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APRIL 2001

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Downloadable Circuits see page 60

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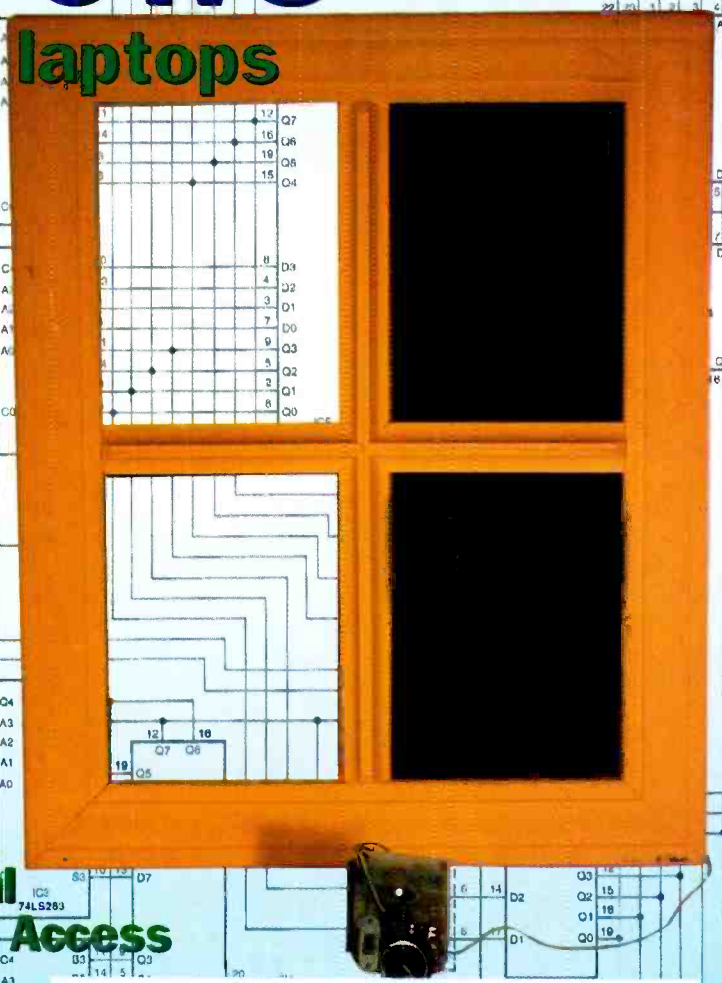

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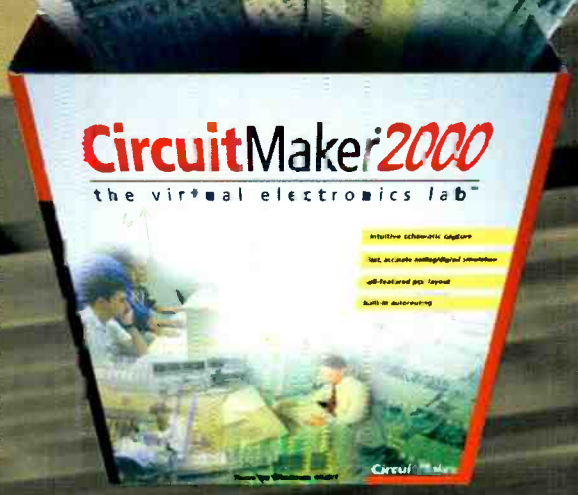

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Electronics Now

April 2001, Vol. 2, No. 4

Popular Electronics®

Poptronics®

THE MAGAZINE FOR THE HANDS-ON ELECTRONICS ACTIVIST!

FEATURES

PRODUCT REVIEWS

DEPARTMENTS

AND MORE

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Editorial

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Coming And Going

Some of the press releases that we receive have little to do with electronics itself, but are for the *business* aspect of the electronics industry ("XYZ buys BCD," "Smedly Pleembeck promoted to VP," or "Ecraf Technologies sues all other chip-makers over patent infringements"). Normally, I would simply say, "That's nice," and place them in the old "circular file."

However, one stood out a bit. When read carefully, there's something ugly brewing beneath the surface.

Valence Technologies, of Henderson, NV, has been developing lithium-ion battery technology for several years, along with other major players in the battery industry.

Yeah? So what?

Their big announcement is that they are buying up the rights to all the remaining lithium-ion battery patents.

So it's just another business deal. Where's the big whoopie?

Let me quote from the press release:

"Valence will be transforming itself into a licensor of this technology...licensing its technology to battery manufacturers worldwide. Any portable electronic device that will be using lithium-ion technology (and all are projected to do so) will have to pay Valence royalty revenues."

Well, of course, *they're going to charge the battery people a royalty. That's how patents are supposed to work.*

Read that second sentence again. Carefully. Let me quote it again with emphasis:

"Any portable electronic **device** that will be using lithium-ion technology (and all are projected to do so) will have to **pay Valence royalty revenues**."

Now, is it sinking in? If you make lithium-ion batteries, you would naturally expect to pay a "tithe" to Valence. But if you make, say, a cell phone—with a lithium-ion battery *compartment*—you pay Valence a royalty.

Since when does having a certain type of battery compartment become illegal without anteing up? Does that mean that if you build a project in your basement and power it with lithium-ion batteries, the "battery police" will be breaking down your door? What about buying a new cell phone in 2005 or so that's been retrofitted with a "micro-fuel cell" that burns butane? Does Valence still dip their fingers into your pocket? Why do we the consumers have to pay twice—once for the battery and once for the compartment? Talk about them getting you both coming *and* going!

Pay we will. Do you think the equipment manufacturers will happily absorb that cost without passing it on to the retailers and, ultimately, us?

Joseph Suda
Managing Editor

P.S. As this issue was going to press, I got word that there might have been a small production problem in a handful of issues. If you happen to receive a copy with something "odd" to it that slipped through, hang on to it for the "collector's value" or sell it on eBay!

YESTERDAY'S NEWS

A PEEK INTO THE GERNSBACK ARCHIVES

1900

1910

1926

1930

1940

1951

1960

1970

1980

1986

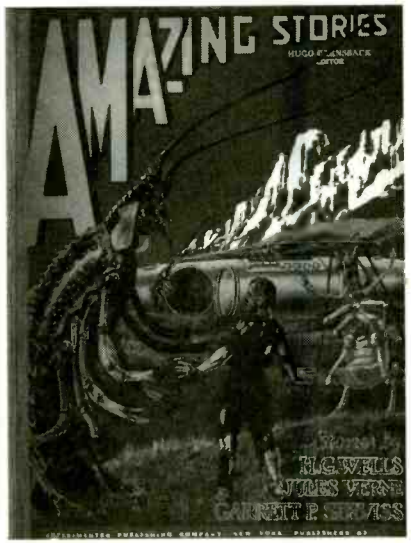
1990

2000

Dateline: April 1926 (75 years ago)

Based on the positive feedback from the fiction stories he published in **Science & Invention**, Hugo Gernsback started a new magazine devoted solely to the fledgling science-fiction market. Volume 1, No. 1 of **Amazing Stories** hit the newsstands, featuring several short stories such as H. G. Wells' "The New Accelerator" and the novel "Off on a Comet" by Jules Verne.

Many of our readers don't realize the connection between Hugo Gernsback and science fiction. The "Hugo" award for notable science-fiction writing is named after Mr. Gernsback. It is sponsored by the World Science Fiction Society and presented at their annual World Science-Fiction Convention *(WorldCon). (Unfortunately, a few of our early archived issues have not survived the rigors of time—the cover pictured here is October, 1926, the seventh issue.)*



Dateline: April 1951 (50 years ago)

Two news columns in **Radio-Electronics**—"The Radio Month" and "Radio Business"—kept readers up to date by reporting that:

- The US TV set population reached 10,549,500 *(Today, that number reaches to the hundreds of millions.)*
- A new desk-sized computer sported a paltry 100 vacuum tubes and a single moving part—a 10,000-digit rotating memory drum with a 0.3-mS retrieval speed. *(Today's notebook-sized computers store billions of digits, but the retrieval speed is much slower—6 mS vs. 0.3 mS—and they still use a mechanical rotating system!)*
- A pair of coaxial deep-sea telephone cables—one each for northbound and southbound traffic—were laid between Key West and Havana. Developed by Bell Labs, the bottom-dwelling links had amplifiers every 40 miles of their 115-mile length. *(That cable is still in use today, although there have been recent political problems between the US and Cuba about fee increases.)*

Dateline: April 1986 (15 years ago)

Hands-On Electronics featured a review on satellite-television systems for the home. A sage piece of advice to the readers was that "...10- to 12-foot dishes are a sufficient size for most parts of the United States." *(Today's digital-satellite systems have an 18-inch diameter dish and fit in the back of the car...not the back of the tractor-trailer!)*

LETTERS

mailto: letters@gernsback.com

But Is It Art?

In your January 2001 editorial, you asked for feedback about the first use of computer-generated schematics in the magazine. The schematic on page 35 in the article "An RF Field-Strength Meter" is fine, except it is printed too small. The part IDs, especially, are too small. I wasn't sure of the ID of Q3 and Q4, even with a magnifying glass.

There are two other problems: All four transistors were left out of the Parts List, and Q3 and Q4 aren't referred to by part number in the text. A nearby library has copying machines that copy at 200% to 11- by 17-inch paper. From the enlarged copy, I am 99% sure that Q3 and Q4 are 2N3563.

I probably won't build the field-strength meter of that article, but I plan to use parts of the circuit in other projects.

BILL STILES
Hillsboro, MO

More Construction Articles Please

Here are some projects I would like to see in the magazine:

Power inverter—12 volts DC to 110 volts AC. (About 300 watts or so is okay, but the bigger the better.)

Charger for 12-volt lead-acid batteries. (A charger that would regulate itself so that it could be left connected. It would charge the battery, and then trickle charge or shut off when the battery is fully charged.)

Home intercom. (What I'm looking for is an intercom that would have a master station from which I could select remote stations. When the selected station is called, it could be answered hands-free by talking into a remote speaker. Stations would be connected by wire. I think these systems are available to buy, but it would be fun to build.)

I'd also like to see an article on doing IF alignments of radios. (I've got a particular old Dynaco tuner in mind.)

BRIAN TRACY (A faithful subscriber)
via e-mail

More Suggestions

I very much enjoy reading your magazine and would appreciate articles on midi applications. There are many older keyboards around that could be retrofitted to work with the MIDI input on computers. The problem I am finding is that there is precious little information out there that is reliable on this subject. It seems that anyone that has worked on these units becomes biased toward their particular make or method of installation.

In particular, where can I find information on which chips are available and how to interconnect them to other components (MIDI in, MIDI out, channel select, etc.)?

MIDI music has come a long way in a very short time. I am sure many readers would be very interested in this topic.

STAN STREKER
via e-mail

Keep It Cooking

My first subscription to your magazines was in January 1967. As a long-time reader, here's my wish list for editorial content. Firstly, with the combining of ***Electronics Now*** and ***Popular Electronics***, I hope that the number of articles will increase.

Secondly, it would be nice to have a section on reader's circuits, tips, and suggestions. Lastly, how about articles on model-railroad circuits and digital-train control; uses for old computers, monitors, and printers; a circuit that detects AC current and then energizes a relay, such as one that monitored the outside motion-detector lights and sounds an alarm when current flows; and one on a circuit to build a telephone voice changer, etc.

Your magazine is great, and I hope it keeps getting better.

KEN CECKIEWICZ
via e-mail

KEEP IN TOUCH

We appreciate letters from our readers. Comments, suggestions, questions, bouquets, or brickbats ... we want to hear from you and find out what you like and what you dislike. If there are projects you want to see or articles you want to submit—we want to know about them.

You can write via snail mail to:

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

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

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

NEW GEAR

USE THE FREE INFORMATION CARD FOR FAST RESPONSE

Electronic Soldering Station

CIRCLE 60 ON FREE INFORMATION CARD

IDEAL FOR PROFESSIONALS, STUdents, and hobbyists, the *SL5 Soldering Station* is electronically controlled to power soldering irons from 5 to 40 watts or 5 to 60 watts. The unit features an on/off indicator light, adjustable temperature for any project, a steel tray for the included tip-cleaning sponge pad, and a heavy steel nonslip base. The compact soldering station has a footprint of approximately 6½ by 3½ inches.

A special safety feature of the SL-5 is its ground-fault-detection circuit. Very important when working with static-sensitive electronic components or high-voltage circuitry, this circuit warns users if the station is not properly connected to earth ground because of reversed hot and ground wires.

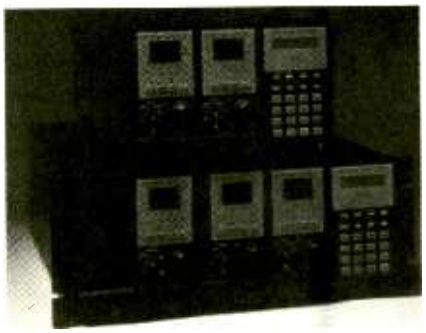
Comfortable to hold, the soldering iron boasts a cushion grip handle. Its grounded, long-life, plated, conical tip is designed for easy soldering of those static-sensitive devices. The reversible iron holder can be situated on the right or left side of the station.

There are several models of the soldering station. The SL-5 ($24.95) does not include a soldering iron, and the SL-5-40 ($33.25) and SL-5-60 ($34.95) come with 40-watt and 60-watt soldering irons, respectively. All three models are available as kits, as well. The kits are the same prices as the assembled units.

ELENCO ELECTRONICS INC.
150 W. Carpenter Ave.
Wheeling, IL 60090
800-533-2441 or 847-541-3800
www.elenco.com

500-Volt Electronic Load

TWO *500-VOLT ELECTRONIC-LOAD modules* have been added to the *MML Series* of modular medium-power programmable DC electronic loads. Designed for testing PFC outputs, AC/DC and DC/DC converters, power-storage devices, and electronic components, they are available in 300- and 600-watt configurations. The MML loads can



CIRCLE 61 ON FREE INFORMATION CARD

simulate a wide range of dynamic loading configurations and feature user-programmable loading waveforms.

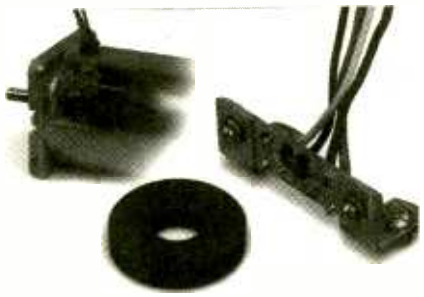
Users can program the MML loads using the keyboard or an RS-232 interface. Ten programs can be stored in EEPROM with up to ten sequences per program for automated testing. Individual modules can be synchronized in parallel with other MML modules.

The starting price for the MML Series of 500-volt electronic-load modules is $1970.

SORENSEN DIVISION OF ELGAR ELECTRONICS CORP.
9250 Brown Deer Road
San Diego, CA 92121
800-525-2024 or 858-450-0085
www.elgar.com

Shaft Encoder Kit

THE *SEK SERIES MOTOR SHAFT Encoder Kits* consists of a sensing board with mounting bracket, plus a multipole ring bracket. The dual-channel-quadrature output provides a low-resolution position-feedback signal for monitoring velocity and direction of rotation.



CIRCLE 62 ON FREE INFORMATION CARD

It is designed for easy mounting for applications such as gate or door control. The standard model is available for a ¼-inch shaft.

The SEK Series Motor Shaft Encoder Kit sells for $30.

WINLAND ELECTRONICS, INC.
1950 Excel Drive
Mankato, MN 56001
800-635-4269 or 507-625-7231
www.winland.com

Capacity Analyzer

FOR TECHNICIANS CHECKING electrolytic capacitors in-circuit, the *CapAnalyzer 88A Series II* has improved test probes for one-handed testing of both radial and surface-mount capacitors. A new ESR display-driver chipset allows for double the battery life with greater ESR accuracy. In addition, the one-to-five-beep audible alert indicates the approximate ESR reading so that the technician doesn't need to actually glance at the 20-segment LED display.

CIRCLE 63 ON FREE INFORMATION CARD

The front of the analyzer offers a DCR range set-alert that is adjustable from zero to 500 ohms, allowing in-circuit checking of both electrolytic and tantalum caps, and a QuickESR test for super-fast ESR-only testing. The three-color chart on the front panel permits comparison of ESR to capacity.

The CapAnalyzer 88A Series II sells for $179.

ELECTRONIC DESIGN SPECIALISTS
4647 Appalachian St.
Boca Raton, FL 33428
561-487-6103
www.eds-inc.com

Board-Level Color Camera

A HIGH-PERFORMANCE BOARD-level color camera, the *GP-CX-161* is among the smallest in the industry at less than one square inch. The Charge-Coupled Device (CCD) is lightweight and comes with a fully functional Digital Signal Processor (DSP).

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The camera is available in several lens styles with a choice of horizontal field-of-view lenses, as well as with a no-lens option. It offers full VGA resolution in NTSC or PAL analog outputs. Accessories include a connector cable, the 12C interface board, and free software for modifying the DSP parameters.

The GP-CX-161 board-level color camera sells for $99.

PANASONIC INDUSTRIAL COMPANY
DTG IMAGING GROUP
Two Panasonic Way
Secaucus, NJ 07094
201-348-7000
www.panasonic.com

Thermometer Datalogger

FEATURING DUAL INPUTS AND displays from Type J or K thermocouples, the *J/K Thermometer Datalogger Model 422130* can store time and 8000 measurements in up to 255 recording sessions. Recorded data can be transferred to a PC via RS-232 interface and cable, and software. Both Type J measurements (-300 to 1400°F) or Type K measurements (-310 to 2431°F) have 0.1% accuracy and resolution.

The datalogger provides a real-time clock and both Min/Max/Average and Relative settings. It comes complete with a 9-volt battery, Type K bead wire temperature probe, Windows95/98-compatible software, RS-232 cable, and carrying case.

The J/K Thermometer Datalogger Model 422130 sells for $249.

CIRCLE 65 ON FREE INFORMATION CARD

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Laptop Carrying Case

SECURE, COMFORTABLE TO CARRY, and a practical workstation—all in one, the *Lapdog* is a truly portable work place. In its closed position, it provides complete protection for your laptop computer. The padded case unfolds for use on any work surface from an airline tray to your lap. Its non-slip surface keeps your laptop in place, and the fold-over pockets hang down on either side of your lap for greater balance and stability.

CIRCLE 66 ON FREE INFORMATION CARD

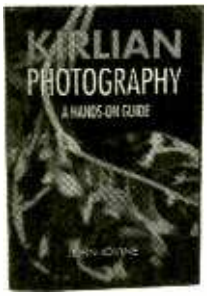
The pockets store all your computer accessories in easy reach, from batteries to disks to external drives. A padded ergonomically designed shoulder strap comes with the case.

The Lapdog has a list price of $139.95.

SHAUN JACKSON DESIGN INC.
P.O. Box 130500
Ann Arbor, MI 48113-0500
734-975-7500
www.sjdesign.com/ldpr.html

NEW LITERATURE

Kirlian Photography: A Hands-On Guide



by John Iovine
Images Company
39 Seneca Loop
Staten Island, NY 10314
718-698-8305
www.imagesco.com
$24.95

Electrophotography, commonly called Kirlian photography, remains a fascinating and controversial subject—almost 150 years since its discovery. In this book, John Iovine—our "Amazing Science" columnist—shows readers how to produce Kirlian photographs using standard 35-mm or video cameras. He also analyzes one of the most baffling phenomena in this field: the "phantom leaf" aura.

The book includes complete plans and instructions for building low-cost electrophotography equipment. The included disk features full-color Kirlian photographs.

50th Anniversary Catalog

from B&K Precision Corp.
1031 Segovia Circle
Placentia, CA 92870-7137
714-237-9220
www.bkprecision.com
Free

The 96-page, full-color catalog features over 50 new products. These include IC testers, programmable power supplies, cable testers, environmental instruments, and video-monitor testers, as well as a full line of accessories. This catalog is an ideal resource for electrical and electronic field-service technicians, hobbyists, and engineers.

All the newest products are placed at the front of the catalog. Specifications, prices, and ordering information accompany each product. The entire catalog is on the Web site in a downloadable format.

Exploring Solid-State Amplifiers

by Joseph J. Carr
Prompt Publications
Sam's Technical Publishing
5436 W. 78th St.
Indianapolis, IN 46268
800-428-7267
www.samswebsite.com
$29.95

This practical guide is designed to provide a solid foundation on the subject of amplifiers. It covers op-amps, as well as both audio small-signal and power amplifiers; and transistor amplifiers, including bipolar NPN/PNP transistors, JFETs, and MOSFETs. Radio frequencies are also mentioned.

Topics include small-signal RF amps, solid-state parametric amps, MMICs. There is also information on troubleshooting solid-state amplifiers and selecting replacement parts.

Hacking Exposed: Second Edition

by Joel Scambray, Stuart McClure, and George Kurtz
Osborne/McGraw-Hill
2600 Tenth St., Sixth Floor
Berkeley, CA 94710
800-2MCGRAW
www.osborne.com
$39.99

Do you lose sleep worrying over your computer security? As several of our columnists discussed in this issue, it's a real concern in today's round-the-clock, hyperconnected world. The second edition of this book brings up-to-date insight into how hackers infiltrate e-businesses and other networks and how they can be stopped, with easy-to-follow technical detail and revealing case studies.

Newly updated material includes chapters on Internet client attacks on Web browsers and e-mail software, as well as discussions of attacks on Windows 2000 and countermeasures. There's also information on new Network discovery tools and techniques and on security attacks against Windows, Unix, Linux, and NetWare. The operative motto here is "Be Prepared."

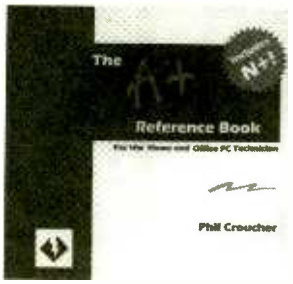
Net-Wit.Com

by Marv Rubinstein
Schreiber Publishing
P.O. Box 4193
Rockville, MD 20849
800-822-3213
www.schreibernet.com
$17.50 plus S&H

Internet addicts will enjoy this "smorgasbord of e-mail and Internet wit"—a collection of the best humor floating around the Net or widely circulated on e-mail. It's not a book of jokes, but a group of commentaries on the funny things that happen when "man meets machine."

The author delves into such deep philosophical questions as what is the gender of a computer. Does it have a standard one, or does it depend on whether the speaker is male or female?

The A+ Reference Book CD-ROM

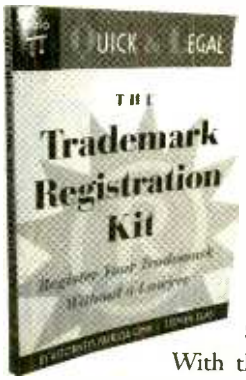


by Phil Croucher
Electrocution Technical Support Services
P.O. Box 1403
Okotoks, Alberta
T0L 1T0 Canada
403-938-9979
www.electrocution.com
$35 (U.S.) plus S&H

Based on the publisher's popular technical reference books, the CD version makes it easy to search on any keyword. It is intended to get readers through the A+ exam—a test for international certification of computer technicians. In addition, it is a valuable resource, with over 2000 pages of hard information on secret BIOS settings; on 6600 hard drives and over 700 motherboards; and on DOS, Windows, NetWare, and Linux.

There is also coverage of the Network+ exam. The CD is also useful for CNE and MCSE studies. The material is updated once a year, and upgrades are available at a discounted price.

The Trademark Registration Kit

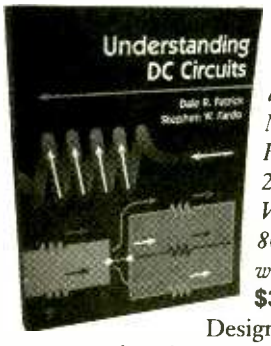


by Patricia Gima and Stephen Elias
Nolo.com
950 Parker St.
Berkeley, CA 94710-2524
800-992-6656 or 510-549-1976
www.nolo.com
$19.95

With this book, readers get a streamlined guide to the trademark-registration process. What business owners don't know *can* hurt them. Many don't realize the pitfalls and difficulties involved in registering trademarks.

The authors—both attorneys—provide step-by-step instructions—in plain English, not legalese—for filling out all the forms required by the U.S. Patent & Trademark Office. Readers can use this kit to register their trademarks on their own and avoid costly mistakes while doing so.

Understanding DC Circuits



by Dale R. Patrick and Stephen W. Fardo
Newnes, Butterworth-Heinemann
225 Wildwood Ave.
Woburn, MA 01801
800-366-2565
www.newnespress.com
$34.95

Designed for the electronics beginner and student, this practical book makes it easy to learn both complex concepts and basic theory and applications. Each chapter contains easy-to-read text, accompanying graphics, and instructions for designing simple circuits and building several small electronic projects.

Integrating theory and lab experiments, this text covers the first half of a basic electronic circuit theory course. Dozens of topics are explored, including energy and matter; static electricity; electrical current; conductors; schematic, wiring, and block diagrams; series and parallel circuits; magnetism; inductance and capacitance; and soldering techniques.

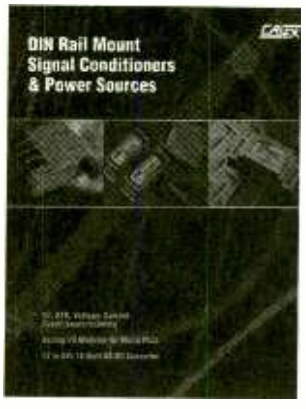
Photodetectors: Devices, Circuits, and Applications

by Silvano Donati
Prentice Hall
One Lake St.
Upper Saddle River, NJ 07458
800-282-0693
www.phptr.com
$70

Today's optoelectronic devices rely on accurate detection of light sources across the spectrum. A useful reference for engineers and an ideal sourcebook for college students, this comprehensive guide surveys single-point devices and their image counterparts, covering the range from UV to far IR.

Basic operations, performance parameters, and special features are presented in the context of application circuits. Special attention is given to sensitivity and noise limit issues. Concluding chapters deal with coherent detection and advanced techniques, while the appendices conveniently reference key principles.

DIN Rail Mount Signal Conditioners & Power Sources (CIS544)



from CALEX Mfg.Co, Inc.
2401 Stanwell Drive
Concord, CA 94520-4841
800-542-3355 or 925-687-4411
www.calex.com
Free

Providing detailed specifications on the company's latest DIN rail-mount signal-conditioning and power-source solutions, this 14-page brochure covers the new 8900 Series and details on the 8500 and 8600 Series. Power solutions presented include the Model 12S24.625DIN DIN rail-mount DC/DC converter. All of the signal-conditioning products shown here are single-channel units designed primarily for discrete automation applications. P

Business Buzz

AIRPLANE, PHONE HOME

Keeping in constant touch anywhere has never been more important. That's why an airborne access server from Miltope Corp., the E-Server, is being field tested on several major airlines in the U.S. and Canada. The server incorporates Ariel Corp.'s RS2000-EBX—a 56K/ISDN remote access card that gives up to 30 passengers simultaneous access to the Internet, e-mail, and other services. The aircraft's E1 LAN links the E-server with each passenger-seat group, which contains one or more phone terminals. To access the Internet or send e-mail, passengers simply plug their modem-equipped notebook computers into a port on the phone and place a call. The server answers the calls and forwards them to the aircraft's *C*entral *T*elephone *U*nit (CTU), which uses a wireless RF up/down link to connect passengers with the public switched telephone network, Internet backbone, and other ground-based services.

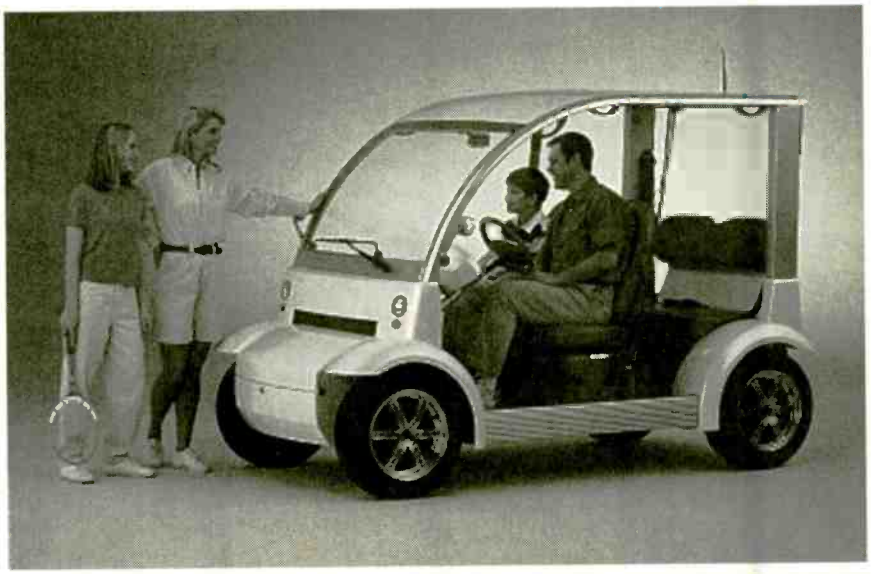
MORE ON STAYING CONNECTED

ThinkersGroup.com recently released ThinkConnectT, its free wireless Web-to-wireless application. ThinkConnectT seamlessly translates any Web site to any wireless device with no site mapping, XML, or outside conversion required—regardless of browser, protocol or markup language—in as little as 15 minutes. It is said to make data accessible on any type of wireless device from a phone to a PDA. ThinkConnectT is not only for Web-site owners, but it is also available for wireless-device users to freely browse the Internet simply by signing up at *www.thinkconnect.com*.

"IT'S NOT MY FAULT"

The recent GFCI Circuit Breaker Field Study conducted by the Leviton Institute showed that a high percentage of home *G*round *F*ault *C*ircuit *I*nterrupters (GFCIs) didn't work when they were tested. The study reviewed data from 13,380 building inspections and found that, on average, 15 percent of GFCIs were inoperative, and the percentage rose to 58.2 percent in lightning-prone areas. Even if ground-fault protection is compromised, traditional GFCIs may still deliver power. One possible solution is a "lockout-action" GFCI that cannot be reset unless the circuit breaker is working properly.

"TH!NK" Electric



With a top speed of 25 mph, the TH!NK neighbor is designed for commuting around closed communities and for other non-highway, short-distance travel.

With far less fanfare than when they introduced the now infamous Edsel, Ford recently launched the TH!NK brand. Ford's new TH!NK Group will market electric-power, zero-emission, personal-transportation vehicles.

Let's Be Neighbors

One of these very environmentally friendly vehicles is the TH!NK Neighbor. With a top speed of 25 mph, this electric car is designed for commuting around closed communities, industrial sites, resorts, private roads, and golf courses. Other potential uses include meter reading, law enforcement, on-campus transportation, on-site security, and transportation in parks.

Constructed with an extruded aluminum space frame covered with thermoplastic, this vehicle has modular body panels whose colors are easily changed. The interior is weather-resistant and designed for ergonomic simplicity, function, and on-board stowage. The two-passenger version is 91.5 inches long and weighs 980 pounds including batteries, while the four-passenger model is about 10 inches longer and 300 pounds heavier.

Powered by a 5-kW DC motor, the TH!NK Neighbor features 65 foot-pound peak torque at 1500 rpm. It comes equipped with a two-speed selector for street and golf-course applications. The "high" setting enables a maximum speed of 25 mph, and the "low" setting limits speed to 15 mph for golf-course duty.

Energy is stored in six, 12-volt lead-acid batteries, with a range between recharges of about 30 miles. Recharging takes four to eight hours using a standard, on-board 110-volt system. Its regenerative braking ability recovers braking energy, providing onboard charging to the batteries during stop-and-go driving.

This electric vehicle meets the new U.S. Federal Highway Traffic Administration's (NHSTA) FMVSS500 safety requirements for *L*ow-*S*peed *V*ehicles (LSV), as well as very similar regulations currently being proposed by Transport Canada. Safety features include three-point restraints at all seating positions, an AS-1 glazed windshield, and 3-mph bumpers.

TYPE

An electric urban car, TH!NK City can carry two occupants in its high-tech body, has a top speed of 56 mph, and has range of just over 50 miles between recharges.

Just like any other car, it has headlights, stop lights, tail lamps, turn signals, reflectors, rearview and side mirrors, parking brakes, horns, reverse chime, adjustable seats, and a windshield washer/wiper. Instrumentation includes speedometer, odometer as well as trip odometer, energy-level indicator, and operation-mode indicator and switch. Purchasers can personalize their vehicle from a list of options such as evaporative cooler, heater option, cup holders, AM/FM radio w/CD, maintenance-free batteries, trailer-tow hitch, and seating/cargo storage module.

Ford plans to market the TH!NK Neighbor, which will be built in a new plant in Manhattan, KS, through selected retail outlets including participating Ford dealers. Buyers can also order on-line at *www.thinkmobility.com* and have it delivered right to their door. While prices have not been finalized, the TH!NK Neighbor is expected to be available by the time of publication for around $6000.

The TH!NK Bike Fun and TH!NK Bike Traveler are electrically assisted bicycles, with ranges between battery charges of 22 miles at 12 mph and 15 miles at 12 mph, respectively.

Urban Electric

Another Ford electric offering is the TH!NK City, an electric urban car. The 9.8 foot long TH!NK City can carry two occupants in its high-tech body that features an aluminum spaceframe covered with thermoplastic body panels and a ABS plastic roof.

Recharging of the 19-module NiCd-battery-pack takes four to six hours. The one-ton plus TH!NK City *E*lectric *V*ehicle (EV) has a range of just over 50 miles between recharges and has a top speed of 56 mph. A 27-kW AC induction motor drives the front wheels.

Ford plans to import several hundred TH!NK Citys over the next two years for demonstration purposes. Already sold in other parts of Europe and in Norway where they are built, they are scheduled to be available in the U.S. in 2002. Prices have not yet been announced.

Two-Wheel Travel

Bicycles are also getting a powered boost from Ford. The TH!NK Bike Fun and TH!NK Bike Traveler are electrically assisted bicycles that provide motorized assistance when added power is needed. TH!NK Bike Fun has a fixed frame, and THINK Bike Traveler has a folding frame. The Bike Fun has a range of 22 miles at 12 mph, and the Bike Traveler gets 15 miles at 12 mph. Both use a 24-volt battery pack that takes about six hours to recharge.

They are now available on-line and through retail outlets, including participating Ford dealers. The Bike Fun lists for $1000, and the Bike Traveler has a list price of $1200.

Other Developments

The TH!NK organization is also responsible for developing and commercializing Ford's fuel-cell technology. Among the fuel cells being marketed is the TH!NK FC5, which is used in the four-door 2000 Ford Focus.

With their strict rules on emissions

Research Notes

LET THERE BE LIGHT

With technical support from Sandia National Laboratory, the *N*avajo *T*ribal *U*tility *A*uthority (NTUA) is using solar power to bring electricity to remote areas of the reservation where stringing wire would be prohibitive. Between 10,000 and 30,000 Navajos throughout the reservation that covers parts of three states are estimated to live without electricity. The NTUA bought and installed 200 photovoltaic systems that convert solar energy into electricity and store it for future use. Each system furnishes electrical power to a single home.

ANYONE FOR A FUSION "POP"?

A way to create fusion energy in a cylinder roughly the size of a soda can is under investigation at Los Alamos National Laboratory. *M*agnetized *T*arget *F*usion (MTF) is a process where a magnetized fusion fuel in the form of an electrically neutral, high-temperature ionized gas—a plasma—is pre-heated before being injected into a soda-can-sized aluminum cylinder. The cylinder and its contents are then quickly compressed by driving a powerful electrical current through the "can's" wall. As the fast-moving solid metal wall compresses the fuel, it burns in a few millionths of a second at pressures millions of times greater than the Earth's atmosphere. Within this mass of super-compressed, high-density plasma, scientists hope to produce tiny amounts of fusion energy—a potentially unlimited energy source.

