this will give you a real indication of the pulse train that you are measuring.

RPM Meter

The calculated RPM at pin 11 will be displayed while in this mode. The slower the sample rate, the more accurate the reading. Just hit the button S2 while in this mode to make adjustments.

PWM Output

While in this mode, you use both S2 and S3 to adjust the period

and target frequency. You can measure the actual output by tying pin 9 to pin 11 and selecting the Frequency Mode.

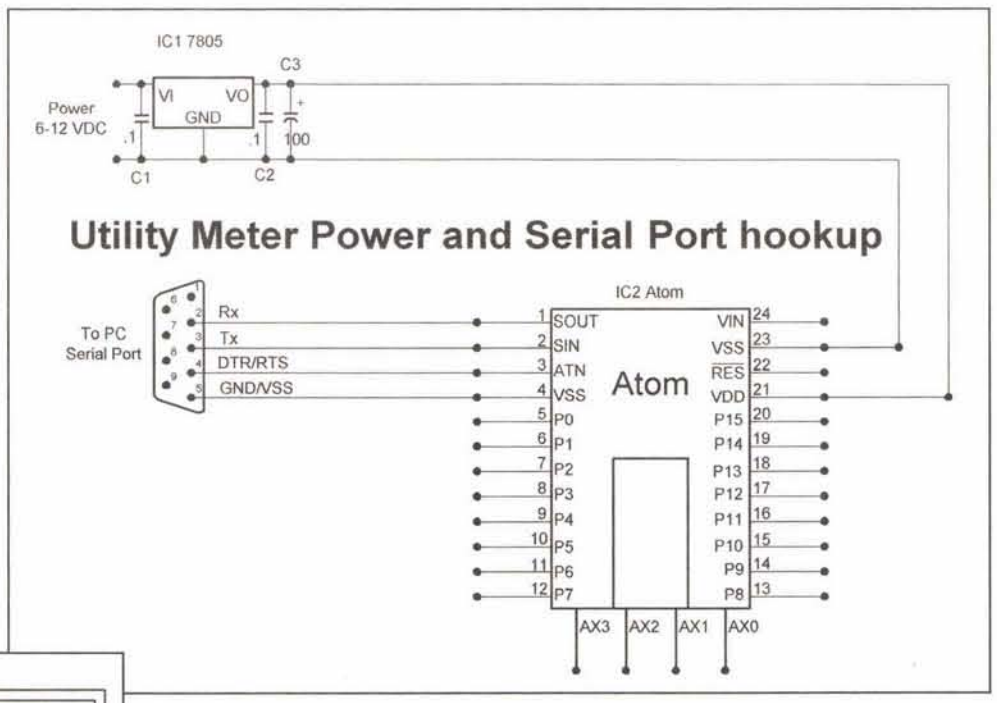
The period is actually measured in clock cycles and, since the Atom is clocked at 20MHz, you must divide the displayed period by 20 to get the period in microseconds. I normally don't bother with this as the target frequency is also calculated for you and displayed.

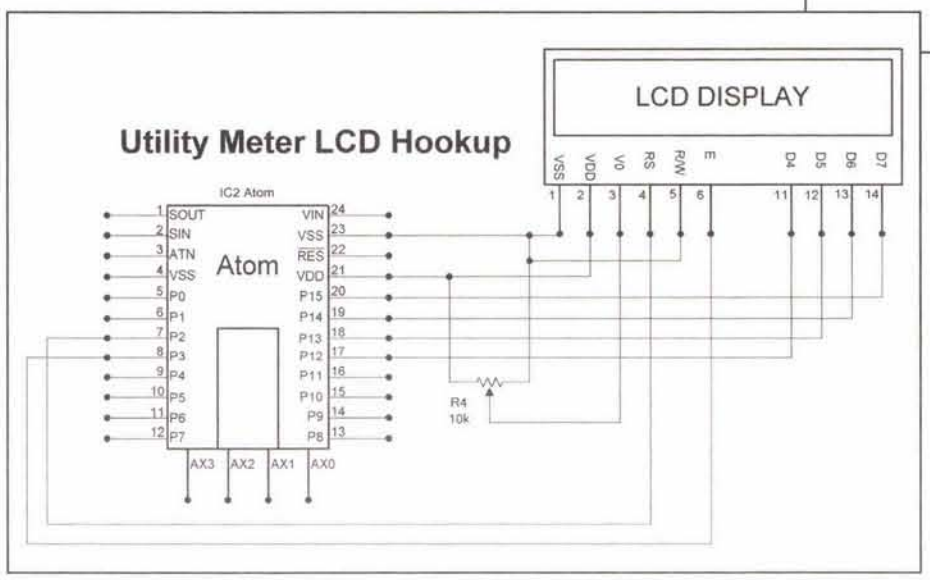
Keep in mind that the PWM has a 10-bit resolution so generating the exact target frequency may not be possible. For instance, a target frequency of 2,000Hz may be selected, but only 1,998Hz will be output. The higher the frequency, the more this becomes apparent.

Now a note on output frequency. The Hardware PWM will send a signal as low as 1.5KHz and as high as 4 or 5 MHz. I have measured it on my scope. Just keep in mind the frequency counter will stop at about 100KHz.

Logic Probes

Like the voltmeter, the logic probes are sampled in the background. They are set up to look at the states of pin 0 and pin 1 and may not register quick changes. Probe 1 is tied to the hardware interrupt so it would be possible to tie a small beeper with the interrupt handler to detect pulses. Maybe in a future upgrade.





Data Backup

Whenever you make parameter changes such as sample rate or PWM frequency, these are all written to EEPROM and reloaded the next time you power up the meter. This way, if you are working on a particular project like a sonar range finder you can set the PWM to 40KHz and it will stay there forever until you change it.

Building the Circuit

I recommend building it on a breadboard first so you can play around. You may even come up with some enhancements of your own.

This project might seem a bit intimidating at first, but I will break the circuit down into four very simple sections.

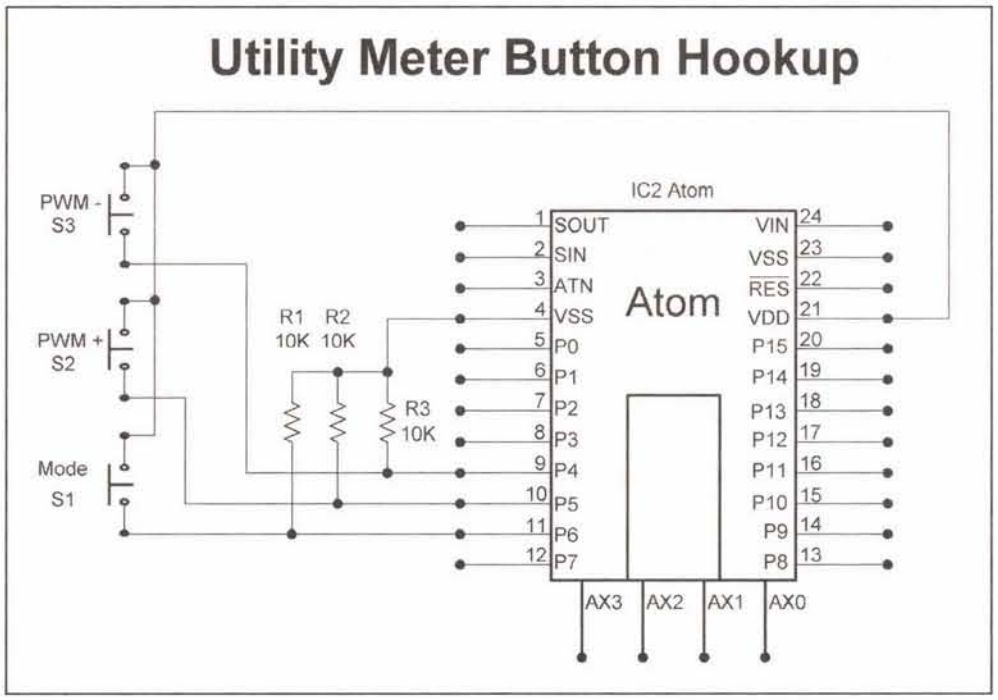
Serial and Power

Let's start by looking at the power and serial hook-up for the Atom.

A simple 7805 regulator with enough power to drive the Atom and the LCD display is all that is needed. You can get by with one of the 100mA 78L05 if your LCD is not a power hog. My meter and backlit

Program Listing

```
'*****************************************
' Variables
'*****************************************
'Work variables used by the button commands.
 but1work var byte
 but2work var byte
 but3work var byte

'Variable used to hold raw analog value.
 adval var word

'Metermode determines which display mode the
'meter is in. Currently modes 1 - 4 are
'supported
 metermode var byte  'The actual mode:
'Freq, Duty, RPM
 metermode=1 'The initial mode

'Used in the frequency counter mode to
'determine samples per second.
 freqdur var word
 freqmult var word
 freqmode var byte
 freqcounter var long  'This one holds the
'counts

'Used in the duty cycle mode.
 pulsehigh var word 'Duration of high pulse
'used in Duty mode
 pulselow var word  'Duration of low pulse
'used in Duty mode
 duty var byte      'Calculated duty cycle

'Used in the RPM mode to determine samples
'per second.
 rpmdur var word
 rpmmult var word
 rpmmode var byte
 rpmcounter var long  'This one holds the
'counts

'Used to hold the data used by the hardware
'PWM command.
 pwmperiod var word 'This is the period for
'use with the HPWD command.
 pwmduty var word   'The duty period.

'This is a flag used to determine when to
'write the new PWM period data to the
'EEPROM
 changepwm var byte
 changepwm = 0


'*****************************************
'  EEPROM Data Storage
'*****************************************
'The data command is used to store data in
'the EEPROM. This data can be changed with
'the write command.

'PWM Out Period: low,high bytes
 data @0,192,38

'Freq data:  Mode, dur low, dur high, mult
'low, mult high
 data @2,3,250,0,4,0

'RPM Data:  Mode, dur low, dur high, mult
'low, mult high
 data @7,3,250,0,240,0

'The Read command reads EEPROM data into
'actual variables. Note that the data
'statement stores the data in 8-bit chunks
'only. When we read or write the data, we
'must break down the data as well.

'As you see here I am reading in the low
'byte from EEPROM address 0 and storing it
'in pwmperiod.  In this case, the value
'will be 192. Next I will read in the high
'byte and store it in pwmperiod. Its value
'is 38.  Now pwmperiod is loaded and has a
'value of 9920.
 read 0,pwmperiod.lowbyte
 read 1,pwmperiod.highbyte

 read 2,freqmode
 read 3,freqdur.lowbyte
 read 4,freqdur.highbyte
 read 5,freqmult.lowbyte
 read 6,freqmult.highbyte

 read 7,rpmmode
 read 8,rpmdur.lowbyte
 read 9,rpmdur.highbyte
 read 10,rpmmult.lowbyte
 read 11,rpmmult.highbyte

'Later we will use the write command to
'alter the defaults.


'*****************************************
' Hardware
'*****************************************
'Initialize the LCD
 pause 500
 lcdwrite 2\3,outd,[INITLCD1,INITLCD2,
 TWOLINE,CLEAR,HOME,SCR]
 lcdwrite 2\3,outd,[CLEAR,HOME] 'Just to
'make sure it has cleared
 lcdwrite 2\3,outd,["Utility Meter"]
 pause 1000
```



LCD pull less than 40mA of current while running. Pins 4 and 23 on the Atom are tied together as VSS, so you can use whichever one you like.

The serial connector is a standard nine-pin female. When working with the Atom on my breadboard, I use a DB9 connector with a small four-pin right angle header as shown.

Sources

Basic Micro: www.basicmicro.com
Kronos Robotics: www.kronosrobotics.com
Digi-Key: www.digikey.com

You can find a complete kit with sources at the Kronos Robotics website. Along with additional upgrades, pictures, and application notes.

You only need the serial connector to program the Atom. However, you may want to include one on your final project to make program changes or enhancements. Of the code space available on the Atom, this project only uses slightly over half.

LCD Display

The LCD hook-up is quite simple. Any two-line LCD with a Hitachi 4470 or equivalent controller will work.

The backlight hook-up for most LCDs is different so the diagram only shows the data connections. Consult your LCD documentation. On the LCD that I am using, you tie pin 15 to VDD and pin 16 to GND or VSS. I normally place a 39-ohm resister in series with the backlight to dim the display a bit and save on power.

Button Interface

I use three buttons to control the various modes of the meter. Any normally open push button will work. The Atom's built-in button command will take care of debounce and auto repeat as needed.

The S1 mode button is the major work horse. It is used to put the meter into the following modes:

- Frequency Counter
- Duty Cycle Read Out
- RPM Meter
- PWM Signal Out Period Adjustment

While in PWM signal adjustment mode, the S1 and S2 buttons will adjust the PWM period/target frequency.

While in frequency counter and RPM modes, S2 adjusts the samples per second for that particular mode. This will allow you to choose the best speed/accuracy ratio to suit your needs.

I/O Connections

The I/O connections are pretty straightforward. However, while you can just plug wires into the breadboard as needed, you will want to use some sort of binding posts or barrier strip for your final project.

I use the 6853 Hall-Effect sensor to measure RPM on my motor projects. Just tape or hot glue the magnet to the rotating surface you want to measure. The rare earth magnets work the best.

You may also want to include a small SPST switch that ties pin 9 and pin 11 together. This will allow you to see the actual frequency of the PWM signal generator.

Once completed, here are your actual pin designations for input

```
lcdwrite 2\3,outd,[CLEAR,HOME,SCRRAM,
 "Freq"]

'Write a custom character to the CGRAM of
'the LCD display at position 0 and 1
'Empty Box
 lcdwrite 2\3,outd,[CGRAM +0,$00,$1f,$11,
 $11,$11,$1f,$00,$00]

'Filled Box
 lcdwrite 2\3,outd,[CGRAM +8,$00,$1f,$1f,
 $1f,$1f,$1f,$00,$00]

'Set up the timer interrupt. This will be
'used as a background task for the volt
'meter and the logic probes.

 settmr1 tmr1int1 ' Set timer1 mode

'The oninterrupt command tells the atom
'where to go on a particular interrupt.
'In this case, we will call the routine
'othermetertasks.
 oninterrupt tmr1int,othermetertasks

 enable tmr1int 'Turn on the interrupt

'Load pwmduty with 1/2 the pwmperiod value.
'This will give us a 50% duty cycle.
 pwmduty = pwmperiod/2
'Setup the initial pwm signal on pin 9.
' (mode=0 for pin8 and 1 for pin9)
 hpwm 1,pwmperiod,pwmduty

'*****************************************
'Main loop. Check the button status and
'display the results
'*****************************************
mainloop:

'Check the status of S1 S2 and S3
 Button 6,1,255,255,but1work,1,modechange
'S1 no auto repeat
 Button 5,1,100,1,but2work,1,valueup 'S2
 Button 4,1,100,1,but3work,1,valuedn 'S3

'Depending on the value of metermode let's
'go display some readings
 Branch metermode, [mainloop,dispfreq,
 dispduty,disprpm,disppwm]

'If everything falls through wait a few
'milliseconds and go back and do it all
'again.
 pause 5
 goto mainloop


'*****************************************
' Display routines
'*****************************************
'-------------------------
'Frequency counter mode #1
'-------------------------
dispfreq:

'count for the duration set up by the
'freqdur variable.
 count 11,freqdur,freqcounter 'Set up our
'counter on pin 11.

'Display the returned count. Depending on
'the duration we need to multiply the value
'so that it is correct. This gives us our
'samples per second.
 lcdwrite 2\3,outd,[SCRRAM+64,dec
freqcounter*freqmult,_
    " Hz            "]

'Here we are just going to display the
'samples per second mode so the user
'knows which mode they are in.
 if freqmode = 1 then
   lcdwrite 2\3,outd,[SCRRAM+75,"1/s   " ]
 elseif freqmode = 2
   lcdwrite 2\3,outd,[SCRRAM+75,"2/s   " ]
 elseif freqmode = 3
   lcdwrite 2\3,outd,[SCRRAM+75,"4/s   " ]
 elseif freqmode = 4
   lcdwrite 2\3,outd,[SCRRAM+75,"10/s  " ]
 endif

 goto mainloop


'-------------------------
'Duty mode #2
'-------------------------
dispduty:

'Set up the initial values. The pulsin
'command will not change them if it times
'out.
 pulsehigh=0
 pulselow=0

'First we will look for the duration of the
'highbit then the duration of the lowbit.
 pulsin 11,1,pulsehigh
 pulsin 11,0,pulselow

'Calculate the duty cycle based on the
'duration of each bit.
 duty = (pulsehigh *100) / (pulselow+
 pulsehigh)
'I don't want to display large numbers so
'if both of the returned values are greater
'than 10000 let's convert to milliseconds.
 if pulsehigh > 10000 and pulselow > 10000
 then
    pulsehigh = pulsehigh /1000
    pulselow = pulselow /1000
    lcdwrite 2\3,outd,[SCRRAM+64,dec
```

and output.

