

CircuitMaker 2000™

the virtual electronics lab™

CircuitMaker 2000 lets you quickly and easily capture, model and prototype your designs with the integration of schematic entry, mixed mode simulation, and now included as standard - PCB design, editing, and autorouting, all in a single box.

Service Pack **1**

now available for
FREE DOWNLOAD
from www.circuitmaker.com

Intuitive schematic entry

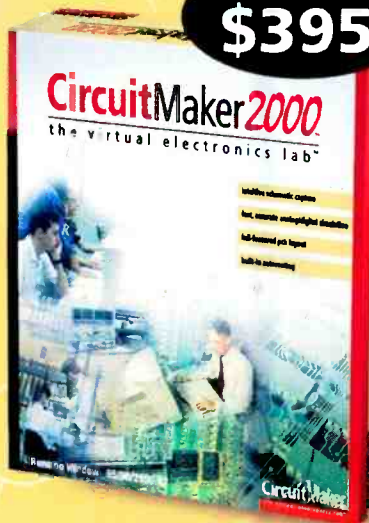
Fast, accurate mixed-mode simulation

Powerful circuit analyses

PCB layout & autorouting

FREE CircuitMaker 2000 Trial Version and product brochure available.

Visit www.circuitmaker.com
or call your local CircuitMaker Sales & Support
Center on **800 419-4242**



From
\$395*

CIRCLE 133 ON FREE INFORMATION CARD

*\$395 for CircuitMaker 2000 Standard Edition, \$995 for CircuitMaker 2000 Professional Edition
CircuitMaker is a registered trademark of Protel International Limited. CircuitMaker 2000 and the virtual electronics lab are trademarks of Protel International Limited.

www.americanradiohistory.com

Poptronics®

THE MAGAZINE FOR THE HANDS-ON ELECTRONICS ACTIVIST!

FEATURES

THE LASER CLINICSkip Campisi 31
How to play with that surplus laser without damaging it...or yourself!

COMPUTING WITH LIGHTKenny A. Chaffin 25
In development since the early 1960s, optical computers have made great strides toward practical applications.

HOW I'VE TRIED TO REMAIN COMPUTER ILLITERATELaona Gale Knighton 40
Tips on controlling a modern family while dealing with the "electronic beast."

PRODUCT REVIEWS

GIZMO® 15
Home-theater speakers, portable CD burner, all-in-one remote control, digital-music player, PDA, light pen, image scanner, and more.

DEPARTMENTS

COMPUTER BITSTed Needleman 5
Are e-books finally poised to become the "wave of the future?"

PEAK COMPUTINGTed Needleman 7
Got an older laptop that's getting a bit "long in the tooth?" Upgrading selected bits and pieces might be easier than you think!

PROTOTYPE 10
Airborne laboratory, "smart" batteries and related power-storage technologies, new plastics, engine tester, and more.

NET WATCHChris La Morte 19
Network-borne computer "diseases."

SURVEYING THE DIGITAL DOMAIN.....Reid Goldsborough 21
Searching for search engines to search the Web for the best Web sites.

Q&ADean Huster 43
Improving clock-radio reception, crafting IC Sockets, working with phase splitters, and more.

AMAZING SCIENCEJohn Iovine 47
Buying parts, cutting metal, and actually building two different types of fuel cells.

SERVICE CLINICSam Goldwasser 50
The grand wrap-up on the VCR saga!

BASIC CIRCUITRYCharles Rakes 57
Position-sensing and power-supply circuits for toy...er..."model" trains.

AND MORE

EDITORIAL 2

LETTERS 3

YESTERDAY'S NEWS 4

NEW LITERATURE..... 54

NEW GEAR..... 55

POPTRONICS SHOPPER 61

ADVERTISING INDEX 88

FREE INFORMATION CARD 88A

Poptronics (ISSN 1526-3681) Published monthly by Gernsback Publications, Inc. 275-G Marcus Blvd., Hauppauge, NY 11788. Second-Class postage paid at Hauppauge, NY and at additional mailing offices. One-year, twelve issues, subscription rate U.S. and possessions \$24.99, Canada \$33.15 (includes G.S.T. Canadian Goods and Services Tax Registration No. R125166280), all other countries \$33.99. Subscription orders payable in U.S. funds only; International Postal Money Order or check drawn on a U.S. bank. U.S. single copy price \$4.99. Copyright 2001 by Gernsback Publications, Inc. All rights reserved. Hands-on Electronics and Gizmo trademarks are registered in U.S. and Canada by Gernsback Publications, Inc. Poptronics trademark is registered in U.S. and Canada by Poptronix, Inc. and is licensed to Gernsback Publications, Inc. Printed in U.S.A. Postmaster: Please send address changes to Poptronics, Subscription Dept., P.O. Box 459, Mount Morris, IL 61054-7629

A stamped self-addressed envelope must accompany all submitted manuscripts and/or artwork or photographs if their return is desired should they be rejected. We disclaim any responsibility for the loss or damage of manuscripts and/or artwork or photographs while in our possession or otherwise.

As a service to readers, Poptronics publishes available plans or information relating to newsworthy products, techniques, and scientific and technological developments. Because of possible variances in the quality and condition of materials and workmanship used by readers, Poptronics disclaims any responsibility for the safe and proper functioning of reader-built projects based upon or from plans or information published in this magazine.

Larry Steckler, EHF, CET,
editor-in-chief and publisher

EDITORIAL DEPARTMENT

Joseph Suda, managing editor
Chris La Morte, associate editor
Evelyn Rose, assistant editor

CONTRIBUTING EDITORS

Dean Huster
Reid Goldsborough
Sam Goldwasser
John Iovine
Gordon McComb
Ted Needleman
Charles D. Rakes
Teri Scaduto

PRODUCTION DEPARTMENT

Ken Coren, production director
Kathy Campbell, production manager
Michele L. Musé, prepress specialist

ART DEPARTMENT

Russell C. Truelson, art director
Michele L. Musé, graphic artist

CIRCULATION DEPARTMENT

Gina Giuliano, circulation manager

REPRINT DEPARTMENT

Maria Menichetti, Reprint Bookstore x235

BUSINESS AND EDITORIAL OFFICES

Gernsback Publications, Inc.
275-G Marcus Blvd.
Hauppauge, NY 11788
631-592-6720
Fax: 631-592-6723

President: Larry Steckler
Vice-President: Adria Coren
Vice-President: Ken Coren

SUBSCRIPTION CUSTOMER SERVICE/ ORDER ENTRY

800-827-0383
7:30 AM - 8:30 PM EST

Advertising Sales Offices
listed on page 88

Cover by Michele Lyn Musé
Cover illustration by Amy Coet

VISIT US ON THE INTERNET AT:
www.gernsback.com

Since some of the equipment and circuitry described in POPTRONICS may relate to or be covered by U.S. patents, POPTRONICS disclaims any liability for the infringement of such patents by the making, using, or selling of such equipment or circuitry, and suggests that anyone interested in such projects consult a patent attorney.

<mailto:popeditor@gernsback.com>

“We Interrupt This Broadcast...”

“Ladies and gentlemen, it has been an honor and a pleasure to share my humble services and visions with each and every one of you. I'd like to think that I did my best to keep the spirit of Hugo Gernsback alive within these pages. I trust that my replacement will follow suit.”—From “End of The Trail,” by Joseph Suda, Managing Editor/ghostwriter

So it was, that Christopher La Morte was promoted to managing editor (or as he prefers to think, *Editor-at-Large*). From this point on, under the guidance of Editor-in-Chief Larry Steckler and with the *massive* support of a competent crew of professionals, this “newbie” is going to try to make a difference.

“Never one to filibuster, I'll save the introduction. Credentials are available upon request; and all questions, comments, and criticism are welcome. Be advised: Due to a sour stomach, I can only eat six pounds of crow a day.”—From La Morte's “Yargh!”

Now Back To Our Show (Already In Progress)

This month, we feature Skip Campisi, Kenny A. Chaffin, and Laona Gale Knighton—all three writers shed some light on current technologies.

Campisi and Chaffin delve into the world of optics. For the last forty years or so, advances in the study of optics have allowed mankind to master light—to some extent. Now you can read about the application of lasers in optical computers, as well as experiment with your own laser projects.

Knighton shows us how a computer moves into a household and takes over the family—sort of. This essay explains how young and old alike are becoming dependent upon a tool that was once used only by the “larger-than-average frontal lobe-set.”

Enjoy!



Christopher La Morte
Managing Editor

LETTERS

mailto: letters@gernsback.com

When Is A Standard Not A Standard?

I thoroughly enjoyed Thomas Gould's article, "A Colorburst-Based Frequency Standard" (**Poptronics**, September 2000). He demonstrated a PLL technique that is interesting, elegant, and potentially useful for a number of applications.

However, as a frequency standard his "reference" is practically worthless. Due to the nearly universal use of frame synchronizers, the frequency that his unit produces will be no more accurate than the frequency standard of the received station's sync generator. This signal might be accurate to one part in 10^6 , but it is a far cry from the one part in 10^9 that one would expect from a typical rubidium standard.

I realize Mr. Gould has made no claims for rubidium-standard accuracy, but if he believes that 10 Hz out of 3.579545 MHz (roughly 2.79 parts per 10^6) is high accuracy, he does not understand what "high accuracy" means.

JOSEPH D. RICHMOND
Foppa, MD

And The Answer Is . . .

I tried to be clear regarding the accuracy of the reference obtained from using the oscillator. As you correctly state and as I also stated in the article, the FCC requires the accuracy of the color burst on over-the-air broadcasts to be $3.579545 \text{ MHz} \pm 10 \text{ Hz}$.

The reference obtained was never implied to be as accurate as a typical rubidium standard. Accuracy is a relative term, and most electronics hobbyists do not have any frequency standards available to calibrate their frequency counters. This unit provided a low-cost, simple way to see if their counter is within the accuracy range provided by an over-the-air TV signal. As in any project one may build, the end user must determine whether the project would meet his or her requirements. Thank you for taking the time to express your opinion.

THOMAS GOULD

KEEP IN TOUCH

Letters
Poptronics
275-G Marcus Blvd.
Hauppauge, NY 11788

Sending letters to our subscription address instead of our editorial offices above increases the time it takes to respond, as the mail is forwarded.

Our e-mail address can be found at the top of the column.

Of course, e-mail is fast.

All of our columnists can be reached through the e-mail addresses at the head of each column.

And don't forget to visit our Web site: www.gernsback.com.

Surprise

The April issue has pages 42 to 48 upside down! After looking at it a while, I finally figured out how it can be read!! I also saw, afterwards, that you had a P.S. in your editorial about this.

In addition, I saw the point that Dean Huster made in his first answer in "Q&A." He said **Poptronics** and *Nuts & Volts* are the only two electronics hobby magazines in the whole USA!! Is that true? That's really amazing, if so! After all, there's far more electronics parts dealers now than ever before.

While on the subject of electronics hobby projects, how about a telephone box that passes only selected phone numbers and rejects all others? Since there's "telephone caller ID" boxes, there must be a way to do this too.

MOSES BERNARD, JR.
N. Las Vegas, NV

Mr. Bernard has been a loyal subscriber and letter writer to this magazine and its predecessors for many years. We look forward to and enjoy his monthly epistles.—Editor

Have & Needs

I am looking for ARC-5 receivers. I would like about fifty units, preferably in original condition, but any would be considered.

JOHN BROUSSARD
312 Guilbeau
Breaux Bridge, LA 70517

Personal Oscilloscope

20 MSa/s Pen-Type Oscilloscope
stand-alone or connects
to your PC

ChipCenter
Product of the Year
2000
TEST & MEASUREMENT



world-wide smallest portable oscilloscope
Made in Germany

Pen-Type Oscilloscope V5.0 2000,
supplied items: PC-Software with
Operator's Manual on 3.5" disk, Serial
PC-Interface cable (6ft), External Trigger
Cable with clip, Ground Cable with clip,
External Power Cable
with Alligator clips **US\$ 99.99**



Software MS-DOS/Windows 3.1/95/98 compatible

Palm Software includes 6ft Serial Cable
US\$ 8.99 (Option), for Palm OS 3.5

Battery PowerPack includes two AA-size
batteries US\$ 9.99 (Option) up to 8h
continuous operation, typical alkaline

Add shipment and handling cost total
US\$ 9.99. Delivered by Express Service
within 5 days, anywhere in the U.S. and
Canada.

Developed by Wittig Technologies AG
Sales (516) 794 4080 or Toll-Free (800) 247 1241
Fax (516) 794 1855
sales@wittigtechnologies.com

Technical Support available by e-mail or fax, only.
support@wittigtechnologies.com

All trademarks belong to their respective owners.

 **Wittig Technologies**
www.wittigtechnologies.com

CIRCLE 141 ON FREE INFORMATION CARD



YESTERDAY'S NEWS

A PEEK INTO THE GERNSBACK ARCHIVES



Dateline: June 1941 (60 years ago)

Flight is an illustration-intensive monthly, which highlights technologies relevant to aircraft, air armament, and air defense. Every issue of this classic magazine contains technical data and dozens of detailed drawings pertaining to the role of aircraft in the war—Allied and Axis powers alike. (*Flight* ran until September 1941—two months before the United States of America officially entered World War II.)

1900

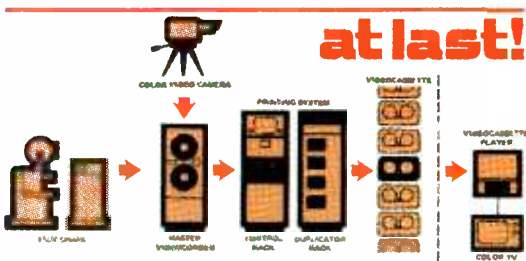
1910

1930

1941

1950

1960



at last!

**HOME VIDEO RECORDING
—or is it?**

1971

Dateline: June 1971 (30 years ago)

Radio-Electronics features an article ("At Last! Home Video Recording") that predicts the availability of affordable VCRs and a boom in videotape sales. Other features in the magazine include a "how-to" on repairing electro-static air cleaners, as well as an informative piece on preventive maintenance of tape cassettes. (In 1971, a typical VTR and camera set-up could cost \$1500—almost half the price of a new car. Today, a decent camcorder can be purchased for less than \$500, and some stand-alone decks cost only \$50.)

1980

Dateline: June 1981 (20 years ago)

Once again, **Radio-Electronics** shows its readers the latest in home-brewed technology. Readers can examine the plans for building a 300-baud acoustic modem, the inner workings of a twelve-inch videodisc player, and samples of voice-recognition circuits. The "Hi-Fi Stereo" column introduces Sony's MDR-7—one of the first truly lightweight headphone units (*The headset would set the stage for the Walkman rage.*)

1981

1990

2000

Radio-Electronics

CIRCUITS WITH EARS — THEY LISTEN AND OBEY

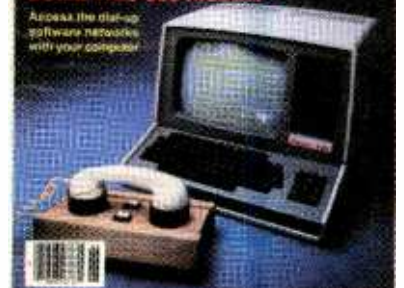
01.31 JUNE 1981

Build a versatile flight computer
Inside the RCA videodisc player
Semi-state devices for 100 kHz

Rating circuitry performance
Adding sensors to your robot
Sag's unique new headsets

BUILD THIS \$60 MODEM

Access the dial-up software networks with your computer



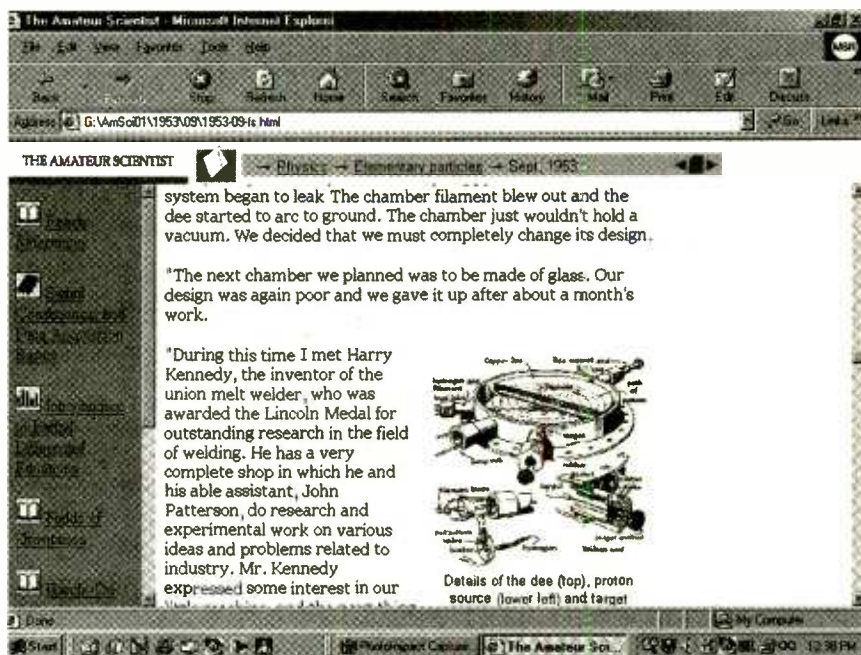
Anyone Up For Building A Cyclotron?

While it may be a strange thing for a self-admitted computer geek to proclaim, I'm really not a big fan of electronic books. These seem to be a coming thing, with e-book readers like the one from RCA and software-based readers from both Adobe Systems and Microsoft.

At the risk of sounding like a Luddite, I admit to preferring the feel and smell of paper when I'm reading, especially when I'm reading for pleasure. Another strike against the current trends in e-publishing, at least in my mind, is the cost. I could probably get one on loan, but if it's coming out of my pocket, there's little chance that I'd spend \$299 on an electronic reader. Because of that, I cannot, in good conscience, recommend that you spend that amount, either.

The "bottom line" is that there's no compelling economic reason to go the electronic route. One quick visit to the e-books section of www.barnesandnoble.com or www.amazon.com will show you that while there are a large number of books now becoming available in electronic format, they are usually priced exactly the same as their paper versions.

That makes sense in a way. After all, you are receiving the same intellectual product regardless of the form factor. At the same time, the expenses of publishing in paper and electronic formats are vastly different. All the up-front work and costs are the same—acquisition of the manuscript, advances on royalties, editing, layout, and illustra-



Want to build a cyclotron? Here are the instructions in a Scientific American column from 1959.

tion. After that, though, things become very different.

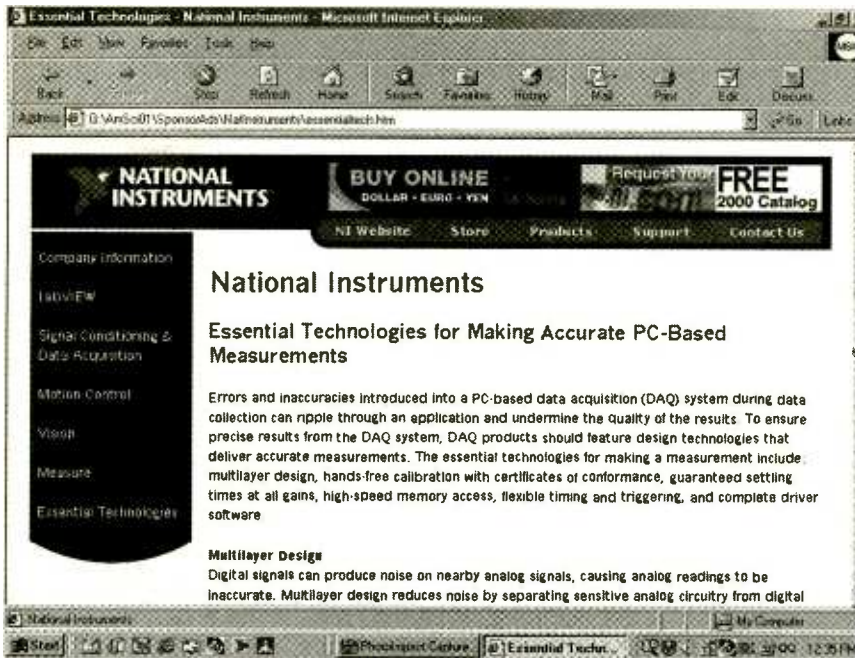
With paper-based publishing, there are then final pages, usually called "bluelines" (due to their color—they come directly from the film-based image that will create the actual printing plate). When everything is satisfactory, pages are printed, assembled, bound, packaged, and delivered to bookstores to be sold.

With e-publishing, the "book" is formatted in special software and uploaded to a server. It's quicker, substantially less expensive, and no trees are killed in the process.

THERE AIN'T NO SUCH THING AS A FREE...

Since publishing electronically is so easy—at least in comparison to paper-based publishing—you might wonder why there aren't more authors and publishers taking advantage of the medium.

Actually, more and more authors are experimenting with self-publishing. The most visible of those "early adopters" was Stephen King, who started publishing his last book on the Web, selling several chapters at a time. At the time this is being written, that endeavor seems to have been suspended, leaving the novel unfinished—at least to Web subscribers.



Along with the columns, the CD contains additional material, such as this National Instruments white paper on making detailed measurements with PC-based instruments.

Science-fiction publisher Jim Baen is trying something a bit different with his Baen Books. Several of Baen's authors have agreed to put some of their older works up on Baen's Web site (www.baen.com). Those "tales of yesteryear" can be downloaded for free, with the hope that you'll discover a new author whose work you like and will then run over to the bookstore to stock up on the rest of those

authors' titles. Baen has also started a new subscription service where readers get "first dibs" on new books coming out, downloading chapters over the Web months before the books hit the stores (and, incidentally, saving money over the paper-based versions, as well!)

Considering that Hugo Gernsback, the founder of this magazine's predecessors, was also a science-fiction

author and publisher (this year is the 75th anniversary of **Amazing Stories**, as was reported in the April issue), it doesn't surprise me that one of the more innovative approaches to electronic publishing comes from Baen. Of course, you'll still need to download the book (or read it on-line). Baen offers each free title in several formats and has links to reader software if you don't want to use rich-text format (RTF) or HTML.

SOMETHING A BIT DIFFERENT

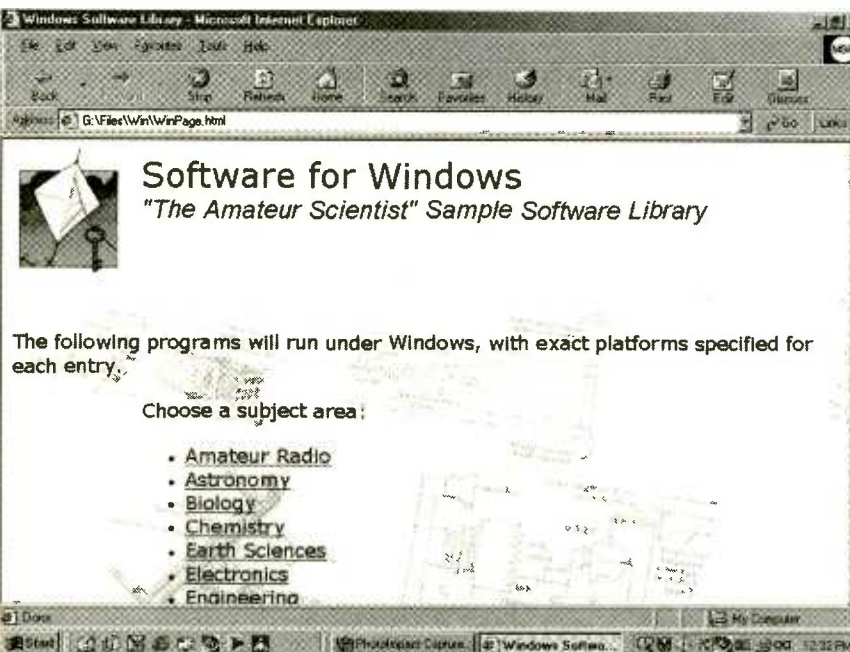
As much as I appreciate Baen's approach, I think the real potential for electronic publishing lies in the specialty titles. These are works with a limited audience. Right now, the trade-press publishers are the primary source of these specialty books. The problem is that while publishers limit their costs by producing only a few thousand books per print run, all of the other costs associated with the publishing process remain the same. What winds up happening is that the publisher has to price the book very high and, in many cases, loses money on the title anyway.

With the affordable, yet extremely powerful, tools now available for converting text into international-standards-based HTML pages or PDF (Adobe's proprietary portable-document file) format, publishing electronically is easier than ever. In fact, the most expensive and time-consuming parts of the process are the initial acquisition of the material and the editing required to make it readable.

Once the material is in a readable file format, the big problem is how to get the reader to pay for it. Some authors have tried subscription services over the Web. The approach that's been most successful, however, is publishing on CD-ROM.

The first real success with this approach was over a decade ago, when the 70s' classic *Whole Earth Catalog* was published on CD-ROM. There really haven't been a lot of other successes along the way, but that should change, given how easy it now is to burn

(Continued on page 46)



New Life for Older Laptops

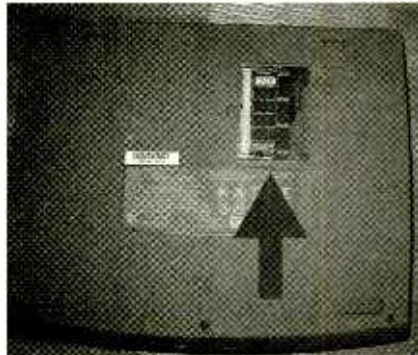
Recently, a friend of mine asked whether he should buy a new laptop or if it made more sense to try and upgrade the one he already had. When he first purchased it, the Compaq Presario was the top of the line, with a 166-MHz Pentium MMX CPU and an 11-inch color active-matrix LCD. With only 32 MB of RAM and a 2-GB hard disk (already an upgrade from the original 540-MB drive), the laptop was losing its charm. He was looking somewhat enviously at newer models, but was a bit loath to spend the \$1500 to \$2000 that even a moderately-equipped entry-level laptop runs these days.

DON'T FLIP THAT COIN

The decision whether to upgrade an older laptop or just throw in the towel and buy a new one isn't really a matter of guesswork. On the other hand, it isn't entirely a matter of dollars and cents. Rather, it requires that you analyze exactly what you use the laptop for, how well (or poorly) the current configuration serves, just what will be gained from each upgrade, and how much each alternative will cost.

Put the results of that analysis into a simple matrix or table, and you'll have a really handy tool to help with your decision.

Laptops are, by their basic design, more difficult to upgrade than desktops—at least internally. That doesn't mean that they can't be upgraded, but it does limit what you can do. For example, you are stuck with the display that your laptop has unless you plug in an external monitor. I have no doubt that there are some **Poptronics** readers



Upgrading the RAM was a simple matter of plugging a SODIMM into this socket.

capable of interfacing a 15-inch LCD in place of an existing 11-inch panel. However, the cost of that 15-inch panel, as well as the level of expertise required to perform the upgrade (and retrofit the laptop case), takes almost all of us out of consideration.

The same is true for the keyboard. You can always plug in a full-size keyboard (or one of the available numeric keypads) using the PS/2 connector that most laptops offer. However, you are, again, going to be stuck with the bundled keyboard.

PUMP IT UP!

That being said, there are three areas that lend themselves to upgrades. One is the operating-system software. I'm not going to argue the merits of alternative operating systems, such as Linux. There's simply not enough room in this column. Moving up from Windows 3.X—or for that matter, Windows 95/98—to WindowsME usually does improve application performance. The downside, however, is that newer versions of Windows also require more

resources, in the way of memory and disk space, than the older versions. Fortunately, those are the two areas that are easiest to upgrade on most laptops.

I had already upgraded the hard drive on my friend's Presario once, so I knew the drill. Before doing anything, we sat down and looked at what it would cost to perform upgrades of both the RAM and the hard drive.

This particular system was used primarily for word processing, creating and giving PowerPoint presentations, and surfing the Web. The 166-MHz Pentium CPU didn't deliver blistering performance in any of those applications, but my friend also had a much newer desktop for applications where performance was a factor.

After looking at what the upgrades would cost, we decided to go all the way: bump up the RAM from 32 MB to 96 MB, upgrade to WindowsME, and replace the hard drive with a 20-GB model. The total cost for that set of upgrades was just under \$1000. That's a lot to spend on a laptop that's several years old. On the other hand, the large amount of RAM and hard disk space, which my friend considered necessary for his needs, would have put him in a \$2000 laptop had he decided to simply replace the older unit.

Laptop memory is generally an easy upgrade, at least if your laptop is not more than four or five years old. Before that, vendors used a whole variety of proprietary modules. Newer laptop models use a type of module called a SODIMM, or small-outline DIMM (dual-inline memory module). You can find out



Kingston's StrataDrive Plus comes with a PC-Card interface, letting you transfer the operating system and applications to the new drive without strain or pain.

if those devices are available for your laptop model with a quick visit to the Web sites of the major memory suppliers, such as Kingston Technology (www.kingston.com) or PNY (www.pny.com). Both vendors have lookup facilities that will help you find the right part number. Memory-module prices vary, but computer stores frequently put the modules on sale, with 64 MB selling for as little as \$50 or so.

On the Presario, we opted for a Kingston module. A small door on the laptop's bottom panel comes off, and there's a socket for the SODIMM. We simply popped it in, and the Presario's BIOS recognized the new amount of RAM. The total time for this upgrade was under five minutes.

We also opted to go with Kingston Technology for the hard drive upgrade. You can find "raw" laptop hard drives at numerous Web sites and computer stores. The problem with those units is that it's really difficult to get all of the applications and data files transferred.

There are about a half dozen companies offering upgrade kits that include an interface to use to transfer the operating system and all of your files to the new hard drive before you install it in the laptop. A few of these vendors include Apricorn (www.apricorn.com), Simple Technologies (www.simpletech.com), and the aforementioned Kingston Technology.

I've had good luck with all of those vendors. In fact, the 2-GB hard drive that was already in the

Presario was an Apricorn EZ-GIG upgrade, performed several years earlier. For this upgrade, however, we chose the Kingston Strata-Drive Plus. This comes in various sizes, and the 20-GB model we used costs about \$900 or so, depending upon where you buy it.

The StrataDrive Plus kit comes in a conductive plastic bag that turns into a static-draining wrist strap. The actual kit contains the 2.5-inch form-factor drive, a PC-Card interface with a connecting cable for the drive, and software. To upgrade the old drive, simply run the StrataMove software, and insert the PC Card into a PCMCIA slot when prompted. The software formats the new hard drive, and then moves the operating system, files, and applications over. It also expands the drive partition to encompass the size of the new drive. Finally, if the BIOS does not support large drives, it installs a utility that allows larger drives to be used with an older BIOS.

Once that process is finished—about 25 minutes on our system—you disconnect the cable from the drive, shut the system down, open it up, remove the old drive, and install the new one. Kingston provides instructions for a variety of different systems. On the Presario, the keyboard lifts up to provide access to the drive. The physical part of

the upgrade added about 15 minutes to the process.

We left the WindowsME upgrade for last. If you will be upgrading the hard drive, you may want to perform this upgrade first, depending upon what file system is installed on the current drive. My friend had already upgraded to Windows 95 previously, so the hard drive already had the more efficient FAT32 file system. If he had been running FAT16, we would have performed the Windows update before upgrading the hard disk.

The total time to upgrade all three areas was about an hour and a half, with the greatest portion spent in performing the upgrade to WindowsME. My friend is delighted, since his applications do run noticeably faster with the additional memory; and the 20 GB of disk space gives him plenty of room.

At almost a thousand dollars, this particular upgrade was just marginally justifiable from an economic point of view. However, RAM upgrades almost always make sense, and smaller hard drive upgrades are a lot more affordable than the 20-GB drive we selected. So don't be afraid to pour some upgrade money into that older laptop if it will buy you another year or two of use out of it.

P

VENDOR INFORMATION

Apricorn
12191 Kirkham Rd.
Poway, CA 92064
800-458-5448
www.apricorn.com

Kingston Technology
17600 Newhope St.
Fountain Valley, CA 92708
877-546-4788
www.kingston.com

PNY
299 Webro Rd.
Parsippany, NJ 07054
973-515-9700
www.pny.com

Simple Technologies
3001 Daimler St.
Santa Ana, CA 92705
949-476-1180
www.simpletech.com



MULTIMEDIA on the PC!

What is Multimedia? What can it do for you? What can it do lots of nice things! This 184-page book helps you create your own multimedia presentation. Multimedia applications by people like you can revolutionize educational and business applications as well bring more FUN, FUN, FUN into your leisure computer activities.

Mail coupon to:

Electronics Technology Today, Inc.
P.O. Box 240
Massapequa Park, NY 11762-0240

Please send me my copy of *Multimedia on the PC* (PCP120). I enclose a check or money order for \$18.45 to cover the book's cost and shipping-and-handling expenses. NY state residents must add local sales tax.

Name

Address

City State ZIP

All orders must be paid in U.S. funds only. Sorry, no orders accepted outside of USA and Canada. Please allow 6-8 weeks for delivery.

MA02

www.jameco.com

In a Jam?



The Products You Need... The Service You Deserve!™

1•800•831•4242

JAMECO[®]
ELECTRONICS

CIRCLE 139 ON FREE INFORMATION CARD

Business Buzz

LUNCHROOM ID

Three Pennsylvania school districts (Lower Merion, PennCambria, and Tussy Mountain) are using a fingerprint identification program that enables pupils to buy lunch—no cash needed. Students place their index fingers on small scanners, and a template matches 27 grid points with the electronic fingerprint's ridges. Since the fingerprint image is discarded and the points are assigned numbers, those numbers cannot be reinterpreted into a fingerprint image. Sagem Morpho Inc., Tacoma, WA, supplies the system, which costs between \$4000 and \$5000 per lunch line. It was developed to comply with federal law prohibiting schools from overtly identifying those receiving free and reduced-price lunches. Within the next year, fingerprint scanners will be available as optional equipment for mobile phones and personal computers.

WHERE'S THE BEEF?

Effective January 1, 2001, the Canadian cattle industry implemented a tracking system for beef to prevent potential problems such as outbreaks of mad cow disease. This technology developed by Toronto-based Antitech Information Systems involves tagging all cattle at birth with either a bar-coded or electronic tag and placing data-collection stations in meatpacking plants. Its ability to be linked to a packer's existing computer system allows data to be collected on individual animals in real time as they are being processed.

TV/INTERNET INTEGRATION

Starting in the second quarter of 2001, twenty families in Raleigh, NC are taking part in a six-month pilot program from Texas Instruments called the "Complete TV" project. The program gives the families a home-entertainment experience that combines broadcast High-Definition (HD) programming and Internet-based infotainment. They received a Panasonic large-screen, rear-projection HD home-entertainment system, which comes with both HD capability and PC interfaces to enable it to act as a multi-functional screen. The complete system includes a high-performance broadband "entertainment computer," integrated by RKR Video, Huntington Beach, CA. HD broadcasting will be provided by WRAL Digital—the first station to broadcast a digital signal and a full HDTV newscast in the US.

Flying Laboratory



NASA's DC-8 Flying Laboratory is a converted long-range jetliner that is now a world-class airborne scientific laboratory that can carry 30,000 pounds of scientific instruments and equipment along with scientists and experimenters.

For four months, a team of scientists from NASA and several research institutions conducted a comprehensive Earth-observing mission in the most volcanically active region in the world—the Pacific Rim. Called *Pacific Rim 2000* (PacRim II), the program collected data in more than 15 countries around the Pacific Ocean. Among the areas studied were Cambodia's Angkor Wat Temple, French Polynesia, Papua New Guinea, the Philippines, and the Australian coastal wetlands.

Science In The Air

Conducted by NASA's Earth Science Enterprise, the mission used the DC-8 Flying Laboratory from NASA's Dryden Flight Research Center at Edwards, CA. This highly modified aircraft carried a suite of precision instruments to document geographic and atmospheric factors throughout the Pacific Rim area.

NASA's DC-8 Flying Laboratory, a dash-72 version powered by four CFM-56 high-bypass turbofan engines, is a

former long-range jetliner that has been converted into a world-class airborne scientific laboratory. It can carry 30,000 pounds of scientific instruments and equipment along with scientists and experimenters, cruising at altitudes up to 42,000 feet. Its range is 5400 nautical miles, and it has a flight duration of up to 12 hours.

According to Ellen O'Leary, PacRim II mission coordinator at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, CA, the mission gathered geographic and atmospheric data for coastal analysis and oceanography, forestry, geology, hydrology, and archaeology.

Seeing In The Dark

The primary PacRim II instrument is the *Airborne Synthetic Aperture Radar* (AIRSAR). Designed and built by JPL, AIRSAR is NASA's radar technology testbed and is used to demonstrate technology for spaceborne radar missions. AIRSAR also collects data for Earth Science research purposes and is an all-

TYPE

weather imaging tool able to see through clouds and collect data at night. Radar's ability to collect data of the Earth's surface, even in cloud-covered regions such as the Pacific Rim, makes it a particularly valuable tool for tropical areas. The instrument's longer wavelengths can also penetrate into the forest canopy, providing scientists with data at different levels in the forest. The AIRSAR radar antenna panels are mounted on the outside of the aircraft and the instrument looks to the side of the flight path.

The radar transmits microwaves, and the return signal is collected after the Earth reflects it. Rough areas, such as cities, mountains and forests, have more surfaces from which the signal can reflect, and therefore return more of the radar signal to the antenna—appearing brighter on the resulting radar image. In contrast, smooth areas, such as deserts, roads and water surfaces, return less of the radar signal and appear darker on the radar images.

Three-Dimensional Images

In addition to collecting data about the roughness characteristics of the surface, AIRSAR can also collect data that is processed to high-resolution Digital Elevation Models (DEMs), which are three-dimensional topographic maps of the surface. A third type of AIRSAR data is used to measure motion of currents



This three-dimensional perspective view of the volcanic island of Manam in Papua New Guinea is an example of a dramatic image acquired by AIRSAR, NASA's Airborne Synthetic Aperture Radar. The volcano was in the midst of its largest eruption since 1992 when this image was taken. Two weeks later, the eruption intensified, killing several people and forcing the evacuation of thousands of others.

and waves. DEM data are particularly important to disaster managers around the Pacific Rim who are responsible for developing plans to mitigate and respond to natural hazards such as typhoons, earthquakes and volcanic eruptions.

Also onboard the DC-8 is the MASTER instrument, which is the MODIS/ASTER airborne simulator. The Moderate Resolution Imaging Spectroradiometer (MODIS) and the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) are two instruments on NASA's Earth Observing System (EOS) Terra satellite launched in December 1999. The MASTER instrument is used to obtain detailed maps of land surface temperature, emissions and reflectance.

PacRim II is the first mission to operate both the AIRSAR and MASTER instruments simultaneously on the DC-8. Combining AIRSAR and MASTER data collected over the same site could produce dramatic results. For example, MASTER data can be draped over digital elevation model data generated by AIRSAR, providing scientists with additional insight on how topography affects the vegetation and land surface temperature as seen in the MASTER data.

Currently, data from PacRim II is being analyzed and shared with the participating countries. **PT**

"Smart" Batteries Included

In today's vehicles, engines, transmissions, suspensions, brakes, and air conditioning are all electronically controlled. The one obvious exception is the battery. However, this is about to change with Smart Energy Management (SEM) technology developed by Canadian iQ Power Technology Inc., Vancouver, B.C., and its German subsidiary, iQ Battery Research & Development GmbH, Munich.

The "brains" of the iQ SEM system are Texas Instruments microcontrollers. The *smart* battery communicates with

Research Notes

THERE ARE SPRITES AMONG US

Magnetic field measurements of ghostly, high-altitude "sprites" were recently conducted by Martin Fuellekrug of Frankfurt University's Institute for Meteorology and Geophysics and Steven Cummer, assistant professor of electrical and computer engineering at Duke University. Sprites are faint, colorful, and exceedingly brief flashes that erupt just below the ionosphere—only scientifically documented in the past decade. Cummer's antenna studies analyzed low-frequency electromagnetic (EM) returns, showing unaccountable gaps in activity between bolts. He teamed up with Fuellekrug, who works with magnetic field sensors exceptionally sensitive to ultra-low EM frequencies. Applying mathematical modeling analysis, Cummer found continuing cloud-to-ground currents in one event that varied from about 4000 to 7000 amps over a period of about 150 milliseconds.

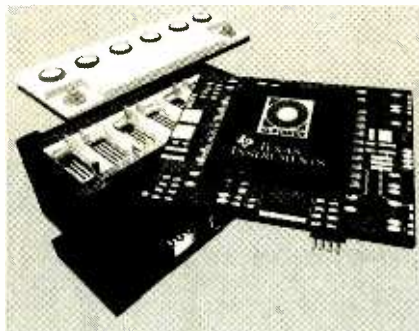
DONT ADJUST YOUR TV!

Scientists at the DoE's Los Alamos National Laboratory have developed a transmission algorithm that compresses a HDTV data stream for broadcast over the same channel as analog TV signals. The algorithm allows both new digital and old analog TV sets to receive a compatible signal without requiring two distinct signals on two separate channels to be simulcast. No converter is required, since an added software loop in the HDTV receivers recovers the digital information from the same channel. Since Congress has mandated HDTV broadcast television signals by 2006, this technology makes the transition easier.

IDAHO SOLID ELECTROLYTE

A team of chemists at the DoE's Idaho National Engineering and Environmental Laboratory (INEEL) has unveiled an award-winning lithium-battery solid electrolyte, which lasts about 50% longer than other electrolytes. The INEEL electrolyte is also safer and more environmentally friendly, since the waste products are essentially glass, phosphate, and nitrogen compounds. A mix of a liquid polymer and a ceramic powder that turns into a clear, non-toxic flexible membrane, it creates a stable scaffold. Liquid polymers weave through it like ribbons. Most importantly, this way of stabilizing the polymer interferes with lithium transport 20 times less than other stabilization methods.

Prototype



Seen here is a cross section of the iQ Power smart battery. The “brains” of the system are microcontrollers from Texas Instruments.

the vehicle’s onboard computer via the existing data bus or *Powerline* Communication (PLC), exchanging data with the alternator, other computerized systems, or the diagnosis systems. Extra wiring is not required because data is transmitted through the two battery terminals. The solid battery case is made of polypropylene foam (BASF) to protect against vibration, to better survive a crash, and to provide thermal insulation.

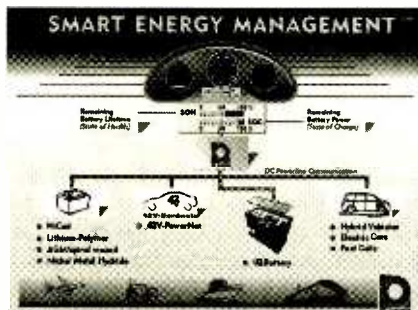
The microchip in the self-learning SEM system calculates the optimum operation for the battery, and then it electronically manages the battery to adjust for the driving conditions and driving profile of the individual car. The SEM system can keep the driver informed of the battery’s state of charge (SOC)—remaining power—and the state of health (SOH)—remaining battery life. In addition, the battery stores basic operating values for later diagnostics—in the same way that an aircraft’s flight data recorder does.

According to iQ CEO Peter Braun, their next-generation battery is lighter, smaller, more powerful, and longer lasting than other batteries on the market. While providing as much power as normal lead-acid batteries, the iQ battery weighs 40- to 50-percent less because it requires about 30-percent less lead. This is a real benefit in today’s weight-sensitive automotive designs.

iQ Power also asserts that there’s a 600 percent improvement in charging capacity with more current provided in a shorter time. Using SEM technology, the smart battery performs several energy management functions. For example, it controls the electrochemical processes

in the cells through a sophisticated mixing system that ensures an optimum acid concentration.

A temperature-control system and built-in electric heater supplies heat to stimulate the chemical processes inside the battery for easier cold starts. Sensors record the ambient and operating conditions including the internal and external temperature. At below-freezing temperatures, this means both reliable cold-starts and a doubling of battery life. The battery will start the engine reliably even in extreme temperatures of -40°C (-40°F). While it usually takes around an hour to recharge a conventional battery, the iQ battery is ready in just ten minutes. A dead battery recharges considerably faster when it is equipped with iQ technology. In just one hour, a 32-amp-hour (Ah) battery that is 57 percent charged recharges to 92 percent of its nominal capacity.



This poster illustrates how Smart Energy Management (SEM) technology would maintain and display the battery status on a dashboard—state of battery health and state of battery charge—in various types of batteries and/or vehicles.

While a normal 32-Ah battery has little chance of starting an engine at -25°C , the same battery using iQ technology easily starts the engine at that temperature. Indeed, its performance is even better than that of a normal 68-Ah battery, which is twice the size.

The iQ battery technology was developed for use in current lead-acid-battery production lines with only minor changes. The SEM technology can also be used with other battery chemistries including Lithium Polymer, Nickel Cadmium, or Nickel Metal Hydride. In addition, the performance of AGM/spiral-wound batteries can be increased significantly when equipped with iQ’s SEM

system. This technology can be used with 42-volt systems when they become available. Indeed, because of the iQ battery’s compact size, both the 12-volt and 36-volt batteries that will be initially used in 42-volt systems could be installed in a common casing, which would not take up more space than one of today’s batteries.

The world’s first “thinking” battery has been a collaborative effort. iQ Power has actively pursued industry feedback and participation. The company was invited to join the MIT/Industry Consortium on Advanced Automotive Electrical/Electronic Components and Systems. The Consortium is a cooperative effort between the Massachusetts Institute of Technology and such major automotive names as Audi, BMW, Daimler-Chrysler, Ford, General Motors, Toyota, and Volvo, as well as electronic-parts suppliers such as Delphi, Dow, Johnson Controls, Lear, Matsushita, Mitsubishi, Motorola, and Siemens.

Currently, 1500 iQ SEM system batteries are being tested by major auto manufacturers. Israeli battery-maker Schnapp and Co. will produce the world’s first microchip-controlled automotive batteries. Initially, these smart batteries will probably be exported to Europe. Check www.iqpower.com for the latest developments.—by Bill Siuru **PT**

Other Battery Research

The California Air Resources Board is maintaining their mandate for zero-emission vehicles, ZEV, (electric) to become a reality in 2003. Automobile and truck manufacturers are clamoring for practical, economic, and powerful batteries to fulfill their needs.

Over the past three years, inventor Alvin A. Snaper, who holds several hundred patents ranging from the IBM Selectric Ball to a Rocketdyne Fluidic Missile System, has been developing a battery to replace the lead-acid battery. It is intended for use in automobiles, trains, airplanes, and marine craft; and it’s also meant to power electric vehicles more effectively. Mr. Snaper and his team have developed the Power Technology battery with a unique elec-

Prototype

trode structure, which increases the electrochemically active surface area within the battery 1000 times. It is also lightweight, produces more charge, and recharges very quickly.

Power Technology's, Generation No. 2 has an internal battery structure, which, when coupled with the correct application of nickel and iron, will require half the size and half the charging time of a lead-acid battery to produce an equal number of watt-hours. In addition, it does not require thermal-management packages for high-output uses such as EVs.

This technology improves the use, ease, and efficiency of any battery-powered product, by using specially formulated reticulated foam plates and metallic pastes. Previous foam plating developed by competitors has proven too weak to support the battery's internal structure.

The company is in the process of developing commercial production. While Power Technology, Inc. is initially seeking to deliver an updated battery for the electric car, it can be used in boats, ships, and airplanes to reduce weight and increase power today. **PT**

A Mechanic, A Tinker, A Retiree, A Thinker

In his spare time, "tinkerer" Curtis Ford continues to work on KOOL CHEK, his patented automotive invention. KOOL CHEK is a thermostat and cooling system tester that can quickly and accurately pinpoint malfunctions in the cooling system of a liquid-cooled internal-combustion engine—especially in the engine's thermostat. The thermostat controls the engine temperature, and the correct engine temperature ensures efficient operation and protects air quality.

Clean air is a major problem worldwide. In many metropolitan areas, air quality is below the EPA standards—and motor vehicles are big factors. An accurate instrument that diagnoses an engine's cooling system can effectively "rebalance" the equation. KOOL CHEK can improve emissions monitoring and help motorists comply with *The Clean*

► Get A Grip

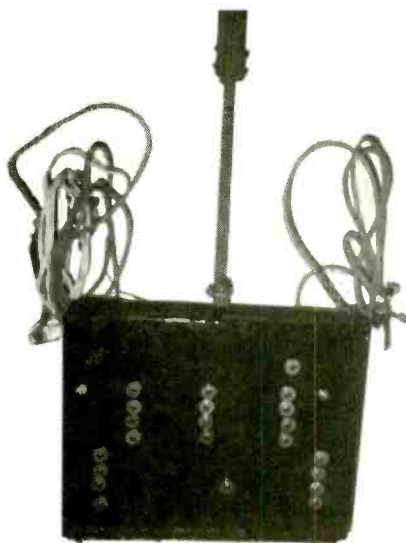
Advanced Elastomer Systems, L.P. (AES) recently introduced the B100 Series of ThermoPlastic Vulcanizates (TPV), announced as the first that bond to ABS copolymers, PolyCarbonate (PC), ABS/PC blends, PolyStyrene (PS), and other such materials. Santoprene, the initial developmental grade, enables designers, molders, and manufacturers to injection mold or extrude a soft TPV onto a variety of rigid substrates to produce a durable bond without adhesives. These soft type grips will help enhance user/product interaction.

The first application on the market is a handle grip on Oreck's new ergonomically designed upright Dual Stack commercial vacuum. In this application, the pre-form requires no preheating. Other applications include comfortable grips for power tools, lawn equipment, household appliances, and hand-held electronic devices such as cellular phones. More information can be found at the company's Web site: www.aestpe.com. **PT**



The first application of the breakthrough in thermoplastic technology is the insert-molded handle grip on Oreck's new ergonomically designed upright Dual Stack commercial vacuum.

Air Act of 1990, according to Ford, since engine temperatures are important in automobile emissions. An engine running below the correct temperature emits excessive carbon monoxide (CO) and hydrocarbons (HC), while above the correct temperature it emits excessive nitrogen oxide (NOX).



It's a black box. It's a VCR. It belongs to ET. No, it's KOOL CHEK, an automotive tester that pinpoints malfunctions in the cooling system of a liquid-cooled internal-combustion engine—especially in the engine's thermostat.

On new vehicles, the Computer Command Control (CCC) system cannot function properly unless the engine runs at the correct temperature. The computer can crunch numbers and process data very quickly, but it cannot, for example, figure out that the thermostat is stuck in the open position. The CCC system "sees" a cold coolant sensor and orders more fuel to the engine, retards the ignition timing, and causes the computer to stay in open-loop mode and not control anything. If the thermostat is functioning but set at too low a temperature (160° F), 100-200 parts per million of HC could be emitted in a vehicle's exhaust.

Ford, a veteran mechanic, used KOOL CHEK at his job at the NYC Department of Transportation Queens Repair and Maintenance Shop for four years before he retired. During that time, he was able to pinpoint difficult-to-diagnose problems. For example, he discovered that defective water pumps on a fleet of new trucks caused an overheating problem. They were returned to the vendor for repair at no cost to the department. **PT**

FREE CONSUMER
INFORMATION CATALOG.
Call toll-free 1-888-8 PUEBLO.

CD ROM based resources for learning and designing



The internationally renowned series of CD ROMs from Matrix Multimedia has been designed to both improve your circuit design skills and to also provide you with sets of tools to actually help you design the circuits themselves.

Electronic Circuits and Components provides an introduction to the principles and application of the most common types of electronic components and how they are used to form complete circuits. Sections on the disc include: fundamental electronic theory, active components, passive components, analogue circuits and digital circuits.

The **Parts Gallery** has been designed to overcome the problem of component and symbol recognition. The CD will help students to recognize common electronic components and their corresponding symbols in circuit diagrams. Quizzes are included.

Digital Electronics details the principles and practice of digital electronics, including logic gates, combinational and sequential logic circuits, clocks, counters, shift registers, and displays. The CD ROM also provides an introduction to microprocessor based systems.

Analog Electronics is a complete learning resource for this most difficult subject. The CD ROM includes the usual wealth of virtual laboratories as well as an electronic circuit simulator with over 50 pre-designed analog circuits which gives you the ultimate learning tool. The CD provides comprehensive coverage of analog fundamentals, transistor circuit design, op-amps, filters, oscillators, and other analog systems.