A LIGHT AT THE END OF THE FUNNEL

Researchers at The University of Texas at Austin led by Chemistry Chair Dr. Paul F. Barbara have discovered that conjugated polymer molecules used in LED displays in computers funnel energy to single points. They found that conjugated polymers, which are large organic molecules that have alternating single and double bonds between their atoms, behave in this way because of the manner in which their molecules are folded. The research was done using a technique called *S*ingle-*M*olecule *S*pectroscopy (SMS), as well as a new technique for keeping the sample polymer molecules stable during SMS. This work has potential applications for future polymer-based semiconductors.

and with the new regulations going into effect that by 2003 ten percent of new cars and light trucks sold in the state must have zero emissions, California is the frontier for EV research. Recognizing that Southern California in particular is the center of electric-vehicle development and marketing, Ford is setting up their outposts on this EV frontier. TH!NK headquarters is in the process of moving from Michigan to Carlsbad, CA in San Diego County. In addition, a separate facility located in nearby Poway, CA will be devoted to engineering and fuel-cell research.—**by Bill Siuru** PT

Stop Burning Money

Shortfalls in electric power and the skyrocketing prices of home heating oil have both been in the news this year. Researchers in the Combustion Equipment Technology Program at the U.S. Department of Energy's Brookhaven National Laboratory are working on one of these issues, improving fuel-oil efficiency to help homeowners and small businesses keep costs down. Future improvements in oil-heat technology under development at the laboratory may help oil-heat customers save up to $19.5 billion by the year 2010. Brookhaven's research is also leading to the development of ultra-low emissions combustion technologies that will contribute to a cleaner environment.

Researchers in this combustion equipment technology program are currently working on several projects. The Fan-Atomized Burner is an oil burner, developed at Brookhaven, that fires fuel at low input rates to match the smaller heating loads of well-insulated homes. It offers improved fuel- and air-mixing for better performance, produces about a five to ten percent improvement in efficiency over conventional burners, and is now in the second generation of commercialization. The new burner also reduces nitrogen-oxide emissions by as much as 30 percent.

Another project is the Flame-Quality Indicator, an electronic device that monitors flame brightness in residential oil burners. It is designed to alert the homeowner when service is required weeks before the oil burner's primary control would normally shut down the system due to severe flame-quality problems. Currently, Honeywell Corp. of Minneapolis, MN and Insight Technologies of Bohemia, LI are performing a 100-unit field study of an improved version of a decade-old Brookhaven flame-quality indicator.

Brookhaven National Laboratory (BNL) researcher Thomas Butcher inspects the flame pattern in the BNL fan-atomized oil burner.

Brookhaven is also conducting laboratory and field studies to determine the benefits of long-term use of reduced-sulfur fuel. Such fuel is already used in diesel trucks.

In addition to improving and refining existing technology, Brookhaven is exploring totally new heating methods. The laboratory has begun preliminary tests on biofuels, fuels derived from vegetable oils. The researchers are evaluating cost, emissions, wear and tear on oil-burner components, and efficiency of biofuels. They are studying whether blending a small percentage of biofuel with conventional fuel oil is both a feasible way to stretch oil supplies and a viable alternative to conventional fuel oil for residential heating. PT

"The Sound of Music"

Chris Kyriakakis calls his invention "the time machine." It can put you in the front row at Carnegie Hall to hear the Beatles or in a 1940s ballroom with Tommy Dorsey and Frank Sinatra.

Kyriakakis, assistant professor of electrical engineering in the University of Southern California (USC) School of Engineering, has developed a new technology called "Virtual Microphone." It transforms old one- or two-channel audio recordings into true concert-hall quality sound that precisely mimics the acoustical characteristics of a hall. The technology also makes it possible to transmit six audio channels or more over the Internet at low bandwidth without using compression.

It is difficult to accurately reproduce sound from a concert hall. Recording engineers typically use 20 or more microphones in their attempt to capture all of the sound produced by a large orchestra within such a complex acoustical environment.

"If you don't have a mike right next to the flute, for example, you won't be able to hear it in the final mix," Kyriakakis said.

Chris Kyriakakis, assistant professor of electrical engineering in the USC School of Engineering, has developed a new technology called "Virtual Microphone" that transforms old one- or two-channel audio recordings into true concert-hall quality sound—precisely mimicking the acoustical characteristics of a hall.

➤ It's A Snap

SanDisk Corp. and Photo-Me International recently debuted their silver-halide-processing digital-photo kiosk, said to be the world's first. It enables people who are taking digital photos to insert flash data storage cards into the kiosk and edit the photos on the kiosk's display screen. Then they can quickly print them on high-quality photographic paper—using Silvertronix technology, the process that combines silver-halide processing and LCD booster technology. Digital Portal Inc. (DPI), a joint venture by the two companies, will operate the SanDisk kiosks in North America—expected to be launched by the time of publication.

Besides printing photos, the kiosks will allow consumers to upload their personal files of digital pictures either from the kiosk or from their home PC to the DPI Web site. Then PC-less friends and relations elsewhere could visit the local kiosk, download the file under a unique user pass key, and select what pictures to print there and then. In addition to accepting a variety of digital storage media, the DPI kiosk provides consumers with a picture resolution of 15 million pixels, a user-friendly interface, speedy development, and low-cost prints. PT

This silver-halide-processing digital-photo kiosk from SanDisk provides a one-stop digital-photo service, where customers can insert flash data storage cards, edit their photos on the kiosk's display screen, and print them out immediately.

Sound waves bounce off walls, the ceiling, the floor and other surfaces, so that a listener present in the hall hears sounds from different directions and at slightly different times. Kyriakakis "maps" concert halls or other venues by placing an array of microphones in different locations. He creates an algorithm using adaptive signal-processing techniques for each mike in the array that compares the sound captured by the array with the sound captured by a single central-reference microphone. The algorithm acts as a digital filter that will exactly re-create that array's unique sound from the sound picked up by the single reference mike.

"Once we have worked out the algorithms for a concert hall, we only need the sound from one microphone to generate sound equivalent to what you would hear in the best seat in the house," said Kyriakakis. "It sounds just like you were in the room during the recording."

He can also manipulate the sound to place the listener in different locations within a hall or to place an orchestra in a different venue from the one in which it was recorded. "Even if we don't know the room—perhaps it's no longer in existence—we can make a very good approximation."

High-quality audio files currently sent over the Internet are usually subjected to some degree of undesirable compression. "The amount of compression required for today's Internet introduces artifacts that significantly degrade the quality of the sound," Kyriakakis said.

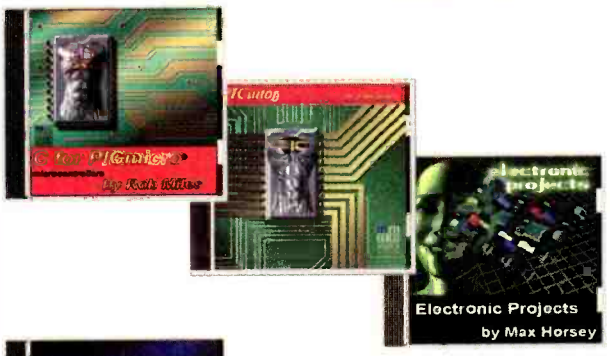
A single channel of audio commonly traverses the Internet today unaided by compression technology, and the digital filters that Kyriakakis creates require negligible bandwidth. "So that means we can send that single audio channel from the reference mike over the Internet, accompanied by the appropriate digital filters and produce concert-hall quality sound at the other end," he said. "With a single microphone in place, you could listen to the Boston Pops on your six-channel surround-sound system in your living room in Southern California, in real time."

The new format is similar to the 5.1-channel sound found on DVDs, and there are more than 30 million 5.1 systems installed worldwide.

According to Kyriakakis, there are hundreds of thousands of one- or two-channel recordings that Virtual Microphone technology could convert into true concert-hall experiences and deliver on DVD audio—classical music, in particular.

Kyriakakis has been asked to map concert halls in Europe in preparation for converting music to the new DVD format for a record company with a large German classical music library. USC and the researchers have filed for a patent for the Virtual Microphone process, and USC is negotiating licenses with a venture capital firm and two music companies. PT

CD ROM based resources for learning and designing



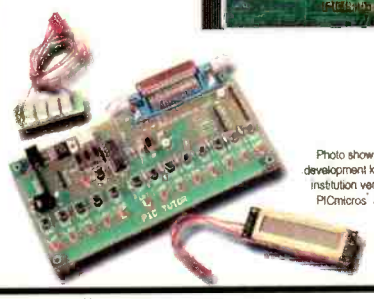


Photo shows PICmicro development kit supplied with institution versions of C for PICmicros and PICtutor

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.

matrix multimedia

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.

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.

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C for PICmicros	$179	$350
Digital Works	$50	$99
CADPACK	$75	$159
Analog Filters	$75	$159
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GIZMO®

Touchscreen Remote

Does it take longer to find the right remote than to find something worth watching on TV? Check out Proton's *SRC-2000 Touchscreen Smart* infrared remote control ($170). It can operate up to ten devices, with settings for TV, VCR, amplifier, DVD, satellite receiver, CD, tuner, laserdisc player, video CD player, and two auxiliary devices. The SRC-2000 lets you customize as many as 12 macro functions, each capable of holding up to 25 commands. The remote also offers 12 timer functions that automatically send commands, in sequence, at the specified time and date.

Frequently used functions, such as volume, channel, play, mute, and stop, can be accessed directly via rubber keypad buttons. Other commands are entered using the LCD dot matrix screen, which boasts a 128- × 64-dot resolution and an adjustable light-level sensor that keeps the screen visible in low lighting. Users can customize the size of the on-screen buttons and label them in a way that make sense—no more guessing what "alt/aux 2" could possibly mean.

The optional *SDS-2000* docking station ($90) keeps the batteries charged and makes it hard to misplace the remote. It offers a power adapter as well as a data link cable for connection to a PC.

Proton U.S.A., 13855 Struikman Road, Cerritos, CA 90703-1031; 562-402-2222; *www.proton-usa.com*.

CIRCLE 50 ON FREE INFORMATION CARD

Lightweight Light Source

Lightwave's *Pocket-Bright Personal Lighting System* ($19.95) is a different kind of flashlight. The tiny device measures 1¾ × 1⅛ × ½ inches and weighs less than one ounce, including batteries. Instead of a standard flashlight bulb, it uses a super-bright LED said to have a typical life of more than 100,000 hours over 11 years of continuous usage (with battery changes as needed). The Pocket-Bright uses a custom IC and PC board to digitally control the flow of current from the two included lithium batteries. This energy-efficient arrangement is said to result in battery life of 100-plus hours of continuous use and many times that with regular pulse use.

The LED flashlight is shockproof and waterproof, making it a good choice for camping and other outdoor activities. To turn it on, you press the top of its case once. It will stay lit until you press it again, eliminating the need to keep squeezing the unit. A key ring, neck lanyard with clip, and self-stick Velcro button are included.

Lightwave, 24702 Kim Circle, Laguna Hills, CA 92653; 800-563-9405; *www.longlight.com*.

CIRCLE 51 ON FREE INFORMATION CARD

Hands-Free Talking

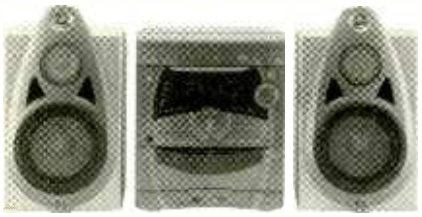
In this neck of the woods, it's now illegal to hold a cell phone while operating a moving vehicle. If you want to talk, you can either pull over or use a headset such as the *M50* ($29.95) from GN Netcom. (Such headsets are a smart choice even when not required by law.) The M50's noise-canceling microphone reduces road and background noise. Its Acoustic Director feature perfectly positions the speaker against your ear, and a patented three-dimensional pivot allows you to adjust the headset single-handedly. With an over-the-head or over-the-ear design, the M50 can be easily slipped on, allowing you to keep your hands free while driving.

GN Netcom, Inc., 77 Northeastern Blvd., Nashua, NH 03062; 800-826-4656; *www.gnnetcom.com*.

CIRCLE 52 ON FREE INFORMATION CARD

Pint-Sized Powerhouses

The *SoundGEAR* line, consisting of the *SG-3030* ($379) and the *SG-2020* ($279), represents JBL's first foray into the mini-system arena. Both models include a 3-disc CD changer, a dual-well cassette deck, and an AM/FM tuner. There's a wealth of digital features including VMAx virtual surround-sound processing, which is said to produce realistic three-dimensional sound in 360-degrees using just two speakers. Each speaker has a curved center section with a large, futuristic LCD display that lends it a high-tech look.



The SG-3030 delivers 200 watts of power and comes with three-way speakers. The SG-2020 has a pair of two-way speakers and a 150-watt output. Both models feature synchronized CD-to-tape dubbing, a clock with sleep timer and dual wake-up alarms, three preset equalizer settings, and a three-position Bass Boost control. Optical and coaxial digital outputs allow direct connection to a CD recorder. A front-panel auxiliary input and an output for connecting to a powered subwoofer are also provided.

JBL Consumer Products, 250 Crossways Park Drive, Woodbury, NY 11797; 516-496-3400; *www.jbl.com*.

CIRCLE 53 ON FREE INFORMATION CARD

Sound Design

It often seems that the more functions a consumer-electronics product offers, the more difficult it becomes to access the very features that made you want to buy the thing in the first place. Rotel attempts to reverse that trend with its *RSX-972 100-Watt Multi-Channel Home-Theater Receiver* ($1299). Resulting from their studies, this device is said to combine high performance, non-intimidating operation, easy setup, forward compatibility, and space-conscious design.

The RSX-972 includes Dolby Digital and DTS processing. The receiver also includes an independent six-channel input for surround formats such as DVD-Audio.

The amplifier section features efficient chimney-style heatsinks to enhance natural air flow and lower internal temperatures. Six preamplifier outputs allow you to add external power amps for complex system configurations. The AM/FM tuner section includes a PLL digital-synthesizing tuner with Radio Data System (RDS) capability. It offers 30 station presets, custom-programmed station IDs, and a keypad for direct access to specific frequencies.

The RSX-972 provides five assignable digital audio inputs (three coaxial and two optical); and its analog inputs include phono, CD, and two-tape-monitor circuits with dubbing capability. Video connections include composite, S-, and component signal switching. The receiver also provides a fully independent Zone 2 audio output to allow second-source distribution to another room. The included *RR 969* learning remote control has an LCD readout.

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

CIRCLE 54 ON FREE INFORMATION CARD

Versatile Speakers

Designed for both home-theater and audio applications, Cerwin-Vega's *RL* line of contemporary home loudspeakers have a compact, small-footprint design suitable for use in any room. All are fully shielded to allow placement near a video monitor.

The centerpiece of the line is the *RL-18P* ($499.95 each), a full-range tower that features the EX+ extended-throw 8-inch rear-firing active subwoofer, powered by a built-in 100-watt rms amplifier. An output level control allows you to precisely match the output of the subwoofer with your electronics and the room's acoustics.

The RL-18P uses a ferrofluid-cooled 1-inch soft-dome tweeter and a six-inch midrange, both housed in a dedicated sub-enclosure to reduce unwanted modulation distortion. The loudspeaker comes with convertible spiked feet.

The *RL-28W* powered subwoofer ($499.95) has two front-firing EX+ 8-inch drivers powered by a discrete 200-watt rms amplifier in a compact cabinet. The subwoofer features a continuously variable crossover and volume control so it can be matched to other speakers. Phase switching ensures constant overall system coherency regardless of subwoofer location.

The *RL-16M* ($149.95 each) is a 6-inch two-way bookshelf monitor that uses the same 1-inch tweeter and 6-inch midrange found in the RL-18P. When combined with the powered subwoofer, the RL-16M is ideal for use as a front- or surround -channel speaker.

The *RL-25C* center-channel speaker ($249.95) is voice-matched to the RL-18P and RL-16M to provide a seamless presentation. It features a 1-inch soft-dome tweeter and two 5-inch midrange woofers arranged in a D'Appollito array.

Cerwin-Vega, 555 East Easy St., Simi Valley, CA 93065-1805; 805-584-9332; *www.cerwinvega.com*.

CIRCLE 55 ON FREE INFORMATION CARD

Customizable Handheld Computer

When you need to organize your personal and business information, a popular pocket organizer is often the answer. Handspring has transformed their organizers into customizable handheld computers with its innovative Springboard expansion slot. Just snap in a module. Based on the Palm OS, the *Visor* family of products, which range from $149 for the *Visor Solo* to $449 for the *Visor Prism*, can run thousands of applications.

Handspring, Inc.; 888-565-9393 or 650-230-5000; *www.handspring.com*.

Internet Browser

The *ThinModem* ($119.95) by Card Access provides e-mail and Web browsing capability. Power efficient, the modem has no on-board batteries. It uses advanced chip design and power management features that draw minimal power from the Visor's internal battery.

A Sampling of Modules

Currently, there are over 25 Handspring modules designed to fit into the expansion slot. These modules can transform the Visor into an MP3 player, a digital camera, a GPS device, or a powerful calculator; or they can allow users to browse the Internet, or play a game, or make a call. Here is a small sampling. All of these modules are available from Handspring's Web site: www.handspring.com.

Digital Camera and Images

IDEO's *eyemodule* ($149) digital camera turns the Visor into a convenient image-capture device. Black and white or color images can be categorized, beamed to other Visors or Palm OS devices, or synchronized to a PC for editing, e-mailing, or printing. In addition, the *eyecontact* software application works in conjunction with the eye-module and the user's existing address book to attach photos to individual entries. Now you really can connect a name with a face. The software is free to download at *www.eyemodule.com*.

Folding Keyboard

A full-size keyboard when open, the *Stowaway Keyboard* (under $100) from Think Outside folds instantly to the size of the Visor itself. Users can quickly write and respond to e-mail messages on a keyboard that is described as having the same spacing between keys, the same key top size, the same tactile feedback, and the same key travel as the best portable computer keyboard. It includes a built-in docking station so that the Visor "sits up" for easy viewing.

Mobile Phone Module

Handspring's own *VisorPhone* allows users to dial directly from their address book by tapping on a number entry in it and hitting "dial." This compact mobile phone module provides three-way conference calls and can check your calendar or use other applications while you call. Extending beyond the top and back of the Visor, the module contains a battery, speaker, and antenna. There are three buttons: power, voice operation, and text messages. The VisorPhone is available for $299 with service activation, with a service provider of your choice.

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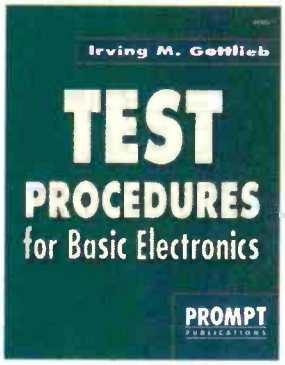

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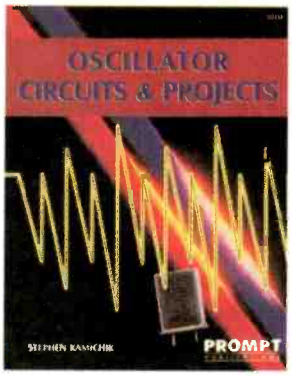

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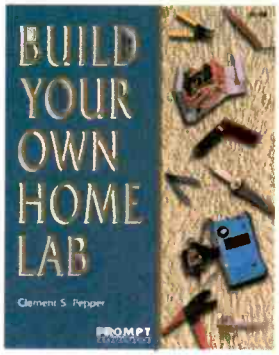

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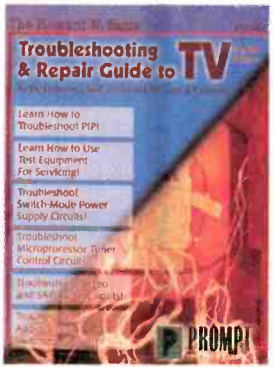

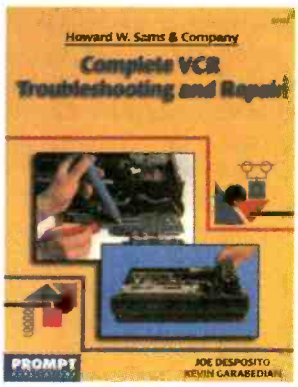

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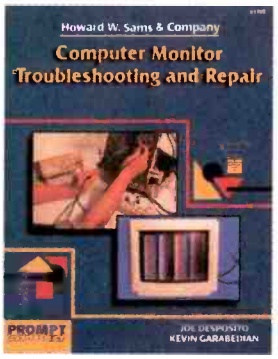

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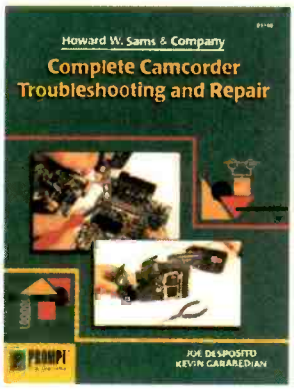

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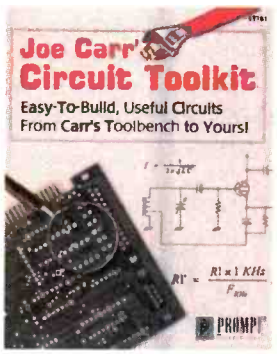

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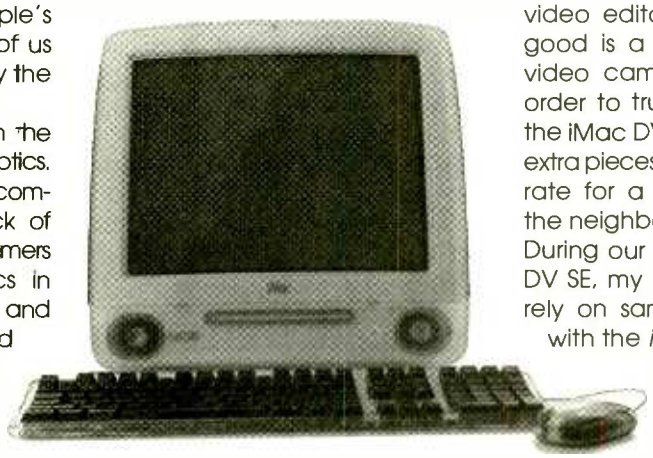
A Hands-on Electronics® REPORT

iMac DV SE

Powered by a 500-MHz PowerPC G3 processor, Apple's iMac DV Special Edition is a must for fledgling artists and jaded PC consumers, alike.

I have to confess—there was a time when I was terrified of Apple computers, but now I appreciate them. The iMac DV SE has broadened my digital horizon, thanks to its impressive features and Apple's splendid software. In fact, all of us at the office were impressed by the machine's performance.

When the iMac first arrived on the tech scene, it had its share of skeptics. Critics scoffed at the computer's compact design and apparent lack of upgrade potential. Soon, consumers began to purchase the iMacs in throngs. Underneath all the glitz and glamour of packaging, users found a capable machine driven by a stable operating system.



Mac-In-the-Box. Sporting a list price of $1499, the iMac DV SE is the top-line model in Apple's iMac arsenal. The unit is available in either of two colors, Graphite or Snow; and it comes complete with an Apple Pro keyboard (that contains 2 USB ports) and an optical mouse. The entire system sets up in a snap and stands slightly taller than a brief case (it is only 15- by 15-inches wide and 17.1-inches deep). It hardly takes up any room, when compared to a PC with a separate tower and monitor set-up. Powered by a 500-MHz PowerPC G3 processor, the iMac DV SE also features 30 GB of hard drive space; a DVD-ROM; a built-in 56K V.90 modem; as well as built-in jacks for USB, FireWire, and Ethernet cables. All iMac DV models also support Apple's exclusive AirPort wireless technology. Purchased separately, the AirPort assembly plugs into the iMac and allows the user to enjoy the freedom of wireless networking.

A hearty bundle of software accompanies the iMac DV SE. The most notable is *iMovie 2*. Apple's latest contribution to the multi-media marketplace, *iMovie 2* allows users to create desktop presentations that can be viewed on the computer, published on the Web, or even sent to VHS. A digital camcorder can be connected via the FireWire jacks.

Apple also offers a complete suite of Internet-related utilities for use with the iMac DV SE. Users can click on *www.apple.com* and register with *iTools*. E-mail, 20 MB of virtual hard drive space, a home page, and child-safety settings are all part of the *iTools* package. Note that you don't have to own a Mac to enjoy the benefits of Apple. Anyone can log on and join at *www.apple.com*.

The user's guide included with the package contains all the steps required to get your system up and running. For those of us who have been raised on Microsoft, have no fear. The operating instructions are concise and user friendly. In fact, after a few minutes of tinkering, the average user will be zipping along in the Mac environment. Mac Os 9 is the current version of Apple's operating system, and it deserves praise for its stability. Even under the burden of video and audio multi-tasking, the iMac DV SE seldom crashes.

The Need for Expensive Toys. There is no question that the iMac DV SE is an incredible machine. Our biggest gripe was the lack of peripherals. Sure *iMovie 2* is one of the best video editors available, but what good is a video editor without a video camera? Sad, but true—in order to truly reap the benefits of the iMac DV SE, you will need a few extra pieces of equipment. The going rate for a digital camcorder is in the neighborhood of $500 and up. During our exploration of the iMac DV SE, my associates and I had to rely on sample footage provided with the *iMovie 2* software.

The head of production cited the iMac's small footprint as its highlight. Thanks to Apple's innovative design, the iMac DV SE does not clutter up the workplace. Also, the system operates without fan noise. The sleek package and quiet operation removes distraction from the office.

Final Thoughts. It's a vicious cycle. It seems that the average computer is only cutting-edge for barely half a decade. Although CPUs are reaching staggering speeds and 3-D graphics improve on a monthly basis, there are a few standards that will be here to stay for at least another ten years; and the iMac DV SE has those standards. USB ports, FireWire, and Ethernet are going to be with us for some time—so if you are looking to take the leap into the new millennium, why not do so with the iMac DV SE? Apple is destined to lead the revolution in multi-media applications with the help of its iMac line.

For more information on the iMac DV SE, contact Apple, 1 Infinite Loop, Cupertino, CA 95014; 408-996-1010; *www.apple.com*; or circle 80 on the Free Information Card.

NET WATCH

CHRIS LA MORTE

mailto: netwatch@gernsback.com

Web Portals

Whether you prefer Yahoo!, Lycos, or Ask Jeeves—a matter of personal taste—web portals now come in a plethora of flavors. These portals can range from search engines to complex communities. They are a dime a dozen these days, and, because of their abundance, we tend to take them for granted. Yet, where would we be without them? This month, let's peer at some less popular portals and learn what they have to offer.

PONDERING PORTALS

Many of us spend time cruising the Net in a seemingly endless search for more information. Whether that information is market analysis, recipes, or current events, there is a lot of it out there. This is where portals come into the picture (or should I say architecture), because they (with the help of a browser) are our links to the Web. Let's examine some common portal features.

Search Engines—Almost every portal offers a search engine. Search engines rely on compiled directories of URLs. Specialized computer programs, called bots and agents, are responsible for crawling the Net and gathering addresses and errata. Improved programming techniques can allow those bots and agents to perform a task known as data mining, in which data is analyzed for related patterns in order to refine search data.

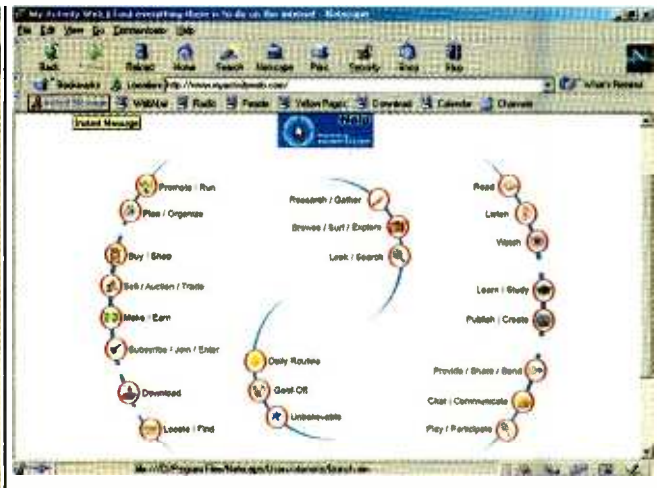
Link Directory—This feature is like an interactive phone book. Web sites often contain a hypertext listing grouped by interests. A simple click of your favorite subject whisks you away aboard your browser.

Chat Rooms—What can one say? Whether you want to be one of a million attendees at a virtual symposium on culture in modern society or just tell corny jokes to a roomful of imbeciles, chat rooms are available. Many portals offer free chat rooms where people with common interest can share ideas.

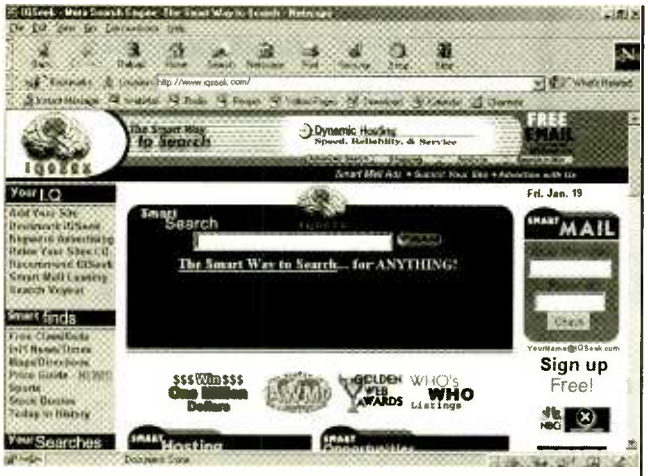
Instant Messaging—These programs are growing more and more popular. The ability to talk with someone via the Net and across the world is amazing. Of course, instant messaging has managed to tick a few "heavies" off. Ma Bell wasn't tickled when people realized they could use *ICQ* or *NetMeeting* as a long-distance carrier of information. Neither were some musicians happy when a budding technology allowed users to form a network for exchanging MP3 data files. My guess is that instant messaging and file swapping are here to stay, and it's only going to get better (or is that worse?).

E-Mail—It is safe to say that every ISP offers its clients an e-mail address. There are hundreds of free e-mail services available on the

Google *has an expansive directory of links related to a plethora of topics. The directory combines with* Google's *search engine to form a valuable Web portal.*



My Activity Web *uses a selection of icons to help steer travelers around the Internet. With an accent on "activity," it is designed with enthusiasts in mind. Whether researching the Human Genome Project or finding a discount supplier, this site takes you where you want to go (virtually, that is).*



IQSeek *promises to shake up a few of the old-timers. This alluring site engages the viewer and supplies him/her with the "goods." With games, mail, chat and a hefty search engine,* IQSeek *is a "convenience" stop on your cyber journey—the Piggly Wiggly of Portals.*

HotDiary offers a free service to fledgling portal proprietors. Instead of brushing up on languages and releasing a horde of bots, users can have the pleasure of clicking through menus in order to design their custom portal. Imagine being the overlord of a virtual Penn Station—complete with newsstands and entertainment.

Net. Computer technology has brought about an age of aliases and alter egos. Thanks to e-mail, not only can Granny see a picture of the kids, but anyone can have 16 identities and the 16 GB of spam to go with them.

Platform Servers—Sites like WestWood Studios and HEAT are fine examples where you can get together with friends and strangers alike in order to duke it out. Perhaps, you'd prefer a simple game of Chess with someone 7000 miles away. Portals bring gamers together for some good old-fashioned competition (and bragging rights too!).

IS IT BETTER TO SEARCH OR GOOGLE?

Most browsers have a search button on their tool bar. When users click the search button, they are usually given a list of search engines. *Google* (at *www.google.com*) is an alternative to the ordinary search engine in that it incorporates a system known as PageRank. Created by Larry Page and Sergey Brin (the founders of *Google*), PageRank keeps a running record of various Web sites' popularity. Each time a search is conducted on a topic, *Google* searches its database for the most popular sites. Popularity is based on the amount of "hits" a site receives.

Google relies on its users for this voting process. *Google's* servers poll computers while they are tallying votes. This explains why there is a privacy disclaimer on *Google's* Web site. Some paranoid Web surfers prefer to keep their business under tight security, and the thought of someone snooping around their system is disturbing. According to *Google's* "integrity" statement, "*Google* does not sell placement within the results themselves...A *Google* search is an easy, honest, and objective way to find high-quality websites with information relevant to your search."

An excellent feature *Google* offers is a toolbar that is downloadable free from *toolbar.google.com*. This toolbar can be accessed while running your favorite Windows-based browser. With a click of the "Search Site" button, *Google* will scan the site that your browser is currently on for keywords. All keywords are color-highlighted in the text for ease of reading. Using the "Page Info" button offers four handy options—view a cached version of a page, find similar pages, view backward links, and navigate up one directory in the current URL. The cached image is a snapshot from the *Google* archive. This is useful if the servers happen to be down for your choice. The backward link option shows a list of pages that are linked to the current page. Pressing "up" can take you from *www.monkey.com/diet* to *www. monkey.com*. The *Google* toolbar saves time and is always readily available.

The *Google* Web Directory serves as a topic-driven Web Portal. *Google* makes use of the Open Directory Project (the largest human-edited directory on the Web) and *Google's* PageRank technology. Web surfers can navigate the Web by clicking on various topics of interest. This directory vaguely resembles the directory at Yahoo's site. Sites are listed by order of popularity, and hyperlinks are provided. Unlike most Web portals, *Google* does not offer a community for chatting, nor does it offer e-mail services.

PICTOGRAMS A-PLENTY

My Activity Web (at *www.myactivityweb.com*) uses an interesting platform of tiny pictograms that leads to various searches across the Web. There are over twenty different categories at your fingertips, such as "locate/find," "research/ gather," and (my favorite) "goof-off." Each pictogram branches off into a more refined search, allowing users to narrow down the numerous sites pertaining to their interests.

Web communities (e.g. AOL and CompuServe) also use icons and toolbars to help their users navigate about the Net. Pictures have served to inform us since we could scribble on rock, and as times change so do the pictographs. The magnifying glass has become a universal symbol for search, and an envelope brings e-mail to mind.

ALTERNATIVES TO THE MAINSTREAM

Chances are you already have a favorite portal, but it never hurts

(Continued on page 52)

REID GOLDSBOROUGH

mailto: digitaldomain@gernsback.com

Getting Productive With Software Utilities

Every time Microsoft releases a new operating system, the question arises anew—What utilities do I need for my computer? Computer utilities are small programs that help you work better with your hardware or existing software. Unlike application programs, they don't let you do anything externally, such as prepare a letter or budget.

To its credit, with each new version of Windows (and in the past, DOS) Microsoft has bundled in utilities that you previously had to pay extra for. Windows ME includes tools for restoring corrupted system files, sharing an Internet connection among multiple PCs and reattaching files that become fragmented; as well as viewing graphics, deleting unnecessary files, and backing up data and programs.

PowerQuest's PartitionMagic has been around for quite some time. This utility is perfect for users who have jumbo-sized hard drives and wish to organize their data in an efficient manner.

PRODUCTION-BOOSTING TOOLS

The utilities Microsoft typically provides are limited compared with the numerous "third-party" programs available—and this continues with Windows ME. That's why utilities remain popular. Five of the top ten best-selling business software programs are utilities (according to the latest numbers from the market research firm PC Data).

Whether you use a PC in a business or home setting, utilities can boost your productivity. They also can be fun (in a "geeky" sense) to experiment with. However, there's a slight risk to such experimentation. On rare occasions, poorly designed utilities can corrupt other software.

The remedy typically involves simply reinstalling the corrupted software, though very infrequently it can necessitate wiping your hard disk clean and reinstalling everything. What's more, when used carelessly, some utilities can temporarily disable a computer. In organizational settings, some system administrators restrict the use of utilities to advanced users for that reason.

The financial risk to using utilities is usually small. Most programs cost little and some are free—released to the public by the developer in an act of goodwill, to promote a consulting or publishing business, or to show off programming virtuosity. Here's a round-up of some of the best utilities on the market today:

Norton SystemWorks—This award-winning suite is a product of Symantec and can be ordered at *www.symantec.com/sabu/sysworks*. Peter Norton popularized third-party utilities back in the 1980s. After he sold the store to utility powerhouse Symantec, his products kept their well-respected brand name but sometimes experienced the indignity of bug infestation. The latest version of Symantec's everything-but-the-kitchen-sink utility suite, *Norton SystemWorks*, seems stable. Included are top-notch tools for system maintenance, debris clean-up, and virus protection. The pro

In today's fast-paced world, we always seem to be on the go. Now you can access your data from virtually any on-line device via XDrive. This Web service offers personal users 100 MB of Internet storage space—for free!

version also offers fax and drive-imaging programs.

Norton AntiVirus—Set your "sites" for *www.symantec.com/nav*, which is home to this popular and protective program. Virus protection is the most vital tool missing from all versions of Windows, and if you don't have access to anti-virus software, you can buy this award-winning utility.

PowerDesk—Found at *www.ontrack.com/powerdesk*, *PowerDesk* allows you to take control of your files. One of the earliest types of utility was the file manager. *Windows Explorer*, which comes with Windows, offers everything most people need to copy, move, and otherwise manage files. However, if you work with lots of files, you can do better with *PowerDesk*. This program was recently sold by its creator Mijenix to Ontrack, best known for its data recovery services. The most useful improvements over *Windows Explorer* are the two-pane view of the files on your hard disk and the bundled tools for working with zip-compressed files.

