

Enclosed Switching Power Supplies **UL Approved**

Single, Dual & Triple Output Models **NOW IN STOCK!**

Single Output Supplies (5V, 12V, 15V, 25V)

25 watt series **AS Low as \$20.55 ea.**

60 watt series **AS Low as \$27.95 ea.**

150 watt series **AS Low as \$42.95 ea.**

Dual Output Supplies

100W, 5V/12V

100W, 5V/24V ...as low as \$38.00

50W, 5V/24V ...as low as \$27.00ea.

Triple Output Supplies

100w, 5v/12v/-5V as low as \$44.00

100w, 5V/12V/-12V as low as \$44.00

See Our Web Site for Details

Removable Hard Drive Rack

For IDE/Ultra DMA Hard Drives

We Sold Over 14,000 in 1998!

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

ONLY \$14.95 any qty.

#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

- Frequency Range: 100KHz to 2,000MHz
- Narrow Band FM (NFM), Wide Band FM (WFM), AM and Single Side Band (SSB) Modulated Signals May Be Measured
- PLL Tuning System for Precise Frequency Measurement and Tuning
- LED Backlight LCD (192x192 dots)
- Built-In Frequency Counter
- Hand-Held and Battery Operated
- All Functions are Menu Selected
- RS232C for PC Interface and Printer

ONLY \$1989

#3201

CTRL - D to bookmark this site

www.web-tronics.com

Don't forget the dash

- Easy to Navigate
- Includes a Search Engine That Really Works
- New Items Added Constantly

Circuit Specialists Inc.

In Business Since 1971

Mini CCDs (B/W & Color)

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

- Ultra Miniature Design
- Black & White Versions Only 25mm x 25mm
- Color Versions Only 32mm x 32mm
- Available in Standard Lens or Pinhole Lens

All Include Pre-Wired Cable Harness for Video & Power

12V Regulated Power Supply Required (120mA typical power consumption)

- 0.1 LUX Rating (B/W), 1 LUX (color)
- CCD Area Image Sensor for Long Camera Life
- Back Light Compensation Circuit
- Built-In Electronic Auto Iris Lens

VMCW-H11A 32mmx32mmx30mm, Color CCD with standard lens, pre-wired cabling 12V DC Power \$139.00 / \$129.00 5 or more

VMCW-H12A 32mmx32mmx19mm, Color CCD with pinhole lens, pre-wired cabling, 12V DC Power Input \$139.00 / \$129.00 5 or more

VMPS-718A 25mmx25mmx30mm, B/W CCD with standard lens, pre-wired cabling, 12V DC Power Input \$59.00 / \$49.00 5 or more

VMPS-250A 25mmx25mmx15mm, B/W CCD with pinhole lens, pre-wired cabling, 12V DC Power Input \$59.00 / \$49.00 5 or more

VCC-3232 32mmx32mmx30mm, CMOS COLOR, std lens, see web for specs \$79.00 / \$72.00 5 or more

LOWER PRICES

Detailed Specs on the Web

CCD B&W Board Cameras

- ASIC CCD Area Image Sensor
- Extremely Low Power Consumption
- 0.5 Lux Min Illumination
- Built-In Electronic Auto Iris for Auto Light Compensation

VM1030PA-B 30mmx30mmx25mm, Pinhole lens, 12V \$39.00 any qty.

VM1030A 30mmx30mmx26mm, Standard lens, 12V \$39.00 any qty.

VM1035A 42mmx42mmx25mm, Standard lens, 12V with back light compensation \$49.00 any qty.

VMCB21 44mmx38.5mmx28mm, with 6 infra-red LEDs, 12V \$49.00 any qty.

VM1036A 32mmx32mmx25mm, Standard lens, 12V, reverse mirror image feature \$49.00 any qty.

Detailed Specs on the Web

LOWER PRICES

Bullet CCD Cameras B&W and Color

- Smart Rugged Metal Housing
- Extremely Low Power Consumption
- 12 Volt
- CCD Area Image Sensor for Long Camera Life
- Built-In Electronic Auto Iris for Auto Light Compensation
- No Blooming, No Burning
- 0.1 Min Lux Illumination (B&W), 1 Lux Min Lux Illumination (color)

VMBLT1020 B&W, 21mm(D)x58.5mm(L) \$54.00 any qty.

VMBLT1020W B&W Weatherproof, 21mm(D)x58.5mm(L) \$79.00 any qty.

VMBLTJC19BW COLOR! Weatherproof, 17mm(D)x88mm(L) \$139.00 any qty.

Detailed Specs on the Web

LOWER PRICES

COLOR CCD Mini Board Cameras

- Low Power Consumption
- 1 Lux Illumination
- Internal Synchronization
- 12Volts
- 400 TV Lines
- Built-In Electronic Auto Iris for Auto Light Compensation

VM3010PA 33mmx33mmx18mm, Pinhole lens \$99.00 any qty.

VM3011-A 45mmx40mmx24mm, Standard lens, single board \$89.00 any qty.

VM3010-A 33mmx33mmx32mm, Standard lens \$99.00 any qty.

Detailed Specs on the Web

PRICE REDUCTION

DC to AC Power Inverters!

150 watt up to 3000 watt models!

150w modified sine wave: \$29.95(G-12-015B)

300w modified sine wave: \$39.95(G-12-030)

150w pure sine wave: \$69.00(G-12-150S)

300w pure sine wave: \$109.00(G-12-300S)

800w modified sine wave: \$139.00 (G-12-800)

1000w modified sine wave: \$179.00(G-12-100)

3000w modified sine wave(phase corrected), (G-12-300).....\$489.00

See Our Website for DETAILED Specs.!

Industry Best Pricing!

PROTEK 506

Our Most Sophisticated DMM **We Sold Over 700 Last Year!**

with RS-232 Interface & Software: 3-3/4 Digit, 4000 Count, Auto-Ranging with Analog Bargraph

- True RMS Mode
- 10MHz Frequency Counter
- Time Mode with Alarm, Clock, and Stop Watch
- Dual Display
- 10 Location Memory
- Min, Max, Avg and Relative Mode
- Decibel Measurement
- Cap and Ind. Measurement
- Temperature Mode (C/F)
- K-Type Temperature Probe Included
- Pulse Signal for Logic & Audible Test
- Continuity/Diode Test
- Logic Test
- Auto Power OFF/ Keep ON* Mode
- Fixed 20A Input with Warning Beeper
- Back Light
- Data Hold/Run Mode
- Safety Design UL1244 & VDE-0411
- Protective Holsler
- Silicon Test Leads

NOW ONLY \$149

Reg. \$169

More Details on our Web Site

BEST DEALS! **new!**

NOW OFFERING

Dish Network & Direct TV

Great Equipment & Service

See Our Website for our Incredible Offers!

Also Great HDTV Prices!

new! O'Scope Offer ONLY \$299

30MHz! ONLY \$299!

Industries Best Price!

See web for specs

#OSC-1030

- Dual Channel
- Dual Trace
- Vert Trigger
- 1 Year C.S.I. Warranty!

Manufactured for CSI by a leading O.E.M. manufacturer. See our website for detailed specifications!

3000 Series Digital R/O Bench Power Supply

• Low Cost Single Output • 3 Amp

AS LOW AS \$89

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: $2 \times 10^{-4} + 1\text{mA}$

Load Regulation: $1 \times 10^{-4} + 5\text{mV}$

LED Accuracy: Voltage $\pm 1\%$ + 2 digits

Current $\pm 1.5\%$ + 2 digits

Wave Line Noise: $\leq 1\text{mVrms}$

Dimensions: 291mm x 158mm x 136mm

CSI 3003: 0-30v/0-3amp Digital R/O Bench PS, 1x10⁻⁴+5mv Load Regulation \$99.00 5/\$89.00

CSI 5003: 0-50v/0-3 amp Digital R/O Bench PS, 1x10⁻⁴+5mv Load Regulation \$129.00 5/\$119.00

Poptronics®

THE MAGAZINE FOR THE HANDS-ON ELECTRONICS ACTIVIST!

FEATURES

BUILD YOUR OWN PENTIUM IV SYSTEM Ted Needleman 25
Learn how to save money by building your own custom PC.

A HIGH-TECH MP3 PLAYER OF YOUR OWN Paul Stoffregen 27
Here are the plans for constructing a high-tech MP3-audio device.

PRODUCT REVIEWS

GIZMO® 7
Catch up on the latest consumer electronics including Web phones and pet trainers.

DEPARTMENTS

TEST YOUR KNOWLEDGE 3
How well do you know your components and schematic symbols?

PROTOTYPE 10
See how cars and roads are learning to communicate electronically for safer driving.

SURVEYING THE DIGITAL DOMAIN Reid Goldsborough 14
It looks as if the Internet is here to stay, so learn how to connect.

TECHSCOPE Elizabeth Jamison 21
Here is a primer on how Global Positioning Satellites help us navigate.

PEAK COMPUTING Ted Needleman 23
How fast is the new Pentium IV? Ted puts the newest Intel CPU to the test.

Q&A Dean Huster 45
Readers' questions are brought to light.

ROBOTICS WORKSHOP Scott M. Savage 49
The latest software makes robot building easier and even more fun.

AMAZING SCIENCE John Iovine 53
Real electronics are used for a speculative science.

SHORT CIRCUITS 57
Use these schematics for building basic test equipment.

BASIC CIRCUITRY Charles Rakes 59
See how transducers are used to build a shooting gallery.

AND MORE

NEW LITERATURE5

YESTERDAY'S NEWS16

POPTRONICS SHOPPER63

ADVERTISING INDEX82

FREE INFORMATION CARD82A

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

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

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

January 2002, Poptronics

Poptronics

REPRINT BOOKSTORE

- | | |
|---|---|
| <input type="checkbox"/> 229 Popular Electronics (1999 back issues) \$5.00
Write in Issues desired _____ | <input type="checkbox"/> 218 Electronics Now (1998 back issues) . \$5.00
Write in Issues desired _____ |
| <input type="checkbox"/> 228 Popular Electronics (1998 back issues) \$5.00
Write in Issues desired _____ | <input type="checkbox"/> 217 Electronics Now (1997 back issues) . \$5.00
Write in Issues desired _____ |
| <input type="checkbox"/> 227 Popular Electronics (1997 back issues) \$5.00
Write in Issues desired _____ | <input type="checkbox"/> 216 Electronics Now (1996 back issues) . \$5.00
Write in Issues desired _____ |
| <input type="checkbox"/> 226 Popular Electronics (1996 back issues) \$5.00
Write in Issues desired _____ | <input type="checkbox"/> 215 Electronics Now (1995 back issues) . \$5.00
Write in Issues desired _____ |
| <input type="checkbox"/> 225 Popular Electronics (1995 back issues) \$5.00
Write in Issues desired _____ | |
-
- | REPRINTS | REPRINTS |
|---|--|
| <input type="checkbox"/> EH96 Experimenters Handbook (1996) . . . \$5.00 | <input type="checkbox"/> 174 Electronics Cartoons (The Best of) . . . \$1.99 |
| <input type="checkbox"/> EH95S Experimenters Handbook
Summer Edition (1995) . . . \$5.00 | <input type="checkbox"/> 173 From Not-Working to Networking
Troubleshooting Local-Area Networks \$2.99 |
| <input type="checkbox"/> EH94S Experimenters Handbook
Summer Edition (1994) . . . \$5.00 | <input type="checkbox"/> 172 33 Bench-Tested Circuits . . . \$1.99 |
| <input type="checkbox"/> EH94W Experimenters Handbook
Winter Edition (1994) . . . \$5.00 | <input type="checkbox"/> 171 36 Time Tested Circuits . . . \$1.99 |
| <input type="checkbox"/> EH94 Experimenters Handbook (1994) . . . \$5.00 | <input type="checkbox"/> 170 High-Voltage Project for Fun and
Science Book 1 . . . \$2.99 |
| <input type="checkbox"/> EH93 Experimenters Handbook (1993) . . . \$5.00 | <input type="checkbox"/> 170A High-Voltage Projects for Fun and
Science Book 2 . . . \$2.99 |
| <input type="checkbox"/> HH95S Hobbyists Handbook
Spring Edition (1995) . . . \$5.00 | <input type="checkbox"/> 169 Think Tank (133 Circuits) . . . \$1.99 |
| <input type="checkbox"/> HH95F Hobbyists Handbook
Fall Edition (1995) . . . \$5.00 | <input type="checkbox"/> 169A Think Tank Vol. 2 . . . \$1.99 |
| <input type="checkbox"/> HH94S Hobbyists Handbook
Spring Edition (1994) . . . \$5.00 | <input type="checkbox"/> 168 Fact Cards (#34-66) . . . \$1.99 |
| <input type="checkbox"/> HH94F Hobbyists Handbook
Fall Edition (1994) . . . \$5.00 | <input type="checkbox"/> 168C Fact Cards (#67-99) . . . \$1.99 |
| <input type="checkbox"/> HH93 Hobbyists Handbook (1993) . . . \$5.00 | <input type="checkbox"/> 168D Fact Cards (#100-132) . . . \$1.99 |
| <input type="checkbox"/> HISTORY Crystal Radio History, Fundamentals
& Design . . . \$10.95 | <input type="checkbox"/> 167 Designing With IC's . . . \$2.99 |
| <input type="checkbox"/> XTAL Crystal Set Handbook . . . \$10.95 | <input type="checkbox"/> 166 Collected Works of Mohammed Ullyses
Fips (62 pages, April Fools Collection) \$6.99 |
| <input type="checkbox"/> XTALPRO Crystal Set Projects . . . \$14.95 | <input type="checkbox"/> 165 How to Repair CD Disc Players . . . \$2.99 |
| <input type="checkbox"/> XTALBLD Crystal Set Building . . . \$15.95 | <input type="checkbox"/> 164 Modern Electrics (April 1908) . . . \$1.99 |
| <input type="checkbox"/> POP96 POPtronix Hobbyist Handbook (1996) \$5.00 | <input type="checkbox"/> 160 New Ideas - 42 Circuits . . . \$1.99 |
| <input type="checkbox"/> POP97 POPtronix Exper Handbook (1997) \$5.00 | <input type="checkbox"/> 159 Low Frequency Receiving Techniques
Building and Using VLF Antennas . . . \$2.99 |
| <input type="checkbox"/> Radiocraft 1993 Projects for Hobbyists . . . \$5.00 | <input type="checkbox"/> 158 Electro Importing Co. Catalog
(Circa 1918) . . . \$2.99 |
| <input type="checkbox"/> 219 Electronics Now (1999 back issues) . \$5.00
Write in Issues desired _____ | <input type="checkbox"/> 157 All About Kits . . . \$1.99 |
| | <input type="checkbox"/> 156 How To Make PC Boards . . . \$1.99 |
| | <input type="checkbox"/> 154 How To Repair VCR's . . . \$1.99 |

To order any of the items indicated above, check off the ones you want. Complete the order form below, include your payment, check or money order (DO NOT SEND CASH), payable to and mail to Claggk Inc., Reprint Department, P.O. Box 12162, Hauppauge, NY 11788.

Please allow 4-6 weeks for delivery. No COD's!

To place a credit card by phone, Visa Mastercard or Discover only. You can also order and pay by e-mail. Contact Claggk@gernsback.com for details.

CALL: 631-592-6721

To use your Visa, Mastercard or Discover, complete the following:

Bill my Visa Mastercard Discover

Card No. _____

Exp. Date _____

Signature _____

MAIL TO: Claggk Inc.

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

All payments must be in U.S. funds

SHIPPING CHARGES IN USA & CANADA

Up to \$5.00 \$2.00	\$30.01 to 40.00 . . . \$6.00	Overseas Orders must contact
\$5.01 to \$10.00 \$3.00	\$40.01 to 50.00 . . . \$7.00	CLAGGK for shipping charges.
\$10.01 to 20.00 \$4.00	\$50.01 and above . . . \$8.50	
\$20.01 to 30.00 \$5.00		

Total price of merchandise	\$ _____
Shipping Charge (see chart)	\$ _____
Subtotal	\$ _____
Sales Tax (New York State Residents only)	\$ _____
Name _____	Total Enclosed \$ _____
Address _____	
City _____ State _____ Zip _____	

CL01

Poptronics®

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

EDITORIAL DEPARTMENT

Chris La Morte, managing editor
Evelyn Rose, assistant editor
Maria Orlando, editorial assistant

CONTRIBUTING EDITORS

Reid Goldsborough
Sam Goldwasser
Dean Huster
John Iovine
Elizabeth Jamison
Ted Needleman
Charles D. Rakes
Scott M. Savage
Teri Scaduto

PRODUCTION DEPARTMENT

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

ART DEPARTMENT

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

CIRCULATION DEPARTMENT

Gina Giuliano, circulation manager

REPRINT DEPARTMENT

Maria Menichetti, Reprint Bookstore x235

BUSINESS AND EDITORIAL OFFICES

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

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

SUBSCRIPTION CUSTOMER SERVICE/ ORDER ENTRY

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

Advertising Sales Offices
listed on page 82

Cover by
Michele Lyn Musé

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

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

TEST YOUR KNOWLEDGE

Can you match the following components with their proper description?

A. Transformer

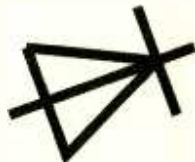


1. This component is used as a blocking device in DC circuits and as a coupling device in AC circuits. This device stores energy between two plates separated by a substance known as dielectric. The non-polarized types of these components are made of polystyrene, polyester, and ceramic. The polarized types are often referred to as electrolytic.

B. Transistors

2. These components are designed to have low ohmic-resistance and a very high reactance at radio frequencies. They will pass DC, but will block high-frequency AC if both AC and DC are present in the same circuit. At low frequencies, this device will react similar to a series-resonant circuit, and at high frequencies it will react similar to a parallel-resonant circuit.

C. Resistor

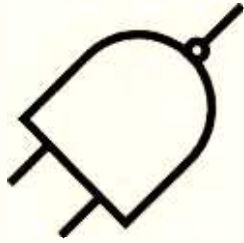


3. This component consists of two coils that have mutual inductance. One coil is referred to as the primary winding, and the other is referred to as the secondary winding. This component is used in AC circuits in order to step-up/step-down voltage.

D. Capacitor

4. This component is the equivalent of two diodes placed back-to-back with a common middle layer. It contains three elements—base, collector, and emitter—and is categorized as either a PNP or NPN. Common uses for this component are as an amplifier, a switch, or a detector in a simple radio circuit.

E. RF Choke



F. LED

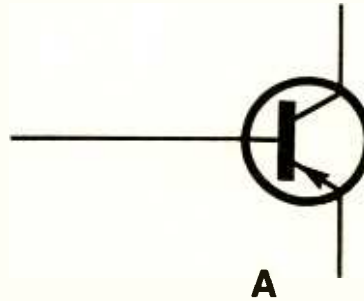
5. This component is a two-element semiconductor that releases energy in the form of light when conduction occurs in a specific direction. A ballast resistor is used in conjunction with this device in order to limit the voltage applied to it, as well as limit the current flowing through it.

6. This component is designed to absorb energy, which is dissipated in the form of heat. Frequency does not affect this component, so it is found in both AC and DC circuits. A series of color bands is used to label the component's value and tolerance.

A3, B4, C6, D1, E2, F5

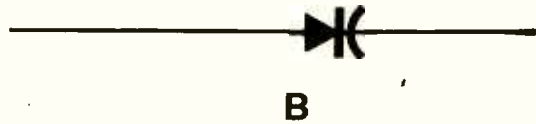
Now, let's test your knowledge of schematic symbols. Match each symbol with the correct component name.

1. Tunnel Diode



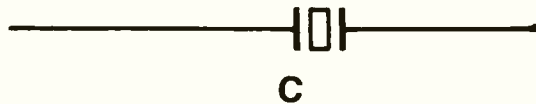
A

2. PNP Transistor



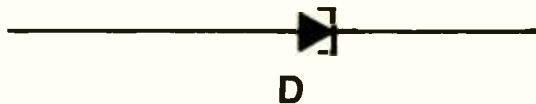
B

3. Varactor Diode



C

4. Crystal



D

1D, 2A, 3B, 4C

NEW LITERATURE

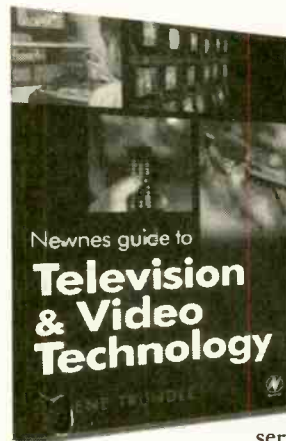
The ARRL Handbook for Radio Amateurs 2002

Edited by Dana George Reed, KD1CW

ARRL
225 Main St.
Newington, CT 06111-1494
888-277-5289
www.arrl.org

\$34.95

Providing a wealth of technical information, this handbook is a classic in its field—a valuable, highly respected resource for hams, engineers, and technicians at all skill and knowledge levels. The 79th edition covers the latest in DSP and wireless technology and includes new projects, such as a VHF receiver, a UPS, and a modular RF voltmeter.



Newnes Guide To Television & Video Technology

by Eugene Trundle
Newnes,

Butterworth-Heinemann
225 Wildwood Ave.
Woburn, MA 01801-2041
781-904-2500
www.bh.com

\$29.95

Designed for electronic servicing students and professional service engineers alike, this guide to television and video technology offers fundamental information about Digital TV (satellite, cable, and terrestrial) and Digital Video. It also includes a thorough foundation in analog systems. No matter what area of television you're interested in or even to simply gain a better understanding of your home-video equipment, you may want to add this to your technical library.

The Little Red Book of Adobe LiveMotion

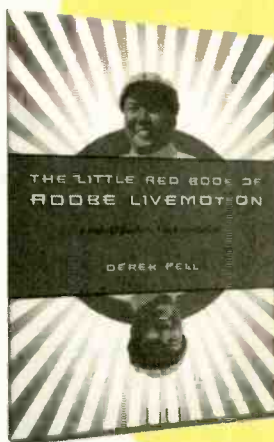
by Derek Pell
No Starch Press

555 DeHaro St., Suite 250
San Francisco, CA 94107
800-420-7240

www.nostarch.com

\$19.95

If you are looking for a humorous, original approach to learning flash animation, this book may be for you. The satirical how-to guide pokes political fun while providing legitimate tools to navigate *Adobe LiveMotion*. Not the ordinary textbook style, this manual uses innovative methods to tap the reader's creativity and to introduce graphics design for the Web. Learn to create *Javascript* rollovers, use *Photoshop* to enhance Flash animations, build *Pre-loaders*, and much more.

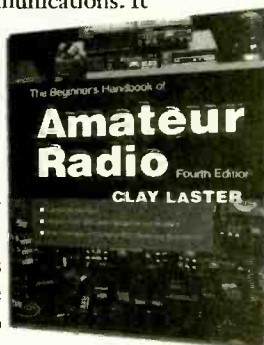


The Beginner's Handbook of Amateur Radio, Fourth Edition

by Clay Laster
McGraw-Hill
Two Penn Plaza
New York, NY 10121-2298
800-2MCGRAW
www.books.mcgraw-hill.com

\$34.95

A useful tool for anyone interested in amateur radio, this handbook is a comprehensive guide to radio communications. It offers a mini-course in electronics, a study guide for FCC exams, recent FCC safety rules and regulations, short-wave operator's procedures, and more. The combination of theory and practice provided, complete with numerous illustrations, makes the material clear and easy to understand.



Phonons in Nanostructures

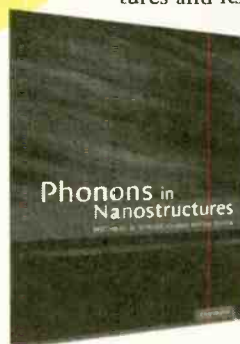
by Michael A. Stroscio
and Mitra Dutta
Cambridge University Press
40 West 20th St.

New York, NY 10011-4211
212-924-3900

www.cambridge.org

\$100

The authors present the theory of phonon interactions in nanoscale structures and its application to modern nanostructure-based devices, particularly modern electronic and optoelectronic devices. Appropriate for both graduate and undergraduate students of physics and engineering, the text emphasizes models of confined phonons and how they apply to semiconductor heterostructures.



The Extreme Covert Catalog

by Lee Lapin
Intelligence Here
404 N. Mt. Shasta Blvd., #134
Mt. Shasta, CA 96067
530-926-1316
www.intelligencehere.com
\$49.95



Unofficially labeled the source for the hottest electronic surveillance toys and equipment, this catalog is chock-full of cell-phone detectors, automobile-tracking systems, miniature video recorders, computer interception gear, and much more. Organized by the type of equipment, the catalog includes detailed descriptions, photos, and supplier information.

Video and Camcorder Servicing and Technology

by Steven Beeching
Newnes, Butterworth-Heinemann
225 Wildwood Ave.
Woburn, MA 01801-2041
781-904-2500
www.newnespress.com
\$59.95



The scope of this manual includes practical, up-to-date coverage of the entire range of current home-video equipment—analogue and digital. It furnishes readers with everything they need to know about troubleshooting and repairing traditional VCRs, video cameras designed for home use and editing systems, and the latest DVD equipment. The aim is to give the service engineer and student alike the base of technological knowledge that's not usually found in the servicing data from the manufacturers.

On The Air With Ham Radio

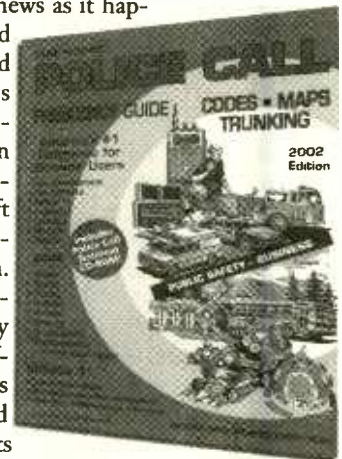
by Steve Ford, WB81MY
ARRL
225 Main St.
Newington, CT 06111-1494
860-594-0200
www.arrl.org
\$17.95



You're invited to explore the world of amateur radio through this concise guide filled with practical advice and technical know-how. All the information you need to get started is right here. Find out about satellite communications, hooking up hardware, shopping for transducers and antennae, and more. You'll be able to set up an amateur radio station, make air contacts through your computer, exchange pictures with other hams, and discover a host of other projects.

Police Call, 2002 Edition

by Gene Hughes
Hollins Radio Data
P.O. Box 35002
Los Angeles, CA 90035
www.policecall.com
\$19.95 each plus S&H



Radio scanners hear news as it happens. Bearing in mind that there are laws and legal issues which this book covers in detail, listeners can hone in on police-pursuit communications, follow aircraft across the skies, or witness a rescue situation. With the included CD-ROM, this frequency guide serves as a reference and contains codes, maps, and many useful hints for getting the most out of your scanner. There are nine regional volumes.

GIZMO®

For more information go to page 82A

or e-mail: requests@berkshire-is.com

Pack Some Power

Designed for use on the road or at home during blackouts, the *Jazz Portable Power 250* (\$119.95) uses an inverter to produce AC or DC power from a battery source. Its two AC outlets can supply power to TVs, lamps, and computers; and DC power from the unit can jumpstart cars or boats. It can be recharged through a car cigarette lighter socket or a standard wall outlet. A safety feature warns you if the cables are connected incorrectly.



Xantrex Technology Inc., 8999 Nelson Way, Burnaby, BC, Canada V5A 4B5; 604-422.8595; www.xantrex.com.

CIRCLE 50 ON FREE INFORMATION CARD

Web-Browsing Phone

The *CDM-8100* is a slim, tri-mode phone with built-in UP 4.1 Web browser and advanced data/fax capabilities. Weighing less than four ounces, the phone operates on the 800-MHz and 1900-MHz frequencies. It features two-way SMS, T9 predictive text messaging, a one-way speakerphone, and 100 memory locations. Two soft-touch navigation keys provide easy Internet access.

Audiovox Communications Corp., 555 Wireless Blvd., Hauppauge, NY 11788; 631-233-3300; www.audiovox.com.



CIRCLE 53 ON FREE INFORMATION CARD

Quick Charge

Using patented Neotherm technology, the *Mach 1 Speed Charger* (\$99.95) is said to charge lithium-ion camcorder and digital-camera batteries three times faster than any other charger—30 minutes to fully charge a standard battery. Because it also works with 12-volt sources, you can charge batteries en route to an event. A microprocessor dynamically controls the charging process to deliver the maximum energy level and to test and condition the battery without overheating it, thus extending battery life.



Lenmar Enterprises, Inc., 31328 Via Colinas #102, Westlake Village, CA 91362; 818-879-2700; www.lenmar.com.

CIRCLE 52 ON FREE INFORMATION CARD

3-2-1 Blast Off!

The *3-2-1* home entertainment system (\$999) provides realistic surround sound from just two speaker arrays. Bose Video-stage 5 decoding and post-processing circuitry generates and processes five discrete channels for a full surround effect from Dolby Digital, DTS, or even mono sources, as sound

seems to come from where there are no speakers. The media center includes a tuner, DVD player, amplification, equalization, and three inputs for additional sources. Basic setup requires only four simple connections.

Bose Corp., The Mountain, Framingham, MA 01701-9168; 800-444-BOSE; www.bose.com.

CIRCLE 51 ON FREE INFORMATION CARD



Whole-House Sound

The *CT 610* multi-zone receiver (\$3498) features two AM/FM tuners, six programmable IR inputs and nine programmable IR outputs; and it delivers 12- X 55-watts of power. Whole-house A/V distribution can be configured via B&K's proprietary *Software Suite*, making it easy to manage all of the receiver's basic parameters and functions.

B&K Components, Ltd., 2100 Old Union Road, Buffalo, NY 14227; 800-543-5252; www.bkcomp.com.

CIRCLE 54 ON FREE INFORMATION CARD



Pet-Free Zone

What do your pets do while you're not home? If their favorite pastime is shedding on—or shredding up—your favorite furniture, the *Pet Peeve* (\$49.95) could help. The device combines a vibration sensor with a voice recorder. When your pet jumps on the couch, the sensor triggers an ultrasonic tone (not audible to humans) followed by a digital recording of a command in your voice: "Off the couch, Spot!"

The Sharper Image; P.O. Box 7031, San Francisco, CA 94120-9703; 800-344-4444; www.sharperimage.com.

CIRCLE 55 ON FREE INFORMATION CARD

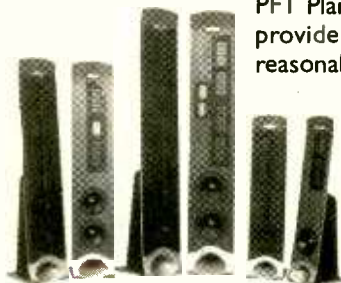


Flat-Panel Speakers

Monsoon floor-standing speakers use PFT Planar Focus Technology to provide high performance at reasonable prices. Models FPF-600 (\$599/pair), FPF-1000 (\$999/pair), and FPF-1600 (\$1599/pair) each use a hybrid design to increase dynamic range and are said to provide excellent spatial imaging, clarity, and sound positioning.

Sonigstix Corp., 11782 Hammersmith Way, Suite 201, Richmond, BC, Canada, V7A 5E3; 604-271-2237; www.monsoonaudio.com.

CIRCLE 57 ON FREE INFORMATION CARD



Mobile Subwoofers

The *High Energy HED Series* mobile audio subwoofers are available in 8-, 10-, 12-, and 15-inch sizes and in single-voice coil (SVC) or double-voice coil (DVC) designs, with prices ranging from \$89 to \$149.

Each sports a unique surround with proprietary V-Flex suspension, said to mechanically resist lateral "cone drift." The cone is attached to a metal frame, which allows greater voice-coil suspension for increased mechanical power handling (150 watts RMS or 200 watts RMS, depending on woofer size).

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

CIRCLE 56 ON FREE INFORMATION CARD



Video Doorman

The *VES Video Entry System* (\$249.99) features infrared technology to give users a clear view of their front-door area even in near-total darkness. The system consists of an intercom/doorbell with an IR TV camera, and a telephone-style monitoring station with a four-inch black-and-white video screen, handset, and speakerphone so you can see and talk with visitors. A continuous monitor function lets you maintain constant video and audio surveillance.

VOS Systems Inc., 13000 Danielson St., Suite J, Poway, CA 92164; 800-596-0061; www.vosystems.com.

CIRCLE 58 ON FREE INFORMATION CARD



Photo Printer

The *P500 Digital Photo Printer* (\$249) produces high-resolution, pocket-sized Polaroid 500 prints directly from the SmartMedia or CompactFlash memory cards used in digital cameras—without a computer. The compact, handheld device combines the quality of digital imaging with the instant gratification of Polaroid snapshots. It creates color instant photos in 20 seconds or less and is powered by a unique battery in the film pack.

Polaroid Corp., 784 Memorial Drive, Cambridge, MA 02139; 781-386-2000; www.polaroiddigital.com.

CIRCLE 59 ON FREE INFORMATION CARD



Concert in a Pocket

The *PocketConcert* (\$299) is a portable digital audio player that can store up to four hours of MP3 or Windows Media Audio (WMA) files or more than 20 hours of spoken-word audio in its 128 MB of StrataFlash memory. Its intuitive software suite makes it fast and easy to play audio files downloaded from the Internet or created from CDs. It also includes PC tools to convert and encode CDs from audio files. An optional accessory kit (\$50) provides a carrying case, car adapter, and StereoDock for connection to a home stereo.

Intel Corp.; 503-696-8080; www.intel.com.



Personal Digital Data Bank

The *Terapin mine* (\$599), a handheld personal digital data bank, lets you store, play, network, and even access the Internet, all at the touch of a button. The "mine" is like a portable hard disk with 10–12 Gb of internal mass storage and tremendous interconnectivity options. It has both host and

master USB ports, a PC card slot, built-in 10-Mbps Ethernet connectivity, composite-video-out for digital photos, stereo-audio-out for MP3 and other formats, and Internet Plug-and-Play shared storage. It uses Linux OS, which allows it to act as either a master or slave device to various digital appliances.

Teracptix Inc.; 888-654-0645; www.mineterapin.com.



Cool and Calculating

The translucent, metallic silver *TI-83 Plus Silver Edition* calculator (\$129.99) has more than nine times the power and twice the speed of the popular *TI-83 Plus*. It has room for up to 94 software applications and comes bundled with nine: *CellSheet* portable spreadsheet (may need to be downloaded), *Organizer*, *Periodic Table*, *Probability Simulator*, *StudyCards* electronic flashcards, *Catalog Help* (mathematical functions), and *Start-Up Customization*. The *CBL/CBR* application lets students examine real-life world data using the *Calculator-Based Laboratory* or *Calculator-Based Ranger* tools and probes. With the included *TI-GRAPH LINK* cable, teens can connect the calculator with a PC to upgrade and add software and/or transfer files and data to be printed or stored on a disk.

Texas Instruments, Inc.; 972-644-5580; www.ti.com.



Driven to Learn

Drive Across the Americas (\$59.99) is a driving and sightseeing game that uses 3-D graphics and digital sound to teach kids aged 8 and up about history, geography, and even driver safety. It includes a plastic steering-wheel console with built-in game controls, PC connection cable, and the software, which includes many kid-safe hot links for additional exploration.

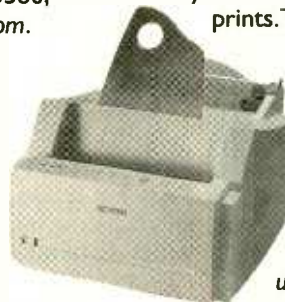
Oregon Scientific; 800-853-8883; www.oregonscientific.com.



Lightning-Fast Laser Printer

The *ML-6060* (\$399) cranks out 1200- × 1200-dpi-resolution copy at 12 pages per minute. A special toner-saver feature allows you to get up to 40% more output from the cartridge by reducing the resolution during draft prints. The printer has a 100-sheet flip-down paper tray as well as a 550-sheet paper cassette that lets you load a full ream of paper. It features both parallel and USB interfaces.

Samsung Digital Information Technology Division; 888-887-8536; www.samsungusa.com.



Business Buzz

BATTERY BOOSTER

Texas Instruments' first chipset for capacity monitoring and safety protection in Lithium-Ion or Lithium-Polymer battery packs provides a high-performance battery-management solution while minimizing component count, cost, and board space. The highly integrated chipset has applications in notebook computers, handheld terminals, and medical and test equipment. The chipset, which consists of the bq2081 Smart Battery System Gas Gauge IC and the bq29311 Li-Ion Protector IC, can fit in less than one square inch of PCB space and reduces the number of required components by up to 40%.

SINGLE-MOLECULE COMPUTER

IBM researchers have created and demonstrated the world's first logic-forming computer circuit within a single molecule. The team made a "voltage inverter"—one of the three basic logic circuits at the heart of all computers—from a carbon nanotube, a tube-shaped molecule of carbon atoms 100,000 times thinner than a human hair. "Carbon nanotubes are now the top candidate to replace silicon when current chip features just can't be made any smaller," said Dr. Phaedon Avouris, lead scientist on the project. "Such 'beyond silicon' nanotube electronics may then lead to unimagined progress in computing miniaturization and power."

HACKER LOCK-OUT

A team at HP Labs Bristol (UK) has made Linux more secure. Their two-year research project has resulted in a product that can detect, prevent, and contain break-ins to the Linux operating system and applications. Dubbed *HP Secure OS Software for Linux*, the product prevents unauthorized communications between programs, networks, and files; locks a program if penetrated; and detects hacks and attempted hacks. After the team analyzed the potential threats to users and looked at existing security platforms, they developed an experimental secure platform—called *Trusted Linux*—to protect Internet gateway systems from some of the most common attacks. Sensitive information cannot be accessed or modified by a hacker, and an administrator's error can't compromise the system. No special training is required; and because it delivers security at the OS level, all applications are protected.

Clever Cars, Resourceful Roads

Cars in France are getting smarter. Playing host to as many as 200 microprocessors that are connected to multiple sensors, the cars boast increased reliability for the drive-train, steering, and braking systems. On-board navigation, multimedia, and communications systems benefit as well. Many new vehicles are also able to interact with the intelligent road infrastructure developed by the Application for Motorway Information (AIDA) project.

Smart Cards

One example of the French automobile's cleverness is Renault's Laguna II's keyless entry that uses a card-based system developed in conjunction with French auto-equipment manufacturer Valéo. A personal card, credit-card size, provides access to the car—without being inserted. Carrying his card, the driver touches the door handle, and the doors open automatically. A sensor embedded in the door handle initiates a recognition procedure that culminates in the door unlocking, the automatic positioning of the mirrors and seat, and even setting the sound system and climate-control to meet the driver's preferences. When the card is inserted into the dashboard-mounted card reader, the system's immobilizer and steering-column lock are deactivated; and a button is used to start the engine. The card also stores car-identification and maintenance information.

Informed Navigation

Renault's Laguna is also equipped with the Odysline integrated GPS and GSM system, providing access to services for guidance, traffic information, breakdown assistance, reservations, and medical and emergency assistance.

GPS systems might provide the best route; but the Carminat navigation, available on the Renault Laguna II, takes it a step further. It now includes traffic information transmitted by a network of



The multi-functional center console on the Peugeot 607 includes a GSM telephone system and a CD-ROM navigation system.

FM transmitters fitted with RDS-TMC (*Radio Data System-Traffic Message Channel*) coders. The driver receives traffic warnings in real time. He is informed of traffic jams, roadwork, or accidents, and offered an alternative route.

Pressure Points

Other Renault vehicles benefit from a system, developed with Michelin, that monitors tire pressure. It can detect any defect, from poor inflation to a slow leak. Each wheel is fitted with a sensor in the valve that measures the internal pressure of the tire. The information is transmitted to an on-board computer that uses an advanced algorithm to distinguish between a real fault with pressure and a variation due to normal use or climatic changes.

Tail-Gate Terminator

Another innovation will be unveiled in the Renault Vel Satis, scheduled for a January 2002 launch. It is outfitted with Adaptive Cruise Control, a system that

TYPE

not only maintains the speed set by the driver, but also changes the speed according to traffic patterns. Radar built into the front bumper detects the presence and estimates the distance of moving vehicles in the same lane. The driver chooses a safe speed and distance, and the system automatically adjusts the speed to keep a constant space between vehicles.

Valéo is also currently developing Traffic Environment Sensing (TES) radar. This driver-assistance device detects obstacles and sounds a warning in the event of changing lanes or a dangerous bend. An Intelligent Cruise Control function protects the driver from being cut off by other vehicles, and a "Stop and Go" system operates in slow-moving city traffic.

Car Talk

In other developments in France, PSA Peugeot Citroën and Vivendi have formed a company called Egery to develop automotive telematics services, based on mobile telephony, Internet, and GPS technologies. Voice recognition and voice synthesis will be crucial elements in these new services.

Last year, Citroën marketed a special edition Xsara equipped with a built-in PC that enabled the driver to receive Short Messaging Service (SMS) messages directly, to search automatically for previously selected radio stations, and to access a directory or navigation aids—all using voice control. The Peugeot 607 includes a GSM telephone



The tire-pressure monitoring system on a Renault Laguna keeps track of slow leaks or poor inflation.

system that allows the driver, with the push of a button, to immediately contact a call center. The center provides emergency assistance and data on vehicle maintenance or repair. The 607 also boasts a built-CD-ROM navigation system with an option for GPS integration.

Multiplexing

Adding all these advanced functions has forced manufacturers to re-examine the electrical and electronic architecture of vehicles. Multiplexing—using only one wire rather than numerous ones to carry coded information from several computers—improves reliability and allows increased information exchange.

PSA Peugeot recently developed a multiplexed steering-column head. Known as Com2000, it provides a high level of functional integration. The Com2000 directly senses all steering wheel switching (lights, wipers, buttons, etc.), and sends the information electronically to the other systems via the multiplexed network.

Information Highway

In addition to the smart car, information is available from the very roadway itself. France's AIDA was a joint project, of French motorway companies Co-froute and CSSIRoute, in connection with Renault and PSA Peugeot Citroën. AIDA's goal is to inform the driver in real time of obstacles created by construction, accidents, or inclement weather. Similar to Easy Pass technology, the system uses beacons above the road at 6-mile intervals and vehicle hyper-frequency tags linked to a termi-

Research Notes

BAD VIBRATIONS

Researchers at the Center for Electromechanics of The University of Texas at Austin have designed an electrical suspension system to replace conventional spring/shock absorber systems. Tests conducted at the U.S. Army's Yuma Proving Grounds have demonstrated a fivefold reduction of shock and vibration to the passengers, double the off-road top speed, and better handling in cornering—all of which result in improved off-road fuel economy. The electrical suspension system uses a soft spring for a smooth ride and an electromechanical system to minimize pitch and roll. Key components include an electric motor driving a rack and pinion at each wheel, accelerometers, and an advanced control system. Dynamic adjustment of the vehicle's center of gravity during turns reduces rollover risk. Besides military applications, the technology could be used in ambulances, SUVs, and large trucks.

A BRIGHT IDEA

Organic light-emitting diodes, or OLEDs, emit their own light and can be incorporated into arrays on very thin, flexible materials—but they are not very efficient. A standard OLED consists of a layer of organic polymer that emits light when excited by electrical current, sandwiched between two conducting layers. When voltage is applied to the conducting layers, a current runs through the polymer layer, and it emits photons, creating a light. Researchers at Los Alamos National Laboratory have applied an intermediate chemical layer a mere molecule thick that helps shuttle electrical charges between a conducting layer and the polymer layer to achieve more efficient current flow.

WATER SNIFFER

A real-time gas- and water-quality monitoring system developed by Sandia National Laboratories consists of a miniature sensor array in a waterproof housing. Unlike traditional methods, which require samples taken at the site to be sent to a lab for analysis, the "Sniffer" remains on-site, sending back to a data-collection station real-time data on solvents present and their concentrations. An array of miniature sensors, called a chemiresistor, detects and measures volatile organic compounds in water reservoirs or gas-storage tanks.



On the AIDA screen, icons or short messages display information about road hazards.

nal built into the dashboard. When the car passes under the beacons, information is transmitted to a central unit, where it is processed and sent to the cars. In the vehicle, it is displayed on a screen with icons or short text messages. Safety messages are received automatically and immediately, while general traffic and weather data is available upon request.

In a way that's invisible to the driver, the vehicle sends back information, as well. The system can determine traffic flow by calculating the time it takes the vehicle to pass between two successive beacons, can detect when windshield wipers have been switched on, or when the brakes have been applied sharply. The driver also has the ability to send messages—for instance, to report an accident or a hazard on the roadway.

From automobile architecture and roadways that provide information to smart-card entry and self-monitoring vehicles, the era of cars that practically drive themselves is on the way. **PT**

Biorhythm Passwords

In the old days, when telegraph operators sent messages by hand using Morse code, an experienced operator could tell who was sending by the "fist of the operator." Today, how a person types his or her user name and password on a computer keyboard is being used to identify the person for security purposes.

Now Net Nanny Software Inc., the developer of the *Net Nanny* filtering software, is commercializing a unique technology originally developed by the Stanford Research Institute to solve spiraling computer security problems. As its name implies, *BioPassword*, is a biometric identification technique. However, unlike other biometric ID technologies that are dependent on recognition and comparison of unique human characteristics such as fingerprints, hand geometry, faces, or the eye's iris and retina, *BioPassword* does not require any additional hardware.

It is all done with the *BioPassword* software installed on a computer or workstation. This software is based on keystroke dynamics—that is, the rhythm and speed

an individual uses when typing-in user names and passwords to gain access to computers, databases, secure sites, and so forth. Like voiceprints and handwriting, keystroke dynamics is a *behavioral* biometric identification technique.

The Rhythm Method

The *BioPassword* log-on software is installed via a CD-ROM. To enroll, new users type in their user name and password repeatedly from 10 to 20 times. This allows *BioPassword* to "learn" the individual's keyboard dynamics. Once enrolled, the user types in a user name and password as usual. The *BioPassword* software then compares the typing rhythm with the stored biometric template. If a match is made, access is granted.

Just how much security does it provide? Surprisingly, it is virtually impossible for someone to duplicate another person's keystroke dynamics. They are unique. Of course, the person must have the correct username and password in the first place. *BioPassword* just adds another level of security. Security can be increased further by the choice of user name and password. Net Nanny recommends eight-character user names and passwords. Testing shows that this results in an error rate of less than two percent.

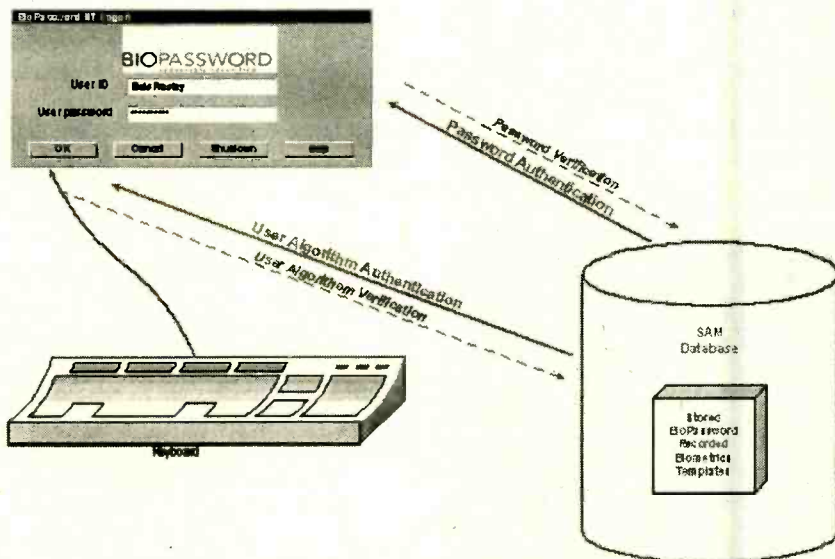
Several security levels are available, so registered users can tailor the system for

optimum security desired. Too low a level and every one is accepted; too high and legitimate users are denied access. The *BioPassword* software can be disabled temporarily. For example, if a user has a temporary hand injury that affects his keystroke dynamics, a system administrator could disable the system so the user could still have access. If the change is more permanent, a new template is prepared.