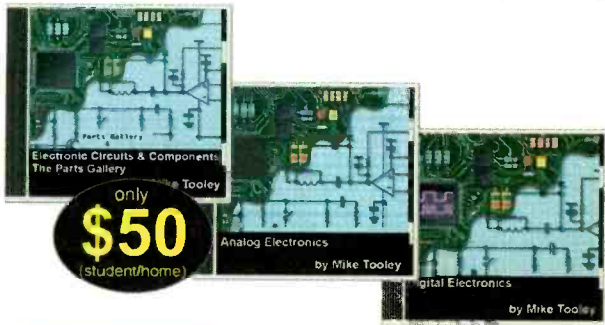
Electronic Projects is just that: a series of ten projects for students to build with all support information. The CD is designed to provide a set of projects which will complement students' work on the other 3 CDs in the Electronics Education Series. Each project on the CD is supplied with schematic diagrams, circuit and PCB layout files, component lists and comprehensive circuit explanations.

PICtutor and **C for PICmicro** microcontrollers both contain complete sets of tutorials for programming the PICmicro series of microcontrollers in assembly language and C respectively. Both CD ROMs contain programs that allow you to convert your code into hex and then download it (via printer port) into a PIC16F84. The accompanying development board provides an unrivaled platform for learning about PIC microcontrollers and for further development work.

Digital Works is a highly interactive scalable digital logic simulator designed to allow electronics and computer science students to build complex digital logic circuits incorporating circuit macros, 4000 and 74 series logic.

CADPACK includes software for schematic capture, circuit simulation, and PCB design and is capable of producing industrial quality schematics and circuit board layouts. **CADPACK** includes unique circuit design and animation/simulation that will help your students understand the basic operation of many circuits.

Analog Filters is a complete course in filter design and synthesis and contains expert systems to assist in designing active and passive filters.



only
\$50
(student/home)



Photo shows PICmicro development kit supplied with institution versions of C for PICmicros and PICtutor

Shareware/demo CD ROM with more than 20 programs \$4.99 refundable with any purchase.

Order Form:

Please circle the products you would like to buy on the table below, calculate the total cost, fill in the rest of the order form and send it to us. NY residents add sales tax. Please allow 6 weeks for delivery.

	Student	Institution
Electronic Cts. & Comps.	\$50	\$99
Digital Electronics	\$50	\$99
Analog Electronics	\$50	\$99
Electronic Projects	\$75	\$159
PICtutor	\$179	\$350
C for PICmicros	\$179	\$350
Digital Works	\$50	\$99
CADPACK	\$75	\$159
Analog Filters	\$75	\$159
Postage - USA	\$5	\$5
Postage - Canada	\$5	\$5

Name: _____
Address: _____

Phone your order to us on:

631-592-6721

or send your order to:

CLAGGK Inc.
PO Box 12162
Hauppauge, NY 11788



Zip: _____ Phone: _____

Card Type: _____
Mastercard, Visa, or Discover only

Expire date: _____

Card number:

I have enclosed my check for \$: _____ Signature: _____

Please charge my credit card for \$: _____

CL02

Order online NOW from: www.poptronics.com

GIZMO®

Speaker Bridge

Sometimes it seems as if it's just as hard to find the right places for your home-theater speakers as it is to find the right speakers for your home theater. Infinity cleverly solves both problems with its *Modulus Home-Theater System* (\$1699) and optional TV mounting bracket (\$150).

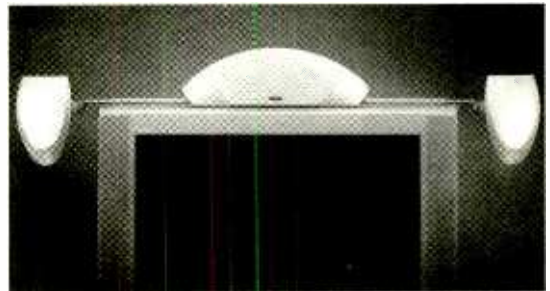
The Modulus satellites feature an integral swiveling-mounting bracket that allows them to be mounted on a wall, in a corner, or freestanding on a shelf. The bracket can be mounted anywhere along the satellite's curved-bottom mounting surface, so that the speaker can be positioned to face straight ahead or at a downward-firing angle.

The system boasts four two-way satellite loudspeakers and a dedicated center-channel speaker, each featuring a 4-inch woofer (the center speaker has *dual* 4-inch woofers) and a 3/4-inch tweeter. The included compact subwoofer has a 12-inch driver, a built-in 300-watt amplifier, and Infinity's Room Adaptive Bass Optimization System (R.A.B.O.S.). The low mass, highly rigid diaphragms in these drivers are said to deliver extraordinary clarity, transient response, detail, and resolution, while reducing distortion. R.A.B.O.S. allows the user to precisely optimize the bass to the individual room characteristics. All tools needed to calibrate the system, including a test CD, sound-level meter, and step-by-step instructions, are included.

The optional TV bracket links the left and right speakers to the center speaker on telescoping arms. The arrangement can be placed atop any 30- to 55-inch television, extending the right and left speakers beyond the TV screen for a wide, panoramic sound field.

Infinity Systems, Inc., 250 Crossways Park Drive, Woodbury, NY 11797; 800-553-3332; www.infinitysystems.com.

CIRCLE 50 ON FREE INFORMATION CARD



Outboard CD Burner

TDK's *Model FE-161040 veloCD burner* (\$399) offers PC users the ease of IEEE-1394 Firewire connectivity for high-performance recording and rewriting of discs. With 16X writing, the external peripheral can burn a full CD in just five minutes and rip a three-minute track in less than six seconds. The device offers 10X rewrite and 40X data read and is capable of ripping CD audio tracks at 32X with

bit-perfect musical accuracy. With BURN-Proof write-assurance technology, you're free to surf the Web or download music while you burn CDs.

Designed as an all-in-one solution for CD music and multimedia recording, the outboard veloCD burner comes with TDK's *CD Blender* software suite, plus *Nero 5.0* CD recording software, *InCD* drag-and-drop packet-writing software, and other utilities.

TDK Electronics Corp., 901 Franklin Ave., Garden City, NY 11530-2933; 516-535-2600; www.tdk.com.

CIRCLE 51 ON FREE INFORMATION CARD

Tabletop Remote Control

Reduce coffee-table clutter with the *RR-1090* tabletop remote control (\$299) from Rotel. The elegant, gently curved device can replace up to eight of those easily misplaced handheld remotes with their closely spaced, tiny buttons.

The RR-1090 features a large backlit LCD screen that provides instant feedback even in darkened rooms. Its intuitive layout makes even complex home-theater systems easy to operate. There are 12 "menu command" buttons for choosing components. Users can program the remote to activate up to 48 individual commands for each device. Two large, multi-axis buttons toward the bottom of the RR-1090's command panel control major functions.

The self-contained menu system provides access to an extensive array of pre-programmed codes in the unit's non-volatile archival memory. Users can also "teach" the unit individual commands for other components. Once the desired IR commands have been placed in active memory, four macro keys can individually or sequentially activate up to ten of them. A "custom ID" option allows system-specific IDs for each device to be programmed in. Password protection is available to limit children's access to system functions. The RR-1090 also comes with *PC Link* software and cable to store or load IR codes. An AC adapter and rechargeable batteries are included.

Rotel of America, 54 Concord St., North Reading, MA 01864-2699; 978-664-3820; www.rotel.com.

CIRCLE 52 ON FREE INFORMATION CARD



Pocket Full of Tunes



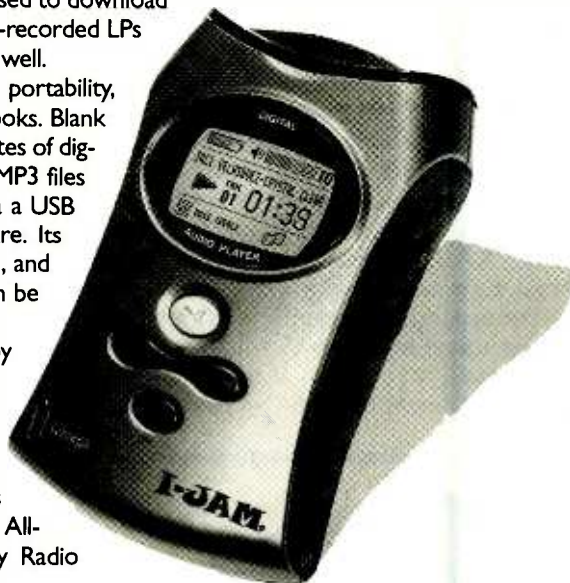
If the term "LP" makes you think of a 12-inch, pre-recorded vinyl record, it's time to move into the 21st century. These days, LP stands for the *License Plate*, a silver-dollar-sized digital-audio storage medium from I-Jam Multimedia that is based on the PocketZip disk from Iomega Corporation. LP tracks are permanently recorded in the Windows Media Format and support Microsoft's Windows Media Digital Rights Management (DRM) system exclusively. Although LPs cannot be copied, they can be shared between compatible devices, including digital audio players that use PocketZip technology and Iomega PC Card drives. Blank LPs can be used to download audio files, and pre-recorded LPs will be available as well.

The disks, which are encased in metal for durability and carefree portability, carry suggested retail prices of \$19.98 for music and \$29.99 for books. Blank PocketZip disks sell for about \$10; a 40-MB disk holds up to 120 minutes of digital music. I-Jam's IJ-360 digital audio player, which is compatible with MP3 files and the Microsoft Windows Media format, allows fast downloads via a USB connection and is bundled with Windows Media Player 7 software. Its \$299.95 suggested retail price includes headphones, a carrying case, and two 40-MB PocketZip disks loaded with pre-recorded music that can be recorded over (as with any blank PocketZip disk).

Several popular book and music titles are scheduled for release by the time this is published. Recording artists include Bender, the Charlie Daniels Band, Snoop Dog, XTC, Al Green, Selena, and Amy Grant. Books from John Grisham, Danielle Steele, Michael Crichton, Bob Costas, James Bradley, and Rosamunde Pilcher will be offered. Rounding out the first releases will be a selection of radio shows including *Alfred Hitchcock*, *Jack Benny*, the "Smithsonian Collection of All-Time Radio Shows," the "Smithsonian Collection of Great Mystery Radio Shows," and 27 episodes of *Superman*.

I-Jam Multimedia L.L.C., 1092 National Parkway, Schaumburg, IL 60173; 847-839-1233; www.ijamworld.com.

Iomega Corporation, 1821 West Iomega Way, Roy, UT 84067; 888-446-6342; www.iomega.com.



CIRCLE 53 ON FREE INFORMATION CARD

Pint-Sized PDA

Royal's Vista TS (\$69) is a credit-card-sized Personal Digital Assistant with a touch screen, an upgradeable operating system, and 2-MB of Flash memory. Packaged with a battery-operated desktop cradle, the device offers easy data entry. It can be directly synchronized to a PC with Royal Link PC Personal Information Manager (PIM) software, as well as *Microsoft Outlook*, *Schedule+*, *ACT!*, *Lotus Organizer*, and *Palm Desktop*. An optional, palm-sized, folding keyboard (less than \$30) makes it simple to input text.

The Vista TS offers an address/phone book, a full-function calculator, a schedule function, to-do and anniversary trackers, home- and world-time clocks, and other management software features. Additional applications, such as an expense manager, can be downloaded from Royal's Web site.

Although the device is PC compatible, no computer savvy is required. In fact, no PC is required at all. The Vista TS is a self-contained unit that can be used right out of the box. Data can be input using a stylus and the touch screen, which has adjustable contrast for easy viewing.

Royal Consumer Business Products, 765 US Highway 202, Bridgewater, NJ 08807; 908-526-8200; www.royal.com.



CIRCLE 54 ON FREE INFORMATION CARD

CD Memory System

The *SongBank SL CD Memory System* (\$799) delivers the benefits of CD players, CD mega-changers, and CD recorders in one unit. Up to 14 days worth of continual music is stored digitally—entire collections of up to 7000 songs. (For comparison, see I-Jam's LP—mentioned previously—that holds 120 minutes of digital music.) Simply insert a CD and the SongBank rips it, recording the full contents or a selected portion in one-quarter the usual playtime. An easy-to-use TV display guides you through the SongBank. A simple software upgrade will allow you to download music from the Internet directly, with no PC needed.

Lydstrom, Inc.; 617-451-5888; www.lydstrom.com.



FireWire/USB Scanner

The *ScanMaker 8700* (\$999) is ideal for professional graphics, Web-site design, and photography. With a stunning 1200-dpi resolution and both OCR and PDF capabilities, the

ScanMaker 8700 uses a 14-bit analog-to-digital converter and a 10,600-pixel element CCD for rendering crisp color scans.

Microtek; 310-297-5000; www.microtekusa.com.



Take Control With Light Pens

Have you had it with your mouse or track ball? Here's another option: a complete light pen kit (interface, light pen, cable and software). Basic kits start as low as \$400. The *PXL-2000* USB interface doubles as a four-port hub (starter kit from \$553) and the *PXL-795*, featuring an

external-serial interface, is priced at \$500 for a complete starter kit.

FastPoint Technologies; 800-962-3900; www.fastpoint.com.



The Amazing ZiO!

ZiO! is a USB device that allows you to transfer files from either SmartMedia, Compact Flash or MultiMedia storage cards found in devices like digital cameras and MP3 players. Priced at an affordable \$40 and PC and Mac compatible, the *ZiO!* can be used for fast data transfer on the go.



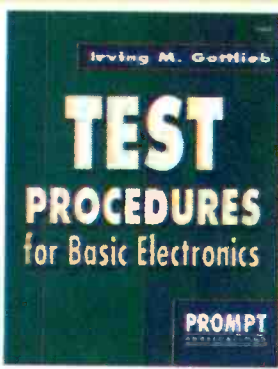
Microtech International, Inc.; 203-483-9402; www.microtechint.com.

Network-Ready Laser Printer

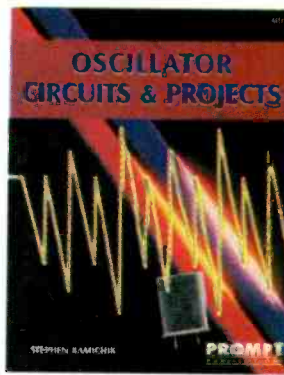
The *HL-1670N* (\$749) is a network-ready laser printer with built-in duplex printing that ensures flawless printing on both sides of a sheet of paper. With a print speed of 16-pages per minute, the printer has an expandable memory of up to 144 MB (16 MB is included) and is compatible with USB and parallel interfaces.

Brother International Corp.; 800-521-2846; www.brother.com.



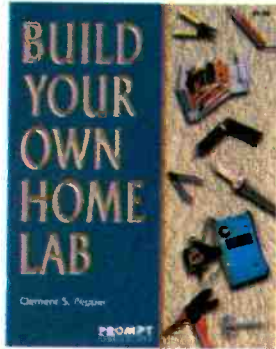


Test Procedures for Basic Electronics. #61063. -- \$19.95
 Many useful tests and measurements are covered. They are reinforced by the appropriate basic principles. Examples of test and measurement setups are given to make concepts more practical. 7 3/8 x 9 1/4", 356 pp, paperback.

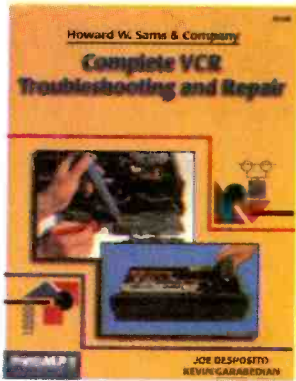
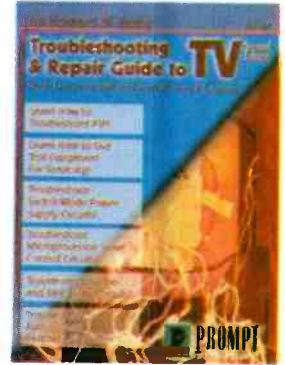


Oscillator Circuits and Projects. #61111. -- \$24.95
 A Textbook and project book for those who want to know more about oscillator circuits. You can build and enjoy the informative and entertaining projects detailed in this book. Complete information is presented in an easy-to-follow manner. 7 3/8 x 9 1/4", 249 pp, paperback.

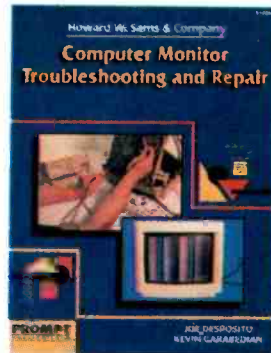
Build Your Own Home Lab. #61108 -- \$29.95
 Shows you how to assemble an efficient working home lab, and how to make it pay its own way. Includes projects for creating your own test instruments too. 7 3/8 x 9 1/4", 249 pp, paperback.



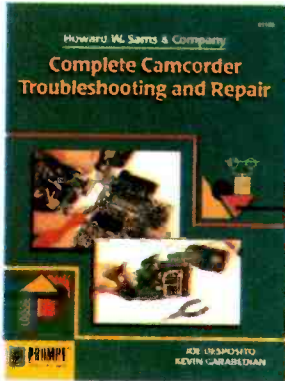
Troubleshooting and Repair Guide to TV. #61146. -- \$34.95
 Repairing and troubleshooting a TV is very simple and economical with help from the information in this book. It is the most complete and up-to-date TV repair book available, with tips on how to handle the newest circuits. 8 1/2 x 11", 263 pp, paperback.



Complete VCR Troubleshooting and Repair. #61102. -- \$34.95
 Though VCRs are complex, you don't need complex tools or test equipment to repair them. This book contains sound troubleshooting procedures that guide you through every task. 8 1/2 x 11", 184 pp, paperback.

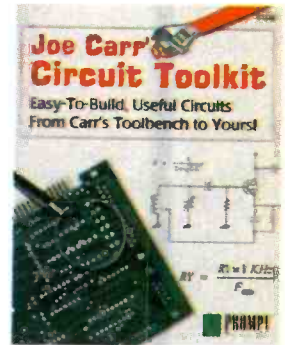


Computer Monitor Troubleshooting and Repair. #61100. -- \$34.95
 This book can save you the money and hassle of computer monitor repair by showing you how to fix it yourself. Tools, test instruments, how to find and solve problems are all detailed. 8 1/2 x 11", 308 pp, paperback.



Complete Camcorder Troubleshooting and Repair. #61105. -- \$34.95
 Learn everything you need to know about the upkeep and repair of video camcorders. Start by examining camcorder troubleshooting procedures, then move into more advanced repair techniques. 8 1/2 x 11", 208 pp, paperback.

Joe Carr's Circuit Toolkit. #61181. -- \$29.95
 Easy-to-build, useful circuits from Carr's workbench to you. They will spark new ideas in your day-to-day use of circuits and help solve frustrating problems. 256 pp, paperback. Contact Jim Surface.



Please circle the products you would like to buy on the page above, calculate the total cost, include shipping charges, using in the form below and send it to us. Please allow 4 - 6 weeks for standard delivery.

Name: _____

Address: _____

Zip: _____ Telephone: _____

I have enclosed my check for \$: _____

Signature: _____

Please charge my credit card for \$: _____ Number: []

Card Type: _____
 Mastercard, Visa or Discover only

Expiration Date: []

Note: The delivery address and the address at which the credit card is registered must be the same.

SHIPPING CHARGES IN U.S.

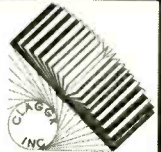
CANADA ADD \$5.00	
1 Book	\$ 5.00
2 Books	8.00
each add'l book	3.00
2 Day UPS	\$10.00 extra
Next Day UPS	\$20.00 extra

CLAGGK INC.
 PO Box 12162
 Hauppauge, NY 11788
 Tel: 631-592-6720
 Fax: 631-592-6723
 email: claggk@gernsback.com

SORRY No orders accepted outside of USA & Canada No. of Books Ordered

Total price of books.....	\$.....
Shipping (see chart).....	\$.....
Subtotal.....	\$.....
Sales Tax (NYS only).....	\$.....
Amount Enclosed.....	\$.....

All payments must be in U.S. funds!



mailto:netwatch@gci.com

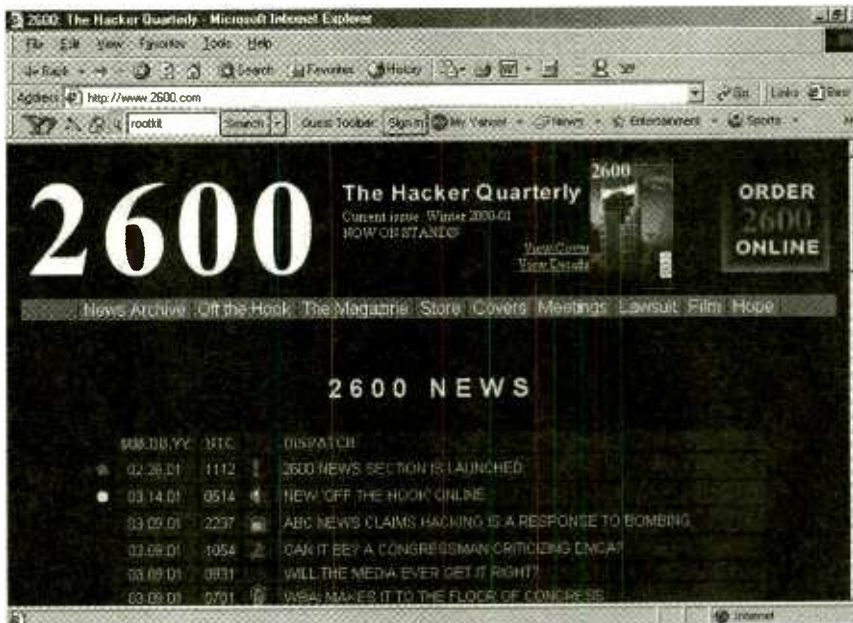
GERM-WARFARE ON The Cyber-Front

Even the most heavily guarded systems are threatened by "Binary" bacteria. Culprits with names like "CIH," "Ska," and "I Love You" have managed to infiltrate and cripple networks across the planet. The widespread use of high-speed and always-on services (like cable and DSL-modems) has allowed viruses, parasites, and other "malware" creations to achieve maximum dissemination. Hackers and crackers alike are finding the sport of crashing computers easier than ever.

WORMS, AND PARASITES

Worms are routines capable of self-replicating throughout an entire network. In 1988, Robert T. Morris released one of the first Internet worms. What began as an innocent experiment soon proved fatal for many servers. In the world of cyber-terrorism, worms are mostly used to clog e-mail servers. The Ska virus is a good example of a worm that implants itself as a .dll file and sends off clones of itself to the names found in a victim's address lists. The constant shuffling of data creates a logjam within a mail sorter.

A parasite is just like its biological counterpart. Computer-based parasites enter a system by deceptive means—perhaps piggybacked on a seemingly benign file—and set up camp. Once inside, parasites assume control of their host. After taking command, a parasitic code can use its host to attack other machines in a network or it might begin to destroy all the data it can reach.



"Mommy, make the bad site go away!" 2600 has been offering only the best in "phreak" boxes, secret frequencies, and hacker advice for years. The group has grown with the times, and now it boasts a Web site in place of its aging BBS.

Devious programmers are having a field day creating and implementing their legion of contagion codes. Open-sourced applications and freeware platforms are often used as the skeleton for their creations. Two common building blocks for viruses are the pseudo-code compiling Java, and the freeware interpreter PERL (Practical Extraction and Report Language). Free versions can be obtained for each of those languages via the Internet.

TOOLS OF THE TRADE

Every keen hacker has a virtual box of goodies often referred to as

a "rootkit." Kits are collections of programs and applications that allow hackers and crackers to gain entrance into machines and assume root-privileges over a network (hence the name). Once inside, intruders can scan networks for sensitive information and even create and release viruses over the Internet. WinNuke was a popular program passed about hacker circles. The program allowed users to enter a target's IP address and send a "PING of Death" to a hapless victim, which resulted in the infamous "blue screen of death" a.k.a. the "BSOD." Script Kiddies are young terrorists-in-training who man-

the university circuit, 2600 has its own URL at www.2600.com.

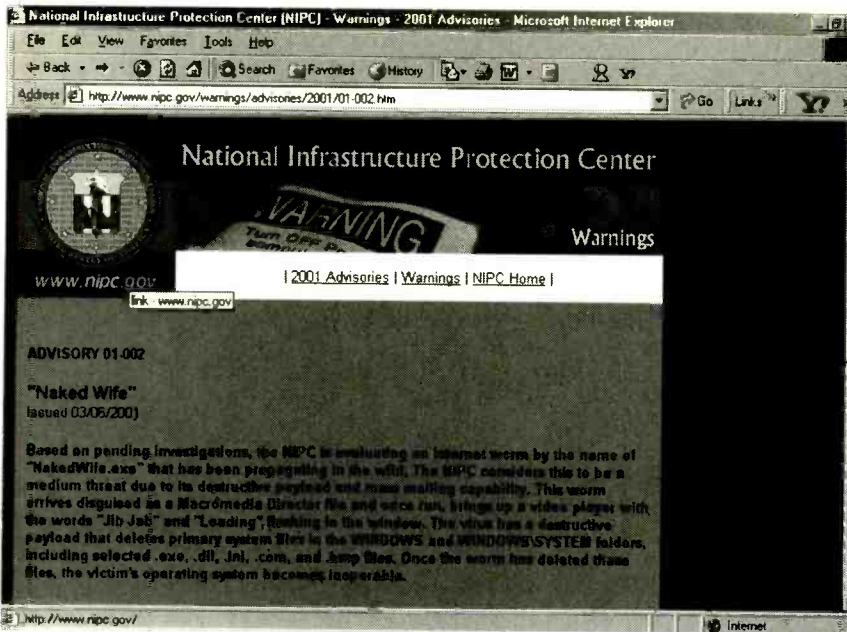
BUILDING IMMUNITY

There are many anti-virus programs available. Symantec, Sophos, McAfee, and F-Secure are just some of the heavyweights of system security. Like other converted conventional thieves who have traded a life of crime in for a steady paycheck as consultants, many rehabilitated hackers have been hired by firms to bolster security. However, you don't have a symposium of "sneakers" (hired hackers) at your disposal in order to assure your computer's safety. Purchasing a virus-protection suite complete with a firewall is usually sufficient and worth the price of updates and software. One cannot stress the importance of updating your virus-protection software. Most company Web sites offer weekly updates that include protection from the latest viral strains.

Unfortunately, no matter how current your system is and no matter how formidable your firewall seems, there always exists the remote possibility of intrusion. No computer is totally protected unless it's never turned on—defeating the reason for owning a system in the first place. Recent news releases have exposed the December 2000 attack on the USAF Space Command's network. OS/COMET—the program used to control the movement of U.S.-owned space objects—was "snarfed" (stolen electronically) from a server located within the Mt. Cheyenne complex. It is safe to say that the Air Force uses top-quality protection, but it only takes a bit of ingenuity and a slice of luck to crack into a system.

The only surefire defense is to limit a computer's access to the Internet. A hacker can't gain remote access without an initial connection. If you plan to leave your system unattended, disconnect from the Net. Idle connections are the breeding ground of malicious attacks. Another way of avoiding security breaches is by verifying incoming e-mail sources. It is safe practice to avoid "chain-letters" and forwarded documents with an extensive list of multiple receivers.

(Continued on page 46)

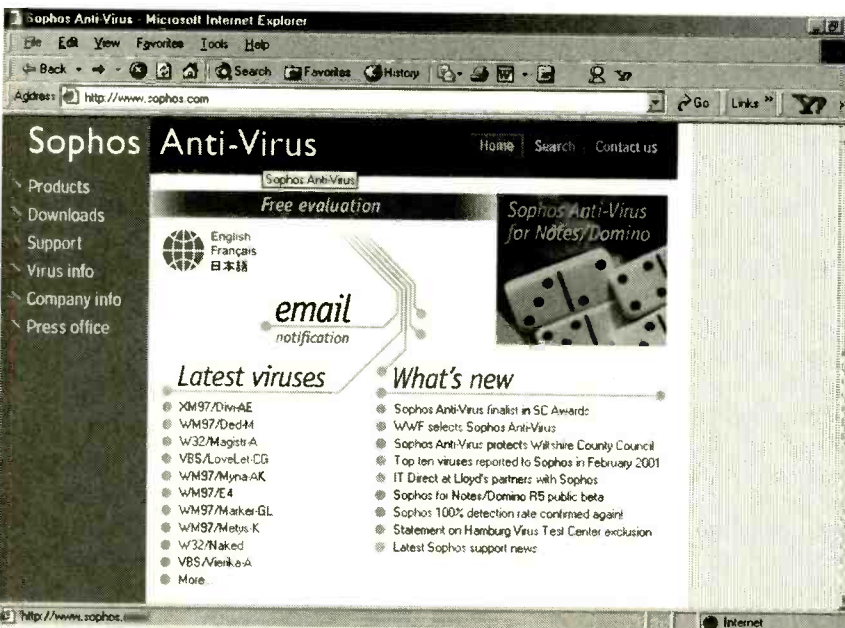


The NIPC has the financial backing and cutting-edge technology to wage war against cyber-terrorists. This U.S. government organization is spearheaded by the FBI and is headquartered on Washington, D.C.

age to get their delinquent little digits on the various pre-written malicious scripts that are similar to *WinNuke*, rather than having to take the time and effort to design their own weapons of digital destruction.

Some of the more popular applications used to breach and exploit systems include *Ethernet sniffers* used to "sniff" out passwords and usernames, *TTY watchers* designed to hijack terminals, *IP*

spoofers that allow hackers to mask their identity, and *phage* programs for unauthorized modification of a victim's operating system and programs. The majority of tools needed for cyber-crimes are available via deviant Web rings and "floating" sites that never seem to be in the same location twice. One hot spot for Hackers has hit the mainstream—*2600 The Hacker Quarterly*. Once a "rag" that was traded on



Sophos is just one of the many companies who are making a living protecting computers from malicious attacks. Weekly (if not daily) visits to the Sophos URL allow users to update their virus protection and scan the list of the latest viruses discovered.

SEARCHING FOR THE BEST WEB SITES AROUND... OR FOR WHATEVER YOU NEED

There's nothing more central to the Internet than looking things up, and there's nothing that changes at Internet speed as much as Internet search sites.

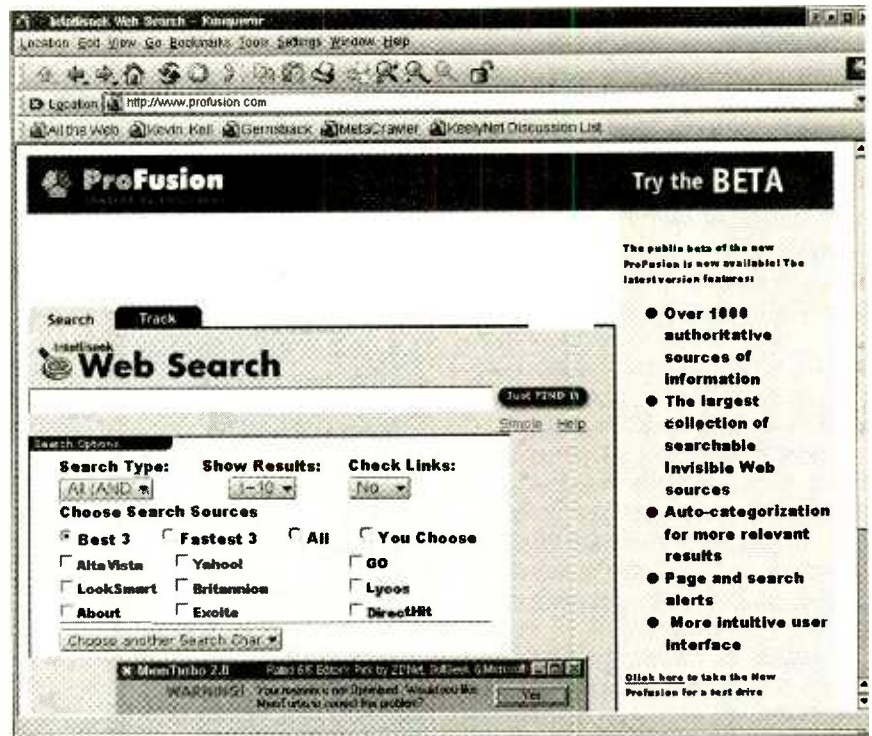
The Internet search industry is in a state of upheaval. Familiar search engines are losing their usefulness, in some cases with top management bailing out. Meanwhile, upstarts are trying to buy your patronage. Fortunately, a few standouts are eminently click-worthy.

IN THE BEGINNING...

Web old-timers, many still in their twenties, might remember *Yanoff's List*—the first widely used compilation of useful Internet destinations. Created in 1991, it bit the dust in 1995 when overtaken by Yahoo!. First, it made its creators, Stanford University Ph.D. students David Filo and Jerry Yang, billionaires.

Yahoo!, at www.yahoo.com, has remained the dominant Web directory, organizing the vast stretches of cyberspace into a semblance of a library card catalog and helping surfers find their way.

Unfortunately, Yahoo! as a search tool has lost its own way recently as the company has diversified into a dizzying array of other Net activities, including—but not limited to—shopping, business-to-business e-commerce, Web e-mail, Web hosting, Web telephony, streaming



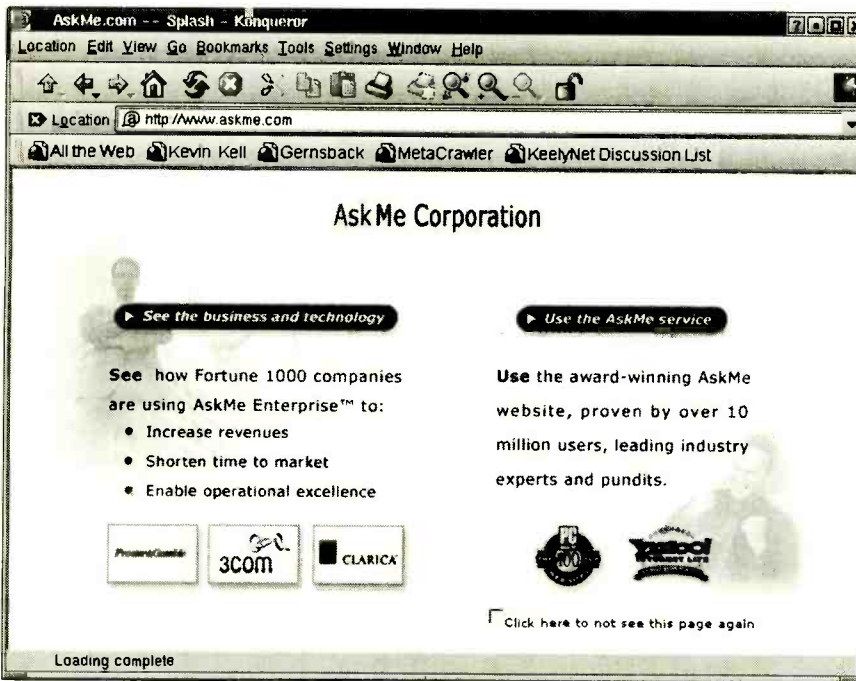
Tired of discovering after the fact that a better Web site wasn't listed on the search engine you just used? Try a "meta" search engine: Your search request is automatically sent to dozens of other search engines. Such sites—like ProFusion shown here—can even strip out the duplication and just show you the top hits.

video, and multimedia software.

You're better off going elsewhere if you're looking for good Web sites. Many key sites aren't included in Yahoo!'s categories, some of its "Most Popular Sites" are wildly esoteric, and site submissions to it may never show up.

AND IN THIS CORNER

A smarter choice for browsing categories of sites is a newer service called Open Directory Project, at www.dmoz.com. Spearheaded by Netscape (now a part of America Online), it has a database useful enough to be licensed by



Rather than having computers scour the Internet—resulting in hundreds of links that have little to do with the subject at hand—human-generated search engines deliver results that make sense to organic lifeforms.

AltaVista, HotBot, Lycos, and MetaCrawler, among some one hundred other sites.

AltaVista, at www.altavista.com, is another early "name" in the Internet search game experiencing a loss of stature. It was the first popular pure search engine, relying upon technology instead of people by sending its automated "spiders" to crawl through the Web and index what they found.

Search engines such as AltaVista were, and still are, better at finding narrowly defined information, while directories such as Open Directory Project and Yahoo! are better at presenting broad categories of information.

Despite its promising start, AltaVista suffered from a dearth of investment early on, and it has been superseded by newer search engines that return more relevant results. Recently, it slashed 25 percent of its workforce, and its CEO resigned.

THE CURRENT "TOP DOG"

The hottest search engine today is Google, at www.google.com, officially launched during the fall of 1999. It uses sophisticated technology that returns results based on the number of other URLs that link

to specific information on a site. When key domains, such as CNN's, link to a particular page, that's counted more heavily.

The end result: An uncanny ability to turn up what you're looking for.

So confident is Google in its technology that it includes an "I'm Feeling Lucky" option. If you click on that after typing in your search terms, Google will take you directly to the site it feels is most relevant.

This is mostly braggadocio, though tolerable under the circumstances. You're usually better off looking at its list of possible locations, with brief excerpts, before deciding yourself which one you want. Still, the technology works so well that more than one hundred other sites have licensed it.

CHEERING ON THE UNDERDOGS

Some new search engines are trying to gain your surf-time by throwing money at you. The leader

POINT AND CLICK

AltaVista
www.altavista.com

AskMe.com
www.askme.com

Best of the Web
www.pcworld.com/reviews/article.asp?aid=17178

Gold Star Sites
www.zdnet.com/yil/goldstars

Google
www.google.com

iWon.com
www.iwon.com

Media Metrix
www.mediametrix.com

MetaCrawler
www.metacrawler.com

Nielsen//NetRatings
www.nielsenratings.com

Open Directory Project
www.dmoz.com

Open Directory Best of the Web
www.dmoz.com/Computers/Internet/WWW/Best_of_the_Web

PC Data Online
www.pcdataline.com

Profusion
www.profusion.com

Readers Rate the Web
www.zdnet.com/pcmag/stories/reviews/0,6755,2643490,00.html

The Top 100 Family Web Sites
familypc.zdnet.com/learning/reference/feature/100websites

The Top 100 Web Sites
www.zdnet.com/pcmag/stories/reviews/0,6755,2394453,00.html

Web Business 50/50 Awards
www.cio.com/archive/070100_awards.html

The Webby Awards
www.webbyawards.com

Yahoo!
www.yahoo.com

101 Most Incredibly Useful Sites
www.zdnet.com/yil/content/mag/0007/useful_main.html

here is iWon.com, at www.iwon.com. Backed by CBS, it has extensively advertised its \$1-million-a-month sweepstakes giveaways on television. In aggregating news and other content to encourage users to stick around and read ads, it's better as a "portal" than for research.

So far, iWon's strategy seems to be working—it's now the 21st most visited Web site, according to the latest numbers from Media Metrix. Also, it's true to its word, recently awarding its twelfth million-dollar monthly prize to a New Jersey resident.

Despite recent advances, searching through the Internet's murky depths is still an inexact science; and it sometimes pays to use more than one search engine. You can do this automatically with a "metasearch" site. After you type in your search terms, it sends them out to a number of search sites and compiles the results. The best metasearch sites are ProFusion, at www.profusion.com, and MetaCrawler, at www.metacrawler.com.

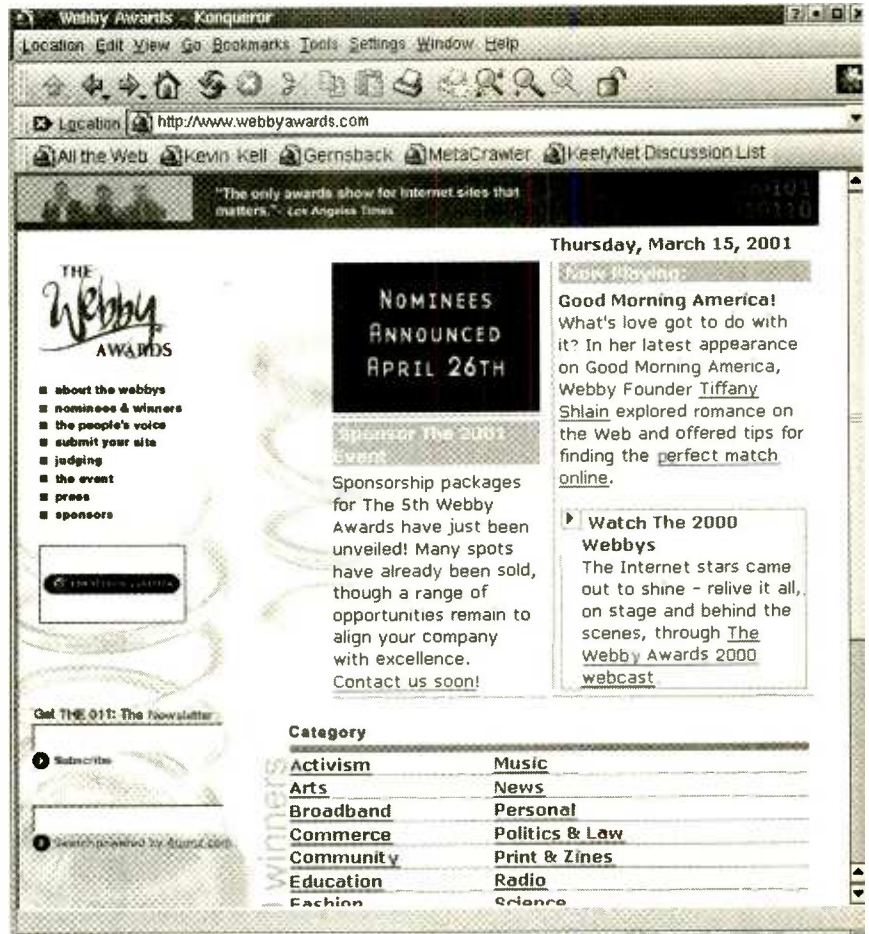
Finally, despite the Web's technological wizardry, sometimes you can't beat the human touch. AskMe.com, at www.askme.com, is one of a number of so-called expert sites whose volunteer staffers try to dig up information for you.

WHO'S THE BEST AND BRIGHTEST?

In just a decade, the World Wide Web has grown from a physicist's research project to a gargantuan marketplace contributing hundreds of billions of dollars and millions of jobs to the nation's economy. Three billion Web pages, according to market research firm Cyveillance, are now out there for your perusal. Some are more surf-worthy than others.

In recent years, a number of organizations, publications, and Web sites have made qualitative designations of the best Web sites. Such designations are necessarily subjective and sometimes idiosyncratic, but useful nonetheless.

If you're looking for specific facts, you're best off drilling down directly with one of the aforementioned search engines. However, if you're browsing categories of infor-



Create a truly "award-winning" Web site, and some day you might be able to say, "I'd like to thank the Academy..."

mation, you're often better off surfing to Web addresses that have been chosen as the best by someone, rather than clicking to URLs listed by portals such as AOL, Yahoo!, or MSN.

Some domains may be prominently listed by portals solely because they have business relationships with the portal, not because of the quality or comprehensiveness of the content. Here's a roundup of some of the top outfits that have selected top sites. Exploring these selections can be useful not only for the content available but also—if you're in the business of creating Web sites—for getting ideas.

The Webby Awards—Awarded by the 350-member International Academy of Digital Arts and Sciences, the Webbys are the Oscars of the Internet. See who won this year in the 27 categories, from commerce and science to

activism and music, at www.webbyawards.com.

The Webbys also have a populist component, the People's Voice Awards. This year more than a hundred thousand surfers voted for their favorites.

Best of the Web—The editors of *PC World* magazine, the most widely circulated consumer-oriented computer magazine, identified what they consider the best 64 sites in 32 categories, including career information, Webmaster tools, health, and entertainment. Check out their recommendations at www.pcworld.com/reviews/article.asp?aid=17178.

The Top 100 Web Sites—The editors of *PC Magazine*, a biweekly publication targeted toward computer professionals, also published their choices of the best Web sites—100 in 20 categories—from small business services to lifestyle. Read all about it at www.zdnet.com/pcmag/

ACCREDITED
ASSOCIATES and BACHELORS DEGREES

COMPUTER SCIENCE
&
COMPUTER ENGINEERING

Self-paced degree programs allow you to earn a college degree on your schedule. Degree paths in Internet Engineering, MIS, Web Design, and Computer Programming. Transfer up to 50% of coursework for A.S. degree and 75% of coursework for Bachelors degree for prior college credit or professional certifications. Receive up to 8 credit hours for directly relevant professional experience. Textbooks, software and instructor support included in tuition. VA/ military benefits & tuition assistance provided by most employers (see FAQ at www.grantham.edu).

34641 Grantham College Road
Slidell, LA 70469
Toll Free 888.423.4242
www.grantham.edu

CIRCLE 282 ON FREE INFORMATION CARD

www.poptronics.com

[stories/reviews/0,6755,2394453,00.html](http://www.zdnet.com/yil/content/mag/0007/0,6755,2394453,00.html).

Readers Rate the Web—More than 3000 technologically savvy readers of *PC Magazine Online* chose the 53 best Web sites in nine categories, including investments, banking, shopping, and travel. Read their choices at www.zdnet.com/pcmag/stories/reviews/0,6755,2643490,00.html.

101 Most Incredibly Useful Sites—*Yahoo! Internet Life*, an Internet "lifestyle" magazine, identified what it considers the 101 best sites in nine categories, from home and shopping to mailing/shipping and automotive. Investigate further at www.zdnet.com/yil/content/mag/0007/0,6755,2394453,00.html.

Each month, the magazine also publishes a list of "Gold Star Sites" in a particular category. Recent categories include e-business, health, getting expert advice, trip plan-

They're more than television. They're more than radio. The world-renowned Nielsen Ratings applies its expertise in the statistical analysis of what's popular to the Web.

ning, and finding a job. It's all at www.zdnet.com/yil/goldstars.

The Top 100 Family Web Sites—The editors of *FamilyPC*, a magazine targeted toward home-computer users, selected what they consider the best sites in 36 categories, including patenting, genealogy, food and drink, beauty, kids, and seniors. You can find out more at familypc.zdnet.com/learning/reference/feature/100websites.

Web Business 50/50 Awards—*CIO* magazine, a computer publication for chief information officers and other business people, recognized 50 business-oriented Internet and 50 internal intranet sites for excellence in the categories of business-to-business, business-to-consumer, small company, start-up, and nonprofit. Read who won at www.cio.com/archive/070100_awards.html.

In addition, there are lots of Web sites that select best pages. The Open Directory Project lists 184 of

them at www.dmoz.com/Computers/Internet/WWW/Best_of_the_Web, including 93 that offer award designations and 32 URLs that review other sites.

Though popularity and quality don't necessarily go hand in hand, you may also find it useful to uncover the most popular sites—as a whole and in given categories.

Nielsen//NetRatings, at www.nielsenratings.com, provides lots of statistics about the Web, including the top ten Web properties in terms of usage ("properties" encompass multiple sites owned by the same company). Media Metrix, at www.mediametrix.com, offers a listing of the 50 most popular Web properties in the U.S. and globally, as well as a listing of the 500 most popular ones. PC Data Online, at www.pcdonline.com, publishes a list of the top 100 Web sites and the top 50 Web properties, according to the number of unique visitors and the "reach"—the percentage of the total Web population that visits.

COMPUTING WITH LIGHT

KENNY A. CHAFFIN

Squeezed light, holograms, and lasers sound like things you'd find in a science-fiction novel, but they can also be found in the labs around the world where they are used in the "thinking" machines of tomorrow—optical computers. Since they are based on light-wave technology, optical computers can process information a million or more times faster than electronic computers. They are inherently parallel processors and almost completely immune to interference.

Optical computers use laser beams in place of wires. Unlike wires, laser beams can cross and intersect without affecting one another. Furthermore, multiple beams can converge on a single switching point with any combination of one or more beams triggering the switch. An electronic equivalent of such a multiple-input switch is much more complex. Optical computers have all these advantages because of the fundamental nature of light.

Photons. Quantum theory tells us that light has the properties of both waves and particles. When discussing its particle nature, we call the particles "photons." However, because of light's wave-like properties, photons can do things that are impossible for typical particles—such as electrons. For example, thousands of photons can pass through a single point simultaneously without interfering with one another. Photons can also travel faster than electrons, which makes faster computational speeds possible.

As we'll discuss later on, light can also be used to represent information in many *different* ways. For



At the dawn of electron-based logic computing to a close. Scientists are now turning the job of computing over to beams of light.

example, one could modulate the brightness (photons per second) of a beam of light, which would produce an amplitude-modulated signal (AM) for analog computing. AM signals can also be used to transmit binary data—you just need to define a brightness threshold to represent a one and another to represent a zero. Furthermore, we can frequency-modulate (FM) light. Changing the frequency is equivalent to changing its color. More advanced methods of light manipulation—like

"spatial modulation" and holograms—will be discussed later. All these intriguing possibilities have been tempting scientists since the 1950s, but the technology to support them only began to appear during breakthrough research dating back to the eighties.

The Early Days. The early optical-computer research in the 1950s was performed using mercury-arc lamps and sunlight. The method proved less than effective.

Today, the laser (invented in 1960) is the key to optical computing. A laser produces a single coherent beam of light (all the light has the same frequency, energy phase, and direction) that is used to transmit optical information in a concise, coherent, and controlled manner.

The first laser used a ruby crystal rod. Ruby crystals emit photons when stimulated by a powerful flash of light. A ruby laser is made by using a ruby rod with a mirror on one end. A partially reflective mirror covers the other end. The mirrors help establish and direct the beam emitted by the rod.

Unfortunately, the first lasers had some drawbacks.

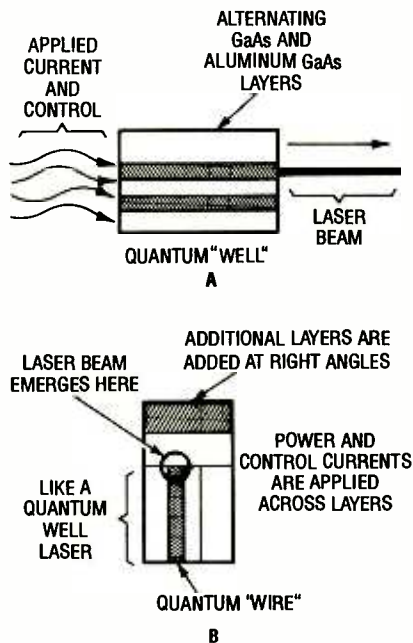


Fig. 1. The quantum-well (A) and quantum-wire (B) lasers are quantum-effect devices that take advantage of the physical layout of semiconductor layers to produce light.

They were bulky, needed lots of power, and generated a great deal of heat. The major problem in using them for computation was the lack of a practical optical-switching device. IBM was one of the first companies to explore optical computing using this young technology. They spent over four years and \$100 million (1960s dollars) trying to develop a practical optical computer. Because of the energy, cooling requirements, and unreliability of the early switching devices, they finally abandoned the project. Various attempts at building optical computers over the next twenty years had some small successes, but the real advances had to wait for optical switches and semiconductor lasers.

Modern-Day Lasers. Since the original ruby lasers, many other lasers have appeared. Helium neon (HeNe) lasers are the most popular because they are relatively cheap. Carbon dioxide lasers—the result of weapons research—are among some of the most powerful newer lasers.

The problem with most of these lasers is that they are somewhat large. An optical computer may need thousands or even millions of

controlled laser beams. We can create them by splitting a single beam into as many beams as necessary, but that is a messy approach. A better solution is provided by the semiconductor laser.

The first semiconductor lasers worked by applying a current through the alternating layers of gallium arsenide (GaAs) semiconductor material. The steadily moving electrons generate in-phase photons, which emerge from the edge of the layered semiconductor material as a coherent laser beam.

More recent semiconductor lasers take advantage of quantum effects that result from the physical layout of chip layers. This technology has given us “quantum-well” lasers (see Fig. 1A). Although these laser chips put out only a few milliwatts of power, they are useful in CD players, laser-based “tape measures,” and optical telephone circuits.

One step beyond the quantum-well laser is the quantum-wire laser (see Fig. 1B). Quantum-wire lasers are composed of alternating layers of GaAs and aluminum gallium arsenide (AlGaAs). These efficient diode lasers are smaller and more powerful than their predecessor—producing about 10 milliwatts of output power. Optical computing requires this greater power because the beam must be sufficiently strong even after it is split.