Pin 4 GND or Common
Pin 5 Logic Probe 1
Pin 6 Logic Probe 2
Pin 11 Frequency/Duty and RPM Counters
Pin 9 PWM Signal Generator
AX0 0-5 Volt DC Voltmeter

The Software

I have broken the code down into seven sections as follows:

Variables

Variables are declared for each of the display modes and PWM signal generator.

EEPROM Data Storage

In this section, we set up the initial settings for some of the more important variables. The data is initially written to the EEPROM with the Data command.

At the start of the program, I read the EEPROM with the Read command. Later in the program, we will write data to the EEPROM when certain parameters are changed. This way each time the program is booted, we load the new settings.

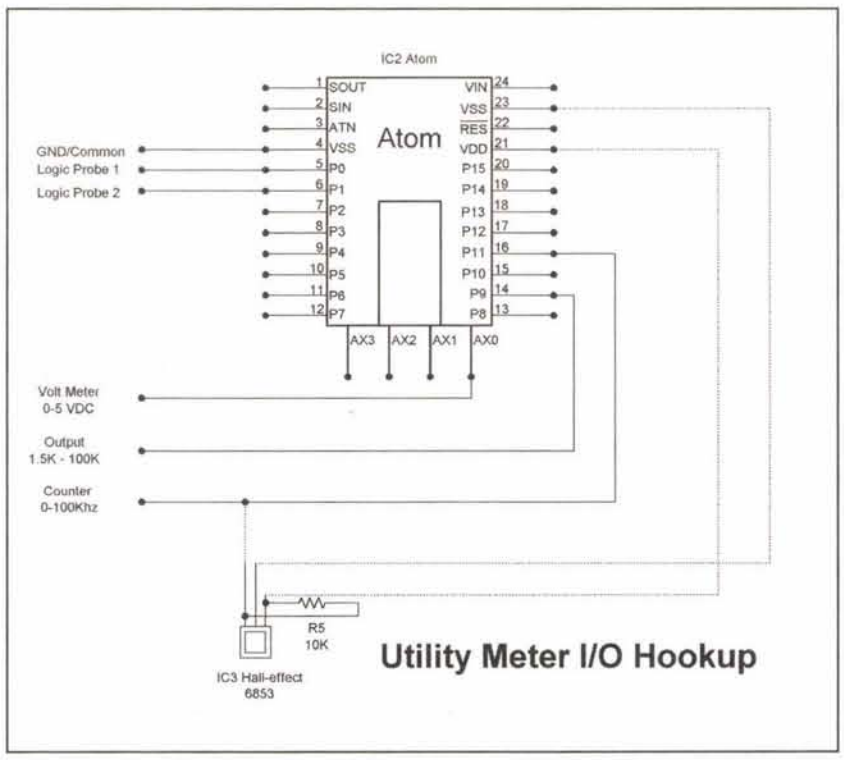
Hardware

In this section, we initialize the LCD, set up the timer interrupt for background tasks, and start the PWM signal generator. I also write a couple of custom characters to the LCD character RAM.

Main Loop

We scan the three push buttons and jump to the appropriate button processing routines if pushed. Depending on the value of metermode, we branch to the various display routines. Currently metermode can contain a value from 1 to 4.

Frequency Counter mode = 1
Duty Cycle mode = 2
RPM mode = 3
PWM Output Set-up mode = 4



Display Routines

The display routines are each called depending on the value of metermode. For example, if meter-

```
pulsehigh,"/",dec pulselow,_
     " ms ",dec duty,"%        "]
else
   lcdwrite 2\3,outd,[SCRRAM+64,dec
pulsehigh,"/",dec pulselow,_
     " us ",dec duty,"%        "]
endif

goto mainloop

'-------------------------
'RPM mode #3
'-------------------------
disprpm:
'count for the duration set up by the
'rpmdur variable.
 count 11,rpmdur,rpmcounter 'Set up our
'counter on pin 11

'Display the returned count. Depending on
'the duration we need to multiply the value
'so that its correct. This gives us our
'samples per second.
 lcdwrite 2\3,outd,[SCRRAM+64,dec
 rpmcounter*rpmmult," RPM          "]

'Here we are just going to display the
'samples per second mode so the user
'knows which mode they are in.
 if rpmmode = 1 then
    lcdwrite 2\3,outd,[SCRRAM+75,"1/s  " ]
  elseif rpmmode = 2
    lcdwrite 2\3,outd,[SCRRAM+75,"2/s  " ]
  elseif rpmmode = 3
    lcdwrite 2\3,outd,[SCRRAM+75,"4/s  " ]
  elseif rpmmode = 4
     lcdwrite 2\3,outd,[SCRRAM+75,"10/s " ]
 endif

 goto mainloop

'-------------------------
'PWM OUT Setup Mode #4
'-------------------------
disppwm:
'Display the current pwmperiod and target
'frequency.  We will use the formula
'greq=1000000/(period/20)
 lcdwrite 2\3,outd,[SCRRAM+64,dec
 pwmperiod,"    ",_
   real (float 1000000 fdiv (float
 pwmperiod fdiv float 20))\1,_
    "Hz   "  ]

'Check to see if we made any changes to
'the pwmperiod. If we did, then we are
'going to write the data to the EEPROM. I
'could have written the data in the value
'change routines but this would cause too
'many writes. The EEPROM can only accept a
'finite number of writes. Somewhere on the
'order of 10 million. By doing the write
'when all the adjustments are done we
'minimize the number of writes.
 if changepwm = 1 then
   changepwm = 0
   write 0,pwmperiod.lowbyte
   write 1,pwmperiod.highbyte
   endif
 goto mainloop


'*****************************************
'Button Processing Routines
'*****************************************

'-----------------------------------
'S1 the mode button
'-----------------------------------
modechange:
 metermode = metermode + 1 'Increment the
'mode
'We only have 4 modes so wrap it if it's
'greater than 4
 if metermode > 4 then
   metermode = 1
 endif

'Display the current mode on the LCD
 if metermode = 1 then
  lcdwrite 2\3,outd,[SCRRAM,"Freq "]
 elseif metermode = 2
  lcdwrite 2\3,outd,[SCRRAM,"Duty "]
 elseif metermode = 3
  lcdwrite 2\3,outd,[SCRRAM,"RPM "]
 elseif metermode = 4
  lcdwrite 2\3,outd,[SCRRAM,"OUT "]
 endif
 goto mainloop


'-----------------------------------
'S2 the value up button
'-----------------------------------
valueup:

'----------
'PWM OUT
'----------
'We only want to make changes if we are in
'PWM Out mode
 if metermode = 4 then
  pwmperiod = pwmperiod + 1 'Make the
'change

 'Set the write flag.  We will write the
 'data to eeprom when we are done
 changepwm = 1

 'Wrap the value if it is greater than
 '16383.
 if pwmperiod > 16383 then
   pwmperiod = 0
 endif

 'Set the duty and update the hardware.
 'The change will take affect immediately.
 pwmduty = pwmperiod/2
 hpwm 1,pwmperiod,pwmduty

 'Display the period and target frequency
 lcdwrite 2\3,outd,[SCRRAM+64,dec
 pwmperiod,"    ",_
  real (float 1000000 fdiv (float
  pwmperiod fdiv float 20))\1,_
  "Hz   "  ]
 goto mainloop
endif


'------------------
'Frequency Counter
'------------------
'We only want to adjust the frequency
'counter sample rate if we are in mode 1
 if metermode = 1 then

  freqmode = freqmode + 1 'Change the
'sample rate mode

  'We only support 4 sample rates
  if freqmode > 4 then
    freqmode = 1
  endif
```

mode is 3, then the disprpm routine is called.

Button Processing Routines

Each button has a handler routine.

The S1 (mode) button calls the mode-change routine. This routine is where the metermode is actually changed. It cycles from 1 to 4 — one step at a time — each time the S1 button is pushed.

The S2 (value up) button has three specific jobs depending on which metermode we are in. If it's one, then the sample rate for the frequency counter is changed.

If it's 2, then the sample rate for the RPM meter is changed. If it's 4, then we increase the PWM period thus changing the target frequency.

The S3 (value down) button is only used if the metermode is set to 4. In that case, the PWM period is decreased, thus changing the target frequency.

Background Tasks

This is where the Atom really makes the job easy. Here we collect the analog value from AX0 and display it.

We also test the two logic probes and display their results. **NV**

Parts List

Item	Description	Source
IC1	7805 5V Regulator	RadioShack 276-1770
IC2	Atom	Kronos Robotics ATOM101
IC3	Hall-Effect 6853	Digi-Key DN6853A-ND
LCD	LCD Display	Kronos Robotics LCD201
C1-C2	.1uF Capacitor	RadioShack 272-1069
C3	100uF Electrolytic Capacitor	RadioShack 272-1044
R1-R3, R5	10K Resistor	RadioShack 271-1335
R4	10K Trimmer Resistor	RadioShack 271-282
Connector	9-pin Female Connector	RadioShack 276-1428
PCB	Universal PC Board	RadioShack 276-168
S1-S3	SPST Momentary Push Button	RadioShack 275-1556

```
'Set up the duration and multipliers
'for each sample rate
if freqmode = 1 then
   freqdur = 1000
   freqmult = 1
elseif freqmode = 2
   freqdur = 500
   freqmult = 2
elseif freqmode = 3
   freqdur = 250
   freqmult = 4
elseif freqmode = 4
    freqdur = 100
    freqmult = 10
endif

'Write the new data to the eeprom
write 2,freqmode
write 3,freqdur.lowbyte
write 4,freqdur.highbyte
write 5,freqmult.lowbyte
write 6,freqmult.highbyte
 goto mainloop
endif

'------------------
'RPM
'------------------
'We only want to adjust the RPM sample rate
'if we are in mode 3
 if metermode = 3 then
  rpmmode = rpmmode + 1 'Make the change

  'We only support 4 sample rates
   if rpmmode > 4 then
     rpmmode = 1
   endif

   'Set up the duration and multipliers for
   'each sample rate
   if rpmmode = 1 then
     freqdur = 1000
     freqmult = 60
   elseif rpmmode = 2
     freqdur = 500
     freqmult = 120
   elseif rpmmode = 3
     freqdur = 250
     freqmult = 240
   elseif rpmmode = 4
     rpmdur = 100
     rpmmult = 600
   endif

  'Write the new data to the EEPROM
  write 7,rpmmode
  write 8,rpmdur.lowbyte
  write 9,rpmdur.highbyte
  write 10,rpmmult.lowbyte
  write 11,rpmmult.highbyte

  goto mainloop
 endif

goto mainloop



'-----------------------------------
'S3 The Value Down Button
'-----------------------------------
'Currently, we only use S3 to change the
'PWM period value
valuedn:

'We only want to make changes if we are in
'PWM Out mode
 if metermode = 4 then
  pwmperiod = pwmperiod - 1 'Make the
'change

  'Set the write flag.  We will write the
  'data to EEPROM when we are done
  changepwm = 1

  'Wrap the value if it is less than zero.
  'Remember we don't have signed numbers so
  'we test to see if the word wrapped
  if pwmperiod > 16384 then
   pwmperiod = 16383
  endif

  'Set the duty and update the hardware.
  'The change will take effect immediately.
  pwmduty = pwmperiod/2
  hpwm 1,pwmperiod,pwmduty

  'Let's display the period and target
  'frequency
  lcdwrite 2\3,outd,[SCRRAM+64,dec
  pwmperiod,"    ",_
   real (float 1000000 fdiv (float
   pwmperiod fdiv float 20))\1,_
     "Hz   "  ]
  goto mainloop
 endif


goto mainloop

Disable ;disable interrupts so it can not
call its self.

'*****************************************
'This is our background handler routine. We
'scan the input lines for voltmeter and
'logic probes.
'*****************************************
othermetertasks:

'Pull in the analog data from the first
'analog pad and place into adval
 adin AX0,3,AD_RON,ADval

'The adin command returns a 10-bit value.
'This gives us 1024 steps of 0-5 volts. So
'for 5v thats .0048828 per unit. I just
'round it to .00489.
   lcdwrite 2\3,outd,[SCRRAM+11,_
     real (float ADval fmul float
0.00489)\2,"v"]

'Let me explain the above command a little
'bit.

'  2\3,outd
'     This sets up the pins that are tied
'     to the LCD display. The Atom is so
'     versatile that you can use just
'     about any pin combination for the
'     LCD. This also means you can use two
'     LCDs at once.

'  real(expression)\2
'     Display a floating point number.
'     The \2 says only display the
'     first two decimal places.

' float adval and float 0.00489
'     While the Atom does support full
'     32-bit math internally it only
'     supports floating point via built in
'      commands.  What we are doing
'     here is telling The Atom to convert
'     these values to IEEE 754
'     (floating point) format internally.

' fmul
'     This is a floating point function.
'     It will take the converted
'     values and do a floating point
'     multiply.

' So put it all together and the Atom is
' multiplying adval by .00489 and display
' the results.

'Now test the logic probes.
   lcdwrite 2\3,outd,[SCRRAM+6,in0,in1," "]

' When I initialized the LCD earlier I
' built two characters in the LCD character
' RAM of the LCD at positions 0 and 1.
' Position 0 is an empty box and position
' 1 is a filled box. Now when I write ASCII
' value 0 the LCD will display an empty
' box. Likewise when I write ASCII value 1
' the LCD will display a filled box. The
' in0 and in1 commands will return the
' pin state for pins 0 and 1. The state
' will be 0 or 1.  Now when I write those
' states a empty or filled box will be
' displayed depending on the state of the
' pin.

resume  'this is how we end a interrupt
'task
```

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ELECTRONICS Q & A

With TJ Byers

In this column, I answer questions about all aspects of electronics, including computer hardware, software, circuits, electronic theory, troubleshooting, and anything else of interest to the hobbyist.

Feel free to participate with your questions, as well as comments and suggestions.

You can reach me at:

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or by snail mail at Nuts & Volts Magazine, 430 Princeland Ct., Corona, CA 92879.

What's Up:

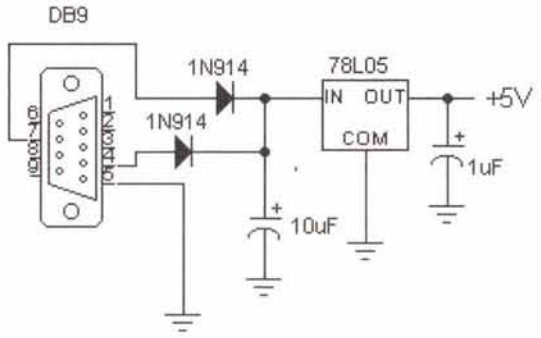
A high-school student listens to gas molecules. What do you do with discarded disposable cameras? Recycle them into all kinds of neat projects, like strobe lights and zappers. Serial port makes +5V power supply. Readers respond to the problem of stalled legacy DOS software on fast PCs.

PIC Power

Q - I am building a PIC controller circuit that I want to connect to my PC port. There isn't room for a battery, and I think I've heard that you can steal power from the serial port, but I can't remember where I read about it or how to do it.

Jack Simpson
via Internet

A - This is a fairly common practice, and one that's easily implemented. Basically, the power supply runs off the CTR (pin 4) and RTS (pin 7) signal lines, one of which is usually high at any time.



The 1N914 diodes prevent interaction from these outputs and smoothes out bumps in the road via the 10 uF capacitor. The 78L05 regulator maintains a constant 5-volt output to your design. If you experiment a lot with PIC chips, you'll be interested in the *A PIC Of A Power Supply* construction project elsewhere in this issue.

TV Transmitter

Q - I have a small B&W board camera pointed at our front door. It has video output for a VCR, but I would like to feed the signal to a small B&W television set I have had lying around for years. The TV set doesn't have a video input jack, just rabbit ears antenna. How can I feed the camera into this TV?

Donald J. Johnson
Nolan Innovation, Inc.

A - Way back when games like Pong appeared on the scene, this was done using an RF modulator. This gadget would connect to the antenna terminals of a TV set to create the image — and were even sold by RadioShack. Unfortunately, these devices are all but extinct. Today, remote surveillance cameras use a low-power TV transmitter to wirelessly connect the camera to the monitor. They have a range of up to 300 feet and can operate in the VHF or UHF bands. Better yet, you can buy them in kit form for under $30.00. Here are two sources.