The *BioPassword* software is currently available only for users of Windows NT and Windows 2000 in large workstation environments. The license fee ranges from about \$4000 for 100 workstation to nearly \$70,000 for 4000 "seats." However, like most everything in the computer world, availability should increase and cost should decrease as usage becomes more widespread. Future possible applications include added security for on-line banking and on-line credit-card transactions and for a user-friendly method to protect the intellectual property owned by record labels, artists, composers, publishers, and distributors.

Since it requires only software, keyboard dynamic biometric identification could be incorporated in all types of keyboard devices, from cell phones to building-access systems

For further information, contact Net Nanny Software; 15831 NE 8th St., Suite 200; Bellevue, WA 98008; 425-688-3008; www.biopassword.com.—by Bill Siuru **PT**



This diagram illustrates how *BioPassword* works. Based on keyboard dynamics, the software recognizes registered users' style of typing-in their passwords.

► Rising Broadband-Over-Airwaves

According to an Allied Business Intelligence (ABI) study, wireless broadband technologies will become increasingly popular over the next five years. ABI predicts that wireless broadband subscribers, who accounted for just 2% of the total broadband subscriber base in 2001, will constitute 15% in 2006. Total revenues from broadband subscribers are expected to increase from \$16.8 billion this year to \$59.4 billion in 2006, with wireless technologies making a leap from 9% of total revenues in 2001 to 22% in 2006.

Because equipment and installation costs are so high (more than \$3000 per subscriber), wireless broadband technologies have a hard time competing with cable and DSL.

Several factors will facilitate wireless broadband's rise in popularity. First and foremost, wireless broadband offers higher quality connections. The costs of deploying and maintaining the wireless infrastructure are lower, and wireless connections are not hindered by distance limitations. A large number of customers can be serviced by a single wireless node, particularly with satellite broadband services. "To make an impact on the market, wireless broadband providers must prove to consumers that their services are not only equal to cable and DSL, but actually better in terms of pricing, speed, reliability, and security," said Mark M. Fox, author of the ABI report, *Broadband Delivery in the Local Loop: By Land and By Air*. "The potential is there, but first they have to catch up to the wireline technologies in terms of available infrastructure." PT

Water Safety

In the wake of September 11, the concept of public safety has taken on a new significance. For almost two years now, Sandia National Laboratories researcher Jeffrey Danneels has been working with the EPA and the American Water Works Association Research Foundation (AwwaRF) to develop a training program that would teach water utilities to assess the vulnerabilities of their systems and to institute measures to reduce the risks and decrease the consequences of terrorist attacks. The EPA is especially concerned about the water distribution systems serving the 340 cities that have 100,000 or more residents. Many of these systems are more than 60 years old and were built with little thought of security, and few are configured alike.

"We started exploring the possibility of working together to enhance the security of America's water infrastructure—supply, treatment, and distribution—well before the September 11 attacks on the World Trade Center and the Pentagon," says Danneels. "We are putting a program in place that involves on-site assessments of utilities and training sessions for utility personnel." Workshops for members of the AwwaRF and the American Water Works Association (AWWA) were scheduled to

begin in November 2001.

The program offers three steps for assessing the vulnerability of a utility's water infrastructure—detect, delay, and respond. The first step is to determine how well the system detects a problem, such as chemical contamination. (Sandia's "water sniffer," described in *Research Notes*, is one possible detection device.) The second is to measure delay capabilities to learn how well the system can stop undesired events. How long is water stored before being distributed? Are barriers, such as fences and walls, in place? Finally, response capabilities are examined. How quickly are private security forces and local, state, and federal authorities able to respond, and in what capacities? "It is important that utilities be able to detect the problem and delay it long enough for the response to arrive and defeat it," Danneels says.

Underlying the program is the need to fully understand the site, including its overall mission and operating procedures. The cost of security depends on the level of protection a facility wants and can afford. Hiring a security guard and installing some basic detectors "won't cost a lot," according to Danneels, "but to stop a fairly organized group from committing a terrorist act could be extremely expensive." PT

Pumped-Up Mileage

Technology originally developed by Ford Motor Company for use in diesel engines has the potential to improve fuel economy in gasoline engines by about 20 percent. Called DISI, for Direct Injection Spark Ignition, it is being tested in a 1.1-liter three-cylinder engine that can achieve 70 HP. When used mainly in urban driving, DISI achieves a 21 percent improvement in fuel economy, while in mixed urban and highway driving, the improvement is expected to be 10 to 15 percent. Even greater savings might be realized by combining DISI with other new technologies that take advantage of its low-RPM efficiency.

In a conventional fuel-injected engine, all cylinders are supplied with a mist-like mix of air and fuel at a constant 14.7:1 ratio. One or more injector nozzles spray fuel into the air stream being fed to the intake valves. The spray is mixed with air during the intake stroke and flushed into the cylinder, where it is ignited by the spark plug. The throttle valve determines how much of the air-fuel mixture enters each cylinder. The mixture itself, however, cannot deviate much from the 14.7:1 ratio; mixtures that are too lean won't ignite.

DISI technology uses "stratified" charging to overcome this limitation. The injection nozzle is located inside the combustion chamber. When fuel is sprayed toward the spark plug just before ignition, the spark plug is surrounded by a small, precisely shaped volume of ignitable air-fuel mix. Only the area directly around the plug, at the top of the cylinder, contains the air-fuel mixture. The stratification of the charge allows the DISI engine to burn mixtures with a much higher ratio of air to fuel—up to 60:1. The cushion of non-combustible gas around the combustion chamber also requires less combustion heat, improving the engine's thermal efficiency. The charge-stratification process works best at low and medium loads in the lower half of the engine speed range, where traditional gasoline engines are least efficient. The technology also allows the compression ratio to be increased from 10:1 to approximately 11.7:1 without the need for premium fuel, because direct injection reduces engine knock. PT

ONLINE ESSENTIALS: CONNECTING TO THE INTERNET

Let's say you're not yet online. You want to be connected to the Internet, but you don't want to mess with a complicated computer. Maybe your parents or grandparents fit this description. What should you do?

This dilemma has spawned an entire category of simple Internet access devices called Internet appliances. Yet, these devices have failed miserably in the marketplace. Exploring the reasons for their failure will shed light on the challenge of getting "Grandma" online, and, if you're Grandma, what your options are today.

Clearly, there's a potential market out there. The latest data from the market research firm Dataquest shows that 39 percent of U.S. households still aren't online. A whopping 85 percent of U.S. senior citizens don't yet have Internet access, according to the Pew Internet & American Life Project. Yet, within the past year, three major manufacturers of Internet appliances have dropped out of the market: Sony, 3Com, and Netpliance.

A SOLE SURVIVOR

The sole surviving stand-alone Internet appliance actively marketed to consumers is Compaq's iPAQ Home Internet Appliance. Designed for surfing the Web, sending and receiving e-mail, and engaging in instant messaging, it's also easy to set up and use. My 74-year-old father and I tested the unit in detail and, despite great potential, it has problems of its own.

Compaq sells two versions that are both attractively priced. The smaller and more portable IA-1 has a flat-panel screen and retails for \$399,



Easy to set up and use, the Compaq iPAQ Home Internet Appliance puts you online directly—without the help of a computer.

while the bulkier IA-2 has a conventional computer monitor and retails for \$299. Prices at consumer electronics stores, where they're typically sold, are sometimes even less. Both units are similar. They look and act like PCs; but they lack a hard drive, which is appropriate since Internet appliances aren't meant for storing letters, budgets, and so on. Without a hard drive, there's no waiting for the device to "boot up" when you turn it on.

Let's look at some of the problems. The biggest drawback is that Compaq's System is inextricably bundled with MSN Companion, Microsoft's operating system for Internet appliances. MSN Companion is tied closely to MSN Internet Access, and like the MSN Internet Service Provider (ISP), it's slow and buggy. *Consumer Reports* recently ranked MSN last among eight national ISPs for speed, interruptions, and availability.

You don't have to use MSN to connect to the Internet with Compaq's Home Internet Appliance. However, as just one more example of Microsoft's

monopolistic mindset, there is a catch. Because of Compaq's licensing agreement with Microsoft, if you use another ISP, you still have to pay Microsoft \$9.95 per month in addition to the fee you pay your new ISP. On the positive side, if you stay with MSN, it's free for your first six months of access. After that, though, access will cost \$21.95 per month.

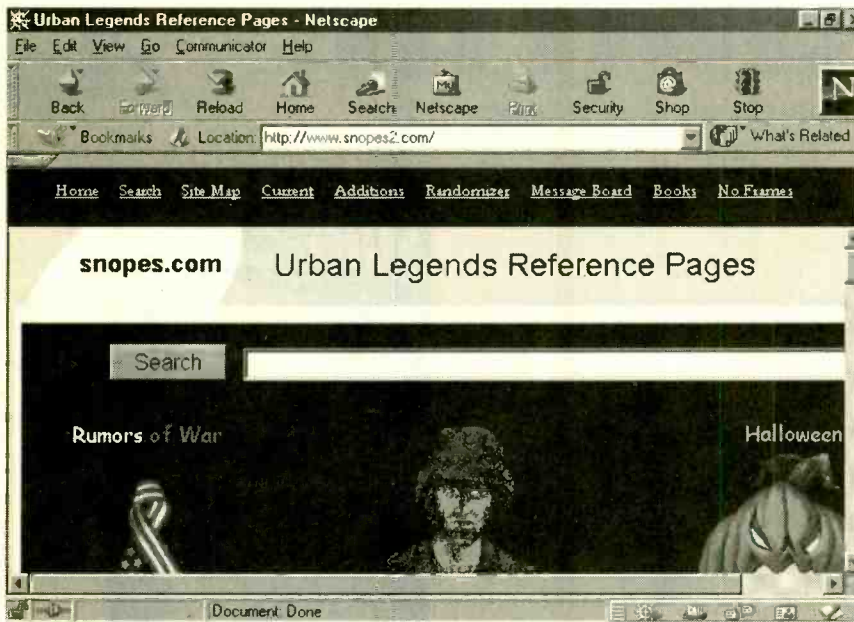
Another problem was that some reviewers found the screens too small and the touch-pad finicky, but we had no problems with either. More important is that the device doesn't support a number of widely used Internet formats from companies other than Microsoft, such as *Adobe Acrobat*, *RealAudio*, and *QuickTime*.

Browsing Internet forums revealed that advanced users typically found it too limiting, while beginners appreciated the ease of its use. This result leads to the core of the Internet appliance quandary for manufacturers.

TO MARKET, TO MARKET

They've failed, thus far, to market these devices to their logical audience, the "Net-laggards." Now they're marketing them to the "Net-sophisticates," who want more than one Internet-access device in their homes. However, it seems that this audience will not likely tolerate the devices' technological limitations. Compaq officially says it's committed to the Internet appliance market, and it seems to recognize the way to improve the device. "In the future we hope to provide access not tied to Microsoft," says Compaq spokesperson David Albritton.

However, the larger challenge



Anti-hoax Web sites such as the *Urban Legends Reference Pages* at www.snopes.com can help eliminate the misinformation that circulates on the Web.

remains—persuading Net-laggards that paying for Net access is worthwhile. “This audience will wait until they absolutely cannot do without,” says Bryan Ma, an analyst from IDC, a market research firm in Framingham, MA.

Does it make sense to buy the Compaq Home Internet Appliance? Despite the current limitations, maybe. The price is right, and it’s suitably simple if you’re just getting started.

Another option is MSN-TV (formerly called Web-TV), a device that you connect to your TV for Internet access—ranging in price from \$99 to \$199. It’s from Microsoft, easy to use, but even more limited. The older Web-TV Classic is also available, even less expensive, but even more restrictive than Compaq and MSN-TV. If you can swing it, it might make more sense to spend \$600 to \$800 on a low-end PC or Mac that’s easier to use than ever and gives you freedom of choice.

ANOTHER INCENTIVE TO LOG ON?

For some, the importance of being connected to the Internet surpasses e-mailing, shopping, and surfing. For those who venture online to keep up with current events, there is the more serious, more significant, aspect of staying in touch with the world. However, to say that the Internet is the best source for explosive, timely, news stories is still somewhat arguable.

The question arises, during a disas-

ter, where is the first place you should turn for information? You might think the Internet would be ideal. After all, it was set up by the military in the 60s to ensure communications during a nuclear war. Yet, as recent events have shown, during a crisis, other media sources might do a better job at delivering breaking news. Still, the Net is uniquely suited for certain things.

THE SET VS. THE NET

The Net’s biggest problem stems from its very nature. To somewhat oversimplify, unlike TV networks that send one signal to millions of TV sets, Web sites have to send millions of signals to millions of computer screens. Web sites thus get overloaded if they receive too many visitors. During the hours immediately after the terrorist attacks of the World Trade Center and the Pentagon, the top news sites were completely bogged down. The Net’s most popular news site, *CNN.com*, received 162 million page views on the day of the attacks, 12 times more than normal. Millions of people in offices throughout the country, without easy access to TV or radio, tried to find out what was happening through their computers, often without success. Some of the big news sites tried coping by slimming down the size of their pages and adding servers, but this helped only marginally.

Television surpassed the Internet at providing second-by-second coverage

LynX-10
HOME AUTOMATION KIT

- Software Included
- Use Existing Wiring
- Simple Inexpensive

1-800-928-5299 www.marrickltd.com

of the events. What’s more, while the major Web news services had to scale down their content to provide any service at all, the television networks beefed up their programming to satisfy information-hungry viewers.

Once you go beyond breaking news at big-name sites, what the Net is exceptionally good at is providing depth. “In the same way people turn to newspapers instead of TV for more depth, people turn to the Internet,” says Steve Outing, an online publishing consultant from Boulder, CO. On the Web, for instance, you can conveniently read overseas news sources, which provide a different, and sometimes eye-opening, perspective. If you’re so inclined, you can view shockingly graphic images that the networks don’t carry. With the Internet, “you’re not as dependent as you were once were on hearing things that someone else wanted to tell you,” says Ed Traves, a Temple University journalism professor.

POINT AND CLICK

CNN.com
www.cnn.com

Compaq
www.compaq.com

MSN.com
www.msn.com

Urban Legends Reference Page
www.snopes.com

UP CLOSE AND PERSONAL

The Internet’s most distinctive advantage is its personal nature. On September 11th, personal Web sites, sometimes called Web logs, sprung up with eyewitnesses providing unfiltered, first-hand accounts of the tragedy from their own perspectives. Likewise, Internet discussion groups disseminated personalized news. “The Internet

(Continued on page 62)



YESTERDAY'S NEWS

A PEEK INTO THE GERNSBACK ARCHIVES



1900

1910

1930

1942

1950

1960

1972

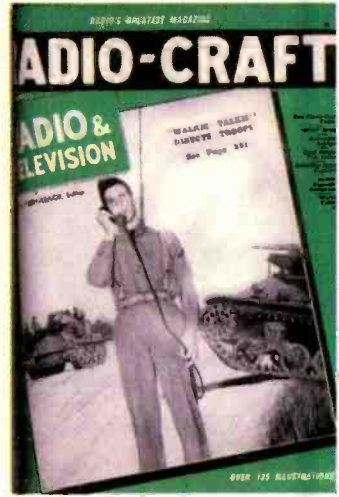
1980

1992

2000

Dateline: January 1942 (60 years ago)

For the "Radio Month In Review," this issue of **Radio-Craft** mentions the Army's use of walkie-talkies for constant two-way communication, the use of television in national defense, and the apparatus used for Electro-shock therapy. Readers are shown how to build a "Wien Bridge" Audio Oscillator and how to refinish radio cabinets for a sleek, complete look.



Dateline: January 1972 (30 years ago)

Just as Dorothy's perception and view changed when she stepped into the land of Oz, so do those of **Radio-Electronics'** readers as color TV steps into the public domain. This issue deals almost entirely with color TV, from automatic tint controls for tone regulation to a color convergence generator. Television accessories and enhancements are on the rise and in demand, as are solutions to simple problems such as how to eliminate hum bars.

Dateline: January 1992 (10 years ago)

Air pollution was as much a concern in the early 90s as it is today. **Popular Electronics** features building a negative-ion generator and asks the readers and builders to decide whether this high-voltage operation really improves one's health by sterilizing airborne bacteria. This issue also reviews new products such as a heart-rate monitor, a wireless video transmitter, and an 8mm camcorder, along with new ideas for an old pastime—HAM radios.



Poptronics, January 2002

Season's Greetings

Plug a Friend into

Poptronics[®]

*and Save \$44.89**

*This holiday season you can give an electrifying gift ... plug a friend into **Poptronics**[®] and brighten the whole new year! Whether electronics is your friend's livelihood or hobby, your gift will illuminate the whole spectrum of electronics throughout the coming year and provide a monthly reminder of your friendship.*

Poptronics[®] Magazine will keep your friend informed and up-to-date with new ideas and innovations in all areas of electronics technology ... computers, video, radio, stereo, solid-state devices, satellite TV, medical electronics, communications, robotics, and much, much more.

Poptronics[®] combines the best attributes of *Electronics Now* and *Popular Electronics*. It is the magazine for the hands-on electronics activist. We will be presenting articles on just about everything electronic—from satellite TV equipment to DVDs, gadgets and gizmos to energize your life, audio amplifiers, professional service features, PC-related projects, and much, much more.

PLUS: A selection of computer-oriented columns that explore the digital realm from the inner workings of a PC to the latest the Web has to offer. On the electronics side, there is something for everyone—from the beginner (Basic Circuitry and Q&A) to the expert. Whether your interest is fixing equipment (Service Clinic), tinkering with robots (Robotics Workshop),

or adventuring to the farthest reaches of electronics and science (Amazing Science)—**Poptronics**[®] takes you there.

SAVE \$44.89* ... OR EVEN \$89.78* ... For each gift of **Poptronics**[®] you give this holiday season, you save a full \$44.89* off the newsstand price. And as a gift donor, you're entitled to start or extend your own subscription at the same Special Holiday Gift Rate—you save an additional \$44.89*!

No need to send money ... if you prefer, we'll hold the bill till January, 2002. But you must rush the attached Gift Certificate to us to allow time to process your order and send a handsome gift announcement card, signed with your name, in time for the holidays.

So do it now ... take just a moment to fill in the names of a friend or two and mail the Gift Certificate to us in its attached, postage-paid reply envelope. That's all it takes to plug your friends into a whole year of exciting projects and new ideas in **Poptronics**[®]!

*Newsstand price—8 issues @ \$4.99 each
4 issues @ \$5.99 each

CD ROM based resources for learning and designing



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

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

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

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

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

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

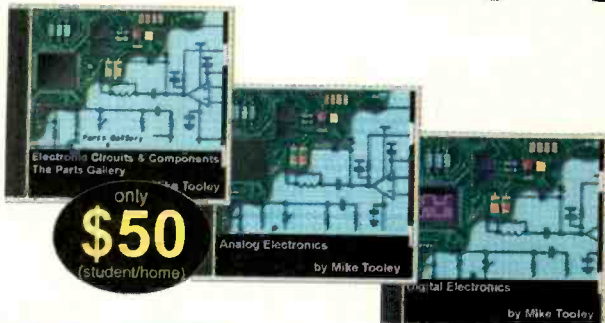
PICtutor and **C for PICmicro microcontrollers** both contain complete sets of tutorials for programming the PICmicro series of microcontrollers in assembly language and C respectively. Both CD ROMs contain programs that allow you to convert your code into hex and then download it (via printer port)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

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

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

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

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



only
\$50
(student/home)

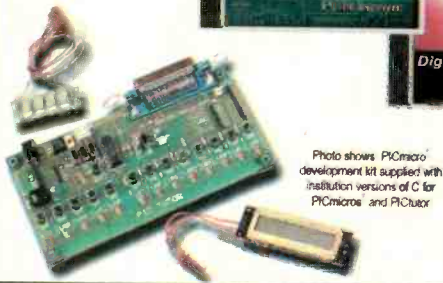
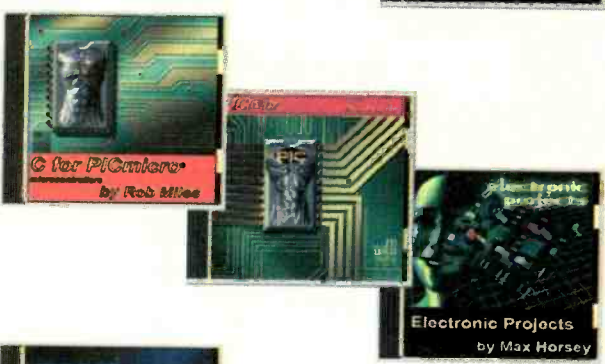


Photo shows PICmicro development kit supplied with institution versions of C for PICmicro and PICtutor

Order Form:

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

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

Name: _____ Phone your order to us on: _____
 Address: _____ 631-592-6721
 _____ or send your order to:
 Zip: _____ Phone: _____ CLAGGK Inc.
 _____ PO Box 12162
 _____ Hauppauge, NY 11788
 Card Type: _____
Mastercard, Visa, or Discover only
 Card number:
 Expire date:
 I have enclosed my check for \$: _____ Signature: _____
 Please charge my credit card for \$: _____

Poptronics, January 2002

Order online NOW from: www.poptronics.com

CL02

GPS—Your Ticket to Ride

Today, when consumers are buying gadgets formerly reserved for NASA engineers and MIT research scientists, you never have to worry about finding your way again. The GPS (Global Positioning System) is available and affordable, and it's making the average road trip simple to navigate and a heck of a lot more interesting.

According to the www.GPSStore.com Web site, the Global Positioning System, "...is a constellation of satellites that orbit the earth twice a day, transmitting precise time and position (latitude, longitude and altitude)." With a GPS receiver, it is possible to determine your location anywhere on the Earth.

By the start of the new millennium, this \$10 billion satellite-based navigational system became generally available, with new-model vehicles touting their dashboard-installed GPS as the wave of the future. Around the same time, hand-held versions that were simple to operate were also being offered by companies like Garmin.

So who has a need for such a high-tech piece of equipment when one can just as easily stop at a convenience store and ask for directions or—hold on to your hat, now—actually look at a map? The answer is, just about everyone. "Anyone who needs to know the precise time or the exact location of people or objects will benefit from GPS."—GPSStore.com

A GPS can be beneficial in a myriad of settings. Hunters will find that with the easy tracking, route setting and waypoint (points of interest, like a breadcrumb in a forest) creating, it is virtually impossible to get lost in the wilderness. For marine use, where a fixed reference point is not always visible, the GPS provides invaluable nav-



The Street Pilot III is one example of a GPS—this is a turn-by-turn voice-navigation system from Garmin.

igational aid in boating and sailing. "Surveyors, natural resource managers, wildlife managers, geologists, geographers, mappers, forestry managers, and mineral explorers are just some of the people taking advantage of the GPS."—GPSStore.com.

Imagine getting through an entire road trip with no wrong turns. Now, you can chart your route beforehand, record waypoints, and see when, to the second, you will arrive at your destination. The GPS will also tell you things like highway exit information, time of sunset, speed, current location, and the nearest cities. With a GPS, you can drive on a deserted highway and plan when you're going to stop at that fast food restaurant that may be fifty miles down the road. The GPS will even tell you where the restaurant is once you take the exit!

So why hasn't the GPS caught on with more consumers? I've talked to a number of technically savvy people about the merits of owning one; and, while most of them understand the reasoning behind the high-tech instrument, they usually respond with a variation of the following statement: "I don't want to take the time to learn how to operate it—it looks too difficult."

Au contraire. While a GPS receiver is truly a marvel of technology, it does not take a rocket scientist to learn how to operate one. Like most video games or computer software programs, a GPS is user friendly and easy to operate.

THE 24-STEP CONNECTION

The complete Global Positioning System consists of twenty-four satellites that are in geosynchronous orbit approximately 12,000 miles above the Earth. Five ground stations manage these satellites, monitoring them twenty-four hours a day. These satellites provide continuous coverage for two- and three-dimensional positioning anywhere on the Earth.

The first thing that happens when you power up your GPS is a connection with these satellites. (Don't worry, this happens automatically. All you have to do is sit back and watch.) The GPS must receive signals from at least three of the satellites in order to track the location of the user. By measuring the interval of time between the transmission and the reception of the satellite signal, the GPS is then able to calculate the location of the user and each satellite. Information from three satellites is required for two-dimensional positioning (latitude and longitude), and four satellites are required for three-dimensional positioning (latitude, longitude, and altitude).

This process takes less than a minute—just enough time for you to start your car and pull out of the driveway.

THE DISPLAY

What may at first seem like a complicated remote control is actually a simple display panel with a few buttons. With one click you can change the view on the screen, alter fields, set

routes, create waypoints, and check the distance from your chosen destination. You can even see your top driving speeds, the time of sunrise and sunset, the time in different zones, and detailed street maps across the globe.

SETTING THE ROUTE AND WAYPOINTS

This is where the fun begins. Each GPS has enough memory for many routes, so don't be shy about tracking every trip you take. Going out of town takes on a new color as you discover the best possible place for your waypoints, record the cleanest restrooms and quickest routes, and track your favorite restaurants along the way. As you drive, simply press the waypoint button at a point you'd like to return to on your route. Next, name the waypoint and save. That's it—simple and quick.

This is also where the investment on your GPS becomes worth the expense. How many times have you taken a road trip and had to stop the car, take out your atlas, find the right page, look up your exit or street number, etc. Finally, after several minutes of precious driving time has been spent locating your particular map, you now have to figure out where you are and plot a course. It's worse when you are in a new city and have forgotten your map. You have an appointment and are driving aimlessly—unsure of your destination and direction. With a GPS, you will never get lost; and you need never look at a paper map again. It's all there, instantaneously, at your fingertips.

Plotting a waypoint is as effortless as it is fun. As you are driving, walking, hiking, canoeing, flying, etc., you may reach a place that you want to remember. You press the waypoint button, name it and save it, and one more piece of your route is recorded.

Be frivolous and, above all, have fun, because your basic GPS can handle upwards of 500 of these little breadcrumbs. Go ahead, mark that gas station and record your trip to the dentist. Hey, if your favorite fast food restaurant happens to be Arby's, shouldn't you know the *exact* location of every one from here to Fresno? Sure—your GPS can take it, so plot on.

GPS TECHNOLOGY

There are a few basic steps to understanding the technology behind your GPS. These include triangulating,

measuring distance, timing, and the satellite's position. The following section is an overview of these terms, coined and explained in full at www.trimble.com, a GPS informational site.

Triangulating—Satellites are used as a reference point for locations on Earth. In order to track a location, we would need to accurately measure our distance from a minimum of three satellites. So how do we do this?

"Suppose we measure our distance from a satellite and find it to be 11,000 miles. Knowing that we're 11,000 miles from a particular satellite narrows down all the possible locations we could be in the whole universe to the surface of a sphere that is centered on this satellite and has a radius of 11,000 miles"—www.trimble.com. If the second satellite is 12,000 miles away, we now know that we're somewhere on the circle where these two spheres intersect. When we make a final measurement and find that we're 13,000 miles away from the third satellite, that narrows our position down to only two possible points in space. We could then get a fourth measurement, but usually that is not necessary. One of the two possible points usually winds up being unrealistically far from Earth or moving at an impossible speed.

Measuring Distance—How do you measure something that is out in space? In order to calculate the distance to a satellite, you need to measure how long it takes a radio signal to reach your location from the satellite. This can be accomplished by using a formula that is taught in most high school math classes.

$$\text{Velocity} \times \text{Time} = \text{Distance}$$

Measuring travel time is the trickiest part of the equation. Each satellite has its own Pseudo-Random Code, a complicated digital code (sequence of "on" and "off") that it sends out. The complexity of this code ensures that the receiver doesn't accidentally join with another signal. It also drastically reduces the probability of another signal with the same exact shape. Since each satellite has its own unique signal, they can all use the same frequency. These crucial pseudo-random codes enable the GPS to function without a large satellite dish.

Timing—For the GPS, timing is

crucial and must be exact. "If measuring the travel time of a radio signal is the key to GPS, then our stop watches had better be darn good, because if their timing is off by just a thousandth of a second, at the speed of light, that translates into almost 200 miles of error."—Trimble.com.

According to Trimble, extra measurement cures the timing offset. If the receiver's clocks were perfect, all the satellite ranges would intersect at a single point. However, with imperfect clocks, a fourth measurement taken will intersect at a different point.

The computer on the receiver sees this and realizes that it is out of sync with the universal time. It then looks for a single correction factor that it will subtract from all its measurements. This will get the four satellite ranges to intersect at a single point. The correction brings the receiver's clock back into universal sync, and atomic accuracy is achieved. Once it has that correction, it applies it to all the measurements, coming up with precise positioning.

Satellite Location—These twenty-four satellites are thousands of miles away, so how can we determine where they are, *exactly*? Each GPS satellite runs on a precise orbit, and since they are above the earth's atmosphere, the orbits are very predictable. With simple mathematics, we can determine their position.

The Department of Defense (DoD) constantly monitors these basic orbits with precise radar that checks each satellite's exact altitude, position, and speed. The agency checks for errors caused by gravitational pulls from the moon and sun and by pressure of solar radiation called "ephemeris errors," which affect the satellite's orbit. Once the DoD measures the satellite's exact position, it relays this information to that satellite, which then corrects its position.

The Global Positioning System is fun, simple to use, and well worth the expense. So next time you embark on a family vacation, why not take one along? When little Joey asks, "How much longer, Dad?" you'll be able to tell him—to the second. D

Poptronics®
SHOPPER

Begins on page 63

ANOTHER CHANCE FOR THE P4

As hard as Intel has been pushing, sales of Pentium 4-based PCs have been slow to take off. Even with Intel having announced that it intended to phase out Pentium III desktop CPU production by the end of 2001, consumers have been slow to embrace the newer processor.

Part of the reason for this is that the Pentium 4, for all of the hype, simply hasn't yet provided any spectacular increase in performance over its main competitor, AMD's Athlon Thunderbird CPU. The Pentium 4 processor does have some new technology in its design, which will give it the edge on heavy graphics applications. However, these additional instructions and capabilities need to be taken advantage of in the application software, and vendors have been slow to release application upgrades that make use of the new functions that the Pentium 4 provides.

This is history repeating itself. The same thing happened when Intel released its first Pentium containing the now standard MMX extensions. It took a while for software vendors to recompile their applications so the software would use the new MMX instructions. Since the upcoming versions of AMD's Athlon XP will implement the newest SSE2 instruction set, perhaps vendors will finally get on the boat with this and provide applications that run faster on the new processors.

Another reason for the slow acceptance of the Pentium 4 has been price. When initially introduced, the CPUs were considerably more expensive than the previous Pentium III processors, which are at the end of their production life. Interim price reductions have dropped the per-unit price considerably. At the time this is being writ-



Here are the two PCs that were used to perform the benchmark tests. One unit contains an Intel motherboard, while the other unit contains a Soyo motherboard.

ten, it is possible to buy a 1.7-GHz P4 using the new .13-micron fabrication for about \$220. That price is for a retail box, which includes a fan, heat sink, and three-year warranty. If you can live with a "white box" version (no fan, heat sink, and with a 15- to 30-day warranty), the price drops to below \$200.

One factor that's really contributed to high Pentium 4 system prices, however, is the need for RAMBUS, or RD RAM. Intel adopted this new type of memory when it first designed the P4, and reference motherboard design built around the i850 core logic chipset.

RDRAM is very high performance and offers a greater memory bandwidth. It is, however, produced by only a few memory module suppliers and costs more, for an equivalent amount of memory, than SDRAM or DDRAM.

To help push the Pentium 4 into the mainstream, two new core logic chipsets have been introduced. The P4X266 from Via Technologies lets the Pentium 4 run with DDR RAM, which is faster than SDRAM, but slower than RD RAM. This core logic set also supports SDRAM, but most motherboard

vendors are using it with DDR RAM. That's because Intel has also thrown its hat into the ring with the release of a second Pentium 4-oriented core logic set, the i845, or Brookdale, chipset. The i845 lets motherboard designers use standard, very affordable, PC133 SDRAM with the Pentium 4. It's somewhat slower than a motherboard using 800-MHz RDRAM, but also hundreds of dollars less expensive.

'CAUSE THEY'RE COUSINS, IDENTICAL COUSINS, IN EVERY WAY

How well do these Brookdale-based PCs perform? To test them, we built a pair of identical PCs, one with Intel's D845WN motherboard, the other with an SY-P4ISR motherboard from Soyo. Both motherboards are very similar in basic features, since they are both based around the Intel i845 core logic chipset. Both offer six PCI slots, embedded audio, and can accommodate up to 3GB of SDRAM using 1-GB DIMMs in each of the three available memory sockets.

The Intel motherboard is available as a retail product, selling for about \$145, though its major market is to PC manufacturers who incorporate the board into their own systems. The Soyo P4ISR sells for about \$10 more than the Intel, depending on where you buy it. It does, however, offer several additional features that make it very attractive if you are building your own PC or upgrading an older system. These include a built-in 10/100BaseT Ethernet adapter and a Promise Technology RAID controller. This RAID controller is in addition to the standard ATA/100 IDE controller, and it lets you add two additional ATA/100 hard disk drives using either RAID 0 or RAID 1

TABLE 1

Benchmark Used	i850-based P4 with RD RAM	Intel i845 Mobo with SDRAM	Soyo i845 Mobo with SDRAM	Soyo 1-GHz P3 System
Performance Test 3.3 Passmarks	183.6	208.9	210.8	131.9
Performance Test 3.3 MFLOPS	417.5	444.6	453.6	319.7
SANDRA CPU Test Dhrystone MIPS	3199	3141	3093	2632
SANDRA CPU TEST Whetstone FPU MFLOPS	1003	882	882	1335
SANDRA CPU TEST Whetstone SSE2 MFLOPS	2081	2089	2077	N/A
Dr. Hardware CPU TEST Hardstones	1615	1723	1746	1059
Dr. Hardware CPU Test Softstones	512	510	506	592

mode. These two modes accomplish different things. Striping puts sequential disk cylinders on alternating drives. This lets one drive start performing a "disk seek" while a data transfer is taking place on the other drive. This essentially almost doubles the data-transfer rate offered by a single drive. In this mode, the operating system sees the two attached drives as one large fast hard disk. The alternate RAID mode is called mirroring, and it writes everything identically on both drives. If the primary drive suffers a read or write error, the RAID controller automatically switches to the secondary, or mirrored, drive.

Both the Intel and Soyo motherboards use a new version of the Intel Pentium 4 CPU. This new version uses .13-micron fabrication technology, which makes the die size and CPU itself a bit smaller. That change also requires a new socket on the motherboard, called a Socket 478. For our test, we used two 1.7-GHz P4s so we could benchmark our test systems against the 1.7-GHz P4 we constructed with an i850 motherboard and RDRAM for the "Build A Personal Pentium 4 System" article in this issue. That PC had only 256MB of RD RAM, however, compared to the 1.5GB of SDRAM we used in the i845-based systems.

In all other respects, the two PCs we built were pretty much the same. Antec supplied us with two of its terrific SX1040 server cases—one in beige and the other in black. These both have the special power supply required by a Pentium 4 (or AMD Athlon Thunderbird) motherboard. You could save a few bucks using a less

expensive case, but your PC won't look as nice as ours did. With bays for the drives that slide out for ease of installation and rolled edges that don't cut your hands to ribbons when you're working, Antec cases have become our favorite. They are widely available in a variety of styles and price ranges.

Because the real advantage of using an i845-based motherboard is SDRAM compatibility, we loaded up our test system with three 512MB DIMMs. We used Kingston ValueRAM in one PC and Crucial Technology RAM in the other, switching the DIMMs to make sure that the different vendors' offerings had no effect on the benchmark results (it didn't.) We've been using ValueRAM for years and have always loved it. Crucial Technologies is a division of Micron Electronics, one of the major producers of RAM in the world.

Finally, we installed identical Western Digital 40GB ATA/100 hard-disk drives in each of the test platforms and used Windows 2000 Professional as the operating system on all three systems.

AND THE WINNER IS?

I ran three sets of tests on the three P4 systems, as well as on a 1-GHz Pentium III system. This last system was included to provide a base point of reference. As expected, all three Pentium 4 PCs outperformed the 1-GHz Pentium III system by a substantial margin.

Most of the benchmark tests contained in the three applications I used, Passmark's *Performance Test*, *Dr. Hardware*, and *SANDRA*, are primarily CPU tests. Since the CPUs

used in all three test PCs are 1.7-GHz Pentium 4s (though the two in the i845-based systems are slightly newer), there's not much variation between the RDRAM system (the i850 motherboard), and those PCs using SDRAM.

The most telling of the benchmarks is the PassMark scores from *Performance Test 3.3*. This is a totally synthetic benchmark, but does fold in memory, video, and even disk tests to come up with a "PassMark" score. If you are interested, sign on the vendor's Web site (www.passmark.com) to see a more thorough explanation of how the PassMark score is derived or to download a copy of the software for your own use.

On this particular test, the i845-based motherboard systems actually turned in a higher benchmark score than the i850-based system. This is largely due to the increased amount of RAM in the i845-based systems—almost eight times as much as that installed in the i850-based PC.

SOURCE INFORMATION

DR. HARDWARE

www.drhardware.de

SANDRA

www.3bsoftware.com

PASSMARK

www.passmark.com

PENTIUM 4

www.intel.com/pentium4

This pretty much supports the contention that in many applications, the newer i845-based motherboards will offer performance that's pretty equal to the RDRAM-based PCs. That's simply because while the memory subsystem operates at a slightly lower speed and bandwidth, SDRAM is still substantially less expensive. You can afford to really load your P4 system up with it, while you might not have the budget to add anywhere near as much RDRAM.

So if you've been wondering whether the new "Brookdale" chipset-based P4s offer a good reason to make the jump, for many users, the answer will be a resounding YES. **□**

Build A Personal Pentium 4 System

TED NEEDLEMAN

With PC prices sometimes dipping below the \$500 mark, assembling your own PC is something that seems to have fallen out of vogue. That's unfortunate for those of us old enough to remember that **Popular Electronics** published the first popular Build-It-Yourself microcomputer project, the Altair 8080. That construction article was instrumental in launching the microcomputer revolution, with thousands of Altair 8080 kits sold, as well as thousands more microcomputers that were based on the Altair 8080's S-100 bus. In fact, Microsoft's first product was a BASIC language interpreter for the Altair machine. (Originally, Microsoft was located in New Mexico, right next to the Altair factory.)

These days, it's just plain easier to walk into a store and walk out with a system you can just unpack. In a lot of cases, it's also just as economical to buy your PC already assembled. With a top-of-the-line PC, however, you can save several hundred dollars by putting the system together yourself. To prove this, we put together a top-of-the-line PC based on Intel's Pentium 4 CPU. The Pentium 4 is the next generation in Intel's consumer and business processor line and is optimized for exceptional graphic performance. As with previous iterations of the Pentium, especially the Pentium MMX, it will take a bit of time before software vendors completely incorporate the new capabilities that the Pentium 4 offers. (See the sidebar: "Taking It A Notch Higher.")

Our *Build-It-Yourself P4 Project* was assembled from premium components—in many cases, the identical ones used by premium PC vendors, including Compaq and Dell. The Intel D850GB motherboard is, at the time

of writing, the only OEM model available for the Pentium 4. So just about any Pentium 4 system currently being sold uses this identical motherboard, regardless of the vendor label on the case.

The same is true with other important components of the system. The hard disk, CD-RW drive, and video card are all top-of-the-line, the best the vendors have to offer. So is the RDRAM we installed—it's the same vendor that sells RAM to every major PC vendor.

Our system wasn't inexpensive to build, coming in at a bit under \$2200 at the time this was written. At the same time, comparable systems from the major PC vendors were running about \$500 more (both priced without a monitor or speakers).

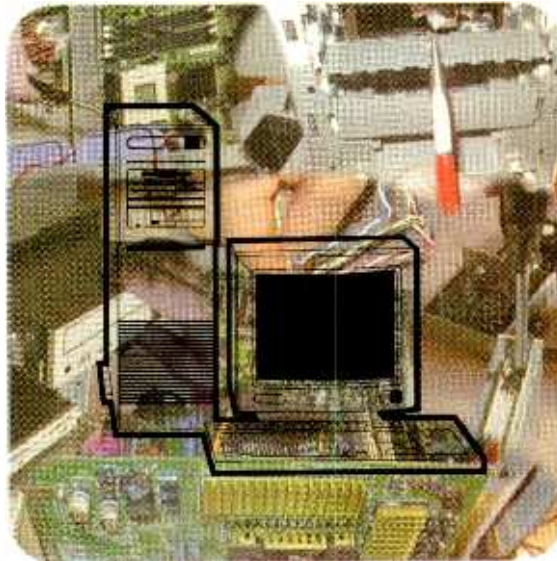
Considering that our system took a little less than two hours to put together once we collected all the parts, it works out to about \$250 per

hour for your labor! The down side is that the system you assemble is not under warranty by a single source. If something goes wrong with it, you'll have to troubleshoot it yourself. Be sure to save all of the receipts!

Great to the Core. The center of any PC is its motherboard. This contains the core logic chipset that directs data throughout the computer, a socket for the CPU, a front-side bus that connects the CPU to the RAM, and PCI and AGP buses that provide a way to

connect peripherals.

There are probably a dozen major vendors of motherboards, with some of the better-known ones being ASUS, Abit, Soyo, Gigabyte, MicroStar, and FIC. We're sure that we're leaving some other vendors out. One



Fasten your seat belt—it's time to assemble a build-it-yourself powerful P4 system. Then boot it up and get ready to blast off.

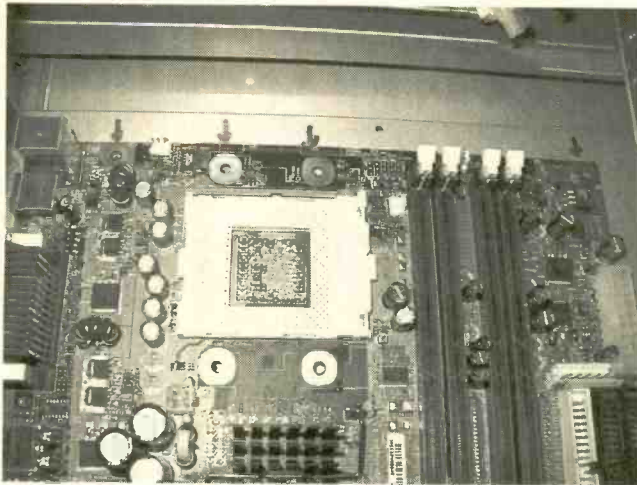


Photo 1. Shown above is the CPU socket surrounded by four plated-through holes.

major vendor of motherboards is Intel. Intel motherboards are among the most widely used, especially in products from premium PC vendors. That's the one we used for this project.

Intel's D850GB has a lot going for it. In addition to being specially configured to help support the humongous heat sink that the P4 requires (more on this later), it has embedded audio and Ethernet adapters. You can use the BIOS to disable the built-in audio if you'd rather add a premium card such as the Creative Labs SoundBlaster Live! or Hercules Game Theater XP. However, we found the sound quality of the built-in

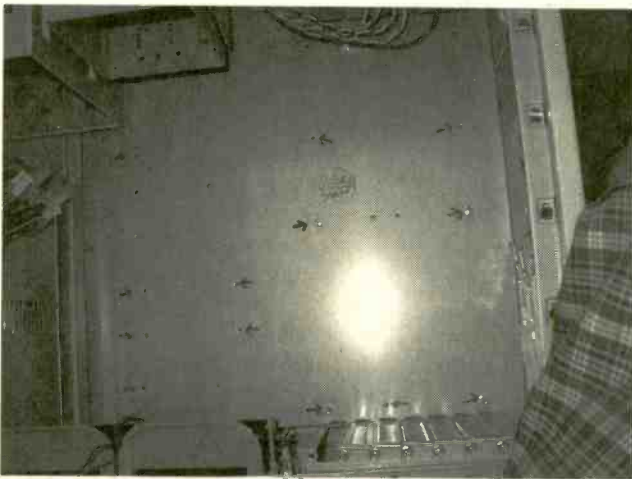


Photo 2. Make your markings as shown here, before screwing in the metal stand-offs.

audio more than satisfactory, especially with a set of good quality speakers.

We also appreciated the built-in 10/100BaseT Ethernet. We have 100BaseT Ethernet running throughout the house to take advantage of our StarBand satellite high-speed Internet access. We added a US Robotics Internet Call modem so that we could also use our AOL account. StarBand does allow us to access our AOL mail, but does not yet support any of AOL's other features.

26 The D850GB has four RIMM sockets, which require

RDRAM modules. As with the older EDO RAM, you need to install RIMMs in pairs. If you're installing RIMMs in only two of the four sockets, use a special terminator in the opposite socket. That's because the P4 motherboard uses a dual bus for the memory, and you'll need to have half of the total memory on each side of the memory bus. It also means that you need

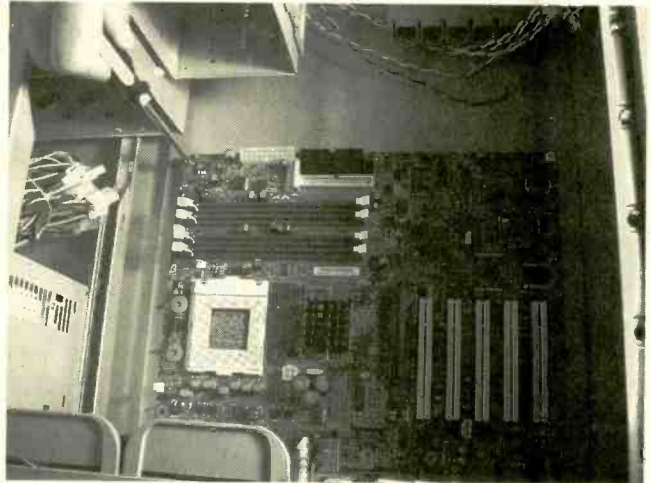


Photo 3. Here the motherboard is mounted to the stand-offs.

to balance the memory, using identical RIMMs. You can have two 128-MB and two 64-MB RIMMs, or two 256-MB RIMMs installed. You can't have a single 128-MB RIMM and three 64-MB RIMMs.

We installed two 128-MB RIMM modules and two terminator strips into the four RIMM sockets. The vendor we used was Kingston, who has a competitively priced ValueRAM line. These RIMMs were PC800 rated, which lets the P4's front-side bus operate at its full rated 400-MHz speed.