The problem with quantum-wire lasers is the expensive cost of growing the zero-dimensional wires found in the AlGaAs lasers. A typical array consisting of four micro-

lasers can cost upwards of \$50,000. The price should fall dramatically in the near future with improved manufacturing techniques and larger quantities. Scientists in Japan’s Basic Research Labs have predicted that quantum-wire lasers should be able to switch on and off at rates up to 100 GHz.

One Optical System. As mentioned earlier, there are many basic methods of sending signals by light. The simplest technique is to simply turn it on and off, like Morse code. As previously stated, the presence of a beam could denote a one and its absence a zero.

That is the binary method used in the most widely known optical computer, built at AT&T Bell Labs by Alan Huang. Let’s look at how he and his colleagues built their optical computer, and then we’ll discuss some other approaches. You may even get some ideas for experiments along the way.

Huang has been working in the optical computer field for over thirty years. When he started thinking about optical computers, lasers and semiconductor chips were both relatively new developments. In the beginning, he had to work with crude technology. Then, he needed to wait for many new developments to occur such as better lasers, ICs, and the optical switch.

The switches, known as Self Electrooptic-Effect Devices (SEEDs), are key to the computer’s operation. A control laser beam turns each switch on or off. The switch controls the passage of a second

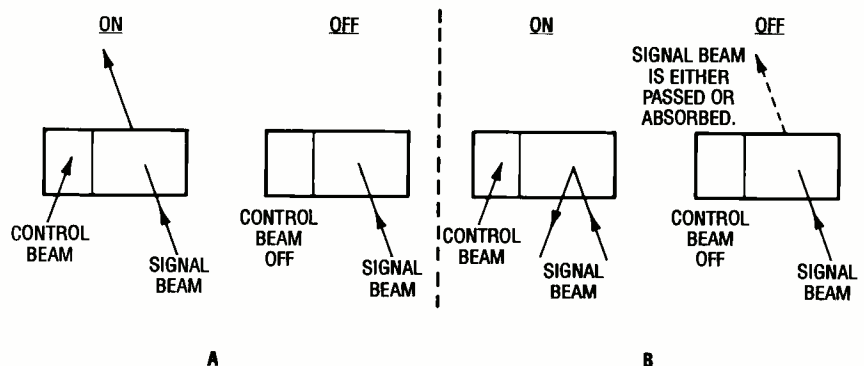


Fig. 2. There are two main types of optical switches: transmissive (A) and reflective (B). Both of them can keep a beam from traveling to a particular destination, but a reflective switch can redirect the beam to a new destination.

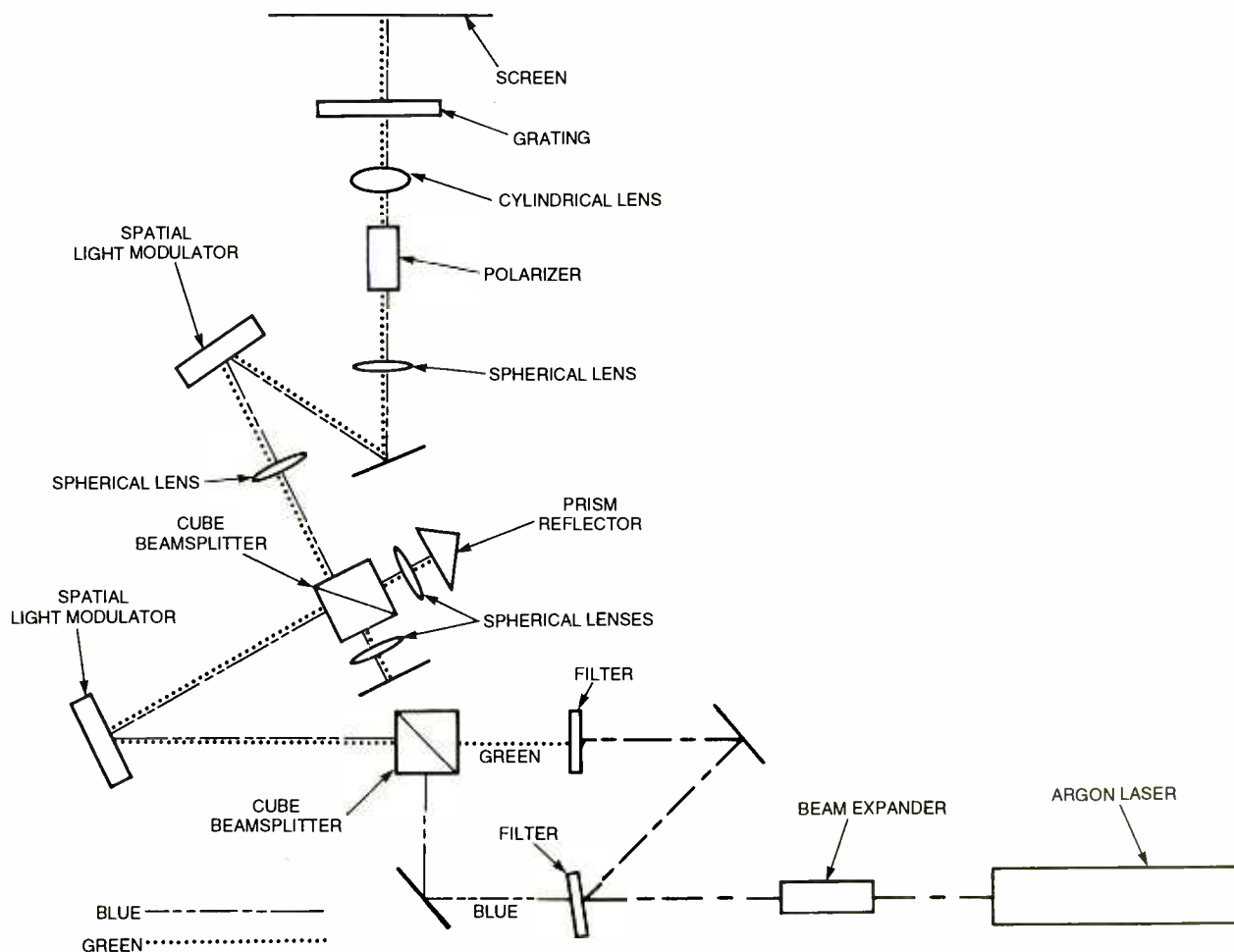


Fig. 3. A pair of reflective spatial-light modulators redirects the blue-green light of an argon laser after it passes through a cube beamsplitter.

laser beam—the signal beam—based on the presence or absence of the control beam.

There are two classes of optical switch: transmissive and reflective (see Fig. 2). A transmissive switch (Fig. 2A) either blocks the signal beam or allows it to pass to its destination. A reflective switch (Fig. 2B) reflects the signal beam to a destination or prevents it from getting there, either absorbing it or permitting it to pass through to somewhere else.

Regardless of its type, when a switch is on, the signal beam can continue to travel. When it's off, the signal beam is stopped, so a SEED acts exactly like a transistor in an electronic computer. In fact, an optical computer works like any other computer; it just uses the optical switches and laser beams in place of transistors and electric currents, respectively.

Although David Miller (also of

Bell Labs) developed the switches in 1986, it still took five years to build an optical computer. Alan Huang and twelve colleagues built an optical computer at Bell Labs early in the nineties. It has 8000 optical switches—each one only ten micrometers (.00004 inch) wide. Huang's optical computer uses only a small percentage of its thousands of switches. For now, it only counts, but even that is significant for a completely optical computer. It has proven the theory behind optical computing.

Huang's computer uses the SEED switches connected as NOR gates to form two eight-bit counters. Each NOR gate has a switching time of one nanosecond. That compares favorably to electronic NOR gates that switch at between 5 to 50 nanoseconds.

The computer also uses two ten-milliwatt lasers and various

lenses, beam splitters, and pattern masks. Optical computers have one problem that electronic computers do not—alignment. You can't do much computing if a beam misses a switch, and it takes considerable work to line up all the beams precisely. Alignment difficulties are among the reasons Huang's computer only uses a part of its capability. That isn't a problem in a standard computer since the electrons travel within conductors—mask registration difficulties during IC wafer fabrication notwithstanding. Once an IC chip is built and tested, it will always work without worry of further alignment adjustments.

As we said, the AT&T computer is a straightforward reproduction of existing computer architecture on a different medium—light. There are other ways of using light to compute; let's look at some of the alternatives.

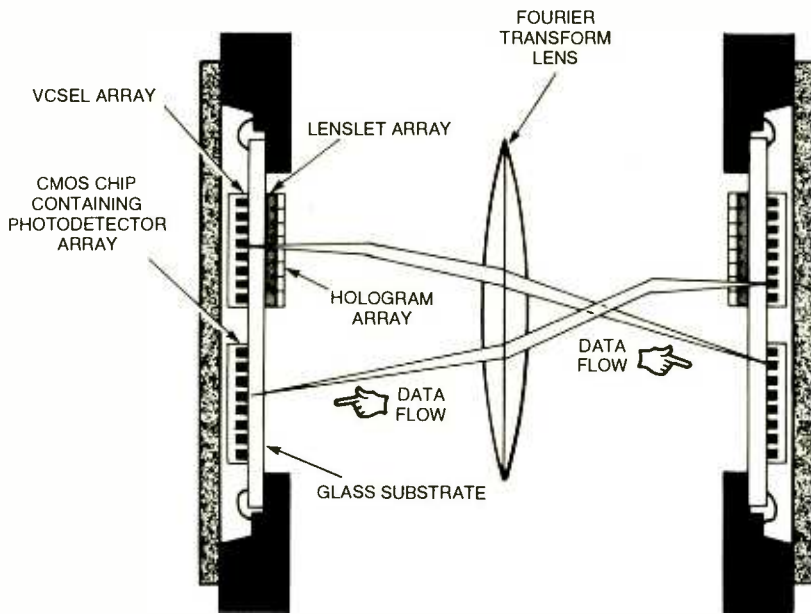


Fig. 4. Smart-Pixel Arrays are the latest in laser parallel ports. This diagram illustrates the data flow of light between two systems in an optical network. A laser array works in unison with a hologram array in order to direct light towards specific inputs of a photodetector array.

Spatial Light Modulators. Spatial Light Modulators (SLMs) take advantage of light's unique properties. They direct multiple beams in multiple directions to permit parallel-processing operation. SLMs are like a cross between a piece of photographic film and a Liquid-Crystal Display (LCD). They are made up of many tiny squares, and electronics or light controls each square. A square allows some, none, or the entire signal beam to pass.

One of their primary uses is pattern matching. An input signal controls one SLM. The result comes from comparing its output to a second SLM controlled by the computer. This method can determine exact matches or near misses. It also gives the answer, literally, at the speed of light, allowing for easier and faster "fuzzy-logic" matching than today's computers.

Like other optical switches, SLMs can be either transmissive or reflective. The transmissive type either passes or stops the light. The reflective type either reflects or absorbs (redirects) the light. The reflective type requires beam splitters to direct the reflected light (see Fig. 3).

As mentioned, SLMs can store reference patterns. These patterns might be actual images, numbers, or any other encoded information.

They can hold binary numbers by encoding them positionally along the squares. With proper encoding and positioning, they perform extremely fast mathematical calculations. Using two SLMs and passing light through their associated squares allows them to add, subtract, multiply, or divide. The nice thing is that the calculation takes place immediately regardless of the length of the number. In a digital computer, calculations usually take a considerable amount of digit shifting and manipulation. An optical computer calculates the entire number simultaneously. It's only limited by the number of squares and the complexity of the SLM.

Using Holograms To Compute.

Holographic computers work similarly to SLMs, but with greater accuracy. Such computers can compare a holographic image with a reference hologram. The reference hologram must be created specifically for the task and can be either computer generated or created from real-world input, such as an image or other signal. Refer to the sidebar for some more information on holograms.

To use a holographic computer, you apply a holographic input signal to the reference hologram,

which is used as a filter. The resulting light pattern is usually monitored by a charged-coupled device (CCD) array. The CCD is a digital-imaging unit, like a television camera, that is used for optical imaging in camcorders, telescopes, and other devices. A CCD produces a digital output representing any image focused on its surface. This combination of holographic filtering and CCD matching and monitoring can identify faces, fingerprints, or parts on an assembly line.

Holograms are also being used to aid in data transfer and storage. Smart-Pixel-Array (SPA) modules use hologram arrays to help direct light sent by tiny Vertical-Cavity Surface-Emitting Lasers (VCSEL). Researchers at the University of Colorado at Boulder are currently working with SPA-modules for their ongoing optical-computer research (see Fig. 4).

A BRIEF HISTORY OF HOLOGRAMS

In 1947, Dr. Dennis Gabor developed the theory of holography while trying to improve the resolution of an electron microscope. Until the invention of the laser in 1960, no coherent source of light existed for the creation of holograms. Only four years after the creation of the laser, Emmett Leith and Juris Upatnieks created the first laser-hologram entitled "Train and Bird." The basic equipment has not changed from that day—a continuous wave laser, optics (lens, mirror, and splitter) for directing the light, a film holder, and an isolation table for exposing the subject to laser bombardment.

In 1971, Dr. Gabor received a Nobel Prize for his discovery. By that time, holographic art was flourishing and there were techniques that made it possible to view the images under white-light conditions. Over five decades have passed since the birth of holography, and, like all major breakthroughs, holograms have found themselves absorbed by the mainstream. Even bulk-mail advertising employs holograms as a flashy eye-catcher. Credit cards, UPC scanners, and heads-up displays—all of these use holograms. The latest advance in holograms is the use of blue-green laser light to record an image on a polymer called azobenzene. The process takes a matter of nanoseconds and requires no chemical processing—instant holograms! Holograms created from this method may one day be used to form waveguides for blazing optic switches.

NEURAL NETWORKS

Computers that learn are no longer characters in science-fiction novels. Major organizations have been funding research in the field of neural networks. As the name implies, neural networks are meant to mimic the operation of the neurons within our brain. The result is a mesh of tiny switches that exist in a spatial environment where (theoretically) parallel communication is possible in the direction of any of the three freedoms (x, y, and z axes). Information is passed along carriers of light waves at speeds pushing the envelope of the microwave-band frequencies. Neural networks can be used to control self-assessing assembly lines, replace deteriorating portions of a living brain, and serve as the AI (Artificial Intelligence) for an android.

Don't search the Web for an android just yet. Work in the field of neural networks is still in a highly experimental stage. Most of the work until now has gone into computer simulations rather than actual physical models. Those test systems are designed to recognize patterns in numbers. As computers begin to pick out patterns in data flow, the machines actually develop a memory of their own—the process of learning! It seems that neural networks, like most computer technologies, have to be developed from the ground up—no short cuts. Today's neural node struggling in a lab to count to one trillion by radicals of sixteen might be, in a decade, able to balance a budget for a nation.

num size and the applications of optical devices. Even so, the limit is so small that it is usually not a problem. By the time we reach the point where we must deal with the positions of single photons, we may have completely new computing methods or have learned enough that the uncertainty doesn't matter.

Scientists are using "squeezed light" to reduce some of the uncertainty. They do this by controlling a laser beam to create areas of greater uncertainty at certain points along the beam. Since the overall uncertainty is conserved, this process results in areas with lower uncertainty elsewhere in the beam. In other words, there are points along the beam where the photons are restricted to a smaller area than average; we are more certain where they are. By increasing most of the uncertainty in a particular area, we can work more precisely with the remaining areas.

Optical Storage. While the Bell Labs' computer has no significant storage capacity, the capability of optical storage is enormous. The commercial Compact Disc (or CD) can store about 650 megabytes of optical information with some CD recorders pushing the limit to 700 megabytes. Furthermore, that is by no means near the physical limit of optical storage. Experiments at the University of California at Irvine are approaching the true limits. They have shown that the theoretical storage density of a two-dimensional medium, like a CD, is about 350 megabits per square centimeter. This means a CD could hold about 44,000 megabits or about 5.5 gigabytes. That is the equivalent of 10 standard CDs. DVD discs have realized that density. One layer weighs in at 4.7 gigabytes.

Even that isn't the true limit of optical storage. The DVD specifications allow for two "layers" per surface. By focusing the laser deeper into the disc, a second "disc" becomes visible. Today's hardware is designed for eventual double-sided (top and bottom), double-layered discs. The four-layer "sandwich" will top out at a whopping 17 gigabytes. If we go to three-dimensional optical cubes, we can store 6500 billion bits per cubic centimeter. A handful of these cubes could easily hold the equivalent of the Library of Congress. Combining this type of storage with the speed of light for retrieval and processing will provide some significant technological achievements.

Quantum Limits. According to the Heisenberg Uncertainty Principle, the more you know about the position of a photon in time and space, the less you'll know about its mass and energy. Since a laser beam consists of photons that have approximately the same energy and frequency, we know the energy of the photons pretty well. That limits the certainty with which we can know where a particular photon is in space.

Because the most we can say about a photon's location is that it will be within a given area, we must allow for detection of photons over the entire area. That limits the mini-

Researchers in Colorado have managed to steer rubidium atoms through fibers as narrow as 10 microns. Advances in particle control may lead to the "painting" of circuits on an atomic scale—something far more practical than IBM's demonstration of writing the letters "IBM" with individual gold atoms.

The Optical Future. One of the holy grails of computing is artificial intelligence. A machine that can think like a human has been sought since before the beginning of the computer age. Recent neural-network research shows promise in that vein. It attempts to mimic the way neurons are connected and operate in the brain, but it is restricted by today's computer technology. One of the problems is duplicating the millions of parallel connections that exist between real neurons as well as imitating neurons' analog nature (see the sidebar for more information on neural networks).

Optical computing may overcome those limitations. Holographic and SLM techniques may give us the parallel and analog capabilities needed to mimic the brain. If so, optical computing will lead to true artificial intelligence and take us one giant step into the future.

However, the future of optical computing is still questionable. If optical computers are to become standard, they must be faster, better, and/or have significantly unique ability. Better is probably out of the question because of the critical alignment needs—an electronic computer is better from a maintenance and manufacturing viewpoint—at least for now. Today's computers are faster right now, but as semiconductors become smaller and chip designers begin taking advantage of quantum effects, speed may not be an issue in the future. The real advantage of optical computers will come from their special abilities: holographic storage and processing. The high capacity of three-dimensional storage and the non-interfering qualities of light are the keystones of optical computing and may help it overtake electronic technology.

RETAILERS THAT SELL OUR MAGAZINE EVERY MONTH

Arizona

Elliott Elec. Supply
1251 S. Tyndell Ave.
Tucson, AZ 85713

California

All Electronics
14928 Oxnard Street
Van Nuys, CA 91411

California Electronics
221 N. Johnson Ave.
El Cajon, CA 90202

Electronics Plus, Inc.
823 4th St.
San Rafael, CA 94901

Electronics Warehouse
2691 Main Street
Riverside, CA 92501

Ford Electronics
8431 Commonwealth Ave
Buena Park, CA 90621

HSC Electronics
5681 Redwood Drive
Rohnert, CA 94928

HSC Electronics
4837 Amber Lane
Sacramento, CA 95841

Halted Specialties Co.
3500 Ryder Street
Santa Clara, CA 95051

Inland Electronic Suppliers
1012 N. Carpenter Rd.
Modesto, CA 95351

Kandarian Electronics
1101 19th Street
Bakersfield, CA 93301

Mar Vac Electronics
2001 Harbor Blvd.
Costa Mesa, CA 92627

Mar Vac Electronics
1759 E. Colorado Blvd.
Pasadena, CA 91106

Mar Vac Electronics
4747 Holt Blvd.
Montclair, CA 91763

Mar Vac Electronics
5184 Hollister Blvd.
Santa Barbara, CA 93111

Mar Vac Electronics
2537 Del Paso Blvd.
Sacramento, CA 95815

Mar Vac Electronics
2000 Outlet Center Dr. #150
Oxnard, CA 93030

Mar Vac Electronics
12453 Washington Blvd.
Los Angeles, CA 90066

Metro Electronics
1831 J Street
Sacramento, CA 95814

Orvac Electronics
1645 E. Orangethorpe Ave.
Fullerton, CA 92631

Sav-On Electronics
13225 Harbor Blvd.
Garden Grove, CA 92643

Colorado

Centennial Elec. Inc.
2324 E. Bijon
Colorado Springs, CO
80909

Connecticut

Cables & Connectors
2315 Berlin Turnpike
Newington, CT 06111

Illinois

Tri State Elex
200 W. Northwest Hwy.
Mt. Prospect, IL 60056

Maryland

Mark Elec. Supply Inc.
11215 Old Baltimore Pike
Beltsville, MD 20705

Massachusetts

Electronic Hook-Up
104 Main St.
Milford, MA 01757

"You-Do-It" Electronics
40 Franklin Street
Neeham, MA 02494

Michigan

Purchase Radio Supply
327 East Hoover Avenue
Ann Arbor, MI 48104

The Elec. Connection
37387 Ford Road
Westland, MI 48185

Minnesota

Acme Electronics
224 Washington Avenue N.
Minneapolis, MN 55401

Missouri

Gateway Electronics
8123-25 Page Blvd.
St. Louis, MO 63130

New Jersey

Lashen Electronics Inc.
21 Broadway
Denville, NJ 07834

New York

LNL Distributing Corp.
235 Robbins Lane
Syosset, NY 11791

T&M Elec. Supply, Inc.
472 East Main Street
Patchogue, NY 11772

Unicorn Electronics
Valley Plaza
Johnson City, NY 13790

Ohio

Parts Express
725 Pleasant Valley Drive
Springboro, OH 45066

Oregon

Norvac Electronics
7940 SW Nimbus Avenue
Beaverton, OR 97005

Texas

Computers Electronics Etc.
110 E. Medical Center Blvd.
Webster, TX 77598

Electronic Parts Outlet
3753 B Fondren
Houston, TX 77063

Tanner Electronics
1301 W Beltline
Carrollton, TX 75006

Washington

Supertronix Inc.
16550 W. Valley Hwy.
Tukwila, WA 98188

*Barnes & Noble • B. Dalton • Crown Books • Tower Books • Super Stand
Borders Book Store • On Cue • Hastings • Media Play • Walden Book Store
Just About Every Major Book Store!*

**If you'd like to sell our magazine in your store, please circle 180 on free
information card or Contact Gina Giuliano at (631) 592-6720 ext 215**

THE LASER CLINIC

SKIP CAMPISI

Here are five practical circuits that can be utilized as design guides for powering up your own laser, along with some tips on optical-beam collimation.

If you're like me and a lot of other hobbyists out there, you've probably succumbed to the tempting low surplus price of at least one laser tube or laser diode. After all, how could we resist? The pleasure of building our own operational laser system guarantees us a spot in the "high-tech" realm of our hobby, especially when impressing the uninitiated!

As you've probably since discovered, it might also have been a very wise idea to obtain the appropriate power supply along with the laser—something that always seems to get neglected. Having 20/20 hindsight is always wonderful! However, the laser is still collecting dust due to a lack of driver-design information on using off-the-shelf components. This article will teach you methods of using readily available, standard, parts to get your laser up and running quickly without spending a fortune.

We're not going to discuss laser-operating theory here—just the "nuts and volts" required to make them lase. We'll also have a look at using lenses to optically collimate the laser beam and at methods for heatsinking diode lasers. If you'd like to look more in depth at the subject of lasers, there are many good books available. Among them is *The Laser Cookbook* (published by TAB Books) by former **Poptronics** columnist Gordon McComb,

He-Ne Laser Tubes. We'll start our discussion with our old friend the Helium-Neon (He-Ne) laser tube, which requires the most difficult (and dangerous!) power-supply design. The high voltages necessary for plasma generation are usually beyond the average hobbyist's design capabilities, and high-voltage components are expensive and difficult to obtain. But, fear not! There is always another suitable method available.

Several years ago, I purchased a He-Ne laser tube from MWK Industries *without* the supply. It was their part number RO99 and was rated at 1 mW at 3.7 mA when using a 1230-volt DC supply. MWK recommended an 8- to 10-kilovolt (that's right: 10,000 volts!) ignition to light the plasma. Referring to Fig. 1, you'll see the cir-

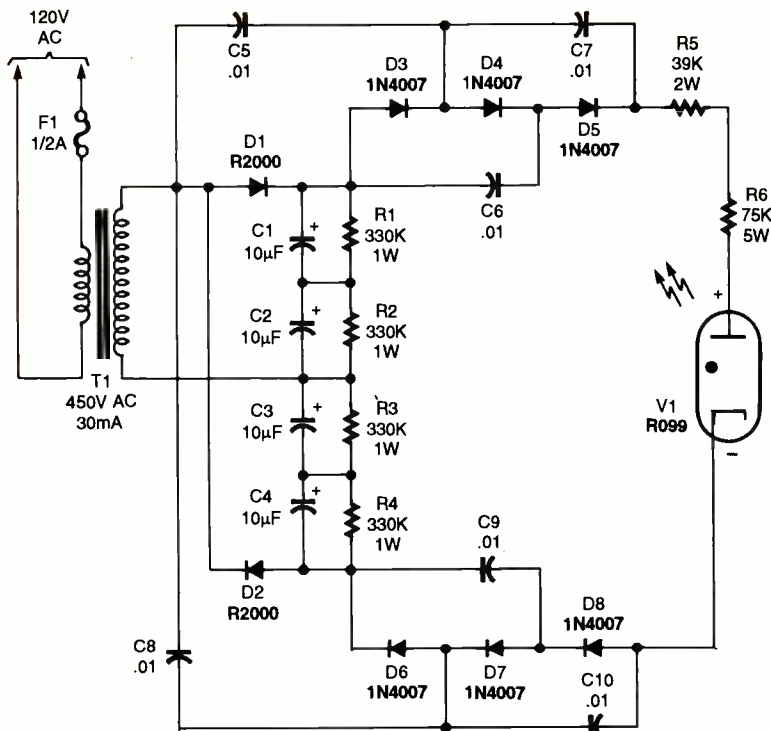


cuit I finally designed from what I had on hand, which functioned perfectly.

The first problem was deciding whether to use a battery supply or straight AC from the wall socket. Many good 12-volt DC-operated laser supplies exist in surplus; however, they are somewhat "current-hungry" and soon run your battery down. Powering one of these supplies with an AC adapter is rather redundant, so I decided to "cut out the middleman" and design a straight AC supply. Of course, that meant finding an appropriate high-voltage transformer—not an easy task!

Luckily, I had a 450-volt, 30-mA AC transformer (T1) on hand. Similar types might still be available from electrical supply houses, but could take a little digging to locate. An alternate method is to use two 230-volt, 25-mA AC units: Wire the secondaries in series, with the 120-volt AC primaries in parallel. The Magnetek FP230-25 "Flat-Pack" transformers (Mouser number 553-FP230-25) are "hi-pot" tested at 2000 volts AC, and they should be ideal. Those devices just mentioned are PC-mounted types.

WARNING: Laser radiation is dangerous and can cause permanent eye damage. Avoid direct or reflected exposure. The voltages used in this project are hazardous and can be lethal. Have a partner work with you when building and testing this system.



PARTS LIST FOR THE HE-NE TUBE DRIVER (FIG. 1)

SEMICONDUCTORS

D1, D2—R2000 silicon rectifier diode, 2000 PRV
 D3—D8—1N4007 or 1N5408 silicon rectifier diode, 1000 PRV

RESISTORS

(All resistors are 5% units unless otherwise noted.)
 R1—R4—330,000-ohm, 1-watt, carbon-film
 R5—39,000-ohm, 2-watt (see text)
 R6—75,000-ohm, 5-watt (see text)

CAPACITORS

C1—C4—10-µF, 450-WVDC, aluminum electrolytic
 C5—C10—0.01-µF, 1000-WVDC, ceramic-disc

ADDITIONAL PARTS AND MATERIALS

F1—½-amp fuse
 T1—120-volt AC primary/450-volt AC, 30-mA secondary step-up transformer
 V1—MWK type RO99 He-Ne laser, 1-mW
 Terminal strips, heatsink material, lenses, enclosure, fuse holder, wire, hardware, etc.

Fig. 1. This line-operated He-Ne laser power supply provides automatic high-voltage plasma ignition upon startup.

Transformer T1's actual open-circuit output measured about 550 volts AC, and adding a well-filtered doubler yielded about 1500 volts DC unloaded. Using a dummy load (drawing 3.7 mA) resulted in a 1375-volt DC output, which is typical for low-current transformers. The laser tube came with a 75,000-ohm, 5-watt ballast resistor (R6), which, at 3.7 mA, drops about 280 volts. Thus, the tube drops 1230 - 280, or about 950 volts at 3.7 mA. We need to drop an additional 145 volts (1375 - 1230) with R5 to maintain the tube voltage. A 39,000-ohm, 2-watt resistor was selected to drop 145 volts at 3.7 mA. Use a similar technique to select your ballast resistors. The higher-than-expected power ratings are necessary due to the high ignition voltages.

The doubler itself is comprised of D1, D2, C1-C4, and R1-R4. Use "R2000" diodes (devices with a 2000-volt peak-reverse-voltage, or PRV, rating) for D1 and D2; 10-µF, 450-WVDC capacitors for C1-C4; and 330,000-ohm, 1-watt resistors for R1-R4. For the sake of safety, all of the components (except T1 and the tube) were mounted on barrier-terminal strips using test-probe wire for all of the interconnections. Once you have the doubler working and have selected R5 and R6, you may proceed with the ignition multiplier.

NOTE: After removing power from the circuit, make sure that all of the capacitors are discharged before making any circuit adjustments. The charged capacitors present a shock hazard that could be harmful or lethal.

The remaining six diodes (D3-D8) and six capacitors (C5-C10) comprise the high-voltage ignition circuit. Each diode/capacitor "cell" provides an additional 750 volts, totaling 4500 volts for the six cells used. Add

that to the 1500 volts from the doubler, and the tube will see 6000 volts when power is first applied.

This was sufficient to ignite the plasma in my tube; you may add more cells (if needed) for yours. Diodes D3-D8 can be either 1N4007 or 1N5408 units (1000-volt PRV rating), with 0.01-µF, 1000-WVDC ceramic capacitors used for C5-C10. Install those components on barrier strips, also.

Once the plasma is ignited, the supply voltage drops rapidly down to its 1375-volt level, due to the small values of C5-C10 as compared to C1-C4. The laser tube should now be drawing its normal 3.7 mA. To monitor that current, you may simply install a 5-mA analog panel meter in series with the laser's cathode supply lead. For best operation, the anode lead from the laser to the ballast resistor should be as short as possible, say, less than three inches. Note that this particular tube emits the beam from its anode aperture. Check yours to be sure! If you haven't figured it out yet, the cathode end of the laser tube contains most of the metal in the form of a "cage." The anode end is mostly empty glass, with the "capillary" tube running down the central axis.

The output beam from a He-Ne tube typically has very low divergence and can easily be focused to a small point with a simple, convex lens. On the other hand, if you want to project the beam for long distances, it will be necessary to eliminate the initial divergence as much as possible. First, use a short-focal-

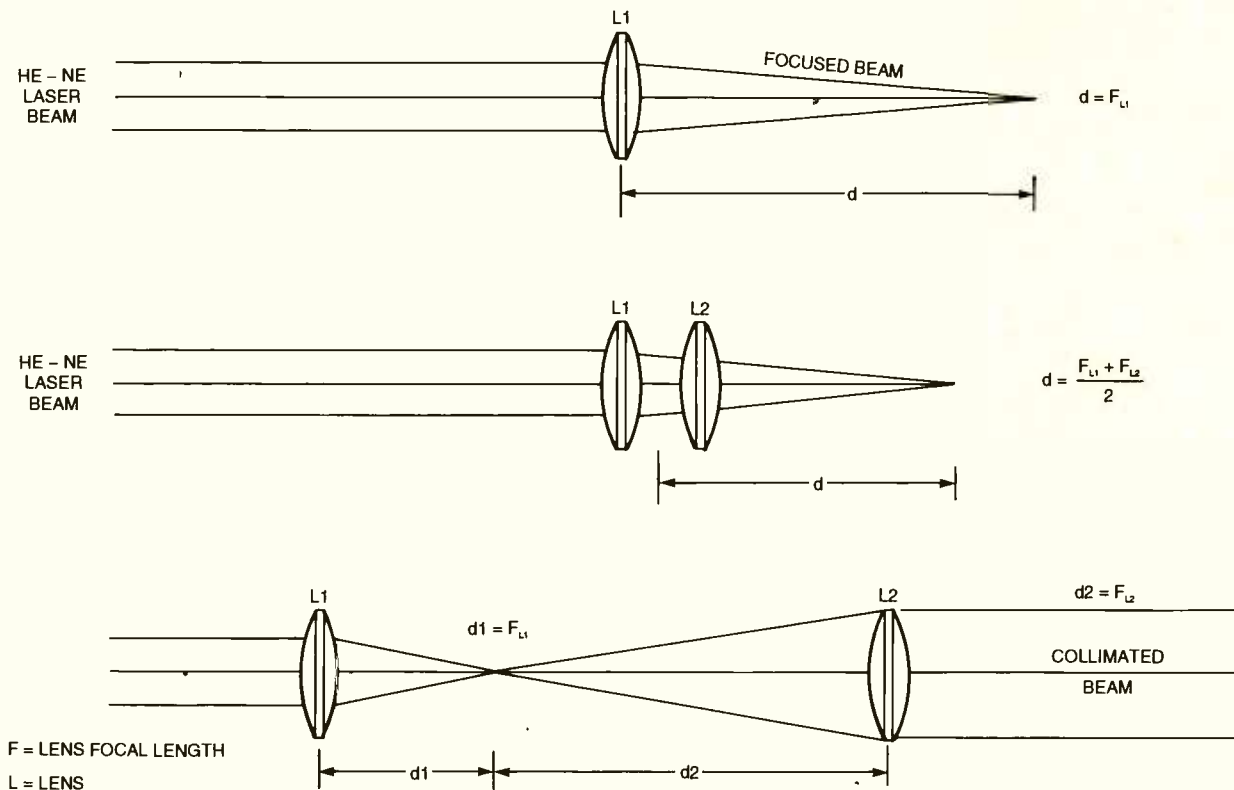


Fig. 2. Collimation and focusing of laser beam emission is quite easily accomplished using short focus (over 1/2 inch) small diameter glass or plastic lenses. If you require shorter focal lengths, stack two similar lenses back to back—the effective focal-length is then halved.

length convex lens to focus the beam to a point. Place another convex lens (about two to five times the focal length of the first lens) ahead of the first lens as shown in Fig 2. Adjust the spacing of the lenses to provide a parallel output beam. Have fun, but be super-careful with this laser system!

Semiconductor Lasers. So far, there are two basic types of laser diodes in use: single-heterostructure (SH) and double-heterostructure (DH) varieties. All require a heatsink of some type, and usually we have to determine the pinouts and polarity ourselves. To obtain a usable beam from them, we also need some sort of collimating optics to focus their diverging (and elliptically shaped!) outputs. The older SH-injection lasers were originally operated at cryogenic temperatures to ensure reasonable operating lifetimes. If you apply continuous operating current at ambient temperature to one of these, it'll simply explode! We'll be exploring the *pulse mode* type of operation for the SH laser. On the other hand, the DH laser has much lower output power and can be operated either in its continuous (CW) or pulse-mode operation at normal ambient temperatures.

A note of caution here: All diode lasers are electrostatic discharge (ESD) sensitive and easily damaged from static discharge. Use the same handling techniques with the diodes as you would with CMOS ICs.

Single-Heterostructure Laser. Most lasers available to

the hobbyist in the surplus market only provide outputs in the milliwatt range. However, the SH diode's output is measured in watts, and the operating currents are in amps—thus, the need for cryogenic cooling or pulsed operation at ambient temperatures. Those high currents make pulsed operation a real chore, as you'll soon see.

My driver circuit was designed around a LASD59 laser diode, which is similar to RCA's 40861. This laser has an invisible 904-nm (infrared) output beam rated at 5 to 9 watts, with a threshold current of 10 amps. The maximum pulsed operating current is 40 amps, with a maximum pulse width of 200 ns and a maximum duty cycle of 0.1%. The circuit illustrated in Fig. 3 achieved those criteria. The circuit oscillates at about 4 to 5 kHz, providing a 20–25-amp current pulse to the laser with a duration of about 50–100 ns—a safe region for this particular diode.

The waveshape of the current pulse is extremely critical, and any current "under-shoot" can damage the laser. I elected to base the current-switching section of my design on a circuit designed by the "original guru" himself, Forrest M. Mims. This one appeared in the October 1971 issue of **Popular Electronics**. In that article, he explained an excellent method for using a transistor (Q1) operating in its "avalanche-breakdown" mode to supply the correct current-pulse waveform to the diode.

Once again, I chose an AC-outlet power for the supply. In this case, a standard "cube" adapter (T1),

PARTS LIST FOR THE SINGLE-HETEROSTRUCTURE LASER DRIVER (FIG. 3)

SEMICONDUCTORS

- LASD1—LASD59 laser diode, 5–9-watt, SH type
 Q1—TO-5/TO-39 metal-can transistor (see text)
 Q2—HEPS3021 NPN silicon transistor
 D1–D5—1N4001 silicon rectifier diode
 D6—1N752 silicon Zener diode

RESISTORS

- (All resistors are 1/4-watt, 5% carbon-film units unless otherwise noted.)
 R1—220,000-ohm
 R2—820-ohm
 R3—7500-ohm
 R4—1.0-ohm, 1-watt

CAPACITORS

- C1, C2—22- μ F, 50-WVDC, aluminum electrolytic
 C3, C4—22- μ F, 100-WVDC, aluminum electrolytic
 C5—0.01- μ F, 250-WVDC, Mylar

ADDITIONAL PARTS AND MATERIALS

- T1—24-volt AC, 100-mA AC wall-mounted adapter
 Terminal strips, heatsink material, lenses, enclosure, wire, hardware, etc.

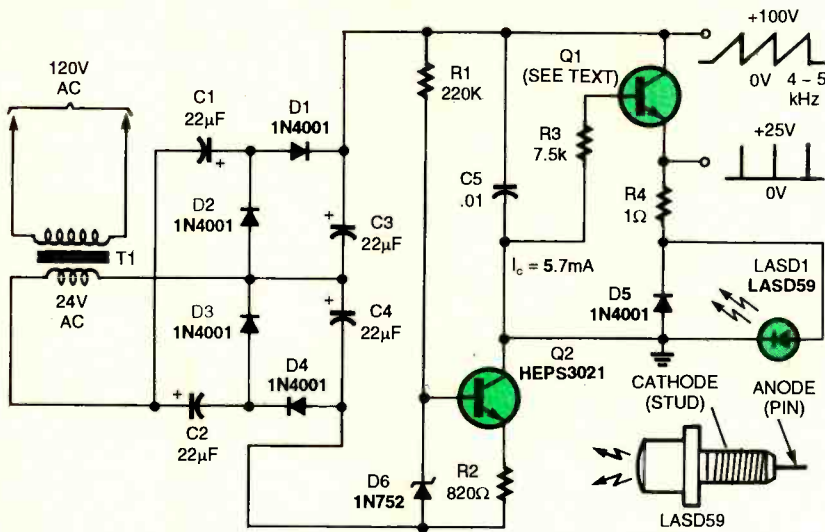


Fig. 3. The single-heterostructure laser diode requires special high-current pulse circuitry when operating at normal, ambient temperatures.

rated at 24-volts AC and 100 mA, drives a full-wave "quadrupler" with an output of about 120 volts DC. I used 1N4001 diodes for D1–D4; 22- μ F, 50-WVDC capacitors for C1 and C2; and 22- μ F, 100-WVDC capacitors for C3 and C4. An HEPS3021 transistor was selected for Q2, configured as a 5.7-mA constant-current sink, along with R1, R2, and D6. Any NPN-type medium-power transistor with a rating of 1 watt and a V_{CE} of 150 volts or more can be used for Q2. Diode D6 is a standard 5.6-volt, 1/2-watt Zener diode.

Assemble all of the above power-supply components on a small piece of perfboard (except for T1) and attach a heatsink to Q2. Before you begin assembling the driver itself, Q1 must be hand selected for the proper breakdown voltage. **Note: Q1's collector—and thus its case and heatsink—is a high-voltage terminal**

and poses a shock hazard.

Capacitor C5 should be a 0.01- μ F, 250-WVDC Mylar capacitor, with D5 a 1N4001 diode. Additionally, R4 should be a 1.0-ohm, 1-watt carbon or carbon-film resistor only.

Put R3, R4, C5, and D5 on a solderless breadboard, leaving holes open to properly

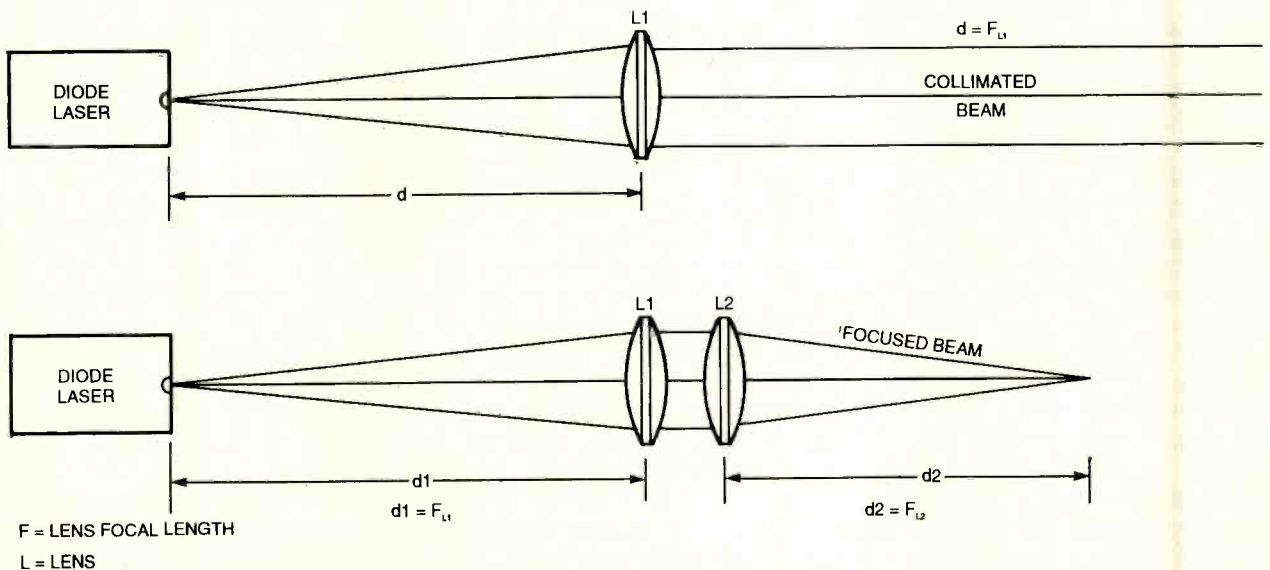


Fig. 4. Collimating and focusing a semiconductor laser takes a bit more thought than the He-Ne variety. Compare this illustration to that in Fig. 2 for the differences. Note that you have to work with a more diverging beam with semiconductors.

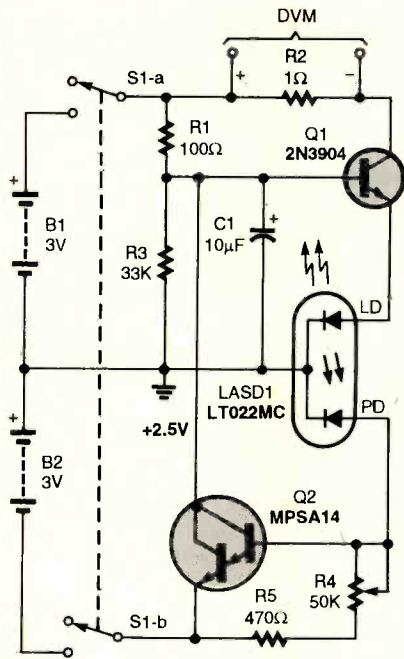


Fig. 5. Note the simplicity of the driver circuit used for the LT022MC 780-nm, 5-mW double-heterostructure laser diode. The ± 3 -volt supply is merely four "N" cells

plug in Q1. Don't install the laser diode yet. Install a bus wire "short" across D5 and connect this "ground" to Q2's collector on the perfboard. The positive lead from D1, R1, and C3 on the perfboard goes to C5 and Q1's collector. Transistor Q1 can be any metal-cased (TO-5/TO-39) NPN transistor such as the 2N2219 or 2N3053 series.

The smaller TO-18 transistors such as the 2N2222 may not survive in this application. Install a "slip-on" heat sink on the transistor and then plug it into Q1's location. Apply 24 volts AC power from T1 to the perfboard. (Use high-voltage precautions.) Using a digital voltmeter (DVM), verify the 120-volt DC output found across the C3-C4 series combination. Attach an X10 oscilloscope probe to Q1's collector with the common lead connected to circuit ground at D5's anode. If Q1's breakdown voltage is below 120 volts, you should see a linear ramp display running at several kHz. This is generated as C5 charges with the 5.7-mA constant current until Q1 breaks down, discharging C5 and restarting the charge cycle. The peak voltage of the ramp should fall between 90 and 110 volts DC to provide a 20-25-amp current pulse.

Keep substituting transistors for Q1 until you find one that breaks down in that range. Be sure to allow the power-supply capacitors time to self-discharge before attempting circuit changes. Verify that with your DVM! Finally, attach the scope leads directly across R4, the 1.0-ohm resistor. You should see a 50-100-ns, 20-25-volt pulse displayed at about a 4- to 5-kHz repetition rate. When satisfied, proceed with the final assembly.

SH-type laser diodes have a package with a threaded mounting stud (usually the cathode) and a

PARTS LIST FOR THE 780-NM DOUBLE-HETEROSTRUCTURE LASER DRIVER (FIG. 5)

SEMICONDUCTORS

- LASD1—SHARPLT022MC laser diode, 5-mW, DH-type
- Q1—2N3904 NPN silicon transistor
- Q2—MPSA14 NPN silicon Darlington transistor

RESISTORS

(All resistors are 1/4-watt, 5% carbon-film units unless otherwise noted.)

- R1—100-ohm
- R2—1.0-ohm
- R3—33,000-ohm
- R4—50,000-ohm, multi-turn potentiometer
- R5—470-ohm

ADDITIONAL PARTS AND MATERIALS

- B1, B2—1.5-volt "N" cell, alkaline
- C1—10- μ F, 15-WVDC, tantalum electrolytic capacitor
- S1—Double-pole, double-throw mini-toggle or slide switch
- Terminal strips, heatsink material, lenses, enclosure, wire, hardware, etc.

center-conductor lead wire (usually the anode). Refer to the sidebar for polarity identification information. Mount the diode in a clearance hole through a 1/8-inch-thick piece of aluminum about 1-inch square or larger. Use a matching nut (the LASD59 has 4-40 threads) to hold the diode in place, while also capturing a solder lug under the nut. Assemble Q1, D5, R3, R4, and C5 on another small piece of perfboard using very short leads for interconnections.

Maintaining proper polarity, connect the laser diode/heat sink assembly to the driver board: Its

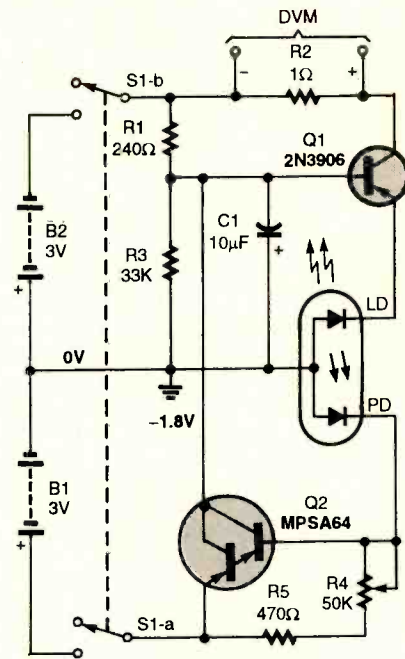


Fig. 6. Due to its common-anode package configuration, the ML720 1300-nm, 5-mW DH laser diode uses a "flip-flopped" version of the driver shown in Fig. 3.

PARTS LIST FOR THE 1300-NM DOUBLE-HETEROSTRUCTURE LASER DRIVER (FIG. 6)

SEMICONDUCTORS

- LASD1—ML720 laser diode, 5-mW, DH-type (Mitsubishi)
- Q1—2N3906 PNP silicon transistor
- Q2—MPSA64 PNP silicon Darlington transistor

RESISTORS

(All resistors are 1/4-watt, 5% carbon-film units unless otherwise noted.)

- R1—240-ohm
- R2—1.0-ohm
- R3—33,000-ohm
- R4—50,000-ohm, multi-turn potentiometer
- R5—470-ohm, 4-watt

ADDITIONAL PARTS AND MATERIALS

- B1, B2—1.5-volt "N" cell
- C1—10- μ F, 15-WVDC tantalum electrolytic capacitor
- S1—Double-pole, double-throw mini-toggle or slide switch
- Terminal strips, heatsink material, lenses, enclosure, wire, hardware, etc.

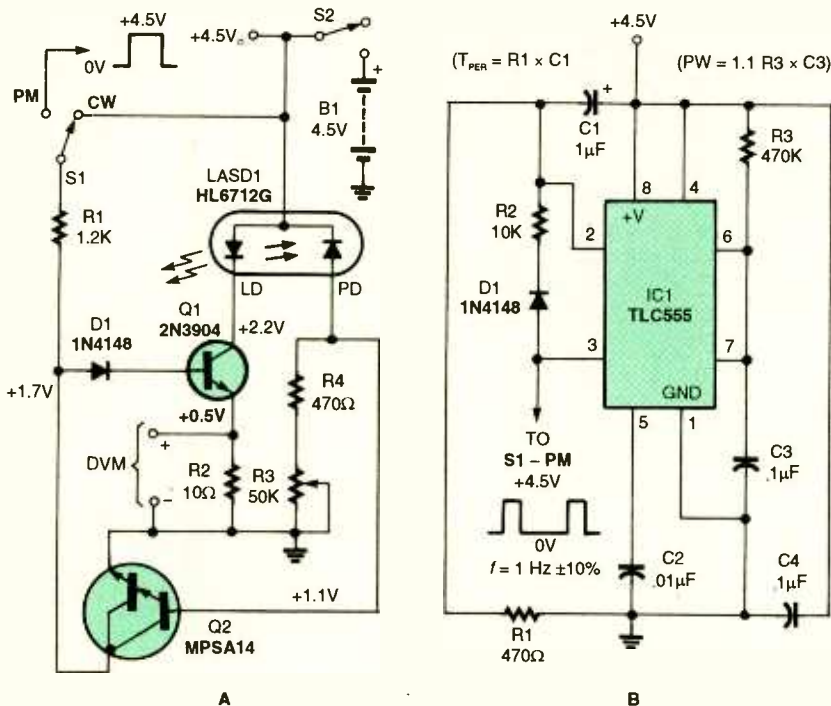


Fig. 7. The 670-nm, 5-mW visible DH laser driver (A) uses only a positive supply and may be operated in either continuous or pulsed mode. The simple fixed oscillator shown (B) provides a 50-ms pulse at a 2-Hz rate.

anode lead goes directly to D5's cathode lead, and its cathode lug is connected to D5's anode lead with a short piece of 18-gauge bus wire. Connect the previously assembled power-supply board to the driver board with a 3-inch or shorter "twisted-pair" of insulated/stranded wire. (Again, maintain proper polarity.) Install an appropriate power jack at the supply inputs for the wall-mounted "cube" adapter.

Once you have everything completely wired and checked out, you're ready to test the laser. **WARNING:** This device emits invisible, high-power, infrared laser radiation, which can cause permanent eye damage. Avoid direct or reflected exposure to the beam. Point the laser away from you and towards a non-reflecting surface. You may use an infrared-sensing phosphor card to locate the beam and collimating optics. RadioShack carries such an item: Their part number 276-1099 IR Sensor Card is made for this purpose.

To do any useful work with the SH laser, you'll probably want to collimate the diverging laser beam into a parallel beam or even focus it to a small point. Refer to Fig. 4 for an easy method that uses simple lenses to do so safely!

Double-Heterostructure Laser. Packages containing DH laser-diode chips resemble TO-18 metal-can transistors with a window installed on the end of the can. Those packages may have three or four leads, depending on their pinouts. All modern DH lasers include an optical-power monitor in their cans, along with the laser chip. The monitor is a PIN-type photodiode used as a negative-feedback element to maintain a constant optical-power output.