Gateway Electronics
800-669-5810; www.gatewayelex.com
KIT-089

Ramsey Electronics
800-446-2295; www.ramseyelectronics.com
TV6, VS2

Don't Bug Me!

Q - Some years ago, I was watching a TV show on electronic espionage and counter-espionage when mention was made of a device that could detect bugs, even when they were not operating, by virtue of its ability to detect silicon junctions; in other words, a transistor detector. Do you know anything about this technology — if indeed it exists? If so, can you direct me to a source where I can find out more about it?

Mike Johnson
via Internet

A - Oh yes, it exists. This isn't a James Bond pipe dream from Hollywood. How does it work? Using magic and a divining stick. Kidding, it's a natural property of a dissimilar junction. When a semiconductor junction is drenched in a low-power microwave signal, it resonates much like a quartz crystal and generates overtones — harmonics. It's the second harmonic that defines a transistor from rusty metal, also a dissimilar junction, which has its strongest peak at the third harmonic. A sensitive receiver can detect and sort these harmonics to identify "bugs" even if they're not powered up. For more information go to **www.electromax.com/boomer.html**.

Hash House, Go-Go

Q - The outboard engine on our houseboat causes our (12-volt) radio to scream. My corrective measure consisted of opening the antenna wire, placing an inductor in series and a 1,000 pF capacitor in parallel. This sorry attempt served only to increase the noise slightly. HELP!

Ken and Anne Schultis
via Internet

A - The noise is coming from the 12-volt power source, not the antenna. RadioShack sells a noise eliminator kit (270-030) that should fix the problem. If not, you'll need to add noise suppressers to the engine itself, which includes replacing the spark plug wires with carbon wires and adding an alternator filter, like the RadioShack 270-055. Oh yeah, put the antenna back to its original configuration.

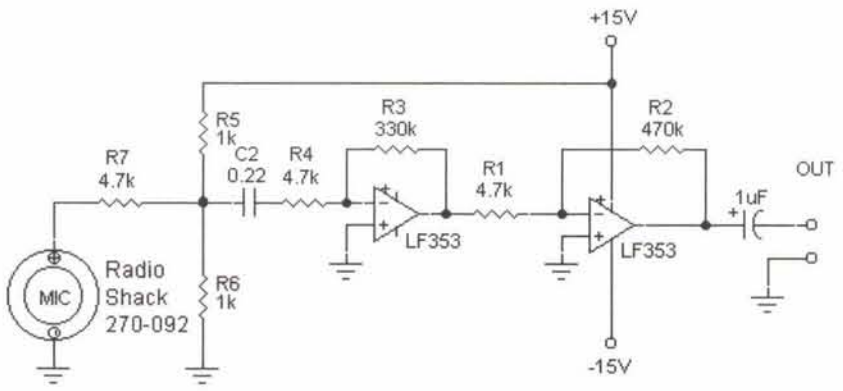
PAS: Do You Hear What I Hear

Q - My science class is currently trying to construct a PAS (photoacoustic spectrometer) cell for an experiment we are working on. While PAS cells are available commercially, it's way more money than I can even think of spending. Without going into a lot of detail, a PAS cell works by sensing slight changes in the pressure of a gas when infrared energy is passed through the cell. We want to use it with an IR spectrometer to study the absorption of gases such as CO2 and gas mixtures that contain CO_2. The FTIR I have access to can produce IR in the range of 400-4000 wave lengths, cm-1.

The two components I am missing are sensitive microphone transducers and an op-amp circuit that will take the signal produced by the transducers and produce a useful output. A PAS usually incorporates two sensors which allows the user to select an option of addition or subtraction of the signals. I have searched, but not yet found a source for small yet sensitive microphone transducers or an op-amp circuit that might work for this project. Before I just give up the idea, I thought I would take a chance at asking if you knew a person who knows about designing circuits.

Ray Hamilton
Science Teacher
Greenwich High School
Greenwich, CT

A - I think I can conjure up a circuit that will work for your PAS project. To begin with, the circuit has to be simple enough for your students to build using components you can buy from a local RadioShack. If the mic/amp design requires special devices or tricky construction, chances are it'll never see the inside of your lab. With this in mind, I came up with the following circuit.

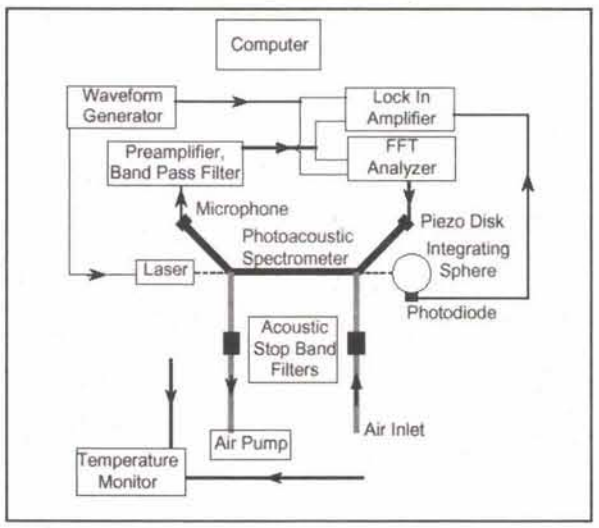


The sensor is an electret microphone with a frequency range of 30 - 15kHz with good sensitivity. The output of the microphone is amplified by the cascaded op amps. The first stage has a gain of 70, followed by a second stage gain of 100 for a total of 70,000. Ordinarily an amplifier with this much bandwidth and gain is followed by a bandpass filter, which I understand you already have. The gain can be adjusted up or down by changing the value of the 330k and/or 470k feedback resistors. The gain of each stage can be calculated using the formula

Vgain = Rfeedback/Rin

For the curious, here's a block diagram of a typical gas detection system using a PAS cell detector. Also check out the **www.sci.kun.nl/tracegasfac/index.html** web site for further information on the subject.

Block Diagram of the Photoacoustic Spectrometer and Detection Electronics



(Editor's note: I've followed the progress of this project since the first query, and recently received the following message. — TJ Byers)

Dear Mr. Byers:

Thank you for helping with my research project and including the project in one of your future articles. I have included a short summary of my work.

I conducted an independent research project concerning the construction of a photoacoustic spectrometer (PAS) cell. The PAS cell is an instrument that measures gas expansion within the cell when IR light is shined through it. The cell uses microphone elements that detect changes in pressure. My mentor, Mr. Hamilton, suggested I contact TJ Byers of *Nuts & Volts* to receive assistance to construct the proper electronic circuit. The assembled circuit amplified electronic signals received by the microphones. The circuit and PAS components all work well and I've been able to measure some revealing results when analyzing components in various gases.

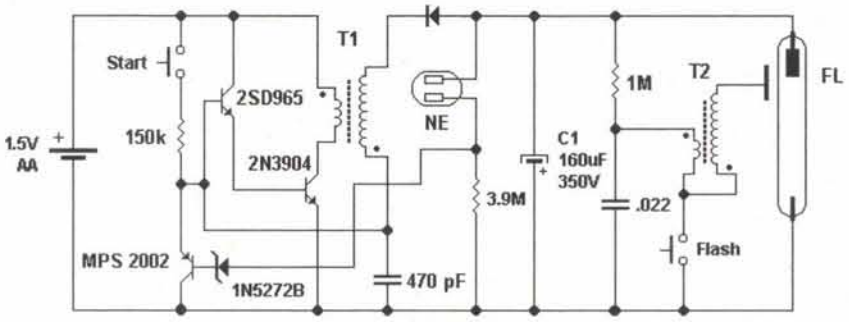
Katherine Rakoczy
Greenwich, CT

A Kodak Moment

Q. I need to make a small, battery-powered "shocker" much like those used in invisible fence dog collars. Only in this application I wouldn't need the fence. The device will simply have two wires (+ and -) in close proximity and when they are contacted, zap! I could use almost any battery, but I'd rather stay with something smaller than C or D cells. What is the best way to achieve this high-voltage, low-current source?

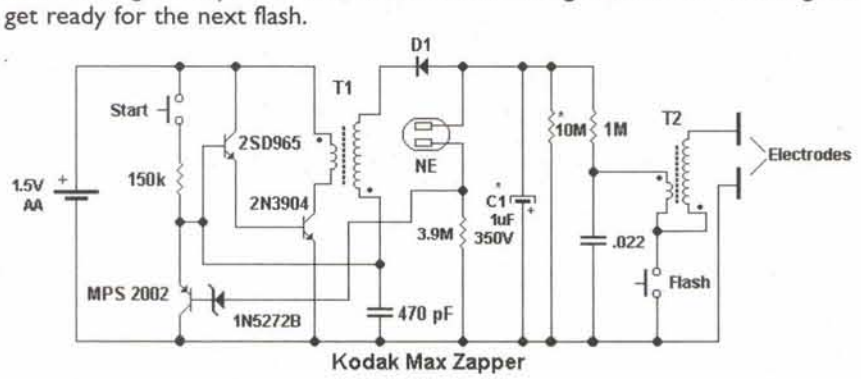
Dale Dorsey
via Internet

A. The fastest, easiest, and cheapest way to achieve your goal is to use a flash unit from a disposable camera. You can obtain these units for free from most camera shops — the one-hour kind are the best places to ask. While the flash circuits may vary slightly, they all do the same thing: generate a high voltage that is discharged by a xenon flash tube. Here is the circuit for the Kodak Max Disposable.



Orignal Kodak Max

When the voltage across C1 reaches 350 volts, the NE lamp comes on. It's very important that you understand that nothing happens with the flash at this point. In fact, this state of affairs will hold indefinitely (or at least until the battery goes dead). The tube won't flash until you press the Flash button, at which time the .022 uF capacitor discharges through the primary of T2, which outputs a 4 kV pulse to the reflector shield surrounding the flash tube. This high voltage ionizes the gas inside the tube which, in turn, causes the charge in C1 to ignite the ionized gas and produce the flash. NE now extinguishes and C1 recharges to get ready for the next flash.



Kodak Max Zapper

It's the trigger voltage that we'll use for the zapper. It's a high-voltage pulse of short duration and very little current, which means it'll get your attention without doing harm. Moreover, the modifications are minor. First remove the flash tube (put it into your spare parts bin), and change the value of C1 from 160 uF to 1uF. The higher capacitance is required to supply the heavy current required by the flash tube; with the flash tube gone, all C1 has to do is remove

Circle #37 on the Reader Service Card.

the ripple from the power supply. As a precaution, I'd add a 10 Meg resistor across C1 so that it discharges after the Start button is turned off and prevents accidental shock. (See the modified diagram.) This is just one of the many things you can do with salvaged flash boards, as shown in the question below, "Strobe On The Cheap."

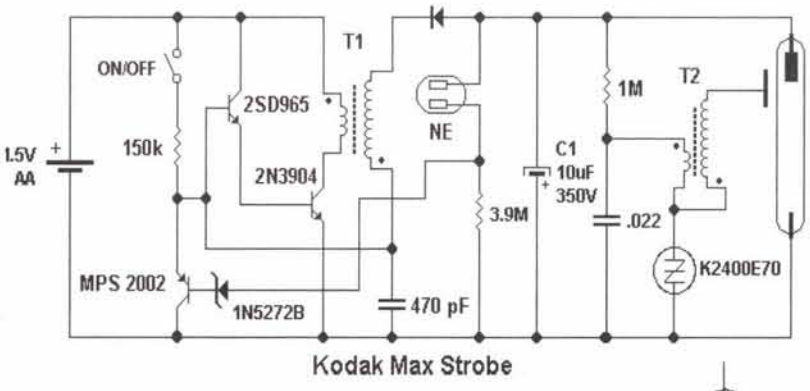
Strobe On The Cheap

Q. I'm looking for a cheap strobe lamp that I could use as a lighting source for my science fair project. It doesn't have to be terribly bright and a repetition rate of one to two flashes per second is about right. Do you know of such a circuit?

Kelly
via Internet

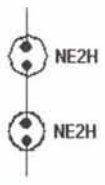
A. Here is another instance where I'd use a disposable camera to cut to the chase and save money. In this case, you don't have to remove the flash tube, just simply change a couple components. First, remove the flash unit from the camera case and immediately discharge C1 by shorting the leads across with an flat-blade screwdriver with an insulated handle. While the electrical shock it delivers may not kill you, you won't forget again!

Remove and replace C1 with a 10-uF, 350-volt electrolytic capacitor. Next replace S2, the Flash switch, with a Teccor K1300E70 Sidac semiconductor. Both are available from **Digi-Key (800-344-4539; www.digikey.com)**. If you have trouble locating the Sidac, it can be replaced with two NE2H neon lamps wired in series, as shown in the lower right corner. Finally, you'll probably want to replace the push button Start button with a toggle or slide SPST switch.



Kodak Max Strobe

Place the strobe back in its case or other suitable box to prevent shock during operation. The strobe rate is determined by the size of C1; the larger the capacitance, the less often the flash occurs, so you may wish to experiment with this to get the rate you desire.



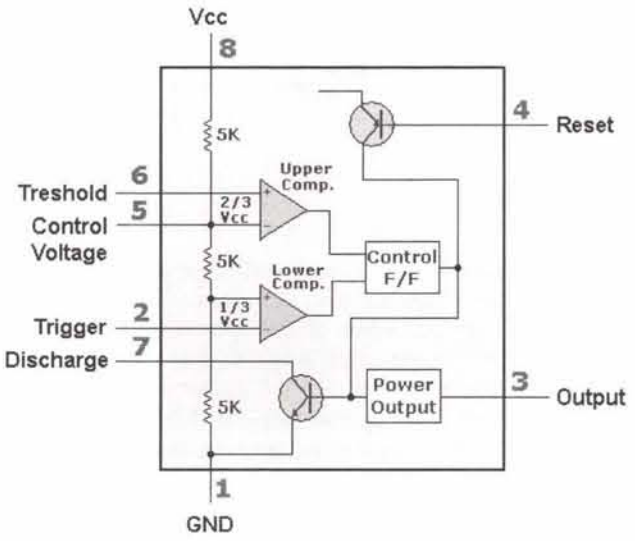
K2440E70 Alternative

They Call Them Maintenance Chargers

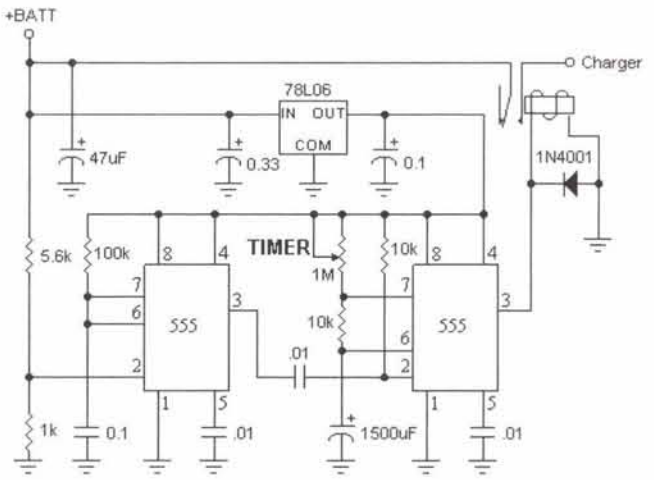
Q. I would like to construct a device that senses battery voltage so that when it drops to 13 volts, it turns on a charger by means of a solid-state relay. The charging period should be adjustable between 5 and 15 minutes — the end voltage isn't important, the charge time is. After the charging period, the monitor again goes into the sense mode and repeats itself each and every time the battery falls below 13 volts.

Tom Wahl
via Internet

A. You didn't mention the charger current, so I'm going to assume it's 5 amps or less (more on that later). First we need a voltage monitor, which is easily done using a comparator, like an LM339. For this circuit, though, I'm going to use a 555 (or half a 556, if you wish). The secret to using a 555 as a comparator is a balanced ratio of voltages and resistors.



To elaborate, the 555 contains a lower and an upper comparator, whose trigger voltages are 1/3 Vcc and 2/3 Vcc, respectively. Let's assume a Vcc value of 12 volts. That means the trigger points are 4 volts and 8 volts, for a hystersis (dead zone) of 4 volts. If Vcc equals 6 volts, then the trigger points are 2 volts and 4 volts, with a hystersis of 2 volts. For this project, I'd use an LM78L06, which gives us a Vcc of 6 volts.