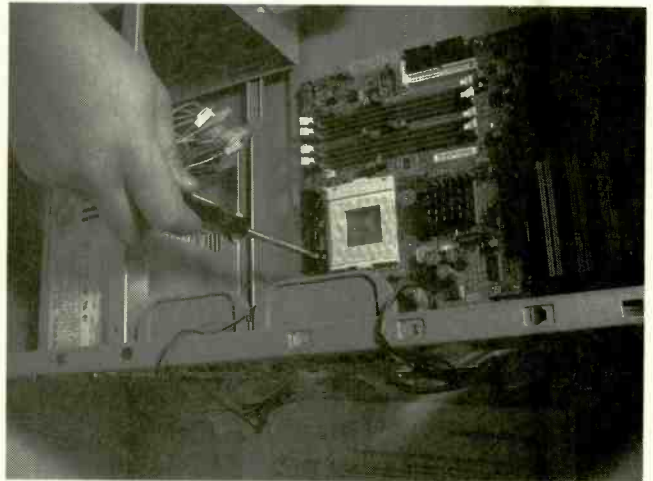


Photo 4. Insert a screw through the clips into the stand-offs.

Making the Case. When putting together a Pentium III or Athlon system, it doesn't really matter what kind of case and power supply you use—as long as the power supply is hefty enough to handle whatever you decide to load on the system.

(Continued on page 39)

A High-Tech MP3 Player

PAUL STOFFREGEN

Perhaps you've wanted a CD changer with enough capacity for your entire CD collection for your car or home, or you've looked at portable MP3 players, but haven't been impressed with their limited memory. Maybe you've thought about doing a specialized project, but it required complex customized playback from large collections of audio samples.

This high-capacity *High-Tech MP3 Player* project, which plays MP3 files from a standard hard drive, may be the answer. Its maximum capacity of

137 gigabytes allows 91 days of music to be stored! Even an older model hard drive provides plenty of storage space. For example, a 1-gigabyte drive stores over 16 hours of music.

Not only is the completed project much smaller than a stack of hundreds of CDs, but those original and expensive discs can stay safely stored at home when you take the player with you or install it in a car or other location.

Unlike any commercial off-the-shelf devices, this project is an open-source design that you can customize to your own special requirements. The firmware source code is provided as a free download. The flash upgradable design allows

you to download new code using a standard PC serial port, so no special EPROM programmer or other equipment is needed to reprogram the code. The C

compiler and the other software needed to compile the project's firmware are also available as free downloads, making this a truly customizable and flexible design. (How and where to access these free downloads is discussed in the "Open Source Code" sidebar.)

Theory Of Operation.

Before getting into the circuit details, let's take a quick look at

the major sections of this MP3 player and how they work together. In the center is the DMA (Direct Memory Access) engine, which transfers data from the IDE hard drive to a large DRAM buffer. The DRAM buffer is implemented with a standard 72-pin SIMM,

which may be 4, 8, 16, or 32 megabytes. Since many minutes of MP3 data can be held in the buffer, the hard drive can be placed in its full sleep mode to avoid draining batteries.

This mode also minimizes the time that the drive's media is spinning, greatly increasing resistance to mechanical shock. The DMA engine also automatically transfers MP3 data from the DRAM buffer to the MP3 decoder, as it is needed.



Store up to 91 days of music. This build-it-yourself MP3 player has humongous 137-GB capacity. See for yourself.

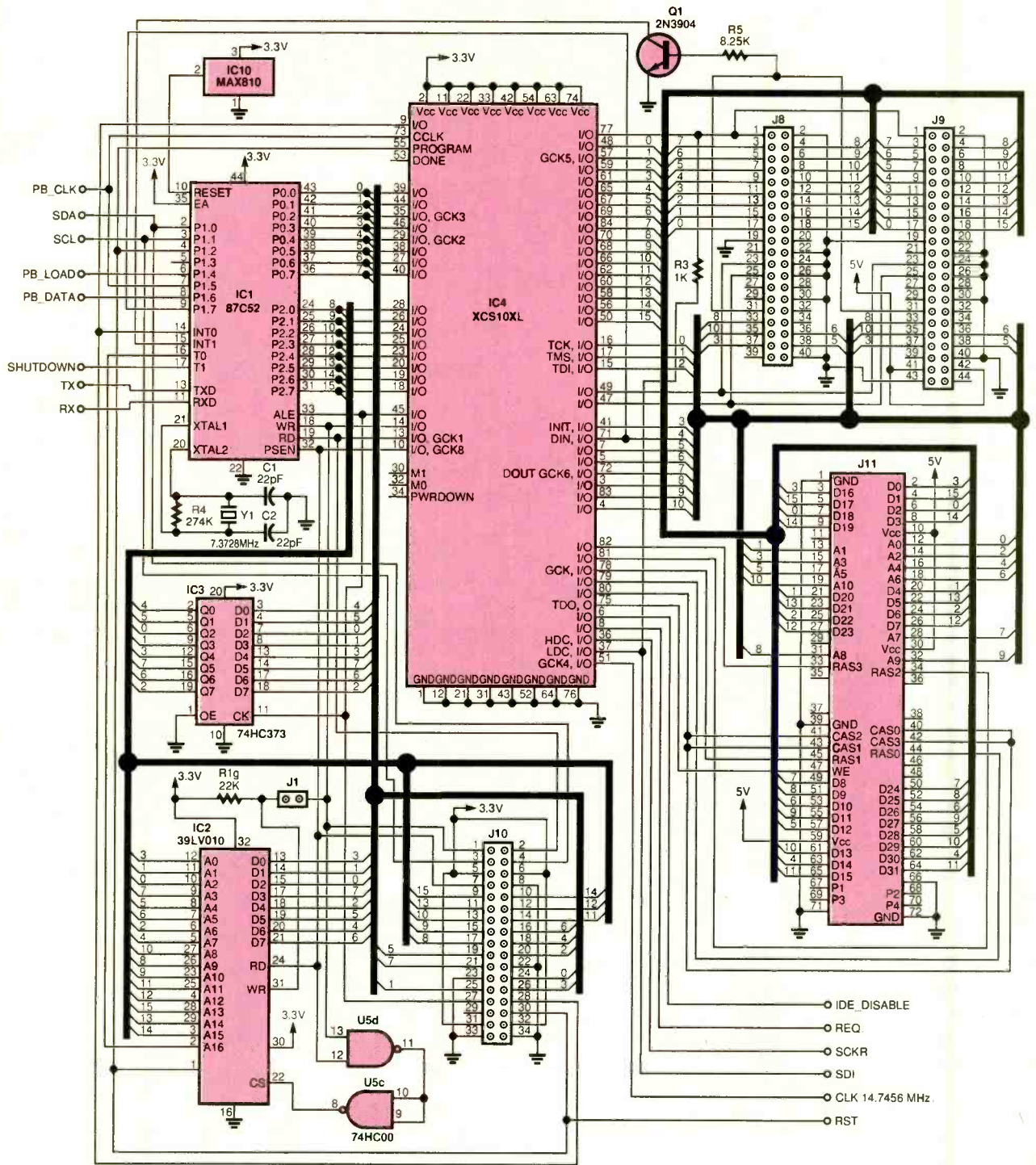


Fig. 1. The schematic above is for the project's main circuit board. An 87C52 chip performs the role of the microcontroller for the MP3 player.

The two DMA data transfers may be in progress at the same time; during these transfers, the microcontroller has full access to the DRAM. This flexible DMA-based approach provides very fast and efficient data transfers with minimal burden to the microcontroller.

The firmware executed by the microcontroller controls every aspect

of the MP3 player. When the player is turned on, the firmware scans the hard drive. The firmware recognizes the FAT32 file system, which is the standard format used by Microsoft Windows. All that is needed is to copy files onto a drive using Windows Explorer or any other standard file-management software. The root directory and all subdirec-

tories, up to five levels deep, are scanned; and the firmware builds a list of all MP3 files on the drive and the directories in which they were found.

Once all the files are located, the player enters normal playback mode. The player begins reading the first file into the DRAM buffer and begins playing it also. Since

the data is read from the drive much more rapidly than the MP3 decoder plays it, the drive spins down and enters a low-power sleep mode after several seconds. The firmware continues to direct the DMA engine to play the remainder of the file. When the end of the file is reached, this process is repeated.

The firmware handles a variety of other tasks as it manages normal playback. It continuously scans the six pushbuttons and also accepts commands via the serial port. Messages are sent to the LCD display that cause it to show the file-name, elapsed time, bit-rate, and other playback information. The MP3 ID3-tag information (specifying the song title, artist, and album) is extracted from the MP3 file and sent to the display.

Various playback modes are available, including sequential and random shuffle—both for the whole drive or for just the files in a single directory. A button on the board toggles random mode on and off. Buttons on the display change the mode and navigate between different directories, as well as between files within a particular directory. The display is constantly updated to reflect the current playback mode and the directory that's being played.

The firmware also implements a cursor-based navigation system on the display and multiple screens to access different settings and features. Four buttons in a diamond pattern on the display, together with buttons for incrementing and decrementing and entering parameters, adjust a variety of special settings.

Because the firmware is so important and defines the overall character of the MP3 player, the board design uses an easily upgradable flash-ROM chip to store it. The microcontroller is programmed with a monitor program that allows the firmware to be downloaded to the flash ROM. The monitor program cannot be changed or erased by downloading, which makes it safe to experiment with changes to the firmware. It is always possible to interrupt the boot process with a

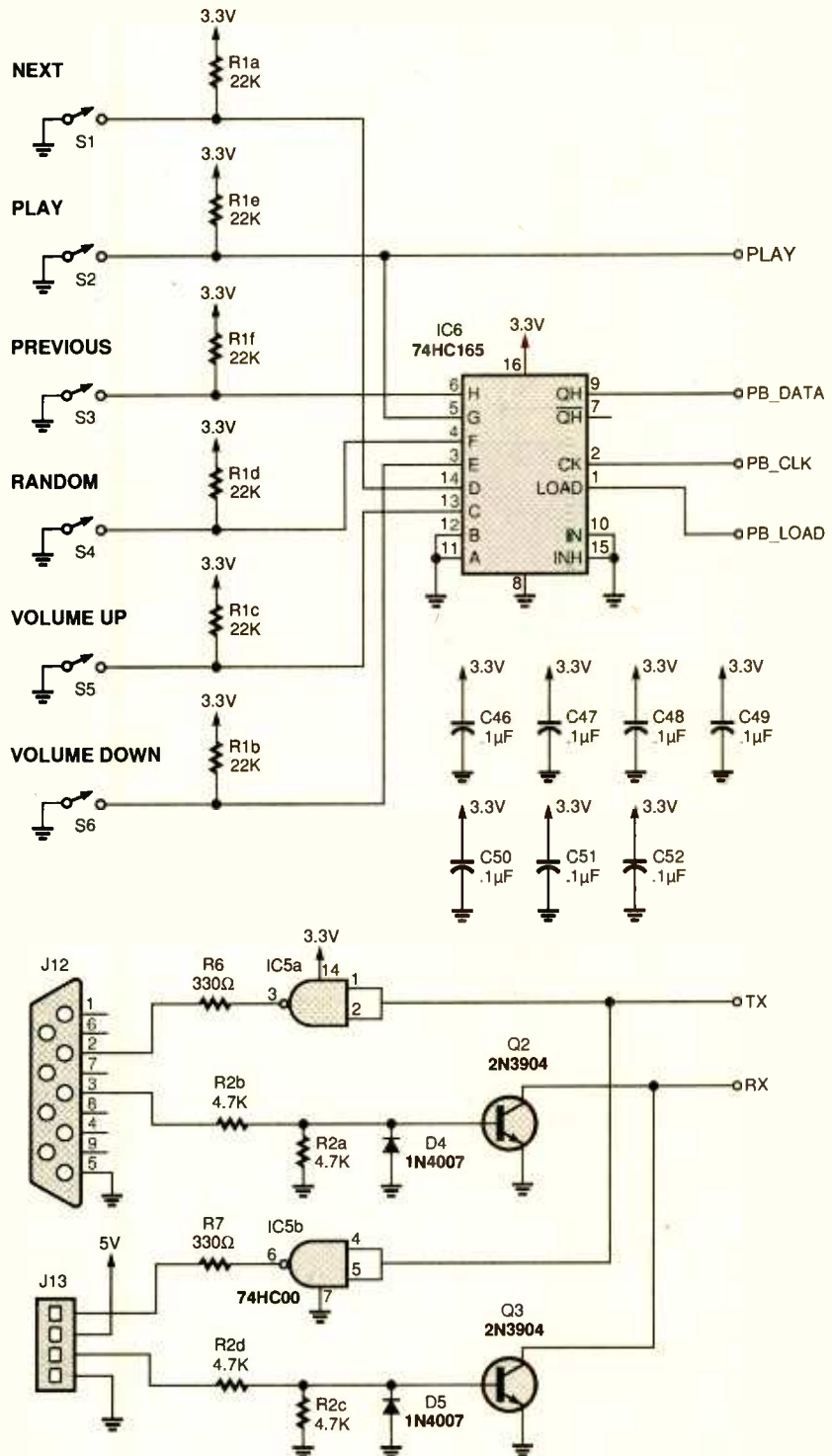


Fig. 2. This is the schematic for the pushbutton interface that is constructed separately. The 74HC165 Parallel-Input/Serial-Output Shift Register is the main interface between the pushbuttons and the microcontroller.

command via the serial port and then to erase the flash chip and download a new firmware image. We'll cover how to modify the firmware in the section on "Testing and Troubleshooting." First, we'll take a more detailed look at the hardware.

Circuit Details. The microcontroller system that controls every aspect of the MP3 player is made up of an 87C52 processor (IC1); the 39LV010 flash ROM that holds the firmware (IC2); and an octal D-latch (IC3). This latch is needed to interface the 87C52's multiplexed bus to the

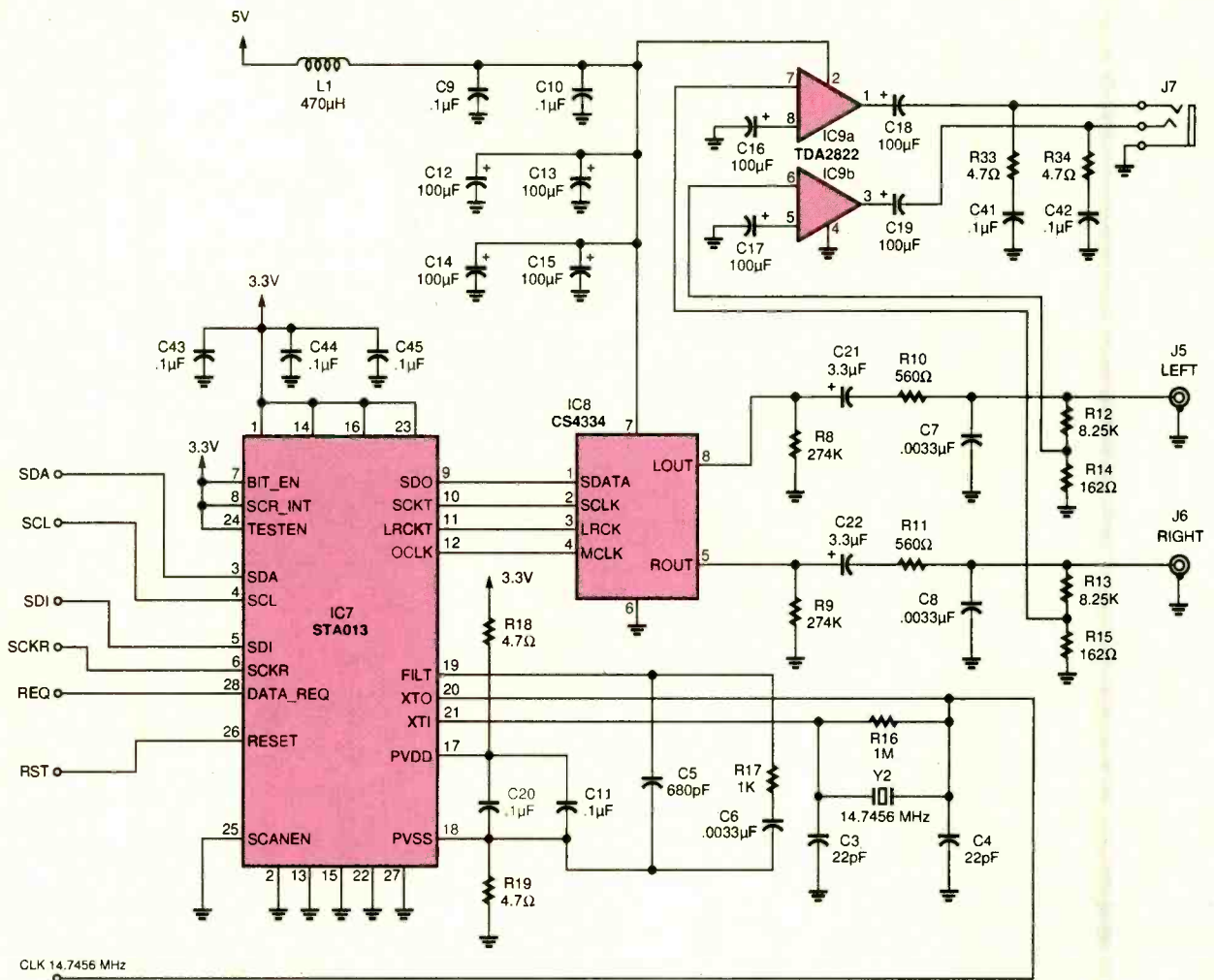


Fig. 3. The audio section schematic is centered around the STA013 MP3-decoder chip. This chip's output is sent to the CS4334 Digital-to-Analog Converter.

non-multiplexed bus of the flash ROM (see Fig. 1). A MAX810 reset-generator chip (IC10) ensures that the processor will not begin running until the power-supply voltage is stable. The NAND gates (IC5) cause the flash ROM to enter a low-power mode while it is not being accessed by the firmware. A 7.3728-MHz crystal (Y1) supplies the clock for the microcontroller. A 34-pin header in the center of the board (J10) provides all the important microcontroller signals to allow expansion cards to be developed in the future.

The DMA engine is implemented in the Xilinx XCS10XL Field Programmable Gate Array, or FPGA (IC4). This FPGA chip is programmed by the firmware as one of its first steps as it boots. The programming data is a small 12-Kb file embedded within the firmware code stored in the flash ROM. When programmed,

the FPGA implements a DRAM-memory interface, the IDE interface, and the DMA controller with two concurrent channels. A bus arbitrator is implemented to sequence access to the DRAM between the microcontroller, the two DMA channels, and the required DRAM refresh.

The memory controller inside the FPGA divides the 32-MB DRAM SIMM into 8192 4-Kb blocks. A small page-lookup table allows the 87C52 to select any 15 of these 4-Kb blocks to fill 60 Kb of its 64 Kb of address space. The memory controller constantly monitors the 87C52's bus as it fetches code from the flash ROM. When an opcode is observed that will access the DRAM, the bus arbitrator finishes any in-progress operation to the DRAM and reserves the DRAM bus exclusively for the microcontroller. When the 87C52 sends signals to

access the memory, the DRAM controller performs the requested operation and returns the data to the microcontroller for a read or stores data for a write. When the 87C52 is fetching code from the flash ROM or not making any access to its bus, the bus arbitrator inside the FPGA allows the DMA channels and DRAM refresh to have complete access to the DRAM.

The FPGA also implements an IDE interface and an interface to its own internal configuration registers. The DRAM memory, IDE interface, and configuration registers are each mapped to particular regions of the 87C52's address space. That way the appropriate actions can be taken to access each of these, depending on which address the 87C52 contacts.

A pair of registers controls each of the DMA channels. The 87C52

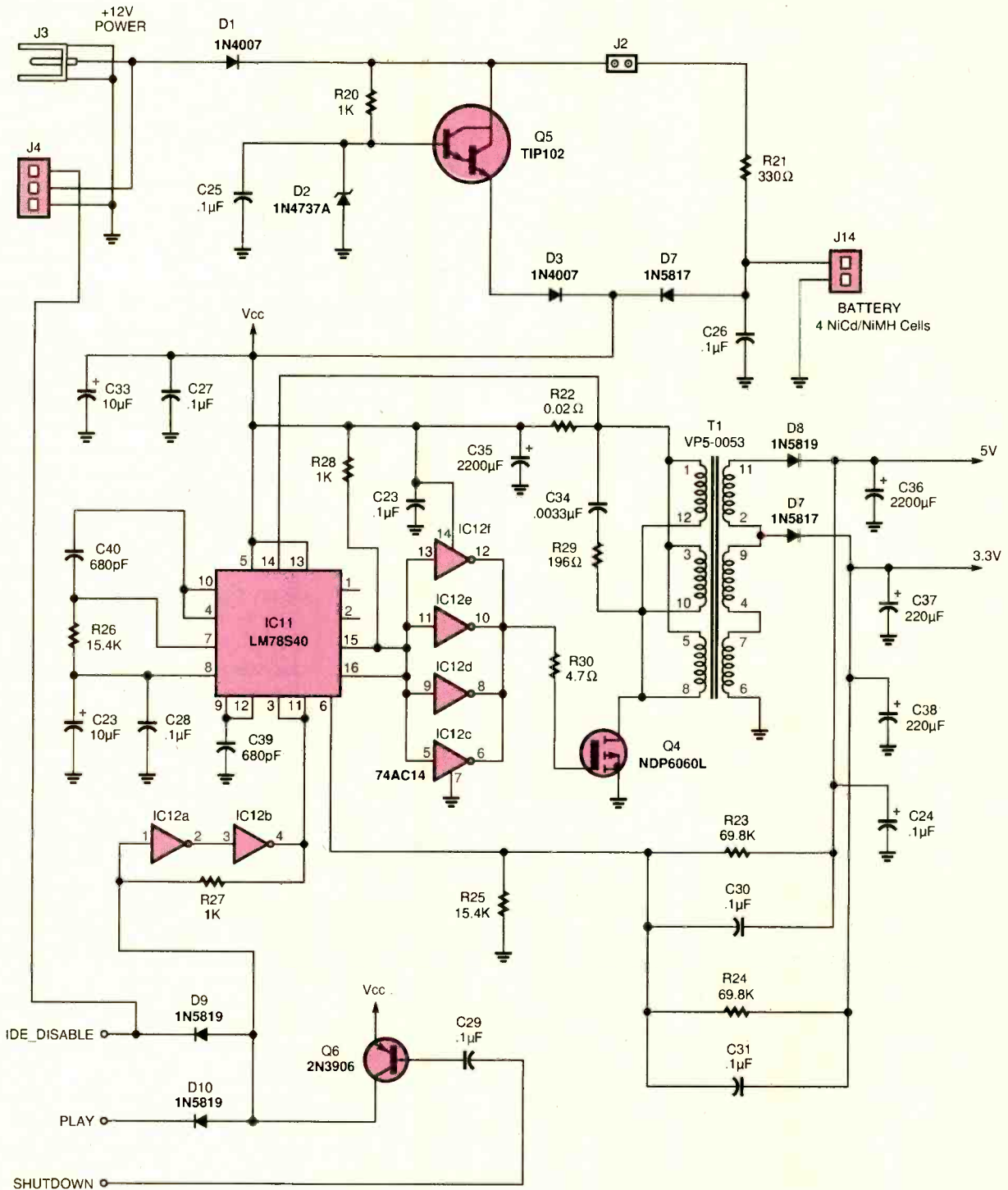


Fig. 4. The board contains a simple power supply that can create the required 5- and 3.3-volts of power from either a 10- to 15-volt or 4.5- to 6-volt input. An LM78S40 chip handles power regulation.

first configures the page-lookup table to map the desired section of the DRAM memory. It then writes the starting address and number of bytes to transfer into configuration registers; finally, it writes to a register to instruct the FPGA to begin automatically transferring the data. The FPGA sends an interrupt signal to the 87C52's INTO pin to alert the

firmware that the requested transfer has been completed. DMA transfers from the IDE interface are executed as rapidly as possible. DMA transfers to the MP3 decoder are performed only when the MP3 decoder requests data. The firmware does not need to monitor if the MP3 decoder is requesting data, as it can simply instruct the

DMA controller to transfer a large block and receive an interrupt when it has finished. The automatic data transfer using these two DMA channels relieves the 87C52 microcontroller of all substantial data-movement tasks and allows it to go about computing FAT32 sector addresses and servicing the user interface, while the DMA engine

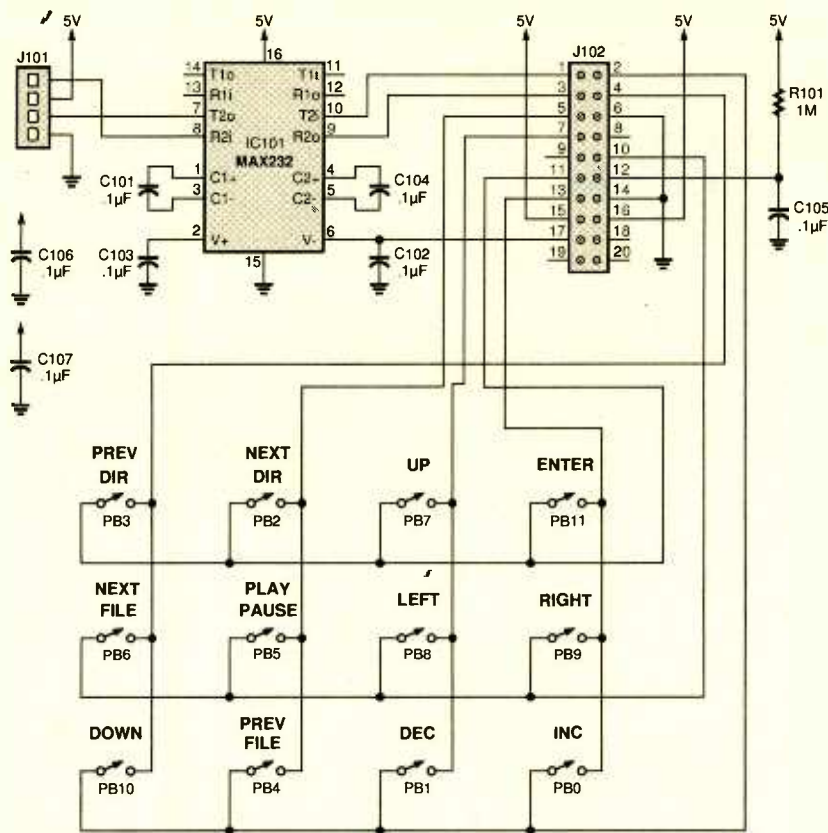


Fig. 5. The LCD display board interfaces with the MP3 player using serial communication. The serial-data inverting-function is handled by a MAX232 interface-chip.

moves the data very efficiently.

The actual IDE interface on the circuit board has two connectors—a 40-pin 0.1-inch header (J8) for connecting a standard 3.5-inch hard drive and a 44-pin 2-mm header (J9) for connecting a 2.5-inch laptop hard drive. An NPN transistor (Q1) and resistor R5 convert the active-high IDE interrupt signal to the active-low signal needed by the microcontroller's INT1 input. The DRAM interface is designed to use a standard 72-pin memory SIMM, installed in the SIMM connector (J11). Because there are only a limited number of pins on the FPGA chip, the 32-bit DRAM data is connected to the same 16-bit bus as the IDE interface. In addition, the DRAM control lines operate so that only half of the SIMM's 32 bits are used at any one time. This approach allows the use of an 84-pin FPGA chip and its through-hole socket, rather than the 144-pin FPGA version, which is supplied in a fine-pitch surface-mount package!

A 74HC165 parallel-input serial-output shift-register chip (IC6) is

used to connect the six pushbuttons to pins on the 87C52 microcontroller (see Fig. 2). As the firmware runs, it scans these pushbuttons by pulsing the PB_LOAD signal and then extracting each signal on PB_DATA by applying clock pulses to PB_CLK. The firmware executes this scan every 20 ms, taking a sequence of steps to perform the user's request when it detects that the user has pressed a button.

The firmware communicates to both the display board and its serial port using the TX and RX signals. When the firmware transmits data, it is sent to both locations. The display listens for specific character sequences to start and stop the display of incoming characters and to perform various functions such as scrolling, cursor positioning, screen clear, etc. This design allows additional messages to be sent to the PC that will be ignored by the display, which is particularly helpful when testing new code in the firmware. The NAND gates (IC5) invert the signal as required by RS-

232, and resistors R6 and R7 provide some protection against poorly connected cables. The output level is a 0- to 3-volt signal, which does not fully conform to the RS-232 spec (-3 to 3 volts). Yet, virtually all RS-232 receivers can properly receive this 0- to 3-volt signal.

Commands from both the PC and display are merged together and presented to the microcontroller. If both ports send a command at the same moment, the result is garbled data. However, in practice, one does not usually press the buttons on the display while communicating with the MP3 player via a PC. Transistors Q2 and Q3 invert the signals and merge them together. Diodes D4 and D5 protect the transistors from negative voltages, and the resistors in a resistor network (R2) limit the input current and establish a zero input when no signal is connected.

A dedicated STA013 MP3-decoder chip (IC7) performs the actual MP3 decoding (see Fig. 3). The STA013 accepts input data with just two wires, a clock (SCKR) and data (SDI). It automatically identifies the MP3 sample rate, bitrate, and other parameters and provides a data-request signal to indicate when it requires more data. The DMA controller inside the FPGA (IC4) receives the data-request signal and automatically sends more data when requested. It also suspends transmission when the STA013 cannot accept more input. The STA013 can be controlled using two wires and the I2C protocol. These wires connect to the microcontroller. The microcontroller initializes the STA013 using these pins. While the STA013 is running, it queries parameters and controls settings, including the output attenuation (volume). The actual MP3 data is never sent from the microcontroller; the DMA engine always transfers it.

The STA013 contains a phase-locked-loop (PLL) circuit, which creates clock signals corresponding to the sample rate selected by the MP3 data it is decoding. Components R18, R19, C20, and C21 comprise a filtered power source for the PLL; and R17, C5, and C6 provide required filtering for the PLL's feedback loop. A

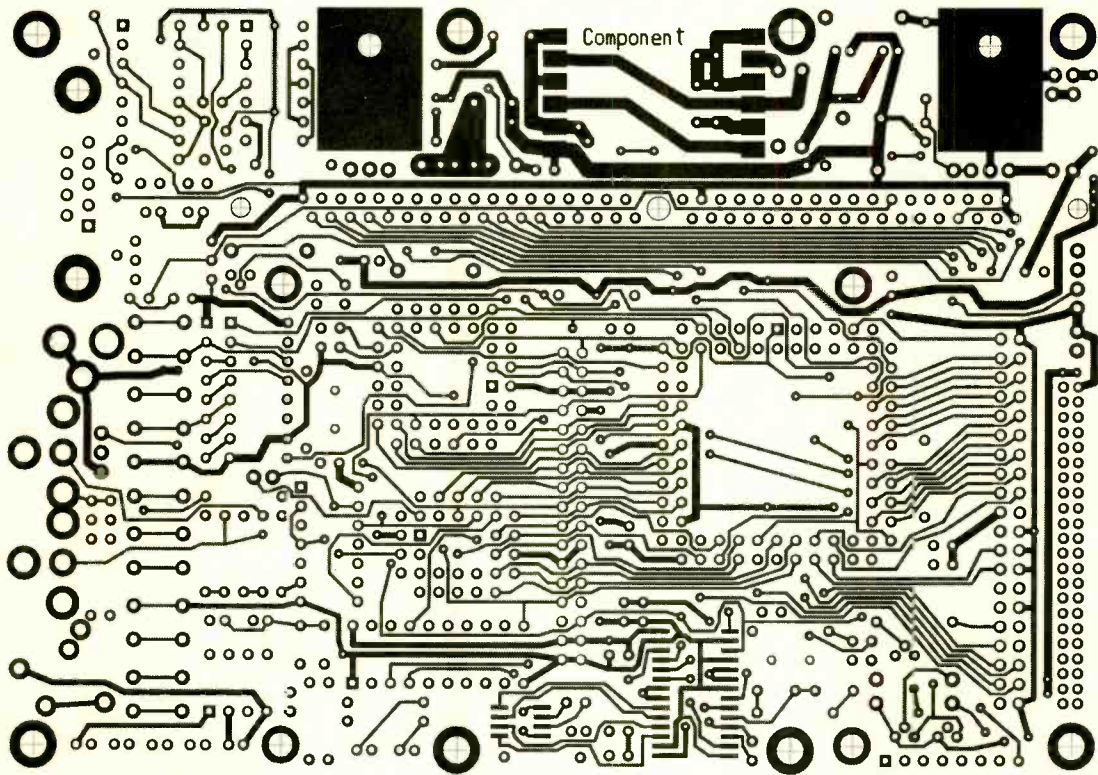


Fig. 6. Here is the component-side foil pattern. High-resolution images can be downloaded at www.pjrc.com/tech/mp3/pcb_layout_reva.html.

14.7456-MHz crystal (Y2) supplies the master clock for the STA013. This clock is also connected to the

FPGA (IC4) and ultimately produces all the timing for the DRAM and IDE interfaces.

The STA013, which offers decoded digital output in I2S format, is directly connected to IC8—a 24-bit

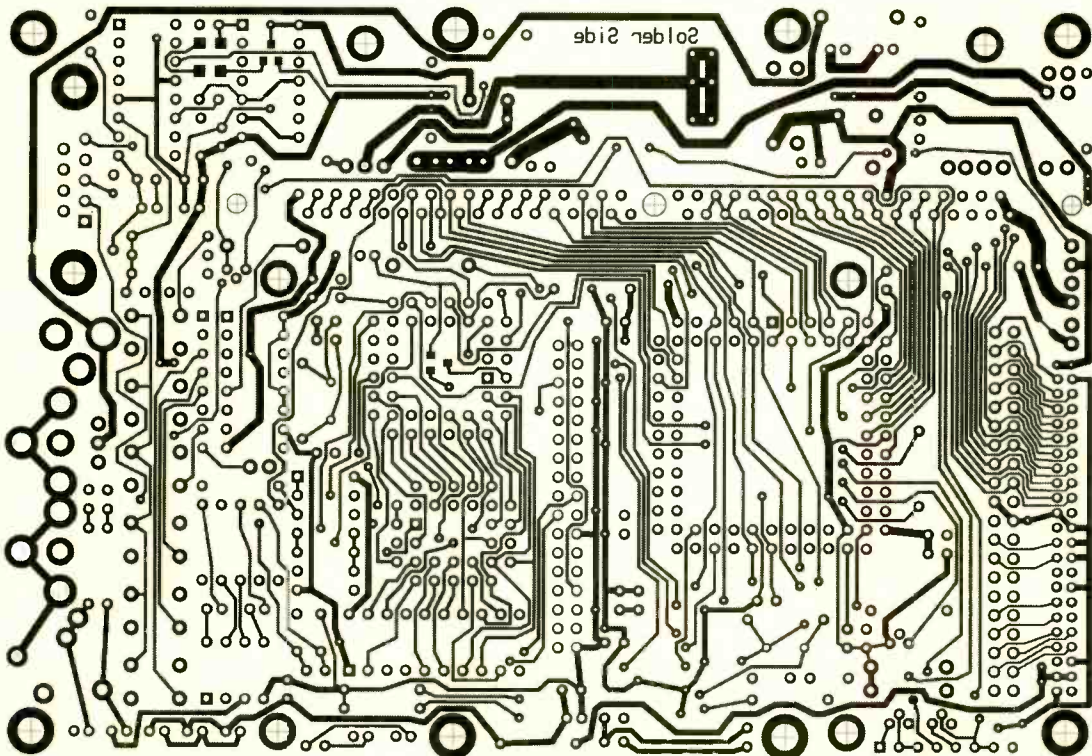


Fig. 7. Here is the solder-side foil pattern for the main board. A high-resolution image can be downloaded at www.pjrc.com/tech/mp3/pcb_layout_reva.html.

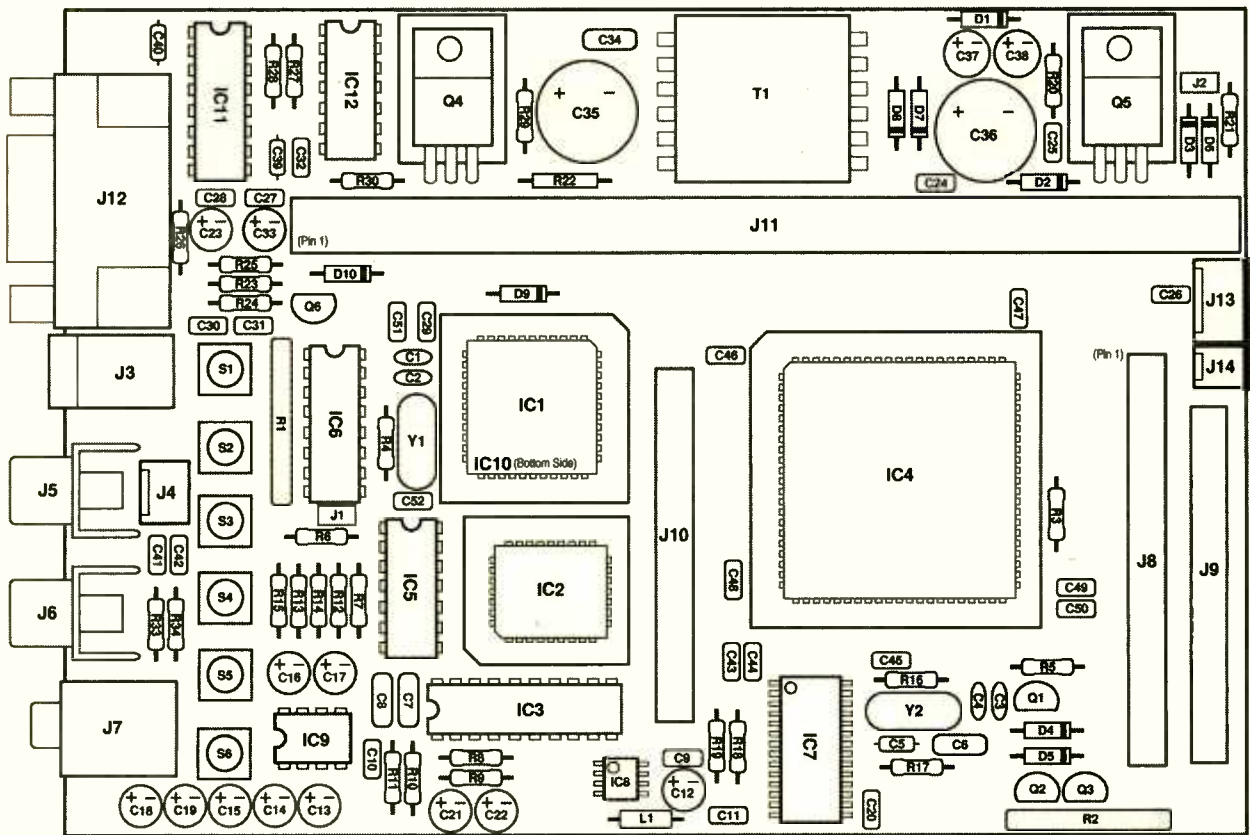


Fig. 8. This is the parts placement diagram for the main board. Be careful to observe polarity where necessary and protect against ESD when handling any sensitive semiconductors.

Digital-to-Analog Converter (DAC). Resistors R8 and R9 and capacitors C21 and C22 provide DC-level shifting from the DAC's internal DC bias to ground. Resistors R10 and R11 and capacitors C7 and C8 form a simple filter to remove aliased images of the DAC's sample frequency. The CS4334 DAC includes 4X interpolation and an internal filter, which allows this simple R-C filter to be used rather than a complex op-amp-based circuit that might add noise to the system.

The amplified headphone output used here is a TDA2822 dual amplifier (IC9). Capacitors C16-C19 provide the AC coupling required by the amplifier, and resistors R33 and R34 and capacitors C41 and C42 attenuate RF pickup that could otherwise couple into the amplifier. An inductor (L1) and a group of capacitors permit filter-

ing of the 5-volt power supply to create a low-noise power source for the analog circuitry. The exact value of inductor L1 is not critical, and different inductors may be substituted with little or no impact on the analog outputs.

Power Supply. The board contains a simple power supply (see Fig. 4) that can create the required 5- and 3.3-volts of power from either a 10- to 15-volt or a 4.5- to 6-volt input. Transistor Q5 together with a Zener diode (D2) and resistor R20 forms a 6-volt pre-regulator. The pre-regulator provides protection against large voltage spikes—common in 12-volt automotive systems—and also protects the main portion of the power supply, which cannot safely run above 7 volts.

The power supply is a flyback-switching topology, with an LM78S40

PWM control chip (IC11). A power MOSFET (Q4) is driven by the inverters, IC12, which drives the primary of the transformer, T1. The outputs are rectified by diodes D7 and D8; and the resistors R23-R25 together with the output-turns ratio define the output voltages at 5 and 3.3 volts.

A pair of inverters (IC12) and a resistor (R27) form a simple 1-bit memory, which is used to implement a firmware-controlled shutdown. When pin 4 is high, the PWM chip is turned off; and the remainder of the power supply shuts down. The firmware can initiate shutdown by pulling low on the base of transistor Q6 via capacitor C29. Power is turned on by pulling low on pin 1, by either D9 or D10.

The flyback-switching power supply provides both of its outputs via rectifier diodes D7 and D8. Because these diodes will prevent externally applied power from flowing back into the transformer, it is possible to run the board using an external regulated power supply that offers both +5 and +3.3 volts.

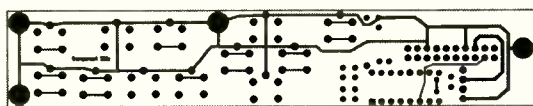


Fig. 9. Here is the component-side foil pattern for the pushbutton board. A high-resolution image can be downloaded at www.pjrc.com/tech/mp3/pcb_layout_rev4.html.

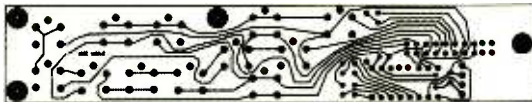


Fig. 10. Here is the solder-side foil pattern for the pushbutton board. A high-resolution image can be downloaded at www.pjrc.com/tech/mp3/pcb_layout_reva.html.

Display-Circuit Details. The LCD display board interfaces with the MP3 player using serial communication (see Fig. 5). The display circuit board contains its own micro-controller system, and its EPROM is programmed with *LCD.HEX*. A small adapter board provides the interface circuitry and 12 pushbuttons. A MAX232 RS-232 interface IC (IC101) inverts the serial data signals and also features a charge-pump power-supply using four capacitors (C101–C104). Negative 10 volts is produced at pin 6, which is fed to the display board to produce the negative bias voltage that it requires. Resistor R101 and capacitor C105 create a simple power-on reset for the display board. Twelve pushbuttons (PB0–PB11) are connected in a 3- × 4-matrix to the seven I/O lines from the display. The *LCD.HEX* firmware regularly scans these lines and sends messages to the MP3 player when the buttons are pressed.

Main Board Construction. PC board construction should be used to build this MP3 player. Though the digital circuit is not highly sensitive to the layout, there are numerous connections between the parts. The opportunity for a wiring error and the difficulty of locating an error among so many connections makes PC-board construction with the foil patterns essential. The power supply is sensitive to component layout and trace impedance; if breadboard assembly is attempted, an external regulated power supply should be substituted.

The PC board should be fabricated with plated-through holes. The PLCC sockets and SIMM socket require connections to the top of the board, and these sockets cover up the top side pads when they are installed. A bare board with plated-through holes may be ordered from the source listed in the Parts List. If you decide to fabricate your own circuit board, you may use the foil patterns printed in Figs. 6 and 7 or download high-resolution copies of these foil patterns at www.pjrc.com/tech/mp3/pcb_layout_reva.html.

As always, it is advisable to solder the low-profile components first and work up toward the taller parts to ease the assembly process. Follow the parts placement diagram in Fig. 8. Double-check the diode and electrolytic capacitor polarities. When soldering the PLCC sockets and SIMM socket, be very careful to align them correctly. It can be very difficult to desolder a component with so many pins.

Before applying power, double-check resistors R23, R24, and R5, and their connections to IC11. These parts set the power-supply voltage. If there is an error that holds pin 6 of IC11 near ground, the power supply can produce a relatively high output voltage and damage all of the other chips, so a few moments double-checking these few critical parts is time well spent.

Display Construction. The display pushbutton board may be built using a PC board. See the foil pat-

terns in Figs. 9 and 10. Breadboard construction may also be used. If a socket is used for IC101, its height relative to the pushbuttons should be considered prior to soldering. Follow the parts placement diagram in Fig. 11. The polarity of J102, the ribbon cable, and its connection to the display itself should be carefully checked. Pin 17 conducts a -10-volt supply—one that could damage the display if connected to any other pin.

The display board uses its own firmware, stored in an EPROM chip. This EPROM must be programmed with *LCD.HEX*. If an EPROM programmer is not available, a pre-programmed EPROM or a display with the programmed EPROM may be purchased from PJRC. A proper PLCC extraction tool must be used, as the socket on the display board is easily damaged when excessive prying force is applied. Once the correct firmware is installed, the only assembly step remaining is connecting the ribbon cable. If stranded conductors are used in the cable, they should be twisted and tinned to assure a good connection. The display board's 17-pin connector has a latch that lifts slightly to release the pressure on its contacts. Carefully insert the 17 tinned leads, while paying careful attention to pin 17 (-10 volts). Press the latch firmly downward to secure the wires, and your display will be ready for use.

Testing and Troubleshooting. The first test should be to verify that the power supply is producing the correct +5- and +3.3-volt power for the rest of the board. This test can be performed before the other ICs are installed if a 100-ohm resistor is added from the +5-volt power-line to ground. When power is first applied, there can be a large in-

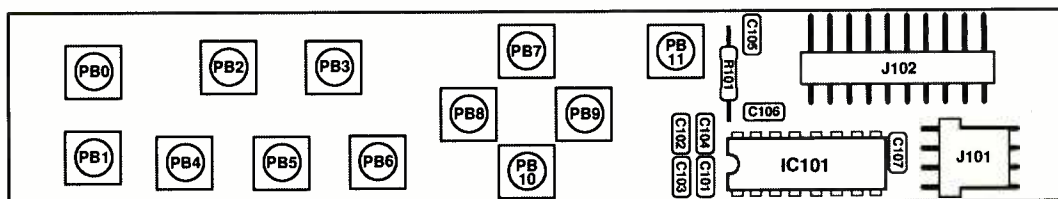


Fig. 11. This parts placement diagram for the push-button board will be helpful during the construction process.

PARTS LIST FOR THE MP3 PLAYER

SEMICONDUCTORS

- IC1—87C52-SBAA, microcontroller with internal EPROM (programmed with *PM2_MP3.HEX*), Philips
 IC2—SST39LV010, Flash ROM, 128Kb × 8, SST
 IC3—74HC373, octal D-Latch
 IC4—XCS10XL-PC84, Field Programmable Gate Array, Xilinx
 IC5—74HC00, Quad NAND gate
 IC6—74HC165, parallel in-serial out-shift register
 IC7—STA013, MP3 decoder, ST Microelectronics
 IC8—CS4334-KS, 24-bit stereo Digital-to-Analog Converter, Cirrus Logic
 IC9—TDA2822-M, dual-power amplifier, ST Microelectronics
 IC10—MAX810, reset generator, Microchip (or equivalent), Maxix
 IC11—LM78S40, PWM regulator, National Semiconductor
 IC12—74AC14, Hex-inverting Schmitt trigger (see text)
 Q1—Q3—2N3904, NPN transistor
 Q4—NDP6060L, N-channel power MOSFET, Fairchild Semiconductor
 Q5—TIP102, NPN Darlington power transistor
 Q6—2N3906, PNP transistor
 D1, D3—D5—1N4007, general-purpose rectifier diode
 D2—1N4737A, 7.5-volt Zener diode
 D6, D7—1N5817, Schottkey diode
 D8—D10—1N5819, Schottkey diode

RESISTORS

(All resistors are ¼-watt, 5% carbon-film units, unless otherwise noted.)