Several different pinout configurations are used, depending on the laser manufacturer. The laser anode may share a common lead with the monitor anode; the laser cathode may share a common lead with the monitor cathode; or the laser anode may share a common lead with the monitor cathode. Other possibilities do exist; if you're not sure about your laser, refer to the sidebar for safe polarity-identification procedures.

DH lasers also come in two different-size cases: 5.6 mm and 9.0 mm. Both sizes require adequate heatsinking. The smaller case has a barrel diameter of about $\frac{5}{16}$ inch; the larger is about $\frac{1}{4}$ inch in diameter. A good heatsink could be anything ranging from a clip removed from a 3AG fuse holder to a re-shaped TO-18 transistor heatsink to a sophisticated "clamp" made from a piece of aluminum barstock. Many off-the-shelf collimating lenses include a built-in heatsink. Be sure to use something for a heat sink before powering up your laser!

PARTS LIST FOR THE 670-NM DOUBLE-HETEROSTRUCTURE LASER DRIVER (FIG. 7A)

SEMICONDUCTORS

LASD1—HL6712G laser diode, 5-mW, DH-type
Q1—2N3904 NPN silicon transistor
Q2—MPSA14 NPN silicon Darlington transistor
D1—1N4148 silicon switching diode

RESISTORS

(All resistors are $\frac{1}{4}$ -watt, 5% carbon-film units unless otherwise noted.)

R1—1200-ohm
R2—10-ohm
R3—50,000-ohm, multi-turn potentiometer
R4—470-ohm

ADDITIONAL PARTS AND MATERIALS

B1—1.5-volt "N" cell
S1, S2—Single-pole, single-throw mini-toggle or slide switch
Terminal strips, heatsink material, lenses, enclosure, wire, hardware, etc.

PARTS LIST FOR THE LASER-DIODE PULSER (FIG. 7B)

SEMICONDUCTORS

IC1—TLC555 or 7555 CMOS timer, integrated circuit
D1—1N4148 silicon switching diode

RESISTORS

(All resistors are $\frac{1}{4}$ -watt, 5% carbon-film units.)

R1, R3—470,000-ohm
R2—10,000-ohm

CAPACITORS

C1—1- μ F, 16-WVDC, tantalum electrolytic
C2—0.01- μ F, ceramic-disc
C3, C4—0.1- μ F, ceramic-disc

SOURCE INFORMATION

American Science & Surplus

3605 Howard St.
Skokie, IL 60076
847-982-0870
www.sciplus.com

All types of lenses and other electromechanical "doo-dads." Item number 21332 (\$2 each) contains an assortment of 20 small acrylic lenses—ideal for laser collimation

Meredith Instruments

5420 W. Camelback Rd. #4
Glendale, AZ 85301
623-934-9387
www.mi-lasers.com

All types of lasers and laser accessories

Mouser Electronics

958 N. Main St.
Mansfield, TX 76063
800-346-6873
www.mouser.com

All standard and high-voltage components and semiconductors

MWK Industries

455 W. La Cadena 14
Riverside, CA 92501
800-356-7714
www.mwkindustries.com

All types of lasers and laser accessories

Timeline, Inc.

2539 W. 237 St.
Building F
Torrance, CA 90505
310-784-5488
www.digisys.net/timeline

670-nm visible-red and 1300-nm IR laser diodes at \$15 each

One of the main considerations in designing DH driver circuits is the operating voltage of the laser diode when drawing full operating current. That voltage drop dictates the voltage "ceiling" required for extended battery life and, thus, the minimum power-supply voltage needed. The low current drains of the following three circuits allow us to use alkaline 1.5-volt type "N" cells (series-connected) for the supply.

780-nm DH Laser Diode. The Sharp LT022MC laser diode is now quite commonly found through surplus suppliers for anywhere from \$5 to \$20 and is available in both package sizes. It is rated at 5 mW maximum at 780 nm or very-near infrared; all you'll see from this one is a dull red glow. However, be forewarned: it's just as dangerous as a 5-mW visible laser! Avoid direct or reflected exposure, as permanent eye damage could result.

Referring to Fig. 5, you'll notice that this design uses a 3-volt split supply (four series-connected "N" cells with a center-tapped ground) due to the common-cathode laser package configuration. At a typical operating current of 45 mA, the laser's operating voltage is about 1.8 volts. Adding this to the 0.7-volt V_{BE} of Q1 yields a total drop of 2.5 volts, only $\frac{1}{2}$ volt below the 3-volt supply rail. This is a bare-bones ceiling. However,

you can always swap the "N" cells from the negative supply (which draws little current) with those of the positive supply, when needed.

To get the most out of the positive power supply, R1 (100 ohms) was selected to draw 5 mA at the 0.5-volt drop. Reducing R1 to 51 ohms may further extend usage, at the cost of a 1-mA drain. When calculating this current, allow about 1 mA for biasing Q1. For extended use, it might be wise to add another "N" cell to the positive supply for a +4.5/-3.0-volt supply. You be the judge!

This simple circuit can be built on a small piece of perfboard—nothing is critical. However, it is recommended that you first breadboard the circuit, which will allow you to eventually replace R4 and R5 with a fixed resistor after calibration is complete. That way, you'll never have to worry about mechanical vibration disturbing the "delicate" setting of R4.

The first step is to purchase or fabricate a heatsink for the laser package. One square inch of metal is more than sufficient for those low-power units. Install the heatsink and proceed to breadboard the circuit. Transistor Q1 is a standard 2N3904 NPN general-purpose transistor, with Q2 being an MPSA14 NPN Darlington unit in a TO-92 plastic package. A 2N6427 unit is a good substitute for the MPSA14. Capacitor C1 is a 10- μ F tantalum capacitor, and all fixed resistors are $\frac{1}{4}$ -watt, 5% carbon-film units.

Select a good quality multi-turn trimpot for R4, the 50,000-ohm calibration unit. A 22-turn device would be ideal if you can find such a beast. Install the trimpot on the breadboard wired as a variable resistor. Using a DMM (digital multimeter), pre-set R4 to its maximum resistance. Failure to do so might result in the destruction of your laser diode! Connect the leads from a DVM across R2 (1.0 ohms nominal), whose voltage drop will be used to monitor laser current. **NOTE:** As with the previous laser driver, be sure to point the laser beam towards a non-reflecting surface!

When power is first applied to the circuit with R4 set at its maximum resistance, minimal lasing will occur with threshold current flowing through the laser diode. That result is due to the negative feedback action of the photodiode and Q2. The current appears at the bottom of the "knee" on the power-out/ current-in characteristic curve of the laser.

Before the knee, the diode behaves just like an LED, with a linear increase of *incoherent* radiation as the current increases. Lasing begins at the knee, producing *coherent* radiation, which increases at a much steeper linear rate per current increase.

THINK "SAFETY!"

WARNING: Laser radiation can cause permanent eye damage. Avoid direct or reflected exposure from the beam and never point the beam at other people or at animals.

DANGER: The high voltages used in these circuits pose a harmful or lethal shock hazard, including charges stored in the filter capacitors. Use standard high-voltage insulating techniques throughout and have a helper assist you in assembly and testing of such circuits.

POLARITY TIPS FOR SAFE PINOUT DETERMINATION

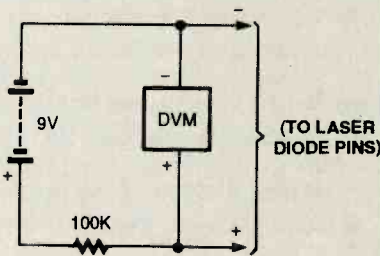
Semiconductor laser diodes tend to have very low reverse-breakdown voltages, where high reverse currents may damage or destroy the diode. Thus, testing these diode junctions with a standard ohmmeter is not recommended. Here's a way to fabricate a simple, low-current meter to test polarity and pinouts in a safe manner.

All you need for this test is a DVM (the voltage measurement section of your DMM) along with a 100,000-ohm, ¼-watt resistor connected to one terminal of a standard 9-volt battery. The resistor will limit current through the diode to less than 100 microamps. Using a clip lead, connect one end of the resistor to the positive terminal of the battery. Connect the other resistor lead to the DVM's positive lead. This connection will be your positive test lead. Connect the DVM's negative (common) lead to the negative battery terminal; this will become your negative test lead. Use color-coded clip leads from those two points for connection to the laser-package pins.

Apply those two leads to the first two package pins (observing ESD precautions) and note the DVM display. A reading of 0.4 to 0.6 volts is typical of a forward-biased PIN photodiode (positive test lead at the anode of the diode). Similarly, a reading of 1 to 2 volts is typical of a forward-biased laser diode. A reading of about 9 volts indicates that your connection has reverse-biased one of the diodes. Reverse the polarity of your connection to see which diode is connected.

There are two other possible displays using this method: a reading of about 1.4 to 2.6 volts might indicate that you've forward biased both the photodiode and laser together and are reading the sum of their forward voltages. That result can occur when the common lead of the package is shared by opposing diode polarities. Another reading might indicate something between about 4 and 9 volts on certain lasers. That result is due to the low breakdown voltage of the reverse-biased laser diode—some leak and some don't!

The easiest way to sort all of this out is to make a simple diagram of the pin arrangement of your laser diode. Make notes right on the diagram of the voltage readings you observe at each pair of pins. Be sure to test each and every possible combination of pin pairs, switching input polarity at each pair. That is not as complicated as it sounds! Once you've written down all of your readings, it's a simple matter to identify the pinouts and polarities used on your particular package.



The DVM should now be indicating about 40 mV or so. Thus, at a scale-factor of 1 mV per mA, the threshold current of the laser is about 40 mA. This is typical and may be anywhere from 35 mA to 65 mA, depending on the unit. Since this current is on the bottom of the knee, we can expect the "safe" operating level to be in the range of 5–10 mA higher than threshold. Indeed, I tested this circuit (and the following two laser drivers) at 15 mA above threshold with no apparent damage to the laser diodes. Going any further than that without an optical power meter is inviting disaster—stick with 10 mA or less above threshold!

Now that you have a threshold-voltage indication, slowly reduce R4's resistance while monitoring R1's voltage increase. Let it rise about 10 mV maximum above threshold while using an IR phosphor card to verify that you're still lasing. When satisfied, shut off the power and remove R5 from the breadboard. Without disturbing its setting, measure R4's new set resistance and the actual resistance of R5. Total those two values and select a fixed resistor of the same total value.

Install this new resistor in place of R4/R5 on the breadboard and apply power. You should see the same voltage level obtained during calibration, indicating a correct operating level. Once satisfied, assemble the circuit on a small piece of perfboard. Rather than soldering directly to the laser's leads, you can use a standard TO-13 transistor socket. You may mount it on the board or hang it on insulated, stranded hookup wire for off-board laser mounting. Refer to Fig. 4 for tips on optically collimating the beam.

1300-nm DH Laser Diode. The infrared laser diode used in this next circuit (see Fig. 6) is quite interesting! The ML720 has a rating of 5 mW maximum at 1300 nm—a totally invisible output beam. Mitsubishi (the manufacturer) evidently selected this far-infrared wavelength to match their fiber-optic material for low-loss transmission. It has a four-lead, 5.6-mm case, with the fourth lead attached to the case only. The other three leads are in a common-anode configuration and isolated from the case.

This laser is available from Timeline (see the supplier sidebar) for only \$15 plus shipping. It comes in its own ESD-protected foil envelope, which is plainly marked with the operating levels for the individual unit contained within. Half of your work is already done for you! Its output power, threshold current, operating current, operating voltage, monitor current, and actual wavelength are all listed—a real bargain!

Referring to Fig. 6, you'll notice that this design also uses a 3-volt split supply (as in Fig. 5) due to the common-anode laser-package configuration. At a typical operating current of 20 mA, the laser's operating voltage is about 1.1 volts. Adding this to the 0.7-volt V_{BE} of Q1 yields a total drop of 1.8 volts, about 1.2 volts above the 3-volt supply rail. That's a fairly good "ceiling" voltage, resulting in extended battery life. Resistor R1 is selected to draw 5 mA once again, with a value of 240 ohms required for a 1.2-volt drop. You'll also notice that the common-anode configuration requires a "flip-flop" of the circuit shown in Fig. 5.

To maintain the proper forward-bias to the laser diode and reverse-bias to the photodiode, we have substituted PNP transistors for Fig. 5's NPN units. Otherwise, negative-feedback circuit action is exactly the same. Transistor Q1 is now a standard 2N3906 PNP general-purpose unit, and Q2 is a MPSA64 Darling-ton PNP unit in a TO-92 plastic package. Breadboard and calibrate this circuit exactly as the previous DH laser, except this time set the operating current per the laser's package data.

A word of warning: Since this laser has a beam that is totally invisible, it's doubly dangerous—you won't

even know it's causing eye damage until the damage is already done! Be extremely cautious when operating this device. Use the IR phosphor card to continually keep track of the beam.

Once you've set the correct operating level, select a fixed resistor (as with the previous driver circuit) and install it in place of R4/R5. When satisfied, assemble the circuit on a small piece of perfboard, using a TO-18 transistor socket for the laser diode connection as before. Using the IR phosphor card while referring to Fig. 4, you may collimate the beam parallel or focus it to a point as desired.

670-nm DH Laser Diode. Our last circuit is always the most popular of the semiconductor lasers: the 5-mW, 670-nm visible red laser diode. As luck would have it, the driver circuit turns out to be the most flexible of all my designs! This one is based on the HL6712G diode, which is index-guided, rather than gain-guided as with older devices. Once again, Time-line has this laser available for only \$15 plus shipping.

Being index-guided, the HL6712G laser has a threshold current that's less than half of the gain-guided devices—about 35 mA is typical for this diode. Another nice feature is that the laser anode shares a common lead with the photodiode cathode, allowing us to use a single, positive supply instead of split supplies. At a typical operating current of 45 mA, the HL6712G has a voltage drop of about 2.3 volts that leaves only a 0.7-volt "ceiling" if used with a 3.0-volt supply. Assuming that we'd like to keep Q1 and Q2 from saturating, a 4.5-volt supply was chosen so that negative feedback is always 100% reliable in controlling output power. Refer to Fig. 7A to see the advantages gained.

The higher supply voltage allows us to increase the value of R2 (1.0 ohms previously) to 10 ohms and add D1 (1N4148) to Q1's base circuit. That forces Q2's collector to operate at about 1.7 volts, well above its 1.3-volt saturation level. Transistor Q1's collector then operates at 2.2 volts (4.5-2.3) at a V_{CE} of about 1.7 volts—again, well above its 0.7-volt saturation level. Thus, this driver can be switched at high frequencies to yield a pulsed-laser output beam without the risk of damage to the laser! The original 33,000-ohm resistor and 10- μ F capacitor (used for "soft" starts in the previous DH drivers) are not required (or even desirable) in this high-speed circuit.

Switch S1 allows us to select either a continuous-mode (CW) or a pulse-mode (PM) signal for the output beam. For easy interfacing to low-power oscillators, such as TLC555/7555 CMOS timers, R1 (1200 ohms) has been selected to draw only 2 mA at a 2.8-volt (4.5 - 1.7) drop. Note that Q1 is a 2N3904 NPN unit, with Q2 a MPSA14 (or 2N6427) Darlington NPN unit. Breadboard this circuit as with the two previous drivers and perform a similar calibration with S1 set for CW.

DISCLAIMER

Neither the publisher nor the author assumes any liability for the misuse of these devices by any person, resulting in bodily injury to himself or others, intentionally or not.

This time, the scale factor for R2 (now at 10 ohms) is 10 mV per mA. The threshold level will now be about 350 mV (35 mA is typical). The operating level should then be set to no more than 100 mV above the threshold level.

Again, **avoid direct or reflected exposure** to this visible beam. Remember, laser radiation can cause permanent eye damage. Once more, select a fixed resistor to replace (in this case) R3/R4 and fabricate the circuit on a small piece of perfboard, using a TO-18 transistor socket for the laser. Note that this driver may be "flip-flopped" to drive a package configuration where the laser cathode shares a common lead with the photodiode anode. As with Fig. 5 and Fig. 6, Q1 and Q2 must be switched from NPN units to PNP units for proper biasing.

As previously mentioned, this driver allows the output beam to be pulsed. For a real attention-getting "pointer" display, try the simple circuit illustrated in Fig. 7B, which provides a 50-mS pulse every 1/2 second. Refer again to Fig. 4 for tips on collimation and focusing of the divergent laser beam.

There you have it—five different laser driver circuits, all of which are easily modified to suit your particular needs and laser type. Why not dig out that old laser, dust it off, build a suitable driver, and go out and impress the neighbors!

P

From Not-Working to Networking!

Troubleshooting Local-Area Networks!

Now, complete for the first time in one detailed booklet!

Gain a fuller knowledge of network fundamentals and how they developed from the early days of main frames, from XNS to Ethernet technology, the OSI stack for interconnecting different computers, basic and specialized test instruments, etc. Several tough LAN case histories brings you from theory to the practical side of troubleshooting.

ONLY \$4.99

CLAGGK Inc., Reprint Bookstore
P.O. Box 12162, Hauppauge NY 11788

Please rush my copy of "From Not-Working to Networking." I enclosed payment of \$4.99 which includes shipping charges. U.S.-First Class, Canada and Overseas-Surface Mail.

Name

Address

City State Zip

All Payments must be in U.S. funds. Send check or money order payable to CLAGGK Inc.—do not send cash or stamps. New York State residents add applicable sales tax. Allow 6 to 8 weeks for delivery **RBS02**

HOW I'VE TRIED TO REMAIN COMPUTER ILLITERATE ...AND OTHER SMALL FAIRY TALES

*A quick guide to sanity maintenance
in the 21st century.*

COMMENTARY BY LAONA GALE KNIGHTON

I'm proud to say that, in this day and age, I've tried to remain computer illiterate! Dealing with computers at work has become mandatory; however, that doesn't mean that I want to bring them home with me. Besides, I don't like it when a machine laughs in my face because it is smarter than I am.

I remember when my favorite, open-minded third grade school teacher (it was 1970) very astutely explained to twenty-five restless, yet eager, children the concept of the "world to come." She told us that in the not-too-distant future people would be able to stay in their own homes and feel as though they were actually experiencing adventures. She continued to explain what sounded (to us) like a *Twilight Zone* episode.

"A person's body will actually be sitting still in a chair," she said, "but the mind will be able to experience such things as flying, scuba diving, race car driving—the possibilities will be endless!"

Of course, our eight-year-old minds thought she was an old lady and, maybe, even a little off her rocker. Well, guess what, Mrs. McKissick? It's true! This wonder you were describing has arrived. It is called the *personal computer*, and at the ripe old age of thirty-eight, I have finally decided that "if you can't beat 'em...join 'em."

My PC is the fourth in our household. My needs had to follow our four-years-old's yearning to play her *Barbie* and *Blue's Clues* games, even though Daddy was home at night laying claim to his own Compaq Presario 4880-Series P-II 400. Hers was our third investment, a Pentium 120. However, it didn't take long to figure out that Daddy's computer is faster; so she manages to commandeer his quite often, nevertheless.

Of course, we have the standard ongoing race for the "best in the house" between my husband and my teenage son's technological hardware. They claim that it isn't a power war, but I've noticed that whenever one of them gets more megabytes of RAM, the other must immediately run out and get more, too! With my son's new job at Domino's and his careful spending habits, he has won momentarily with his AMD-K7 800, which was the fastest (without refrigeration) on the market for one whole week.

I still have one question: "With all this modern technology in the house, why is it so hard for Mommy to be blessed with using one?"

"Honey? May I use the computer to type a letter?" I asked the back of my husband's head.

"Sure...in a minute. Let me finish this first," he said. To a computer junkie, a minute could be hours, days, or—if you're lucky—the next time nature calls!

Iced tea helps.

"Darling pie?" I turned to my son. "Can I type a letter on your computer real quick?"

"Gee, Mom. I don't think my computer does that anymore. I had to remove the software to make room for my 'Super-Duper-Crazy-Driver-Space-Racing' game."



I turned then to my four-year-old daughter, "Baby-doll? Can Mommy use your computer, just for a minute?"

This is almost always met with tears and whining (hers, not mine), which makes me lose my train of thought completely, rendering it utterly impossible to even begin the task at hand.

"I just want to type a simple letter!" I said to the backs of three heads in my living room. I would have considered myself lucky to have received even a grunt in reply from any of them.



Dinner time was another issue. I am a firm believer in the whole family sitting down together for at least one meal a day to study each other's faces and, maybe, even have a little light conversation. Of course, if the dinner is really good, there is not much conversation anyway since all mouths are full.

With computers in the house, delivering the exciting message, "Dinner's ready!," can receive the following popular replies:

Husband: "In a minute!"

Teenager: "But I'm the farthest I've ever got!"

Four-year-old: "Whaaaaa!"

One evening, after staring at three cold, thirty-minute-old, well-balanced meals, I was forced into retaliation. I pretended to give their dinner to the dogs. It was really just some leftover scraps "disguised" by being placed on our good dinner plates.

"If you guys don't want my dinner, the dogs would love to have it." I promptly set two of the plates out the door.

This offensive tactic brought forth looks of horror and disbelief from my "computer nerds." Now, they come right away (almost) when they are called for dinner.

I am finally the proud owner of my own personal

computer made up of cast-off portions from the others. I call it a "mutt" series, and that is fine with me. Now, I can type a plain, old-fashioned letter to "Grandma Moses" any time I like!

I've set mine up in a different room from the rest and can actually have a little peace and quiet without explosions, singing, or car wrecks for background ambiance. Of course, my family members walk by the open doorway (I'm on the route to the bathroom) and laugh and point at me occasionally. "Can you imagine, a mother *playing* computer!"

My four-year-old asks, "Mommy? Can I play your computer now?"

"Mommy's computer doesn't play games," I reply. "It just makes words." (Guilt, guilt, guilt.) The best part is when I hear, "I'm hungry. When is dinner going to be ready?" I smile as I answer, "In a minute!"

One extremely important tip to remember: When people ask if you have an e-mail address, quickly answer "NO!" and try to have a vague look in your eye. I made the mistake early on of giving my prized address out to a couple of friends. Now when I check my messages, I have no less than fifty "you've-got-mails" awaiting me. Let's not even mention being in the middle of scheduling an airline flight, only to have "Hi! Whatcha doin?" flash on your screen via instant messaging. It is a frightening experience. I could easily become a nightly prisoner to this rolling chair if I'm not careful. I may have to learn to sleep upright and arrange to have food thrown at me for nourishment.

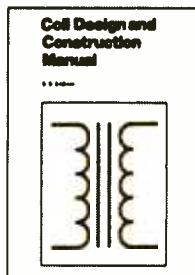
It reminds me of my former answering machine. The last time ours hit the floor, it broke. I was actually relieved to be able to throw the thing away. I no longer





come home to a blinking light nagging me to return Aunt Jewel's or Cousin Alberta's call (you realize, of course, that once they've left a message you are surely nabbed).

I must say this for computers: It keeps my family off the streets at night. In regard to that subject—like computers—sometimes ignorance can be bliss. P



YOU CAN WIND YOUR OWN COILS?

There's no trick to it except knowing what you are doing. In a unique, 106-page book you can become expert in winding RF, IF, audio and power coils, chokes and transformers. Practically every type of coil is discussed and necessary calculations are given

with the mathematical data simplified for use by anyone. Get your copy today!

Mail coupon to:

Electronics Technology Today, Inc.
P.O. Box 240 • Massapequa Park, NY 11762-0240

Please send me my copy of *Coil Design and Construction Manual* (BP160). I enclose a check or money order for \$8.99 to cover the book's cost and shipping-and-handling expenses. NY state residents must add local sales tax.

Name _____

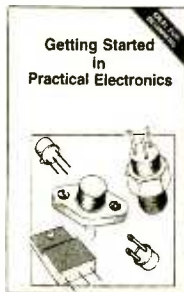
Address _____

City _____ State _____ ZIP _____

All orders must be paid in U.S. funds only. Sorry, no orders accepted outside of USA and Canada. Please allow 6-8 weeks for delivery.

ET06

You can Build Gadgets! Here are 3 reasons why!

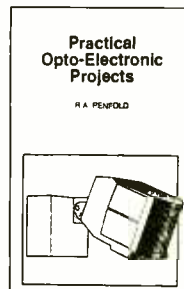


BP345—GETTING STARTED IN PRACTICAL ELECTRONICS . \$6.99

If you are looking into launching an exciting hobby activity, this text provides minimum essentials for the builder and 30 easy-to-build fun projects every experimenter should toy with. Printed-circuit designs are included to give your project the professional touch.

BP349—PRACTICAL OPTO-ELECTRONIC PROJECTS \$6.99

If you shun opto-electronic projects for lack of knowledge, this is the book for you. A bit of introductory theory comes first and then a number of practical projects which utilize a range of opto devices, from a filament bulb to modern infrared sensors and emitters.



Practical Electronic Music Projects

BP363—PRACTICAL ELECTRONIC MUSIC PROJECTS \$6.99

The text contains a goodly number of practical music projects most often requested by musicians. All the projects are relatively low-in-cost to build and all use standard, readily-available components. The project categories are guitar, general music and MIDI.



Mail to: **Electronic Technology Today, Inc.**
P.O. Box 240 • Massapequa Park, NY 11762-0240

Shipping Charges in USA & Canada

\$0.01 to \$5.00.....	\$2.00	\$30.01 to \$40.00	\$6.00
\$5.01 to \$10.00.....	\$3.00	\$40.01 to \$50.00	\$7.00
\$10.01 to \$20.00.....	\$4.00	\$50.01 and above	\$8.50
\$20.01 to \$30.00.....	\$5.00		

Sorry, no orders accepted outside of USA and Canada. All payments must be in U.S. funds only.

Number of books ordered.

Total price of books	\$ _____
Shipping (see chart)	\$ _____
Subtotal	\$ _____
Sales Tax (NYS only)	\$ _____
Total enclosed	\$ _____

Name _____

Address _____

City _____ State _____ ZIP _____

Please allow 6-8 weeks for delivery.

ET02

Inadequate Clock-Radio Antennas

Q We have several clock radios that use their power cords as FM antennas. It is hard for us to pick up the NPR (National Public Radio) stations we prefer to wake up to. I thought that we could buy one of the inexpensive FM transmitter kits advertised in your magazine and use a hollow-core inductor to transmit its signal into our house wiring. Will this work at all? What would be a good type of inductor to use as the coupler? Would it be possible to have more than one transmitter going at a time on different frequencies?—G.S., Davis, CA

A I've had similar problems with clock radios. Let's work yours from two angles. When I opened up our clock radio, thankfully I found that it had a little power transformer in it. If your radio(s) doesn't have a power transformer, don't attempt any external electrical connections. I found that my radio coupled to the line by wrapping a wire around the line cord several times inside the radio. I unwrapped it and soldered the end to a pin jack that I mounted on the cabinet. Now I could have an external antenna. Instead of the reception being finicky with placement of the power cord, it was finicky with placement of the antenna.

Another idea I heard of was to replace the two-wire line cord with one of those flat three-wire cords. Install a regular two-wire plug on the end and clip the ground wire back from the plug; make sure that it doesn't contact anything in the plug. Connect that third wire to the antenna input.

The transmitter idea might work, although I would try over-the-air transmission first rather than a "carrier-current" method using the AC power lines. A low-power transmitter in your house will put out a stronger signal at your radios than a powerful transmitter that's nearby. Just be sure to tune the transmitter, one for each station you're trying to rebroadcast, to a clear area on the dial so you don't upset the neighbors or degrade the transmitted signal. Ramsey

Electronics has their model FM10A transmitter that may work in your application. You can find them at www.ramseyelectronics.com on the Internet.

Metal-Can IC Sockets

Q Where can I obtain sockets for an integrated linear transistor, RCA type CA3018 or SK3542, with 12 leads?—W.D., Benson, AZ

A Sockets for the TO-5, TO-99, and TO-100 metal-can ICs that were commonplace in the 1970s are a lot more difficult—but not impossible—to find. One hint is to look in catalog indices under "transistor sockets" rather than "IC sockets." Often, 8-pin "canned" ICs, such as the LM741, have their leads preformed to fit a standard DIP socket. You could do the same with a 10-pin IC, if necessary, although the end leads may get a little long. You'll have to be careful with each lead while inserting the IC into the socket.

New sockets are available from Newark (Augat), catalog number 65F1881, for \$4.25 each. Digi-Key has their catalog number ED2154-ND for \$1.77 each, and Allied/Avnet (Mill Max) has catalog number 900-0298 for \$1.36. I might add that most manufacturers long ago discontinued using sockets, not to save money but to enhance product reliability, which ends up saving money in both manufacturing and in customer satisfaction. They have found that a significant percentage of warranty and other repair work has been traced to intermittent sockets and connectors. Many of us with "vacuum tube" mentalities just can't pull ourselves away from sockets. I stopped using them years ago and have never regretted that decision.

Here is some pertinent contact information for the companies I just mentioned:

Allied/Avnet
7410 Pebble Dr.
Ft. Worth, TX 76118
800-433-5700
www.allied.avnet.com

Digi-Key
701 Brooks Ave. S.
Thief River Falls, MN 56701
800-344-4539
www.digkey.com

Newark Electronics
4801 N. Ravenswood
Chicago, IL 60640
800-463-9275
www.newark.com

Splitting Hairs...Or Phases

Q What's a phase splitter?—H.F., via e-mail

A A push-pull output amplifier input requires two complementary (180 out of phase), equal-amplitude signals. It is the job of a phase splitter to provide those two signals. The circuit has been around since the vacuum-tube days, and a more modern transistor equivalent is illustrated in Fig. 1. Its name is derived from the fact that the collector load is split between the collector and the emitter. Since the collector and emitter resistors are of equal value (R5 is bypassed by C4, so does not figure in to the AC resistance), the output voltages from the collector and emitter will be nearly the same.

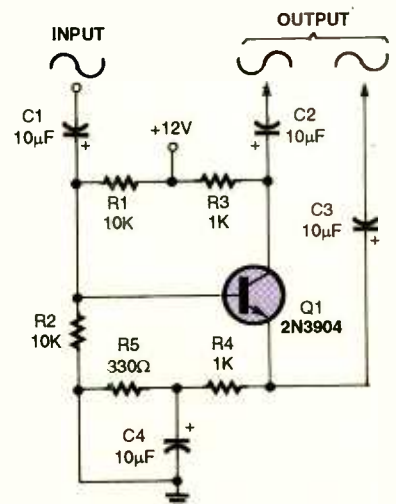


Fig. 1. A transformer with a center-tapped secondary makes a nearly perfect "phase splitter" at the sacrifice of lower- and upper-bandwidth limitations.

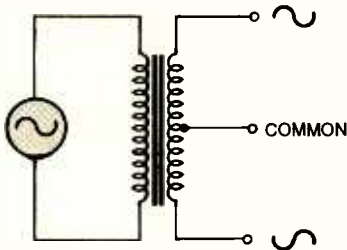


Fig. 2. The traditional phase splitter "divides" the original signal into two complementary signals using a unity-gain amplifier.

As you may know from transistor theory, a common-emitter circuit (signal taken from the collector) has a signal that is inverted from the input. A common-collector circuit (signal taken from the emitter) has a signal that is in-phase with the input. This circuit is a combination of the two. Capacitors C1, C2, and C3 are DC-blocking capacitors that are used to isolate one amplifier stage from another.

There are other ways to do this "phase splitting." The simplest way, shown in Fig. 2, is to use a transformer with a center-tapped secondary. This was a common practice in vacuum-tube days and is still a common practice in modern-day tube amplifiers that are sold for ridiculous prices to unsuspecting consumers.

Ah, but that's another story.

With respect to the transformer's center tap, one leg of the secondary will be 180° out of phase with the other.

The circuit of Fig. 3 uses two diodes biased up by R1 and R2. At first glance, one would assume that the diodes act as rectifiers to direct the positive alterna-

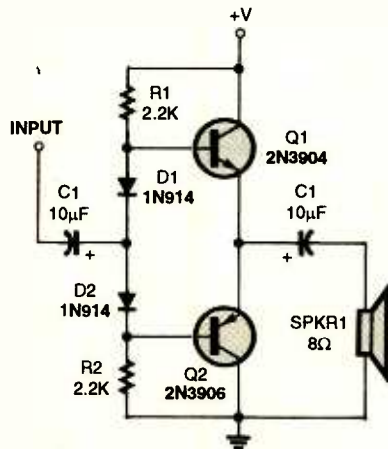


Fig. 3. A simple dual op-amp "phase splitter" is a slick way to obtain complementary signals. Careful selection of devices can yield bandwidth from DC to 1 MHz to guarantee frequency-independent phase splitting.

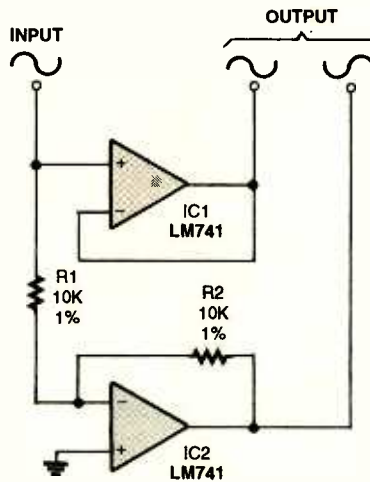


Fig. 4. A bargain-basement phase splitter really isn't a phase splitter. Instead, it uses diodes to set transistor bias to reduce crossover distortion while the transistors naturally conduct or cut off on the appropriate waveform alternations.

tion to Q2 and the negative alternation to Q1, effectively "splitting" the signal. However, the diodes are biased "on" all the time and are transparent to the AC-input signal. Their purpose is to offset the base-emitter drops of Q1 and Q2, in order to eliminate the crossover distortion during the times when the input signal is less than ± 0.7 volts. The transistors themselves either go into conduction or into cut-off, depending upon the voltage level at their bases.

The final circuit of Fig. 4 is a dual op-amp circuit that provides a buffer (IC1) for the non-inverted signal and a unity-gain inverter (IC2) to provide the complement of that signal.

DC "Phase Inversion"

Q I'm trying to design a circuit to modify the output of an automotive manifold absolute-pressure (MAP) sensor. The sensor puts out a DC analog signal of 0 to 5 volts. I want to replace the original (air flow restrictive sensor), which has an output of 5 to 0 volts. The new sensor's output is reversed from what the onboard computer has to have.

I'm using an LM307 in the circuit, which worked on Circuit Maker 2000. I wired it up on a breadboard, and it does not work. With 5 volts in, pin 6 should be near 0 volts, but it's at 4.9 volts or so and decreases as I decrease the input level. I must be doing something fundamentally wrong, possibly with grounding. Should pins 4 or 7 be involved somehow? I know little about electronics and sure do need some help.—R.S., via e-mail

A Your circuit, as you described it in your letter, is shown in Fig. 5. Not too bad for someone who "knows little about electronics." It's fundamentally sound and should work just fine. Your voltages and your questioning of pins 4 and 7 tell me that the op-amp is floating. Without pin 4 (V-) connected to ground and pin 7 (V+) connected to 12 volts, the op-amp is nothing but a pretty lump of impure silicon. I have a couple of suggestions, including the power-supply connections, illustrated in Fig. 6, which should make things better.

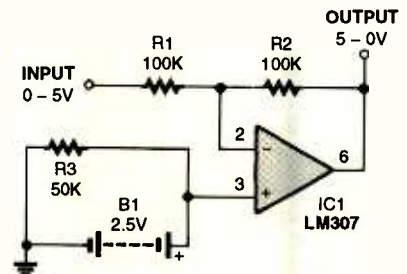


Fig. 5. This reader-designed unity gain op-amp inverter is intended to reverse the output "phasing" of an automotive sensor.

I'm not sure what you're using for the 2.5-volt supply, but I'd derive it from the same 5-volt supply that feeds the sensor. That way, the 2.5 volts will track small variations in the 5-volt supply and hold the 5-volt output point better. The adjustment of R3 will allow you to set the 5-volt point (with 0 volts in) accurately. I've added some capacitors to help decouple the circuit from noise spikes that might appear on the power

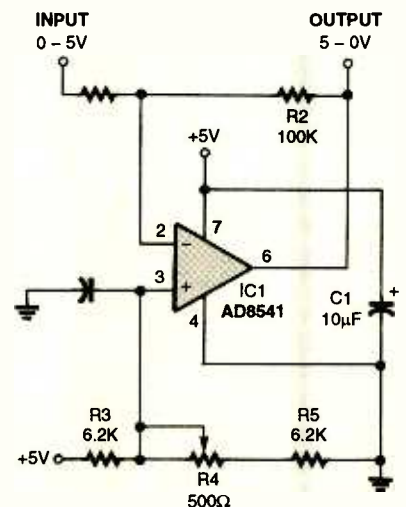


Fig. 6. Modifications to the unity-gain op-amp inverter include a "rail-to-rail" op-amp and additional offset adjustment circuitry.

HOW TO GET INFORMATION ABOUT ELECTRONICS

On the Internet: See our Web site at www.poptronics.com for information and files relating to **Poptronics** and our former magazines (**Electronics Now** and **Popular Electronics**) and links to other useful sites.

To discuss electronics with your fellow enthusiasts, visit the newsgroups *sci.elec*, *sci.electronics.repair*, *sci.electronics.components*, *sci.electronics.design*, and *rec.radio.ama*, *rec.radio.swap* and *misc.industry.electronics.marketplace*.

Many electronic component manufacturers have Web pages; see the directory at www.hitex.com/chipdir/, or try addresses such as www.ti.com and www.motorola.com (substituting any company's name or abbreviation as appropriate). Many IC data sheets can be viewed online: www.questlink.com features IC data sheets and gives you the ability to buy many of the ICs in small quantities using a credit card. You can also get detailed IC information from www.icmaster.com, which is now free of charge although it formerly required a subscription. Extensive information about how to repair consumer electronic devices and computers can be found at www.repairfaq.org

Books: Several good introductory electronics books are available at RadioShack, including one on building power supplies.

An excellent general electronics textbook is *The Art of Electronics*, by Paul Horowitz and Winfield Hill, available from the publisher (Cambridge University Press, 800-872-7423) or on special order through any bookstore. Its 1125 pages are full of information on how to build working circuits, with a minimum of mathematics.

Also indispensable is *The ARRL Handbook for Radio Amateurs*, comprising over 1000 pages of theory, radio circuits, and ready-to-build projects, available from the American Radio Relay League, Newington, CT 06111, and from ham-radio equipment dealers.

Back issues: Copies of back issues of and past articles in **Electronics Now**, **Popular Electronics**, and **Poptronics** can be ordered on an "as available basis" from Claggk, Inc., Reprint Department, P.O. Box 12162,

supplies.

There's one more important thing that you'll have to do: Find a different op-amp. The LM307, although a nice amplifier, is older than my 1973 edition of National Semiconductor's *Linear Databook*! It suffers from the fact that as the output voltage approaches the supply rails, it begins to get non-linear and saturates about 1.5 volts away from the rail. That means that your amplifier output won't be able to go below about 1.5 volts. Manufacturers have had 28 years since then (am I getting that old?) to develop what are called "rail-to-rail" op-amps. Those amplifiers are usually tar-

getted for lower-voltage systems, where they want to get every last millivolt of output range.

Poptronics and many other magazines are indexed in the *Reader's Guide to Periodical Literature*, available at your public library. Copies of articles in other magazines can be obtained through your public library's interlibrary loan service; expect to pay about 30 cents a page.

Service manuals: Manuals for radios, TVs, VCRs, audio equipment, and some computers are available from Howard W. Sams & Co., Indianapolis, IN 46214; (800-428-7267). The free Sams catalog also lists addresses of manufacturers and parts dealers. Even if an item isn't listed in the catalog, it pays to call Sams; they may have a schematic on file which they can copy for you.

Manuals for older test equipment and ham radio gear are available from Hi Manuals, PO Box 802, Council Bluffs, IA 51502, and Manuals Plus, 130 N. Cutler Dr., N. Salt Lake, UT 84054.

Replacement semiconductors: Replacement transistors, ICs, and other semiconductors, marketed by Philips ECG, NTE, and Thomson (SK), are available through most parts dealers (including RadioShack on special order). The ECG, NTE, and SK lines contain a few hundred parts that substitute for many thousands of others; a directory (supplied as a large book and on diskette) tells you which one to use. NTE numbers usually match ECG; SK numbers are different.

Remember that the "2S" in a Japanese type number is usually omitted; a transistor marked D945 is actually a 2SD945.

Hamfests (swap meets) and local organizations: These can be located by writing to the American Radio Relay League, Newington, CT 06111; (www.arrl.org). A hamfest is an excellent place to pick up used test equipment, older parts, and other items at bargain prices, as well as to meet your fellow electronics enthusiasts—both amateur and professional.

I'd suggest trying the AD8541 from Analog Devices (www.analog.com). If you need more op-amps in a similar design, the same amplifier is available in dual (AD8542) and quad (AD8544) configurations with common power-supply connections. It has exactly the same pinout as the LM307, and if it wasn't for the fact that it's available only in surface-mount packages, you could plug it right into the same socket. The maximum power-supply voltage for the AD8541 is only 5.5 volts, but it sounds like you

have a 5-volt supply you can use for that, and it'll be a lot cleaner than the junk that runs your power windows.

Contact Analog Devices for a differential amplifier if you have to have it in a dual in-line package. Be sure to specify that you need a rail-to-rail, single-supply, general-purpose op-amp for use with a 5-volt power supply. You should be able to find what you need on their Internet site. Analog Devices is very nice about providing free samples of their reasonably-priced chips.

I think these improvements will result in a circuit that will work well for you.

Writing to Q&A

As always, we welcome your questions. Please be sure to include:

- (1) plenty of background material,
- (2) your full name and address on the letter (not just the envelope),
- (3) and a complete diagram, if asking about a circuit; and
- (4) type your letter or write neatly.

Send questions to Q&A, **Poptronics**, 275-G Marcus Blvd., Hauppauge, NY 11788 or to q&a@gernsback.com, but do not expect an immediate reply in these pages (because of our backlog). We regret that we cannot give personal replies. Please no graphics files larger than 100K. P



A public service of this magazine

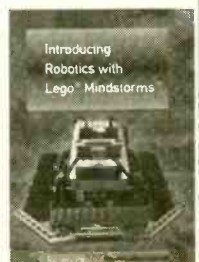
Introducing Robotics with Lego® Mindstorms™

For Robot Lovers. Shows how to build a variety of increasingly sophisticated computer-controlled robots using the brilliant Lego mindstorms Robotic Invention System (RIS). Covers the fundamental building techniques needed to construct strong and efficient robots. Explains to the reader how robot control programs may be simply constructed on their PC screens.

Detailed building instructions are provided for all the robots featured. 270 pages, 7/2 x 10 5/7 in. **\$19.99.**

Plus \$2.45 shipping in U.S. Order from CLAGGK Inc., P.O. Box 12162, Hauppauge, NY 11788

CLX1



COMPUTER BITS

(continued from page 6)

and label even a modest quantity of CDs.

One new title that I think really epitomizes CD-ROM-based publishing is *The Amateur Scientist—The Complete Collection* on CD-ROM. Priced at \$90, this two-CD set is published by a small company called Tinkers Guild (www.tinkersguild.com).

SOURCE INFORMATION

Tinkers Guild
405 El Camino Real
PMB 326
Menlo Park, CA 94025
650-853-1001
www.tinkersguild.com

CIRCLE 100 ON FREE INFORMATION CARD

It's considered "bad form" to mention one magazine in another (*Perhaps, but we're not that insecure. Look at all the titles Dean Huster listed in "Q&A" back in April!—Editor*), but I've always enjoyed the "Amateur Scientist" column that *Scientific American* has been publishing since 1928. I'm not quite old enough to have been reading it since then, but I did start during the 1960s when it was edited by C.L. Stong. In fact, one of my

cherished books was a compendium of those columns, published by Scientific American Press in the 60s. That book, unfortunately, disappeared during a move and has been out of print for some time.

The CD-ROM from Tinkers Guild solves that problem. Not only does it have the columns from the original book, but it has every "Amateur Scientist" from its inception in 1928 through 1999. Missing, however, are last year's columns as well as those published so far this year. The columns are navigated through a Web Browser, since the original text and illustrations have been converted into HTML.

Much of what has been published is pretty dated. Some of the projects published in the 50s and 60s use vacuum tubes that might not be available any more. The same is true about transistors and ICs used in the 70s and 80s.

On the other hand, many of the techniques and fabrication problems that were cleverly addressed in those old columns have become much easier to accomplish. Materials and equipment that were unavailable and unaffordable 40 years ago are commonplace now.

What I really love about this set of CD-ROMs, however, is how it catches my imagination every time I go through it. The 1959 column about how students at a California

high school built a cyclotron is not only fascinating, but even more practicable now.

The CD is divided into different scientific disciplines. You can learn how to grind a telescope mirror, build an X-ray machine (though you'll probably have to blow your own glass tube), or use electrophoresis to separate compounds. A second CD-ROM has loads of science- and math-oriented shareware, and there's even a trial copy of Wolfram Research's terrific *Mathematica* software on a third CD.

The \$90 price tag will definitely put some readers off. To be honest, though, this CD was on my holiday gift list until I received a review copy. I can't imagine any **Poptronics** reader who wouldn't enjoy receiving this CD as a present, or who won't spend hours perusing the material.

If you've read this column for a while, you'll know that I don't have any special awards that I give products. No "Editor's Choice" and no "Best Buy." My highest accolade is finding something that I would actually buy myself.

With the wealth of software and equipment I receive to review, there aren't that many products that meet that criteria. The Tinkers Guild CD, however, is something I would definitely spend my own money on. **P**

NET WATCH

(continued from page 20)

STRIKING A BALANCE BETWEEN PARANOIA AND APATHY

Although cyber-terrorism is on the rise, it is not quite a pandemic. Just because your computer is surfing the Net doesn't mean that it will be stricken with some awful virus. Hackers and crackers usually strike specific targets. Common sense is our best protection against malware assaults. The FBI, together with various private-sector players, has formed the National Infrastructure Protection Center (NIPC). Established in February 1998, the NIPC is working to further digital security in a constant effort to protect U.S. national security.

How can you do your part to

HOT SITES

- 2600 The Hacker Quarterly**
www.2600.com
- F-Secure**
www.fsecure.com
- McAfee**
www.mcafee.com
- NIPC**
www.nipc.gov
- Sophos**
www.sophos.com
- Symantec**
www.symantec.com

help in the fight against cyber-terrorism? Although there have been cases of violent JavaScript exploding into systems uninvited (like a

busload of drunken party crashers), nine out of ten times a virus attack is triggered by a user executing a file or opening an attachment. Obtain and run a virus-protection program and be sure to update it regularly. If you see suspicious e-mails or programs from an unknown origin, quarantine and delete them. As for protection against intruding hacks—there is little hope. Where there is a will there is a way, and hacking is certainly no different. A software firewall program is at best a minimum form of protection. At least when users run a firewall, they can see whenever their system either accesses or is accessed by another computer. Final advice—stay alert! You never know what or who is poking around the Internet. **P**

Fuel-Cell Finish

Well, we're back to finish the series on fuel cells. Let's get right to it and construct a derivative of the fuel cell made famous by NASA.

Hydrogen-Oxygen Fuel Cell

This fuel cell, see Fig. 1, would more properly be called an *open-air fuel cell*, because leaving one side of the cell open to the atmosphere provides the oxygen. Using pure O₂ at the oxygen electrode provides superior performance. However, the additional work required for construction and subsequent operation doesn't merit the performance increase.

Gather together the items listed in the sidebar. While you're out shopping, pick up some galvanized nails (a good source of zinc) and some hydrochloric acid—muriatic acid (found in home-improvement stores for cleaning brick and stone); you'll need those items to produce hydrogen—the fuel cell's fuel.

The fuel cell is made from 1/8-inch thick plastic. The plastic is fashioned into three 2 1/2-inch squares. Two of the plastic squares have an internal 1 1/2-inch square cut out from the center, see Fig. 2. Two gaskets are cut to the same dimensions as the two internal plastic pieces. The nickel screen is cut to fit inside the cell and overlap the internal cutout. A tab is placed on each electrode that extends outside the fuel cell to make electrical connections easy. The outer plastic piece has two additional center holes for gas vents.

Make a solution by mixing one gram of platinum chloride in 100 milliliters of distilled water. Clean the nickel screens in the alcohol to remove any grease or dirt. Then plate the two nickel screens with platinum by soaking them in the platinum chloride solution until they turn black.

To activate the fuel cell, soak some filter paper in a solution of potassium hydroxide. You can use the same solution from last month's alcohol fuel cell.

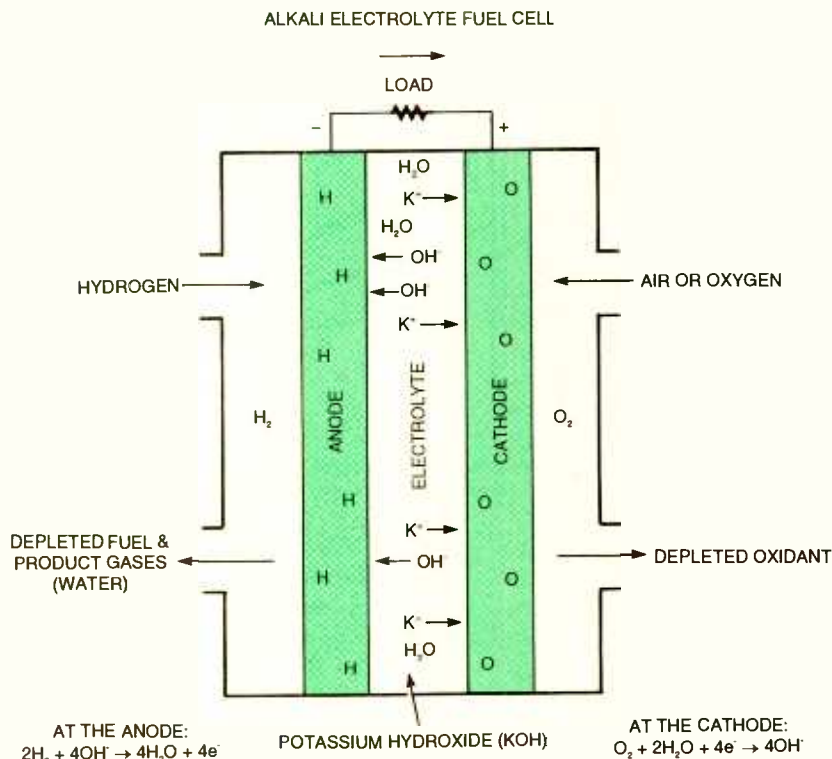


Fig. 1. An alkali-electrolyte hydrogen/oxygen fuel cell, in the process of combining hydrogen and oxygen, strips a few extra electrons during the chemical reaction to create an electromotive force—electricity.

After the filter paper has absorbed the electrolyte, blot the excess liquid from the paper with a blotter, leaving the filter paper damp.

Next, assemble the fuel cell. Place a gasket on the outside case, followed by a nickel screen, filter paper, nickel screen, second gasket, and finally the open plastic piece. Make sure during assembly that the two nickel screens don't touch one another; if they do touch, they will short the output of the fuel cell.

Use the plastic machine screws and nuts to keep the assembly together.

Hydrogen Gas Production

Many experimenters generate hydrogen gas from the electrolysis of water. I did not want to set up the apparatus to

do this; I wanted a fast and simple method of H₂ production. Zinc and magnesium react with hydrochloric acid to generate hydrogen gas. I assume that you've already picked up the muriatic acid (a solution of hydrochloric acid) and galvanized nails—zinc is the “galvanizing” coating that protects iron and steel from the elements when used outside. Roofing nails are a good example. Although I've probably already said it until I'm “blue in the face,” always wear gloves and eye protection when handling acid.