A simple resistance divider provides the lower trip point, i.e., when the voltage drops below 13 volts (1k and 5.6k). Normally I'd use a second divider to set the upper trigger point, but it's not needed for this design because the charger is timer controlled and not voltage controlled. Which brings up an interesting dilemma. The timer will be a second 555 with an adjustable range of up to 15 minutes. The problem is that the 555 is negative edge triggered, whereas the output of the first 555 comparator goes positive when triggered. Sure you can use an inverter gate to set things right, but that requires another chip. A novel solution is to make the comparator into a multivibrator.

An interesting thing about the 555, and a warning given to designers when

designing monostable multivibrators, is that if the trigger input (lower comparator) remains low for longer than the time-out period, it will continue to reset itself and time over. By turning the comparator into a multivibrator of about 100 Hz, the output will toggle high and low as long as the battery voltage remains below 13 volts. This will ensure that the second 555 timer will see a negative-going pulse and guarantee its operation. Once the trigger voltage exceeds 2 volts, oscillation stops.

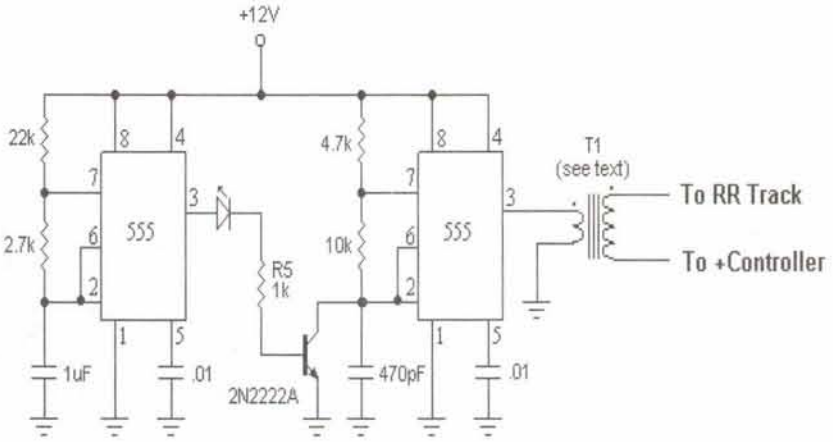
The relay can be any 5-volt SPST (or SPDT) type, such as the Omron G6B1114PUSDC5 available from **Jameco (800-831-4242; www.jameco.com)**, part no. 187311. For higher currents, you can have the first relay drive a second of higher current contacts. I know you asked for a solid-state relay, but they get very expensive for those that can control DC currents (AC solid-state relays are less expensive). If you insist, I suggest the Kyoto KG series.

Chattanooga Choo Choo

Q - Do you know the frequency and power out for a high-frequency track cleaner used in model railroading? Have you ever published a schematic for such a device?

A. L. Hooper
Warner Robins, GA

A - Let me explain to the reader first what we are talking about. Model trains run on metal tracks which are electrified — like trolleys and subway trains — but at much lower voltages and current, typically 12 volts DC at 1 amp. Over time the tracks accumulate "crud," which prevents good electrical contact to the pickup wheels. High-frequency is but one method used to clean the tracks. It works by placing a high-frequency (in the range of 50 kHz-200 kHz), high-voltage pulse atop the 12-volt controller. This circuit will probably get the job done.



The cleaner, which gets its power from the 16 VAC accessory output, has automatic switching. If there is contact to the train, the HF voltage is turned off. When the wheels hit dirt on the track, contact is lost and the HF voltage kicks, which causes sparking that blows away the dirt. It consists of a 2 mS blast of 100 kHz squarewave signal every 17 mS. T1 can be any transformer with a turns ratio between 1:4 and 1:10, like the RadioShack 273-1380 or 273-1385. Be forewarned, it won't work with all controllers.

I've heard mixed results from people using HF cleaner devices, some good some bad. General agreement is that it should be used in conjunction with regular track maintenance, not instead of.

Dead Recording Media Museum

Q - Could you or one of our fellow readers have any information on a Peirce (yes, it's spelled right) wire recorder model 270? It has a two-position foot switch and an earphone: which jack is for which?

Peter Stratigos
via Internet

A - There is an excellent history of Peirce Wire Recorders (which began as Radiotechnic Laboratories of Evanston, Illinois) at **www.rci.rutgers.edu/~dmorton/peirce.htm**. Most of the details concerning the recorders themselves came from David Morton, curator of the IEEE Center for the History of Electrical Engineering, who can be contacted at **dmorton@rci.rutgers.edu**.

If you can't identify the different jacks by size and shape, try measuring the voltage across the jack's contacts using a DMM. The foot switch will need to have a voltage across it to switch the motor on/off, whereas the earphone jack won't have any voltage across it until the footswitch is engaged.

MAILBAG

Mr. Byers:

I read your recent article, "Getting Started on a Shoestring" and wanted to mention an additional low-cost method of acquiring electronics components. All useable non-hazardous, non-demil required U.S. military surplus electronics are available to hobbyists through Internet Auctions and Sealed Bid sales. All of our goods are sold online at www.govliquidation.com. There are pictures, descriptions and a listed contact at the physical warehouse for each lot.

Only registered users can bid, but registration is free. Payments are made by credit card or wire transfer. Shipping is on the buyer and merchandise is located at our warehouses throughout the United States, Puerto Rico and Guam. Look forward to telling you more about our company and the values on our site.

Hunter Hoffmann
Public Relations and Communications Manager
Government Liquidation, LLC
Phone: 480-609-3281

Response: Let me also point out there are other government agencies that sell through the Internet, including the DEA ***(www.bid4assets.com)****, where you'll bid on real estate and confiscated vehicles, and the U.S. Postal Service* ***(www.pages.ebay.com/promo/usps.html)*** *for unclaimed packages and dam-*

aged merchandise. If in doubt as to where to look for your particular needs, download a copy of the GSA's "Guide To Federal Government Sales" at ***www.pueblo.gsa.gov****. or use the main search engine for everything .gov at* ***www.firstgov.com****.*

TJ Byers
Q & A Editor

Dear TJ:

This is a comment about the question "Blame It on Windows! No, The Programmer! in the Oct. 2001 issue. Steve Roberts wrote that he was unable to run his DOS program (Procomm Plus) on his new Windows 98 SE computer. I think his new computer is faster than his old Windows 95 computer, and I think he found the computer clock speed limit that's hidden within every DOS program created with an old version of Borland Pascal. Please tell Mr. Roberts to check out the following web sites for a possible solution.

Borland Pascal Start-Up Runtime Error 200, by J R Stockton
http://www.merlyn.demon.co.uk/pas-r200.htm

Boxed Pentium II Processors — Compiler Errors
http://support.intel.com/support/processors/pentiumII/run200.htm

Also note that just days ago I found a way to install Windows 98 SE on my slow computer (use setup /nm). Then I installed my DOS version of Procomm Plus on the same slow computer and it ran just fine — with the computer clock slowed down. Just like Mr. Roberts, I once installed Procomm Plus for DOS under Windows 98 SE on a fast computer, and it wouldn't run.

Ken Jensen
Portland, OR

Dear TJ:

In reference to Steve Roberts question on DOS programs, I have found that in most cases, the processor speed causes the trouble. I have just upgraded to Win98 and so far my DOS goodies work fine, but with an easy fix that I use. I have AT boxes with unneeded Turbo switches that I have recycled to use as Clock speed switches. (The Turbo switch didn't really die!) Just connect the plug end to the appropriate clock speed jumper position and processor speed can be changed with a reboot. I have tried some patch utilities for the EXEs without any positive results.

Mike Wendt
Hope, MI

Dear TJ:

In the Oct. 2001 issue, a reader tells how his DOS programs will not run on his new computer. I had a similar problem. My son told me that DOS cannot access more than 2GB of hard drive, so I moved my DOS programs to the secondary 350MB drive where they work okay. I could have partitioned the 10GB main drive into 2GB and 8GB virtual drives, but that wasn't necessary in my case.

Russel
via Internet

Cool Web Sites

Have questions? These web sites have answers.

Ramsey Fall Electronics Sale

Looking for that special gift for the electronics enthusiast in your life? Ramsey Electronics, maker of electronic kits and components, has a new Fall 2001 catalog, new web site, and monthly hot deals on close-out items arriving just in time for the holidays. Sign up now and have a chance at their free monthly drawing.

www.ramseyelectronics.com

555 Timer Tutorial

This way too cool web site is a must view for anyone who have ever wanted to know what makes the 555 timer tick. It describes everything from theory to applications, and even has a pop quiz to test what you have learned.

www.uoguelph.ca/~antoon/gadgets/555.htm

IrfranView File Viewer

Do you have a bunch of old graphics files that you can no longer view? If so, grab a copy of IrfranView. It's a freebie that lets you look at virtually any image you'll ever find in your archives or receive across the Internet — even if they are Sun Raster files, X11 Bitmaps, or ancient GEM Raster images. IrfanView also lets you play audio CDs and many types of sound, animation, and movie files (including QuickTime formats).

www.irfanview.com

Windows XP News Center

Windows XP launched last month with much fanfare. Follow all the news, related new product announcements, and solutions.

www.channelweb.com/sections/Newscenters/WindowsXP.asp

by Robert Nansel

Amateur Robotics

This month, I've got some great old books on robotics to recommend. Why old books? As long-time readers know, I like old tech almost as much as new tech. In many cases, the old books are forgotten for good reasons, but often are forgotten only because the book is out of print. You never know unless you look. I've bought many, many robotics books over the last 20 years, but I have kept only a select few. I list only the very best among these sadly out-of-print classics in a sidebar. As a bonus, I also have bits of an interview with David L. Heiserman, author of several of them.

Looking at these books brought back lots of memories. Most gearheads remember their first robot the way other people remember their first car. Well, complete with all its warts, I'll tell you about mine.

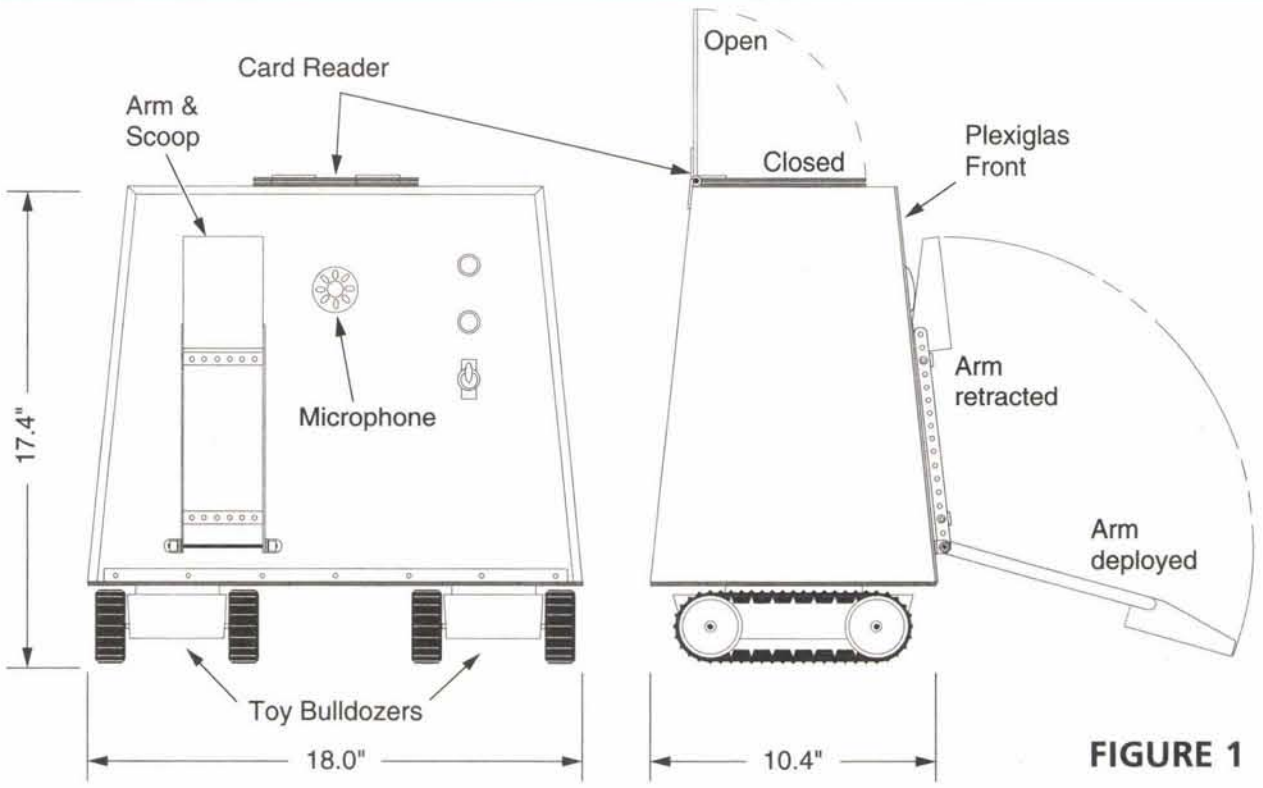


FIGURE 1

My First Robot

When I started building robots in the early '70s, there were no books available on the subject. I had never heard of microprocessors — indeed, I'd never seen an integrated circuit other than in pictures. My first working robot included a crude punched card reader (with brass brad contacts to sense the largish holes) and a salvaged remote controlled garage door opener. I had gutted the remote control board of its RF components, leaving behind the audio tone decoder section. The tone decoder consisted of some audio amplifier circuitry feeding a finicky resonant reed relay.

The reed relay was an electromagnet with several metal reeds of different lengths that resonated at different audio frequencies. The reeds were fixed at one end and resembled tiny diving boards. When a reed resonated, the movement caused it to make and break contact with a closely spaced metal contact bar.

Each time the reed made contact, a short pulse of the B+ battery voltage conducted through the reed to a simple RC network in the base drive circuit of a transistor switch. When enough pulses accumulated, the transistor turned on, and this output was used to turn on either the drive motors or the arm motor.

Rather grandiosely, I called this contraption the "F-4 Drone." I had just seen the SF movie *Silent Running*, and its wedge-shaped robot drones Huewy, Dewy, and Lewy inspired me. A communications microphone picked up tones I blew on my trumpet, and when everything worked right — rare — the robot responded. I envisioned a prerecorded eight-track tape of different tones would eventually control

everything, but I started with just the microphone.

I spent more time than I care to remember filing down the ends of the metal reeds in my attempts to tune them to specific frequencies. Eventually I broke all but one of the reeds (tuned to A-flat). My dream of a robot controlled by an audio tape with multiple tones to select the desired functions remained a dream. I was eager to get rid of the card reader, which didn't work very well and had no mechanics to automatically feed in new cards. With only one good reed left in the relay, though, I had no choice but to retain the card reader.

The arm was a single-jointed affair with a winch mechanism fashioned from a tape recorder motor, a jerry-rigged rubber-band belt drive reducer, and a thread spool. It was good enough in the spring of 1974 to take me to the state science fair in Missoula, MT and to the State Fair in Great Falls that summer (though it wasn't good enough to win in either). The robot itself is long gone, but Figure 1 shows my recollection of its basic configuration.

The body of my Drone was made from thin-gauge sheet aluminum used by the local newspaper as photo offset printing plates. These were shiny on one side and matte finish on the other, and they measured about 30" x 24". The matte-finish side had an ink-repellant gunk that formed a negative image of the pages to be printed; sometimes they also had residual ink on them, too, which made quite a mess, but at fifty cents a sheet, they were a bargain. The sheets were so thin they were easy to cut with tin snips or even heavy scissors. Likewise, it was a cinch to bend the metal with just a few pieces of plywood and some C clamps.

