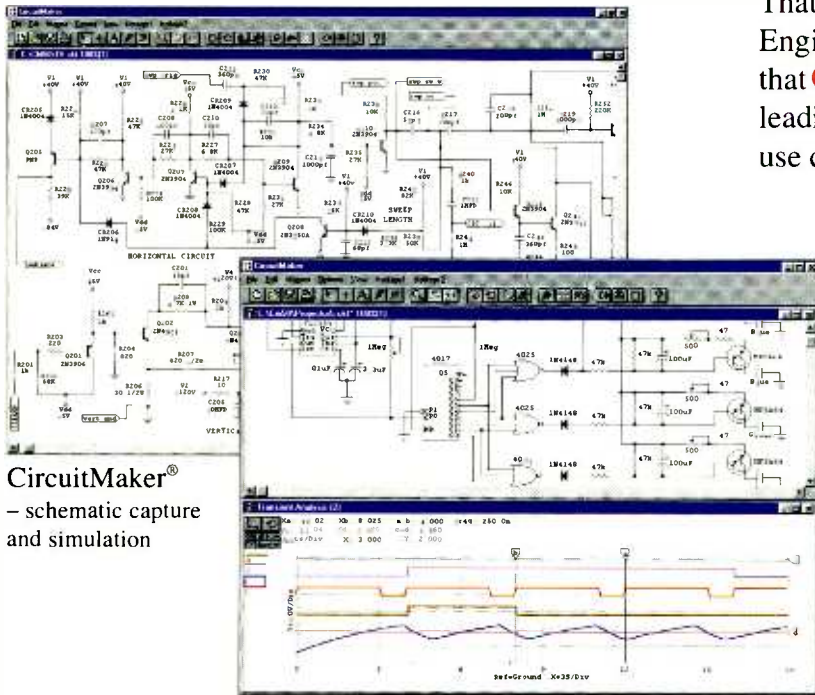


Professional Power

at a hobbyist price.

That has been our philosophy at MicroCode Engineering since 1987. So it's no surprise that **CircuitMaker** and **TraxMaker** are the leading software tools for affordable, easy-to-use circuit design, simulation and PCB layout.



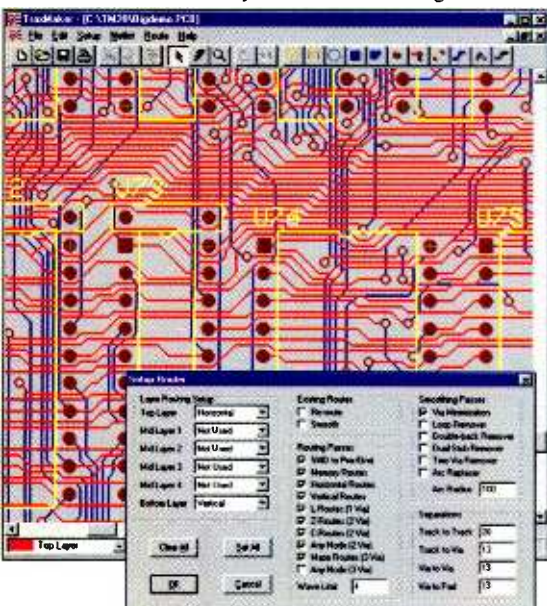
CircuitMaker®
– schematic capture and simulation

QUICKLY DESIGN analog, digital or mixed analog/digital circuits with CircuitMaker's advanced schematic features. You fully control the wiring, device placement, annotation and colors. And the Symbol Editor and macro features let you create unlimited custom devices and symbols.

SIMULATE and **ANALYZE** what you create – try all the “what if” scenarios with:

- Fast, proven 32-bit SPICE 3f5/XSpice simulator
- True mixed analog/digital simulation
- Fully interactive digital logic simulation
- 4,000-device library
- AC Frequency Analysis
- DC Operating Point Analysis
- DC Transfer Function
- Transient Analysis
- Step Function – step component values and sources over a user-definable range

TraxMaker® – PCB layout and autorouting



TAKE MEASUREMENTS at any point in the circuit with a click of the Probe tool. Results appear immediately on virtual instruments like the Digital Oscilloscope, Curve Tracer, Digital Multimeter and Bode Plotter. No other simulator lets you take measurements as quickly and easily as CircuitMaker.

COMPLETE the design process with TraxMaker, a professional printed circuit board layout program with built-in autorouter. Import netlists from CircuitMaker and other schematic programs, or design boards from scratch.

- Includes autorouter, auto component placement and Design Rules Check
- Supports up to 8 copper layers, board sizes up to 32 x 32 inches
- Surface mount and through-hole components from a customizable library
- Outputs your PCB as a Gerber file, Excellon N/C drill file, and prints to any Windows-selectable printer or plotter

RELY ON free technical support from qualified engineers. And every MicroCode product is backed by our **30-day Money-Back Guarantee** if it does not live up to your expectations.

Call 800-419-4242 for more information and free demos

(or download from www.microcode.com)

CIRCLE 171 ON FREE INFORMATION CARD

CircuitMaker Version 5	\$299
TraxMaker Version 2	\$299
CircuitMaker Design Suite™	\$549
(CircuitMaker and TraxMaker)	

CONTENTS

OCTOBER 1997

ON THE COVER**41 BUILD THE MARINELIFE UNDERWATER ACOUSTIC SENSOR**

Most of us think of the sea as a quiet, tranquil place. In truth, however, it is anything but. The denizens of the deep create a wide variety of sounds—some familiar, some mysterious. Then there are the sounds created by Man. The problem is, human ears are just not built to hear the cacophony of sound that exists under the sea. But this month's cover story, about an educational and fun listening device with a special transducer that's designed to withstand the rigors of undersea use, gives Humans a way to eavesdrop on the wondrous world that exists under the water. — *Bill Green*

**TECHNOLOGY****45 A NEW VOLTAGE STANDARD**

How superconductor technology is being used to create a new, programmable voltage standard.

— *Douglas Page*

50 RECRUITING TOMORROW'S ELECTRONICS TECHNICIANS

What can be done today to prevent a shortage of technicians tomorrow.

— *Joel Goldberg, Ph. D, CET, CA*

56 ENERGY FROM FUEL CELLS

Will fuel cells help us extract the most energy possible from our dwindling fuel reserves?

— *Alvin Sydnor*

As a service to readers, ELECTRONICS NOW 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, ELECTRONICS NOW disclaims any responsibility for the safe and proper functioning of reader-built projects based upon or from plans or information published in this magazine.

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

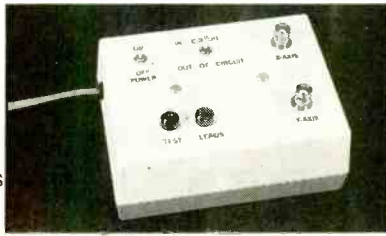
ELECTRONICS NOW, (ISSN 1067-9294) October 1997. Published monthly by Gernsback Publications, Inc., 500 Bi-County Boulevard, Farmingdale, NY 11735-3931. Periodicals Postage paid at Farmingdale, NY and additional mailing offices. Canada Post IPM Agreement No. 334103, authorized at Mississauga, Canada. One-year subscription rate U.S.A. and possessions \$19.97, Canada \$27.79 (includes G.S.T. Canadian Goods and Services Tax, Registration No. R125166280), all other countries \$28.97. All subscription orders payable in U.S.A. funds only, via international postal money order or check drawn on a U.S.A. bank. Single copies \$3.99. © 1997 by Gernsback Publications, Inc. All rights reserved. Printed in U.S.A.

POSTMASTER: Please send address changes to ELECTRONICS NOW, Subscription Dept., Box 55115, Boulder, CO 80328-5115.

A stamped self-address 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.

BUILD THIS

53 BUILD THE QUICK-TESTER
 Test a wide variety of devices—even in-circuit—with an oscilloscope and this handy tester.
 — James Melton



59 BUILD A SOLAR-CHARGE CONTROLLER
 Get the maximum efficiency from your solar-power system.
 — Blake Reed



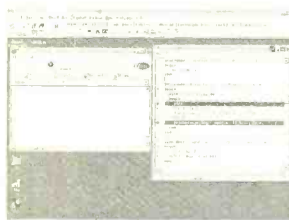
DEPARTMENTS

18 EQUIPMENT REPORT
 RF-Link Wavecom Sr. A/V rebroadcaster.



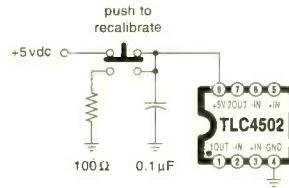
22 AUDIO UPDATE
 Setting up the Wien-bridge audio generator.
 — Franklin J. Miller

29 SERVICE CLINIC
 Repairing microwave ovens.
 — Sam Goldwasser



34 COMPUTER CONNECTIONS
 The Internet, Java, and hype aplenty.
 — Jeff Holtzman

69 TECH MUSINGS
 Measuring low-voltage signals, reading Web site log files, and more.
 — Don Lancaster



AND MORE

- | | |
|----------------------|------------------------------|
| 4 EDITORIAL | 25 NEW PRODUCTS |
| 6 WHAT'S NEWS | 33 NEW LITERATURE |
| 8 LETTERS | 118 ADVERTISING INDEX |
| 12 Q&A | 118 ADVERTISING SALES |

Electronics NOW®

Hugo Gernsback (1884-1967) founder

LARRY STECKLER, EHF, CET,
 Editor-in-chief and publisher
ADRIA COREN, Vice-President
KEN COREN, Vice-President

EDITORIAL DEPARTMENT
CARL LARON, editor
JOSEPH J. SUDA, technical editor
JULIAN S. MARTIN, associate editor
EVELYN ROSE, assistant editor
TERI SCADUTO, assistant editor
MICHAEL A. COVINGTON, N4TMI
 contributing editor
SAM GOLDWASSER, service editor
JEFFREY K. HOLTZMAN,
 computer editor
FRANKLIN J. MILLER,
 audio editor
DON LANCASTER,
 contributing editor
DEBBIE CYBULA, editorial assistant

ART DEPARTMENT
ANDRE DUZANT, art director
RUSSELL C. TRUELSON, illustrator

PRODUCTION DEPARTMENT
RUBY M. YEE, production director
KATHRYN R. CAMPBELL,
 production assistant
KEN COREN,
 desktop production director
LISA BAYNON, desktop production
MELISSA GIORDANO, desktop production

CIRCULATION DEPARTMENT
THERESA LOMBARDO,
 circulation manager
GINA GALLO,
 circulation assistant

REPRINT DEPARTMENT
MICHELE TORRILLO, reprint bookstore
 Typography by Mates Graphics

Electronics Now is indexed in *Applied Science & Technology Index*, and *Readers Guide to Periodical Literature*, *Academic Abstracts*, and *Magazine Article Summaries*.
 Microfilm & Microfiche editions are available. Contact reprint bookstore for details.

Advertising Sales Offices listed on page 118.

Electronics Now Executive and Administrative Offices
1-516-293-3000.

Subscriber Customer Service:
1-800-999-7139.
7:00 AM-6:00 PM Monday-Friday MST

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



Audit Bureau of Circulations
 Member

Where do more people go for electronics accessories?



Surprised?
Of course you weren't.

RadioShack has the accessories people need for all sorts of personal electronics. Need a case for your cellular phone, a longer-lasting battery, a universal remote control, an adapter for your portable CD player? We can provide accessories that will help you get the most enjoyment and greatest benefit from thousands of products. No matter who made it or where you bought it—you already know who'll get you connected. For our store near you, call 1-800-THE-SHACK®.

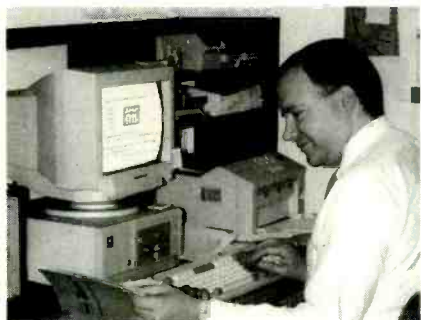


RadioShack®

You've got questions. We've got answers.®

CIRCLE 78 ON FREE INFORMATION CARD

EARN YOUR B.S. DEGREE IN COMPUTERS OR ELECTRONICS



By Studying at Home

Grantham College of Engineering, now in our 47th year, is highly experienced in "distance education" – teaching by correspondence – through printed materials, computer materials, fax, modem, and phone.

No commuting to class. Study at your own pace, while continuing on your present job. Learn from easy-to-understand but complete and thorough lesson materials, with additional help from our instructors.

Grantham offers three separate distance-education programs, leading to the following accredited degrees;

(1) the B.S.E.T. with Major Emphasis in Electronics. (2) The B.S.E.T. with Major Emphasis in Computers. (3) The B.S.C.S. – the Bachelor of Science in Computer Science.

The B.S.E.T. programs now include Electronics Workbench Professional 5.0.

An important part of being prepared to *move up* is holding the right college degree, and the absolutely necessary part is knowing your field. Grantham can help you both ways – to learn more and to earn your degree in the process.

Write or phone for our free catalog. Toll free, 1-800-955-2527, or see mailing address below.

•
Accredited by
the Accrediting Commission of the
Distance Education and
Training Council

•
GRANTHAM
College of Engineering
Grantham College Road
Slidell, LA 70460

EDITORIAL

Between Earth and Mars

This past July, after a nearly 21-year absence, Man's presence returned to Mars in the form of the Mars Pathfinder mission. For days, the Nation and the World seemed transfixed, first by the technical difficulties that threatened to derail the entire mission, and then to the breathtaking photographs of the Martian surface, including some whimsically named rocks including "Yogi," "Barnacle Bill," "The Couch," and so on.

Unfortunately, it sometimes seems that the collective Human consciousness is possessed with the attention span of a gnat. The comedian's jokes came quickly, but that was expected, and besides, they occasionally were even funny.

But soon after, some other, more disappointing rumblings started to make the rounds. Comments like: "Gee, it's just a bunch of rocks," "We have more pressing needs at home," "A huge waste of money and resources," and the like were soon heard in conversations, and, even worse, in the op-ed pages of some newspapers and magazines.

That is unfortunate, and perhaps truly tragic. In this writer's opinion, the Pathfinder mission represents some of the best aspects of the Human spirit: That is the ability to question and to wonder . . . Who are we? What are our neighbors like? Are we alone? If that ability has begun to wither, if our quest for knowledge has been replaced by a quest only for what benefits each of us personally and immediately, we as a species may be in big trouble.

Do the authors of the negative comments speak for the bulk of humanity? I hope not—I know that they certainly do not speak for me. Still, for the non-scientific, non-technical community, some letdown should not come as that big a surprise. After all, just weeks earlier, many of those same newspapers and magazines were trumpeting the impending landing with hype and hyperbole that was beyond what the science could possibly deliver. The fact that the mission gave scientists and geologists reams of information that they could not have obtained in any other way was not readily apparent to the common person. To many, it was indeed just a bunch of rocks, and not much different than what was seen before, or could be seen in the deserts of our own planet, so the natural question to ask is: "Why did we spend all that money?"

The funny thing is, we didn't. Estimated at around \$266 million, the entire mission cost each of us around a dollar. Most of us will pay many times that to see some far less-important entertainment—and in some cases, entertainment that turns out to be far less interesting.



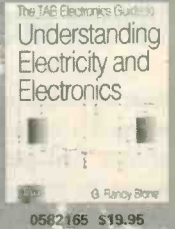
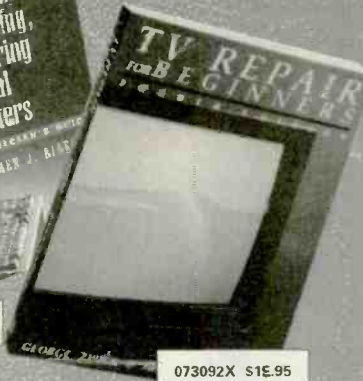
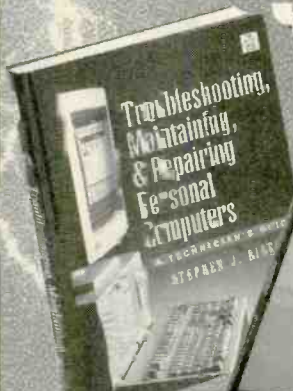
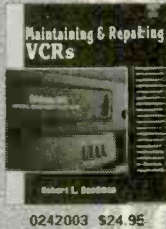
Carl Laron
Editor

ELECTRIFY Your Library

when you join EBC

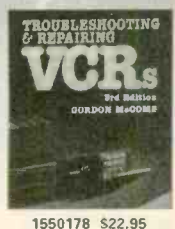
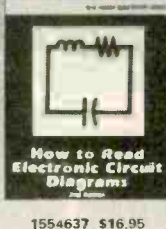
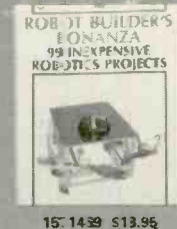
GET **5** Books
FOR ONLY
\$4.95

Values to
\$22.90



9120989-XX \$59.95
Hardcover/Courts as 2

073092X \$1E.95



As a member of the **ELECTRONICS BOOK CLUB...**

you'll enjoy receiving Club bulletins every 3-4 weeks containing exciting offers on the latest books in the field at savings of up to 50% off the regular publishers' prices. If you want the Main selection, go nothing and it will be shipped automatically. If you want another book, or no book at all, simply return the reply form to us by the date specified. You'll have at least 10 days to decide. If you ever receive a book you don't want due to late delivery of the bulletin, you can return it at our expense. Your only obligation is to purchase 2 more books during the next 12 months, after which you may cancel your membership at any time. And you'll be eligible for FREE BOOKS through our Bonus Book Program.

A shipping/handling charge and sales tax will be added to all orders. All books are softcover unless otherwise noted. Publishers' Prices as Shown © 1997 EBC

If card is missing, write to:
Electronics Book Club®

A Division of The McGraw-Hill Companies
P.O. Box 549, Blacklick, OH 43004-9918

Electronics Book Club®

A Division of The McGraw-Hill Companies

YES! Please send me the books listed below, billing me just \$4.95, plus shipping/handling & tax. Enroll me as a member of the EBC according to the terms outlined in this ad. If not satisfied, I may return the books without obligation and have my membership cancelled. I agree to purchase just 2 more selections at regular Club prices during the next 12 months and may resign anytime thereafter.

--	--	--	--

If you select a book that counts as 2 choices, write the book number in one box and XX in the next.

Name _____

Address/Apt. # _____

City/State _____ Zip _____ Phone _____

Valid for new members only, subject to acceptance by EBC. Canada must remit in U.S. funds drawn on U.S. banks. Applicants outside the U.S. and Canada will receive special ordering instructions. A shipping/handling charge & sales tax will be added to all orders.

RPIE1097



PHONE: 1-614-759-3666 (8:30 a.m. to 5:00 p.m. EST Monday-Friday)



FAX: 1-614-759-3749 (24 hours a day, 7 days a week)



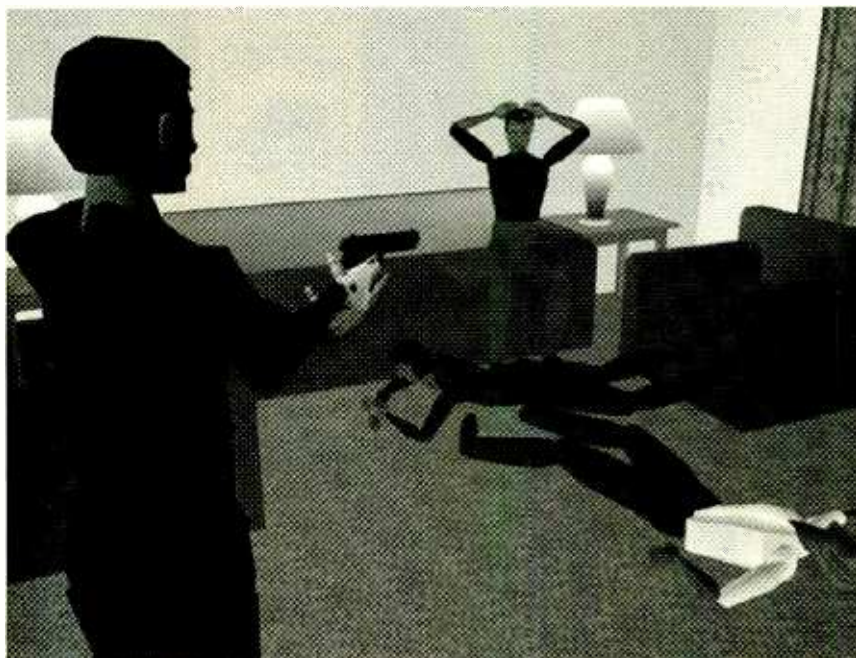
WHAT'S NEWS

A REVIEW OF THE LATEST HAPPENINGS IN ELECTRONICS

Virtual Hostage Rescues

Researchers at Sandia National Laboratories (Albuquerque, NM) have prototyped a virtual-reality simulation that allows two-person law enforcement teams to grip guns, don virtual-reality glasses, and burst into the "environment"

VRaptor doesn't give detailed images, but rather provides important visual clues, such as a falling or rising body, lifted arms, or an outthrust weapon. "The advantage is that multiple participants can appear in embodied forms within a common, shared virtual environment," says Sandia researcher Dan Shawver.



IN THIS SCENE, A TERRORIST, wearing a white shirt, lies on the floor after being shot by a law-enforcement officer, left. The terrorist had raised his gun at the officer in the previous scene.

of hostage-takers and their victims. The simulation, called VRaptor—Virtual-Reality Assault Planning, Training, Or Rehearsal—is intended to widen access to such training while reducing cost. The participant has to determine who the hostages are, save them, take prisoner the kidnappers who surrender, and shoot those who fire weapons.

Human participants represented by graphical figures interact with four virtual-reality characters—two men and two women—in a sparsely furnished apartment. The trainees are monitored by sensors placed on their backs and hands.

"They can experience situations in which they otherwise would have no opportunity to practice effective responses."

Since the scenes are not preprogrammed, the unpredictable outcomes arise from the decisions the trainer makes for each session based upon the actions and reactions of the participants. Project leader Sharon Stansfield says, "It's less like a video game and more like a flight simulator. It familiarizes law enforcement teams with scenarios." She says the VR system is better than existing training systems in "shoot houses," where kidnappers are played by pop-up mannequins.

Magnetite-Producing Bacteria

Astrobiology scientists at NASA Ames Research Center for the SETI Institute report that desert varnish, a shiny coating on the surface of certain rocks, is home to a common mineral-producing bacteria. This is the first direct evidence that biological processes play a role in the formation of the shiny clay-metal glaze that covers rocks found in extreme climates, such as the desert.

The finding is important in that it suggests that desert varnish contains magnetite—a biologically produced, magnetic mineral—which means that it could be a useful paleobiomarker. Paleobiomarkers are fossils that indicate past signs of life.

"Desert varnish, via magnetite, might be a particularly useful paleobiomarker because the extremely dry, oxidizing environment of the desert is akin to that of other planets," said Melisa White, an associate research scientist at the SETI institute.

The team identified the magnetite-producing bacteria by growing scrapings from the desert varnish in a bacterial culture medium and then attracting the microbes with a magnet. They are now in the process of further confirming the data by extracting DNA from the desert varnish and comparing it with that from the magnetite-producing microbes.

Superconducting-Wire Development Team

With the goal of producing longer superconducting wires, which could help revolutionize electrical devices and power transmission, Los Alamos National Laboratory (Los Alamos, NM) has signed an 18-month, \$3-million Cooperative Research and Development Agreement with 3M (St. Paul, MN). As part of the

agreement, Los Alamos will join 3M, Southwire Company, and Oak Ridge National Laboratory to develop high-temperature, thin-film superconducting wires that could be used in prototype superconducting motors, generators, power cables, and other electrical device that might be introduced early in the 21st century.

Superconducting materials, which could greatly reduce costs and improve efficiency of power transmission, lose nearly all electrical resistance when chilled to very low temperatures. "High-temperature" superconductors lose resistance at or near the temperature of liquid nitrogen (-320° Fahrenheit).

"Los Alamos' Superconductivity Technology Center has been on the cutting edge of superconductor development—most recently with the introduction of a high-temperature, high-current-density, flexible superconducting tape," said Dean Peterson, leader of Los Alamos' Superconductivity Technology Center. "It seems fitting that we would be included in an initiative that could usher in the next millennium with the introduction of products that could revolutionize the way this nation and the world delivers power."

That superconducting tape has a current density of nearly one-million amperes per square centimeter at liquid-nitrogen temperatures. Its current density is close to 100 times greater than anything that had previously been developed. Current density is a measure of the amount of current that can travel through a cross section of a material. Number 12 copper wire, commonly used in many households, carries less than 800 amperes per square centimeter.

To date, Los Alamos researchers have been able to produce one-meter lengths of the "Super Tape," made of a thin film of the superconducting ceramic compound yttrium, barium, and copper oxide deposited on a strip of nickel and cubic zirconia. One-meter lengths are too short for most industrial applications. The agreement with 3M will explore ways to produce long lengths of the tape at low costs without losing its superconducting properties.

The R&D team will also explore ways to capitalize on an Oak Ridge superconducting development known as Rolling-Assisted, Biaxially Textured Substrates (RABITS). RABITS, made with a technique in which superconducting films are deposited on metals to produce high-temperature superconducting tapes, also

have shown current densities of one-million amperes per square centimeter.

"If there is a way to scale up production of the Los Alamos and Oak Ridge technologies for commercial use, their potential in applications like motors, generators, transformers, current limiters, underground power cables, and magnetic-energy storage is incredible," said William Coyne, senior vice president of 3M research and development. "Products using electrical wiring could be vastly improved. For instance, transformers could be produced at half the weight and operate without oil, and far more efficient

motors would run more quietly and produce double the output."

The use and development of superconducting materials in the next 20 years might play a key role in helping meet the world's ever-increasing demands for electricity.

"Super-V" LCD

Sharp Corporation has developed a color TFT (thin film technology) liquid crystal display (LCD) for use in desktop monitors for personal computers and

PC BOARD DESIGN

made easy



Invented in Germany
1 in Europe

EAGLE is a powerful, user-friendly, and affordable CAD package. More than 50% of our inquiries are coming through the word-of-mouth of our users!
FREE Support - No Maintenance Fee!

EAGLE 3.5

for Windows 95/NT

Select the
power you need

- * Board Layout
- * Schematic Capture
- * Autorouter

EAGLE-Professional

Max. Boardsize: 64 x 64 inches
Max. Signal-Layers: 16 / \$ 399/Mod.
\$ 1,197.00*

All three versions contain all of the powerful features of EAGLE. Limitations are only Boardsize and number of Signal-Layers.

EAGLE-Standard

Max. Boardsize: 6.25 x 3.75 inches
Max. Signal-Layers: 4 / \$ 199/Mod.
\$ 597.00*

EAGLE-Light

Max. Boardsize: 3.75 x 3 inches
Max. Sig.-Layers: 2 / 1 Sch.Sheet
\$ 150.00*

* These prices include all three modules!

800-858-8355
www.cadsoftusa.com

Order a FREE demo today, and experience EAGLE first hand. You will be surprised. For a Guided Tour, detailed information, and user comments, check out our Web site.

CadSoft Computer, Inc. Hotline (561) 274-8355 Fax (561) 274-8218 E-Mail: info@CadSoftUSA.COM

Windows 95, and Windows NT are trademarks of Microsoft Corporation.

CIRCLE 129 ON FREE INFORMATION CARD

Medical miracles start with research

American Heart
AssociationSM
Fighting Heart Disease
and Stroke



LETTERS

SEND YOUR COMMENTS TO THE EDITORS OF
ELECTRONICS NOW MAGAZINE

engineering workstations. The Super-V (Super-View) LCD, a proprietary Sharp TFT LCD, simultaneously achieves breakthroughs in viewing angle and contrast as well as brightness and low power consumption. Conventional technologies require trade-offs between those feature pairs; one feature could be emphasized only at the expense of the other.

The Super-V LCD has a wide viewing angle of 140 degrees horizontal and 110 degrees vertical. The 20.1-inch diagonal, SXGA-compatible (1280x1024) LCD is comparable in size to a 22-inch CRT, with a depth measuring just 10 centimeters (3.9 inches). Power consumption when used as a desktop monitor is approximately 40 watts.

Future applications for the Super-V LCD include presentation boards in meeting rooms, information displays for art museums, and high-resolution HDTV wall-hanging televisions.

Electronics Research Center

LG, a leading South Korean industrial group, will be establishing a research and development center in Princeton, NJ. The LG Electronics Research Center of America (LGERCA) will focus on digital multimedia and consumer electronics. Over the next five years, LG plans to invest \$40 million in the lab. LGERCA will be headed by Dr. Mark Simpson, who has held senior research positions with Adobe Systems, Apple Computer, and Xerox Corporation, and he will oversee a staff that will grow to over 20 by the end of the year.

The plan is to develop technology for network devices—an emerging category of products, which will bring new services and features to appliances, such as telephones and televisions; to develop software for embedded systems and network applications; and to conduct research on digital image and video processing. LGERCA will also serve as liaison for the collaboration that LG companies have with the Sarnoff Corporation, a world leader in digital and video consumer electronics techniques. One reason Princeton was chosen was because of its proximity to the Sarnoff Corporation.

Crystal Clear

I would like to build the FM Stereo Transmitter (**Electronics Now**, June 1997) and the CallDirector (**Electronics Now**, May 1997), and I need to find 4.864-MHz and 10.240-MHz crystals. I also need to know if the 3.58-MHz crystal in the CallDirector is the same as a 3.579545-MHz crystal. I would like to experiment with a 38-kHz crystal, too. It would be really pleasant to find all of these at one store since it would save me a lot of shipping and handling costs. Thanks in advance.

A.J. BUSH
via Internet

A good one-stop source for crystals is JAN Crystals, 2341 Crystal Drive, P.O. Box 06017, Fort Myers FL 33906-6017; Tel: 1-800-JAN-XTAL. You might also try your local RadioShack store; they can get a wide range of common crystals for you via their special order program. And yes, you can use a 3.579545-MHz crystal for the 3.58-MHz crystal specified in the CallDirector article.—Editor

Beyond my Command

In past issues of **Electronics Now** I have seen many circuits and applications that allow a PC to communicate with or control other devices via its serial or parallel port using BASIC commands (in particular, the ones by JJ Barbarello are among the best of this type I've ever seen). These days, however, I am using Windows 95, and I don't have access to a standard BASIC program. I can write programs in Microsoft Visual Basic (versions 3 and 5), but I can't seem to find the similar commands. Can you help?
PETER S. MAY
Eaton, IN

What Mr. Barbarello is doing is writing a data pattern directly to the data output port connected with LPT1. That is why he

uses the address 888 (decimal for 378—the hexadecimal address of LPT1:).

While writing directly to the hardware, although frowned upon, is done in DOS, trying that in a multi-tasking environment like Windows is a major mistake. Microsoft has built into Windows an API—application-programming interface. Many different services are built into Windows to handle many different tasks from mouse status to handling multiple child and parent windows.

Buried in there is a routine for sending data to an I/O port. A good reference book on the Windows API will show you exactly how it should be coded. You could also check some of the Visual Basic Newsgroups on the Internet. If someone else has not already asked (or answered) that question, you could post one yourself. Another source of information is the Microsoft Knowledge Base at www.microsoft.com.

A word of warning—trying to run a direct-control project like the ones developed by Mr. Barbarello might not work quite as well under Windows. The response time could be affected by how many different tasks the computer is trying to juggle at the same time. Windows 95 should give you a much better response, especially if you compile a true Windows 95 application. Windows 95 is much better at multitasking than Windows 3.1. If you upgraded your computer to Windows 95 from Windows 3.1/MS-DOS, you might have Microsoft QBASIC still hiding in your DOS folder. Although QBASIC is just an interpreter, it runs well under Windows 95.—Editor **EN**

Write To:
Letters,
Electronics Now Magazine,
500 Bi-County Blvd.,
Farmingdale, NY 11735

Due to the volume of mail we receive, not all letters can be answered personally. All letters are subject to editing for clarity and length.

Free Best Seller! Write:
Consumer Information Catalog
Dept. BEST, Pueblo, CO 81009

Studies show that jobs for computer service technicians will be up by 38% in the next 10 years.

Prepare for today's opportunities in computer service with NRI's flexible, state-of-the-art training

As an NRI student, you're in charge. You decide when and where to study. You set your own pace. You even build a computer system that suits your needs and budget. Only NRI training gives you the control you want, the expertise you need!



You prepare for A+ Certification with one-on-one instruction and NRI's CD-ROM tutorial

Throughout your course, your work is reviewed and evaluated by your experienced instructor. So even though you're studying at home, you're never alone. You can reach your instructor by mail, phone, fax, or modem.

That's right! With NRI's exclusive Online Connection you can chat with your instructor, attend online seminars, get the answers to

frequently asked questions, download supplemental materials, find out about changes in technology, and more.

As the culmination of your training, you receive NRI's interactive CD-ROM with tutorials related to the A+ Certification exam. In no time at all, you'll have the skills, experience, and confidence you need to sit for the A+ exam and take advantage of the booming opportunities in computer service. Just think — everyone with a computer is a potential client!



YOU GET EVERYTHING YOU NEED FOR SUCCESS

- **PENTIUM® 166 PC** Features 16 meg RAM, 256K cache memory, and 1.6 gigabyte hard drive for exceptional data storage capacity and data access speed
- **SUPER VGA COLOR MONITOR** Plus 1 meg video memory
- **EXCITING MULTIMEDIA PERIPHERALS** 8X CD-ROM drive, 16-bit sound card, and stereo speakers
- **FAX/MODEM** 28,800 baud for fast communications, plus Netscape Navigator™ Web browser and ten free hours of America Online
- **DIAGNOSTIC PACKAGE** The portable ForeFront Troubleshooter™ software and CD-ROM for quick detection of system and multimedia failures
- **NRI DISCOVERY LAB** Complete breadboarding system to design and modify circuits, diagnose and repair faults
- **DIGITAL MULTIMETER** Professional, hand-held test instrument for quick and easy measurements
- **WINDOWS 95** Today's popular, time-saving operating system
- **CD-ROM TUTORIAL** Easy prep for A+ Certification!

With a combination of step-by-step lessons and hands-on training projects, NRI builds your skills and confidence quickly. You begin with an exploration of electronics and move on to such cutting-edge subjects as virus protection, multimedia troubleshooting, PC communications, Local Area Networks, and more.

Best of all, you get the top-notch computer and diagnostics you need to put theory into practice — and start earning while you learn!

You train with and keep the exact computer you want

Understanding that technology changes rapidly, NRI has just created its unique PC Options Plan. When you're due to receive your Pentium® processor-based system, you're given options based on future developments in technology. You may choose the Pentium® 166 system described here or purchase selected upgrades at special student rates. It's our state-of-the-art guarantee!

No matter what PC features you prefer, you'll get the software and diagnostics respected throughout the industry: Windows 95, Netscape Navigator™, and the self-booting ForeFront Troubleshooter™ diagnostic package. No school gives you more!

FREE CATALOG!
1-800-321-4634, Ext. 2744
Visit our Home Page at <http://www.mhcec.com>

SEND TODAY FOR FREE NRI CATALOG!

NRI Schools

4401 Connecticut Avenue, NW, Washington, DC 20008

Check one **FREE catalog only. High school diploma or GED recommended for all courses, required for degree programs.**

MICROCOMPUTER SERVICING

- Computer Programming
- TV/Video/Audio Servicing
- Desktop Publishing with PageMaker

- PC Applications Specialist
- Networking with Windows NT
- Bookkeeping and Accounting

OR GET YOUR DEGREE!

- AAS Degree in Accounting
- AAS Degree in Business Management

- Visual Programming in C++
- Mastering Microsoft Office
- Webmaster

Name _____ (please print) Age _____

Address _____

City _____ State _____ Zip _____

A Division of The McGraw-Hill Companies



Accredited Member, Distance Education and Training Council

0003-1097

Q & A

READERS' QUESTIONS, EDITORS' ANSWERS

Digital Volume Controls Found

In June, a reader asked about a pushbutton-operated digital volume control. Jim Shand (Aptos, CA), Steven Herbold (via e-mail), and Franklin J. Miller (*Electronics Now's* Audio Editor) wrote to point out that Dallas Semiconductor and Xicor make ICs that do this. Xicor calls them EEPOTs or E²POTs (electrically erasable potentiometers).

Figure 1 shows how to use the simplest chip of this type, the Dallas Semiconductor DS1669. The chip contains a string of resistors, a set of analog switches that connect the output to the tap between any two resistors along the string, and digital support circuitry, including a non-volatile memory. You change taps by pressing the up or down buttons (which auto-repeat if held down more than one second), and the chip remembers its setting if powered off and then on again.

The voltages on all three terminals of the resistor string must be between +5V and ground, or close to that range. You can use ground-referenced audio signals if the amplitude is low (less than 0.4-volt peak-to-peak according to our experiments). Better yet, build the volume control into your circuit at a point that is biased above ground, such as the collector of a transistor, and you'll have no problems.

The DS1669 comes in three versions, with resistances of 10k, 50k, and 100k ohms. You can use it with all kinds of signals, not just audio.

How to use a more sophisticated volume-control chip, the Dallas Semiconductor DS1802, is shown in Fig. 2. That IC provides two stereo channels with log-taper potentiometers. As shown in the figure, the circuit uses separate "up" and "down" pushbutton switches to set the volume for the two channels, but if you ground pin 7, S1 and S2 become bal-

ance controls, with S3 and S4 controlling volume to both channels in unison. To prevent pops and crackles, the chip waits until the audio waveform crosses zero before changing position. The DS1802 does not retain its setting when powered off; instead, it sets itself to minimum volume every time it is powered up. Also note that Fig. 2 shows normally-open pushbuttons; those are correct, even though Dallas' data sheet shows them as normally closed.

Why use a digital volume control? Maybe because you like pushbuttons or because you need to control the volume using a microprocessor. But the best reason might be that there's no mechanical wiper to get dirty or wear out. Potentiometers are among the least reliable parts in modern electronic equipment, especially if there's sand, dust, or anything corrosive in the environment; these digital pots aren't bothered by sand or chemicals.

Both the DS1669 and the DS1802 have serial interfaces for microprocessors. You can purchase these chips directly from Dallas Semiconductor by calling 800-336-6933 or 972-371-4000; they take credit cards. Data sheets are available from <http://www.dalsemi.com> or by writing to Dallas Semiconductor, 4100 Spring Valley Road, Suite 302, Dallas, TX 75244. Similar Xicor products are described on the Web at <http://www.xicor.com>. You can contact Xicor at 3333 Bowers Avenue, #238, Santa Clara, CA 95054.

A Dot of A Different Color

Q I have a rather extensive home theater system that includes nine channels of amplification from three different amplifiers. I'd like to construct a novel VU meter system to display outputs of several of the amplifier channels.

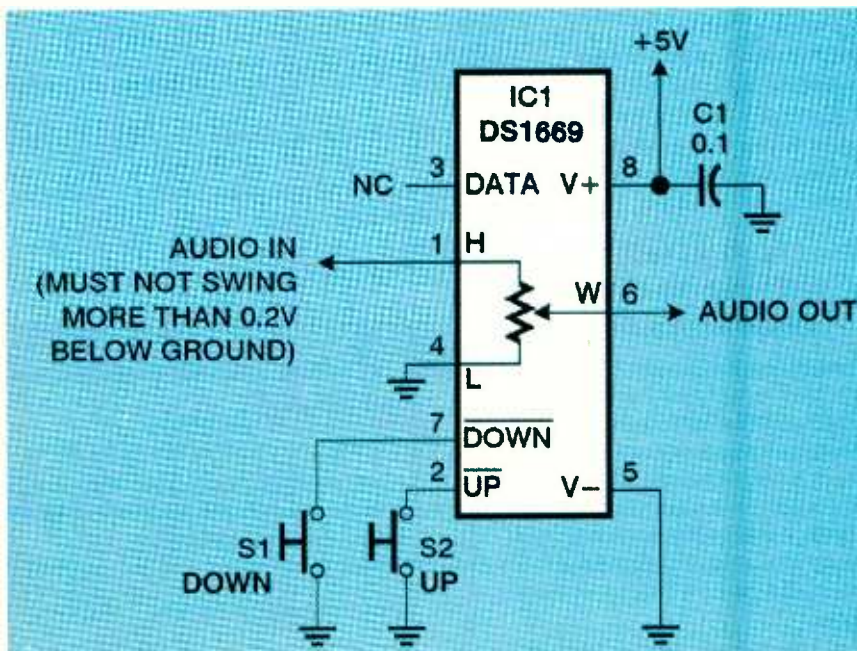


FIG. 1—THE DALLAS SEMICONDUCTOR DS1669 IC acts as a pushbutton-controlled potentiometer. The device comes in 10k, 50k, and 100k versions, and retains its setting when power is removed.

JAMECO - Your One Stop Component & Computer Source

Special Prices for Electronics Now Readers. Please mention VIP #0R7!

486SLC-66 Multimedia System

System includes:

- 4MB RAM
- 420MB hard disk drive
- 512KB SVGA
- 2X CD-ROM
- Sound card and speakers
- 101-key keyboard
- 2-button mouse
- MS Windows® for Workgroups
- MS Works™
- Computer Care Kit

Monitor not included

Part No.	Description	Price
132281	486SLC com. sys.	\$474.95

MicroPlug™ PIC™ Prototyping System

- With this flexible design system, the perf area can be detached from the microcontroller area allowing changes without scrapping the board
- 141170: Micro2 processor board for 28-pin DIPs
- 139272: perf board for use with Micro2 processor board
- 141188: parts kit for Micro2 board

141170

139272

141188

Part No.	Description	Price
141170	Micro2 processor board	\$17.95
139272	MicroPerf proto board	\$11.95
141188	Parts kit for Micro2	\$9.95

PCI Bus Prototype Board

- All plated through holes
- 0.1" hole spacing
- Impedance matched to bus specifications
- Allows mounting access to every signal on the bus
- Size: 12.4"L x 5.0"W • Weight: 0.6 lbs.

Part No.	Description	Price
141372	PCI prototype brd	\$69.95

PCI Bus Extender Card

- Expands life of motherboard connectors
- Size: 5.9"L x 5.4"W
- Weight: 0.4 lbs.

Part No.	Description	Price
141381	PCI bus ext. card	\$69.95

Jameco Electronic Component Cabinet Kits

Kits include the most popular components with extra space for your customized expansion. Each kit includes a 20 drawer component cabinet.

More kits available - call for details!

Part No.	Description	Price
84953	330 pc. 7400 series IC kit	\$169.95
84961	420 pc. 74LS series IC kit	\$119.95
84970	300 pc. CD4000 series IC kit	\$84.95
84988	385 pc. Linear series IC kit	\$159.95
108329	540 pc. 1/8 watt Resistor kit	\$29.95
81832	540 pc. 1/4 watt Resistor kit	\$28.95
107879	540 pc. 1/2 watt Resistor kit	\$31.95
108433	2200 pc. Electr. Hardware kit	\$39.95
81867	110 pc. Radial Capacitor kit	\$34.95
81859	320 pc. Ceramic Capacitor kit	\$29.95
81883	160 pc. Mylar Capacitor kit	\$34.95
81841	129 pc. Tantalum Capac. kit	\$49.95
82587	270 pc. Diode kit	\$39.95
82595	180 pc. Transistor kit	\$49.95

LG Precision 3 1/4-Digit LCD Digital Multimeter

- DC voltage range: 300mV - 450V
- AC voltage range (50/60Hz): 3V - 450V
- DC current: 300µA - 300mA
- AC current (50/60Hz): 300µA - 300mA
- Resistance: 300Ω - 30MΩ
- Auto ranging w/ manual ranging override
- Size: 2.5"W x 1.0"D x 4.8"H
- Weight: 0.5 lbs. • One-year warranty

Part No.	Product No.	Price
143757	DM733	\$29.95

EDWin NC (CAD/CAE) Software

The first truly seamlessly integrated suite of software running in all Windows® formats...simulation, schematics, and PCB design.

Part No.	Description	1-4	5-9
141680	EDWin NC	\$149.95	\$134.95

Jameco 66 Piece Tool Kit

A comprehensive set of tools for field technicians, engineers and lab personnel. Aluminum case features removable pallets, surface-type locks, a black plastic handle, side buckles and strap. • Size: 18.0"L x 14.0"W x 6.0"H • Wt: 18.2 lbs.

Part No.	Description	1-4	5-9
105646	66 piece tool kit	\$179.95	\$161.95

Jameco 54 Watt Switching Power Supply

- Input: 110/220VAC @ 47/63Hz
- Overcurrent protection: 110-130% automatic current limiting
- Minimum load: all outputs at 10% of rated load
- Data sheet included
- Size: 6.3"L x 3.9"W x 1.5"H
- Weight: 1.2 lbs. • One-year warranty

Part No.	Product No.	1-9	10-24
17056	FCS604A	\$44.95	\$39.95

Jameco ABS Speedy Boxes

Will not crack or split when drilled or punched. PCB mounting slots on all four sides and the lid has a lip for precision fit (adds 0.4" height). Complete with four screws and lid. All sizes below are for interior dimensions. • Black ABS plastic

Part No.	Size (L x W x D)	1-9	10-49	50-99
18921	3.1" x 2.0" x 0.9"	\$2.25	\$1.95	\$1.59
18913	4.9" x 2.5" x 1.5"	2.49	2.25	1.79
18892	6.0" x 3.5" x 1.9"	2.95	2.69	2.39
18905	7.5" x 4.3" x 2.3"	3.49	2.95	2.49

1 and 3 Axis Accelerometer Modules and Interface Card

- For motion sensing, vibration analysis and other acceleration applications

Part No.	Description	Price
141591	1 axis accelerometer	\$89.95
141575	3 axis accelerometer	\$159.95
141583	Digital interface card	\$199.95

Jameco 900MHz CCD Wireless Audio/Visual Observation System

- Get excellent audio and visual clarity in your monitoring applications.
- 4-channel transmission/receiving modules
- Supports NTSC format
- VCR ready for recording
- Transmission distance up to 200 meters
- Weight: 6.7 lbs. • One-year warranty

Part No.	Description	Price
135976	900MHz observation sys.	\$329.95

Jameco Laser Pointer Kit

- Power requirements: 2 AAA batteries (included)
- Some soldering required
- Size: 4.5"L x 1.0"W x 0.6"H
- Weight: 0.4 lbs. • One-year warranty

Part No.	Description	Price
121339	Laser pointer kit	\$35.95

NetMouse

- New innovative way for browsing the Internet! With the magic button feature you can easily scroll through your Windows® and documents.
- Includes software and PS/2 pin adapter
- Weight: 0.5 lbs. • One-year warranty

Part No.	Description	Price
141815	4-button serial mouse	\$29.95

4-Button Joystick with View Control

- IBM PC/XT/AT or 100% compatible
- Rotary control for extra thrust, 4 fire buttons for easy access, x and y axis trim controls
- Size: 10"L x 7"W x 9"H • Weight: 3.1 lbs.