PartitionMagic—Point and click your way to *www.powerquest.com/partitionmagic*, the virtual home of *PartitionMagic*. Dividing a hard drive into "partitions" is an effective way of keeping organized if you have lots of programs and data or run multiple operating systems from one computer. This is the best collection of tools for managing these partitions. The most innovative lets you quickly move programs and associated files and links from one partition to another.

TweakIE—Wander to *www.tweakie.com* and see this nifty Internet tool. As its name implies, this small utility lets you tweak *IE—Microsoft Internet Explorer*. Among other things, it can help you cover your tracks when surfing by instantly wiping out your history, cache, and cookies lists.

RoboType—If you are tired of repetitive typing, then browse your way to *www.zdnet.com/downloads/stories/info/0,,000OHO,.html*, for a look at *RoboType*. This free utility, distributed by *PC Magazine*, lets you quickly insert "boilerplate" text—a word, phrase, or even paragraph you use again and again—in any program.

AI RoboForm—This gem is waiting for you at *www.roboform.com*. A free offering from Siber Systems, this program instantly fills in those pesky Web forms for you. The "AI" in the product's name stands for artificial intelligence.

XDrive—Here, at *www.xdrive.com*, you can use this free Web service that places a utility on your hard drive. This program makes it easy to store files offsite. You simply use Windows to back up files, share them with colleagues, or access them from the road.

"I CAST A LEVEL-THREE-COROPRATE-FIREWALL AGAINST YOUR PUNY VIRUS!"

Another type of utility that is vital when surfing the Net over high-speed access is a firewall. According to Winn Schwartau (a computer security consultant and author of the new and very readable book *Cybershock: Surviving Hackers, Phreakers, Identity Thieves, Internet Terrorists and Weapons of Mass Destruction)*, personal firewalls are almost required at this point, especially for people with high-speed connections to the Net. Personal firewalls work in two ways—they block hackers from entering your system; or if your system has been breached, they block attempts to send information back to the hacker.

DIGITIZED PARANOIA

On any given day, Internet hackers try to breach my computers a half dozen or more times, looking for a "server" to launch attacks against others or trying to plant "trojan" or "zombie" programs on my PCs to take control of them.

I'm not alone. If you have a full-time Internet connection, you're in the same boat. The media is full of high-profile computer break-in reports. One would think we were in the midst of an all-out info-war.

Hacking ("cracking" according to the purist) has been around nearly as long as computers. "I cracked it because it was there" could well be a slogan describing the mindset of a typical hacker, often a bright, bored young man with too much time on his hands and too few scruples about what to do with it. Hacking, however, has become more of a problem lately, for several reasons.

POINT AND CLICK

AI RoboForm
www.roboform.com

McAfee.com Personal Firewall
www.mcafee.com

Norton AntiVirus
www.symantec.com/nav

Norton Internet Security 2000
www.symantec.com/nis

Norton SystemWorks
www.symantec.com/sabu/sysworks

PartitionMagic
www.powerquest.com/partitionmagic

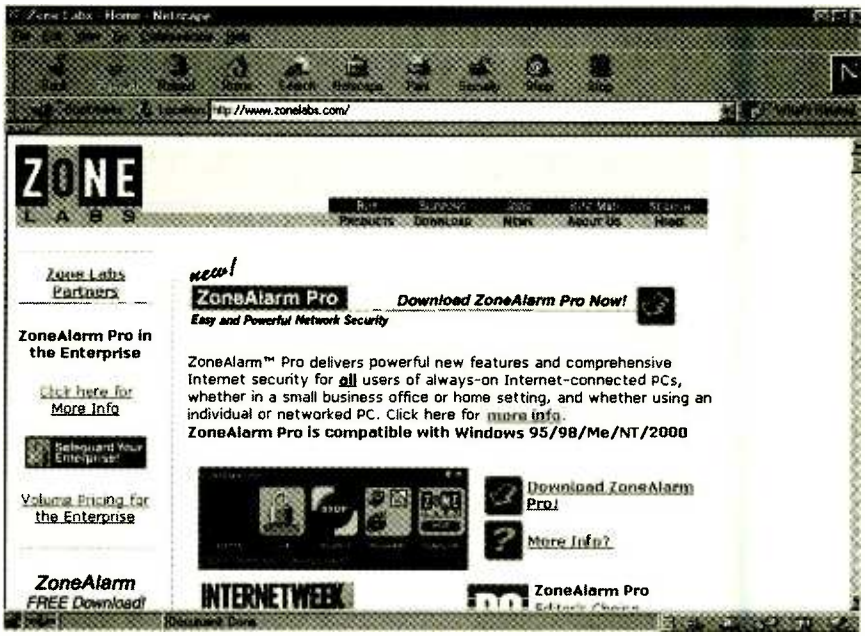
PowerDesk
www.ontrack.com/powerdesk

RoboType
www.zdnet.com/downloads/stories/info/0,,000OHO,.html

TweakIE
www.tweakie.com

XDrive
www.xdrive.com

ZoneAlarm
www.zonelabs.com



ZoneAlarm *is a firewall program that is downloadable for free from ZoneLabs. As more people reap the rewards of high-speed access, cyber-vandals have turned their sights on the non-partisans. It is a good idea to protect your system with a firewall when it is connected to the Web.*

Sophisticated hacking tools are more widely available. Second, hackers as a rule hate what they regard as oppressive authority, which is epitomized in their minds by Microsoft, and Microsoft's increasingly visible products are being attacked with a vengeance. Lastly, with the growing popularity of cable and *D*igital Subscriber *L*ine (DSL) modems, which unlike older modems keep you connected to the Internet as long as your computer is turned on, more people than ever are hacker targets.

HOW DO WE PROTECT OURSELVES?

What to do, besides pulling the plug and returning to typewriters and calculators? As with computer viruses, hard disk crashes, and other potential disasters, keep things in perspective. You can make yourself nuts worrying about all this. *Forbes* magazine recently reported that a NASA security expert became so obsessed with stopping one group of hackers that it may have destroyed his marriage.

The truth is that computer use, as with the rest of life, isn't risk-free, and any quest to create a risk-free PC, network, company, or society is self-defeating. You can't stop all the bad stuff. But what you can, and should, do is reasonably minimize the risks. Large organizations have long taken extensive security precautions, relying on experts. These days, smaller businesses and individuals are having to bone up on security and take precautions themselves, often without hired help. The solution here, for many, is a software program called a personal firewall.

PERFORMANCE NOTES

For a few weeks now I've used both a cable and DSL connection to test the three personal firewalls that are getting the most attention. I didn't test *BlackICE Defender*, because it's more of an intrusion-detection system than a full-fledged firewall. Here is a brief description of the three firewall programs.

Norton Internet Security 2000— This program (*www.symantec.com/nis*) is the most comprehensive—and expensive ($60/year)—of the group. Along with a firewall, it includes tools for preventing virus attacks, barring access to porn sites, eliminating Web banner ads, and blocking "cookies" that some sites place on your hard disk. It's easy to set up, though as with all firewall products, you have to delve into the program to make the best use of it.

McAfee.com Personal Firewall— I found this program (*www.mcafee.com*) too complex, and according to the experts I talked with, it does not adequately protect against hackers who replace programs on your hard disk with "Trojan" programs having the same name. It costs $40 for a one-year subscription.

ZoneAlarm—Free for individuals and $20 per year for businesses, this firewall program (*www.zonelabs.com*) is generating the most excitement. It's easy to set up and surprisingly sophisticated. One tool lets you automatically block any incoming and outgoing traffic when your screensaver kicks in. Another lets you create different settings for a corporate intranet.

One final tip: Keep up with the latest security bug fixes for your programs by using their update features or visiting their Web site. P

COMPUTER BITS

TED NEEDLEMAN

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FAST, AT LAST!

Nowadays, if you don't have Internet access, you're considered disadvantaged. Advertisements in all other forms of media—from radio, to TV, to print—all refer you to the "dot com" address of a vendor's Web site.

It's amazing how rapidly the Internet has become an everyday part of life. Ten years ago, if you gave people your e-mail address, they looked at you like you had two heads. Five years ago, they would smile, shrug, and ask for your phone number.

SPEED IS WHAT WE NEED!

With the Net so pervasive, it's not surprising that Internet users frequently demand more from the Web. Broadband content is taking a leap forward, so phone-line users are quickly becoming frustrated with the limitations of dial-up access. It's gotten a lot easier to provide rich graphic and even motion-intensive content on the Net. Unfortunately, sucking data down through a 26-Kbps telephone-line connection is often so frustratingly slow that many users simply abandon a site, rather than wait a minute or more for a page to load.

There have been a number of approaches taken to improve the speed and bandwidth achievable over the dial-up telephone system or *POTS* (*P*lain *O*ld *T*elephone *S*ystem). There are jacks in my house where I can occasionally get a connection as fast as 44 Kbps, but the majority of the times I hook up to the Internet with an average connection speed of 24 Kbps. Things have improved a great deal from the days when we used acoustically coupled modems that meandered along at 300 baud.

The antenna must be installed and aligned by professionals, a process that took just under three hours on my installation.

THOU SHALL NOT COVET THY NEIGHBOR'S BANDWIDTH

For years, I've (not so) silently suffered from broadband envy. This condition was made worse several years ago, when I held a position in a company that used a T1 connection to the Internet that provided access speeds (over the company's network) of up to 1.5 MBps. Coming home each day to 24-Kbps access felt a lot like running the mile in under four minutes, and then having both legs duct-taped together the rest of the time.

That was years ago—during the interim I've been relegated to crawling the Net at 24 Kbps (once again). Advertisements for broadband, which are so common these days, are just cruel jokes that rub salt in my low-speed wounds.

A *D*igital *S*ubscriber *L*ine (DSL) requires that the central office (CO) that provides telephone service to your exchange, be wired for the capability. Patiently, I waited for that upgrade to happen to my phone company. Now my CO *can* provide DSL; however, it *can't* bring the service beyond 15,000 feet from the switch without use of another switch or a repeater station. My house, unfortunately, is at 18,600 feet—a bit more than a half-mile too far.

Cable modems are the second popular broadband alternative. They require coaxial cabling—which my home has—and a cable company that has upgraded their equipment at the cable head to provide this service—which my cable company hasn't done. People living in a different town that is a mile away (and uses a different cable vendor) have cable modem access. The inequality of land-based systems is a pity.

HELP FROM ABOVE: A SATELLITE'S TALE

Though the odds were against me, I finally have fast Internet access. Recently, StarBand Communications, Inc.—a company formed by a partnership between Gilat (a satellite communications vendor), Microsoft, and EchoStar (the company that provides DISHNetwork satellite TV programming)—started to offer satellite Internet access to consumers in my area. This isn't the first service of its kind. Hughes Network Systems (a division of General Motors) has provided its DirecPC service for several years. DirecPC is a one-way service. You connect to the Internet over a standard telephone line at a maximum speed of 33.6 Kbps and download the sites at satellite speed, which is about 400 Kbps. The result is similar to hooking a 500-gallon pool filter to Lake Huron; the puny copper phone lines just

aren't tough enough to handle the booming bandwidth of a direct, two-way satellite transmission.

AND NOW, A LOOK AT STARBAND

StarBand is a two-way service. The user actually uplinks to the satellite, from home, via a satellite dish. The dish used is elliptical, and measures 24 × 36 inches. A 1-watt transmitter shoots the outgoing data up to a satellite that maintains a geo-synchronous orbit around the equator. The satellite provides a link to a StarBand ground-control hub that has a high-speed Internet backbone connection. The user's browser works through the StarBand pipeline, and the data is transmitted back up to the satellite where it is sent down to your home-based dish.

The big advantage with satellite connections is speed. StarBand is aiming for an average *downlink* (download) speed ranging from 400 Kbps during heavy usage periods to as high as 650 Kbps. The service is asymmetrical, because *uplink* (upload) speeds are considerably slower than downlink speeds. StarBand hopes for uplink speeds in the area of 150 Kbps or so, though I've yet to see anywhere near those speeds.

StarBand service requires some special equipment that makes it a more expensive choice than either DSL or cable modem. Initially, the service will be sold through two outlets—RadioShack and selected DISHNetwork dealers. If you purchase StarBand through RadioShack, you will have to purchase a PC with the special pair of StarBand interface cards already installed, as well as the antenna and professional installation. The actual cost depends precisely on how the PC you purchase is configured, but it probably won't cost less than a grand including the antenna and installation costs.

There is a USB version of the transceiver available ($399), and it plugs into an existing PC's USB interface. At the moment, this USB-compatible transceiver is only available from the EchoStar dealers. You still have to pay for the antenna and installation, which adds another $200-$300 to the mix. One side benefit with both vendors is that you can also purchase DISHNetwork programming (though it costs extra).

SETUP AND GO

My setup required a configured PC. StarBand supplied a Dell OptiPlex GX100 (a Celeron-based system targeted at office use). It's not fancy, and it came with a 15-inch monitor; but it also came with a built-in Ethernet adapter that I quickly put to good use.

The equipment was shipped directly to my house, along with a huge box for the antenna. An appointment was made so technicians could meet the parts at my home and complete the install. At the appointed time, the doorbell rang, and the installers appeared ready to go.

One worry I had was whether I had the direct line-of-sight to the southern or southwestern sky needed for satellite communications. StarBand uses one of two satellites, and there must be nothing (such as trees) that blocks the antenna's "view" of one of those satellites. A quick site survey performed by the technicians proved that the antenna could be mounted on my roof, where it has a great "view" of the satellite. The installer could have also put the antenna on a 5- or 7-foot pole in either the back or front yard (if that had been required for a good line-of-sight).

The antenna was mounted on the roof; and two cables (one for the transmitter on the antenna, the other for the satellite receiver) were run down the side of the house, through the wall, and to a faceplate on the wall near were the PC would be kept. The PC was set up, and a set of coax cables was used to form a connection from the two cards in the computer to the wallplate. The technician then had to align the antenna for the best signal-to-noise ratio (8:1 is the ideal). This process attains a peak signal from the satellite's beacon frequency. The entire process took about three hours. When it was finished, I was able to launch *Internet Explorer*, and browse the Web—fast!

SOURCE INFORMATION

StarBand Communications, Inc.
1760 Old Meadow Rd.
McLean, VA 22102
877-827-4290
www.starband.com
CIRCLE 100 ON FREE INFORMATION CARD

PERFORMANCE REVIEW

At the moment, StarBand does not support AOL, so I have to access AOL through a standard dial-up connection. I can, however, check my AOL e-mail through my StarBand connection via AOL's Web site.

The StarBand service has been fantastic so far. I've noticed a drop in speed during heavy rain and snowstorms, something that all satellite systems suffer from (this is due to the transmitter power being factory set, because an increase in transmitter power can "cut" through inclement weather). Downlink speeds have been excellent and in most cases faster than StarBand claims—with 650-Kbps speeds common, and even burst downloads of more than 1 Mbps. Downlinks can often take place at about 2 MB a minute!

This service, however, doesn't come cheap. In addition to the upfront expense for equipment and installation, the monthly service charges ($59/mo from RadioShack or $69/mo from DISH-Network; each based on a one-year commitment) are considerably more expensive than the $30-$40 per month that DSL and cable usually go for. At the same time, since I can't get either of these less expensive alternatives, the money StarBand charges is not unreasonable. The service finally gives me high-speed Internet access and is definitely worth the price in my location!

PARTING WORDS

As with DSL and Cable modems, StarBand service is always on. This condition presents a security problem, especially because I've set up the Dell as an Internet gateway on my home Ethernet network. I'll detail how we networked our fast Internet access, as well as some of the precautions you need to take with "always-on" service, in the next column (See this month's "Digital Domain" for further discussion of security issues). P

PEAK COMPUTING

TED NEEDLEMAN

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Sweeter Sound

One of the easiest upgrades to perform on your PC is replacing the speaker system. After all, what could be simpler? Just unplug the old speakers, and plug the new ones in.

Actually, performing this upgrade (except in certain circumstances) is easy. Choosing the right set of speakers, however, becomes more involved. As with most purchases, it's a matter of matching needs, wants, and budget. However, with speakers, an additional factor comes into play—personal preference.

This time around, we'll look at a couple of different approaches to upgrading your speakers. Let's examine some of the features and specifications you should consider when shopping around for a new sound system for your PC.

The FPS2000 surround-sound system from Creative Labs features Cambridge SoundWorks-designed satellite cubes (4) and a 25-watt sub-woofer. The FPS2000 is a must-have for any serious gamer.

SPEAKERS: TWO, THREE, FOUR, OR MORE?

Today's speaker systems come in lots of varieties and with a different number of components. Generally, the most popular use either two or three pieces. A two-piece set of speakers has one speaker for the left channel and another speaker for the right channel. A three-piece set adds a third speaker, called a subwoofer, specifically for bass. The subwoofer handles the bass chores of both left and right channels, because the lower frequency bass sounds are non-directional (they are "felt" instead of heard).

DO YOU PREFER THEM FLAT?

Some of the wilder-looking models use flat-panel speakers for the left and right channels, though even these "flat" speaker sets use a standard cone driver for any subwoofer. True flat-panel speakers have been around for decades in the audio world. In fact, I remember having a set of PolyPlanair flat-panel speakers on my stereo in the late 60s.

There are two designs of true flat-panel speakers that are prevalent in today's market. The first design can be found in Sonigistix's Monsoon brand speakers. The design uses an expanded flat foam panel with a voice coil. The second approach, used by companies such as Benwin, incorporates a NTX transducer into the design. This transducer is a special device that attaches to any flat panel—turning the panel into a sound radiator.

After testing both types of flat-panel speakers, I found similar problems with each of the two aforementioned designs. Flat-panel speakers radiate from the front as well as the rear, so sound radiates in two directions from the speaker. When trying to achieve a sharp sense of directionality (i.e. environmental equalization), speakers that have multiple directions of sound output tend to be very difficult to align. I really like being able to aurally "locate" instruments and performers "on-stage" when listening to music. If you generally don't make use of this capability, you obviously won't be annoyed by the limitations of flat-panel speakers. Many games, however, make extensive use of directional audio clues. If directional capability is not a factor to you, then a monaural sound system will more than suffice.

The biggest drawback with most flat-panel speaker systems is the big "hole" in the lower mid-range. Voice falls within this mid-range, and often vocals seem muddy and weak. Subwoofers can make up for this poor bass response in desktop satellites. Most flat-panel radiators are good at reproducing treble, but usually very weak in the mid-range. Monsoon has dealt with this by including a standard cone-type driver in some of its "flat-panel" systems. This breaks up the flat silhouette, but improves the overall response.

AFFORDABLE AUDIO SOLUTIONS

Standard technology speaker systems have improved dramati-

cally over the last several years. I've recently tested several inexpensive sets of speakers that deliver quite creditable sound and cost well under a hundred bucks. Here are two fine examples of comfortably priced sound systems that are available.

Yamaha—Yamaha's new YST-MS201s ($50) are outstanding. They use a set of 9-inch tall, 2-inch wide satellites and a compact subwoofer. With a total weight of less than 9 pounds, these speakers put out a room-filling 30 watts of power and sound great. The thin tower satellites use an oval cone diaphragm that provides excellent mid-range along with the treble. A large power switch/volume control is conveniently located on one of the satellites, and each speaker can pump out about 6 watts. The subwoofer uses a 4.5-inch driver, puts out a maximum of 19 watts, and has a wood case. The denseness of wood is a desirable feature in a subwoofer, as the additional mass of the case lets the subwoofer handle deep notes better than a lightweight case.

MidiLand—For a bit more money, MidiLand's ($70) three-piece S4 3050M puts out a bit more power (about 50 watts). This system also has two satellite speakers and a subwoofer, though MidiLand's approach is a little different from Yamaha's. The satellites each use a single 2.5-inch acoustic suspension driver, mounted in a small case made out of a reinforced resin that provides more heft than most inexpensive plastic cases. This seems to give the S4 3050M's mid-range slightly more mellowness, though treble response is a little bit flat. Each satellite puts out up to 10 watts. The subwoofer is a 6.5-inch drive, mounted in a case made from MDF (*M*edium *D*ensity *F*iberboard), which gives the case a nice heft. The sub-woofer's 30-watt output has excellent bass response and is crisp without being "boomy."

ROUND AND ROUND

If your PC is fairly new or if you've recently upgraded your audio card, you might want to consider moving up the ladder somewhat. Many of the newer audio cards are capable of providing more than just left and right channels of audio. Depending upon the type of card your PC has, it may be able to provide as many as six different channels of output (commonly referred to as a 5.1 configuration). This is common with cards that have Dolby Digital 5.1 decoding capability. These cards provide five discrete channels of audio—left- and right-front channels, left- and right-rear channels, and a front-center channel—as well as a sixth (the ".1") channel for the subwoofer.

All of the new Sound Blaster Live! models produced by Creative Labs have this technology, so it won't come as a surprise that one of the more popular surround-sound sets of speakers also comes from this vendor. The Four-Point-Surround FPS2000 ($150) is marketed under the guise of Cambridge SoundWorks. Cambridge SoundWorks is a company founded by audio legend Henry Kloss. In a successful merger, Creative purchased Cam-bridge SoundWorks several years ago.

The FPS2000 is not a true 5.1 set of speakers, in that it lacks a speaker for the front-center channel. While it's suitable for home-theater use, it's really targeted toward a gamer who wants to become fully immersed in the gaming experience. There are a quartet of compact satellite speakers, each of which can put out up to 7 watts, and a 25-watt subwoofer that packs a wallop inside a standard case. A variety of mounting options are provided for the satellite speakers, which include four small desk brackets and a pair of 4-foot tall speaker poles. A separate volume control puck is provided, and it plugs into a connector on the subwoofer to allow you to adjust the volume remotely. You can also adjust the bass balance from the subwoofer.

Hooking up the FPS2000 is a bit more involved than with some of the less expensive systems. Connections between the subwoofer and satellite speakers are made with heavy pigtailed speaker wire. You can connect the speaker system to the sound card with either two mini-RCA plugs, or you can use the mini-DIN-to-mini-DIN cable provided for SoundBlaster Live! cards.

Overall, the FPS2000s are just a bit light in the mid-range, compared to several of the other systems I've tested. But when you've placed the satellites, and use it with a Sound Blaster Live! card, aural placement is outstanding. With some games you can literally hear someone coming up behind you. That's realistic enough to raise the hairs on the back of your neck, which is pretty much all you can reasonably ask from any game.

CONSIDERING A SOUND INVESTMENT

The bottom line when looking for new speakers is that you should really try to listen to the speakers that you are considering purchasing. This can be pretty difficult,

(Continued on page 64)

SOURCE INFORMATION

(Benwin) Kwong Quest, LLC.
1116 Coiner Court
City of Industry, CA 91748
626-935-8888
www.benwin.com
CIRCLE 110 ON FREE INFORMATION CARD

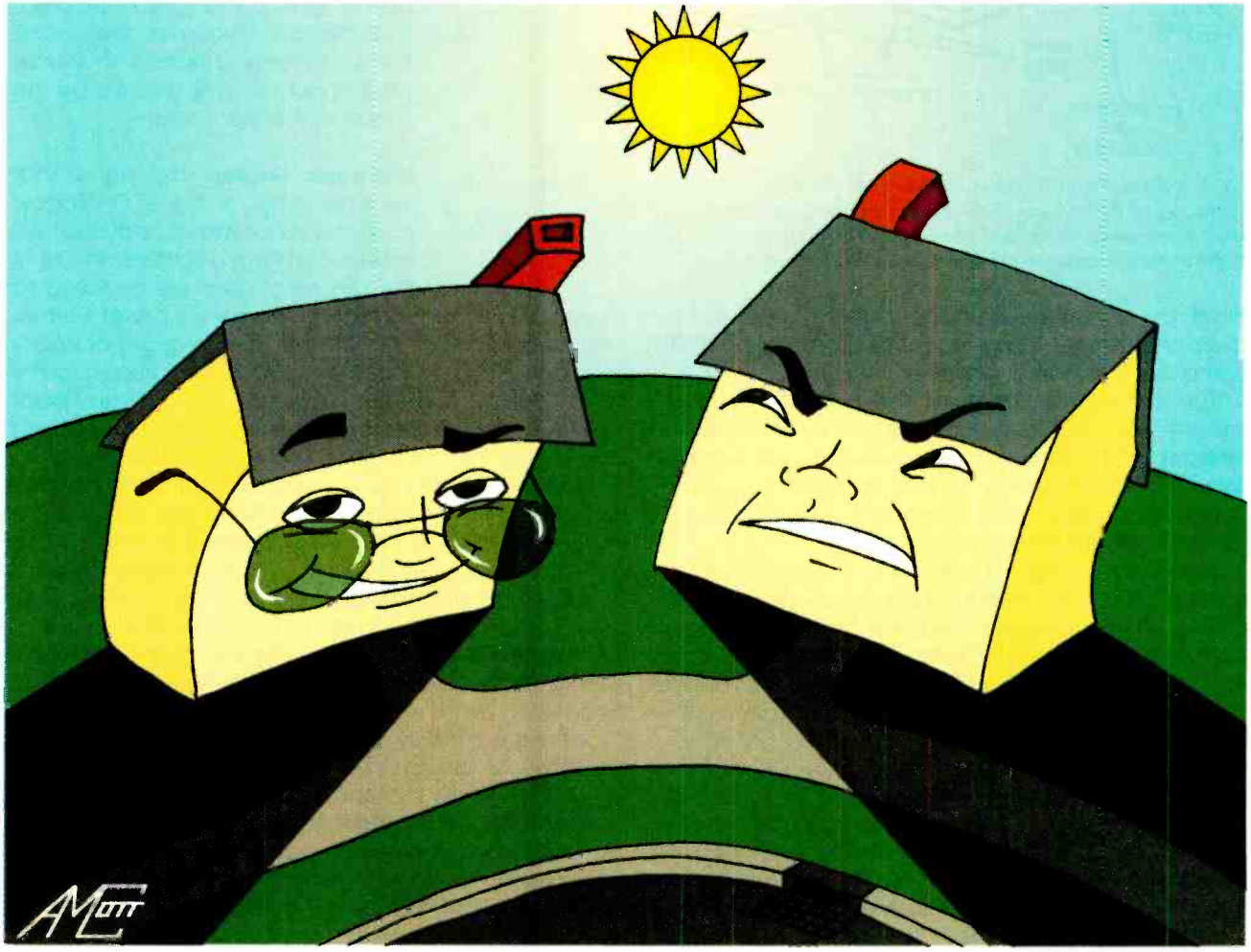
Creative Labs, Inc.
(Cambridge SoundWorks)
1901 McCarthy Blvd.
Milpitas, CA 95035
408-428-6600
www.soundblaster.com
CIRCLE 111 ON FREE INFORMATION CARD

MidiLand Inc.
3410 Pomona Blvd.
Pomona, CA 91768
909-595-1568
www.midiland.com
CIRCLE 112 ON FREE INFORMATION CARD

Sonigistix Corp. (Monsoon)
11782 Hammersmith Way, Suite 201
Richmond, BC
Canada V7A 5E3
604-271-2237
www.sonigistix.com
CIRCLE 113 ON FREE INFORMATION CARD

Yamaha Corporation of America
Consumer Products Division
6600 Orangethorpe Ave.
Buena Vista, CA 90620
714-522-9011
www.yamaha.com
CIRCLE 114 ON FREE INFORMATION CARD

LCD Windows



CONRAD HOFFMAN

Learn about liquid-crystal displays by converting a surplus LCD panel into a variable-density, remote-controlled window.

A liquid-crystal display (LCD) is an electronically switched display panel that depends on changes in the reflective properties of liquid crystals when exposed to an electric field. LCDs are found all around us, from cell phones to car radios to information kiosks at the local mall. However, when we hear the phrase "LCD," our first image is of a laptop computer.

Indeed, the portable-computing market was a driving force behind the development of LCDs. How many of us remember the "transportable" or "luggable" computers from the early 1980s? Back then, any computer could be designated "portable" if a handle was attached. Some examples of that mentality tipped the scales at upwards of 50 lbs!

That's hardly my definition of portable.

Liquid-crystal displays were one of the first major breakthroughs in freeing portable computers from the confines of the wall outlet. Until then, displays were usually miniature cathode-ray picture tubes (CRTs) or the more exotic vacuum-fluorescent displays. Both systems required high voltages, complicating the power-supply design and increasing the computer's current consumption.

The advent of liquid-crystal displays dropped the voltage requirements to only a few volts—easily sup-

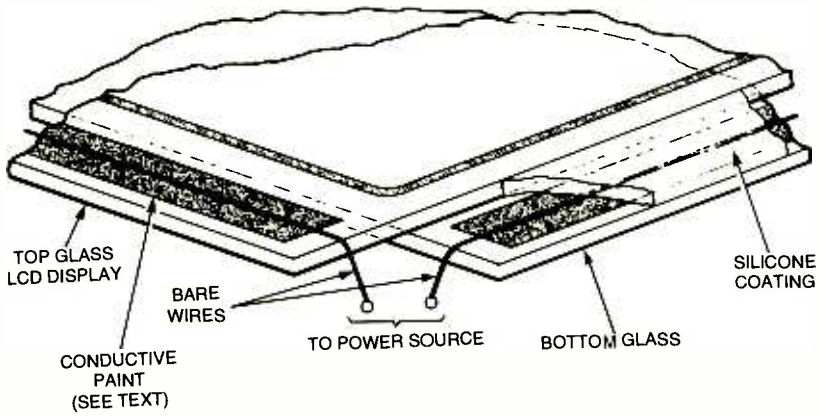


Fig. 1. A dot-matrix LCD display uses rows and columns of electrodes to form the display pixels. Connecting all the rows and all the columns together allows the display to be treated as having one large column and one large row. Shorting the individual electrodes together makes all of the electrodes respond in unison to changes in the DC voltage across them.

plied by batteries—and the current draw to the microamp range. The prospect of a battery-operated computer was now a reality!

The ensuing explosion of the portable-computer industry had (and to this day, still has) a fortuitous side-effect for the hobbyist and experimenter: vast quantities of older LCD panels appearing on the surplus market as older laptop designs are superseded by the latest and greatest offerings.

Rather than letting those displays end their days in a landfill that will someday come back to haunt our grandchildren, let's see what we can do to recycle and reuse some of that ancient technology. To that end, we present the *LCD Window* project—a variable-density, remote-controlled window made from now-obsolete and surplus laptop LCD panels.

A Closer Look At LCD Technology. Liquid crystals are chemical mixtures that behave like crystals in an electric field. An LCD panel is an assembly of glass plates with transparent, conductive electrodes that enclose a thin film of liquid crystals. Those electrodes can be in whatever form is needed for the type of display. Examples include bars arranged in the traditional form of seven-segment display digits (useful for a clock or watch) or special word phrases or pictures (sometimes used in car stereos). The version that we're going to concentrate on has a matrix of closely spaced dot electrodes that are suitable for reproducing text or graphics on a laptop computer.

The liquid-crystal material has the unusual property of polarizing light. Normally, light waves vibrate in random directions. If you shine a flashlight across a room, some of the light waves are oriented vertically (up and down) as they cross the room. Other waves are horizontal, weaving side-to-side in their travels. Of course, light is not restricted to those two planes; the waves travel along an infinite number of planes as they streak across the room.

When light passes through a polarizing filter, only the waves traveling in a particular plane are allowed to pass through; the rest of the light is blocked. A liquid-crystal display has such a polarizing filter in it. The liquid-crystal molecules, when a voltage is applied selectively across the electrodes, are rearranged to form a straight or twisted path that polarizes the light passing through. A polarized filter at the rear of the display either blocks or passes the light, depending on the polar orientation of the light. If the light is blocked, that region becomes dark and forms whatever character (a square pixel in our case) is defined by the shape of the electrode.

Electronic Shades. The panel that we'll be using for the LCD Window project is a dot-matrix array that will be wired to form a light shutter. All of the dot electrodes will be wired to respond in unison so that the complete panel is either nearly transparent (to let light pass through) or nearly opaque (to block incident light). The usual circuitry and "drivers" (from the hardware, not software, point of view) that creates the text and graphic patterns are not used.

Typically, the drive transistors used in LCD displays are intended for binary operation; they turn the display elements fully on or fully off. Since we don't need any fancy pictures or words, we can simplify the connections by wiring all of the elements together. Dot-matrix displays have rows and columns of electrodes. Where the electrodes cross, they form the individual display dots (also known as *pixels*—short for *pic*ture *el*ements). What we *do* need, however, is the ability to control the intensity of "on" and "off" for the display.

Those of us who are somewhat familiar with how LCDs work know that they need some form of AC signal (usually on the order of a few hundred Hz) for proper operation. However, it is *DC* that can control the amount of "twist" in the crystals and, therefore, the amount of light that passes through. To say it another way, the light transmission through the panel is a linear function of the applied DC voltage.

Acquiring The LCD. As much fun as it is to learn about LCD technology, getting your hands on an actual panel and performing experiments represents the "fun" side of education. Once you gain some hands-on experience in working with LCD panels, you'll start seeing that there are many possible practical applications for a light shutter. One such example might have to do with controlling plant exposure to light in a growth experiment. How the LCD Window is used is limited only by your imagination.

Obtain a suitable LCD panel that measures at least 6 × 9 inches. At the time that I made my original experiments and tests, surplus Epson LCD panels were readily available, low in cost, and reliable. Although the editors frown on projects that rely on components from the surplus market, LCD panels are available by the millions. New, unused, and RFE (*r*emoved *f*rom *e*quipment) devices can be found at a wide variety of

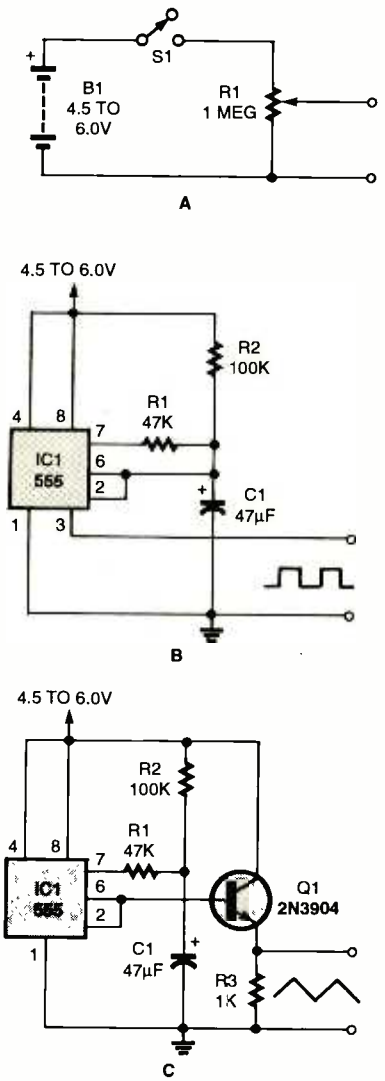


Fig. 2. A basic control for the LCD Window (A) varies the battery voltage with a simple potentiometer. If you'd like automatic control, a simple 555 timer wired as an oscillator (B) switches the LCD Window from transparent to opaque with a "snap"-like response. For a gentler transition, a triangle wave is buffered and amplified (C).

PARTS LIST FOR THE SIMPLE PANEL CONTROL (FIG. 2A)

B1—Battery, 4.5- to 6-volts
R1—1-megohm potentiometer
S1—Single-pole, single-throw switch

PARTS LIST FOR THE "SNAP-ACTION" AUTOMATIC CONTROL (FIG. 2B)

C1—47-µF, 16-WVDC, electrolytic capacitor
IC1—LM555 timer, integrated circuit
R1—47,000-ohm, ¼-watt, 5% resistor
R2—100,000-ohm, ¼-watt, 5% resistor

PARTS LIST FOR THE "GENTLE-ACTION" AUTOMATIC CONTROLLER (FIG. 2C)

C1—47-µF, 16-WVDC, electrolytic capacitor
IC1—LM555 timer, integrated circuit
Q1—2N3904 NPN silicon transistor
R1—47,000-ohm, ¼-watt, 5% resistor
R2—100,000-ohm, ¼-watt, 5% resistor
R3—1000-ohm, ¼-watt, 5% resistor

prices and quantities. I've included a sidebar that, while not exhaustive, will give you a good start in finding suitable LCD panels.

Furthermore, I'm going to assume that you have LCD panels from Epson America, Inc. and that you're intelligent enough to figure out any differences between your panel and mine. LCD panels made by other manufacturers will work, but differences in their construction might require that the reader perform tests to determine if their response differs from that of the panel described here and modify the instructions accordingly.