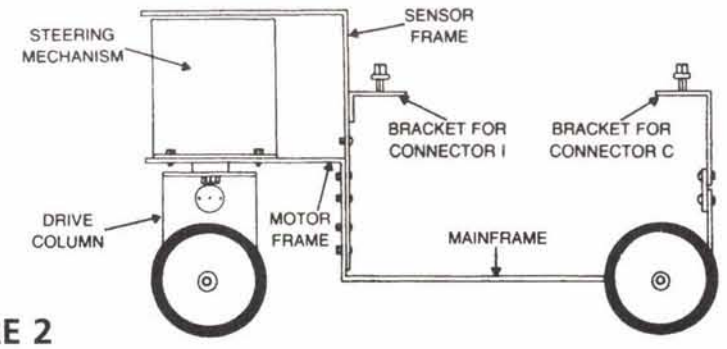


FIGURE 2

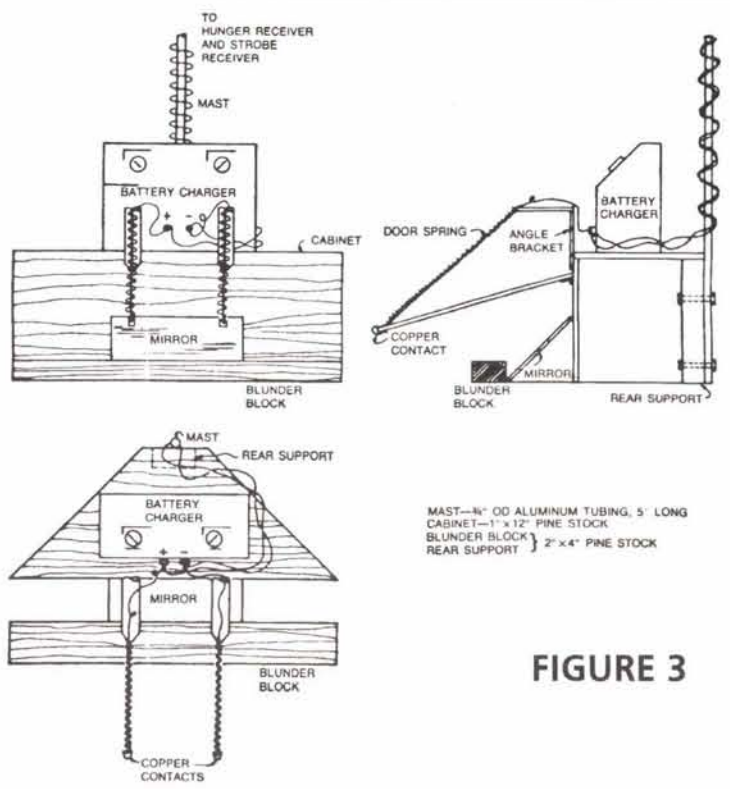


FIGURE 3

Data Books

I learned a lot building this robot, and though I was disappointed not to win at the state-level competitions, I also learned important stuff from other participants. One guy introduced me to TTL logic and seven-segment LED displays, and another guy introduced me to electronic data books.

A good deal of my subsequent electronics education came just from reading data sheets. I'll never forget my first data books: a couple of Fairchild Semiconductor data books on analog and digital ICs and Exar data sheets on their linear IC line. Among the Exar data sheets was one for the 567 tone decoder chip. I barely understood what I was reading, but I did understand that here was a tiny eight-pin chip that performed the same function as a resonant reed relay, only much faster and much smaller.

With this chip, I could decide what exact tone my robot would respond to, as well as how narrow or wide the range of tones, just by changing the values of a few external resistors and capacitors. No more filing those darned metal reeds!

The only problem was price: a single 567 tone decoder went for about $12.00 in '74, and I was a stone-broke junior high school student. The data sheets were free, though, so I studied them and dreamed. I learned how to do basic combinational logic design using Karnaugh maps from an article in *Popular Electronics*. I filled my note-

Out-of-Print Robotics Classics

Albus, James S., *Brains, Behavior, and Robotics* (BYTE Books, Peterborough, NH, 1981). ISBN 0-07-000975-9 (hard)

DaCosta, Frank, *How to Build Your Own Working Robot Pet* (Tab Books, Blue Ridge Summit, PA, 1979). ISBN 0-8306-9796-9 (hard), 0-8306-1141-X (paper)

Heiserman, David L., *Build Your Own Working Robot* (Tab Books, Blue Ridge Summit, PA, 1976). ISBN 0-8306-6841-1 (hard), 0-8306-5841-6 (paper)

Heiserman, David L., *How to Build Your Own Self-programming Robot* (Tab Books, Blue Ridge Summit, PA, 1979). ISBN 0-8306-9760-8 (hard), 0-8306-1241-6 (paper)

Heiserman, David L., *How to Design and Build Your Own Custom Robot* (Tab Books, Blue Ridge Summit, PA, 1981). ISBN 0-8306-9629-6 (hard), 0-8306-1341-3 (paper)

Heiserman, David L., *Build Your Own Working Robot, the Second Generation* (Tab Books, Blue Ridge Summit, PA, 1987). ISBN 0-8306-1181-9 (hard), 0-8306-2781-2 (paper)

Weinstein, Martin Bradley, *Android Design: Practical Approaches for Robot Builders* (Hayden Books, Rochelle Park, NJ, 1981). ISBN 0-8104-5192-1 (paper)

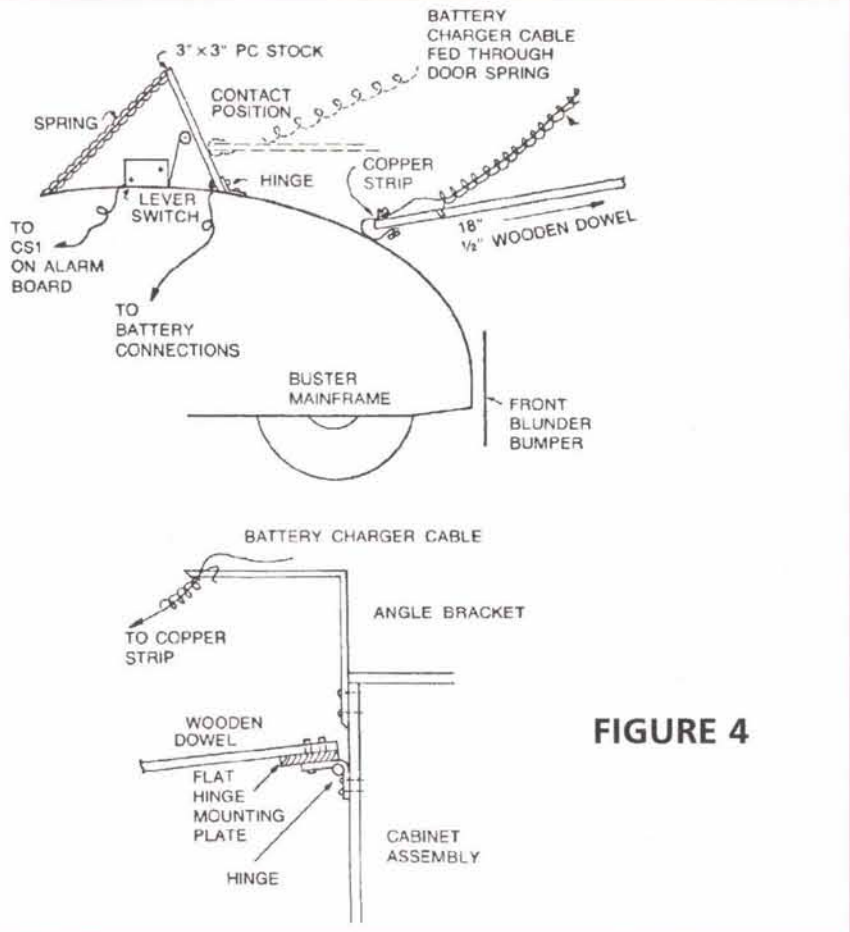


FIGURE 4

books with Karnaugh maps and truth tables for various robot controllers. I didn't yet understand state machines and flip-flops, but I did grasp the concept of timers and counters, so pretty soon I was busy designing a computer on paper. I lost interest when I realized I'd need hundreds of logic chips to build anything interesting, and the cost of all those chips was too appalling to contemplate.

The January 1975 issue of *Popular Electronics* changed everything. On the cover was the Altair 8800, a real computer that you could build for under $500.00. That was still way more money than I had, but I started accumulating parts to build it. I watched prices on the 8080A MPU drop from $300.00 to $150.00 and down. When, after a few years, the price dropped to $17.95 at RadioShack, I bought one. I still have it. I never did build a robot with it. The lesson here: If you accumulate parts for a project slowly enough, they'll be obsolete before you ever use them.

If you have suggestions, questions, or comments about amateur robotics topics, or if you want to enter the Third Lonely Gearhead Contest, you can reach me at:

Robert Nansel
Box 228
Ambridge, PA 15003

E-Mail: bnansel@nauticom.net

Great Old Books

Unlike computer chips, robotics books sometimes age well. When I went to write the review of Gordon McComb's update to his *Robot Builder's Bonanza*, I wanted to compare the new book to my battered copy of the first edition. The book has been in a box in my basement, along with all my other old robotics books, ever since we moved the Robot Ranch to Ambridge nearly two years ago. I keep a detailed inventory of what books are in what boxes, though, so whenever I've had occasion to refer to a book, it hasn't been hard to find.

This time, rather than merely grabbing the one book I was after, I found myself sitting down next to the open box and leafing through the other books — books I hadn't looked at in 10, 15 years. Most of them were hard cover Tab Books from the late 70s and early 80s, long before Tab was bought up by McGraw-Hill.

A few books I've looked through only once, such as *Robots and Robotology* by R. H. Warrin, *Build a Remote-Controlled Robot for Under $300*, by David R. Shircliff, and the endlessly eccentric *Robots on Your Doorstep* by Nels Winkless and Iben Browning. I'm not sure why I've kept these particular books, but if any readers want one or another of them, they are yours for the postage.

Then there are the books I still won't part with, meat-and-potatoes books by authors such as DaCosta, Heiserman, and Weinstein.

Robot Pet

Even after 23 years, Frank DaCostas's *How to Build Your Own Working Robot Pet* is excellent. It describes a three-wheeled robot controlled by an 8085 MPU. The book is filled with photos, plans, schematics, and code for the basic robot and its subsystems, including a battery charger, ultrasonic sensors, a 100-baud tape interface for saving and retrieving programs, and audio I/O modules.

The mechanics and sensors of the robot are quite good, and those parts of the design are still applicable (see Figure 2 for a side view of the robot without its sensor head). Indeed, the robot pet's chassis is quite similar to those of Dr. W. Grey Walter's Machina Speculatrix tortoises of 1948. (For more on Dr. Walter and his robots, check out my January 2001 column.)

The tortoises used a tricycle drive where the front wheel provided both drive and steering functions, while the two rear wheels were fixed casters. A photocell was mounted on the front-wheel steering spindle, thus always pointing in the direction of travel.

Unlike the photocells of Walter's robots, the sensor array of DaCosta's robot does not rotate with the steering spindle, though it looks like it would be a straightforward modification. Rereading the book reminded me that a pleasant feature of tricycle drives is that you don't really need matched motors as you would for a robot with two drive wheels.

The brain of DaCosta's robot — the "RCU-85" — uses a 3 MHz Intel 8085 and three 8155 RAM/IO/timer chips, giving altogether 768 bytes of RAM, a very respectable 66 I/O pins (six eight-bit and three six-bit I/O ports), and three 14-bit timers. While this was state-of-the-art for 1978 when the robot was built, nowadays a robot builder would probably choose a more capable microcontroller than the 8085. If you swap out the NMOS 8085 and 8155 chips for their CMOS 80C85 and 81C55 equivalents, even that part of the design is still workable.

Baroque Circuitry

You would want to make major changes to some of the I/O subsystems, though. DaCosta was very concerned about off-loading "mun-

dane" I/O tasks from the precious RCU-85. These days you can pick up an 80C85 for $5.95 and an 81C55 for $3.95 at Jameco (www.jameco.com), but the NMOS versions of those chips went for more like $50.00 each in 1978. With only 768 bytes of memory, it made some sense to trade off a bit more hardware complexity for simpler software, but DaCosta went a little overboard.

For instance, his tape interface is an amazingly baroque circuit made up of about 30 digital and linear chips. Most tape interfaces of the era had much simpler hardware — two or three chips — helped along by a modest block of clever software. DaCosta's interface has to be much more complex because the RCU-85 lacks a boot ROM. This means the interface must generate all the signals required to sequence and control the MPU bus to read and write program memory. The whole mess could be replaced now by a single $3.00 PIC if you really wanted to retain the tape I/O functionality. Better yet, add a 32K flash EEPROM and avoid the problem altogether.

Then, too, there are the quirky audio I/O modules called "Excom" and "Audigen." With "Excom" the robot could receive four-bit serial binary commands — whistled or sung by the builder.

Talk about a user-cruel interface! "Audigen" produces audio chirps programmable for four different starting frequencies and four different durations to give the robot a repertoire of animal-like barks. Again, all of this is done with external chips so the 8085 can loaf along doing more cerebral stuff.

Buster

David L. Heiserman was the most influential writer in the hobby robotics boom of the late 70s and early 80s. He has written over 40 technical books, but among gearheads most beloved are his books on robotics and machine intelligence. All but one of Heiserman's books (*Exploring Chemical Elements and Their Compounds*) are out of print. I interviewed Dave recently about his robotics books.

He told me he built his first robot in the 60s. It used an old AM radio — a vacuum tube model designed for cars — as the receiver for its radio control system. "It worked great unless there was interference from lightning storms. Then, look out!"

The robot that really got him going, though, was Buster, which he designed in 1976 as a class project for his second-year electronics students at the Ohio Institute of Technology. Dave will never forget the first time he saw Buster functioning. "I had been out of town, but my students kept working on Buster while I was gone. When I came back, I was walking toward the lab when here comes Buster around the corner all by himself. It was quite a moment."

Buster was built on the chassis of an electric kiddie car, and its brain was made from about 116 chips, mostly 7400-series logic, some timers, and assorted linear ICs. The bulk of the electronics fit in slots of a home made card cage that held 30 4" x 8" printed circuit boards.

Dave described in detail the three successive phases of the design and construction of the project in *Build Your Own Working Robot*. The book came out shortly before the cinematic release of Star Wars, and the surge of popularity of robots inspired by the movie helped make the book a hit. It was written up in the Wall Street

Journal, and Dave was even interviewed by Rolling Stone. "I had some strange people calling and writing me for a while."

Rodney

Dave's second robotics book, *How to Build Your Own Self-Programming Robot*, came out in 1979. This book is about Rodney, a microprocessor-based robot. Like DaCosta's RCU-85, Rodney uses a controller based on the 8085 MPU, though one with a bit more program RAM and a bit less I/O than the RCU-85. The Rodney design goes considerably further than the RCU-85 in that it also incorporates a separate 4K block of RAM devoted to a self-programming memory that Rodney relies on to develop a unique personality.

The third Heiserman book I added to my collection was his 1981 *How to Design and Build Your Own Custom Robot*, which is not devoted to any single robot but to the general design principles behind mobile robots and robot arms. Like its predecessors, the book is filled with drawings and schematics, only it is twice the length of the previous books. For a decade this book and Weinstein's *Android Design* were the "bibles" of amateur robotics. Weinstein's book seems to be harder to find, to judge from the prices I've seen at Advance Book Exchange (abebooks.com), but if you can find one, snap it up.

The Buster design is my favorite of the early robots. Figures 3 and 4, reproduced from the figures in the 1976 book, show a few details of Buster's charging "nest." Dave updated the Buster design in his *Build Your Own Working Robot: the Second Generation* in 1987. Using tristate circuitry and multiplexer logic, he built a version of Buster using a quarter of the chips needed in the original. It's fascinating to compare the two designs.

The Rodney book also has a slick charging system based on two parallel rings on its bumper skirt. The point is, today's amateurs can learn from all of the robots I've discussed.

Have Fun

I asked Dave what words of advice he has for today's robot amateurs. "Have fun, and don't take it all too seriously," he said. "You can't create anything new without getting deep into a project — and then making a few mistakes. That's when you really learn something. I was in the middle of Rodney before I figured out his self-programming hardware."

I asked him if he'd ever considered turning one of his robots into a kit. "No," he said. "I don't encourage students to build kits because everything is all neat and tidy. You don't get the chance to learn from design mistakes."

Dave doesn't have plans to write another robotics book, but his wife insists he should, even though it typically takes him nine months to write a book. "She says I have one more robot book in me." He laughs. "She says I'm different when I'm writing a robot book."

Dave also told me that he would like to put the content of his old robotics books on the web, but that he doesn't have the time to scan them in himself. He welcomes volunteers to scan the drawings and text. If you are interested, contact him at daveh@free-ed.net

Don't Forget

Third Lonely Gearhead Contest entries are due by December 31, 2001. All who respond by then will get their names thrown in a hat; I will randomly select one person to receive a Solarbotics BEAM experimenter board. Anybody anywhere who wants to find a local robotics club or get one going can send me a letter or email. Also, anybody who has a club going should give me contact information.