Part No.	Description	1-4	5-9
141364	4-button joystick	\$49.95	\$44.95

High Luminous Intensity White LEDs

- Part No. Size 1-9 10-99 100 1000
- 142885 T1 ... \$4.95 \$4.49 \$3.95 \$3.49
- 142893 T1 1/2 ... 4.95 4.49 3.95 3.49

Hyper Peppy Robot Kit

- Changes course when comes in contact or hears a loud sound

Part No.	Description	Price
140863	Robot kit	\$24.95

Unipolar Stepper Motor Driver Kit

- Will drive unipolar stepper motors rated at 6-30VDC @ 1.25A (or less)
- Drives 5, 6 or 8 lead unipolar stepper motors
- Standard and wave drive
- Output: 50V max. • Weight: 0.07 lbs.
- Size: 2.6"L x 1.9"W x 1.0"H

Part No.	Product No.	1-4	5-9
139109	DK-109	\$29.95	\$26.95

Speech Recognition Circuit Kit

- Speaker dependent
- External RAM support
- Maximum 40 word recognition at .96 seconds word length
- Requires 9VDC battery • Weight: 0.6 lbs.

Part No.	Description	1-4	5-9
141401	Speech kit	\$99.95	\$89.95

Making Your Own Printed Circuit Board Book

Design and create your own printed circuit board inexpensively and reliably. (37 pages) • Size: 8.5" x 11" • Weight: .05 lbs.

Part No.	Description	1-4	5-9
141524	Making PCBs Book	\$14.95	\$13.49

Robotics 14.4 kbps Data/Fax Internal Modem

- Supports 14.4 down to 300 bps of data
- Compatible with ITU-T standard
- System requirements: 486 or Pentium®, Windows® 3.xx to Win® 95, 4MB RAM, 2MB hard disk space • One-year warranty

Part No.	Description	Price
139871	14.4 int. modem	\$34.95

139 Piece LED Hardware Assortment

- LED panel lenses and circuit mounts
- Red, yellow, green, blue and clear lenses
- Mounts and pre-wired solderless LED indicators
- LED PCB mounts, sockets and standoffs
- Size: 8.5"L x 4.5"W x 1.5"H • Weight: 0.4 lbs.

Part No.	Description	1-4	5-9
140759	LED hardware kit	\$22.95	\$19.95

Jameco Solderless Breadboards

- Low static plastic body - CMOS safe
- Nickel plated clips designed to withstand up to 5,000 insertion cycles

Part Number	Contact Points	Size L x W	1-9	10-49
94457	100	6.5 x 0.4	\$2.49	\$2.25
20600	400	3.3 x 2.1	4.95	4.49
136910	960	5.5 x 2.8	Classroom!	7.95
136901	1,600	5.5 x 2.3	21.95	19.95
20669	630	6.5 x 1.4	5.49	4.95
20722	830	6.5 x 2.1	7.95	6.95
20757	1,360	6.5 x 3.1	11.95	10.95
20773	1,660	6.5 x 4.3	17.95	15.95
20790	2,390	6.9 x 5.8	22.95	20.49
20811	3,220	7.3 x 7.5	30.95	27.95



1355 Shoreway Road
Belmont, CA 94002-4100
FAX: 1-800-237-6948 (Domestic)
FAX: 415-592-2503 (International)
E-mail: info@jameco.com
http://www.jameco.com

Order Toll Free 24-Hours
7-Days a Week!



Call 1-800-831-4242 day or night!

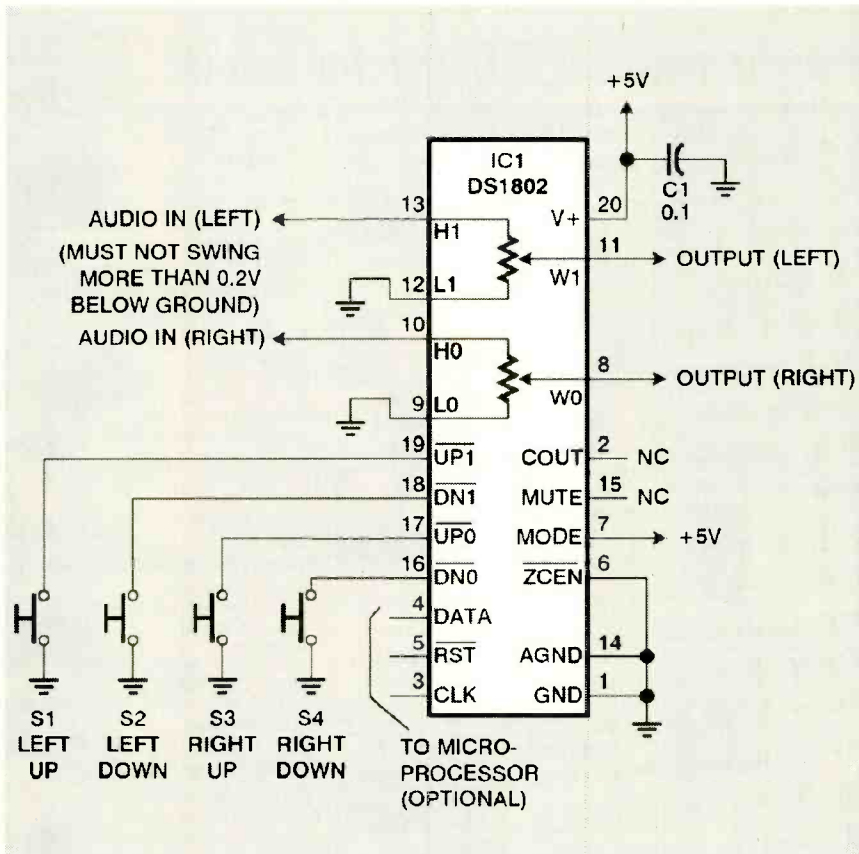


FIG. 2—THE DS1802 IS A HIGHER-PERFORMANCE audio-volume control that offers two channels, log taper, low noise, and zero-crossing detection.

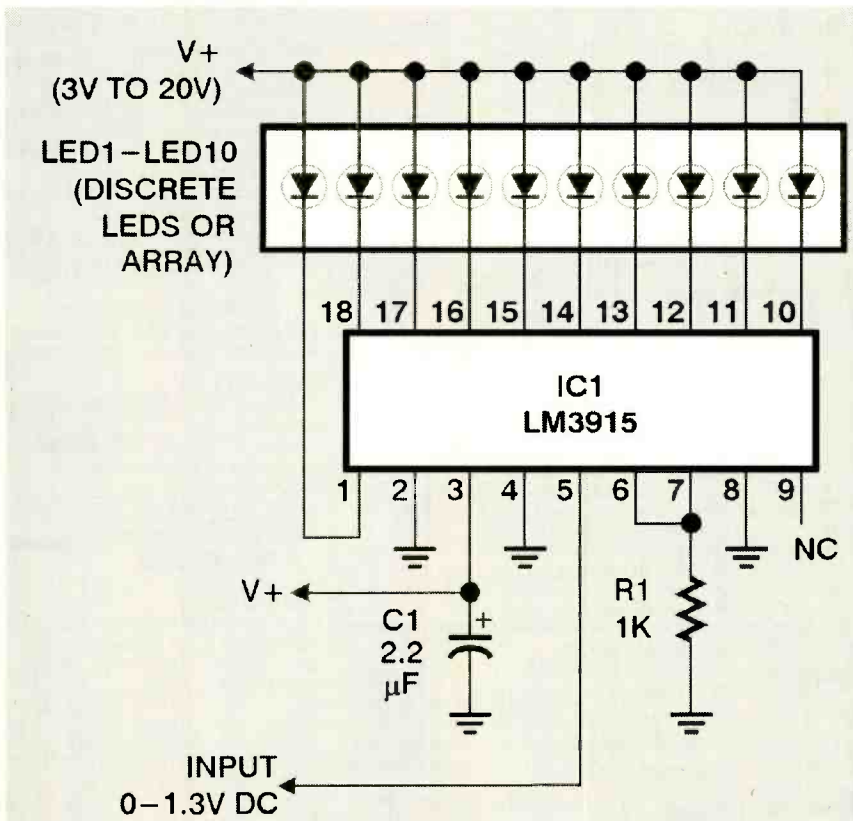


FIG. 3—HERE'S A BASIC MOVING-DOT display built around the LM3915. Note that grounding pin 9 provides a bargraph display.

Can you tell me how to use the National Semiconductor LM3915 integrated circuit in a "moving dot" display using two-color LEDs? My desire is to have a moving red dot on a green background to display amplifier output. — P. D., Portsmouth, NH

A The LM3914, 3915, and 3916 ICs let you use a row of LEDs as a meter, either in moving-dot or in bargraph mode. The LM3914 is linear; the LM3915 is logarithmic (hence good for audio work); and the LM3916 more closely matches the behavior of a VU meter.

Figure 3 shows the basic circuit. National Semiconductor's data sheets, available from <http://www.natsemi.com>, tell you in detail how to supply the input, which can be taken across a speaker through a resistor network.

Your idea of a moving red dot on a green background is a good one, but because green LEDs look brighter than red ones, you might want to do it the other way around, as a moving green dot on red.

Figures 4 and 5 will help you to implement your idea. As Fig. 4 shows, the LM3915 contains a switching transistor and current limiter for each LED. By putting a 10k resistor in place of the LED, you can obtain a logic-level output, which you can then feed to a pair of CMOS inverters, as shown in Fig. 5. The polarity across the LED reverses depending on the logic level, making it switch from one color to the other. Which color is "high" and which color is "low" depends on which way the two-color LED is inserted, of course. If it alternates rapidly between green and red, it will look yellow. Note that while Fig. 5 specifies a 74HC04 CMOS hex inverter, you could also use a 74HCU04, 74HCT04, or, for a wider range of supply voltages, 4049.

Disk Drives and Flybacks

Q In April, a reader asked how to use a 16-bit IDE disk drive in an 8-bit PC XT. A suitable adapter, with onboard BIOS, is available as part #10268 from Jameco Electronics, 1355 Shoreway Road, Belmont, CA 94002 (Tel.: 800-831-4242) for about \$55.

Now for my question: Where can I get schematics and parts such as flybacks for older TTL computer monitors? I've tried many places and no one has been able to help. — Steve Fuesting, Effingham, IL

A Thanks for the tip! Jameco has a number of hard to find parts for older computers, even Apple IIs.

As to your question, the trouble with TTL monitors such as the IBM Monochrome Display is that they're completely obsolete—you can get a complete used monitor cheaper than you can get any spare parts, and if you look in the right places, people are giving old monitors away.

The schematic of the IBM Monochrome Display was published in the *IBM Personal Computer Technical Reference* (1982). It's a single page with no explanatory text. Some newer IBM monitor service manuals can be purchased from <http://www.us.pc.ibm.com/cdt/hmm.html>, and Service Editor Sam Goldwasser's excellent notes on monitor repair are online at <http://www.paranoid.com/~filipp>.

Apart from that, there's not much information available. Magazines such as *Computer Hotline* and *Nuts and Volts* used to carry ads for monitor parts and repair guides, but in recent issues the pickings have become very slim. As a last resort, go to the newsgroup sci.electronics. repair and post your questions; if anyone on earth knows, you'll probably find them there.

Half A Digit?

Q I recently started a course in electronics and am puzzled by a term used when describing the features of digital multimeters. Can you explain what is meant by a "4 1/2 digit display"? — I. J., Trinidad & Tobago

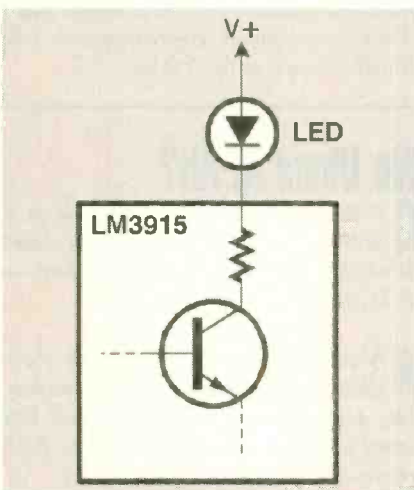


FIG. 4—EACH OF THE LM3915's outputs features an internal switching transistor and a current limiter, which is shown here as a resistor.

Wavetek. The Way Value Is Measured.

For the best values in digital multimeters everyone is turning to the Wavetek XT Series. Each of these full-function DMMs measures voltage, current, resistance, and also a set of additional electrical or electronic properties you work with every day. Inductance. Capacitance. Frequency.

Temperature. There is an XT Series DMM right for you.

With oversized character displays, these DMMs are as easy to read as they are to use. All have fully-fused current inputs and input warning beepers to protect you and the meter. Each comes with safety test

leads and are approved to IFC1010-1 safety standards.

Our commitment to reliability and high quality is backed by the industry's only "No Hassle" warranty program. If your XT Series meter requires

warranty service, your local dealer replaces it immediately. Call today for full details and the names of your local Wavetek distributors. You'll find that when it comes to Wavetek performance and price, nothing else measures up.

Wavetek Corporation
9145 Balboa Avenue, San Diego, CA 92123
(800) 854 2708

WAVETEK



27XT

A unique combination of DMM and component checking in a single meter.

- Inductance
- Capacitance
- Logic
- Frequency

Accessories include current clamps, RF & HV probes, temperature converters, holsters, boots and carrying cases.

23XT

Electronic and electrical test functions for general duty and HVAC/R.

- VAC Safety Tester
- Temperature
- Transistor
- Logic

25XT

A full C-meter in a DMM, and more! Ideal for AV, cell-phone & antenna matching, component inspection.

- Full Capacitance 0.1pF to 20mF
- Capacitance Zeroing & Test Slots

28XT

A thermometer + DMM for HVAC/R, building or plant maintenance.

- Temperature
- Capacitance
- Frequency
- Max-Hold

85XT

A precision True-RMS reading DMM, ideal for equipment like copiers.

- 4 1/2 digit Accuracy
- True-RMS
- Frequency
- Duty Cycle

LCR55

Full-function LCR, extra test features for "best-buy" in a component dealer.

- Inductance
- Capacitance
- Resistance
- Transistor
- Dual Diode

HOW TO GET INFORMATION ABOUT ELECTRONICS

On the Internet: See our Web site at <http://www.gernsback.com> for information and files relating to our magazines (**Electronics Now** and **Popular Electronics**) and links to other useful sites.

To discuss electronics with your fellow enthusiasts, visit the newsgroups sci.electronics.repair, sci.electronics.components, sci.electronics.design, and rec.radio.amateur.homebrew. "For sale" messages are permitted only in rec.radio.swap and misc.industry.electronics.marketplace.

Many electronic component manufacturers have Web pages; see the directory at <http://www.hitex.com/chipdir/>, or try addresses such as <http://www.ti.com> and <http://www.motorola.com> (substituting any company's name or abbreviation as appropriate). Many IC data sheets can be viewed online.

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, 1-800-872-7423) 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 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.

Copies of past articles: Copies of past articles in **Electronics Now** and **Popular Electronics** (post 1992 only) are available from our Claggk, Inc., Reprint Department, P.O. Box 4099, Farmingdale, NY 11735; Tel: 516-293-3751.

Electronics Now 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 (1-800-428-7267). The free Sams catalog also lists addresses of manufacturers and parts dealers. Even if an item isn't listed in the catalog, it pays to call Sams; they may have a schematic on file which they can copy for you.

Manuals for older test equipment and ham radio gear are available from Hi Manuals, PO Box 802, Council Bluffs, IA 51502, and Manuals Plus, PO Box 549 Tooele, UT 84074.

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

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

Hamfests (swap meets) and local organizations: These can be located by writing to the American Radio Relay League (Newington, CT 06111; <http://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.

Audio Time Delay

Q I am looking for a 0–3 second monophonic audio-delay circuit to use with a PA system for special effects and to compensate for distant speaker placements. Would it be better for this processing to occur before or after the amplifier? Would passive or active circuitry be preferred? —D.F.C., Concord, OH

A The processing should definitely be done ahead of the amplifier so that it

doesn't have to deal with high power levels. Active circuitry will be necessary—an LC delay line long enough for 3 seconds would be enormous and would lose nearly all of the signal.

Instead, use bucket-brigade devices. These are analog memories that record a signal level and play it back after a time delay. As the name implies, the memory consists of many cells, and the signal is passed from one to another until it reaches the end.

Panasonic bucket-brigade devices and data books are available from Digi-Key (701 Brooks Ave. S., Thief River Falls, MN 56701; Tel.: 1-800-DIGIKEY). Call them for a free catalog. They're on the Web at <http://www.digikey.com>. Oddly, Panasonic semiconductor data sheets do not appear to be on the Web yet.

Flip-Flop Tip

Q In your February issue, your Q&A column addressed a question about erratic flip-flops. The writer used a 7473, which, as I recall, had a peculiarity that was not well documented. For the chip to function as described in the truth table, the J and K inputs must not change while the Clock input is high. Could that have been the reader's problem? —

R. A. Browning, N. Las Vegas, NV

A That's right—the 7473 is easily disrupted by momentary changes in J and K at times when it ought to ignore them. This effect is called "ones-catching" and, in their book, *The Art of Electronics*, Horowitz and Hill warn that it "can have dire consequences for the unsuspecting." They recommend edge-triggered J-K flip-flops such as the 74112.

No Ohms At All?

Q What does a zero-ohm resistor do in a circuit? How do you measure zero ohms? What is a zero-ohm resistor used for? —P. D., Warren, RI

A A zero-ohm resistor conducts electricity with no appreciable resistance, like a plain piece of wire. (It still has some resistance, of course—maybe 0.01 ohm—but it's too small to notice.)

You can measure zero ohms with any ohmmeter—it's the reading you get if you touch the probes together with no resistor between them.

A Certainly. A "half digit" is a digit that goes only from 0 to 1, not 0 to 9. Thus, a display that goes up to 19999 (not 99999) is a four-and-a-half digit display. It's more than four digits but less than five.

Most digital multimeters (DMMs) have 3½ digits, i.e., they go from 0000 to 1999 (with the decimal point freely movable).

A few DMMs have a "¾ digit" that goes from 0 to 3. Thus, a 3¾-digit display goes from 0 to 3999.

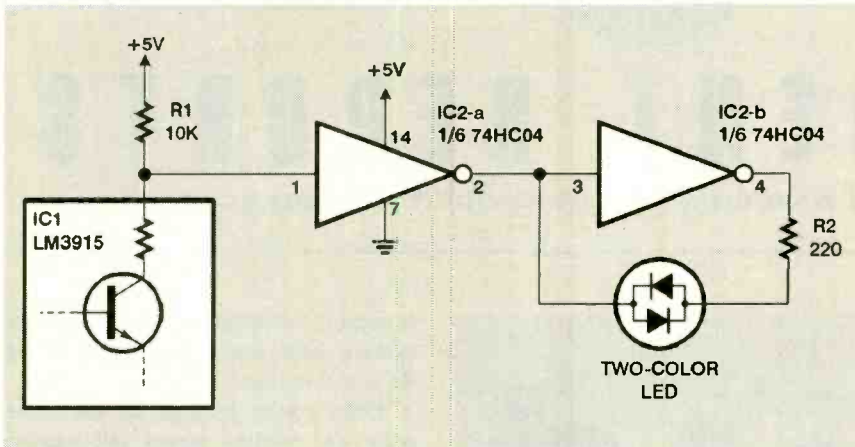


FIG. 5—TO GET A TWO-COLOR LED to switch colors rather than just lighting up, drive it with a pair of CMOS inverters as shown here.

Zero-ohm resistors sound like a joke, but they really exist for use as jumper wires. Unlike plain wires, they can be placed in PC boards by automated machinery designed to insert resistors. Their insulated coating is tougher than the insulation on ordinary wire. Sometimes a single-sided board needs a few jumpers to make connections across the traces. Sometimes an engineer specifies a resistor, but then finds out that a direct connection is better. In either case, zero-ohm resistors come to the rescue.

Writing to Q&A

As always, we welcome your questions. The address is Q&A, Electronics Now Magazine, 500 Bi-County Blvd., Farmingdale, NY 11735. The most interesting ones are answered in print. Please be sure to include plenty of background information (we'll shorten your letter for publication). *If you are asking about a circuit, please include a complete diagram.* **EN**

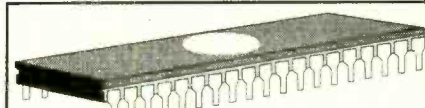
How Does It Know?

Q How does a pixel on a video screen react to a light pistol on a video game, and how does the information return through the tuner to the video game? —
D.K., Lancaster, TX

A Actually, the communication takes place in the opposite direction than what it looks like. That is, the light pistol doesn't affect the video screen; the screen affects the light pistol.

The light pistol contains a photocell that sees the electron beam scanning the CRT. Although a TV screen seems to glow continuously, only one spot on it is at full brightness at any particular instant. The screen is scanned so rapidly that our eyes can't see the bright spot flying across it, but a photocell can.

The CPU in the video game knows, moment by moment, exactly what part of the screen is being scanned—after all, it's generating the image. So when the light pistol sees the bright spot go by, it notifies the CPU and the CPU can deduce exactly what part of the screen the light pistol is aimed at.



CABLE CONVERTER DIAGNOSTIC TEST CHIP

LOAD FULL ACTIVATION OF CABLE CONVERTER

WE STOCK A COMPLETE LINE OF CHIPS, TOOLS, WIRELESS QUICK INSTALL TEST BOARDS AND DIAGNOSTIC CUBES FOR ALL CONVERTERS!

*** ANYONE IMPLYING ILLEGAL USE WILL BE *** DENIED SALE. WE SELL PRODUCTS ONLY!! TO TECHNICIANS OR CABLE REPAIR FACILITIES!!

#1 IN CUSTOMER SERVICE & TECH. SUPPORT!

*ALL ORDERS SHIP WITHIN 24HRS, UPS/ FED-X.

*PRIORITY NEXT DAY SHIPPING AVAILABLE!

*SALE= BUY 5 TEST BOARDS AND GET 1 FREE.

*MON-FRI - 8AM-7PM - SAT 10AM-2PM EST.

*WEB PAGE HTTP://WWW.800-GOCABLE.COM



VISUAL

COMMUNICATIONS INC.

ORDERS/CATALOG 1-800-GO-CABLE

TECHNICAL SERVICE DEPT. 717-620-4363 EST. 1975

ANTIQUE RADIO CLASSIFIED Free Sample!

Antique Radio's Largest Circulation Monthly. Articles, Ads & Classifieds.

6-Month Trial: \$19.95. 1-Yr: \$38.95 (\$55.95-1st Class).

A.R.C., P.O. Box 802-L19, Carlisle, MA 01741

Phone: (508) 371-0512 VISA/MC Fax: (508) 371-7129

Study at home...

become an

Electronics Technician



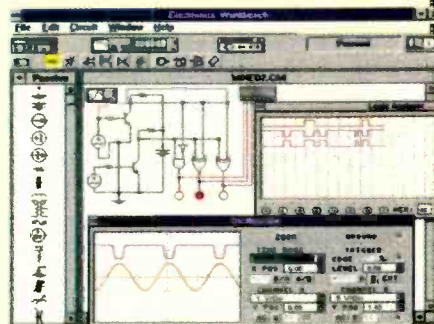
Unique CD-ROM based learning program.

Purchase the CD-ROM separately or earn College credits.

Includes the easy-to-use simulated electronics lab — **Electronics Workbench***



George Brown College
160 Kendall Ave., Toronto, Canada M5R 1M3
web site: <http://www.gbrownc.on.ca>



- Easy at home learning!
- Quality instruction — low tuition
- Chart your future in electronics today!

Call now! Toll Free!

1-888-553-5333



EQUIPMENT REPORTS

RF-LINK TECHNOLOGY WAVECOM SR. AUDIO/VIDEO RE-BROADCASTER

Send audio and video signals from one place to another, and control the source with your existing remote control, without running wires.

CIRCLE 15 ON FREE INFORMATION CARD



It outputs baseband video and line-level (stereo) audio, but also offers a standard RF (coax) output.

Once you've hooked up the three units and applied power (all needed accessories including A/V cables and two 12-volt AC wall-mount transformers are included), you're nearly set to go. The unit offers four selectable operating channels, and you'll have to be sure that both the receiver and transmitter are set to the same one. There are two reasons for the multiple channels. One, it allows up to four receiver/transmitter pairs to operate simultaneously over the same area. Two, in some set-ups, somewhat better performance might be obtainable using one channel over another. To see if that's the case for you, simply switch both units through all four channels and observe the results.

Audio/video re-broadcasters have always been popular and sought-after accessories, even when FCC regulations made their sale and use questionable. Their legal status has long since been clarified, and purchasing a unit these days is no more difficult than going down to your local retailer and paying your money. Unfortunately, what you can purchase often leaves the buyer disappointed.

There are a few reasons for that. One, the bands used by the majority of the available products, 900 MHz, has become increasingly crowded as it is also used by such things as cordless telephones, baby monitors, and the like. The result is interference, and picture and sound degradation. The second is that few if any offer a way to control the source unit. For instance, in the case of a cable box, to change channels one would have to physically go to the box, or within range of its remote control—not at all convenient if you are on another floor or on the other side of the house.

That's all past now, thanks to a product from RF-Link Technology (+11 Amapola Ave., Torrance, CA 90501; Internet: www.rflinktech.com). That product, the Wavecom Sr. (which the company says stands for Wireless Audio Video Everywhere Communicator), combines a 2.4-GHz audio/video re-broadcaster with a 400-MHz remote-control extender to provide a product whose performance surpasses anything in its category that this reviewer has seen thus far.

Aside from home use, the product also has important applications in the security and monitoring fields; more on that later. For those who don't need the remote-extender function, there's also the Wavecom Jr., which lacks that function and costs less.

Details

The Wavecom Sr. is a three-piece assembly consisting of a transmitter, receiver, and IR mouse. The transmitter and receiver appear identical at first glance though their functions can not be interchanged. Each is in black, resembles a small answering machine, and measures 6.9 by 4.4 by 1.8 inches. Each sports two antennas. One, which somewhat resembles a micro satellite dish (and measures less than 3 inches square), handles the audio and video. The second, which is a mast that's about 3½ inches tall, handles the remote-control signal. The antennas swivel and turn, allowing flexibility in positioning for best results, and the larger A/V antenna can be folded flat to the unit for storage or transport. The tiny IR mouse measures about 1 by ½ by ½ inches.

The transmitter is placed near the source unit. It requires baseband video and line-level audio (stereo) inputs. The IR mouse plugs into the transmitter and is placed in front of the source unit such that its signals will reach that unit's IR sensor; usually somewhere in front and close by will work. The receiver is placed near the remote TV or monitor.

Performance

All of the foregoing is wonderful, but ultimately useless if the system does not perform as claimed. To test the unit, we set it up in what to us seemed like a typical, if not demanding, application. For the signal source, we used a DSS receiver located in a living room. The remote receiver was a high-end 20-inch stereo monitor located in an upstairs bedroom that was diagonally across the house.

So how did it perform? In short, nearly perfectly. Under normal conditions, no notable degradation in either video or audio quality was noted during the test period. Further, the remote-control extender worked flawlessly.

That's not to say that the potential for problems does not exist. For one thing, because of the frequencies used, interference from objects passing between the transmitter and receiver are possible. That can be effectively combated by placing the unit as high up as possible, which was done in our test set up. Second, and perhaps more serious, the frequencies used are very susceptible to interference from microwave ovens, especially ones

continued on page 24

GET HERE.

LEARN A SKILL YOU ENJOY... ...THEN FIND A JOB THAT HAS A FUTURE.

New Web Site!
Visit our new web site at
www.cie-wc.edu
• Preview a sample from one of our lessons, detailed course descriptions, visit the bookstore, order a free catalog & much more!

Everyone has to start somewhere.

As 150,000 CIE graduates have discovered, independent-study from

The Cleveland Institute of Electronics can get you where you want to be. In a

secure, financially rewarding, exciting career field of your choice.

Since 1934, CIE has been on the forefront of an ever expanding technological revolution.



Industrial Robotics

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. In fact, CIE's curriculum is so well respected many Fortune 1000 companies utilize it for their own employees.



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

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

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 Computer Programming Course
- CIE's 12 Career Courses
- World College's Bachelor Degree Program

AE106

Name _____

Address _____

City _____

State _____ Zip _____

Phone: _____

Check for G.I. Bill Details
 Active Duty Veteran



*It's More Than Just Training...
...It's an Education.*

1776 East 17th Street
 Cleveland, OH 44114
 (216) 781-9400 • 1-800-243-6446

Setting up the Audio Oscillator

NOW THAT YOU'VE COMPLETED ASSEMBLING YOUR AUDIO OSCILLATOR, YOU NEED TO ALIGN YOUR UNIT FOR OPTIMUM PERFORMANCE. THE OUTPUT LEVEL MUST BE SET FOR +18DBM, OR 7.95 VOLTS. THAT CAN BE DONE WITH ANY METER

that can read AC volts. Most meters will read this value accurately at low frequencies—say 100 Hz. Set your oscillator to +18 dBm which is its maximum output, and the output frequency to 100 Hz (note: if your voltmeter can read true rms, any output frequency within the range of the meter will do).

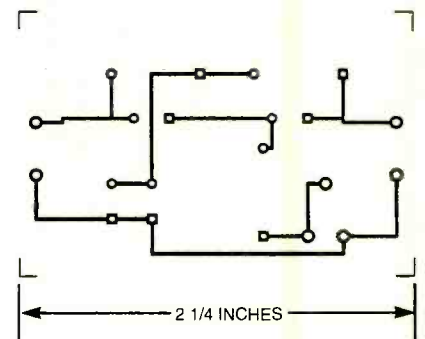
The adjustment is made using trimmer potentiometer R22, which is located in the center of the PC board, toward the front; see Fig. 1. Set R22 so that your meter reads 7.95 volts (+18 dBm). Be as accurate as possible. This adjustment sets the accuracy of the output lev-

els that are set by the precision resistors.

The second and last adjustment is needed to minimize total harmonic distortion plus noise (THD + N). It is made using R21, the 15-turn trimmer potentiometer located in the upper left hand corner of the main PC board. If you are lucky enough to own or can borrow a THD + N analyzer, just connect it to the oscillator's output and adjust potentiometer R21 to obtain the lowest THD + N level possible.

A Notch Filter

If you do not own a THD + N ana-



IF YOU CHOSE TO USE A PC BOARD, here's a suitable foil pattern.

lyzer, I have designed a simple twin-T bridge filter circuit for you to use to set R21. Figure 2 shows the circuit. While the circuit is simple enough that you can build your unit on a piece of perf board, a PC board makes things neat and simple; a suitable foil pattern is provided here. If you chose to use that foil pattern, the corresponding parts-placement diagram is shown in Fig. 3.

Regardless of your construction technique, be sure to observe proper construction practices. One note about the circuit itself: For proper operation, all components must be close tolerance. That means 1% or better resistors and capacitors. Now, the resistors are no problem, but where do you get the capacitors? Unfortunately, the answer is to use 5% or 2% polypropylene units and match them to 1% or better. Even the resistors should be selected for as close a match as possible. In particular, the closer the match between C1 and C2, C3 and C4, and R1 and R2, the deeper the notch you will be able to obtain, and the better the results. Note

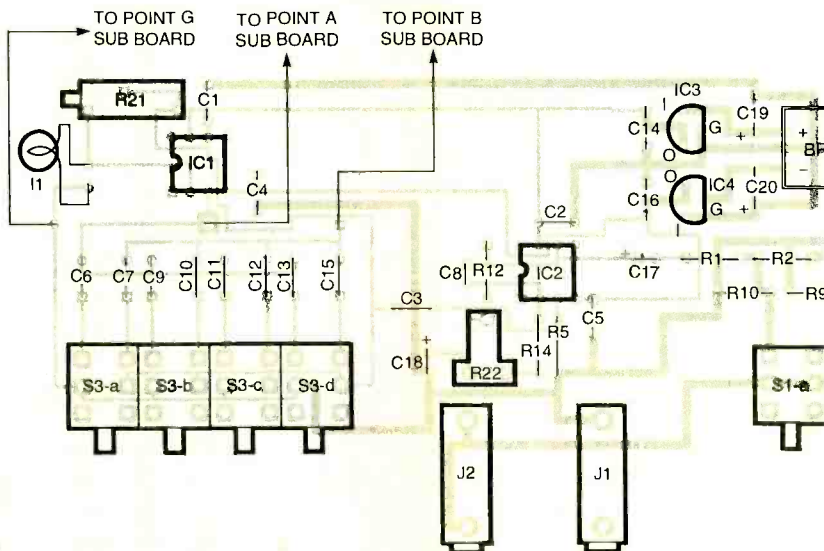


FIG. 1—HERE IS PART OF THE parts-placement diagram from last month's column. It shows the locations of R21 and R22.

What's better than speed reading? *Speed Learning.*

Speed Learning has replaced speed reading. It's a whole new way to read and learn. It's easy to learn...lasts a lifetime... applies to everything you read. It may be the most productive course you've ever taken.

Do you have too much to read and too little time to read it? Do you mentally pronounce each word as you read? Do you frequently have to go back and reread words, or whole paragraphs, you just finished reading? Do you have trouble concentrating? Do you quickly forget most of what you read?

If you answer "Yes" to any of these questions — then here at last is the practical help you've been waiting for. Whether you read for business or pleasure, school or college, you will build exceptional skills from this major breakthrough in effective reading, created by Dr. Russell Stauffer at the University of Delaware.

Not just "speed reading" — but speed reading — thinking — understanding — remembering — and — learning

The new *Speed Learning Program* shows you, step-by-proven step, how to increase your reading skill and speed, so you understand more, remember more and use more of everything you read. The typical remark from over one million people taking the Speed Learning program is, "Why didn't someone teach me this a long time ago." They were no longer held back by their lack of skills and poor reading habits. They could read almost as fast as they could think.

What makes Speed Learning so successful?

The new *Speed Learning Program* does not offer you a rehash of the usual eye-exercises, timing devices, and costly gadgets you've probably heard about in connection with speed reading courses, or even tried and found ineffective.

In just a few spare minutes a day of easy reading and exciting listening, you discover an entirely new way to read and think — a radical departure from anything you have ever seen or heard about. Speed Learning is the largest selling self-study reading program in the world. Successful with Fortune 500 corporations, colleges, government agencies and accredited by 18 professional societies. Research shows that reading is 95% *thinking* and only 5% eye movement. Yet most of today's speed reading programs spend their time teaching you rapid eye movement (5% of the problem), and ignore the most important part, (95%) *thinking*. In brief, *Speed Learning gives you what speed reading can't.*

Imagine the new freedom you'll have when you learn how to dash through all types of reading material at least twice as fast as you do now, and with greater comprehension. Think of being able to get on top of the avalanche of newspapers, magazines and correspondence you have to read...finishing a stimulating book and retaining facts and details



FOR FASTER SHIPMENT CALL 1-800-729-7323 OR FAX 1-609-273-7766

more clearly, and with greater accuracy, than ever before.

Listen — and learn — at your own pace

This is a practical, easy-to-learn program that will work for you — no matter how slow a reader you think you are now. The *Speed Learning Program* is scientifically planned to get you started quickly...to help you in spare minutes a day. It brings you a "teacher-on-cassettes" who guides you, instructs, and encourages, explaining material as you read. Interesting items taken from *Time Magazine*, *Business Week*, *Wall Street Journal*, *Money*, *Reader's Digest*, *N.Y. Times* and many others, make the program stimulating, easy and fun...and so much more effective.

Executives, students, professional people, men and women in all walks of life from 15 to 70 have benefitted from this program. Speed Learning is a fully accredited course...costing only 1/4 the price of less effective speed reading classroom courses. Now you can examine the same easy, practical and proven methods at home...in your spare time...without risking a penny.

Examine Speed Learning RISK FREE for 15 days

You will be thrilled at how quickly this program will begin to develop new thinking and reading skills. After listening to just one cassette and reading the preface, you will quickly see how you can achieve increases in both the speed at which you read, and in the amount you understand and remember.

You must be delighted with what you see, or you pay nothing. Examine this remark-

able program for 15 days. If, at the end of that time you are not convinced that you would like to master Speed Learning, simply return the program for a prompt refund. (See the coupon for low price and convenient credit terms.)

RISK-FREE ORDER FORM

YES! I want to try Speed Learning for 15 days without risk. Enclosed is the first of 4 monthly payments of \$32.25*. If I'm not completely satisfied, I may return it for a prompt refund.

SAVE 8.00! I prefer to pay the \$129.00 now, and save the \$8.00 shipping & handling charge. I may still return the program for a full refund.

Method of payment: (Federal Tax Deductible)

Check or money order payable to Learn Incorporated

Charge to: Visa MC Am Ex Discover

Card # _____ Exp. _____

Signature _____

Phone (_____) _____

Name _____

Address _____

City _____ State _____ Zip _____

*Plus \$8.00 shipping and handling. U.S. funds only. For New Jersey residents, sales tax will be added.

learn INCORPORATED Dept. LEC-01, 113 Gaither Drive, Mt. Laurel, NJ 08054-9987

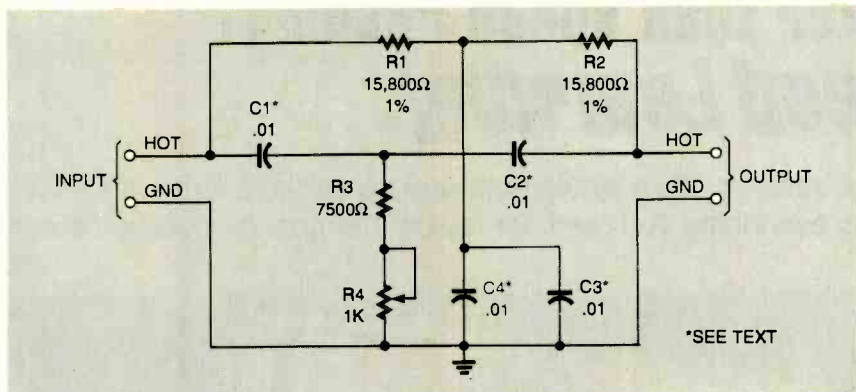


FIG. 2—THE TWIN-T FILTER CIRCUIT is simple and straightforward. It is important that the resistors and capacitors be closely matched for best results.

that the kit available from the supplier mentioned in the Parts List contains prematched units.

The trimmer potentiometer, R4, is used to set the notch for maximum depth. In my prototype, I was able to get a 40-dB notch. Since we are reading voltage at the output, the 40-dB delivers an output of 0.795 volts, which is an excellent notch for this simple circuit.

Next, connect the output of the oscil-

lator to the input of the filter, and the output of the filter to the input of the oscillator. Use one-conductor shielded cable for the connections, with the shield running between the ground inputs and outputs on all three pieces of equipment.

Set the audio oscillator for +18 dBm at a frequency of 100 Hz. If you are using a meter that reads true rms, set the output frequency to 1 kHz. Set R21 on the oscillator until the meter reads a voltage of 0.795 volts or lower. Please take your time to make this adjustment—it will be the standard for all future audio tests you make with the instrument.

The final step is to go back to R22 and readjust it as there is some interaction between the two settings. The most important measurement is the output voltage of 7.95 volts or +18 dBm. If the oscillator has a small amount of distortion (which you will see if you use a THD +N analyzer), don't worry too much about it; it should not effect most of the tests that we will be making.

Audio Testing

Testing audio gear almost always requires some sort of test fixture or some related devices to make the correct test. So our first step will be to take a look at the accessory items that you might want to construct. To get reliable and repeatable test results you need to be able to duplicate the setup at any time. The test fixtures described here make that easy to do. They may be an investment in time and money in the beginning, but over the long haul they will save you much more than you spend.

The first fixture you need is a load resistor to use when checking the output of a power amplifier. You need a simple

terminating resistor for active line-level devices. The values are 600 ohms for professional equipment (use a 604-ohm, 1% resistor for that). For consumer type gear use a 10,000-ohm, 5% unit. For the speaker outputs, you'll need power resistors; use 8-ohm, 5% units rated at the same power as the amplifier. That could be anywhere from several watts to several hundred watts.

Up to 20 watts or so, that is not a problem, but what do you do for higher output ratings? The answer is to combine units in parallel and/or series as needed to get 8 ohms at whatever wattage. For example, combining two 8-ohm, 20-watt resistors in series, and placing them in parallel with two other 8-ohm, 20-watt resistors yields 8 ohms at 40 watts. Use non-inductive resistors where possible for this, though for larger amps you might find it more economical to use wire-wound units. **EN**

EQUIPMENT REPORTS

continued from page 18

that suffer from poor shielding. In our test, using the microwave did cause a few bursts of heavy interference (hum bars etc.) While that interference source can be controlled in a single-family home, there is potential for problems when used in an apartment/condo situation.

Applications

The obvious applications are in home audio/video set ups. In particular, the Wavecom Sr. is ideal for use with DSS, and can, in some instances, eliminate the need for, and cost of, a second receiver.

However, the unit can also find other uses. For instance, when used with a video camera, it is ideal for surveillance and monitoring situations. For example, it could be used to monitor a baby's room on any TV set in the house, or to monitor the front entrance in a home or office. Since up to four channels can be in operation at any one time, it can be effective in monitoring the goings-on throughout a small warehouse or plant. And none of those applications require costly wiring or special installation.

The RF-Link Wavecom Sr. costs \$249.95; the Wavecom Jr. (without remote-control extender) costs \$199.95. For more information, contact the manufacturer directly, or circle 15 on the Free Information Card. **EN**

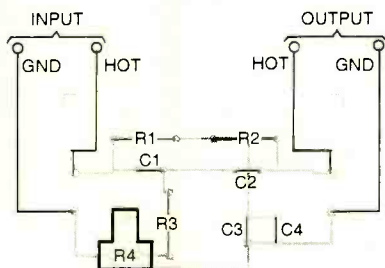


FIG. 3—USE THIS PARTS-PLACEMENT DIAGRAM when assembling the twin-T filter's circuit board.

PARTS LIST FOR TWIN-T FILTER

- R1, R2—15,800-ohm resistor, ¼-watt, 1%
 - R3—7500-ohm resistor, ¼-watt, 1%
 - R4—1000-ohm potentiometer, Digi-Key D4AA-13ND or equivalent
 - C1—C4—0.01-μF capacitor, polypropylene, 1%, see text
- PC or perf board, wire solder, etc.
- The following is available from Franklin J. Miller, 2100 Ward Dr., Henderson, NV 89015: Complete kit of parts for the T-Filter, \$12. Kit includes drilled solder mask; solder-plated PC board; pre-matched resistors and capacitors; and all other board-mounted parts.



NEW PRODUCTS

USE THE FREE INFORMATION CARD FOR FAST RESPONSE

Wireless Color Surveillance System

American Innovations' WSS-300 Wireless Color Surveillance System is the solution for the person or business who needs to have their eyes in two

The WSS-300 comes complete with a working AM/FM radio, the color camera, the transmitter, and a four channel FCC-approved receiver. Also included is the



CIRCLE 20 ON FREE INFORMATION CARD

places at once. It can be used as a child monitor, as a security system, or to monitor on-the-job performance. The WSS-300 has a range of up to 300 feet, and is capable of penetrating walls, floors or ceilings.

The Wireless Surveillance System is housed in a compact AM/FM cassette-radio (11-inches wide by 6-inches high, 3½ inches in diameter), incorporating both the camera and transmitter. (Due to camera placement, the cassette player can't operate.) With a super low sensitivity rating of 2 lux, as well as built-in backlight compensation, the high-resolution (380 lines) color camera and the FCC-approved transmitter deliver consistently sharp video images to the designated receiver. In addition, the state-of-the-art, circular-polarized directional transmitting and receiving antennas maximize the signal range and minimize interference.

video cable to connect to your VCR or monitor, an A/B switch to select between receiver and cable/antenna reception, coax cable, power adapter to provide 12 VDC power to the receiver, and an easy-to-follow instruction book.

The WSS-300 Wireless Color Surveillance System has an introductory price of \$895.

AMERICAN INNOVATIONS, INC.

119 Rockland Center
Suite 315

Nanuet, NY 10954

Tel: 914-735-6127

Fax: 914-735-3560

Web: <http://www.spysite.com>

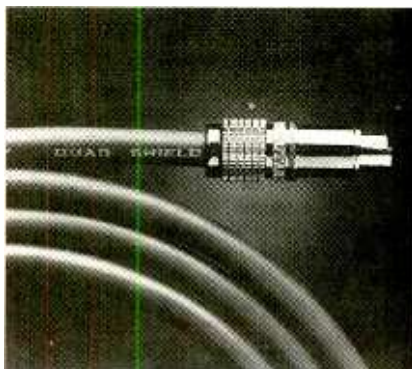
Quad-Shielded Super-Video Cable

Tributaries' Quad-Shielded SCV S Silver Series S-Video Cable is intended for use with high-quality Super-Video sources, such as DSS receivers, DVD

players, laserdisc players and S-VHS VCRs. Even at distances over 20 feet, Tributaries' S-video cable with "quad shielding" delivers uncompromised signal transfer.