- R1—22,000-ohm, resistor network, 8-lead, bussed (7 resistors)
 R2—4700-ohm, resistor network, 8-lead, isolated (4 resistors)
 R3, R17, R20, R27, R28—1000-ohm
 R4, R8, R9—274,000-ohm, 1%, metal-film
 R5, R12, R13—8250-ohm, 1%, metal-film
 R6, R7, R21—330-ohm
 R10, R11—560-ohm, 1%, metal-film
 R14, R15—162-ohm, 1%, metal-film
 R16—1,000,000-ohm
 R18, R19, R30, R33, R34—4.7-ohm
 R22—0.02-ohm
 R23, R24—69,800-ohm, 1%, metal-film
 R25, R26—15,400-ohm, 1%, metal-film

R29—196-ohm, 1%, metal-film

CAPACITORS

- C1—C4—22-pF
 C5, C39, C40—680-pF
 C6—C8, C34—0.0033-μF
 C9—C11, C20, C24—C32, C41—C52—0.1-μF
 C12—C19—100-μF, 6.3-volt
 C21, C22—3.3-μF, 16-volt
 C23, C33—10-μF, 16-volt
 C35, C36—2200-μF, 10-volt, low-ESR
 C37, C38—220-μF, 10-volt, low-ESR

CONNECTORS

- J1, J2—Header, 2-pin, 0.1-inch
 J3—Power jack
 J4—Header, 3-pin with locking ramp, Molex 22-23-2031
 J5—RCA Audio, PCB-mount, white (left)
 J6—RCA Audio, PCB-mount, red (right)
 J7—Stereo headphone jack, ¼-inch, PCB-mount
 J8—Header, 40-pin, dual-row, 0.1-inch
 J9—Header, 44-pin, dual-row, 2-mm
 J10—Header, 34-pin, dual-row, 0.1-inch
 J11—SIMM Socket, left polarized, Amp 822030-3
 J12—D-subminiature, 9-pin socket, PCB-mount
 J13—Header, 4-pin with locking ramp, Molex 22-23-2041
 J14—Header, 2-pin with locking ramp, Molex 22-23-2021

ADDITIONAL PARTS AND MATERIALS

- Y1—Crystal, 7.3728-MHz, parallel-type
 Y2—Crystal, 14.7456-MHz, parallel-type
 S1—S6—Switch, momentary, PCB-mount, 6-mm
 L1—Inductor, 470-μH (see text)
 T1—Transformer, VP5-0053, Coiltronics 44-pin PLCC socket, through-hole (for IC1)
 32-pin PLCC socket, through-hole (for IC2)
 84-pin PLCC socket, through-hole (for IC4)
 Heatsinks, 4-40 ¼-inch screws, 4-40 nuts
 72-pin SIMM Memory Module, 4-, 8-, 16-, or 32-MB
 Hard disk drive, 3.5- or 2.5-inch
 Disk-drive cable
 Standoffs or other mounting hardware, as desired

PARTS LIST FOR THE MP3 DISPLAY

- IC101—MAX232, RS-232 interface
 R101—1,000,000-ohm
 C101—C107—0.1-μF
 S101—S112—Switch, momentary, PCB-mount, 6-mm
 J101—Header, 4-pin with locking ramp, right angle, Molex 22-05-3041
 J102—Header, 20-pin, dual-row, 0.1-inch
 PB0—PB11—Soft-contact pushbuttons, SPST
 Display, JW-002, Earth Computer Tech; EPROM for JW-002, programmed with *LCD.HEX*; ribbon cable with 20-pin socket connector; display data cable: terminal housings (Molex 22-01-3047), crimp pins (Molex 08-50-0114), 24-AWG wire

A complete kit of all parts including a bare PC board may be ordered from PJRC for \$140 at www.pjrc.com/store/mp3_pcb_kit.html. A fully assembled and tested board is also available for \$150 at www.pjrc.com/store/mp3_pcb_assem.html. A bare PC board, with plated-through holes, is available for \$25 at www.pjrc.com/store/mp3_pcb_bare.html. The LCD display and pushbutton adaptor board is available for \$42 at www.pjrc.com/store/mp3_display_beta.html. Many of the semiconductors and other components, including the transformer, may be ordered from PJRC. Visit www.pjrc.com/store/ for details.

power supply is preferred.

Once it's verified that the power supply produces the correct voltage, it is safe to install all the chips. Apply power and check the output of the MAX810 chip (pin 10 on the 87C52 microcontroller). The MAX810 output should be high very briefly when power is applied and then go low to allow the processor to start running. If you have an oscilloscope, you could also check that the 7.3728-MHz crystal is oscillating, though this is rarely a problem.

If your 87C52 chip is blank, you must program it with the *PM2_MP3.HEX* file (built with the firmware). If you do not have an EPROM programmer capable of writing this chip, you can order an 87C52, pre-programmed with *PM2_MP3.HEX*, from the supplier listed in

rush current as the switcher charges the capacitors and stabilizes its feedback loop. This in-rush can trip

the current limiting in some lab bench supplies, so a 12-volt, 1-amp unregulated "wall wart" style

OPEN SOURCE CODE

The firmware for this project is open source. You may download the source code for free at www.pjrc.com/tech/mp3/firmware.html. To compile the source code, you will need the SDCC C compiler, the AS31 assembler, and a few other utility programs. Fortunately, all of this required software is also available for free download, and it is also open source. SDCC and AS31 may be downloaded at www.pjrc.com/tech/8051/index.html#as31_assembler. These programs will run on either Microsoft Windows or Linux systems. If you have a Linux-based system, then you probably have all the other tools already installed or available as part of the distribution.

If you use Microsoft Windows, a few more steps are needed to set up a working environment to successfully compile the firmware. There are two basic approaches. The first is to use *CYGWIN*, which provides a comprehensive Unix emulation layer and Unix environment running on top of Windows. Complete step-by-step instructions, specific to this project, may be found at this Web page: www.pjrc.com/tech/mp3/cygwin_setup.html. *CYGWIN* is a large download, and most of its functionality is not needed for this project.

The second Windows build approach is to set up 100% native programs. Fortunately, the AS31 and SDCC download is already native, and their package includes *GNU Make*, so the only major missing piece is the *Perl* scripting language. Fortunately, ActiveState provides a native *win32 Perl* package, available as a free download from their Web site, www.activestate.com. Some minor editing may be needed in the project "Makefile" for a native win32 environment. Also, the win32 GUI-based CVS client program can be downloaded at www.wincvs.org.

Regardless of which system you use to build the firmware, you simply type "make" from your command shell (or MSDOS prompt, as the case may be). The *GNU Make* program will run and execute the commands in the "Makefile." If some program is missing or improperly installed (or you've edited the code and made an error), the process will stop with some type of error message of some sort. If everything goes well, you should end up with *MP3PLAYER.HEX*, the down-

loadable firmware image. You should also get *MAIN.HEX* and *DEV-MAIN.HEX*, which are partial firmware images files that correspond to the partial flash erasure ("X" and "Y" commands at the monitor). These partial images allow faster download, while hacking on the code and trying changes over and over. The Makefile will also build *LCD.HEX* and *PM2_MP3.HEX*, which are the firmware images for the display board and the 87C52 chip (IC1).

The MP3 player firmware is divided into two portions: the application-level code, which is written primarily in C, and the driver-level code, which is written entirely in assembly language. There are many files in the source code, but it is probably best to start by looking at *main.c*, which has the main program loop and other very important application-level code. At the beginning of the main function, there are many steps taken to set up the player. Ultimately, the code reaches a giant infinite loop, which runs all of the player's functions.

The player's user interface operates using an event queue. When various things occur, such as a pushbutton press, events are added to this queue. The first thing the main program does is fetch the next pending event (if any) and perform the action needed for that particular event. Much of the display updating is done here in response to events added by the timer-device driver.

Following the event processing is a software-state machine, which causes the player to perform the next required action, whatever that may be. Initially this is locating a file to play. Later, it is loading data from the file into the SIMM, and, shortly after, also delivering blocks of data to the STA013 decoder chip (if it is ready), and so on. The process of servicing a pending event (if any) followed by doing another step in the main state machine is repeated indefinitely.

There is much more code than can be described here, even briefly. Most of the application code is divided into distinct modules called from this main function, so it is fairly easy to locate portions of the application that are responsible for particular behavior of the player. Since it's an open-source

project, a number of people from around the world have contributed to the firmware source code in one way or another. To facilitate this happening, the source code is maintained using a program called CVS, which stands for Concurrent Version System. CVS is software that allows many programmers to work together to develop code. Like all the other programs, it is free software. CVS has many advanced features, but most people use only three of them: Checkout, Update, and Commit. All of these communicate via the Internet to the server, which maintains a master copy of the code. "Checkout" downloads a fresh copy of the code. "Update" merges any changes on the server into your local copy, without discarding any changes you may have written. "Commit" causes changes you have made to the code to be merged into the master copy on the server. Commit requires a password, but Checkout and Update can be done by anybody using anonymous access.

To use CVS for the first time, you would type the command "cvs -d :pserver:anonymous@pjrc.com:/usr/local/cvs login" and simply press ENTER when prompted for a password. Then, to make an initial checkout of the code, you would use the command "cvs -z5 -d :pserver:anonymous@pjrc.com:/usr/local/cvs checkout mp3." After these two lengthy commands, you can always get the latest changes with *cvs update*.

At the time of this writing, people from several countries have contributed to the development of this project, using CVS. A developer forum is available here: <http://groups.yahoo.com/group/pjrcmp3dev>. If you are interested in contributing to the project or just getting a few hints about how the code works, this is an excellent forum to join. Generally, a CVS commit password is assigned to anybody who is interested in the project and manages to demonstrate that they can make some reasonable edits to the code. Haphazard as this process seems, it leads to an environment where almost anyone is welcome to share their improvements with everyone else who built a player; and a constant stream of new features and improvements are added to the project.

the Parts List. *PM2_MP3.HEX* is the monitor program that will boot the board and provide you with the capability to download the firmware to the flash ROM

At this point, you should connect the board to your PC computer serial port and run a standard terminal-emulation program. *Hyperterminal* is a popular choice, because it is included with Microsoft Windows. If you use Linux, *minicom* is a terminal-emulator program installed with most Linux distributions. Nearly any terminal emulator will work. The baud rate must be set to 19200 baud, and the format to 8 bits, no parity, 1 stop bit. You should disable flow-control, if possible.

Hyperterminal may not work if flow control is set to the default "hardware" setting. When you turn on the board, a start-up message should appear. If the flash ROM is empty, you will get a prompt from the monitor. If there is firmware loaded in the flash ROM, it will run shortly after the start-up message appears, unless you press the s key to abort running the firmware automatically.

A bit of caution should be observed the first time you connect the board to your PC's serial port. The computer's ground will be connected to the ground from the power source for the board. Nearly all PCs connect their ground to the earth ground from their power cord. If your power source has a ground that is floating or connected to earth ground (the two common cases), there is no problem. If your power source is at a different ground, the board and possibly your computer could be damaged by the large current flow between the two grounds. This is an issue when connecting any two devices together joins their grounds.

Once you get the monitor prompt displayed, you are ready to download the firmware. The latest firmware (and many other earlier firmware revisions) may be obtained, including source code, at www.pjrc.com/tech/mp3/firmware.html. You must transmit the file *MP3PLAYER.HEX* to the board, using a plain ASCII transfer. In *Hyperterminal*, this appears as "Send Text File..." in the "Transfer" menu. Do not use a file transfer protocol (xmodem, zmo-

dem, kermit, etc.). As the firmware downloads, you should see dots appearing on the screen. When it is completed, you should see a summary indicating the number of lines and bytes transferred and whether any errors occurred.

If an error occurs in the download, try erasing the flash chip (press z and confirm) and try downloading again. If errors remain, there is quite likely a faulty connection in one of the many wires between IC1, IC2, IC3, IC4, and J10. Often visual inspection is the best way to catch solder bridges and cold or missing solder joints.

If the problem isn't visible, you can attempt to use the memory editor and other monitor features that show a view of the memory that the 87C52 can "see." If the flash chip is poorly connected, it will not respond to any write attempts, so you should remove it. With no flash chip, each memory location should read the same as the LSB of the current address (because the lines are floating, but were pre-charged with the LSB earlier in the 87C52's time multiplexed bus access). If you see some locations that do not follow this pattern, how they differ can provide clues as to which wires may be disconnected. Finally, it is possible to connect a 1-Kb resistor pullup and/or pulldown resistor to each of the data lines (pins 36 to 43) on the 87C52 and to verify that each one is not shorted high or low or to another nearby signal. The same 1-Kb resistor trick can be used to attach each of the 16 address pins to one of the data pins and make sure it appears correctly in the memory views. Hopefully, this tedious testing won't be necessary, but if the flash won't write you can use this approach with the monitor memory dumps to verify almost every signal until you are finally able to download firmware into the flash ROM.

Many of the firmware revisions contain a simple memory tester that will write several byte patterns to various locations within the SIMM and attempt to read them back. Usually this is installed as a monitor command, so you can press the t key to run the test. This test will veri-

OTHER COMPONENT SOURCES

All American
www.allamerican.com

Arrow Electronics
www.arrow.com

Digi-Key
www.digikey.com

Earth Computer Tech
www.earthlcd.com

Future Electronics
www.futureelectronics.com

Insight Electronics
www.insight-electronics.com

TTI Electronics
www.ttiinc.com

fy most of the connections between IC4 and J11. If there is a bad connection between the FPGA and SIMM, checking which addresses failed and which data bits were incorrect will oftentimes help pinpoint which line is bad.

There is also a utility included in most firmware revisions that can test the IDE interface. Great care should be observed while running this utility, as pressing w will write directly to a sector on the disk drive, without any regard to the file system, directories, and files on the drive. Usually this utility is installed as a normal program, so press R at the monitor prompt, and then select the IDE test utility from the list. It will attempt to read the drive's model number, serial number and cylinders, and heads and sector information from the drive. These should match either the information printed on the drive or the message that a PC BIOS prints as it detects the drive in a PC. If they differ, checking which bit positions are different from the correct values can sometimes lead you to which pin may be connected incorrectly. Fortunately, this is rarely a problem when the SIMM memory test has passed, because most of the signals are shared between the SIMM and IDE interface.

Once you've successfully downloaded the firmware, you may run

(Continued on page 44)

PENTIUM 4

(continued from page 26)

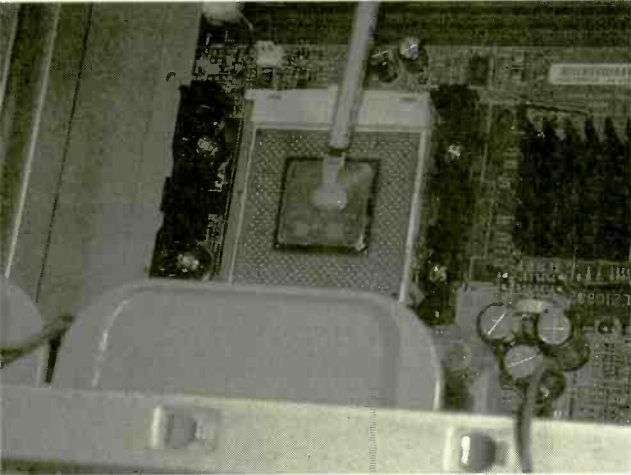


Photo 5. Use the syringe to squeeze thermal paste onto the CPU, as shown here.

That's simply not true with the D850GB motherboard. This motherboard requires a power supply that's compatible with the ATX12V Power Supply Design Guide V1.1 specification. These power supplies have two more motherboard connections in addition to the standard motherboard connector. There's a new 4-pin, +12-volt power connector to enable the delivery of more 12-volt power to the motherboard. There's also a 6-pin auxiliary power connector that delivers extra current to meet the heavier +3.3-volt and +5-volt needs.

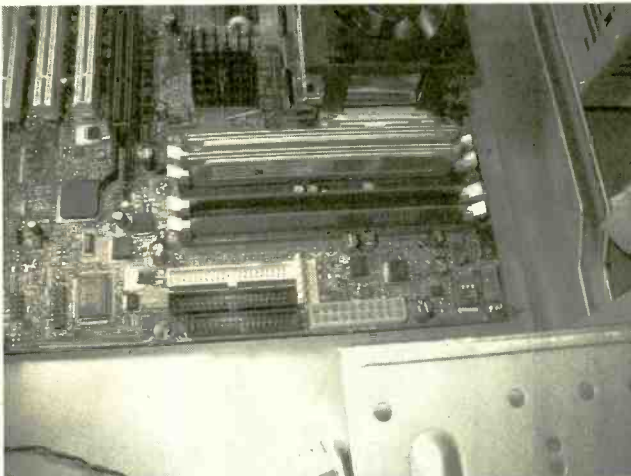


Photo 6. Mount the two RDRAM RIMMS and their terminators in position. You can see the CPU heat sink in the background.

Intel's specifications for the D850GB motherboard require a power supply rating of at least 250 watts and suggest a 300-watt supply. To be on the safe side, we selected an SX840 case from Antec, Inc. This beauty of a case is a full-size tower, with three external 5.25-inch and two external 3.5-inch drive bays, a pull-out cage for mounting up to three hard drives, and almost enough interior space to park an SUV. As delivered, Antec provides three fans on the rear panel (one of

which is in the power supply), so there's plenty of air movement. We also mounted a third fan on the front panel and a fourth to the cage with our hard-disk drive. The heavy steel case keeps the noise level down, while there's lots of air movement to keep our heavily loaded P4 system nice and cool.

Best of all, the SX840 comes with a P4-compatible power supply, rated at an impressive 400 watts. If you want to save a few bucks and don't plan on quite as

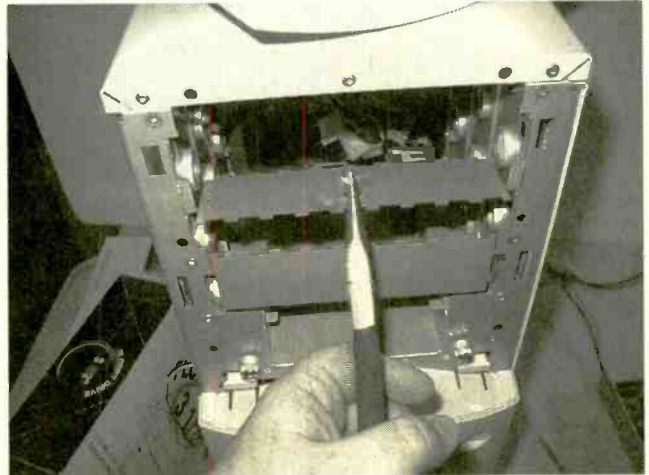


Photo 7. A pair of pliers is used to remove knockouts where the two optical drives will go, as shown here.

hefty a system as we built, Antec also offers an identical case (SX830), with a 300-watt power supply, for about \$50 less. We used this SX830 model to house the 1-GHz Pentium III we built for running RAM tests for a "Peak Computing" column in an earlier issue.

Making Your Mark. Once you've gotten all of the components that you'll need for putting your system together, the first thing to do is mark the Antec case to show where the motherboard supports should be mounted. The case itself has numerous holes and can support pretty much any type of motherboard form factor, including the ATX-style D850GB. We took the motherboard, carefully placed it in the case, and used a marking pen to put arrows where the holes on the motherboard lay.



Photo 8. The Antec case provides a slide-out cage for mounting the drives.



Photo 9. The case has a stick-on mounting to store the unneeded third set of rails.

Note: It's a good idea to use a wrist-grounding strap whenever you handle the motherboard or any other electronic component that's delivered in a conductive bag, including the CPU and RAM. You can purchase one of these straps for about a dollar in many electronics stores or make one yourself from a piece of copper wire, wound around your wrist, and attached on the other end to a ground. This drains off any static charge before it can damage a sensitive piece of electronics.

In mounting the D850GB motherboard, the one place you need to be extra careful is around the CPU socket. The Pentium 4 CPU itself is just a bit larger than the Pentium III. What's considerably larger, however, is the heat sink included with our "boxed" CPU. It weighs



Photo 10. Slide the drives into the case, as shown here.

close to a pound, and if not correctly mounted, it can pull the CPU right out of the motherboard socket when you turn the case vertical!

If you look at the CPU socket in Photo 1, you'll notice that the socket is surrounded by four plated-through holes. You need to mark the area under these holes on the case for mounting stand-offs. These stand-offs allow you to fasten the heat sink directly into the case, making sure that no excessive force is applied to the

processor socket. The heat sink also thermally conducts a bit of the heat produced down the screws into the stand-offs and into the case.

Once you've made your marks (Photo 2), tightly screw in the metal stand-offs supplied with the Antec case using a pair of pliers. Make sure there's a stand-off placed wherever the motherboard has a hole for mounting. The more stand-offs you use, the more rigidly the motherboard will be held.

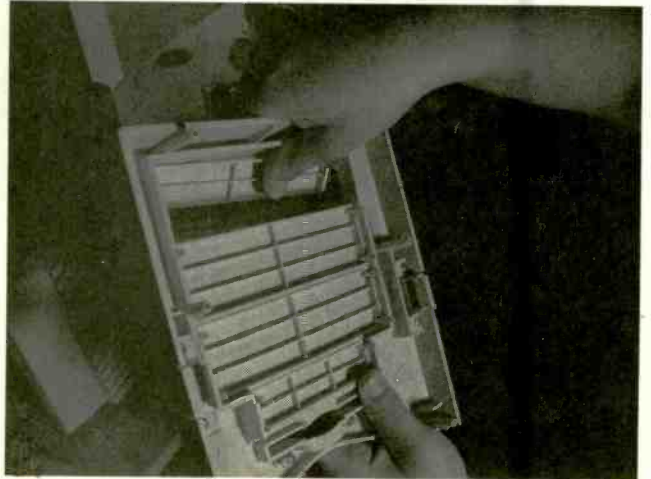


Photo 11. Push out the appropriate plastic plate on the case's front panel.

Next, mount the motherboard to the stand-offs, using the screws provided with the Antec case (Photo 3). Do NOT mount the four screws around the CPU socket yet!

As mentioned previously, the heat sink for the P4 CPU needs some special mounting to distribute its weight. The boxed 1.7-GHz P4 we used was supplied with the heat sink, a fan, and a special set of mounting clips. A screw goes through these clips into the stand-offs that surround the CPU socket (Photo 4). Once these clips are secured, there's also an extra plastic clip that attaches to the video card AGP slot, providing an extra measure of security. Just slide it on and push into place.

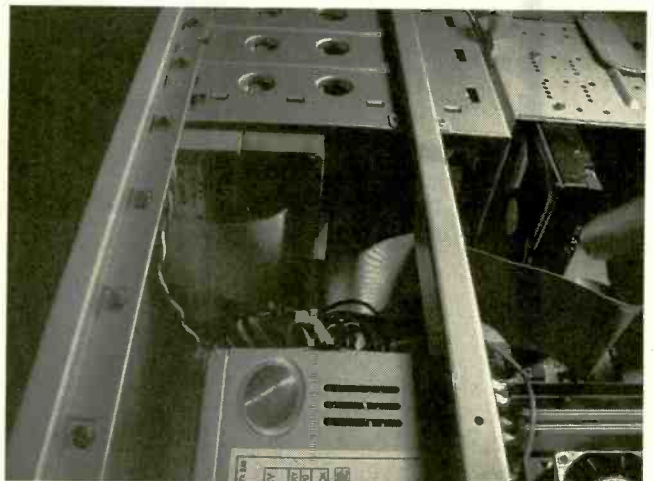


Photo 12. Run the cable from the drives to the sockets on the motherboard, as shown here.

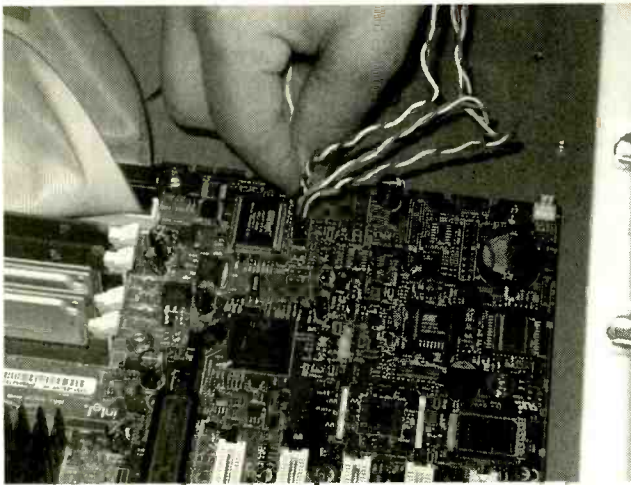


Photo 13. Seen here is the way to attach the cables from the case's power switch, LEDs, and speaker to the motherboard.

Getting Down To Business. The next task is to install the Pentium 4 CPU's heat sink and fan. The CPU socket on the motherboard is a ZIF (zero-insertion force) model. There's a locking lever that must be lifted up before the CPU will fit. Carefully align the CPU—it only fits one way—and let it drop down into the socket. Lightly press it with your finger to make sure it's fully seated, and then close the lever. The CPU comes with a syringe of gray goop. This is thermal paste, which helps transfer heat from the CPU into the large heat sink. Use the syringe to squeeze a good dollop of this goop onto the CPU (Photo 5). Then fit the heat sink onto the CPU socket, pressing it until it clicks into place in the clips that you've previously mounted. The fan included with the heat sink simply snaps in place and gets plugged into a small set of pins on the motherboard labeled CPU Fan.

Next, mount the two RDRAM RIMMs and their terminators (Photo 6). You can see the CPU heat sink in the background of this photo.

With the motherboard mounted and CPU and memory in place, much of the rest is simple assembly work. The case has knockouts where we'll have to

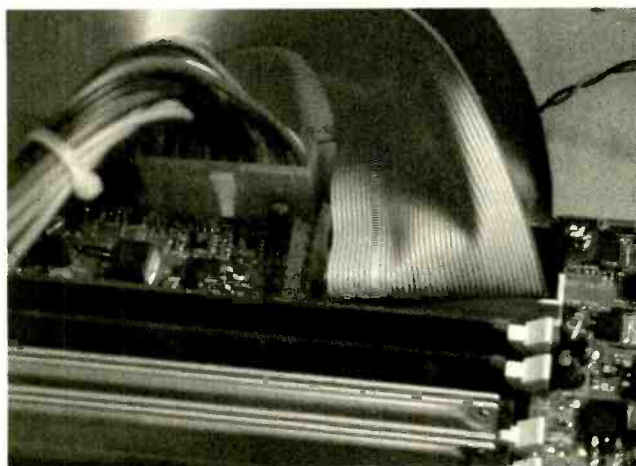


Photo 14. Pictured above, the main and other power connectors are plugged in to the system.

mount the two optical drives, so a pair of pliers is used to remove them (Photo 7).

Mounting The Drives. After you've prepared the case, you have to mount the drives. We really loaded up our system here. The Antec case has room for two 3.5-inch drives, so we added an internal 250-MB Iomega Zip drive as a supplement to a standard 3.5-inch floppy disk drive. We've found the 250-MB Zip disks to be an effective way to send files to some of our clients who have standardized on the Iomega drives. The Antec case provides a slide-out cage for mounting these 3.5-inch drives (Photo 8).

The two optical drives are mounted on rails, supplied with the case. (The case also has a stick-on mounting to store the unneeded third set of rails for future use, so they won't get misplaced.) (See Photo 9.) We decided to use both a DVD drive and a separate CD-RW drive. The DVD was a 16X model from I/O Magic, which pro-

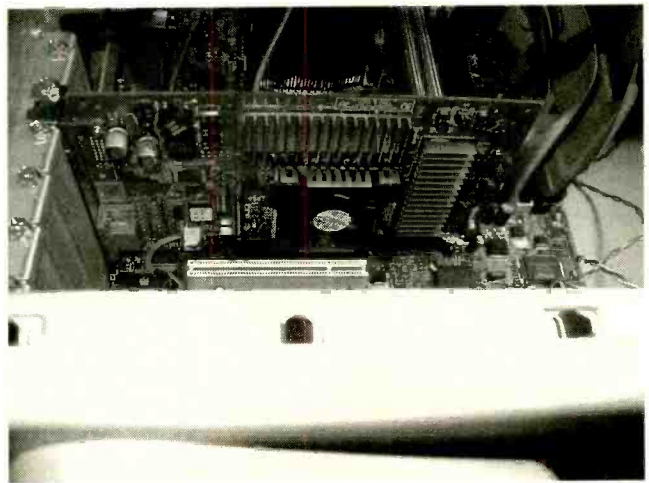


Photo 15. The last assembly step is to plug the Hercules 3D Prophet Ultra video card into the AGP socket and secure the mounting screw.

vides excellent performance, but is value priced. The CD-RW drive, one of TEAC's latest models, is also a super performer—with 16X on CD-Rs and 10X on CD-RWs, a fast 40X audio rip rate, and Version 5 of Roxio's *Easy CD Creator and Direct CD*.

As you finish mounting the drives, make sure that the drive jumpers on each drive are set correctly. Since the DVD and CD-RW drives will be on the same cable, set the CD-RW as the master drive and DVD as the slave. This setup will insure that you get the fastest burn speeds the CD-RW drive can render. Once you've set these jumpers, slide the drives into the case (Photo 10) and push out the appropriate plastic plate on the case's front panel (Photo 11).

Finally, the Western Digital 40-MB ATA/100 hard-disk drive was mounted in the drive cage. This drive slides out of the Antec case with a simple lever movement, which also makes it easy to mount a fan at the case-side of the cage to improve airflow over the drive. The fan isn't absolutely necessary, but since the drive spins at a fast 7200 RPM, we figured it wouldn't hurt to keep it as cool as possible.

TAKING IT A NOTCH HIGHER

Introduced last year, the Pentium 4 is actually the sixth generation of Intel processor. It is based on 0.18 micron manufacturing technology, which allows 42 million transistors to be used on the CPU die. At the time this is being written, clock speeds on the Pentium 4 range from 1.3 GHz to the 1.7-GHz processor used in our P4 project. It is possible that by the time this article appears, Intel may have announced even faster P4s.

One big difference in the P4 architecture is the system, or front-side bus. Intel has bumped up the bus speed and bandwidth. Where the Pentium III front-side bus runs at a maximum of 133-MHz, the P4 runs at 400 MHz, tripling the bandwidth from 1.06 Gb (gigabits)/sec to 3.2 Gb/sec. With the release of the Pentium 4, Intel has enhanced the design to support even more robust graphic capabilities. These design enhancements take place in several areas of the CPU. One immediate improvement over the Pentium III is in the amount of memory that can be directly addressed by the CPU—up to 64 GB

of physical RAM.

Intel lumps several of the new design features under a single label, "NetBurst Micro-Architecture." Bundled under this fragment of techno-speak are a number of new features like Hyper-Pipelined Technology, a 400-MHz front-side system bus, Execution Trace Cache, and a Rapid Execution Engine. Enhancements include an Advanced Level 2 Transfer Cache, enhanced floating point and multimedia unit, and Streaming SIMD Extensions 2 (SSE2.)

Hyper Pipelined Technology doubles the number of pipeline stages. Pipeline allows the processor to "predict" which instructions it will need to execute next, and the P6 (Pentium III) design used 10-stage pipelines. The Pentium 4 Hyper Pipelined Technology increases the number of pipeline stages to 20.

Intel has also changed the cache geometry in the Pentium 4. The P4 adds an Execution Trace Cache, which stores decoded micro-ops, removing the micro-op decoder from the main execution loop. The Pentium 4's Level 2

Cache has also had its bandwidth boosted. Where the 1-GHz Pentium III's L2 Cache has a data transfer rate of 16 GB/sec, the Pentium 4's L2 Cache maxes out at 48 GB/sec.

Also new in the Pentium 4 design is a Rapid Execution Engine. Two ALU (arithmetic logic units) on the P4 are clocked at twice the core frequency. These units allow basic integer instructions such as Add, Subtract, Logical AND, Logical OR, etc., to execute in half a clock cycle.

The floating-point and multimedia unit has also been enhanced in the P4 by the expansion of the floating-point registers to 128-bits, as well as the addition of another register for data movement.

Finally, the SSE technology that was initiated with the introduction of the first Pentium MMX has been extended. SSE2 adds 144 new instructions that will help accelerate graphics applications such as photo-image processing and video. As with the original MMX technology, it will be a while before software developers take advantage of these new SSE2 instructions.

Now For The Big Finish! Once all of the drives are installed, carefully run the cables from the drives to the proper sockets on the motherboard (Photo 12). If you add the lomega Zip 250 drive, as we did, you'll find that you are a connector short on the motherboard. The floppy drive plugs into the floppy connector on the motherboard, the hard-disk drive plugs into IDE channel 1, and the chained pair of optical-disc drives plugs into the secondary IDE channel. The lomega Zip 250 drive also needs an IDE interface, but since it is so much slower than the hard-disk, you don't want to plug it into the same channel and cable. The answer is to add a second IDE controller. I/O Magic offers one for about \$30. Plug it into one of the empty PCI slots and run a cable between the new controller card and the Zip 250 drive. There's also a second IDE connector on the controller card, which lets you add an additional pair of ATA/100 hard disk drives at a future time.

Now is also the time to attach the cables from the case's power

switch, LEDs, and speaker to the motherboard (Photo 13). These locations are clearly marked on the motherboard. Plug in the main and other power connectors at this time, as well (Photo 14).

Finally, plug the Hercules 3D Prophet Ultra video card in the AGP socket and snug down the mounting screw (Photo 15). Route the wires so that they are neat—we used nylon cable ties for this—and get ready to run the system.

Attach a monitor to the video card, a power cord to the power supply, and a keyboard and mouse. We used Logitech's Freedom keyboard and mouse, which are wireless, and a small RF transceiver that's plugged into the keyboard and mouse ports.

System Check. Our system powered up on the first try. If yours doesn't, turn it off and check to see that all of the connectors are snugged in, that the RAM is correctly mounted in the socket, and that all of the add-in cards are correctly inserted in the PCI slots. One common cause of a no-boot is that the

cables to the hard-disk and/or floppy and/or optical drives are not properly connected.

When the system boots, you will have to install an operating system (OS). This particular PC got Windows 98SE, simply because we're pretty happy with the way it runs. You could also install Windows Me, which costs about the same, or Windows 2000 Professional, which is a bit more expensive. Installing the OS is simply a matter of placing the CD-ROM in one of the optical drives. You may have to set the BIOS to permit a boot from a CD-ROM before the operating system setup autoloads.

As Windows installs, it will ask you for various drivers. Some of them—like those for the embedded audio and network adapters—are on the CD-ROM that was included with the D850GB motherboard. Others, such as the driver for the I/O Magic ATA/100 controller card and the Hercules 3D Prophet Ultra, will be asked for after the operating system installs and re-boots. We found that the installation of the operating system, along with the format-

TABLE 1

COMPONENTS AND SOURCES

COMPONENT	VENDOR	STREET PRICE
SX840 Case and Power Supply	Antec, Inc.	\$149
850 Chipset Motherboard	Intel	\$149
1.7-GHz Pentium 4 CPU	Intel	\$329
128-MB 800-MHz RDRAM RIMMs (two)	Kingston ValueRAM	\$118
ATA/100 IDE Controller Card	IOMagic	\$ 29
56-Kbps Modem Card	US Robotics	\$ 98
40-GB 7200 RMP ATA/100 Hard Disk	Western Digital	\$129
16X10X40X CD-RW Drive	TEAC	\$199
16X DVD Drive	IOMagic	\$119
250-MB Zip Drive	Iomega	\$129
1.44-MB Floppy-Disk-Drive	CompUSA	\$ 19
3D Prophet Ultra	Hercules	\$410
Wireless Keyboard and Mouse	Logitech	\$ 87
Windows 98SE Operating System	Microsoft	\$189
	Total System Cost	\$2153

SOURCE INFORMATION

Antec, Inc.
510-770-1200
www.antec-inc.com

Hercules, Inc.
514-279-9960
www.hercules.com

Intel Corp.
408-765-8080
www.developer.intel.com

IOMagic Corp.
714-953-3000
www.iomagic.com

Iomega Corp.
888-4-IOMEGA
www.iomega.com

Kingston Technology Corp.
877- KINGSTON
www.kingston.com

Logitech Corp.
800-231-7717
www.logitech.com

Microsoft Corp.
425-882-8080
www.microsoft.com

TEAC America, Inc.
323-726-0303
www.shop-teac.com

US Robotics Corp.
888-904-2243 or 866-2-USR-NOW
www.usrobotics.com

Western Digital
877-934-6972 or 949-672-7000
www.westerndigital.com

ting of the 40-GB hard-disk drive, took about an extra hour. Once completed, however, we installed our applications and the system was up and running!

Saving More Money. Basically, we went all out when building our P4 Project system, using the highest-performance components that were available when we assembled our P4. We wanted to see what we could save against the equivalent, commercially available, high-end P4s being offered by major vendors such as Compaq and Dell.

If you are working with a tight budget, you can get much the same performance but save hundreds of dollars more by going for several less expensive components. If you substitute a GeForce2 MX card, such as the \$99 MagicVideo 3DMX from IOMagic for the Hercules 3D Prophet Ultra, you'll save \$300 right there. Eliminate the Zip drive, choose a less capable (and less expensive) CD-RW drive, and there's another couple of hundred dollars off of the bottom line. If you want, you can even substitute a combo DVD/CD-RW drive for the two optical drives we used. These budget moves bring our P4 project down into the price realm of store-bought 1-GHz Pentium III systems, but make it easy to pump up the system with a

few inexpensive peripheral upgrades in the future.

We don't, however, recommend skimping on the CPU—buy the fastest version that's available at the time that you build your system. This is a much more expensive upgrade to perform in the future. Consider memory an investment as well. While several vendors were, at the time this was being written, working to bring out motherboards that used less expensive DDRAM rather than RDRAM, these motherboards won't offer the same level of performance that RDRAM allows. At the same time, if you need a lot of RAM for your applications, DDR-RAM may be an important consideration in assembling your PC.

Plug It In, Plug It In. When you have all the components arrayed in front of you, all in their original boxes, your first impulse may be to cut and run. If you've looked through the photos and have read the text, you'll find that putting together your own high-powered P4 is really just a matter of attaching components into the case and onto the motherboard. Scott and Bryan, 14-year-old brothers, put together our P4 project system in about two hours, taking time for photos. The system immediately powered up, and was ready to go once the Windows 98SE operating system was installed.

In fact, the hard part is collecting all the components you'll need. That can take several weeks if you use various mail-order suppliers, but we greatly recommend that you have everything you need on hand before

starting. That way, the process goes as smoothly as possible.

One last word of caution—be careful where you purchase the CPU. Make sure that you are getting a "boxed" version of the P4, with the proper heat sink. It may

cost you a few dollars more, but Intel does stand behind the retail version of its CPUs if you have a problem.

Have fun with your new P4 system. Don't forget to fasten your seat belt before booting it up! **P**

MP3 PLAYER

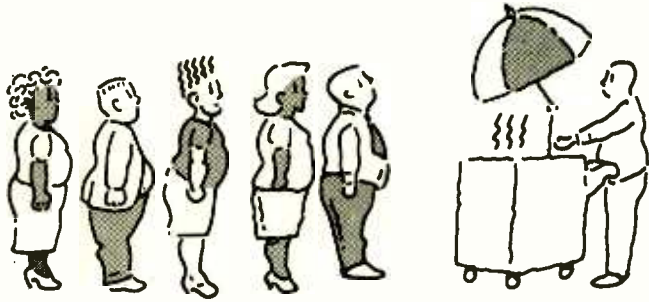
(continued from page 38)

It using the R command, or by simply rebooting. As the firmware


runs, it will print messages about each step as it initializes the hardware, detects and scans your hard drive, and then plays the files. If something is wrong, the firmware

will usually print a message about what was wrong before it returns to the monitor. Hopefully, everything will go well; and your MP3 files will be playing before you know it. **P**

IT'S NOT WORTH THE WEIGHT.



For better health and fitness,
exercise.



American Heart Association

© 1992, American Heart Association

UNITED STATES POSTAL SERVICE

Statement of Ownership, Management, and Circulation

(Required by 39 U.S.C. 3685)

1. Publication Title POPTRONICS	2. Publication No. 1 5 2 6 - 3 6 8 1	3. Filing Date 10/01/01	14. Issue Date for Circulation Data Below JUNE 2002
4. Issue Frequency MONTHLY	5. No. of Issues Published Annually 12	6. Annual Subscription Price 24.99	

7. Complete Mailing Address of Known Office of Publication (Street, City, County, State, and ZIP+4) (Not Printer)

275 G Marcus Blvd., Hauppauge, NY 11788

8. Complete Mailing Address of Headquarters or General Business Office of Publisher (Not Printer)

275 G Marcus Blvd., Hauppauge, NY 11788

9. Full Names and Complete Mailing Addresses of Publisher, Editor, and Managing Editor (Do Not Leave Blank)

10. Owner (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of the total amount of stock. If not owned by a corporation, its name and address as well as that of each individual must be given. If the publication is published by a partnership or other unincorporated firm, its name and address as well as that of each individual must be given. If the publication is published by a nonprofit organization, its name and address must be stated.) (Do Not Leave Blank.)

Full Name	Complete Mailing Address
Gernsback Publications, Inc.	275 G Marcus Blvd., Hauppauge, NY 11788
Adria Coren	275 G Marcus Blvd., Hauppauge, NY 11788

11. Known Bondholders, Mortgagees, and Other Security Holders Owning or Holding 1 Percent or More of Total Amount of Bonds, Mortgages, or Other Securities. If none, check here None

Full Name	Complete Mailing Address
-----------	--------------------------

12. Publication of this Statement of Ownership is required by 39 U.S.C. 3685. The purpose, function, and nonprofit status of this organization and the exempt status for federal income tax purposes: (Check one)

Has Not Changed During Preceding 12 Months
 Has Changed During Preceding 12 Months

13. Publication of this Statement of Ownership is required by 39 U.S.C. 3685. The purpose, function, and nonprofit status of this organization and the exempt status for federal income tax purposes: (Check one)

Has Not Changed During Preceding 12 Months
 Has Changed During Preceding 12 Months

15. I certify that all information furnished on this form is true and complete. I understand that anyone who furnishes false or misleading information on this form or who omits material or information requested on the form may be subject to criminal sanctions (including fines and imprisonment) and/or civil sanctions (including multiple damages and civil penalties).

16. Signature and Title of Editor, Publisher, Business Manager, or Owner

Adria Coren - Vice President Date **9/26/01**

17. I certify that all information furnished on this form is true and complete. I understand that anyone who furnishes false or misleading information on this form or who omits material or information requested on the form may be subject to criminal sanctions (including fines and imprisonment) and/or civil sanctions (including multiple damages and civil penalties).

18. Instructions to Publishers

19. Complete and file one copy of this form with your postmaster on or before October 1, annually. Keep a copy of the completed form for your records.

20. Include in items 10 and 11, in cases where the stockholder or security holder is a trustee, the name of the person or corporation for whom he is trustee is acting. Also include the names and addresses of individuals who are stockholders who own or hold 1 percent or more of the total amount of bonds, mortgages, or other securities of the publishing corporation. In item 11, if none, check box. Use blank sheets if more space is required.

21. Be sure to furnish all information called for in item 15, regarding circulation. Free circulation must be shown in items 15d, e, and f.

22. If the publication had second-class authorization as a general or requester publication, this Statement of Ownership, Management, and Circulation must be published; it must be printed in any issue in October or the first printed issue after October. If the publication is not authorized for second-class, item 18 must be signed.

23. Item 18 must be signed.

24. Failure to file or publish a statement of ownership may lead to suspension of second-class authorization.

Form 3826, October 1994

1. Publication Name
POPTRONICS

2. Extent and Nature of Circulation

Average No. Copies Each Issue During Preceding 12 Months	Actual No. Copies of Single Issue Published Nearest to Filing Date
Total No. Copies (Net Press Run)	81,106
1) Sales Through Dealers and Carriers, Street Vendors, and Counter Sales (Not Mailed)	9,831
2) Paid or Requested Mail Subscriptions (Include Advertisers' Proof Copies/Exchange Copies)	45,116
Total Paid and/or Requested Circulation (Sum of 15b(1) and 15b(2))	54,947
Free Distribution by Mail (Samples, Complimentary, and Other Free)	3,769
Free Distribution Outside the Mail (Carriers or Other Means)	
Total Free Distribution (Sum of 15d and 15e)	3,769
Total Distribution (Sum of 15c and 15f)	58,716
Copies Not Distributed	
1) Office Use, Leftovers, Spoiled	2,273
2) Return from News Agents	22,616
Total (Sum of 15g, 15h(1), and 15h(2))	83,606
Total Paid and/or Requested Circulation (15b(1) + 15b(2))	73,765

13. Signature and Title of Editor, Publisher, Business Manager, or Owner

Adria Coren - Vice President Date **9/26/01**

14. I certify that all information furnished on this form is true and complete. I understand that anyone who furnishes false or misleading information on this form or who omits material or information requested on the form may be subject to criminal sanctions (including fines and imprisonment) and/or civil sanctions (including multiple damages and civil penalties).

15. Instructions to Publishers

16. Complete and file one copy of this form with your postmaster on or before October 1, annually. Keep a copy of the completed form for your records.

17. Include in items 10 and 11, in cases where the stockholder or security holder is a trustee, the name of the person or corporation for whom he is trustee is acting. Also include the names and addresses of individuals who are stockholders who own or hold 1 percent or more of the total amount of bonds, mortgages, or other securities of the publishing corporation. In item 11, if none, check box. Use blank sheets if more space is required.

18. Be sure to furnish all information called for in item 15, regarding circulation. Free circulation must be shown in items 15d, e, and f.

19. If the publication had second-class authorization as a general or requester publication, this Statement of Ownership, Management, and Circulation must be published; it must be printed in any issue in October or the first printed issue after October. If the publication is not authorized for second-class, item 18 must be signed.

20. Item 18 must be signed.

21. Failure to file or publish a statement of ownership may lead to suspension of second-class authorization.

Form 3826, October 1994

Living Errors

Q In the October 2001 column, at least you didn't use the phrase "Last month, errors crept into the column." I hate that! Errors aren't alive; it's people that screw up!—M.S., via e-mail

A Ah, but it's much more tasteful to blame those non-sentient errors rather than finding a scapegoat in an individual. Besides, I'd have to blame myself too much of the time. Still, I'd rather be known as a person who readily admits a mistake as opposed to putting on a false front as being perfect and omniscient.

Meter or Motor?