Send me contact names, addresses, URLs, email addresses, phone numbers, etc., whatever way you would wish other robot builders to get in touch with you. If you have a club you want folks to know about, drop me a line. Likewise, if you are looking for a club. I'll publish both lists in my Feb. 2002 column. Let's hear from you. **NV**

Continued from page 32

If you settle on the BASIC Stamps remember they are featured monthly in an *N&V* column authored by Jon Williams and all the past columns have been compiled into a two volume set available at the *N&V* online bookstore (www.nutsvolts.com).

By way of a few suggestions Parallax offers the QV306 Sound Module (see *N&V June '01 pg.78* for an article on how to use it) which can hold four minutes of stored sound in 240 different files. When that LED or incandescent bulb lights do you want an audio response as well? Is your application better suited to IR instead of RF? Your 3x4 keypad has 10 numbers, but two leftovers (* and #). Perhaps these could be used as "shift" or "command" keys. Sending *1 would cause the display to blink or #4 might be a preprogrammed pattern of lights?

As you check out microprocessors be certain to make the manufacturer's web site your first stop. This will give you access to a wealth of material: datasheets, applications notes, free software tools, development kits and the location of user group sites.

Finally I have no relationship whatsoever with any of the companies listed below nor do I have company stock or any other financial interest in any of the products listed. The diversity of products listed simply brings this write-up full circle to illustrate the vast assortment of resources available to the electronics professional and hobbyist alike for very reasonable costs. Many projects today do not require the designer to ask "How am I going to do this," but instead he or she is forced to answer the question "Which of these dozen equally good solutions should I go with?" As you go through the resources listed below you will see that we "suffer" from an abundance of high quality, reasonably priced alternatives. Would that all life's problems were so sweetly difficult.

Good Luck on a very interesting project!

Bob Miller
Trenton, NJ

ANSWERS TO 10014 - OCT. 2001

I need to design a circuit to automatically reset a PC after a power failure. After examination, the reset button shorts two pins on the motherboard which have an isolated +5V and GND.

I've attempted several circuits using a 555/556 to give a delay, but the only source of voltage at that point is the 5V at that pin. I want to be able to build a circuit which will not require cutting or jumpering the motherboard.

#1 If you want to add a delay to your current relay circuit, try an RC circuit. Basically, a capacitor across the relay driver will act as a short, initially, depriving the relay of power. Then, after RC seconds (the value of a resistor in series with the relay in ohms times the value of the capacitor in microFarads), it will act as an open, letting current flow to your power-on circuit.

If you just want to have your computer come back on after the power comes back on, here are three ideas:

1. Switch to an older AT style power-supply with an actual power switch. This will solve the power on problem, but disable the "soft power" shutdown feature. (Whereby Win9x can shut off the computer.)

This shouldn't be a problem since you obviously want this computer to be on most of the time, anyway.

If your mainboard doesn't have the old AT style PS connectors, you'll need to make/buy an adapter cable. Here are the pinouts:

AT Power Supply

P8

Pin	Name	Color	Description
1	PG	Orange	Power Good, +5 VDC when all voltages have stabilized.
2	+5V	Red	+5 VDC (or n/c)
3	+12V	Yellow	+12 VDC
4	-12V	Blue	-12 VDC
5	GND	Black	Ground
6	GND	Black	Ground

P9

Continued on next page

uP Families and Development Resources

AVR
N&V August '01 – "Getting Started with the AVR" by James Cart An excellent article with many resources listed

Atmel Corp.
1-408-436-4270; www.atmel.com
Manufacturer of the AVR family, as well as the AT89S8252 (8051/2 derivative)

68HC705/11/12, etc.
N&V December '00 – "Starting with the 68HC11" by Al Williams An excellent article with many resources listed

Motorola, Inc.
1-847-576-5000; www:motorola.com
Manufacturer of the 68HC705/11/12, etc. Source for huge amounts of info and software for these devices.

VESTA Technology, Inc.
11465 W. 48th St. N.
Wheat Ridge, CO 80033
303-422-8088; www.vestatech.com
PIC & 68HC11/12 "Stamps"

8051/52 and derivatives
Philips Semiconductors
212-536-0500; www.philips.com
Manufacturer of 8051/52. There are scores of versions of this terrific, powerful and diverse uP. This is a good starting point.

PIC, SX, and BASIC Stamps:
Microchip Technology, Inc.
2355 W. Chandler Blvd.
Chandler, AZ 85224
1-888-628-6247; www.microchip.com
Maker of the PIC and source for TONS of info and FREE resources.

Parallax
1-888-512-1024; www.parallaxinc.com
BASIC Stamps, books, development systems, I/O modules of all types
Also carries PIC and SX development systems.
www.stampsinclass.com – tutorial kits

TechTools
P.O. Box 462101
Garland, TX 75046
972-272-9392; www.tech-tools.com
Free assembler (CVASM16) & "C" as well as fancier commercial versions.
Lots of PIC hardware including ICE & debugger.

CCS
Custom Computer Services, Inc.
P.O. Box 2452
Brookfield, WI 53008
262-797-0455 ext. 35; www.ccsinfo.com
PIC C Compilers from $99.00 to $350.00

Z8, Z80, Z180, et al
Zilog
www.zilog.com
Manufacturer and good first stop

RABBIT Semiconductor
2932 Spafford Street
Davis, CA 95616
530-757-8400; www.rabbitsemiconductor.com
Makes a spiffy, modern, fast new Z80 offspring. Lots of low-cost software tools and development hardware.

Z-WORLD
2900 Spafford Street
Davis, CA 95616
530-757-3737; www.zworld.com
Lots of Z180 and RABBIT embedded control products

Tx and Rx Modules:
Abacom Technologies
416-236-3858; www.abacom-tech.com
Rx and Tx wireless 433MHz radio modules
AM-RT5 418MHz or 433.92MHz Tx (250') - $12.10; AM-RSS2 Rx (300') - $24.50

LEMOS International
48 Sword St.
Auburn, MA 01501
1-800-587-5069; www.lemosint.com

Linx Technologies
1-800-736-6677; www.linxtechnologies.com
See also N&V June '01 "Build an RF Sensor Block" by Karl Lunt Mr. Lunt used LINX TX and Rx modules with a PIC16F873.

General Electronic Supplies:
Digi-Key
701 Brooks Ave. South
Thief River Falls, MN 56701-0677
1-800-344-4539; www.digi-key.com

JAMECO Electronics
1355 Shoreway Road
Belmont, CA 94002-4100
1-800-831-4242; www.jameco.com

MCM Electronics
650 Congress Park Dr.
Centerville, OH 45459-4072
1-800-543-4330; www.mcmelectronics.com

Mouser Electronics
1000 N. Main Street
Mansfield, TX 16063-1511
1-800-346-6873; www.mouser.com

Pin	Name	Color	Description
1	GND	Black	Ground
2	GND	Black	Ground
3	-5V	White or Yellow	-5 VDC
4	+5V	Red	+5 VDC
5	+5V	Red	+5 VDC
6	+5V	Red	+5 VDC

ATX Power Supply

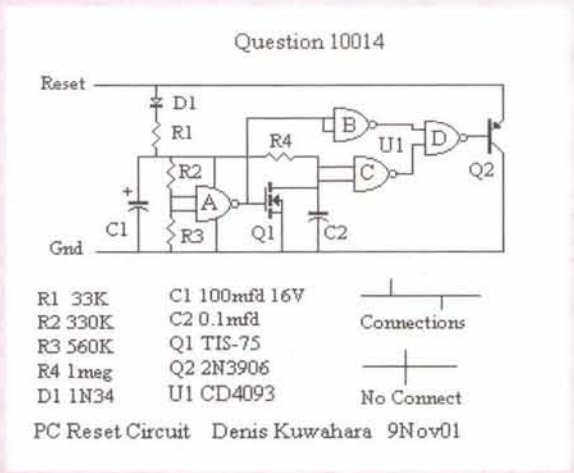
20-pin MOLEX 39-29-9202 at the motherboard.
20-pin MOLEX 39-01-2200 at the cable.
Square pin = 1; row with square pin = 1-10; next row is 11-20 starting at square pin end.

Pin	Name	Color	Description
1	3.3V	Orange	+3.3 VDC
2	3.3V	Orange	+3.3 VDC
3	COM	Black	Ground
4	5V	Red	+5 VDC
5	COM	Black	Ground
6	5V	Red	+5 VDC
7	COM	Black	Ground
8	PWR_OK	Gray	Power OK (+5V if +5V and +3.3V are OK)
9	5VSB	Purple	+5 VDC Standby Voltage (max 10mA)
10	12V	Yellow	+12 VDC
11	3.3V	Orange	+3.3 VDC
12	-12V	Blue	-12 VDC
13	COM	Black	Ground
14	/PS_ON	Green	Power-supply ON (active low)
15	COM	Black	Ground
16	COM	Black	Ground
17	COM	Black	Ground
18	-5V	White	-5 VDC
19	5V	Red	+5 VDC
20	5V	Red	+5 VDC

2. Buy a (more expensive?) "server" power-supply that automatically turns on when power is applied.

3. Maybe this thing would work: **www.geocities.com/apd2k/.**

Amos Bieler
via Internet



#2 Being between houses, this circuit has not been breadboarded. But the theory of operation describes the function and elements that may need adjustment. This circuit stores energy in C1, when a threshold is reached, a timer is started, pulling the reset line low for a period of time. Now, the details:

R1 limits the current drawn while charging C1 to prevent holding the reset line low.

R2, R3 is a voltage divider setting the threshold of Schmitt Trigger U1a to 4 volts.

U1a output goes low when the voltage of C1 is above threshold.

Q1 releases the clamp on C2 allowing the current from R4 start charging C2.

U1c output goes low when the voltage on C2 is above threshold.

The timing sequence starts with U1a output being high, is inverted by U1b, providing a low input to U1d. C2 being clamped low U1c output will be high. U1d output will be high until C1 charges to about 4 volts, and U1a output goes low, and U1b output goes high. The output of U1d goes low until C2 charges and U1c output goes low.

Denis Kuwahara
via Internet

#3 I suggest you stay with the relay, but operate it with a "wavefront" circuit. The hookup is very simple. Connect an electrolytic capacitor between the +5V supply and the relay coil (i.e., the power supply, the capacitor, and the relay coil are in series). Make sure the positive terminal of the capacitor is toward the +5V supply. Then wire a resistor across the capacitor. Make that resistance about 100 times the relay coil resistance.

When the power comes on, the capacitor will charge through the relay coil. That current will operate the relay. Ultimately, the capacitor becomes fully charged and the current stops. The relay then releases and remains released as long as the voltage is present. When the power is shut off, the capacitor will discharge through the resistor and the circuit will be ready for the next power-up cycle.

The capacitance will determine how long the relay stays operated. Start with about 10 uF, and work up until you get the desired relay pull-in time. I have used wavefront circuits many times in industry, and they are very simple and reliable.

Wallace R. Rust
via Internet

#4 A very inexpensive and straightforward solution can use a 1232 MicroMonitor IC (see diagram and sources below).

This little guy is a wonder. When VCC goes out of bounds (5% or 10% settable from pin 3), the RESET outputs are asserted (one active HIGH and one active LOW – take your pick) and stay that way until VCC returns in-bounds.

On VCC's return, the RESET outputs remain asserted for a minimum of 250ms in order to give the power supply, system circuits, and the processor time to stabilize. The PBRST input can be connected to one side of the push button you have now (ground the other side) in order to preserve your manual reset.

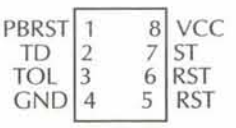
The IC will debounce the button and guarantee a RESET of at least 250ms.

All this for $2.00 and you won't have to cut a single PCB trace!

Bob Miller
Trenton, NJ

Digi-Key
1-800-344-4539
www.digi-key.com
#158-1042-ND $1.87 (TelCom Semiconductor Brand)

Jameco
1-800-831-4242
www.jameco.com
#106260 $2.49 (MAXIM brand)
#114331 $2.75 (DALLAS brand)



xx1232 MicroMonitor Chip
8-PIN DIP

PBRST: Push Button Reset Input
TD: Set Time Delay
TOL: Set 5% or 10% VCC trip point
GND: Ground
RST: RESET Output (Active High)
RST: RESET Output (Active Low)
ST: Strobe Input for "Watchdog" Function (otherwise tie LOW)
VCC: +5 Volt Power

More Bytes

Continued from page 17

to help in response to disasters of all kinds. The problem is that these good intentions frequently overwhelm the capabilities of relief agencies to handle the donations of non-cash assets," said Stephen Meade, chief executive officer of 2Xchange. "That's why we are so proud to offer the EAMS system to the disaster relief efforts in New York. We believe we will be able to connect the generous donations of companies and individuals with the departments and agencies that need those items most." Added Andrew "Flip" Filipowski, chairman and CEO of divine: "We are very pleased to join the EAMS effort. By participating in EAMS, companies are able to donate goods such as computers, clothing, heavy equipment, and other needed items, and be confident that those items will be available when the relief agencies need them."

Once a business registers with EAMS, it can post items it intends to donate to the relief effort. Government or relief agencies also register and post items that they need. An online credit system is utilized to enable the agencies and affected businesses to acquire the donated goods if and when needed. The system also is capable of taking online donations of volunteer time.

Companies and individuals wishing to donate goods and services should go to www.EAMS.org and register.

HomeontheCam.com Breaks New Ground on the Web

HomeontheCam.com™ applies cutting edge web cam and server technology to custom home construction. This unique service gives homeowners remote video access to the building of their dream home from ground breaking through completion.

In addition to the homeowner, custom homebuilders, developers, designers, and realtors can also use this service as both a virtual supervision and marketing tool. Several "Featured Home" projects are currently online and open to the public for review by logging on to www.HomeontheCam.com .

HomeontheCam.com features live streaming video from jobsite to website. Each jobsite can be hosted as either open to the public, or as a password-restricted location, allowing only a selected few to view the progress of the project online.

Contractors and homeowners can check on their homes. General contractors can keep an eye on multiple jobsites without leaving their offices. Likewise, homeowners can view progress from anywhere, any time — even if they are on the other side of the world.

According to Alan Bechtold, President of HomeontheCam.com, Inc., "Our service is especially useful for soon-to-be transferred business executives, their families, and others who live or work a great distance from their new home's lot. They can watch their home go up at any time and from any place with a computer connected to the Internet. It's an invaluable, cutting-edge service that gives homeowners the comfort of knowing their project is in capable hands, in turn giving contractors an edge on their competition."

In addition to online supervision, HomeontheCam.com offers solutions to several problems faced by the general contractors on jobsites including vandalism, theft, and miscommunication between contractors, subcontractors, and homeowners.

Another feature that Homeon theCam.com offers is continually updated and archived editorial content

and information of interest to homebuyers and contractors. For additional information on HomeontheCam.com products and services, visit HomeontheCam.com at www.HomeontheCam.com or call 888-580-3821 toll-free.

Flight Explorer and Satellink Technologies, Inc., Team Up to Put Real-Time Ground and In-Flight Situational Awareness Info into the Cockpit

Flight Explorer®, the world's leading provider of Internet-based real-time flight tracking information, and Satellink Technologies, Inc., the premier provider of broadcast satellite information delivery systems, now have an agreement to offer Flight Explorer as part of the Satellite Technologies Merlin™ System. The agreement provides, for the first time, a fully functional aircraft situation display for subscribers in the cockpit.

The new service, called "FE InFlight," will provide live flight tracking and decision tools to pilots in the cockpit to enhance situational awareness during ground and in-flight operations. Specifically, pilots will be able to view, in real-time, air traffic and weather along their routes and at their destinations to help them make decisions about the route and timing of their flights. Merlin uses satellite broadcast technology to provide a suite of flight information, weather data, and other capabilities directly to pilots in the cockpit. The service will be available in the first quarter of 2002.

Flight Explorer is the maker of Flight Explorer Professional™, one of the easiest, most powerful and reliable aircraft situation displays in the industry. With only a personal computer and Internet access, anyone — from a major airline dispatcher, fleet operations or airport manager, even an awaiting limousine company — can use Flight Explorer Professional to track, in real time, aircraft anywhere over the US (including Alaska and Hawaii), Canada, the UK, and portions of the Atlantic and Pacific oceans. Flight Explorer Professional information is updated every 10 seconds.

Walter Kross, CEO of Flight Explorer, said, "We're excited to team up with Satellink to bring the power of Flight Explorer's real-time situation display directly into the cockpit, giving pilots another tool to enhance flight safety, awareness, and efficiency." Harlan Hamlin, vice president and general manager of aviation services for Satellink Technologies, said, "The addition of Flight Explorer's aircraft situation display to Merlin's broad range of high-quality, real-time graphical and text weather products is exciting news for all pilots. The combination of real-time weather and air traffic information provides pilots, for the first time, with a vast array of flight-safety and mission-critical information. We believe this system will significantly improve flight safety and reduce the cost of operations. Initial reaction from the aviation community has been outstanding."