"Quad shielding" consists of two silver-plated center conductors, each with a dedicated aluminum/Mylar wrap and an oxygen-free, high-conductivity, copper-braided shield within a second aluminum/Mylar wrap and another shield. Heavy-duty, gold-plated brass "S" connectors, soldered with high-silver-content solder, further enhance signal integrity.

The SCV S is available in one to three meter lengths, as well as custom lengths. Suggested retail prices: \$75 for one meter, \$100 for two meters and \$125 for three meters.



CIRCLE 21 ON FREE INFORMATION CARD

TRIBUTARIES

1307 East Landstreet Road

Orlando, FL 32824

Tel: 800-521-1596

Shortwave Receiver

The R.L. Drake Company's SW2 shortwave receiver is microprocessor controlled and has continuous coverage from 100 to 30,000 kHz, allowing the user to listen to AM-broadcast, amateur, citizen-band, and shortwave bands. Full AM and single-sideband operation give complete coverage of all world-band broadcasts. The SW2 cleans up fading

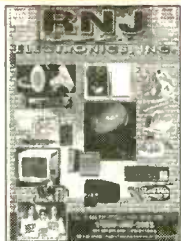
CATALOG SUPERMARKET



Top Secret Consumertronics

This eye-popping catalog features 200+ exciting and controversial Hi-Tech Survival Offers. Includes Computers, Phones, Crime, Security, Survival, Vehicles, Energy, Mind Control, Strange Phenomena, Medical, Financial, much more! Discover how people are making \$\$\$\$ hacking just about everything! How to protect yourself from hi-tech crimes. Since 1971. Order today! **\$3.00**

number 504 in coupon



RNJ Electronics, Inc. New 1997 Catalog

RNJ Electronics, Inc., a distributor of electronic products since 1981, is now offering their new 1997 catalog. The catalog contains 136 pages of test equipment, TV and VCR repair parts, electronic kits, instructional videos, tools & soldering equipment, CCTV systems, commercial sound & intercom systems as well as parts and accessories. In addition the catalog also contains breadboarding aids, digital trainers, as well as A/V carts, screens and projectors. **\$2.00**

For a catalog call 1-800-645-5833.

number 509 in coupon



All Phase Video Security Inc.

The All Phase Video Security Catalog contains electronic test equipment, cable TV converters, connectors and cable accessories. Video surveillance equipment, video cameras, monitors, etc. Power supplies, metal detectors (power line stabilizers and UPS's). Cables for audio. Telephone connectors & accessories. Hand tools. PA sound equipment. DJ lighting effects & sound systems. Car Radios, C.B.'s & two-way radios. Solder & soldering equipment. Security mirrors. **\$2.00.**

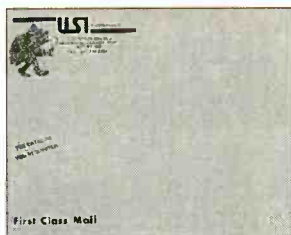
number 503 in coupon



Professional Sign Making Machines

Production machines for professional sign makers. The Roland Corporation produces the CAMM-1 series of roll-feed sign making machines. Catalog 963 features a sampling of the 10,000 computer items that California Digital offers. Please contact our technical service representatives to assist you with items not featured in this publication. **\$2.00**

number 508 in coupon



Surveillance and Counter-Surveillance Catalog

U.S.I. Corporation specializes in intelligence-gathering and countermeasure equipment for security minded individuals and companies. We stock and sell off-the-shelf products. We also have Space Age engineers who can design complete systems for any need. Included: VHF crystal controlled transmitters and receivers, micro covert video, voice changers, and much more! Comprehensive 50 page catalogue. In business since 1977. Free technical assistance. **\$5.00**

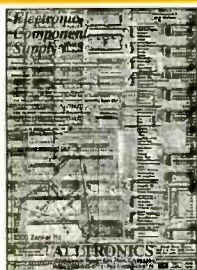
number 507 in coupon



American Eagle Publications

American Eagle Publications offers a unique catalog of educational information about computer viruses, computer hacking, security and cryptography that you just won't find anywhere else. The information offered here goes far beyond the vague descriptions offered by most publications, giving you the solid how-to information you need if you want to explore these little-discussed subjects from a technical point of view. **\$2.00**

number 500 in coupon



Alltronics

Distributor of electronic components from franchised manufacturers and overstocked sources, operating over-the-counter service. Distributors for: American Antenna - antennas; American Hakko - soldering irons, desoldering systems; Amidon - toroids, baluns; Centurion - two-way antennas, batteries; Circuit Works - conductive IC pens for PC board repair; ICO-Rally - tubing, sleeving, insulation, terminals, cable ties; KLM - antennas; Larsen - antennas; LMB Heeger - metal cabinets, chassis boxes. **\$2.00**

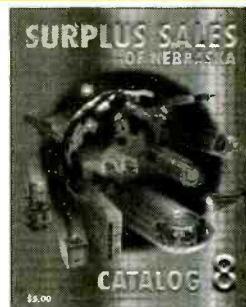
number 512 in coupon



LNS Technologies Electronic Kits

Tired of the same old electronic projects? Then take a look at the latest catalog from LNS Technologies Inside you'll find exciting & educational kits including a solid state laser, a laser light show, an electromagnetic levitator, a secret voice disguiser, a hall-effect digital compass, a solid-state message recorder and many more high-tech items. Each kit comes with a drilled PC board, all necessary parts and easy to understand instructions. The kits are perfect for teachers, students or hobbyists and make great science projects. **\$1.00**

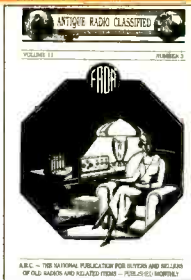
number 513 in coupon



Surplus Sales of Nebraska "Hard-To-Find" Parts Catalog

Surplus Sales of Nebraska has released its latest catalog, Catalog 8. The catalog features Collins parts, vacuum capacitors and relays, high-voltage components, high power transmitter parts, rack cabinets, power supplies, test equipment and much more.... The catalog is priced at \$5.00 in the US. A \$5.00 rebate is offered on the first order from the catalog.

number 514 in coupon



Antique Radio Classified

Antique Radio Classified is antique radio's largest-circulation monthly magazine. A typical 100-page monthly issue contains articles and hundreds of classifieds for old radios, TVs, ham equipment, hi-fi, art deco and transistor radios, telegraph, books & more. We also offer price guides and books on repair and restoration and guides for the novice collector. Antique Radio Classified is your link to the world of collecting old radios. Sample: **\$4.00**

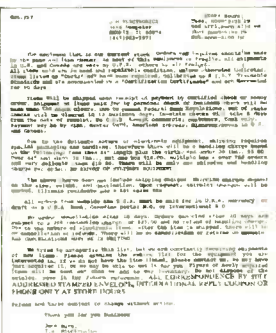
number 502 in coupon



Information Unlimited

The catalog of amazing and fascinating electronic and scientific products. Learn how to build a burning, cutting laser, an electronic gun capable of ballistic velocities, particle beams, surveillance devices, force fields, anti-gravity, mind control and hypnotism, ultrasonic, infra-sonic shockwaves, telsa coils, lightning generators, free energy, telekinetic enhancers, time quenchers, plasma guns, high power pulsers for rail guns and exploding water, security, personal protection, electronic, magic devices plus etc., etc. **\$2.00 refundable on first order.**

number 505 in coupon



J.B. Electronics

Current stock includes all types of Military frequency meters, AC voltmeter, and multi-amp meters, Tektronix oscilloscopes, Hewlett-Packard frequency meters and voltmeters, Fluke DVM's. We also carry a variety of electronic test equipment from B&K Precision, Weston, Central Scientific, General Radio, G.E., and more. Catalog **\$2.00** refunded on 1st order.

number 515 in coupon

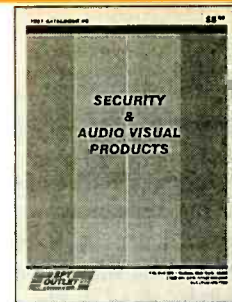
AMERICAN INNOVATIONS

**SURVEILLANCE
COUNTERSURVEILLANCE
PROTECTION
SECURITY EQUIPMENT**
FOR BUSINESSES, INDIVIDUALS &
LAW ENFORCEMENT AGENCIES

American Innovations Catalog

Featuring: Micro Cameras, Hidden Cameras, Board Cameras, Voice Changers, Scrambling Systems, Tracking Devices, Transmitters, Bomb & Weapons Detection, Drug Detection, Telephone Analyzers, Tape Recorder Detection, Video Detection, Recording Devices, Telephone Recorders, PBX Security, Wireless Video Systems, Night Vision, Bionic Ears, Body Armor, Air Tasers, Employee Cameras, Baby Cameras, Nanny Cameras, And Much More... **\$6.00** (Includes \$10 discount off 1st order.)

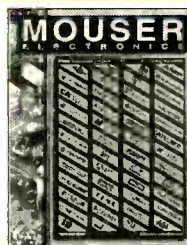
number 501 in coupon



EDE Spy Outlet

The Latest High Tech Professional Electronic Devices. Our latest catalog offers a **HUGE** selection of surveillance, counter-surveillance/privacy devices: hidden video equipment, pinhole camera w/audio \$159., electronic kits, telephone recording systems: 7-Hour \$125 - 16-Hour \$199., touch tone decoders, scanners, bug/phone tap detectors, voice disguisers, telephone scramblers, locksmithing tools, and more. **\$5.00**

number 510 in coupon



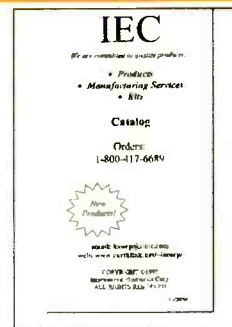
Free

Electronics Purchasing Manual

Same day shipping, helpful technical assistance, no minimum order and broad inventory selection, send for Mouser's newest catalog featuring 69,000+ components from 130+ leading manufacturers. 3M, Amp, Dale, NEC, SGS Thomson, Sprague, and more. **Mouser Electronics**, 2401 Hwy 287 North Mansfield, TX 76063.

Catalog (800) 992-9943/ (817) 483-6828; Fax (817) 483-0931; <http://www.mouser.com>; E-mail: catalog@mouser.com.

number 506 in coupon



International Electronics Corporation

International Electronics Corporation offers a variety of quality SMT kits for students and hobbyists as well as engineers. Our 1997 catalog contains pictures, detailed descriptions, and pricing of all kits currently available, as well as manufacturing services offered. **\$2.00**

number 511 in coupon

ORDER YOUR CATALOG TODAY!

Circle the numbers of the items you are ordering. Completely fill out the coupon. Enclose your payment, add \$1.50 for service and handling.

- | | | | |
|-------------------------------------|----------|----------------------------------|----------|
| 500 - American Eagle Catalog | - \$2.00 | 508 - California Digital Catalog | - \$2.00 |
| 501 - American Innovations Catalog | - \$6.00 | 509 - RNJ Catalog | - \$2.00 |
| 502 - Antique Radio Classified | - \$4.00 | 510 - EDE Spy Outlet Catalog | - \$5.00 |
| 503 - All Phase Video Sec. Catalog | - \$2.00 | 511 - IEC Catalog | - \$2.00 |
| 504 - Consumertronics Catalog | - \$3.00 | 512 - Alltronics Catalog | - \$2.00 |
| 505 - Information Unlimited Catalog | - \$2.00 | 513 - LNS Technologies Catalog | - \$1.00 |
| 506 - Mouser Electronics Catalog | - Free | 514 - Surplus Sales Catalog | - \$5.00 |
| 507 - U.S.I. Corporation Catalog | - \$5.00 | 515 - J.B. Electronics | - \$2.00 |

Payment, please check one Check Money Order

Total for items selected \$ _____ Service and Handling \$1.50 _____ Total Enclosed

Name _____

Street _____

City/State/Zip _____

Mail to: CATALOG SUPERMARKET, P.O. Box 5110, Pittsfield, MA 01203-5110

Void after September 30, 1997

1

signals by using selectable sideband synchronous detection. There are 100 programmable channel memories; 32 of them are preprogrammed for the most popular global broadcast stations such as the BBC, Monitor Radio, Radio Havana, Radio Moscow, and the Voice of America.

Tuning can be done either with a tuning knob, tuning buttons, or by direct numeric entry. All tuning controls are conveniently located on the front panel of the receiver, along with an adjustable RF-gain control and an extra-large LED display. The LED display shows both the receive frequency and meter band designation.

On the rear panel there are dual antenna input terminals, which provide for connection of either a coaxial 50-ohm feedline or a wire antenna to the receiver. The SW2's 12-volt capability, combined with an optional mount antenna, allows the receiver to be used in vehicles as well.

The SW2 shortwave receiver by Drake has a suggested retail price of \$499. An optional infrared remote control can be purchased for an additional \$49.



CIRCLE 22 ON FREE INFORMATION CARD

R.L. DRAKE COMPANY

230 Industrial Drive
Franklin, OH 45005
Tel: 513-746-4556
Fax: 513-743-4510
Web: <http://www.rldrake.com>

Low-Profile IC Test Clips

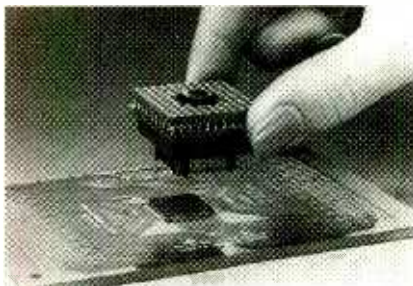
ITT Pomona's low-profile IC test clips make it easy to connect test instruments to the industry's latest high-density TQFP (thin quad flat package) and SQFP (small quad flat package) surface-mounted devices.

The 100-pin Model 6150, 144-pin Model 6151, and 176-pin Model 6152 test clips provide spring-loaded contacts spaced at 0.5mm to assure positive electrical contact with each pin tested. Mechanical fingers specifically designed to hold on to thin TQFP chips assure positive retention in both vertical and horizontal positions. The patented chip design allows the user to test an on-

board, surface-mounted device while the host board is inserted into a standard-spaced computer or system slot. Signals can then be sampled during normal system operation. The board-level space requirements for each test clip are only about 2-mm greater than the space required for the chip itself.

The test clips are the first products available that allow reliable testing of state-of-the-art TQFP and SQFP devices used in PCMCIA cards, pagers, and portable computers. Their compact design facilitates testing on small, densely populated boards with a minimum of noise and cross-talk.

The Models 6150, 6151, and 6152 cost \$385, \$465, and \$512, respectively.



CIRCLE 23 ON FREE INFORMATION CARD

ITT POMONA ELECTRONICS

1500 East Ninth Street
Pomona, CA 91766-3835
Phone: 909-469-2900
Fax: 909-629-3317

Data-Acquisition Software

National Instrument's LabVIEW 4.1 data-acquisition (DAQ) and analysis software package is easier to use than previous versions. With the addition of DAQ Wizards on the Windows platforms, DAQ development is streamlined through automatic, point-and-click program generation. Users simply describe their measurement connections and LabVIEW generates a ready-to-run program that meets their specifications. It takes only a few minutes to generate programs in native LabVIEW "G" source code. Version 4.1 also adds an online tutorial for Windows users, automated links to important LabVIEW sites on the World Wide Web, and an Object Linking and Embedding (OLE) automation interface for automated report generation via HiQ for Windows 95/NT.

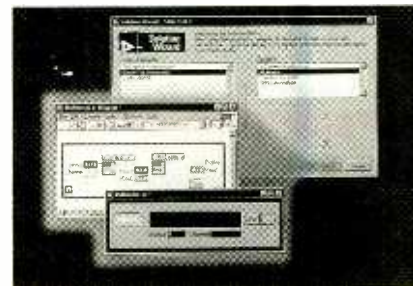
LabVIEW 4.1 will be available for Windows 3.1/95/NT PCs, Macintosh/Power Macintosh computers, Sun

SPARCstations, and HP workstations, as well as Concurrent Computer real-time systems. Only the Windows platforms will have the new DAQ Wizards.

With the DAQ Solution Wizard, users describe their application through a series of dialog boxes. By selecting from a list of common options, such as analog input, digital I/O, file I/O, etc., users quickly build a recipe for their DAQ solution. When the user is finished describing the system, LabVIEW generates a ready-to-run application in its patented "G" programming environment, which users can further customize and enhance. LabVIEW 4.1 also offers the Solutions Gallery, a collection of virtual instruments—including an oscilloscope, a multimeter, a function generator, a data logger, a transducer measurement system, and a signal analyzer—for common applications.

The DAQ Channel Wizard allows the user to simply fill in the blanks to define the signal types, connections, and transducer equations. Users can then reference the channel name for the input signal throughout the applications, with all of the conversion processes performed transparently.

LabVIEW 4.1 is priced starting at \$995; existing LabVIEW for Windows users can upgrade to Version 4.1 for \$295. Mac, Sun, HP, and Concurrent users can upgrade for free.



CIRCLE 24 ON FREE INFORMATION CARD

NATIONAL INSTRUMENTS

6504 Bridge Point Parkway
Austin, TX 78730-5039
Tel: 800-258-7022
Fax: 512-794-8411
e-mail: info@natinst.com
Web: <http://www.natinst.com>

CRT Analyzer and Restorer

The CR7000 "BEAM-RITE" CRT Analyzer and Restorer from Sencore tests all CRTs, including computer monitors, video displays, televisions, projection

Continued on page 36

Troubleshooting and Repairing a Microwave Oven

THE PAST COUPLE OF TIMES WE HAVE EXPLORED THE WORKINGS OF A MICROWAVE OVEN AND SOME OF THE THINGS THAT CAN GO WRONG. NOW IT IS TIME TO ROLL UP OUR SLEEVES AND GET DOWN TO SOME PRACTICAL TROUBLESHOOT-

ing. We will also look at some sources for the replacement parts you may need.

Testing the Oven

If cooking just seems to take longer than you think is normal, a quick check of the actual microwave-power available can eliminate unnecessary troubleshooting! Measuring the precise number of degrees a known quantity of water increases in temperature for a known time and power level is a very accurate test of the microwave power. A couple of minutes with a container of water and a thermometer will conclusively determine if your microwave oven is weak or you are just impatient.

The following procedure comes from a Litton microwave handbook: Fill a one liter (L) plastic container with cool water. Measure the temperature of the container (in degrees C). Place the container in the microwave and heat on high for 1 minute. Measure the temperature of the water (again in degrees C). The oven power can then be found from: oven power = temperature rise in degrees C multiplied by 70. Note that a plastic container rather than a glass one is used to minimize the energy loss by conduction from the water to the container. Also, if the water is boiling when it comes out (100 degrees C) the test is invalid. Run the test again using colder water to start.

If there is any significant discrepancy between your measurements and the specified microwave power levels—say more than 10%—there may be a prob-

lem. Possible causes of low output power include a weak magnetron (likely if your oven has seen hard service over the last 15 years), intermittent connections (particularly to the magnetron filament), or a controller problem.

Before we get our hands inside an oven however, the following warning must be repeated:

WARNING! *Microwave ovens are probably the most dangerous consumer appliance to service. They use high voltage—up to 5000 volts—at high current levels. Even with the power off, there is a high-voltage capacitor that can produce quite a kick. This capacitor must be discharged before touching anything in the microwave generator circuitry. If you have the slightest doubt about your ability to work safely, stop right here. A \$150 microwave oven isn't worth your life!*

WARNING!!

This article deals with and involves subject matter and the use of materials and substances that may be hazardous to health and life. Do not attempt to implement or use the information contained herein unless you are experienced and skilled with respect to such subject matter, materials, and substances. Neither the publisher nor author make any representations as for the completeness or the accuracy of the information contained herein and disclaim any liability for damages or injuries, whether caused by or arising from the lack of completeness, inaccuracies of the information, misinterpretations of the directions, misapplication of the information, or otherwise.

Getting Inside

Note that in almost all cases opening the case of a microwave will void any warranty, at least in principle. However, you probably should return any unit still under warranty for service rather than attempting the following yourself.

The first step is to unplug the oven! Usually, the sheet metal cover over the top and sides is easily removed after unscrewing a bunch of Phillips-head sheet-metal screws. Most of these are on the back but a few may screw into the sides, and often they are not all the same! At least one of the screws will include a lockwasher to securely ground the cover to the case. Make note of any differences in screw types. It is important to get the same screws back into the same holes when you are done. Once all of the screws have been removed, the cover will then lift up and off. If it doesn't lift off easily, look for a screw you did not find the first time. Note how fingers on the cover interlock with the main cabinet—these are critical. They ensure against microwave leakage after reassembling the oven.

Discharge the high-voltage capacitor as described in the in the August 1997 installment of Service Clinic. This is very important and is the first step to perform immediately after removing the case from any microwave oven or any time you need to go near the internal wiring after it has been plugged in. Do not overlook this step—your life may depend on it!

A schematic showing all of the power-generation components is usually glued to the inside of the cover. A typical example of such a schematic is shown in Fig 1, which also appeared in last month's installment. How much of the controller circuitry is included varies, but is likely to

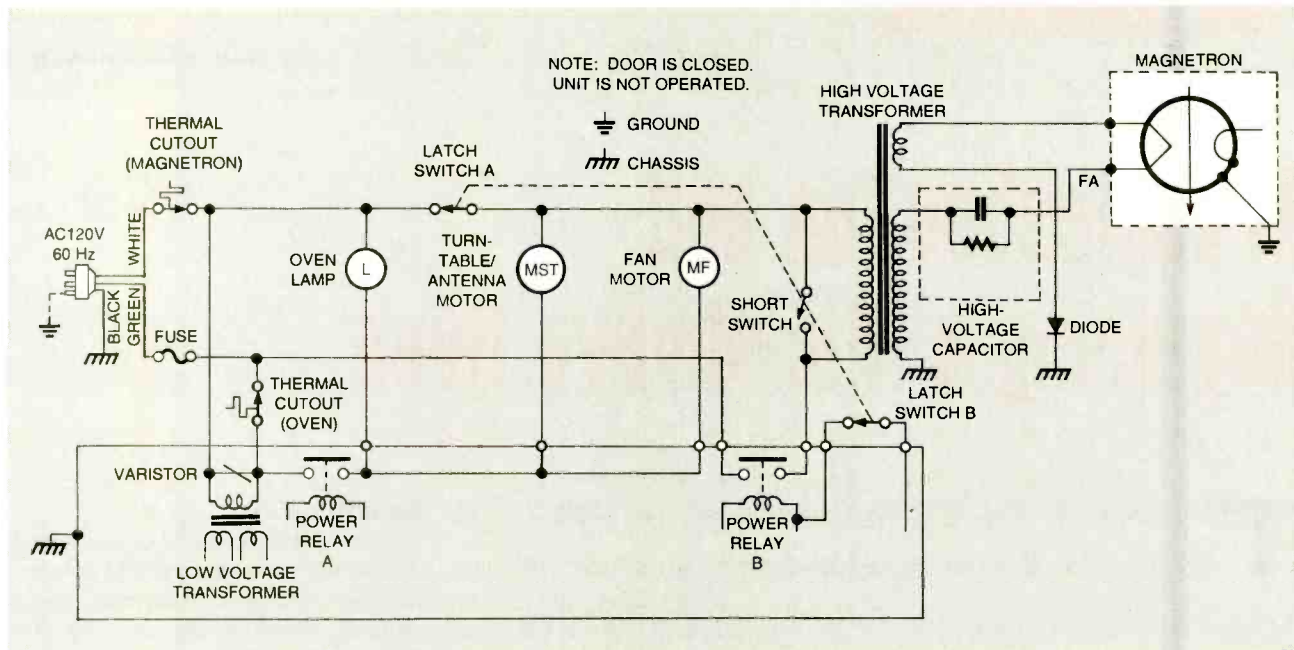


FIG. 1—HERE'S A TYPICAL MICROWAVE OVEN SCHEMATIC like the one likely to be found pasted inside the unit's cover; this schematic also appeared in last month's installment of this column.

be minimal. Fortunately, all the parts in a microwave can be easily replaced and most of the parts for the microwave generator are readily available from places like those mentioned later on in this article.

Later on, when the repair is complete, reassemble the oven in reverse order. Be sure that you do not pinch any wires when reinstalling the cover. Fortunately, the inside of a microwave is relatively wide open and that is not difficult to avoid. Make sure that all of the metal fingers around the front edge engage properly with the front-panel lip. That is critical to avoid microwave emissions should the waveguide or magnetron become damaged in any way. Confirm that the screws you removed go back in the proper locations, particularly the one that grounds the cover to the chassis.

Testing the Main Fuse

If the oven is dead, the main fuse is the place to start. Locate and remove it. Usually it is a 1 by 1/4 ABC ceramic type. Test it with an ohmmeter. It should read zero ohms. If it is blown, suspect problems with the interlock switches, high-voltage capacitor, or high-voltage wiring. If the fuse is good, but the oven makes a loud humming sound when you attempt to cook, suspect the magnetron or high-voltage diode. Sometimes the fuse is open for no good reason at all. A replace-

ment fuse may be all that is needed. But check for other problems first; there is usually a reason why a fuse blows.

Interlock Switches

With the oven unplugged (and a new fuse installed if the original was blown), put an ohmmeter across the AC input just before the interlocks. Open and close the door slowly several times—there should be no significant change in resistance. If you spot any change at all, it should be no more than a few ohms. If your reading approaches zero while opening or closing the door, check the interlock switches and door alignment. (You may need to disconnect one side of the transformer primary since its resistance is a fraction of an ohm. Refer to the schematic pasted inside the cover.)

High-Voltage Components

WARNING: *If you haven't already done so—and you should have—with power disconnected, discharge the high-voltage capacitor before going further!*

If the oven passes the test for interlocks and door alignment, the Triac (if used) might be defective. There could also be a wire shorting to the chassis. However, the most likely problems are in the microwave generator. Use an ohmmeter to quickly determine if the capacitor, high-voltage diode, or magnetron are a dead short (look for an open magnetron filament too).

Testing the High Voltage Diode

If the high-voltage diode has failed, it can be either shorted or open. A shorted high-voltage diode is likely to cause a loud hum from the high-voltage transformer when a cook cycle is initiated. The main fuse will probably not blow.

An open high-voltage diode will result in AC instead of DC across the magnetron with a peak negative value (the only one that matters) about half of what it should be. The result will likely be little or no detectable heat but no other symptoms.

The resistance measured across the leads of the high-voltage diode should be greater than 10 megohms in at least one direction, when the diode is disconnected from the circuit. However, its forward-voltage drop will be too great (6 volts or more) for a DMM to test properly. The high-voltage diode can be tested with a DC power supply (even a wall adapter that delivers an output of at least 12 to 15 volts), a series resistor (to limit current), and your multimeter. This will determine proper behavior, at least at low voltages.

Figure 2 is the schematic of a simple high-voltage diode test set up. The voltage drop in the forward direction should be at least 6 volts with a few milliamps of current, but might sometimes be somewhat higher (8 volts or more) with a few hundred milliamps. If it is not shorted, it is fairly safe to assume, for now, that the diode is good.

Testing the High-Voltage Capacitor

A shorted high-voltage capacitor will blow the fuse instantly. An open high-voltage capacitor will result in no heat, but no other symptoms. The following assumes no internal rectifier or other circuitry with the exception of a bleeder resistor. Adjust procedures accordingly if your oven is different.

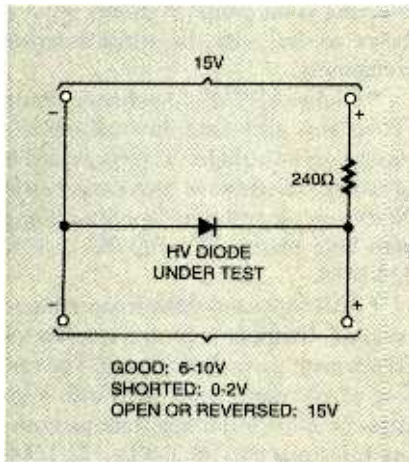


FIG. 2—TESTING A HV DIODE is difficult with a standard DMM so use this setup to accomplish the task.

The resistance measured across the terminals of the high-voltage capacitor should be very high—several megohms for a bleeder resistor. If it is less than 1 megohm, the capacitor is definitely shorted. Unfortunately, a high resistance does not prove that the capacitor is actually functional—it just shows that it is not shorted with no voltage across it. If you have a capacitance meter, check it for proper value (should be printed on the case), but even that does not prove that it will not short when full voltage is applied. Substitution is the only sure test.

Testing the Magnetron

Being the heart of a microwave oven, the magnetron is likely to be an expensive replacement part. Therefore, it would be nice to determine reliably if your magnetron is indeed defective. A magnetron with an open filament will result in no heat, but no other symptoms. The bad connection might be internal (in which case the magnetron will need to be replaced) or external at the filament terminals (which might be repairable).

A magnetron with a short between the filament/cathode and anode is likely to cause a loud hum from the high-voltage transformer and/or magnetron when the cook cycle is initiated, but the main fuse

will probably not blow. A magnetron with other faults might cause a variety of symptoms including erratic or low output power or intermittent operation. Unfortunately, there is no totally definitive way to determine if a magnetron is good without actually powering it under operating conditions. However, the following tests will catch most problems:

• You should read infinite resistance between the filament connections to the case, and a fraction of an ohm between the filament terminals with the wiring disconnected from the magnetron. While measuring resistance from filament to chassis, gently tap the magnetron to determine if there is an intermittent short. The most common magnetron failure mode is the filament shorted to the case but that might only show up under power.

• Evidence of arcing (visible blackening around ventilation holes in base or a burnt odor) usually indicates a bad magnetron.

• Melting or other damage to the antenna cover (bull-nose or bullet) might be the result of arcing due to problems in the oven cavity or waveguide (perhaps operating with nothing in the oven) or a defective magnetron. If any other problems are corrected, the bull-nose piece itself can be pulled off and replaced if you can locate one. (However, the bull-nose is only visible after removing the magnetron from the waveguide or by using a dental mirror through the microwave window from inside the oven cavity.)

Replacement Magnetrons

Both original and generic replacement magnetrons are available. Going direct to the oven manufacturer will guarantee a compatible magnetron, but is by far the most expensive option. For a typical oven, such a replacement could be more than half the cost of a similar new oven. In some cases (like Sears), you may need to convince their service department that you are qualified to be poking around inside one of their appliances before they will consider selling one to you. In some cases, original magnetrons may also be available from parts suppliers—like MCM Electronics—at somewhat less ridiculous prices. They will be identified as original or genuine along with the manufacturer and their part number.

Generic replacement magnetrons are available for the majority of microwave ovens. These will almost certainly be

much less expensive than original parts. Essentially, there is only one type of actual device (at least for any similar power range). The differences are mostly mechanical. However, quality may vary. In some cases, the generic variety may actually be better than the original. See the parts sources listed near the end of this article for details.

Testing the High-Voltage Transformer

A shorted winding or short between a winding and the core/chassis in the high-voltage transformer might result in a blown fuse, loud hum, overheating, audible arcing, a burnt aroma, or simply no heat. An open winding is likely to cause no heat, but no other symptoms. Disconnect terminals as required to make the following tests:

• The resistance of the primary should be 0.1 to 0.5 ohms (0.2 ohms is typical).

• The resistance of the filament winding is likely to be so low that it will not be detectable with your multimeter. The only measurement you can easily make is to be sure that there is no short to the chassis.

• Typical resistance readings for the transformer's high-voltage secondary are in the 25- to 150-ohm range (depending on the power rating of the oven) at the high-voltage connection to chassis. An open would be an obvious failure. However, a winding-to-winding short likely would not cause enough of a resistance change to be detected.

Testing the high-voltage transformer more fully is difficult without fancy equipment. Only major short circuits can be identified in the transformer with an ohmmeter, since the nominal resistance of the windings is unknown. However, open windings (not very likely) can be located and other faults can be identified by the process of elimination.

Wiring and Connections

Inspect the wiring—especially between the magnetron, high-voltage transformer, and other components of the high-voltage circuits—for signs of arcing and excessive heating or burning. Arcing may be the result of the wire scraping against a sharp sheet-metal edge due to poor placement and or vibration. A bit of electrical tape may be all that is needed to effect a repair.

Since the magnetron filament in particular uses high current, any resistance

at the crimp-on connections will result in heating, weakening of the lug, more heating, and eventual failure or erratic operation. Those connections should not be loose—you should have to work at removing them. However, note that some lugs are of the locking variety and require that you push a little tab before you can release them. Check for loose, burnt, or deteriorated lugs in the filament circuit (not just the magnetron). It may be possible to repair those if they are not too far gone (*i.e.*, vaporized).

Thermal Protectors and Fuses

There are two types of devices that may be in your oven that you need to know about. Thermal protectors are thermostats that open a set of high-current contacts at a preset temperature. They should reset when they cool off. However, like a relay or switch, the contacts sometimes deteriorate.

Thermal fuses will open at a preset temperature but do not reset. They blow and need to be replaced. At room temperature, both types should read as a dead short with an ohmmeter (disconnect one terminal as there might be low-resistance components or wiring that might otherwise confuse your readings). Replacements are available. You must match both the temperature and current ratings. If you suspect a bad thermal protector in the high-voltage transformer primary, clip a 100-watt light bulb or AC voltmeter across it and operate the oven. If the thermal protector is functioning properly, there should never be any voltage across its terminals unless there is actual overheating.

The Triac or Power Relay

Your oven may use either a Triac or relay (or conceivably a combination of both) to control power to the microwave generator. In rare instances, there may even be a relay on the high-voltage side as well. A Triac could fail in a variety of ways. A shorted Triac would result in the oven coming on as soon as the door is closed. It might also cause the power level to always be on high no matter what the touchpad setting.

An open Triac, or one that didn't respond to the gate, would result in no heat and possibly other things like the fan and turntable not working as well. A Triac that didn't turn off would result in the parts of the oven continuing to run even after the timer counted to zero. A Triac that had one half shorted would

result in a blown fuse due to it acting as a rectifier pumping DC through the high-voltage transformer. A Triac where one half doesn't properly turn off would result in the main fuse blowing when the cook cycle completed.

One quick way to test a Triac is to measure the resistance across the MT1 and MT2 terminals (the power connections) with an ohmmeter. If good, you should read a high resistance. A reading of a few ohms means a bad (shorted) Triac. But since Triacs can fail in other—possibly peculiar—ways other than shorting, substitution or bypassing may be necessary to rule out all possibilities. If a Triac is the cause of your problems, replacements are very easy to find and substitutions are straightforward.

A defective relay can result in a variety of symptoms. A relay with its contacts welded (stuck) closed would result in the oven coming on as soon as the door is closed or the power level being high no matter what the touchpad setting. A relay that doesn't close (due to defective contacts or a bad coil) would result in no heat and possibly other things like the fan and turntable not working. If the relay is totally inoperative, test for voltage to the coil. If the voltage is correct, the relay may have an open coil. If the voltage is low or zero, the coil may be shorted or the driving circuit may be defective.

If the relay makes a normal switching sound, but does not correctly control its output connections, the contacts may be corroded, dirty, worn, welded closed, binding, or there may be other mechanical problems.

Obtaining Replacement Parts

A local appliance store may have common parts such as oven light bulbs and fuses. For anything like an interlock switch or magnetron, you will probably have to go to a national distributor. The following are good sources for all kinds of consumer-electronics replacement parts, including common microwave-oven parts:

- MCM Electronics (VCR parts, Japanese semiconductors, tools, test equipment, audio, consumer electronics including microwave oven parts and electric range elements, etc.) Tel: 1-800-543-4330; Fax: 1-513-434-6959.

- Dalbani (Excellent Japanese semiconductor source, VCR parts, other consumer-electronics parts, car stereo, CATV.) Tel: 1-800-325-2264; Fax: 1-305-594-6588.

- Premium Parts (Very complete VCR parts, some tools, adapter cables, other replacement parts.) Tel: 1-800-558-9572; Fax: 1-800-887-2727.

The following suppliers have Web sites with on-line catalogs and list a very extensive selection of microwave-oven parts. There is a chance that the first two may not want to sell to the general public. However, it is definitely worth checking as the public Web sites imply a desire to deal with the entire Internet community.

- Global/MPI/All Appliance Parts (Their web site—<http://www.allapplianceparts.com>—includes a very extensive selection of microwave oven parts; nearly 50 different magnetrons are listed along with little photos of each!) Tel: 1-800-325-8488.

- AMI (Appliance Maintenance International. Distributor of major appliance replacement parts. Extensive on-line catalog of microwave-oven parts with Web pages for other major-appliance parts under construction.) Tel: 1-800-522-1264; Fax: 1-800-442-3601; e-mail: microwav@netins.net; Web: <http://www.netins.net/showcase/microwav>.

- Electronix, Corporation (Magnetrons, interlock switches, lamps, glass trays, diodes, thermal fuses, couplers, latches, rivets, stirrers, fans, waveguides, and more.) Web: <http://www.electronix.com/>

Wrap Up

You are now “experts” at microwave oven repair. Don't believe me? OK, you are wise. However, with the information given in this and the previous two installments of Service Clinic, and what can be found at the Repairfaq (see below) and Microtech (<http://www.yup.com/microtech>) Web sites, you should be able to deal with most common problems. Just think logically and above all else, heed the safety guidelines.

For a more in-depth treatment, there is at least one comprehensive book that might be available in your local public library: *Microwave Oven Repair*, 2nd Edition, by Homer L. Davidson, TAB Books, a division of McGraw Hill, Inc., 1991, Blue Ridge Summit, PA 17294-0850.

That's all for now. Until next time, if you have any specific questions, you can contact me directly at sams@stdavids.picker.com. For general information on electronics troubleshooting and repair, you can visit my Web site at <http://www.repairfaq.org>.



NEW LITERATURE

USE THE FREE INFORMATION CARD FOR FAST RESPONSE

Linear IC Applications: A Designer's Handbook

by Joseph J. Carr
Butterworth-Heinemann
225 Wildwood Avenue
P.O. Box 4500
Woburn, MA 01801-2041
Tel: 617-928-2500
Fax: 617-933-6333
\$47.95



CIRCLE 338 ON FREE INFORMATION CARD

A fiction voiced by many observers of the electronics world is that analog electronics, the domain of the linear IC, is dead, and digital electronics is taking over. It is true that digital electronics is growing rapidly

and has already taken over many functions previously performed in analog circuits. However, that doesn't mean that analog electronics is ready to die. There are still jobs that are either best done by analog circuits or where they are more cost-effective. In fact, demand for analog electronics is increasing and there is a worldwide shortage of skilled personnel.

This book addresses that shortfall and equips the reader to apply linear ICs in a wide range of settings, and is filled with practical applications of linear IC circuits, mostly based on op-amps. Designing circuits for applications and design principles are covered thoroughly. But more than that, the principles of design for each class of circuit are transferable to other projects that are similar in function. Aimed at electronics engineers, the handbook prepares them to apply linear ICs anywhere.

Each of the ten chapters is organized in an easy-to-learn manner, with objectives and a pre-quiz; followed by explanations of different circuits, design prob-

lems, and solutions, with examples and illustrations; and ending with a summary, a recap, student exercises, and problems. Subjects included are: nonlinear applications, signal-processing circuits, measurement and instrumentation circuits, integrated circuit timers, IC data-conversion circuits, audio applications, communications applications, analog multipliers and dividers, active-filter circuits, and troubleshooting discrete and IC solid-state circuits.

Free supplemental software is available on the Butterworth-Heinemann Web site.

Catalog #974Q

Digi-Key
701 Brooks Avenue South
Thief River Falls, MN 56701-0677
Tel: 1-800-344-4539
Fax: 218-681-3380
Web: www.digikey.com
Free



CIRCLE 339 ON FREE INFORMATION CARD

connectors, cable assemblies, and IC sockets; semiconductors, ICs, transistors, diodes, and rectifiers; crystals and oscillators; inductors, coils, and filters; capacitors; audio products; resistors, potentiometers, thermistors, and ZNRs; switches; wire; tools, solder, and hardware; fuses; fans; batteries; transformers, power supplies and test equipment; and optoelectronics, LEDs, LCDs, lasers, and displays.

Many major manufacturers' products are represented. This catalog fea-

tures many new products, such as logic ICs from Toshiba, flash memory and EPROMs from Advanced Micro Designs, surface-mount inductors from Panasonic, digital panel meters from Jewell, and 7-segment LED displays from Lumex.

Electronic Components Selection and Application Guidelines

by Victor Meeldijk
John Wiley & Sons, Inc.
605 Third Avenue
New York, NY 10158-0012
Tel: 800-225-5945
Web: <http://www.wiley.com>
\$95



CIRCLE 340 ON FREE INFORMATION CARD

Aimed at electronics engineers and technicians, sales staff, marketing personnel, and other electronics professionals, this source book incorporates a vast amount of current information from thousands of catalogs, reference books, textbooks, newsletters, trade papers, and journals. The information is organized logically and cross-referenced to provide easy access to crucial component specifications and instructions. Clear, direct presentations make even complex technical information comprehensible for non-technical professionals as well as for those with electronics backgrounds.

The book helps users select the best component for any application. It covers the entire spectrum of electronic components in use today. The book explores the latest innovations and trends in the field, and covers all aspects of component design and application. It helps electronics professionals understand the

Continued on page 40

The Internet, Java, and Hype-Aplenty

VIEW THIS AS THERAPY. I'M IN A BAD MOOD (-;-). I'M REALLY TIRED OF . . . CERTAIN THINGS. I'M GOING TO TELL YOU WHAT BUGS ME (COMPUTER-WISE, OF COURSE). THEN YOU CAN TELL ME WHAT BUGS YOU. I'LL COMPILE A LIST AND PUBLISH IT

here. Then we'll all feel better. So, to get the ball rolling, ... the two at the top of my list are Java and the Internet. As you might suspect, it's not the things themselves that bug me, but the hype surrounding them. Let's take 'em one at a time.

The Internet

The Internet bugs me because during the past two years, society has transformed it from a nice quiet private little postal and information service for geeks and nerds into a huge, crowded, noisy, over-commercialized shopping mall cluttered with the kinds of people I would never have anything to do with in "real" life. O give me a home....

Why is that? An analogy occurred to me. The computer has swallowed everything it has touched, for example, digital typography, audio and video processing (still underway), and corporate secretarial pools. Maybe it is now the computer itself that is begin subsumed within a larger revolution.

A related aspect is loss of innovation. There is precious little innovation involved in anything to do with the Internet. Experiencing life through a browser may seem innovative to some, but I find the paradigm simple-minded, and the implementation atrocious. What passes for innovation—HTML, spinning globes, click-and-go, so-called electronic commerce (EC)—to me resemble

warmed up leftovers more than a hearty meal for a grownup.

Actually, that's not true. EC is not leftovers; it's the driving force behind most of what's happening on the Internet today. Don't get me wrong. Having access to solid information, be it tech support, computer science, or anything in between, is great. But blatant commercialism and greed are clogging the airwaves and polluting the paradigm.

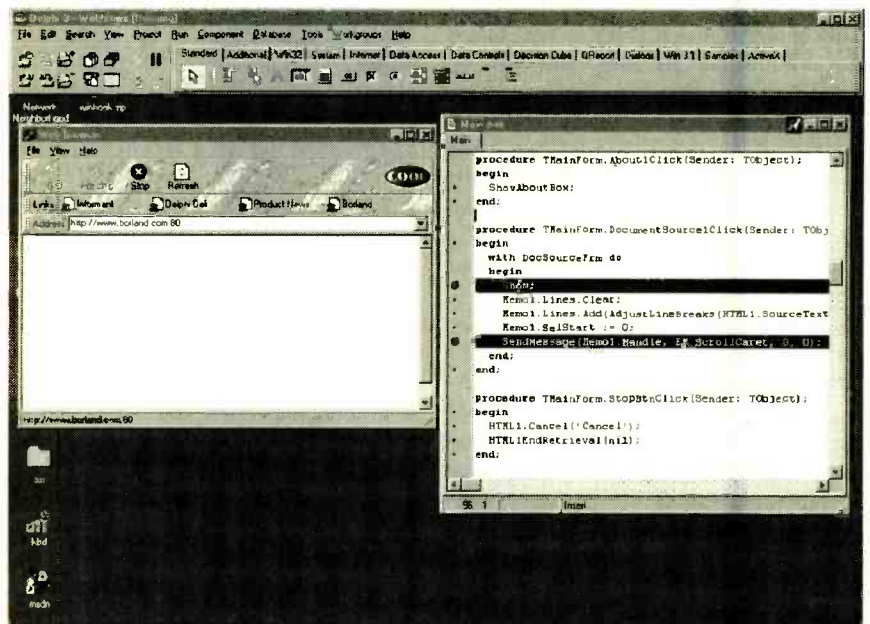
The latest instance of this is so-called

push technology, which is being discussed everywhere from trade journals to Time magazine. Push is a means for vendors to shove commercial advertising down our throats via the browser paradigm. We already have major bandwidth problems. Now they want to start running sewage through the supply lines. What's wrong with this picture?

OK; that's enough for now. Let's turn to Rant Number Two.

Java

Java is a programming language based on C++, but without some of the dangerous features of the latter, primarily pointers and dynamic memory management. Java is going to change the world, according to the hucksters. Sun Microsystems ("the network is the computer") promises "write once, run anywhere," but recent



DELPHI 3.0 IS FASTER, more powerful, and easier to use than any other rapid-application development system, but can it save Borland?

reports indicate that even the initial implementations of the Java Virtual Machine (the thing that makes Java programs platform independent) show compatibility problems, not to mention wide disparities in performance.