A note of caution before we begin: Handle the LCD panel carefully because it is made of glass and is easily broken or chipped. You should also wear safety glasses while working on this project to prevent possible eye injury should the glass break.

Panel Disassembly. If you got a panel as a surplus laptop display, the first procedure is to disassemble the frame and remove the LCD panel. With needle-nose pliers (again, I'm assuming an Epson assembly), bend the 20 locking tabs positioned around the metal frame of the LCD panel so they are parallel with the edges. Turn the module over and lift the metal part of the frame away from the plastic part, exposing the LCD panel and its circuitry. A glass polarizing sheet is located on top of the panel. Mark its orientation with respect to the original assembly with a china-marking pencil, lift off the sheet, and set it aside. The marks will be helpful in reassembling the panel correctly.

Remove the LCD panel from the plastic part of the frame and place it on a clean, softly padded work surface. Observe how the flexible circuits are bonded to the three edges of the panel. Cut the flexible circuits parallel to the edges of the display with a small pair of sharp scissors and discard the narrow circuit boards. Be sure to handle the LCD display carefully while cutting the flexible circuit to avoid cutting yourself on the sharp edges. Peel the remaining flexible circuit from the panel with needle-nose pliers or sharp-pointed tweezers.

It is likely that some of the adhesive used in assembling the LCD panel will remain on the glass. Remove this adhesive by first applying acetone or other suitable solvent/remover to the residual adhesive with a cotton swab. Then remove the softened adhesive with a clean, soft cotton cloth. Do this adhesive removal in a well-ventilated room and avoid touching the solvent or breathing its vapors. Such chemicals are downright nasty and can have far-reaching health effects through the years.

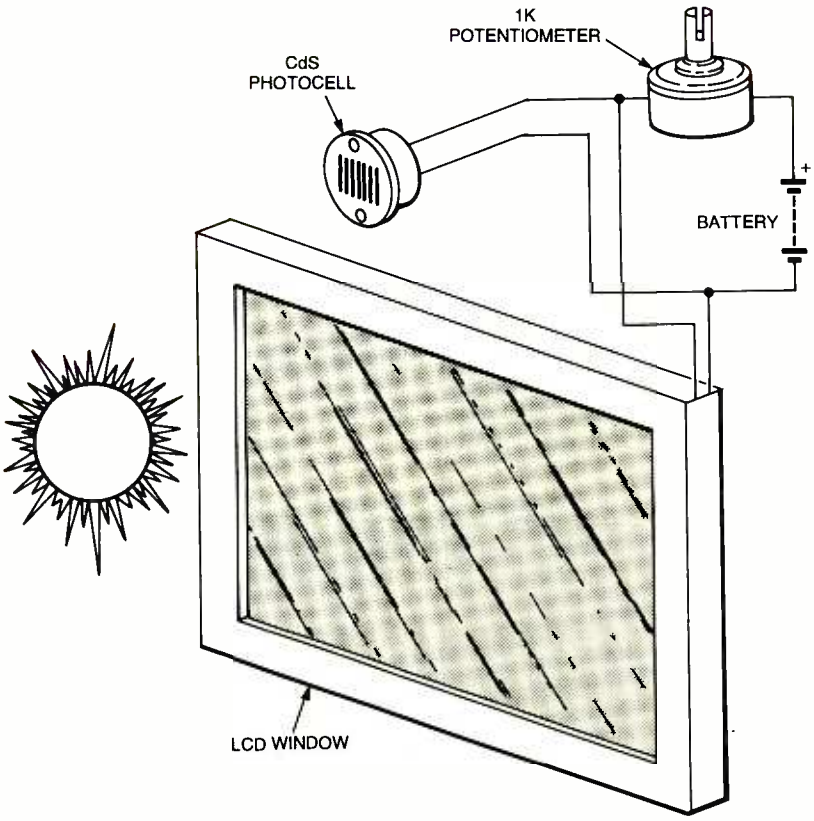


Fig. 3. This circuit will automatically control the LCD Window's opacity. A cadmium-sulfide photocell is the sensing element that places an additional load on the battery, dropping the voltage at the panel.

Electrical Connections. The applied DC voltage reaches the dot-matrix electrodes of the LCD panel through semi-transparent conductive traces, typically made from deposited tin oxide. These can be seen with a magnifying glass in good light. In this project, all traces will be short-circuited together by a conductive paint.

Commercial conductive paints and coatings, such as silver-bearing lacquers, are available from specialized suppliers, but they are expensive and difficult to obtain in the small quantities that you will need for the LCD Window project. Moreover, high-conductivity paint is overkill in this project because the LCD panel is a high-input-impedance device. What I did was to create my own form of conductive paint from pencil-lead shavings mixed into a binder chemical. While the resulting product is not to the low-ohmic standards of the fancy stuff, it's cheap to make in any quantity that you need. Even if you don't build the LCD Window, this little formula might come in handy some day in some "McGyver"-esque way.

The basic plan is to mix a fast-drying lacquer or model-airplane dope with carbon powder prepared by crushing or scraping "HB" pencil lead. Any brand of clear nail polish is a suitable substitute. It is easier to find and, while still an unhealthy chemical to inhale, is easier to work with than lacquer and easier on the body than dope fumes (why do you think they call it "dope?")

Obtain some standard five-inch lengths of HB pencil leads for mechanical drafting pencils at an art- or office-supply store. This type of lead is soft (similar to the lead in No. 2 pencils) and has the appropriate conductivity for this project. With an ohmmeter, verify that a five-inch length of the pencil lead that you use has a resistance of less than 10 ohms.

Place the lead on a piece of clean paper and scrape its surface with a razor blade or hobby knife to produce a fine carbon powder. Prepare about a quarter teaspoonful. Add the binder (nail polish, lacquer, dope, etc.) to the powder in a clean glass bottle that can be capped to make a viscous paint. Mix the filings with a clean glass rod until an even consistency is obtained. When applied as a thin coating and allowed to dry, this mixture will have a fairly high resistance, but it will be adequate for short-circuiting the conductors on the LCD panel.

Some experimentation might be required before you arrive at a satisfactory mixture. Make up a small test batch and record the quantities in the mixture for later reference. Brush a 5-inch strip of the paint on a piece of paper and let it dry. Note that this mixture might not develop full conductivity until it has dried for eight to ten hours.

Measure the resistance of the dried sample. It should have a resistance of less than 100,000 ohms per inch. If you can't get a low enough resistance reading, make a new batch by grinding the pencil lead to a finer powder and add a higher percentage to the binder. In general, the finer the powder, the lower the resistance value.

After you are satisfied that your conductive mixture will give the proper results, apply a stripe of the mix in a thin layer across the short edge of the LCD panel where the flex circuit was originally bonded. This will be one of the voltage-input strips. Repeat this procedure for the long edges of the panel. Allow the conductive paint around edges to dry completely.

Cut the insulation from about a three-foot length of lamp cord and strip out some of the 18- to 14-gauge bare copper conductors. Place a thin wire close to the conductive paint and temporarily tape the ends to clamp the wire flat against the paint. Apply a bead of silicone RTV sealant over the wire and conductive paint on the LCD panel edge to bond the wire to the paint. Be sure that sufficient lengths of bare wire protrude from the ends; you'll need to make connections later to power the panel.

When the silicone sealant has set completely, replace the polarizer on the panel the same way it

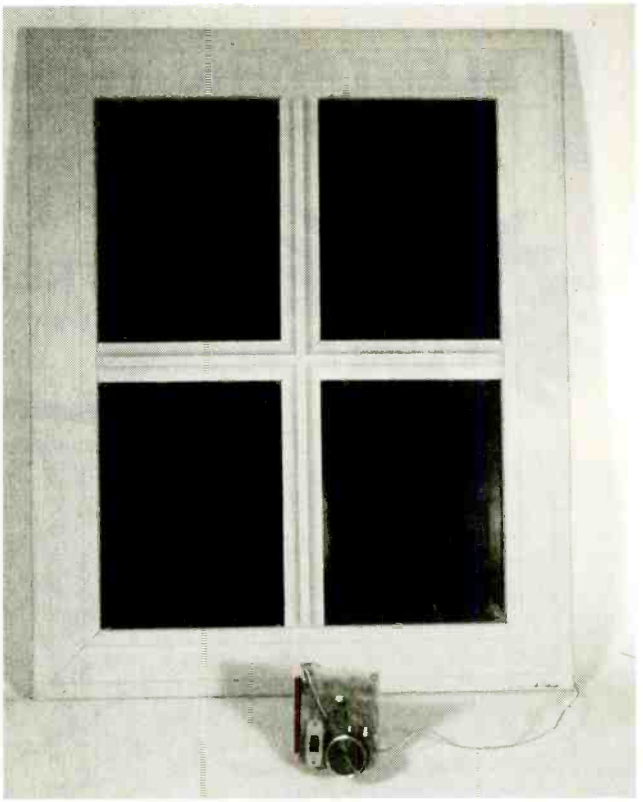
was when removed. Test the panel by applying 5 volts DC across the connections. There might be gradations in shading between the inner and outer surfaces of the panel, but it should be nearly uniform over most of the panel. If the LCD panel switches cleanly from opaque to transparent, reinforce the connection wires by coating them with liquid epoxy to prevent the wires from separating from the dry conductive paint.

If the panel does not switch, examine its edges for breaks in the conductive paint, short circuits, or poor connections. Make any corrections needed so the panel will switch as required.

When you are satisfied that all the connections have been made satisfactorily, wrap the edges of the panel with vinyl electrical tape to protect them. You can either reinstall the panel in its original large frame or build a small wooden frame for it.

Controlling The Shades. You should now be able to control the light transmission through the panel by connecting a variable DC voltage from 0 to 5 volts to the connection wires. Maximum transparency will occur when the voltage is about 3.6 volts DC. The polarity of the applied DC is not critical for this project, and current drain is very low. Figure 2 shows three different power-supply circuits for the remote-controlled window. Figure 2A is a simple adjustable DC supply with a 1-megohm panel-mounted control potentiometer that will vary the voltage and, as a result, the opacity of the window. Figure 2B is a circuit that will change the window from opaque to transparent at a preset cyclic rate, snapping the panel on and off due to the squarewave nature of the output. If you'd like to have that automatic control in a somewhat less-abrupt style, Fig. 2C is a circuit (modified from Fig. 2B) that will fill that need. The squarewave output of the 555 is ignored. Instead, the triangle wave that appears on the timing capacitor (C1) is buffered and amplified by Q1. The gentle slopes of the output gradually shift the window from transparent to opaque and back to transparent at the same rate as the circuit in Fig. 2B.

In Figs. 2B and 2C, if R1 has a value of 47,000 ohms, R2 has a value of 100,000 ohms, and C1 has a value of 47 µF, the on/off cycle time is from 2 to 3 seconds. However, this can be increased by increasing the value of C1.



Mounting several LCD panels in a window frame makes for an electrically dimmable window—a very "futuristic" application!

Window Experiments. You can simulate the response of light-sensitive lenses with the LCD Window. By connecting a cadmium-sulfide (CdS) photoconductive cell in the circuit as shown in Fig. 3, the opacity of the window will be controlled by the photocell. The photocell will provide negative feedback, continuously adjusting the panel to maintain constant light transmission. Set the potentiometer so that the window is nearly opaque in bright light.

If you move your hand over the front of the panel, interrupting the light source and shading the photocell, the panel should instantly respond by allowing more light to pass. You can also position two or four panels in a sash and mount it over a window where it will act as an automatic solid-state Venetian blind.

SOURCES OF LCD PANELS

While it is impossible to predict the supply of a particular item on the surplus market, here are a few dealers that carry LCD displays on a regular (or semi-regular) basis:

All Electronics Corp.
P.O. Box 567
Van Nuys, CA 91408-0567
818-904-0524
www.allelectronics.com

B.G. Micro
555 N. 5th St., Suite 125
Garland, TX 75040
972-205-9447
www.bgmicro.com

ECSC
(Electronics and Computers Surplus City)
P.O. Box 3148
Redondo Beach, CA 90277
310-217-8021
www.eio.com

General Science & Engineering
PO Box 447
Rochester, NY 14603
716-338-7001
www.gse-science-eng.com

Marlin P. Jones, Inc.
P.O. Box 12685
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BP187	A Prac Ref Guide to Word Pro Amstrad PCW8256/PCW8512	$7.99	
BP190	More Advanced Electronic Security Projects	$3.99	
BP194	Modern OPTO Device Projects	$3.99	
BP232	A Concise Introduction to MS-DOS	$3.99	
BP245	Digital Audio Projects	$3.99	
BP256	An Intro to Loudspeakers and Enclosure Design	$3.99	
BP264	A Concise Advanced User's Guide to MS-DOS	$3.99	
BP272	Interfacing PCS and Compatibles	$5.99	
BP290	An Intro to Amateur Communications Satellites	$5.99	
BP297	Loudspeakers for Musicians	$6.99	
BP299	Practical Electronic Filters	$6.99	
BP302	A Concise User's Guide to Lotus 1-2-3 Release 3.1	$5.99	
BP304	Projects for Radio Amateurs and S.W.L.S	$5.99	
BP317	Practical Electronic Timing	$6.99	
BP320	Electronic Projects for Your PC	$5.99	
BP322	Circuit Source Book 2	$6.99	
BP329	Electronic Music Learning Projects	$6.99	
BP332	A Beginners Guide to TTL Digital ICS	$6.99	
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BP378	45 Simple Electronic Terminal Block Projects	$6.99	
BP379	30 Simple IC Terminal Block Projects	$6.99	
BP384	Practical Electronic Model Railways Projects	$6.99	
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BP394	An Introduction to PIC Microcontrollrs	$7.99	
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PCP107	Digital Logic Gates and Flip-Flops	$10.99	
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Stem the Rising Tide with This ELECTRONIC PUMP CONTROLLER

JAMES J. BARBARELLO

Worried that your house will drown if you're not there to flip the pump switch or oversee its operation? Ease your fears—our Pump Controller will watch for when the floodwater gets too high!

Water is essential for life. Unfortunately, too much water can range from just a bother to life threatening; it's all a matter of quantity. With all the hurricanes and other natural disasters of late, there's been an increase in flooded houses and basements. Many homeowners have had to put sump pumps into service to keep their property dry. For those of you not yet enlightened, a *sump pump* is a water pump driven by an electric motor. It is placed in a pre-formed hole in the basement floor (called the *sump hole*). Ground water, collected in pipes under the floor, is directed to and collects in the sump hole. When the collected water rises to a pre-determined level, the pump is triggered. The water is pumped out of the basement, and the lowered water level in the sump hole turns off the pump. Like a spider in its web, the system then lies in wait for more ground water to collect. When everything works right, a sump pump ensures a dry basement.

The control mechanism on many moderately priced sump pumps is a microswitch that is activated by a lever arm, which is, in turn, activated by a rod-and-float mechanism. As the water rises, it raises the float and the attached rod. That movement forces the lever arm up until it trips the switch, turning the pump on. As the water is pumped out, the float lowers and eventually pushes the lever arm down, disengaging the switch (and turning the pump off).

Over the years, I've experienced continual problems with this type of control mechanism. The float's seams periodically open up, causing it to take on water. The waterlogged float will not trigger the pump, and a flooded basement resulted. Other times, the float gets lodged against the side of the sump hole, with the same result. Still other times, the float triggers the pump, but does not come down again. This keeps the pump running until it eventually burns out.

If we can eliminate this mechanical control mechanism—the "weak link" in the chain—and replace it with a fully electronic one, we'll have a much more reliable device with no moving parts. The result of that research is the *Electronic Pump Controller* presented here. This unit can also be used for situations other than a sump pump, such as where a pre-determined level of electrically conductive liquid is required—a laboratory or manufacturing area, for example. Best of all, it uses just a few commonly available integrated circuits and associated components.

How It Works. It should be an easy matter to sense water level due to water's electrical properties—namely, conductivity. Just place some probes in the sump hole and connect them to a simple control cir-

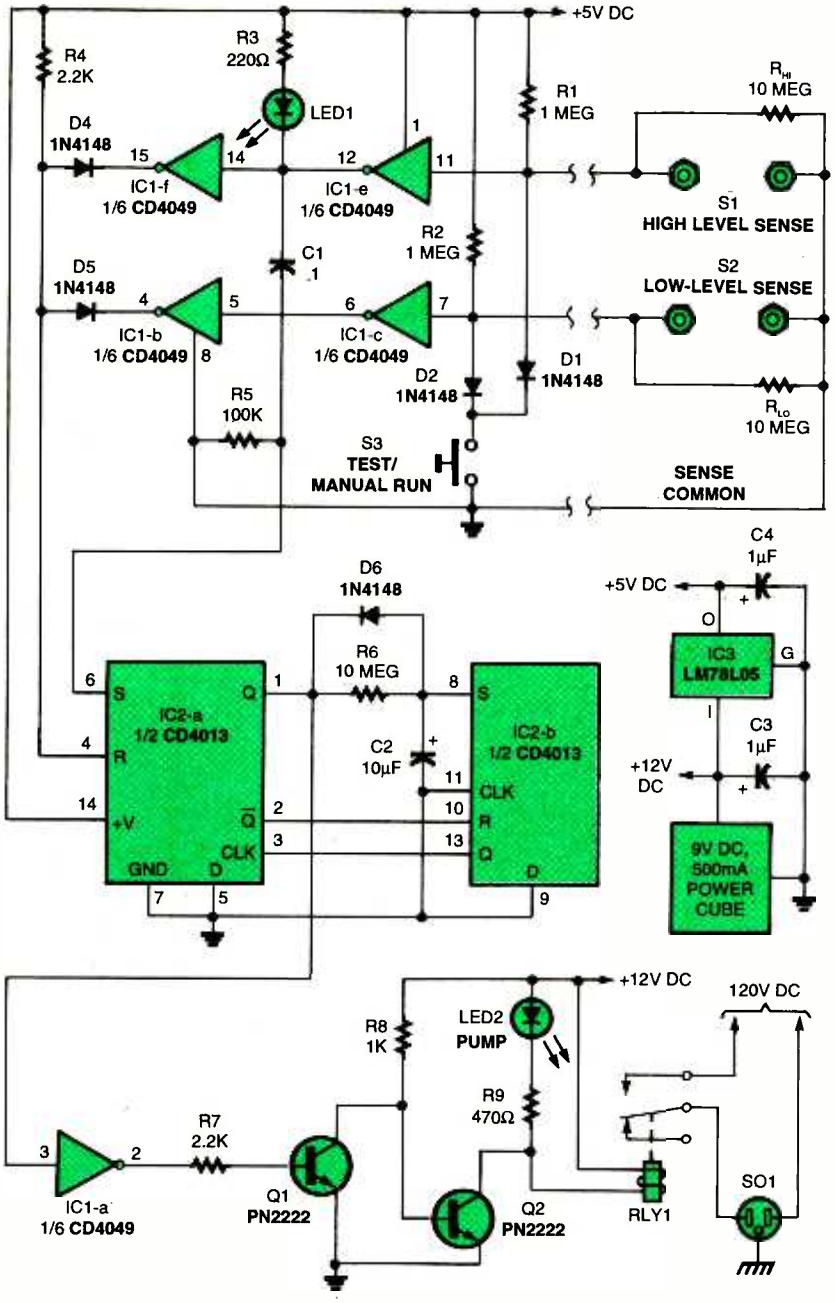


Fig. 1. The Electronic Pump Controller has proven itself more reliable than the traditional mechanical float system that comes with most sump pumps. By sensing the water level electrically (measuring resistance), the pump is turned on when the high level is reached and off when the water drops to the low level.

cuit. An easy matter? Well, yes and no. We have to realize that the water in the sump hole is not a perfect conductor. In fact, its resistance can vary widely—from a few hundred to tens of thousands of ohms—depending on salinity, iron level, and other contaminants. Our circuit will have to respond to a wide range of water conductivity.

Referring to the schematic of Fig. 1, we see that the circuit's sensor is composed of a high-level-sense (S1) switch and a low-level-sense (S2) switch. Each switch feeds a single CMOS inverter. Resistors R1 and R_{HI}, and R2 and R_{LO}, respectively, form voltage dividers that keep the CMOS inverters' inputs at a logic high (and their outputs at a logic low) level. Placing a short circuit across either of the switches changes its inverter's output from logic low to logic high. Alternatively, we can cause a state change by bridging the switch contacts with a material that has a conductivity of about 400,000 ohms or less. So, we can replace the switches with simple contacts and have the liquid perform the switching action...as long as its conductivity is less than 400,000 ohms.

Diodes D4, D5, and R4 comprise a discrete-component AND gate. The outputs of IC1-f and IC1-b must both be high for IC2-a, a D-type flip-flop, to be reset; the junction of D4, D5, and R4 feed the reset pin (pin 4) of IC2. Therefore, if both S1 and S2 are "open" (not detecting any liquid), IC2-a is reset. When the liquid rises to close S2, the output of IC1-b goes low, causing pin 4 of IC2 to go low as well. With its reset line cleared, IC2-a is capable of being triggered through its "set" pin (pin 6). When the water rises to where S1 is activated, C1 and R5 convert the change in logic level to a short pulse. That pulse is fed to pin 6, causing the non-inverting output of IC2-a (pin 1) to go high. This does two things. First, it begins charging C2 through R6. Second, it causes the input to transistor Q1 (from IC1-a) to go low. This turns off Q1, which was previously on. With Q1 off, the base of Q2 is no longer grounded, and it begins to conduct, energizing RLY1 and turning on the pump.

If for some reason, the water level does not go down and S1 remains activated, C2 will continue charging until it triggers the "set" pin of IC2-b. This causes its non-inverting output to go high, sending a positive level to the clock pin of IC2-a. That action clocks in the current level on the "set" pin, which is logic low because the previous pulse from C1 and R5 has subsided. That has the effect of resetting IC2-a and causing its non-inverting output to go low. The low output allows C2 to discharge rapidly through D6 and also turns off RLY1. This portion of the circuit protects the pump motor; if there is a failure of the sensors, the pump will shut down after about a minute, given the values of R6 and C2.

If everything is working properly, the water level will begin to drop as the water is pumped out. The water will first drop below S1, causing the output of IC1-f to go high. Since the water is still above S2, IC1-b's output is still low. That keeps IC2-a's reset pin low. When the

water level drops below S2, IC1-b's output also goes high, sending a high logic level to IC2-a's reset pin. This resets IC2-a and turns off RLY1, completing the cycle.

Closing S3, a "Test/Manual Run" switch, grounds the inputs to IC1-e and IC1-c simultaneously through D1 and D2. This allows you to test the circuit without having to trigger the sensors. It also provides a convenient method to manually run the pump, which will run as long as S3 is depressed, and turn off immediately when S3 is released.

Power for the circuit (except for Q1, Q2, and associated components) is provided by IC3, a low-power 5-volt DC regulator. Power to Q1, Q2, and RLY1 is provided directly from a 9-volt DC wall transformer. In practice, a 9-volt DC, 500-mA wall-mounted power supply usually provides sufficiently high unregulated DC voltage to pull in the 12-volt relay. If your relay will not pull in with this arrangement, simply substitute a 12-volt transformer with a 12-volt DC regulator in front of IC3. This will ensure that the DC voltage to Q1, Q2, and RLY1 is no higher than 13 volts. Otherwise, the 12-volt relay could be damaged.

Construction. Like the study of the lives of artists and classical composers, we'll divide the Electronic Pump Controller project into three phases:

- Building the circuit
- Preparing the case and front cover
- Completing the unit and building the sensors.

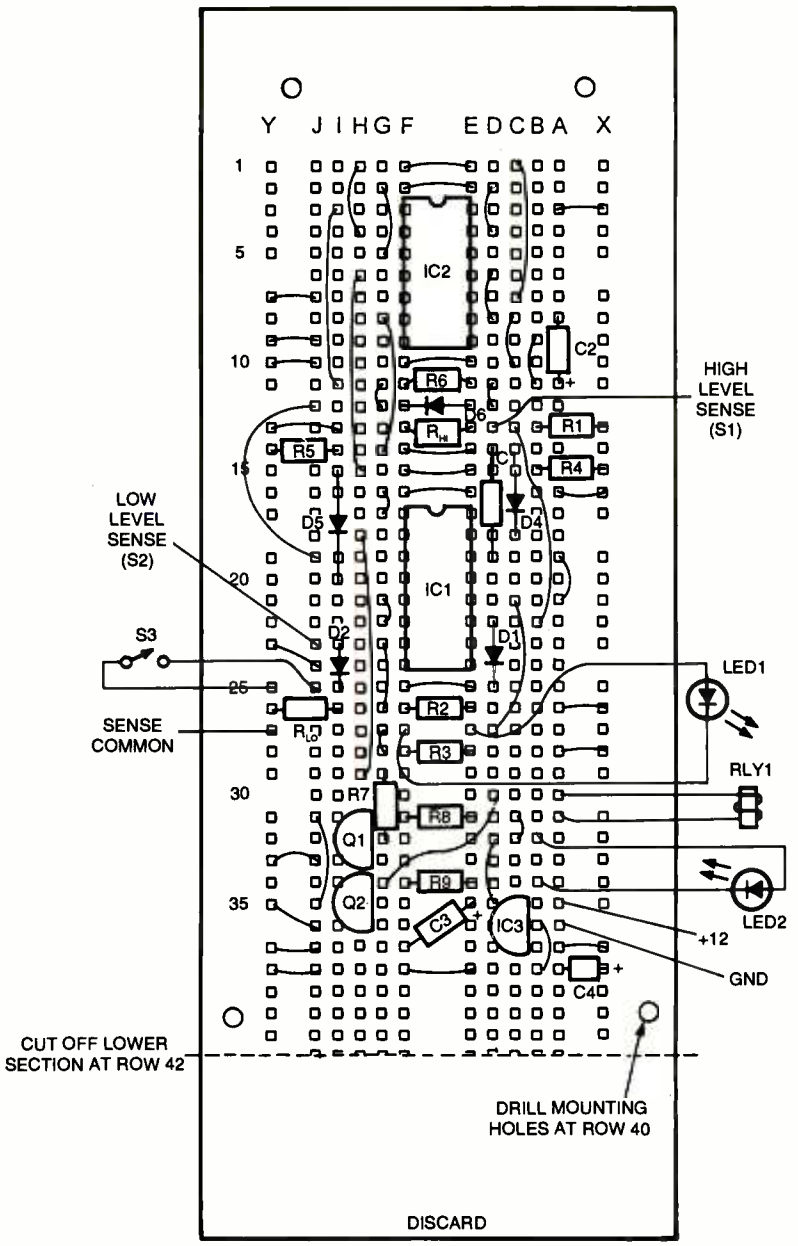


Fig. 2. The circuit is simple enough to lay out on an "experimenter's board" that mimics—in copper and fiberglass—a solderless breadboard.

Phase 1—building the circuit—is straightforward using a perfboard or experimenter's board and standard construction techniques. I happen to use an "Experimenter's PC Board" available from RadioShack. That board (stock no. 276-170) is a copper-clad duplicate of their solderless breadboard. Its main purpose is to help make your successful circuit experiments permanent by transferring the components and jumper wires from the solderless breadboard to the Experimenter's Board and soldering the connections. We're going to do the same thing, only from scratch. Of course, you can build the circuit on a breadboard to verify that the system works and that no errors crept into my original drawings or occurred during editing and publishing.

Before we begin installing any components or soldering, we need to modify the board. Following the guidelines shown in Fig. 2, trim the board at row 42—note how all rows and columns are marked with numbers and letters, respectively. Those reference designations will come in handy as you build the board. Drill two new mounting holes as indicated in the approximate locations shown as well.

Start construction with the jumper wires. I've provided two location methods: the parts-placement diagram shown in Fig. 2 and a "from-to" list given in Table 1. Note how each wire is listed with a pair of letter/number coordinates that correspond to the references on the board—I told you those designations would come in handy! Since there are 48 jumpers to install—six of them *require* insulated wire—use both resources to double-check your work as you go. Nothing is more frustrating than trying to troubleshoot a project that has a single misfiring.

Note that I mentioned the half-dozen insulated wires. That means that you can use bare copper bus

TABLE 1

FROM	TO	REMARKS
H1	H4	
F1	E1	
G2	G5	
F2	E2	
D2	D4	
C1	C7	
A3	X3	
I3	I11	
H6	H15	
D6	D8	
Y7	J7	
G11	G12	
G8	G14	Insulated
C8	C10	
Y9	J9	
B9	B11	
Y10	J10	
F10	E10	
D11	D12	
J12	J19	
F14	E14	
F15	E15	
G16	G17	
F16	E16	
A16	X16	
H18	H29	
A19	A21	
G21	G22	
C21	D27	Insulated
Y23	J24	
G23	G26	
F25	E25	
A26	X26	
G27	G28	
A28	X28	
D30	G34	Insulated
Y33	J33	
J31	J35	Insulated
C31	C32	
D32	D35	
Y35	J36	
B36	B38	
Y37	J37	
A37	X37	
Y38	J38	
F38	E38	
C13	B22	Insulated
Y13	I13	Insulated

TABLE 2

	FROM	TO	VALUE
R1	B13	X13	1 MEG
R_{HI}	F13	E13	10 MEG
R2	F26	E26	1 MEG
R_{LO}	Y26	I26	10 MEG
R3	F28	E28	220 ohm
R4	B15	X15	2.2K
R5	Y14	I14	2.2K
R6	F11	E11	10 MEG
R7	G29	G32	2.2K
R8	F31	E31	1K
R9	F34	E34	470 ohm

TABLE 3

	ANODE	CATHODE	VALUE
D1	D22	D25	1N4148
D2	I23	I25	1N4148
D4	C15	C18	1N4148
D5	I15	I20	1N4148
D6	E12	F12	1N4148

TABLE 4

	POSITIVE	NEGATIVE	VALUE
C1	D14*	D19*	0.01-µF
C2	A11	A8	10-µF
C3	E35	F37	1-µF
C4	X38	A38	1-µF

*Non-Polarized

TABLE 5

	FROM	TO	NOTES	VALUE
IC1	F17	E17	F17=Pin1	CD4049
IC2	F3	E3	F3=Pin1	CD4013
IC3	C35	C37	Flat ->X	78L05
Q1	H31	H33	Flat ->X	PN2222
Q2	H34	H36	Flat ->X	PN2222

wires for the rest of the connections. In fact, I'm assuming that you *are* using bare wire for most of the jumpers. Of course, you can use insulated wire throughout the project as well; the choice is yours. In either case, use 22- or 24-gauge solid wire.

Once you have the jumpers installed, start with the components. It is easiest to start with the smallest components and work your way up to the big ones. I've included additional tables for the various classes of components: Table 2 for resistors, Table 3 for diodes, Table 4 for capacitors, and Table 5 for the high-end semiconductors. It's best to follow the tables in ascending numerical order. Not only are the parts roughly in size order, the static-sensitive ICs are saved to be installed last; you don't want to expose CMOS devices to unnecessary handling before the project is completed.

Phase 2: Enclosure. The case for the Electronic Pump Controller holds the PC board just built, the AC relay, the two indicator LEDs (LED1 and LED2), and a modified AC duplex wall outlet. I used a standard 7 × 5¼ × 2¼-inch plastic case. However, any case that can house all the components is fine...just make sure that the case is non-conducting to avoid any AC-voltage hazards.

Make the front cover from a 6½- × 5-inch piece of ⅛-inch-thick hardboard or other suitable non-conductive material. In total, nine holes are needed in the case:

- LED1
- LED2
- S3
- 12-volt power supply
- AC wall outlet (2 holes)
- AC wall outlet mounting screw
- AC power cord
- Sensor cable (3 wires)

Although you can arrange the panel any way you choose, you might want to place S3 and LED2 next to each other. The pattern for the AC wall outlet is best

copied from any standard wall-outlet plate. Don't forget the small hole that normally holds the outlet plate to the wall outlet. We'll use that to mount the outlet to the front panel. If you want, you can mark and drill the traditional mounting holes for the wall outlet, but that would be overkill here; we're not going to be constantly plugging and unplugging wires. A single 6-32 screw will suffice.

The power transformer supplying 12-volts DC will plug into one of the wall-outlet receptacles. However, the low-voltage power is still on the outside of the case. You can run the wire through the case and direct-connect it to the PC board. A better method would be either to use a connector of your choice or one that matches whatever connector is on the power-supply transformer.

The remaining two holes should be just large enough to allow an AC power cord and a three-conductor sensor cable to pass through.

Mount the LEDs on the front cover. You can use mounting hardware, a dab of epoxy, or simply press-fit the LEDs in place. Mount a normally open, momentary-contact pushbutton switch as S3. If you are using a connector for the power transformer, mount that as well.

We need to modify the outlet so the pump power can be switched on and off. Figure 3 shows how to break off the tab on the "hot" side of the outlet so the receptacles are connected individually. Use the aforementioned 6-32 screw to mount the outlet to the front panel. Label the top outlet "PUMP" and the bottom outlet "POWER CUBE".

The power cord is a 15-amp-capacity cable of suitable length with a standard prong-style plug on one end. Run the free (non-plug) end through its hole so that the free end is within easy reach of the cover, depending on where you decided to drill the pass-through hole (mine is on the cover). Finally, obtain a suitable length (6 to 10 feet) of three-conductor cable and pass it through the hole for the sensor cable. Secure the power and sensor cables in place by attaching a cable tie to each cable on either side of their respective holes.

Prepare the case to hold the board and RLY1 by any method of your choice: screws, nuts, and spacers are recommended. Remember, we're going to have high-voltage house current running around inside the unit; over-engineering always makes for a safer product.

Phase 3—Final Assembly. Using Table 6 as a guide, cut suitable lengths of stranded hookup wire and make the various connections between S3, LED1, LED2, and the board. Make the connections between the power transformer and the board—whether by direct wiring or through the optional panel-mounted connector. Referring back to Fig. 3 and using wire of appropriate gauge for your intended load (the pump), make the connections between RLY1's common and normally open contacts and the duplex outlet.

TABLE 6

	FROM	TO
Power	A35	12-volt DC Power Supply Positive
	A36	12-volt DC Power Supply Negative
Coil	A30	RLY1 Coil (Either End)
	A31	RLY1 Coil (Either End)
S3	J25	S3 (Either Spade)
	Y25	S3 (Remaining Spade)
LED1	E27	Anode
	F27	Cathode
LED2	B32	Anode
	B34	Cathode
Sense	D13	High-Level Sense (S1)
	J23	Low-Level Sense (S2)
	Y27	High/Low Sense Common

Mount the board and the relay in the case, put the front cover in place, and secure it with appropriate hardware.

Initial Tests. Although we still need to make the sensors, connect them to the Electronic Pump Controller, and mount the unit at the sump site, let's do an initial checkout.

Plug the power transformer into the lower ("POWER CUBE") outlet of the AC receptacle. If you used a connector for the low-voltage power, connect that as well. Make sure that none of the wires in the three-con-

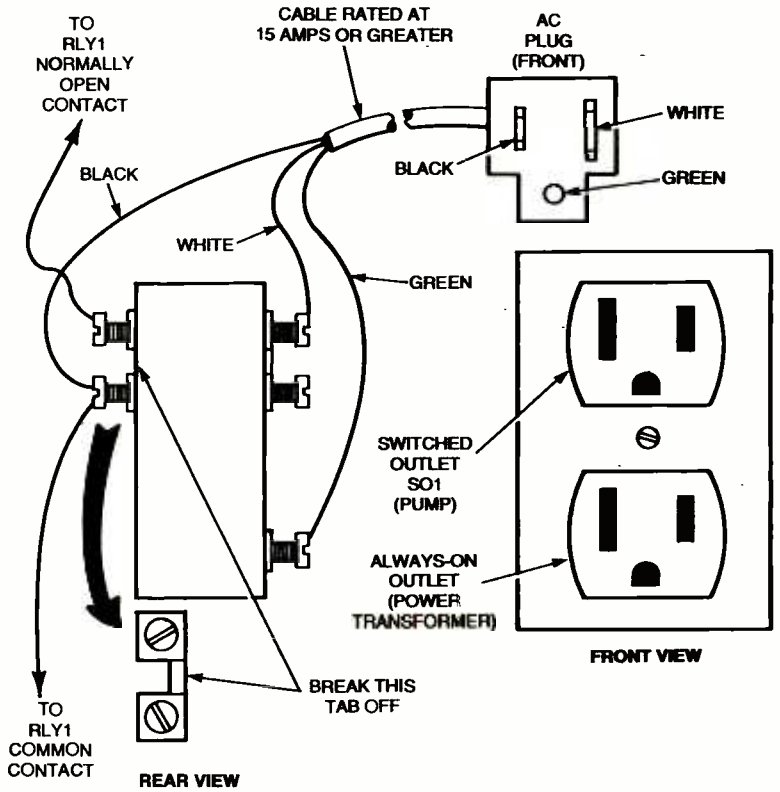


Fig. 3. Breaking off the tab on the "hot" side allows one outlet on a standard dual-outlet receptacle to be used as the switched-power connection for the sump pump. The other outlet remains powered all the time—very handy for the wall-mounted power supply that runs the Electronic Pump Controller circuit.

ductor cable are making contact with each other. Connect the AC plug to an AC wall outlet. Light-emitting diode LED2 should immediately illuminate.