Prepare a gas-generating vessel using a jar with a metal screw-on lid, see Fig. 3. First, drill a 1/4-inch hole in the cover of the jar. Next, pass an inch or two of 1/4-inch rubber or silicone tubing through

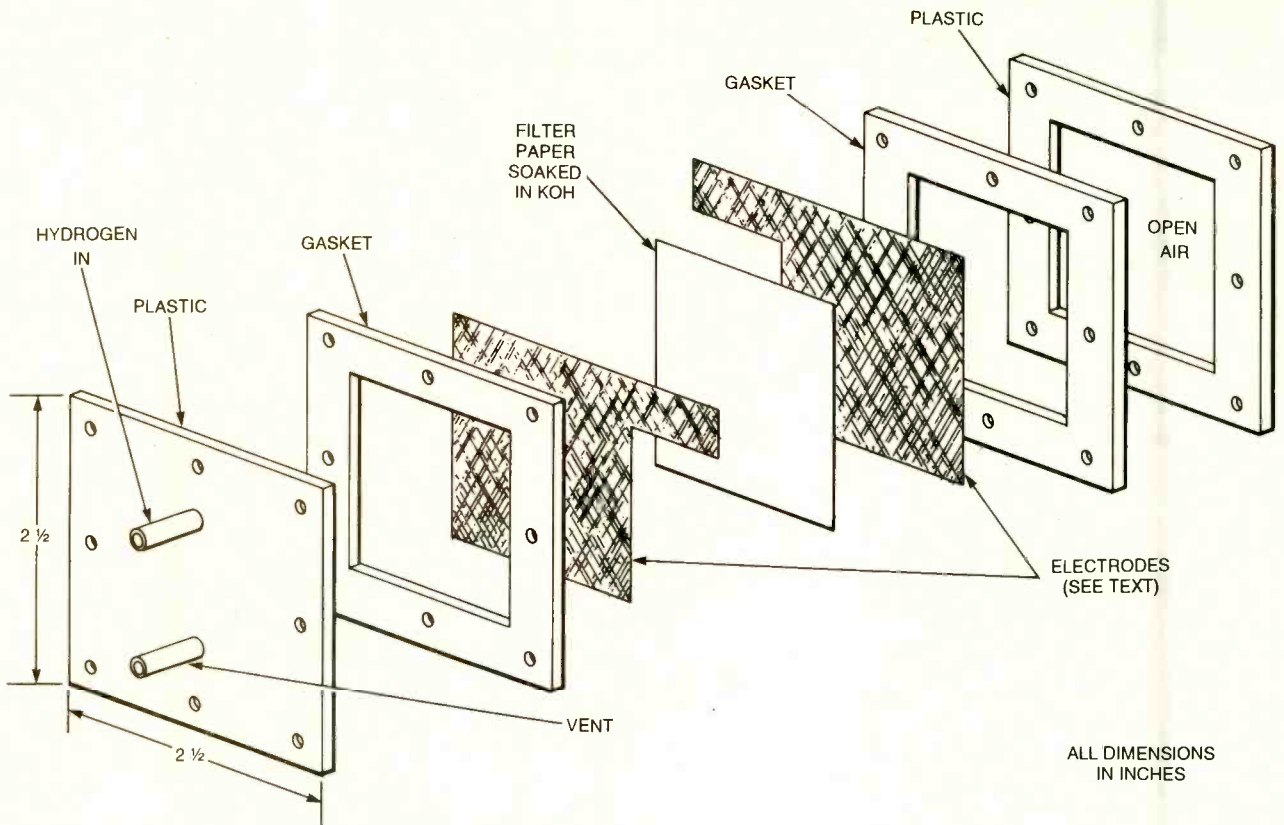


Fig. 2. The construction cross section of the hydrogen/oxygen fuel cell is a sandwich of electrodes, electrolyte-soaked paper, and gaskets surrounded by a pair of flat plastic end pieces.

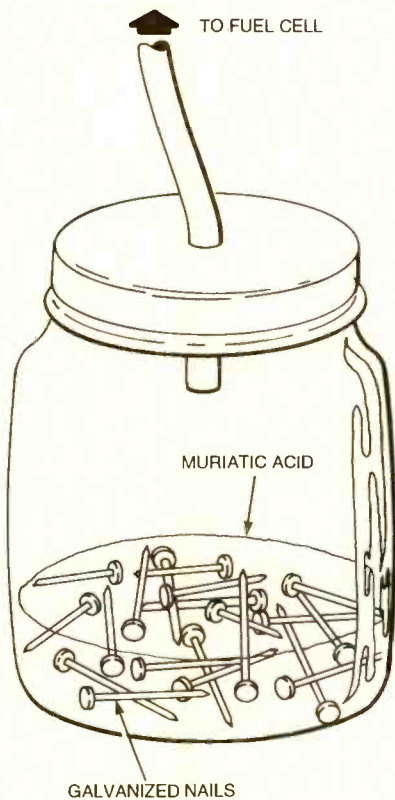


Fig. 3. A "quick and dirty" hydrogen-gas generator uses galvanized nails and hydrochloric acid to produce hydrogen gas.

the hole. Make the junction between the jar lid and tube airtight by coating the seam—both on the top and bottom of the lid—with aquarium silicone sealant. Allow the sealant to dry (about 24 hours).

To generate hydrogen gas, cover the bottom of the jar with galvanized nails. Pour in enough muriatic acid to cover the nails. Screw the lid of the jar in place. Let the hydrogen gas vent for a minute through the rubber tube and then attach the open end of the tube to the fuel cell.

Remember, muriatic acid is corrosive; take proper precautions when handling this chemical. Hydrogen gas is explosive. Do not operate the hydrogen-gas generator near open flames or sparks (remember the Hindenburg!). The hydrogen-gas generator, when generating gas, must always remain open to the atmosphere, allowing the hydrogen gas to vent. This will prevent any gas pressure from building that could cause the jar to explode.

The finished fuel cell, see Fig. 4, generated between 0.8 and 1.0 volt. You should expect similar results with your fuel cell.

Now that we've taken that "small step for [a] man" in building NASA-style fuel cells, let's move on to...

Microbial Fuel Cell

The "bug battery," as it's affectionately known, uses yeast to generate electric power. Originally, I believed that the yeast cells metabolized sugar to produce alcohol and that the alcohol became the fuel to power the fuel cell. While that secondary type of fuel cell has been built many times, it is not the principle behind this fuel cell. The actual process is more complex and elegant. Essentially, current is generated by cellular respiration and digestion!

I was surprised to find out that bug batteries aren't new technology. In fact, they date back to 1910, when Michael

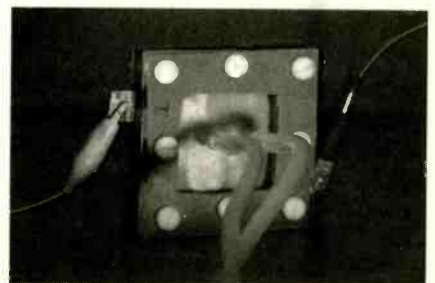


Fig. 4. The finished hydrogen/oxygen fuel cell might not be as pretty as some of NASA's best space-faring designs, but it works the same.

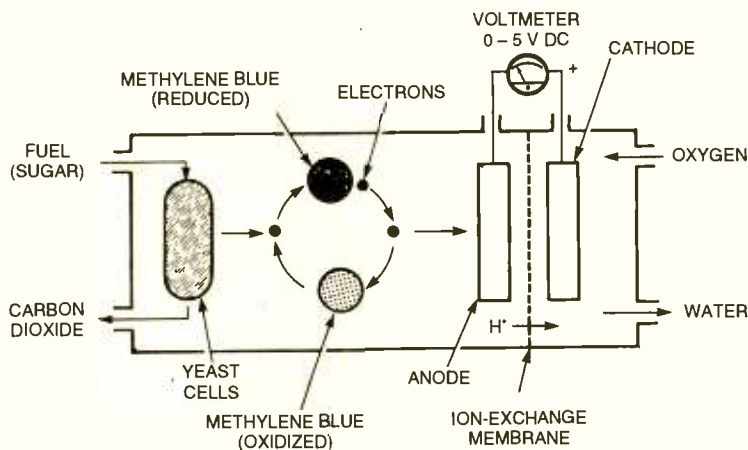
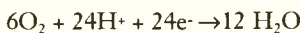


Fig. 5. A microbial fuel cell uses yeast as the active element, with methylene blue as a mediator.

Potter placed a platinum electrode into a solution of yeast and another in an organism-free solution and measured a current. In 1931, Barnett Cohen, a biochemist at Cambridge University, put together a 35-volt microbe-powered battery.

The basic bio-chemical mechanics of microbe-powered fuel cells follows the process of digestion and respiration. Carbohydrates, such as sugars, starches, and cellulose, are basic food nutrients. When a carbohydrate is broken down, electrons in the molecule are released (oxidized). Those electrons are used (reduced) in intermediate compounds before they finally react with oxygen in respiration:



Electrons may be stolen from the respiration cycle by a *mediator*. The mediator ferries the electrons to an electrode. To complete the circuit, a second (positive) electrode is needed in the solution, usually separated by an ion-exchange membrane.

A basic microbial fuel cell is illustrated in Fig. 5. On the left side of the illustration, we have sugar being fed to a yeast culture. The yeast cells digest the sugar, producing carbon dioxide. The electrons in the digestion cycle are stolen by the mediator—in this case, methylene blue—and delivered to the electrode. Hydrogen ions are able to pass through the ion-exchange membrane to combine with the electrons on the cathode side with oxygen gas to form water.

In the demonstration bug battery and microbial fuel cell, a solid oxidizing reagent (potassium ferricyanide) is used in place of oxygen gas.

Bug Battery Design

A basic bug battery is shown in Fig. 6. The electrodes are carbon rods salvaged from old dry-cell batteries. The electrodes, once removed from the batteries, should be cleaned first with alcohol to remove as much chemical compound as possible and then washed in distilled water and allowed to dry.

Standard metal electrodes should be avoided when constructing a bug battery because the metal could cause spurious electric current from its electrochemical dissolution.

First, one needs a standard phosphate buffer with a pH of 7.0 made by dissolving 4.08 grams Na_2HPO_4 and 3.29 grams $NaH_2PO_4 \cdot 2H_2O$ in 500 milliliters of distilled water.

The oxidizing solution (catholyte) is a 0.01-0.10 Mole solution of potassium ferricyanide in the standard phosphate

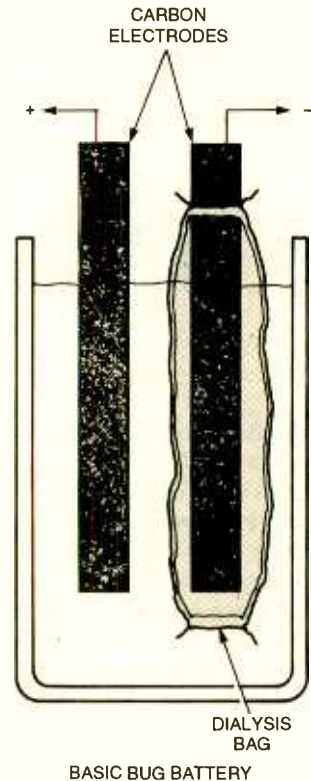


Fig. 6. A simple "bug battery" contains the living portion of the fuel cell in a dialysis membrane. Carbon electrodes collect the electrical energy.

milliMole in water). The top of the dialysis bag is tied with string. The bag/electrode assembly is placed in the vessel with the potassium ferricyanide solution.

The current and voltage generated by this bug battery is measured in millivolts and microamps. The dialysis bag is permeable to ions, including the potassi-

FUEL-CELL COMPONENTS		
Nickel Screen	150-200 mesh	2.5 x 5 inches long
Platinic Chloride		1 gram
Isopropyl Alcohol (rubbing alcohol)		1 pint
Potassium Hydroxide		500 grams
Distilled Water		2 liters
1/4-inch thick plastic acrylic plastic		
Filter Paper		
1/4-inch rubber gasket material		
6-32 plastic machine screws and nuts		
		Eight

buffer. (See the warning on potassium ferricyanide.)

The anode and cathode of this cell are separated by a length of tubular dialysis membrane that's made into a bag by tying a knot in one end. The bag is filled with the second electrode—the microorganisms (yeast or E.coli) suspended in the pH 7.0-buffered solution and a mediator (methylene blue 5-10 mM or

um ferricyanide oxidant. However, the dialysis membrane will only last for about 30 minutes—more than enough time for a demonstration.

Microbe Cell Recipe

One may also purchase a microbial fuel cell in kit form, see Fig. 7. However, be aware that the kit does not include

(Continued on page 53)

The End Of A Saga

We've finally reached the end of our series on VCR repair—you can now breath a sigh of relief! This "Grand Wrapup" will cover a couple of the unfortunate types of accidents that can and do happen and how to deal with them. I'll also toss in a list of references for more VCR-related information and suggestions for parts suppliers when you have found the cause of a particularly nasty problem.

Most VCRs live out their lives peacefully, but sometimes those that are perched on top of the TV sitting on the rickety roll-around stand take a nose-dive to the floor. They could also get wet due to rain through a window or for some other reason that we won't describe (I'm sure your imagination can fill in the gaps!). Camcorders, which are basically portable VCRs with a bit of extra stuff (image sensors, optics, and viewfinders), more frequently take a dunking at the beach.

We'll start with the biggest "oops" of all:

Hit The Deck!

So your cat decided that it was time to practice its long jump and didn't quite pick a stable destination. Your VCR is on the floor and Tabby is cowering in the basement. Where do you start?

Overall, VCRs are quite tough. However, falling in just the right (or wrong, come to think of it) way can do substantial, and possibly not immediately visible, damage.

If you take the unit in for service, the estimate you get might make the national debt look like pocket change in comparison. Attempting to repair a VCR that has been dropped is a very uncertain challenge—time is money for a professional. Spending an unknown amount of time on a single repair is very risky. There is no harm in getting an estimate (though many shops charge for just

agreeing that what you are holding is a VCR!)

This doesn't mean you should not tackle it yourself. There may be nothing wrong or very minor problems that can easily be remedied.

First, unplug the VCR even if it looks fine. Until you do a thorough internal inspection, there is no telling what might have been knocked out of whack or broken. Electrical parts might be shorting due to a broken circuit board or one that has just popped free. Let me say that again if it didn't sink in: **DON'T** be tempted to power the VCR even if there are no obvious signs of damage—turning it on might blow something due to a shorting circuit board.

Inspect the exterior for cracking, chipping, or dents. In addition to identifying cosmetic problems, this will help locate areas to check for internal damage once the covers are removed.

Next, remove the top and bottom covers and the front panel. Check for mechanical problems like a bent or deformed cassette basket, broken or cracked plastic parts, or anything that might have shifted position or jumped from its mountings.

Carefully straighten any bent metal parts. Replace parts that were knocked loose. Glue and possibly reinforce cracked or broken plastic. Plastics, in particular, are troublesome because most glues—even plastic cement—do not work very well. Using a splint (medical term) or sistering (construction term) to reinforce a broken plastic part is often a good idea. Use multiple layers of Duco Cement or clear windshield sealer and screws (sheet metal or machine screws might be best depending on the thickness and type of plastic). Wood glue and Epoxy do not work well on plastic. Some brands of superglue, PVC pipe cement, or plastic hobby cement might work depending on the type of

plastic.

Cycle the cassette-loading and tape-loading mechanism manually by turning the appropriate motor shaft, if possible. Check for free movement of the various parts of the tape transport.

Inspect for any broken electronic components; these will need to be replaced. If the fluorescent panel is broken, you can run the VCR without it; however, you won't be able to see any front-panel displays. Check for blown fuses—the initial impact might have shorted something that, in turn, blew a fuse.

There is always a slight risk that the initial impact has already fried electronic parts as a result of a momentary short or from broken circuit traces. Obviously, those will still be problems even after repairing the visible damage and/or replacing the broken components. Remember the old saying: Inside every big problem is a little problem struggling to get out!

Examine the circuit boards for any visible breaks or cracks. These will be especially likely at the corners where the stress may have been greatest. If you find *any* cracks—no matter how small—in the circuit board, you will need to carefully inspect any circuit traces that might run across those cracks. If they do, then there are certainly breaks in the circuitry which will need to be repaired. Circuit boards in VCRs are never more than two layers, so repair is possible. However, if any substantial number of traces are broken, it will take a great deal of painstaking work to jumper across those traces with fine wire—running over them with solder will not last. Use a fine-tipped low-wattage soldering iron under a magnifying lens and run 28- or 30-gauge insulated wires between convenient endpoints. Those connections don't need to be directly on either side of the break, as long as they make prop-

MECHANICAL INTENSIVE CARE

1—Disassemble the unit as much as possible. Sand and surf (or other liquids) can find their way into the tiniest nooks and crannies. You need to get it all.

2—Make a drawing of the belt routing, remove the belt(s), wash and dry them, and label and set them aside.

3—Use a soft brush (like a paintbrush) to dust out as much sand as possible. Hopefully, you can get it all that way. A vacuum cleaner with a wand attachment may prove handy to suck out sand. Sand will tend to collect on lubrication, especially grease, which will need to be completely cleaned out and replaced. Don't use high-pressure compressed air; you will just spread the sand around. Any grease or oil on which sand has collected will need to be totally removed and replaced with fresh lubrication.

4—If there is evidence of salt (yes, I said to forget repairing it, but if you insist...), you will need to wash it off—yes, wash it. Keep water out of the motors. Use low-pressure compressed air (a blow dryer on low heat should be fine) to dry the unit so that it does not rust. The same advice applies if it is still wet with contaminated liquid. Wash with fresh water to remove all traces of salt and contamination as quickly as possible and then dry completely. Depending on the situation, a final rinse with 91% or pure isopropyl alcohol may be desirable to decrease drying time. That should be safe for most mechanical assemblies. A chemical degreaser may be used if it is safe for plastic and rubber parts.

5—Lubricate all bearing points with a drop of light machine oil such as electric-motor oil, sewing-machine oil, etc. Never, never, never use WD-40! Lubricate the gears, cams, and sliding parts with a light, plastic-safe grease such as Molylube.

6—Parts like the idler clutch may need to be disassembled to get at the friction felt. Other mechanical parts like cam gears may need to be removed to be properly cleaned. Don't mess up the timing relationships when you do this!

7—Reinstall the belts and reassemble the unit in reverse order.

er electrical continuity. Double-check each connection after soldering for correct wiring and for any possible shorts before proceeding to the next.

If the circuit board is beyond hope or you do not feel you would be able to repair it before the reading of your last

will and testament, replacements might be available. The sad fact is that their cost more than likely will be more than the VCR is worth. Locating a junk VCR of the same model for parts cannibalization might be a more realistic option.

Once all visible damage has been repaired and broken parts have been replaced, take a deep breath, cross your fingers, and power the VCR up to see what happens. Be prepared to pull the plug if there are serious problems—billowing smoke would qualify. Determine if it appears to initialize correctly without shutting down. Play a garbage tape to check if there are any problems that might damage the tape. Watch and listen carefully for any evidence of poor tracking, video noise, tape-speed instability, or weak or muddy audio that might indicate that tape-path alignment requires further attention. Listen for any unexpected mechanical sounds that were not there before.

Very likely, the VCR will be fine. If so, you can replace the covers and find a more secure spot for it.

Use your own judgment with respect to the cat.

Surf's Up!

Someone took your camcorder to the beach, and now it has sand or perhaps salt inside. A similar situation on the home front is that cup of tea on top of the VCR that wasn't as stable as you thought. Now the system behaves... well...strangely. Can this possibly be fixed? Will it be worth the effort or expense?

Unless this is a really sophisticated (i.e., costly) unit, I doubt whether it will pay you to take it anywhere for repair. Even if it is successfully repaired, its reliability might be questionable. Furthermore, as with any equipment that has been dropped or physically abused, few repair shops will be inclined to touch the job. They really don't like challenges of that sort.

That leaves you!

If anything got wet with salt water and it has been just sitting, you can probably forget it. Without immediate attention, and I mean *immediate*—not later, not tomorrow, **NOW!**—salt-water corrosion can set in very quickly and attack electronic components, circuit-board traces, cable wiring, and mechanical parts. The only thing worse might be a peanut-butter and jelly sandwich “played” in your VCR. On second

ELECTRONIC INTENSIVE CARE

1—Remove the circuit boards and label the connectors if there is any possibility of getting them mixed up. If the circuit board(s) are soldered to the rest of the equipment, then you will have to improvise and work around them.

2—Wash with water and dry thoroughly. This does work—I do that routinely for degunking remote controls and rubber-membrane keypads, for example. I have heard of people cleaning contaminated computer keyboards in their dishwasher! The important objective should be to get corrosive liquids off the components and circuit traces as quickly and completely as possible. A final rinse with 91% or pure isopropyl alcohol will decrease the drying time. However, there is a slight risk of damage to sensitive electronic components should some water be trapped inside. Pat dry and then use warm air from a hair dryer (or a heat gun on low) to completely dry everything. Moisture will be trapped in controls, coils, selector switches, relays, transformer cores, connectors, and under large components like ICs. **DO NOT** operate the unit until everything inside and out is thoroughly dry.

3—Use a spray-type contact cleaner on the switches and control cleaner on the control and adjustment pots. **DON'T** turn the internal adjustments without precisely marking the original position, or else realignment will be needed. However, exercise the user controls to help the cleaning process.

Note that the drying time might be quite long. For parts with inaccessible areas like membrane keypads, you might need to wait a *week* before normal operation is restored. Be patient!

4—Once everything is completely dry as a bone and reassembled, power up the system; but be prepared to pull the plug or pop the batteries if there are serious problems. See if the display comes alive and the transport appears to initialize. Attempt to play a garbage tape to determine if there are any mechanical problems that might damage the tape. Look and listen for any abnormalities that might require additional attention and then address specific problem areas.

thought, food probably would not be all that bad compared to the corrosive characteristics of sea water.

Although it is probably too late, the first thing to do when electronic equipment gets wet is to remove the power source; pull the plug or remove the batteries. Don't be tempted to apply power

SUGGESTED VCR REPAIR TITLES

All-Thumbs Guide To VCRs
(Gene B. Williams)
Guide To VCRs, Camcorders, And Home Video (Gene B. Williams)
Home VCR Repair Illustrated
(Richard C. Wilkins)
How To Keep Your VCR Alive
(Steve Thomas)
Maintaining And Repairing VCRs
(Robert L. Goodman)
Operating Your VCR (Victor A. Wayne)
Practical VCR Repair (David T. Ronan)
Troubleshooting And Repairing VCRs
(Gordon McComb)
VCR Troubleshooting And Repair
(Gregory R. Capelo)
VCR Troubleshooting And Repair Guide
(Robert C. Brenner)

until you have determined that everything is completely dry inside and out.

DO NOT use strong solvents anywhere! They can attack various plastic parts or cause internal damage to electronic components.

I've collected a pair of general-purpose lists—one for mechanical, one for electrical—in the accompanying sidebars on how to triage a system that decided to play "U-Boat Commander." Those instructions were written assuming that sand, salt, and liquid contamination is everywhere! Modify those instructions as needed based on your specific situation.

Although it should go without saying, the procedures outlined in those sidebars are very simplistic. The important thing is to get every last grain of sand, salt, and other contaminant off the mechanisms and circuit boards quickly.

When VCRs get wet, moisture may collect *within* certain electronic parts—motors, for example. It is essential that these items be dried completely before applying power to the unit. If you do not, the best to hope for is that the unit will not work properly. Of course, luck never shines when you need it most; and you may do additional serious damage due to short circuits.

For camcorders, some parts of the optics or enclosed DC-DC converter modules might be impossible to access and clean of scum.

In addition to the mechanical tips, here's something else to keep in mind: certain parts need lubrication to operate. If the unit took a dunk in the drink, that lubrication might have washed away or become contaminated with solid parti-

cles. Some of those lubrication points might not be readily accessible or obvious. Don't be tempted to overdo the lubrication—too much is worse than too little.

Advanced VCR References

Of all modern consumer electronics, VCRs probably have the most books covering maintenance and repair. Having such a reference handy when you're up to your armpits in VCR parts can be a godsend. I've collected a short list of titles (see sidebar) that would be a good addition to any amateur repair technician's bookshelf. Before someone complains that I didn't mention <insert title here>, I apologize in advance for any that I left out. Just because a particular guide isn't listed does not mean that its omission was intentional or implies anything about any book's quality or usefulness—I only have so much space to write.

Service Parts Sources

For general electronic components like resistors and capacitors, most electronics distributors will have a sufficient variety at reasonable cost.

However, for consumer-electronic equipment repairs, places like Digi-Key, Allied, and Newark do not have the variety of Japanese semiconductors like ICs and transistors or VCR-specific components like RF modulators, idler assemblies, belts, tires, pinch rollers, video heads, etc.

On my Web site, www.repairfaq.org, I have a document that discusses that issue: "Major Service Parts Suppliers." That page lists some companies that I have used in the past, as well as others that have been recommended. Those companies include MCM Electronics, Dalbani, and Parts Express. I've also listed a few in the sidebar.

For VCR parts in particular, there are several good replacement part sources for the do-it-yourselfer. Studio Sound Service stocks a large selection of new VCR parts, including belts, idlers, gears, mode switches, semiconductors, rebuild/cap kits, and much more for Panasonic and Samsung VCRs. They will ship direct to you with no minimum order—an important consideration for the home-based repair technician. They will even help you determine what part you need if you don't have the part number—all at no extra charge.

The Dale Harper Web site looks like

REPAIR PART SOURCES

Allbrand Audio and Video Parts
368 Ball Hollow Rd.
Pulaski, TN 38479
615-427-6262
allbrand@juno.com
www.usedvcrparts.com/
www.quickpage.com/V/vcrgraveyard/

Dale Harper's VCR Parts and Help for the Do-It-Yourself Technician
vcrparts@superb.net
www2.superb.net/vcrparts

Studio Sound Service
3404 Greenview Dr.
New Albany, IN 47150-4229
studio.sound@datacom.iglou.com
www.iglou.com/studiosound/

a promising resource for help and for new/used VCR parts for the DIY'er. They have a collection of VCRs with salvageable parts as well as general repair info.

There are also some places specializing only in used VCR parts. (Perhaps they would get more respect if they were called "previously owned" or "broken-in" VCR parts!) Allbrand Audio has huge quantities of used and rebuilt VCR parts. For example, a lower drum for a two-head machine usually goes for around \$15. Major parts come with a 30-day warranty. Well, it beats no warranty, I guess! Such places are even better than junk yards as they do the searching and pulling for you. For major sub-assemblies in older VCRs, this may be the only realistic economical option even if the original part is available from the manufacturer.

The Big Finale

While we've only covered a small fraction of the troubleshooting and repair of VCRs, I hope that, if nothing else, some of the mystery surrounding these indispensable gadgets has been eliminated. Once you have an understanding of the "secret voodoo" that goes on behind the front panel, you won't fear opening the top in an attempt to determine why your faithful servant is being uncooperative. For much more information on the VCR subject, see the VCR-related resources at my Web site, www.repairfaq.org. For even more in-depth coverage, consider an actual book. You know, one of those low-tech "things" that can be borrowed from a public library or ordered on-line!

elcome feedback on this and all
s "Service Clinic" columns. I
recognize that the series on VCRs prob-
ably dragged on about 50 percent too

long and won't make that mistake again.
What would you like to see in this
column? How about the format? Would
you like to have specific questions

addressed? Please send your comments
to me at the e-mail address at the top of
this column.

See you next time!

P

AMAZING SCIENCE

(continued from page 49)

any of the chemistry or microbes to
make it work. To make the kit work, you
need:

- Dried baker's yeast
- 50 milliliters of methylene blue solution (10 mM)
- 50 milliliters of glucose solution (1M)
- Potassium ferricyanide

In addition, you will also need 0.1 Mole solution of phosphate buffer with a pH of 7.0 made by dissolving 4.08 grams of Na_2HPO_4 and 3.29 grams of $\text{NaH}_2\text{PO}_4 \cdot 2\text{H}_2\text{O}$ in 500 milliliters of distilled water.

If you do not have the means to obtain or make the above-mentioned chemistry, do *not* purchase the microbial



Fig. 7. Here's an experimenter's microbial fuel-cell kit. You add the chemistry and microbe portion of the formula.

fuel-cell kit.

Toward The Future

While microbial fuel cells are just starting to peek out of the laboratories, two key microbial fuel-cell researchers—Peter Bennetto and John Stirling—see a bright future for bug batteries. Looking

CHEMICAL WARNING

Potassium ferricyanide is poisonous. Eye protection should be worn when handling this chemical. If the solution comes into contact with the eyes, flood them with tap water and seek medical attention. If swallowed, give plenty of water to drink and seek medical attention.

SOURCE INFORMATION

The microbial fuel-cell kit in this month's text is available for \$100. NY residents must add appropriate sales tax.

Images Company
39 Seneca Loop
Staten Island, NY 10314
718-698-8305

ahead, they anticipate electric cars getting eight miles per pound of sugar. Bug batteries can theoretically provide energy densities comparable to lithium. P

FACTCARDS



**Jampacked with
information at your
fingertips**

■ ALL YOU NEED to know about electronics from transistor packaging to substitution and replacement guides. FACTCARDS numbers 34 through 66 are now available. These beautifully-printed cards measure a full three-by-five inches and are printed in two colors. They cover a wide range of subjects from Triac circuit/replacement guides to flip-flops, Schmitt triggers, Thyristor circuits, Opto-Isolator/Coupler selection and replacement. All are clearly explained with typical circuit applications.

■ WANT TO EXPAND your knowledge of electronics? Do it the easy way

by studying the Electronics Fact Cards. Do you travel to and from your job each day? Drop a handful of cards in your pocket before you leave, and the bus becomes a schoolroom! At home, you can build some of the projects and not only have fun building and using them, but learn how they work at the same time.

■ YOU'LL BE AMAZED both at how rapidly you learn with these cards, and how easy it is to understand. These new cards are available right now. Don't miss out. Send your check or money order today.

FACTCARDS—Facts at your fingertips for Experimenters and Project Builders!

Please send one copy of FACTCARDS \$1.99. Shipping \$2.00 (U.S. and Canada only).

Please send _____ copies of FACTCARDS. Total cost is sum of copy price and First Class postage and handling cost multiplied by number of card sets ordered.

New York residents add sales tax to total cost of each order.

Please print

Allow 6-8 weeks for the material to arrive.

(Name)

(Street Address)

(City)

(State)

(Zip)

Detach and mail today:
CLAGGK Inc.
P.O. Box 12162
Hauppauge, NY 11788

All Payment must be in U.S. Funds!

BS168

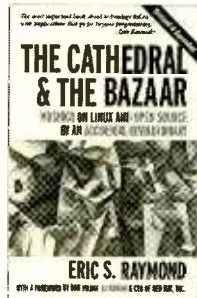
NEW LITERATURE

The Cathedral and The Bazaar, Revised Edition

by Eric S. Raymond
O'Reilly and Associates, Inc.
101 Morris St.
Sebastopol, CA 95472
800-998-9938 or
707-829-0515
www.oreilly.com

\$16.95

This is the tale of an open-source creation (*Fetchmail*) from its conception to its implementation. Readers have the chance to see the computer programming industry from an insider's perspective. Recently updated, this edition includes essays that address both open-source economic principles and the mechanics behind *bazaar* (open-collaboration) software development.



The ARRL Antenna Book CD, Version 2.0

from ARRL
225 Main St.
Newington, CT 06111
888-277-5289 or 860-594-0200
www.arrl.org
\$39.95

Whether you are a Ham who wants to build the perfect Yagi antenna or a RF technician who needs to brush-up on transmission theory, this *e-reference* is just as handy as its paper counterpart. The CD version—both Windows and Macintosh compatible—contains over 70,000 pages of propagation tables, as well as Windows- and DOS-based utilities for analysis and design.

Practical Electronics for Inventors

by Paul Scherz
McGraw-Hill
2 Penn Plaza, 12th Floor
New York, NY 10121-2298
800-2MCGRAW
www.books.mcgraw-hill.com

\$39.95



This book provides a foundation for budding inventors. Even a *mad scientist* can benefit from reading this text, which is a complete reference for the hands-on study of basic electronics. Each chapter educates and challenges the reader on subjects ranging from basic electronic theories to circuit troubleshooting. There are numerous colorful illustrations, which highlight the text.

The Loudspeaker Design Cookbook, Sixth Edition

by Vance Dickason
Audio Amateur Inc.
P.O. Box 876
395 Union St.
Peterborough, NH 03458-0876
888-924-9465 or 603-924-9464
www.audioXpress.com

\$39.95

Completely revised, this edition is a comprehensive discussion of loudspeaker design and construction. New material includes reviews of current technologies, such as Dr. Earl Geddes' Acoustic Lever enclosure design. Accompanied by graphs and drawings, a complete five-speaker home-theater system construction project features LCR, surrounds, and a powered subwoofer.

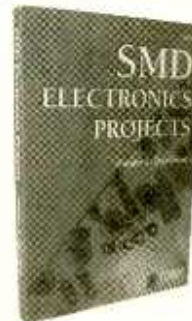


SMD Electronic Projects

by Homer Davidson
Prompt Publications
Sam's Technical Publishing
5436 W. 78th St.
Indianapolis, IN 46268
800-428-7267
www.samswebsite.com

\$29.95

SMDs (Surface-Mounted Devices) have opened up a brand new area of electronic project construction. Each of the 30 projects here is accompanied by a parts list, schematic, wiring hook-up, board layout, photos, drawings, and troubleshooting tips. Projects include an earphone radio, baby monitor, a code oscillator, and a pink-noise generator.



NEW GEAR

USE THE FREE INFORMATION CARD FOR FAST RESPONSE

Satellite Radio

The *IC-910H Satellite Radio* (\$1799 with included cable and microphone) provides 100 watts VHF and 75 watts UHF for mode-J satellites. Packet operation is easy with the radio's two data sockets for simultaneous receiving on the main and sub bands. With an easy-to-read display and a 10-key entry pad, the IC-910H is ready for portable operation any time.

ICOM AMERICA, INC.

2380 116th Ave., N.E.

Bellevue, WA 98004

425-454-8155

www.icomamerica.com

CIRCLE 60 ON FREE INFORMATION CARD



Rechargeable Batteries

The *Millennium Rechargeable Power Systems* provide high performance for high-drain portable devices like hand-held computers and digital cameras. For example, the cells (priced from \$7-\$13) are said to take 270,000 pictures during their lifetime compared to an alkaline battery's 216 photos. Battery chargers (\$16-\$22) and rechargeable power packs (\$31-\$93) for camcorders and cellular phones are also available.

MILLENNIUM RECHARGEABLE POWER SYSTEMS

P.O. Box 147114

Gainesville, FL 32614-7114

877-661-6302

www.millenniumbatteries.com

CIRCLE 63 ON FREE INFORMATION CARD



Clamp-On Meter

Meant for electrical measuring applications, the *AC40A Clamp-On Ammeter* (\$79.95 with carrying case) is a compact 400 A, 4000-count, AC digital mini-meter. A non-invasive instrument, it has a T-shape design that fits the hand and is ideal for field work.

The control buttons and an amps/volts/ohms/power switch are conveniently located on the front of the meter. The large display features Digi-Glo backlighting. Protective precautions include extra fusing, safety test leads, voltage safety testers, and a warning beeper that sounds when a wrong input is used.

WAVETEK METERMAN TEST TOOLS

P.O. Box 9090

Everett, WA 98206-9090

877-596-2680

www.metermantesttools.com

CIRCLE 61 ON FREE INFORMATION CARD



Linear Power Supplies

The *HWD Series Linear Power Supplies* (priced from \$950 to \$1200) are designed for the lab bench or for system applications. They feature a digital voltmeter and an ammeter that eliminate the need for external DVMs. The availability of RS485 and RS232 programming makes them versatile test instruments.

MID-EASTERN INDUSTRIES, INC.

100 School St.

Bergenfield, NJ 07621

201-385-0500

www.mideastind.com

CIRCLE 62 ON FREE INFORMATION CARD



Mini Soldering Iron

Ideal for work with heat-sensitive components, the *Antex Model M/3U Miniature Soldering Iron* (under \$24, with tips at \$4.25 each) heats up to 650°F

in under 45 seconds and cools within two minutes. It measures only eight inches and has a three-wire grounded cord. The iron operates on 115-volts AC with heat directly into the tip, keeping the plastic handle cool.

M.M. NEWMAN CORP.

24 Tioga Way

P.O. Box 615

Marblehead, MA 01945

781-631-7100

www.mnewman.com

CIRCLE 64 ON FREE INFORMATION CARD



Multimedia Generator

The VP300 "Video Pro" Multimedia Video Generator (\$1995) is a portable, lightweight, battery-operated, reliable video signal source. An all-in-one instrument for home-theater installation, the tester provides everything needed for fast, accurate alignment of all video modes—such as composite, S-Video, and NTSC/PAL.



SENCORE INC.

3200 Sencore Dr.
Sioux Falls, SD 57107
800-736-2673
www.sencore.com

CIRCLE 65 ON FREE INFORMATION CARD

Embedded Controller

An embedded DOS controller, the LogicFlex is a compact, expandable Single-Board Computer (SBC) with flexible Internet and Ethernet protocols. Powered by a 25-MHz Intel 386Ex processor with 512 kB, each of SRAM and Flash memory, the board (\$279 individually) offers non-volatile mass-storage options from 2–144 MB. Source code for a Web server, along with other protocols and example code, is included in the LogicFlex Development Kit (\$449).

JK MICROSYSTEMS, INC.

1403 Fifth St., Suite D
Davis, CA 95616
530-297-6073
www.jkmicro.com

CIRCLE 68
ON FREE
INFORMATION
CARD



Test-Clip Set

The Model 6405 Insulation-Piercing Test Clip Set (\$30) provides the exact pressure needed to pierce through a wide range of insulated wires: plastic, Teflon, or silicone. A rotating banana jack prevents the test lead from twisting while the wire is pierced. The small, easily attached clips can access individual wires within large bundles.



POMONA ELECTRONICS

1500 E. Ninth St.
Pomona, CA 91766
909-469-2900
www.pomonaelectronics.com

CIRCLE 67 ON FREE INFORMATION CARD

In-Circuit Meter

The lightweight, battery-powered, hand-held Synthesized In-Circuit LCR/ESR Meter (Model 885) tests components at frequencies up to 10 kHz. Designed for both production-line and bench-top testing, the meter (\$549 with included manual, battery, surface-mount probe, and case) quickly checks the ESR of a capacitor. In addition, the surface-mount probe gives users an easy way to test these tiny components.



B&K PRECISION CORP.

1031 Segovia Circle
Placentia, CA 92870-7137
714-237-9220
www.bkprecision.com

CIRCLE 66 ON FREE INFORMATION CARD

Fold-Up Thermometer

The Model 39272 Pocket Fold-Up Thermometer (\$39, complete with wrist strap and battery) offers a stainless steel probe that can be adjusted from 0° to 180° for convenient measuring and viewing. Temperature measurements are °F/°C switchable and range from -58 to 572°F (-50 to 300°C). Features include a Data Hold function, Min/Max recording, and fast response time.

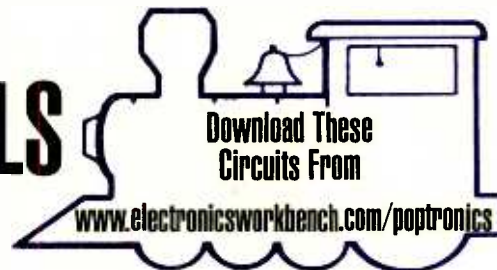
EXTECH INSTRUMENTS CORP.

285 Bear Hill Road
Waltham, MA 02451-1064
781-890-7440
www.extech.com

CIRCLE 69 ON FREE
INFORMATION CARD



CRUISING DOWN THE RAILS



Around Christmas time each year, I drag out and dust off a few of my model electric trains and arrange a hurried layout for the holidays. Believe me, if you have a train fan in the family, a simple layout will really get them into the holiday spirits. A beautiful Märklin Maxi 1 gauge "Glaskasten" (a Glass Palace) lightweight tank locomotive and two passenger cars were added to my meager Garden railroad layout this Christmas. Thanks, dear!

No matter what gauge—Z to G—you favor, all model electric trains require some electrical equipment to

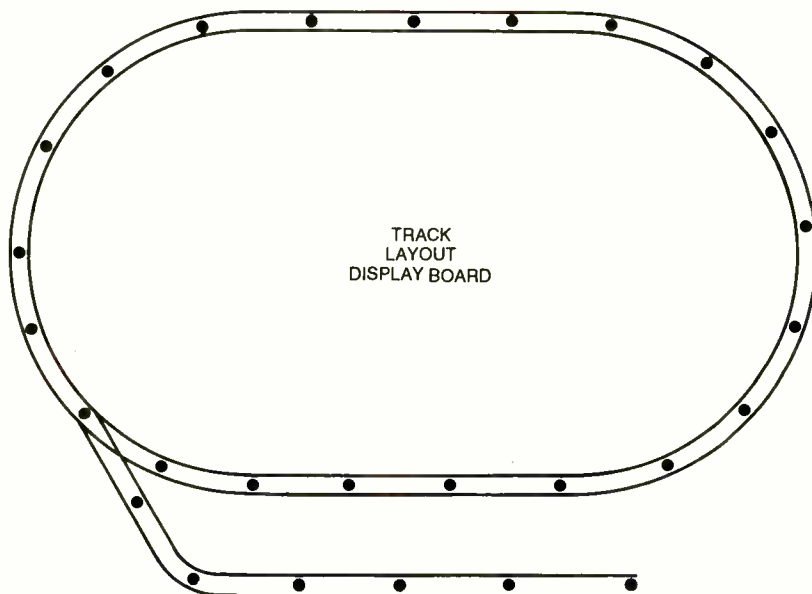


Fig. 2. By spacing sensors at regular intervals around the layout, you can create a board that lights up to indicate train position.

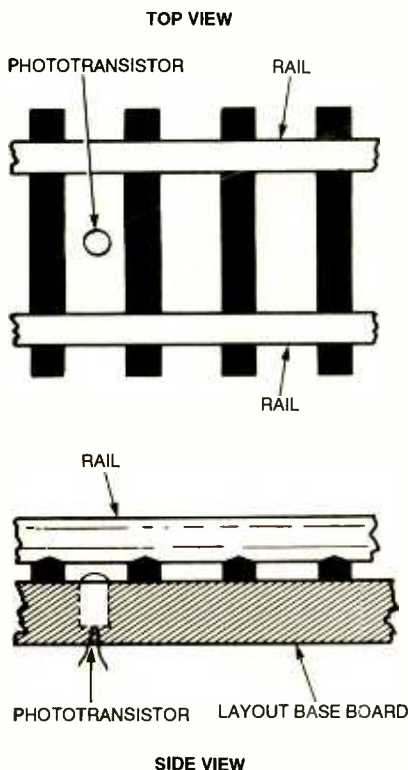


Fig. 1. If you want an easy method of sensing model train locations on the track without resorting to sophisticated electronic-detection circuits wired to the rails, you can't get much simpler than placing a phototransistor between the rails. Ambient light in the layout room lets the devices sense when a train passes over them.

operate. The model trains available today are truly an embedded part of the digital age. It's not difficult to run almost any number of trains on the same track at the same time; each locomotive can be controlled individually. Electronics and model trains are a great combination that goes back decades. If you enjoy building both electronic circuits and mechanical

devices, stick around and we'll look over some basic electronic train circuits. Hey, even if you are not into model trains, these circuits can be used for many other applications and could end up in one of your future projects. So stay tuned.

Keeping Track

I've always been intrigued with the control systems used in the operations centers of full-sized railroads. You've probably seen them in railroad-centric

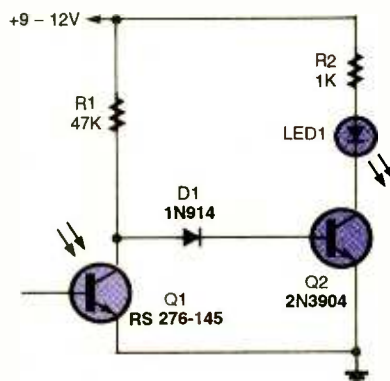


Fig. 3. This detector circuit uses a second transistor to drive an LED indicator.

PARTS LIST FOR THE BASIC PHOTOTRANSISTOR CIRCUIT (FIG. 3)

- D1—1N914 silicon signal diode
- LED1—Light-emitting diode, any color
- Q1—Phototransistor (RadioShack 276-145 or similar)
- Q2—2N3904 NPN silicon transistor
- R1—47,000-ohm, ¼-watt, 5% resistor
- R2—1000-ohm, ¼-watt, 5% resistor

SECOND CHOICE BASIC
PHOTOTRANSISTOR CIRCUITS

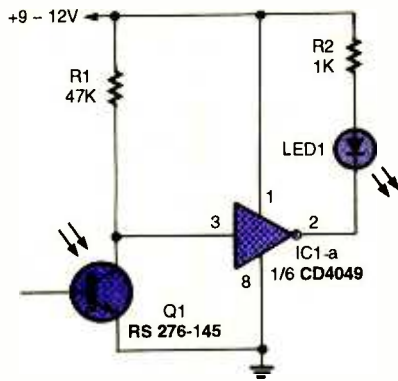


Fig. 4. This detector circuit substitutes an IC inverter for the second transistor of Fig. 3.

PARTS LIST FOR THE IC-BASED
PHOTOTRANSISTOR CIRCUIT
(FIG. 4)

- IC1—CD4049 CMOS hex-inverter buffer, integrated circuit
- LED1—Light-emitting diode, any color
- Q1—Phototransistor (RadioShack 276-145 or similar)
- R1—47,000-ohm, 1/4-watt, 5% resistor
- R2—1000-ohm, 1/4-watt, 5% resistor

films: the series of lights that display the train's location. The lights are configured in the shape of the actual track patterns on a large wall-mounted display. Following a similar scheme for model trains should be an easy task, and that is what we'll look at for our first entry this visit.

Assuming that most model train layouts are operated in a lighted area, our simple approach to keeping track of our model train is as easy as monitoring the ambient light around. Placing photo-

transistors along the track, as shown in Fig. 1, supplies the data necessary to track the train (pun intended!) as it moves around the track. Each phototransistor is mounted between the rails face up to detect ambient light from above. When the train blocks the light source, the phototransistor's output changes and signals an LED to turn on at that location on the display board. All covered phototransistors send out the same signal, turning on their corresponding LEDs and giving a moving light display of the operating train. Figure 2 shows one layout scheme for a display board.

The number of phototransistors and LEDs used in a layout will determine the display's resolution as to the actual train's position on the track. A "Z" gauge (the *really* tiny stuff) layout might require phototransistors located as close as every two inches; a "G" or "No. 1" gauge layout (the "garden-scale" size) should probably be no closer than one foot. In any case, it's your choice.

Circuit Choices

There are many ways to approach the problem electronically. Our first choice, see Fig. 3, uses a phototransistor and a general-purpose NPN transistor to light the LED. Transistor Q1's collector is near ground level when exposed to ambient light. The base of Q2 is also near ground level, keeping it turned off and the LED dark. Blocking the light from Q1 allows its collector to rise in voltage, supplying a positive bias through D1 to Q2, which lights LED1. This scheme is a good one if your junk box is overflowing with similar general-purpose NPN transistors.

The second choice (Fig. 4) is one that I prefer, using a CMOS CD4049 hex

PARTS LIST FOR THE
COMPLETE SENSING SYSTEM
(FIG. 5)

- IC1—CD4049 CMOS hex-inverter buffer, integrated circuit
- LED1-LED3—Light-emitting diode, any color
- Q1-Q3—Phototransistor (See text for type)
- R1-R3—47,000-ohm, 1/4-watt, 5% resistor
- R4-R6—1000-ohm, 1/4-watt, 5% resistor

inverter/buffer as the LED driver. One advantage of the CD4049 IC is that it has six inverters in a single package and is inexpensive. The circuit operation is very similar to our previous circuit. Ambient light hitting the phototransistor causes it to conduct, pulling its collector to near ground level. Whichever logic level, either a high or a low, is applied to the input of a CD4049 inverter/buffer, the output will always be opposite. A high input produces a low output, and a low input produces a high output. In the circuit in Fig. 4, the IC's input at pin 3 is low and the output at pin 2 is high. Therefore, no current will flow through the LED, and it will remain dark as long as no input change occurs. A locomotive or car crossing the phototransistor will block the ambient light source and turn on the LED.

Putting it All Together

A simplified version of the display board circuitry is shown in Fig. 5. Since all circuits are identical, only three are shown in the drawing, but a total of six circuits may be built with each CD4049 IC. If your layout require 24 sensors, then only four CD4049 ICs are needed.

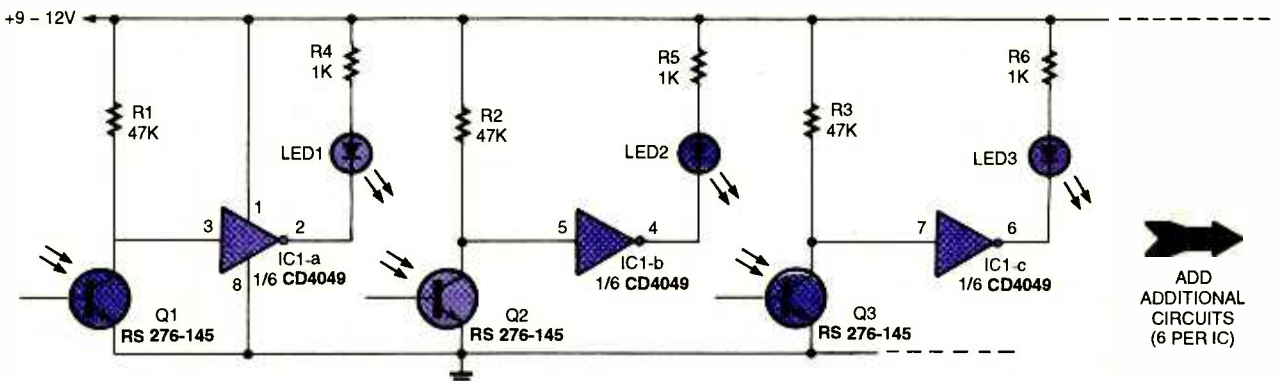


Fig. 5. Although only three stages of the Fig. 4 circuit are shown, you can have six detectors per IC chip—one for each gate.

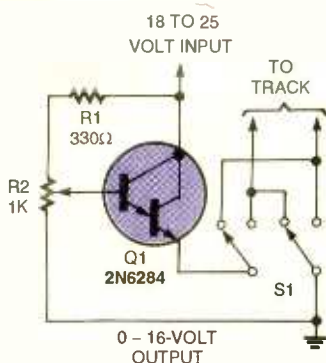


Fig. 6. This simple DC-control circuit uses a Darlington transistor to control the current to the track. Switch S1 sets the train direction.

PARTS LIST FOR THE TRANSISTOR-BASED DC-CONTROL CIRCUIT (FIG. 6)

- Q1—2N6284 Darlington NPN silicon power transistor
- R1—330-ohm, 1/4-watt, 5% resistor
- R2—1000-ohm potentiometer
- S1—Single-pole, single-throw switch

Selecting A Suitable Phototransistor

The heart of the circuitry is choosing the right phototransistor for the job. The best way to determine if a particular type of phototransistor will work with your layout is to breadboard the Fig. 4 circuit and substitute various phototransistors in Q1's position. Drill a hole in the base of your layout between the rails (refer back to Fig. 1) for the phototransistor to snugly slide into place facing up. Ideally, the voltage at the collector of Q1 should be less than 2 volts with ambient light. Roll a train car over the photocell, and the voltage should rise to near supply level. If so, the selected type of phototransistor will suffice.

The following list of inexpensive phototransistors should get you well on your way to building your very own tracking circuit. For starters, RadioShack's 276-145 is a handy item to try and should work in most cases. The following are devices available from Mouser Electronics (www.mouser.com) and all cost less than 50 cents each:

- 512-QSD122
- 512-QSD123
- 512-QSD124

Those are all 0.195-inch diameter devices. Layouts that are not well light-

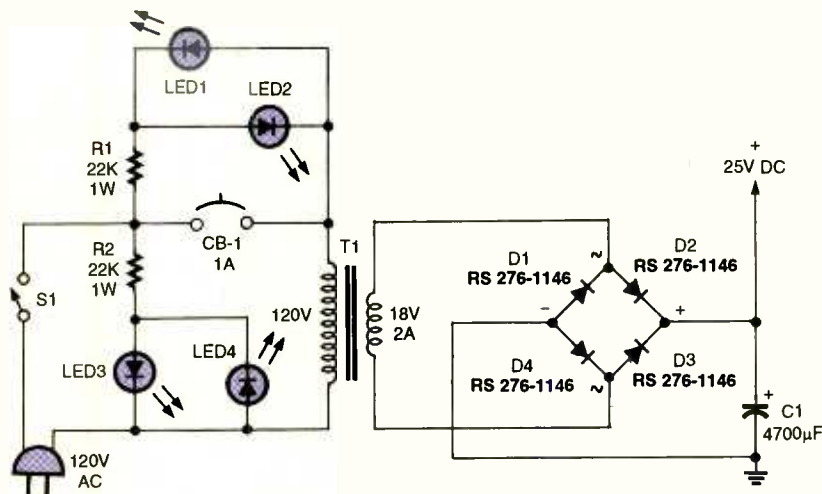


Fig. 7. To power the Fig. 6 controller, this power supply has indicators for both "power on" and "circuit breaker open."