Personally, I would be surprised if those platform-specific discrepancies don't increase as JVM vendors (Microsoft, IBM, NetScape, etc.) tweak the code to enhance performance or provide special capabilities. Microsoft has unabashedly and overtly stated its intention to do just that. It is making the Win32 API available to Java developers. Said developers will then wittingly or otherwise start to take advantage of said platform-specific APIs. The result is that pretty soon Windows Java programs won't run anywhere else.

Then, as long as MS owns those programmers—*i.e.*, sells them the tools—it doesn't care what language they code in. And coincidentally enough (or, maybe not), the company is working hard at integrating all its development tools, from C/C++ to Basic to Java, into a single development environment. Sure, you can probably write "pure" Java programs in Developer's Studio, but will you be able to resist the temptation to enhance performance or capabilities by dropping into native APIs?

Meanwhile, all those budding Java developers are busy producing some pretty compelling applications. Let's see, Corel Corp., is rewriting WordPerfect and related apps in Java. Now there's a compelling activity, one bound to turn the tide against Microsoft Office. Then there are all those wonderful applets running in our browsers presenting scrolling headlines, spinning globes, and so on. Oh, and every computer game ever written is being ported to Java. Yes sirree, I always wanted to play Tetris in my browser, and no thanks, I don't want to play it if it happens to be written in C or Delphi. I only want to play games written in Java.

Huh? I don't think so. The vast majority of people know nothing and could care less about the language the programs they use are written in. Do I care about the brand of wrench used to tighten the lug nuts on my car? Noooo!

The Java "standard" has been under Sun's control from the beginning. The company is making moves to gradually release chunks of it to impartial international-standards organizations. But Sun still wants to maintain overall evolution-

ary control. No one ever accused Microsoft of employing tactics like that. No sir, not Microsoft; and not Sun either—right?

I read a comment recently in which someone stated that the biggest benefit Java may bring is to introduce object-oriented programming to the mainstream of programmers. That truly would be a benefit, but doesn't that thereby relegate Java to the status of a teaching language, much like Pascal? Never mind the fact that there are more than 600,000 Delphi/Pascal programmers out there, including yours truly, producing real-world applications to solve real-world problems. So I think that Java may catch on in that sense, but that it will never attain the status the hypsters would have us believe.

Is learning Java a good career move? I wouldn't suggest investing everything you've got (either financially or emotionally) into Java. But once you get past the trivial stuff, Java, Delphi, and C++ are so similar that a thorough grounding in one will make learning another relatively quick. Java may be getting the headlines, but for now, C/C++ is what appears in the classifieds.

Small(er) Rants

One thing I really do like about NT 4.0 is the Task Manager (TM). You can view it by right clicking the taskbar. TM displays summary information about the applications and processes currently running. It also provides graphs and numeric indicators of memory and CPU utilization. You can configure TM to display an iconic version of the CPU utilization chart in the taskbar. That way you can keep tabs on how busy your system thinks it is.

It is instructive to watch that graph during various types of operations, such as modem downloads, LAN-based file copies, and simply running application programs. It is especially interesting to watch the graphs associated with certain application programs, for example, Microsoft Visual SourceSafe 4.0, and Microsoft Access version 7.0. Loading

either program pegs the meter at 100%, even in an idle state.

Delphi 3.0

Speaking of Delphi, Borland has just released version 3, and it is a major upgrade.

A new (to Delphi) technology called Packages allow applications and runtime libraries to be segmented more intelligently. Under prior versions, a simple "Hello world" application took up on the order of 200K of memory. Now such a program can be compiled in 10K. Not that many people really care about efficiency anymore; but Internet downloads of ActiveX controls can happen at an acceptable rate using Packages.

And speaking of ActiveX, Delphi 3 now fully supports the underlying architecture, COM (Component Object Model). COM is a serious attempt by Microsoft to deploy objects that can communicate across language boundaries (*e.g.*, Delphi to C++), process boundaries (MyApp to YourApp running on the same machine), and, using Distributed COM (DCOM), machine boundaries (MyApp on my machine to YourApp running on your machine), while also providing a robust means of component versioning and evolution. COM/DCOM does not yet provide much in the way of cross-platform support, but Microsoft has enlisted third parties to aid in ports to a variety of mainframe and UNIX environments.

That means Delphi can create ActiveX controls for decorating Web pages (so there, Java!). It also means that Delphi can create complex database and manufacturing systems that distribute a variety of processes across multiple machines. For example, I am in the final stages of a custom publishing system written in Delphi that literally distributes custom database, "manufacturing," and management/control modules across an NT 4.0 network. The manufacturing module uses a proprietary scripting language to build up high-level page descriptions, which are then compiled into PostScript and fed to a queue manager, and eventually to a high-speed tabloid-format color laser printer.

Delphi 3 includes a fancy code editor, like that in the latest release of Visual Basic (VB), that provides context-sensitive syntax help for Object Pascal, Windows API calls, and even your own routines. VB supports only internal syntax assistance.

RESOURCES

Delphi 3.0
Borland Intl., Inc.
100 Borland Way
P.O. Box 660001
Scotts Valley, CA 95067-0001
Tel: 800-233-2444
Internet: www.borland.com

Whatever
you're
looking for...
look to NTE!

WINDRAFT® SCHEMATIC CAD SOFTWARE PROGRAM

Now available
in Low-cost
2.0 CD-Rom
Version



U.S. Version Only

- User-definable Parts Palette for 20 frequently used parts
- Works with Windows®
- Imports BMP graphic files
- True-type fonts
- Design statistics and on-screen pin count indicator
- Improved editing functions
- 200-pin capacity (upgradable to higher pin capacities)



For CAD Software literature,
use reader service #.....

or call 1 (800) 683-6837.

Visit our website at
www.nteinc.com



NTE ELECTRONICS, INC.
ACTION, NOT EMPTY PROMISES

CIRCLE 71 ON FREE INFORMATION CARD

There are tons of smaller new features, including more and better Internet components (oh joy), and more and better components for creating apps that look like Microsoft apps (oh joy). There is also an amazing device Borland calls a "decision cube" that allows you to embed an extremely powerful cross-tab report generator (with graphing) into your apps and dynamically establish query parameters, perform roll-ups and drill-downs, and so forth.

Although not quite as fast as C/C++, the code produced by Delphi runs like lightning in comparison with other environments like Visual Basic (despite recent Microsoft's claims to the contrary). And the new package technology blows VB's run-time engine out of the water in terms of storage and download efficiency.

Delphi is fully object oriented, supports pointers and dynamic memory allocation, and can call (and be the object of any callback of) any Win32 API. Delphi can build console-mode apps, but they run only under Win32 (i.e., a "DOS box"). Borland has basically frozen development on the 16-bit version, which is included with the 32-bit versions. Delphi has its own component architecture, called VCL, but Delphi 3 can compile just about any VCL control into an ActiveX control with little or no recoding. Delphi also has strong interoperability with Borland's C++ Builder, which more or less puts a C++ engine inside the Delphi IDE.

I have spent the better part of the past year working in Delphi, and I have extremely ambiguous feelings about it. On one hand, I love Pascal as a language; it is by far the most elegant computer language I have ever used. Delphi's IDE (Integrated Development Environment) has a slick look and feel that is unmatched by any in any language I have ever used. The new version supports debugging DLLs directly under the IDE.

On the other hand, Borland has experienced deep troubles the past few years, and is not out of the fire yet. Late last year, Microsoft managed to lure the chief Delphi architect, who had been with the company for more than a decade. Since then, there has been a steady brain drain. In fact, Borland has taken Microsoft to court over what it calls Microsoft's anti-competitive practices in this area.

When Delphi first came out about two years ago, there was little interest in it in my part of the country. Interest gradually grew to the point where finding

work was easy. But interest has definitely been on the wane the past few months, at least prior to the introduction of Delphi 3. We'll see if that makes any difference.

Otherwise, and I hate to say it, Visual J++ is looking more and more appealing. Let me know what bugs you; contact me via e-mail at jkh@acm.org. **EN**

NEW PRODUCTS

continued from page 28

TVs, and oscilloscopes. The CRT tester's full dynamic range allows for the testing of older CRTs as well as the new models. Simply connecting one of the six supplied adapters allows the user to test virtually all the new CRTs without resetting setup switches. It also tests all three guns of color CRTs and displays the results simultaneously with interpretation-free "Good/Bad" results.

The CR7000 provides full bias ranges, a sliding "Good/Bad" scale, and "Lo- and High-Level" emission tracks, as well as testing all gun elements for shorts or leakage. The analyzer has six levels of "Progressive Restoration," a self-limiting shorts-removal function, and a broad restoration range. In addition, Sencore has newly designed the sockets to allow easy connection to hard-to-reach CRTs.

Sencore's CR7000 "BEAM-RITE" CRT Analyzer and Restorer costs \$1995.



CIRCLE 25 ON FREE INFORMATION CARD

SENCORE INC.
3200 Sencore Drive
Sioux Falls, SD 57107
Tel: 800-SENCORE or 605-339-0100
Fax: 605-339-0317 **EN**

The demand for computer programmers will double by the year 2005...

Train now for a high-paying career as a computer programmer!

Only NRI at-home training gives you in-demand programming skills in three of today's hottest computer languages: BASIC, C, and Visual Basic.

Plus, you now train with and keep state-of-the-art programming tools: a Pentium® 200 multimedia computer system, Visual Basic, Windows 95, and more!

Opportunities are skyrocketing

The Bureau of Labor Statistics forecasts that job opportunities for computer programmers will increase much faster than the average over the next 10 years, with as many as 400,000 new jobs opening up by 2005.

Now, with NRI, you can get the new skills you need to build a top-paying career — even a full- or part-time business of your own — in this high-growth field.

Learn today's hottest languages!

With NRI's unique Discovery Learning Method, you get hands-on programming experience as you master today's most popular languages and programming environments. Step by step, you learn to

create the kinds of full-featured, powerful programs today's employers and clients demand:

- You **start with BASIC**, building your confidence enough to create and modify several programs of your own.
- You move on to **master C**, a sophisticated language that's become the programming tool of choice for a variety of applications.
- You're then ready to **explore Visual Basic**, a high-level, object-oriented language designed specifically for creating programs in a Windows 95 environment.

Best of all, you master these important languages as you train with and keep the

most powerful computer system available from any school!

Send for your FREE catalog today!

See how NRI can give you the programming skills, the full-featured computer system, and the state-of-the-art software you need to get started in this top-paying field.

If the coupon is missing, write to us at NRI Schools, 4401 Connecticut Avenue, NW, Washington, DC 20008.

CALL 1-800-321-4634, Ext. 2747

<http://www.mhcec.com>



More equipment, more advanced software, and more real-world programming experience than any other school!



- Pentium® 200 processor
- 16 meg RAM and 256K cache memory
- 1.6 gigabyte hard drive
- Super VGA color monitor; 1 meg video memory
- 8X CD-ROM drive and 16-bit sound card
- 33,600 baud fax/modem
- Netscape Navigator™ Web browser
- BASIC interpreter
- Power C and Visual Basic compilers
- Windows 95
- Exclusive access to NRI's Online Connection

Now, with NRI's new PC Options Plan, you can keep up with late-breaking advances in technology by upgrading your computer system at special student rates. You'll get all the details shortly before your computer is scheduled for shipment. It's NRI's state-of-the-art guarantee!

SEND TODAY FOR FREE CATALOG

NRI Schools

4401 Connecticut Avenue, NW, Washington, DC 20008

- Check one FREE catalog only
- COMPUTER PROGRAMMING
 - PC Applications Specialist
 - Visual Programming in C++
 - Networking with Windows NT
 - Microcomputer Servicing
 - Desktop Publishing with PageMaker
 - Bookkeeping & Accounting
 - Multimedia Programming
 - Mastering Microsoft Office
 - Introduction to PCs and the Internet

Name _____ Age _____
 (please print)
 Address _____
 City _____
 State/Zip _____

A Division of The McGraw-Hill Companies

5415-1097

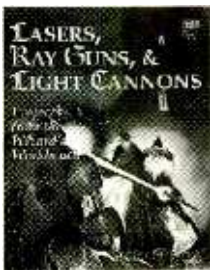
NEW LITERATURE

continued from page 33

many types of devices currently available, streamline the component-selection process, avoid component over- and under-specification problems, understand device parameters, and reduce costs.

Lasers, Ray Guns & Light Cannons: Projects from the Wizard's Workbench

by Gordon McComb
McGraw-Hill Companies
11 West 19th Street
New York, NY 10011
Tel: 800-2MCGRAW
Fax: 212-337-4092
\$21.95



CIRCLE 341 ON FREE INFORMATION CARD

This 413-page paperback book is geared to the hobbyist, either expert- or student-level, and shows how to build over 88 laser and optics projects using inexpensive, easy-to-obtain components.

Those projects include building a laser ray gun, putting on a professional light show, creating holograms, as well as performing dozens of experiments. Other construction projects can detect intruders around a perimeter, measure precisely the speed of light, perform laser "snooping," transmit data with lasers, and carry your voice over a beam of light.

The projects are presented with step-by-step simple instructions, and many clear illustrations accompany the instructions. The complete and field-tested plans include many projects that are suitable for science fairs.

The book is organized into 25 independent modules. There is scientific history and theory, as well as instructions for the projects themselves, both basic and advanced. In addition, there are chapters on tools for laser experimentation, buying laser parts, and computer-controlled laser projects. Appendixes guide you to other sources and suggested reading, and the book has a complete index and glossary.

Electronic Parts and Accessories Catalog

Parts Express
340 East First Street
Dayton, OH 45402-1257
Tel: 800-338-0531
Fax: 937-222-4644
e-mail: sales@parts-express.com
Web: <http://www.parts-express.com>
Free



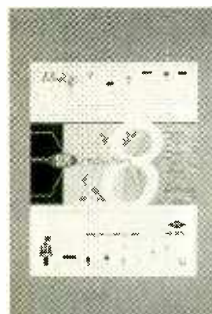
CIRCLE 342 ON FREE INFORMATION CARD

Geared toward the consumer-electronics industry and the technical hobbyist, this 244-page catalog features full lines of electronic parts and accessories.

It includes an impressive selection of raw loudspeaker drivers for home and automotive applications, CATV and VCR repair parts, semiconductors, tools and technical aids, home-theater and home-automation products, test equipment, alarm systems for home and car, computer accessories, chemicals, telephone products, wire, connectors, speaker-design software, cellular-phone accessories, stage lighting, professional sound equipment, and instructional books and videos.

Semiconductor Catalog 1997

NTE Electronics, Inc.
44 Farrand Street
Bloomfield, NJ 07003
Phone: 800-683-6837
Fax: 800-683-3338
Web: <http://www.ntelinc.com>
Free



CIRCLE 343 ON FREE INFORMATION CARD

This comprehensive reference contains more than 4000 NTE semiconductors matched to over 259,000 American, Asian, and European counterparts. The guide is well suited for use in industrial, consumer, commercial, and other applications. It also provides information on replace-

ment considerations, mounting techniques, accessories, and hardware.

The eighth edition features hundreds of new devices, including surface-mount CMOS and Zener diodes, logic-level MOSFETS, 1600-volt SCRs, voltage regulators in isolated TO-220 packages, and ultra-fast rectifiers. Additions to existing lines of bi-directional and unidirectional transient suppressors, power MOSFETS, and power and Darlington transistors are also listed in the catalog.

The entire catalog can be accessed directly on NTE's Web site, noted above.

Serial Communications Data Acquisition and Control Products 1997 Catalog 22

B&B Electronics Manufacturing Company
707 Dayton Road
P.O. Box 1040
Ottawa, IL 61350
Tel: 815-433-5100, ext. 200
Fax: 815-434-7094
e-mail: catrgt@bb-elec.com
Web: <http://www.bb-elec.com>
Free



CIRCLE 344 ON FREE INFORMATION CARD

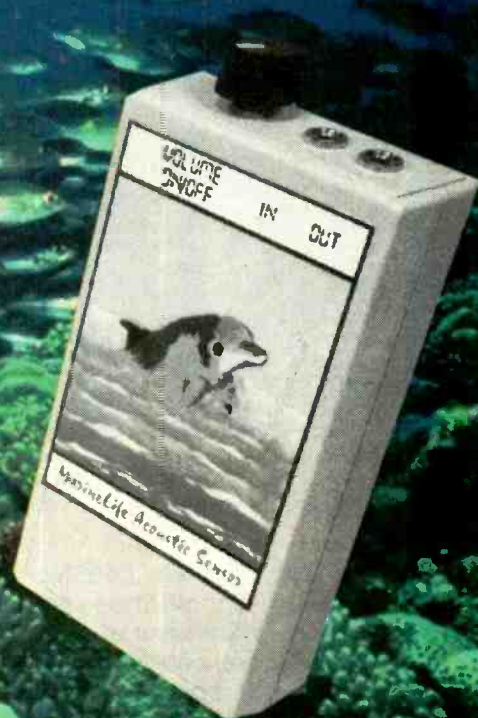
This 40-page catalog shows solutions to computer serial-port connection problems. Port-mounted Interface Converters allow you to connect incompatible interfaces and communicate at distances

of up to 4000 feet. New product highlights include a 5-port smart switch, which may be daisy-chained to connect up to 17 devices to one serial port; a port reverser; signal conditioning modules; pH electrodes; a variety of bridge-type outputs; optoisolators; surge protectors; and security devices. Also featured are digital multimeters designed to read low-voltage communications-line signals, some with built-in memory and the ability to download to a PC. Three new PCMCIA Cards for parallel, serial and multiport applications are shown.

The entire catalog can also be accessed directly on the Web site noted above.

BUILD THE MARINE LIFE ACOUSTIC SENSOR

*Eavesdrop on the sounds of the deep
with this simple, handheld device!*



BILL GREEN

In truth, the silent deep is far from silent—the raucous deep would be a better name. Most of us are aware that marine mammals make sounds or noise for communication, searching for food, self-defense, or other reasons. Shrimp, for example, make a clicking or popping sound that might be caused by the movement of the parts of their shells, legs, or jaws. A certain breed of fish, called a Drum, makes a sound very much like, well, a drum.

Man-made devices, such as boat motors and ship engines add to the noise of the marine environment. In fact, the oceans are so filled with sounds and noises, it can be difficult (or impossible) to determine what the various noises are. A safe assumption is that any marine life that is much larger than a microscopic organism will make noise.

A swimmer or diver in the ocean will not hear much in the way of sound, except perhaps during a close encounter with a medium or large marine mammal such as a whale or dolphin. The sound is

there, but we can't hear much of it because our ears are designed to work in air rather than water.

Most of us have heard of the marine-sonar and passive-listening devices that were developed before World War II. Their use was, and is, essential in both submarine and anti-submarine warfare. It is known that schools of fish and marine mammals would often foul up those sonar operations. We can use that fact to listen to, or eavesdrop, on the denizens of the deep.

The MarineLife Acoustic Sensor project described here is an electromechanical listening device that works on the same principle as the passive sonar devices in submarines. It has the same basic components: an acoustic transducer, a high-gain amplifier, and connections for headphones, speakers, or a tape recorder. It is small, lightweight, compact, and battery operated. Those features make it easy to use the MarineLife Acoustic Sensor in a large boat, a small boat, a rowboat, or even a

canoe. You can even use it off a pier or a bridge.

About The System. The MarineLife Acoustic Sensor is built around an LM386 high-gain audio amplifier. That IC is able to drive a 4-, 8-, or 16-ohm speaker or headphones with at least 250 mW of power.

The tricky part of the system is the receiving transducer. It will be immersed in a hostile saltwater environment, so it must be waterproof. A regular microphone could be made waterproof, but that would interfere with the microphone's sensitivity. Any transducer for listening to underwater sounds must be quite sensitive, so a waterproofed microphone would be useless for our needs.

However, a device exists that is almost perfect for the job at hand. It is a piezo-electric transducer, which is usually used to make sound. It can also act as a sound receiver. It consists of a thin, round, brass disc, a little under 1½-inches in diameter. Bonded to the surface of

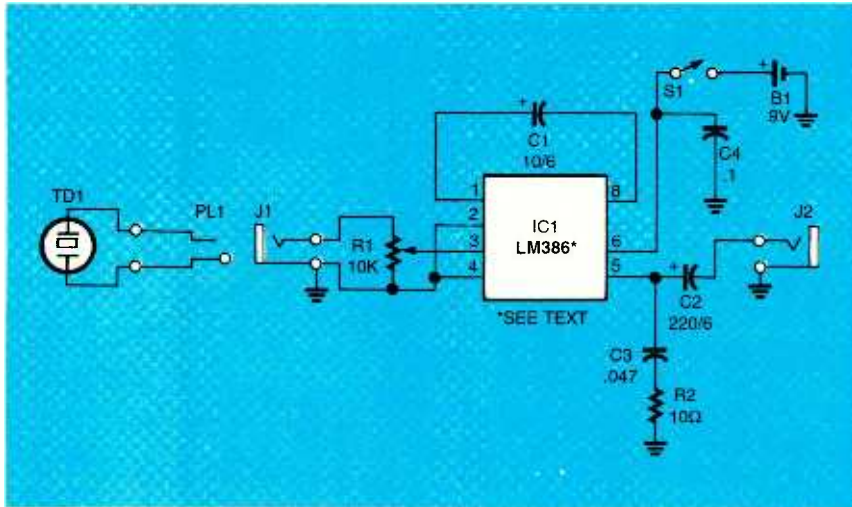


Fig. 1. The MarineLife Acoustic Sensor is a simple headphone amplifier built around an LM386 amplifier chip. A piezo-ceramic transducer picks up sound from the water. There are two different versions of the LM386, depending on what voltage battery you will be using.

the brass disc is a thin ceramic wafer of barium titanate. The wafer is coated with a thin layer of silver that forms a second contact. Like a quartz crystal, the barium titanate will physically vibrate when an AC signal is applied to it. It will also generate a voltage when pressure is applied to it—just like a microphone. That piezo-electric effect is perfect for a waterproof acoustic sensor. With a cable attached to the two plates (the brass and the silver), we can amplify the generated voltage and hear the vibrations that are striking the sensor. Encapsulating the sensor with an insulating and waterproofing material will result in a marine acoustical transducer. It will be very sensitive, waterproof, and able to withstand the harsh saltwater environment of the ocean.

About The Circuit. The schematic diagram in Fig. 1 shows that the heart of the circuit is, as previously mentioned, IC1, an LM386 audio-amplifier IC. The inverting input is grounded and the input signal from J1 is fed to the non-inverting input through volume control R1. The overall gain of IC1 is set by C1. The output, pin 5, is AC-coupled to J2 by C2. The output of IC1 is bypassed to ground with C3 and R2. That will prevent radio-frequency interference from affecting the circuit. Additional protection from AC signals is provided by C4.

MarineLife Acoustic Sensor can be built on either a perfboard or a printed-circuit board. If you choose to use the PC board approach, a foil pattern has been provided. Should you choose to use the foil pattern, the parts-placement diagram in Fig. 2 should be followed for the correct component location and wiring.

The usual precautions for handling semiconductors should be followed during assembly. Be sure to observe the polarity of the electrolytic capacitors when inserting them into the PC board. If those components are installed back-

PARTS LIST FOR THE MARINELIFE ACOUSTIC SENSOR

Capacitors

- C1—10- μ F, 6-WVDC, electrolytic
- C2—220- μ F, 6-WVDC, electrolytic
- C3—0.047- μ F, ceramic-disc
- C4—0.1- μ F, metal-film

Resistors

- R1—10,000-ohm potentiometer (integral with S1—see text)
- R2—10-ohm, 1/4-watt, 5% carbon-film

Additional Parts and Materials

- IC1—LM386N-1 or LM386N-3 audio amplifier, integrated circuit (see text)
- B1—6- or 9-volt battery
- J1, J2—Mini stereo or mono phone jack
- S1—Single-pole, single-throw switch (integral with R1—see text)
- TD1—Piezo-ceramic disc, see text
- Battery clip, case (RadioShack 270-211 or similar), label, knob, PC board, potting compound, wire, solder, hardware, etc.

wards, the circuit will be destroyed and the capacitors might explode!

There are two versions of the LM386 that can be used in the MarineLife Acoustic Sensor. The LM386N-1 is rated for a 250-mW output with a 6-volt supply, while the LM386N-3 can put out 500 mW at 9 volts. The LM386N-1 will draw

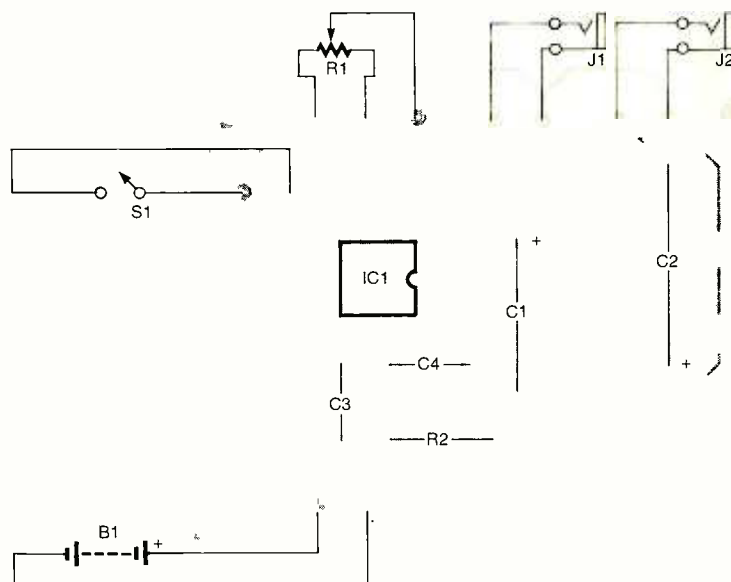


Fig. 2. Use this parts-placement diagram if you are going to use the foil pattern included here.

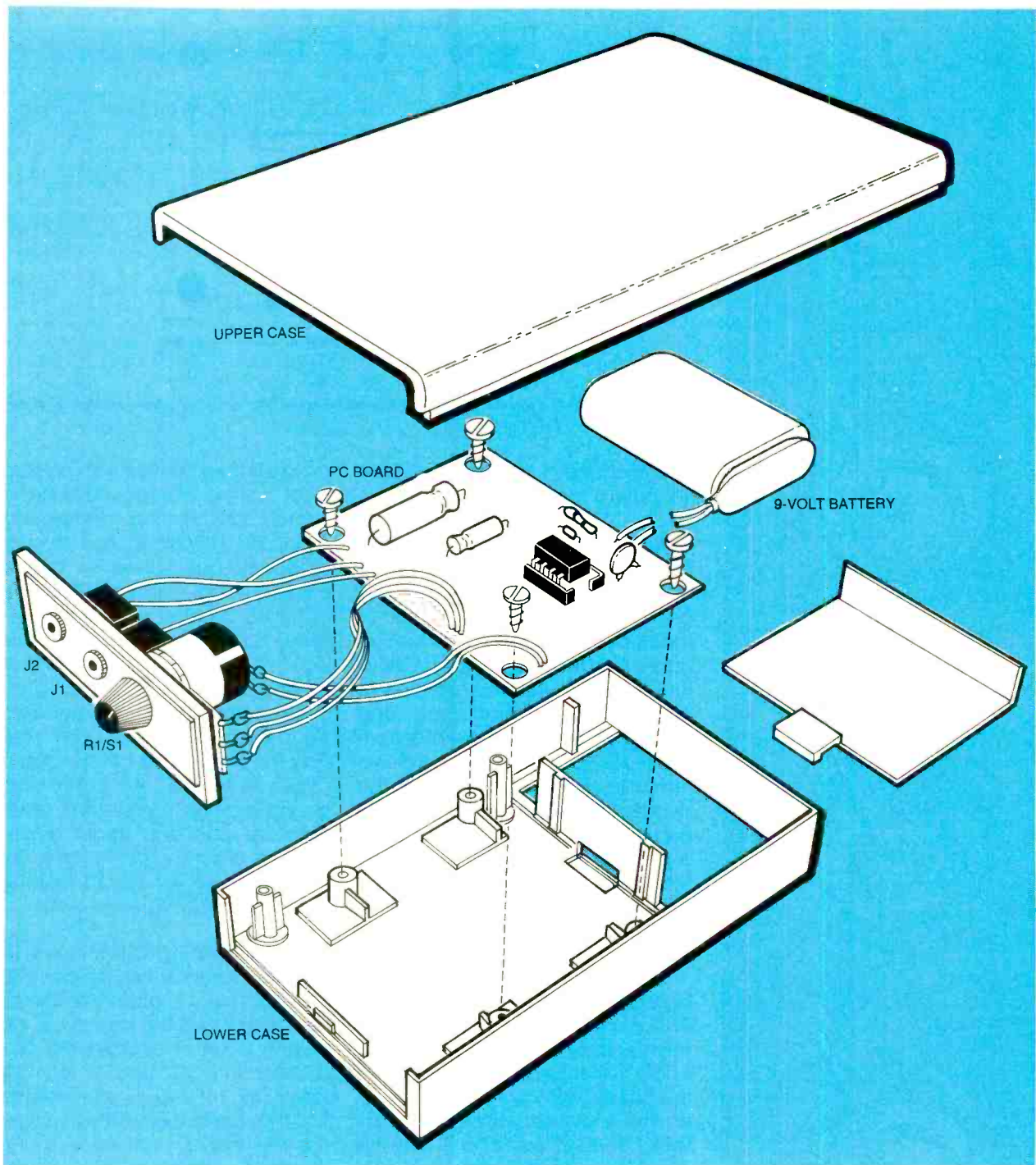


Fig. 3. The MarineLife Acoustic Sensor fits easily into a hand-held case that includes a battery compartment. Using a potentiometer with an integrated on-off switch for R1 and S1 makes operating the Acoustic Sensor easy.

less power from a 9-volt battery. That part will give you longer battery life, but the sound will not be as loud. As with most designs, there is a trade-off between performance and economy. As either will work, the choice is yours.

Select a suitable case to hold the PC board, battery, and controls.

One type of case is a split-type with an accessible battery compartment. Those types of cases sometimes come with a removable end panel. Having such a panel makes drilling the holes for the jacks and controls easy. A suggested arrangement using that type of case is shown in Fig. 3.

If you use stereo jacks for J1 and J2, be sure to wire both channels together. That way, both mono and stereo plugs can be used—especially with stereo headphones. Switch S1 can be either a separate switch or integral to R1. The second arrangement is preferred and lets the MarineLife Acoustic Sensor be

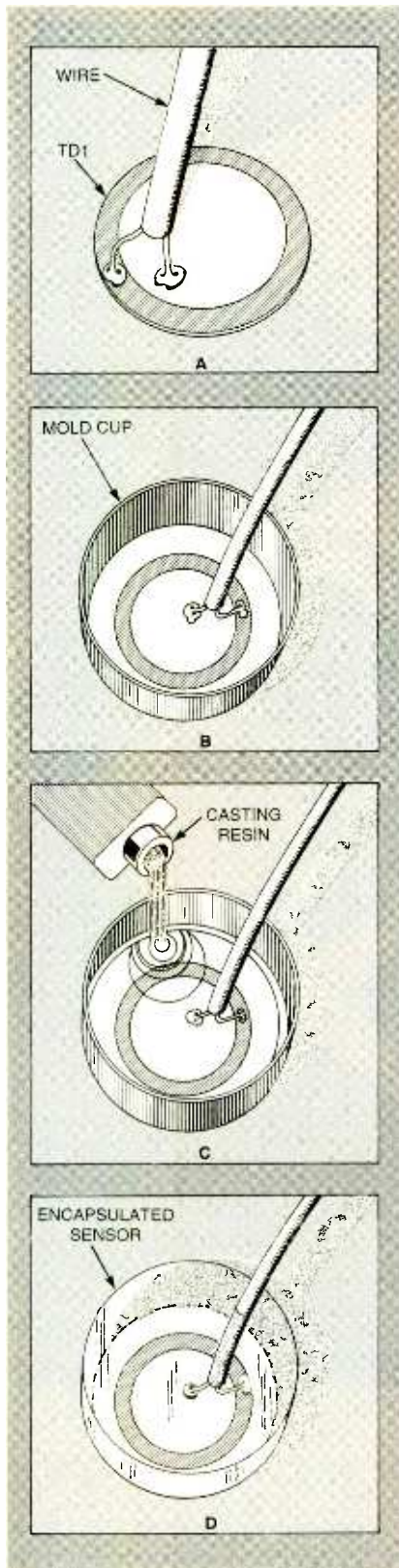
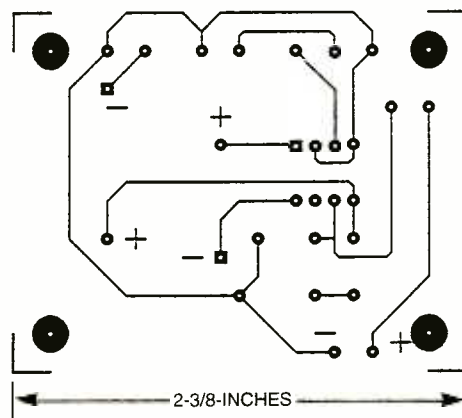


Fig. 4. The acoustic sensor itself is simply a barium-titanate transducer with an audio cable attached to it (A). To assemble the sensor, place the transducer in a plastic cup (B). The brass side should be facing down. Fill the cup with potting compound or acrylic casting plastic (C). After the compound cures, remove the mold (D). The sensor is then ready to go.



Here's the foil pattern for the MarineLife Acoustic Sensor. The circuit is simple enough to fit on a small, single-sided PC board.

operated like a radio—the volume knob turns the unit on and off.

Building the Sensor. The barium titanate disc used for TD1 can be salvaged from a piezo buzzer. They are also available from various mail-order sources. The transducer cable is a single-conductor vinyl-jacketed shielded microphone or audio cable. It should be long enough to reach to the water from wherever you plan to use the system. You should also consider the depth of the water in which you will be using it. A 100-foot cable is not excessive and will not attenuate the signal enough to notice. However, that's a lot of cable to deal with, especially when rolling and unrolling it.

Strip one end of the wire about 1 inch and separate the shield from the inner conductor. Strip the end of the exposed center conductor about $\frac{1}{8}$ inch. Tin both the wires and the braid. Carefully tin a small area on the brass disc and on the silvered back of the wafer. Solder the shield braid to the brass and very carefully solder the center conductor to the silver. Do not overheat the silver, and do not stress or bend the cable at the disc. The silver coating is very delicate, and will peel off the disc with very little effort. Follow Fig. 4A for that procedure.

A small plastic or metal cup about 1-inch deep and large enough in diameter to hold the sensor will be used as a mold. Place the disc in the cup so that it is flat against the bottom (Fig. 4B). The

mold will then be filled with an electrical potting compound such as ScotchCast. Potting compounds might be difficult to find through mail-order companies, so a well-stocked local electronic supplier might be a better source. An alternative is to use a clear acrylic-casting resin that is available from most art and craft supply stores.

The compound is mixed according to the manufacturer's directions. Pour the compound into the cup as shown in Fig. 4C. After the compound is cured, remove the sensor from the cup and solder a plug onto the other end of the cable. The completed sensor should look like the illustration in Fig. 4D.

Testing. Testing the MarineLife Acoustic Sensor is very simple. With S1 off, connect a battery to the circuit and plug in the transducer into J1 and a set of headphones or a speaker into J2. Turn S1 on and rotate R1 to one-quarter volume. Tap the transducer with your fingertip. You should hear some sound. Gradually advance the volume control until the maximum comfortable volume is reached.

Using the Sensor. Of course, you will need a source of underwater sound to perform the final checkout of the system. Either the ocean of a saltwater aquarium will do. Simply dunk the sensor into the water and start listening. Although the author has not tested the MarineLife Acoustic Sensor in fresh water, it should also work there. Ω

Scientists at the government's National Institute of Standards and Technology (NIST) have made an advance in low-temperature superconducting electronic technology that could lead to replacement of the DC-voltage standard with a fast, programmable, AC-voltage standard. The new standard would make use of the AC Josephson effect, where an alternating current at a known frequency is applied across a Josephson junction and the current-voltage curve that results exhibits equally spaced, constant-voltage steps. A Josephson junction is made up of two superconducting electrodes with a thin barrier between them, usually an insulator of a normal metal.

"This device will have worldwide impact on instrument manufacturers who require improved standards for calibrating D/A and A/D converters, international standards laboratories, and industrial and military standard laboratories," says researcher Samuel Benz, of NIST's Boulder, CO, laboratory. "The average customer may not

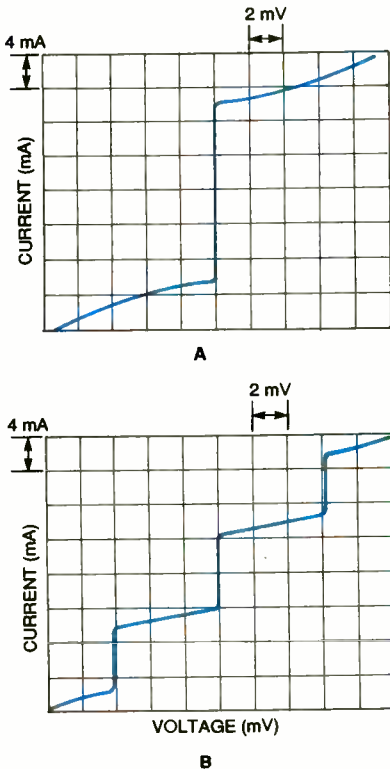


Fig. 1. The current-voltage characteristic curve for a 400-junction series SNS array at 4°K with no microwave power applied (A) and at 7.5 GHz (B).

A NEW VOLTAGE STANDARD

Learn how superconductor technology is being used to create a new, programmable, and super-accurate AC-based voltage standard.

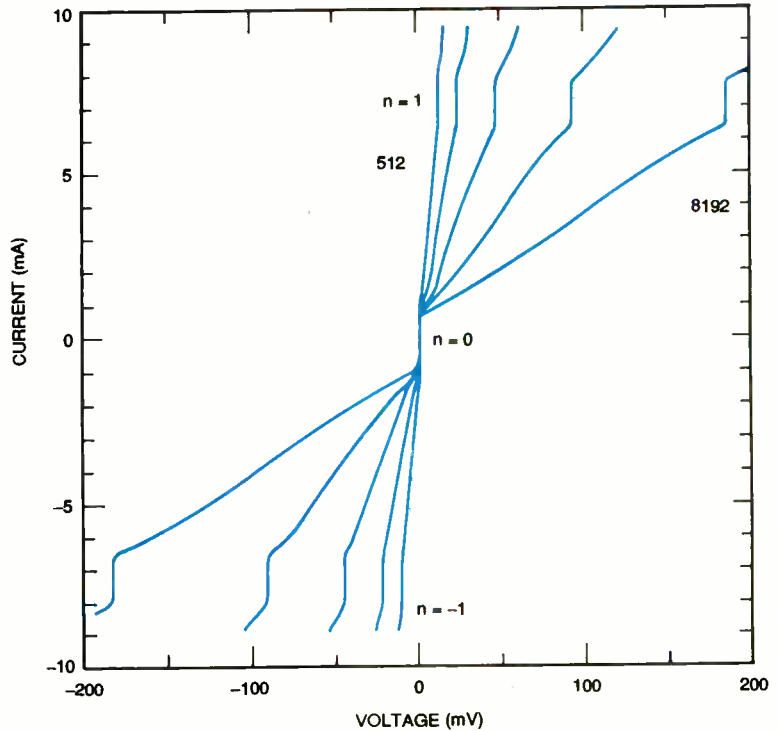


Fig. 2. Here are the current-voltage curves for each of the different arrays (512, 1024, 2048, and 4096 junctions) and for all the arrays connected in series (8192 junctions) when biased by an 11-GHz microwave waveform. The power and junction uniformities were sufficient to operate all segments at the same microwave power and DC bias. That is the ideal operating condition for a programmable voltage standard.

notice, but the programmable voltage standard may ultimately improve the ability of power companies to accurately measure the power delivered to consumers."

Creating a New Standard. Figure 1 shows the voltage-current characteristic curves for a 400-junction superconductor-normal-superconductor (SNS) array. Scientists at NIST's Electromagnetic Technology Division have fabricated and tested arrays of 4,096, 2,048, 1,024 and 512 SNS junctions using niobium-paladium and gold-niobium. They also have built a microwave circuit that provides uni-

form microwave power distribution so that each junction has constant voltage steps with the same bias-current range. Each array showed constant voltage steps of at least 1 milliamperere amplitude with the same applied microwave power (see Fig. 2). When all the arrays were measured in series, the power distribution was sufficiently uniform to achieve milliamperere-wide steps.

With a four-fold increase in the number of junctions, the researchers believe it should be possible to demonstrate a programmable voltage standard with a range of plus-or-minus one volt, 15-bit resolution, and

TIPS FOR MAIL ORDER PURCHASE

It is impossible for us to verify the claims of advertisers, including but not limited to product availability, credibility, reliability and existence of warranties. The following information is provided as a service for your protection. It is not intended to constitute legal advice and readers are advised to obtain independent advice on how to best protect their own interests based upon their individual circumstances and jurisdictions.

1. Confirm price and merchandise information with the seller, including brand, model, color or finish, accessories and rebates included in the price.

2. Understand the seller's return and/or refund policy, including the allowable return period, who pays the postage for returned merchandise and whether there is any "restocking" or "return" charge.

3. Understand the product's warranty. Is there a manufacturer's warranty, and if so, is it for a U.S. or foreign manufacturer? Note that many manufacturers assert that, even if the product comes with a U.S. manufacturer's warranty, if you purchase from an unauthorized dealer, you are not covered by the manufacturer's warranty. If in doubt, contact the manufacturer directly. In addition to, or instead of the manufacturer's warranty, the seller may offer its own warranty. In either case, what is covered by warranty, how long is the warranty period, where will the product be serviced, is there a charge for service, what do you have to do to obtain service and will the product be repaired or replaced? You may want to receive a copy of the written warranty before placing your order.

4. Keep a copy of all transactions, including but not limited to cancelled check, receipt and correspondence. For phone orders, make a note of the order including merchandise ordered, price, order date, expected delivery date and salesperson's name.

5. If the merchandise is not shipped within the promised time, or if no time was promised, within 30 days of receipt of the order, you generally have the right to cancel the order and get a refund.

6. Merchandise substitution without your express prior consent is generally not allowed.

7. If you have a problem with your order or the merchandise, write a letter to the seller with all the pertinent information and keep a copy.

8. If you are unable to obtain satisfaction from the seller, contact the consumer protection agency in the seller's state and your local Post Office.

If, after following the guidelines, you experience a problem with a mail order advertiser that you are unable to resolve, please let us know. Write to Advertising Department, Gernsback Publications Inc., 500B BI-County Blvd. Farmingdale, NY 11735.

Be sure to include copies of all correspondence.

30-bit accuracy. Eventually, that could be used to replace the DC voltage standard.

The Advantages. AC voltages are presently calibrated using thermal converters, which are detectors that convert AC voltages at a certain frequency to DC through heating. Such standards are not fundamental, as the accuracy of the thermal converters relies on the ability to accurately compute the AC/DC conversion. The physical properties and temperatures of each device affect the accuracy, so that each converter must be independently calibrated. Currently, the accuracy of thermal converters is about 0.5 ppm for frequencies below 1 kHz.

A programmable AC Josephson standard, on the other hand, would be a fundamental standard based solely on voltage accuracy. For the first time, such a standard will enable independent checking of thermal converters.

"We have invented a novel Josephson-junction technology," Benz said, "based on Nb-PdAu-Nb junctions that will enable higher-frequency waveforms to be generated and more current to be drawn from them by external loads. The results [we're getting] demonstrate for the first time that large arrays of superconducting-normal-superconducting junctions can be fabricated with uniform characteristics and that uniform microwave power can be coupled to them.

"We are now in the process of fabricating the first 1-volt programmable voltage standard based on these SNS junctions. We hope this array of 32,768 junctions will demonstrate programmable voltage-standard operation with a range of plus-or-minus 1-volt, 33-microvolt resolution, and better than 0.5-ppm accuracy."

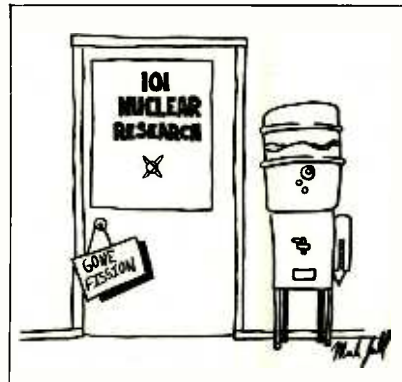
According to Benz, SNS junctions have several advantages over resistively shunted tunnel junctions. First, their higher critical current ($I_C > 1$ mA) provides greater stability against thermal fluctuations, greater output current, and faster slew rates. Second, their lower characteristic voltages ($I_C R$, where R is the junction resistance) imply lower operating frequencies, which enable ~ 20 - μ V resolution and less expensive microwave electronics.

The third advantage of SNS junctions is that they are available in high- T_C technology so the devices might be operated at higher temperatures. The primary disadvantage of SNS junctions over the unshunted tunnel junctions used in the existing DC-voltage standard is that their high microwave losses complicate the problem of providing uniform AC-power distribution to each junction in the device.

NIST has been developing Josephson DC-voltage standards with fundamental accuracy using superconducting electronic technology since implementation of the first Josephson voltage standard in 1972. DC-voltage standards were developed to enable primary voltage-standard calibration accuracy in any laboratory, which has provided improved accuracy for U.S. instrument manufacturers. Improved accuracy translates into improved instrument quality, which means more foreign and domestic sales.

DC Josephson voltage standards are also used by the military for high-accuracy calibration of sensitive equipment. Last year, a team from the USAF Standards Laboratory at Newark AFB, OH, visited the NIST Boulder, CO, lab for a briefing on the new system's potential capabilities.