Press and hold S3; LED2 should go dark and LED1 should illuminate. You should also hear RLY1 click on. Release S3. The relay should click off, LED1 should go dark, and LED2 should illuminate.

Building The Sensors. Each of the two sensors is simply a set of electrical contacts. The conductive liquid bridges the contacts, and its resistivity parallels the associated 10-megohm resistor (either R_{HI} or R_{LO}). The contacts are mounted on a non-absorptive substrate. The combination of a "waterproof" mounting substrate and an approximate ¾-inch separation between contact pairs ensures that when the liquid subsides, there will be no chance of any residual liquid clinging between the two contacts.

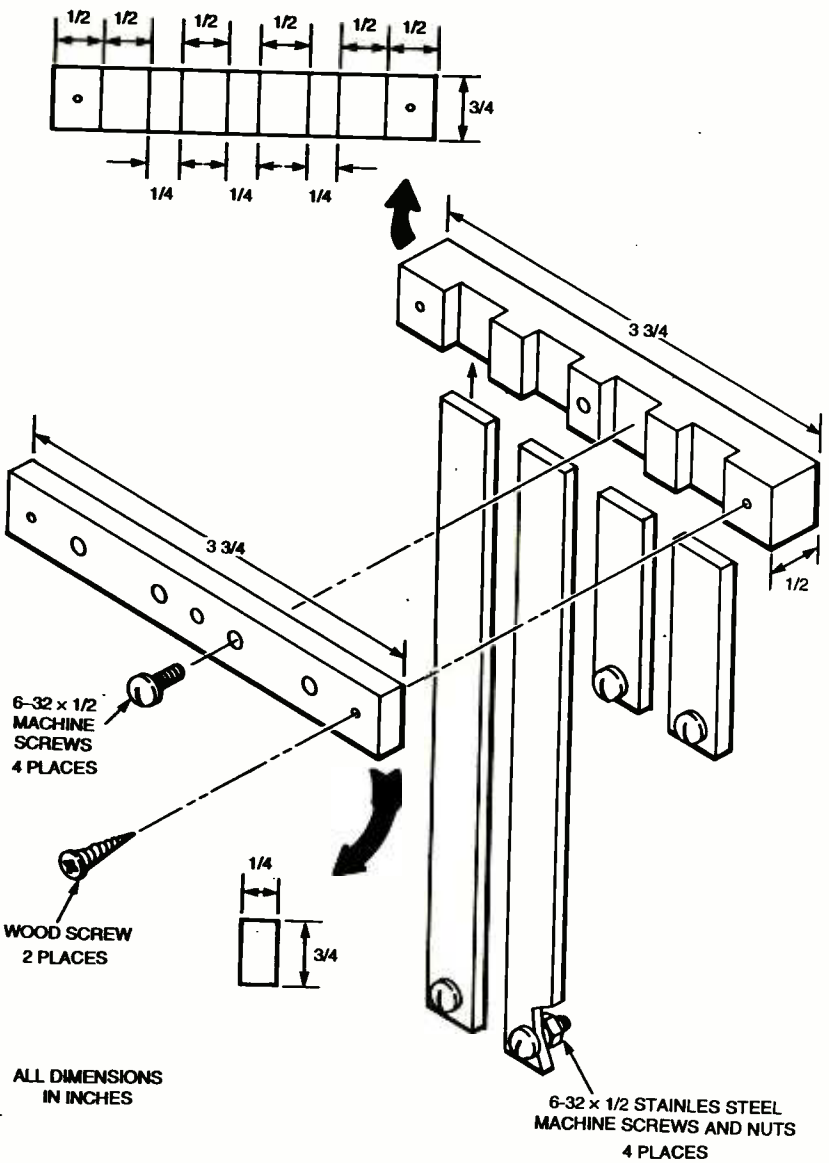


Fig. 4. The sensing elements are strips of plastic or other waterproof material that suspend the machine-screw "sensing contacts" in the sump. Note how the strips are held in place with a series of screws. You can adjust the depth of the contacts to suit your situation.

Plastic is a good material for the substrate, although any material that will not absorb water or get corroded will work as well. Stainless-steel machine screws and nuts serve as the contacts, since they will not corrode in water, are relatively easy to obtain in any large hardware store or marine outlet, and are inexpensive.

An exploded diagram of the basic sensor assembly is shown in Fig. 4. The substrate holder is a 3¾- × ¾- × ½-inch piece of wood or other appropriate material. Cut four notches as shown. An additional 3¾-× ¾- ×¼-inch piece of wood (a hard wood such as oak or maple will work better) acts as a clamp face; secure it to the first piece with two wood screws and some glue at each ¼-inch section.

Drill four holes, each one centered in one of the slots. Each hole should be small enough so that a 6-32 × ½-inch machine screw can be threaded into it—the reason for choosing a hard wood over a soft wood like pine. Finally, drill a mounting hole through the center of the assembly (between the two inner slots).

The four waterproof substrates are ½-inch wide and ⅛-inch thick. Make the S2 substrates long enough so when they are installed in the sump, they will project down to the level where you want the pumping action to stop. Remember, most sump pumps shouldn't be allowed to run dry—check your owner's manual in case of doubt.

The length of the S1 substrates should allow you to position their ends at the point where you want pumping to begin. Typical lengths are two feet for the S2 substrates and one foot for the S1 substrates, depending on the depth of the sump.

Drill a hole in the end of each substrate to accept a stainless steel machine screw. Although I suggested a 6-32 size, any size at least ½-inch long will do. Mount a screw in each hole and install a stainless steel nut on each screw.

Strip one inch of insulation from each of the three wires in the three-conductor cable. Secure the wires to the substrates by twisting them around their respective screws and then secure them with the nut against the substrate. Using a length of hookup wire, make an additional connection between S1's common and S2's common.

Installation. Place the substrates into the substrate holder and adjust their positions as needed. The threaded end of the stainless-steel machine screw should be facing out into the sump hole. Secure the substrates by

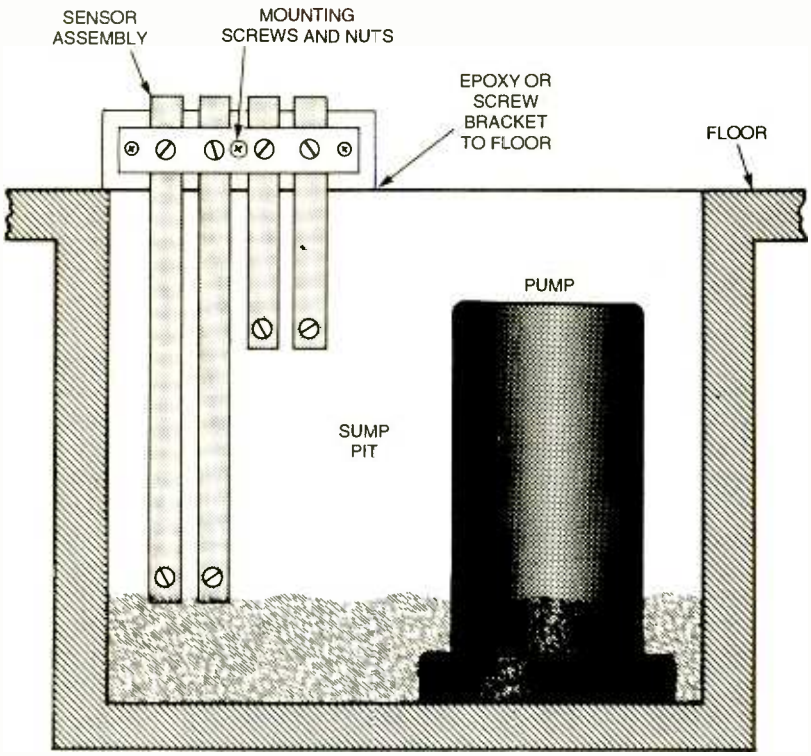


Fig. 5. Mount the sensing assembly at the edge of the sump on an "L" bracket that's epoxied to the floor.

PARTS LIST FOR THE ELECTRONIC PUMP CONTROLLER

SEMICONDUCTORS

IC1—CD4049 hex inverter, CMOS integrated circuit
IC2—CD4013 dual D-type flip-flop, CMOS integrated circuit
IC3—78L05 5-volt fixed regulator, integrated circuit
Q1, Q2—PN2222 NPN silicon transistor
LED1, LED2—Light-emitting diode, red
D1, D2, D4–D6—1N4148 silicon switching diode
D3, D7—Not used

RESISTORS

(All resistors are ¼-watt, 5% units unless otherwise noted.)
R1, R2—1-megohm
R3—220-ohm
R4, R7—2200-ohm
R5—100,000-ohm
R6, R_{HI}, R_{LO}—10-megohm
R8—1000-ohm
R9—470-ohm

CAPACITORS

C1—0.1-µF, ceramic-disc
C2—10-µF, 16-WVDC, electrolytic
C3, C4—1-µF, 16-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

RLY1—Single-pole, single-throw relay, 12-volt DC coil (150-ohm or greater), 30-amp, 120-volt AC contacts (Jameco 104926 or similar)
SO1—120-volt AC duplex wall outlet, modified (see text)
PC board (RadioShack 276-170 or similar), 9-volt DC, 500-mA wall-mounted power supply (Jameco 15561 or similar), 15 -amp power cord, three-conductor cable, plastic strip sheet, wood, mounting bracket, case, hardware, wire, etc.

tightening down the associated screw in the substrate holder and clamp. Referring to Fig. 5, position the sensor assembly in the sump hole, making sure that the substrate holder is above the top of the sump hole. Secure the assembly to an "L" bracket with a machine screw and nut. Secure the "L" bracket to the floor with epoxy or other means.

Mount the Electronic Pump Controller in any convenient location, subject to wire and cable lengths. Plug the sump pump motor into SO1, the switched outlet on the front panel. The power cord plugs into any convenient wall outlet. Although I haven't said it (because it seems somewhat obvious), you need to bypass the automatic controls on your sump pump and run the motor directly from the Electronic Pump Controller. Consult your owner's manual on how to access the pump's wiring. Due to the many different models and designs on the market, I can't give detailed instructions on how to go about that modification.

Closing Thoughts. When building this project, remember that AC voltage is present at the duplex outlet and relay contacts. Keep your hands and tools away from those areas and ***never*** work on the circuit with the AC power cord plugged in. Make sure that the connections are firm and the wire used for carrying AC is gauged appropriately to the current load.

The Parts List specifies a standard 30-amp appliance-type relay. One such device is available from Jameco Electronics as part number 104926, but appliance-repair centers should also carry a suitable relay. Any relay that you use should have a coil that draws no more than 100 mA, should activate at between 9 and 12 volts DC, and should have relay contacts that are rated higher than the load to be switched.

You can modify the sensor assembly to suit your needs as long as you keep the following design criteria in mind:

(1) Don't let liquid surface tension short out the contacts when they're supposed to be dry.

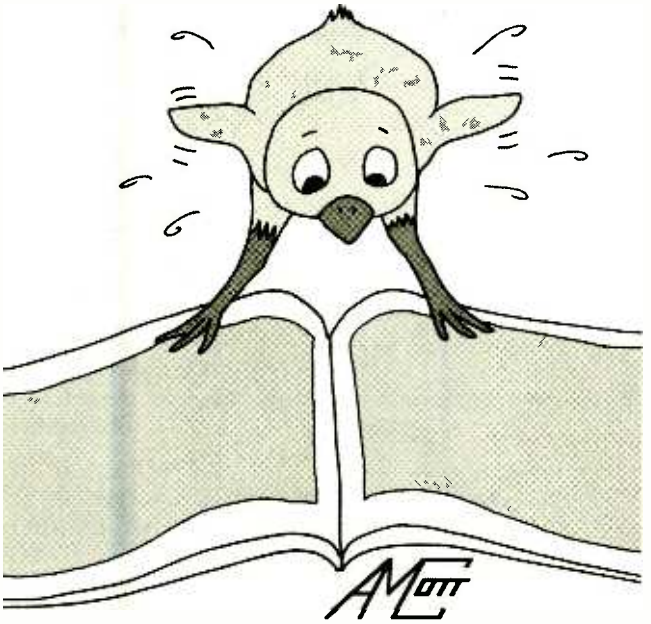
(2) Contact corrosion will hinder operation (stainless steel won't corrode).

(3) The physical connection of the leads to the sensor contacts must also be such that the leads do not corrode. A small amount of silicone sealant around the joint will help to ensure this.

With the Electronic Pump Controller on the job, you can rest easy, secure in the knowledge that your basement won't float up to the attic.

couldn't do!

To a technology hobbyist like Chicken Little, it was a dream come true! Wings a-tremble, a very agitated Chicken Little scampered first a few steps to the left, then a few steps to the right, not knowing whom she should tell first about this amazing chip. The first one to come into her field of vision was Ducky Lucky.



"Ducky Lucky! Ducky Lucky!" Chicken Little squeaked, dragging her magazine to the duck pond, "You have to see this! There's a chip in here that can run at 900 gigahertz!"

"Really?" quacked the astonished duck, who waddled over to the shore to get a closer look at the article. Indeed, the article boasted of such chip speed. This caught his attention because he had been trying to play *Final Fantasy VII* on his under-powered 486 and was frustrated by the computer's low frame rate. Such a chip would make the game not only perform the way it was supposed to, but perhaps even better. The article even said that game graphics would look like the painting on the box!

"Why this is wonderful!" Ducky Lucky exclaimed, "I must buy one of these chips. Let's show the others; maybe we can get a quantity discount." With that, the two birds scampered off to find Goosey Lucy, who shared the pond with Ducky Lucky.

Goosey Lucy's hind end stuck up out of the far side of the pond like a little iceberg as she probed the pond's bottom for new, sweet shoots. When she came back up for air, she found Ducky Lucky and Chicken Little on the shore, looking very excited, as if eager to tell her something. Goosey Lucy was a very dignified goose, though, and wouldn't jump at the merest click of a beak. Instead, she daintily swallowed the mouthful of shoots she had plucked and greeted the birds.

"Good morning, Ducky Lucky, Chicken Little," she called with a cordial smile and a dip of her head.

"Good morning, Goosey Lucy," they replied in kind, barely able to contain themselves. Goosey Lucy steered herself away from the birds on the shore, while keeping her gaze upon them. This was waterfowl-speak for "you may now enter my side of the pond."

"Is there something you wanted to talk to me about?" she honked melodiously.

Chicken Little was about to cry out across the pond about the wonderful chip when Ducky Lucky whispered out the corner of his beak, "Hold on. Goosey Lucy's a bit of a snob. If you shout at her, she'll just ignore you." Chicken Little's beak snapped shut contritely."Besides," Ducky Lucky continued, "she thinks we webfoot birds are better than anybody. That's why she just invited me into her side of the pond...lemme handle this." Ducky Lucky then waded into the water and paddled to the goose. The two conferred briefly and then paddled back to the chick.

"Where is this article you were talking about?" Goosey Lucy queried.

"Over here," Chicken Little peeped, running a few feet away from the shore to where she had left the magazine. "I didn't want it to get wet."

With a barely perceptible sigh, Goosey Lucy stepped over to the magazine. As graceful as she was in water and in flight, she was aware of what an awkward figure she cut on land. Nonetheless, if this chip was half what it promised to be, she could suffer such an affront to her vanity...this once. She waddled over toward the magazine to peer at the article. Chicken Little pondered whether Goosey Lucy fancied herself the world's prettiest goose, or its homeliest swan.

Reading the article, Goosey Lucy saw that indeed this chip seemed to be all Ducky Lucky had said it was, and more. She thought to herself, "That Swannie Lannie thinks she's so hot with her Macintosh. Wait'll she sees the performance I'm going to get with this baby!" Belying her excitement, Goosey Lucy languidly moved to return to her pond.

"I'd certainly be interested in this chip. Please put me down for one."

"Great!" chirped Chicken Little. She turned to Ducky Lucky. "Let's go see if Swannie Lannie wants in!"

"Oh, there's no need to bother the poor dear," honked Goosey Lucy solicitously, turning quickly back to the two birds and shepherding them away from the pond and back toward the farm, a maternal wing around each of them. "She's been so busy rebuilding her nest after that last downpour that she hasn't even been able to get around to preening herself properly, the poor thing. I can't be-*lieve* how grubby she's allowed herself to become. How about we go talk to Turkey Lurkey instead. Why, there he is now!"

Now, Turkey Lurkey was a huge, succulent-looking bird, and, as such, nobody thought that he would see the end of another November. For that reason, all forgave him the fact that he appeared to be a tad on the slow-witted side.

"Hi folks! What's up?" Turkey Lurkey gobbled amiably, gulping a beakful of the corn the farmer's wife had scattered for the birds. Goosey Lucy winced. Turkey Lurkey's bulk was surpassed only by his appetite. Combined, they spelled a hot date with a gravy boat.

"Turkey Lurkey, dear," Goosey Lucy tried interjecting

Chicken Little and the EC-909

FICTION BY SHEP SCARFUTO

AS THE ROOSTER'S RAUCOUS CRY SUNG IN THE MORNING, THE SUN PEEKED OVER THE HORIZON OF THE HAPPY KINGDOM ON A GORGEOUS SPRING MORNING IN 1999. DUCKY LUCKY AND GOOSEY LUCY pulled their heads out from under their wings and waddled down to their respective sides of the minnow pond for a morning dip. Turkey Lurkey lazily ruffled himself awake and began preening his feathers. Doggy Loggy cracked open an eye, yawned, stretched front legs and back, and began his rounds of the farm. At the farmhouse, Catty Latty leapt up to her favorite windowsill to soak up the morning light; while in the woods, Foxy Loxy trotted into her den, pleasantly tired after a good night's hunting.

In the henhouse, Chicken Little shook herself awake, blinking bright black button eyes. She gave her yellow fluff a quick preen and scampered outside to greet the morning.

Just like that morning a week ago when Chicken Little had burst out of her shell, it was a delightful day. The Sun was golden and warm. Her cousins, the bluebirds, sang sweetly in the trees. But bluer than the bluebirds was the sky. Oh, the sky was...

Just because it fell from the sky shouldn't mean that it's too good to be true...or should it?

CLUNK!

Knocked off her feet, Chicken Little was sitting on her fluffy, yellow rump. Woozy, she tried to collect her thoughts. What could have bowled her over? The little chick tried to recall what happened just before she was hit. She had woken up. She had gone outside. She had admired the sun...the birds' song...the sky...

The sky!

"The sky is falling! The sky is falling!" cried the terrified chick, flapping her insubstantial wings into a blur.

"Now, now, it's just the mailman delivering the April issue of **Electronics Now**," clucked Henny Penny, coming up behind Chicken Little. The hen picked up the rolled magazine in question. "He probably didn't see you, so it accidentally landed on your head." Penny set the startled chick back onto her feet, gave her a quick dusting off with a big soft wing, and handed her the magazine. "Now why don't you go over there to that nice, quiet corner and read your magazine until the farmer's wife comes out with breakfast. I have bread that needs baking."

As Chicken Little took the periodical and scampered over to said corner, the elder chicken clucked to herself, "First it was Y2K. Today, the sky is falling. Honestly, you'd think she was hatched yesterday!"

Being a young chick—sharp of eye, ear, and emotion (if not insight)—Chicken Little could not help but hear the wise hen's words. "Penny's right," Chicken Little thought to herself, resignedly. "I really *do* jump to conclusions too quickly." With sharp little claws, the chick pensively removed the rubber band from around the magazine, flopping it flat. "Maybe I should think twice before I peep once. At this rate, I'll worry myself into a skinny little fryer before I grow up." With that, Chicken Little clawed open her copy of **Electronics Now**.

The articles and columns were fascinating to the fluffy electronics buff. The columns, features, and advertisements all had something to catch her eye. (She had wanted to read Gizmo® as well, but that column appeared in **Popular Electronics**, and she could only afford one subscription at a time. Perhaps in the future, they would be combined. Ah well, a chick can only hope.) As was her wont, Chicken Little saved the feature articles for last.

Thereupon, she came across an article describing a new computer chip called the EC-909 from Ecraf Technologies. According to the article, this wonderful chip was limitless in its capabilities and boundless in its power.

It improved computer performance!

It was energy efficient!

It was affordable!

It seemed as if there was nothing that this chip

thing," she added to the birds with a shrug.

Once they were winded and out of earshot, Doggy Loggy and Foxy Loxy slowed to a walk and then a stop. The fox turned then to the dog.

"Red rascal?" she asked incredulously. "There's no need to get ethnic about this."

"You're right. I'm sorry," Doggy Loggy panted, "But I've got to look like I'm earning my keep. I mean, you understand, don't you? We *are* cousins."

"Tell that to my brother-in-law," the vixen sneered, chewing out a knot in her brush. "A pack of hounds and some bunch of idiots on horses almost did him in last fall. His kits are still having nightmares." She spat the tangle into the woods with satisfying contempt.

"Look, I'll make it up to you," the dog began.

"Well, it's about time," the vixen sighed, relieved. "Every time I leave some tracks around your farm to frighten the chickens, I risk your master perforating my pretty red pelt with buckshot. All so you can be the hero. And what do I get out of it?"

"I give you a cut of my Alpo," Doggy Loggy protested.

"Yeah, I've had your Alpo. Tastes like dog food!"

"It *is* dog food."

"You could save me a doggy treat once in a while. Or maybe even a table scrap..." Foxy Loxy licked her chops as Doggy Loggy waved an impatient paw.

"Forget about that for now." He gave Foxy Loxy a sidelong, conspiratorial smile. "You want in on a real sweet deal?"

"What kind of deal?" Foxy Loxy asked cautiously.

Doggy Loggy regarded the nails on one forepaw, feigning boredom. "Oh, just a processor chip that can multiply your hard disk space over four thousand times, simply by dropping it in..."

"Four thousand...?!?" yelped the fox.

"...and with a clock speed of over 900 gigahertz."

"Nine hundred gigahertz?!?" Foxy Loxy exclaimed.

"...and is so powerful, that despite its ceramic shielding, it kicks out enough light to light up a city, all on two AA batteries..."

"Huh?" Foxy Loxy grunted, perplexed.

"...it's also both a perfect insulator and a perfect conductor..."

"Wait a minute..."

"...and it sells for only twelve bucks..."

"But how could it..."

I've gotten the interest of some potential investors," Doggy said, nodding toward where the other animals waited. "You want in on the ground floor of this?"

"Doggy, let's think this through."

"Could be big."

"There's something that just doesn't ring..."

"Look," Doggy Loggy said with good-natured impatience, "We're on our way to Castle Gernsback right now to discuss this opportunity with the King. If you want a piece of this, join up with us by then, otherwise..." he let his voice trail off, as if being left out would be too awful for words.

"But Doggy..." Foxy Loxy tried to interject, but Doggy Loggy had already turned to go.

"However, let me warn you," the canine called over his shoulder, "When birds get excited over something, they tend to run. Real fast. So make your mind up quickly, 'cause we're making very good time." With that, Doggy Loggy trotted back toward the group, his tail wagging in satisfaction.

As she watched Doggy Loggy disappear down the path, Foxy Loxy said to herself, "I always knew there was a downside to domestication." With due vulpine speed, she flowed down the path after her canine cousin.

Once Doggy Loggy rejoined the others, he addressed his fellow animals.

delicately, "Maybe you should think about cutting down a bit." She extended a wing toward Chicken Little, "Wouldn't you rather maintain your chick-ish figure?" Chicken Little blushed beneath her yellow fluff.

"I'll leave chick-ish figures to the chickens," Turkey Lurkey chuckled, "For turkeys like me, life's for living and enjoying today. After all, one never knows...one may not be here to enjoy it tomorrow." Turkey Lurkey jabbed a knowing elbow into Goosey Lucy's ribs, "Know what I mean, sis?"

"I'm sure I don't!" honked the goose a little too loudly, shooing Turkey Lurkey's elbow away.

The turkey smiled shrewdly, "Okay, fine. But I hope you like plum pudding as much as I like cranberry sauce." While Goosey Lucy flustered and fluttered indignantly, Chicken Little considered that, maybe, Turkey Lurkey was not quite as dim as everyone thought.

"Anyway," the turkey said with an enthusiastic flap of his useless wings, "what's the dope...besides me?"

"If you must know," honked Goosey Lucy, holding out the magazine, "this." She jabbed the article with a lead pinfeather.

Turkey Lurkey peered at the article for what seemed like an eternity. Turkey Lurkey was not a fast reader and tended to move his beak as he read. Soon, Goosey Lucy's wing became very tired and heavy.

"I'm not a podium, you silly goose!" she finally cried out irritably, tossing the magazine at the turkey, "We all want to get this chip. Are you in or out?"

After perusing the article, Turkey Lurkey replied, "In," and calmly handed the copy of **Electronics Now** back to the goose. "But only so long as the chips come in before November. I mean, you can't beat a price of twelve dollars for a chip like that!"

"A chip like what?" asked Catty Latty, dropping gracefully down from her windowsill.

"A chip like that," said Turkey Lurkey, pointing to the article. The cat's whiskers twitched as she read it.

"You mean, it can throw off enough light through its ceramic sheathing to illuminate an entire city from two AA batteries?" the feline exclaimed, looking up. With such a chip, she would no longer have to wait for the sun—any windowsill would be perfect for sunning herself.

"That's the chip for me!" she meowed, her tail a-switch in pleasant anticipation. Not far away, she spied her old friend, Doggy Loggy.

"Hey table-scrap breath," she yowled to Doggy Loggy. The pooch's ears picked up and soon he was trotting over.

"Check this out," the cat nudged the magazine under the dog's nose. The dog's pointy snout flicked back and forth as he scanned the article. Soon, the canine sat back on his haunches and cocked his head to one side, panting as he did when lost in thought. The impressiveness of this chip was not lost on him.

"You're drooling again," Catty Latty nudged the dog, who contritely pulled his tongue in. "You've really got to get a grip on that," the cat added, nodding to Chicken Little who was being wiped dry by Ducky Lucky, "You damn near drowned the poor kid."

A penitent Doggy Loggy apologized and then replied, "This is very interesting. We need more information on this company. Maybe order some prototype chips. This would make one beauty of an investment in my portfolio. Lemme make a call to my broker, then we'll go see the King. He's got opposable thumbs and a credit card; he can order the chips for us."

Once Doggy Loggy had made his call, (fortunately for Doggy, the farmer had an easily-nosed touch- tone phone), all the animals had re-assembled at the farm's front gate. Together, they set off down the forest path to see the King at Castle Gernsback.

They had trekked for a good part of the morning when Foxy Loxy strolled out before the merry travelers.

"Greetings, one and all!" she yipped with a cheery swish of her bushy tail. The birds cowered, mindful of Doggy Loggy's cautionary tales of Foxy Loxy's rumored taste for fowl.

"Foxy, sis!" chirruped Catty Latty pleasantly, "How are you doing?" Doggy Loggy bounded up between the fox and the other animals and cut the cat off.

"Everyone, stand back," he growled to his traveling companions, "I'll take care of this red rascal!"

"Red rascal?" Catty asked quizzically, "It's just Foxy Loxy. She wouldn't hurt—"

"Catty," Doggy Loggy interrupted, "the birds are in danger! Let me handle this."

"But Doggy," Catty protested, "Foxy Loxy's never even tried to touch a feather on—"

"I said let me handle this!" Doggy Loggy snarled. He then turned his attention back to Foxy Loxy, whom he chased down the path, barking all the way.

"Fine, fine," Catty Latty meowed, taking the break in their journey to wash behind an ear. As fast as Doggy Loggy was, the cat knew there were few things on four feet that could outrun a fox. "Must be a canine

"Well, that takes care of—"

Foxy Loxy suddenly appeared behind Doggy Loggy and sat humbly upon her haunches.

"Doggy Loggy, I'm sorry if I frightened the chickens, and I'll try not to do it any more."

"Eh?" Doggy Loggy snapped his head around to face the vixen. Doggy Loggy hadn't expected this.

"I also want to try to make it up to you. To all of you," Foxy Loxy added. "Let me accompany you. The King will more likely grant an audience with me."

"Why should the King prefer you over us?" Goosey Lucy demanded.

Foxy Loxy bowed her head in apology for what she was about to say.

"You're farm animals. I'm wild," she muttered simply, embarrassed that she had to give voice to such a cold, blunt truth.

"I don't know if we can trust you to present this notion properly..." Doggy Loggy began.

"You can present the idea, Doggy Loggy. I'll just get you in the door," Foxy Loxy replied. Then she added to the others, "And you can even watch me the whole time so that you can see that I won't say anything bad or untrue about you, or the chip, or anything."

For the benefit of the birds, Foxy Loxy then gathered her fluffy tail up and hugged it to her chest. "Furthermore, I swear that I won't hurt any of you," she then buried her delicate muzzle into the fur of her tail, "Upon my brush."

The animals, both furred and feathered, sat in stunned silence, for all present knew that there were only two things that a fox held more dear than its lovely tail: its kits and its life.

Still, Doggy Loggy wasn't sure. Something about this didn't smell quite right to the dog, but he couldn't find a loophole that would allow the vixen to wriggle through. Catty Latty, though, was the first to break the silence.

"Foxy, what gives with all this oath-taking? We've prowled together, so I know you go after rodents, maybe the stray grasshopper, or a trash-can raid now and then. But I've never seen you eat—"

"Agreed!" barked Doggy Loggy, desperate to cut his well-meaning feline friend off before she blew the dog's cover. He then added for effect, "But know this, Foxy Loxy. I will be keeping my eye on you."

"That is fine," the vixen said, taking her place next to Catty Latty, allowing Doggy Loggy to lead.

Once the travelers had resumed their hike, Catty Latty whispered to Foxy Loxy, "Alright, what's the deal, here?"

"No deal at all," Foxy Loxy answered, "I'm going to do exactly what I said I would."

"Why?"

"Let's say I just want to reserve a front row seat."

By midday, the animals had reached Castle Gernsback and approached the guard out front. He was a portly fellow with shiny chainmail. He carried a long spear and had a sword slung at his hip.

"Here now, you critters," he exclaimed, "Be off with you! This is no place for your paws and talons."

"If you please, sir," Foxy Loxy said, stepping shyly forward, "I am the fox from the King's wood. My traveling companions would like a brief audience with the King. They have business that might be of interest to him." She then extended a paw to her friends, "They are well-bred, well-mannered, and have only the best of intentions for their king and kingdom. I will personally vouch for them." Unconsciously, all the animals pulled themselves up just a tiny bit taller at Foxy's complimentary words.

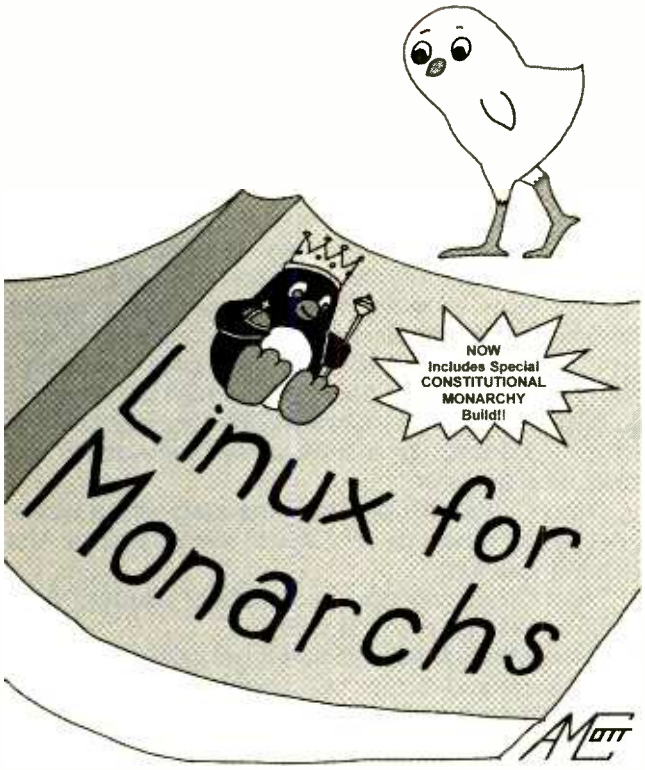
The guard considered this. After all, it wasn't every day that a wild fox vouched for a dog, a cat, a turkey, a goose, a duck, and a week-old chick. So he sent word to the herald, who granted them entrance into the castle.

It was an impressive edifice, Castle Gernsback. There were portraits of good King Hugo I (the first king of the land), and many finely rendered tapestries depicting great deeds and visions of the monarch and his knights. The animals wanted to stop and stare at each of them, but they hurried on to the throne room, not wanting to keep the King waiting.

When they entered the throne room, they found the King diligently hammering away at a computer, set up beside his throne. The animals stopped a respectful ten paces away and bowed their heads. The herald strode up and announced them.

"Foxy Loxy and traveling companions," the herald declared. The King kept working at the keyboard, oblivious.

"Ahem...Foxy Loxy and traveling companions," the herald tried again. The King still sat sideways on his throne, ensconced by the computer. With a tired sigh, the herald trudged up to the King and gave the cuff of the royal sleeve a gentle tug. When the King startled, the herald resumed.



"Foxy Loxy and traveling companions," the herald announced. The King waved the herald away and seated himself more formally upon his throne, straightening his robes to seem more kingly. He muttered, "Sorry about that. I got kind of absorbed in trying to do a Linux kernel upgrade over here." Once he was settled, he then addressed the group, "So Foxy Loxy, to what do we owe the pleasure?"

"My friends have business that they wish to discuss with you." Foxy Loxy stepped to the side to give the animals their say.

Just as the entire troop was about to launch into a cataloguing of the virtues of this chip, Doggy Loggy grandly held up a forepaw, as if holding the others back like water behind a dam.

"Rather than all of us speaking at once and letting his Majesty think we were raised in a barn," Doggy Loggy intoned meaningfully, "perhaps your Highness would prefer to read the article that brought us here?" With that, Doggy Loggy passed Chicken Little's magazine to the monarch.

After reading the article end to end, the king looked up at the group. Doggy Loggy resumed.

"I'm sure your Majesty could easily imagine how such a chip would be useful in all the computers in the kingdom. Investing in its manufacturer would be of great benefit to you and your subjects as well," Doggy Loggy explained. "For that reason, we would like your assistance in tracking down this EC-909 chip and the manufacturer, Ecraf Technologies.

The King sized Doggy Loggy up, along with the other animals.

"Let me see if I've got this straight," he began. "You've all read this article?"

The animals nodded.

"And no one found anything peculiar about it?"

"Like what?" meowed Catty Latty.

"For instance," he said, "how can anything draw enough juice from two measly AA batteries to light... the King paused meaningfully, "...a city?" Catty Latty wrapped her tail about her feet in humility. In her excitement, she hadn't thought about that.

"And even if this chip could do that," the King continued, "how could the light penetrate the chip's ceramic sheathing?"

While a dumbfounded Catty Latty pondered this, the King went on, "And nine hundred *giga*hertz? I mean, technology just doesn't evolve—or even mutate—that fast. According to Moore's Law, the performance of state-of-the-art hardware doubles every eighteen months or so. Not by three orders of magnitude...overnight." Ducky Lucky pulled his head in close to his chest, trying to look as small as possible. *Final Fantasy VII* would have to continue to wheeze on his machine back at the minnow pond.

"And even if it did advance that much," the King continued, "how could they afford to throw them away at twelve bucks a pop? By making them out of construction paper?" Turkey Lurkey nodded in resigned agreement.

"Do you mean that it can't increase hard drive space over 4000 times?" Goosey Lucy demanded.

"Not unless you can explain how a simple processor-swap could do that," the King chortled. "Or how anything can be a perfect insulator and a perfect conductor at the same time. I mean, if the switch takes place at a voltage drop of 1.2-whatever volts, how do you get a voltage drop in a *perfect* conductor, which—by definition—has zero resistance and therefore, zero voltage drop? Talk about having your cake and eating it too." The goose tried not to harrumph in front of royalty.

"But why would **Electronics Now** print an article about a hoax chip?" Chicken Little asked the King.

"When did the article say was the chip's release date?" the King quizzed the chick.