An open-collector output could drive a meter movement, but it would be a little pointless, wouldn't it? For some reason, in the bottom circuit of Fig. 6 in the October "Q & A," my little circle with brushes and an "M" in the center was translated as a meter movement by the layout folks. That's supposed to be a motor in that spot. I suppose the diode would still be necessary if it was a meter, but I doubt that a meter movement would have much of an inductive kick-back!

Marine Transceiver

Q I would appreciate your assistance in finding a copy of the circuit diagram for a Ray Jefferson model 987 handheld marine transceiver. It appears that the manufacturer has fallen by the wayside, and no information is available on the Web or from Sam's. The Ray Jeff handhelds are sufficiently similar, so that any one of their diagrams should provide the insight I need.—B.E., via e-mail

A Neither I nor the readers want this column to become a manual resource "Dear Abby," but I think it can be helpful to other folks when the answer can point out some other resources that might be helpful for less-common types of equipment. When Google only sends back a few items on a search, that's bad.

When the commercial and Internet sources are dry, you have to depend upon the benevolence of others for your help. The search did pop up with a few Ray Jefferson hits, and they were embedded within a nautical forum. I think that if you post your request on that nautical forum and on the scanner/receiver forum that I've mentioned in a previous column, you might find someone who has the resources you need. Try the Strong Signals forum at www.strongsignals.net/msgboard/index.html and for the nautical forum, try www.yachtingnet.com/forums/electronics.html. While you're at it, it never hurts to post on the Resource Bin on the Gernsback site at www.gernsback.com. There may be some readers who have access to this documentation. If anyone does, let me know; and I'll forward that information on to B.E.

Trailer Light Wiring

Q I'm adding a trailer hitch to my new 2001 Saturn LS2 (I must be crazy!). I have many applications for a trailer hitch with small loads under 1000 pounds. I'll be using a universal converter (5 to 4), but I'm still worried about shorting out my auto lights or computer. How do these converters operate? Any suggestions? Any protective circuitry I can add?—B. K., via e-mail

A B.K. is referring to converting a car that has separate turn signals and brake lights to a trailer electrical connector that is compatible with standard trailer lights that share brake and turn signal lamps. If you're using a commercial adaptor designed for this task, you shouldn't have any worries. In the indus-

try, they only refer to the actual lamp lines, so they call it a 3-wire to 2-wire adaptor. Reese, the venerable hitch manufacturer, has such an adaptor as their part number 85210. You can contact them online at www.reeseprod.com. These adaptors advertise "no voltage drop" to the lights, so I'm reasonably sure that modern versions use power MOSFETs for the power-controlling element, as do modern electronic brake controllers.

Fig. 1 shows what would be the simplest implementation that should work in this application. To minimize voltage drops to the lamps, use hot-carrier (Schottky) diodes in the circuit that are capable of handling at least 2 to 3 amps of current. The diodes serve to isolate the brake line from the turn-signal lines, so that application of the brakes won't turn on all the lights in the world on the back of your car and trailer. You could build a clunkier version using relays for no voltage drop and a lot of potential reliability problems. Of course, if you want a guarantee of no damage, stick with a tried-and-true commercial unit.

If you do any wiring for the trailer yourself, remember that automotive and marine environments are second only to aeronautical and astronautical environments for harshness. I suggest that you use uninsulated crimp connectors so that you can solder the crimps. Then double-insulate the connections with at least two layers of heat-shrinkable tubing. Use lots of cable ties to firmly keep the wiring out of harm's way and to keep it from flopping and vibrating. I realize that you're dealing with relatively small towing loads, but if you do a lot of mountain driving with a trailer, I recommend trailers with brakes and adding a

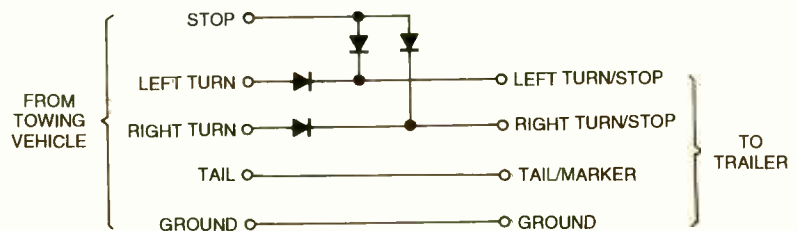


Fig. 1. A simple four-diode isolation circuit for tail and brake lights can adapt a three-light automotive system to a two-light trailer system with minimum voltage loss.

brake controller to the car. They're easy to install and decent ones are only around \$60. There's no need to give your car brakes an extra half-ton to deal with while negotiating switchbacks, especially on slick roads where the trailer can push you into a jackknife or an exciting trip down the mountainside.

There's an active RV forum on the Internet that may be useful for you, especially if you decided to snap a tent camper or inky (REALLY dinky) travel trailer to the back of the Saturn. It has "towing" and other categories that may be of interest to you no matter what you pull. The forum is a spur off www.rv.net.

Open Collector Caboose

Q I have been trying to understand the advantage of an "open collector" vs. one without such a collector. Please explain to me in plain layman's language what it is and what it can do. What are its uses? Applications?—R.P., via e-mail

A In the October 2001 installment of "Q & A," I covered the various applications, advantages, and limitations of open-collector (OC) TTL logic. I thought I'd add something here about the logic of tying various open-collector outputs together.

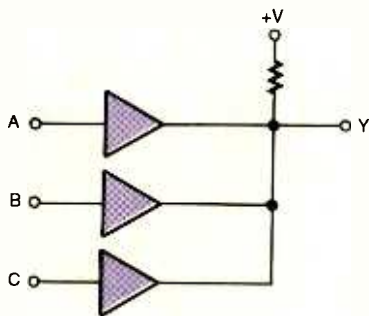


Fig. 2. Open-collector non-inverting buffers with their outputs tied together create AND gates.

If you tie OC non-inverting buffer outputs together, you will end up with an AND truth table. All it takes is one buffer per AND input, as shown in Fig. 2. If you tie OC inverter outputs together, you have a circuit with a NOR truth table as shown in Fig. 3; again, each inverter input becomes one of the NOR inputs.

Multiple OC NOR gate outputs can be connected together and the result is just a wider NOR gate. Interestingly, you can connect either NOR gate or inverter outputs together, as shown in Fig. 4. The whole circuit operates as a wide

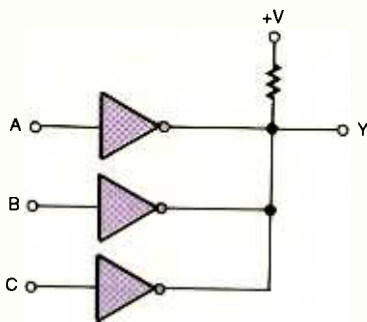


Fig. 3. Open-collector inverters with their outputs tied together create NOR gates.

NOR gate, no matter the combination of inverters or individual NOR gates.

Like the NORs, multiple OC AND gate outputs can be connected together. The result is a wider AND gate, as illustrated

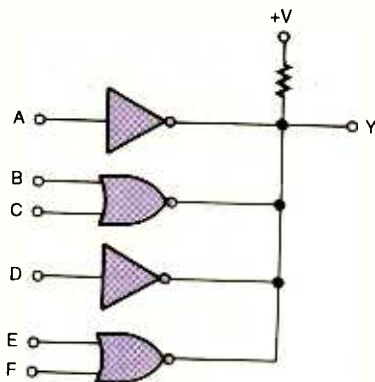


Fig. 4. Multiple NOR gates make wider NOR gates, while inverters added to the circuit add more NOR gate inputs.

in Fig. 5. In a similar fashion, you can connect non-inverting buffers with the AND gates, and the whole circuit will operate as a huge AND gate no matter how many buffers and/or AND gates are in the circuit.

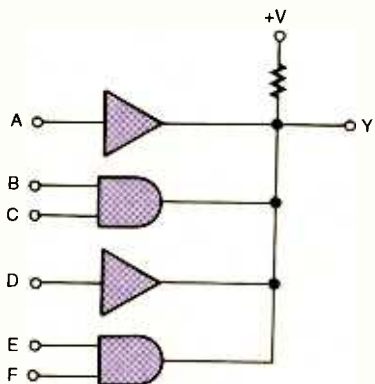


Fig. 5. Multiple AND gates make wider AND gates, while non-inverting buffers added to the circuit add more AND gate inputs.

If you try to connect OC NAND gates or OC OR gates together, you'll end up with some weird truth tables. The same will be true if you connect an OC NAND with an OC inverter or a non-inverting OC buffer. An OC OR connected with OC inverter or non-inverting buffer will also produce an odd truth table.

DMM Diode Test Function

Q I was reading the August 2002 issue and got to your "Q & A" section where you answer a reader's inquiry on testing transistors with a DMM's (digital multimeter) diode-test function. Could you tell me what brand and model DMM you were using? Your DMM seems to either be designed peculiarly or have a problem on its diode-test function if it reads "3.00" volts across a reverse-biased junction! In over 20 years as a professional electronics service tech, I've never run across a DMM that gave a voltage reading with a good silicon reverse-biased junction. Also, you might mention that most DMM diode-test ranges read about 0.4 to 0.5 volts for a forward-biased power transistor junction like that of a 2SC3856 and about 0.6 to 0.7 volts for a small-signal device like a 2N2222.—D.H., via e-mail

A I guess that was a little confusing. Most DMMs are 3½- or 4½-digit models with a maximum reading of 1999 or 19999. With a 3-volt internal source, they would indicate "OL" vs. the actual voltage on a reverse-biased junction. I happened to be using an inexpensive Elenco LCM-1950 3½-digit DMM with a maximum reading of 3999, which doesn't produce an "OL" at the 3-volt level. I'd been using this particular model so long that I didn't even consider the fact that most other DMMs would operate differently. Of course, any DMM manufacturer could design their box so that it used a less-precise range for indicating a higher bias voltage, but most don't.

Your observation is certainly valid, and your point is well taken. Since I was working with a "less-normal" DMM, readers should be aware that most DMMs will not indicate a reverse voltage over 1.99 volts and will instead indicate "over range" with the typical "OL" display.

It should be noted that any forward-biased semiconductor junction does not always adhere to the textbook 0.7 volts. Larger, clunkier junctions of power

transistors tend to read lower for a given current than a small-signal transistor. For instance, a 1N4001 rectifier diode may indicate 0.6 volts on a DMM diode-test function, but in operation can have as much as a 0.9-volt forward drop when running at its full one-amp rating.

Since 1972, I've always had some form of a Tektronix semiconductor curve tracer at my disposal, and something like that can spoil you rotten. For the last four years, I've not had a working curve tracer at all, no time to get one of the two I have repaired; and it's really hard for me. The transistor test function

of a DMM just doesn't get it. The weekly meetings don't help much either. "Hello. My name is Dean. And I can't work without a curve tracer."

Inductive Audio Loop

Q *I would like to see a schematic of a constant current amplifier with at least 20 watts output! I wish to construct such an amplifier to drive an inductive audio loop for hard of hearing people. —via e-mail*

A Back when I was a teenager, I used an inductive loop so that my headphones

didn't have me leashed to the shortwave receiver. I could listen late at night without bothering the rest of the family while I continued to work on other projects. For the uninitiated reader, an inductive-loop system is nothing more than a giant audio transformer. It worked very well for me with about four turns of wire as the primary around the perimeter of my 150-square-foot shop area, and driven directly by the 3-watt output of the receiver in place of the speaker. I used the little amplifier from a small portable reel-to-reel tape recorder with a couple of hundred turns of wire around a ferrite rod as the transformer secondary. It was connected to the former tape head input of the amplifier. The amplifier and ferrite bar were attached to one earpiece of the headphones, which were connected to the amplifier output. The system was a great monophonic wireless headphone system that had no "dead spots" as a more modern infrared system might have.

I don't understand why you would need a constant-current source. Normally those are used for instrumentation loops where an off-the-shelf transmitter might be connected to any length of signal line to the receiver and must have a range of compensation to keep the output at an accurate level at the receiver. It appears that your inductive audio loop would be installed permanently in one location, so you would not have to deal with any resistance changes.

I would decide what loop impedance I needed by determining the minimum wire gauge I want to use. For instance, if you settle on 18-gauge wire with 6.51 milliohms of resistance per foot, you can calculate that 4 ohms would have a length of about 614 feet. If the room you're working with has a perimeter of 100 feet, you would run six turns of the wire around the room. An 8-ohm impedance would require 1200 feet of wire and 12 turns around the room. A lower impedance is the better choice for maximizing the output capabilities of a typical solid-state amplifier.

Connecting the wire ends to the output of an amplifier rated for your 20 or 30 watts should do the trick. You can adjust the loop impedance by increasing or reducing the number of turns or by changing the wire gauge. The larger the room, the higher the power you might have to run in the primary turns around the room for good pickup by the

HOW TO GET INFORMATION ABOUT ELECTRONICS

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

To discuss electronics with your fellow enthusiasts, visit the newsgroups *sci.elec.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.repairfaq.org

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

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

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

Back issues: Copies of back issues of and past articles in **Electronics Now**, **Popular Electronics**, and **Poptronics** can be ordered on an "as available basis" from Claggk, Inc., Reprint Department, P.O. Box 12152,

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, 130 N. Cutler Dr., N. Salt Lake, UT 84054.

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

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

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

FREE CATALOGS

C&S SALES, INC.

64 pgs., Test
Equipment Catalog,
see pg. 75

RAMSEY ELECTRONICS

Projects and Kits Catalog,
see pg. 71

SMARTHOME

144 pgs., Home
Automation Products,
see pg. 67

LYNXMOTION

Robotic Kits Catalog,
see pg. 67

MENDELSON'S

Electronic Surplus and
Components Catalog,
see pg. 66

ABACOM TECHNOLOGIES

Radio Data Modules Catalog,
see pg. 68

COMMAND PRODUCTION

FCC License Training Facts,
see pg. 64

MODERN ELECTRONICS

Cable/Video
Products Catalog,
see pg. 73

POLARIS INDUSTRIES

Video Technology Catalog,
see pg. 63

ALL ELECTRONICS

96 pgs., Electronic
Components and kits
see pg. 66

INFORMATION UNLIMITED

Amazing Science
Devices Catalog,
see pg. 68

FREE DOWNLOADS

ENGINEERING EXPRESS

Free PCB Layout Software,
see pg. 72

BEIGE BAG SOFTWARE

Free Trial Circuit
Design Software,
see pg. 67

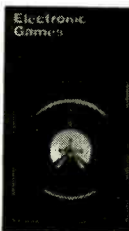
FREE DEMO TAPE

LT SOUND

Audio Products,
Free Brochure and Demo,
see pg. 73

ELECTRONIC GAMES

BP69—A number of interesting electronic game projects using IC's are presented. Includes 19 different projects ranging from a simple coin flipper, to a competitive reaction game, to electronic roulette, a combination lock game, a game timer and more. To order BP69 send **\$4.99 clearance (includes s&h)** in the US and Canada to **Electronic Technology Today Inc., P.O. Box 240, Massapequa Park, NY 11762-0240**. US funds only. Use US bank check or International Money Order. Allow 6-8 weeks for delivery. MA07



receivers. Nothing says that you can't drive it from a 70.7-volt system along with the rest of the speakers using the right transformer, providing your power amplifier has enough headroom for the larger-than-normal speaker load.

For a more reliable system, I'd recommend going the wireless RF (radio frequency) route. Commercial units have no "dead spots," have a range outside of the auditorium (great for "cry rooms"), and are much easier to install.

Reflections

When I was living in Oklahoma City, I lost two good friends in the Alfred Murrah Federal Building bombing. We heard and felt the explosion and Honda, my wife who is a registered nurse, was with some of the first groups at the site providing help at the rescue workers' first aid tent. Devastating as that was, it is but a small fraction of what our many friends in New York are experiencing at this time in September as I finish this month's column. My prayers are for those families and their tragic losses, for the injured, for the rescue workers, for the families of the rescue workers who died that others might live, for our leaders as they work through the issues that must be confronted, and for our nation and its citizens. "Let there be peace on Earth, and let it begin with me."

Writing to Q&A

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

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

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

BUY BONDS

Robot Simulation

Last month, my article dealt with creating a formula that would correct a robot's course while it was traveling down a hallway.

The robot described in that article is shown in Fig. 1. It used two drive wheels, each with its own motor. One drive wheel is placed on each side of the robot, and a coaster is in the back with the weight of the batteries holding it down. Given this configuration, the robot makes turns by slowing down the wheel on one side, while speeding up the wheel on the other side.

Correction Angle

The course correction formula took the input values from two infrared distance rangers and, using a little trigonometry, calculated the speed needed for each drive wheel of the robot.

As shown in Fig. 2, if the robot is not in the middle of the hall, then the correction angle for turning to return to the middle can be derived by taking the ratio of the robot's offset from center (Y) and the distance to a point out in front of the robot (X) in an Arctangent calculation.

$$[\text{CorrectionAngle} = \text{Arctangent}(Y/X)]$$

The Y value was easy. It was calculated from the Infrared Distance rangers on the robot. (discussed in detail last month). The X value in the formula, however, is an unspecified point in front of the robot. Any distance, within certain limits, can be used. If the distance is too small, then the robot will overcompensate for being out of center and will wind up weaving back and forth around the center of the hall. If the distance is too large, then the second angle of correction will not adequately overcome any mechanical error. The correct distance really depends on the mechanics of your robot and needs to be tuned.

The question now is: How to tune the value for X? The most mathemati-

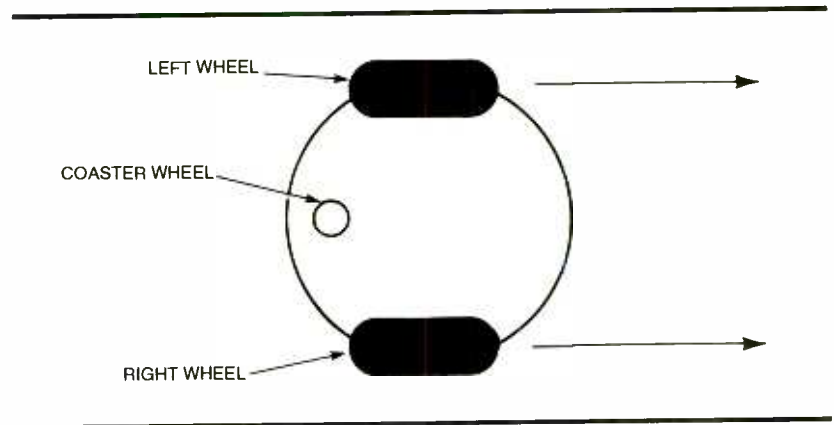


Fig. 1. If both wheels are turning at the same speed, the robot travels straight down the hall.

cally correct answer would be to take the RPM rating for the motors, the gearbox reduction, the total voltage supplied from the batteries, the distance between the wheels, the diameters of the wheels, the total weight of the robot, and the total friction of the robot's drive train all together in a complex formula. After evaluating that course of action for a very short period of time (a very short period of time), I decided it would be much faster to just make an educated guess and make up a number to try. I figured this should be easy.

After a little more contemplation, I started thinking that the guessing game could turn into an extraordinarily tedious chore. Just imagine how many times one would need to pick a number, code it into the robot's program, put the robot in a test area, test the robot, and then based on how the robot failed, guess a new number, and repeat the process.

An easier and more enjoyable solution was found in an unusual source, Cognitoy's *MindRover*. This computer-based robot simulation allowed me to

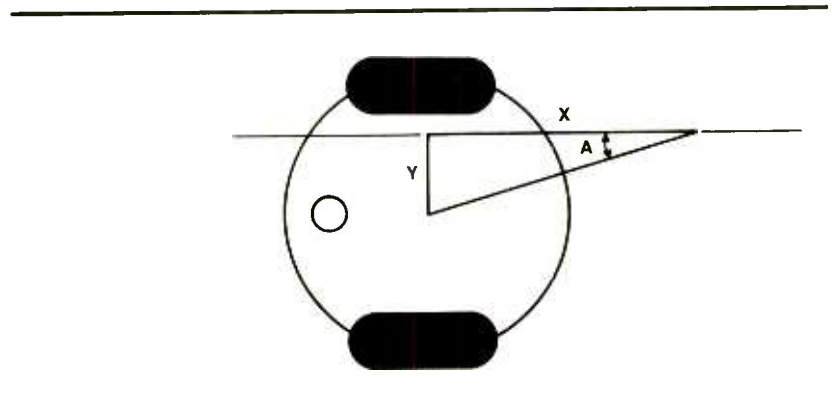


Fig. 2. When the robot is not in the middle of the hall, a second angle of correction can be calculated.



Fig. 3. CogniToy's MindRover is a robotic simulation program.

build and test a prototype in a virtual environment, which saved hours of time. The code used to control the virtual robot could be sent to an OOPic in order to control the actual physical robot.

Let's examine *MindRover* closely.

CogniToy's MindRover

CogniToy's *MindRover* (as seen in Fig. 3) is a PC game, and, as such, has found a large following in the PC gaming group. Now, I am not much of a gamer, but I found that *MindRover* worked, for me, more like an unusually fun utility for robotic simulation and testing.

From a gamer's point of view, *MindRover* takes you to a whole new level of participation within the game. You are actually required to wire the robot's functionality. By this, I don't just mean wiring a power supply to the drive system; I mean actually creating the wiring for the robot's brain. CogniToy calls it "3D strategy/programming." This process all takes place with a 3D environment and graphical wiring system. *MindRover's* slogan prompts the gamer to "think more and twitch less."

The players construct small virtual-reality robotic "rovers" that compete with one another in a variety of challenges. What's particularly different from other games on the market is that in the end, it's not just a matter of choosing a weapon from the keyboard and dri-

ving around with the joystick, frantically pressing the fire button. The player actually programs the robot's behavior before the testing and competition begins, just as a real robot would require. This makes *MindRover* robots autonomous. CogniToy took that a step further even by giving their virtual-reality autonomous robots the ability to become real robots by downloading the robot's program to an OOPic or to a LEGO RCX pack—effectively taking the robots off the screen and putting them on the floor.

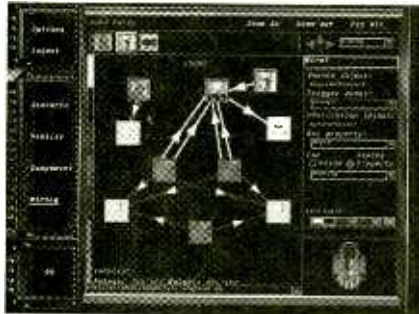


Fig. 5. Using the construction lab's "Wiring" page, players wire the components together.

In the construction lab portion of the game, players choose bodies, drivetrains, sensors, weapons, and manipulators for their robots from a large array of possibilities (Fig. 4); and then they visually wire these components together to give each rover a unique set of behaviors (Fig. 5). The rover is then moved to the competitive arena and set free (Fig. 6). In the arena, the robot's design is tested in a real-time 3D simulation, where it can compete with other robots, or, in my case, tune the formula for tracking the wall—a nice, neat solution.

MindRover has three types of robotic vehicle chassis: wheeled, treaded, or hovercraft, and each comes in varying sizes. *MindRover* also supports three major categories of competition: Race, Sport, and Battle, as well as a miscellaneous category and tutorials. In the Miscellaneous category, players find puzzles, mazes, hunts, and other unique problem-solving tasks.

I am sure that some of you out there are already imagining what kind of Battle-Bot to build with this.

Underlying the game is an accurate physics simulation system and a complete object-oriented programming language, ICE, which CogniToy developed for this game. ICE forms the foundation of the entire game and is used for every-

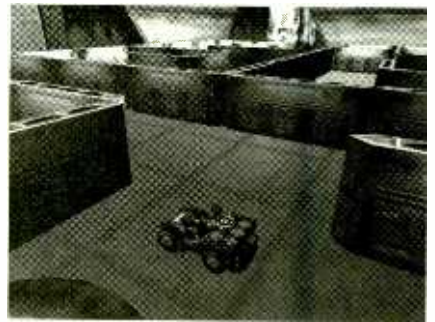


Fig. 6. The arena is used to test the robot's design in a real-time 3D simulation.

thing. The arenas, the goals, and all the intelligence in the game—even parts of the user interface—are all coded in ICE.

MindRover and OOPics

By chance, I met Kent Quirk, the CEO of CogniToy and designer of *MindRover* at the Trinity College Fire Fighting Robot Contest in 2000. At that time, he was looking for a method of taking *MindRover's* virtual-reality autonomous robots off the screen and putting them on the floor. What he needed was a microprocessor that used an Object-Oriented programming model. After some discussion, we both quickly realized that not only did both the OOPic and *MindRover* use an Object-Oriented programming model, but both products also used a method of wiring the Objects together that allowed the Objects to exchange data in a multi-tasking environment.

One major difference between the OOPic's wiring method and *MindRover's* method that had to be overcome was that when a connection was made between the Objects in the OOPic, the Object's data was continually updated between the Objects. In *MindRover*, when a connection was made between the Objects, the data was updated only when an event occurred. It might also be noted that in *MindRover* the Objects are referred to as "components" and that in the OOPic components are referred to as "Objects."

With this in mind, Kent and I set out to create updates that would allow *MindRover* to simulate a robot in virtual reality and download its program directly into an OOPic, which would control a robot in reality.

For the OOPic, the changes that were required for this alliance can be found in the OOPic II in the form of Clocked Objects. These Objects work like *MindRover* counterparts that transfer data when an event occurs.



Fig. 4. With the construction lab's "Component" page, players choose bodies, drivetrains, sensors, weapons, and manipulators for their robots.

For *MindRover*, the changes are available as a software add-on that is installed after the *MindRover* program is installed. This add-on creates an OOPic program that is the function equivalent of the *MindRover* ICE program.

A chart showing the similar Objects/components can be found at www.oopic.com/mrc.htm.

Using *MindRover*

To help the players get started, using *MindRover*, the game comes with a programming tutorial scenario that guides players through building and wiring your first robotic rover. The robotic rover built in the tutorial is a hovercraft with two thrusters that uses a set of components called "MediumRadar" to detect other robotic rovers and objects in the scenario. You can set the properties of the radar to define a cone-shaped area where the radar is looking. When a vehicle or other object comes into the cone of the radar, the radar triggers a "TurnOn" event. When an object leaves the cone, the radar triggers a "TurnOff" event. The information that was gathered from the "MediumRadar" component is then used to hunt down and tag an opponent. To keep the tutorial from getting too complicated, the opponent in the tutorial doesn't move.

While creating and wiring your robotic rover, a display box is shown at the top of the screen that lists icons for all the available components. Clicking on the icons will give a name and description of the component. The components are placed on the robotic rover by dragging them to the rover and dropping them in place. When they are placed on the robotic vehicle, they appear as small icons in the lower right corner.

A feature of the design environment that I really like is that by clicking on the body of the vehicle with the right mouse button, you can drag it around and it will rotate in place. This feature allows you to preview what it will look like from all angles.

Component Properties

Once the components are placed, the robotic rover needs to be programmed. This is done in the "Wiring" section of the construction lab. In this screen, you configure and connect the components you have just placed on the robotic rover, making them work together to accomplish the goals of the scenario.

The tutorial guides you through configuring the components with a collection of input boxes, slide bars, and wheels. Each component requires configuration, and the tutorial gives recommended values for each of these. After you try the recommended values in the real-time simulation, different values can be experimented with to see how they affect your robotic rover's behavior.

Wiring Components Together

When something passes in front of either radar, the radar will send out a signal. The wires are used to instruct the robotic rover what to do when it sees that signal. In order to create a wire, you click and drag from the component's icon. This will cause a drag box to appear. When the drag box reaches another component, a wire will appear. Releasing the mouse button will create a wire. This also brings up a property box with information on that wire on the right side of the screen. The properties that are shown in that box describe the function of that wire.

As seen in Fig. 7, the tutorial wires are created between the "MediumRadar" components and the "Thruster" components in such a way that if the one of the radars spot the opponent rover, it will steer the hovercraft towards it by firing the thruster on the opposite side of the robotic rover. Lastly, a set of wires is added that tell the radars to turn off the thrusters that aren't being used.

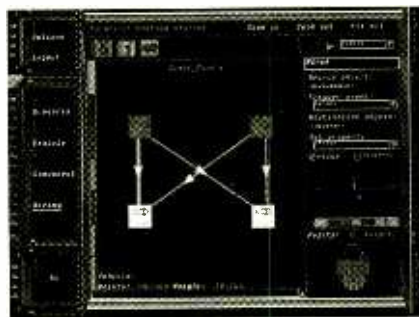


Fig. 7. Wires are formed between radars and thrusters, creating the program for this robotic rover.

Testing It Out


Clicking on the "GO" button in the lower left of the console starts the simulation. When you do this, you just sit back to watch your robotic rover go to work. When the robotic rover reaches the opponent, a message saying so appears and asks you if you want to see a replay, restart this scenario, continue, or

go back to the console. "Return to console" will give you the ability to tweak your robot, add components, and start the competition again, or even start a new scenario.

Next Month

Next month, I will discuss how to create a virtual-reality robotic rover. After testing it in virtual reality, I will explore how to move it off of the screen and on to the floor.

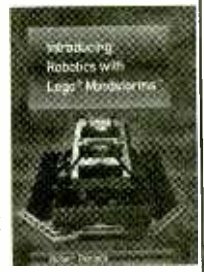
On The Web

More information on Cognitoy's *MindRover* can be found at www.mindrover.com. More information on the OOPic can be found at www.oopic.com. 

Introducing Robotics with Lego® Mindstorms™

For Robot Lovers. Shows how to build a variety of increasingly sophisticated computer-controlled robots using the brilliant Lego mindstorms Robotic Invention System (RIS). Covers the fundamental building techniques needed to construct strong and efficient robots. Explains to the reader how robot control programs may be simply constructed on their PC screens. Detailed building instructions are provided for all the robots featured. 270 pages, 7 1/2 x 10 5/7 in. **\$19.99.**

Plus \$2.45 shipping in U.S. Order from CLAGGK Inc., P.O. Box 12162, Hauppauge, NY 11788 **CLX1**



Electronic Projects 1.0

By Max Horsey

A series of ten projects to build along with audiovisual information to support hobbyists during construction. Each project is complete with schematic diagrams, circuit and PCB layout files, component lists and comprehensive text to guide the hobbyist through the project. A shareware version of CAD-PACK—schematic capture and PCB design software is also provided. Projects include a reaction timer, logic probe, egg timer and seven more. Get your own copy of this CD-ROM today. **\$75 including shipping in the U.S.** Order from CLAGGK Inc., P.O. Box 12162, Hauppauge, NY 11788. Visa, MC, Discover, OK.



CLX2

ELECTRONIC TECHNOLOGY TODAY INC.

P. O. Box 240 • Massapequa Park, NY 11762

INVENTORY BLOWOUT SALE



* ALL CANADIAN CHECKS MUST CLEAR THROUGH AN AMERICAN BANK

BP07 ... 100 Radio Hookups	\$3.00	BP317 ... Practical Electronic Timing	\$6.99
BP36 ... 50 Circuits Using Germanium, Silicon & Zener Diodes	\$2.99	BP320 ... Electronic Projects for Your PC	\$5.99
BP44 ... IC 555 Projects	\$5.99	BP322 ... Circuit Source Book 2	\$6.99
BP56 ... Electronic Security Devices	\$3.99	BP329 ... Electronic Music Learning Projects	\$6.99
BP64 ... Semiconductor Technology Elements of Elect Book 3	\$5.99	BP332 ... A Beginners Guide to TTL Digital ICS	\$6.99
BP74 ... Electronic Music Projects	\$3.99	BP333 ... A Beginners Guide to CMOS Digital ICS	\$6.99
BP76 ... Power Supply Projects	\$3.99	BP334 ... Magic Electronic Projects	\$6.99
BP78 ... Practical Computer Experiments	\$2.99	BP355 ... A Guide to the World's Radio Stations	\$7.99
BP80 ... Popular Electronic Circuits	\$3.99	BP359 ... An Introduction to Light in Electronics	\$6.99
BP103 ... Multi-Circuit Board Projects	\$2.99	BP367 ... Electronic Projects for the Garden	\$6.99
BP109 ... The Art of Programming the IK ZX81	\$3.99	BP370 ... The Superhet Radio Handbook	\$6.99
BP112 ... A Z-80 Workshop Manual	\$5.99	BP371 ... Electronic Projects for Experimenters	\$6.99
BP114 ... The Art of Programming the 16K ZX81	\$3.99	BP374 ... Practical Fibre-Optic Projects	\$6.99
BP115 ... The Pre-Computer Book	\$2.99	BP378 ... 45 Simple Electronic Terminal Block Projects	\$6.99
BP124 ... Easy Add-On Projects for the Spectrum, ZX81 & ACE	\$3.99	BP379 ... 30 Simple IC Terminal Block Projects	\$6.99
BP143 ... An Intro to Programming the Atari 600/800 XL	\$2.99	BP384 ... Practical Electronic Model Railways Projects	\$6.99
BP148 ... Computer Terminology Explained	\$2.99	BP385 ... Easy PC Interfacing	\$6.99
BP154 ... An Introduction to MSX Basic	\$3.99	BP391 ... Fault-Finding Electronic Projects	\$6.99
BP156 ... An Introduction to QL Machine Code	\$3.99	BP392 ... Electronic Project Building for Beginners	\$6.99
BP187 ... A Prac Ref Guide to Word Pro Amstrad PCW8256/PCW8512	\$7.99	BP393 ... Practical Oscillator	\$6.99
BP190 ... More Advanced Electronic Security Projects	\$3.99	BP396 ... Electronic Hobbyists Data Book	\$7.99
BP194 ... Modem OPTO Device Projects	\$3.99	BP401 ... Transistor Data Tables	\$7.99
BP232 ... A Concise Introduction to MS-DOS	\$3.99	BP411 ... A Practical Intro to Surface Mount Devices	\$6.99
BP256 ... An Intro to Loudspeakers and Enclosure Design	\$3.99	BP413 ... Practical Remote Control Projects	\$7.99
BP264 ... A Concise Advanced User's Guide to MS-DOS	\$3.99	BP416 ... Practical Alarm Projects	\$6.99
BP272 ... Interfacing PCS and Compatibles	\$5.99	BP439 ... Troubleshooting Your PC	\$8.99
BP290 ... An Intro to Amateur Communications Satellites	\$5.99	PCP107 ... Digital Logic Gates and Flip-Flops	\$10.99
BP297 ... Loudspeakers for Musicians	\$6.99	PCP112 ... Digital Electronics Projects for Beginners	\$10.99
BP299 ... Practical Electronic Filters	\$6.99	PCP114 ... Advanced MIDI Users Guide	\$10.99
BP302 ... A Concise User's Guide to Lotus 1-2-3 Release 3.1	\$5.99	ETT1 ... Wireless & Electrical Cyclopeda	\$4.99
BP304 ... Projects for Radio Amateurs and S.W.L.S	\$5.99		

PRICES DO NOT INCLUDE SHIPPING & HANDLING. ALL SALES ARE FINAL, NO RETURNS

ORDER FORM

Book No.	Title	Price	No. of Copies	Cost

Name _____
 Address _____
 City _____ State _____ Zip _____

If you wish to use a Credit Card:

MasterCard Visa Expire Date ____ / ____
 Card No. _____
 Signature _____

Allow 6-8 weeks for order to be fulfilled.

Please return this order form to:
ELECTRONIC TECHNOLOGY TODAY, INC.
 P.O. Box 240
 Massapequa Park, NY 11762-0240



SHIPPING COSTS		Total Amount \$
\$0.01 to \$5.00	\$2.00	- 30% off
\$5.01 to \$10.00	\$3.00	Subtotal
\$10.01 to \$20.00	\$4.00	Local NY State Sales Tax
\$20.01 to \$30.00	\$5.00	Add shipping cost (see table)
\$30.01 to \$40.00	\$6.00	TOTAL COST \$
\$40.01 to \$50.00	\$7.00	
\$50.01 and above	\$8.50	

Telephone Orders: If you wish to place your credit-card order by phone, call 631/592-6720. Have your credit-card ready. Sorry, no orders accepted outside of U.S.A. and Canada. New York State Residents must add applicable sales tax. Offer expires 3/31/02.

UFO Detector, Part 1

Do Unidentified Flying Objects (UFO's) exist? Of course, they exist! UFO sightings are reported all over the world by thousands of people. The real question is whether UFO's are interstellar travelers visiting Earth. Most UFO sightings can be classified as misidentified aircraft, planets, or other aerial phenomena, but not all of them. There is that small percentage of UFO reports that can't be explained by any known aircraft or natural phenomena. It is these reports that create an exciting possibility.

Granted, the open possibility attracts fringe personalities and UFO groups that should not be taken seriously. But one should not discount the entire UFO subject based upon the ramblings of a few individuals or groups. Real UFO enthusiasts know the odds are stacked against their credibility and try to root out lunatics and hucksters as best they can.

The UFO issue can be intelligently debated on both sides of the fence. This article will not join into the debate. However, if UFOs arouse your curiosity you may be interested in building this month's project: a UFO Detector.

The first question is how do we detect something we don't even know really exists? Well, to do so we must rely on information gathered from past UFO sightings. According to many reports, some UFO's cause major electrical and magnetic disturbances and anomalies. For instance, a running car engine will start to stumble, cough, and then eventually stall dead. Magnetic compasses swing wildly, around and around. If this information is accurate, we can use these UFO side effects to make a UFO detector.

By using the magnetic anomaly side effect, we can make a simple UFO detector from a standard magnetic compass. You place the compass down, away from any magnetic fields, electrical fields, and ferrous materials. Let the

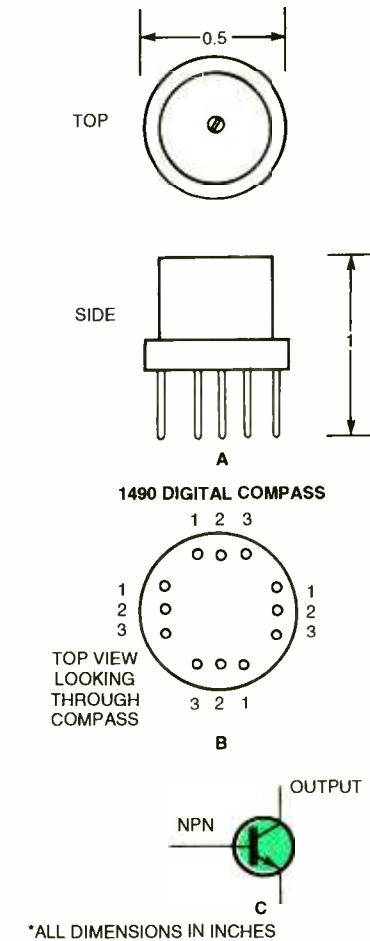


Fig. 1. Shown here is the schematic for the 1490 Digital compass from Dinsmore Instrument Co.

compass needle settle down and point to Earth's magnetic north. The compass-detector is now set; you sit and watch the compass needle. If the needle starts jumping around and swinging wildly, you may have detected a UFO. However, just because the needle started jumping around doesn't always mean it's detecting a UFO. There can be other (more common) reasons that the compass needle started to act erratically.

For instance, somebody passing the compass holding a strong permanent

magnet or carrying a quantity of ferrous materials could cause the needle to move. If the compass is lying close to an electrical line and someone switches electrical power on or off through the line, this action can also cause the compass to react. Placing the compass close to any electrical device may also cause the compass to react erratically. After eliminating these possible terrestrial triggers, you may be left with a legitimate event to investigate.

Typically, UFO sightings are rare events. Therefore, you may have to keep looking at that compass for days, weeks, months, or years at a time before you detect an event. Obviously that is not practical, and that is where our UFO Detector comes in. The UFO Detector described operates 24 hours a day, seven days a week, for over six months on one 9-volt battery.

Circuit Function

The UFO Detector works in a similar way to the method described earlier that used a magnetic compass. Since this is an electronic circuit, we are using an electronic compass. The electronic compass for our detector is a 1490 digital compass sold by Dinsmore Instruments Company. A pre-programmed 16F84 continuously monitors and checks the status of the compass for any anomalies. When it detects a magnetic anomaly, it signals by flashing an LED and beeping.

The Digital-Compass Sensor

The 1490 compass contains four solid-state Hall-effect devices. Each device corresponds to a position of the four cardinal points on a standard compass, North (N), South (S), East (E), and West (W). When used as a compass, it can detect the four cardinal points as well as the intermediate directions North East (NE), North West (NW),

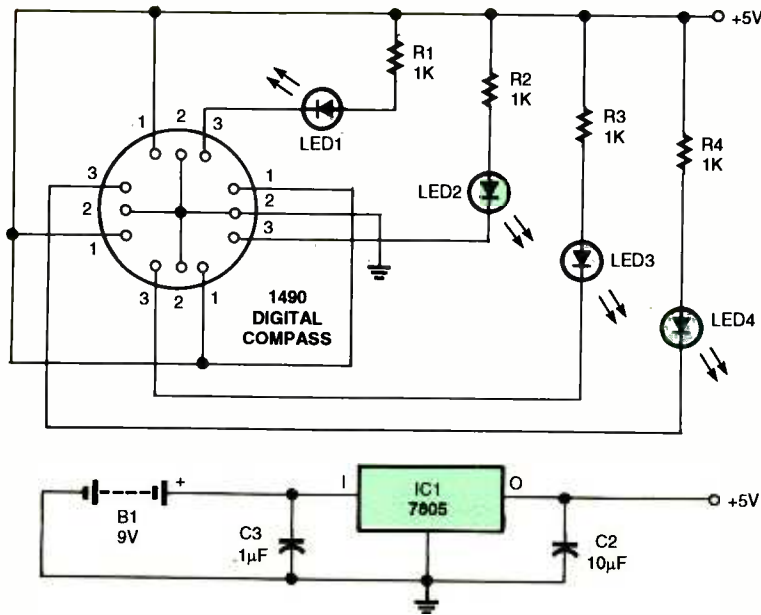


Fig. 2. This basic digital compass circuit allows the user to test the operation of the compass.

South East (SE), and South West (SW). The bottom of the device has a total of twelve leads, arranged in four groups of three leads. Looking down at the device from the top, you can see that each group of leads is labeled 1, 2, and 3 (see Fig. 1). The group of leads labeled 1 is connected to VCC (+5V). Those labeled 2 are connected to ground, and those labeled 3 are our output leads. The output leads of the device are equivalent

to an open collector of an NPN transistor (see Fig. 1). Each output is capable of sinking 20 mA continuously or 25 mA intermittently.

Figure 2 is a basic compass circuit. I am presenting this circuit to clearly illustrate how the Dinsmore sensor works; it isn't necessary to construct this circuit for the UFO Detector. The circuit uses four LEDs for directional display. Each cardinal position on the com-

pass lights one of the four LEDs. Intermediate directions light two LEDs.

To use the circuit in Fig. 2 as a digital compass, we need to calibrate the circuit. First, find the direction of magnetic north with a standard compass. Rotate the circuit so that just one LED is lit. Use that LED as North. I used the LED furthest away from the sensor for North (see Fig. 1). If you also follow the wiring in the schematic exactly, the other three LEDs will fall into the sequence shown in Table 1. (1 = on, 0 = off)

The 1490 Digital Compass sensor is sensitive to tilt. Any tilt greater than 12 degrees will create errors and reduce sensitivity.

Under Control

The UFO-Detector (see Fig. 3) uses a pre-programmed 16F84 microcontroller from Images SI Inc. (see Parts List). The microcontroller is responsible for monitoring the four outputs from the digital compass and sounding an alarm when a potential UFO event has occurred.

When power is applied to the circuit (or reset), the microcontroller waits about seven seconds before beginning active scanning of the digital compass sensor. These seven seconds allow the user to place the UFO detector down wherever the user wants and

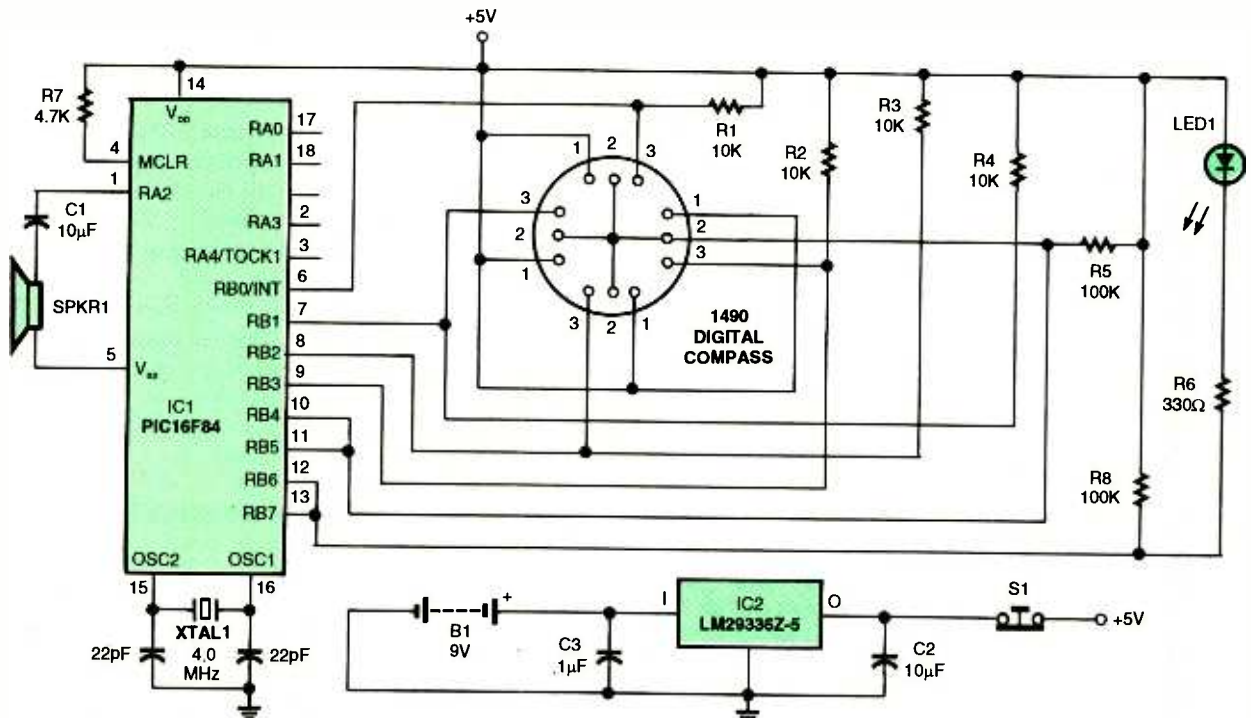


Fig. 3. The UFO-Detector circuit schematic is shown above. A PIC microcontroller is used to monitor and control the compass.

TABLE 1

<u>DIRECTION</u>	<u>LEDs</u>	<u>DECIMAL NUMBER EQUIVALENT</u>
North	0001	1
North East	0011	3
East	0010	2
South East	0110	6
South	0100	4
South West	1100	12
West	1000	8
North West	1001	9

PARTS LIST FOR THE UFO DETECTOR

SEMICONDUCTORS

IC1—PIC16F84, pre-programmed microcontroller
 IC2—5-volt voltage regulator
 LED1—Green, super-bright LED

RESISTORS

(All resistors are 1/4-watt, 5% units.)
 R1—R5—10,000-ohm,
 R8—100,000-ohm
 R7—4.7K-ohm
 R6—330-ohm

CAPACITORS

C1, C2—10- μ F capacitor, 12 volts
 C3—.1- μ F capacitor, 12 volts

ADDITIONAL PARTS AND MATERIALS

Dinsmore 1490 Digital Compass
 X1—4.0-MHz crystal
 (2)—22-pF capacitors, 12 volts (for crystal)
 9-volt battery clip; mercury tilt switch; miniature speaker (approx 1-inch diameter, 8 ohms); UFO-detector housing; 9-volt lithium battery.