"We're very impressed by this new technology," said Capt. Roger Wood, a metrologist at the Air Force Aerospace Guidance and Metrology Center. "This system has the potential to replace several electronic measurement standards while reducing our test uncertainties. And perhaps most importantly, we would no longer have to rely on NIST traceability for these standards. One of our goals is to increase our organic measurement capability and thus reduce our reliance on NIST certified standards." Ω



The Four-Year Electronics Degree Program That Really Hits Home!

Bring The Technology Home With A Bachelor Of Electronics Engineering Degree. No Hassles. No High Cost!



Now's the time to prepare for a profitable career.

We've lowered the cost of higher education.

It's true! You can earn a four-year Bachelor of Electronics Engineering Technology degree today ... and prepare yourself for a high-paying electronics career ... without quitting your job or ever leaving your home. Because World College, an affiliate of the Cleveland Institute of Electronics, offers you the total flexibility of independent study programs proven effective for people like you who truly want to succeed! World College independent study lessons help you build valuable skills

**Mail/Fax Today
or Call
1-800-696-7532**

step-by-step, and expert instructors are personally available to you with a toll-free call. What a way to earn an education!

A world of opportunity.

Where is your career headed? With a four-year bachelor's degree from World College, you call the shots, choosing from incredible, high-paying opportunities in electronics, telecommunications, computer, electrical power, and many other growing fields.

World College gives you the skills, the knowledge, the power to take advantage of your best opportunity in electronics. And you can do it all at your own pace!

Without leaving home.

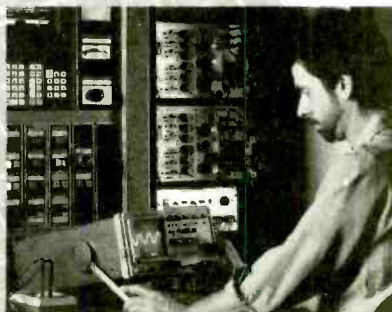
World College continually works to provide its students with the most advanced education tools. From the latest equipment and reference books to breakthrough computer-simulated experiments, students are exposed to the latest technological advancements.

All the equipment, parts, and software you need are included in your affordable tuition, including more than 300 hands-on lab experiments you can complete in your home.

Choose your own pace.

Earn your bachelor's degree on your time — and at your pace — because you pay tuition to World College only as you complete the upper-level semesters close to graduation. The faster you make it through, the less you pay. So you have an incentive to make your future happen quickly — yet the freedom to choose your own pace!

Send today for your FREE course catalog — and give yourself that future you've always wanted — with an electronics degree education from World College.



Take charge of your future in electronics.

Four Powerful Reasons To Connect With World College Today:

- 1. Earn your four-year degree!**
- 2. Self-paced training!**
- 3. Independent study in your home!**
- 4. Expert instruction!**

Give Me The Power!

Send me a FREE World College course catalog today!



(Please Print Neatly)

Name _____

Address _____

City _____

State, Zip _____

Phone () _____

Age _____

**For faster service, call
1-800-696-7532,
or call
1-804-464-4600.**

**Or fax this coupon to
1-804-464-3687.**



Lake Shores Plaza
5193 Drive, Suite 113
Virginia Beach, VA 23455-2500



Affiliated with
Cleveland Institute of Electronics
WAE52

RECRUITING TOMORROW'S ELECTRONICS TECHNICIANS



*While the demand for electronics technicians is increasing,
the pool of qualified workers is shrinking.*

Here's what we can—and must—do about it.

We'll begin this article with just one, seemingly simple question: "What makes a good electronic service technician?" However, the answer is not at all simple.

For example, discussions with employers who are looking for electronic service technicians reveal that they require a person, or persons, who have the ability to troubleshoot. Those people must understand the basic electronics theories we all know and respect. In addition,

The author thanks the faculty, staff and students at Oakland County, Michigan's Southeast Technical Center for their willingness to permit me to enter their electronics classroom and take the photographs I have included in this article. The efforts of teacher Fred Schelter (seen in these photographs) in working with local industries has placed graduates in positions in the electronics industry.

JOEL GOLDBERG, PH.D CET, CA

tion, they must be able to apply those theories as they analyze circuits and systems requiring repair. Further, today's electronics technicians must also have good communications skills and be adept at interpersonal relationships. Finally, they must be willing to keep up with the rapidly changing technology we are experiencing by attending training sessions provided by manufacturers and other sources dedicated to our industry.

For an individual who has mastered the concepts listed above, the earning potential is very strong. If you don't believe it, just take a look at the numbers and types of

consumer-electronics products produced and sold over the past few years. Information provided in the booklet *U.S. Consumer Electronics Sales & Forecasts 1992-1997*, published by the Consumer Electronics Manufacturers Association (CEMA), which is part of the Electronics Industry Association (EIA), tells this tale: Annual factory sales of consumer-electronics products reached \$47,408,000,000 in 1992, and \$63,143,000,000 in 1995. By 2000, sales were estimated to reach \$85,952,000,000.

These days few, if any, homes are without some form of consumer-electronics product, and the largest growth in the consumer electronics industry has occurred in the past two decades. Almost every type of product has shown an increase in

sales. For 1996, estimated household penetration of goods was almost 98% for all television receivers (and 97% for color receivers), 98% for home radios, and 96% for corded telephones.

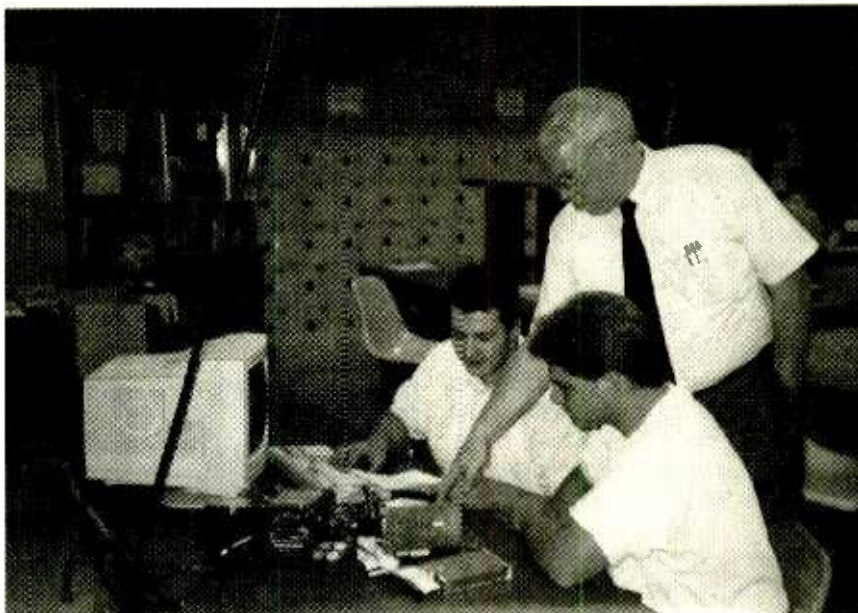
While the efforts on the part of the electronics industry to produce better products with fewer failures have met with good success, things still break and fail, so the potential for servicing those products is unlimited. Despite that, however, fewer and fewer people are choosing to enter the servicing profession. To compound the problem, without constant training, current electronics technicians face the threat of obsolescence.

EIA Efforts. Fortunately, the situation is not hopeless. A variety of efforts are presently taking place in an attempt to provide the qualified technical support required for service.

The EIA provides training about new and upcoming circuits and systems for educators and for those presently employed in the electronics-service industry. That program has been in effect and successful for many years. The EIA has sponsored competitive programs through VICA (Vocational Industrial Clubs of America), and the International Society of Certified Electronic Technicians (ISCET) has offered an Associate entry-level certification to entry-level technicians for many years.

However, those excellent efforts are directed toward those who are currently enrolled in electronics programs at the high schools, community colleges, technical colleges, and technical schools throughout the country. Those efforts could fall short if nothing is being done to encourage young people to enter those programs in the first place.

For years, many of those who teach electronics have presented a very traditional curriculum. The result of that approach has, in many schools, reduced enrollments and even forced the closing of electronics programs. In my 20 years of visiting and evaluating educational systems throughout the central part of the United States, I have seen this reduction in program enrollment



Computers and their peripherals provide yet another servicing opportunity for the young electronics technician

and removal of electronics programs in a great number of our educational institutions. If the United States is to provide trained and qualified electronics technicians for our service industry, then the industry along with educators have to work to encourage people to train for entry-level employment in the electronics field.

Standards and Certification.

Fortunately, things are beginning to change. The EIA is in the process of developing a set of national skills standards for the industry and education. This project is thorough and covers all aspects of the knowledge required for servicing electronics products, including technical skills, use of test equipment, electronics theory, mathematics, interpersonal relationships, mechanics, and communications. When those standards are adopted and placed in the curricula of our educational institutions, those who graduate will be quickly employed by industry.

There also is a national movement to establish a set of measurable standards for certification of electronics technicians. Much of the work has been accomplished by ISCET. Their present testing system is the largest in the country. ISCET also has the greatest number of Certified Electronic Technicians (CETs) at this time. Other groups are also involved in the certification

process and, while not as large as ISCET, are providing a needed service to those in the industry. Still other efforts are being developed by the EIA and other qualified certification groups throughout the United States.

The Major Need. All of the above is wonderful, but it is not enough. What is lacking, in my opinion, is a concentrated effort on the part of the electronics industry to provide recruiting information and programs for our youth. Materials available from the EIA include brochures and videos that show what kinds of jobs are available in the service industry. Unfortunately, those materials can only be used by those who are aware that they exist and know how to obtain them. That is also true for materials available from other industry sources.

What's needed is a major marketing campaign to "sell" our young people on the importance of learning how to diagnose and repair electronic devices. That program must also be directed at the parents of our youth, since they do have a major influence on their direction and future.

There are many potential ways to do that. For example, the electronics industry spends millions of dollars annually to advertise electronic products. As we move into

the 21st century, data provided by this industry informs us that we will be using many more electronic devices, some of which are still in the developmental stages. My suggestion is to divert a small percentage of the funds currently used to sell products and use it to market the need for more trained electronics technicians. Specifically, use those funds to encourage our youth to enroll in electronics programs at their local schools and colleges. That, to this writer, would pay off in the future when more trained electronics service technicians will be in demand by the industry.

Secondly, I would encourage the service dealers, both individually and through their local and or regional associations, to adopt a local high school's electronics program. If the local school does not now have a program, spend some time with their faculty and the guidance counselors to convince them that one is needed. Get to know the local technical-education teachers. Show them that there is a great need for an electronics curriculum in their school.

While you are learning about their school facilities and whatever program they may have had in the past, or even now have, talk about what you consider to be important to you and your company. In other words, what skills and knowledge would you be looking for when you interview a potential employee. Almost all vocational programs in the public sector are required to have an advisory committee made up of those in the specific industry. Consider offering your services to this committee either as a member or as an advisor to the committee. The purpose of those committees is to provide guidance to the curriculum and keep it relevant to the needs of the industry employing graduates from the specific educational program. Most educational institutions will welcome your input and eagerly consider any advice you can offer.

A third way to show that there is a need for trained electronics-service technicians is to meet with the State Employment Agency. Express your concerns about the lack of

trained potential employees. Tell them what your needs are. Be specific when you describe your requirements. Efforts on this level may best be conducted by your state and local associations rather than on an individual basis.

Become a Mentor. Moving away from the need to encourage people to enter the field of electronics

program who was, to say the least, an average student (he earned C grades continuously). Mathematics was not one of his better subjects. He convinced one of our co-op counselors to send him to IBM. He returned one day and proceeded to inform me that our curriculum was inadequate. His reasoning was that we did not teach calculus in



A lone student at work at his bench. Efforts are needed to fill this classroom and others like it around the country.

servicing, let us look at some additional methods of recruiting. Once a student is enrolled in an electronics program, we need to be able to show them why the servicing field is so important. One way to accomplish that is through a program of mentoring. A mentor is one who "adopts" an individual and provides leadership and guidance to that person. Our Federal Government is now doing that though a program that utilizes both mentors and cooperative education. Those in the service industry could identify one or more potential electronic graduates and bring them into their service facilities. Those people would be receiving some on-the-job training and recognize the need for further electronics studies. Often the student who has "seen the light" will grow into one of the individuals who will rapidly advance in the industry.

Several years ago, I had a stu-

dent enrolled in our electronics program who was, to say the least, an average student (he earned C grades continuously). Mathematics was not one of his better subjects. He convinced one of our co-op counselors to send him to IBM. He returned one day and proceeded to inform me that our curriculum was inadequate. His reasoning was that we did not teach calculus in our program. He had discovered a need for that subject and was teaching himself all about it. My response to him was simply "If we had tried to teach calculus, you probably would have left our program." The student agreed with my analysis. However, this student had discovered a need and pursued it. The important component in all of this is that his efforts as a co-op student provided him with the incentive and recognition of the need to learn calculus. The rest was up to him. That holds true for all studies. We must provide a need to know and then learning will be accomplished.

Where are the Educators? My final question is: "Where are we going to obtain qualified teachers to provide this training?" Most of the field of electronics service can earn much more money directly in that field

(Continued on page 55)

QUICK-TEST COMPONENT TESTER

**Find bad components
in-circuit on a crowded
circuit card. Build this inexpensive,
yet very useful tester in a single evening.**

JAMES MELTON

IN TODAY'S WORLD OF ELECTRONICS, technicians sometimes forget or have never learned the older methods used to troubleshoot components. The result is that they spend way too much time working on a problem that a more experienced technician would quickly locate. Today, as always, time is money, and if you spend too much time on simple problems, you are not making as much money or profit as you could. By saving time you might also be able to reduce the charges to your customer. There are several old-time methods for finding trouble in electronic circuits that still apply to the most modern of electronic marvels.

One such troubleshooting method calls for injecting an AC signal into a component, and then reading the voltage produced across the component and the current flowing through it on an oscilloscope. Many test instruments have been sold that perform this task. The advent of more and more digital, CMOS, mega-transistor logic modules that must be replaced as a unit has made these testers harder and harder to find, and people who know how to use them are becoming scarce.

With a *Quick-Tester* and an oscilloscope, you can determine the status of capacitors, resistors, diodes, transistors,

SCR's, Zener diodes—in fact just about any bipolar junction device—either in-circuit or out-of-circuit. Therefore you can pinpoint the defective component on a board, eliminating unnecessary and often damaging desoldering of good, but suspect components from densely packed circuit boards. Best of all, the tester can be built from readily available components found in the barest of scrap boxes.

Experienced troubleshooters will tell you that 90 percent of the problems in electronic gear arise in two major areas: the power supply, and then any circuit sections that interface the circuit board to the outside world, such as the power transistors, sensors, driver or interface IC's. Many circuits will

continue to operate to some degree with a bad power supply. But when supply voltage dips or rises, or if there is too much AC ripple on the supply, the circuit can act up at unpredictable times. The problem may appear to be a bad component, yet you will find it extremely difficult to trace this kind of power supply problem to a specific bad component on the board. Many electronic assemblies can be repaired by simply testing the power supply first, to be sure it is doing its job.

All the interface components of a printed-circuit board are subject to a variety of unusual stresses: stray static charges, connectors wired wrong, and lightning or other surges that can also damage components. The *Quick-Tester* shown here

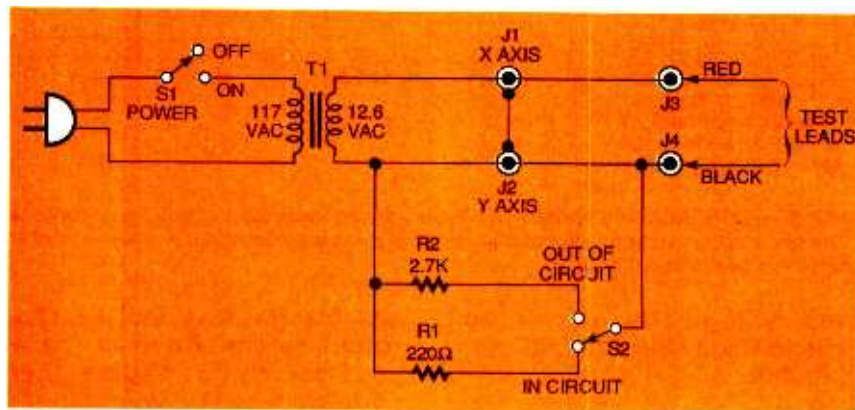


FIG. 1 — FULL SCHEMATIC OF THE instrument. When you use it to check components it creates a specific signature waveform on your scope.

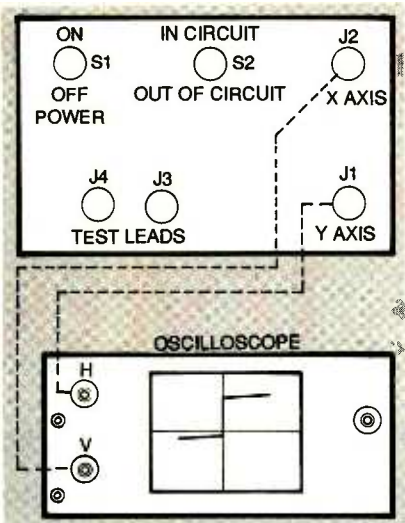


FIG. 2 — HOW TO CONNECT THE TESTER to your scope.

There are two BNC connectors for the oscilloscope inputs, two banana jacks for the test leads to the component under test, two resistors, two switches, one line cord and one transformer. Once you have assembled your tester you will need an oscilloscope to view the waveforms. No special construction techniques are required to assemble this device. There are not enough components to justify a printed circuit board. All the wiring inside is point to point, and all the components are mounted to the top (lid) of the box. Since all the components come out of the box with the lid, there are fewer connecting wires to break, and

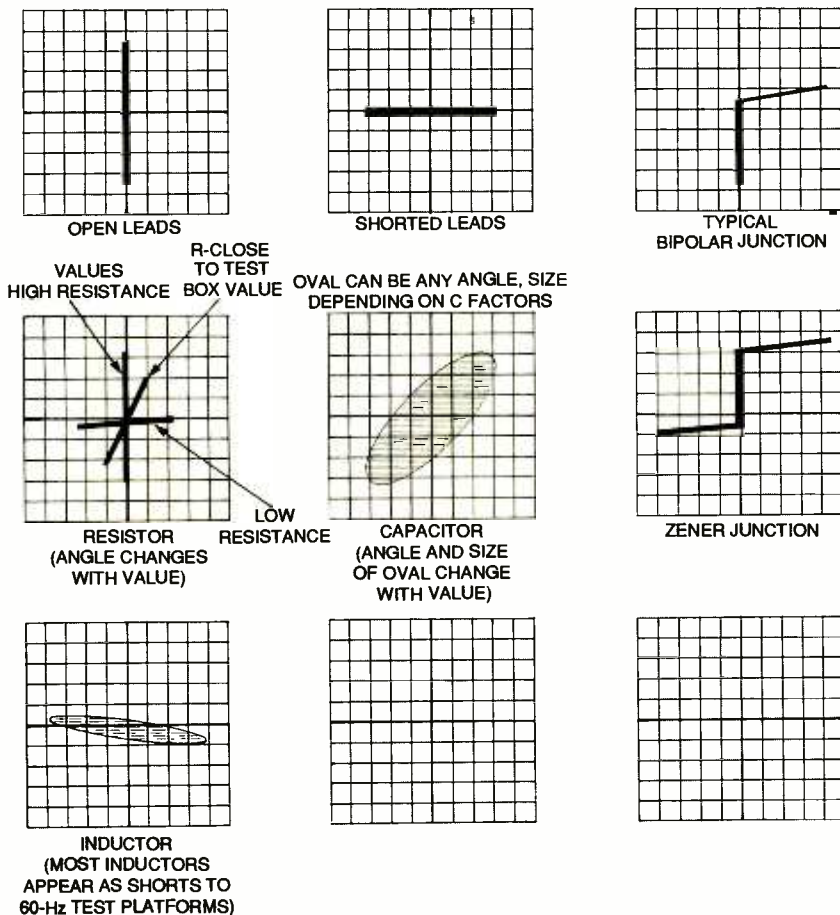


FIG. 3 — TYPICAL WAVEFORMS THAT you will see when testing good components. The blank scope screens should be used to draw in the traces you find when use the tester on new components.

will help you to quickly and efficiently locate the bad component.

Inside the tester

The circuit is shown in Figure 1.

troubleshooting will be that much easier. Anyway, build your test box as shown, then connect it to the components you wish to test as shown in Fig. 2. The polarity of the leads will

PARTS LIST

- R1—220 ohms, 1/4 watt, carbon film resistor
- R2—2,700 ohms, 1/4 watt, carbon film resistor
- J1, J2—BNC jacks
- J3, J4—Banana jacks
- S1—SPST toggle switch
- S2—DPST toggle switch
- T1—Transformer: primary 120 volts, secondary 12.6 volts, 10 mA or greater
- Miscellaneous: Case, line cord
- Note: The following are offered by SolarWorks, 2747 Wentworth Drive, Grand Prairie, TX 75052.
- Kit of all parts mentioned in the parts list is available for \$45.00 plus \$3.00 S&H.
- Fully assembled and tested Quick-Tester is available for \$55.00 plus \$3.50 S&H.

affect the diagram shown on the oscilloscope (reverse the leads and the trace turns upside down), but the actual polarity of the device or the leads is not important as far as troubleshooting is concerned.

How to put it to work

This test box allows you to place an AC voltage across the DUT (Device Under Test) and measure the voltage across it and the current through it simultaneously. As you can see from the circuit diagram in Fig. 1, the black test lead can be considered to be the ground lead, and the red can be considered to be the positive or active test lead. Connect your oscilloscope as shown in Figure 2. For this explanation, let's assume that the DUT is a Zener diode with a reverse voltage rating of 6.3 volts. If this diode is hooked up as shown in Fig. 2, you can see that as the voltage becomes more positive on the red lead, the diode will allow the voltage to rise and there will be no current flow. This will cause the scope vertical input (Y) to rise, and it will go straight up, because there is no current flow.

At some point near the Zener voltage, current will start to flow through one of the resistors (in circuit or out) and the voltage will slow or stop rising as the current goes up. This will have the effect of putting a small volt-

age on the X axis (horizontal) input of the oscilloscope, and the trace will then move in a positive direction (to the right) for the rest of the half cycle of AC. On the reverse cycle, the opposite occurs. You will be able to see the Zener knee voltage quite clearly (as shown in Fig. 3) and you will also see a knee in the opposite direction as the voltage passes through the normal or diode junction of the Zener in the forward biased mode.

When testing any junction devices, the procedure is the same, but the waveforms will be slightly different in values according to the breakdown voltages of the DUTs. The point of this procedure is to become familiar with the expected waveforms. With practice you will be able to identify components without looking at the waveform chart simply because there are not that many waveforms to remember.

Other discrete devices that you will encounter and will want to test include capacitors, resistors and inductors. See Fig. 3 to see the waveforms for each of these devices.

You've got to think

One important note about using the *Quick-Tester*. When you use it to test components in a circuit, you must analyze the circuit to figure out why you have a particular waveform on your scope. In most cases, the really odd waveforms are the result of mixing two or more components in parallel (or perhaps in series inside a component) when using the unit. It is perfectly normal to see a capacitor across the base-emitter junction in a transistor circuit, and when you check that junction you will see a combination of the two discrete waveforms on the screen. Do not let that pattern throw you; just learn what it looks like and go on to the next piece to be tested. Ω



ELECTRONICS TECHNICIANS

(continued from page 52)

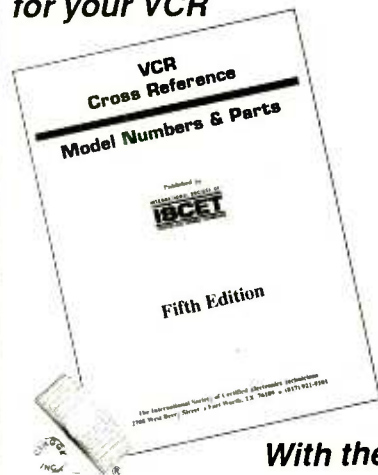
and not in education. Do we need to develop a cooperative work program for educators? A cooperative salary schedule would make the field of education more attractive. How many of our teacher-education facilities are even providing the training for electronics instruction? That, too, has shown a distinct drop in enrollment and the elimination of vocationally oriented teacher-education programs across our nation.

I suggest developing a cooperative program between industry and education where the educational institutions can provide the expertise in curriculum development, how people learn, and the use of instructional technology. The community college or technical college can provide the required electronics-specific education to the potential educator, and industry can provide the necessary hands-on experience with state-of-the-art equipment for both future educators and those presently employed in electronics education. The three groups, working hand in hand, can provide a qualified and well-trained individual to teach the future generations of electronics technicians.

Getting it Done. None of the suggestions presented here will occur without the total involvement of all facets of our industry and our educators. We need a national movement to support such endeavors. Without it, we will never provide the people required to service the rapidly growing number of electronics products owned and used by consumers. I call upon the entire electronics-service industry and its manufacturers to work together with educators and our educational system to develop and deliver the materials necessary to meet this demand. The present need as well as the future need for qualified electronics-service personnel is not going to diminish—it can only increase. Only through a joint effort will this critical need be met and the future of this very important industry be continued. Ω

VCR Cross Reference

**NOW Find the right Part
for your VCR**



**With the
ISCET VCR
CROSS REFERENCE**

This 119-page reference contains both model and part-number cross-references updated to include 1994 units.

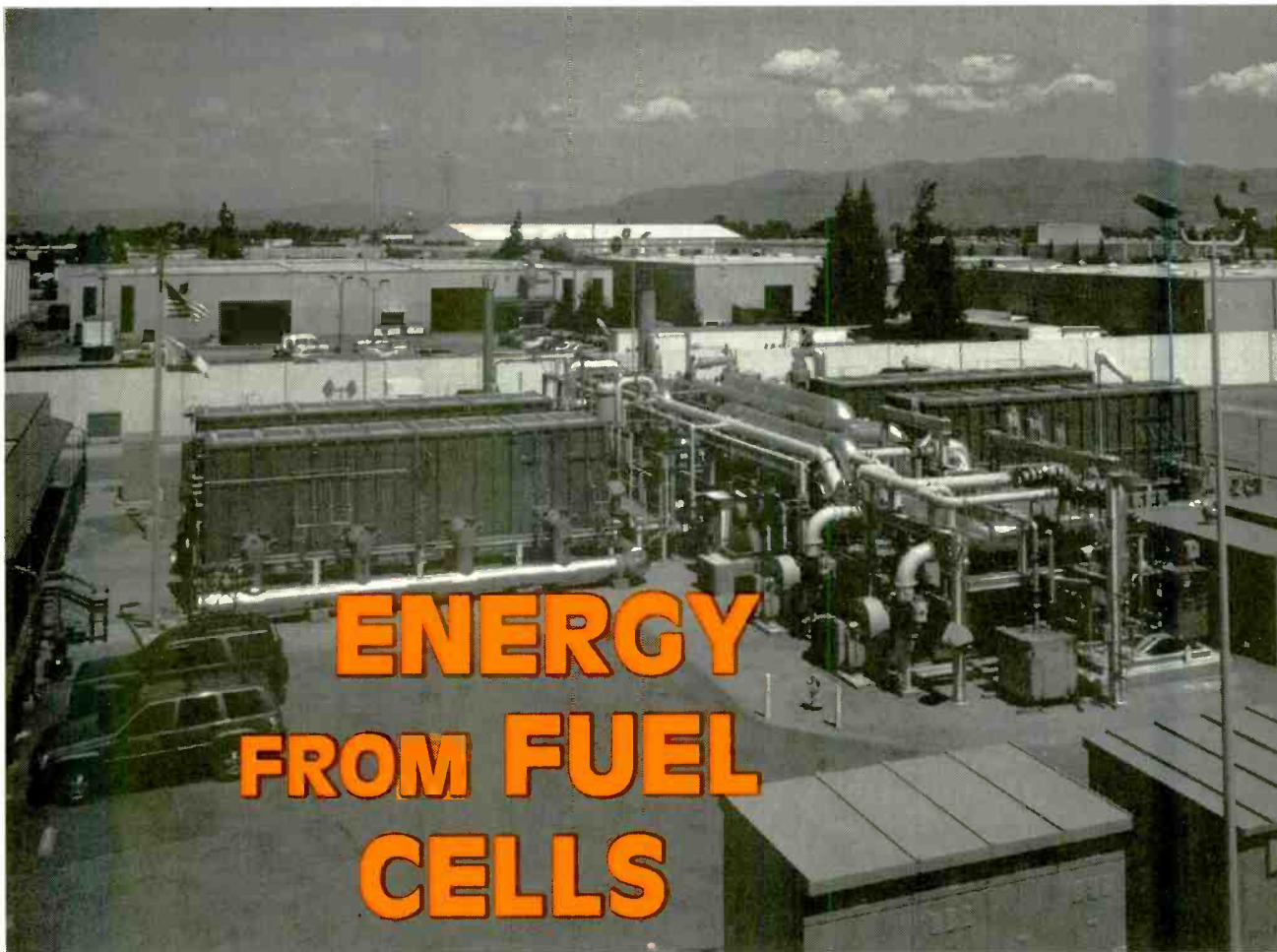
VCR's are made in a few factories from which hundreds of different brand names and model numbers identify cosmetically-changed identical and near-identical manufactured units. Interchangeable parts are very common. An exact replacement part may be available only a few minutes away from you even though the manufacturer supplier is out-of-stock. You may be able to cannibalize scrap units at no cost!

The ISCET VCR Cross Reference is pre-punched for standard loose-leaf binding. . . \$38.00 plus \$3.00 for shipping for each Reference.

**Claggk Inc.
VCR CROSS REFERENCE OFFER
P.O. Box 4099
Farmingdale, New York 11735-0793**

Name _____
Business _____
Address _____
City _____
State _____ Zip _____
Phone _____

Enclose \$38.00 for the Fifth Edition of the ISCET VCR Cross Reference and \$3.00 for shipping for each Reference.
The total amount of my order is \$ _____
Check enclosed—do not send cash.
or please charge my credit card.
 Visa MasterCard Exp. Date ____/____/____
Card No _____
Signature _____
New York State residents must add applicable local sales tax to total. US funds only. Use US bank check or International Money Order. CB02



As fuel reserves dwindle, research is turning to ways to extract the most energy from what remains, and to do so at a reasonable cost.

Few of us think about our energy supply—unless it is disrupted—but we all rely on the things it makes possible, including cooking, lighting, and heating. However, we are living in a time of dwindling resources, including the fuels we need to create energy. In light of that, our technological challenge is clear: we must learn how to extract the maximum energy from our fuels economically and efficiently, while minimizing harm to the environment.

Classically, a fuel is considered the storehouse of the sun's energy. In "fossil fuels," the energy is usually liberated through burning. But the intermediate processes in that conversion are very inefficient. For example, the conversion of fuel to electricity in a steam turbine involves a number of steps: Fuel is first burned to produce heat. Pres-

ALVIN SYDNOR

surized steam then does work by turning large turbines. Finally, the turbines power an electrical generator. At each step, some energy is sacrificed.

With today's technology, electrical energy is the most convenient form of energy to handle, and can be very easily converted to mechanical power or heat. For that reason researchers have been intensely interested in finding ways to produce electricity directly, resulting in much higher efficiencies.

An Ideal Power Source. The efficiency of various energy converting devices and systems are compared in Fig. 1. As seen in that figure, the internal-combustion engine can approach efficiencies of 25%-30%.

But that does not take into account the mechanical linkage necessary to power an automobile; when that is added, efficiency falls to about 15% for the total system.

Steam turbines, on the other hand, can approach efficiencies of up to 45%, and high-temperature gas turbines are rated at as high as 40%. However, it is clear that whenever heat is a part of the energy-conversion cycle, there is a definite limit to the efficiencies that may be obtained. Those efficiencies are further limited by any moving parts in the generator or overall system.

However, a quick glance at Fig. 1 clearly shows that one technology offers superior efficiency. That technology is the fuel cell. It achieves its high efficiency because the fuel cell contains no moving parts and the small amount of heat produced is not part of the conversion cycle.

Essentially, a fuel cell is simply a continuous-feed primary cell. In it, positive and negative charges are separated during a chemical reaction. The electrodes provide a purely catalytic action, speeding up the reaction without being consumed by it. Unlike a battery, the fuel cell doesn't require recharging. Instead, it is "refueled" by a continuous infusion of hydrogen or other fuel. Actually, in theory, any oxidation-reduction reaction could form the basis of a fuel cell, but in practice, only certain ones prove to be suitable.

The fuel cell is not a new development. The first use of a fuel cell in a land vehicle (a 15 kW unit installed in a tractor) occurred in 1959. In 1963, fuel cells reached space in the Gemini program. And 1996 saw the opening of an 1.8-megawatt power plant (the largest to date) in Santa Clara, CA; more on that later.

Fuel-Cell Theory. The principle behind the fuel cell is actually the reverse of the chemical process called electrolysis. Electrolysis produces chemical change by passing current through an electrolyte, a solution capable of acting as a conductor. For example, if electrodes are suspended in water and a current is passed between them, hydrogen gas will form at the cathode (negative terminal) and oxygen gas will appear at the anode (positive terminal).

While experimenting with electrolysis in 1839, Sir. William Grove discovered that the reverse was also true. He brought hydrogen and oxygen together under controlled conditions and produced water and electric current. Thus, we credit Grove with the discovery of the fuel cell.

The first fuel cells used hydrogen and oxygen. Many other chemical reactions that produce electricity are now being used, but for a basic understanding of the fuel cell we will examine the hydrogen unit.

As shown in Fig. 2, a fuel cell contains two electrodes separated by an electrolyte. Hydrogen (the fuel) is available at the anode and oxygen (the oxidizer in the chemical reaction) is at the cathode. As the two gases are applied to the elec-

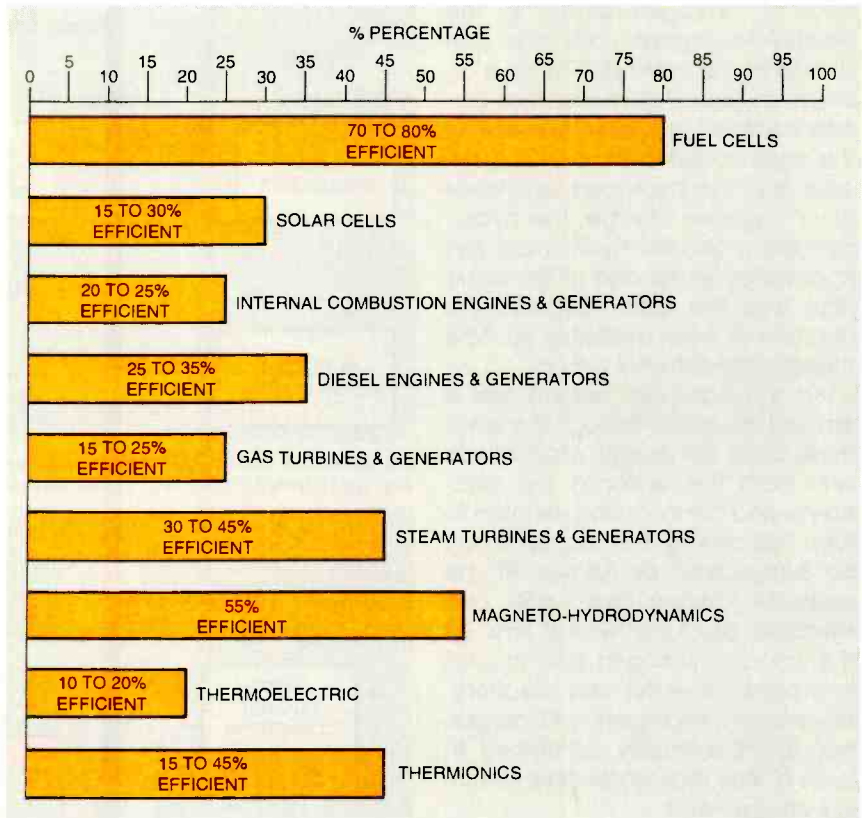


Fig. 1. Because they use no moving parts and do not require heat to be applied during the conversion process, fuel cells are the most efficient sources of electrical power devised to date.

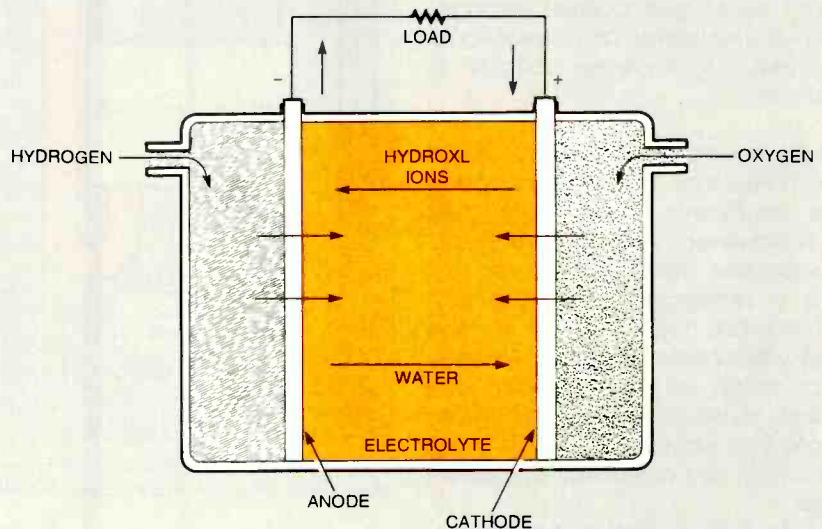


Fig. 2. In a hydrogen-oxygen fuel cell, hydrogen joins with hydroxyl ions at the anode to create water, freeing electrons to do work. At the cathode, oxygen reacts with water in the electrolyte and electrons from the external circuit to form hydroxyl ions.

trodes, separate reactions take place. When hydrogen is passed over the anode, electrons are generated and can be made to do electrical work through an external circuit. At the cathode, the electrons join with the oxygen to pro-

duce hydroxyl ions, which travel through the electrolyte to complete the electrical circuit.

A closer look at the chemical reactions in a fuel cell will further explain the process. At the anode, hydrogen gas is absorbed in the

form of hydrogen atoms. In the electrolyte, hydroxyl ions are produced at the cathode. An ion is an atom or group of atoms that has either gained or lost an electron. In this case an extra electron is available and the hydrogen ions takes on a negative charge. The hydrogen atom and the hydroxyl ions join to produce water and at the same time free the extra electron. This electron is now available to flow through the external circuit.

At the cathode, oxygen gas is similarly absorbed through the electrode. Here, the oxygen atom reacts with both the water in the electrolyte and the incoming electron to form hydroxyl ions. The reactions can be summarized as follows: At the cathode, oxygen plus water plus electrons produce hydroxyl ions. At the anode, hydrogen plus hydroxyl ions produce water and electrons. In summary, hydrogen and oxygen can be continually combined in such a way that water and electrical energy result.

The output of a fuel cell is a low-voltage, high-current DC source. Individual cells can be stacked in both series and parallel arrangements, the same as conventional batteries, to increase voltage or current.

Batteries vs. Fuel Cells. It should be noted that conventional batteries are closely related to the fuel cell. However, the battery is self-contained and must either be discarded or recharged when its stored energy has been used up. The fuel cell will continue to produce electrical energy as long as fuel is supplied. However, it is important to note that when no current is being drawn, a fuel cell does not expend fuel.

The storage battery has advantages where high power is needed over a short period of time. The fuel cell is more practical for applications where moderate power is needed over longer times. A combination of the two, with the fuel cell charging the storage battery between uses, could capitalize on the strong points of both.

Other Fuels. As noted earlier, the hydrogen-oxygen fuel cell was first

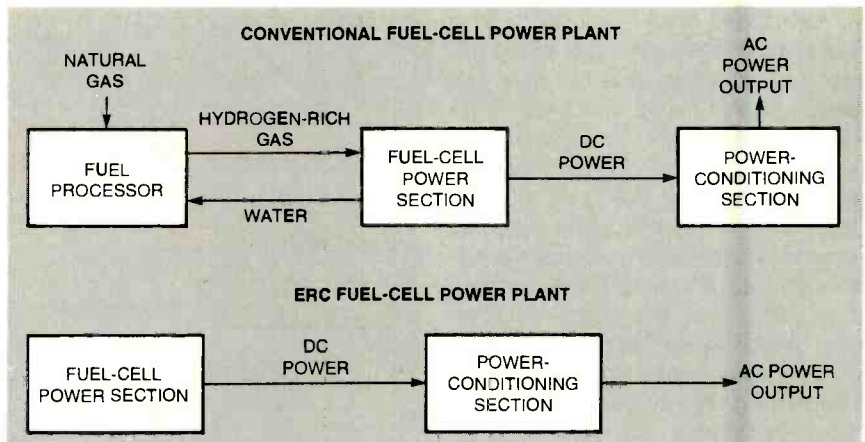


Fig. 3. The ERC fuel cell offers an advantage over other designs because it can process the fuel (natural gas) internally. Other cells require an external process to extract hydrogen from natural gas.

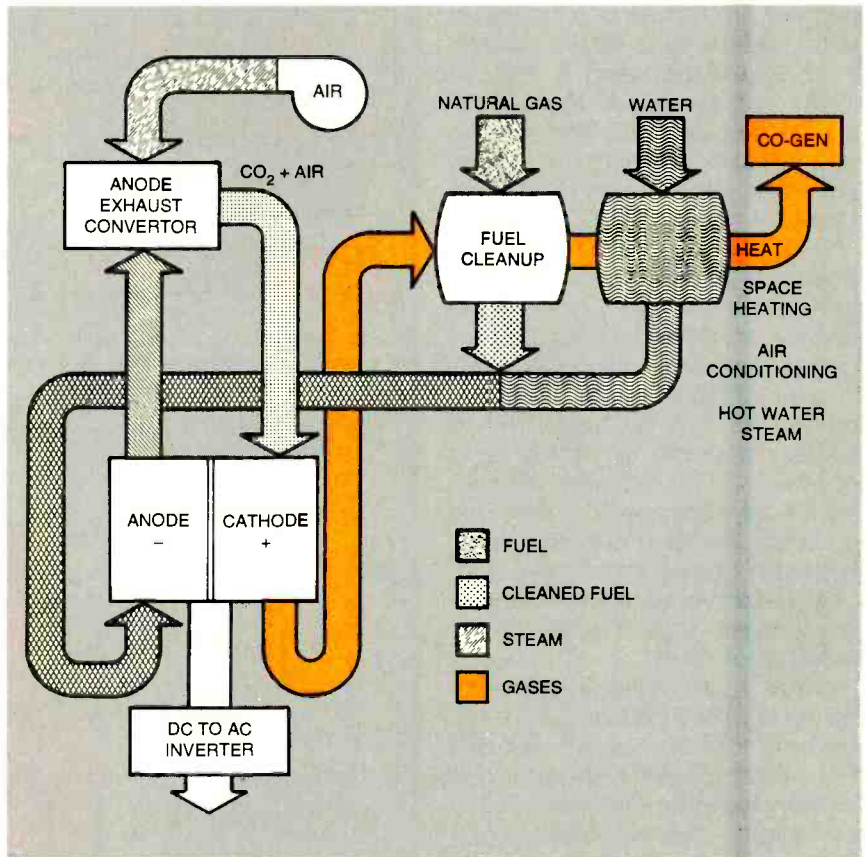


Fig. 4. This simplified block diagram shows how the Santa Clara Demonstration Project power plant works. The plant, which opened in 1996, is rated to produce 1.8 megawatts of power.

to be produced and received most of the early research efforts. In its basic form as described, it is not too difficult to follow the progress of chemical events. However, even the first successful cells were more sophisticated than our example.

For instance, the hydrogen and oxygen gases do not readily interact at room temperatures. Some cells operate at a much higher temperatures (250 to 500 degrees F)

and use a chemical catalyst in the electrodes to help the reactions along.

These days, development has shifted to systems that operate on fuels other than hydrogen. For one thing, hydrogen is a dangerous fuel that is not easily transported. Hydrocarbon fuels, on the other hand, seem ideal because of their availability. A cell using fuel oil or natural

(Continued on page 68)



BUILD A SOLAR-CHARGE CONTROLLER

With energy costs continually rising, using photovoltaic panels to get "free" electricity from the sun has become an intriguing concept. However, the cost of setting up such a system can be high enough to cancel out any potential savings. The most costly part of a system is the solar panel itself. Other than shopping around for good used or surplus panels, there is not much that can be done in the way of lowering costs in that area.

Just buying a panel and connecting it to a load is the simplest

Harness the sun's energy to charge batteries with this easy-to-build controller.

BLAKE REED

way to set up a solar power station, but that arrangement will not work very well. The more traditional way is use the panel to charge a battery and draw energy from that battery. That will compensate for

any fluctuations from the panel's output, which can occur from passing clouds or the changing angle of the sun as it crosses the sky during the day. Storing the sun's energy in a battery will also let you use power at night.

If we study how a storage-type photovoltaic generating system is designed, some cost-cutting methods might be incorporated, making such a system affordable to the average person.