Chicken Little scanned her memory. "April first?"

"And what "holiday" is that?" the King queried with a smile.

Six jaws and beaks dropped open in unison as the King mouthed "April Fools." Foxy Loxy tried to hide a quiet giggle in her tail.

"Still," honked the indignant goose, "I find it hard to believe that **Electronics Now** would print..."

"This EC-909 chip is made by Ecraf Technologies?" the King shot back, interrupting the goose.

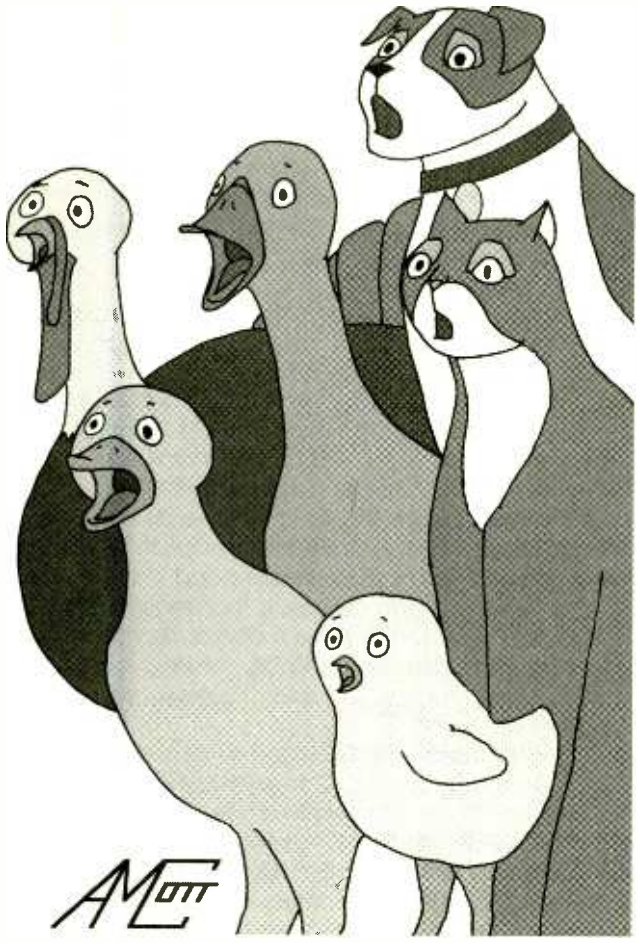
"Yes," the goose honked.

"Could you spell "Ecraf" backwards for me?" the King requested.

"F-A-R...," the goose's voice grew fainter and more halting with each letter. "...C...E...!"

The animals recognized their folly.

"If you will excuse me, your Majesty," Doggy Loggy said nervously, "I have to run home and cancel an appointment with my stockbroker. He's a timber wolf and really can't take a joke!" The dog bolted from the castle and ran all the way home.



"Take it easy on Doggy Loggy, your Highness," Foxy Loxy advised the King, "He's really a good egg deep down. He just gets fouled up in his plans sometimes." The King gave a dismissing nod, as if to say, 'of course'. Castle Gernsback's King was a very reasonable monarch.

"If you will excuse me, your Majesty," Goosey Lucy honked superciliously, "I won't waste any more of your time." As she turned to go, she confided in Chicken Little, "I thought that magazine of yours was serious. If I were you, I'd cancel that subscription."

As she waddled away, the King couldn't help but notice the chick's crestfallen look. "She's just acting as if someone yanked the chocolate chips out of her Oreos," he said.

This was lost on the chick, but only very briefly.

"Wait a minute, Chicken Little responded, "Oreos don't have chocolate chips."

"Exactly," the King winked. "She's upset about losing something she only thought she had."

"Not bad, kid," Foxy Loxy confided to the chick. "You'd make a pretty good fox."

"Chocolate chips or no, I'd better go too," quacked a dejected Ducky Lucky. "I guess I should pay more attention to what I read, huh?"

"Of course," the King piped. "You miss fewer jokes that way." The duck considered this, nodded and waddled out of the throne room, his head a little higher. Turkey Lurkey approached the throne.

"Well, they sure got us good, didn't they?" gobbled Turkey Lurkey.

"That they did," yipped Foxy Loxy.

Turkey Lurkey paused and reflected upon this for a few moments. Then a sly grin spread across his beak.

"Can't wait until next April!"

"Me neither!" agreed the fox and the King as the turkey turned and left.

"It sure would've been nice if the chip had been real, huh?" asked Catty Latty. The others present agreed. The cat cocked her head in thought.

"You know, if I leave now, I can get to my second favorite windowsill just in time to catch the afternoon sun," Catty Latty mused. "I'll see you later." Catty trotted away with her tail pertly carried high like a flag.

Finally, a remorseful Chicken Little approached the King. "I guess you must think we're pretty dumb animals," she peeped.

"Naah," the King dismissed the idea with a wave. "We all get nailed by a 'gotcha' sooner or later. This was just your turn."

"And if you know how to chuckle at yourself," Foxy Loxy added, "it's not so bad."

The chick nodded. "I'd better get going, too."

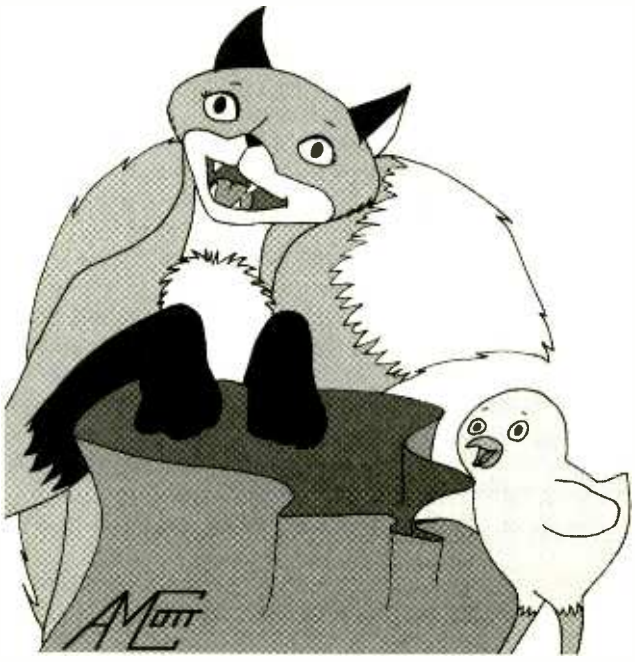
"I'll keep you company," Foxy Loxy added, stepping to the bird's side. "After all, who knows what wild animals could be lurking in the wood."

"Before you two go..." the King summoned his page and bade him fetch a sack bulging with some unknown treasure. "These are for you and your friends. No hard feelings?" the King asked.

Foxy Loxy took the bag, and both she and Chicken Little peeked inside. The bag held seven warm, golden, crusty, fresh-baked loaves of bread, and they let off an aroma that rivaled the summer's finest rose.

"No, sir!" the two of them beamed. Chicken Little had missed breakfast and was very hungry. Foxy Loxy would finally get some tasty human food.

"By the way," the King winked and said, "tell Henny Penny I said 'hi!'" P



Q & A

mailto: q&a@gernsback.com

READERS' QUESTIONS, EDITORS' ANSWERS
CONDUCTED BY DEAN HUSTER

Whatever Happened to *Electronics World* and *Wireless World*?

Q *The address for* Electronics World *and* Wireless World *magazines would be greatly appreciated.—K.P., Tennessee Colony, TX*

A *Electronics World*, as published in the U.S., was folded into **Popular Electronics** with the January 1972 issue back when both were published by Ziff-Davis. The United Kingdom (U.K.) publication, *Wireless World*, like many U.S. electronics magazines, has undergone some changes. In an effort to "despecialize" the magazine image by reducing the emphasis on the word "Wireless," it was renamed *Electronics and Wireless World*. Later, it was changed to *Electronics World & Wireless World*, then to *Electronics World incorporating Wireless World* (with the "incorporating Wireless World" in considerably smaller print), and finally to simply *Electronics World*.

Hmmmm.

If you've been reading U.S. electronics hobbyist magazines since the early 1970s, it sounds like a familiar story, doesn't it? *Electronics World* is published by Reed Business Publications in the U.K. and has a Web site at *www.reedbusiness.com* where you can find more information. Many thanks to Trevor Wright of Marconi for his help in ferreting out this information from a local technical library in the U.K.

I might mention (or "editorialize") at this point that between the mid-1960s and today, there have been—not including name changes—at least eight different general electronics-hobbyist magazine titles under nearly as many publishers. Older readers might remember names like **Radio-Electronics** (**Electronics Now**), **Popular Electronics** (*Computers & Electronics*), *Radio-TV Experimenter*, *Electronics Illustrated*, *Elementary Electronics*, *Modern Electronics*, and **Hands-On Electronics**. At one time, six of those titles were in concurrent publication, and they provided a lot of really fantastic construction articles and great monthly columns. We're now down to just two magazine in the U.S.: **Poptronics** and *Nuts & Volts*. I'm sure that specialization has caused some movement of readership into other magazine titles, and information on the subject is increasingly available on the Internet. But for the most part, interest in electronics as a hobby and related magazine readership is down tremendously since the old days. If this can be treated as a trend, I would urge readers whose hobby is electronics to share their enthusiasm with others. Encourage them to subscribe to magazines like **Poptronics** so that the few remaining hobbyist magazines in the world aren't forced to cease publication due to lack of readers.

Which Oscilloscope Probe?

Q *I just bought a Tek 5110 scope with plug-ins for $50. What probe should I use with it?— M.S., Piedmont, OK*

A Now *that* is a bargain if ever there was one—assuming that the scope works. The 5110 was most commonly outfitted with one or two 5A18N vertical preamps and a 5B10N timebase. Overall, the system has a bandwidth of around 2 MHz, so probes will be cheap. I prefer X10 attenuator probes, because they give you less resistive and capacitive circuit-loading at the expense of a decade decrease in sensitivity. Attenuator probes are also available for X100 and X1000 attenuation factors, but it's not likely that you'll need them. A pair of new probes, even cheap ones, is going to cost more than you paid for your scope! If I were you, I would buy new ones. Used probes have taken a beating, and the integrity of their cables and probe tips might not be the best.

You can buy new probes from nearly any electronics distributor for around $35 each. Be sure that the probe's compensation range will cover the input capacitance specification for your vertical preamp. That figure is usually around 20 pF; but Tek has made some preamps as high as 47 pF which is out of range for some probes. The high-impedance input resistance of all but a tiny percentage of all scopes ever made is one megohm, so that won't be an issue when selecting a probe. The probe bandwidth should be greater than that of the scope, again not an issue with your 2-MHz bandwidth.

A 1X probe allows you to have the full sensitivity of the scope, but every bit of the scope's input capacitance and the probe's capacitance in parallel with the scope's 1-megohm resistance will be on any point you try to measure. Most folks don't think about the capacitance, but 50 pF at 2 MHz is like putting a 1600-ohm resistor from your measuring point to ground. You can buy switchable probes (1X/10X), but I prefer separate probes myself. They're more reliable, and the 1X bandwidth of a switchable probe is usually far lower than that of a dedicated 1X probe.

The Tek 5K plug-ins also have probe-encoding rings. When they are used with a probe designed with a special BNC connector, the rings will automatically shift the CRT readout or knob-skirt illumination to reflect the use of an attenuator probe, reducing measurement error.

Longer Ferrite Rods

Q *In reference to a question by G. K. of New York in the October 2000 issue about a 24-inch ferrite rod, I remember reading a long time ago that the properties of a ferrite core would be the same if it consisted of two pieces glued together with epoxy. If that is true, then G.K. could make his long rod out of the shorter pieces that you referred to.—F.K., via e-mail*

A I would tend to agree with that statement, although one must always be careful to modify the claim with a substitution so that it reads "nearly the same." Since ferrite is essentially a mashed-together collection of iron dust with each grain insulated from the other, magnetic induction is the major issue.

Just to make the substitution even better, I'd make sure that the two ends to

be joined were smooth and flat and would use superglue to make the union. That would keep the space between the rods to a minimum. If you look at the core of a typical television or computer-monitor high-voltage transformer, you'll find that it's made of two symmetrical halves similarly glued or mechanically clamped together.

Zener Diodes to Reduce Voltage

Q *In your answer to "Need 16 Volts, 900 mA" in the May 2000 column, you reduce the LM317T's input voltage by using a string of 1N4001 diodes or another LM317T in series. Why not consider the use of a Zener diode connected in series? I had a similar problem with an LM7824 with a 37-volt supply at the input. A 6.8-volt, 1-watt Zener in series with the input reduced the voltage to a safe 30-volt value. Since my load current is near 50 mA, a 1-watt Zener was sufficient. Do you see any problem with the use of a Zener here?—G.W., Recife, Brazil*

A The LM317 regulator specifies a 60-volt maximum *differential* between input and output voltage, so there often isn't a need to *preregulate*, or lower the input voltage. On the other hand, the LM340- (LM78xx-) series of regulators specify a 35-volt *maximum input* voltage, so voltage-limiting techniques would be used on them more often. In either case, the power being dissipated by the regulator is usually the key issue. Both the LM317 and LM340 are limited to 20 watts (in a TO-3 package) or 15 watts for the TO-220 package, respectively.

The previous moderator of "Q & A," Michael Covington, cited a second example (30 volts in, 16 volts at 900 mA out); there a well-heatsinked LM317 should be able to handle the power (14 volts × 900 mA = 12.6 watts). In his first example (40 volts in, 16 volts at 900 mA out), the regulator would be overtaxed at 21.6 watts as he calculated. Let's keep the dissipation at a conservative 10 watts. To do that, we have to keep the regulator drop at less than 11 volts (10 watts/900 mA = 11.11 volts), which means we have to drop that 40 volts down to about 27 volts. That would put less than 13 volts across a preregulator as he had described, dissipating 11.6 watts there.

Using the forward-biased 1N4001 diodes in series to kill that voltage is a no-brainer. Each diode can handle an amp of current. But it takes about 14 of them to drop the voltage down to the needed 27 volts; and that takes up twice as much space as a regulator, although it would be cheaper than another LM317. By the way, we normally think of silicon diodes as dropping 0.6 or 0.7 volts. But at a 1-amp current, a 1N4001 is specified with a drop of 0.9 volts, which is what I used in figuring 14 of the little buggers.

A Zener does make a good series-lossing device, but like the linear regulators, power dissipation becomes the key issue. In this case, we can use a 12-volt Zener, but it would have to be rated to handle over 10.8 watts; those devices are not easy to find. This is one example of why I prefer to use Zeners as voltage references and not voltage regulators. However, the Zener solution in your particular situation worked out well. I think the defining factor is that a Zener is a better solution for lower voltage drops and lower currents, while using a second linear regulator in series is better for higher voltages and higher currents.

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.electronics.repair, sci.electronics.components, sci.electronics.design*, and *rec.radio.amateur.homebrew*. "For sale" messages are permitted only in *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.repair faq.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, Hauppauge, NY 11788; Tel: 631-592-6721. To ensure receipt of the correct material, readers must supply complete information on the article or issue that they wish to buy.

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, PO Box 549, Tooele, UT 84074.

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.

Operator/Service Manual Sought

Q *Where can I purchase a Luxman R115 operator/service manual? Alpine/Lux Corp. no longer stocks it.—E.W., Fremont, CA*

A I finally tracked down a Lux R-115 manual at *www.treasurechestcorp.com* on the Internet. I'd start with them to see what they have.

24-Volt Power Supply

Q *Please send me a detailed schematic on how to build a 24-volt regulated power supply with a load of 250 mA. I am building a project at work that requires this type of power supply, and I believe it might be cheaper to build rather than to buy. I would appreciate a detailed schematic with parts numbers and vendors, if possible.—R.H., Kearney, NE*

A The simple schematic of Fig. 1 should suffice. For power, it's more convenient, safer, and usually more economical to use a wall-mounted ("wall wart") transformer/adapter rather than buying line cord, fuse, switch, transformer, rectifier, etc. to provide the regulator's raw supply voltage. It's common practice for manufacturers to use such wall transformers to simplify UL approval of their product and to keep their product safe if a consumer opens it up. The output of the "wart" should be marked as having an output of anywhere from 25 to 30 volts and a current capability of at least 500 mA. Capacitor C1 can have any value between 100 and 1000 µF as long as it's rated at 50 volts or more. I'd suggest no more than 100 µF if your wart has built-in filtering. The output should have a 10-µF electrolytic capacitor paralleled with a 0.1-µF capacitor to ground to take care of any load transients. Watch the polarities of the electrolytic capacitors, and be sure to heat sink the LM7824 so that you have more versatility in selecting the wall wart. Most of the parts can be purchased through one of the many suppliers that advertise in the back of **Poptronics**.

To make this answer more generic for other readers and because these simple little power supplies are used everywhere, note that it's easy to change the output voltage. Simply select a different linear regulator such as an LM7805 or LM7812. The last two digits indicate the output voltage of the device. Keep the input voltage at least three volts higher than the output voltage, but don't let it get too high or you'll waste a lot of power in the LM78xx regulator. Don't let your raw supply exceed the 35-volt maximum-input voltage of the regulator and make sure that it can supply the minimum current needed by your load.

You can build a negative-polarity version of this supply by using LM79xx regulators and reversing all polarities. Note that the pinout of an LM79xx regulator is different from that of the LM78xx series.

Converting from 24 VDC To 12 VDC

Q *I'm looking to make a converter with a 24-volt DC input and a 12-volt DC output. It's for plugging in a cellular phone. My wife operates heavy equipment at a local mine, and the available power source is 24 volts. She cannot charge her phone with this, and I would like to make her something to use.—S.T., Ft. McMurray, Alberta*

A Again, this conversion is the job of a simple three-terminal regulator, as in Fig. 1. The difference is that you'll be replacing the "wall wart" transformer with the 24-volt supply from the equipment. Watch the polarity and install a 2-amp fuse in series with the 24-volt line. In this case, you'll use an LM7812 linear regulator; all other components will be the same.

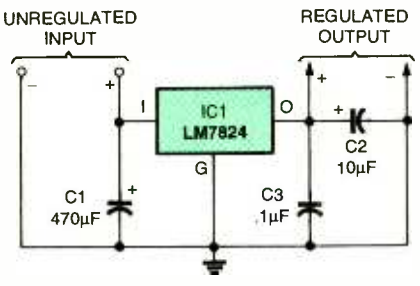


Fig. 1. The advent of fixed three-terminal regulators makes designing simple power supplies a snap.

One caution is in order here. I'm assuming that you're replacing the phone charger's wall transformer with this converter rather than connecting the circuit's output directly to the phone battery or trying to bypass the phone's battery. If you're attempting to connect directly to the battery, DO NOT use this circuit. Unlike the nickel-cadmium and gel-cell technologies that you may be used to, modern lithium and nickel chemistries require sophisticated charging schemes that monitor voltage, current, and time and/or temperature. The wrong charging parameters can end up undercharging the battery, which kills your talk time; or overcharging the battery, which severely shortens its life or, worse yet, causes it to explode—not a good thing for a device that you have plastered against your ear.

Hannimex Slide-Projector Information

Q *I own a Hannimex slide projector (LaRonde), which is about 20 years old. It used to have auto-focus, but not any more. I took it apart and noticed that the highest DC voltage applied to the auto-focus motor is about one volt. That voltage seems to be very low to drive that motor adequately. All the mechanics are in good shape. Would you please help me find information about the electronics and lens alignment for the projector?—O.S., Toronto, Ontario*

A There aren't as many Hannimex projectors floating around on this side of the world as there are Carousels. And I think you'll find that projector manufacturers will be loath to release schematics to the general public. Why, I don't know. I did a pretty exhaustive Internet search and came up dry trying to find anything about Hannimex other than auction items. I'd suggest that you search out photographic forums for more specific help, but get in there fast, for it seems that digital cameras are attracting all the attention.

Here are a few examples of photography-based forums:

- *forums.thathomesite.com/forums/photo*
- *www.gtdesigns.com/forum*
- *forums.compuserve.com/gvfo rums/default/asp?srv=photography*

Of the three I found, the Compuserve forum seemed to be the most promising. Maybe one of our readers can tell us of a photographic forum that leans more toward the repair end of the subject or toward projection equipment. I also invite readers who might be familiar with Hannimex to help us out here.

When Is CMOS Better Than TTL?

Q *As a designer, I would like to know when a TTL-based (5-volt) design is considered a better choice than a CMOS-based (12-volt) design and vice versa?—G.R.G., Scarborough, Ontario*

A You made the first comparison in your question. TTL is locked into operation with a 5-volt supply, while CMOS has a broad supply range. This broad supply range also gives CMOS better noise immunity. If the application is automotive, TTL can only be used if you add a power supply, while CMOS is ready-to-go for the 12- to 14-volt operation range found in modern automobiles.

CMOS also has the advantage of very low-power operation, especially when you're talking about static logic conditions. CMOS power consumption rises dramatically when you begin to change logic states rapidly.

During the early years of CMOS, its main advantage was low-power operation at the sacrifice of speed. However, that gap narrows each year as manufacturers begin to provide devices with the advantages of both processes. Nevertheless, battery power demands CMOS unless you're willing that your project battery have 550 cold-cranking amps available.

Often, the advantage of one over the other may not be in the performance, but in the function. For instance, a design that I'm working on for next month's column began as a TTL-based design only because I have a lot of TTL stock on hand. As I converted the design to CMOS for an automotive application, I was suddenly shocked to find that I couldn't match the circuit function-for-function. CD4xxx and 74Cxxx CMOS have few truly digital decoders; my original design had been based on a 74LS139. On the other hand, CMOS has analog multiplexers, bilateral switches, and Johnson counters, while TTL does not.

TTL is a logic system that's "listening to the fat lady sing;" many of its devices are long-since discontinued. CMOS is a still-developing technology that's seeing new devices on the market all the time. A designer looking to future repairability might not want to consider TTL for that reason.

Your question screams for me to put together an easy-to-read chart outlining the characteristics of all the available logic families. I'm just beginning to work on that, and maybe I'll have something that's publishable in a couple of months. Stay tuned!

Writing To Q&A

As always, we welcome your questions. The most interesting ones are answered in print. Please be sure to:

(1) include plenty of background information (we'll shorten your letter for publication);

(2) give your full name and address on your letter (not just the envelope);

(3) type your letter if possible, or write very neatly; and

(4) if you are asking about a circuit, include a complete diagram.

Questions can be sent to Q&A, **Poptronics** Magazine, 275 G Marcus Blvd., Hauppauge, NY 11788, or e-mailed to *q&a@gernsback.com*, but please do not expect an immediate reply in these pages (because of our backlog) and please don't send graphics files larger than 100K. Due to the volume of mail, we regret that we cannot give personal replies. P

NET WATCH

(continued from page 21)

to try something new. Here are just two fine examples of the many portals available.

IQSeek—When you log onto *www.iqseek.com* you'll find a delightful change to the boring portals of past. Aesthetically pleasing to the eye and chock full of links, this site has become a favorite of many a Web surfer. *IQSeek's* search engine is like a top-forty radio station, in that it complies lists from various other search engines when retrieving site information. *IQSeek* also offers e-mail, news and games (you have to try *Pong Attack* for a laugh).

HotDiary—Do you think you have the gumption to manage your own Portal? Head to *www.hotdiary.com* and live your dream. This free service leads you through the steps of setting up your own portal. Registering with *HotDiary* gives you numerous features, including: chat, link directory, file swapping, and file storage. Users can link their portals with other organizations, people, and/or businesses. The programmers at *HotDiary* use the term collaboration to describe the interaction.

AND AWAY WE GO!

Well, folks, I hope my words have inspired you to explore the Net even further. That is a pretty impressive machine you have perched upon your desk; don't be afraid to exploit it! Portals are just another way for us to travel—a virtual hub of social clubs, libraries, and terminals. So don't just stand there! Log on, click in, and link out. P

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JOHN IOVINE

Grey Walter's "Turtle" (Part 2)

Last month, we started building a replica of one of Grey Walter's experimental robots. Let's finish up the mechanical portion of the project so we can delve into the electronic control and—most importantly—the experiments.

We'll pick up with mounting the front drive wheel to the gearbox motor. The wheel used in this prototype is made to friction fit a 3-mm (0.118-inch) shaft. However, the shaft diameter of the 100:1 gearbox motor is about 2 mm (0.078 inch).

To solve this mismatch problem, I placed a 3-inch length of 3-mm hollow metal tubing on the gearbox motor shaft, using a flathead screwdriver and a hammer. It's important to support the motor's shaft and tubing on a hard (metal) surface; force can be applied directly on the shaft without damaging the gears or motor. The next step is to place the screwdriver head on the shaft-tubing assembly and hit it sharply with the hammer. This force causes the tubing to collapse onto the shaft, making a strong friction fit. Striking the 3-mm tubing in one or two locations gives extra insurance.

There is a keyway (flattened cutaway) cut into the gearbox motor shaft. Properly striking the tubing at that location collapses the tubing into the keyway, creating a very secure fitting.

The drive wheel is pushed onto the 3-mm tubing. The friction fit of the wheel is strong enough to drive the robot without any problem. If one wishes to mount the wheel permanently (something I have not done) to the shaft, I would suggest mixing slow-setting epoxy and coating the 3-mm shaft before mounting the wheel.

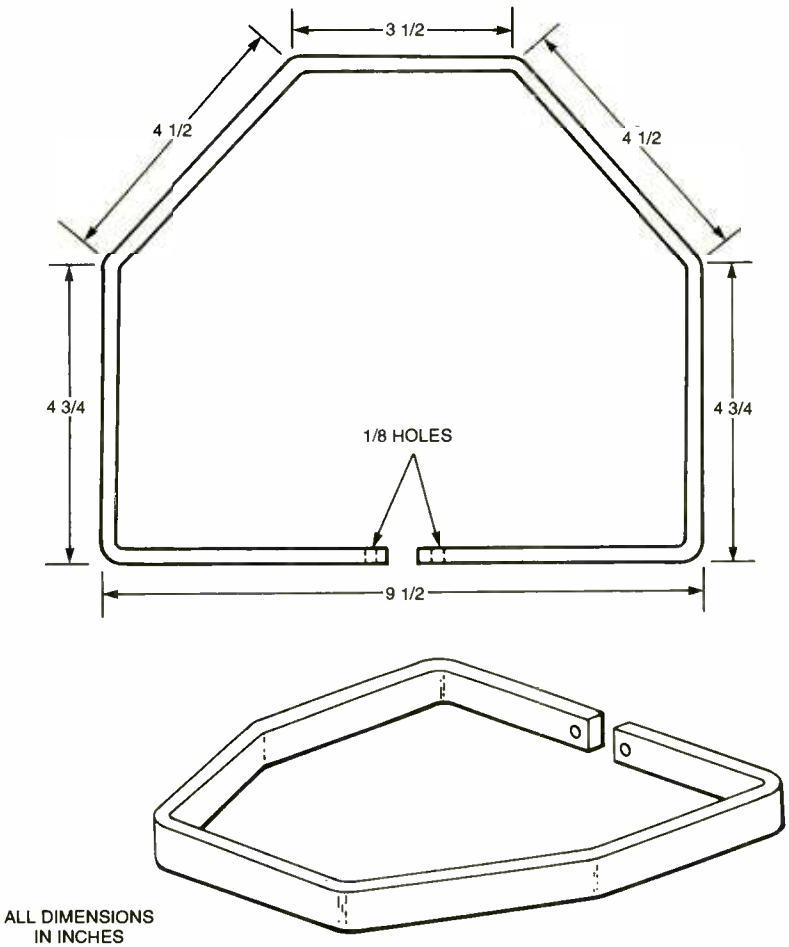

Fig. 1. The bumper is made from ⅛- × ½-inch aluminum bar.

Counterbalance

When the gearbox motor is mounted on the U channel, the weight of the gearbox motor on one side results in an off-balance assembly. To balance the U channel, I placed 3 to 4 ounces of ¼-inch lead sheet (that I happen to have on hand) on the opposite side. Cutting and drilling the lead is easy—just keep in mind the extreme health risks involved with lead exposure: Don't breathe the dust (use a mask) and wash thoroughly after working with the metal. Lead poisoning is not something to be taken lightly. As an alternative, mount any heavy object onto the shaft as a counterweight. Examples of such counterweights include "fender" washers and brass rod.

Shell

The original tortoise used a transparent plastic shell that was connected to a "bump" switch, which caused the robot to go into "avoid" mode when activated. After looking at, trying, and rejecting a number of different shells, I ended up fabricating my own shell. The term "shell" is used in a virtual sense here. The robot's skin consists of little more than a bumper that encompasses the device.

Take a 32-inch length of ⅛- by ½-inch aluminum bar, mark the center, and measure out the bend locations according to Fig. 1. Clamp the bar in a vise at each pencil mark and bend to the

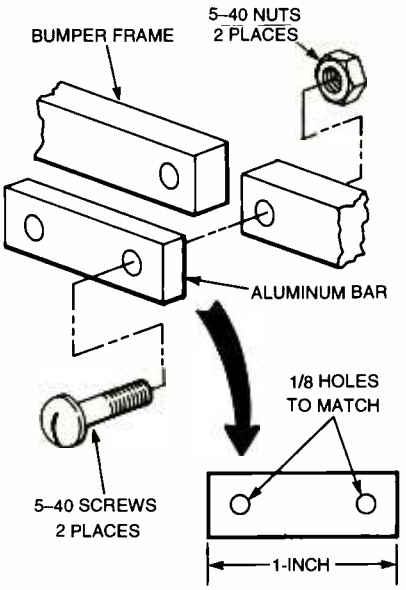

Fig. 2. The ends of the bumper are joined together with a splice plate, screws, and nuts.

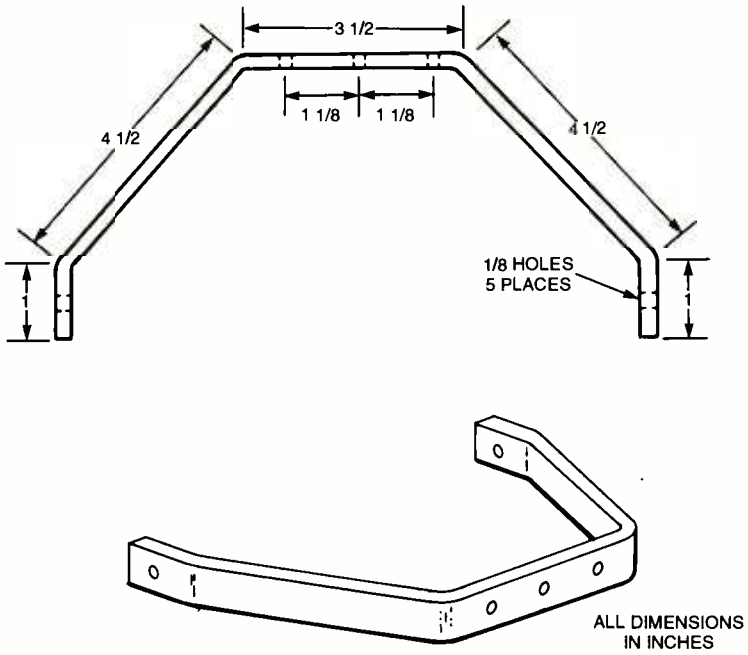

Fig. 3. The bumper bracket supports the bumper on the robot. Note how its dimensions match those of the bumper.

required shape. Note how the two ends meet at the center of the longest side. Drill two ⅛-inch holes in those ends and join them together with a 1-inch piece of similar aluminum barstock, screws, and nuts. I used 5-40 hardware, but you can substitute 6-32 screws and nuts if you have them available. Figure 2 shows the details.

The bumper is supported by an upper bracket that's shaped identically to the front end of the bumper. See Fig. 3 for the details and dimensions. The upper bracket is made from a 14½-inch length of the same size aluminum bar as the bumper. Mark and bend the bracket the same way.

The three holes at the top of the bracket (or center of the bar) will be used when mounting the bracket/bumper assembly to the robot. The two holes at the ends are where the bumper bolts to the bracket. Before drilling the holes in the bumper, it is necessary to...

Find The Center Of Gravity

Finding the bumper's center of gravity is important: The bumper assembly must be balanced, or it will not work. Identifying that location is simple. Rest the bumper's 4¼-inch sides on a length of aluminum bar; the "nose" and splice-plate joint are free to rock back and forth. Move the bumper back and forth until it balances evenly. Mark the centerline positions on each side of the bumper. Drill a ⅛-inch hole at those locations to match the holes on the ends of the bracket, and secure the bracket to the bumper using 5-40 machine screws and nuts.

Attaching Bumper to Base

Using the bracket as a guide, mark and drill three holes on the robot body behind the servomotor. The holes should be placed so that the bumper (once secured to the base) has adequate clearance (⅛- to ¼-inch) from the back wheels. The matching center hole on the base must be offset by about ¼ inch toward the front of the unit (closer to the steering servo).

The outer holes are used for mounting the bumper/bracket assembly. In each robot-base hole, place a 1-inch 6-

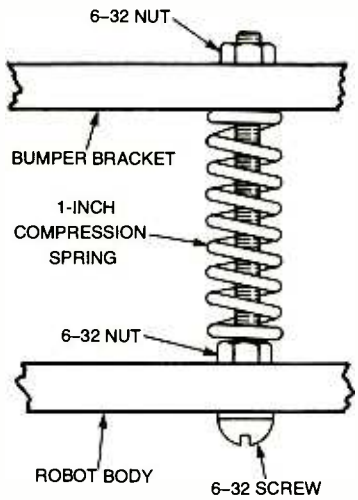

Fig. 4. The bumper bracket is supported on the robot by a pair of compression springs. How tight or loose you leave the top nuts determines the bumper's response to strikes and collisions.

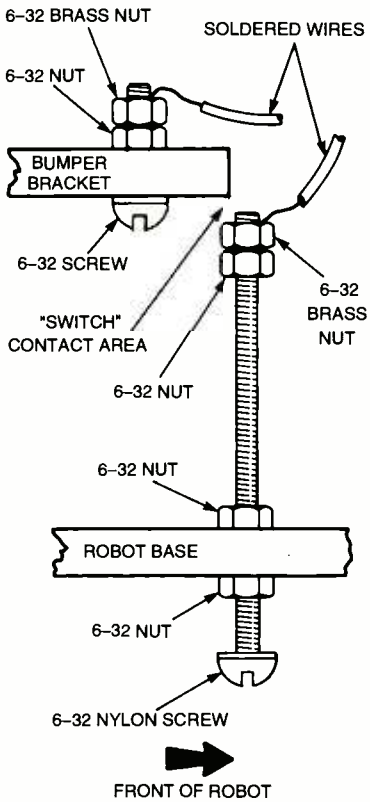

Fig. 5. The tilt switch closes when the robot strikes an object in front of it. The bracket forms one switch contact. The other contact is a brass nut supported on a plastic (nylon) screw. The space between the nut and the bracket contacts set the switch's sensitivity. Note that brass nuts are used for wire connections; brass is easy to solder.

Fig. 6. This close-up photograph shows the detail of the tilt switch and the spring mounting of the upper bracket.

32 machine screw pointing up and secure it with a nut. A 1-inch, 2-pound compression spring slips over each screw shaft. Rest the bumper/bracket assembly on the springs and add an additional nut on each screw. Those nuts adjust the bumper's tension and resiliency.

Each screw/spring mount should look like Fig. 4.

Tilt Switch

The tilt switch makes use of the center holes. See Fig. 5. On the bumper bracket, fit a 6-32 screw from the underside and lock it in place with a nut. Add a second nut for now. That nut, made from brass, is the "terminal" to which a wire will be soldered—the reason for using brass. Ever tried soldering to zinc-plated steel? It isn't easy—or even possible without specialized brazing equipment—for the average hobbyist to tackle. Brass is definitely the way to go.

The lower half of the tilt switch uses a 1-inch 6-32 *plastic* machine screw and four 6-32 nuts. Again, one nut must be brass for soldering a wire to this second "terminal." The screw—with one nut attached—is run up the hole in the robot base from underneath. A second nut locks the screw in place. Remember, when working with a plastic screw, don't overtighten the nuts or the screw threads will shear. Adjust the height of the screw so that it is close to, without touching, the bracket bar. The third nut and brass nut are fitted to the end of the screw. Their position is adjusted so that contact is made by the bumper bracket when the front of the bumper is pushed, tilting the bracket forward.

A close-up photograph of the completed tilt switch is shown in Fig. 6.