Palm Launches Regional Training Workshops for Individuals and Schools

Palm, Inc., now has available regional workshops aimed at providing professional development for individual educators and schools on how to effectively integrate Palm™ handheld computers into teaching and learning.

Regional workshop providers are located in California, Indiana, Texas, and Massachusetts and provide a high-quality learning experience specially designed to meet the needs of administrators and teachers using Palm handhelds in the classroom.

The workshop providers have expertise in the Palm OS® platform and years of personal experience as K-12 educators and administrators. Additional information is available at www.palm.com/education.

Compaq Helps Make Holiday Shopping Easier with 'Gifts That Go' Online Gift

While online shopping has made holiday gift hunting faster and more convenient, it still doesn't solve

the problem of knowing what to buy. Compaq Computer Corporation has a solution: the "Gifts That Go" Gift Center and Wish List web site of great tech gifts for today's busy lifestyle.

Found at www.compaq.com/gtg, the "Gifts That Go" Gift Center features a Wish List function that allows visitors to "browse" a selection of portable digital audio and computing products and choose items they would like to receive as a gift. After browsing, the visitor can choose to send an email, including information and details about how to purchase the gifts chosen, to as many friends and family members as he or she wishes.

"Compaq and many other companies are helping to take the guesswork out of holiday shopping with wish lists and similar online services, to help consumers save time and reduce stress during one of the busiest times of the year," said Trey Litel, marketing manager in Compaq's Access Business Group. "Compaq is taking that concept one step further, by also offering a selection of portable products that help consumers bring balance to their work and home lives by providing anytime, anywhere access to information and entertainment."

Consumers Lost $4.3 Million to Internet Fraud in First 10 Months of 2001

Consumers reported losses totaling $4.3 million, or $636.00 per person, in Internet fraud to the National Consumers League's (NCL) Internet Fraud Watch (IFW) during the first 10 months of 2001, up from $3.3 million and $427.00 per person for all of 2000.

"Increases in loss coupled with predictions of less travel and more online shopping this holiday season make it more important than ever for consumers to understand how to avoid online scams and shopping mishaps," said Susan Grant, director of the National Consumers League's Internet Fraud Watch.

Though consumers are using their credit cards more online, money orders are still the most common way Internet fraud victims paid for their products or services.

"Credit cards are the safest way to pay because you can dispute the charges if something goes wrong, Grant said. "And new technologies like substitute or single-use credit card numbers add an extra measure of protection against someone else fraudulently using your account."

NCL has released *Six Tips for Shopping Safely Online* to help consumers avoid scams and mishaps this holiday season.

1. Get the scoop on the seller. Check complaint records at your state or local consumer protection agency and Better Business Bureau. Get the physical address and phone number to contact the seller offline. Look for sellers belonging to programs that encourage good business practices and help resolve complaints.

2. Use a credit card. It's the safest way to pay because you have the legal right to dispute charges for goods or services that were never ordered, never received, or misrepresented.

3. Ask your credit card issuer about "substitute" or "single-use" credit card numbers. This new technology allows you to use your credit card without putting your real account number online, protecting it from abuse by "hackers" or dishonest employees of the seller.

4. Look for clues about security. When you provide payment information, the "http" at the beginning of the address bar should change to "https" or "shttp." Your browser may show whether the information is being encrypted, or scrambled, as it is being sent. See what web sites say about how they safeguard your information in transmission and storage. Don't provide sensitive information by email.

5. Know the real deal. Get all details before you buy: a complete description of items; total price, including shipping; delivery time; warranty information; return policy; and what to do if you have problems.

6. Keep proof handy. Print and file the information in case you need proof later. **NV**

Classifieds

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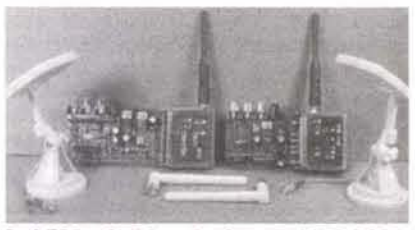
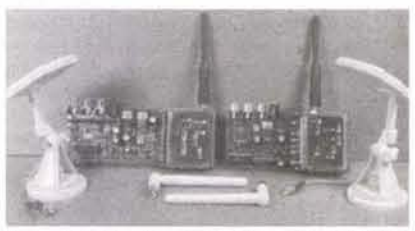


2.4GHz ATV — 8 channel TRANSMITTERS AND RECEIVERS. 35mW output power, 1 video channel, 2 audio. SMA connectors. NTSC/PAL compatible. Includes 1/4 wave rubber duck antenna. Standard frequencies are: 2398, 2405, 2412, 2416, 2420, 2428, 2435, 2442 MHz. Custom frequencies are available. See ad in this section for power amplifier. **$79/each for transmitter**. **$79/each for receiver**. EzATV. Visit our web-site for dealers or order on-line at www.4atv.com



1.2GHz ATV — 8 channel TRANSMITTERS and RECEIVERS. 75mW output power, 1 video channel, 2 audio. SMA connectors. NTSC/PAL compatible. Includes 1/4 wave rubber duck antenna. Standard frequencies are: 1250, 1255, 1260, 1265, 1270, 1275, 1280, 1290 MHz. Custom frequencies are available. **$79/each for transmitter**. **$79/each for receiver**. EzATV. Visit our web-site for dealers or order on-line at www.4atv.com

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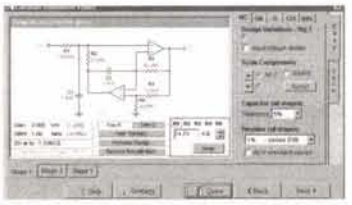

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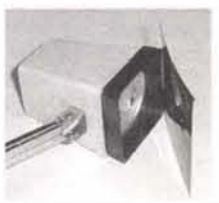

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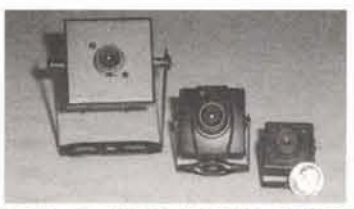

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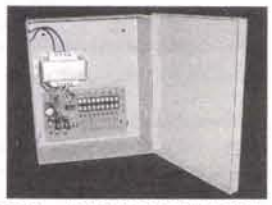

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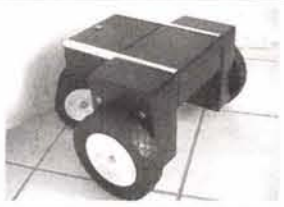

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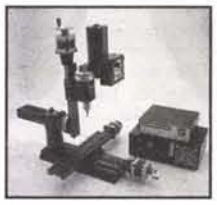

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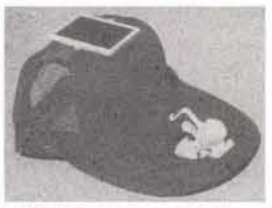

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AIBO UPDATE

by Jeff Mazur

While Sony introduces two new AIBO models, it also takes action to shut down the AiboPet website — THE premiere source of information and freeware for AIBO owners.

In late October, a scary thing happened in the AIBO community — and it had nothing to do with terrorism or Halloween. AiboPet, arguably the most popular figure in the online AIBO world, removed all AIBO materials from his website after receiving the following letter from Sony:

SONY
Sony Electronics, Inc.
Entertainment Robot America
6701 Center Drive West, Suite 640
Los Angeles, California 90045

October 24, 2001

{my name and address}
Registrant
www.aibopet.com

Re: www.aibopet.com

Dear {my name}:

We refer to the letter sent by our predecessor, Takeshi Yazawa, to you dated April 19, 2001 regarding your website "www.aibopet.com" and also to your email response dated April 20, 2001.

Entertainment Robot America — a division of Sony Electronics, Inc. — ("Sony") continues to be concerned about the contents of your site. The concerns enumerated in Mr. Yazawa's letter were as follows:

(i) the contents of your site contain Sony copyrighted software which you are copying and distributing in violation of Sony's rights;

(ii) your site provides the means to circumvent the copy protection protocol of Sony's AIBO™ Memory Stick™ to allow access to Sony AIBO-ware software; and

(iii) your site promotes the distribution of your original software such as "Disco AIBO," "AIBO Scope," "Bender AIBO," etc., which appear to have been created by copying and decrypting Sony's software.

While your timely email response to Mr. Yazawa's letter was appreciated, it did not alleviate Sony's concerns nor did it adequately justify the contents of your site. You mentioned that you merely provide backup copies of AIBO-ware for the convenience of users. Your reasoning for providing this code does not matter. By copying and distributing this code you are violating Sony's copyrights and are in breach of the End User License Agreement governing the use of the software. The exclusive rights enjoyed by a copyright holder are absolute rights, and the fact that the wrongfully acquired AIBO-ware can only be utilized by devices utilizing rightfully acquired AIBO-ware is of no consequence. In other words, the fact that an AIBO Life Memory Stick (rightfully acquired through Sony) is needed to run AiboLife Plus (wrongfully acquired through your website) does not create a defense to your infringement of Sony's copyrights.

Similarly, your response regarding the copy protection protocol does not justify your actions. Your discontinuation of "Format AIBO" is certainly a step in the right direction. However, your site still contains information providing the means to circumvent AIBO-ware's copy protection protocol constituting a violation of the anti-circumvention provisions of the Digital Millennium Copyright Act.

As previously mentioned by Mr. Yazawa, Sony appreciates your enthusiasm for AIBO. Further, Sony is excited about the proliferation of value added software for AIBO owners, but only when such software does not infringe Sony's rights. Sony would like to see your site continue its interest in AIBO; however in order to enforce Sony's intellectual property rights, we are requesting the removal of the following files from your site.

http://www.aibohack.com/210/RCodePlus15.zip
http://www.aibohack.com/210/RCodePlus_F.zip
http://www.aibohack.com/210/RCodePlus_J.zip
http://www.aibohack.com/rcode/MasterStudioPlus14.zip
http://www.aibohack.com/210/AiboLifeplus_11.zip
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http://www.aibohack.com/210/files.htm
http://www.aibohack.com/310/tonecmd.htm (and all MIDI files linked to from that page)

Very truly yours,
{signature}
Victor Matsuda
Vice President
Entertainment Robot America
Sony Electronics, Inc.

Reaction within the AIBO community was swift and unanimous: disbelief and anger against Sony. Many other sites shut down in protest or posted open letters to Sony in support of AiboPet (see Figure 2). As mentioned in the letter, AiboPet had been contacted earlier this year with similar concerns and it seemed like they had reached an agreement. AiboPet has never encouraged anyone to bypass Sony's copy protection and prominently stated so in numerous places on his site. It seems, however, that with the recent management change at Sony ERA, this issue floated to the top again.

Let me start by saying that I'm not a lawyer. Having gotten that out of the way, I suppose I'm free to espouse my

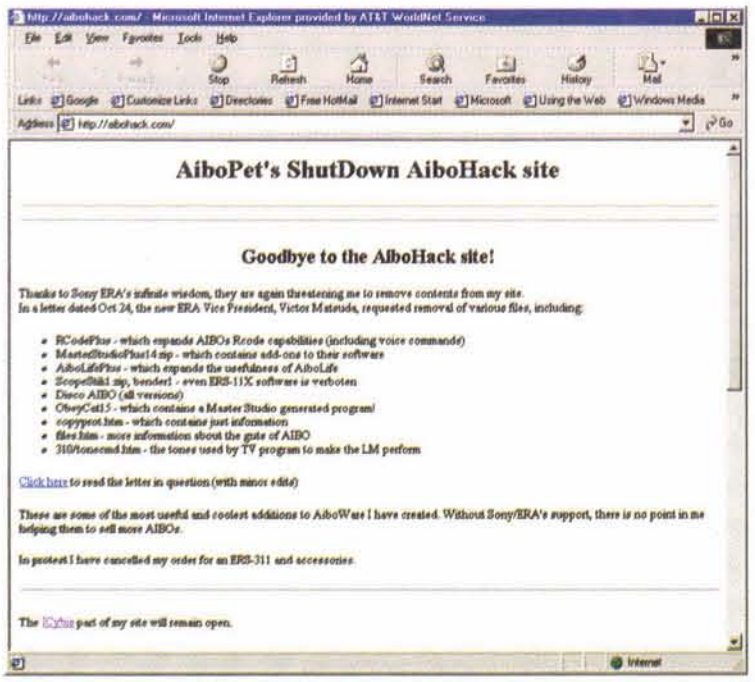
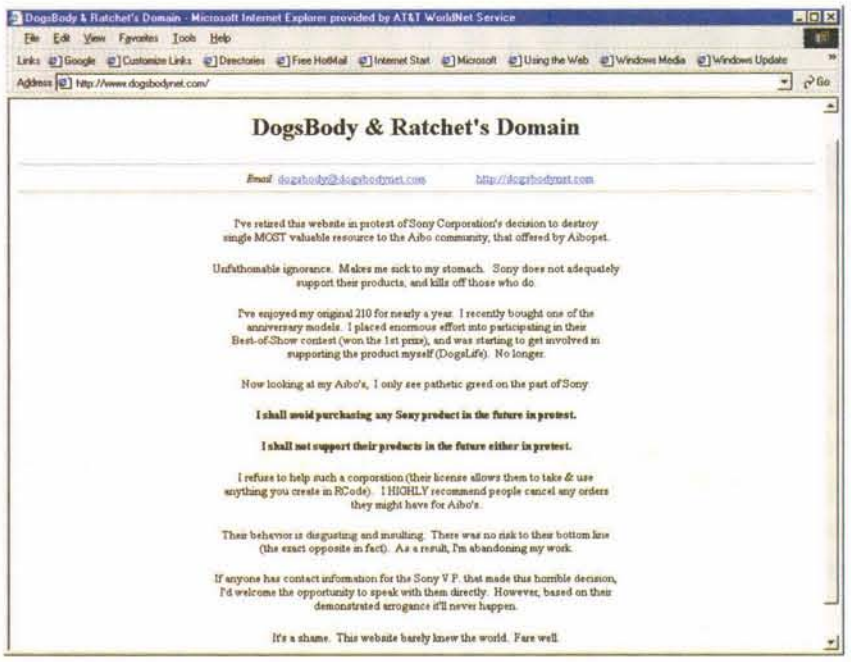
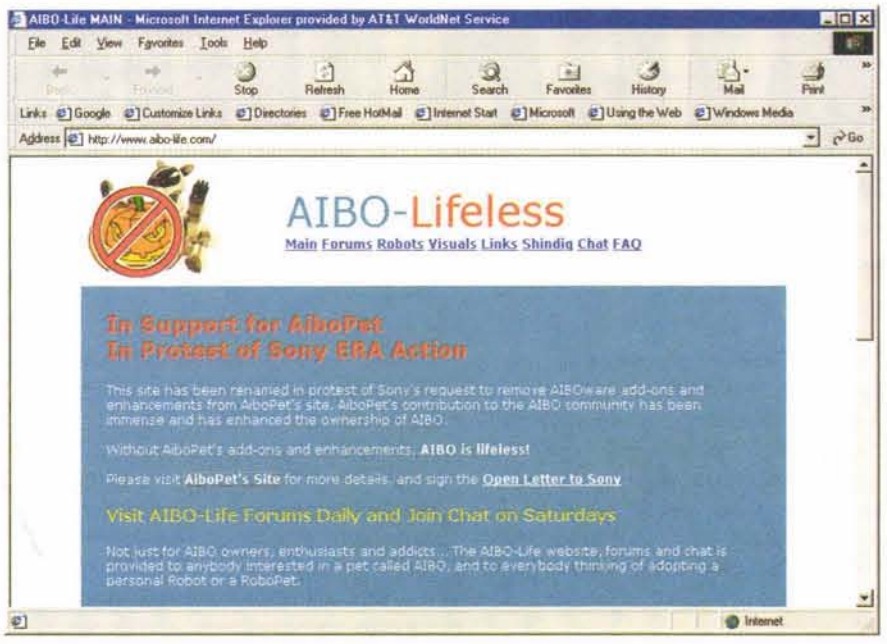


Figure 1. Visitors to AiboPet's website now see this. Gone is all the wonderful AIBO info, tools, and software.





a

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Figure 2. Other AIBO related websites have joined in protest against Sony. a) DogsBody, b) aibo-life, c) aibo persona, and d) this statement found on the aiboworld.tv site.

own opinion. So, let me try to put this debate into perspective, especially from the viewpoint of an AIBO owner who likes to tinker with his rather expensive robotic toy.