PARTS LIST FOR THE DC POWER SUPPLY (FIG. 7)

- D1-D4—4 amp, 50-volt silicon rectifier diode (RadioShack 276-1146 or similar)
- CB1—1-amp circuit breaker (Mouser 655-W28-XQ1A-1 or similar)
- C1—4700-µF, 35-WVDC, electrolytic capacitor
- LED1-LED4—Light-emitting diode, any color
- S1—Single-pole, single-throw switch
- T1—18-volt transformer (RadioShack RSU10524239 or similar)

ed still have a chance of operating with one of the following photo Darlington transistors from Mouser. These average about two bucks a shot:

- 512-L14F1
- 512-L14F2

Those are 0.189 inches in diameter.

Tracks running through tunnels or other dark locations can also be monitored by using infrared-(IR) emitter LEDs mounted over the track above each of the phototransistors. Using these basic circuits, you can make the layout display board as simple or as complex as you like. The CD4049 inverter outputs may also be used to activate crossing signals, horn signals, or just about anything else you desire.

Power Source and Control Circuitry

Our next entry is a simple variable-DC control unit suitable for operating DC-powered model trains. The circuit,

shown in Fig. 6, takes the output of an 18- to 25-volt DC source and supplies a variable DC output to the train tracks. Switch S1 is connected as a polarity inverter that allows the train to change directions.

The 2N6284 Darlington transistor can output several amps to the train tracks and should be mounted on a heat sink with at least 25 square inches of surface area. If the DC source is not fused, it would be a good idea to insert a 3-amp fuse in series with the circuit's positive input lead. This circuit will work with many of the HO trains and G gauge trains. Of course, you should always check to be sure what your train requires for power and how it reverses direction before using any control system not specifically designed for it.

DC Power Supply

Our next entry (Fig. 7) is an unregulated 25-volt DC power source for use with the controller circuit in Fig. 6. An 18-volt, 2-amp RadioShack (or other suitable source) transformer is the power source for the DC supply. Four 4-amp silicon diodes arranged in a full-wave bridge produces an output of about 25 volts DC. Capacitor C1, a 4700-µF, 35-WVDC electrolytic capacitor, helps to filter out the AC ripple and store the DC energy. Light-emitting diodes LED3 and LED4 indicate that S1 is closed and the AC power is on.

Protection is provided by CB1, a 1-amp circuit breaker, should a short occur on the railroad tracks. Light-emitting diodes LED1 and LED2 will turn on if the circuit breaker blows, indicating the fault condition.

**PARTS LIST FOR THE
VARIABLE DUAL-POWER
CONTROLLER CIRCUIT
(FIG. 9)**

- C1, C2—4700- μ F, 35-WVDC electrolytic capacitor
- D1—D4—1N5401 3-amp, 100-volt silicon rectifier diode
- D5, D6—1N4002 1-amp, 200-volt silicon rectifier diode
- F1—1-amp fuse
- Q1—2N6284 NPN Darlington power transistor
- Q2—2N6287 PNP Darlington power transistor
- R1, R2—10,000-ohm, 1/4-watt, 5% resistor
- R3—2000-ohm potentiometer
- S1—Single-pole, single-throw switch
- T1—25.2-volt, 2-amp power transformer (RadioShack 273-1512 or similar)

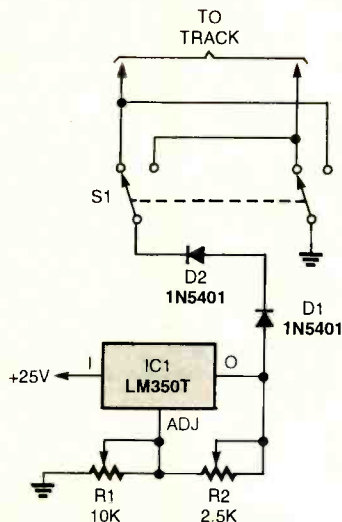


Fig. 8. A variation of the Fig. 6 circuit is to use a high-amperage voltage regulator in place of the simple transistor. Be sure to provide ample heatsinking for IC1.

**PARTS LIST FOR THE
REGULATOR-BASED DC
CONTROLLER CIRCUIT
(FIG. 8)**

- D1, D2—1N5401 3-amp, 100-volt silicon rectifier diode
- IC1—LM350T variable voltage regulator, integrated circuit
- R1—10,000-ohm potentiometer
- R2—2500-ohm potentiometer
- S1—Single-pole, single-throw switch

Another DC-Controller Circuit

The controller circuit shown in Fig. 8 uses an LM350T variable voltage-regulator IC, which can supply over 2 amps to the rails. The output may be varied from less than 1 volt to over 18 volts, using the power supply in Fig. 7. A double-pole, double-throw switch, S1, reverses the DC output. Potentiometer R1 is the voltage control, and R2 sets the maximum output voltage. The IC must be mounted on a heat sink of at least 25 square inches in order to output its maximum current. Diodes D1 and D2 allow the circuit to adjust to near zero volts out at the low end. Without the two diodes in place, the minimum output voltage would be slightly over one volt.

**A Variable Dual-Polarity
Controller Circuit**

Our last train circuit for this visit, see Fig. 9, is a complete single-control positive and negative 0-to-16 volts DC variable power supply. A RadioShack 25.2-volt, 2-amp center-tapped power transformer serves as the power source for both positive and negative outputs. Diodes D1 and D4 provide the positive DC output voltage, and diodes D2 and D3 provide the negative DC output voltage. Capacitors C1 and C2 are filter and energy-storage capacitors.

Two complementary Darlington power transistors are connected in a

common-emitter output circuit, with the NPN transistor (2N6284) controlling the positive output voltage and the PNP transistor (2N6287) controlling the negative output. When the output voltage-control potentiometer, R3, is adjusted to its center position, the output voltage will be zero. As the potentiometer is turned toward the positive supply, Q1 is biased on, supplying a variable positive output to the tracks. Rotating R3 toward the negative supply turns Q2 on, producing a variable negative output. Although I seem to be repeating myself with this requirement this month, remember the two power transistors should be mounted on at least a 25-square-inch heatsink for maximum current output.

Looks like the train has just pulled into the station, and it's time to depart. Come back next month, and we'll look at some more basic circuits. May your train never jump track. **P**

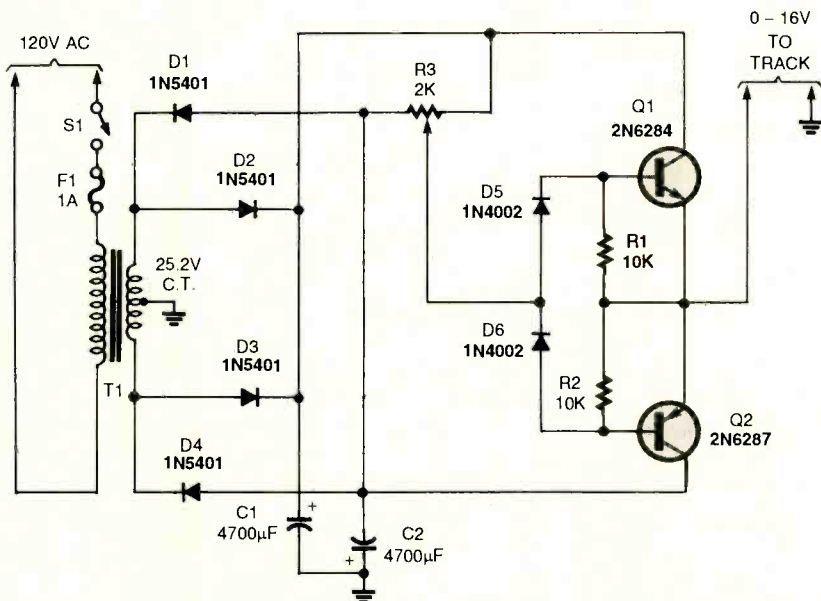


Fig. 9. An interesting approach to reversing track polarity, and therefore train direction, is this circuit. By simply turning R3 in the appropriate direction, voltage of either polarity is applied to the track. An advantage of this design is that you can reverse direction of your train in a smooth and prototypical manner: in order to reverse direction, you must reduce the voltage (and speed) to zero. With the switch in Figs. 6 and 8, you can reverse direction while going full blast—an arrangement your model passengers and cargo won't enjoy in the least!

POPTRONIX®
Online Edition
We're on the web FREE
<http://www.poptronix.com>

Poptronics®

SHOPPER®

POLARIS CAN SUPPLY YOU WITH ALL OF TODAY'S HOTTEST VIDEO TECHNOLOGY!

CALL OR GO ON-LINE TO ORDER YOUR FREE VIDEO CATALOG - 100's OF PRODUCTS - MICRO CAMERAS - WIRELESS VIDEO - LIPSTICK CAMERAS - DIGITAL VCR'S
WEB CAMERA WITH BUILT-IN PAN/TILT/ZOOM CONTROLS **WEATHERPROOF DIGITAL STORAGE CAMERA**



Compact Web Camera For Online Image Monitoring and Delivery Over The Internet

Featuring a built-in Web server, powerful 10x zoom, pan/tilt, and alarm input/output capability, all in an ultra-compact unit. These Web cameras can be installed virtually anywhere and deliver high-quality images to the Internet for real-time monitoring or broadcast. Better yet, these cameras can be controlled and monitored via a standard Web browser, making it ideal for a wide variety of applications.
 Size: 122mm x 82mm x 97mm.

- ☛ Ultra-compact, all-in-one web camera with built-in web server
- ☛ Monitoring and camera control possible via web browser
- ☛ 10x optical zoom and multi-angle pan/tilt capability
- ☛ 10Base-T interface for direct connection with network
- ☛ Alarm In/Out function for automatic surveillance
- ☛ Three different security levels

The SWC-40R combines a black & white video camera, digital image storage, video motion detection and an alarm interface in a compact, vandal proof enclosure. It is unique as it offers a complete CCTV surveillance system within a single compact enclosure.

- ☛ All-in-one CCTV system
- ☛ Built-in digital image storage
- ☛ Programming and image retrieval by remote control
- ☛ Built-in video motion detection

NO TAPES!

SWC-40R
\$849.95

Dimensions
5" x 4" x 4.5"



"YOUR WEB BROWSER IS YOUR REMOTE EYE!"

The Flexcam acts as an internet camera server. No software needed in order to view your video. All you need is a web browser such as Internet Explorer or Netscape. Flexcam includes many special functions including video quality control, pan/tilt/zoom interface and network configuration. All of them are controlled by the web browser. Features 4 video inputs - 3 external.

FLEXCAM \$CALL



CONTROL PAN / TILT AND ZOOM REMOTELY OVER THE INTERNET!

LIVE VIDEO!

COLOR & B/W SUBMERSIBLE CAMERAS



CAN SEE IN THE DARK!
CAN SEE UNDER WATER!
 B/W version comes with attached 80 meter cable (color-20 meter). Built-in white LED's give this camera a 15 meter infrared range. Heat resistant glass and water resistant design allow for rugged applications.

VIDEO CAMERA HEAD CAN BE SUBMERGED UP TO 100 FEET!
 SUBCAM-BW (B/W) - \$249.95
 SUBCAM-CL (COLOR) - \$299.95

5" COLOR WIRELESS OBSERVATION SYSTEM



ADD UP TO 3 ADDITIONAL CAMERAS!

Now you can enjoy peace of mind with our new wireless observation system. Comes with 5" wireless color monitor and a wireless color camera. Just Plug-&-Play Perfect for around the house or office.



Includes an attractive swivel mount indoor / outdoor patch antenna for extra range!
 2.4GHz GW-2400S - \$379.95

MICRO-VIDEO HEAD "SNAKE" CAMERA

Incredibly small micro head color camera incorporates a CCD chipset. (Not CMOS). Fully adjustable focus from 0.5 inches to infinity. Automatic iris for varying light levels.



VIDEO HEAD IS ONLY 7mm IN DIAMETER!

MH-SCO1
\$479.95

6.4" COLOR TFT-LCD MODULE
TFT MONITORS AVAILABLE FROM 2.5" - 15"



Back Side of Module
HIGH RESOLUTION!

Our new 6.4" Color TFT Module can be used for a variety of purposes such as: custom automotive dash installations, video phone, door phone, boat installations, covert ultra-compact surveillance packages, security and more.
 Dimensions
 1.5"(W) x 1.75"(H) x 0.5"(D)
TFT-64M - \$319.95

COVERT COLOR SPY CAMERA

It's small sleek indestructible design and pinhole lens allow for various applications and simple installation. Comes equipped with a RCA JACK for easy connection to TV monitor or VCR. Great for covert use in any-place imaginable.
 25mm(W) x 17mm(D) **CM-550CP - \$79.95**

MICRO BOARD CAMERAS - MANY MODELS IN STOCK TO CHOOSE FROM!

MB-1250HRP
 Hi-Res Color
 Pinhole
 5.0mm Lens
 1.27" x 1.27"
 \$109.95

WEATHERPROOF CAMERA

Color Camera
 400 TV Lines
 Automatic Iris
Hi-Res Color Lipstick Camera
 Length: 2.6"
 Diameter: .785"
WP-300C - \$159.95



2.4 GHz A/V TRANSMITTING MODULE



Makes any camera wireless! Excellent for hobbyist / remote control airplanes.
 2.4GHz 4 channel video transmitting module with audio capability / power switch and antenna.
MPX-2400 - \$89.95
 2.4GHz RECEIVER
GFR-5002 - \$119.95
 Dimensions
 1.5"(W) x 1.75"(H) x 0.5"(D)

MONITOR UP TO 4 VIDEO CAMERAS SIMULTANEOUSLY THRU YOUR INTERNET CONNECTION OR OVER YOUR MODEM!

MOTION DETECTION - ALARM RECORDING - NOTIFICATION
 ✓ TCP/IP Highlight an area on your video screen, and the DMRS will inform you via modem thru your telephone or pager if there is movement in that highlighted area while recording to your hard disk.
 ✓ MODEM
 ✓ LAN/WAN
 DMRS-4....4 Input Digital Video Card....\$289.95



Video can be viewed in Quad style (above), full screen mode or audio switching mode.

POLARIS INDUSTRIES 800-752-3571 470 Armour Drive NE • Atlanta GA 30324-3943 **WWW.POLARISUSA.COM**
 Tech 404-872-0722 • Fax 404-872-1038

CIRCLE 228 ON FREE INFORMATION CARD



Spring 2001 Catalog is now available. Over 100 new products! Get yours today!



COMMERCIAL 35W FM TRANSMITTER



Clean and powerful, plus an on board computer that's your "virtual" station engineer! We can now supply turn-key packages for your community or LPPM station.

Call or visit our broadcast web site, www.highpowerfm.com, for more details.
PX1 **\$1,795.00**

BROADCAST YOUR MP3 AND .WAV FILES



Our FM broadcaster designed specifically for PC sound-cast. Broadcast MP3s, internet radio and more to any FM radio in your house or yard. You can't buy an assembled broadcaster this powerful or clean. Kit includes case and power supply.
MP3FM **\$99.95**

FM100 SYNTHESIZED FM STEREO RADIO STATION



- Synthesized 88 to 108 MHz for no frequency drift!
- Built in mixer - 2 line inputs and one microphone input!
- Strappable for higher power output
- Low pass filter for great audio

Our FM100 is used all over the world by serious hobbyists as well as churches, drive in theaters, and schools. The kit includes metal case, whip antenna and built-in 110 volt AC power supply.

FM100 Super-Pro FM Stereo Radio Station Kit **\$249.95**
FM100WT 1 Watt, Wired Export Version **\$399.95**

FM STEREO RADIO TRANSMITTER



Great entry level FM broadcast kit. Thousands in use. Handy for sending music through house and yard, ideal for school projects too - you'll be amazed at the exceptional audio quality! Runs on 9V battery or 5 to 15 VDC. Add matching case and whip antenna set for great pro look.

FM10A Tunable FM Stereo Transmitter Kit **\$34.95**
CFM Matching Case and Antenna Set **\$14.95**
FMAC 12V DC Wall Plug Adapter **\$9.95**

CARPET ROVER II ROBOT KIT



This advanced kit is an 8 x 8" differentially steered base that is excellent for carpet or tiled floor experimentation. It uses the Next Step microcontroller, a BASIC Stamp 2 controller that can use the BS2 or BS2-E (sold separately). A host PC is required to download programs to the robot. This complete kit includes the Rover, programming cable, IR proximity detector, bumper switch kit, and line follower kit.

RK3000 Carpet Rover II Complete Kit **\$185.00**

COMBUSTIBLE GAS DETECTOR KIT



Build this kit and detect combustible gases and vapors including natural gas, gasoline, propane, and dozens more. Model GLD1000 is a local alarm only, GLD1010 includes a relay to control external alarms.

GLD1000 **\$29.95**
GLD1010 **\$39.95**

BUILD YOUR OWN STEREO!



We've got the kit! Our K4500 is a synthesized FM stereo tuner, the K4100 is a matching pre-amp. Both are fully digitally controlled with an optional IR remote control (kit also). Add our

K4020 2 x 155W Class A power amplifier kit to complete your drop-dead stereo. We also have tube amplifier kits. Visit us on the web, or request our new catalog for more information.

K4500 Synthesized FM Stereo Tuner Kit **\$399.99**
K4100 Digital Preamp Kit **\$399.99**
K4101 IR Remote Control Kit **\$69.95**
K4020 Solid State 310W Power Amp Kit **\$499.99**

ELECTRONIC PROTOTYPING SOFTWARE...

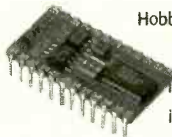


Priced for the hobbyist!

You can create and test AC and DC circuits minutes after installing this package on your PC. Start from scratch, or from the included library of pre-designed circuits. Drag and drop placement from a complete list of active and passive components. Test using a complete list of virtual instruments, Oscilloscope, voltmeter, ohmmeter, ammeter, and watt meter.

PLAB4 **\$49.95**

RAMSEY NOW CARRIES BASIC STAMPS



Hobbyists and educators have embraced the Basic Stamp family of microcontrollers thanks to their power, ease of programming and simple interface. Ramsey now offers popular BS boards, kits, and trainers. If you've been wanting to learn microcontrollers, or build them into a project, now's the time!

BS11C Basic Stamp I Module **\$34.00**
BS21C Basic Stamp II Module **\$49.00**
27205 Basic Stamp 1 Starter Kit **\$109.00**
28150 Board of Education Full Kit **\$109.00**

MINI-KITS



These are easy to build kits that can be used either stand alone or as building blocks for more complex projects.

BN9 Super Snoop 2W Audio Amp **\$8.95**
MB1 Mad Blaster 15W Warble Alarm **\$4.95**
TS1 Touch Switch **\$6.95**
SA7 RF Broadband Preamp +20 dB **\$14.95**
TT7 Touch Tone Decoder **\$29.95**

RF WIRELESS LINK MODULES



- SAW Resonators for high stability - NO Drift!
- Powerful +10 dbm output
- Range up to 600'
- 433 MHz license-free band
- Sensitive superhet receiver with RF LNA
- Stable over full 3-12 VDC range
- Optional on-board 12 bit encoder/decoder using Holtek HT12 series chips

RXD433 433 MHz Receiver/Decoder Mod., Assembled **\$26.95**
TXE433 433 MHz Transmitter/Encoder Mod., Assembled **\$24.95**
RX433 433 MHz Data Receiver Mod., Assembled **\$21.95**
TX433 433 MHz Data Transmitter Mod., Assembled **\$19.95**



Ramsey Electronics • 793 Canning Parkway • Victor, NY 14564
Order Toll Free: 800-446-2295 • Technical Info or Order Status: 716-924-4560
See our catalog online: www.ramseykits.com



Custom Auto Install



What You Want.....
Today!™

25th
year

You Must Provide this Source Code to Receive Discount Pricing

POP86

call toll free

1-800-543-4330

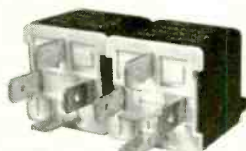
fax toll free

1-800-765-6960

customer service call toll free

1-877-626-3532

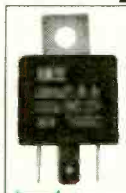
Whether installing video in a van or a great sound system in a car. MCM has the mobile installation products you need.



multicomp Automotive 12 Volt Relays

- Available in popular four and five pin configurations
- Dimensions: 1" (H) x 1" (W) x 1" (D) (less mounting tab)

Order #	Contact Type	Contact Current	Pins
26-533	SPST	40A	Four
26-534	SPDT	30A	Five



MCM GOLDLINE® 1 Farad Power Reinforcement Capacitor

- Provides instantaneous current needed for demanding bass response
- LED charging module displays operating voltage
- Includes mounting brackets and charging resistor
- Rated 20VDC

Order # 60-9706 Reg. \$100.00

Only! \$88.00

MCM GOLDLINE® 40A Amplifier Wiring Kit

- 8AWG power and ground cables
- 17' of NFT technology stereo audio cable
- Remote turn-on wire
- Waterproof AGU style in-line fuse and fuse
- Assorted hardware and connectors

Order #60-9666



Only! \$29.95

MCM CUSTOM AUDIO 4" Color LCD Monitor Module

- Open circuit board has no case or housing
- May be incorporated into automotive seat backs, custom panels and other enclosures
- 383 (H) x 234 (V) resolution

Order # 60-9855 Reg. \$110.00

Only! \$85.00



MCM CUSTOM AUDIO 6.8" Pull Down Color LCD Monitor

- Universal housing mounts to most ceilings
- 1152 (H) x 234 (V) resolution
- Only 2" thick when closed

Order #60-9880

Only! \$449.00



- Amplifiers
- Antennas
- Auto Security
- Bulldog
- Fuses
- Gold Plated Power Blocks
- Head units
- Jensen
- Legacy
- Mobile DVD Players
- Mobile VCRs
- Power Acoustik
- Primary Wire
- Pyramid
- Radar Detectors
- Relays
- Sound Deadening Material
- Speakers
- Ultimate
- Woofers

Visit and order from our secured website

www.mcmelectronics.com

Source Code: POP86

Prices effective May 8 through August 4, 2001.

CIRCLE 324 ON FREE INFORMATION CARD

A Premier Farnell Company

mcm electronics

EARN MORE MONEY!

Be an FCC LICENSED ELECTRONIC TECHNICIAN!



No costly school. No commuting to class. The Original Home-Study course prepares you for the "FCC Commercial Radiotelephone License." This valuable license is your professional "ticket" to thousands of exciting jobs in Communications, Radar, Radio-TV, Microwave, Maritime, Avionics and more...even start your own business! You don't need a college degree to qualify, but you do need an FCC License.

No Need to Quit Your Job or Go To School
This proven course is easy, fast and low cost!
GUARANTEED PASS-You get your FCC License or money refunded. **Send for FREE facts now.**

Call 1-800-932-4268 Ext. 210

Fax 1-415-332-1901

Email: fcc@commandproductions.com

Visit our Website: www.LicenseTraining.com

COMMAND PRODUCTIONS

FCC LICENSE TRAINING - Dept. 210
P.O. Box 2824 San Francisco, CA 94126-2824

Please rush FREE details immediately!

Name _____

Address _____

City _____

State _____ Zip _____

Mail This Coupon Today!

CIRCLE 321 ON FREE INFORMATION CARD

Your Next Great Design Begins HERE!!

NEW!

Global Specialties brand Proto-Boards have been the standard bearer for quality in electronic circuit design workstations since 1973. The new Proto-Board Model PB-505 combines the quality and craftsmanship inherent in other Global design workstations by adding expanded features such as a rugged steel case and a large removable prototyping area. There's only one Proto-Board, and it's made by Global Specialties.



The NEW Proto-Board Model PB-505

FLEXIBLE

The new PB-505 combines four instruments, a large removable breadboard area and other commonly used components into one workstation to allow for maximum circuit design flexibility.

RELIABLE

Backed by an industry-best 3-year warranty against manufacturing defects and a lifetime warranty on breadboard sockets, the PB-505 features unparalleled craftsmanship utilizing materials of the highest integrity.

DURABLE

With its heavy-duty design and rugged steel case, the PB-505 is built to withstand the use and abuse of any laboratory environment.



GLOBAL SPECIALTIES
INSTRUMENTS

www.globalspecialties.com

1486 HIGHLAND AVE., UNIT 2, CHESHIRE, CT 06410

800-572-1028 • FAX 203-272-4330

RF Data Modules

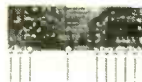
AM Transmitter



- Sub Miniature module
- SAW Controlled
- No adjustable components
- Low current - 2.5mA
- Supply 2.5-12Vdc
- 418MHz or 433MHz
- Range up to 300ft
- CMOS TTL data input
- 7 x 11 x 4mm !

AM-TX1-xxx \$12.60

AM Receiver



- Compact Hybrid Module
- Very stable
- CMOS/TTL output
- Patented Laser Trimmed
- 5Vdc, 0.8mA (HRR6)
- 2kHz data rate
- Sensitivity -105dBm
- 38 x 12 x 2 mm

AM-HRR6-xxx... \$16.33

FM Transceiver



- Only 23 x 33 x 11mm
- Up to 40,000bps data rate
- Up to 450ft. range.
- 5V operation
- 418MHz or 433MHz FM
- 5V CMOS logic interface
- Fast 1ms enable
- Power saving feature
- Carrier Detect output

BiM-xxx-F \$87.36

RS232 Transceiver



- 3wire RS232 interface
- 19.2Kbps half duplex
- 418MHz or 433MHz FM
- 7.5-15Vdc, 20mA
- TX/RX Status LED's
- Up to 400ft. range
- 1/4 wave ant. on board
- User data packetizing
- 58 x 40 x 15mm

CYPHERNET \$139.30

AM Transmitter



- Range up to 250ft.
- SAW controlled stability
- Wide supply range 2-14V
- CMOS/TTL input
- Low current, 4mA typ.
- Up to 4kHz data rate
- Small: 17 x 11mm

AM-RT5-xxx \$12.10



ABACOM
TECHNOLOGIES



tel: (416)236 3858

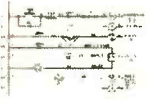
fax: (416)236 8866

www.abacom-tech.com

MasterCard / VISA

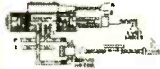
Start A Career With High Wages, Excellent Benefits and Job Security!!

With UCANDO's extraordinary maintenance training programs you can quickly and easily enter a high paying field as a maintenance technician for a very small investment of time and money.



RC-M ONLY \$165 RC-M is a 15 hour training course on relay ladder logic systems. Includes a 5-part video and workbook. **Great Value!**

PLC-M ONLY \$198 PLC-M is a 32 hour training course on PLC systems. Includes (2) 4-part video's and workbook. This training is valuable.



HYD-M ONLY \$209 HYD-M is a 32 hour course on Fluid Dynamics. Includes (2) 4-part video's and workbook. This Module is a must.

SC-M ONLY \$215 SC-M is a 32 hour training course on AC & DC Servo Controllers. Includes (2) 4-part video's and workbook. Learn everything you need about AC and DC servo Control Systems.



Electronic Training Videos: Basic Electronics, Digital Electronics, TV Repair, LASER and Fiber Optic training videos available at very affordable prices starting at **Only \$35.00 each.**

For information or to place an order call:

1-800-678-6113
www.ucando-corp.com

UCANDO VCR Educational Products Corp., Greenville, OH

MEETING TOMORROW'S CHALLENGES TODAY

The men and women in the Navy's Seaman/Airman/Fireman Program are working for America, while learning valuable skills through on-the-job training. They're building solid futures, succeeding in a competitive, high-tech world and advancing as quickly as their abilities and performance allow. Find out more about the Seaman/Airman/Fireman Program, as well as other exciting Navy job opportunities, from your local Navy recruiter. This ad is brought to you as a public service of this newspaper.

Navy. Full Speed Ahead.

ON SCREEN DISPLAY CHARACTER OVERLAY BOARD



OSD-232 on board a radio controlled airplane!

Intuitive Circuits, LLC
2275 Brinston • Troy, MI 48083
(248) 524-1918
http://www.icircuits.com

Ever wish your LCD module could display more lines of text? OSD-232 is the solution! From any RS-232 serial source like a PC, PIC, or Basic Stamp, display 28 columns by 11 rows of information (308 characters total) directly onto any NTSC or optional PAL baseband (video in) television or VCR. OSD-232 can overlay monochrome text onto an incoming video source or display colored text on a self-generated colored background screen.

OSD-232 \$99.00
Visa/Mastercard/Prepaid check

Home Automation



World's Largest Source for Home Automation!

- Voice Control
 - Gadgets & Motorized Devices
 - Home Theater
 - Phones & Intercoms
 - X10 & Lighting Control
 - Home Security & Surveillance
 - Home Networking & Structured Wiring
- and Much More...

800-SMART-HOME
www.smarthome.com

Free 144 pg. Color Catalog!

Dealers/Resellers ask our
SmartHome PRO Dealer Program 800-949-6255



EPROM+

A device programming system for design, repair and experimentation

- ◆ EXCEPTIONAL POWER FOR THE PRO
- ◆ EASY-TO-USE FOR THE NOVICE
- ◆ INCLUDES STEP-BY-STEP TUTORIAL

Here's what you get: A rugged, portable programming unit including the power pack and printer port cable both of which store inside the case. A real printed user and technical manual which includes schematic diagrams for the programming unit plus diagrams for all technology family adapters. * Comprehensive, easy-to-use software which is specifically designed to run under DOS, Windows 3.1, 95 and 98 on any speed machine. The software has features which let you **READ, PROGRAM, COPY and COMPARE** plus much more. You have full access to your system's disk including **LOADING and SAVING** chip data plus automatic processing of **INTEL HEX, MOTOROLA S-RECORD and BINARY** files. For detailed work the system software provides a full screen **buffer editor** including a comprehensive bit and byte tool kit with more than 20 functions.

Broad device support: FIRST GENERATION EPROMS (2708, TMS2716*, 25XX) SECOND GENERATION EPROMS (2716-28C080), 40 AND 42 PIN EPROMS* (27C1024-27C160) FLASH EPROMS (28F, 29C, 29EE, 29F), EEPROMS (2816-28C010), NVRAMS (12XX, X2210/12) 8 PIN SERIAL EPROMS* (24, 25, 85, 93, 95, 80011A) PLUS ER1400/MS8657* AND ER5901 BIPOLAR PROMS* (72S/82S), FPGA CONFIGURATORS (17CXXX) MICROCONTROLLERS* (874X, 875X, 87C50X, 87C75X, 89C50X) ATMEL MICROS* (8-40) PIN 89C0051, 89CXXX (AVR) 90SXXX PIC MICROS* 8, 18, 28, 40 PIN (12CXXX-16CXXX, 16FX, 17C) MOTOROLA MICROS* (68705P3/U3/R3, 68HC705, 68HC711)

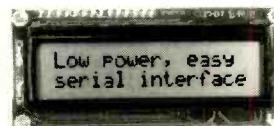
\$289

REQUIRES SNAP-IN ADAPTER (ORDER FACTORY DIRECT OR BUY YOURSELF) \$5.00 SHIPPING • \$5.00 C.O.D. 1 YEAR WARRANTY - 30 DAY MONEY BACK GUARANTEE VISA MASTERCARD* AMEX

ANDROMEDA RESEARCH, P.O. BOX 222, MILFORD, OH 45150
(513) 831-9708 FAX (513) 831-7562 website - www.arlabs.com

SERIAL LCDs

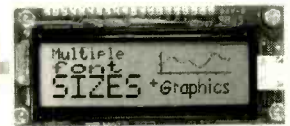
Serial LCDs work great with BASIC Stamps® and other microcontrollers. One-wire interface • simple serial protocol • low cost • high quality • in stock



BPI-216N

- 2x16 text LCD
- 2400/9600 bps
- \$45 (non-backlit)

- SGX-120L**
- Mini graphics LCD
- 2400/9600 bps
- just \$99



Many other models available—see www.seetron.com!

Scott Edwards Electronics, Inc.
www.seetron.com • 520-459-4802

**MODERN
ELECTRONICS**

**CABLE TV
DESCRAMBLERS**



- ★ **FREE CATALOG!**
- ★ **BEST DEALER PRICING!**
- ★ **DISCOUNTED PRICING!**
- ★ **30 DAY FREE TRIAL!**
- ★ **100% MONEY BACK GUARANTEE**

**COPY RENTAL TAPES WITH
OUR VIDEO STABILIZER**

1-800-906-6664

2609 S. 156th Circle • Omaha, NE 68130
www.modernelectronics.com



**plink®
Series**

**Wireless Video
Transmitters**

Lowest
Prices!



SAW Based Digital PLL

- SAW based 434 & 916 MHz ATV video transmitters*
 - 3 Channel PLL digital ATV video transmitter*
 - All units work w/ CMOS & CCD color or b/w cameras
- * requires technician class amateur radio license to operate

www.xilor.com

© Xilor Inc. Tel: 800-417-6689 or 865-546-9863
Visa/Master/Discover 10am-6pm ET

Do You Repair Electronics?

- | | |
|---|---|
| Repair Databases for
TV, VCR, Monitor, UL
Audio, FCC, and more. | - Over 76,000 records
- Private user forums
- Live on-line chat rooms |
|---|---|

RepairWorld.com

Electronics Corp 1 Herald Sq. Falmouth, OH 45324 (937) 878-9878

"X-Ray" Filters, Cameras, Camcorders, Lights

Infrared (IR) Equip sees through some fabrics!
2 Million Candle Power Rechargeable IR Spotlight
Information, Equipment Examples and FAQ's
Ultraviolet (UV) LED Flashlights, Invisible Inks
SpyCams, Specialty Optical Products
Home Automation Software, Free Fax Software

www.MaxMax.com/OpticalProducts.htm

Data Acquisition and Control

The ADR series of Interfaces allow control of analog, digital and relay I/O via RS232 or RS485. Visit the web site for specs, applications and programs in VB, C, BASIC etc. (705) 674-2652

www.ontrak.net

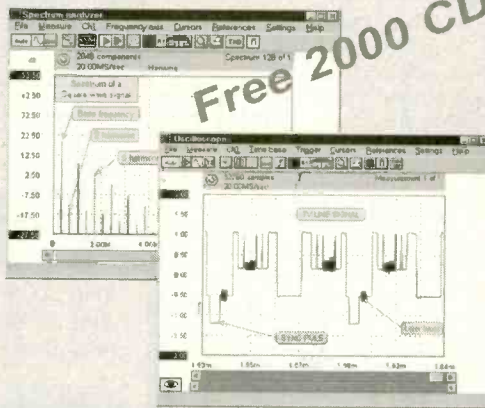
Ontrak Control Systems Inc.

TiePieScope HS801 PORTABLE MOST

Reliability



- 50 MHz ARBITRARY WAVEFORM GENERATOR-
- 100 MHz STORAGE OSCILLOSCOPE-
- 50 MHz SPECTRUM ANALYZER-
- 6 DISPLAY MULTIMETER-
- 200 DAYS TRANSIENT RECORDER-



Free 2000 CD

The HS801: the first 100 Mega samples per second measuring instrument that consists of a MOST (Multimeter, Oscilloscope, Spectrum analyzer and Transient recorder) and an AWG (Arbitrary Waveform Generator). This new MOST portable and compact measuring instrument can solve almost every measurement problem. With the integrated AWG you can generate every signal you want.

A user defined toolbar with which over 50 instrument settings quick and easy can be accessed is offered by the versatile software. An intelligent auto setup allows the inexperienced user to perform measurements immediately. Through the use of a setting file, the user has the possibility to save an instrument setup and recall it at a later moment. The setup time of the instrument is hereby reduced to a minimum.

Analyzing signals is done with an 8 bit resolution and a maximum sampling speed of 100 MHz. The input range is 0.1 Volt full scale to 80 Volt full scale. The record length is 32K/256K samples. The AWG has a 10 bit resolution and a sample speed of 25 MHz.

Convince yourself and download the demo software from our web page: www.tiepie.nl. When you have questions and / or remarks, contact us via email: support@tiepie.nl. The HS801 is delivered with a user manual, two probe's, Windows and DOS software.

US dealer:
Feedback Incorporated; Tel 800-526-8783;
Fax 919-644-6470, www.fbk.com

Outside US:
TiePie engineering, P.O. BOX 290, 8600 AG SNEEK, The Netherlands.
Tel: +31 515 415 416 Fax: +31 515 418 819
Web: www.tiepie.nl

Thanks to you, all sorts of everyday products are being made from the paper, plastic, metal and glass that you've been recycling. But to keep recycling working to help protect the environment, you need to buy those products.

BUY RECYCLED.



AND SAVE.

So look for products made from recycled materials, and buy them. It would mean the world to all of us.

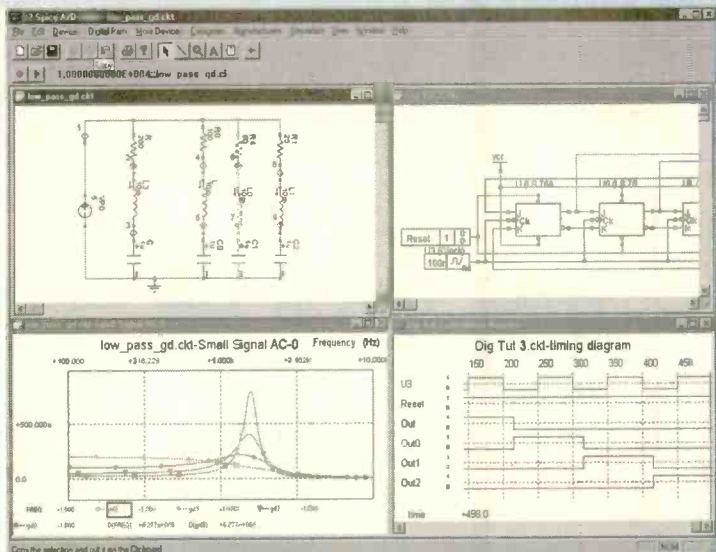
For a free brochure, write *Buy Recycled*, Environmental Defense Fund, 257 Park Ave. South, New York, NY 10010, or call 1-800-CALL-EDF.



B² Spice A/D 2000

\$299

Mixed-Mode Circuit Design



- Build complex circuits in minutes with our intuitive schematic editor.
- Turn any circuit into a functional part with just a few simple clicks.
- Interpret simulation results with customizable graphs.
- Find exactly the part you need from our database of 4500 parts.
- Run an interactive Digital Simulation and view signals in the Timing Diagram

Competitive Analysis

Characteristics	B ² Spice A/D 2000	EWB Multisim Personal
PRICE	\$299	\$399
DC Operating point	X	X
DC Parameter Sweep	X	X
Temperature Sweep	X	-
Transient	X	X
Fourier	X	X
Parameterized transient	X	-
AC Analysis (freq sweep)	X	X
Parameterized AC Sweep	X	-
Pole Zero	X	-
Transfer function	X	-
DC Sensitivity	X	X
Distortion	X	X
Noise	X	X
DC Cp. Pt. Monte Carlo	X	-
DC Sweep Monte Carlo	X	-
AC Monte Carlo	X	-
Transient Monte Carlo	X	-
Interactive, free running digital logic simulation.	X	-

Visit our web site for a free trial.

\$99 Lite Version

Beige Bag Software • www.beigebag.com • 734.332.0487 • info@beigebag.com

CIRCLE 319 ON FREE INFORMATION CARD



"I can learn great stuff every step of the way. Radical fun!"



ROBOTIKITS®
DIRECT

MAK IT YOURSELF SOLDERING KITS

WAO II
Programmable.
Actually draws.
OWI-961K
\$69.95
87 Soldering
Components

BEAMSTER

Five function flashlight.
OWI-209K
\$19.95
16 Soldering
Components



MOONWALKER II

Sound & Light Sensor.
OWI-979K
\$39.95
37 Soldering
Components



WE MAKE A GREAT TEAM!

Build, Personalize & Learn

- Robotic & Electronic Kits
- Beginner to Advanced Levels
- Solar & Electricity Kits
- Award Winning Designs



ROBOTIKITS®
DIRECT

17141 Kingsview Ave. Suite B
Carson, CA 90746 USA

Phone: (310) 515-1900

Toll Free: (877) 515-6651

Fax: (310) 515-1606

E-mail: robotikitsdirect@pacbell.net

Web: www.robotikitsdirect.com

CIRCLE 256 ON FREE INFORMATION CARD

CALL TOLL FREE
(800) 292-7711
Orders Only
 Se Habla Español

C&S Sales

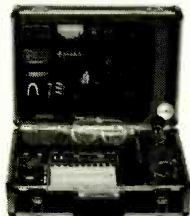
Look For Other
 Monthly Specials
 On Our Website

Excellence in Service

www.cs-sales.com

D/A Trainer

Elenco Model XK-700



\$195

Elenco's advanced designed Digital/Analog Trainer is specially designed for school projects. It is built on a single PC board for maximum reliability. It includes 5 built-in power supplies, a function generator with continuously variable sine, triangular, and square waveforms. All power supplies are regulated and protected against shorts. The trainer is mounted in a professional technician tool case made of reinforced metal with heavy-duty handles and locks.

Soldering Stations

Weller Low Cost Soldering Iron Model WLC-100



\$34.95

- Variable power control produces 5-40 watts
- Ideal for hobbyists, DIYers and students.
- Complete with 40W iron.

Weller Soldering Station Model WES50

50 watts of controlled power - designed for continuous production soldering.

\$119



Deluxe Electronic Soldering Station

Elenco SL-5 Series

Electronically controlled, ideal for professionals, students, and hobbyists. Available in kit form or assembled.

Works w/ any iron! Turn any soldering iron into a variable iron.

As Low As
\$29.95

Ordering Information:

Model SL-5 - No iron. (Kit SL-5K) **\$29.95**

Model SL-5-40 - Includes 40W UL Iron (Kit SL-5K-40) **\$35.95**

*** Limited Time Offer ***
 FREE SP-1A Solder Practice Kit w/ Kit Order!



Features:

- Cushion Grip Handle Soldering Iron (optional) with Grounded Tip for Soldering Static-Sensitive Devices. Easily Replaceable. Uses Long-Life, Plated Conical Tip.
- Heavy Steel, Non-Slip Base.
- Iron Holder Funnel - Reversible, left or right side.
- Steel Tray for Sponge Pad.
- Sponge Pad.

Generators & Counters

B&K 20MHz Sweep/Function Generator with Frequency Counter Model 4040

- 0.2Hz to 20MHz
- AM & FM modulation
- Burst Operation
- External Frequency counter to 30MHz
- Linear and Log sweep

\$425



10MHz Model 4017 **\$319**
 5MHz Model 4011 **\$249**
 3MHz Model 4003 **\$205**

BK PRECISION

Four Functions in One Elenco Model MX-9300B



Features:

- One instrument with four test and measuring systems:
- 1.3GHz Frequency Counter
- 2MHz Sweep Function Generator
- Digital Multimeter
- Digital Triple Power Supply - 0-3V @ 2A, 5V @ 2A, 15V @ 1A

\$450

Elenco Handheld Universal Counter 1MHz - 2.8GHz Model F-2800



\$99

Features 10 digit display, 16 segment and RF signal strength bargraph. Includes antenna, NiCad battery, and AC adapter. C-2800 Case with Belt Clip **\$14.95**

Elenco RF Generator with Counter (100kHz - 150kHz) Model SG-9500



Features internal AM mod. of 1kHz. RF output 100MV - 35MHz. Audio output 1kHz @ 1V RMS.

\$225

SG-9000.....\$119.95 (analog, w/o counter)

Elenco Sweep Function Generator w/ built-in frequency counter Model GF-8046



\$195.95

This sweep function generator with counter is an instrument capable of generating square, triangle, and sine waveforms, and TTL, CMOS pulse over a frequency range from 0.2Hz to 2MHz.

GF-8025 - Without Counter **\$139.95**

Kit Corner

over 100 kits available

Quantity Discounts Available

Elenco Model RCC-7K Radio Control Car Kit

- Fun & Easy to Assemble
- 7 Functions
- Radio Control Transmitter Included
- Also available as Model AK-870 (No Soldering) **\$24.95**



\$29.95

Elenco Model AK-700 Pulse/Tone Telephone Kit

\$15.95

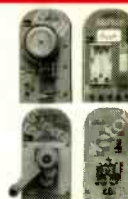


Ideal School Project

Action Lab Kit Model MX-902

- Safe, Solderless, Educational, and Fun!
- Easy-to-read, illustrated, Lab-Style Manual Included.
- Requires 2 "AA" Batteries
- Build your own operating motor - It's easy, it's fun, it's Safe!
- For Ages 10 and up.

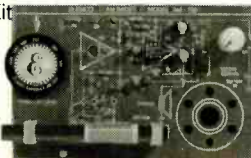
\$24.95



Elenco Model AM-780K Two IC Radio Kit

\$11.95

Also available: Model AM/FM-108K AM/FM Radio Kit **\$29.95**



OWI Model OWI-007

Robotic Arm (Wired Control) Teaches the basic robotic sensing and locomotion principles while testing motor skills.

\$55.95



Elenco Digital Multimeter Kit Model M-2665K

- Extra large 1 1/4" x 2 1/2" LCD display area.
- 34 ranges - includes capacitance, transistor testing hfe, diode testing
- 20A AC/DC current
- Overload protected

\$49.95



Guaranteed Lowest Prices

UPS SHIPPING: 48 STATES 5%
 OTHERS CALL FOR DETAILS
 IL Residents add 8.25% Sales Tax

C&S SALES, INC.

150 W. CARPENTER AVENUE
 WHEELING, IL 60090
 FAX: (847) 541-9904 (847) 541-0710

15 DAY MONEY BACK GUARANTEE
2 YEAR FACTORY WARRANTY

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

SAME DAY SHIPPING
Secure on-line ordering

C&S Sales

Excellence in Service

CALL OR WRITE FOR OUR FREE
64 PAGE CATALOG!
(800) 445-3201

Elenco Oscilloscopes

Free Dust Cover and 2 Probes



S-1325	25MHz	Dual Trace	\$325
S-1330	25MHz	Delayed Sweep	\$439
S-1340	40MHz	Dual Trace	\$475
S-1345	40MHz	Delayed Sweep	\$569
S-1360	60MHz	Delayed Sweep	\$725
S-1390	100MHz	Delayed Sweep	\$895

DIGITAL SCOPE SUPER SPECIALS

DS-203	20MHz/10Ms/s Analog/Digital	\$695
DS-303	40MHz/20Ms/s Analog/Digital	\$850
DS-603	60MHz/20Ms/s Analog/Digital	\$950

Digital Multimeters

Fluke 7911I



\$195

Features analog bargraph, automatic touch hold, diode test, continuity beeper, fused current inputs, lead resistance compensation, ohms, and true RMS.

Elenco LCR & DMM Model LCM-1950



\$69

- Large 1", 3 3/4 digit LCD
- Autoranging frequency to 4MHz
- Capacitance to 400µF
- Inductance to 40H
- Resistance to 4000MΩ
- Logic Test
- Diode & Transistor Test
- Audible Continuity Test

Elenco Model M-1740



\$34.95

- 11 Functions
- Freq. to 20MHz
- Cap. to 20µF
- AC/DC Voltage
- AC/DC Current
- Beeper
- Diode Test
- Transistor Test
- Meets UL-124 safety specs

Model M-2760 - \$19.95 (9 functions)

Dual-Display LCR Meter w/ Stat Functions B&K Model 878



\$225

Auto/manual range
Many features with Q factor
High Accuracy

Elenco LCR Meter Model LCR-1810



\$99.95

- Capacitance: 1pF to 20µF
- Inductance: 1µH to 20H
- Resistance: 0.1Ω to 2000MΩ
- Temperature to 750°C
- DC Volts 0 - 20V
- Frequency up to 15MHz
- Diode/Audible Continuity Test
- Signal Output Function
- 3 1/2 Digit Display

Elenco DMM Kit Model M-1005K



\$19.95

- 18 Ranges
- 3 1/2 Digit LCD
- Transistor Test
- Diode Test
- Training Course

M-1000B (Assembled) \$15.95

Quantity Discounts Available

Project Labs

Elenco 50-in-1 Electronic Playground Model EP-50

Easy-to-build experiments teach you the operation of over 50 electronic circuits. Fully assembled, includes all the parts needed. No tools or soldering required! Build these exciting circuits: finger touch lamp, magnetic bridge, voltmeter, Morse code alarm, electronic noisemaker, electronic kazoo, electronic keyboard, transistor radio, radio announcer, metal detector, and many more. 76 page manual teaches you about voltage, current, resistors, capacitors, transistors, diodes, transformers, speakers, and antennas. Requires one 9V battery.



\$19.95

Maxitronix 300-in-1 Electronic Project Lab Model MX-908

\$48.95

Everything you need to build 300 exciting electronic projects:

- A Transistor Radio
- IC Organ
- Burglar Alarm
- Delayed Timer
- Electronic Game
- Optical Volume
- Multiplier
- Multiple Counter
- Digital Light Dimmer
- Tone Burst Generator
- Audio Signal Tracer
- Electronic Candle
- Voice Level Meter
- and many, many more!



* Easy-to-read, illustrated, lab-style manual included.

Maxitronix 500-in-1 Electronic Project Lab Model MX-909

\$170

Everything you need to build 500 exciting electronic projects:
Learn the basics of electronics and put your knowledge to work creating 500 different electronic experiments, special lighting effects, radio transmitter and receivers, amazing electronic sound effects, cool games and MORE!
Includes built-in breadboard for easy wiring and connection of components, and an LCD (Liquid Crystal Display) Indicates the information during the experiments in process.



* Fact-filled, illustrated, lab-style manual included.

Power Supplies

Elenco Quad Power Supply Model XP-581

\$79.95



4 Fully Regulated DC Power Supplies in 1 Unit
4 DC voltages: 3 fixed - +5V @ 3A, +12V @ 1A, -12V @ 1A
1 Variable - 2.5 - 20V @ 2A

Elenco AC/DC Variable Power Supply Model XP-800

The XP-800 is a high current power supply with 3 variable outputs. Choose from either 0-120VAC @ 2A, 0-40VAC @ 7A, or 0-28VDC @ up to 10A. The precision LED displays allow for exact readout of volts and current. The XP-800 is ideal for Principles of Technology experiments in schools or it can be used as a bench power supply in OEM labs.



\$325

Elenco Power Supply Kit Model XP-720K

- 1.5VDC - 15VDC @ 1A
- -1.5VDC - -15VDC
- 5VDC @ 3A
- 6.3VAC @ 1A & 12.6VAC center tapped @ 1A

\$54.95



XP-720 Fully Assembled
\$85

Elenco DC Power Supply Model SPL-603 3A 0-30VDC

\$79.95

The SPL-603 is a solid-state DC power supply providing the exact output voltage no matter what current you use. Output fully protected from overload.



Tool Kits

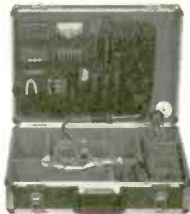
Elenco Deluxe Electronic Tool Kit Model TK-3000

\$79.95

A professional technician service tool kit in a metal reinforced tool case with heavy-duty handle and locks. A removable, double-sided panel hides most of the tools listed below with more room for tools and parts in the lower half. A special ramp in the tool case will lock your meter of choice in place.

Tools included in case:

- Deluxe Soldering Iron
- Soldering Iron Stand
- Diagonal Pliers
- Long Nose Pliers
- Deluxe Wire Stripper
- Solder Ease Kit
- 3 pc. Nut Driver
- Precision Screwdriver Set
- Screwdriver Slotted 3/16"
- Screwdriver #1 Phillips
- IC Extractor
- Solder Pump
- Safety Goggles
- Pocket Screwdriver
- Solder Tube
- and Solder Wick



Elenco Deluxe 26pc. Computer Service Tool Kit Model TK-1200

\$39.95

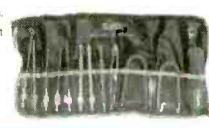
Includes everything you need to service today's computers. Tools include deluxe soldering iron, 5" needle nose pliers, reversible star bits T10, T15, reversible bit nut drivers 3/16" and 1/4", deluxe wire stripper, IC extractor, and more!