Designing a Solar-Energy Station. Surplus and used panels are in-

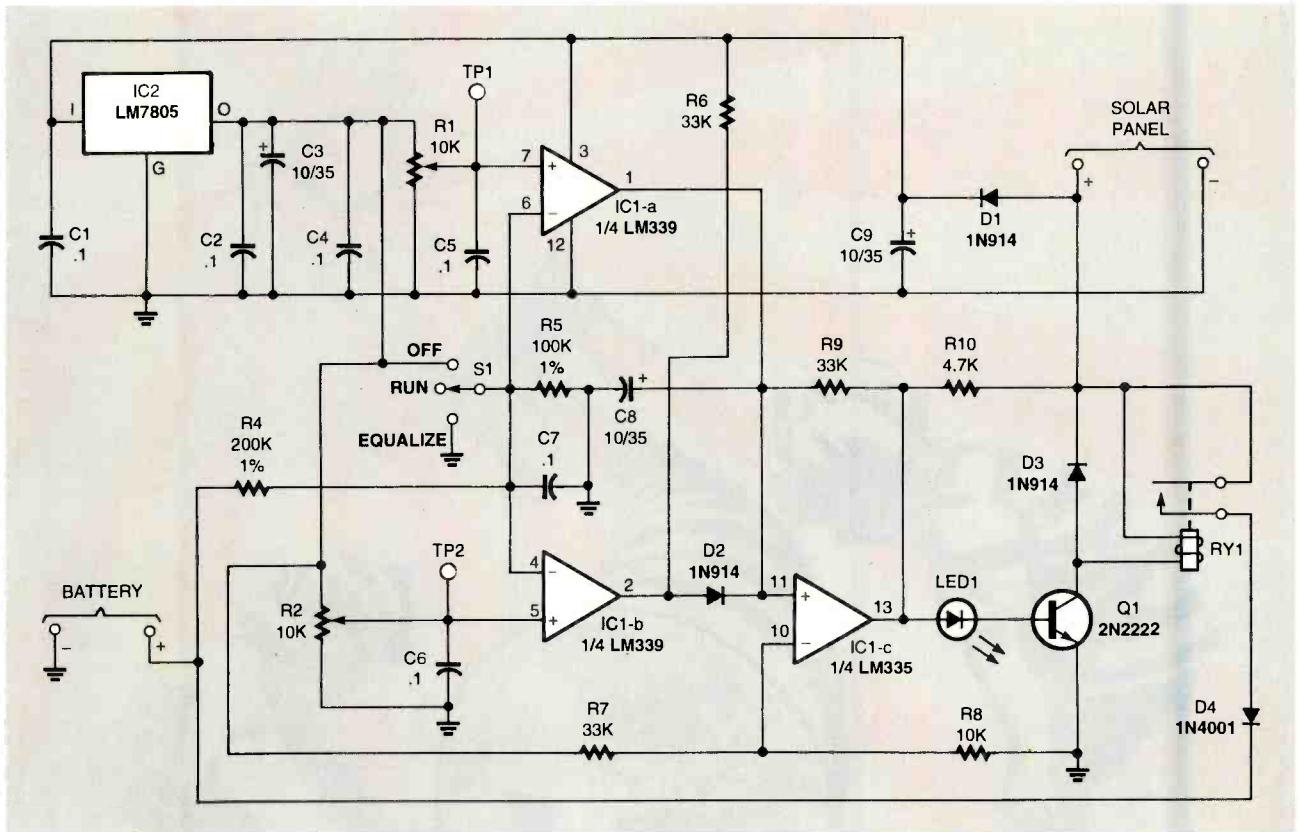


Fig. 1. The Solar-Charge Controller is a simple comparator circuit that connects a solar panel to a battery when it senses that the battery voltage is getting too low.

creasingly appearing on the market at reasonable prices. Often, new panels are "seconds" from the manufacturers. Those panels usually work fine but don't quite meet all of the manufacturer's specifications. Used panels, on the other hand, often come from solar-electric power stations. When the panels have dropped to 80% of their original rated output, they are replaced. Although the panels no longer put out their rated power, they can still put out plenty of energy and will continue to do so for many years. The power loss on panels is a logarithmic function, so it is unlikely that a decrease of power would be noticed by the average home user, even after 20 or 30 years of service. Those panels are often very reasonably priced and have the best "bang for the buck."

As we've said previously, the output of the panels will fluctuate during the day depending on the amount of sunshine falling on the panel. Solar panels are typically designed to put out about 16 volts. The output voltage can run as high as 28 volts on an extremely bright

day, depending on the particular panel used. Those types of panels will work well when charging a 12-volt battery system while allowing for some losses.

Using a charge controller when charging batteries from a solar panel is required to keep the batteries from being overcharged. Overcharging batteries, especially gel cells (which cannot tolerate any amount of overcharge), will greatly shorten their life. The charge controller monitors the battery's condition and connects the solar panel when the battery needs charging and disconnects the panel when the battery is full.

There are many types of controllers available with different features such as keeping the batteries at their best "float-charge" voltage or the ability to compensate for temperature changes. Such controllers are often very expensive—over \$200 for a fancier high-current unit. Spending a small fortune on a controller is probably the last thing someone wants to hear after shelling out big bucks on a panel and batteries.

The charge controller presented here is a very basic unit that will meet most needs. In fact, it can be used to maintain a battery from just about any power source so long as the charging voltage is less than 30 volts DC and the charging current is within the capability of the controller. In addition to running a photovoltaic generator, the controller is very handy for keeping an RV battery up to snuff over the winter or for keeping the ham-shack battery ready at all times. In those cases, a wall transformer can be used as the power source instead of a solar panel.

The charge controller is designed to handle charging currents up to 1 amp. By changing three components, currents up to 20 amps can be handled. All components are available at any RadioShack for about \$26. That cost will rise to about \$46 if the controller is modified to handle 20 amps. If the unit is hard wired into a photovoltaic generator station, a case and terminal block might not be needed, lowering the cost a bit.

Drawing a small amount of

power over a long period can easily drain a battery, especially if it has a small capacity. Powering the controller from the solar panel will not drain any power from the battery. Besides, if there is no sun, there is no reason to turn on the controller. The modified 20-amp controller, on the other hand, uses up to 100 mA when the panel is charging the battery. Because of that amount of current draw, it makes no sense to use the high-power version in a low-power station. The high-power controller would use up a majority of the panel's output current, leaving little or no energy to charge the battery. For any panel with more than a 1-amp capacity, the 20-amp controller should work well.

Solar-Panel Ratings. Most solar panels are rated by the power they can produce. Unfortunately, a wattage rating is very deceiving and doesn't tell what the actual useful power will be. The reason for that is that solar panels are constant-current devices. Their output current remains about the same as long as the load voltage is below what the panel can produce. An average solar cell can produce about 0.45 volt, which drops as the panel gets hot. As the voltage drops, the total wattage will drop since the current remains the same. Therefore, a 12-volt panel will always have considerable overhead, typically running 16 volts or more. That will compensate for the voltage drop on very hot days. It also guarantees that full charging current will be available for a battery pack, whose voltage can vary from 12 to 16 volts.

The panel rating is usually the total power available at the maximum current (which is constant) and the maximum voltage under ideal conditions. To show how those ratings work in the real world, let's look at the author's setup: The panel is rated at about 87 watts, producing about 5.27 amps at 16.5 volts. The battery pack being used runs on average at about 12.6 volts while charging. That means that the actual useful power produced by the panel to charge the batteries is a bit over 66 watts. The 22-watt difference is lost by the voltage drop across the charge controller's

Battery Type	Float Voltage	Turn-off Voltage
Deep-cycle lead acid (single)	13.4	14.6
Deep-cycle lead acid (two in series)	13.3	15.0
Gel cell (single)	13.5	14.1
Gel cell (two in series)	13.7	14.4
PbCa (lead calcium)	13.2	14.3
NiCd (single)	14.0	16.0
NiCd (two in series)	14.5	16.0

diode (3.7 watts), the resistance of the cables, and heating on the panel itself (which reduces its output voltage).

The power lost in the diode and cables is not much of a concern as removing those losses will not result in more useful power, only more heat across the panel. The only limitation to the losses is that they must be low enough to keep the overall system voltage (battery + cable + diode) less than the solar panel's output voltage under worst case conditions. To calculate the useful power of a panel, take the current of the panel times the voltage of the battery used and multiply that by the sun hours each day. That will give the number of useful watt-hours a day from the panel.

Batteries. The type of battery used for a solar power system is very important. Although there are many inexpensive automobile batteries available, they are not suitable. The reason for this is that they are designed to supply high current for a very brief period and then to be recharged right away, such as what happens when starting a car. If they are discharged and not recharged until the next day, they will fail very rapidly. A better choice is an RV or a marine trolling-motor battery. Those batteries are designed for many discharge and recharge cycles. One of the best batteries for a solar station is a golf-cart battery. They are designed for a high capacity and very heavy discharge/recharge cycles. As those batteries are 6-volt devices, two should be wired in series to make 12 volts.

Although the internal construc-

tion of those batteries is somewhat different, they are all variations of lead-acid battery technology. They all require periodic maintenance such as adding water and cleaning the terminals. Lead-acid batteries have a habit of generating hydrogen while being charged. Hydrogen in a great enough concentration and a spark can easily cause a very nasty explosion. The acid itself can cause severe burns or damage if any is spilled or a leak develops. It is a good idea to put lead-acid batteries into a sealed box that is resistant to acid and is vented to the outdoors if the batteries are kept indoors, which is the preferred setup. Here's why:

The best place to keep a battery is in a stable temperature environment. A battery's output capability drops considerably when the temperature drops. As much as 70% of a battery's power capability can be lost in extreme cold. The capacity will return when the temperature returns to normal. Extreme heat can greatly shorten the life of the battery. The other problem with having the battery outdoors is that the voltage at which the battery is fully charged changes with temperature. That could cause the battery to either be under- or overcharged when very cold or hot. An advantage to having the battery indoors is to keep losses in the wiring to a minimum. As with the solar panel wiring, the losses in the power cables can be significant. That is even more of a problem for the battery cabling as the currents used by the loads are often many times greater than those of the solar panel. It is therefore best to have the batteries as close as pos-

sible to the loads in a weatherproof environment.

For indoor use, it is best to use sealed batteries like gel cells. Those types of batteries do not generate enough hydrogen to cause any problems, unless they are overcharged, in which case they will be destroyed quickly. They have no liquid acid that can spill or leak. In addition, their terminals do not corrode and they work well together when there are several in a pack. Unfortunately, gel cells are very expensive unless they can be found on the surplus market. Great care must be taken when buying surplus batteries as it is very easy to get bad ones.

Gel cells often can not take a charge current of more than $\frac{1}{10}$ of their rated capacity. A 50-amp-hour battery, for example, should not be charged with more than 5 amps. Doing so may cause the battery to dry out and fail in a short period. It is best to have a battery amp-hour capacity that is greater than 10 times the maximum output of the solar panel.

There are also other types of batteries that can be used, such as NiCd and lead-calcium. The voltage characteristics of those batteries are slightly different from those of the standard lead-acid batteries. Be aware that there are even minor differences between lead-acid and gel-cell batteries. Some of those differences are shown in Table 1. Because of those differences, use only one type of battery in a system. Do not mix batteries—even mixing manufactures of batteries can cause problems. It is best to use batteries that, after having a full charge and sitting for awhile, have the same voltage and have the same rated capacity.

Most deep-cycle batteries are useful for a defined number of cycles. That is the number of times the battery can be taken down to the fully discharged state (about 1.8 volts per 2-volt cell for most lead-acid batteries) and recharged before having to be replaced. That can vary from less than 500 to over 1500 times depending on the battery's construction. In most solar applications, the battery is discharged throughout the day and

recharged the next day. If the battery is fully discharged each time, it can be expected to last only as long as specified by the manufacturer. Even though a cycle number such as 500 may seem good, cycling the battery once a day will mean the batteries will have to be replaced about every

days, and much greater battery life.

The total capacity of the battery required for a solar system must take into account several factors, such as discharge factor, solar panel output, average sun-hours per day, and battery load (whether it is an everyday load or only occasional). If the power is to be used

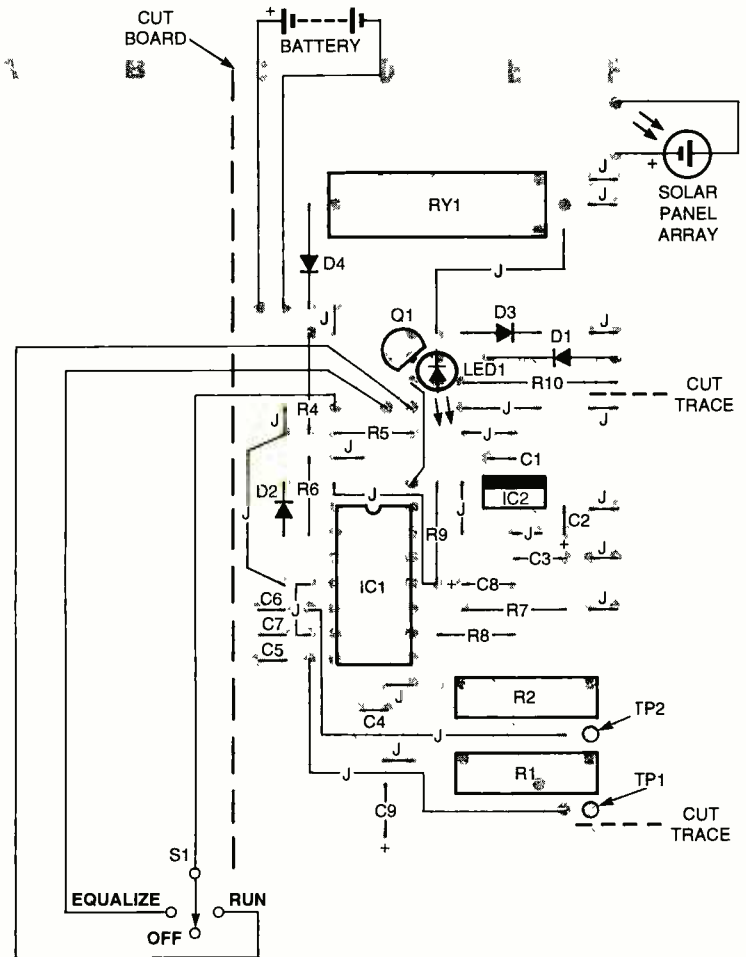


Fig. 2. The controller circuit is simple enough to lay out on perfboard. This layout is the author's design. Based on RadioShack's 276-168 universal breadboard, the unused portion of the board can be cut off if it is not needed. Don't forget to cut the trace that runs along line "F" at the two places shown.

16 months—a very expensive procedure. Fortunately, the cycle life of the battery increases logarithmically as the depth of the cycle decreases. Discharging the battery by only 30% of its total capacity greatly increases its life. Most manufactures recommend discharging only to the 30% level so a 100-amp-hour battery is effectively only useful for 30 amp-hours. It is even better to cycle the battery to only its 15% level. That allows for some slop in the load usage, a couple of cloudy

every day, it is best to be sure that the load doesn't use any more than the solar panel's daily output. A 5-amp panel that gets 5 hours of full sun a day means up to 25 amp-hours of power can be used every day. At that rate, the battery capacity should be at least 83 amp-hours for a 30% discharge rate, or preferably 167 amp-hours at a 15% rate. That will allow for a day of no sun without discharging the battery too much.

Circuit Description. The heart of

the schematic diagram in Fig. 1 is a set/reset flip-flop circuit. That flip-flop is made from the comparator gates in IC1. When the battery voltage drops below the turn-on trip point set by R2, RY1 is turned on. That connects the solar panel to the battery, charging it up. The relay remains on until the battery voltage gets to the turn-off point set by R1. At that point, the battery is fully charged. The relay is then turned off and remains off until the battery voltage drops back down to the turn-on point.

The controller is powered from the solar panel through D1. Filtering of the power supply is done by D1, C9, and C1. However, drastic voltage variations might occur each time RY1 connects or disconnects the panel from the battery. It was found on early prototypes that high-frequency pulses from the switching of RY1 caused IC1 to latch.

Power for IC1 comes directly

from the solar panel. A 5-volt regulator, IC2, is used as a voltage reference for the trip points. The components associated with RY1 (R10, Q1, D3, and D4) are connected directly to the unfiltered solar panel instead of the filtered power on the board after it has gone through diode D1. Those components don't need a clean power supply.

Battery voltage is divided to $\frac{1}{3}$ of its actual voltage by R4 and R5. The turn-on and turn-off points can be set as high as 5 volts, so the maximum battery voltage that the controller can handle is 15 volts. All voltage comparisons occur within the range of the reference (5 volts) which is well within IC1's common-mode voltage range. The battery input is filtered by C7 to keep noise from affecting the circuit.

The charging cycle is centered on IC1-c. When the battery is not being charged by the solar panel, the output of IC1-c is low. No volt-

age flows through LED1 or Q1, so RY1 is off, disconnecting the solar panel from the battery. Feedback resistor R9 holds the input to IC1-c at a low level, keeping the circuit in an off state.

While the battery voltage is above the turn-on level set by R2, IC1-b remains grounded. When the battery voltage drops below that voltage, the output of IC1-b goes high. The voltage from pull-up resistor R6 flows through D2 to the non-inverting input of IC1-c. The ground signal from R9 is overridden, and pin 11 of IC1 is pulled above the reference voltage set by R7 and R8. The output of IC1-c goes high, letting current flow through R10 to LED1 and Q1. That, in turn, closes the contacts of RY1. The solar panel is then connected to the battery through the relay contacts and D4. The purpose of D4 is to prevent cur-

PARTS LIST FOR THE SOLAR-CHARGE CONTROLLER

SEMICONDUCTORS

IC1—LM339 quad comparator, integrated circuit
 IC2—LM7805 5-volt regulator, integrated circuit
 Q1—2N2222 NPN transistor
 D1-D3—1N914 silicon diode
 D4—1N4001 silicon diode
 LED1—Light-emitting diode, red

RESISTORS

(All resistors are $\frac{1}{4}$ -watt, 5% units unless otherwise noted.)
 R1, R2—10,000-ohm, 15 turn trimmer potentiometer
 R3—Not used
 R4—200,000-ohm, $\frac{1}{4}$ -watt, 1% (see text)
 R5—100,000-ohm, $\frac{1}{4}$ -watt, 1%
 R6, R7, R9—33,000-ohm.
 R8—10,000-ohm
 R10—4,700-ohm

CAPACITORS

C1, C2, C4-C7—0.1- μ F, ceramic-disk
 C3, C8, C9—10- μ F, 35-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

S1—Single-pole, double-throw, center-off toggle switch.
 RY1—12-volt relay, single-pole, single-throw, 1-amp contacts
 PC board, terminal strip, double-sided foam tape, enclosure, wire, hardware, etc.

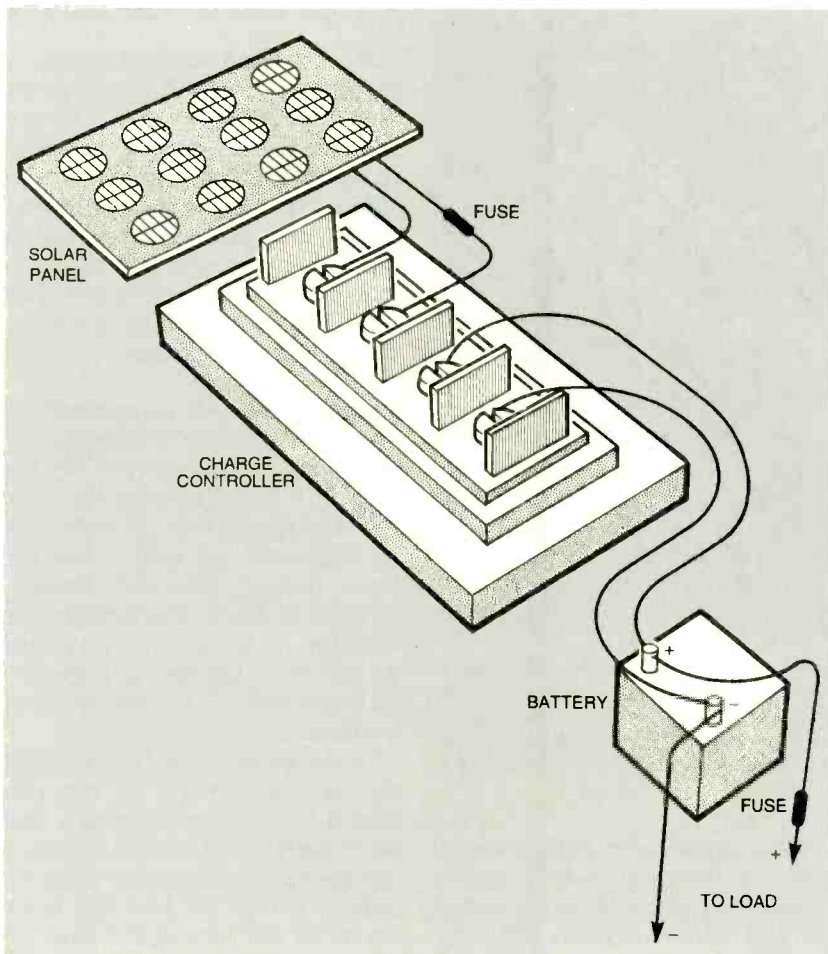


Fig. 3. Wiring up a solar-panel generator is quite straightforward. It's always a good idea to put fuses between a source of power and its load.

rent flow from the battery back to the solar panel and controller. That keeps the battery from powering the controller at night and eliminates the danger of a short circuit.

As the battery is charged, its voltage increases. Once the voltage rises above the level set by R2, the output of IC1-b returns to a low state. The state of IC1-c is held on

es off. The solar panel is disconnected from the battery and stops charging it. Diode D3 suppresses the voltage spikes generated by the relay coil when it is turned off. Resistor R9 holds IC1-c in a low state again, and the cycle repeats. Capacitor C8 helps keep RY1 from chattering due to any transients caused by the switching.

voltage as zero. The controller will then try to continuously charge the battery. That is used on occasion to briefly overcharge the batteries in a multi-battery pack to equalize them. Equalizing the batteries will make sure they are all at the same state of charge. Equalizing should only be done occasionally and with great care in order not to damage the batteries. Setting the switch to the equalizing position briefly and then returning it to the center-off position will start the charging cycle. That can be used to "top off" a partially discharged battery that is not low enough to trigger a full charging cycle. When S1 is set to the other position, the cir-

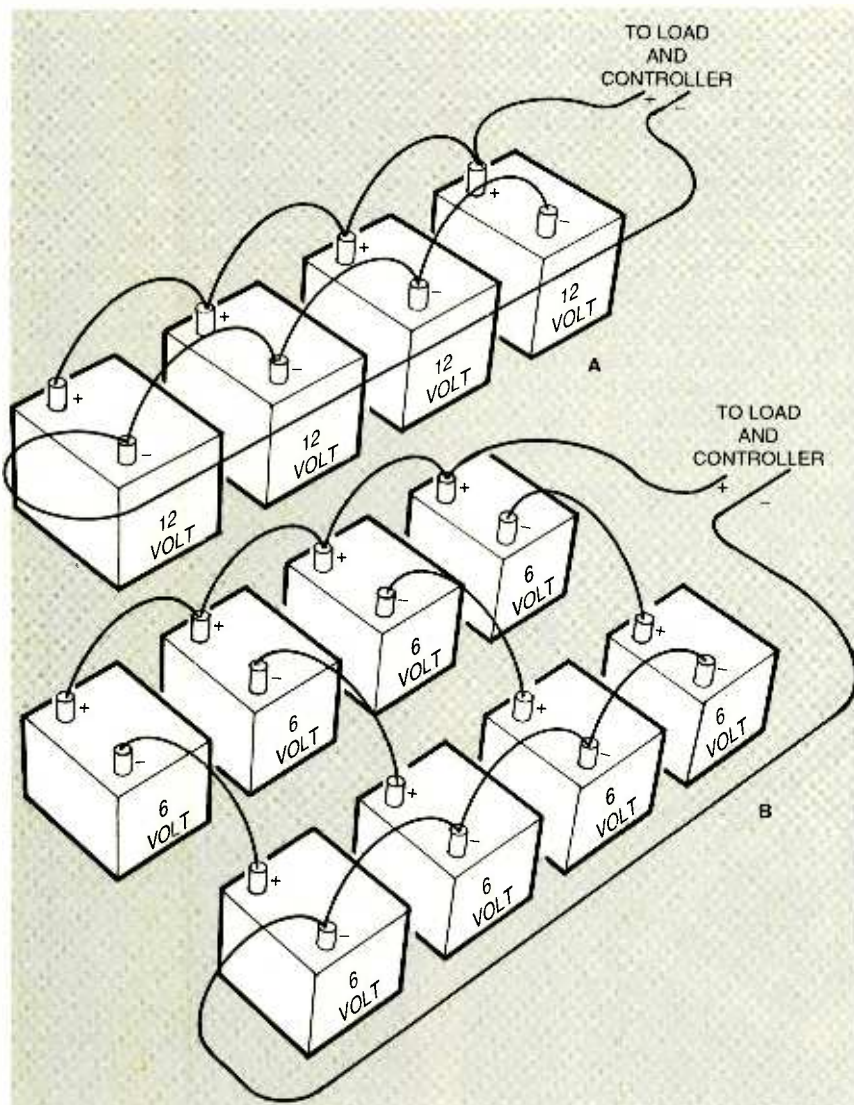


Fig. 4. If you want to use several batteries wired together in a pack, these diagrams show how to hook them together. For 12-volt devices, simply wire all the positive and negative terminals together (A). If you are using 6-volt batteries, connect pairs together to make 12-volt assemblies that are paralleled (B). In either case, don't connect the load to both terminals of one battery, or that battery will work too hard and fail first. Instead, use the terminals at opposite corners of the pack to spread the load evenly across all of the batteries.

by R9. The battery will continue to charge until the battery voltage reaches the turn-off point set by R1. At that point, IC1-a goes low. That pulls the input to IC1-c low, turning off IC1-c. Current stops flowing through LED1 and Q1, so RY1 switch-

The control switch S1 is a single-pole, double-throw switch with a center-off position. When the switch is in the center position, the controller operates normally. When it is set to the grounded position, the circuit will always see the battery's

PARTS LIST FOR THE 20 AMP UPGRADE
 R10—2,200-ohm, 5%, 1/2-watt resistor
 RY1—12-volt relay, double-pole, double-throw, 10-amp contacts
 BR1—Bridge rectifier, 25-amp, 50-volt
 Wire, solder, etc.

circuit will always see the battery as being fully charged. That will prevent the controller from charging the battery. That allows the battery to be disconnected from the circuit without having the relay oscillate or having any unconnected battery leads laying around with power on them. Depending on the solar panels used, severe shocks or fire hazards could result otherwise.

Construction. All components for the solar-charge controller are available at RadioShack. No special parts or PC boards are needed. The circuit can be built easily on a perfboard with trace patterns, making assembly easier. A suggested component-placement diagram is shown in Fig. 2. That placement diagram is based on RadioShack's 276-168 universal perfboard.

The layout in Fig. 2 also allows the unused portion of the perfboard to be trimmed down, making it easier to fit in an outlet box. If the board is going to be used that way, it is best to trim the board down to size before installing any components. To do that, place the board in a vise with the desired breakpoint at the top of the vis-



Plug a Friend into
Electronics
NOW[®]
and Save \$31.91*

This Christmas give an electrifying gift ... plug a friend into Electronics Now 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.

Electronics Now 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.

We'll provide great plans and printed circuit patterns for great electronic projects. In just the last few years, Electronics Now has presented amateur TV equipment, robots, computer peripherals, microcontroller programmers, test equipment, audio amplifiers, telephone projects, relay circuits, and much more.

PLUS ... equipment troubleshooting techniques ... circuit design ... reports on new technology and products ... equipment test reports ... in-depth coverage on computers, video, audio, vintage radio ... and lots more exciting features and articles.

*Basic sub rate — 1 yr/\$19.97 2 yrs/\$38.97

SAVE \$31.91* ... OR EVEN \$63.82* ... For each gift of Electronics Now you give this Christmas, you save a full \$31.91* 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 \$31.91*!

No need to send money ... if you prefer, we'll hold the bill till January, 1998. 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 Christmas.

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 in to a whole year of exciting projects and new ideas in Electronics Now!

jaws. The portion of the board that will be used for the circuit should be between the vise jaws. That will protect the usable part of the board if the board does not snap cleanly. Put pressure on the board just above where it comes out of the vise jaws and the board should break cleanly along the desired line. Be sure to make the two trace cuts shown in Fig. 2 before adding any components.

Placing IC1 on the board first will act as a reference for placement of the other components. Using a socket for IC1 is not necessary. In fact, if the controller is placed outdoors or in an unheated area, a socket might cause intermittent problems after several years. After confirming that IC1 is installed in the correct direction, fold pins 3 and 12 of IC1 over so that they touch the traces running between the legs of IC1 before soldering it in. That will connect the power and ground lines to the IC.

Install the fixed resistors next. The lead of R8 that connects to pin 9 of IC1 should be folded over so that it also connects to pin 10. Save the leads clipped off the resistors after soldering them in. They will be used for the jumpers later.

When installing the capacitors, place them as shown in the parts-placement diagram. Pay attention to the polarity of C3, C8, and C9. If those components are installed backwards, the board might fail or the capacitors could explode. Again, save the clipped-off leads. The polarity of D1-D4 and LED1 should also be double-checked before installing them. The lead from the cathode (band side) of D2 is folded over to make a connection with pin 1 of IC1.

The flat side of LED1 is installed facing toward Q1. If it is installed backward, RY1 will not be able to turn on. If you want, LED1 can be connected with leads and mounted on the case for easier viewing. Install Q1 and RY1 as shown.

Use the leads clipped off the installed components for the jumpers that connect straight from hole to hole without any bends. The jumpers that must bend around components or corners should use any convenient insulated wire, such

as 26-gauge wire or wire-wrap wire. Two jumpers share connecting points with a resistor and another jumper. It is best to use small gauge wire, like 30-gauge wire-wrap wire, for those connections. When installing the jumpers that go to R1 and R2, be sure to route them so they don't get in the way of installing the pots. Use a short piece of component lead for the test points at the pots. Adding the test points will be necessary if the board is being installed in an outlet box, otherwise it will be difficult to calibrate the controller.

SUPPLIERS OF SOLAR PANELS AND ACCESSORIES

Caleb Wholesale Products
8015 Carrisa Hwy.
Santa Margarita, CA 93453
(805) 475-2128

Jada Mountain
P.O. Box 4616
Boulder, CO 80306-4616
(800) 442-1972
(303) 449-6601

Sierra Solar Systems
109 Argall Way
Nevada City, CA 95959
(800) 517-6527
(916) 265-8441

At this point, the trimpots are installed. Fold the lead on each pot closest to the board edge so that they connect with the power trace. Fold the center leads so they connect to the trace the jumper wire connects to before soldering in the pots. Finally, install IC2 as shown.

Use 5-inch lengths of insulated wire to connect S1 to the board as shown. If you only need to force the controller either on or off, you may substitute a single-pole switch for S1. A push-button switch can be used to the ground connection in place of a center-off switch if you only want to top off the battery charge as discussed before. If you can find one, a center-off toggle switch with a momentary position would make a good combination switch for both disabling the controller and topping off the battery charge with one control.

If you are mounting the controller in a case, use 5-inch lengths of at least 22-gauge wire to connect the circuit board and the con-

necter together. If the board is going to be hard-wired into the system, it is best to use wire as short and as heavy as possible. It is especially important to keep the leads between the board and the battery as short as possible. The controller will see any voltage drop developed across those leads as a part of the battery's voltage, causing it to turn off too early.

Verify that all the solder connections are properly made and that all polarized components are installed correctly. Check that the wiring on the board matches the schematic diagram. Once that is done, the controller is ready for testing and installation.

Testing. For testing the controller and setting the turn-on and turn-off points, it is best to use a 12-volt, low-current (100 ma to 1 amp) power supply instead of a battery. If there is a problem with the circuit, a battery can supply enough current to cause significant damage.

Set S1 to either the on or off position and connect the power supply to the connector for the solar panel leads. Connect a voltmeter to the circuit ground—the tab on IC2 works well. Measure the voltage on TP1 and adjust R1 for a reading of 4.7 volts. That sets the controller to disconnect the solar panel when the battery voltage reaches 14.1 volts. Connect the meter to TP2 and adjust R2 for a reading of 4.15 volts. That sets the controller to turn on at 12.45 volts, which is just below the point at which a gel-cell battery sits when fully charged. If you are using batteries of a different technology or different voltages, it is easy to calculate the values for TP1 and TP2—just take the values desired and divide by 3.

When S1 is set to the equalize position (always on), LED1 and RY1 should turn on. Measure the voltage at the battery leads on the terminal block; it should be about 0.7 volts less than the power supply voltage. With S1 in the off position, there should be no voltage on the battery connections.

If you also have a variable power supply available, connect it to the battery leads. As the variable supply is adjusted up and down,

nals, the other batteries will not work as hard. Those batteries will receive less of a charge, and those that are closer to the connections will fail prematurely.

Modifications. As shown, the charge controller can accommodate about any battery with the exception of the NiCd type. For that type of battery, replacing IC2 with a 7806 will allow the controller to function up to 18 volts, allowing its use with NiCds. When using a different type of battery, set the turn-off voltage of the controller according to the recommendations obtained from the manufacturer. If that is not possible, the values in Table 1 can be substituted if you know the type of battery. If neither of those methods can be used, the turn-on set point can be found experimentally. Charge the battery pack to its turn-off point and let it sit for awhile before measuring the voltage again. The turn-on point should be set just below that reading.

If a 20-amp controller is desired,

simply replace R10, RY1, and D4 as shown in Fig. 5. The diode is replaced with a bridge rectifier, which is less expensive than a pair of 25-amp diodes. Using a double-pole relay allows an auxiliary output to be connected directly to the solar panel when the battery is not being charged.

For more information on solar and other alternative energy parts and equipment, getting a catalog from one of the suppliers listed is recommended. The catalogs are full of solar devices, wind generators, water-turbine systems, batteries, and inverters. They also contain many products that can be run directly off a 12-volt system with no inverter required. Some companies carry such items as fluorescent lamps, refrigerators, and even washing machines. The catalogs often have a great deal of information on setting up a system such as tables and work sheets for determining the size of solar panel and battery pack for running the loads desired. Those catalogs are well worth the \$4 or \$5

that is charged for them. Most times, the catalog price will be refunded with the first purchase.

The Solar-Charge Controller is a great project for maintaining the charge on batteries whether they are used in a solar panel station or elsewhere. You might not be able to thumb your nose completely at the monthly electric bill, but you can certainly put a dent in it! Ω



FUEL CELLS

(continued from page 58)

gas can be operated almost any place in the world without the complications that arise in transporting hydrogen.

A Fuel-Cell Power Plant. On June 3, 1996, the Santa Clara Demonstration Project (SCDP) formally dedicated the world's largest direct fuel cell power plant. The Santa Clara Demonstration Project represents a unique collaborative effort between the public and private sector. The fuel cells themselves were manufactured by the Fuel Cell Manufacturing Corporation, which is a wholly owned subsidiary of Energy Research Corporation, (ERC).

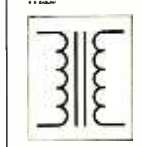
Most fuel cells require the hydrogen from natural gas to be extracted in a separate process. The ERC fuel cell can process the fuel inside the fuel cell itself, where the fuel is immediately consumed to generate electricity. The two approaches are compared in Fig. 3. It is believed that the direct system offers the

potential for a simpler and more efficient power plant as compared to other types of fuel cells.

The power plant in Santa Clara is rated at 1.8 megawatts net (it actually reached 1.9 MW AC net). It contains more than 4000 individual cells, grouped into 16 stacks, each capable of producing approximately 1.25 kW of DC power. The direct current from the fuel cells is converted to AC in a power conditioning unit prior to being fed into Santa Clara's distribution system. A block diagram of the SCDP system is shown in Fig. 4, and a photograph appears at the beginning of this article.

The SCDP system is just the first utility-scale demonstration of a direct fuel-cell power plant. The next generation power plant will be a 2.85 MW packaged unit that is expected to be available by the turn of the century. By increasing the size of the fuel cells in the stacks, as well as the height of the stacks, and compressing the plant layout, the overall space will be decreased by 90 percent, yet the proposed power plant will produce an additional megawatt of power. Ω

Coil Design and Construction Manual



YOU CAN WIND YOUR OWN COILS?

There's no trick to it except knowing what you are doing. In a unique, 106-page book you can become expert in winding RF, IF, audio and power coils, chokes and transformers. Practically every type of coil is discussed and necessary calculations are given with the mathematical data simplified for use by anyone. Get your copy today!

Mail coupon to:

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

Please send me my copy of *Coil Design and Construction Manual* (160). I enclose a check or money order for \$8.95 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.

Measuring Low-Voltage Signals, Reading Web-Site Log Files, and More

TAKE YOUR CHOICE OF A LARGE "PETROVOLTAIC" ROCK, A JUNK ELECTROLYTIC CAPACITOR, OR ANYTHING ELSE HANDY; MEASURE THE VOLTAGE ACROSS IT; AND RECORD THOSE VARIATIONS AGAINST TIME AND YOU WILL SEE A FEW MILLIVOLTS

of diurnal and other mysterious cycles. Depending on where you look on the Web, you'll find conclusions that what you have seen is scalar gravity waves, Uncle Louie's ghost, overunity zero-point energy sources, extraterrestrial communications, or new geological phenomena.

Of course, what you are usually seeing is nothing more than plain old noise. But such a mundane answer will rarely satisfy your typical pseudoscience "practitioner."

The crucial difference between serious research and pseudoscience is this: Whenever a real scientist or a real engineer gets a controversial or a strange result, they promptly spend monumental amounts of time and effort in *proving themselves wrong*. That is, finding out exactly where and how their measurements lied. Your pseudoscience practitioner instead runs out and starts gathering investors or getting on late night talk shows. That's because those folks are genuinely convinced they are "right" and often insist it is up to the rest of the world to drop everything they're doing, just to find out that an obvious and "not even wrong" mistake was made. So, I guess it may be way past time to review . . .

Measuring Low-Level Signals

It is trivially easy to trash up *any* low-voltage measurement, especially when high impedances are involved. I've summarized some steps you can take to avoid several more glaringly obvious problems in Fig. 1. Some problem areas are . . .

- **Know your op-amps**—Typical op-amps have an input DC-offset error of a few millivolts. At higher gains, offset can cause several *volts* of output error or level shift. That offset is highly time and temperature dependent. Op-amp noise very much depends upon your source impedance and goes sharply up at very low frequencies. A badly chosen "low-noise" op-amp can end up much noisier than a regular one.

- **Always work differential**—If you use a balanced or differential circuit, your input signal appears as the difference across an opposed pair of amplifying devices. Any interfering or common-mode signals that bounce both inputs up and down together will be pretty much ignored. A multiple op-amp instrumentation amplifier circuit is particularly adept at processing low-level differential signals.

- **Carefully shield and guard**—Sensing leads to any input should always be as short as possible and be carefully shielded against both electric and mag-

netic fields. Analog and digital grounds have to be kept strictly separate. It is extremely important to prevent any ground trace noise from ending up in series with your sensed input! The finest shielding of all comes from driven guards, where shielding is actively powered from a unity-gain and low-impedance copy of the actual input signal. That forces zero volts (and thus zero current) between signal and shield.

- **Know your noise floor**—If you turn up any amplifier loud enough, you will get output every time, and a lot of it will not appear to be all that random. You'll usually see thermal noise from the input resistance, first-stage noise additions, hum, interference, local radio stations, excessive bandwidth, microphonics, poor shielding, nearby computers, and anything electronic within a few miles. Always be able to show your noise floor and know your signal-to-noise ratio.

- **Quickly go digital**—The more analog parts to your circuit, the more possibilities there are for noise, drift, and interference. Always do your digital conversion as early as possible at the lowest possible level. Analog Devices has a number of signal conditioning chips that are ideal for that.

- **Isolate**—Long test leads or excessive electronics near what is being sensed can very much affect what you'll see. One option is to build your sensing electronics as small as possible, and then opto-isolate them using an IRDA driver or whatever. Special isolation amplifiers are also available through Burr Brown and others that will nearly completely isolate a front-end sensor from the rest of your system.

- **Suspect all capacitors**—Electrolytic capacitors are a witches' brew of chaotic and nonlinear electrochemistry. They should never be used in low-level

NEED HELP?

Phone or write all your US Tech Musings questions to:

Don Lancaster
Synergetics
Box 809-EN
Thatcher AZ, 85552
Tel: 520-428-4073

US e-mail: don@tinaja.com
Web: <http://www.tinaja.com>

**new from
DON LANCASTER**

ACTIVE FILTER COOKBOOK

The sixteenth (!) printing of Don's bible on analog op-amp lowpass, bandpass, and highpass active filters. De-mystified instant designs. \$28.50

CMOS AND TTL COOKBOOKS

Millions of copies in print worldwide. THE two books for digital integrated circuit fundamentals. About as hands-on as you can get. \$28.50 each.

**INCREDIBLE SECRET
MONEY MACHINE II**

Updated 2nd edition of Don's classic on setting up your own technical or craft venture. \$18.50

LANCASTER CLASSICS LIBRARY

Don's best early stuff at a bargain price. Includes the CMOS Cookbook, The TTL Cookbook, Active Filter Cookbook, PostScript video, Case Against Patents, Incredible Secret Money Machine II, and Hardware Hacker II reprints. \$119.50

LOTS OF OTHER GOODIES

Tech Musings V or VI	\$24.50
Ask the Guru I or II or III	\$24.50
Hardware Hacker II, III or IV	\$24.50
Micro Cookbook I	\$19.50
PostScript Beginner Stuff	\$29.50
PostScript Show and Tell	\$29.50
Intro to PostScript Video	\$29.50
PostScript Reference II	\$34.50
PostScript Tutorial/Cookbook	\$22.50
PostScript by Example	\$32.50
Understanding PS Programming	\$29.50
PostScript: A Visual Approach	\$22.50
PostScript Program Design	\$24.50
Thinking in PostScript	\$22.50
LaserWriter Reference	\$19.50
Type 1 Font Format	\$16.50
Acrobat Reference	\$24.50
Whole works (all PostScript)	\$380.00
Technical Insider Secrets	FREE

POSTSCRIPT SECRETS

A Book/Disk combination crammed full of free fonts, insider resources, utilities, publications, workarounds, fontgrabbing, more. For most any PostScript printer. Mac or PC format. \$29.50

BOOK-ON-DEMAND PUB KIT

Ongoing details on Book-on-demand publishing, a new method of producing books only when and as ordered. Reprints, sources, samples. \$39.50

THE CASE AGAINST PATENTS

For most individuals, patents are virtually certain to result in a net loss of sanity, energy, time, and money. This reprint set shows you Don's tested and proven real-world alternatives. 28.50

BLATANT OPPORTUNIST I

The reprints from all Don's Midnight Engineering columns. Includes a broad range of real world, proven coverage on small scale technical startup ventures. Stuff you can use right now. \$24.50

RESOURCE BIN I

A complete collection of all Don's Nuts & Volts columns to date, including a new index and his master names and numbers list. \$24.50

FREE SAMPLES

Check Don's Guru's Lair at <http://www.tinaja.com> for interactive catalogs and online samples of Don's unique products. Searchable reprints and reference resources, too. Tech help, hot links to cool sites, consultants. email: don@tinaja.com

FREE US VOICE HELPLINE VISA / MC

SYNERGETICS
Box 809-EN
Thatcher, AZ 85552
(520) 428-4073

- 1 – Know your opamp's offset, offset drift, noise voltage, and noise currents.
- 2 – Always use balanced differential inputs in an "instrument" configuration.
- 3 – For lowest noise, carefully match your opamp to your source impedance.
- 4 – Effective electric and magnetic shielding is a must.
- 5 – Never permit any ground currents in series with your inputs.
- 6 – Thoroughly separate all of your analog and digital grounds.
- 7 – Consider using active guarding instead of grounded shields.
- 8 – Know your system noise floor and noise sources, both external and internal.
- 9 – Restrict bandwidth to only that needed for an effective measurement.
- 10 – Convert to digital as near to the front end and at as low a level as possible.
- 11 – Suspect all capacitors. Never use an electrolytic in a low level signal path!
- 12 – Isolate low level circuitry with optocouplers or special isolation amps.
- 13 – Consider using carriers, lock-in amps, sync demods, or autocorrelation.
- 14 – Always assume controversial results are dead wrong. Blame yourself first!
- 15 – Always use Ockham's Razor to seek the simplest explanations.
- 16 – Always seek independent third party verification.
- 17 – Never jump to conclusions!

FIG. 1—MY GUIDELINES for lab measurement of low-level signals can prevent you from being fooled.

signal or filter paths. Other capacitors have "bounce-back," memory, and electret effects that depend upon the previous charge history. Some respond more than others to temperature, motion, voltage, stress, humidity, or pressure. Any could act as microphones, seismometers, or even as piezo actuators.

• **Watch circuit details**—Op-amps have gain and phase margins that might become unstable with certain loads and certain feedback combinations; know all those margins! Supply pins should always be well bypassed and decoupled as close to your chips as possible. Prevent all unintentional feedback through careful PC-board routing that keeps outputs far away from any inputs.

• **Consider a carrier**—By modulating a desired signal onto an input carrier, drift and excess low-frequency noise can often be eliminated. Narrow-band filtering can also end up being much easier. While such techniques were once called lock-in amplifiers, modern applications apply digital autocorrelation, phase-locked loops, or sync demods.

• **Don't jump to conclusions**—Even when you're cleanly measuring some low voltage, a signal can easily have a wildly different source than you think it does. Always examine the simplest and most obvious possible answers first, and always seek an independent check of some sort

to fully verify that what you think you have is really there.

You can find more on dealing with "too good to be true" results in HACK 87.PDF, and more on pseudoscience stuff in the Pseudoscience Library Shelf and the Oddball Pseudoscience links. All of that can be found on my <http://www.tinaja.com> Web site.

A Self-Zeroing Op-Amp!

As we've just seen, all operational amplifiers have an unavoidable input offset. A typical offset in a low cost op-amp might be 5 millivolts, with a temperature drift of 100 microvolts per degree C.

One cause of that offset is a slight and unavoidable mismatch between the bipolar transistors or FET devices on the non-inverting and inverting inputs. At high gains, such an offset can generate several volts of DC output offset.

One way to measure the offset of a higher gain op-amp is to simply short your inputs and measure your output level. Some op-amps bring out offset-adjustment pins that let you purposely introduce an unbalance to take out most of the offset as long as the temperature doesn't change.