Some have brought up the argument that AIBO should be an open system, like the early PCs, instead of a closed, proprietary box like the first Apple Macintosh. They point to this openness as a key factor in the success of PCs vs. Macs. Even Sony's use of the term OPEN-R to describe some of AIBO's technology begs to agree that this should be an open system architecture. Yet it is this very OPEN-R software that Sony wishes to keep private.

While I believe the PC's dominance over Macs is due to other factors, I do see a parallel in the Apple II era that is quite similar to what is going on here. Before computers had hard drives, they had to be booted from floppy disks (don't even ask what we did before floppies).

For a floppy disk to be "bootable," it had to have system software on it. This Disk Operating System, or DOS, was proprietary software written by, owned by, and copyrighted by Apple Computer.

As commercial software for the Apple II began to appear on floppy disk, many publishers included DOS so that the user could boot from the application disk and then go right into their program without changing disks. Otherwise, a user would have to boot with a system disk and then physically swap in the program disk to continue. Or he would need to place DOS onto a copy of the program disk. Publishers may have included DOS simply as a convenience to the end user, but they were clearly violating Apple's copyrights when they did so.

At first, Apple did not appear very concerned about this infringement. After all, Apple's DOS could only be used by purchasers of their own hardware. When Apple II clones began to appear however, this issue became more important — not to mention the other violations posed by the copied hardware. For a while, Apple tried to license DOS for a fee, but I don't know how many publishers actually paid up. Dual floppy drives and eventually hard disks rendered this issue moot. In today's world, we all know how vehemently Microsoft tries to protect its flagship OS product, Windows.

No one denies Sony's right to protect its assets under copyright law and the Digital Millennium Copyright Act (DMCA). And there is no question that Sony is diligent in protecting its copyrights — all AIBO software comes with a separate 100-page booklet just to spell out the End User License Agreement! Okay, the English portion is only 12 pages.

Nevertheless, the Agreement specifically states that, "You may not distribute the Software to other computers over any information network (expressly including the Internet ..." Furthermore, it continues, "You may not modify, reverse engineer, decompile, or disassemble." This is standard legal stuff and must be clearly posted to preserve one's legal rights.

But the primary goal of such an agreement is to prevent illegal copying of such software. In spirit, the idea is to not deprive the copyright owner of any revenues to which it is entitled. Purchasing the software and then giving a copy to someone else, or even making copies to use in more than one AIBO would clearly be illegal. It is only legal to make a backup copy for your own protection.

While AiboPet was clearly in violation of the literal provisions, no one would deny his adherence to the spirit of the law. Because Sony AIBOware is supplied on uniquely prepared Memory Sticks, just posting the unprotected contents of a stick is not tantamount to giving away a usable copy of the program. More importantly, it is doubtful that Sony lost much, if any, revenue due to the AiboPet website. In fact, some of the coolest software for AIBO came directly from AiboPet and probably helped sell many AIBOs. Even Sony itself recognized this fact by awarding the top prize in its San Francisco Best-of-

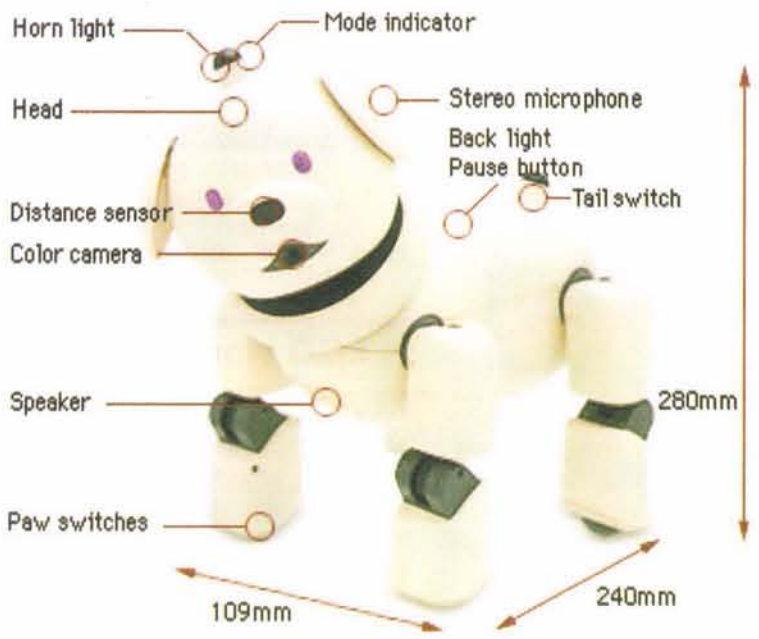

Figure 3. Location of various parts on the LM series.

Show contest to a routine created using AiboPet's software. In short, to most of us, he was the good guy.

As we say online ... <end soapbox>. By the time you read this, the situation may have changed. Many of us hope Sony will reach some agreement to allow AiboPet to resume sharing his AIBO development. For example, it may be possible for AiboPet to make his creations available as patches or scripts which require the original software (like adding DOS to a program disk).

However, this will just make his job more difficult, as well as all those who try to use it. It is also not clear, however, if the relationship has been irreparably damaged and whether AiboPet could ever be convinced to come back. If not, the entire AIBO community is the loser. Okay ... now <end soapbox>.

Meet Latte and Macaron

Amidst the AiboPet debate, Sony also released two new AIBO models, the ERS-311/312 also known as the LM series: LATTE and MACARON. While there are slight differences between the Japanese versions of these models, the US versions only differ in their color: LATTE is ivory while MACARON is gray. Although the 300 series AIBOs share some similarities with the older ERS-110/111 and 210 series, their physical appearance is radically different. Most importantly, the price has been slashed almost in half — an LM series AIBO should only run you about $850.00.

Developed by visual creator Katsura Moshino, the new AIBOs have a more rounded appearance designed to give them a "friendlier, more affectionate look." While they are cute — the face is especially endearing, despite non-functional stick-on eyes, nose, and mouth — they don't possess the degree of expression found in their older siblings. This can readily be seen from the comparison shown in Table 1. One improvement that I liked is the sound emitted by the new models. Instead of the rather harsh tonal melodies, the LM series emit softer and richer sounds — think tribbles instead of R2D2.

Like their predecessors, the LM series features three degrees of movement in each leg. The head also moves in three directions, with ears that dangle similar to the 110 series. There is a subtle difference in the head joint. Instead of giving it roll, pitch, and yaw, the LM head moves up and down using two separate joints — one just below and another just above the wide collar. The head also rotates left and right above the collar. This seems to work quite well with the larger, round head.

For interactivity, the LM series uses a joystick-like device as its tail that can be pressed left, right, forward, or back. There is also a sensor in the head. The main visual feedback comes from a "horn light" on top of AIBO's head. Using red, green, and blue LEDs within the frosted dome gives a wide range of colors that can be projected from the lamp. There is also a small LED just behind the horn light that indicates in which mode the robot is currently operating.

Stereo microphones and a speaker give AIBO its audio capabilities, much like the ERS-210. A series of internal sensors, as well as the 100,000 pixel CMOS image sensor round out the electronic components of the LM series. The locations of these are shown in Figure 3. Although they still have a built-in clock/calendar circuit, there did not seem to be any way to set this device without the optional Energy Station Core, which fits into the supplied stand.

On the other hand, setting the robot's speaker volume is now simply accomplished via a slide switch located near the battery compartment. One position completely mutes all sounds. Another switch marked RESERVED hints at future options.

LM Series Software

Like previous models, the LM series won't do much without an additional AIBOware Memory Stick installed. In conjunction with the initial release, LM versions of AIBO Life and AIBO Pal were available. AIBO Life lets the robot grow from baby to adult progressing through various stages similar to the ERS-210. AIBO Pal is the LM equivalent of Hello AIBO! and turns AIBO into a fully mature robot. Both programs let AIBO react to various greetings, praise and admonishment, and will take snapshots on command using its camera.

AIBO Pal also has a watchdog mode — simply say "Watch the house." — and AIBO will wave goodbye and then go to sleep. However, AIBO will wake up every 30 minutes and look around the room. If it sees anything moving, it will take a snapshot. When you return, tell AIBO, "I'm here" and then you can ask, "What happened?" AIBO will then nod yes or no to indicate if it took any pictures.

Of course, you have to remove the Memory Stick from AIBO and place it in your PC reader to view the images. Images are now saved as JPEG files instead of the former APH format. Since there is no slot for a wireless LAN card, programs such as Navigator and Messenger will not work on the LM series.

Media Link Mode

LATTE and MACARON were designed to interact with other AIBOs, as well as audio from devices such as a TV.

An animated television program starring a friendly LATTE and mischievous MACARON aired in Japan on the Fuji Television Network. Viewers with an LM series AIBO could place their pets into a special mode that would allow it to respond to aural cues from the program.

For this purpose, the software is able to determine in which model it is running to provide different behaviors for LATTE and MACARON.

Another new feature mentioned in the LM Series literature is called Sequence Choreography Capture. This would allow you to move AIBO's joints around and have it remember the motions and replay the sequence on command.

Unfortunately, there was no mention of this feature in the actual operating manual or in the AIBO Pal user's guide. Perhaps this feature will show up in future software offerings.

Figure 4. Preliminary photo of the ERS-220.

ERS-220

While the LM series lowered the bar for AIBO ownership, many are eagerly awaiting the next generation of improved functionality AIBOs. The ERS-220 is not this device; it is more of an incremental replacement for the 210.

Unfortunately, there was not much information available on the 220 at press time. Figure 4 shows what the new model should look like; the major difference is a new retractable spot light in the head (presumably to help the camera in low-light situations).

Gone, however, are the moveable ears (actually THERE ARE NO EARS!) and tail.

They will be missed, in my opinion. **NV**

Table 1.

AIBO SERIES COMPARISON CHART

	ERS-110/111	ERS-210	ERS-310/311	ERS-220
Number of joints	16	17	13	14
Degrees of freedom	18	20	15	16
Typical voice commands	0	50	75	75
Number of LEDs	0	9	4	19
Touch sensors	0	7	6	6
Infrared distance sensor	YES	YES	YES	YES
Acceleration sensor	YES	YES	YES	YES
Vibration sensor	NO	YES	YES	YES
Inclination sensor	NO	NO	YES	NO
Temperature sensor	YES	YES	NO	YES
Wireless LAN option	NO	YES	NO	YES

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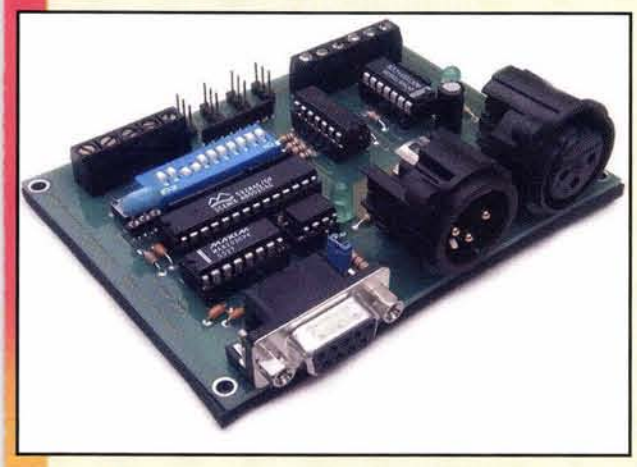

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Price is 65 UK pounds (approximately $95.00) and can be ordered directly from Milford Instruments in the UK – shipping is typically $15.00 to the US – and a full data sheet can be downloaded from www.milinst.com.

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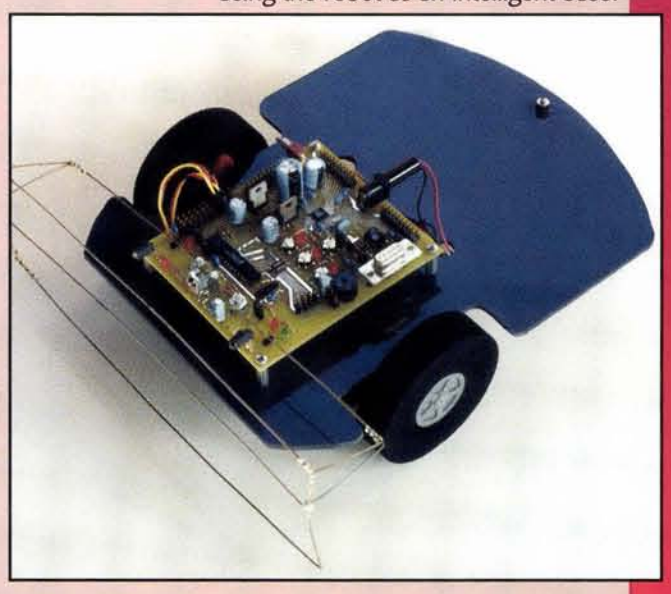

Although designed in a traditional runabout style, the new robot has some important differences when compared to other available products. The first and most dramatic departure is the fact that, while it comes full-featured and pre-assembled, it costs less than most kits.

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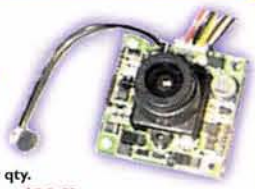

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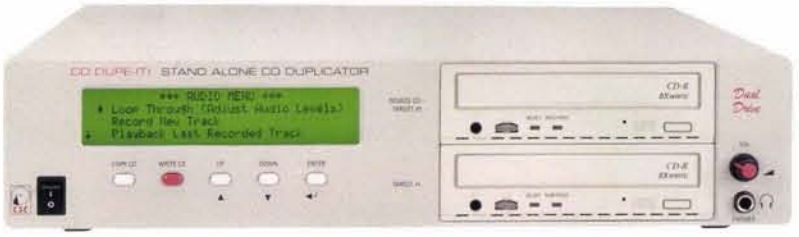

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BOE-BOT

Order online 24-hours a day at www.parallaxinc.com

The Boe-Bot is an ideal Christmas gift for people of all ages. If you can put small parts into a breadboard and type our PBASIC commands into the editor, you're quickly on the way to learning about robotics using one of the most popular technology education products available today: the Parallax Boe-Bot.

Our Boe-Bot Full Kit includes everything you'll need to get going: a BASIC Stamp 2, Board of Education, BASIC Stamp Manual, the 192-page Robotics! Text, all robot hardware including wheels, screws and standoffs, and electronic components necessary to run the Robotics! projects. You'll need a PC to load programs into the BASIC Stamp.

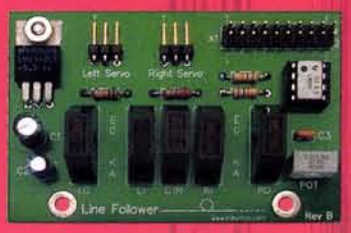
After an hour of robot construction, you'll start by making the robot move in all directions by writing PBASIC code for the BASIC Stamp. You'll quickly progress towards input-oriented projects with bumper switches, infrared object detection and photoresistors. The educational text introduces motor control, code structure and mechanical/electrical problem solving. Circuits are shown in schematic and pictorial format to achieve success.

When you're done with the projects in the text, you can add your own to the numerous mounting holes and slots on the Boe-Bot's board and chassis.

Boe-Bot Full Kit ($219 - #28132)
Everything you'd imagine is included in one great kit that's shipped in a nice plastic box! Carefully designed hardware fits together in a very functional fashion. The aluminum chassis can be painted the color of your choice.

PARALLAX

Order online at www.parallaxinc.com or call toll-free in the US, 888-512-1024.



Line Follower (#29115 - $49)
The Line Follower module attaches to the bottom of your Boe-Bot using the included standoffs and screws. The cable connects the module to the Board of Education on top of the robot. The module uses five infrared sensors so the Boe-Bot can follow a line on the floor. This module can also be used to learn proportional control so the robot moves quick on straight-aways and slows through the corners!

A fun and easy addition to your Boe-Bot!

Compass AppMod
($79 - #29113)
Don't know where to take your project next? The Compass Module can give your application direction. Why spend an arm and a leg to buy a GPS unit and then invest a ton of time writing software to interface to it? Thanks to this handy little sensor from Dinsmore Instruments, our Compass AppMod provides a low cost, direct interface, direction sensor that is perfect for many applications, particularly Boe-Bots. Additionally, we added a co-processor to make the module as useful and as easy to use as it can be. Eight directions are depicted with 4 LEDs and a simple serial interface with the BASIC Stamp provides directional feedback. All Parallax AppMods plug into our Board of Education as well as our BASIC Stamp Activity Board.

Circle 154 on Reader Service Card.

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