Xcellite® PC Repair Kit Model 99-SPC

- Ideal for repairs on all PCs.
- Anti-static chip tools protect from ESD damage.
- Convenient roll-up pouch.

\$34.95



Guaranteed Lowest Prices

UPS SHIPPING: 48 STATES 5%
OTHERS CALL FOR DETAILS
IL Residents add 8.25% Sales Tax
SEE US ON THE WEB

C&S SALES, INC.

150 W. CARPENTER AVENUE
WHEELING, IL 60090
FAX: (847) 541-9904 (847) 541-0710
www.cs-sales.com

15 DAY MONEY BACK GUARANTEE
2 YEAR FACTORY WARRANTY

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

CIRCLE 290 ON FREE INFORMATION CARD

The Pocket Programmer



The Best just got Better!!!

The Best portable programmer that uses the printer port instead of an internal card just got Better!! Now with easier to use Windows based software that programs E(E)prom, Flash & Dallas parts. 25/27/28 & 29 series from 16k to 8Mbit. Adapters available for MCU's 874X, 875X, Pic, Atmel, PLCC packages, Bi-Prom's, 40-Pin X16 Eproms, Rom Emulator to 32K X 8 (2716-27256) and More...

Only \$149.95

Same Name, Address & Phone # for 19 Years.... Isn't it Amazing ?

Intronics, Inc.

Box 13723 / 612 Newton St.
Edwardsville, KS 66113
Tel. (913) 422-2094 Add \$7.00 COD
Fax (913) 441-1623 Add \$6.00 Shipping

WWW.IN-KS.COM Visa/MC/Amex/Disc

MECI

340 East First Street
Dayton, Ohio 45402

Your Electronics Value Company

Tons of Electronics

Get your FREE catalog today and discover some of the best deals in electronics. We have thousands of items ranging from unique hard-to-find parts to standard production components. Call, write or fax today to start your subscription to one of the most unique catalogs in the industry, filled with super values on surplus electronic and hobbyist type items.

FREE CATALOG!



Checkout our 10,000 item on-line catalog <http://www.meci.com>

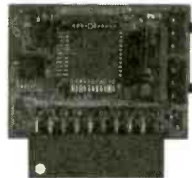
Order Toll Free
1-800-344-4465

Why pay more?
Call today!
Fax Order Line
1-800-344-6324

CIRCLE 323 ON FREE INFORMATION CARD

World's Smallest 68HC11 Microcontroller Module!

MicroStamp1™



- telemetry
- microrobotics
- smart toys
- animatronics
- model railroading
- home automation

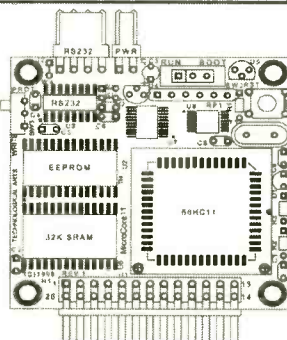
NEW Windows-based development software included free!

- tiny, light-weight (0.5 oz.) 1-inch x 1.4-inch 68HC11 module
- 5V regulator, 8MHz crystal
- choice of 8K or 32K EEPROM
- optional 32K RAM (32K EEPROM version)
- plugs into your breadboard like a DIP
- SCI, SPI, OCs, ICs, timers, & more
- all 14 I/O lines and 2 interrupts brought out to versatile 20-pin connector
- program in BASIC, assembler, or C
- easy code-loading with Docking Module
- Starter Packages:*
- 8K EEPROM (#MS11SP8K).....\$49
- 32K EEPROM (#MS11SP32K).....\$72
- 32K EE+32K RAM (#MS11SP64K)...\$90

* Includes MicroStamp11, manual, PC software (free-ware assembler, SBASIC compiler, Smartload11 utility, and sample programs), serial cable, Docking Module, accessories.

Optional ImageCraft 68HC11 C cross-compiler for W3.119x available (#ICC11WIN)..... \$153

MicroGore-1™



- tiny 2-inch x 2-inch 68HC11 module
- 12 inputs/outputs plus 8 analog inputs
- RS232, 5V regulator, 8MHz crystal
- 32K SRAM plus 8K or 32K EEPROM
- plugs into your breadboard like a DIP
- easy program loading from any PC
- motor driver & accessories available
- ideal for MicroMouse robot competitions
- 8K Starter Package #MC11SP8K.....\$68
- 32K Starter Package #MC11SP32K.....\$93
- Motor driver boards, LCD/keyboard/keyboard interface & prototyping cards available

Technological Arts

Many other modules & accessories available. Visit our website at:
www.technologicalarts.com
sales@technologicalarts.com
TOLL-FREE: 1-877-963-8996
Phone: (416) 963-8996
Fax: (416) 963-9179
Visa • MasterCard • Discover • Amex

ROBOTS, ROBOTICS, ROBOTICS, ROBOTICS...CI



Robot Kits, Programmable Robots, LEGO® Robots, Living Robots, Muscle Wires®, Home and Office Robots, Electronic Kits & More!

Request our FREE 48 page catalog with over 300 items!

www.RobotStore.com
800-374-5764

Mondo-tronics Inc.

PMB-K, 4286 Redwood Hwy, Dept. 171
San Rafael, CA 94903
ph 415-491-4600 fx 415-491-4696
info@robotstore.com

**More Features
More Power
Less Money**

Ivex Complete Power Tools include: WinDraft P350 Schematics, WinBoard P350 PCB Layout, Ivex Spice Standard Simulation and Gerber Viewer together in a complete, affordable package.

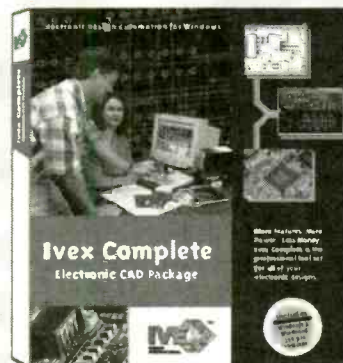
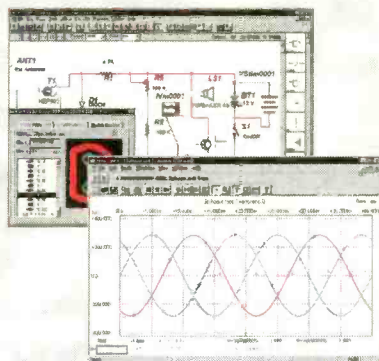
Ivex Complete Plus includes everything in the Complete package plus 650 pin versions of WinDraft and WinBoard with Ivex Spice Advanced.

Ivex 650 pin versions have no feature limitations like other low cost products on the market. Fast expert technical support, free 24 hour Knowledge Base on the web, and professional full-featured tools have made Ivex the preferred choice for designers.

For larger designs use these Ivex Products:

WinDraft unlimited \$495
WinBoard unlimited \$495

Ivex Complete Electronics CAD Package



Advantages

Full-feature tools
17,000 Schematic parts
Part edit & model making
Part Search
Bill of Materials with Sort & Spreadsheet output
Hierarchy for large designs
ERC (electrical rules check)
15 Netlist outputs
7 Analysis Types
Spice Advanced includes 14 analyses
16 PCB layers
0.01 micron grid resolution
Advanced DRC
Micro via
Gerber & NC Drill report
24 hour FREE Technical Support Internet Knowledge Base
No hardware protection lock!
New: Schematic DXF output

Ivex Complete

Schematics
Simulation
PCB Layout
Gerber Viewer

\$350

Ivex Complete Plus

P650 Schematics
Adv. Simulation
P650 PCB Layout
Gerber Viewer Plus

\$550

Free board quote

pcbCite.com

The Internet source for PCB manufacturing

Visit the Ivex web site for complete product information and download full function demos.

www.ivex.com

Tel: (503) 531-3555 e-mail: sales@ivex.com

IVEX™
DESIGN INTERNATIONAL

ADV8_4

SECURETEK

DIRECT FROM MANUFACTURER

"WE WILL BEAT ANY COMPETITOR'S PRICE"

**WORLD SMALLEST
WIRELESS VIDEO CAMERA**
(BLACK & WHITE OR COLOR)
TRANSMITS VIDEO UP TO 1000FT.

CAMERA SHOWN
ACTUAL SIZE

WE ALSO CARRY:

- COVERT VIDEO CAMERAS
- COUNTER-SURVEILLANCE PRODUCTS
- CUSTOM MADE VIDEO SYSTEMS
- IN HOUSE ENGINEERING DEPT.



RUNS ON 9V BATTERY
FOR UP TO 12 HRS.

**DISTRIBUTOR
PROGRAM
AVAILABLE**

CALL FOR CATALOG:

SECURETEK

7152 S.W. 47TH STREET
MIAMI, FLORIDA 33137

TEL.305.667.4545

FAX.305.667.1744

www.securetek.net

CONTROL RELAYS • LIGHTS • MOTORS

MEASURE TEMPERATURE • PRESSURE • LIGHT LEVELS • HUMIDITY

INPUT SWITCH POSITIONS • THERMOSTATS • LIQUID LEVELS

MODEL 30 \$79



- PLUGS INTO PC BUS
- 24 LINES DIGITAL I/O
- 8 CHANNEL-8 BIT A/D / M
- 12 BIT COUNTER
- UP TO 14K BMP/SEC

MODEL 45 \$189



- RS-232 INTERFACE
- 8 DIGITAL I/O
- 3 ANALOG INPUTS
- 2 ANALOG OUTPUTS
- 2 COUNTERS-24 BIT

MODEL 100 \$279



- 12 BIT 100 KHZ A/D
- 4 ANALOG OUTPUTS
- 3 TIMER COUNTERS
- 24 DIGITAL I/O

MODEL 150-02 \$179



- RS-232 INTERFACE
- TRMS, 28 AMPS
- 8 BIT A/D
- JPTO-ISOLATED
- COMPLETE DMM

MODEL 40 \$109



- RS-232 INTERFACE
- 25 LINES DIGITAL I/O
- 8 ANALOG INPUTS
- PWM OUTPUT

MODEL 70 \$239



- RS-232 INTERFACE
- 18 BIT A/D
- 5.5 DIGIT
- JP TO 60 BMP/SEC

Prairie Digital, Inc.

PHONE 608-643-8599 • FAX 608-643-6754

920 SEVENTEENTH STREET • PRAIRIE DU SAC, WISCONSIN 53578

CIRCLE 219 ON FREE INFORMATION CARD

ELECTRONIX EXPRESS

Visit Our Website At
<http://www.elexp.com>

WELLER SOLDERING STATION - MODEL WLC 100

- Variable power control (5 to 40 watts)
- Replaceable heating element
- Quality light-weight pencil iron

\$36⁹⁵



LOWEST PRICE 20MHZ

INSTEK[®] OSCILLOSCOPE

MODEL GOS-620
Dual Channel - 20MHZ
(INCLUDES PROBES)

\$299⁰⁰



SCOPE PROBE 60 MHZ
SWITCHABLE X1, X10

\$12⁹⁵

DIGITAL MULTIMETER

32 Ranges - 3 1/2 Digit
MODEL MY-64
AC/DC Volt/Current, Res. Cap.,
Frequency. Rubber Holster Included

\$27⁹⁵



PAD-234
DIGITAL/ANALOG TRAINER

Complete portable workstation. Variable and fixed power supplies, function generator, digital I/O, rugged design, high impact case.



Assembled

\$150⁰⁰

Kit

\$110⁰⁰

HIGH QUALITY TOOLS

With Cushion Grips and Return Spring
Needle Nose Pliers \$2⁹⁵ Wire Stripper \$1⁵⁰ Diagonal Cutter \$2⁹⁵

DC POWER SUPPLIES

MODEL HY3003 - DIGITAL DISPLAY
Variable output, 0-30 VDC, 0-3 Amp \$89⁰⁰

MODEL HY3003-3 - TRIPLE OUTPUT
Two 0-30 VDC, 0-3 Amp
variable outputs plus 5V 3A
fixed. Digital Display. \$215⁰⁰



RSR TELECOMMUNICATIONS TRAINER

HANDS-ON TELEPHONY, LAN, CATV EXPERIENCE
WITH ONE SELF-CONTAINED UNIT

T-Comm Trainer (TCM-100) \$199.95
Lab Manual / Work Book 26.95
Component and Supplies Kit 37.95
Tool Kit 119.95

Only
\$199⁹⁵

MODEL TCM-100



SOLDERLESS BREADBOARD

830 tie points. MB102PLT
model features 3 binding posts
and aluminum backplate.

Part No.	1-9	10+
MB102	5.95	5.00
MB102PLT	8.95	8.00

MOTION DETECTOR

\$2 ea. - 10 For \$15

LM555 10 Min.	22c ea.
LM741 10 Min.	27c ea.
74LS00 10 Min.	18c ea.
7805 Regulator 10 Min.	30c ea.
2N3904 10 Min.	6c ea.
PN2222 10 Min.	6c ea.
Red LED T 1 1/4 10 Min.	6c ea.
Green LED T 1 1/4 10 Min.	7c ea.
Yellow LED T 1 1/4 10 Min.	8c ea.
Photo Cell 10 Min.	65c ea.
100K Pot., 1" Shaft PC ML 10 Min.	15c ea.

PRESS-N-PEEL



RESISTOR
KIT

1/4 W 5%
film. 5 pieces
each of 73
values. 365
pieces total.

PC Board Transfer Film
PNP Blue 5 Sheet \$9.90
PNP Wet 5 Sheet 9.90
PNP Blue 20 Sheet 28.95
PNP Wet 20 Sheet 28.95

\$9³⁵

FREE CATALOG

MORE
Low-Priced
Items In Our
FREE

256-Page Catalog



TERMS: Min. \$20 + shipping. School Purchase Orders, VISA/ MC, Money Order, Prepaid. NO PERSONAL CHECKS, NO COD. NJ Residents Add 6% Sales Tax.

In NJ: 732-381-8020
FAX: 732-381-1006

365 Blair Road • Avenel, NJ 07001-2293

800-972-2225

<http://www.elexp.com>
email: electron@elexp.com

CIRCLE 206 ON FREE INFORMATION CARD

www.americanradiohistory.com

Learn PC Repair!

The Ultimate Self-Paced PC Assembly and Repair Course

This is the simplest, easiest and most complete course on how to understand, assemble, and diagnose PCs available today. It contains all the text, videos and diagnostic software you'll need to succeed.

Self-Study Course Manual

The manual is a self-study workbook that will enable you to quickly teach yourself all about computers, how they're put together and how to keep them working. Just follow the step-by-step instructions on each page.

At the end of the course you'll know how to build a PC and install & configure Microsoft Windows.

Call **(800) 321-2155**

Videos

The two videos included contain over 3 hours of the Micro 2000 engineering team teaching everything from the basics of PC assembly all the way to using the MicroScope software to troubleshoot them! Watch the pro's in action as they build a completely functional Pentium system with all the major peripherals.

Software

This course includes a Limited Edition version (25 uses) of the award winning MicroScope Diagnostic Software. Use it to build your own PC (computer not included), upgrade it and troubleshoot any problems.

www.ciebookstore.com



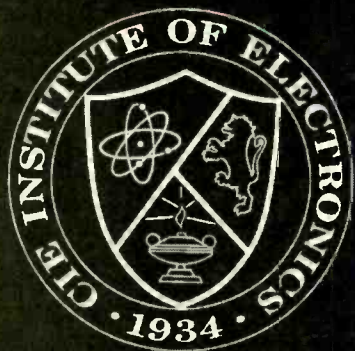
Only \$99.95
Complete Course

Product # 02-020

Course includes:

- 200 + Page Training Manual
- PC Assembly & Configuration Video
- PC Diagnostic Video
- Micro-Scope Diagnostic Software (LE)
- CD-ROM - contains videos and manual

CIE Bookstore: 1776 E 17th Cleveland, OH 44114



It's almost like being paid to study.

Earn an Associate Degree in Electronic Engineering Technology...

Put your knowledge of electronics to work for you. CIE offers the most comprehensive Associate Degree program offered in electronics. Best of all you study at your own pace with the full resources of CIE just a phone call or a click of a mouse away.

It's Comprehensive and Unique. You Pay for Only the Time You Use!

You won't find a better school than CIE if you want to accomplish your goals without pesky time restrictions (commuting, 8 hour class days, etc.) at CIE you study at your own pace, even an accelerated pace. And if you're like most readers of this magazine, your electronics background can help you receive your degree in less than the maximum 8 terms allowed. Finish sooner and you can save thousands of dollars in tuition. It's almost like being paid to study.

Get all the details on CIE's Associate Degree Program, World College's Bachelor Degree Program and CIE's 10 Career Courses today!



Free Course Catalog!

(800) 243-6446

www.cie-wc.edu

For a FREE Course Catalog on all of our Programs send to CIE: 1776 E. 17th St., Cleveland, OH 44114-3679 or visit www.cie-wc.edu PT30

Name: _____

Address: _____

City: _____

State: _____ Zip: _____

Phone: _____

E-mail: _____

CIRCLE 320 ON FREE INFORMATION CARD

www.americanradiohistory.com

New! Your own weather forecaster!



Davis Instruments
Vantage PRO

- Monitor temperature, wind, rain, barometric pressure, UV, humidity, solar radiation, and more.
- Quick-view icons show the forecast at a glance.
- Moving ticker tape display gives more details.
- On-screen graphing for every sensor—hourly, daily, and monthly.
- Data logging and software, too!
- Wireless or cabled, starting at just \$495!

Order now, or ask for your FREE catalog.

Davis Instruments 800-678-3669
3465 Diablo Ave, Hayward, CA 94545 www.davisnet.com



POE0106

electronic components



MOUSER ELECTRONICS
A TTI, INC. COMPANY Catalog 905

www.mouser.com
sales@mouser.com
(800) 346-6873





1-800-346-6873

MOUSER ELECTRONICS
A TTI COMPANY

www.mouser.com
CIRCLE 205 ON FREE INFORMATION CARD

PIC'n Books

LEARN ABOUT PIC MICROCONTROLLERS

See Table Of Contents: <http://www.sq-1.com>
Secure Online Ordering is Available

PIC is a trademark of Microchip Technology Inc.

SQUARE 1 ELECTRONICS

Voice (707) 279-8881 Fax (707) 279-8883

<http://www.sq-1.com>

Microprocessor Hands-On Training



The PRIMER Trainer is a flexible instructional tool featured in a Prentice Hall textbook and used by colleges and universities around the world. Ruggedly designed to resist wear, the PRIMER supports several different programming Languages including Assembler, Machine Language, C, BASIC, and FORTH. A comprehensive Instruction Manual contains over 25 lessons with several examples of program design and hardware control. The Applications Manual provides theory and sample code for a number of hands-on lab projects.

Application Projects Include:

- Scan Keypad Input & Write to a Display
- Detect Light Levels with a Photocell
- Control Motor Speed using Back EMF
- Design a Waveform Generator
- Measure Temperature
- Program EPROMs
- Bus Interface an 8255 PPI
- Construct a Capacitance Meter
- Interface and Control Stepper Motors
- Design a DTMF Autodialer / Remote Controller

The PRIMER can be purchased as an unassembled kit (\$120) or as an assembled/tested kit (\$170). Upgrades provide battery-backed RAM and PC connectivity via an RS232 serial port (shown in picture). Additional options include a heavy-duty keypad (shown in picture) and a 9V power supply - see our website. Quantity discounts are available. Satisfaction guaranteed.

Since 1985 OVER 16 YEARS OF SINGLE BOARD SOLUTIONS

EMAC, inc.
Phone 618-529-4525 Fax 618-457-0110
2390 EMAC Way, Carbondale, Illinois 62901
World Wide Web: <http://www.emacinc.com>

SINGLE CHIP COMPUTER

- ZERO external components
 - Built-in BASIC / Assembly
 - RS232 program download
 - 1K flash, 64ee, 3irq, 2timers
 - 15 I/O bits, A/D comparator
 - 20mips, faster than pic/8051
 - 20 pin DIP part #MV1200
- oem (1k) **\$1.99**
eval (1) **\$7.00**



- NEW! 8K SUPER CHIP**
40x the BASIC program space!
- 32 i/o, 12 irq, 3 timers, Bus
 - 8K flash, 512ee, 512nvram
 - Watchdog with internal osc.
 - 40 pin DIP part #MV8515
- oem(1k) \$7.10 eval(1) \$25.00

CREDIT CARD COMPUTER

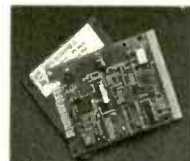


New PLUG-N-GO, no cables/power supply to buy!
Lo-power RISC cpu 10x faster than PIC, Z80, 8051
256k NV mem, ser, par, RTC, 4ch 50khz ADC, ISA bus
Built-in BASIC/Assembly, other compilers avail.
Friendly instruction set, unlike PIC or 8051
oem (1k) price 44.20 eval kit (1) \$50.00

PC WATCHDOG CARD

No More Hangups!

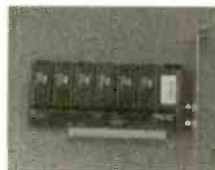
Reboots PC on hardware/software hang
3 versions: RESET, TIMER, PHONE
reset version oem \$21.30, eval kit \$75



LO COST MINI-PC

Includes DOS, NV mem, ADC, RAM, clock, ISA bus
Ports for serial, parallel, LCD, keyboard
Program in Turbo C, BASIC, MASM, etc.
Complete, no costly development kits required
Lowest power lowest cost PC compatible available
XT: oem \$27 eval \$95 AT: oem \$55 eval \$195

PC SOLID STATE DISK



Replace mechanical drives with faster, more reliable, more secure solid-state.
Use FLASH, NVRAM, UV EPROM.
Both DIP and PCMCIA versions from 32Kbyte (PCMI) to 1Gigabyte (PCD2) starting at \$14.20oem(1k) \$50.00eval(1)

640x480 VGA LCD \$27

Controller for most single/dual scan LCDs
Works with lo-res (160x120, 320x240, etc.)
Use with PC or SBC, standard VGA BIOS
Source code demo shows VGA initialization
Adaptable for other CPU's (i.e. Z80, HC11)
oem(1k) \$27 evalkit(1) \$95 w/10"LCD \$195



SERIAL MINI-TERMINAL

RS232 terminal for Stamp, PC, Z80, AVR etc.
-super low-current, powers from serial line
-LED backlit LCD, visible in all conditions
-115.2kbps, DB9 conn, simple commands
-specify 20 customizable or 16 tactile keys
eval(1) \$75, oem(1k) \$21.30, w/BASIC cpu \$27



STAMP DRIVE!!

Read / Write PC compatible hard disk, PCMCIA, & Compact Flash.
RS232 to ATA drive adapter for Stamp, 8051, AVR, PIC, Z80, x86 ANY controller, big or small:
-up to 4 gigabyte capacity
-low power operation 5v 2ma
-simple software commands
-baud rates up to 115.2kbps
-\$14 IDE & \$21 ISA/104 versions

oem(1k) **\$27**
eval kit(1) **\$95**



WWW.STAR.NET/PEOPLE/~MVS

MVS Box 850
Merr., NH 03054
(508) 792 9507



5yr Limited Warranty
Free Shipping
Mon-Fri 10-6 EST

SERVING THE EMBEDDED COMMUNITY SINCE 1979!

*FREE!

CTRL - D
to bookmark
this site



- Don't forget the dash
- Easy to Navigate
- Includes a Search Engine That Really Works
- New Items Added Constantly

This Full-Sized Rugged Handheld 3 1/2 Digit Multimeter is *FREE with any order placed on our web site that equals or exceeds \$30.00 in merchandise value (Or, if you prefer, purchase just the meter for our regular low price of \$29.00 + S&H)



In Business Since 1971

**Brand New!
Not a Mini Sized
Cheapie**



BASIC FEATURES:

- *Max. Display: 1999 counts (3 1/2 digits) auto polarity ind.
- * Measuring Method: Dual Slope integration A-D con system.
- * Overrange Indication: 1 appears alone on the display
- * All ranges fully protected
- * High Surge Voltage Protection (1.5KV-3KV)
- * Diode Testing with 1mA fixed current
- * Audible Continuity Test
- * Transistor Hfe Test
- * DC Voltage Ranges: 200mV, 20V, 200V, 1000V
- * AC Voltage Ranges: 200mV, 2V, 200V, 700V
- * DC Current Ranges: 20uA, 2mA, 20mA, 200mA, 2A, 20A
- * AC Curr. Ranges: 200uA, 200uA, 2mA, 20mA, 200mA, 10A
- * Resistance Ranges (ohms) 200, 20K, 200K, 2M, 20M
- * Ships with Rubber Boot, Test Leads & Instruction Booklet

Don't Forget to Enter the PROMO CODE

**Item# is: CSI TECHMETER
RUBBER HOLSTER IS INCLUDED !**

Detailed Specifications on the CSI TECHMETER can be viewed on our web site under Test Equipment

Over 8,000 items on our web site. small parts, computer boards, test equip. CCD cameras, tools & solder equipment, industrial PC supplies & MUCH MUCH MORE

The Promo Code for this offer is **DMM FREE**
Simply enter this code into the promo code field located on our on-line order form. Any order that does not include the promo code will not be eligible for the free DMM offer. See terms & conditions below

* Free DMM offer is subject to certain terms & conditions. One free DMM per customer. If qualifying order is returned for a refund, then free DMM must also be returned or purchased at the regular price of \$29.00. Offer does not apply to orders placed previously or orders placed at any time that do not reference the special promotion code contained in this add. To qualify for this promotion, your order MUST be placed on the internet. You MUST enter the promo code DMM FREE in the PROMO CODE field found on our on-line order form. The value of your order must equal or exceed \$30.00 to qualify. The value of the CSI TECHMETER does not apply toward this qualifying order value. For extended technical specifications & warranty statement on this product, please visit: www.web-tronics.com & view our DMM section under TEST EQUIPMENT. Item number for this DMM is: CSI TECHMETER

Poptronics, June 2001

High Performance Auto Ranging DMM *New to our DMM line-up and possibly (probably) the best DMM value anywhere!* Includes: Analog Bar Graph! Auto-Ranging! Data Hold! Temperature Probe! Frequency Test! Continuity Test! AND MORE!

ONLY \$29.95

NOW IN STOCK!

#CSI9903

Specifications

Accuracy	±1.0% reading +5 digits
Vdc:	±1.5% reading +8 digits
Vac:	±1.2% reading +5 digits
Aac:	±1.5% reading +5 digits
Resistance:	±1.5% reading +5 digits
Frequency:	±3.0% reading +5 digits
Temperature:	±1.0% reading +6 digits

Requires two AAA batteries sold separately.

Measures:
 DC Volts: up to 1000V
 AC Volts: up to 750V
 AMPS: up to 20 Amps (AC & DC)
 Resistance: up to 30M ohm
 Continuity Check: with audible signal (signal sounds if resistance is less than 20 ohms. Display reads actual resistance).
 Frequency: (1KHz to 300KHz) displays both digital and bar graph reading.
 Transistor hfe Test: Display shows approximate hfe value based on test condition of 10uA base current and Vce of approx. 3V.
 Temperature Test: Measures from 0° to 1832° F (probe supplied).
 Diode Test: Tests if diodes are shorted or open.
 Input Impedance: 10Mohm (Vdc/Vac); over 100Mohm on 300 mVdc range.

Removable Hard Drive Rack
 For IDE/Ultra DMA Hard Drives
 We Sold Over 14,000 in 1998!
 This product can be used with any 3-1/2" IDE hard drive up to 1" high. It includes an electronic lock for safe removal and insertion. Made of ABS 707 fireproof plastic. Use this product to protect sensitive hard drive data, take your hard drive between work and home or even set up different users with their own hard drives that they physically insert every time they use a PC. Other models available from C.S.I. include RH10 series and RH20 series, which are interchangeable within the same interface design (IDE or SCSI). Other Models are Available. See www.web-tronics.com under "hard drive and accessories" for more details and pictures.

ONLY \$14.95 any qty.

#RH-10C-IDE

Removable Hard Drive Rack with Auto Door and Cooling Fan

- Auto door on the outer frame
- ABS material of outer frame. High efficiency cooling fan
- Worldwide patent pulling function handle
- CE Approved
- Coating iron bottom cover
- For IDE interface
- For 1" high 3.5" HDD
- Not compatible with our RH10 & RH20
- Compatible with our RH17-IDE model.

ONLY \$18.95 any qty.

#MR-27

Details at www.web-tronics.com

2GHz RF Field Strength Analyzer

- Frequency Range: 100KHz to 2.06GHz
- Narrow Band FM (NFM), Wide Band FM (WFM), AM and Single Side Band (SSB) Modulated Signals May Be Measured
- PLL Tuning System for Precise Frequency Measurement and Tuning
- LED Backlight LCD (192x192 dots)
- Built-in Frequency Counter
- Hand-Held and Battery Operated
- All Functions are Menu Selected
- RS232C for PC Interface and Print

ONLY \$1629

#3201

CTRL - D to bookmark this site

www.web-tronics.com

Don't forget the dash

Circuit Specialists, Inc.

In Business Since 1971

- Easy to Navigate
- Includes a Search Engine That Really Works
- New Items Added Constantly

Mini CCDs (B/W & Color)
 Sensational NEW Design for Small Observation Cameras. Smaller and Better!

LOWER PRICES

CCD B&W Board Cameras

- ASIC CCD Area Image Sensor
- Extremely Low Power Consumption
- 0.5 Lux Min Illumination
- Built-In Electronic Auto Iris for Auto Light Compensation

VM1030PA-B 30mmx30mmx25mm, Pinhole lens, 12V \$39.00 any qty.
VM1030A 30mmx30mmx26mm, Standard lens, 12V \$39.00 any qty.
VM1035A 42mmx42mmx25mm, Standard lens, 12V with back light compensation \$49.00 any qty.
VMCB21 44mmx38.5mmx28mm, with 6 infra-red LEDs, 12V \$49.00 any qty.
VM1036A 32mmx32mmx25mm, Standard lens, 12V, reverse mirror image feature \$49.00 any qty.

Detailed Specs on the Web

LOWER PRICES

Ultra Miniature Design

- Black & White Versions Only 25mm x 25mm
- Color Versions Only 32mm x 32mm
- Available in Standard Lens or Pinhole Lens

All Include Pre-Wired Cable Harness for Video & Power
12V Regulated Power Supply Required (120mA typical power consumption)

- 0.1 LUX Rating (B/W), 1 LUX (color)
- CCD Area Image Sensor for Long Camera Life
- Back Light Compensation Circuit
- Built-In Electronic Auto Iris Lens

VMCW-H11A 32mmx32mmx30mm, Color CCD with standard lens, pre-wired cabling 12V DC Power \$139.00 / \$129.00 5 or more
VMCW-H12A 32mmx32mmx19mm, Color CCD with pinhole lens, pre-wired cabling, 12V DC Power Input \$139.00 / \$129.00 5 or more
VMPS-718A 25mmx25mmx30mm, B/W CCD with standard lens, pre-wired cabling, 12V DC Power Input \$59.00 / \$49.00 5 or more
VMPS-250A 25mmx25mmx15mm, B/W CCD with pinhole lens, pre-wired cabling, 12V DC Power Input \$59.00 / \$49.00 5 or more
VCC-3232 32mmx32mmx30mm, CMOS COLOR, std lens, see web for specs \$79.00 / \$72.00 5 or more

Detailed Specs on the Web

Bullet CCD Cameras B&W and Color

- Smart Rugged Metal Housing
- Extremely Low Power Consumption
- 12 Volt
- CCD Area Image Sensor for Long Camera Life
- Built-In Electronic Auto Iris for Auto Light Compensation
- No Blooming, No Burning
- 0.1 Min Lux Illumination (B&W), 1 Lux Min Lux Illumination (color)

VMBLT1020 B&W, 21mm(D)x58.5mm(L) \$54.00 any qty.
VMBLT1020W B&W Weatherproof, 21mm(D)x58.5mm(L) \$79.00 any qty.
VMBLTJC19BW COLOR! Weatherproof, 17mm(D)x88mm(L) \$139.00 any qty.

Detailed Specs on the Web

LOWER PRICES

COLOR CCD Mini Board Cameras

- Low Power Consumption
- 1 Lux Illumination
- Internal Synchronization
- 12Volts
- 400 TV Lines
- Built-In Electronic Auto Iris for Auto Light Compensation

VM3010PA 33mmx33mmx18mm, Pinhole lens \$99.00 any qty.
VM3011-A 45mmx40mmx24mm, Standard lens, single board \$89.00 any qty.
VM3010-A 33mmx33mmx32mm, Standard lens \$99.00 any qty.

Detailed Specs on the Web

PRICE REDUCTION \$99

2.4 GHz A/V Sender/Receiver System

- Wireless FM transmission of video (color or B/W) and sound (stereo or mono) up to 150 meters (line of sight)
- Directional Antenna Design optimizes performance
- Use with remote cameras or any input (satellite TV, cable etc.) where wireless transmission is desired. View on a TV set.
- Performance through walls varies depending on construction methods etc.
- Each set includes a plug-in power supply for the transmitter & receiver.
- 7 segment LED displays channel (1-4) on receiver & transmitter.

Now On Sale Order Now

CSIHTR2400 Includes One Transmitter & One Receiver with Power Supplies \$109.00
CSIHTR2400TX Extra Transmitter/Each Receiver will Monitor up to 4 Transmitters \$89.00

See more detailed specifications at www.web-tronics.com in the CCD camera section.

Our Most Sophisticated DMM *We Sold Over 700 Last Year!* with RS-232 Interface & Software, 3-1/4 Digit, 4000 Count, Auto-Ranging with Analog Bargraph

- True RMS Mode
- 10Hz Frequency Counter
- Time Mode with Alarm, Clock, and Stop Watch
- Dual Display
- 10 Location Memory
- Min, Max, Avg and Relative Mode
- Decibel Measurement
- Cap and Ind. Measurement
- Temperature Mode (C/F)
- Type Temperature Probe Included
- KiSe Signal for Logic & Audible Test
- Continuity/Diode Test
- Logic Test
- Auto Power OFF/Keep ON Mode
- Fused 20A Input with Warning Beeper
- Back Light
- Data Hold/Run Mode
- Safety Design UL1244 & VDE-0411
- Protective Holster
- Silicon Test Leads

NOW ONLY \$129 Reg. \$169

More Details on our Web Site

PROTEK 506

Low Cost Desoldering Station

ONLY \$159

Our Low cost desoldering station is the perfect price/performance system for repair shops, schools & technicians. Implements Japanese made ceramic heater for high isolation, excellent insulation & fast heat-up. Temp range 300-450 deg C (572-842 deg F). Comes with high suction vacuum pump. Zero voltage switching ensures low noise & greater protection for components. SEE DETAILS at web site under "Soldering Equipment & Supplies" ITEM # JF88

O'Scope Offer ONLY \$299

30MHz! ONLY \$299! Industries Best Price! See web for specs

#OSC-1030

- Dual Channel
- Dual Trace
- Vert Trigger
- 1 Year C.S.I. Warranty!

Manufactured for CSI by a leading O.E.M. manufacturer. See our website for detailed specifications!

3000 Series Digital R/O Bench Power Supply

← Low Cost Single Output ← 3 Amp

High stability digital read-out bench power supply featuring constant voltage and current outputs. Short-circuit protection and current limiting protection is provided. Highly accurate LED accuracy and stable line regulation make the 3000 series the perfect choice for lab and educational use.

Line Regulation: 2x10⁻⁴ +1ma
 Load Regulation: 1 x 10⁻⁴ +5mv
 LED Accuracy: Voltage ±1% +2 digits
 Current ±1.5% +2 digits

Wave Line Noise: ±1mVrms
 Dimensions: 291mm x 158mm x 136mm

CSI3003: 0-30v/0-3amp Digital R/O Bench PS, 1x10⁻⁴+5mv Load Regulation \$99.00 5/\$89.00

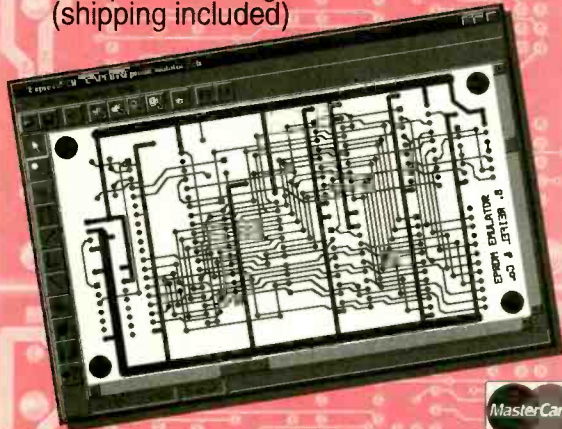
CSI 3005: 0-50v/0-3 amp Digital R/O Bench PS, 1x10⁻⁴+5mv Load Regulation \$129.00 5/\$119.00

AS LOW AS \$89

\$59 PCBs

And our layout software is **FREE**

- 1 Download our board layout software
- 2 Design a 2-sided circuit board 2.5" x 3.8"
- 3 Send us your layout over the Internet
- 4 We ship you 3 excellent quality boards with plated-through holes for \$59 (shipping included)



www.expresspcb.com



Triple Output Variable Power Supply



\$395

Digital Display
one @ 5V, 3A
two @ 0-±30V, 3A



Windows®
Oscilloscope/
Spectrum
Analyzer

\$595

\$89 High Power Digital Soldering Station



48Watts!
160° to 480°C
Digital Display



Full Function
Auto-Ranging
Digital
Multimeter

\$95

Powered Breadboard \$345



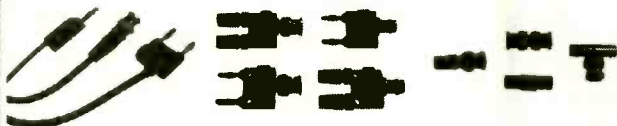
Function Generator,
power supplies,
2290 tie points,
voltmeter, logic,
speaker, switches,
LEDs, DVM, and more!



Solderless
Breadboard
\$25

1660 tie points,
with 3 binding posts,
aluminum back plate.

Cables and Connectors at the Lowest Prices



A-M SYSTEMS, INC.®

www.a-msystems.com

Sales: 800-426-1306

NORTH COUNTRY RADIO

A Quality Supplier of RF, Video, and Specialty
Electronic Kits for Amateur and Experimental Use
Video Cameras and related items



Since 1986

Low Power Transmitter kits:

MPX96 PLL synthesized FM Stereo transmitter. For hobby broadcasting. Features PLL synthesis 100 KHz steps, built in stereo generator. Stable crystal controlled circuitry, no drift. DIPswitch frequency programming 88-108 MHz or 76-92 MHz for export use. Runs from 12V DC, directly interfaces with CD and tape players. Price \$78.00 Plus S/H

MPX2000 Microprocessor controlled PLL synthesized FM Stereo transmitter. PLL synthesized, no drift, for hobby broadcasting applications. Features front panel keyboard frequency entry and bright LED digital frequency readout, and memory. Operates from 16-20 V DC supply and directly interfaces with CD and tape players. Built in audio limiter and deviation metering circuitry. Features LED bar graph modulation meter. Price \$154.95 Plus S/H

AM88 Low Power AM Transmitter. PLL synthesized 100 mw AM transmitter covers the range 160 to 1710 kHz. Useful for Part 15 AM and LF broadcast experimentation, and carrier current applications. Final RF stage is high level amplitude modulated. Covers both medium and longwave AM frequencies in 1 kHz steps. Built in harmonic filters, modulation limiter and audio compressor. DIPswitch frequency programming. Price \$80.00 Plus S/H

ATV12 MK2 2 Watt Television transmitter. Operates in the 420-450 MHz Amateur band. Crystal controlled, 9-15 V DC operation. Accepts standard NTSC or PAL video. Useful for Amateur television operation or as a video transmitter in radio controlled models. Transmits standard video and audio, receivable on standard cable ready TV sets, (CH60) or use downconverter. Small 2.5 X 4 x 1 inch size, wt 2 oz. facilitates use in R/C applications. Includes 439.25 MHz xtal. **REQUIRES NO-CODE AMATEUR LICENSE for USA use.** Price \$122.00 Plus S/H

These are only a few of the kits we have available. We have over 30 more.

Visit our website <http://www.northcountryradio.com> for product and ordering information

Sales: Tel 914-235-6611 Email: ncradio200@aol.com Tech: Tel & Fax 518-854-9280
Fax 914-576-6051

Mail Address: Sales and Orders: PO Box 53 Wykagyl Station, New Rochelle NY 10804 U.S.A.
Tech Service: PO Box 200 Hartford NY 12838 U.S.A.



LOG ON TO FORT777.COM

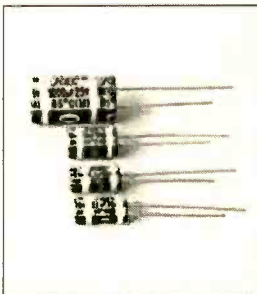
Come & Visit Fort777.com Now!



Come and take a look at all the great products we've got for you at Fort777.com - and they're all at incredibly low prices even if you only want one piece. Just click Product Index to find all the things you need. While you're there take a look at the Novel and read all about the Fort777 of the future. Make Fort777 your first choice and start saving NOW!

Electronic Components

When you want electronic components, visit Fort777.com. We've got large ranges of all the most popular items you'll need. Check out our Resistors, Capacitors, Connectors, Relays, Potentiometers, Fuses, LEDs, Neons, Lampholders, Diodes, Rectifiers, Crimp Terminals, Suppressors, Buzzers, Fuseholders, Clips, Audio, Computer and Telephone Cords and much, much more.



We've got specialty items as well and our range is growing all the time. Take a look at our special offers and click on Star Buys to see our latest hottest items. There are lots of new things happening all the time at the new Fort777.com so come back and visit us regularly then you won't miss any of our great specials. With our low prices you can buy for your friends and save on freight costs. Orders over US\$150 we pay the freight.

Only Top Quality Components



You can rely on the components you'll get from Fort777.com. We only buy direct from the best factories. All our components are fully specified and are the same each time you buy. You can pay much more for these very same items by buying from our competitors. But if you want the best parts at the best prices, come to Fort777. The choice as always is yours.



and drawing if it's pcb mounted. So now you can check out all the specs on line to find the exact part you need. Just click on More Info to see all the details and don't forget to scroll right to the bottom of the page to see the entire specification. In the More Info product screen, you will see a large picture of the product so that you can be absolutely certain that you've got the exact item you need. Take a look at Fort777 right now!

Low Cost Movies That Play On Your DVD Player



Never before sold in US, but now you can buy near-DVD quality video CDs that will play on your DVD player. We've got lots of the latest movies, top movies released over the last few years and classics. Prices are around one third the regular price for DVDs. These discs are 100% legal product, produced under license from the studios. Visit Fort777.com and find out more about how we can do it and check out all your favorite movies.

It's All At Fort777.com

When you need the best quality components and the best prices, you need to visit Fort777.com. Use the menu buttons, search function or index to quickly find the parts you need. Every item has a color picture and full description, specification

ITEMS SHOWN HERE AND ON THE WEBSITE [HTTP://WWW.FORT777.COM](http://www.fort777.com) ARE ONLY AVAILABLE FROM THE WEBSITE

No minimum order quantity. Prices are valid for one piece/pack. Freight charged extra.

*The address below is for returns and servicing:

FORT777.COM NORTH AMERICAN SERVICE AGENTS, FRONTIER ENGINEERING
 628 S. SUNSET ST., LONGMONT, CO 80501 * email: sales@fort777.com



The Standard for checking Capacitors in-circuit



Good enough to be the choice of Panasonic, Pioneer, NBC, ABC, Ford, JVC, NASA and thousands of independent service technicians.

Inexpensive enough to pay for itself in just one day's repairs. At \$179, it's affordable.

And with a 60 day trial period, satisfaction guaranteed or money-back policy, the only thing you can lose is all the time you're currently spending on trying to repair all those dogs you've given up on.

CapAnalyzer 88A

Available at your distributor, or call 561-487-6103

Electronic Design Specialists

Locate shorted or leaky components or conditions to the exact spot *in-circuit*

Still cutting up the pcb, and unsoldering every part trying to guess at where the short is?

\$179



Your DVM shows the same shorted reading all along the pcb trace. LeakSeeker 82B has the resolution to find the defective component. Touch pads along the trace, and LeakSeeker beeps highest in pitch at the defect's pad. Now you can locate a shorted part only a quarter of an inch away from a good part. Short can be from 0 to 150 ohms

LeakSeeker 82B

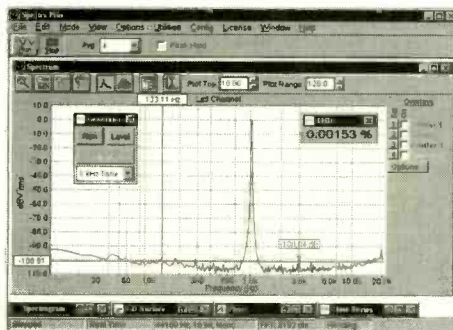
www.eds-inc.com

CIRCLE 210 ON FREE INFORMATION CARD

Turn Your Multimedia PC into a Powerful Real-Time Audio Spectrum Analyzer

Features

- 20 kHz real-time bandwidth
- Fast 32 bit executable
- Dual channel analysis
- High Resolution FFT
- Octave Analysis
- THD, THD+N, SNR measurements
- Signal Generation
- Triggering, Decimation
- Transfer Functions, Coherence
- Time Series, Spectrum Phase, and 3-D Surface plots
- Real-Time Recording and Post-Processing modes



Applications

- Distortion Analysis
- Frequency Response Testing
- Vibration Measurements
- Acoustic Research

System Requirements

- 486 CPU or greater
- 8 MB RAM minimum
- Win. 95, NT, or Win. 3.1 + Win.32s
- Mouse and Math coprocessor
- 16 bit sound card

Priced from \$299

(U.S. sales only – not for export/resale)

DOWNLOAD FREE 30 DAY TRIAL!

www.spectraplus.com

PHS Pioneer Hill Software
24460 Mason Rd.
Poulsbo, WA 98370
a subsidiary of Sound Technology, Inc.



Spectra Plus
FFT Spectral Analysis System

Sales: (360) 697-3472

Fax: (360) 697-7717

e-mail: pioneer@telebyte.com

Call Today And **SAVE!** **Unbeatable PRICES!**

CABLE TV

**DESCRAMBLERS
CONVERTERS · FILTERS
VIDEO STABILIZERS**

- FREE** ➤ 30 Day Trial
FREE ➤ Product Catalog
FREE ➤ 1 Year Warranty

100% MONEY BACK GUARANTEE



Let us point you in the right direction ...

Arrow
Technologies
Omaha, Nebraska

**TOLL FREE
888-554-ARROW**
888-554-2776



New and Pre-Owned Test Equipment

New Equipment Specials

SIMCHECK IIsc PLUS - Module Tester

- * Tests SIMMs/168 pin DIMMs
- * Identifies Module properties
- * Stand alone/portable
- * Built-in Serial Interface

Only \$1,995.00

AVCOM PSA-37D - Spectrum Analyzer

Satellite Downlink - Installation - Maintenance & Service

- Band 1: 10 - 1750 MHz
- Line or Battery Powered
- Band 2: 3.7 - 4.2 GHz
- Built-in DC Block & Power for LNA/LNB's
- Carrying Case Included

Only \$2,395.00

Instek GOS-6103 - Analog Oscilloscope

- 100 MHz Bandwidth
- Time Base Auto-range
- 2 Channel, High Sensitivity
- Includes Two Probes
- Trigger Signal Output
- 2 Year Warranty
- Cursor Readout

Only \$899.00

Leader LF 941 - CATV Signal Level Meter

- ✓ TV/CATV Coverage from 46 - 870 MHz
- ✓ Video/Audio Carrier Measurements

Only \$489.00

Fluke 87 IV - Digital Multimeter

- ✓ Basic DC Accuracy of 0.025% at 50,000 Count
- ✓ True-RMS AC, AC+DC, dBm, & dBV

Only \$319.00

Pre-Owned Oscilloscope Specials

B+K Precision	1466	10 MHz	\$185.00
Tektronix	465	100 MHz	\$599.00
Tektronix	465B	100 MHz	\$729.00
Tektronix	475	200 MHz	\$829.00
Tektronix	475A	250 MHz	\$999.00

- Professionally Refurbished
- Aligned & Calibrated to Original Specifications
- The Industry Standard of Oscilloscopes
- 1 Year Warranty - The Longest Available!!!
- See Website for Complete Specifications

See us on the Web!

www.testequipmentdepot.com

We Buy Surplus Test Equipment

Test Equipment Depot

A FOTRONIC CORPORATION COMPANY

99 Washington St. Melrose, MA 02176
(781) 665-1400 • FAX (781) 665-0780

(1-800-996-3837)

e-mail: sales@testequipmentdepot.com



TOLL FREE 1-800-99-METER

CIRCLE 322 ON FREE INFORMATION CARD

AMAZING DEVICES

NVEN22001EVEN

See and Order from Our "Action" Web Site at www.amazing1.com

Laser Window Bounce Listener

Powerful listening system, yet simple in operation. You shine a laser at a window and intercept the reflected beam with our ultrasensitive filtered optical receiver. Vibrations on the window from internal sounds and voices are now clearly heard. Range can be up to several hundred meters depending on laser power and optics used.

LWB9 Plans for 3 Laser Window Bounce Systems.....	\$20.00
LWB6K Kit of 100' Complete for Science Project.....	\$129.95
LLR3K Low Cost Optical Receiver Kit.....	\$69.95
LLR30 Ready to Use Above Optical Receiver.....	\$99.95
LLR40 Higher Performance of Above Receiver/ Optics.....	\$199.95
LM650P3 Visible Red 5mw Laser Module to 100'.....	\$29.95
CWL10 10 mw Class IIIB Invisible IR Laser up to 500'.....	\$199.95

PLASMA FIRE SABERS Kits, Parts and Accessories

Duplicates effect in the motion picture epic of the centurvi!

Specify blue, grn, pur, red or yel. Moving light appears to evaporate into space. Blades screw into handle for easy replacement.

We stock all size and color blades, mauler adapters, tubes digital drivers, and parts for authentic designs. Wireless interactive sound modules change tone with motion.

SAB15 Assbl'd with 15" Blade.....	\$39.95
SAB24 Assbl'd with 24" Blade.....	\$79.95
SAB24K Kit.....	\$59.95
SAB36 Assbl'd with 36" Blade.....	\$149.95
SAB36K Kit.....	\$129.95

TAKE CONTROL Using Electronic Hypnosis

Electronic circuitry places subject under your control! Induces ALPHA relaxed mind states.

HYP2K Plans.....	\$49.95
HYP2K Kit/Plans.....	\$49.95
HYP20 Ready to Use.....	\$69.95
MIND2 Plans for Mind Control.....	\$15.00
MIND2K Kit/Plans.....	\$49.95
MIND20 Ready to Use.....	\$79.95

Pain Field Pistol

Caution! Do not aim at people!

Blast out rodents with high power ultrasonics.

Handheld and battery operated with all controls. Rental units available.

PPP1 Plans.....	\$8.00
PPP1K Kit/Plans.....	\$49.95
PPP10 Ready to Use.....	\$79.95

Jacob's Ladder

A 1/2" arc expands to over 4" as it travels up the Jacobs Ladder evaporating in space.

- Adjustable arc control
- Uses safe high frequency
- Safety shock shut down
- Full 20" ladder length
- 110/220 vac 150 watts

JACK3K Kit.....	\$149.95
JACK30 Ready to Use.....	\$249.95

Hover Board

28 pages of data related to the most revolutionary advance in transportation. Cutting edge R&D HOVER Plans and Data.....



Anti Gravity

Float an object using anelectric force field. With handbook GRA3 Plans/book..... \$20.00 GRA3K Kit Pwr Sup..... \$99.95 GRA30 Assm'd above..... \$149.95



30" Spark Tesla Coil

Create a spectacular display of nature's own lightning. Many amazing experiments possible. See coil in action on our web site!