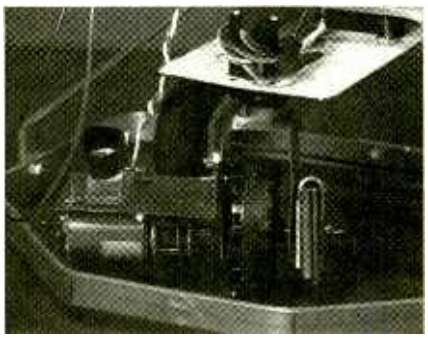

Fig. 7. The light sensor is mounted on the front wheel's gearmotor. The robot can "look" for the brightest light source by simply turning the wheel to the left or right. Note also the weights that counterbalance the gearmotor.

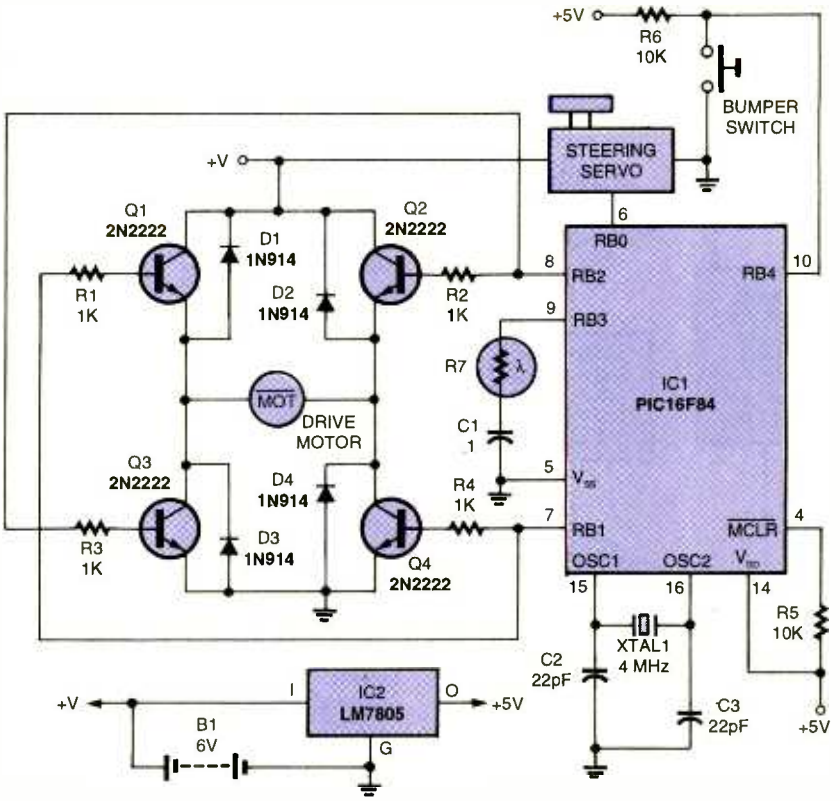

Fig. 8. Although we're replicating Walter's experiments, we don't have to restrict ourselves to the electrical controls he had at his disposal 50 years ago. We can only wonder what he would have done to get his hands on one of today's simple PIC microcontrollers!

Photoresistor

The cadmium-sulfide (CdS) photoresistor that I used in my prototype has a dark resistance of 100,000 ohms and a light resistance of 10,000 ohms. The top of the gearbox-motor bracket is a perfect shelf for mounting the photoresistor, as you can see in Fig. 7. I used a small piece of plastic to mount the photoresistor at a 45 angle. Mounting the photoresistor on the drive wheel assembly has the added advantage of keeping the photoresistor facing the same direction as the drive wheel—the direction that the robot is moving. This replicates the function of the original tortoise robots.

The photoresistor requires a shroud to block light from the sides. Without a shroud, the robot could not accurately sense the light direction from the photoresistor. I fabricated a shroud out of black paper, rolled and taped to a diameter slightly larger than the photoresistor. Slip the shroud over the photoresistor.

Brains And Brawn

The schematic for the robot is shown in Fig. 9. Intelligence for the robot is provided by IC1, a PIC16F84 microcontroller. Several input/output (I/O) pins send and receive signals to and from the robot's motors and sensors.

The steering servomotor requires a precise pulse train of a specific repetition rate and pulse-width range. That type of control signal is a perfect match for the capabilities of a PIC. The control signal appears on pin 6 (RB0) and connects directly to the servo.

The gearbox motor is driven by a standard "H-bridge" circuit consisting of Q1–Q4, D1–D4, and R1–R4. The H-bridge gets its name from the standard way the schematic is drawn: the four transistors form the sides and the motor is the center bar of the letter H.

Two signals from IC1, pins 7 (RB1)

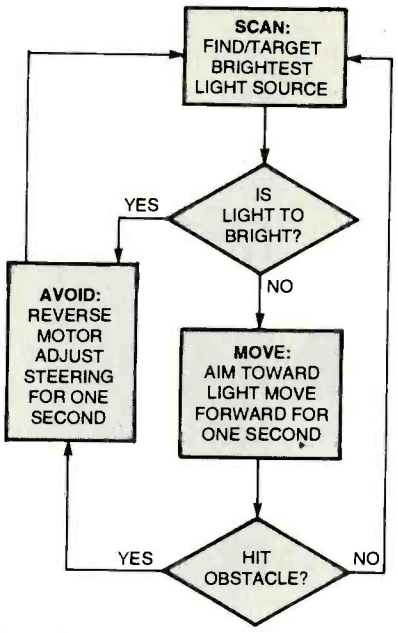

Fig. 9. The program has a very simple function as you can see from this flow chart.

and 8 (RB2), control the bridge. Only one signal is active at a time; note how each signal line turns on two diagonally opposed transistors. That way, one transistor supplies power to the motor and the other provides a ground path. If two transistors are on the same side, there would be a dead short across the power supply and would quickly burn out the transistors. Each transistor pair sends current through the motor in the opposite direction of the other pair. Reversing current through a DC motor reverses its rotation direction. According to the PIC's program, which we'll get to in a moment, pin 8 is designated "forward" and pin 7 as "reverse."

The resistors provide base-current limiting, and the diodes protect the transistors from any back-EMF current surges that motors (or any coil-based devices, for that matter) create when power is switched off. Those surges can damage transistors faster than you can say, "Do I smell smoke?" The diodes provide a safe path for those energy spikes.

On the input side, there are two sensors: the CdS photocell, R7, is read from pin 9 (RB3). Pin 10 (RB4) reads the tilt switch to check if the robot has encountered an obstacle.

Six-volt electrical power for the robot is supplied by a battery pack of four AA batteries. While I used this power supply for testing robot function, I suspect that the batteries may wear out quickly. For longer runs, a beefier battery pack is probably needed.

(Continued on page 64)

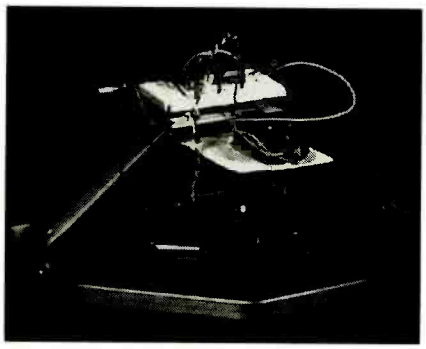

Fig. 10. The finished robot is ready to seek out light and explore its world.

LISTING 1

```
                                    'Turtle Software
                                    'Variables
symbol sv       =   b0              'Sweep value
symbol light    =   b1              'Light intensity value
symbol p1       =   b2              'pause value
symbol BL       =   b3              'Bright light value
symbol BL2      =   b4              'Too bright light value
symbol sv2      =   b5              'Stored sweep value
symbol t        =   b6              'Loop counter
                                    'assign variables
BL2             =   25              'Too Bright
BL              =   255             'Light Intensity Base
Start:
sv = 100:sv2 = 150:BL = 255
sweep:
pulsout 0, sv                       'Servo timing to pin 0
pot 4,255,light                     'Read CdS cell, store value in variable light
p1 = light/51                       'Create pause value from light reading
t = 8 - p1                          'use t for temp storeage
pause t                             'Use value to adjust timing to servo
if light <= BL2 then avoid          'Avoid Bright Light
if light < BL then store            'Store brightest light value in sweep
count:
sv = sv + 1                         'Finished sweep?
if sv > 200 then move               'Yes, then move
goto sweep                          'No, continue sweeping
move:
high 2                              'start motor forward
for t = 1 to 100                    'Start loop
pulsout 0, sv2                      'Aim toward the light
pause 18                            'servo timing
next t                              'continue loop
low 2                               'turn off motor
b7 = 0
button 5,0,255,0,b7,1,avoid         'Check tilt switch for obstacle
goto start
store:
BL = light                          'Store brightest reading in sweep
sv2 = sv                            'and its direction
goto count                          'go back to main
avoid:
high 1                              'reverse motor
if sv > 150 then back               'Check which way we're facing
if sv <= 150 then back2             'and turn away
hold:
low 1                               'cut motor
goto start                          'return to main
back:
sv = sv - 40
goto a2
back2:
sv = sv + 40
goto a2
a2:
for t = 1 to 100                    'start loop
pulsout 0, sv                       'aim
pause 18
next t
goto hold
```

SERVICE CLINIC

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SAM GOLDWASSER

Fuzzy Pictures and Other Annoyances

How has your VCR's color quality been, lately? How about picture quality? This month, we will talk about signal interference and how it can (and does) affect your viewing pleasure. We'll also examine the possible causes and cures for interference. So, with no further ado...

Why Does My VCR Record in Black and White?

If you can play pre-recorded tapes in color but not tapes recorded on this VCR, there may be several possible causes. The simplest is that your input signal is too weak—a misadjusted antenna or cable with a large number of splitters—and the VCR's color killer thinks there is no color. Sometimes the threshold for detecting the color signal is set higher on the VCR than the TV that you are using to monitor the recording. Here are some questions to ask:

- Is the color TV's fine-tuning set correctly?
- Does it play pre-recorded tapes in color?
- Does the tuner output produce color?
- Does the video output work in color?
- Is the problem the same for all recording speeds?
- Do the tapes you record on this VCR play in color on another one?

If the answer to all but the last question is "yes," then the problem is most likely in the video/chroma circuitry associated with the recording function. It could be as simple as the color killer setting being too low. There are other places to search when troubleshooting faulty color recordings—the tuner and the heads.

Check and see if the video output from the tuner is in color. A color image from the tuner indicates it is not a source of the problem. As for the heads, it is best to perform a scheduled routine of preventive maintenance—consisting of a thorough cleaning—insuring that they will not become a source of trouble. Dirty heads and magnetized heads can cause a myriad of woes to spring forth from your VCR (*the horror!*).

Help! My VCR Only Plays In Black and White

If you know your VCR's recording works fine, because the tapes made on it play in color on another VCR while pre-recorded tapes do not play back in color on your system—then there could be several possible causes (some of which were previously mentioned).

- Weak chroma signal level from VCR
- Color killer set too low on TV
- Problems in chroma circuits
- Marginal or dirty video heads

Note that in *all* cases of missing color, checking playback on another TV and/or adjusting the TV's controls should be tried first, as slight differences in signal levels between tuner and playback may cause a TV with marginal settings (fine tuning, color killer, chroma circuits) to switch unexpectedly between color and B/W.

I've Got Those RF Signal Blues

First determine whether there is a problem with broadcast or cable, playing tapes, or both. If it is only broadcast or cable, then your source may be at fault. If it is fine with the VCR off but noisy when using its tuner, the problem could be in the tuner itself. Verify that the direct video output (RCA jacks) works properly with a pre-recorded tape. If this is noisy as well, then there are problems with the video circuitry or video heads. If there are problems with the Channel 3/4 output, but the direct video outputs are fine; then suspect a weak or dead RF modulator. This is a little metal box with the ANTENNA IN and TV OUT connectors. It has circuitry that switches between the VCR's internal video signal and the antenna input. It also converts the video baseband signal to the Channel 3/4 output required by the TV. Inexpensive replacements are available.

Before you conclude that the RF modulator is to blame, check that the channel and fine-tuning of the TV are properly set and that there are no other problems with the TV. As before, test the VCR with another TV. It could be that the signal from the VCR is just a little weaker than it is used to be. Work the Channel 3/4 switch back and forth; it may have developed a bad contact. The other channel (3 or 4) might work better. Try moving the VCR away from the TV—sometimes interference from the TV will degrade the video quality.

VCR Will Not Tune Broadcast Or Cable

Are you sure that the input signal is making it to the VCR? Does the pass-through connection work? Double-check the connections. Connect the cable you have on the ANTENNA IN jack of the VCR directly to the TV. Make sure its center pin is not bent over or broken off. Try a new cable. Is the tuning mode switch (broadcast, CATV, etc.) set correctly on the VCR?

If the signal is preset into the VCR, there still may be a bad connection inside preventing it from making it to the VCR's tuner. Sometimes, there are RCA style plugs inside that work loose. Otherwise, the tuner of the VCR is not working. This could be because it is broken or power to it is bad or missing. If all other functions of the VCR are working, it is likely (though not guaranteed) that the power supply is fine. There could be bad connections or dirty connectors as well. Beyond probing for bad connections and verifying your antenna

hookup, there is not much that can be done without a service manual and test equipment.

If the problem is that it won't tune upper cable channels, that may be by design. Older VCRs (despite being called "zillion-channel cable ready") might not be able to deal with the upper channels of modern cables systems.

Interference Patterns, Such As Parallel Or Diagonal Lines

Such patterns may be due to the proximity of the VCR to a TV or other component, outside interference, or a fault in the VCR. Determine if it is in the video signal, or is it only present when the VCR is close to or sitting on/under the TV? Have you rearranged your setup recently? It is common for TVs and VCRs to interfere with each other's operation. Your only easy fix may be to shuffle the components in your entertainment center. It probably isn't the cables, but see if moving them around changes anything. If it does, then better (shielded) cables might help.

Does it happen when you are watching it from the antenna/cable, or only when a tape is playing or recording? Interference patterns on cable may indicate a problem with the cable company or the hookup. It may even be system-wide and under investigation—such temporary service problems are not uncommon. If you are using one or more splitters to distribute the signal to multiple locations, be aware that each one introduces some signal loss. Eventually this results in noticeable degradation making the system more susceptible to even low-level interference, which might otherwise be undetected.

Interference patterns while using the antenna may indicate just generally poor reception. Try repositioning the rabbit ears or outside antenna (if you have that option). Also check the connections and wiring (all the twisting and maneuvering can break or damage antenna cabling). Interference patterns only on recorded tapes that were not there in the original program may indicate a problem in the record circuitry of the VCR or interference from the TV (only if on). Patterns only on playback of tapes regardless of where they were recorded may indicate a problem in the playback circuitry of the VCR or interference from the TV. Did this just start suddenly without you changing *anything*? Does it now happen at all times of day?

If it does not happen all the time, try to determine what are the common factors when it does occur. Consider other sources of interference. Among them are local ham radio operators or other transmitters, light dimmers, compact or other fluorescent lamps, the vacuum cleaner—even your microwave oven. Although less likely, it may be a neighbor's appliance doing the interfering. To eliminate the VCR as the source of the problem, you may need to take it on a field trip to a friend or relative in a different neighborhood. If the patterns are still the same, it is probably a fault in the VCR and not outside interference.

Firing (Static) Lines In Picture During Playback

These lines may be described as static or short bright or dark lines in the picture. They usually have a sharp start and may trail off or stop abruptly. They may be occasional (once every few seconds) or frequent (multiple instances per video frame). This interference may also be a symptom of worn or damaged video heads. We'll cover video heads in detail at some future time.

Try a different tape—preferably a new recording made on a different VCR or a new commercial video. It is possible that these streaks are simply due to dropouts on the tape (either missing bits of oxide or dirt causing momentary loss of video signal). Old, worn, or cheap off-brand tapes are particularly prone to dropouts.

One characteristic of dropouts is that they may span video lines as well as video frames. If the lines are very short and random, a dirty, missing, or improperly positioned video-drum static brush may be the cause. In most VCRs, you will see a metal strip with a carbon contact pressing against the center of the video drum spindle either above or below the deck (or in rare instances, *between* the upper and lower cylinders). The brush is there to provide electrical contact between the rotating video drum and the stationary lower cylinder and chassis. This is necessary since the bearings on which the upper cylinder rotate may not provide adequate contact, and any static buildup caused by the spinning head cylinder rubbing against the tape may discharge through the bearings resulting in these firing lines. Carefully remove the static brush and clean the end of the spindle and carbon contact. This may be all you need to do to remove the static lines from the picture.

Multiple System Failures

Most VCR problems will be limited to a specific sub-system—video, audio, tuner, servo, or control. When multiple seemingly unrelated problems occur at the same time, suspect a power-supply problem since multiple systems may be fed from common power-supply outputs.

There are always several different voltages used within a VCR. If one of those voltages dies, some subsystems will work but will not receive the proper signals from the dead parts. So, nearly any kind of behavior is possible. Therefore, the first test is to determine, if possible, that the power-supply output voltages are correct—both with power off and power on.

When Power-Supplies Act Screwy

Power-supply problems can range from intermittent behavior due to slightly out-of-tolerance voltages, hum, or noise to a totally dead VCR. Multiple system failures can result if one or more of the half dozen or so voltages used within the VCR are incorrect or missing.

Power surges can harm your system. These may result in a totally dead VCR or in overstress and subsequent failure of various components. A power strip with a circuit breaker, even with a surge protector, is not a reliable protection against power surges especially during lightning storms. The only sure protection is unplugging electronic equipment during storms—but then, what would your insurance agent have to do?

Finding Faults

Troubleshooting is quite straightforward as the components are readily identified; and it is easy to trace through from the power transformer, bridge or center-tapped full-wave rectifiers, regulators, caps, etc. The circuitry is not usually complex, and the most common failures tend to be quite obvious. It should be possible to determine the correct output voltages from basic circuit principles.

Start at the line cord. If there is infinite resistance between the two prongs, there is a problem in the primary side of the transformer. A fuse may be blown, the transformer primary may be open (or a thermal fuse under the outer layers of insulation may be blown), or there may be bad connections between the line cord and the transformer. If this checks out, there may be a problem on the secondary side—bad rectifiers, tran-

sistors or IC regulators, or bad connections. It is unlikely that the secondary winding of the transformer itself is bad.

Failures of one or more of the outputs of these hybrid regulator blocks are very common. Use the ECG, STK, or NTE cross-reference guides to identify the correct output voltages. Test with the power switch in both positions. Any significant discrepancy indicates a likely problem. While an excessive load dragging down a voltage is possible, the regulator is the first suspect. See the document "VCR Power-Supply Regulators" at my Web site for the "pin outs" of some of the common ones. The correct output voltages will be specified on the regulator "pin out." Replacement cost is usually under $10. If you find *no* voltages on the regulator at all, go back and check, starting at the line cord as above.

Switching-supply problems are tougher to diagnose, but it is usually possible to do without service literature by tracing the circuit and checking for bad semiconductors with an ohmmeter. Common problems are: dried-up capacitors, shorted semiconductors, open startup resistors, and bad solder joints. For a sample circuit, see the document "Various Schematics and Diagrams"—also available at my Web site—which includes an example of a switching-power supply found (with minor differences) in many models of Panasonic (and clone) VCRs.

In a supply that is dead (has blown the main fuse), check *all* semiconductors, capacitors, and resistors as a failure in one may damage others. Just replacing the first one you find that is bad may result in it blowing immediately. Fusable (flameproof) resistors (blue or brown body or boxy ceramic power type) may open up if there was a shorted switching transistor. Power resistors supplying current for the start-up circuit may open from age. See the document "Notes on the Troubleshooting and Repair of Small Switch-mode Power Supplies" at my Web site for more detailed information.

Note: The initial test of checking between the prongs of the line cord for power-transformer-based supplies cannot be used with a switcher—it will likely always read open even if the supply is perfectly good.

Problems in either the power transformer/rectifier/filter capacitor section (usually no regulator) or switching supply are possible. However, they can pretty much be dealt with independently. Note: The switching supplies used in these VCRs usually run off of a lower voltage input than the more common off-line non-isolated type, making them somewhat less hazardous to your health to work on (see sidebar).

Problems can occur in either the battery charger or power-supply section. A bad battery usually has a short life span. If possible, try a known-good battery or battery eliminator first to determine which has the problem. Always check for the possibility of bad solder connections. The older style portable units were quite reliable and easy to service. However, modern camcorders are so jam-packed with micro-miniature, surface-mounted, unmarked circuitry that troubleshooting and repair is definitely not fun (Not to mention the joys of just getting inside with only a finite use of expletives).

VCR POWER SUPPLIES

WARNING! Make sure you understand the safety issues with respect to working on line-voltage circuits—at least part of the power supply is connected to the AC line, and switch-mode power supplies may have up to 300 V inside.

VCRs typically use one of four types of power supplies. (There are no doubt others).

Power Transformer with Linear Regulator—Using 78/79XX parts or discrete components, this type of power transformer will be large and very near the AC line cord.

Power Transformer with Hybrid Regulator—Like STK5481 or any of its cousins, this type will have multiple outputs with some outputs switched by power on. If it has one of these, check ECG, SK, or NTE, or post to the USENET newsgroup *sci.electronics.repair* and someone can probably provide the "pin out."

Small Switching-Power Supply—The most common problems that plague this type are shorted semiconductors, bad capacitors, and open fusable resistors. In this case, there is usually no large power transformer near the line input but a smaller transformer in a more central location.

Some Combination of the Previous—These types are less common. An input power transformer may supply low voltage to a switcher.

Camcorders and Portable Video Camera/VCR Combos—Mobile units include a battery charger and run all normal VCR (and camera) functions off the battery. The required voltages are derived using DC-to-DC inverters.

An Elephant Hit Your Power Pole

Power surges or nearby lightning strikes can destroy electronic equipment. However, most of the time, damage is minimal or at least easily repaired. With a direct hit, you may not recognize what is left of it!

Ideally, electronic equipment should be unplugged (both AC line and phone line!) during electrical storms, if possible. Modern TVs, VCRs, microwave ovens, and even stereo equipment is particularly susceptible to lightning and surge damage, because some parts of the circuitry are always alive; therefore there is a connection to the AC line. Telephones, modems, and faxes are directly connected to the phone lines. Better designs include built-in filtering and surge-suppression components.

With a near miss, the only thing that may happen is that the internal fuse blows or the micro controller goes crazy, requiring power cycling. There is no possible protection against a direct strike. Most VCRs have their own internal surge-protection devices like MOVs (Metal-Oxide Varistors) located after the fuse. So it is possible that all that is wrong is that the line fuse has blown. Remove the case (unplug it first!) and start at the line cord. If you find a blown fuse, remove it and measure across the in-board side of fuse holder and the other (should be the neutral) side of the line. With the power switch off, this reading should be very high. With the switch on, it may be quite low if the VCR uses a large power transformer (a typical primary resistance is 15 to 30 ohms).

Some VCRs may be outside this range; but if the reading is extremely low, the power transformer could have a partially or totally shorted primary. If it is very high (greater than 1000 ohms), then the primary of the power transformer may be open; or there may be a blown thermal fuse under the insulation wrappings of the transformer windings.

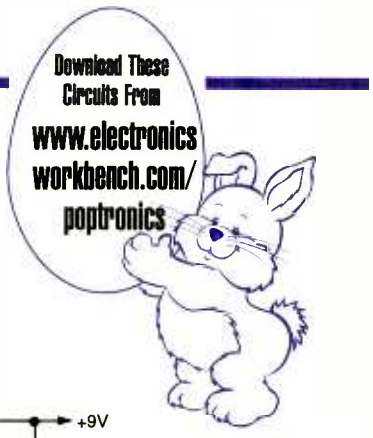
If the resistance checks out, replace the fuse and try powering on the unit. Hopefully it will work fine and the prob-

(Continued on page 64)

BASIC CIRCUITRY

mailto: basiccircuitry@gernsback.com

CHARLES D. RAKES



Stepping Out With The CD4017

Get ready for some real circuitry fun as we investigate the extremely versatile CD4017 CMOS IC divide-by- ten counter. The CD4017 is basically a decade counter with ten outputs that are normally low. The outputs sequentially turn on one at a time in response to a clock-input pulse. The output shifts one position for each positive clock pulse. The decade outputs can supply up to 10 mA to an external load—much greater than a standard CMOS output. In fact, that 10-mA capability is greater than standard LSTTL! The IC operates with a supply voltage of 5 to 16 volts.

All Those Pin Connections

The pin-connection layout for the CD4017 is shown in Fig. 1. Pins 1 through 7 and pins 9 through 11 are the ten output connections. Note that the outputs are *not* in numerical order. Power is supplied through pins 16 (positive voltage) and 8 (ground). The clock input is pin 14, and the clock enable is pin 13. A positive signal on pin 15 resets the count back to the first output pin. Finally, the divide-by-ten output is on pin 12. Think of that signal as a "cascading" output that can drive the next CD4017 if you want a row of devices.

But I'm getting ahead of myself. Let's start with the simple circuits and work our way up to the fancy stuff.

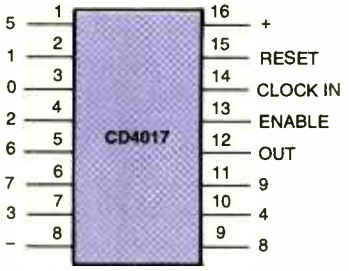


Fig. 1. The CD4017 has ten decoded outputs. The outputs go high in order one at a time with each pulse of the clock pin. Control over the device's behavior includes an enable line (to ignore clock pulses) and a reset line (to reset the output back to the "zero" output).

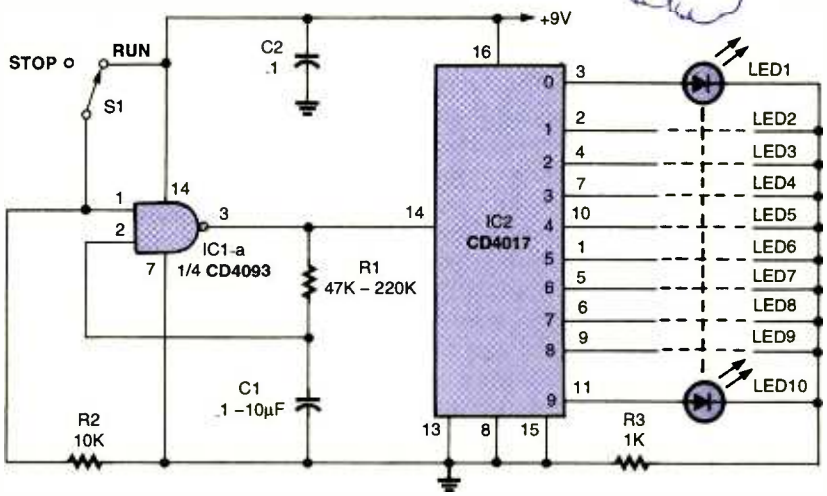


Fig. 2. This circuit demonstrates visually how the outputs turn on in sequence with each clock pulse. The NAND gate wired as an oscillator can be turned on and off with a simple switch. Note how the switch's output—thanks to R2—always presents a valid logic level to IC1-a's input.

PARTS LIST FOR THE "COUNTING-TO-TEN" CIRCUIT (FIG. 2)

SEMICONDUCTORS
IC1—CD4093 CMOS quad 2-input NAND Schmitt trigger, integrated circuit
IC2—CD4017 CMOS decade counter, integrated circuit
LED1–LED10—Light-emitting diode, any color

RESISTORS
(All resistors are ¼-watt, 5% units.)
R1—47,000-ohm to 220,000-ohm
R2—10,000-ohm
R3—1000-ohm

CAPACITORS
C1—0.1-µF to 10-µF, ceramic-disc or electrolytic
C2—0.1-µF, ceramic-disc

ADDITIONAL PARTS AND MATERIALS
S1—Single-pole, single-throw toggle switch

Counting To Ten

Our first counting, or stepping, circuit is shown in Fig. 2. One gate of a CD4093 quad two-input NAND Schmitt-trigger IC forms a simple low-frequency oscillator. The frequency, or *clock rate*, is determined by the values of C1 and R1—about one per second when R1 is a 220,000-ohm resistor and C1 measures 4.7 µF. In what sounds like some bizarre inverted law, lowering either or both component values increases the clock rate; raising them lowers it. Switch S1 turns the clock on or off.

WARNING! The inputs of the remaining three gates of the CD4093 must be tied to something; or you'll be sorry, 'cause bad things will happen to your circuit if you don't! Tie pins 5, 6, 8, 9, 12, and 13 to either ground or battery positive and be safe. That is simple, basic good design practice in the CMOS world. Since I deal with many CMOS devices in my columns, I should probably state that warning more often. On the other hand, I don't want to start sounding like the proverbial "broken record" and have you miss the details.

Now that I've spoken my piece, let's

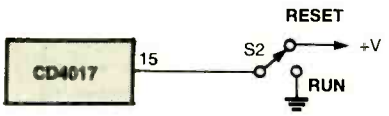


Fig. 3. To use the CD4017's reset function, simply connect pin 15 to the appropriate logic level: grounded to run, logic high to reset the output back to zero. Again, note how the switch is wired to always present a valid logic level to the input pin.

PARTS LIST FOR THE CD4017 RESET FUNCTION (FIG. 3)

S2—Single-pole, double-throw toggle switch

get off the soap box and back to the circuit. The CD4017 is connected in a typical zero-to-nine, count-and-recycle configuration. For the visual excitement of watching the chip in action, I connected an LED to each of the ten outputs, making it easy to keep track of the count. Since only one LED is on at a time, a single current-limiting resistor, R3, may be used for all ten LEDs.

The clock-enable (pin 13) and the reset (pin 15) inputs must be tied to ground for the circuit to function in the counting mode. On each positive edge of the clock's output, the counter advances one step. After step nine, the counter resets and starts over. This process continues as long as the clock runs. The counter can be reset to count zero by momentarily taking the reset pin from ground and connecting it to battery positive. If this is a desirable function, a single-pole, double-throw switch can be connected as shown in Fig. 3.

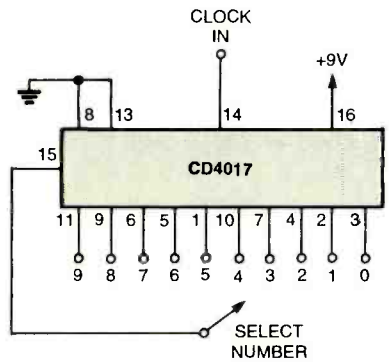


Fig. 4. Part of the CD4017's versatility is that you can set the chip to recycle its count at any number above one. Connect the reset line to the next higher output than what you want. When that line goes high, it resets the chip, bringing the reset line low. The amount of "flicker" depends on the chip's internal propagation time—how long it takes for an input signal (reset in this case) to affect the outputs.

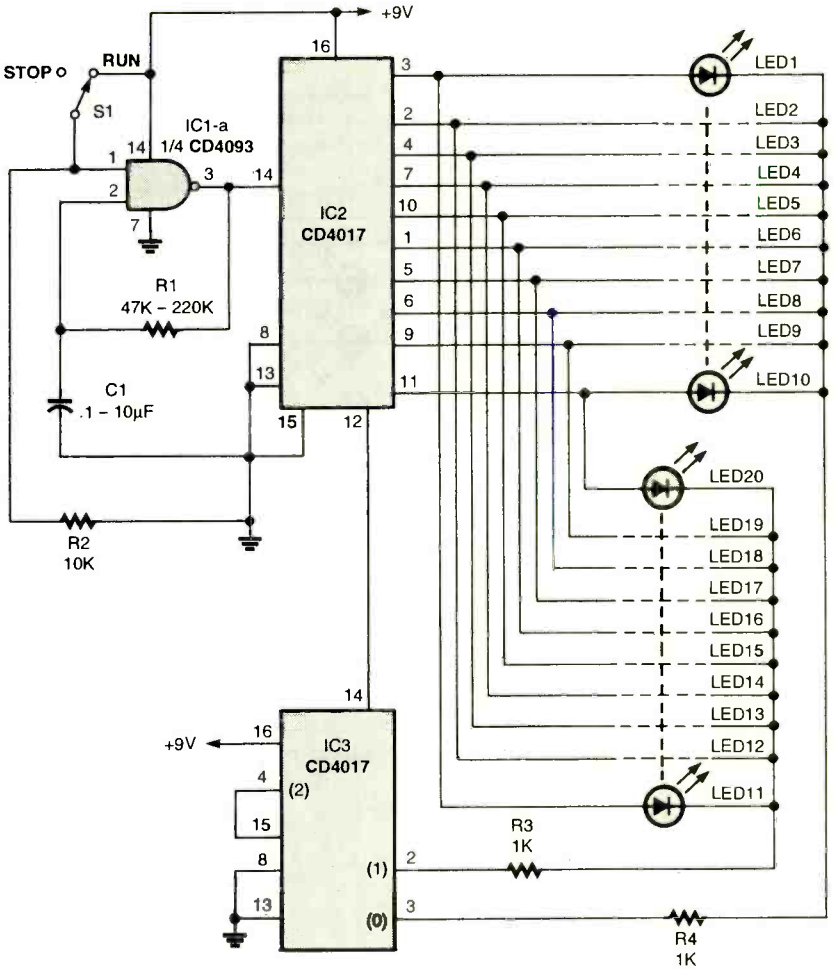


Fig. 5. Counting to 20 uses a second CD4017, acting as a "bank switcher." The outputs of IC2 supply current to the LEDs; IC3 grounds each bank in turn to supply a ground return.

PARTS LIST FOR THE "DOUBLE-THE-COUNT" CIRCUIT (FIG. 5)

SEMICONDUCTORS

IC1—CD4093 CMOS quad 2-input NAND Schmitt trigger, integrated circuit
IC2, IC3—CD4017 CMOS decade counter, integrated circuit
LED1–LED20—Light-emitting diode, any color

RESISTORS

(All resistors are ¼-watt, 5% units.)
R1—47,000-ohm to 220,000-ohm
R2—10,000-ohm
R3, R4—1000-ohm

ADDITIONAL PARTS AND MATERIALS

C1—0.1-µF to 10-µF, ceramic-disc or electrolytic capacitor
S1—Single-pole, double-throw switch

Doubling The Count

Counting to ten can be a drag, so let's see what we can do to up the total count without over-complicating the circuitry. One way is to use the counter's ten outputs twice in sequence. How do we do that? Easy—we use the CD4017's ability to count to a selected number and then recycle.

Take a look at the circuit in Fig. 4 to see how it's done. The reset function is the key to resetting the counter at any selected count. As long as the reset is low, the counter will cycle, but any time the reset goes positive, the counter resets to zero and recycles.

Counting to two and recycling is the function we need for our circuit to count to twenty and repeat. By connecting the reset pin to output number two (pin 4), the counter will count zero and one in the usual fashion. When the count advances to two, that output pin flickers high for a moment—just long enough to activate the reset function, which turns it off again. That action repeats as long as the counter receives clock pulses. The number of counts

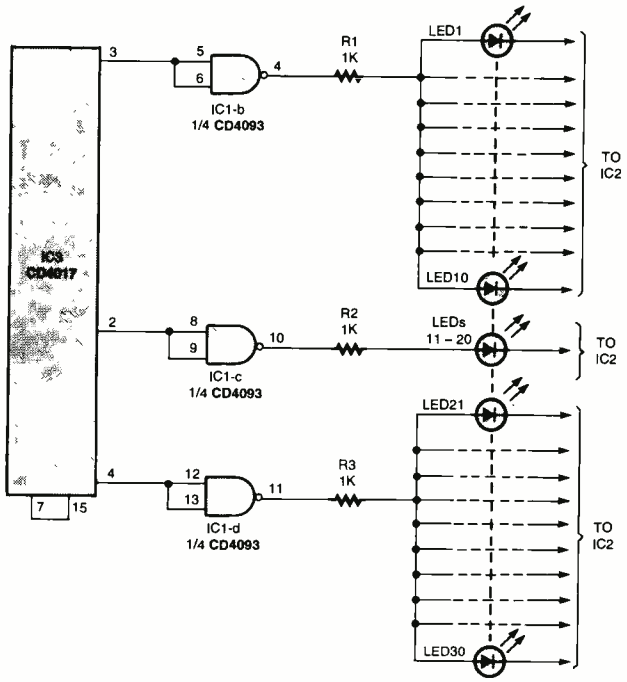


Fig. 6. Taking the count to 30 requires some additional hardware. A set of NAND gates acts as inverters. When the outputs of IC3 go high in turn, the additional IC1 gates invert the signal, presenting a ground return for the LED banks.