Well, Texas Instruments has just gone a giant step further with their TLC4502 self-calibrating op-amp; see Fig. 2. That chip looks and behaves like

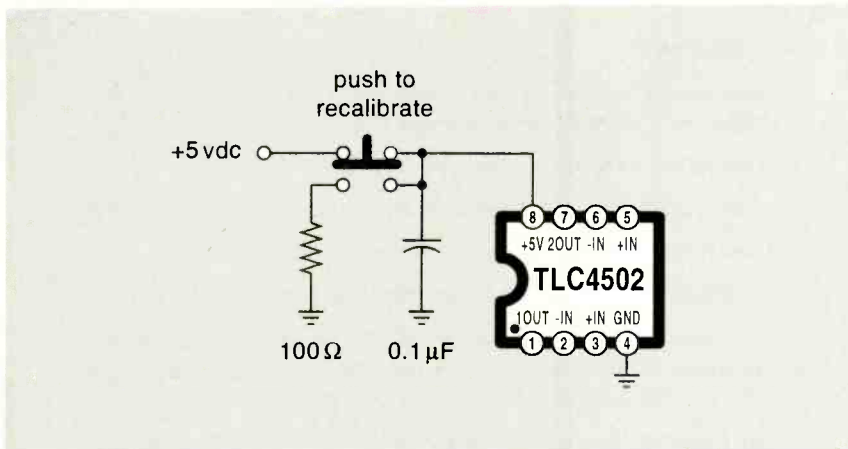


FIG. 2—THE TLC4502 LOOKS AND ACTS like any other \$2 dual operational amplifier, except it automatically measures and then cancels out its input offset on power up. Run time offsets are an astonishingly low 50 microvolts maximum with a temperature drift of under 1 microvolt per degree C.

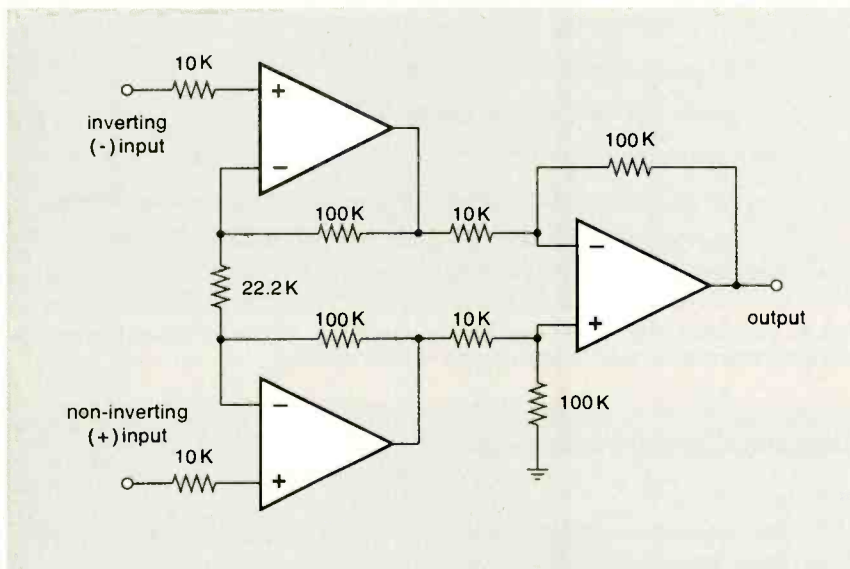


FIG. 3—THIS INSTRUMENT OP-AMP has balanced differential inputs, extreme input impedance, and identical phase delay on both inputs. Values shown give a voltage gain of 100. Use 1% resistors.

nearly any other \$2 small-outline, dual rail-to-rail op-amp, except for a key difference: On power up, a special routine is entered that temporarily shorts the op-amp inputs. At the same time, the output is opened. The input offset voltage is then measured and digitally saved. A mere 0.3 seconds later, the op-amp returns to “normal” behavior, but with input offsets of 50 microvolts and an offset drift of a really amazing 1 microvolt per degree C! That’s a 100:1 improvement, and it gets better.

The unity gain slew rate is 2.5 volts per microsecond, the noise is 12 nanovolts/Hz^{0.5} at 1 kHz, and the supply current is only 1.5 milliamps per amplifier. Open-loop gain is 120 decibels. The large pulse settling time is around 20

microseconds, and small pulses can settle ten times faster. Harmonic distortion is 0.08 percent, specified at a gain of ten. Inputs can be at ground. Output impedance is less than a tenth of an ohm. Output short-circuit protection is built in and self-resetting. Supply voltage is +4 to +6 volts. Input offset current and input bias current are less than 500 picoamperes! The input resistance is an outstanding twelve million megohms. You can recalibrate any time by removing the supply voltage. And those specs just scratch the surface.

What all that tells us is that we have an amazing quantum leap in op-amp technology here, especially for cost-sensitive, higher impedance uses at mid audio frequencies. Lots of use examples appear on

the data sheet (available on line at www.ti.com), including several instrument amplifiers, current sources, and peak detectors. A clone of their classic instrument amplifier appears here as Fig. 3.

New Technical Book Source

Butterworth-Heinemann has opened a new technical paperback series in their Newnes offprint. Many dozens of new and updated titles from an international stable of well-known authors appear in their new free catalog. Several titles I have found rather interesting are *The Basic Stamp* by Kuhnel and Zahnert; *Introduction to Fiber Optics*, by John Crisp; and Lou Frenzel’s reissued *Crash Course in Electronics Technology*.

Also, my *Active Filter Cookbook* and *CMOS Cookbook* are stocked at your favorite bookstore as Newnes titles. Autographed copies are also available from my Synergetics Press. Similarly, the *TTL Cookbook* is available locally as a Macmillan title or from Synergetics Press. The Newnes Web site can be found through www.bh.com

Hand Bookbinding Resources

I just wrote up a major update on “book-on-demand” publishing as RESB N66.PDF (on www.tinaja.com). The bottom line is that nearly all of the tools and needed techniques are in place for successful low-end publishing-on-demand.

The Hewlett-Packard 4M+ or 5M+ make acceptable duplexing printers, while their 5SiMX is absolutely ideal. And the cute little Alps MD2010 makes a great cover printer.

Binding options are still somewhat limited, so big bucks remain to be made for you if you could come up with a simple and low cost home or smaller scale binding solution. Meanwhile, there is always the obvious route of traditional classic hand binding.

I have just run across a bunch of non-obvious tools in this arcane field, so I thought we would cover some of those in our resource sidebar. I suspect that the ultimate BOD solution will end up as a mix of hand-crafted and commercial techniques, so there’s lots to study here.

More on all this is found in my *Book-on-demand Publishing Kit*, per my nearby Synergetics ad, or on the BOD library shelf of www.tinaja.com.

Measuring Web-Site Hits

Actually, “hits” is a monumentally over-inflated concept. For a “hit” is any

access to any site at any time for any reason. Your typical visitor will often create a dozen or more hits as background wallpaper, images, bars, buttons, or whatever are grabbed. But that does not tell you exactly how many left-handed Brazilian cat-fanciers visited your site at 2 A.M. last Tuesday.

Instead of hits, you usually want to know how many user sessions there were. There are all sorts of hit-analysis software of varying cost and quality out there, and your ISP may also offer custom reporting services. Most of this software is based on reading one or more log files that are obtained from your ISP.

Details are shown in Fig. 4. A log file picks up an entry every time your site gets accessed for any reason. Thus, one line of a log file is one Web-site hit. It may be useful to split the log-file line into a grouping of four or more records. You can then mix and match the records to extract useful information.

The examples that follow refer to an older Apache server. Details may differ with newer technology, but the concept of a readable and extractable log document remains.

The first record is the URL address. That is usually a "words" style URL, such as charlie.icjb.com. Sometimes you

The ACCESS log—

Each text line in the access log file consists of a site *hit*.
A hit is one access to a site requesting a single page or file.

A typical *name addressed* hit line may look like this...

```
drooper.mcb.com - - [01/Jun/1997:20:15:06] "GET /file5.pdf HTTP/1.0" 200 14234
```

Or a hit line might use a *numeric address* such as...

```
145.65.224.42 - - [01/Jun/1997:20:15:06] "GET /file5.pdf HTTP/1.0" 200 14234
```

Either way, everything up to the first "-" is the client doing the requesting. Everything in the brackets is the time and date. Everything in quotes is the requested action, followed by the requested protocol.

The three-digit number that follows is the HTML error or status code. Code "200" is a normally filled request and is followed by the number of bytes transferred. Other codes do not transfer bytes and are followed by a hyphen.

The ERROR log—

Each line of an error log reports one client problem.

Here is an error line caused by some network difficulty...

```
[Thu Jun 19 16:19:31 1997] send timed out for 143.86.15.97
```

Here is an error line caused by a possible bad link on your site...

```
[Thu Jun 19 16:21:11 1997] access to usr/home/finedemo failed for scott.mmn.edu
```

In either case, the initial brackets hold the time and date. The rest of the line explains the problem and the client that was involved.

FIG. 4—READING HTML LOG FILES from an Apache server. Newer servers may include additional information, such as referral sites or client software.

HAND BOOKBINDING RESOURCES

SUPPLIERS

BOOKS

Amazon Books

Box 80387
Seattle, WA 98108
(800) 201-7575

Gane Brothers

1400 Greenleaf Avenue
Elk Grove Village, IL 60007
(800) 323-0596

Bookbinders Warehouse

31 Division Street
Keyport, NJ 07735
(908) 265-0306

Gaylord Brothers

PO Box 4901
Syracuse, NY 13221
(800) 634-6307

Bookmakers

6001 66th Avenue
Riverdale, MD 20737
(301) 459-3884

Light Impressions

439 Monroe Avenue
Rochester, NY 14607
(800) 826-6216

Colophon Book Supply

3046 Hogan Bay NE
Lacey, WA 98516
(206) 459-2940

Lindsay Publications

PO Box 538
Bradley, IL 60915
(815) 935-5353

Dover Publications

31 E 2nd Street
Mineola, NY 11501
(516) 294-7000

Talas

568 Broadway
New York, NY 10012
(212) 219-0770

The Art of the Handmade Book, Flora Fenimore, Chicago Review Press, 1992.
Basic Bookbinding, AW Lewis, Dover Publications, 1985.
Binding and Finishing, Geoff Porter, Chapman & Hall, 1991.
Binding and Repairing Books by Hand, David Muir, Arco, 1978.
Book Binding Made Easy, Karen Moore, University Publishing, 1994.
Book Binding: Its Background & Technique, Edith Diehl, Dover, 1985.
Bookbinding: A Manual of Techniques, P. Richmond, Trafalgar Square, 1995.
Bookbinding with Adhesives, Tony Clark, McGraw-Hill, 1995.
Bookworks; Making Books by Hand, Gwennyth Swain, Carolrhoda Books, 1997.
The Craft of Bookbinding, Manly Banister, Dover Publications, 1994.
Creative Bookbinding, Pauline Johnson, Dover Publications, 1990.
Cover to Cover: Creative Techniques Making Books, S LaPlants, Lark, 1995.
Glue-Binding Your Books, David A Wilson, Lorien House, 1990.
Hand Bookbinding: A Manual of Instruction, Aldren A Watson, Dover, 1996.
Handmade Books: An Intro to Bookbinding, R Shepherd, Arthur Schwartz, 1995.
Handmade Books: A Step by Step Guide, Kathy Blake, Little Brown, 1997.
Making Books by Hand: A Step by Step Guide, McCarthy, Rockport Pub, 1997.
The Making of the Book: A Sketch, A. Cox, Oak Knoll, 1986.

WEB SITES

www.amazon.com www.redmark.co.nz holly.colostate.edu www.lindsay.com

NAMES AND NUMBERS

Alps Electric

3553 North First Street
San Jose, CA 95134
(408) 432-6000

Analog Devices

PO Box 9106
Norwood, MA 02062
(617) 329-4700

Astec Semiconductor

255 Sinclair Frontage Road
Milpitas, CA 95035
(408) 263-8300

Burr-Brown

6730 S Tucson Blvd.
Tucson, AZ 85706
(520) 746-1111

Cards of Wood

PO Box 310
Belmont, MI 49306
(616) 887-8257

Chip Scale Review

3099 Orchard Drive
San Jose, CA 95134
(408) 383-3653

Crafters Choice

11248 Playa Court
Culver City, CA 90230
(800) 421-6692

Dicker International

225 Broadway, Suite 2000
New York, NY 10007
(212) 962-3232

e.g. Software/WebTrends

621 SW Morrison #1025
Portland, OR 97205
(502) 294-7025

Global Engineering Documents

15 Inverness Way East
Englewood, CO 80112
(800) 854-7179

NESDA

2708 W Berry Street
Ft Worth, TX 76109
(817) 921-9061

Newnes

313 Washington Street
Newton, MA 02158
(617) 928-2500

Pericom Semiconductor

2380 Bering Drive
San Jose, CA 95131
(800) 435-2336

Philips Technical Training

PO Box 555
Jefferson City, TN 37760
(800) 851-8885

Synergetics

Box 809
Thatcher, AZ 85552
(520) 428-4073

Texas Instruments

PO Box 809066
Dallas, TX 75380
(800) 336-5236

might see a "numbers" URL such as 201.114.162.212. It is tricky to tell which country a numbers URL comes from. The URL record is everything up to the first "[" in the log file line.

The second record is the exact date and time of day, and is everything from your first "[" in the log file to the first "]". The third record is the action that was requested—usually a page or a graphic to be downloaded. That entry is always bracketed by quotes, and usually starts with "GET."

The final record is everything from the second quote to the end of the log line. That usually consists of a code number followed by a hyphen or a numeric. Code "200" indicates the "successful transfer" and is followed by the number

of bytes downloaded. Other codes usually include 001 for interrupted, 304 for "use previous cached information," 403 for forbidden, and 404 for not found. Figure 5 shows those and other codes.

An error file might be separate or included as part of the main log file. The error file lists only problem hits. Such as a send timeout or possibly a read timeout from slow Web routers. Or an access error, possibly caused by mis-entry or a site foul-up.

Error files are particularly useful to pin down problems with your Web site, such as missing, misspelled, or misdirected links. Sadly, an error file cannot normally pin down a broken external link from your site.

There are two fields in an error-log

line entry. The first is a date set in brackets. The second is the problem that has occurred. If a problem keeps happening from several different visitors, chances are it is your fault and not theirs. If the problem isn't that obvious, you can always go back into the main log file to find where these folks just came from. Odds are good the problem is on the previous page hit of yours.

On certain newer servers, there's sometimes a third magic file or entry known as a referral log. That one will reveal to you the immediately previous site your visitor came from and is very useful for tracing how effective site links or ad banners are. You might need to make special arrangements through your ISP to access the referral logs, and there may be an extra charge because more comm or access time might be needed.

One highly useful indirect method of measuring site popularity (and a great ego trip) is to determine how many other sites have active links to yours. One easy way to find possible referral links is with the find URL links feature of Hotbot. Another route is to use Alta Vista, prefixing with link:. Access to these are found on the Web Resources page of www.tinaja.com.

One fairly impressive commercial analyzer is Web Trends sold by e.g. Software. This package nicely presents an amazing amount of detail. Free 15 day trials are available.

I have written a custom Web site analyzer, though it is mostly for Apache servers and in Postscript, of course. It's available free at www.tinaja.com/psutils/websitan.ps.

To use the analyzer, read it in an editor or word processor and change all the filenames and variables as appropriate. Then send it to either Acrobat Distiller or GhostScript.

This routine could be useful any time you are after highly specialized information, such as watching a new and obscure page moving on up through the ranks. It is certainly a great PostScript-as-language demo.

New Tech Lit

Unusual data books for this month include an *Astec Semiconductor Data Book* on power supply chips and the *Pericom CMOS Data Book* on many chips, including bus switches. From Analog Devices, there's the *Accelerometer News* newsletter.

From Lindsay Publications comes a new compendium on *Hot Air Engines*. It's

- 001 - incomplete
- 200 - successful transaction
- 201 - created
- 202 - accepted
- 203 - partial information
- 204 - no response
- 301 - moved
- 302 - found
- 303 - method
- 304 - use previous cache
- 400 - bad request
- 401 - unauthorized
- 402 - payment required
- 403 - forbidden
- 404 - not found
- 406 - incomplete
- 500 - internal error
- 501 - not implemented
- 502 - temporary overload
- 503 - gateway timeout

FIG. 5—SOME HTML error codes.

a well done reprint collection of some 17 patents from 1871 to 1959. Sadly, however, hot-air engines are just that: First

because they get misapplied to woefully inefficient, low-temperature-differential applications, and secondly, because there is a magic part called a regenerator that nobody has ever figured out how to make. Regenerators have to be short and fat and long and thin—and that's besides being both an excellent conductor and an excellent insulator. Nonetheless, we've now got a fine historical document on a monumental engineering rathole. More on other engineering ratholes is stashed in RATHOLES.PDF on www.tinaja.com.

One source for Bliss Electronics musical greeting card modules is Dicker International. An interesting Web site on TV closed captioning can be newly reached at www.caption.com/caption-info.html. The key engineering standards document is EIA #608.

One pricey source for any standard is at Global Engineering Documents. Our new trade journal of the month is *Chip Scale Review*. A brand new *ProService* directory and yearbook is offered by NESDA. From Philips, a new *Technical Training Catalog* on VCR/ camcorder service and such.

Genuine wood microveneers, thin enough for laser printing, are offered by Cards of Wood. There's all sorts of obvious modelmaking possibilities here. Prices start at a dollar per sheet. Free samples of a wide variety of low energy magnets are available by way of Crafter's Choice.

For the fundamentals of starting up your own tech venture, check out my *Incredible Secret Money Machine II*. Per my nearby Synergetics ad. You can also preview the introduction on my web site. Full catalogs are available online at www.tinaja.com, or can be gotten via phone, snail-mail, or email.

My Web site is now getting some 125,000+ hits per month, so we are now accepting surprisingly low-cost, commercial banner ads. For details see <http://www.tinaja.com/advt01.html>.

As usual, most of the mentioned items should appear in the "Names & Numbers" or the "Hand Bookbinding Resources" sidebars. Be certain to check those before you dial up my no-charge US technical helpline that you'll find in the "Need Help?" box. EN

FACTCARDS



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

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

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

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

Jampacked with information at your fingertips

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

Please send one copy of FACTCARDS at \$3.50. Shipping \$1.00 (U.S. and Canada only).

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

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

Please print

Allow 6-8 weeks for the material to arrive.

(Name) _____

Detach and mail today:
CLAGGK Inc.
P.O. Box 4099
Farmingdale, NY 11735

(Street Address) _____

(City) _____

(State) _____

(Zip) _____

All Payment must be in U.S. Funds!

BS168

Electronic

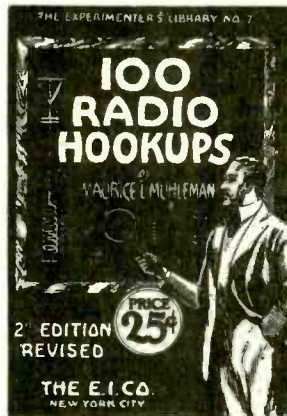
SHOPPER

Paperback Books

GREAT BOOKS AT BUDGET PRICES

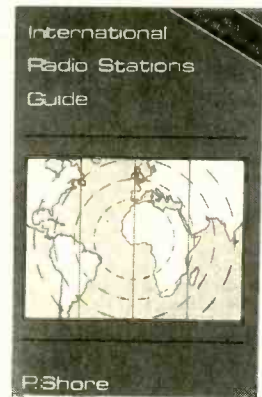
100 RADIO HOOKUPS
—#7—\$3.00

First published in May, 1923 this popular booklet went into reprint editions nine times. It is packed with circuits, theory, antenna installation and tips on consumer radio receivers that were popular in the early 1920's. Antique radio buffs and those inquisitive about the early days of radio will find this booklet an exciting, invaluable and excellent reference into the minds of early-day radio listeners. Sorry, we cannot honor the original 25-cent cover price.



INTERNATIONAL RADIO STATIONS GUIDE—BP255
—\$9.95

Provides the casual listener, amateur radio DXer and the professional radio monitor with an essential reference work designed as a guide for listening to the complex radio bands. Includes coverage on Listening to Shortwave Radio, ITU Country Codes, Worldwide Radio Stations, European Long Wave and Medium Wave Stations, Broadcasts in English and more.



HOW TO USE OP AMPS
—BP88—\$5.95

The engineer's best friend is the op amp. This basic building block is found in many circuits, analog and digital alike. The op amp finds many useful purposes such as: oscillators, inverters, isolators, high- and low-filters, notch and band-pass filters, noise generator, power supplies, audio, MIDI, and much more. Prepared as a designer's guide, some limited math is used, however engineers and hobbyists alike find it a useful text for their design needs.



WIRELESS & ELECTRICAL CYCLOPEDIA
—ETT1—\$5.75

A slice of history. This early electronics catalog was issued in 1918. It consists of 176 pages that document the early history of electricity, radio and electronics. It was the "bible" of the electrical experimenter of the period. Take a look at history and see how far we have come. And by the way, don't try to order any of the radio parts and receivers shown, it's very unlikely that it will be available.

ELECTRONIC TECHNOLOGY TODAY INC.
P.O. BOX 240, Massapequa, NY 11762-0240

Name _____
Address _____
City _____ State _____ Zip _____

SHIPPING CHARGES IN USA AND CANADA

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

SORRY No orders accepted outside of USA & Canada

Number of books ordered

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

All payments must be in U.S. funds!

ET01

October 1997, Electronics Now

SPECIAL PROJECTS



We design/build/modify/repair/consult on any device / system / process / project electronic / computer / mechanical / optical (eg: phone/auto/security/Radionic/lab/energy/HV/EM/RF/radar/ultrasonic/IR/UV/commo) for business and personal/invention needs. Describe & include nonrefundable \$30 pre-engineering fee. Time & cost estimates sent in 7-10 days. Confidentiality guaranteed!

OFF-THE-SHELF HARDWARE

Van Eck Systems ★ Data Card Reader/Writers ★ RF/EM/μWave/Radar/Ultrasonic/IR/Light/Sound Detectors/Xmitters/Jammers/Blasters ★ Security/Surveillance ★ EM Weapon Countermeasures ★ Neurophone/Rife/Crystal Radionics ★ Bug & Tap Detectors/Blasters ★ Lineman's Handsets ★ Phone Color Boxes ★ Voice Disguisers ★ ESS Infinity Devices ★ DTMF Decoders ★ Child Finder ★ Panic Button ★ Slot Machine Masters ★ Subliminal Mixer/Amps (Ultrasonic/Infrasonic) ★ TENS ★ Hearing Assistors ★ Electronic Dowzers ★ Shriek Modules ★ Ghost Detectors ★ Vortex Generators ★ Alien Brainblasters ★ 6th Sense Communicators ★ More! Order Catalog Today!!

AUTOMATIC TELLER MACHINES



ATM crimes, abuses, vulnerabilities and defeats exposed! 100+ methods detailed, include: Physical, Reg. E, cipher, PIN compromise, card counterfeiting, magnetic stripe, false front, TEMPEST, Van Eck, tapping, spoofing, inside job, super-cool, vibration, pulse, high voltage-others. Case histories, law, countermeasures, detailed security checklist, labeled internal photos, figures. ATMs contain up to \$250,000 in cash!

PAGER (BEEPER) MANUAL



Describes in detail how Pagers work, different types and uses, frequencies, advantages over and uses with cellphones, and tips and tricks. How Pagers are hacked and countermeasures. Includes plans for a Personal Pocket Paging System (xmitter and receiver).

HACKING FAX MACHINES



Describes in detail how Fax Machines are hacked and countermeasures. Includes G3 Fax protocols, commo parameters, compression algorithms, Class 1 & Class 2 commands, Spy Fax Switcher, Fax Servers, FODs/FOCs, and Makeup/Terminating Codes. And insights into designing Fax interception devices and modifying existing Faxes into Stealth Faxes. Eye-popping and invaluable!

PBX HACKING



PBXs are hacked to the tune of about \$8 Billion/yr! 'PBX Hacking' exposes all issues relating to PBX hacking, including countermeasures. This manual was featured in Forbes Magazine Shocking!

VOICE MAIL HACKING



Exposes how Voice Mail Box systems are used and specific ways they are hacked. Includes ASPEN, MESSAGE CENTER, BIX, GENESIS, RSVP, CENTAGRAM, EZ, AUDIX, SYDNEY, PHONE MAIL, CINDY, SPERRY LINK, etc. A must for all users, hackers, and security personnel!

10% OFF
Orders Over
\$100!!

TOP SECRET

NOW
BIGGER &
BETTER!

CONSUMERTRONICS

P.O. Box 23097 ABQ, NM 87192

ORDER TODAY! 505-237-2073

Fax: 505-292-4078

Web Adventure: www.tsc-global.com

Established in 1971. Featured on CBS "60 Minutes," Forbes, New York Times.

Add \$5 total S/H (US, Canada). Sold for educational purposes only. Postal M.O. is fastest. VISA, MC OK. COD (\$49-\$999), add \$7.

STOPPING POWER METERS



As reported on "60 MINUTES"! How devices can slow down (even stop) watt-hour meters - while loads draw full power! Device plugs into one outlet and normal loads into other outlets. Describes meter creep, overload droop, etc. Plans!

THE I.G. MANUAL: External magnetic ways (applied to meter) to slow down and stop power meters while drawing full loads. Plans. \$25.

KW-HR METERS: How watt-hour meters work, calibration, error modes (many), ANSI Standards, etc. Demand and Polyphase Meters. Experimental results to slow and stop meters by others. A real eye-opener! \$25.

Special!! All 3 (above), Only \$59!

BEYOND PHONE COLOR BOXES



Dozens of PCB's described - many circuits. Plus Call Forwarding, Conferencing, Phreak History, Glossary, Diverters, Extenders, Loops, REMOBS, Bridging Heads & Cans, Optocom, 3rd Party and many other non-box methods - more! \$29.

BEYOND VAN ECK PHREAKING



Eavesdropping on TV and computer video signals using an ordinary TV described in detail. Range up to 1 KM. Plans include both the Consumertronics Tempest and the original Top Secret Van Eck designs! More! \$29.

HACKING ANSWERING MACHINES



All the known ways answering machines are hacked to listen to and erase messages, and to convert them into mini-VMBs. Plus countermeasures - protect yourself from hackers/thieves! \$19.

CREDIT CARD SCAMS



Completely describes every known means of credit card fraud and scams. How it's done, how to protect yourself, and countermeasures! \$29.

PHREAKING CALLER ID & ANI



Details on how they work and dozens of effective ways of defeating Caller ID, ANI, *69, *57, Call Blocking, *67 etc. Also describes Caller ID, Orange, Beige, Cheese & CF Boxes, ESS, SS7, E-911, various Class services, CN/A, Non Pub DA, CAMA, DNR, 800-ECR, Diverters, LD Extenders, Centrex - much more! \$19.

THE ULTIMATE SUCCESS MANUAL



How to lie, cheat, steal, influence, and intimidate your way to success! Forget job performance. This manual outlines what it really takes to make it to the top in today's corporate BS world! \$15.

CELLPHONE MOD GUIDE



Learn how they are reprogrammed and cloned. Vulnerabilities, scanning, control data formats, freq. and channel allocations, roaming, much more! 10 times more info than any competitors' manual! \$59

THE HACKER FILES



100s of the best eye-popping articles written by top hackers/phreakers. ASCII text. Covers every major topic in hackerdom! On 3 HD PC Disks! \$39.

HACKING THE INTERNET



The latest tricks and methods being used on the Net to pirate software (warez) and the coolest hacking websites. Updated every two months, so you know its fresh. Password Defeats, Packet-Switched Networks, Unix, Sprintnet, X.25, anonymous FTP. Examples, countermeasures, and lots more!

INTERNET CONS & SCAMS



Net cons and related frauds now rake in \$2+ Billion annually! Most are done with little fear of prosecution. Detailed, + countermeasures.

INTERNET TRACKING & TRACING



The Net is infested with spammers, stalkers, scammers and other wrongdoers who hide behind its anonymity. Trace them down using this comprehensive, eye-popping manual!

Special!! All 3 above, Only \$59!

COMPUTER PHREAKING



Describes in detail how computers penetrate each other, and how VIRUSES, TROJAN HORSES, WORMS, etc are implemented. Dozens of computer crime and abuse methods and countermeasures. Includes disk filled with hacker text files and utilities, and the legendary FLUSHOT+ protection system. Internet advice, password defeats, glossary - much more! Manual + PC Disk!

OTHER EXCITING TITLES!

STEALTH TECHNOLOGY \$24

Every known police radar error - stealth method and material used to minimize radar and laser reflections - tactic and strategy to fight speeding tickets!

MIND CONTROL \$29

Fear increases over EM and ultrasonic mind control technologies - especially implants! Many have been victimized. Learn shocking truth about this bizarre phenomena!

THE PLACAK REPORT \$29

How to read and decrypt the magnetic flux-reversals on popular credit/debit card magnetic stripes. How to determine the PIN, bank number, more! No hardware needed!

HIGH VOLTAGE DEVICES \$29

Many HV device plans: Stun Gun, Taser, Prod, Cane, Flasher, Blaster, Zapper, Radar Jammer, Jacob's Ladder, Fence Charger, Geiger Counter, Fish Stunner, much more!

RADIONICS MANUAL \$29

Exciting electromagnetic therapeutic, diagnostic devices (mostly experimental). Descriptions, plans, availability.

POLYGRAPH DEFEATS \$19

How anyone can tell "the truth" to a "lie detector". Many proven methods to beat the test, and what to avoid.

THE REBEL IS GONNA KICK YOUR A**!

ALL-NEW TOP SECRET CATALOG. FEATURES 200+ EXCITING HI-TECH PRODUCTS!

MAIL '3, OR '1 WITH ORDER!

ORDER TODAY!



PROFESSIONAL DESOLDERING with the New & Improved

More Vacuum

Lane Norman - Normans Electronics Inc. Atlanta GA 404-451-5057
A cost effective solution to desoldering equipment at less than half the price of most equipment. It's performance is ASTOUNDING.

Mike Murphy - Service Center - Van Nuys
CA 818-785-7805

The single best investment of repair equipment we've made. It outperforms all other desoldering tools we've used. Easier to use and least expensive.

Quicker Vacuum

Bob Monroe - M.A.R.C. Electronics - Virginia Beach VA 804-468-3932
Best investment we've made. Saves time, especially with multi-sided PCB's. Extremely pleased with warranty. Failed within 6 months and replaced by DEN-ON overnight.

Dick Manning - Dicks Electronics - Hartland WI 414-367-8339
The ease & speed of component removal greatly increases productive time. The SMD kit makes SMD removal a breeze, even for inexperienced Techs.

George Hefner - Hefner Electronics - Coleridge NE 402-283-4333
Being a one-man service center, I hesitated to spend the money on a desoldering tool, however all that changed when I nearly ruined a \$400 computer logic board. It has cut my desoldering time by 50%.

Higher Temperature

Don Cressin - Certified Electronics Service - Ellicott City MD 301-461-8008
We have obtained excellent results with the SC7000 including repairing high density U/V tuners. It is one of the best purchases we have made.

Doug Pettit - LuRay Electronics - LuRay VA 703-743-5400
We found that the SC7000 not only saves money vs. wick, but saves valuable time in troubleshooting. It allows you to be more accurate in removing SMD's.

Randy Whitehead - Service West - Salt Lake City UT 801-262-4069
My techs thought it would be a waste. I bought one anyway after a demo. My techs then fought over it. Now we have three. It is the **Best** desoldering tool we have ever used.

Same Low Price

DEN-ON SC7000Z



FREE TRIAL

Available on Request

Sale Price
\$395.00

Price includes
stand worth \$25.00
one extra filter and
two tip cleaners.

Check us out on the WEB
<http://www.heinc.com>

Timothy Kraft Monikraft, Inc.
Cherry Hill, NJ 609-751-3252
We replaced all our existing desoldering stations with the SC7000. Our technicians are very pleased with the improved performance, portability, and reliability over our previous higher priced equipment.

Bill Warren CET/CSM
Warrens Audio & Video
Knoxville TN - 234-546-1128
We have been extremely satisfied with the quality and durability of the DEN-ON SC7000 as well as with after the sale support.

Keith Sabs - J & M Electronics -
Omaha NE 402-291-7100
It's a must tool for my bench. I can desolder multiple pin IC's quickly and clean. It will even take up large solder amounts on tuner and case grounds.

New Features

- ◆ Totally Self Contained diaphragm vacuum pump and AC motor for high vacuum suction or reversible hot air blow for SMD removal.
- ◆ 100Watt Ceramic heater with zero-crossover switching heater control circuit which prevents spikes and leakage currents.
- ◆ Unique patented long lasting filter cartridge design. Solder builds up on easily cleaned baffle, while air flows around the outside of baffle.
- ◆ Totally ESD Safe. The housing contains carbon and the tip is at ground potential for complete ESD Protection.
- ◆ Maximum vacuum of 650mmHg is attained in 100 milliseconds.
- ◆ Temperature adjustable from 300°C - 500°C (572°F - 932°F).
- ◆ More suction power and hotter temperature if needed.

New Specifications

- ◆ Voltage AC100v, 120V, 230V, 50/60HZ
- ◆ Power Consumption 120W
- ◆ Pump Diaphragm Type
- ◆ Motor Output 12W
- ◆ Vacuum Attained 650mmHg
- ◆ Temperature Range 300°C—500°C (572°F—932°F)
- ◆ Air Flow Rate 15 Liter/Minute (Open)
- ◆ Heater 100W (Ceramic)
- ◆ Control System Feed Back Zero Cross-over Type
- ◆ Net Weight 420Grams
- ◆ Max.Temp. of Hot Blow 400°C

Visa - M/C - Discover - American Express - Terms to Qualifying Companies
30 Day Money Back Total Satisfaction Guarantee - One Year Parts and Labor Warranty

HEIN ELECTRONIC
INSTRUMENTS INC
Your Desoldering Specialists

Toll Free U.S. and Canada

1-800-394-1984

Web Site www.heinc.com
E-Mail sales@heinc.com
International (316) 744-1993
or Fax (316) 744-1994

CIRCLE 315 ON FREE INFORMATION CARD

CALL TOLL FREE
 (800) 292-7711 orders only
 Se Habla Español

C&S SALES
 EXCELLENCE IN SERVICE

CALL OR WRITE FOR
 A FREE 60 PAGE
 CATALOG!
 (800) 445-3201

XK-550 Digital / Analog Trainer

Elenco's advanced designed Digital / Analog Trainer is specially designed for school projects. It is built on a single PC board for maximum reliability. It includes 5 built-in power supplies, a function generator with continuously sine, triangular and square wave forms. 1560 tie point breadboard area.

XK-550
 Assembled and Tested
\$169.95

XK-550K - Kit
\$139.95

Tools and meter shown optional

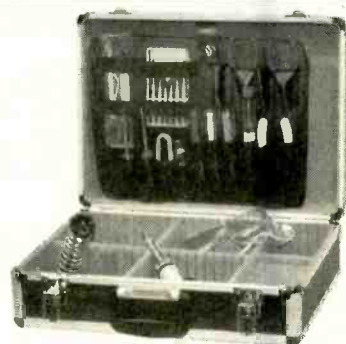


TK-3000

\$89.95

Tools Included:

- SR-2 - Deluxe Soldering Iron
- SH-1 - Soldering Iron Stand
- ST-1 - Diagonal Pliers
- ST-2 - Long Nose Pliers
- ST-30 - Deluxe Wire Stripper
- SE-1 - Solder Ease Kit
- ND-3 - 3 pc. Nut Driver Set
- TL-8 - Precision Screw Drivers
- ST-5 - Screw Driver Slotted 3/16"
- ST-6 - Screw Driver #1 Phillips
- ET-10 - IC Puller
- SP-2 - Solder Pump
- ST-20 - Safety Goggles
- ST-9 - Pocket Screw Driver
- ST-4 - Solder Tube
- SW-3 - Solder Wick



A professional technician service tool kit in a metal reinforced tool case with heavy-duty handle and locks. A removable pallet handles most of the tools listed with more room for tools and parts in the lower half.

GF-8026 w/ Frequency

- Linear and Log Sweep
- Counter Range 1Hz to 10MHz
- .02Hz to 2MHz
- 4 Digit Display

\$225



MX-9300 Four Functions in One

• One instrument with four test and measuring systems:
 Digital Multimeter • Digital Triple Power Supply
 (0-30V @ 3A, 15V @ 1A, 5V @ 2A)
 1.3GHz Frequency Counter • 2MHz Sweep Function Generator

\$479.95



Model XP-581

4 Fully Regulated DC Power Supplies in One Unit
 4 DC voltages: 3 fixed - +5V @ 3A, +12V @ 1A, -12V @ 1A

\$85



Auto Ranging Hand-Held DMM w/ Bar Graph
Model EDM-163

\$89.95

7 Functions with data hold
 Compares to Fluke Model 77II

Digital Multimeter
Model M-1700

\$39.95

11 functions including freq to 20MHz, cap to 20µF. Meets UL-1244 safety specs.



Fluke Multimeters

70 Series	80 Series
Model 7011\$74.95	Model 83\$235.00
Model 7311\$97.50	Model 85\$269.00
Model 7511\$135.00	Model 87\$289.00
Model 7711\$154.95	
Model 7911\$175.00	

B&K Precision Multimeters

Model 391.....\$159.00	Model 388A.....\$99.00
Model 390.....\$139.00	Model 2707.....\$79.00
Model 389.....\$109.00	Model 2860A.....\$85.00

Kit Corner
 over 100 kits available

PT-223K

\$15.95

Phone kit with training course.



Fiber Optics Technology
 with training course
Model FO-30K

\$19.95



Model AM/FM-108K
Transistor Radio Kit
 with training course



M-1005K
Compact Multimeter Kit

\$19.95

6 Functions & Transistor Test



Model M-6100
Programmable DMM

Includes **FREE** Computer Interface and **FREE** Software

- Analog Bar Graph
- Large 3 3/4" LCD Display
- Menu Driven
- Triple Display
- RS-232 Interface
- True RMS
- 9 Basic Functions including cap. & freq.
- Auto Power Off
- Easy-to-use

\$125



WE WILL NOT BE UNDER-SOLD

UPS SHIPPING: 48 STATES 5%

C&S SALES, INC.

150 W. CARPENTER AVENUE
 WHEELING, IL 60090
 FAX: (847) 541-9904 (847) 541-0710
http://www.elenco.com/cs_sales/



15 DAY MONEY BACK GUARANTEE
FULL FACTORY WARRANTY
 PRICES SUBJECT TO CHANGE WITHOUT NOTICE

**FREE PROBES
WITH ALL
SCOPES**

OSCILLOSCOPES

Lowest Prices of the Year!

CALL OR WRITE FOR
A FREE 60 PAGE
CATALOG!
(800) 445-3201

B&K Precision Scopes

60MHz ANALOG WITH DIGITAL STORAGE

Model 2560

- Cursors and readouts
- RS-232 port
- 20MS/s real time sampling
- 1GHz equivalent time sampling (at 0.1µs/div.)
- Prints via RS-232 port to any HP-GL plotter

\$1995

20MHz ANALOG WITH DIGITAL STORAGE

Model 2522A

- 20MHz analog bandwidth
- 20MS/s sampling rate
- 2K memory per channel
- 300MHz equivalent time sampling
- Pre-trigger capture

\$869.95

100MHz THREE-TRACE

Model 2190A

- 1mV/division sensitivity
- Sweeps to 5ns/division
- Dual time base
- Signal delay line
- 15KV accelerating voltage

\$1379.95

60MHz DUAL-TRACE

Model 2160A

- 1mV/division sensitivity
- Sweeps to 5ns/division
- Dual time base
- Signal delay line
- V mode - displays two signals unrelated in frequency
- Component tester

\$949.95

40MHz DUAL-TRACE

Model 1541C

- 1mV/division sensitivity
- Video sync separators
- Z-axis input
- Single Sweep
- V mode displays two signals unrelated in frequency
- Component tester

60MHz, CURSORS & READOUTS, DUAL TIME BASE

Model 2260

- Cursors and readouts
- 1mV/div sensitivity
- 23 calibrated ranges - main time base
- 19 calibrated ranges - delayed time base
- Signal delay time
- V mode - displays 2 signals unrelated in frequency
- Component tester
- Z-axis input
- Single sweep

\$1225

20MHz DUAL-TRACE

Model 2120 - 2 Year Warranty

Special \$389.95

Model 2125 with delayed sweep

\$539.95

- 1mV/division sensitivity
- AUTO/NORM triggered sweep operation
- AC, TVH, TVV and line coupling
- Calibrated 19 step time-base with x10 magnifier
- Compact low-profile design

Affordable Spectrum Analyzers by B&K

500MHz Series
Model 2615 - \$1595
Model 2620 w/ tracking generator - \$1895

1.05GHz Series
Model 2625 - \$2395
Model 2630 w/ tracking generator - \$2995



Quality Scopes by Elenco



**Free DMM
w/ any Elenco
Scope
(\$20.00 value)!!**



60MHz

DS-603 \$1350

- Analog / Digital Storage
- 20MS/s Sampling Rate

S-1360 \$749

- Analog with Delayed Sweep

40MHz

S-1345 \$569

- Analog with Delayed Sweep

S-1340 \$475

- Analog

2 Year

25/30MHz

DS-303 \$1095

- Analog / Digital Storage

S-1330 \$439

- 25MHz Analog
- Delayed Sweep

S-1325 \$325

- 25MHz Analog

OSCILLOSCOPE SELECTION CHART

ANALOG

Model	Bandwidth MHz	Sensitivity (max)	No. of Channels	Sweep Rate Max ns/div	Delayed Sweep	Video Sync	Component Tester	Beam Find	Time Base
S-1360	60	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1345	40	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1340	40	1mV/div	2	10ns/div	No	Yes	No	No	1
S-1330	25	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1325	25	1mV/div	2	10ns/div	No	Yes	No	No	1

DIGITAL STORAGE

Model	Bandwidth MHz	Analog Sen (max)	No. of Channels	Sampling Rate	Memory Channel	Internally Backed Up	Pretrigger %	Output
DS-303	30	1mV/div	2	20MS/S	2K	Yes	0, 25, 50, 75	RS232
DS-603	60	1mV/div	2	20MS/S	2K	Yes	0, 25, 50, 75	RS232

HURRY... AT PRICES THIS LOW THEY'LL BE GONE FAST!

HITACHI SCOPES

Inventory Reduction Sale
Lowest Prices of the Decade!

V-209 - 20MHz Battery Operated
Was \$1505, NOW \$1095 Save \$410

V-695 - 60MHz w/ Cursors
Was \$1815, NOW \$1395 Save \$420

V-422 - 40MHz Was \$965,
NOW \$765 Save \$200

V-1065A - 100MHz w/ Cursors
Was \$2139, NOW \$1565 Save \$574

V-525 - 10MHz w/ Cursors
Was \$1355, NOW \$955 Save \$400

V-1560 - 100MHz Was \$1790,
NOW \$1490 Save \$300

V-552 - 50MHz Was \$1195,
NOW \$850 Save \$345

V-1565 - 100MHz w/ Cursors
Was \$1960, NOW \$1595 Save \$365

V-555 - 50MHz w/ Cursors
Was \$1375, NOW \$975 Save \$400

V-252 - 20MHz **\$419**

Fluke Scopemeters



91 \$1225
92B \$1445
96B \$1695
97 \$1795
97A \$2945
99B \$2095
Call or write for complete specs.

**WE WILL NOT BE UNDER-
SOLD**

UPS SHIPPING: 48 STATES 5%

C&S SALES, INC.

150 W. CARPENTER AVENUE
WHEELING, IL 60090
FAX: (847) 541-9904 (847) 541-0710
http://www.elenco.com/cs_sales/



**15 DAY MONEY BACK
GUARANTEE**

FULL FACTORY WARRANTY
PRICES SUBJECT TO CHANGE WITHOUT NOTICE

CIRCLE 333 ON FREE INFORMATION CARD

BLOWOUT! TIMELINE INC. BLOWOUT!

Over 11 years and 29,000 customers and still growing

LIQUID CRYSTAL DISPLAYS

240x64 dot LCD with built-in controller.
AND 4021ST-EO. Unit is EL back-lit. \$69.00 or 2 for \$129.00 or
OPTREX. DMF5005 (non back-lit) \$49.00 or 2 for \$89.00
 20 character x 8 line 7/8L x 2 1/8H *The built-in controller allows you to do text and graphics.*

Alphanumeric—parallel interface

16x1.....\$7.00	20x2.....\$10.00	40x1.....\$8.00
16x1 (lg. char.).....\$10.00	20x4.....\$15.00	40x2.....2 for \$20.00
16x2.....\$7.00	20x4 (lg. char.).....\$10.00	40x4.....\$20.00
16x2 (lg. char.).....\$10.00	24x2.....\$10.00	4x2.....\$5.00
16x4.....\$15.00	32x4.....\$10.00	

5V power required • Built-in C-MOS LCD driver & controller • Easy "microprocessor" interface • 98 ASCII character generator • *Certain models are backlit, call for more info.*

Graphics and alphanumeric—serial interface

size	Mfr.	price	size	Mfr.	price
640x480 (backlit)	Epson	\$25.00	480x128	Hitachi	\$10.00
640x400 (backlit)	Panasonic	\$20.00	256x128	Epson	\$20.00
640x200	Toshiba	\$15.00	240x128 (backlit)	Optrex	\$20.00
480x128 (backlit)	ALPS	\$10.00	240x64	Epson	\$15.00
			160x128	Optrex	\$15.00

6" VGA LCD 640X480, Sanyo LMDK55-22 \$25.00

LASER PRODUCTS

HeNe Laser Head (10mw max. output) TEM00. 15.5" long MFG: NEC \$99.00
Laser Power Supply (for HeNe tube) \$89.00

LASER SCANNER ASSEMBLY \$19.00

Assembly intended for a laser printer. Includes laser diode, polygon motor (6 sided) and misc. optics and lenses.