BTC4 Plans.....	\$20.00
BTC4K kit.....	\$899.95
BTC40 Ready to use.....	\$1199.95
Smaller Version (8-10" Sparks)	
BTC3 Plans.....	\$15.00
BTC3K Kit.....	\$349.95
BTC30 Ready to Use.....	\$449.95

MINI TESLA COIL Lights 4' light tube! MTC1 Plans.....\$5.00 MTC1K Kit.....\$19.95 MTC10 Assm'd for 12 volts.....\$34.95

6 Transmitter Kits

- 1 Super Sensitive Ultra Clear 1 Mile-Voice Transmitter.
- 2 1 Mile+ Telephone Transmitter.
- 3 Line Powered Phone Transmitter Never Needs Batteries!
- 4 Tracking/Homing Beacon Beeping Transmitter
- 5 Video/Audio Rebroadcaster 1 Mi.
- 6 TV/FM Radio Disrupter. Neat Prank! Discretion Required

Includes Hints Using Wireless Devices COMBOX Above 6 Kits/Plans.....\$59.95 COMBOP Above 6 Plans Only.....\$10.00

4 KV HV MODULE for hovercraft, plasma guns, anti-gravity, pyrotechnics. 12vdc input. MINIMAX4.....\$19.95

Information Unlimited PO Box 716 Amherst N.H. U.S.A. 03031

1 800 221 1705 Orders/Catalogs Only! Fax 1 603 672 5406 Information 1 603 673 4730 Free Catalog on Request Pay by MC, VISA, Cash, Check, MO. Add \$5.00 S&H Overseas Contact for Proforma

CIRCLE 220 ON FREE INFORMATION CARD

CABLE TV REMOTES BLOW-OUT SALE

We carry all models

50pc. 100pc. 500pc. 1kpcs.
\$3.50 \$3.25 \$2.75 \$2.50

Rebellion-3 125ch. Converter

12pc. 50pc. 100pc.
\$50.00 \$47.00 \$44.00

Magnavox Universal Remote Controls

12pc. 50pc. 100pc.
\$4.50 \$4.00 \$3.75

Call Today Globaltech 1-(800)-582-5116
View Our On-Line Display Catalog at:
www.globaltechdistributors.com

SMART CARDS

Complete system! Program your own smart card applications in easy-to-use BASIC!



- Security Systems
- Time Cards
- Emulation
- Access Control - Home, Auto
- Robotics Programming
- DATA Security

Tool Kit comes complete with:

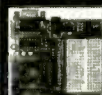
- SmartCard Programmer
- Developer Software Package
- User Manual in printed form
- 3 Blank Smart Cards

Complete system for only \$**995

We accept
VISA • MasterCard • American Express

To Order Call 1-800-773-6698 Worldwyde, Com.
33523 Eight Mile Rd #A3-261, Livonia, MI. 48152
Visit us online <http://www.worldwyde.com>

PIC MICRO TOOLS



Easy Solderless Prototyping!
On board RS-232, In Circuit Programming. No cable or chip swapping! Fully Documented. Starting at Only \$39.95



ISP PRO Programmer
PIC - Scenix - Atmel - I2C - SPI In Circuit or on board. The only programmer you'll ever have to buy! Only \$59.95



Program PIC's In BASIC!
Pic n' Basic Compiler \$89.95
Pic n' Basic PRO Compiler \$149.95
Includes Windows IDE with ISP PRO programmer software built in FREE!

Combo Deal - Pic n' Basic, ISP PRO 1802 Solderless Proto Board and PIC16F84 plus cables and power supply all for only \$179.95

Join our online PIC forums tons of information and help Free!

VISA • MasterCard • American Express
To Order Call 1-248-426-8144 Basic Micro
33523 Eight Mile Rd #A3-261, Livonia, MI. 48152
Visit us online <http://www.basicmicro.com>

GPS Units from Communications Surplus

Trimble SVecSix-CM3

6 channel Differential Module & Magnet Mt. Antenna \$49.95

Rockwell Microtracker LP

5 Channel NMEA 183 Differential OEM Module \$49.95

Call 713-526-8000 or
1-877-878-6GPS or
Fax 713-522-6309

Email commsurplus@v1.net
or www.commsurplus.com

THE Video King



Removes Distortion

Improves Color, Tint & Old Video

Creates & Restores Inverted Video

Works with PAL & NTSC Formats

Perfect for Video Duplication

R.C. Distributing Co. Phone (219) 233-3053 Fax (219) 289-1566
www.rcdistributing.com

10Hr Phone Recorder \$69

Records both sides of conversation automatically

Telephone Scrambler \$159 ea. or 2 for \$149 ea.
Secure phone conversations with this high tech "reding code" scrambler. Thousands of codes! Easy connection. Requires one at each end.

Voice Changer Phone \$99
Disguise your voice with this phone. 16 Pitches! Make your voice deeper or higher. Men can sound like a woman, easy to use.

5 Hr. Phone Recorder Touch-tone decoder \$159
Records both sides of conversation including phone numbers dialed

Phone Information Recorder \$169
Records name and number of callers (requires Caller ID service).

PC Telephone Recorder \$119
Use your PC to record phone calls. Windows 95, Sound blaster compatible sound card 486 or higher PC required.

Phone Tap detector \$159
Protect your phone against phone taps, eaves droppers and RF bugs.

Mini Bug Detector up to 2Ghz \$119
Detects RF "bugs", Video Transmitters and wireless microphones from 5MHz to 2 GHz. LED Bargraph and Audible alarm

VISA • MC • Money Orders • US & Canada Only
NO CHECKS • NO COD • Add \$6.95 S/H
www.mscelectronics.com

MSC Electronics

PO BOX 461 Jessup, MD 20794

(301) 497-1600

FAX (301) 497-1925



PIC Programmer Kits

Super Value!

\$16.95
+ S&H \$4.95*

The P16PRO: can program up to 40 pin PICs including the popular 16F84 & 12C508 • Needs software (extra \$20) • Available assembled or starting from \$16.95 for the kit.

See www.electronics123.com for more info!
The PICALL programmer can also program Atmel AVR's in addition to the PICs it can program • Free software • PICALL programmer kit at \$69.95
See www.electronics123.com for more info!

Video Camera module

Code:BB004

CMOS Camera Module, Black & White, Size: 0.63"x0.63"x0.59"H. Lens: f4.9, F2.8. EIA 320Hx240V. 0.6" DIL Package. 5 pins. Pin 3 is 1V p-p composite video (75 ohm) to monitor. \$36 + \$5 S&H

Running Lights kit

Add \$6 for 8 triacs to drive light bulbs

8 LEDs with 10 push button selectable patterns. 8 speed levels! 80 combinations! \$16 + \$5 S&H

Toll Free: 1-888-549-3749 (USA & Canada)
Tel: (330) 549-3726. Request a FREE catalog or visit us at: www.electronics123.com for more products.
Amazon Electronics, Box 21 Columbiana OH 44408

spyoutlet.com

Countersurveillance - Electronic Devices

Purchase your video cameras from one of the largest Importers in the U.S.

- NEW Underwater Bullet Cameras
- Spy Pinhole Cameras starting at \$79.00
- Wireless Video • Voice Changer
- Micro Recorders • Shotgun Mic
- Locksmithing • Bug & Phone Tap Detectors • Phone Call Register
- UV Pens & Powder • Realtime Telephone Recording Systems:

12 Hour \$125.00 • GPS Vehicle Tracking System (nationwide) And much more

www.spyoutlet.com
Printed Catalog send \$5.00

SPY OUTLET 2468 N & FALLS BLVD
TONAWANDA NY 14150 (716) 695-8660

Press-n-Peel Transfer Film

PC Boards in Minutes

8.5" x 11" Shts.
* Or Photocopy
** Use standard household iron

1. LaserPrint*
2. Press On**
3. Peel Off
4. Etch



Use Standard Copper Clad Board
20 Shts \$30/ 40 Shts \$50/ 100 Shts \$100
Visa/MC/PO/CK/MO \$4 S&H/Foreign Add \$7

Techniks Inc.

P.O. Box 463, Ringoes NJ 08551
ph. 908.788.8249 fax 908.788.8837
www.techniks.com

Visit Our E-Store On-Line!

Lone Star Consulting, Inc.



8900 Viscount, Suite 235
El Paso, TX 79925
915-474-0334

www.lonestartek.net

SPECIAL PROJECTS HARDWARE

Wild - Weird - Wacky - Wonderful Hardware
Electronic - Computer - Phone - Energy - Security - Data
Cars - RF - EM - Audio - Radionics - "Psychic" - Plans - more!

TECHNICAL "LIFE COACHING"

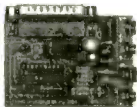
The Answer Team for Many Tech Problems
Tech Decisions - How to do Stuff - Hard-to-find Info/Stuff

WEBSITE DESIGN SERVICES

eCommerce/Personal - English/Spanish
DHTML - Java - cgi - Scripts - Video - Images - Morphs
Scans - Audio - Scrolls - PopUps - SlideShows - Search
Forms - Secure - DB - SiteStats - SiteAudit - OC2 - more!

Low Cost PICmicro Tools

New! PIC-X1
Experimenter/
Lab Board
\$49.95 to \$199.95



EPIC Pocket PICmicro
Programmer - \$59.95

Program PICmicros in BASIC!
PicBasic Compiler - \$99.95
PicBasic Pro Compiler - \$249.95

PICProto Boards make
prototyping with PICmicros
easy - \$8.95 to \$19.95



microEngineering Labs, Inc.

Box 7532 Colorado Springs CO 80933
(719) 520-5323 fax (719) 520-1867
<http://www.melabs.com>

UNIVERSAL DESCRAMBLERS

ANY SYSTEM

\$79

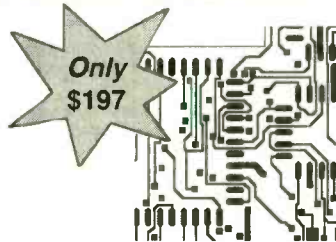
125 CHANNELS

1-888-777-9123

1-888-675-3687 EVE.

NEW Easy-PC For Windows

Schematic & PCB Layout CAD



Only
\$197

- True Windows interface
- True Windows 32 bit application
- Schematic and PCB Design as standard
- Intelligent Cut, Copy and Paste - internal & external
- Multi-level Undo and Redo
- Forward design changes - Schematic to PCB
- Integrated AutoPlace
- Integrated Shape based AutoRouter (Optional Extra)
- Shape based copper pour and split power planes
- And now version 4.0 with many new features !!

Call Ohio Automation (740) 596 1023
www.numberone.com

CABLE SECRETS!!!

Build your OWN cable box "test" devices!

Why pay \$100.00 or more for a "test" device that someone else made? Make your own! Includes complete source code and plans for the most commonly used cable boxes. *Unlock all of the channels on your box!*

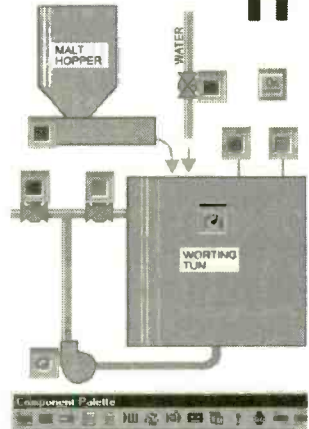
Or start your own lucrative business!
Complete source code \$79.95
Code for individual boxes \$29.95

DSS SECRETS — Vol. 2

Step-by-step instructions on programming your own DSS access card. *Unlock all channels on your own card!* This is the most current information on the market! Includes software, plans, and hardware sources. Book & CD-ROM.
DSS Secrets Vol. 2 \$49.95

VISA • MasterCard • AmericanExpress
To order, call Worldwyde @ 1-800-773-6698
33523 Eight Mile Rd. #A3-261 • Livonia, MI 48152
Visit us on the web at www.worldwyde.com

CONTROL IT



Intec Automation Inc.
www.microcommander.com

SCINTILLATING!

Who Are You? The Encyclopedia of Personal Identification. Insider information directly from the FBI and Customs, top graphic artists, offshore attorneys, master thieves, and professional sharks. *Who Are You?* details ID theft schemes (and prevention), how to create great documents on a home computer, get a new driver's license (suspension? No problem), open offshore or US bank accounts w/o an SS number, acquire the world's best ID, second passports, phony credit cards, reac vehicle tags, much, much more. Sources, sites, suppliers, tips, tricks and techniques. 352 pages \$44.95.

Covert Catalog 2000 The latest, hands-on source guide for law enforcement goodies, electronic surveillance, covert video, counter measures, entry equipment, weapons, tracking systems, computer surveillance, and more. Exact ordering info from suppliers in 13 national 220 Pages. \$39.95.

ORDER BOTH BOOKS — SUBTRACT \$10!!

Intelligence Here
404 N. Mt. Shasta Blvd.
Mt. Shasta, CA 96067
Order by Phone: 866-885-8855
www.intelligencehere.com









Add \$6.00 (priority shipping) CA residents add 8% tax

ComponentsAndMore.com

Toggle Switches • Capacitors • Transistors
LEDs • Diodes • Voltage Regulators • and More

Visit us on the Internet!

 Red LED 20¢ ea	 SPDT on-on 50¢ ea	 100uF/16V 12¢ ea
 2N3904 10¢ ea	 1N4733A 5.1V Zener 16¢ ea	 7805 50¢ ea

Order Toll-free: 1-800-830-9195
www.ComponentsAndMore.com

TOP SECRET!

Hacking • Cracking • Satellite • Cable • Phreaking • Micros
GameBoy I/O • Smart Cards • Emulation • Hardware • Tools

Plus More! Visit us on the web!

Books & CD's:

Hackers Anarchy Cook Book 2000 \$39.95
The Hack & Crack Bible Vol.2 \$39.95
Hackers Gold CD Vol.1 \$29.00
Secrets of Dish Network Vol.1 \$49.95
DSS Secrets Vol.4 Book & CD \$49.95
Cable Test Devices Source Code & Plans . \$79.00
PSX Secrets w/ MODCHIP Source Code \$69.95
The Ultimate Phreaking Guide \$39.95
Emulator Heaven CD \$49.95
Game Boy I/O - Servos/Relays/Sensors \$49.95

Hardware:

PIC, Scenix, Atmel Programmer Complete ... \$99.00
ISO 7816 Smart Card Programmer \$59.95
Smart Cards (from) \$ 6.95
Prototyping Boards PIC & Scenix \$ 9.95

VISA • MasterCard • American Express

To Order Call 1-800-773-6698

Send Money orders to: Worldwyde.Com,
33523 Eight Mile Rd #A3-261, Livonia, MI 48152
Visit us online <http://www.worldwyde.com>

PIC PROJECTS

Book & CD-ROM

Many PIC Projects for Beginners & Experts!
Includes Software, Documentation, and PCB Layout

- LCDs
- X10 - Home Automation
- Keypads
- Serial Port Interface
- On-Screen Displays
- Robotics
- Data Logging
- Serial-Parallel
- And Many More!

Book &
CD Only
\$24⁹⁵

PIC Programmer

Programs all PIC16C55x/6x/7x/8x/9x,
PIC 16F8x, and PIC12C devices.
Optional ZIF adapters for 801C & PLCC.
Includes all necessary software.
Only \$39⁹⁵

Buy
Both for
\$59⁹⁵

We accept!

VISA • MasterCard • American Express

To order, call Worldwyde @ 1-800-773-6698
21365 Randall Street • Farmington Hills, MI 48336
Visit us on the web at www.worldwyde.com/pic

Consumertronics



P.O. Box 23097

ABQ, NM 87192

505-321-1034 505-321-1033

FREE ONLINE CATALOG

www.tsc-global.com

Hi-Tech Survival: Books, Software,
SPECIAL PROJECTS on Electronics,
Computers, Internet, Phones, Energy,
Security, Financial, Medical, Cars,
Jobs, Physical Survival, Improvised
Hacking, Unexplained Phenomena
In business 25+ years!

Hardcopy Catalog: \$3 US/Canada, else \$7

Hack & Crack Bible II

and CD-ROM

Includes all Software, Documentation!

Learn the secrets of:

- Software Serial numbers
- Timed Trial Versions
- Learn how the Pro's do it!
- Step-by-Step Guide
- The only "How to guide"

Only
\$39⁹⁵

Hack & Crack Gold CD

Get thousands of cracks
by the worlds best crackers.
to crack the protection schemes
of thousands of programs
Includes tutorial library that
is a crackers dream come true!

Only
\$29⁹⁵

We accept VISA • MasterCard • American Express
To order, call Worldwyde @ 1-800-773-6698
33523 Eight Mile Rd #A3-261 • Livonia, MI 48152
Visit us on the web at www.worldwyde.com

VISION ELECTRONICS

BEFORE



AFTER



- No Rolls/Jitters/Flickers/Fading
- Works on all TVs, VCR's, Beta, & Cable
- Gold Video Connectors & Cables Included
- 1 Year Warranty
- Money Back Guarantee

FREE
CATALOG!



COPY RENTAL TAPES WITH OUR VIDEO STABILIZER

1-800-562-2252

2609 S. 156th Circle • Omaha, NE 68130
www.modernelectronics.com



EZ-EP DEVICE PROGRAMMER - \$169.95

Check Web!! -- www.m2l.com

Fast - Programs 27C010 in 23 seconds

Portable - Connects to PC Parallel Port

Versatile - Programs 2716-080 plus EE
and Flash (28F,29C) to 32 pins

Inexpensive - Best for less than \$200

- Correct implementation of manufacturer algorithms for fast, reliable programming.
- Easy to use menu based software has binary editor, read, verify, copy, etc. Free updates via bbs or web page.
- Full over current detection on all device power supplies protects against bad chips and reverse insertion.
- Broad support for additional devices using adapters listed below.

Available Adapters

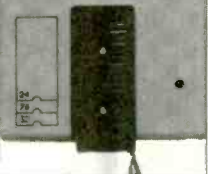
EP-PIC (16C5x,61,62x,71,84)	\$49.95
EP-PIC64 (62-5,72-4)	\$39.95
EP-PIC12 (12C50x)	\$39.95
EP-PIC17 (17C4x)	\$49.95
EP-51(8751 C51)	\$39.95
EP-11E (68HC11 E/A)	\$59.95
EP-11D (68HC711D3)	\$39.95
EP-16 (16bit 40pin EPROMs)	\$49.95
EP-Z8(286E02,3,4,6,7,8)	\$39.95
EP-SEE2 (93x,24x,25x,85x)	\$39.95
EP-750 (87C750,1,2)	\$59.95
EP-PEEL (ICT22v10,18v8)	\$59.95
EP-1051 (89C1051,2051)	\$39.95
EP-PLCC (PLCC EPROMs)	\$49.95
EP-SOIC (SOIC EPROMs)	\$49.95

Many Other Adapters Available

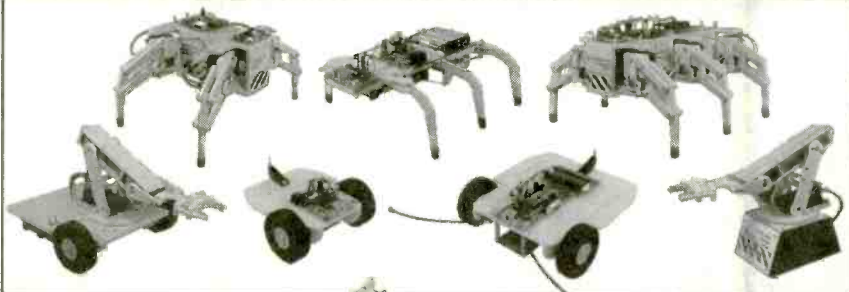
M²L Electronics

970/259-0555 Fax: 970/259-0777
250 CR 218 • Durango, CO 81301
CO orders add 7% sales tax.
<http://www.m2l.com>

EZ-EP
M²L ELECTRONICS
Los Angeles, California



Build Your Own Intelligent Robot, We Make It Easy!



Lynxmotion, Inc.
PO Box 818
Pekin, IL 61555-0818
www.lynxmotion.com



Visit our website or ask for our free catalog!

Tel: 309-382-1816
Fax: 309-382-1254
sales@lynxmotion.com
tech@lynxmotion.com

CONITEC DATASYSTEMS

TOP PERFORMANCE in a small package:
Europe's best selling multi-programmer!



One size fits all!
\$333
COMPLETE KIT

Top of the line multi-programmer in sub-\$500 category. From 20% to 80% market share in Germany in 6 years. 1300+ device output and growing fast. Europe-wide sales 10%-60% mkt share in 6 years. Minimal, 1% return quota for hardware defects. Replaces all low priced dedicated programmers e.g. PIC only or GAL only units. GALEP III also substitutes higher priced universal programmers e.g. ALL-11 (HILO) or LAB-TOOL-48 (ADVANTECH) - It provides virtually matching performance at only 1/3-1/5 the price.

Programs 8-bit and 16-bit EPROMs, EE-PROMs, 0-Power RAM's, Flash, Serial EEPROMs / GAL, PAL CE, ATF/87xxx, 89xxx, PIC12/16/17Cxx/ All DIL devices **without adapter!** Lightning fast parallel data transfer (27C 256 read 2 sec. - prog 8 sec!). Supports HEX, JEDEC and binary formats, with integrated hex and fuse map editor. Fully Windows compatible incl. Win 2000 / NT. Browse 1300+ supported devices on Conitec's website: www.conitec.com. 90%+ of the listed devices require no adapter!

GALEP III / cable, batt. and recharger - \$333.00
PLCC adapt. / 8-bit EPROMs / 16-bit EPROMs / GALs
each \$129.00

GALEP-III
Pocket Multiprogrammer

CONITEC DATASYSTEMS - 1951 4th Avenue, Suite 301 - San Diego, CA 92101 - Tel: 619-702-4420 - Info/Downloads/Orders: WWW.CONITEC.COM

PARTS EXPRESS

ELECTRONICS & MORE
www.partsexpress.com



120 Watt Subwoofer Amplifier

Rated power output: 120 watts RMS into 4 ohms at .1% THD. Measured power output: 110 watts RMS into 8 ohms @ 0.1% THD. 156 watts RMS into 4 ohms @ 0.2% THD. Bass boost: 5dB @ 35Hz. Signal to noise ratio: 98dB (A-weighted). Dimensions: 8-1/4" W x 10-5/8" H x 4" D. Enclosure cut out: 7-1/4" W x 9-5/8" H. Voltage: Selectable, 115/230V, 50-60Hz, 335W.

#300-792 **\$99⁹⁵** EACH

Sound Deadening Sheets

This multi-purpose, noise reduction material actually absorbs the vibration of any solid material. You can reduce interior noise levels 3-10 dB by applying the dampening sheets to the door panels, firewall, floor pan, trunk lid or any interior sheet metal panel.



Part #	Sheet Dimensions	Price (1-3)	Price (4-UP)
268-010	10" x 10"	\$1.35	\$1.25
268-015	29" x 32"	11.50	9.95
268-020	32" x 54"	17.90	16.50

Woofers

6-1/2" Woofer

◆ Power handling: 50 watts RMS/75 watts max ◆ Frequency response: 60-3,000 Hz ◆ SPL: 86 dB 1W/1m

#290-300 (4 ohm) **\$11⁷⁰** EACH

#290-305 (8 ohm)

8" Woofer

◆ Power handling: 50 watts RMS/75 watts max ◆ Frequency response: 60-2,500 Hz ◆ SPL: 87.5 dB 1W/1m

#290-310 (4 ohm) **\$12⁹⁵** EACH

#290-315 (8 ohm)

10" Woofer

◆ Power handling: 70 watts RMS/100 watts max ◆ Frequency response: 40-2,200 Hz ◆ SPL: 87.4 dB 1W/1m

#290-320 (4 ohm) **\$15⁹⁵** EACH

#290-325 (8 ohm)

12" Woofer

◆ Power handling: 70 watts RMS/100 watts max ◆ Frequency response: 35-1,500 Hz ◆ SPL: 88.6 dB 1W/1m

#290-330 (4 ohm) **\$18⁹⁵** EACH

#290-335 (8 ohm)

15" Woofer

◆ Power handling: 80 watts RMS/115 watts max ◆ Frequency response: 27-1,200 Hz ◆ SPL: 86 dB 1W/1m

#290-340 (4 ohm) **\$27⁹⁵** EACH

#290-345 (8 ohm)

YOUR #1 SOURCE FOR AUDIO, VIDEO AND SPEAKER BUILDING COMPONENTS

Piezo Tweeters

AS LOW AS **95¢** EACH

3-1/4" Piezo Tweeter

◆ Similar to KSN1005
◆ Power handling: 50 watts RMS/75 watts max
◆ Frequency response: 3,500-27,000 Hz ◆ SPL: 94 dB

#270-011 **\$1.25** (1-3) **95¢** (4-UP)

2" x 5" Piezo Horn

◆ Similar to KSN1016
◆ Power handling: 50 watts RMS/75 watts max
◆ Frequency response: 3,500-27,000 Hz ◆ SPL: 94 dB

#270-041 **\$1.25** (1-3) **95¢** (4-UP)

Piezo Horn Mid/Tweeter

◆ Similar to KSN1025
◆ Power handling: 60 watts RMS/75 watts max
◆ Frequency response: 1,800-30,000 Hz ◆ SPL: 90 dB

#280-062 **\$1.60** (1-3) **\$1.35** (4-UP)

JBL 12 Watt Stereo Amp Board

Dimensions: 4-1/2" L x 3-1/4" W x 2-1/8" H. Comes with hook-up diagram. Limited availability.

#329-030 **\$9⁹⁵** EACH

6-1/2" Two-Way System

Great for front or rear speakers in your surround system. The 6-1/2" poly-propylene woofer and 1" textile dome tweeter were specially designed with home theatre in mind.



#300-036 **\$59⁹⁵** PAIR

Speaker Surround Repair Kits

Don't throw away expensive loudspeakers just because the foam surround has dry rotted or has been punctured. With these new repair kits from Parts Express, you can save BIG bucks by repairing the foam surround and avoid costly loudspeaker replacements. Each kit contains supplies to repair two speakers and includes foam surrounds, plastic shims, four dust caps (two paper, two poly), a plastic bottle filled with 1 oz. of adhesive, 5 foam swabs for application of glue, and complete repair instructions.

Part #	Size	Price (1-3)	Price (4-UP)
260-915	6-1/2" kit	\$19.50	\$17.90
260-920	8" kit	21.90	18.95
260-925	10" kit	22.50	19.50
260-930	12" kit	23.90	20.90
260-935	15" kit	24.50	21.90
340-076	1 oz. bottle of speaker glue	5.95	5.25

FREE 308 PAGE CATALOG



Car Amplifier Power Stiffening Capacitors

Capacitors can be wired in parallel to increase value. One year manufacturer warranty.

Specifications: ◆ 20 VDC/24 VDC surge ◆ ESR: < .0015 ohms
◆ Tolerance: -10/+50%
◆ Temperature range: -40°C to 95°C



Part #	Value	Dimensions (Dia. x Height)	Price
STANDARD POWER CAPACITORS			
268-450	1.0 Farad	3" x 8-5/8"	\$69.95
268-455	1.5 Farad	3-1/2" x 8-5/8"	99.90
268-460	2.0 Farad	3-1/2" x 8-5/8"	138.90
DIGITAL DISPLAY POWER CAPACITORS			
268-470	1.0 Farad	3" x 10-1/4"	99.90
268-475	1.5 Farad	3-1/2" x 10-1/4"	138.90
268-480	2.0 Farad	3-1/2" x 10-1/4"	174.90



4" LCD Video Module

Customize your mobile sound system by adding video!

- ◆ High resolution
- ◆ 4" LCD flat screen color display module
- ◆ Works on a standard composite video signal
- ◆ Ideal for mounting in seat backs or custom built enclosures

Specifications: ◆ 12 VDC, 500mA ◆ Resolution (dots): 383 (Hor.) x 234 (Vert.) = 89,622 ◆ Overall dimensions (mm): 118 W x 85 H x 40 D ◆ Active area (mm): 82 W x 60 H ◆ Controls for brightness, color and tint
◆ Net weight: 3/4 lb.

#205-050 **\$99⁹⁰** EACH

DETAILED EASY TO FOLLOW INSTRUCTIONS!



Note: The speaker surround kit sizes are based on the diameter of the speaker's frame, not the diameter of the cone. For example, if your speaker frame measures 10" - 10-1/2" in diameter, you would need the 10" Surround Repair Kit.

LARGEST SELECTION OF SPEAKER DRIVERS IN THE COUNTRY!

Visit Us On The Web At www.partsexpress.com
Or Call Toll Free **1-800-338-0531**

725 Pleasant Valley Dr., Springboro, OH 45066-1158 KEY CODE: POM
Phone: 513-743-3000 ◆ FAX: 513-743-1677 ◆ E-Mail: sales@partsexpress.com

CIRCLE 275 ON FREE INFORMATION CARD

ALL ELECTRONICS CORPORATION

Ultrabright Red LED

5 mm diameter T 1 3/4 LED.
3000 MCD ultrabright.
Water-clear in off-state.
Operates at 20 mA.

CAT # LED-50

2 for \$1.00

11+ 25¢ each
1000+ 15¢ each

Miniature DC Motor

Mabuchi # FF-N20PN
Miniature 1.5 to 3 Volt DC motor.
Ideal for models and radio control applications where small size is important.



No load rating: 15,800 RPM @ 2.4 V, 96 mA.
Length (excluding shaft), 0.654" long x 0.47" x 0.39". 0.039"(1mm) dia. x 0.13" long shaft.
Solder-loop terminals. Large quantity available.

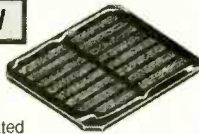
CAT# DCM-166

150 for 60¢ ea.
600 for 50¢ ea.
1500 pieces 35¢ ea.

2 for \$1.50

Solar Panel

Output: approx.
3 Volts @ 40 mA.
2.40" square x 0.13"



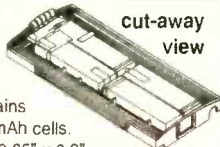
thick epoxy-encapsulated silicon photovoltaic panel removed from solar lighting system. Solid, almost-unbreakable module with easy-to-solder spots on backside. Ideal for solar-powered battery chargers and other projects.

CAT # SPL-60

\$3.50 each

Nickel-Metal Hydride 4.8V 850 mAh Battery Pack

Philips # 25733.
New, rechargeable pack manufactured for cell phones. Contains four 1.2 Volt, 850 mAh cells.
Each cell is 1.8" x 0.65" x 0.3".



With little effort you can remove the cells from the enclosed battery pack and reconfigure them to suit your needs.

CAT# NMH-53

\$2.00 each

10 for \$17.50

ORDER TOLL FREE

1-800-826-5432

SHOP OUR ONLINE STORE
www.allelectronics.com

CHARGE ORDERS to Visa, Mastercard, American Express or Discover

TERMS: NO MINIMUM ORDER. Shipping and handling for the 48 continental U.S.A. \$5.00 per order. All others including AK, HI, PR or Canada must pay full shipping. All orders delivered in CALIFORNIA must include local state sales tax. Quantities limited. NO COD. Prices subject to change without notice.

CALL, WRITE FAX or E-MAIL for our FREE

96 Page CATALOG Outside the U.S.A. send \$3.00 postage.

MAIL ORDERS TO:
ALL ELECTRONICS CORPORATION
P.O. Box 567
Van Nuys, CA 91408
FAX (818)781-2653

e-mail allcorp@allcorp.com

TUBES, BOOKS, TRANSFORMERS
CAPACITORS, PARTS
and MUCH MORE!

ANTIQUE ELECTRONIC SUPPLY

CALL "480-820-5411" TODAY FOR OUR FREE 80 PAGE CATALOG
FAX 480-820-4643 or 800-706-6789
www.tubesandmore.com

ELECTRONIC GAMES

BP69—A number of interesting electronic game projects using IC's are presented. Includes 19 different projects ranging from a simple coin flipper, to a competitive reaction game, to electronic roulette, a combination lock game, a game timer and more. To order BP69 send \$4.99 clearance (includes s&h) in the US and Canada to Electronic Technology Today Inc., P.O. Box 240, Massapequa Park, NY 11762-0240. US funds only. Use US bank check or International Money Order. Allow 6-8 weeks for delivery. MA07



Get your copy of the CRYSTAL SET HANDBOOK



Go back to antiquity and build the radios that your grandfather built. Build the "Quaker Oats" type rig, wind coils that work and make it look like the 1920's! Only \$10.95 plus \$4.00 for shipping and handling. Clagg Inc., PO Box 12162, Hauppauge, NY 11788. USA Funds ONLY! USA and Canada—no foreign orders. Allow 6-8 weeks for delivery. MA01

Coil Design and Construction Manual



YOU CAN WIND YOUR OWN COILS?

There's no trick to it except knowing what you are doing. In a unique, 106-page book you can become expert in winding RF, IF,

audio and power coils, chokes and transformers. Practically every type of coil is discussed and necessary calculations are given with the mathematical data simplified for use by anyone. Get your copy today!

Mail coupon to:

Electronics Technology Today, Inc.
P.O. Box 240
Massapequa Park, NY 11762-0240

Please send me my copy of *Coil Design and Construction Manual* (BP160). I enclose a check or money order for \$8.99 to cover the book's cost and shipping-and-handling expenses. NY state residents must add local sales tax.

Name _____

Address _____

City _____ State _____ ZIP _____

All orders must be paid in U.S. funds only. Sorry, no orders accepted outside of USA and Canada. Please allow 6-8 weeks for delivery. ET07

CLASSIFIEDS

BUSINESS OPPORTUNITIES

\$400 WEEKLY ASSEMBLING Electronic Circuit Boards/Products From Home. For Free Information Send SASE: Home Assembly-PT Box 216 New Britain, CT 06050-0216.

CABLE TV

CABLE TV Descramblers. One-piece units. Scientific Atlanta, Jerrold, Pioneer, and others. Lowest Prices Around. Precision Electronics Houston, TX Anytime. 1-888-691-4610

ABSOLUTE BEST PRICES ON CABLE TV BOXES! FREE 30 DAY TRIAL! 1 YEAR WARRANTY! FREE CATALOG. 1-888-242-0539 WWW.ALLCABLEBOXES.COM All cable TV boxes. We'll beat any price! 30-day no risk money back guarantee! Free catalog! www.allconverters.com 1-877-914-1112

MISC. ELECTRONICS FOR SALE

T&M ELECTRONICS. Large variety of electronic parts since 1966. Visit our Web site at www.tandmelectronics.com

TinyTenna's and more! SASE to: "Shortwave Catalog", POB 87, Hanover, MI. 49241. http://qth.com/dwm or http://qth.com/danger. E(E)PROM/Microcontroller Programmers and Gadgets from \$19.95 up. http://www.geocities.com/xumicro

PLANS-KITS-SCHEMATICS

Transmitter Kit Micro-sized. Excellent sensitivity! Receive with UHF-Scanner \$49.00 VHS 1370 Trancas #201 Napa, CA 94558 Catalog \$5.00.

AM Tube Radio Kits. TRF and Superhets. Visit our website at www.ghostmoon.bigstep.com

SATELLITE EQUIPMENT

FREE Satellite TV Buyer's Guide. Best Products - Lowest Prices - Fastest Service! Dish Network, DirectTV, C/Ku-band, including 4DTV. Parts- Upgrades - Accessories! SKYVISION - 800-543-3025. International 218-739-5231. www.skyvision.com

www.poptronics.com

Wireless & Electrical Cyclopedia



ETT1—Wireless & Electrical Cyclopedia \$4.99. Step back to the 1920's with this reprinted catalog from the Electro Importing Company. Antiquity displayed on every page with items priced as low as 3 cents. Product descriptions include: Radio components, kits, motors and dynamos, Leyden jars,

hot-wire meters, carbon mikes and more. The perfect gift for a radio antique collector. To order ETT1, send \$4.99 (includes s&h) in the US and Canada to Electronic Technology Today Inc., P.O. Box 240, Massapequa Park, NY 11762-0240. US funds only. Use US bank check or International Money Order. Allow 6-8 weeks for delivery. MA11

Gernsback Publications, Inc.

275-G Marcus Blvd. Hauppauge NY 11788

POPTRONICS® CLASSIFIED ADVERTISING ORDER FORM

Advertiser Information

Name _____
 Company _____
 Street Address _____
 City/State/Zip _____
 Telephone () _____
 Signature (required on all orders) _____

Payment Information

Charge my:
 Master Card Visa Discover
 Account No. _____
 Exp. Date _____
 Full payment enclosed. Prepayment discounts offered for multiple insertions (except on credit card orders).
 Payment for first insertion enclose; additional payments will be made prior to closing dates. Prepayment discounts not available.

Do you want any special options? (where available)

- Boldface Type* Add 25% for entire ad Screened Background – Add 30%
 Special Heading – Add \$35.00

The first word of your ad and your name will be printed in boldface caps, at no additional charge.
 For individual boldface words, add .50¢ each.

In what month(s) would you like your ad to run?

- Entire year for publications selected above.
 Jan. Feb. Mar. Apr. May. June July Aug. Sep. Oct. Nov. Dec.

Here's how to calculate the cost of your Regular or Expanded-Ad Classified:

Rate X Numbers of Words + Rate for Boldface + Rate for Screened Background = Cost per Insertion X Number of Months = Cost

Magazine	Rate	x	Number of Words (min. 15)	+ Boldface (add 25%)	+ Screened Background (add 30%)	=	Cost Per Insertion	x	Number of Months	=	Cost		
_____	_____	x	_____	_____	_____	+	_____	=	_____	x	_____	=	_____

Rates:

\$3.50 per word

Minimum 15 Words

Here's how to calculate the total cost of your advertising:

Prepayment Discount:

(Full payment must accompany order, not applicable on credit card orders)

Prepay for 6 insertions in one magazine, 5% 12 insertions in one magazine, 10%

Subtotal _____
 Less Prepayment Discount _____
TOTAL COST \$ _____

Please use a separate piece of paper to write your copy, or for any special instructions you may have.

HAVE A QUESTION? CALL: 1-631-592-6720 ext. 206

Fax signed orders with credit card information to : (631) 592-6723

GP1895

ADVERTISING INDEX

Poptronics does not assume any responsibility for errors that may appear in the index below.

Free Information Number	Page	Free Information Number	Page
- Abacom .....	.64	309 IVEX Design .....	.71
- All Electronics .....	.86	139 Jameco .....	.9
- A-M Systems Inc. ....	.78	- LDP LLC .....	.66
- Amazon Electronics .....	.82	- Lone Star Consulting .....	.83
- Andromeda Research .....	.65	- Lynxmotion .....	.84
- Antique Electric Supply .....	.86	- M ² L Electronics .....	.84
- Arrow Technologies .....	.80	324 MCM Electronic .....	.63
319 Beige Bag Software .....	.67	323 Mendelsons .....	.70
290 C&S Sales, Inc. ....	.68	296 Merrimack Valley Systems .....	.75
- Carl Taylor Inc. ....	.83	- microEngineering Labs .....	.83
133 CircuitMaker .....	.CV2	- Modern Electronics .....	.66
233 Circuit Specialists .....	.76	- Mondo-tronics .....	.70
- CLAGGK, Inc. ....	.14, 18, 53	205 Mouser Electronics .....	.74
320 Cleveland Inst. of Electronics .....	.73	- MSC Electronics .....	.82
321 Command Productions .....	.64	- North Country Radio .....	.78
- Communications Surplus .....	.82	- Ohio Automation .....	.83
- Conitec Data Systems .....	.84	- Ontrak Control Systems .....	.66
- Consumertronics .....	.84	275 Parts Express .....	.85
- Davis Instruments .....	.74	- Pioneer Hill Software .....	.80
- EDE Spy Outlet .....	.82	228 Polaris Industries .....	.61
210 Electronic Design Specialists .....	.80	219 Prairie Digital .....	.72
- Elect. Tech. Today .....	.42	- RC Distributing Co. ....	.82
130 Electronic Workbench .....	.CV4	263 Ramsey Electronics .....	.62
- Electronix .....	.66	256 RobotiKits Direct .....	.67
206 Electronix Express .....	.72	- Securetek .....	.72
- EMAC Inc. ....	.74	- Scott Edwards Electronics .....	.65
- Engineering Express .....	.78	- Smarthome.com .....	.65
- Fair Radio Sales .....	.80	- Square 1 Electronics .....	.74
- Fort777.com .....	.83	- Techniks .....	.82
- Gateway Products .....	.83	- Technological Arts .....	.70
- Global Specialties .....	.64	322 Test Equipment Depot .....	.81
- Globaltech Distributors .....	.82	217 Tie Pie Engineering .....	.66
282 Grantham College of Eng. ....	.24	- UCANDO Videos .....	.65
220 Information Unlimited .....	.81	- Vision Electronics .....	.84
- Intec Automation .....	.83	140 Wittig Technologies .....	.CV3
- Intelligence Here .....	.83	141 Wittig Technologies .....	.3
- Intronics .....	.70	- World Wyde .....	.82, 83, 84
- Intuitive Circuits, LLC .....	.65	- Xilor, Inc. ....	.66

ADVERTISING SALES OFFICES

Gernsback Publications, Inc.
275-G Marcus Blvd.
Hauppauge, NY 11788
Tel. 631-592-6720
Fax: 631-592-6723

Larry Steckler
 Publisher (ext. 201)
 e-mail: advertising@gernsback.com

Adria Coren
 Vice-President (ext. 208)

Ken Coren
 Vice-President (ext. 267)

Marie Falcon
 Advertising Director (ext. 206)

Adria Coren
 Credit Manager (ext. 208)

For Advertising ONLY EAST/SOUTHEAST

Marie Falcon
 275-G Marcus Blvd.
 Hauppauge, NY 11788
 Tel. 631-592-6720 x206
 Fax: 631-592-6723
 e-mail: mfalcon@gernsback.com

MIDWEST/Texas/Arkansas/ Oklahoma

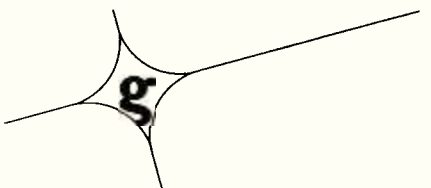
Ralph Bergen
 One Northfield Plaza, Suite 300
 Northfield, IL 60093-1214
 Tel. 847-559-0555
 Fax: 847-559-0562
 e-mail: bergenrj@aol.com

PACIFIC COAST

Megan Mitchell
 9072 Lawton Pine Avenue
 Las Vegas, NV 89129-7044
 Tel. 702-240-0184
 Fax: 702-838-6924
 e-mail: mmitchell@gernsback.com

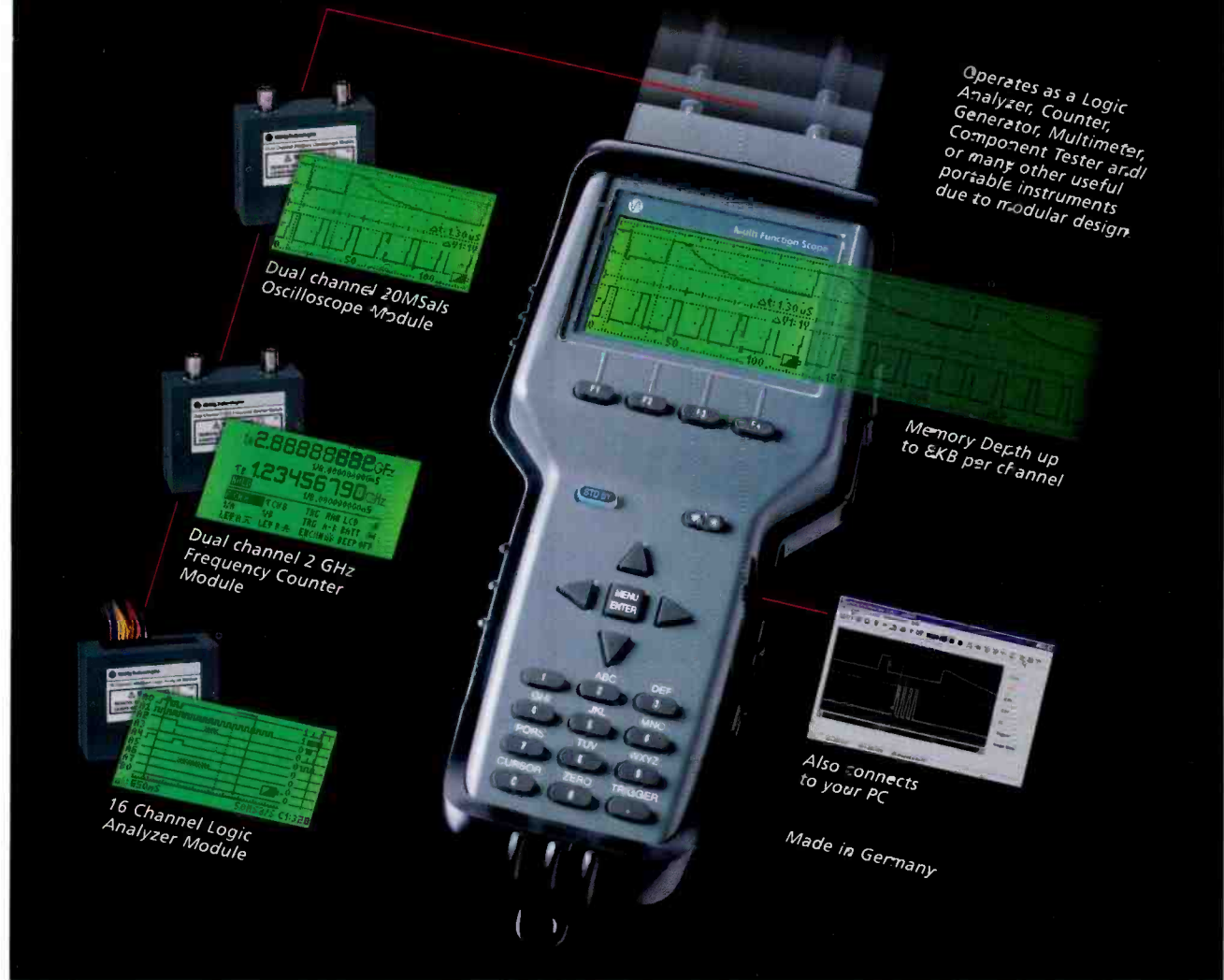
**Subscription/
Customer Service/
Order Entry**
 Tel. 800-827-0383
 7:30 AM - 8:30 PM CST

www.poptronics.com



2-Channel Oscilloscope

 approved. Provides isolated channels for safe operation



Operates as a Logic Analyzer, Counter, Generator, Multimeter, Component Tester and many other useful portable instruments due to modular design

Dual channel 20MSa/s Oscilloscope Module

Dual channel 2 GHz Frequency Counter Module

16 Channel Logic Analyzer Module

Memory Depth up to 8KB per channel

Also connects to your PC

Made in Germany

Master Unit 22-320 with backlit display includes 20MSa/s Dual Channel Oscilloscope Module 22-321, 2 Signal 1:1/10:1 Probes, MS-Windows95/98/NT compatible, PC Serial Interface Cable, AC Adapter, Protective Rubber Boot, Manual and suitable hard-shell carrying case for US\$ 398.00, stock available.

Also downloadable free software at www.wittigtechnologies.com

Dual channel 2 GHz Frequency Counter Module 22-323 (option) features isolated channels, external and internal triggering, 9 Digits, Temperature-Compensated Time Base 10^{-9} , statistic analysis, includes Manual, MS-Windows95/98/NT compatible, US\$ 299.00, available mid 2001

Logic Analyzer Module 22-322 (option) features 16 channel, 40MSa/s, various external and internal triggering, 32k channel, 16 bit event counter, includes dis-assembler for 8051 and Z80 (more in preparation), signal cables, Manual and MS-Windows95/98/NT compatible, US\$ 349.00, available mid 2001

Free shipment: anywhere in the U.S. and Canada, with n 5 days.



Developer by Wittig Technologies AG
Sales (516) 794 4380 or Toll-Free (800) 247 1241
Fax (516) 794 1855
sales@wittigtechnologies.com

Technical support: available by e-mail or fax, only support@wittigtechnologies.com

All trademarks belong to the respective owners.

 **Wittig Technologies**
www.wittigtechnologies.com

CIRCLE 140 ON FREE INFORMATION CARD

The world's most popular electronics simulation software just got better!

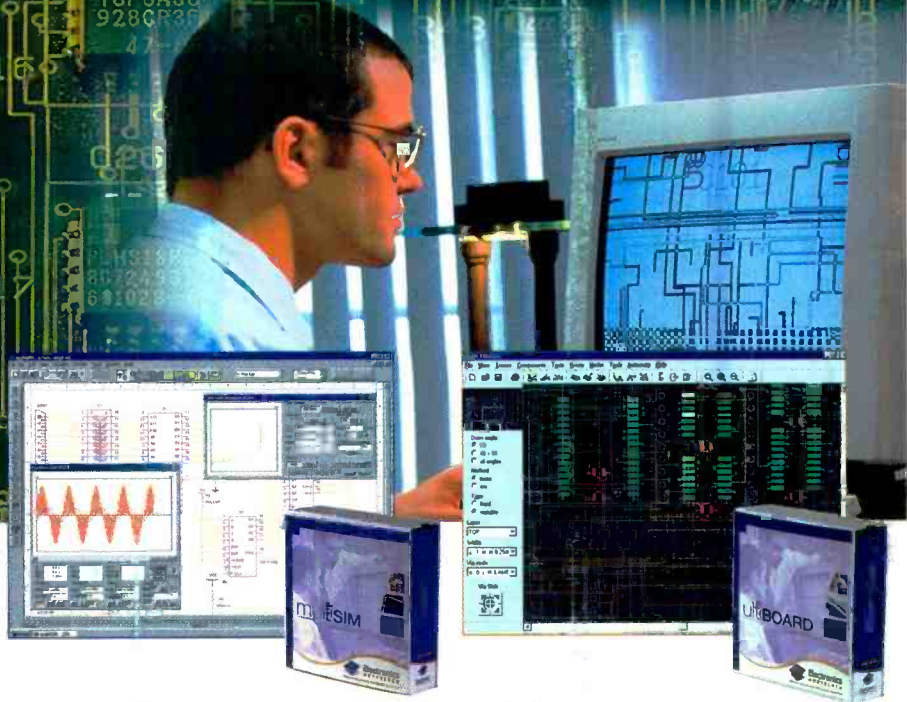
WHY settle for second best?

***FREE**

Virtual Lab with Poptronics Circuits

Check out the circuits from recent issues, including this month's! Tweak the circuits and see the instruments respond instantly.

Download the Multisim demo with pre-built Poptronics circuits from www.electronicworkbench.com/poptronics



BEST PRODUCT! BEST PRICE!

Electronics Workbench is recognized around the globe for developing highly advanced, yet easy-to-use electronics software. Over 150,000 users tell us that they have completed projects using Electronics Workbench in less time than it takes to even install other programs.

And now we've just released Version 6.2! If you've never tried electronics simulation, this is your chance - you can now have your very own virtual lab! Work on your own or create circuits together with others across the country - live on the internet. Start with the **FREE** Electronics Workbench/Poptronics demo and then take advantage of this best price ever when you buy. Tried other products? You owe it to yourself to experience what only the market leader can offer - there is no comparison. And if you own earlier versions of Electronics Workbench, call us now for upgrade pricing starting at just \$149!

multisim V6.2

Schematic Capture & Simulation

~~\$399~~ **\$299**

ultiBOARD

Powerful PCB Layout

~~\$399~~ **\$299**

or get **BOTH** products for **\$498**

Limited Time Offer
BEST price ever!

Multisim Highlights

- ▶ Advanced schematic capture
- ▶ Intuitive auto & manual wiring (no toggle)
- ▶ Change circuits while simulating
- ▶ Mixed-mode SPICE analog/digital simulation
- ▶ Built-in symbol and component editor
- ▶ Parts organized into bins (no alpha lists)

Don't settle for a program that has less than:

- ▶ 6,000 parts in component database
- ▶ 9 virtual instruments & 8 powerful analyses
- ▶ Interactive design on the Internet
- ▶ OLE integration with Excel/MathCAD

Ultiboard Highlights

- ▶ Powerful & easy-to-use PCB layout & editing
- ▶ Reroute while move (full rubberbanding)
- ▶ Built-in autorouter
- ▶ Real-time design rule check
- ▶ Automatic net highlighting (selective)
- ▶ Density histograms/placement vectors

Don't settle for a program that has less than:

- ▶ 3,000+ library of footprint shapes
- ▶ Capability for boards of any shape, up to 50"x50"
- ▶ 32 layers support
- ▶ 1 nanometer internal resolution

To order, or to find out why our products are the most popular in the industry, call **1-800-263-5552** or visit www.electronicworkbench.com (**FREE demo available**)



Electronics
WORKBENCH