NOTE: UFO Detector Kit containing two printed circuit boards, and all the components listed above, (\$ 39.95) can be ordered from Images SI, Inc, 39 Seneca Loop, Staten Island, NY 10314; 718-698-8305; www.imagesco.com.

The following components are sold separately from the same supplier: Dinsmore 1490 Digital Compass, \$14.95; PIC16F84 pre-programmed microcontroller, \$8.95; 9-volt lithium battery, \$8; Area 51 UFO Model (separate delivery charge), \$25; alien-head sculpture (separate delivery charge), \$99.95.

gives sufficient time for the digital compass to come to a complete rest before it begins scanning. After the initial seven seconds have elapsed, the microcontroller flashes the LED and beeps once signaling it's in detector mode. It reads the positional information from the digital compass and stores that value in memory.

The microcontroller then begins active scanning of the digital compass sensor for any changes in its output. However, it does its scanning in an economical way. In order to conserve electrical power, the microcontroller goes into a low-power mode for approximately 2 seconds. It wakes up for approximately 4 milliseconds (.004 seconds), applies power to the main circuit, and checks the digital compass sensor. If the output of the compass is the same as the stored value, it goes back into low power mode for another two seconds and repeats the cycle. If the new reading from the sensor is different then the stored value, the microcontroller sounds an alarm by blinking a super-bright LED and beeping. The alarm will continue until the circuit is reset or the battery runs down.

Since the circuit is only active and drawing full power for .004 seconds every 2.0 seconds, considerable power savings are realized. This allows a 9-volt lithium battery to last longer than six months while in the search or detector mode 24 hours a day. When the alarm is active, full power is applied to the circuit continuously; and the battery life runs down much more quickly.

Battery Power

Although the 9-volt lithium battery looks identical to a standard 9-volt transistor battery, the lithium battery has up to three times the power density of the standard battery. However, that IS NOT the primary reason we use a lithium battery in the UFO detector. The primary reason is the battery's non-metallic,



The Area 51 UFO Model from the Testor Company can be used as a housing for the project.

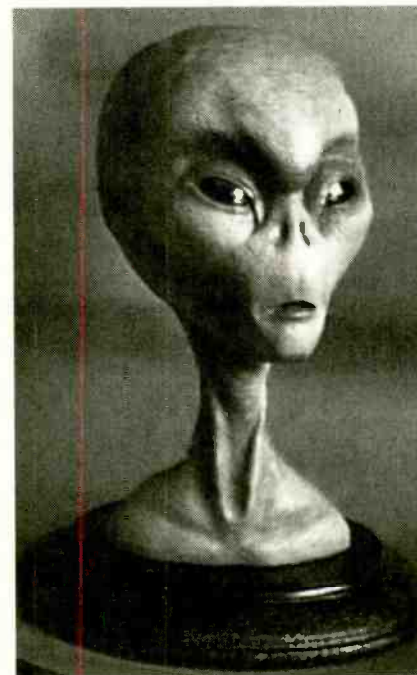
non-ferrous case. Standard carbon and alkaline 9-volt batteries use a metallic ferrous material that will adversely affect the sensitivity of the digital compass sensor.

There is a small amount of ferrous material used in the construction of a lithium battery—the terminal clips on top of the battery. If the terminal clips are placed away from the sensor, they do not affect the sensitivity of the digital compass to any great extent.

While we are on the subject of keeping any ferrous material away from the sensor, the small 8-ohm speaker should also be placed away from the sensor for the same reason.

Get It Mounted

It may appear odd to discuss housings for and mounting of the finished circuit board before we actually begin the circuit construction, but there is a good reason for it. The finished UFO Detector board will occupy a space of 1 × 1.5 × 2.5 inches. There will be



This "Grey" alien-head sculpture, said to be "life sized," can also be used as an appropriate housing for the UFO-detector circuit.

Books that Bridge Theory & Practice

Many electronics enthusiasts discovered that the bridge from classroom theory books to hands-on project building is difficult to span at times without a handy pocket guide. Even the equipment manual to operate a gadget often makes things murkier rather than clearer. A compact text authored by a seasoned expert with hands-on knowledge and a knack of writing in an easy-to-understand style is many times more valuable than the price of ponderous theory and equipment manuals or the parts for a project that could be damaged. Here's a sampler of some titles you may want to own!

ELECTRONIC HOBBYIST DATA BOOK—The info you need to transport you from the schematic diagram to project parts. Pin-outs, color codes, truth tables, parts parameters, etc. **Order BP396- \$10.99 Includes S & H**

PRACTICAL INTRODUCTION TO SURFACE MOUNT DEVICES—A technology that spun off the automated assembly line into the grasp of experimenters and project builders. **Order BP411- \$9.99 Includes S & H**

THE PRE-COMPUTER BOOK—Aimed at the absolute beginner with little or no knowledge of computing. A non-technical discussion of computer bits and pieces and programming. **Order BP115- \$2.99 Plus \$2.00 S & H**

PRACTICAL OSCILLATOR CIRCUITS—If your budding project requires an oscillator, you can design it and build it from the many types described here in a hobbyist-friendly style. **Order BP393- \$9.99 Includes S & H**

PRACTICAL PIC MICROCONTROLLER PROJECTS—This book covers a wide range of PIC based projects. In most cases the circuits are very simple and they are easily constructed. **Order BP444- \$7.99 Includes S & H**



Electronics Technology Today Inc. Number of books ordered

P.O. Box 240 Amount enclosed \$ _____

Massapequa, NY 11762-0240

Please send me the following book(s) that I checked:

BP396 - Electronic Hobbyist Data Book—\$10.99

BP411 - Practical Introduction to Surface Mount Devices—\$9.99

BP115 - The Pre-Computer Book—\$2.99 + \$2.00 S & H

BP393 - Practical Oscillator Circuits—\$9.99

BP444 - Practical PIC Microcontroller Projects —\$7.99

Most above prices include shipping and handling ET05

Name/Company _____

Address _____ Apt. _____

City _____ State _____ Zip _____

Sorry, no orders accepted outside the USA and Canada. All payments must be in US funds! NY state residents must include local sales tax. Allow 6-8 weeks for delivery.

three sets of leads coming out of the circuit board: one pair of leads for the super-bright LED, one for the speaker, and one for the 9-volt battery clip. Before construction, decide whether the finished circuit is to be mounted vertically or horizontally, because the digital compass cannot be tilted greater than 12 degrees without degrading its performance. Keeping this in mind, we have two ways to mount the compass with reference to the main circuit board—vertically and horizontally.

Housing Needs

The decision to build a vertical or horizontal circuit will depend on the housing you choose. You can pretty much choose any non-ferrous housing that's large enough to hold the circuit board and battery. Suitable non-ferrous housing materials include the following: plastic, wood, brass, foam board, and aluminum. If the housing is large enough, you can mount the UFO detector either way.

If you would like an almost ready-made housing I can offer a few suggestions. The Testor Model company sells a plastic AREA 51 UFO model. The model is large enough to hold the detector inside and makes a suitable enclosure. If I were mounting the UFO detector circuit inside this model, I would build the circuit horizontally. I would mount the super-bright LED in the upper portion of the UFO model so that its light would glow through the transparent plastic. The speaker may be mounted inside the model, with a suitable speaker hole drilled into the case at an appropriate position. There are other model spacecraft and rockets that offer an interesting housing as well.

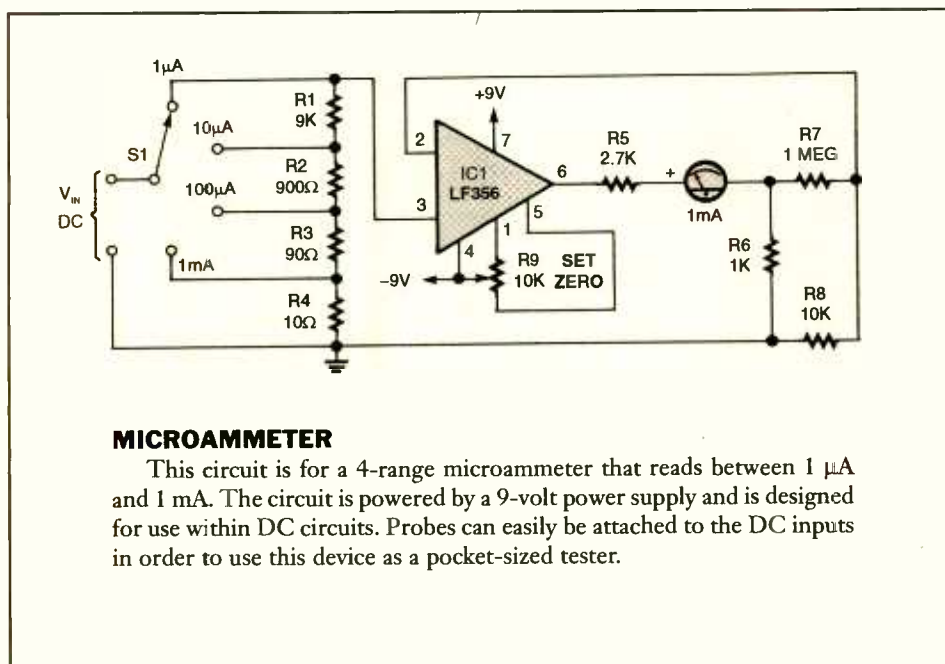
The Grey Alien head shown in the photo is another possibility. This is an exquisitely sculptured (supposedly) life-sized model (based on reports). The finished UFO detector could be mounted behind the head, or the black base may be hollowed out to fit the circuit.

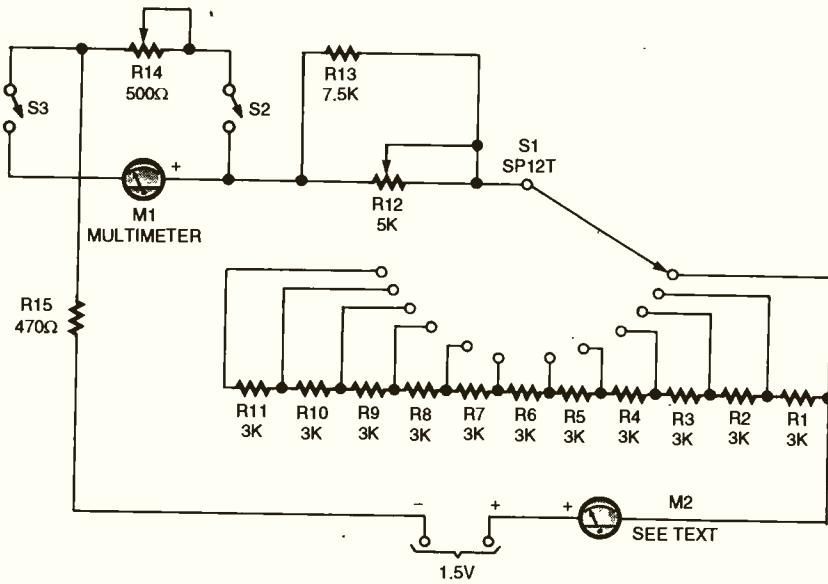
Next Month

We will continue with the construction of the UFO Detector next month. For those who wish to get a head start, you can purchase the components or the kit and begin looking for a suitable housing for your UFO Detector. P

Meters, And Testers, And Detectors . . . Oh My!

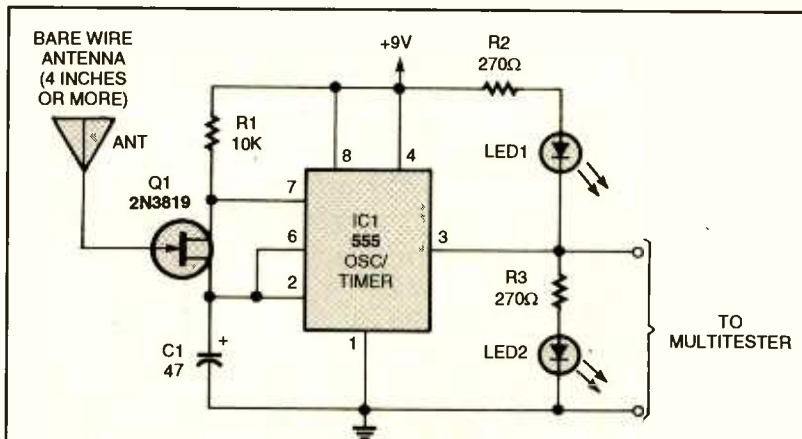
This month we have meters, testers, and testers to test you meters. An electronic workbench should always have a multitude of test equipment, and nothing is more fun than building your own. Here are schematics of some popular test equipment. Break out the “junkbox” and pref-board, folks.





METER TESTER

In this schematic M1 is a multimeter set to measure current and M2 is the meter under test. Start by setting S1 to the maximum resistance and S2 open. Slowly decrease the resistance with S1 and fine-tune the current by adjusting R12. When M2 reads full scale observe the reading on M1. This reading is the full-scale current for the meter under test. After this test, close S2 and adjust R14 and R15 until M2 reads mid-scale. The sum of the resistance of R14 and R15 is the same as the internal resistance of M2. If the internal resistance to be measured is known to be less than 470 ohms, then close S2 and adjust R14 until M2 is mid-scale.



STATIC DETECTOR

This circuit can be used to detect the presence of static fields. A bare-wire antenna feeds a Field-Effect Transistor at the heart of the circuit. The FET has a direct effect on the flashing of the two LEDs. This device can be used to sniff out potentially dangerous environments that might harbor electrostatic voltages, which could zap fragile semiconductors with lethal voltages.

BASIC CIRCUITRY

mailto: basiccircuitry@gernsback.com

CHARLES D. RAKES

SUDDEN IMPACT TRANSDUCERS

In my opinion, electronics is the world's best hobby. Just about any mainstream high-tech hobby you can think of today is filled with electronic circuitry. Model airplanes, boats, trains, cars, and other remote-controlled devices would be dead in the water without electronics. Some of these devices use complex electronic circuitry to get the job done, where others use more basic circuits. However, as we all know, most complex circuitry is made up of numerous simple basic circuits. This month we're going to play with impact transducers, which have a number of applications—including the one I enjoy: shooting air guns.

Building Transducers

Another great attribute we all share in the electronics hobby is the ability to

build most anything we need much more cheaply than it can be purchased ready made. With that said, all of the impact transducers we'll discuss should be inexpensive to duplicate, especially if a well-filled junk box is available.

Our first impact transducer, see Fig. 1, uses a 2.25-inch diameter speaker attached to a .125-inch-thick metal plate. This simple combination produces a super high output signal. Hitting the face of the transducer with about 2- to 4-foot-pounds of energy from a small .177 lead pellet produces an output signal that is several hundred millivolts peak to peak. This signal level is more than ample for most output applications. The output signal can be used to drive audio and visual circuitry, which we'll get into later on.

In putting together the speaker transducer, be aware that the metal plate that the speaker attaches to is the place the pellets impact. This material should be durable and thick enough to stand up to the pounding of the pellets without penetrating or denting. The plate's overall size should be slightly larger than the speaker and can be either round or square. The speaker is attached to the metal plate with a thin layer of silicon rubber. The transducer assembly will be positioned behind a target front with a hole of suitable diameter to allow the

pellet to travel through and hit the metal plate.

The drawing in Fig. 2 shows one method of using the transducer with a

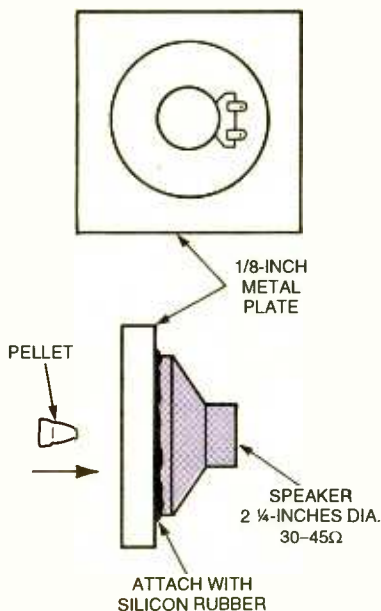


Fig. 1. Our first impact transducer uses a 2.25-inch diameter speaker, attached to a .125-inch thick metal plate.

PARTS LIST FOR THE SPEAKER TRANSDUCER (FIG. 1)

Small 1 1/2-2 1/2-inch diameter magnetic speaker, output impedance of 16 to 45 ohms.

One 1/8-inch metal plate, slightly larger than speaker used. Silicon rubber, etc. See text.

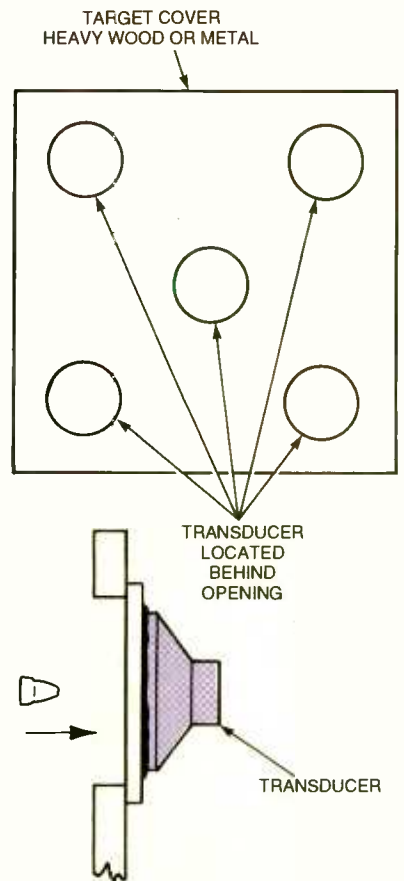
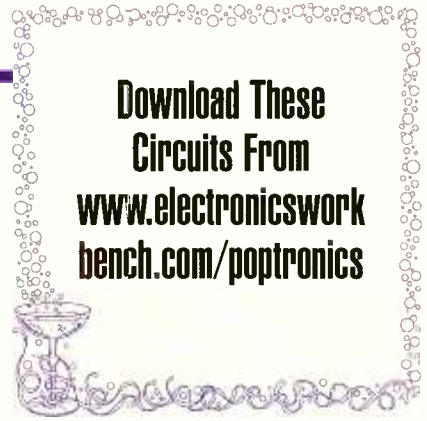


Fig. 2. The transducer is centered about 1/4-inch behind the hole in the target cover, without actually touching the cover

PARTS LIST FOR THE TARGET COVER (FIG. 2)

Heavy wood or metal cover for transducers, see text.



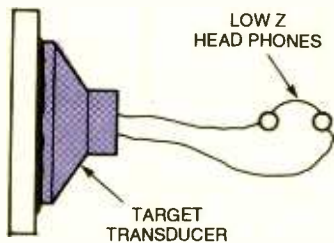


Fig. 3. The speaker transducer produces an output level that can easily be monitored with a pair of low-impedance headphones.

PARTS LIST FOR THE SIMPLE HIT MONITOR (FIG. 3)

Pair of low-impedance headphones.

target cover. The actual target area can be any size hole, from the pellet size to 2 inches in diameter. The transducer is centered about 1/8-inch behind the hole in the target cover without actually touching the cover. The transducer can be supported by any convenient means that restricts contact with the target cover. Also, the opening in front of the transducer does not have to be round. Any desired target figure can be cut out of the target cover to produce a hit-output signal anywhere within the target area.

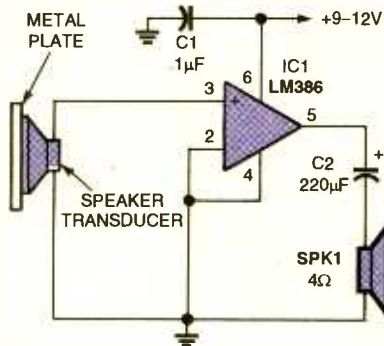


Fig. 4. The circuit shown in the schematic above adds a power-audio amplifier to the transducer's output, allowing monitoring without using headphones.

PARTS LIST FOR JACKING UP THE OUTPUT (FIG. 4)

IC-1—LM386 audio power amplifier IC
 C1—1-µF, ceramic-disc capacitor
 C2—220-µF, 35-WVDC, electrolytic capacitor
 Spk.—Small 2- to 4-inch 4-ohm speaker

Simple Hit Monitor

The speaker transducer produces an output level that can easily be monitored with a pair of low-impedance headphones, as illustrated in Fig. 3. The output sound will depend on many factors including the type and hardness of the transducer's metal plate, the area that the pellet hits, and the energy on impact. With a little practice, it's possible to tell when the target is hit in the center or on the outer edge.

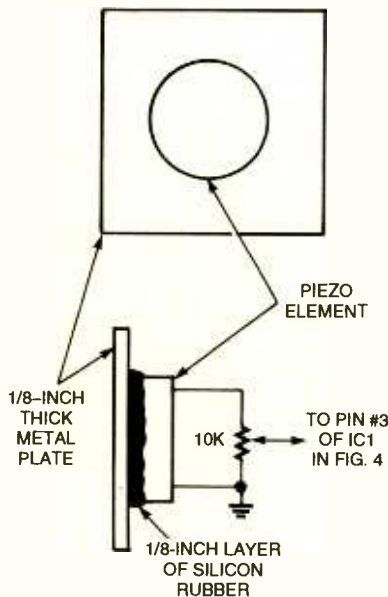


Fig. 5. The basic construction of the piezo impact transducer closely follows our first one in Fig. 1, with a minor, but important change—the use of a piezo device.

PARTS LIST FOR THE PIEZO TRANSDUCER (FIG. 5)

Piezo element, any size from .75- to 1-inch in diameter, and without an internal sound generator.
 One 1/8-inch target plate, silicon rubber, 10K pot, etc.

Now is a good time to add a couple of cautions in using the transducers. Firstly, **never** shoot without safety glasses. Secondly, **only use soft lead pellets** and **never ever BBs**, as they can fly right back and hit you. Just use your common sense as you would in flying model planes or any other hobby that has moving objects that might hurt you if they were to hit you.

Jacking Up The Output

The sounds coming from the transducer can be very interesting and infor-

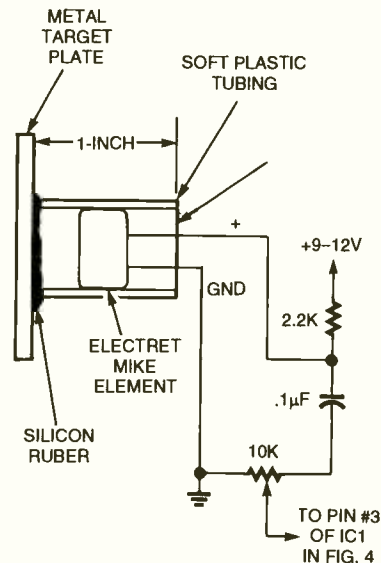


Fig. 6. The figure above illustrates the mounting of the mike element in a 1-inch length of 1/8-inch (inner dimension) by 1/2-inch (outer dimension) vinyl tubing.

PARTS LIST FOR THE ELECTRET-MIKE-ELEMENT TRANSDUCER (FIG. 6)

Electret-mike element, Radio Shack #270-090.
 Metal target plate, 1-inch length of 1/8-inch (inner dimension) by 1/2-inch (outer dimension) vinyl tubing; silicon rubber; 2200-ohm, 1/4-watt, 5% resistor; 10K pot; 1-µF, ceramic-disc capacitor; wire; etc.

mative. The circuit in Fig. 4 adds a power-audio amplifier to the transducer's output, allowing monitoring without using headphones. A single LM386 low-voltage audio-power amplifier IC raises the transducer's output to drive a small 4-ohm speaker. The LM386's circuitry is connected for a minimum voltage gain of 20. Pins 1, 7, and 8 are not used in this configuration. The amplifier circuit may be operated from any solid DC source with 6 to 15- volts and a minimum output of 100mA.

Piezo Transducer

Another great pick-up sensor for impact detection is the piezo transducer, which is available for less than two bucks at your local electronic-supply house. Only the plain Jane piezo element is required for our use; therefore, the more expensive devices that have built-in tone generators are not required and will not

work anyway. Just about any size piezo element will fit; however, I'd recommend one that's about .75 to 1.0 inches in diameter.

The basic construction, see Fig. 5, of the piezo impact transducer closely follows our first one in Fig. 1—with a minor, but important, change. The piezo elements are hardy little fellows, but they can be cracked or broken if handled carelessly. To reduce that chance, the piezo element is mounted to the metal plate with a 1/8-inch layer of silicon rubber to serve as a buffer between the impact area and the piezo element. The silicon rubber should be applied in a circle slightly smaller than the diameter of the piezo element.

Take care in attaching the piezo element to the plate so that no silicon rubber gets into the element. The piezo transducer may be connected to the same amplifier circuit shown in Fig. 4, with the addition of the 10K pot.

Electret-Mike-Element Transducer

The electret-mike element is another great inexpensive device that makes a good impact transducer. The micro-

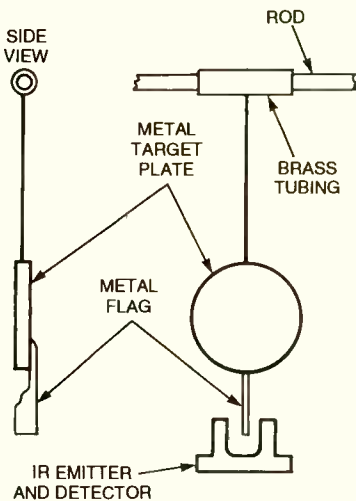


Fig. 7. The circuit above is for a swinging target. An IR detector and emitter are used to monitor the swinging target.

PARTS LIST FOR THE SWINGING TARGET (FIG. 7)

Round metal target plate, brass tubing, metal rod that goes through the brass tubing, metal for flag, IR interrupter switch—Mouser part #512-H21A1 or similar device.

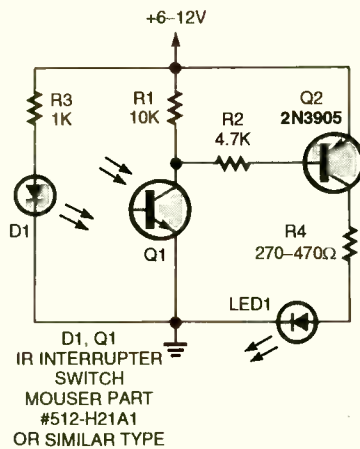


Fig. 8. The circuit above adds a flashing LED to the swinging transducer in Fig. 7. The IR emitter and detector are in the same package and are available from Mouser Electronics, listed as an IR interrupter switch.

PARTS LIST FOR THE SIGNAL LIGHT (FIG. 8)

SEMICONDUCTORS

D1, Q1—IR interrupter switch, Mouser part #512-H21A1

LED1—Any color or size

Q2—2N3905 PNP general-purpose transistor

RESISTORS

(All resistors are 1/2-watt, 5% units.)

R1—10,000-ohm

R2—4700-ohm

R3—1000-ohm

R4—270-ohm to 470-ohm

phone element is very sensitive and must be mounted in such a way that only the pellet impact sound is detected. This is easily done by mounting the mike element in a 1-inch length of 3/8-inch (inner-dimension) by 1/2-inch (outer dimension) vinyl tubing, as shown in Fig. 6. The vinyl tubing is mounted to the center of the metal plate with silicon rubber. After you push the mike element about halfway into the tubing, seal the open end with silicon rubber. Any outside noise or sound reaching the mike element will be greatly reduced by the vinyl tubing and silicon rubber.

The electric-mike transducer can also be connected to the amplifier circuit shown in Fig. 4, by following the drawing in Fig. 6.

The electric-mike transducer can also be connected to the amplifier circuit shown in Fig. 4, by following the drawing in Fig. 6.

Swinging Targets

Many sporting goods and large discount stores offer at least one type of

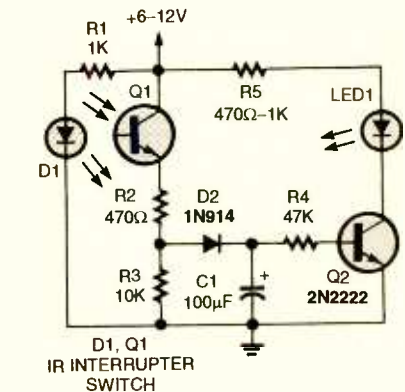


Fig. 9. This circuit adds a turn-off delay function keeping the LED on for a short time period without flashing on and off.

PARTS LIST FOR THE DELAYED TURN-OFF CIRCUIT (FIG. 9)

SEMICONDUCTORS

D1, Q1—IR interrupter switch (same as in Fig. 8)

D2—1N914 silicon diode

LED1—Any color or size

Q2—2N2222 NPN general-purpose transistor

RESISTORS

(All resistors are 1/2-watt, 5% units.)

R1—1000-ohm

R2—470-ohm

R3—10,000-ohm

R4—47,000-ohm

R5—470-ohm to 1000-ohm

CAPACITORS

C1—100-μF, 35WVDC, electrolytic capacitor

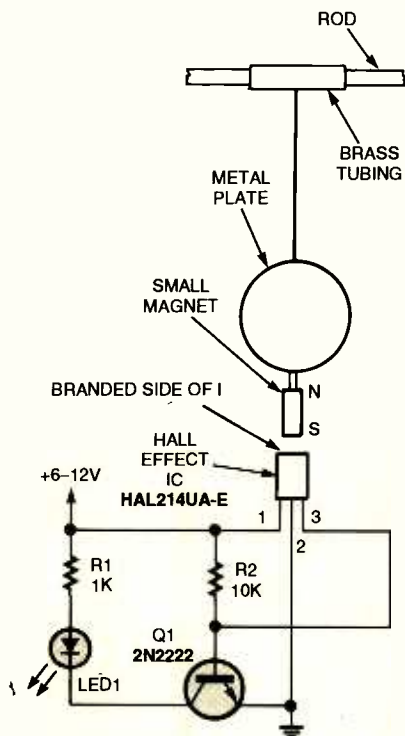


Fig. 10. Our last impact transducer incorporates a Hall-effect circuit into its design.

shown in Fig. 2. This arrangement protects the detector and allows for a selected target area.

Signal Light

The circuit in Fig. 8 adds a flashing LED to the swinging transducer in Fig. 7. The IR emitter and detector are in the same package and are available from

PARTS LIST FOR THE HALL-EFFECT CIRCUIT (FIG. 10)

Same metal parts as in Fig. 7, with a small magnet replacing the metal flag.

IC1—Hall-effect IC # HA214UA-E, sensor available from Digi-Key

LED1—Any color and size

Q1—2N2222 NPN, general-purpose transistor

R1—1000-ohm, ¼-watt, 5% resistor

R2—10,000-ohm, ¼-watt, 5% resistor

Mouser Electronics, listed as an IR interrupter switch.

Transistor Q1 is turned off, and its collector is at positive supply, keeping Q2 turned off as well. When the target swings away from the IR interrupter switch, Q1's collector goes from positive supply to near ground level. This action switches Q2 on and off at the same rate, causing the LED to flash on and off. The LED lights each time the swinging flag is out of the gap between the IR emitter and detector.

A similar circuit, see Fig. 9, adds a turn-off delay function keeping the LED on for a short time period without flashing on and off. The same IR interrupter switch is used as in our previous circuit, with the detector transistor, Q1, connected as an emitter follower. When the metal flag moves from between D1

and Q1, the voltage at the emitter of Q1 rises to near battery voltage, charging C1 through R2 and D2 and supplying base current for Q2. Then Q2 turns on, lighting the LED. The on time can be as much as five seconds with the 100- μ F capacitor, and longer when C1 is increased in value. Resistor R2's purpose is to limit Q1's maximum current flow when charging C1.

Hall-Effect Circuit

Our last impact transducer this time around is the Hall-effect circuit shown in Fig. 10. The swinging metal plate is arranged like our previous target, with a small magnet replacing the metal flag. The south pole of the magnet is facing the branded side of the Hall-effect IC, which causes the output of the IC, pin #3, to go and stay low as long as the magnet remains still. Hitting the target plate causes the magnet to swing back and forth allowing the Hall-effect to turn off and on at the same rate. The LED flashes following the swinging target. The Hall-effect's output can also be used to supply clock pulses to a simple counter to display the number of swings the target makes.

I still have a few more impact transducers to share along with a number of display circuits that can be driven with the transducers. These combinations can turn out to be interesting targets and loads of fun to boot. Come around again next month same time, same station. **P**

DIGITAL DOMAIN

(continued from page 15)

excels at person-to-person journalism," says Trayes. The flip side to the Net's personal nature is the high incidence of misinformation. Without the filter of experience and editing, rumors and hoaxes proliferate. In one Internet discussion group I follow, it was reported that the planes that slammed into the World Trade Center had biological weapons on board.

The misinformation can be visual as well as verbal. In the days after September 11th, a doctored photo circulated around the Internet of a tourist on top of World Trade Center smiling for a camera while a plane in the background was just about to slam into the

building. Anti-hoax Web sites such as the Urban Legends Reference Pages at www.snopes.com can help ferret out the truth.

Television wasn't immune to reporting false rumor as news, including the car bomb outside the U.S. State Department, the three other missing airliners that were presumably heading for Virginia, and the van on the New Jersey Parkway loaded with explosives.

Maybe what's most valuable about the personal nature of the Net is its ability to bring the community together. During a disaster, it's a natural human impulse to reach out to others; and the Net is unparalleled in bridging the distance that often separates us. "In the midst of horror, we need to know that we're not alone," says Steven J.

Vaughan-Nichols, chairman of the Internet Press Guild. "Ultimately, we're family, and like all families we're drawn together when terror's night threatens us."

The Net can also bring together those who otherwise might not think of themselves as family. "The Internet can facilitate discussion among people who otherwise might be belligerent," says Outing. This won't guarantee peace, of course. We've already seen that. "There is a time for everything ... a time for war and a time for peace," according to both Ecclesiastes and the Byrds.

Reid Goldsborough is a syndicated columnist and author of the book *Straight Talk About the Information Superhighway*. He can be reached at reidgold@netaxs.com or <http://members.home.net/reidgold>. **P**

Poptronics®

SHOPPER[®]

POLARIS CAN SUPPLY YOU WITH ALL OF TODAY'S HOTTEST VIDEO TECHNOLOGY!


CALL OR GO ON-LINE TO ORDER YOUR FREE VIDEO CATALOG - 100's OF PRODUCTS - MICRO CAMERAS - WIRELESS VIDEO - LIPSTICK CAMERAS - DIGITAL VCR'S
WEB CAMERA WITH BUILT-IN PAN/TILT/ZOOM CONTROLS **WEATHERPROOF DIGITAL STORAGE CAMERA**

Compact Web Camera For Online Image Monitoring and Delivery Over The Internet

Featuring a built-in Web server, powerful 10x zoom, pan/tilt, and alarm input/output capability, all in an ultra-compact unit. These Web cameras can be installed virtually anywhere and deliver high-quality images to the Internet for real-time monitoring or broadcast. Better yet, these cameras can be controlled and monitored via a standard Web browser, making it ideal for a wide variety of applications.

Size: 122mm x 82mm x 97mm.

- Ultra-compact, all-in-one web camera with built-in web server
- Monitoring and camera control possible via web browser
- 10x optical zoom and multi-angle pan/tilt capability
- 10Base-T interface for direct connection with network
- Alarm In/Out function for automatic surveillance
- Three different security levels



The SWC-40R combines a black & white video camera, digital image storage, video motion detection and an alarm interface in a compact, vandal proof enclosure. It is unique as it offers a complete CCTV surveillance system within a single compact enclosure.

- All-in-one CCTV system
- Built-in digital image storage
- Programming and image retrieval by remote control
- Built-in video motion detection

NO TAPES!

SWC-40R \$849.95

Dimensions 5" x 4" x 4.5"



6.4" COLOR TFT-LCD MODULE
 TFT MONITORS AVAILABLE FROM 2.5" - 15"

Our new 6.4" Color TFT Module can be used for a variety of purposes such as; custom automotive dash installations, video phone, door phone, boat installations, covert ultra-compact surveillance packages, security and more.

TFT-64M - \$319.95

Dimensions 1.5"(W) x 1.75"(H) x 0.5"(D)

HIGH RESOLUTION!

Back Side of Module



COVERT COLOR SPY CAMERA

It's small sleek indestructible design and pinhole lens allow for various applications and simple installation. Comes equipped with a RCA JACK for easy connection to TV monitor or VCR. Great for covert use in any place imaginable.

25mm(W) x 17mm(D) CM-550CP - \$79.95



"YOUR WEB BROWSER IS YOUR REMOTE EYE!"

The FlexWatch acts as an internet camera server. No software needed in order to view your video. All you need is a web browser such as Internet Explorer or Netscape. FlexWatch includes many special functions including video quality control, pan/tilt/zoom interface and network configuration. All of them are controlled by the web browser. Features 4 video inputs - 3 external.

FLEXWATCH-100 - CALLS

CONTROL PAN / TILT AND ZOOM REMOTELY OVER THE INTERNET!

LIVE VIDEO!



2.4 GHz A/V TRANSMITTING MODULE

Makes any camera wireless! Excellent for hobbyist / remote control airplanes.

4 CHANNELS!

2.4 GHz

MPX-2400 - \$89.95

2.4GHz RECEIVER GFR-5002 - \$119.95

Dimensions 1.5"(W) x 1.75"(H) x 0.5"(D)



-MICRO BOARD CAMERAS- MANY MODELS IN STOCK TO CHOOSE FROM!

MB-1250HRP Hi-Res Color Pinhole 5.0mm Lens 1.27" x 1.27" \$109.95




COLOR & B/W SUBMERSIBLE CAMERAS

CAN SEE UNDER WATER!

B/W version comes with attached 80 meter cable (color-20 meters). Built-in white LED's give this camera a 15 meter infrared range. Heat resistant glass and water resistant design allow for rugged applications.

VIDEO CAMERA HEAD CAN BE SUBMERGED UP TO 100 FEET!

SUBCAM-BW (B/W) - \$249.95
 SUBCAM-CL (COLOR) - \$299.95




2.4GHz RECEIVER

MPX-2400 - \$89.95

2.4GHz RECEIVER GFR-5002 - \$119.95

Dimensions 1.5"(W) x 1.75"(H) x 0.5"(D)



WEATHERPROOF CAMERA

Color Camera 400 TV Lines Automatic Iris

Hi-Res Color Lipstick Camera Length: 2.6" Diameter: .785"

WP-300C - \$159.95



5" COLOR WIRELESS OBSERVATION SYSTEM

ADD UP TO 3 ADDITIONAL CAMERAS!

Now you can enjoy peace of mind with our new wireless observation system. Comes with 5" wireless color monitor and a wireless color camera. Just Plug-&Play! Perfect for around the house or office.

2.4GHz GW-2400S - \$379.95

MICRO VIDEO HEAD "SNAKE" CAMERA



MONITOR UP TO 4 VIDEO CAMERAS SIMULTANEOUSLY THRU YOUR INTERNET CONNECTION OR OVER YOUR MODEM!

MOTION DETECTION - ALARM RECORDING - NOTIFICATION

- TCP/IP
- MODEM
- LAN/WAN

Highlight an area on your video screen, and the PV-140 will inform you via modem thru your telephone or pager if there is movement in that highlighted area while recording to your hard disk.

PV-140... 4 Input Digital Video Card... \$299.95

Video can be viewed in Quad style (above), full screen mode or auto switching mode.



VIDEO HEAD IS ONLY 7mm IN DIAMETER!

MH-SCO1 \$479.95



POLARIS INDUSTRIES 800-752-3571 470 Armour Drive NE • Atlanta GA 30324-3943 Tech 404-872-0722 • Fax 404-872-1038 WWW.POLARISUSA.COM

CIRCLE 228 ON FREE INFORMATION CARD

Be an FCC LICENSED ELECTRONIC TECHNICIAN

EARN MORE MONEY



Earn up to \$100 an hour and more!

The Original Home-Study course prepares you for the "FCC Commercial Radiotelephone License" at home in your spare time. This valuable license is your professional "ticket" to thousands of exciting jobs in:

- Communications
- Radio-TV
- Microwave
- Maritime
- Radar
- Avionics & more

You can even start your own business!

No previous experience needed! No need to quit your job or go to school. This proven course is easy, fast and low cost!

GUARANTEED TO PASS – You get your FCC License or your money refunded.

Send for FREE facts now!

Mail coupon today or call
(800) 932-4268 Ext. 240

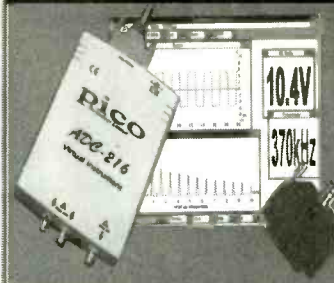
Visit our Website: www.LicenseTraining.com

COMMAND PRODUCTIONS
FCC LICENSE TRAINING - DEPT. 240
P.O. Box 2824 • San Francisco, CA 94126
Please rush FREE details immediately!

Name _____
Address _____
City _____ State _____ Zip _____

CIRCLE 321 ON FREE INFORMATION CARD

Turn your PC into a 16-bit Storage Scope spectrum analyzer, and digital multimeter!

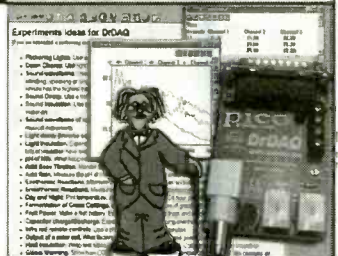


Turn your PC or laptop into a sophisticated storage scope & spectrum analyzer & multimeter. Display on large screen! Print in color! 100MS/s 8-bit, 1.2MS/s 12-bit or 333ks/s 16-bit versions. Great for test depts, schools. Input to Excel, LabView/NT drivers. High precision not high cost! Models from \$95 - \$799!

DrDAQ
science lab in a box!

great for
science fairs!

DrDAQ is a sophisticated digital data-logger that plugs into a PC and comes with sensors for light, sound, pH and temp. Lots of suggested science experiments included which can be done from software supplied. Spectrum analyzer/scope/meter all at once! DrDAQ from only \$99!



www.saelig.com

RS232-422/485 converters, self-powered, opto-isolated I2C adapter boards for PC communication with I2C bus Mini dataloggers for events, voltages, pressures, etc. Enviromon temperature and environment netwk logger Thermocouple and thermistor adapters for PC ports. BASIC-programmable BASIC-TIGER controller modules JANZ CANbus boards - from Germany's leader! SMD adaptor boards for prototyping with any SM parts!



Saelig Company

www.saelig.com saelig@aol.com
716-425-3753 • 716-425-3835 (fax)

1-888-7SAELIG

SERIAL LCDs

Serial LCDs work great with BASIC Stamps® and other microcontrollers. One-wire interface • simple serial protocol • low cost • high quality • in stock



BPI-216N
• 2x16 text LCD
• 2400/9600 bps
• \$45 (non-backlit)

SGX-120L
• Mini graphics LCD
• 2400/9600 bps
• just \$99



Many other models available—see www.seetron.com!

Scott Edwards Electronics, Inc.
www.seetron.com • 520-459-4802

Automotive Installation Accessories



What You Want.....
Today!™



You Must Provide this Source Code to Receive Discount Pricing

POP93

call toll free

1-800-543-4330

fax toll free

1-800-765-6960

customer service call toll free

1-877-626-3532

www.mcmelectronics.com

For more Electronics Visit our website

- Audio Products
- Books
- Cameras
- Car Audio and Security
- Computer Accessories
- Games
- Headphones
- Home Theater
- Joysticks
- Personal Electronics
- Radios
- Receivers
- Test Equipment
- Tools
- Tool Boxes/Cases
- More



MCM CUSTOM AUDIO 5.6" LCD Color Monitor

- NTSC input works with VCR's, DVD players, camcorders and video games
- 3.5mm A/V input • Daisy chain output
- Two camera inputs • Image reverse mode
- Resolution: 960 (H) x 234 (V)
- Requires 12VDC, 650mA, AC adaptor included
- Measures only 4 3/4" x 6 5/8" x 1 1/2"

Order # 60-9233 Reg. \$299.00

Only! \$239.00



Weatherproof Color Camera

- Designed specifically for 5.6" color monitor (#60-9233)
- 30' cable connects directly to the rear of the monitor
- Included AC adaptor and RCA type harness provide composite video signal for use with any monitor or recorder
- Requires 12VDC, 120mA
- Dimensions: 1" (dia.) x 3"

Order # 60-9247 Reg. \$169.00

Only! \$139.00



MCM CUSTOM AUDIO Mobile Video Amplifier

- Single video input is amplified and distributed to seven outputs
- Drive multiple monitors without picture degradation
- All connections are RCA type female
- Requires 10-30VDC, 180mA
- Dimensions: 1" (H) x 3 3/4" (W) x 2 3/8" (D)

Order # 60-9890 Reg. \$39.95

Only! \$29.95



MCM CUSTOM AUDIO 8" Color LCD Monitor Module

- Open module has no rear housing and is designed for incorporation into custom panels and enclosures
- NTSC input works with any standard video source
- Resolution: 1440 (H) x 234 (V)
- Requires: 13.8VDC, 850mA
- Dimensions: 5 1/2" (H) x 7 1/2" (W) x 3/4" (D)
- Note: this module does not provide audio

Order #60-9847
\$499.00



MCM CUSTOM AUDIO FM Stereo RF Modulator

- Accepts any line level audio source
- Provides stereo output on either 88.3MHz or 88.7MHz
- Connects in line with car radio and antenna
- Auto power function turns unit on when audio signal is detected
- Requires 10-30VDC, 140mA
- Dimensions: 1" (H) x 1 1/2" (W) x 2 3/8" (D)

Order # 60-9893 Reg. \$39.95

Only! \$29.95



Whistler 350 Watt Power Inverter

- Plugs directly into automobile cigarette lighter
- Provides 110VAC output, at 350 continuous watts
- Modified sine wave output operates even motorized devices
- Measures only 2" (H) x 5.2" (W) x 6.3" (D)

Order #72-6461
\$69.95

Source Code: POP93

Prices effective December 1 through March 9, 2002.
CIRCLE 324 ON FREE INFORMATION CARD

A Premier Farnell Company

World's Smallest 68HC11 Microcontroller Modules!

MicroStamp11™



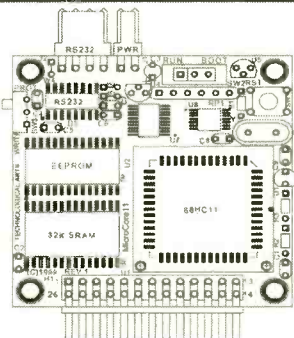
- telemetry
- microrobotics
- smart toys
- animatronics
- model railroading
- home automation

- tiny, light-weight (0.5 oz.)
- 1-inch x 1.4-inch 68HC11 module
- on-board 5V regulator
- 8MHz crystal (9.83MHz on Turbo version)
- choice of 8K or 32K EEPROM
- 32K RAM + 32K EEPROM on 64K version
- plugs into your breadboard like a DIP
- SCI (UART), SPI, Output Compares, Input Captures, hardware timer, pulse accumulator
- all 14 I/O lines and 2 interrupts brought out to versatile 20-pin connector
- program in BASIC, assembler, or C
- easy code-loading with Docking Module
- Starter Packages:*
 - 8K EEPROM (#MS11SP8K).....\$49
 - 32K EEPROM (#MS11SP32K).....\$77
 - 32K EE+32K RAM (#MS11SP64K)....\$90

* includes MicroStamp11, manual, PC software (free-ware assembler, SBASIC compiler, MicroLoad utility, and sample programs), serial cable, Docking Module, and accessories.