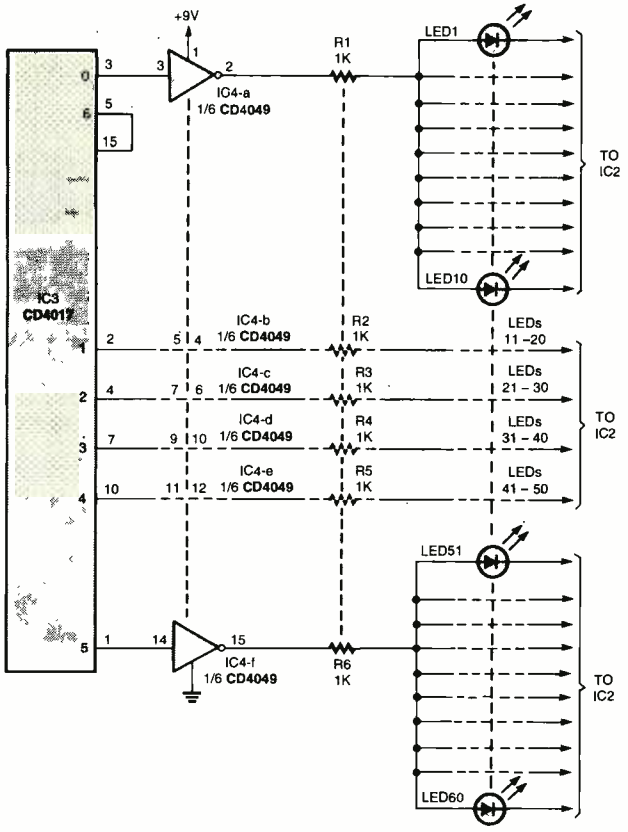


Fig. 7. Since we ran out of gates on IC1, we'll replace them with true inverters (IC4). Now we can count up to 60. This would make a great basis for a 60-LED clock, wouldn't it?

PARTS LIST FOR "COUNTING-TO-THIRTY" CIRCUIT (FIG. 6)

SEMICONDUCTORS
IC1—CD4093 CMOS quad 2-input NAND Schmitt trigger, integrated circuit
IC3—CD4017 CMOS decade counter, integrated circuit
LED1–LED30—Light-emitting diode, any color

RESISTORS
R1–R3—1000-ohm, ¼-watt, 5% resistors

can be any number from 2 to 9. Just connect the reset pin to one number greater than the desired cycle number, and the circuit will count to that number and recycle. I'll bet you have already figured out that our "double-the-count" circuit requires two CD4017s to get the job done.

Putting It All Together

The complete "Double-the-Count" circuit is shown in Fig. 5. The majority of the circuit—including IC1 and IC2—is nearly the same as in our original count-to-ten circuit. The second CD4017, IC3, is the count-to- two-and-repeat circuit just discussed. The clock input to IC3 comes from the divide-by-ten output at pin 12 of IC2.

Two rows of ten LEDs are connected to the outputs of IC2. The cathodes of the first ten LEDs are connected together, and the cathodes of the other ten LEDs are also connected together. The cathodes of the first ten LEDs are connected through a 1000-ohm resistor (R4) to the zero-count output of IC3, and the other ten LEDs through R3 to the one-count output.

Flip The Power Switch On

When you first apply power, IC3's output is at zero. The first clock pulse starts the count, sequentially lighting the first row of ten LEDs. The next clock pulse sends a positive output pulse from pin 12 of IC2 to the clock input of IC3. That pulse steps IC3's output, which produces a low at pin 2 and sets the second string of LEDs up to light in sequence. Pin 3 of IC3 is high during the second row count. After the second row completes its count, the process starts all over again and repeats as long as the clock is running.

What If?

What if we want to count higher than twenty? How can we do that? Actually, counting to thirty won't break a sweat,

PARTS LIST FOR THE "COUNTING-TO-60" CIRCUIT (FIG. 7)

SEMICONDUCTORS
IC1, IC2—see text
IC3—CD4017 CMOS decade counter, integrated circuit
IC4—CD4049 CMOS hex inverting buffer, integrated circuit
LED1–LED60—Light-emitting diode, any color

RESISTORS
R1–R6—1000-ohm, ¼-watt, 5% resistors

'cause most everything needed to increase the count is already available. The three unused gates of the CD4093 are just begging to be put into useful service.

To see how it's done, take a look at the circuit in Fig. 6. First off, we connect IC3's reset pin (pin 15) to pin 7 so the circuit will count to three and repeat. The three CD4093 NAND gates are connected to the three outputs of IC3.

Each of the NAND gate outputs is connected to a row of ten LEDs through a 1000-ohm current-limiting resistor. The LED anodes are connected to the

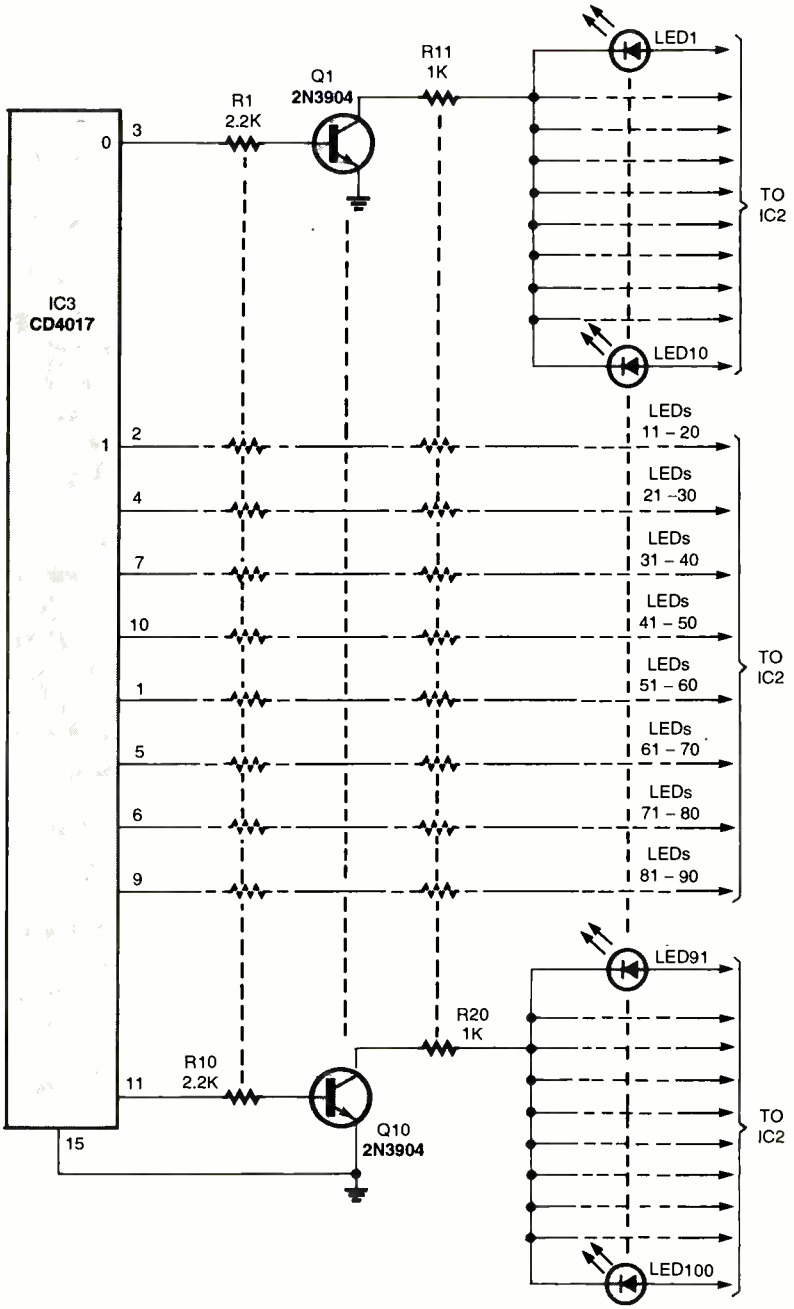


Fig. 8. Why limit ourselves to the gate count in standard IC packages? A general-purpose NPN transistor can do the same inverting function. Since transistors are individual devices, we can add as many as we want; are 100 LEDs enough for you?

PARTS LIST FOR THE TRANSISTOR-BASED INVERTER CIRCUIT (FIG. 8)

SEMICONDUCTORS

IC3—CD4017 CMOS decade counter, integrated circuit
Q1–Q10—2N3904 NPN general-purpose silicon transistor
LED1–LED100—Light-emitting diode, any color

RESISTORS

(All resistors are ¼-watt, 5% units.)
R1–R10—2200-ohm
R11–R20—1000-ohm

outputs of IC2 in the same order as in Fig. 5. Instead of two LEDs per output, there will be three.

Upping The Count

One of the wonderful attributes of electronic circuitry is its versatility. In many ways, designing a circuit parallels computer programming. Seldom do two programmers solve a problem in the same way. The same is true in designing an electronic circuit. With so many options to choose from, it's no wonder each of us often follows a different path. What's this got to do with our counter circuitry? It's an introduction to illustrate various ways in which we can modify our basic counter circuit to increase the number of counts.

The count can easily be stretched to 60 by adding a single CD4049 hex inverting buffer CMOS IC to the basic circuit. See how it's done in Fig. 7. We need to move IC3's reset pin (pin 15) connection to pin 5; that allows six counts before resetting and recycling. Six rows of ten LEDs are connected to the ten outputs of IC2 in the same way as in our previous circuit. Each time one of IC3's outputs goes high, the connected inverter converts the signal to a low, which creates a ground path for that string of ten LEDs. This function is repeated sequentially six times.

JACKING THE COUNT UP EVEN MORE

The circuit in Fig. 7 can easily be modified to handle greater counts by adding another CD4049 hex inverter. Using four of the inverters, expand the circuitry to a full 100 count. To do that, the reset pin of IC3 must be connected to ground, just like our count-to-ten circuit in Fig. 2. Also, four more banks of ten LEDs are connected to the outputs of the four inverters like the original six banks in Fig. 7.

TRANSISTOR INVERTERS

Here's our last entry for this visit. The circuit in Fig. 8 shows another method for switching the LED banks to ground in each group-of-ten count. Ten general-purpose 2N3904 transistors can be used in place of the inverter ICs with exactly the same functional outcome. In fact, any of the gates in the previous circuits may be replaced with 2N3904 transistors.

It's time to close for now, but be sure to be here next month when we'll look at some more CD4017 circuits. P

PEAK COMPUTING

(continued from page 28)

because few computer stores actually maintain listening rooms for computer speakers the way many audio sales places do for home-stereo speakers. That's a shame, since speaker preference is really more a matter of how a particular set of speakers "sound" to you than what a reviewer or spec sheet can tell you.

How much you'll like a particular set of speakers also has to do with how they are used and the type of material that's being played through them. If you mostly use your speakers to listen to rock music, you'll want different response characteristics than if you usually play classical or orchestra recordings. Game players have different needs than music lovers. All of these variables have to factor into your choice. P

AMAZING SCIENCE

(continued from page 56)

PARTS LIST FOR THE ROBOT CONTROLLER (FIG. 8)

SEMICONDUCTORS
IC1—16F84 PIC microcontroller, integrated circuit
IC2—LM7805 5-volt fixed voltage regulator, integrated circuit
Q1–Q4—2N2222 NPN silicon transistor
D1–D4—1N914 silicon diode

RESISTORS
(All resistors are ¼-watt, 5% units unless otherwise noted.)
R1–R4—1000-ohm
R5, R6—10,000-ohm
R7—Cadmium-sulfinde photocell, 100,000-ohm dark, 10,000-ohm light

CAPACITORS
C1—0.1- µF, ceramic-disc
C2, C3—22-pF, ceramic-disc

ADDITIONAL PARTS AND MATERIALS
XTAL1—4-MHz crystal
6-volt battery pack, wire, hardware, etc.

I assembled the entire circuit on a solderless breadboard. The breadboard was then mounted on the battery pack. The whole assembly was then mounted on the robot base. Double-stick tape can be a real friend for tasks such as these.

SUPPLY INFORMATION

Servomotors may be purchased at hobby shops or electronic distributors.

Electronic components may be purchased from:

Any local **RadioShack** store

Jameco Electronics
1355 Shoreway Rd.
Belmont, CA 94002
650-592-8097
www.jameco.com

JDR Microdevices, Inc.
1850 South 10th St.
San Jose, CA 95112
800-538-5005
www.jdr.com

Programmed PIC microcontrollers and front drive wheels may be purchased from:

Images Company
39 Seneca Loop
Staten Island, NY 10314
718-698-8305
www.imagesco.com

The Program

The program's flow chart is shown in Fig. 9; the actual code is given in Listing 1. Upon power up, the drive motor is turned off; and the microcontroller begins scanning for the brightest light source using the servomotor. If a light source is too bright, the robot jumps to the "avoid" mode. Avoid mode backs up the robot while turning the drive left or right. If the light isn't too bright, it aims the drive wheel at the brightest light source and powers the drive motor forward for one second. Then the robot stops the drive motor and checks the tilt switch. If the tilt switch is activated, the robot goes into avoid mode. If not, the process repeats from the beginning by scanning for the brightest light source.

The program is written for the *PICBasic* compiler, software that creates object code directly for the PIC16F84. The program should compile and run with little or no modifications on both the *PICBasic Pro* version of the compiling software and when loaded into a Basic Stamp microcontroller. One will need to rewire the robot to the appropriate I/O lines on the Stamp. If you don't have access to a compiler, you can get a pre-programmed chip directly from me; see the sidebar for contact information. Keep in mind, however, that the pre-programmed chips are "canned." If you have variances in your CdS sensor, drive motor, robot structure, and the like, the software cannot be adjusted for or modified. In that case, you'll have to "bite the bullet" and "roll your own" version of the basic software.

The finished robot is shown in Fig. 10. While the program functions properly, it is undeveloped. Given time, I would be able to modify the program to explore more interesting and exotic behaviors. If you'd like to explore this subject in greater detail, drop me an e-mail message. You can always contact me through the address at the start of the column. P

SERVICE CLINIC

(continued from page 59)

lem will be solved. If it immediately blew the fuse, then there is at least one component shorted—possibilities include an MOV, line-filter capacitor, or a transformer primary. Finally, if it will not work properly or still appears dead, then this could mean there are blown fuses, fusable resistors, or other defective parts in the power supply or other circuitry. In this case, further testing will be needed, and at some point you may require the schematic.

Until Next Time

I hope this month's column has been both educational and helpful. Now you have enough knowledge to troubleshoot your VCR's signal interference maladies, as well as fix frustrating faults within your system. Next month we will be changing gears and exploring new topics.

Please e-mail any comments/or suggestions to *serviceclinic@gernsback.com*. You can check out my Web site at *www.repairfaq.org* for all your repair and laser-optics-related questions. P

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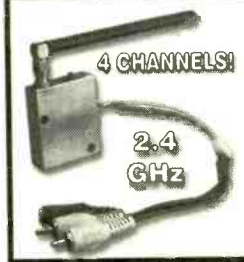

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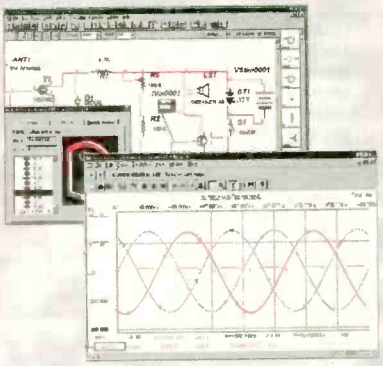

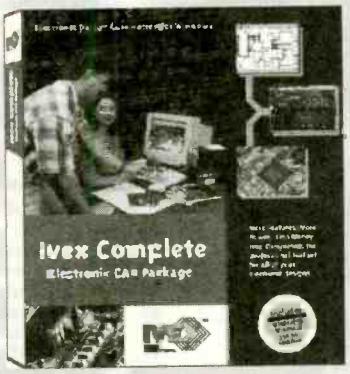

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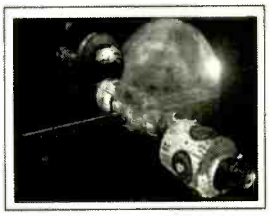

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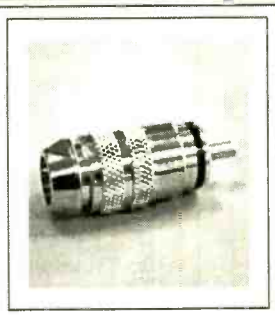

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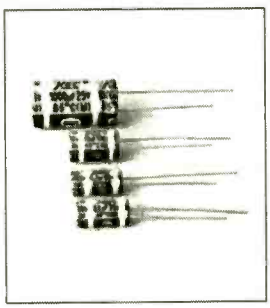

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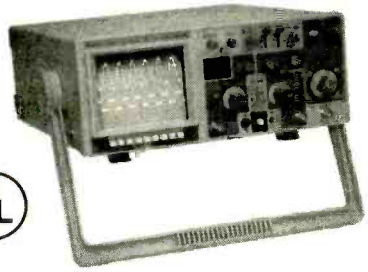

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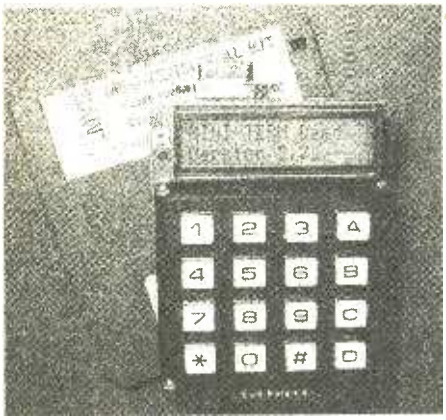

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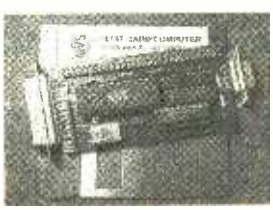

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Track down jammers and hidden transmitters with ease! This is the famous WA2EBY DF'er featured in April 99 QST. Shows direct bearing to transmitter on compass style LED display, easy to hook up to any FM receiver. The transmitter - the object of your DF'ing - need not be FM, it can be AM, FM or CW. Easily connects to receiver's speaker jack and antenna, unit runs on 12 VDC. We even include 4 handy home-brew "mag mount" antennas and cable for quick set up and operation! Whips can be cut and optimized for any frequency from 130-1000 MHz. Track down that jammer, win that fox hunt, zero in on that downed Cessna - this is an easy to build, reliable kit that compares most favorably to commercial units costing upwards of $1000.00! This is a neat kit!!

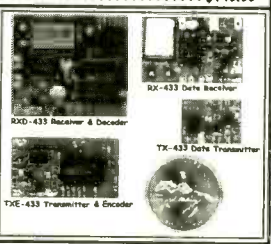
DDF-1, Doppler Direction Finder Kit $149.95

1 GHz RF Signal Generator

A super price on a full featured RF signal generator! Covers 100 KHz to 999.99999 MHz in 10 Hz steps. Tons of features; calibrated AM and FM modulation, 90 front panel memories, built-in RS-232 interface, +10 to -130 dBm output and more! Fast and easy to use, its big bright vacuum florescent display can be read from anywhere on the bench and the handy 'smart-knob' has great analog feel and is intelligently enabled when entering or changing parameters in any field – a real time saver! All functions can be continuously varied without the need for a shift or second function key. In short, this is the generator you'll want on your bench, you won't find a harder working RF signal generator - and you'll save almost $3,000 over competitive units!

RSG-1000B RF Signal Generator $1995.00

Wireless RF Data Link Modules



RF link boards are perfect for any wireless control application; alarms, data transmission, electronic monitoring...you name it. Very stable SAW resonator transmitter, crystal controlled receiver - no frequency drift! Range up to 600 feet, license free 433 MHz band. Encoder/decoder units have 12 bit Holtek HT-12 series chips allowing multiple units all individually addressable, see web site for full details. Super small size - that's a quarter in the picture! Run on 3-12 VDC. Fully wired and tested, ready to go and easy to use!

RX-433 Data Receiver..... $16.95 TX-433 Data Transmitter..... $14.95
RXD-433 Receiver/Decoder..... $21.95 TXE-433 Transmitter/Encoder..... $19.95

Super Pro FM Stereo Transmitter

Professional synthesized FM Stereo station in easy to use, handsome cabinet. Most radio stations require a whole equipment rack to hold all the features we've packed into the FM-100. Set freq with Up/Down buttons, big LED display. Input low pass filter gives great sound (no more squeals or swishing from cheap CD inputs!) Limiters for max 'punch' in audio - without over mod, LED meters to easily set audio levels, built-in mixer with mike, line level inputs. Churches, drive-ins, schools, colleges find the FM-100 the answer to their transmitting needs, you will too. Great features, great price! Kit includes cabinet, whip antenna, 120 VAC supply. *We also offer a high power export version of the FM-100 fully assembled with one watt of RF power, for miles of program coverage. The export version can only be shipped if accompanied by a signed statement that the unit will be exported.*

FM-100, Pro FM Stereo Transmitter Kit $249.95
FM-100WT, Fully Wired High Power FM-100. ..... $399.95

World's Smallest TV Transmitters

We call them the 'Cubes'.... Perfect video transmission from a transmitter you can hide under a quarter and only as thick as a stack of four pennies - that's a nickel in the picture! Transmits color or B&W with fantastic quality - almost like a direct wired connection to any TV tuned to cable channel 59. Crystal controlled for no frequency drift with performance that equals models that cost hundreds more! Basic 20 mW model transmits up to 300' while the high power 100 mW unit goes up to 1/4 mile. Their very light weight and size make them ideal for balloon and rocket launches, R/C models, robots - you name it! Units run on 9 volts and hook-up to most any CCD camera or standard video source. In fact, all of our cameras have been tested to mate perfectly with our Cubes and work great. Fully assembled - just hook-up power and you're on the air! One customer even put one on his dog!

C-2000, Basic Video Transmitter.....$89.95 C-2001, High Power Video Transmitter...$179.95

CCD Video Cameras

Top quality Japanese Class 'A' CCD array, over 440 line line resolution, not the off-spec arrays that are found on many other cameras. Don't be fooled by the cheap CMOS single chip cameras which have 1/2 the resolution, 1/4 the light sensitivity and draw over twice the current! The black & white models are also super IR (Infra-Red) sensitive. Add our invisible to the eye, IR-1 illuminator kit to see in the dark! Color camera has Auto gain, white balance, Back Light Compensation and DSP! Available with Wide-angle (80º) or super slim Pin-hole style lens. Run on 9 VDC, standard 1 volt p-p video. Use our transmitters for wireless transmission to TV set, or add our IB-1 Interface board kit for super easy direct wire hook-up to any Video monitor, VCR or TV with A/V input. Fully assembled, with pre-wired connector.

CCDWA-2, B&W CCD Camera, wide-angle lens $69.95
CCDPH-2, B&W CCD Camera, slim fit pin-hole lens.. $69.95
CCDCC-1, Color CCD Camera, wide-angle lens $129.95
IR-1, IR Illuminator Kit for B&W cameras $24.95
IB-1, Interface Board Kit $14.95

AM Radio Transmitter

Operates in standard AM broadcast band. Pro version, AM-25, is synthesized for stable, no-drift frequency and is setable for high power output where regulations allow, typical range of 1-2 miles. Entry-level AM-1 is tunable, runs FCC maximum 100 mW, range 1/4 mile. Both accept line-level inputs from tape decks, CD players or mike mixers, run on 12 volts DC. Pro AM-25 includes AC power adapter, matching case and bottom loaded wire antenna. Entry-level AM-1 has an available matching case and knob set that dresses up the unit. Great sound, easy to build - you can be on the air in an evening!

AM-25, Professional AM Transmitter Kit..... $129.95
AM-1, Entry level AM Radio Transmitter Kit... $29.95
CAM, Matching Case Set for AM-1..... $14.95

Mini Radio Receivers

Imagine the fun of tuning into aircraft a hundred miles away, the local police/fire department, ham operators, or how about Radio Moscow or the BBC in London? Now imagine doing this on a little radio you built yourself - in just an evening! These popular little receivers are the nuts for catching all the action on the local ham, aircraft, standard FM broadcast radio, shortwave or WWV National Time Standard radio bands. Pick the receiver of your choice, each easy to build, sensitive receiver has plenty of crystal clear audio to drive any speaker or earphone. Easy one evening assembly, run on 9 volt battery, all have squelch except for shortwave and FM broadcast receiver which has subcarrier output for hook-up to our SCA adapter. The SCA-1 will tune in commercial-free music and other 'hidden' special services when connected to FM receiver. Add our snazzy matching case and knob set for that smart finished look!

AR-1, Airband 108-136 MHz Kit..... $29.95
HFRC-1, WWV 10 MHz (crystal controlled) Kit..... $34.95
FR-1, FM Broadcast Band 88-108 MHz Kit $24.95
SR-1, Shortwave 4-11 MHz Band Kit $29.95
SCA-1 SCA Subcarrier Adapter kit for FM radio.... $27.95
FR-6, 6 Meter FM Ham Band Kit $34.95
FR-10, 10 Meter FM Ham Band Kit..... $34.95
FR-146, 2 Meter FM Ham Band Kit..... $34.95
FR-220, 220 MHz FM Ham Band Kit..... $34.95
Matching Case Set (specify for which kit).... $14.95

FM Stereo Radio Transmitters

No drift, microprocessor synthesized! Great audio quality, connect to CD player, tape deck or mike mixer and you're on-the-air. Strapable for high or low power! Runs on 12 VDC or 120 VAC. Kit includes snazzy case, whip antenna, 120 VAC power adapter - easy one evening assembly.

FM-25, Synthesized Stereo Transmitter Kit $129.95

Lower cost alternative to our high performance transmitters. Great value, easily tunable, fun to build. Manual goes into great detail about antennas, range and FCC rules. Handy for sending music thru 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 nice 'pro' look.

FM-10A, Tunable FM Stereo Transmitter Kit..... $34.95
CFM, Matching Case and Antenna Set $14.95
FMAC, 12 Volt DC Wall Plug Adapter..... $9.95

RF Power Booster

Add muscle to your signal, boost power up to 1 watt over a freq range of 100 KHz to over 1000 MHz! Use as a lab amp for signal generators, plus many foreign users employ the LPA-1 to boost the power of their FM transmitters, providing radio service through an entire town. Runs on 12 VDC. For a neat finished look, add the nice matching case set. Outdoor unit attaches right at the antenna for best signal - receiving or transmitting, weatherproof, too!

LPA-1, Power Booster Amplifier Kit $39.95
CLPA, Matching Case Set for LPA-1 Kit $14.95
LPA-1WT, Fully Wired LPA-1 with Case $99.95
FMBA-1, Outdoor Mast Mount Version of LPA-1 ..... $59.95

PIC-Pro Pic Chip Programmer

Easy to use programmer for the PIC16C84, 16F84, 16F83 microcontrollers by Microchip. All software - editor, assembler, run and program - as well as free updates available on Ramsey download site! This is the popular unit designed by Michael Covington and featured in Electronics Now, September 1998. Connects to your parallel port and includes the great looking matching case, knob set and AC power supply. Start programming those really neat microcontrollers now...order your PICPRO today!

PIC-1, PICPRO PIC Chip Programmer Kit $59.95

FM Station Antennas

For maximum performance, a good antenna is needed. Choose our very popular dipole kit or the Comet, a factory made 5/8 wave colinear model with 3.4 dB gain. Both work great with any FM receiver or transmitter.

TM-100, FM Antenna Kit $39.95
FMA-200, Vertical Antenna $114.95

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Range Hold Control: allows for manual selection of your test range
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Fuse-Protected Circuitry
Built-In Stand: Makes one hand operation easier.
Shock Absorbing Rubber Carrying Case: with convenient probe storage clips and hanging tab. Helps protect the DMM from damage if accidentally dropped.

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

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Specifications
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Vdc: ±1.0% reading +5 ditis
Vac: ±1.5% reading +8 digits
Adc: ±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
equires two AAA batteries sold separately.

Removable Hard Drive Rack

For IDE/Ultra DMA Hard Drives
We Sold Over 14,000 in 1998!

ONLY $14.95 any qty.

This product can be used with any 3-1/2 IDE hard drive up to 1" high. It includes an electronic keylock 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.*

#RH-10C-IDE

Removable Hard Drive Rack with Auto Door And Cooling Fan

ONLY $18.95 any qty.

- 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 series. Compatible with our RH17-IDE model.

#MR-27

Details at www.web-tronics.com

2GHz RF Field Strength Analyzer

ONLY $1629

- Frequency Range: 100KHz to 2,060MHz
- 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
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- *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.

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Sensational NEW Design for Small Observation Cameras. *Smaller and Better!*

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- *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*

Detailed Specs on the Web

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

Bullet CCD Cameras B&W and Color

Detailed Specs on the Web

LOWER PRICES

- *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.

COLOR CCD Mini Board Cameras

PRICE REDUCTION $159

Detailed Specs on the Web

- *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.

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- 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.

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 setclon.

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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
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LED Accuracy: Voltage ±1% +2 digits
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Dimensions: 291mm x 158mm x 136mm

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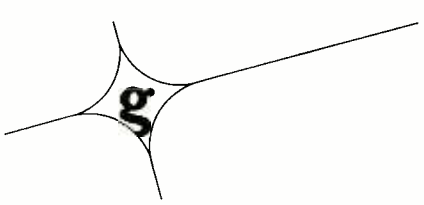
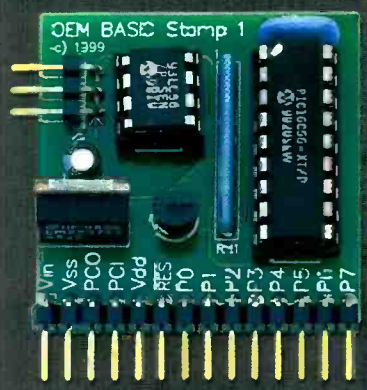


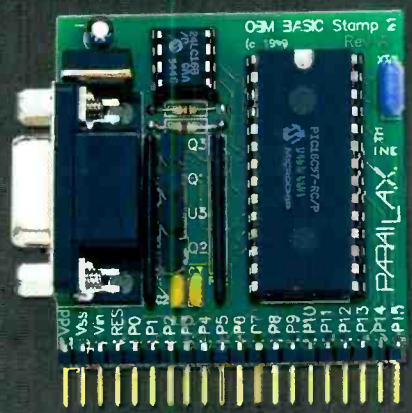
OEM BASIC Stamps are...

Breadboard Friendly!



BASIC Stamp 1 OEM module $45 (#27295)

The original BS1 OEM module is available in a handy through-hole format. This module has a 3-pin header for your parallel port. The module plugs into a breadboard where it connects to +5 V, ground, and 8 I/O pins. The OEM Stamp 1 holds about 80 lines of code and executes 2,000 instructions per second.



BASIC Stamp 2 OEM module $59 (#27290)

The very popular BS2 OEM module has a DB-9 serial connector built right onto the board. All parts are socketed for easy replacement. Our PBASIC interpreter runs in a PIC16C57 and executes 4,000 instructions per second. Holds about 500 lines of code. Useful commands for serial, DTMF and sound.

Order online at
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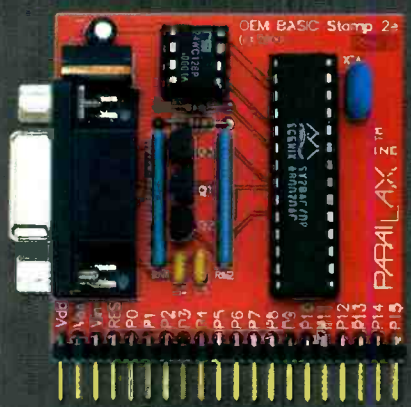
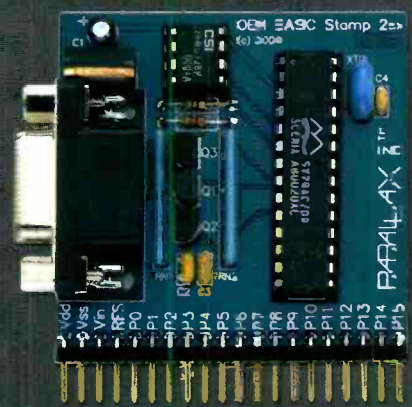


BASIC Stamp 2e OEM module $59 (#27293)

The OEM BS2e module is the solution for customers who need additional RAM and EEPROM space from a OEM Stamp 2 without the higher speed (and associated power consumption) of an OEM BS2SX module. Executes 4,000 instructions per second and holds about 4,000 lines of PBASIC code. Our interpreter runs from a SX28AC/DP.



BASIC Stamp 2sx OEM module $59 (#27294)

The OEM BS2sx is 2.5 times faster than the BS2e (left). Ideal solution for BS2 users who have needed additional program execution speed. Executes about 10,000 instructions per second and holds about 4,000 lines of PBASIC code.

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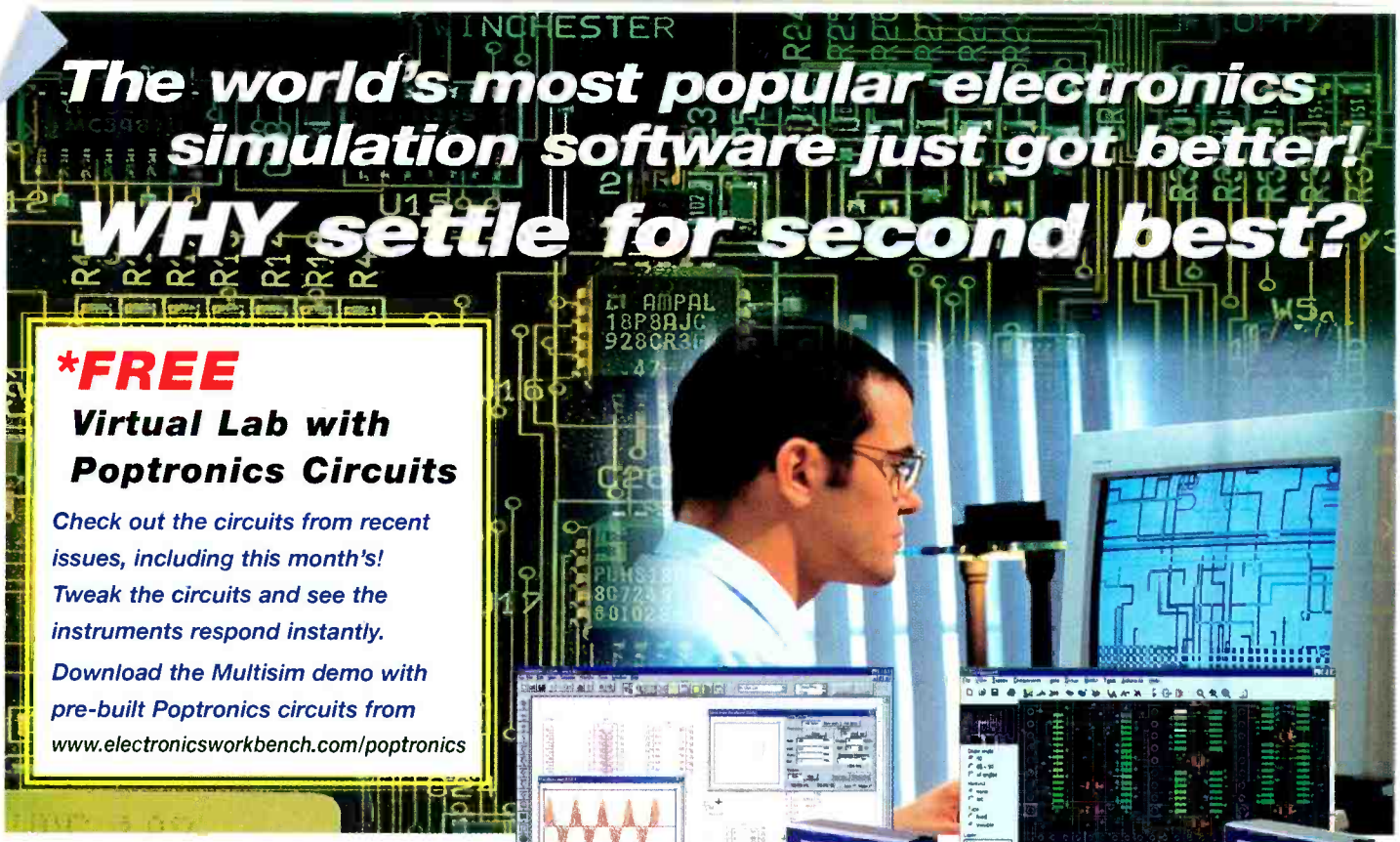

*FREE
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~~$399~~ **$299**

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- OLE integration with Excel/MathCAD

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- Automatic net highlighting (selective)
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Don't settle for a program that has less than:

- 3,000+ library of footprint shapes
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