Attention OEMs:
Embed MicroStamp11 modules into your product!
only \$20 each (100-pc. price, 8K version)

MicroCore-11™



- tiny 2-inch x 2-inch 68HC11 module
- 12 inputs/outputs plus 8 analog inputs
- RS232, 5V regulator, 8MHz crystal
- 32K SRAM plus 8K or 32K EEPROM
- plugs into your breadboard like a DIP
- easy programming from any PC
- ideal for building MicroMouse robots
- now available in Turbo version (9.83MHz)
- 8K Starter Package #MC11SP8K.....\$68
- 32K Starter Package #MC11SP32K.....\$93
- Motor driver boards, LCD/keypad/keyboard interface & prototyping cards available

Technological Arts

Many other modules & accessories available.
Visit our website at:
www.technologicalarts.com
sales@technologicalarts.com
TOLL-FREE: 1-877-963-8996
Phone: (416) 963-8996
Fax: (416) 963-9179
Visa • MasterCard • Discover • Amex

ALL ELECTRONICS

C O R P O R A T I O N

SHOP OUR ONLINE STORE
www.allelectronics.com

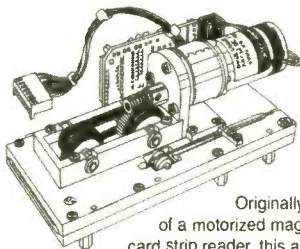
Video / RF Modulator



Converts audio and video line level signals to RF which can be inputted to any television on channel 3 or 4. Channel 3-4 selector switch. Video, audio and power inputs are through a 7 foot cable terminated with a mini-DIN plug which generally needs to be cut off so connections can be made directly to conductors in cable. We supply a hook-up diagram. Requires a 4.5 - 6 Vdc, 50 mA power supply or wall adapter (not included).
\$5.00 each
Large quantity available.
CAT# MOD-6

10 for \$4.50 each

Assembly with 12 Vdc Motor, Gears and Pulleys



Originally part of a motorized magnetic card strip reader, this assembly is driven by one of our gear motors, either CAT# DCM-181U or DCM-182U. A worm gear turns a pair of cog pulleys linked by a cog belt. The rubber covered wheels pull a credit card past a magnetic head and two U-shaped optical sensors. Assembly includes motor, pulleys, belt, magnetic head and opto sensors. Mounted on an aluminum platform 6.25" x 2.75".
CAT # DCM-180
\$17.95 each

ORDER TOLL FREE
1-800-826-5432
CHARGE ORDERS to Visa, Mastercard,
American Express or Discover

TERMS: NO MINIMUM ORDER. Shipping and handling for the 48 continental U.S.A. \$6.00 per order. All others including AK, HI, PR or Canada must pay full shipping. All orders delivered in CALIFORNIA must include local state sales tax. Quantities limited. NO COD. Prices subject to change without notice.

CALL, WRITE
FAX or E-MAIL
for our FREE

96 Page
CATALOG
Outside the U.S.A.
send \$3.00 postage.

MAIL ORDERS TO:
ALL ELECTRONICS
CORPORATION
P.O. Box 567
Van Nuys, CA 91408
FAX (818)781-2653

e-mail allcorp@allcorp.com

The Pocket Programmer



The Best just got Better!!!

The Best portable programmer that uses the printer port instead of an internal card just got Better!! Now with easier to use Windows based software that programs E(E)prom, Flash & Dallas parts. 25/27/28 & 29 series from 16K to 8Mbit. Adapters available for MCU's 874X, 875X, Pic, Atmel, PLCC packages, Bi-Prom's, 40-Pin X16 Eproms, Rom Emulator to 32K X 8 (2716-27256) and More...

Only \$149.95

Same Name, Address & Phone # for
19 Years.... Isn't it Amazing ?

Intronics, Inc.

Box 13723 / 612 Newton St.
Edwardsville, KS 66113
Tel. (913) 422-2094 Add \$7.00 COD
Fax (913) 441-1623 Add \$6.00 Shipping

WWW.IN-KS.COM Visa/MC/Amex/Disc

MECI

340 East First Street
Dayton, Ohio 45402

Tons of Electronics

Get your FREE catalog today and discover some of the best deals in electronics. We have thousands of items ranging from unique hard-to-find parts to standard production components. Call, write or fax today to start your subscription to one of the most unique catalogs in the industry, filled with super values on surplus electronic and hobbyist type items.



Check out our 10,000 item on-line catalog <http://www.meci.com>

Order Toll Free Why pay more?
1-800-344-4465 Call today!
Fax Order Line
1-800-344-6324

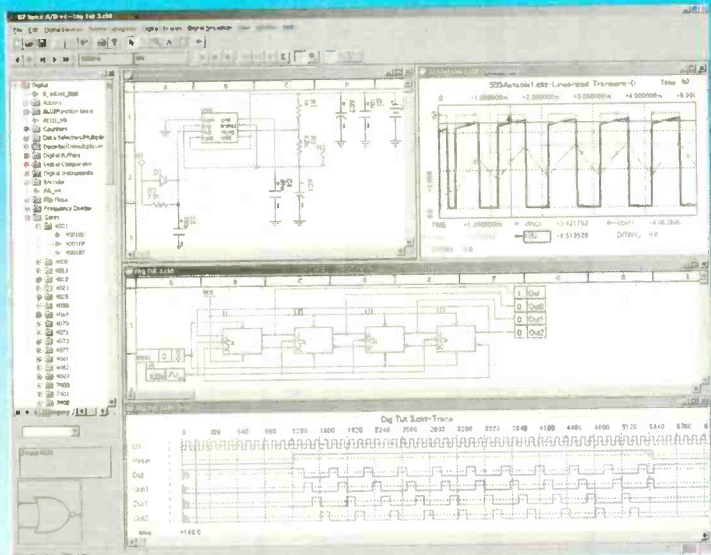
CIRCLE 323 ON FREE INFORMATION CARD

NEW & IMPROVED

B² Spice A/D Version 4

Mixed-Mode Circuit Design

How We Compare



Characteristics	B ² Spice A/D V4	EWB MultiSim Personal
PRICE	\$349	\$399
Parts Database	9600	6000
Parts Search	yes	no
PCB Export	yes	yes
Symbol Editor	yes	yes
Unlimited Undo/Redo	yes	no/no redo
Spice Import	yes	yes
Subcircuits	yes	yes
Interactive Digital Simulation	yes	no
Simulations	15	8
- AC, DC, Transient	yes	yes
- Noise	yes	yes
- Fourier	yes	yes
- Sensitivity	yes	yes
- Distortion	yes	yes
- Monte Carlo	yes	no
- Parameter Sweep	yes	no
- Temperature Sweep	yes	no
- Pole Zero	yes	no
- Transfer Function	yes	no
- Worst Case	yes	no
- RF Simulation	yes	no

- ◆ Build circuits in minutes with our IMPROVED schematic editor.
- ◆ Manage files and quickly select devices with our NEW workspace window.
- ◆ Interpret simulation results with IMPROVED graphics post processor.
- ◆ Find exactly the part you need from our EXPANDED database of 9600 parts.
- ◆ Make your design a reality using our NEW export to PCB feature.

~~\$349~~

Special Introductory Price

\$299

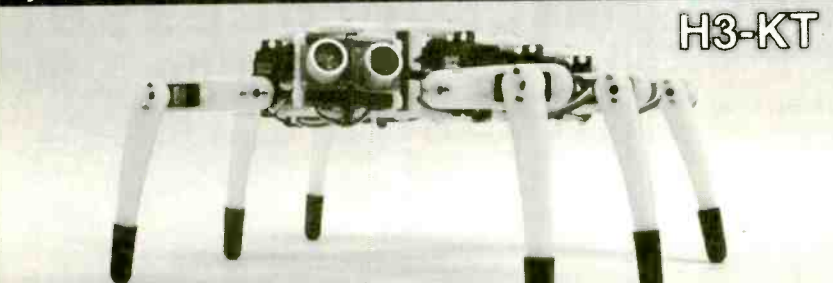
Ends 12/31/01!

Visit our web site for a free trial.

Beige Bag Software • www.beigebag.com • 734.332.0487 • info@beigebag.com

CIRCLE 319 ON FREE INFORMATION CARD

Lynxmotion, When you're tired of playing with toys!



Lynxmotion, Inc.
PO Box 818
Pekin, IL 61555-0818
www.lynxmotion.com



Visit our website or ask for our free catalog!

Tel: 309-382-1816
Fax: 309-382-1254
sales@lynxmotion.com
tech@lynxmotion.com

Call Today And **SAVE!**

Unbeatable PRICES!

CABLE TV

**DESCRAMBLERS
CONVERTERS • FILTERS
VIDEO STABILIZERS**

FREE ➤ 30 Day Trial
FREE ➤ Product Catalog
FREE ➤ 1 Year Warranty

100% MONEY BACK GUARANTEE



Let us point you in the right direction ...

Arrow Technologies
Omaha, Nebraska

TOLL FREE
1-800-554-ARROW
1-800-554-2776
http://www.arrowtek.com

HIGH QUALITY FM
BROADCAST EQUIPMENT
- SINCE 1990 -

You know you want it! We've got it: LPFM & High Power, Stereo FM Transmitters, RF Amplifiers, Low Pass Filters, Antennas, Mixing Boards, Microphones, CD Players, Compressor/Limiters, Digital Reverbs, Automation Software, Studio to Transmitter Links, Emergency Alert Systems, RF Test Equipment, Kits, RF Parts, and much more. Best Prices, Highest Quality. Give Us A Call or Buy It Online...

www.progressive-concepts.com
305 SOUTH BARTLETT ROAD, STREAMWOOD, IL 60107
VOICE: (630)736-9822 FAX: (630)736-0353



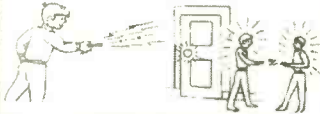
AMAZING DEVICES

NVEN220010DD

See in Action video on our web site at www.amazing1.com

Ion Ray Guns

Star Wars Technology Directs Energy



Star Wars Technology Demonstrates Weapons Potential. Force Fields, IonMotors, Antigravity etc. Projects electric shocks without contact!! Conduct many weird and bizarre experiments. Handheld battery operated and easy to operate.

IOG7/9 Plans \$10.00
IOG7K Kit/Plans \$99.50
IOG70 Assembled/Tested..... \$149.95
Higher Powered Device
IOG9K Kit/Plans \$129.95
IOG90 Assembled/Tested..... \$199.95

Shocker Trigger Ignitor

Variable 20,000 volt pulser used for laser flash tube, spark gap and pyro ignitor, garden pest shocker, electric fence, snake venom removal etc. 12 volt battery operation.

TRIG1K - Kit/Plans \$29.95
TRIG10 - Lab Assembled..... \$49.95

Cybernetic Ear!

Provides that "extra edge" for many listening applications. Enhances 3 to 4x of normal.

CYBEREAR \$19.95

Mini TESLA Coil

Lights up a 4' fluorescent tube-all without any contact!! Yet only 3" tall!

MTC1K Kit/Plans..... \$24.95
MTC10 Assembled..... \$34.95

Ultrasonic Painfield Generators

For property and personal protection. Four transducer matrix intensifies and concentrates effect on target area.

PPF4 Plans \$20.00
PPF4K Kit \$199.95
PPF40 Ready to use..... \$299.95

3 MI Voice Transmitter

Crystal clear. Many applications. Easy to build

FMV1 Kit and Plans...\$39.95

Body Heat Telescope

Detects living bodies over 300' Heat leaks etc. Built in chopper and sens control

BHT6 Plans. \$10.00 BHT6K Kit...\$99.95
BHT60 Ready to use..... \$149.95

Ultra Bright Green Laser

30 to 50x brighter than most red pointers!! Full 5 mw range in excess of 6000 feet !! Operates for hours from 2 "AAA" batteries

LAPNGR5 Pointer... \$Call for Price!!

Low Cost 100,000 Volt DC Supply

Amateur experimenters source of HVDC for many applications

- 100,000 volts at 2ma
- Built in dry filled multiplier.
- Operates on 12vdc or 115vac

HVOLT1 - Plans \$8.00
HVOLT1K - Kit/Plans \$149.95
HVOLT10 - Assembled... \$249.95

Combo Tesla Coil, Jacobs Ladder, Plasma Tomado

Amazing and bizarre effects turn a normal light bulb into a spectacular plasma display!! With adjustable frequency control. Safe 12vdc input

TCLS Plans \$8.00 TCLSK Kit/Plans. \$59.95
TCL50 Assembled and Tested..... \$99.95

Mass Driver



Above photo shows burst impact of Mass Driver

Can Crusher

A can is crushed into the shape of an hour glass demonstrating the awesome power of magnetics. Very popular demo in science museums as users get to crush and keep their own can. Kids love this!!

Wire Exploding

Generate pyrotechnical explosive blasts for many applications. Create a new artistic concept. Uses our unique high energy pulser shielded explosion chamber.

HEP9 High Energy Pulser...\$20.00

Plans pack includes above MASS1 Mass driver, CANCRU1 Can crusher and WIREXPLOD1 Wire exploder/Blast art plans. We stock all parts. kits and completed units for the above items.

Above HEP9 pulser is used for :
EMP / HERF Generation, Build a Rail or Coil Gun, Electrothermal Gun, High Power Pulsed Laser, Mass Warping etc etc

Mind&Brain Controllers

Incredible device Turbo charges memory, Boost mental powers, Controls stress, Speeds up healing processes and Uncover hidden potentials. High quality unit with many features.



BWPLUS-APOLLO Ready to use. \$179.95
BWII- EINSTEIN Lower cost unit. \$129.95

Information Unlimited PO Box 716 Amherst N.H. U.S.A. 03031

1 800 221 1705 Orders/Catalogs Only! Fax 1 603 672 5406

Information 1 603 673 4730 Free Catalog on Request

Pay by MC, VISA, Cash, Check, MO. Add \$5.00 S&H. Overseas Contact for Proforma

CIRCLE 220 ON FREE INFORMATION CARD

RF Data Modules

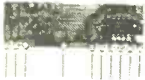
AM Transmitter



- Sub Miniature module
- SAW Controlled
- No adjustable components
- Low current - 2.5mA
- Supply 2.5-12Vdc
- 418MHz or 433MHz
- Range up to 300ft
- CMOS TTL data input
- 7 x 11 x 4mm !

AM-TX1-xxx \$12.60

AM Receiver



- Compact Hybrid Module
- Very stable
- CMOS/TTL output
- Patented Laser Trimmed
- 5Vdc. 0.8mA (HRR6)
- 2kHz data rate
- Sensitivity -105dBm
- 38 x 12 x 2 mm

AM-HRR6-xxx... \$16.33

FM Transceiver



- Only 23 x 33 x 11mm
- Up to 40,000bps data rate
- Up to 450ft. range.
- 5V operation
- 418MHz or 433MHz FM
- 5V CMOS logic interface
- Fast 1mS enable
- Power saving feature
- Carrier Detect output

BiM-xxx-F \$87.36

RS232 Transceiver



- 3wire RS232 interface
- 19.2Kbps half duplex
- 418MHz or 433MHz FM
- 7.5-15Vdc. 20mA
- TX/RX Status LED's
- Up to 400ft. range
- 1/4 wave ant. on board
- User data packetizing
- 58 x 40 x 15mm

CYPHERNET \$139.30

AM Transmitter



- Range up to 250ft.
- SAW controlled stability
- Wide supply range 2-14V
- CMOS/TTL input
- Low current. 4mA typ.
- Up to 4kHz data rate
- Small: 17 x 11mm

AM-RT5-xxx \$12.10



ABACOM TECHNOLOGIES



tel: (416)236 3858

fax: (416)236 8866

www.abacom-tech.com

MasterCard / VISA

Microprocessor Hands-On Training

The PRIMER Trainer is a flexible instructional tool featured in a Prentice Hall textbook and used by colleges and universities around the world. Ruggedly designed to resist wear, the PRIMER supports several different programming Languages including Assembler, Machine Language, C, BASIC, and FORTH. A comprehensive Instruction Manual contains over 25 lessons with several examples of program design and hardware control. The Applications Manual provides theory and sample code for a number of hands-on lab projects.



Application Projects Include:

- Scan Keypad Input & Write to a Display
- Detect Light Levels with a PhotoCell
- Control Motor Speed using Back EMF
- Design a Waveform Generator
- Measure Temperature
- Program EPROMs
- Bus interface an 8255 PPI
- Construct a Capacitance Meter
- Interface and Control Stepper Motors
- Design a DTMF Autodialer / Remote Controller

The PRIMER can be purchased as an unassembled kit (\$120) or as an assembled/tested kit (\$170). Upgrades provide battery-backed RAM and PC connectivity via an RS232 serial port (shown in picture). Additional options include a heavy-duty keypad (shown in picture) and a 9V power supply - see our website. Quantity discounts are available. Satisfaction guaranteed.

Since 1985 OVER

16 YEARS OF SINGLE BOARD SOLUTIONS

EMAC, inc.

Phone 618-529-4525

Fax 618-457-0110

2390 EMAC Way, Carbondale, Illinois 62901

World Wide Web: <http://www.emacinc.com>

GET HERE.

Visit
www.cie-wc.edu
 for complete
 course listings!

LEARN A SKILL YOU ENJOY... ...THEN FIND A JOB THAT HAS A FUTURE.

Everyone has to start somewhere.

As CIE graduates have discovered, independent-study from The Cleveland Institute of Electronics can get you where you want to be. In a *secure* career in electronics.



Industrial Robotics

Since 1934, CIE has been on the forefront of an ever expanding technological revolution.

ment. CIE's curriculum is unique from other independent-study schools in the respect that we not only provide hands-on training utilizing today's technology we also instill the knowledge and understanding of why technology works the way it does. This is the foundation upon which every CIE graduate can trace their success back to and in which CIE's reputation as a quality learning facility is based on.



Project Engineer

Independent study is not for everyone. But, if you have the desire, the basic intellect and the motivation to succeed, CIE can make it happen. Our learning program is patented and each lesson is designed for independent study while our instructors are available to assist you whenever you feel you need help. Simply call or e-mail us with your questions and our instructor staff will be prompt, courteous and thorough with their response.



Telecommunications

CIE offers personalized training to match your background with over ten career courses, an Associate Degree Program and a Bachelor Degree Program through our affiliation with World College. And every CIE graduate got started in a

START HERE...



Electronics

Back then it was radio and TV, today it's computer technology, programming and the electronics that make it all possible. Today and yesterday's similarities are

uncanny... Employers are looking for qualified applicants to hire and having a hard time finding them.

Students at CIE receive the training and the education needed to get hired and to succeed in challenging fields such as computer programming, robotics, broadcast engineering, and information systems manage-

YES! Please send me more information on:

CIE's Associate Degree Program
 CIE's 12 Career Courses

Mail coupon to:

CIE
 1776 E. 17th street
 Cleveland, Ohio 44114

PT30

Name _____

Address _____

City _____

State _____ Zip _____

Phone: _____

Check for G.I. Bill Details
 Active Duty Veteran

successful career the same way you can...by sending for your free CIE course catalog and judging for yourself if CIE's for you.



Computer Programming



*It's More Than Just Training...
 ...It's an Education.*

1776 East 17th Street
 Cleveland, OH 44114

1-800-243-6446

CIRCLE 320 ON FREE INFORMATION CARD

PICmicro® BOOKS

LEARN ABOUT MICROCONTROLLERS

Easy PIC'n - Beginner \$29.95

- Programming techniques
Instruction set, addressing modes, bit manipulation, subroutines, loops, lookup tables, interrupts
- Using a text editor, using an assembler, using MPLAB
- Timing and counting (timer 0), interfacing, I/O conversion

PIC'n Up The Pace - Intermediate \$34.95

- Serial communication - PICmicro to peripheral chips
- Serial EEPROMS
- LCD interface and scanning keypads
- D/A and A/D conversion - several methods
- Math routines

PIC'n Techniques - Intermediate \$34.95

- 8-pin PICmicros
- Timer 1, timer 2 and the capture/compare/PWM (CCP) module
- Talking to a PICmicro with a PC using a terminal program
- Test equipment and data logger experiments

Serial PIC'n - Advanced \$49.95

- Synchronous - bit-bang, on-chip UART, RS-232
- Asynchronous - I2C (Philips Semiconductor)
SPI (Motorola), Microwire (National Semiconductor)
- Dallas Semiconductor 1-Wire bus

PICmicro and MPLAB are trademarks of Microchip Technology Inc.

Table Of Contents And Ordering Information On Web Site

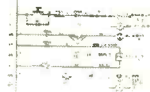
SQUARE 1 ELECTRONICS

P.O. Box 501, Kelseyville, CA 95451
Voice (707) 279-8881 Fax (707) 279-8883

<http://www.sq-1.com>

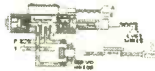
Start A Career With High Wages, Excellent Benefits and Job Security!!

With UCANDO's extraordinary maintenance training programs you can quickly and easily enter a high paying field as a maintenance technician for a very small investment of time and money.



RC-M ONLY \$165 RC-M is a 15 hour training course on relay ladder logic systems. Includes a 5-part video and workbook. **Great Value!**

PLC-M ONLY \$198 PLC-M is a 32 hour training course on PLC systems. Includes (2) 4-part video's and workbook. **This training is valuable.**



HYD-M ONLY \$209 HYD-M is a 32 hour course on Fluid Dynamics. Includes (2) 4-part video's and workbook. **This Module is a must.**

SC-M ONLY \$215 SC-M is a 32 hour training course on AC & DC Servo Controllers. Includes (2) 4-part video's and workbook. **Learn everything you need about AC and DC servo Control Systems.**



Electronic Training Videos: Basic Electronics, Digital Electronics, TV Repair, LASER and Fiber Optic training videos available at very affordable prices starting at **Only \$35.00 each.**

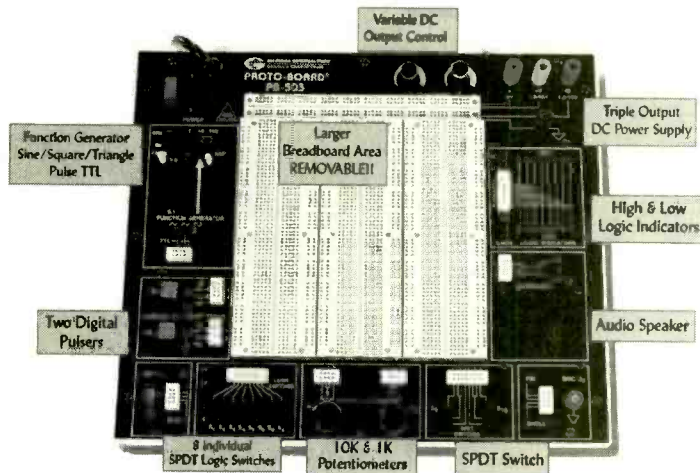
For information or to place an order call:

1-800-678-6113

www.ucando-corp.com

UCANDO VCR Educational Products Corp., Greenville, OH

The BEST is now Better!



Feature-rich Circuit Design Workstation Ultra-affordable at just \$299.95

Portable Version Available for \$349.95

Our classic PB-503 the complete Proto-Board Design Workstation is newly improved. Enhancements Include: an 8-Channel Logic Monitor, High & Low Buffered Logic Indicators, 8 Selectable Logic Switches, and Removable Breadboard Socket Plate. This velcro-backed socket plate allows for greater circuit design flexibility; order extra to suit your needs.

Traditional instrumentation on the unit includes continuously variable Function Generator, Triple Output DC Power Supply, along with Switches, Digital Pulsers, Potentiometers and an Audio Speaker. The highly functional PB-503 is built to last, with an industry best 3-year warranty along with a lifetime warranty on all breadboard sockets. Own the best! Order yours today.



GLOBAL SPECIALTIES
INSTRUMENTS

1486 Highland Avenue • Unit 2
Cheshire, CT 06410
1.800.572.1028
203.272.4330 FAX
www.globalspecialties.com

RAMSEY

GET THE CATALOG TODAY!
Over 100 NEW products!
www.ramseykits.com



SYNTHESIZED FM STEREO RADIO STATION



- Synthesized 88 to 108...no drift!
- Built in mixer - 2 line inputs and one microphone input!
- High power module available for export use
- Low pass filter for great audio

Our FM100 is used all over the world by serious hobbyists as well as churches, drive in theaters, and schools. The kit includes metal case, whip antenna and built-in 110 volt AC power supply.

FM100	Super-Pro FM Stereo Radio Station Kit	\$249.95
FM100WT	1 Watt, Wired Export Version	\$399.95

SYNTHESIZED FM STEREO TRANSMITTER



Professional quality rock stable synthesized transmitter. Dip switch settable for any frequency between 88-108 MHz. Strappable for high power output for export applications. Our most popular kit. Start your own radio station today with the FM25!

FM25	Synthesized FM Stereo Transmitter Kit	\$129.95
------	---------------------------------------	----------

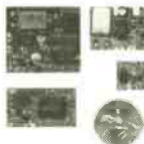
FM STEREO TRANSMITTER



Great entry level FM broadcast kit. Thousands in use. Handy for sending music through house and yard, ideal for school projects too - you'll be amazed at the exceptional audio quality! Runs on 9V battery or 5 to 15 VDC. Add matching case and whip antenna set for great pro look.

FM10A	Tunable FM Stereo Transmitter Kit	\$34.95
CFM	Matching Case and Antenna Set	\$14.95
FMAC	12V DC Wall Plug Adapter	\$9.95

RF WIRELESS LINK MODULES



- SAW Resonators for high stability - NO Drift!
- Powerful +10 dbm output
- Range up to 600'
- 433 MHz license-free band
- Sensitive superhet receiver with RF LNA
- Stable over full 3-12 VDC range
- Optional on-board 12 bit encoder/decoder using Holtek HT12 series chips, Quarter not included!

RXD433	433 MHz Receiver/Decoder Mod., Assembled	\$26.95
TXE433	433 MHz Transmitter/Encoder Mod., Assembled	\$24.95
RX433	433 MHz Data Receiver Mod., Assembled	\$21.95
TX433	433 MHz Data Transmitter Mod., Assembled	\$19.95

THE CUBES! MINIATURE VIDEO TRANSMITTERS



Wireless crystal clear reception, yet smaller than a quarter! Transmits color or B&W with fantastic quality almost like a hard wire connection to any TV or VCR tuned to cable channel 59. Crystal controlled for no frequency drift with performance that equals law enforcement models that cost hundreds more! Basic 20mw unit goes up to 300' while the

high power version can virtually double that range! Fully assembled and tested, and ready to go. Powered by a standard 9V battery. Name that Quarter!

C2000	Video Cube, Factory Assembled & Tested	\$89.95
C2001	High Power Version, Assembled & Tested	\$129.95

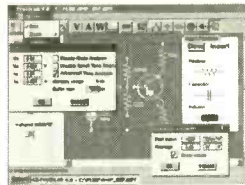
INFRA-RED VIDEO CAMERA ILLUMINATOR



Lets video cameras "see in the dark". Invisible light source to us, but lots of light to CCD B&W cameras! Illuminates the area just like light, yet cannot be seen. Draws 180mA at 12 VDC. 110VAC power adapter available.

IR1	Infra-Red Camera Illuminator Kit	\$24.95
AC125	12VDC Power Supply	\$9.95

ELECTRONIC PROTOTYPING SOFTWARE



Priced for the hobbyist!
 You can create and test AC and DC circuits minutes after installing this package on your PC. Start from scratch, or from the included library of pre-designed circuits. Drag and drop placement from a complete list of active and passive components. Test using a complete list of virtual instruments, Oscilloscope, voltmeter, ohmmeter, ammeter, and watt meter.

PLAB4	Electronic Prototype Software, Win95/98	\$49.95
-------	---	---------

ANALOG-DIGITAL PORTABLE LAB STATION



The COMPLETE analog-digital lab station in one. Includes function generator, clock output, power supplies, level switches, pulsers, pots, LEDs and a LARGE breadboarding area all in one! Includes a custom molded case as shown. Used through the world at universities, technical schools, and R&D labs. Available in "Learn as you Build" kit form or factory assembled and tested. A great buy either way!

ML200	Lab Station, Kit	\$155.95
ML200WT	Lab Station, Factory Assembled & Tested	\$225.95

CABLE WIZARD CABLE TRACER



Did you ever have to identify the "other end of that cable"? No more "ohming it out" with the Cable Wizard. Simply connect the wizard transmitter to one end of the cable and use the receiver to sniff out the other end. It's as simple as that! The transmitter sends a pulsating 2 KHz signal down the cable which is heard when the receiver is close to the cable. Works with any cable including coax, telephone pairs, ethernet and more. Equipped with an RJ45 for all telco connections and clip leads for single wire connections.

WCT20	Wireless Cable Tracer Kit	\$39.95
CWCT	Matching Case Set for Transmitter & Receiver	\$29.95
WCT20WT	Factory Assembled & Tested WCT20	\$99.95

SPEEDY PERSONAL SPEED RADAR GUN



This low cost microwave radar uses the same principle found in police units costing thousands more. This has been the number one Science Fair project for years. Direct digital readout in miles/hour, kilometers/hour, or feet/second. An earphone jack allows you to actually hear the Doppler frequency shift of moving objects. Our detailed manual not only guides you through construction, but covers

the how's and why's of speed radar theory. Learn while you build. Uses two 1.3 oz coffee cans for the antenna (not included) and runs on 12 VDC.

SG7	Speedy Personal Speed Radar Kit	\$99.95
AC125	12VDC Power Supply	\$9.95

AND...OUR FAMOUS MINI-KITS



These are easy to build kits that can be used either stand alone or as building blocks for more complex projects.

TS4	Tickle-Stick Shocker	\$9.95
BN9	Super Snoop Amplifier Kit	\$8.95
BL1	LED Blinky Kit	\$3.95
TD1	Tone Encoder/Decoder Kit	\$6.95
TT7	Touch Tone Decoder Kit	\$29.95
CPO3	Code Practice Oscillator Kit	\$9.95
UT5	Universal Timer Kit	\$8.95



793 Canning Parkway
 Victor, NY 14564
 716-924-4560
sales@ramseykits.com



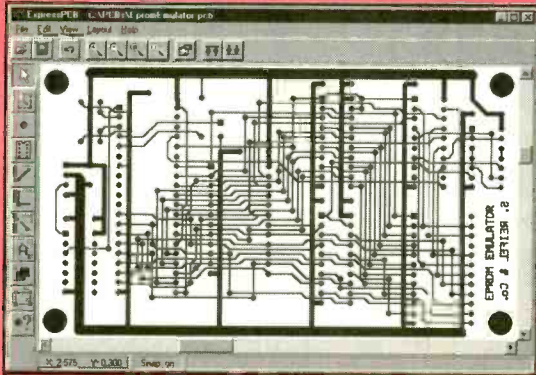
Order Today! 800-446-2295
www.ramseykits.com

CIRCLE 263 ON FREE INFORMATION CARD

\$59 PCBs

And our layout software is **FREE!**

Download ▶ Design ▶ Send ▶ Receive



Download our **FREE** layout software
 Design your two-sided plated-through PCB
 Send us your design with just a click
 Receive in a few business days, often under \$100

Select our MiniBoard special service and get three top quality
 2.5" x 3.8" PCBs for \$59 – shipping included!

expresspcb.com

BASIC MICRO INC.

MICROCONTROLLERS MADE EASY!

The **ATOM**



Get more from your projects! More commands, faster code execution, built-in real-time graphical code debugging, no more 2k program size limits, hardware and software interrupts, multitasking, enhanced math capabilities plus much more!

BASIC Stamp II® Compatible

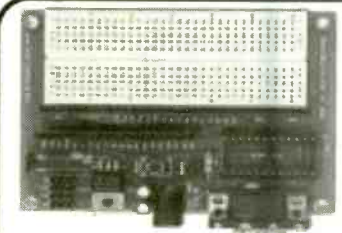
Built in Hardware:

- Over 300 Bytes of RAM
- 256 Bytes of Data EEPROM
- External & Internal Interrupts
- 3 10 bit A/D Converters
- 2 Capture and Compare
- Internal Adjustable Vref
- + / - External Vref
- 3 Timers
- 2 PWM
- UARTS
- I2C, SPI

Software Features:

- Graphical Debugging (ICD)
- More Software Commands
- 32 Bit Integer Math
- 32 Bit Floating Point Math
- Easy to use code editor
- BS2p Compatible Syntax
- Expanded BASIC library
- Firmware upgradeable
- Unlimited Support
- Free Software Updates
- Plus much more!

\$59.95 Complete
 Available in OEM Package



ATOM Development Board

Develop your projects the easy way
 For use with Basic Micro ATOM®,
 OEM ATOM®, and Basic Stamp® 2
 series

- Completely Assembled Board
- Solder-less Bread Board
- Built-in DB-9 Serial Connector
- Built-in Power Regulator
- Full Documentation

\$69.95 Complete
 Combo with ATOM® \$119.95

ATOM DEVELOPMENT TOOLS

Order online at <http://www.basicro.com>
 Order by phone M-F 9AM to 5PM EST 1 (734) 425-1744

Basic Stamp is a registered trademark of Parallax Inc.

Miniature Transmitters and Receivers

2 Button / 3 Channel Transmitter



RF300T

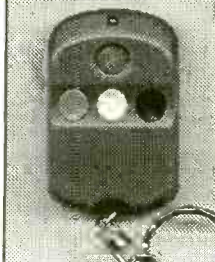
1....\$22.95
 5....\$19.95 ea
 10...\$16.95 ea

RF300XT

1....\$25.95
 5....\$22.95 ea
 10...\$19.95 ea

- 300' (XT), 150' (T) Range
- Frequency: 318 MHz
- 59,049 Settable Security Codes
- 12 Volt Battery and Keychain Included
- Current Draw: 4.8 ma
- Fully Assembled in Case
- Dimensions: 1.25" x 2.0" x .5"
- Push both buttons for the 3rd Channel
- Slide Button Cover Included

4 Button / 15 Channel Transmitter



RF304XT

1....\$27.95
 5....\$24.95 ea
 10...\$21.95 ea

- 250' Range
- Frequency: 318 MHz
- 6,561 Settable Security Codes
- 12 Volt Battery and Keychain Included
- Current Draw: 4.6 ma
- Fully Assembled in Case
- Dimensions: 1.35" x 2.25" x .5"
- Push combination of buttons to achieve up to 15 channels

2-4 Data / 3-15 Channel Receivers



**RF300RL
 RF300RM**

1....\$27.95
 5....\$24.95 ea
 10...\$22.95 ea

**RF304RL
 RF304RM**

1....\$29.95
 5....\$26.95 ea
 10...\$23.95 ea

- Compatible with 300/4 Transmitters
- 11-24 volts DC Operating Voltage
- 13 ma. Current Draw
- Latching (L) or Momentary (M) Output
- Kits Available (subtract \$5.00 ea.)
- Dimensions: 1.25" x 3.75" x .5"
- 2 (300) / 4 (304) Output Data Lines
- Binary to Dec / Hex Converter can achieve up to 15 channels

- Alarm Systems
- Garage / Gate Openers
- Lighting Control

- Magic Props
- Medical Alert
- Monitoring Systems

- Industrial Controls
- Surveillance Control
- Motor Control

- Schematics Available
- Receiver Board Layout Available
- Custom Design Consulting Available

Visitect Inc. (510) 651-1425 Fax: (510) 651-8454 Email: Support@Visitect.Com
 P.O. Box 14156, Fremont, CA 94539 Visa / Mastercard, COD

CIRCLE 224 ON FREE INFORMATION CARD

AM & FM LOW POWER TRANSMITTER KITS

If you are interested in building quality low power transmitters for AM, FM Stereo, and Television transmission, see our website for more information. Kits covering the frequency range of 150 KHz to 1300 MHz. are available, for Amateur, experimental Part 15 uses, hobby, and radio control use.

NORTH COUNTRY RADIO

Visit our website www.northcountryradio.com

Sales: PO BOX 53 New Rochelle N.Y. 10804 Tel 914-235-6611

Technical: PO Box 200 Hartford NY 12838 Tel 518-854-9280

www.poptronics.com

SINGERS! REMOVE VOCALS

Unlimited Low Cost. Instantly Available Backgroun Music from Original Standard Performings! Does Everything Karaoke does Better and gives you the Thompson Vocal Eliminator! Free Brochure & Demo Tape. LT Sound Dept PE 7988 LT Parkway, Lithonia, GA 30058 Internet: <http://www.LTSound.com> 24 Hour Demo/Info Request Line (770)482-2485 • Ex 49 When You Want Something Better Than Karaoke!

SMART CARDS

HIGHEST SECURITY

Complete system! Develop your own smart card applications in easy to use BASIC language



- Security Systems
- Time Cards
- Access Control
- Home, Auto, Business
- Robotics
- Data Security
- Emulation
- Theft Prevention

Smart Card Tool Kit comes complete with

- CyberMouse SmartCard Programmer
- Application Development Software
- Extensive User Manual in printed form
- 3 Blank Smart Cards

Complete system only \$79.95

We accept

VISA • Mastercard • American Express

To Order Call 1-800-773-6698 Worldwyde.Com,
33523 Eight Mile Rd # A3-261, Livonia, MI 48152
See more online at <http://www.worldwyde.com>

MODERN ELECTRONICS

CABLE TV DESCRAMBLERS



- ★ FREE CATALOG!
- ★ BEST DEALER PRICING!
- ★ DISCOUNTED PRICING!
- ★ 30 DAY FREE TRIAL!
- ★ 100% MONEY BACK GUARANTEE

COPY RENTAL TAPES WITH
OUR VIDEO STABILIZER

1-800-906-6664

2609 S. 156th Circle • Omaha, NE 68130
www.modernelectronics.com



GALEP 4 UNIVERSAL PROGRAMMER

Introducing a pocket programmer
with true Universal Output



\$333
COMPLETE KIT



Latest generation pocket sized programmer uses ASIC universal pin driver technology. 1300+ device library, with lifetime free updates. Programs 8/16-bit EPROM'S, EEPROM's, 0-Power RAM, FLASH, Serial EEPROM's, GAL, PALCE,

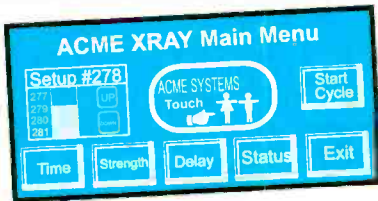
microcontrollers such as 87/89xxx, PIC, AVR, ST62, etc. Low voltage devices down to 1.3V. No adapter required for DIL devices. 8 Hrs. operation on battery (AC charger included). Runs WIN 98, NT, ME, 2000, XP with Hex/Fuse Editor.

Remote control from other apps, (e.g. VisualBasic). Substitutes higher priced universal programmers e.g. ALL-11 (HILO) or LAB-TOOL-48 (ADVANTECH). Providing virtually matching performance at only 1/3-1/5 the price. Info./Orders, call: 619-702-4420

CONITEC DATASYSTEMS - 1951 4TH AVE, SUITE 301 - SAN DIEGO, CA 92101 - TEL: 619 702 4420 FAX: 619 702 4419

Graphic Interface with Touch screen control

Priced From
\$140.00
Qty 1



Easy Operator Interface through serial connection



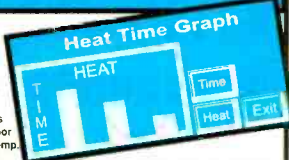
Easy Interface with PC/104, 8051, 68HC11, PIC

Graphic display Touch screen

Serial communication (RS-232C)
Eprom or Flash for screen storage
Only +5VDC power required
Easy to use development software
Create screens by PC paintbrush
Simple to place touch buttons software



Many Sizes Available



Many Types Indoor, Outdoor Factory, Ext. Temp. CCFL, LED Available

Embedded Computer Controller Also Available

Designtech Engineering Co.
2001 S. Blue Island Ave.
Chicago, IL 60608
Phone 312-243-4700
Fax 312-243-4776

www.designtechengineering.com

CONTROL MEASURE INPUT

RELAYS • LIGHTS • MOTORS
TEMPERATURE • PRESSURE • LIGHT LEVELS • HUMIDITY
SWITCH POSITIONS • THERMOSTATS • LIQUID LEVELS

MODEL 30 \$79



- PLUGS INTO PC BUS
- 24 LINES DIGITAL I/O
- 8 CHANNEL
- 8 BIT A/D/IN
- 12 BIT COUNTER
- UP TO 14K BMP/SEC

MODEL 45 \$189



- RS-232 INTERFACE
- 8 DIGITAL I/O
- 8 ANALOG INPUTS
- 2 ANALOG OUTPUTS
- 2 COUNTERS-24 BIT

MODEL 100 \$279



- 12 BIT 100 KHZ A/D
- 4 ANALOG OUTPUTS
- 3 TIMER COUNTERS
- 24 DIGITAL I/O

MODEL 150-02 \$179



- RS-232 INTERFACE
- TRMS, 20 AMPS
- 12 BIT A/D
- OPTO-ISOLATED
- COMPLETE DMM

MODEL 40 \$109



- RS-232 INTERFACE
- 28 LINES DIGITAL I/O
- 8 ANALOG INPUTS
- PWM OUTPUT

MODEL 70 \$239



- RS-232 INTERFACE
- 18 BIT A/D
- 5.5 DIGIT
- UP TO 60 BMP/SEC

Prairie Digital, Inc.

PHONE 608-643-8599 • FAX 608-643-6754

820 SEVENTEENTH STREET • PRAIRIE DU SAC, WISCONSIN 53578

CIRCLE 219 ON FREE INFORMATION CARD

The Standard for checking Capacitors in-circuit



Good enough to be the choice of Panasonic, Pioneer, NBC, ABC, Ford, JVC, NASA and thousands of independent service technicians.

Inexpensive enough to pay for itself in just one day's repairs. At \$179, it's affordable.

And with a 60 day trial period, satisfaction guaranteed or money-back policy, the only thing you can lose is all the time you're currently spending on trying to repair all those dogs you've given up on.

CapAnalyzer 88A

Available at your distributor, or call 561-487-6103

Electronic Design Specialists

Locate shorted or leaky components or conditions to the exact spot *in-circuit*

Still cutting up the pcb, and unsoldering every part trying to guess at where the short is?

\$179



Your DVM shows the same shorted reading all along the pcb trace. LeakSeeker 82B has the resolution to find the defective component. Touch pads along the trace, and LeakSeeker beeps highest in pitch at the defect's pad. Now you can locate a shorted part only a quarter of an inch away from a good part. Short can be from 0 to 150 ohms

LeakSeeker 82B

www.eds-inc.com

CIRCLE 210 ON FREE INFORMATION CARD

CALL TOLL-FREE
(800) 292-7711
Orders Only

C&S SALES

CALL OR WRITE
FOR OUR
FREE

Se Habla Español **Secure On-line Ordering @ cs-sales.com**

64 PAGE CATALOG!
(800) 445-3201

Digital Multimeters

Elenco Model M-1740



\$19.95

- 11 Functions:**
- Freq. to 20MHz
 - Cap. to 20µF
 - AC/DC Voltage
 - AC/DC Current
 - Beeper
 - Diode Test
 - Transistor Test
 - Meets UL-1244 safety specs.



\$89.95

- Cap. 0.1pF to 20µF
- Inductance 1µH to 20H
- Resistance # 01Ω to 2,000MΩ
- Temperature -20°C to 750°C
- DC Volts 0-20V
- Freq. up to 5MHz
- Diode/Audio: # Continuity Test
- Signal Output

Elenco Model LCM-1950



\$65

- Large 1 3/4 Digit LCD
- Autoranging Freq. to 4MHz
- Cap. to 400µF
- Inductance to 40H
- Res. to 4,000MΩ
- Diode & Transistor Test
- Audible Continuity Test

LCR Bridge

B&K Model 878



\$229

- Accurately measures capacitance, resistance, and inductance.
- Measures dissipation factor of capacitors and Q of inductors.

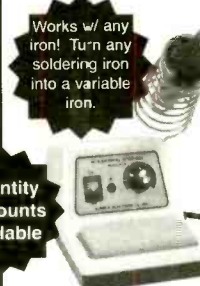
Deluxe Soldering Stations

Elenco SL-5 Series

Electronically controlled, ideal for professionals, students, and hobbyists. Available in kit form or assembled.

Works w/ any iron! Turn any soldering iron into a variable iron.

Quantity Discounts Available



As Low As

\$24.95

Features:

- Cushion Grip Handle
- Soldering Iron (optional) with Grounded Tip for Soldering Static-Sensitive Devices. Easily Replaceable. Uses Long-Life, Plated Conical Tip.
- Heavy Steel, Non-Slip Base.
- Iron Holder Funnel - Reversible, left or right side.
- Steel Tray for Sponge Pad.
- Sponge Pad.

Ordering Information:

Model SL-5 - No iron. (Kit SL-5K) **\$24.95**

Model SL-5-40 - Includes 40W UL iron. (Kit SL-5K-40) **\$29.95**

Test Equipment

Elenco Four Functions in One Instrument Model MX-9300B

Features:

- One instrument with four test and measuring systems:
 - 1.3GHz Frequency Counter
 - 2MHz Sweep Function Generator
 - Digital Multimeter
 - Digital Triple Power Supply



\$450

Elenco Handheld Universal Counter Model F-2800



\$99

Sensitivity:

- <1.5mV @ 100MHz
- <5mV @ 250MHz
- <5mV @ 1GHz
- <100mV @ 2.4GHz

Features 10 digit display, 16 segment and RF signal strength bargraph. Includes antenna, NiCad battery, and AC adapter.

C-2800 Case w/ Belt Clip **\$14.95**



Elenco RF Generator with Counter (100kHz - 150MHz) Model SG-9500 **\$225**

Features internal AM mod. of 1kHz, RF output 100mV - 35MHz. Audio output 1kHz @ 1V RMS. SG-9000 (analog, w/o counter) **\$119**

Elenco Quad Power Supply Model XP-581

4 Fully Regulated Power Supplies in 1 Unit.



\$75

4 DC Voltages: 3 fixed: +5V @ 3A +12V @ 1A, 1 variable: 2.5 - 20V @ 2A • Fully Regulated & Short Protected • Voltage & Current Meters • All Metal Case



Elenco Power Supply Model XP-603 **\$75**

• 0-30VDC @ 3A Output

• 3A Fused Current Protection

• Current Limiting Short Protection

• 0.025Ω Output Impedance



Elenco 13Hz - 1MHz Digital Audio Generator Model SG-9300 **\$225**

Features built-in 150MHz frequency counter, low distortion and sine/square waves. SG-9200 (w/o counter) **\$119**

Elenco 3MHz Sweep Function Generator with built-in 60MHz Frequency Counter Model GF-8046



\$199.95

Generates square, triangle, and sine waveforms, and TTL, CMOS pulse.

GF-8025 - Without Counter **\$139.95**

20MHz Sweep / Function Generator with Frequency Counter Model 4040A

- 0.2Hz to 20MHz
- AM & FM Modulation
- Burst Operation
- External Frequency Counter to 30MHz
- Linear and Log Sweep

10MHz Model 4017A **\$325**

5MHz Model 4011A **\$259**

2MHz Model 4010A **\$225**

\$445
BK PRECISION

Elenco Oscilloscopes

Free Dust Cover and 2 Probes



- S-1328 25MHz Dual Trace **\$325**
- S-1345 40MHz Delayed Sweep **\$54***
- S-1330 25MHz Delayed Sweep **\$430**
- S-1360 60MHz Delayed Sweep **\$72**
- S-1340 40MHz Dual Trace **\$475**
- S-1390 100MHz Delayed Sweep **\$89***

Deluxe 29pc. Computer Service Tool Kit: **\$36.95** Elenco Model TK-1200

Includes Soldering Iron, Solder, Long Nose Pliers, Diagonal Pliers, 11 pc. Screwdriver Bit Set, Wire Stripper, IC Inserter, IC Extractor, Screwdriver, Phillips Screwdriver, Desoldering Pump, and more!



Elenco Educational Kits

Model XK-150

Digital / Analog Trainer

\$89.95



- 830-pin Breadboard
- 8 Data Switches
- 6 LED Buffered Readouts
- Built-in Function Generator (sine and square wave)
- Built-in Clock Generator
- Variable Power Supply

OWI Model OWI-007

Robotic Arm Trainer

\$82.50



Model AK-700 Pulse/Tone Telephone Kit Flashing Neon Lights Great School Project **\$14.95**

Model AK-780K

Two IC Radio Kit

\$9.95



Model RCC-7K Radio Control Car Kit **\$27.95**

• Functions

• Transmitter Included

Model M-1005K DMM Kit **\$18.95**

• Transistor Test

• Diode Test

• Overload Protection

• Pocket Size

Model K4001 7W Amplifier **\$12.95**

Electronic Science Lab

Maxitronix 500-in-1 Electronic Project Lab Model MX-909

Everything you need to build 500 exciting electronic projects:

- Learn the basics of electronics. 500 different electronic experiments, special lighting effects, radio transmitter and receivers, sound effects, cool games and MORE!

• Includes built-in breadboard and an LCD.

• Explore amplifiers, analog and digital circuits plus how to read schematic diagrams.

• Includes 11 parts.

• Lab-style manual included.

• Requires 6 "AA" batteries.



MX-908 - 303-in-1 Lab **\$59.95**

MX-907 - 203-in-1 Lab **\$44.95**

MX-906 - 133-in-1 Lab **\$29.95**

EP-50 - 50-in-1 Lab **\$18.95**

\$149

Guaranteed Lowest Prices C&S SALES, INC.

UPS SHIPPING: 48 STATES 5% (Minimum \$5.00)
OTHERS CALL FOR DETAILS
IL Residents add 8.25% Sales Tax

150 W. CARPENTER AVENUE
WHEELING, IL 60090

FAX: (847) 541-9904 (847) 541-C710
<http://www.cs-sales.com>

SEE US ON THE WEB

15 DAY MONEY BACK GUARANTEE

2 YEAR FACTORY WARRANTY

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

CIRCLE 290 ON FREE INFORMATION CARD

Lone Star Consulting, Inc.

8900 Viscount, Suite 235
El Paso, TX 79925
915-474-0334

Descriptions, Prices, Policies:

www.lonestartek.net

SPECIAL PROJECTS HARDWARE

Unique - Original - Made-to-Order - Special Needs

Electronic - Computer - Phone - Energy - Security - Data
Cards - RF - EM - Audio - Radionics - "Psychic" - Plans - more!
Power Meters Educational Module ♦ KX Radar Emitter
Lineman's Test Set ♦ Bug & Tap Detector & Blaster
Shriek Module ♦ Stealth Paint "Elixer" ♦ Audio Assistor
Multi-Use Magnetometer ♦ Omnimax Tone Stimulator
Radionics Rifle ♦ Neurophone Device ♦ Ultrasonic
Stimulator ♦ Ultrasound Shriker ♦ Ultrasonic Detector
Harassing EMF Jammer ♦ EMF "Signature" Detector
"Aura" Detector ♦ Super Conductor Detector ♦ Unseen/
Unknown Presence Detector ♦ Subliminal Mixer/Amp
Infrared Detector ♦ Secret Communicator ♦ Levitator
Flash Blaster ♦ 6th. Sense Communicator - many more!
♦ TECHNICAL "LIFE COACHING" ♦ WEBSITE DESIGN SERVICES



**Black Feather
ELECTRONICS**

Visit our Website
www.blkfeather.com

- ▶ 4400 S. Robinson Avenue
- ▶ Oklahoma City, OK 73109
- ▶ FAX: (405) 616-9603
- ▶ Email: blkfea@aol.com

Or call & order today:
1-405-616-0374



Thereimin
The PAiA Thereimin uses the same heterodyne principles as the original turn of the century instrument for classic tone and adds features made possible by modern ICs. Shown with optional lectern case.

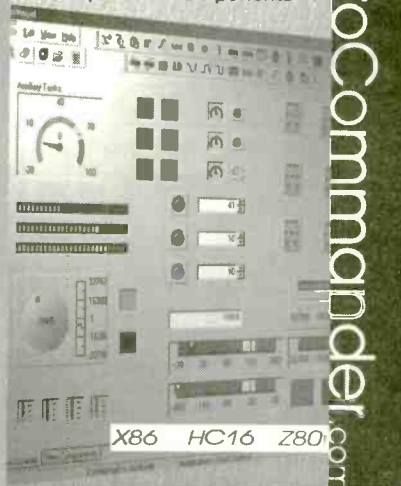
9308K Kit \$154.00
FatMan Analog MIDI Synth
A complete music synthesizer with all the big bottom and phat sound that makes analog famous. 20 knobs and controls for real-time sound sculpting. Compatible with standard MIDI sources like keyboards or computers. Desktop case or rack panel available.

Check out <http://Paia.com> for schematics, tech details, firmware source files and more...

Synthesizer Modules, Guitar Effects, Mixers, EQs, Tube PreAmps, and dozens of kits for **ELECTRONIC MUSICIANS**

PAiA Electronics info@paia.com
3200 Teakwood Lane 405.340.6300
Edmond, OK 73013 fax 405.340.6378

- View Control and Configure your micro over the Internet
- Drag and Drop embedded development tools included
- Build powerful applications with proven Components



microCommander.com

Press-n-Peel Transfer Film PC Boards in Minutes

8.5" x 11" Shts.
* Or Photocopy
** Use standard household iron

1. LaserPrint*
2. Press On**
3. Peel Off
4. Etch



Use Standard Copper Clad Board
20 Shts \$30/ 40 Shts \$50/ 100 Shts \$100
Visa/MC/PO/CK/MO \$4 S&H/Foreign Add \$7

Techniks Inc.

P.O. Box 463, Ringoes NJ 08551
ph. 908.788.8249 fax 908.788.8837
www.techniks.com

Visit Our E-Store On-Line!

PROGRAM PIC'S IN



BASIC

MBASIC for PICmicro® MCU's

Ever wanted to learn how to program PICmicro® MCUs? Now you can with easy to use BASIC. Our software is much simpler than C or Assembly. MBasic for PICmicro® MCUs creates a one click solution that allows you to experiment and test code changes on-the-fly! From beginner to professional, bring your projects to life quicker and easier with MBasic for PICmicro® MCUs!

New - In Circuit Graphical Debugger built in!
Priced from \$99.95

Educational and dealer discounts available

Order online or call 1-734-425-1744
Basic Micro, 34391 Plymouth, Livonia, MI 48150
See more online at <http://www.basicmicro.com>

Scrambling News

915 NW First Ave., Suite 2902
Miami FL, 33136, 305-372-9427

Pay TV and Satellite Descrambling 2002 - New! - satellite and cable. Includes the latest Information. \$19.95 plus \$1.75 shipping.

Hacking Digital Satellite Systems Video 2002 - New! - This 90 minute video focuses on the satellite television piracy business. \$29.95 plus \$ 3.50 shipping.

Scrambling News Online - Online service for those interested in satellite television news. \$59.95/year.

Pay TV and Satellite Descrambling Series CD-ROM - all 13 volumes over 300 pages, \$59.95 plus \$3.50 shipping.

Best Deal - Everything listed above for only \$99.95 plus \$3.50 shipping.

www.scramblingnews.com

SCINTILLATING!

Who Are You? The Encyclopedia of Personal Identification. Insider information directly from the FBI and Customs, top graphic artists, offshore attorneys, master thieves, and professional sharks. *Who Are You?* details ID theft schemes (and prevention); how to create great documents on a home computer, get a new driver's license (suspension? No problem), open offshore or US bank accounts w/o an SS number, acquire the world's best ID, second passports, phony credit cards, read vehicle tags, much, much more. Sources, sites, suppliers, tips, tricks and techniques. 352 pages \$44.95.

Covert Catalog 2000 The latest, hands-on source guide for law enforcement goodies, electronic surveillance, covert video, counter measures, entry equipment, weapons, tracking systems, computer surveillance, and more. Exact ordering info from suppliers in 13 nations! 220 Pages. \$39.95.

ORDER BOTH BOOKS — SUBTRACT \$10!!

Intelligence Here
404 N. Mt. Shasta Blvd.
Mt. Shasta, CA 96067
Order by Phone: 866-885-8855
www.intelligencehere.com.

Add \$6.00 (priority shipping). CA residents add 8% tax

PICmicro MCU Development Tools

**EPIC Plus
PICmicro Programmer
\$59.95**

Program PICmicro MCUs in BASIC!
DOS or Windows operation (includes Windows IDE software).
PicBasic Compiler - \$99.95
PicBasic Pro Compiler - \$249.95

Experimenter Boards
LAB-X1 for 40-pin MCUs (shown) - \$199.95
LAB-X2 for 28 or 40-pin MCUs - \$69.95
LAB-X3 for 18-pin MCUs - \$119.95

**PICProto Prototyping Boards
\$8.95 to \$19.95**
High-quality blank prototyping boards for PICmicro MCUs.

microEngineering Labs, Inc.

www.melabs.com
Phone: (719) 520-5323
Fax: (719) 520-1867
Box 60039, Colorado Springs, CO 80960

Stepper Motor Book

Easy Step'n

- For the experimenter.
- Determine surplus stepper motor specs using simple easy to build test equipment.
- Build microcontroller-based control systems (flow charts and code examples).
- Build stepper motor drive circuits.
- Mechanical design considerations.
- 8.5x11 format. 205 pages. \$34.95

Table Of Contents: <http://www.stepperstuff.com>
+ \$5 s/h in US. VISA, MC, AM, DS, MO, Check
CA residents please add 7% CA sales tax

SQUARE 1 ELECTRONICS

P.O. Box 501, Kelseyville, CA 95451
Voice (707) 279-8881 Fax (707) 279-8883

<http://www.stepperstuff.com>

Solar Panels

160 mW / Sun 8 Cells

200pc 2Kpc 20Kpc 200Kpc
\$2.⁰⁰ ea \$1.⁸⁰ ea \$1.⁷¹ ea \$0.⁸⁵ ea

Battery Holders

AA Singles, and Dual Side by Side

200pc 2Kpc 20Kpc 200Kpc
\$0.⁴⁰ ea \$0.³⁶ ea \$0.³⁴ ea \$0.¹⁷ ea

LED's

High Intensity HPWT-DL00

Similar to Lumex type SSL-LX30448SYC

200pc 2Kpc 20Kpc 200Kpc
\$0.⁵⁰ ea \$0.⁴⁵ ea \$0.⁴³ ea \$0.²¹ ea

Call 1-847-612-2739

Top Secret Consumertronics

In business 25+ years • established professionals

www.tsc-global.com

Exciting Hi-Tech Survival Books, Manuals, Tapes

- | | |
|--------------------------------|------------------------------|
| Stopping Power Meters \$29 | Polygraph Secrets \$29 |
| SPM Demo VHS Tape \$29 | Identity Theft Manual \$29 |
| KW-HR Meters \$29 | Credit Card Security \$29 |
| Gas & Water Security \$19 | Check & M.O. Security \$29 |
| Beyond Phone Color Boxes \$29 | ATM Manual \$39 |
| Cellphone/Cordless Guide \$49 | Mind Control \$29 |
| Pager (Beeper) Manual \$29 | Under Attack! \$29 |
| Caller ID & ANI Security \$29 | EM Brainblaster \$29 |
| Voice Mail Security \$29 | Radionics Manual \$29 |
| PBX Security \$25 | Heal Thyself! \$29 |
| Fax Machine Security \$29 | Ultimate Success Manual \$29 |
| Computer Security \$39 | Stealth Technology \$29 |
| Hacker Files (3 HD Disks) \$39 | High Voltage Devices \$29 |
| Social Engineering \$29 | Secret & Survival Radio \$29 |
| Cons & Scams Databook \$29 | Secrets Solderless BBS \$29 |
| Internet Security \$29 | The "Goldfinger" \$19 |
| Internet Frauds Databook \$29 | Casino Secrets \$29 |
| Internet Tracking/Tracing \$29 | Government Land Grab \$19 |
| Beyond Van Eck Tempst \$29 | Rockets Red Glare \$29 |
| Van Eck Demo VHS Tape \$29 | ...much more in Catalog! |
- Check, MO, VISA, MC - S/H: \$6 USPS, \$9 UPS or Canada
Printed Catalog: \$1 with order, \$3 w/o (descriptions, policies)
Order Today 10% OFF! Consumertronics
P.O. Box 23097, ABQ, NM 87192
505-321-1034 Fax: 505-275-5637

CABLE SECRETS!!!

Build your OWN cable box "test" devices!

Why pay \$100.00 or more for a "test" device that someone else made? Make your own! Includes complete source code and plans for the most commonly used cable boxes. *Unlock all of the channels on your box!*

Or start your own lucrative business!
Complete source code \$79.95
Code for individual boxes \$29.95

DSS SECRETS — Vol. 2

Step-by-step instructions on programming your own DSS access card. *Unlock all channels on your own card!* This is the most current information on the market! Includes software, plans, and hardware sources. Book & CD-ROM.
DSS Secrets Vol. 2 \$49.95

VISA • MasterCard • American Express

To order, call Worldwyde @ 1-800-773-6698
33523 Eight Mile Rd. #A3-261 • Livonia, MI 48152
Visit us on the web at www.worldwyde.com

PICMICRO TOOLS



- Uses PC Serial port (USB w/ adapter)
 - Very Simple to use
 - Free Software updates
 - Complete with Windows IDE!
 - Easy in-circuit programming
 - Supports PIC, Sencis, I2C and more!
 - Firmware upgradeable!
 - RJ-11 / 10 Pin Header
 - Includes RJ-11 Cable
- Optional Items Available:
- Plastic Enclosure Available
- 40 Pin ZIF Adapter all-in-one
- Universal Adapter
- All for \$59.95 Complete

Solderless Development Boards

- Develop your projects the easy way
- Completely Assembled Board
 - In Circuit Programmable (ISP)
 - Solderless Bread Board
 - Built in RS232 (w/ Mac232)
 - Built in Power Connector
 - Removable Oscillator
 - Documentation
 - Auto Disconnect for RB3, RB6, & RB7
 - Available in several models

Starting at \$49.95
Join our online PIC forums
tons of information and help FREE!!!
VISA • MasterCard • American Express
Order Online or Call 1-734-425-1744
Basic Micro, 34391 Plymouth, Livonia, MI 48150
See more online at <http://www.basismicro.com>

IC DEVICE PROGRAMMERS

LARGEST SELECTION OF PROGRAMMERS, ERASERS & EMULATORS
WE ARE NEVER UNDERSOLD - FULL 30 DAY PRICE PROTECTION
PROGRAMMER SALES 800-760-3820

- UNIVERSAL PROGRAMMERS
- 1195. ADVANTECH LABTOOL-48
 - 895. NEEDHAMS EMP-30
 - 869. EETOOLS TOPMAX
 - 849. XELTEK SUPERPRO 680
 - 849. XELTEK SUPERPRO 2000
 - 849. ADVANTECH LABTOOL-148C
 - 449. XELTEK SUPERPRO 280
 - 419. NEEDHAMS EMP-20
 - 419. EETOOLS MEGAMAX
 - 379. XELTEK SUPERPRO LX
 - 339. EETOOLS CHIPMAX
- GANG PROGRAMMERS
- 299. NEEDHAMS EMP-11
 - 2699. ADVANTECH LABTOOL-848 (8)
 - 229. XELTEK SUPERPRO Z
 - 1069. EETOOLS TOPMAX W/B GANG
 - 199. NEEDHAMS EMP-10
 - 519. MEGAMAX 4G (4)

General Device Instruments

Sales (916) 393-1655 Fax (916) 392-4949
www.generaldevice.com

CABLE BOX SUPPLIERS

**VISION MASTER PLUS
W/UNIVERSAL FORMAT
STABILIZERS PICTURE
WORKS ANY SYSTEM!**

"DEALERS WELCOME"

★ **LOW, LOW PRICING** ★
1-888-777-9123
1-888-675-3687

PIC Programmer Kits

Super value!
\$16.95 +S&H \$4.95
The P16PRO: can program up to 40 pin PICs including the popular 16F84 & 12C508 • Needs software (extra \$20) • Available assembled or starting from \$16.95 for the kit.
See www.electronics123.com for more info!
The PICALL programmer can also program Atmel AVR's in addition to the PICs it can program • Free software • PICALL programmer kit at \$69.95
See www.electronics123.com for more info!

Video Camera module

CMOS Camera Module, Black & White, Size: 0.63"x0.63"x0.59"H.
Lens: f4.9, F2.8, EIA 320Hx240V.
0.6" DIL Package, 5 pins. Pin 3 is 1V p-p composite video (75 ohm) to monitor. \$36 + \$5 S&H

Running Lights kit

Add \$6 for 8 triacs to drive light bulbs
8 LEDs with 10 push button selectable patterns. 8 speed levels! 80 combinations! \$16 + \$5 S&H

Toll Free 1-888-549-3749 (USA & Canada)
Tel: (330) 549-3726. Request a FREE catalog or visit us at: www.electronics123.com for more products.
Amazon Electronics, Box 21 Columblana OH 44408

spyoutlet.com

Security • Surveillance • Loss Prevention
Purchase your video cameras from one of the largest importers in the U.S.

- NEW weatherproof Bullet Cameras
- Spy Pinhole Cameras • Wireless Video
- PC Cards • Voice Changer
- Micro Recorders • Shotgun Mic
- Locksmithing • Bug Detectors
- NEW Phone Sentry Plus—defeats telephone tapping and taping
- UV Pens & Powder • Realtime 12 hr Telephone Recording System
- GPS Vehicle Tracking System
- And much more • Quantity discounts

www.spyoutlet.com
Printed Catalog send \$5⁰⁰

**SPY OUTLET 2468 NIA. FALLS BLVD
TONAWANDA NY 14150 (716) 695-8660**

New and Pre-Owned Test Equipment

New Equipment Specials

B+K Precision 2120B - 30 MHz Oscilloscope

- * FREE Model 117B Multimeter
 - * 2 Channel, Dual-Trace
 - * 30 MHz Bandwidth
 - * TV Triggering
 - * (2) Probes Included
- Sale Price \$339.00**

AVCOM PSA-37D - Spectrum Analyzer

- Satellite Downlink - Installation - Maintenance & Service*
- Band 1: 10 - 1750 MHz
 - Band 2: 3.7 - 4.2 GHz
 - Carrying Case Included
 - Line or Battery Powered
 - Built-in DC Block & Power for LNA/LNB's
- Sale Price \$2,395.00**

Instek GOS-6103 - 100 MHz Analog Oscilloscope

- 100 MHz Bandwidth
 - 2 Channel, High Sensitivity
 - TV Trigger - Signal Output
 - Cursor Readout
 - Time Base Auto-range
 - (2) Probes Included
 - 2 Year Warranty
- Sale Price \$899.00**

Leader LF 941 - CATV Signal Level Meter

- TV/CATV Coverage from 46-870 MHz
 - Video/Audio Carrier Measurements
- Sale Price \$489.00**

Wavetek Meterman HD160B Digital Multimeter

- Full Sealing Against Water, Chemicals, & Fluids
 - True RMS
 - Drop-Proof to 10 feet (3.3m)
- Sale Price \$159.00**

Pre-Owned Oscilloscope Specials

Tektronix	465	100 MHz	\$499.00
Tektronix	465B	100 MHz	\$649.00
Tektronix	475	200 MHz	\$749.00
Tektronix	475A	250 MHz	\$949.00

- Professionally Refurbished
- Aligned & Calibrated to Original Specifications
- The Industry Standard of Oscilloscopes
- 1 Year Warranty - The Longest Available!!!
- See Website for Complete Specifications

See us on the Web!
www.testequipmentdepot.com

**We Buy Surplus
 Test Equipment**

Test Equipment Depot

A FOTRONIC CORPORATION COMPANY

99 Washington St. Melrose, MA 02176
 (781) 665-1400 • FAX (781) 665-0780

e-mail: sales@testequipmentdepot.com

(1-800-996-3837)

TOLL FREE 1-800-99-METER



CIRCLE 322 ON FREE INFORMATION CARD

MEETING TOMORROW'S CHALLENGES TODAY

The men and women in the Navy's Seaman/Airman/Fireman Program are working for America, while learning valuable skills through on-the-job training. They're building solid futures, succeeding in a competitive, high-tech world and advancing as quickly as their abilities and performance allow. Find out more about the Seaman/Airman/Fireman Program, as well as other exciting Navy job opportunities, from your local Navy recruiter. This ad is brought to you as a public service of this newspaper.

Navy. Full Speed Ahead.

BREAST CANCER BEGINS EVEN SMALLER THAN THIS. THAT'S WHY YOU NEED A YEARLY MAMMOGRAM, ESPECIALLY AS YOU GET OLDER. MAMMOGRAMS CAN DETECT LUMPS TOO SMALL FOR YOU TO FEEL AND EARLY DETECTION MAY SAVE YOUR LIFE, SO CALL 1-800-ACS 2345.

GET A MAMMOGRAM EARLY DETECTION IS THE BEST PROTECTION.

Get your copy of the CRYSTAL SET HANDBOOK



Go back to antiquity and build the radios that your grandfather built. Build the "Quaker Oats" type rig, wind coils that work and make it look like the 1920's! Only \$10.95 plus \$4.00 for shipping and handling. Clagg Inc., PO Box 12162, Hauppauge, NY 11788. USA Funds ONLY! USA and Canada—no foreign orders. Allow 6-8 weeks for delivery. MA01

ELECTRONIC MILITARY SURPLUS



FAIR RADIO SALES

WEBSITE: faiiradio.com
 E-MAIL: faiiradio@faiiradio.com
 PHONE: 419-227-6573
 FAX: 419-227-1313
 1016 E. Eureka - Box 1105
 Lima, OH 45802
 VISA, MASTERCARD, DISCOVER
 Address Dept. ES

2KW SOLA REGULATOR



Sola CVS 2000 Watt Constant Voltage Transformer provides a very well regulated sinusoidal waveform that is isolated from variations and disturbances in the input voltage. Also provides isolation and step-up/step-down to allow for various input/output voltages. Input 95-130/175-235/190-260/380-520 60Hz. Output 120/240VAC 60Hz 2000VA. 17.8x11.4x9.6, 115 lbs sh. Unused, \$250.00 ea, 2 / \$450.00

Allow money for shipping.

SEND FOR OUR
 2001 CATALOG !!

Radios - Test Equipment - Tubes - Antennas

CRYSTAL SETS: VOLUME V.



Volume V of the Society newsletter includes six issues ending November 1995. Great for new members to get current, those wanting a bound copy for their reference bookshelf, or as a gift to get a friend started. Contents include: The Design of Unpowered AM Receivers, Radio Outfit in a Headset, A Crystal Set Revisited-Reconstructed, Grounded Loop-stick Tuner, The Matching Secret, and lots of membership correspondence. 8 1/2 x 5 1/2 paperback, \$8.95 plus shipping.—Electronic Technology Today Inc., PO Box 240, Massapequa Park, NY 11762-0240. US funds only. Allow 6-8 weeks for delivery. MA06

Learn to use a Multimeter!

CIE's new Self-Paced Multimeter Course will show you how to make detailed measurements using a multimeter - even if you've never touched one before!

An electronics professional uses test instruments on a daily basis to troubleshoot and maintain various electronics equipment. None may be as important as knowing how to use a multimeter.

This new CIE micro course comes straight out of our Associate Degree program and teaches someone with no previous knowledge of multimeters the proper techniques of measuring resistance, voltage and current. This course comes equipped with both a powerful **DIGITAL** and **ANALOG** multimeter to use in the field for years to come.

CIE instructor assistance is available with this program so you never have to study alone and you earn a Certificate of Completion upon finishing.

In addition, this course includes an extra lab with 3 graded lessons on proper soldering techniques. Start with the basics and then move onto more advanced techniques. Learn how to inspect and repair solder joints using the included soldering iron with our easy to follow self-paced lessons.

Look at what you get!

- Digital Multimeter
- Analog Multimeter
- Soldering Iron
- 4 Graded Lessons
- Alarm Lab Kit
- Certificate of Completion

Lessons Covered for a Certificate of Completion:

- Using Your Multimeter to Measure Resistance - 5 experiments
- Working with Printed Circuit Boards - 3 experiments
- Reliable Soldering Techniques - 1 experiment
- Building a Siren with Flashing Light - 4 experiments

Learning Topics:

- How to use the Multimeter
- Multimeter Care
- Precautions
- Multimeter as an Ohmmeter
- Zeroing the Meter
- Measuring Wire Continuity
- Continuity Checks on Switches
- Measuring Lamp Continuity
- Measuring Resistance
- Resistance Scale and Ranges
- Learning the Resistor Color Code
- Marked & Measured Resistance
- Making Practical Resistance Measurements
- Measuring Resistors on a Circuit Board
- The Digital Multimeter
- Measuring Voltage
- Measuring Current
- Tools for Electronic Technicians
- Printed Circuit Boards
- Soldering to Printed Circuit Boards
- How to Repair Solder Joints
- Plus 15 more soldering topics



\$195
Course 02-069

Course includes these Student Privileges:

1. Instructor Assistance:

Use our toll-free Instructor Hot-line to access our faculty and staff if you ever need assistance with your course work. CIE's dedicated staff of instructors do more than just grade your exams; they help guide you, step-by-step, through your studies and hands-on training.

2. Priority Grading:

Exams will be graded and sent back to you within 24 hours.

3. Student Resources:

Upon enrolling, you'll receive a complementary issue of our school newspaper "The Electron".

4. Certificate of Completion

A Certificate of Completion that's suitable for framing will be sent to you once you finish this course.

Cleveland Institute of Electronics - Bookstore
1776 E. 17th Street Cleveland, Ohio 44114
(800) 321-2155 www.ciebookstore.com
(\$15.75 shipping & handling. OH, CA & HI residents must add sales tax.)

Gernsback Publications, Inc.

275-G Marcus Blvd. Hauppauge NY 11788

POPTRONICS® CLASSIFIED ADVERTISING ORDER FORM

Advertiser Information

Name _____
 Company _____
 Street Address _____
 City/State/Zip _____
 Telephone () _____
 Signature (required on all orders) _____

Payment Information

Charge my:
 Master Card Visa Discover
 Account No. _____
 Exp. Date _____
 Full payment enclosed. Prepayment discounts offered for multiple insertions (except on credit card orders).
 Payment for first insertion enclose; additional payments will be made prior to closing dates. Prepayment discounts not available.

Do you want any special options? (where available)

- Boldface Type* Add 25% for entire ad Screened Background – Add 30%
 Special Heading – Add \$35.00

The first word of your ad and your name will be printed in boldface caps, at no additional charge. For individual boldface words, add .50¢ each.

In what month(s) would you like your ad to run?

- Entire year for publications selected above.
 Jan. Feb. Mar. Apr. May. June July Aug. Sep. Oct. Nov. Dec.

Here's how to calculate the cost of your Regular or Expanded-Ad Classified:

Rate X Numbers of Words + Rate for Boldface + Rate for Screened Background = Cost per Insertion X Number of Months = Cost

Magazine	Rate	x	Number of Words (min. 15)	+ Boldface (add 25%)	+ Screened Background (add 30%)	=	Cost Per Insertion	x	Number of Months	=	Cost		
_____	_____	x	_____	_____	_____	+	_____	=	_____	x	_____	=	_____

Rates:

\$3.50 per word

Minimum 15 Words

Here's how to calculate the total cost of your advertising:

Prepayment Discount:

(Full payment must accompany order, not applicable on credit card orders)

Prepay for 6 insertions in one magazine, 5% 12 insertions in one magazine, 10%

Subtotal _____
 Less Prepayment Discount _____
TOTAL COST \$ _____

Please use a separate piece of paper to write your copy, or for any special instructions you may have.

HAVE A QUESTION? CALL: 1-631-592-6720 ext. 206

Fax signed orders with credit card information to : (631) 592-6723

GPI895

CLASSIFIEDS

BUSINESS OPPORTUNITIES

\$400 WEEKLY ASSEMBLING Electronic Circuit Boards/Products From Home. For Free Information Send SASE: Home Assembly-PT Box 216 New Britain, CT 06050-0216

EASY WORK! EXCELLENT PAY! Assemble Products At Home. Call Toll Free 1-800-467-5566 EXT. 1190.

CABLE TV

DESCRAMBLERMANIA! SAVE 80% ALL UNIVERSAL CABLE DESCRAMBLER CONVERTER MODELS! INDIVIDUAL AND BULK SALES! 1-800-246-0434 www.cable_boxcentral.com

TESTCHIPS, masterfiles, all makes/models, lowest prices around! Dealers, Wholesale, Retail, testchips_l@yahoo.com, <http://www.angelfire.com/movies/testchips/index.htm> 1-888-322-3886

For Sale Unmodified Cable TV Converters all makes, models starting at \$35 in quantity. www.apexcabletv.com. Call 800-500-9825

MISC. ELECTRONICS FOR SALE

T&M ELECTRONICS. Large variety of electronic parts since 1966. Visit our Web site at www.tandmelectronics.com

PLANS-KITS-SCHEMATICS

Carl's Electronics - Hundreds of electronic kits, plus the latest in spy and surveillance. www.electronickits.com




BEFORE



AFTER



★ No Rolls/Jitters/Flickers/Fading
 ★ Works on all TV's, VCR's, Beta, & Cable
 ★ Gold Video Connectors & Cables Included
 ★ 1 Year Warranty
 ★ Money Back Guarantee

FREE CATALOG!

COPY RENTAL TAPES WITH OUR VIDEO STABILIZER

1-800-562-2252

2609 S. 156th Circle • Omaha, NE 68130
www.modernelectronics.com

EZ-EP DEVICE PROGRAMMER - \$169.95

Check Web!! -- www.m2l.com

Fast - Programs 27C010 in 23 seconds

Portable - Connects to PC Parallel Port

Versatile - Programs 2716-080 plus EE and Flash (28F, 29C) to 32 pins

Inexpensive - Best for less than \$200

- Correct implementation of manufacturer algorithms for fast, reliable programming.
- Easy to use menu based software has binary editor, read, verify, copy, etc. Free updates via bbs or web page.
- Full over current detection on all device power supplies protects against bad chips and reverse insertion.
- Broad support for additional devices using adapters listed below.

Available Adapters

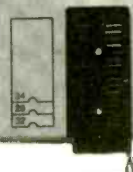
EP-PIC (16C5x, 61.62x, 71.84)	\$49.95
EP-PIC64 (62-5, 72-4)	\$39.95
EP-PIC12 (12C50x)	\$39.95
EP-PIC17 (17C4x)	\$49.95
EP-51 (8751 C51)	\$39.95
EP-11E (68HC11 E/A)	\$59.95
EP-11D (68HC11D3)	\$39.95
EP-16 (16bit 40pin EPROMs)	\$49.95
EP-Z8 (Z86E02, 3, 4, 6, 7, 8)	\$39.95
EP-SEE2 (93x, 24x, 25x, 85x)	\$39.95
EP-750 (87C750, 1, 2)	\$59.95
EP-PEEL (ICT22v10, 18v8)	\$59.95
EP-1051 (89C1051, 2051)	\$39.95
EP-PLCC (PLCC EPROMs)	\$49.95
EP-SOIC (SOIC EPROMs)	\$49.95

Many Other Adapters Available

M²L Electronics

970/259-0555 Fax: 970/259-0777
 250 CR 218 Durango CO 81301
 CO orders add 7% sales tax.
<http://www.m2l.com>

EZ-EP
M²L ELECTRONICS
Los Angeles, California



Poptronics® SHOPPER



MULTIMEDIA on the PC!

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

Mail coupon to:

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

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

Name _____

Address _____

City _____ State _____ ZIP _____

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

MA02



Do You Repair Electronics?

- | | |
|---|---|
| Repair Databases for TV, VCR, Monitor, UL Audio, FCC, and more. | - Over 76,000 records
- Private user forums
- Live on-line chat rooms |
|---|---|

RepairWorld.com

Electronic Corp. 1 Herald Sq. Fairborn, OH 45324 (937) 878-9878

Home Automation



World's Largest Source for Home Automation!

- | | |
|--|---|
| <ul style="list-style-type: none"> • Voice Control • Gadgets & Motorized Devices • Home Theater • Phones & Intercoms | <ul style="list-style-type: none"> • X10 & Lighting Control • Home Security & Surveillance • Home Networking & Structured Wiring |
|--|---|

and Much More...

800-SMART-HOME

www.smarthome.com

Free 144 pg. Color Catalog!

Dealers/Resellers ask about our SmartHome PRO Dealer Program 800-949-6255

ADVERTISING INDEX

Poptronics does not assume any responsibility for errors that may appear in the index below.

Free Information Number	Page	Free Information Number	Page
- Abacom .....	.68	- Intronics .....	.66
- All Electronics .....	.66	- LT Sound .....	.73
- Amazon Electronics .....	.77	- Lone Star Consulting, Inc. ....	.76
- Arrow Technologies .....	.67	- Lynxmotion .....	.67
- Basic Micro Inc. ....	.72, 76, 77	- M ² L Electronics .....	.81
319 Beige Bag Software .....	.67	324 MCM Electronic .....	.65
- Black Feather Electronics .....	.76	- Marrick Ltd. ....	.15
290 C&S Sales, Inc. ....	.75	323 Mendelsons .....	.66
- Carl Taylor Inc. ....	.77	- microEngineering Labs .....	.76
233 Circuit Specialists .....	.CV2	- Modern Electronics .....	.73
- CLAGGK, Inc. ....	.CV3, 20	- North Country Radio .....	.73
320 Cleveland Inst. of Electronics .69, 79		- PAiA Electronics .....	.76
321 Command Productions .....	.64	228 Polaris Industries .....	.63
- Conitec Data Systems .....	.73	219 Prairie Digital .....	.74
- Consumertronics .....	.77	- Progressive Concepts .....	.67
- Designtech Engineering Co. ....	.74	263 Ramsey Electronics .....	.71
- EDE Spy Outlet .....	.77	- Saelig Co., LLC .....	.64
210 Electronic Design Specialists ....	.74	- Scott Edwards Electronics .....	.64
- Elect. Tech. Today .....	.52	- Scrambling News .....	.76
130 Electronic Workbench .....	.CV4	- Smarthome.com .....	.71
- Electronix .....	.81	- Square 1 Electronics .....	.70, 77
- EMAC Inc. ....	.68	- Techniks .....	.76
- Engineering Express .....	.72	- Technological Arts .....	.66
- Fair Radio Sales .....	.78	322 Test Equipment Depot .....	.78
- General Device Inst. ....	.77	- UCANDO Videos .....	.70
- Global Specialties .....	.70	- Vision Electronics .....	.81
220 Information Unlimited .....	.68	224 Visitect Inc. ....	.72
- Intec Automation .....	.76	- Walter Malecki .....	.77
- Intelligence Here .....	.76	- World Wyde .....	.73, 77

ADVERTISING SALES OFFICES

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

Larry Steckler
 Publisher (ext. 201)
 e-mail: advertising@gernsback.com

Adria Coren
 Vice-President (ext. 208)

Ken Coren
 Vice-President (ext. 267)

Marie Falcon
 Advertising Director (ext. 206)

Adria Coren
 Credit Manager (ext. 208)

For Advertising ONLY EAST/SOUTHEAST

Marie Falcon
 275-G Marcus Blvd.
 Hauppauge, NY 11788
 Tel. 631-592-6720 x206
 Fax: 631-592-6723
 e-mail: mfalcon@gernsback.com

MIDWEST/Texas/Arkansas/ Oklahoma

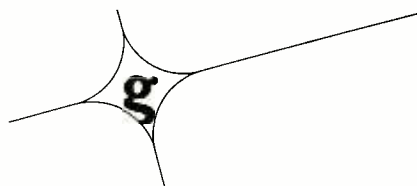
Ralph Bergen
 One Northfield Plaza, Suite 300
 Northfield, IL 60093-1214
 Tel. 847-559-0555
 Fax: 847-559-0562
 e-mail: bergenrj@aol.com

PACIFIC COAST

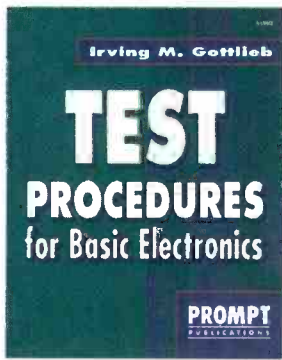
Megan Mitchell
 9072 Lawton Pine Avenue
 Las Vegas, NV 89129-7044
 Tel. 702-240-0184
 Fax: 702-838-6924
 e-mail: mmitchell@gernsback.com

**Subscription/
Customer Service/
Order Entry**
 Tel. 800-827-0383
 7:30 AM - 8:30 PM CST

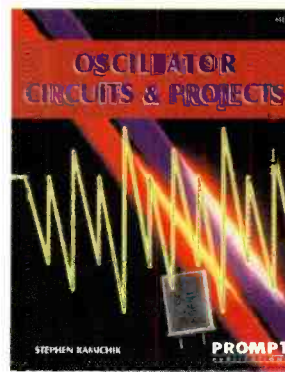
www.poptronics.com



**When you buy products from
 these advertisers, please tell
 them you saw their ads in
 Poptronics® magazine.**



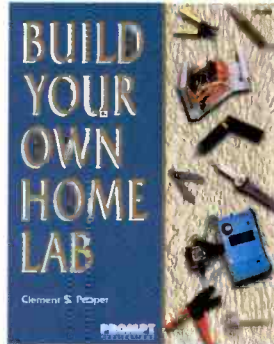
Test Procedures for Basic Electronics. #61063. -- \$19.95
Many useful tests and measurements are covered. They are reinforced by the appropriate basic principles. Examples of test and measurement setups are given to make concepts more practical. 7 3/8 x 9 1/4", 356 pp, paperback.



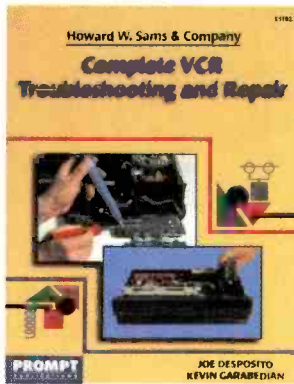
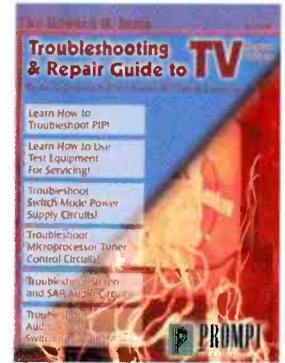
Oscillator Circuits and Projects. #61111. -- \$24.95
A Textbook and project book for those who want to know more about oscillator circuits. You can build and enjoy the informative and entertaining projects detailed in this book. Complete information is presented in an easy-to-follow manner. 7 3/8 x 9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

Build Your Own Home Lab. #61108 -- \$29.95

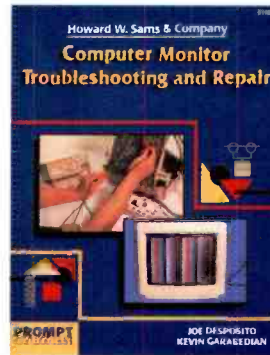
Shows you how to assemble an efficient working home lab, and how to make it pay its own way. Includes projects for creating your own test instruments too. 7 3/8 x 9 1/4", 249 pp, paperback.



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



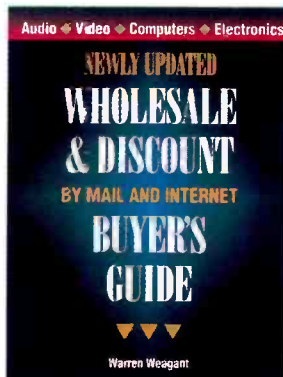
Complete VCR Troubleshooting and Repair. #61102. -- \$34.95
Though VCRs are complex, you don't need complex tools or test equipment to repair them. This book contains sound troubleshooting procedures that guide you through every task. 8 1/2 x 11", 184 pp, paperback.



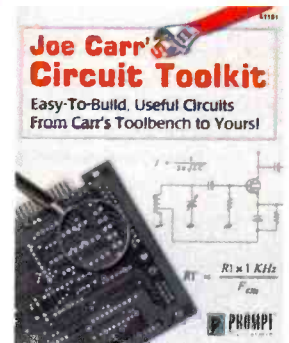
Computer Monitor Troubleshooting and Repair. #61100. -- \$34.95
This book can save you the money and hassle of computer monitor repair by showing you how to fix it yourself. Tools, test instruments, how to find and solve problems are all detailed. 8 1/2 x 11", 308 pp, paperback.

Wholesale & Discount Buyer's Guide #WD-1. -- \$19.95

Save up to 90% off list prices. Audio and video equipment and materials; electronic products and surplus; pro recording and specialty items; computers and components. Source listings include complete address, phone, fax, e-mail and website addresses. 8 1/2 x 11", 72 pp, paperback



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



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

Name: _____
Address: _____

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

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

Card Type: _____ Expiration Date: _____
Mastercard, Visa or Discover only

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

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



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

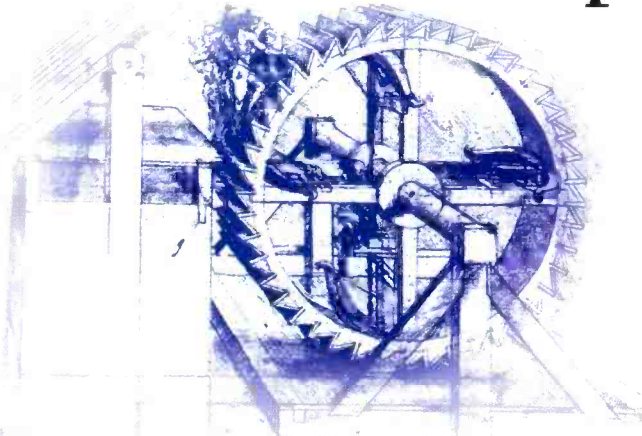
SHIPPING CHARGES IN USA.
CANADA ADD \$5.00

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

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

All payments must be in U.S. funds! CL04

Working on your next masterpiece?



It's time for new tools.



Electronics WORKBENCH

*The World's Most Popular
Electronic Design Tools*

Electronics Workbench products are used by more designers than any other software of their kind. They will help you reduce development times and produce higher quality circuits — We guarantee it, or your money back!

We offer a portfolio of products to meet all your design needs: Schematic Capture, Component Database, SPICE/VHDL/Verilog HDL/RF Simulation, PCB Layout, Autoplacement, Autorouting and now Network & Communications Simulation.

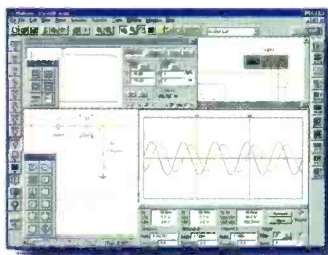
Ease-of-use continues to be one of our biggest strengths, letting you produce designs in the time it takes to install and configure most other programs.

Our unique combination of power and unrivaled ease-of-use allows us to offer this guarantee. Power means you get capabilities simply not available elsewhere, such as patented co-simulation of SPICE/VHDL/Verilog/RF all together.

That's why we are the EDA supplier of choice to over 150,000 users worldwide.

****FREE Virtual Lab with Poptronics Circuits!**

Check out the circuits from recent issues, including this month's! Tweak the circuits and see the instruments respond instantly. Download the Multisim demo with pre-built Poptronics circuits from www.electronicworkbench.com/poptronics



multiSIM 2001 from \$399

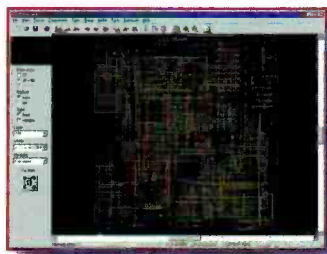
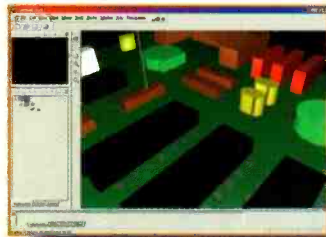
SCHEMATIC CAPTURE, SIMULATION & PROGRAMMABLE LOGIC

- ▶ Advanced modeless schematic capture
- ▶ Library of 16,000 parts supplied, with 12 million online
 - ▶ Analog, digital and mixed-mode simulation
 - ▶ Patented co-simulation of SPICE, VHDL and Verilog
 - ▶ Suite of "virtual instruments" including oscilloscope, wattmeter, spectrum analyzer & network analyzer
 - ▶ Design collaboration across the Internet

ultiBOARD 2001 from \$399

POWERFUL PCB LAYOUT

- ▶ Powerful & easy-to-use PCB layout & editing
 - ▶ Reroute while move (full rubberbanding)
 - ▶ 3D board visualization
 - ▶ Real-time design rule check
 - ▶ Component push & shove with springback
 - ▶ Extensive copper placement capabilities



ultiROUTE from \$399

AUTOROUTING & AUTOPLACEMENT

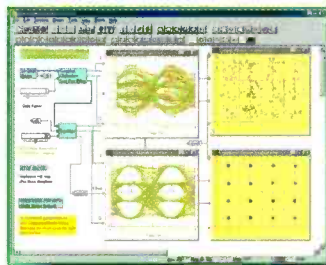
- ▶ Benchmark test leader with superior routing results
- ▶ Combination of grid-based/gridless routing available
- ▶ Highly flexible router provides complete control
 - ▶ Optimal part placement improves routing performance
 - ▶ Supports manual wire pre-placement
 - ▶ Pin and gate swap

CIRCLE 130 ON FREE INFORMATION CARD

commsIM 2001 from \$399

NETWORK & COMMUNICATIONS SIMULATION

- ▶ Powerful, yet easy-to-use fast, accurate simulation tool
- ▶ Model & simulate end-to-end communications systems
- ▶ Analog, digital & mixed system design capability
 - ▶ Industry-leading block libraries — channels, encoders/decoders, modulators/demodulators
 - ▶ View simulation results in various methods — time domain, frequency domain, xy plots, log scale, eye diagrams and power spectra



sales: 800.263.5552 • <http://www.electronicworkbench.com>