LASER DIODE (5mW) with collimator \$20.00

VISIBLE LASER DIODE: 5mw at 670nm \$15.00
 Index guided. Threshold current 40 ma typical.

3 and 4mw, 1,300nm LASER DIODES, 5.6mm package, \$15.00
Mitsubishi Electric part number ML701BIR-E21A, General specs are:
 1. Vop=1.25, Beam Divergence 25.6° x 28.6°; 2. Tc=24°C, Iop=19 to 20mA, ITH=10.7mA; 3. Wavelength range between 1,280nm and 1,330 nm

POLYGON MOTOR UNIT & DRIVER \$79.00

Two-sided first surface mirror mounted on an armature that spins at 125 revolutions per second yielding a beam sweep rate of 1250 sweeps per second. The driver for the polygon unit requires 24 volts and plus and minus 12 volts to operate. There is also an f theta lens in front of the polygon scanning mechanism with a three inch diameter. Great for optical experiments, etc. Very high quality units. (MFR: JAPAN ELECTRONICS)

NETWORK

Proteon ProNet-4 Model p1347 Token Ring Board \$49.00
 16 bit • 4 Mbps • IEEE 802.2 and 802.5 compatible • twisted pair • interoperable with IBM Token Ring network

POS & BAR CODE

MAGNETIC CARD READER \$25.00

Includes: • 20 character dot matrix display with full alpha-numeric capability • keypad with full alpha-numeric entry • separate 7.5 VDC/0.5 Amp power supply • standard telephone interface extension cord • lithium battery and flat cone speaker.

HP bar code wand (HBCS 2300).....\$25.00

POWER SUPPLIES

SWITCHING POWER SUPPLIES \$12.00 or 2 for \$20.00 115/230 Volts
73 WATT (2) 4 pin power connectors attached • Dim: 8.5" L x 4.5" W x 2" H
 Output: +5V @ 2-9.75 A, +12V @ 0-1.5 A, -5V @ 0-0.4 A, -12V @ 0-0.5 A
68 WATT Dim: 5.5" L x 3.2" W x 1.7" H • Output: 5V @ 4 A, 12V @ 4A
60 WATT Dim: 8 1/2 x 4 1/4 x 3 • Output: 5V @ 6A + 12V @ 1A - 5V @ 1A - 12V @ 1A

CHARGE COUPLED DEVICES



"The Spy In The Sky" \$29.00 MATRIX TYPE

Thomson 576X550 pixel CCD
 400-1,100nm resolution and responsivity. \$500.00 Original cost value

Sony CCD Imager - designed for black and white composite video cameras. Picture elements: 384 (H) x 491 (V) \$29.00
 Chip size 10.7 (H) x 9.3 (V) mm² • Unit cell size 23.0 (H) x 13.4 (V) um².
 Ceramic 24 pin DIP package • Mfr: Sony, Part# 016AL

4096 element CCD \$15.00

1024 element CCD \$10.00

2048 element CCD \$10.00 • 1728 element CCD \$10.00

LINEAR TYPE

2539 W. 237th Street, Bldg. F, Torrance, CA 90505
 Order desk only: **USA: (800) 872-8878 CA: (800) 223-9977**
 L.A. & Technical Info: **(310) 784-5488 Fax: (310) 784-7590**
OEM INQUIRIES WELCOME

MONITORS

Non-Enclosed TTL

Comes with pinout. 12V at 1.4 Amp input • Horizontal frequency 15KHz. • Ability to do 40 and 80 column.
5 inch Amber \$25.00 • 7 inch Amber \$25.00
9 inch Amber or Green \$25.00

5" COLOR MONITOR \$39.00

• Flat Faceplate • 320 x 200 Dot Resolution • CGA & Hercules Compatible
 • 12 VDC Operation • 15.75 KHz Horiz. Freq. • 60 Hz Vert. Sync. Freq.
 • Open Frame Construction • Standard Interface Connector • Degaussing Coil included • Mfr. Samtron

2 for \$69.00

9" monochrome SVGA MONITOR \$79.00
 Fully Enclosed - Tilt and swivel type. Mfr: WEN

MISCELLANEOUS

ADAPTEC 4070A (RLI) OR 4000A (MFM), SCSI Controller, your choice \$25.00

IBM 370 option XT and AT emulation boards \$25.00

HACKER CORNER

US made Micronics 486 VLB All in ONE \$69.00 or 2 for \$129.00

motherboard, supports 3.4 or 5V CPU, at either 25 or 33 mhz basic clock. Can use AMD or Intel from 486SX25 thru 486DX4-100 to HOT new AMD 5X86-133 cpu. On board SVGA video. On board 1 meg video ram expandable to 2 meg with ATI Mach 2 chip set. On board 2 high speed serial ports, 1 printer port, floppy and IDE hard drive controller. On board 256K cache. Uses 72 pin simm memory. Landmark speed rating of 479 with AMD chip.

Board will not fit standard All in One case because of non standard location of riser board. VLB riser board is included with motherboard.

COLOR CCD CAMERA \$149.00

• 12 VDC • 1/3-inch, CCD area image sensor • 514 (horizontal) x 491 (vertical) • 2:1 interlaced • 15.734 kHz (horizontal), 59.94 Hz (vertical) • 330 horizontal and 350 vertical lines • 10 lx • IV, NTSC signal format • Lens: 1/3-inch, fixed focus (F:2.8 f.5.6) • Dimensions: (W) 67 (2.63) x (H) 34 (1.45) x (D) 112.6 (4.43)

SONY Miniature Color LCD Display (LCX005BK) \$29.00

• 1.4 CM (0.55 inch) Diagonal Full Color Display • Built In Horizontal and Vertical Drivers • Delta Dot Pattern for High Picture Quality - 537 dots (H) x 222 dots (V) • Compatible with NTSC & PAL Format and Sync Inputs • 12 VDC Operation with -1 to +17 V RGB Signal and Driver Input Voltage • Excellent Display for Virtual Reality Projects, Viewfinders, and Miniature Test Equipment Displays • Pin Outs and Specification Included • Unit Requires Clock, Synchronization and Video

CELL SITE TRANSCEIVER \$79.00 2 for \$149.00

These transceivers were designed for operation in an AMPS (Advanced Mobile Phone Service) cell site. The 20 MHz bandwidth of the transceiver allows it to operate on all 666 channels allocated. The transmit channels are 870.030-889.980 MHz with the receive channels 45 MHz below those frequencies. A digital synthesizer is utilized to generate the selected frequency. Each unit contains two independent receivers to demodulate voice and data with a Receive Signal Strength Indicator (RSSI) circuit to select the one with the best signal strength. The transmitter provides a 1.5 watt modulated signal to drive an external power amplifier. Channel selection is accomplished with a 10 bit binary input via a connector on the back panel. Other interface requirements for operation are 26 VDC (unregulated) and an 18.950 MHz reference frequency for the digital synthesizer. The units contain independent boards for receivers, exciter, synthesizer, tunable front end, and interface assembly (which includes power supplies and voltage-controlled oscillator). Service manual, schematics and circuit descriptions included.

Encased Black & White Composite CCD Camera with Adapter IR viewing to 1000 nm 7 1/2 L x 2 3/4 W x 1 1/4 H

Comes complete with CCD camera, mounting nut on bottom of casing, 12VDC power supply. Excellent low light capability, standard RCA NTSC video out. **\$89.00**

Great for: entryway security/remote monitoring, video conferencing/desktop video conferencing 2 for \$159.00

This miniature camera is perfect for multimedia computer applications as well as security and surveillance. NTSC output allows use with all popular video digitizing boards for Apple Macintosh and Microsoft video for Windows. Connects directly to any composite monitor or VCR with "video" input. Its razor-sharp wide-angle lens focuses from two inches to infinity and its state-of-the-art CCD technology accurately captures 16 level grayscale images for Quick Time movies and still pictures. Records at 30 frames per second and 260 lines resolution with excellent low light capability. Uses 12VDC (adapter supplied) and standard RCA cable.

POINT OF SALE BANK TERMINAL \$39.00 or 2 for \$69.00

• LCD Display 20 Char. x 4 Line • Printer 16 Column Dot Matrix - Epson • 24 Key Domed Membrane Keypad • Intel 80C32 Processor • 2 PCMCIA Sockets (ICC Slots) • Dallas DS1287 Realtime Clock • 2 Solid State Buzzers (Piezo Electric) • 4 Crystals • Rockwell Modem Chip • Telephone Line Interface (4 Pin "RJ" Connector) • RS-232 Interface (8 Pin "RJ" Connector) • NI-CAD Battery Pack Inside
 Note: We have not been able to bypass an access code in the software. Thus, while time of day and other introductory things are displayed on LCD, the full original capabilities of this unit cannot be guaranteed. Also, we do not have a source for the smart cards that were to go in the PCMCIA sockets. Requires 12 volt adapter for power. (Not included) Dimensions: 9-1/2L x 6-1/4W x 2-1/2 D • Original cost over \$450.00

.6" COMPOSITE MINIATURE COLOR DISPLAY \$99.00

Fully encased. Dim: 1.3" x 1.2" x 1.2" • 12VDC power. NTSC signal. 250 H x 300 V resolution (focus adjustable) • replace. Applications include camcorder viewfinder, helmet mounted display, etc.... Original cost over \$600.00

Minimum Order: \$20.00. Minimum shipping and handling charge \$5.00. We accept cashers checks, MC or VISA. No personal checks or COD's. CA residents add 8.25% sales tax. We are not responsible for typographical errors. All merchandise subject to prior sale. Phone orders welcome. Foreign orders require special handling. Prices subject to change without notice. 20% restocking fee for returned orders.

MCM ELECTRONICS®

YOUR Electronics Authority!



SAVE 30%

MCM AUDIO SELECT™

5 1/2" Poly Treated Woofer

Rolled over front basket offers attractive appearance. Rubber surround, reinforced cone and 1" voice coil provide 48Hz-6KHz response and 60/100W RMS/peak power capacity. 8ohm.

Order # 55-1205 Reg. \$9.99 **\$6.99**



NEW

MCM AUDIO SELECT™

Shielded Woofer

This high quality polypropylene cone woofer features rubber surround and shielded magnet, making it ideal for home theater applications. Great for cabinet upgrade or original design, this woofer will meet all of your needs.

Order # 55-1191 (ea.) **\$15.95**

Same Day Shipping!

In stock orders received by 5:00 p.m. (YOUR TIME), are shipped the same day.

FREE Catalog!



Hours: M-F 7 a.m.-9 p.m., Sat. 9 a.m.-6 p.m., EST.

Visit MCM's website at www.mcmelectronics.com

Your Choice \$4.99



Popular Chemicals

Save on these popular service chemicals. Cleaner/Degreaser cleans PC boards, magnetic pick-ups and potentiometers. Contact Cleaner works for switches, connectors, potentiometers and relays. Duster is invaluable as a non-contact dust and contaminant remover. All are safe for most plastics.

Order #	Mfr. #	Size	Reg.	Sale
Contact Cleaner				
20-2090	CV1016	10 oz.	\$6.60	\$4.99
Cleaner/Degreaser				
20-2080	CV2116	10 oz.	6.50	4.99
Duster				
20-2620	ES1217	8 oz.	5.99	4.99

Mini Power Supply/Charger

NEW



Intended to simultaneously power cellular phones and charge the battery, these compact supplies are ideal for any 12V, 1 amp application. Both accept standard cigarette lighter plug. Approximate dimensions: 2 1/4" (W) x 4 1/4" (D) x 2 1/4" (H).

Order #	Type	(ea.)
110-1225	Wall plug	\$7.99
110-1226	Desktop w/cord	9.99

TENMA® Manual Ranging DMM

SAVE 15%

Features 3 1/2 digit LCD display, DC voltage measurement up to 600V, transistor, diode and battery test. Also measures AC voltage to 500V, DC current to 2A, and resistance to 2000Kohm. Holster, manual and test leads included. Requires one 9V battery not included (#290-080)

Order # 72-2055 Reg. #31.95 **\$27.00**



Prices Effective September 2 through October 31, 1997

To take advantage of these prices, you must supply this special price code:

SOURCE CODE: ENS39

Your Choice \$19.95



Round Analog Panel Meters

These meters feature rugged steel backs, U-clamp flush mounting, fade proof lithographed metal dials and glass fronts. Dimensions: 2"(D) x 1.5"(D). Accuracy 5%

Order #	Current range
72-7047	0-15VDC
72-7048	0-50VDC
72-7049	0-5mADC

Your Choice \$19.95



Current Meters

Inexpensive ammeters are ideal for any DC current measuring application including charging systems. Induction type sensing only requires cable to be placed in slot frame on the rear of meter case, no electrical connections or leads to hook up.

Order #	Current range
72-7051	-100-0-100 Amp
72-7043	-30-0-30 Amp

SAVE 22%



9 1/2" Automotive Crimp Tool

Take advantage of terrific savings on this popular style crimping/cutting tool. Popular for automotive installation use, this tool can be yours for a fraction of our competition's price. Designed for solderless terminals from 10-22AWG.

Order # 22-1780 Reg. \$8.99 **\$6.99**

1-800-543-4330



MCM ELECTRONICS®
650 CONGRESS PARK DR.
CENTERVILLE, OH 45459
A PREMIER FARNELL Company

SOURCE CODE: ENS39

REMOTES Remote Control for Any Application

NEW NEW NEW NEW NEW

3.5" x 2.75"

\$69⁹⁵



- 3 Channel Receiver
- Channel 1 - 5 amp Relay, N/O, N/C
- Channel 2 and 3 Digital Outputs
- Compatible with 2 Button or 4 Button Remote
- Code Hopping Receiver at 434 Mhz
- Compatible with All Garage Doors and Some Car Alarms

2.75" x 2.75"

\$99⁹⁵



- 6 Channel Receiver with Digital Outputs
- All Channels are Programmable for Momentary, Latched, Latched with Condition
- 30-60-90 Sec. Timed Outputs
- Code Hopping Receiver at 434 Mhz
- Compatible with 2 Button or 4 Button Remote
- Compatible with Some Car Alarms

1.25" x 1.75"

\$29⁹⁵



- 2 Button - 3 Channel Remote
- Extra Long Range 434 Mhz with S.A.W. Resonator
- Push Both Buttons together for Channel 3

1.25" x 1.75"

\$39⁹⁵



- 4 Button - 15 Channel
- Extra Long Range 434 Mhz S.A.W. Resonator
- Push Combination of Buttons together for Channel 5 through 15, i.e. Push Button 1 and 2 together for Channel 5.

Street Smart Security ■ 800-908-4737

7147 University Avenue • La Mesa, CA 91941

Send, Fax or Call Order In - Use Credit Card or Check. Fax (619) 462-0652

NOW YOU CAN "SEE" INVISIBLE FIELDS AND AVOID THEM

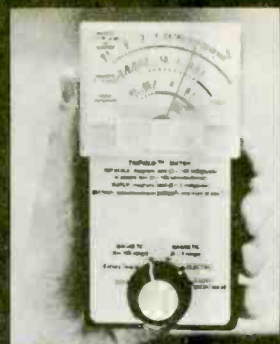
Most homes and offices have hot spots with strong artificial electro-magnetic fields, where chronic exposure may cause mental or physical problems. Even the EPA names these fields as suspected carcinogens. You can reduce your risk by avoiding these high-field areas.

The *TriField™* meter detects far more of these fields than any other electromagnetic pollution meter. It's the only one that independently reads AC electric fields, AC magnetic fields, and radio/microwaves. It also reads field strengths in all directions simultaneously. Every other meter that sells for under \$500 reads only magnetic and only in one direction — they can entirely miss a magnetic field unless pointed correctly and are blind to radio/microwaves and electric fields, both of which cause biological effects.

The *TriField™* meter reads all three types of fields numerically and with a SAFE/BORDERLINE/HIGH SCALE, weighted proportional to effect on the body. Thresholds are based on epidemiological and laboratory studies. (While no absolute hazard thresholds have been established, reduction of relative exposure is prudent.)

The *TriField™* meter comes ready-to-use with battery, instructions, and one-year limited warranty. The cost is \$144.50 postpaid.

AlphaLab, Inc. / 1250 South Third West / Salt Lake City, UT 84101-3049
For literature and information, call (808) 874-9126



FM TRANSMITTER KITS! FUN PROJECTS AND MORE!

ELECTRONIC KITS!

WE ACCEPT VISA, MC, MO, COD SHIPPING & HANDLING EXTRA



XANDI ELECTRONICS, INC. YOUR MANUFACTURER OF HIGH QUALITY KITS

TECH SUPPORT NUMBER (602-829-0755)

- Powerful 2 stage audio amplifier.
- Tunes 88-108 MHz.
- Up to 1 mile range.
- Requires 9V battery. (Not incl.)
- Sensitive, picks up sounds at the level of a whisper.



SUPER-MINIATURE FM TRANSMITTER
Super small FM transmitter. Use with any FM broadcast receiver. Easy to assemble, all chip (SMT) parts are pre-assembled to the circuit board.

XST500 E-Z Kit \$49.95

- Sensitive audio amplifier, picks up sounds at the level of a whisper.
- Tunes 88-108 MHz.
- Up to 1/2 mile range.
- Miniature photo battery mounts right on circuit board. (Included)



MICRO-MINIATURE FM TRANSMITTER
Including the battery, this is the Worlds smallest FM transmitter. Use with any FM broadcast receiver. Easy to assemble, uses pre-assembled circuit board.

XWB1000 E-Z KIT \$46.95

- Up to 1/2 mile range.
- Miniature photo battery mounts right on circuit board.
- Transmits at 143 MHz.
- Amazing audio sensitivity, picks up sounds at the level of a whisper.



CRYSTAL CONTROLLED FM TRANSMITTER
Including the battery, this is the Worlds smallest crystal controlled FM transmitter. Transmits to any scanner type receiver. Easy to assemble, uses pre-assembled circuit board.

XTL1000 E-Z KIT \$69.95

- Transmits a continuous beeping tone.
- Transmits at 143 MHz.
- Up to 1 mile range.
- Works with most any scanner type receiver.



TRACKING TRANSMITTER
Only 0.75 by 1.8 inches including the battery, the XTR300 is ideal for use in locating lost model rockets, bicycles, automobiles, games of hide and seek, and contests.

XTR300 E-Z Kit \$79.95

- Dial your phone from anywhere and listen to the sounds inside your home.
- Two digit Touch Tone code for secure operation.



TELEPHONE SNOOP
The latest in home or office security. Call home from anywhere, enter a two digit security code, and hear the sounds in your home. Automatically turns on without ringing the phone, verifies code, then activates for one and a half minutes.

XPS-CASE KIT \$14.95

XPS1000 C KIT \$55.95

- Smallest Phone transmitter anywhere!
- Tunes 88-108 MHz.
- Up to 1/4 mile range.
- Attach to phone line anywhere in house.
- No battery required, powered by phone line.



SUPER-MINIATURE PHONE TRANSMITTER
Worlds smallest FM phone transmitter. Use with any FM broadcast receiver. Easy to assemble, all chip components are pre-assembled to the circuit board.

XSP250 E-Z Kit \$34.95

- Professional quality.
- Uses new Microwave Integrated Circuit amplifier.
- Assembly is a snap.
- Covers 1 to 2,000MHz.
- Adjustable sensitivity.
- Audio jack for privacy ear phone.



SUPER SENSITIVE BUG DETECTOR
Any intercepted signal causes an audio tone that increases from a low pitched growl to a high pitched squeal as you get closer to the source of the signal.

XBD500 E-Z Kit \$129.95

- Use with any FM broadcast receiver.
- Hear every sound in an entire house!
- Up to 1 mile range.
- Powerful 2 stage audio amplifier.



MINIATURE FM TRANSMITTER
The XFM100 has a super sensitive microphone and is capable of picking up sounds at the level of a whisper and transmitting them to any FM broadcast receiver.

XFM100 C Kit \$21.95

- Will analyze live voice best, but will work over the phone, and even from recordings.
- Has built in microphone.
- Easy to use LED output display.
- Voice-stress analysis instantaneous.



VOICE-STRESS ANALYZER
SEE THROUGH LIES AND DECEIT! This is the latest breakthrough in voice-stress analysis. Know if someone is under stress such as when telling a lie.

XVA250 C Kit \$49.95

- Digital voice changing; male to female, female to male, adult to child, child to adult.
- Use with any modular phone.
- 16 levels of voice masking.
- Connects between handset and phone.



VOICE CHANGING ACCESSORY
STOP THOSE ANNOYING TELEPHONE CALLS!
Sound older and tougher when you want to. Not a kit. Fully assembled. Use with single or multi-line phones.

TRANSITION 2001 \$69.95

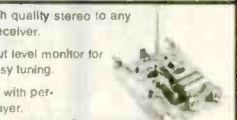
- Uninterrupted coverage of 800 to 950 MHz.
- Works with any scanner that can receive 400 to 550 MHz.



800-950 MHz SCANNER CONVERTER KIT
If your scanner can receive 400-550 MHz, just add the XLC900 for **uninterrupted 800-950 MHz** coverage. It converts all 800-950 MHz signals down to 400-550 MHz so your scanner can receive them! Add our custom case kit for that "Professional" look.

XLC900 C KIT \$49.95

- Transmit high quality stereo to any FM stereo receiver.
- Built-in output level monitor for quick and easy tuning.
- Ideal for use with personal CD player.



FM STEREO TRANSMITTER
Transmit full-bodied Hi-Fi stereo to any FM stereo receiver. Separate left and right inputs and gain controls. Includes an output booster stage for greater range.

XFS-CASE KIT \$14.95
XFS108 C KIT \$39.95

XANDI ELECTRONICS, INC. Serving the public since 1981
1270 E Broadway Rd. # 113, Tempe AZ 85282

TOLL FREE ORDER LINE: 1-800-336-7389
FAX LINE: 1-602-731-4748
CALL FOR YOUR FREE CATALOG


SEND MAIL **XANDI ELECTRONICS**
ORDERS TO: **BOX 25647**
TEMPE, AZ 85285-5647

CIRCLE 280 ON FREE INFORMATION CARD

AMAZING ELECTRONIC & SCIENTIFIC DEVICES

Lasers, Tesla, Ions, Anti-Gravity, Magnetics & More!

Plans • Ready-to-Use • Easy-to-Build Kits



Laser Ray Gun
Handheld, battery operated. Produces an intense burst of light capable of burning holes.
LAGUN2 Plans \$20.00
LAGUN2K Kit/Plans Price on Req



250KV Tesla Coil
10-14" of Explosive Bolts of Lightning!
• Transmit Wireless Energy
• Ion Motors
• Anti-Gravity
• Strange and bizarre pyrotechnical effects
• Many other experiments shown in detail
• Award winning science project!
BTC3 Plans \$15.00
BTC3K Kit/Plans with coil \$299.50
BTC30 Assbl'd Ready to Use \$399.50
BTC4 Plans, 500KV unit \$20.00

ATTENTION: Experimenters & Researchers!
Anti-Gravity, Rail & Coil Guns, Mass Warping, Levitation Research, Exploding Water, Propulsion Drivers, Lattice Snapping, EMP etc. Loss-less Energy Charger with triggered spark switch. • Adjustable 500 to 3KV out
• Charges up to 25KJ • Programmable Output
HEP1 Plans \$15.00
HEP1K Kit/Plans with 500J \$399.50
HEP10 Lab Assembled - to your spec's.
Write, call or fax for price & delivery
...shown connected to potential rail gun system



Visible Beam Gas Lasers
Millions degree temp equiv. Illuminates low level clouds
• Light Shows
• Window Listener
• Optical Projects
• 12/115V
• Science Project
LAS1KM 1 mw, low cost Kit \$69.50
LGU6K 2-3mw Kit \$119.50
HNE70 5-7mw, ready to use \$299.50



Gravity Generator
Levitate an object!
Great science fair project!
GRA1 Plans \$15.00
GRA1K Power Supply Kit/Plans ... \$99.50
GRA10 Assbl'd Kit/Plans \$149.50
Includes text book on Anti-Gravity theory!



Solid State Tesla Coil
• Generate fiery electrical plasma discharge
• Powers light and objects without contact
• Experiment with electrical and mechanical fields. TCL5 Plans \$8.00
TCL5K Kit/Plans 12VDC \$49.50



Pioneer a Futuristic Weapon!
Electric Gun - prototype designed in our lab - Join the research!
• Ballistic Velocities
• Handheld • Battery Operated
• Labelled as DANGEROUS Product
Experiment now before it is classified as a firearm! EGUN1 Plans \$20.00
(Must be 21 for purchase of hardware)




Ion Ray Gun
Project Energy!
Star Wars technology demonstrates weapons potential. IOG7K Kit/Plans \$99.50



4000 Volts 10ma High Voltage Module - Ready to use - for many projects from hoverboards to pyrotechnics.
MINMAX4 While they last! \$19.50

"Talking" Plasma Globe
Spectacular color. Pulsates to music, sounds! 8-9", with intensity and sound controls. PLASMA1 Ready to Use . \$79.50




Electronic Hypnotizer *Caution Required*
Control their minds! Programmable audible and visual stimuli induces hypnotic trances. HYP2K Kit with Book \$39.95
EH2 Hypnosis Book & Plans \$14.95



We can design and build high voltage systems - to your spec's!
Call or fax us with your requirements!

TACTICAL ELECTRONICS

Cybernetic Ear!
Enhances normal hearing 3-4 times!
Adjustable volume control, fits easily into either ear. Many, many uses.
Ready to Use!
CYBEREAR \$19.95



ALL NEW Telephone Line Grabber/Infinity Transmitter
Use tone phone anywhere in the world to:
• Monitor your premises - avoid break-ins
• Access ongoing calls - longwinded kids
• Control up to 8 appliances in your home!
• Re-direct costly toll calls from pay phones!
TELCON3 Plans (credit to purch) ... \$ 10.00
TELCON3K Plans/Kit \$99.50
TELCON30 Ready to Use \$149.50



Long Range "Ultra-Ear"
20" dish uses satellite technology to capture distant sounds. PM5 Plans \$ 8.00
PM5K Kit/Plans \$149.50
• Optional Wireless Retrofit transmits captured sounds to an FM radio.
WMSK Kit for Wireless Option \$29.50



Phasor Sonic Blast Pistol
Rids areas of unwanted pests. Trains and conditions wild and domestic animals. Great for barns, attics, cellars, gardens.
PPP1K Kit/Plans \$39.50

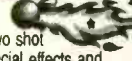


3 Mi Telephone Xmitter
• Tune-able 80-130 Mhz • Undetectable
• Only transmits when phone is use
VWPM7K Kit/Plans \$39.50

3 Mi Voice Transmitter
• Ultra-Sensitive Mike
• Crystal Clear
• Tunes 80-130 MHz.
FMV1K Kit/Plans \$39.50



FireBall Gun
Shoots flaming ball - two shot capacity. Great for special effects and remote fire starting. CAUTION REQUIRED!
FIREBALL Plans (dangerous product) \$10.00



Shocker Force Field/Vehide Electrifier
Make hand and shock balls, shock wands and electrify objects. Great payback for those wiseguys!
SHK1K Easy to Assemble Kit \$19.50



Extended Play Telephone Taping System
• Tapes Phone Conversation • Extends Tape X4 • Check Local Laws before using!
TAP30X Ready to Use \$84.50



"Drop-In" (Imi) Telephone Transmitter
Easily tunable over FM radio. Never needs battery! #DROPIN Kit/Plans \$ 19.95



See In Total DARKNESS!
• High Quality IR Night Vision Scope with IR illuminator.
SD10 Ready to Use \$199.50




Electric Charge Gun
Life is Precious - PROTECT IT!
Stuns & immobilizes attackers 15 feet away! Check your state laws for legality. More knockdown power than most handguns. No permanent injury. ID coded. ECG1 Data
(Creditable to purch) \$10.00
ECG10 Charge Gun, Ready to Use, includes FREE Stun Gun! \$249.50
STUN GUNS - sold separately:
STUN100 100,000 Volts \$34.50
STUN200 200,000 Volts \$49.50



3 Mi Tracker Transmitter
• Tunable Output
• Uses FM Radio
• Excellent Signal Beacon
HOD1K Kit/Plans \$39.50



MIND CONTROL!
Places subjects under your control. Programmable audible & visual stimuli with biofeedback. Induces strange & bizarre hallucinations without drugs. Caution - not FDA approved.
MIND2 Plans \$15.00
MIND2K Kit and Plans \$49.50
MIND20 Assembled Unit \$69.50



FANTASTIC BRIGHTNESS!
High Quality Laser Pointer
LAPN64 15mw equiv, 2000' \$39.50
LAPN61 50mw equiv, 4000' \$84.50



Window Bounce Laser Listener
Aim at window and listen to sounds from reflected light. CAUTION - Not for illegal use. LWB3 Plans \$10.00
LWB3K Kit/Plans (req's vid tripod) \$149.50



1000' Potato Cannon
Not a Toy! Uses electronic or piezo ignition. CAUTION REQUIRED!
POT1 Plans (dangerous product) ... \$10.00



VISIT US ON THE WEB!
<http://www.amazing1.com>

INFORMATION UNLIMITED

Dept ENS-7, Box 716, Amherst, NH 03031
Phone: 603-673-4730 FAX: 603-672-5406
MC, VISA, COD, Checks accepted Please add \$5.00 S & H

CATALOG!
FREE with Order or send \$1 P&H

24 Hour Phone
800-221-1705
Orders Only Please!

Printed Circuits in Minutes Direct From LaserPrint!

8 1/2" x 11"
* Or Photocopy
** Use standard household iron or P-n-P Press.



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

Techniks Inc.
P.O. Box 463
Ringoes NJ 08551
ph. 908.788.8249 fax 908.788.8837
<http://chelsea.ios.com/~techniks>
Retail Dealer Inquiries Invited

ADAPT-11 68HC11 Modules for Solderless Breadboards

- miniature 2.0" by 2.8" module
 - plugs vertically into solderless breadboard for easy development
 - BOOT/RUN switch for easy programming via PC serial port
 - all I/O lines on dual row connector
- Complete modular prototyping system!
Expansion accessories available!



For just US\$74.95, our Starter Package (AD11SP) provides everything you need to get going fast! Now you can harness the power of the popular 68HC11 in your projects! Includes ADAPT-11 with 68HC11E2, providing 2K EEPROM (re-programmable), 8 channel 8-bit Analog-to-Digital Converter (ADC), hardware timers, counters, Interrupts, Serial Peripheral Interface (SPI), Serial Communications Interface (SCI), & more! On-board RS-232 interface (cable included), 5-volt regulator, 8MHz crystal, reset circuit, and convenient program/run switch. Comes with non-commercial versions of 'HC11 Assembler, BASIC, & C, as well as handy utilities & example code. Includes Motorola 68HC11 Pocket Programming Reference Guide and manual with schematic. All you need is a PC to write & program your software, a DC power supply, and a solderless breadboard (or protoboard) to build your application circuits on (or use our modular accessories).

Visa • MasterCard • American Express • Discover
TECHNOLOGICAL ARTS
309 Aragona Blvd., Suite 102, Box 418, Va. Beach, VA 23462
1844 Bayview Avenue, Box 1704, Toronto, ON M4G 3C2
voice/fax: [416] 963-8996 www.interlog.com/~techart

Telephone Line Simulator

NEW! \$229.00

The LINKER 2 lets you test your telco inter-connect devices without using phone lines. It does everything Ma Bell does like dial-tone, ringing, busy. Caller ID version available.

800 - 631 - 0349

<http://www.infinet.com/~jectech>

5-Channel Logic Analyzer

Jan. 1997 Electronics Now

Operates through your computer's printer port.

- Three trigger modes
- No Power Required
- 11 octave sample range
- Save and Print Logic Displays

Surface Mount Components (inside connector)

Kit: \$50.00
Fully Assembled \$65.00

Specs:

- No. Channels: 5
- Sample Rate: 8-1 Mhz*
- No. Samples: 5000
- Display screens: 35
- Timing Cursors: 2
- Trig Thresh: 2-3V
- Timing Error: 5% <

Uses:

- Student Projects
- Teaching Aid
- General Testing
- Production Testing
- Serial Data Analyzer
- Tech. Sales / Demos
- Field Testing

American MicroTech Inc 219-482-3896

<http://home.sprynet.com/sprynet/amtech>
E-mail: amtech@sprynet.com

Notch Filters



Test Chip

- Assembled
- 1 to 2 \$30 each
 - 3 to 9 \$25 each
 - 10 to 49 \$16 each
 - 50 or more \$14 each

- Filter Kits
- 1 to 2 \$20 each
 - 3 to 9 \$15 each
 - 10 to 20 \$9 each
 - 21 or more \$7 each



\$ 599.00
Free Shipping

www.tvfilter.com

Video Media
P.O. Box 93/6025
Margate, Fl. 33093-6025
(954)-752-9202

Laser Modules

Variety of laser modules from 635 to 830 nm with 5-40 mW output power. *World Star Tech.* also has TTL modulated laser modules, adjustable focus laser modules, line generators and etc.

Laser Pointer

Pen-size laser pointer has a range of 150-200 yard with high quality laser beam. Ask for laser modules and laser pointers catalog

World Star Technologies, Inc.

20 Carlton Str. Unit 1626
Toronto, M5B 2H3 Canada

Ph: 416 204 6298 Fax: 416 596 7619
laser@arcos.org

You can visit us on <http://web.arcos.org/laser>

UPGRADE YOUR COMPUTER!

VBAMC
Welcome!

TECHNOLOGY ASSOCIATES

959 W. 5th St. • Reno, NV 89503
(702) 322-6875 • Fax (702) 324-3900
www.techass.com • sales@hoopsware.com

Memory	Hard Drives	Modems
4Mb (4x8-70 ns) \$22	WD 1.2Gb IDE \$200	33.6 Int Fax/Modem \$86
4Mb (1x32-80 ns) \$20	WD 1.6Gb IDE \$210	33.6 Int USR Fax/Modem \$150
8Mb (2x32-80 ns) \$40	WD 2.1Gb IDE \$230	33.6 Ext USR Fax/Modem PNP \$175
16Mb (4x32-80 ns) \$74	WD 2.5Gb IDE \$250	33.6 Int USR Fax/Modem w/voice \$185
32Mb (8x32-80ns) \$180	WD 3.1Gb IDE \$275	56K Int Supra Fax/Modem w/voice \$180
32Mb (4x64-10ns) \$170	WD 4.0 Gb IDE \$380	
CPU's	Video Cards	Sound Cards
Intel 486DX40D \$50	256K ISA VGA \$24	16-bit Sound Blaster Pro compatible \$20
AMD K5-90 \$50	Trident 8800 1Mb ISA SVGA \$32	16-bit Sound Blaster \$55
AMD K5-PR100 \$85	Cirrus Logic 5429 1Mb VLB SVGA \$38	Sound Blaster 32 PNP \$94
AMD K6-200 \$400	Trident 9680 1Mb PCI SVGA w/MPEG \$38	
Cyrix 686-P150+ \$95		
Cyrix 686-P185+ \$100		
Cyrix 686-P200+ \$140		
Intel Pentium 133 \$150		
Intel Pent 200mmx \$480		
Motherboards	Miscellaneous	Controller Cards
486xxx PCI 256K \$95	1.44Mb FDD \$28	ISA Multi I/O IDE, FDC, 2S/1P/1G \$13
Pentium Intel TriCore VX 512K L2, dimm \$105	1.2Mb FDD \$55	PCI Adaptec 2940 SCSI-2 fast \$200
Pentium Intel TriCore TX 512K L2, dimm \$155	8X CD-ROM IDE \$80	
Pentium Intel TriCore TX 512K L2, dimm \$155	16X CD-ROM IDE \$110	
Pentium Intel TriCore TX 512K L2, ATX \$150	HP T3000 3.2 gb tape backup \$20	
	3-button serial mouse \$9	
	101-keyboard \$18	

Prices and availability subject to change without notice.
CALL FOR DAILY LOW PRICES!

Make your own circuit boards at home!!

Don't project-board your electronics circuits, Afford-A-Board them!! Our complete line of circuit board manufacturing equipment lets you create professional single or double-sided circuit boards in your own home. We manufacture affordable, developing, etching and stripping tanks. Afford-A-Board is your source for 2-sided photo-sensitive copperclad board.

12x12 FR4 1 oz. DS \$15.99

Call for our low, low pricing on film, chemicals and drill bits.

Afford-A-Board
P.O. Box 32613
Kansas City, MO 64171
(800) 847-0157

Visa/AMEX/MC/Cash COD/MO

WINDOWS 95

—One Step at a Time

Don't know what to do when confronted with Microsoft's Windows 95 screen? Then you need a copy of *Windows 95—One Step at a Time*. Develop your expertise with the straight-forward presentation of the frequently-used features that make Windows 95 so valuable to the PC user.



To order Book BP399 send \$6.95 plus \$3.00 for shipping in the U.S. and Canada only to **Electronics Technology Today Inc.**, P.O. Box 240, Massapequa Park, NY 11762-0240. Payment in U.S. funds by U.S. bank check or International Money Order. Please allow 6-8 weeks for delivery.

SEC Sun Equipment Corporation

P. O. Box 97903, Raleigh, NC 276 24-7903

Test Equipment for Cost-Minded People

LODESTAR Lodestar Electronics Corp. Since 1979

One Year Warranty. 15 Day Money Back Guarantee. OEM welcome. School purchase order accepted. Bids accepted. VISA, DISCOVER SALES REP/DISTRIBUTORS/OEM WANTED. MASTER, & AMER. 1-800-870-1955/(919)870-1955 24-hr Fax:(919)870-5720

DC POWER SUPPLY

PS-30J \$159.00
0-30VDC, 0-3A; 0.02%+2mV line regulation; 0.02%+3mV load regulation; 1mVrms noise & ripple; Short circuit/overload protection; constant current/voltage(CC/CV).
PS-30JD \$314.95 dual output, tracking
PS-30S \$219.95, 0-30VDC, 0-5A.

PS-30SD \$399.95, dual, tracking.
#110 \$289.95 0-60VDC, 0-3A
#112 \$399.95 0-60VDC, 0-5A
#108(#109) \$549.95(\$699.95) 0-60VDC, 0-3A(5A), dual, independent tracking, Low ripple.
#102(#103) \$399.95(\$489.95) triple output, 0-30V/0-3A(5A) x 2, fixed 5VDC/3A, independent & tracking operation, constant voltage and current. Slave/Master, Serial/Parallel connection.
PS-1610S(#107) \$289.00(\$399.95) 0-16VDC(0-30VDC), 0-10A.
PS-2243(2245) \$139.00(\$159.00) 0-12-24VDC, 3A(5A).
#200(#201) \$179.95(\$239.95) 0-30VDC(digital meter), 0-3A(5A).
#210(#211) \$199.95(\$259.95) two digital meters.
#202(#203) \$499.95(\$549.95) 3 outputs, digital display, dual 0-30VDC/0-3A(5A), a fixed 5VDC/3A, independent tracking operation, constant voltage and current.

AM/FM SWEEMAR SCOPE

SM-6225B/C \$1999.95
Freq Range: (AM)490KHz, (FM) 10-11.4MHz, Accuracy: ± 0.1%
Marker: (AM)455KHz, ±5KHz, ±10KHz, (FM)10.7MHz, ±7.5KHz, ±150KHz.

STEREO SCOPE OS-7505B \$369.00 trigger, 0-10MHz

ALIGNMENT SCOPE OS-7001A \$369.00 0-200KHz

AM/FM STD SIGNAL GEN.

SG-4110A \$1799.00
Freq: 100KHz-110MHz
Display: 6-digit LED
Accuracy:
±(5x10-ES ±1 count)
Resolution: 100Hz (100-34.99MHz); 1KHz (35MHz-110MHz).
Output: -19dBu, -99dBu, 1dB steps. Impedance: 50Ω VSWR 1.2.

NTSC TV COLOR BAR PAT. GEN.

CPG-1366A \$159.95
VHF NTSC;
Freq.: 45.75, 175.25, 187.25 MHz,
RF Output: 10mV
Impedance: 75 Ohm.
Video Output: BNC, 1Vp-p

SWR/RF/mW POWER METER

310 \$89.95
Freq. Range: 1.8-150MHz.
RF Power: 0-4W/20W/200W
SWR Measure: 1.0 - ∞, 4W min.
Accuracy: 5%-10%, SO-239 plugs.
Insertion Loss: 0.3dB.

Input/Output Imp.: 50Ω.
320 \$89.95, 130-520MHz
330 \$119.95, 1.8-520MHz
SWR-3P \$26.95 1.7-150MHz.
RF Power: 0.5-10W, 0.5W-100W
SWR-2P \$22.95, 1.7-30MHz, RF Power: 0.5-10W.

mW RF Power Meter 340 \$219.00

1.8-500MHz, RF power: 20mW/200mW/2W; Imp.: 50Ω;
Accuracy: ±10% full scale; N-type connector; SWR < 1.15.

VHF/UHF ATTENUATORS

RT-8815 \$199.00, VHF, 500MHz, 81dB, 50Ω, 0.5W.
RT-8815U \$359.00, UHF, 950MHz, 81dB, 50Ω, 0.5W.
RT-8817 \$199.00, VHF, 500MHz, 81dB, 75Ω, 0.5W.
RT-8817U \$359.00, UHF, 950MHz, 81dB, 75Ω, 0.5W.
085E-2 \$499.00, UHF, 950MHz, 61dB, 50Ω, 0.5W.
087E-2 \$499.00, UHF, 950MHz, 61dB, 75Ω, 0.5W.

SALES - DC Power Supply

#102 \$999.95 \$359.95 triple outputs, 0-30V/0-3A x 2, fixed 5VDC/3A, independent & tracking operation, constant voltage (CV) & constant current (CC), Slave/Master, Serial/Parallel connection.
PS-30JD \$314.95 \$282.95 dual outputs/tracking, CC & CV. Limited quantity. Full one year warranty.

RF SIGNAL GENERATOR

SG-4160B \$124.95
100KHz-150MHz up to 450MHz on 3rd harmonics; 6 ranges; AM modulation. RF Output: 100mVrms to 3-5MHz. Modulation: Int. 1KHz AM, Ext. 50Hz-20KHz AM.
Audio Output: 1KHz, 1Vrms
for internal & external signals. Specification see SG-4160B above.

AUDIO GENERATOR

AG-2601A \$124.95
10Hz-1MHz, 5 ranges;
Output Level: sinewave 0-8Vrms, square 10Vp-p.
Output Impedance: 600 Ohm.
Distortion: <0.05% 500Hz-50KHz, <0.5% 50KHz-500KHz.

AG-2603AD \$229.95, with Freq. Counter 1Hz-150MHz, 6 digits, for internal & external signals. Specification see AG-2601A above.

FUNCTION GENERATOR

FG-2100A \$169.95
0.2Hz-2MHz in 7 ranges; Sine, Square, Triangle, Pulse & Ramp
Output: 5mVp-p-20Vp-p, 1% distortion
VCP: 0-10V control freq. to 1000.1.

FG-2102AD \$229.95 generates signals same as FG-2100, 4-digit counter display, TTL & CMOS outputs, 30ppm ±1 count accuracy
FG-2020B \$159.00 0.5Hz-500KHz; Sine, Square, Triangle.
(FG)2103 \$329.95, Digital sweep generator, 0.5Hz-5MHz in 7 ranges. Operating Mode: sweep, AM, gated burst, VCG.
Freq. Counter: Int. 0.5Hz-5MHz; Ext. 5Hz-10MHz.
FG-513 \$719.95, Digital sweep generator; Sine, Square, Triangle, Pulse, Ramp, TTL & DC; 2Hz-13MHz in 7 ranges, ±(0.1%+1dgt).
Freq. Counter & TCXO: 5Hz-100MHz, 6.5 digits, x1 & x20 atmt.

FM STEREO MODULATOR

AG-2011A \$549.00
RF SECTION:
Carrier: 98MHz ±2MHz.
Output: 10mV, 1mV & 0.1mV
COMPOSITE SIGNALS:
Pilot: 19KHz ±2Hz, 0.8Vrms
INT. MODULATION: 400KHz, 1KHz ±1%, 1Vrms, distortion < 3% L-R Separation: >50dB.
EXT. MODULATION: Freq.: 50Hz-15KHz, L-R Separation: >45dB 100Hz-3KHz, >35dB 50Hz-15KHz.

AC MILLIVOLT METER

MV-3100A \$159.95 wide band 5Hz-1MHz, 3 scales, mV, dB & dBm, 300μV-100V in 12 ranges, 10μV resolution; -70-40dB in 12 ranges, 0dB=1Vrms, 0dBm=0.755V; ±3% accuracy; input impedance 10MΩ.
Noise <2%. **MV-3201B \$309.95** dual channels, simultaneous measurement.

OSCILLOSCOPE

OS-7305B \$249.00 DC-7MHz
Vertical: 10mV/Div; Horizontal: 250mV/Div, 10Hz-100KHz in 4 ranges; 3" CRT, Internal and External Sync; Input: 1MΩ/35pF.
OS-7010A \$369.00 \$299.95 10MHz, 5" CRT, 10mV/Cm-10V/Cm, 1MΩ.
OS-622B \$344.95 20MHz/dual trace

OS-653 \$699.95 50MHz, dual, delay sweep, ALT trigger, TV syn.
OS-6100B \$1329.95 100MHz, 4ch, 8 traces, delay sweep, bent buy

DIGITAL MULTIMETER

DMM-120 \$24.95, 3 1/2 digit, 600VDC/AC, 2ADC, 2MΩ, hFE/diode test.
DMM-123+Capacitance \$44.95, 3 1/2 digit, 600VDC/AC, 10ADC/AC, 2GΩ, 20μF, hFE/diode test, continuity beeper.
DMM-125 \$54.95, Autorange/Bar Graph, 600VDC/AC, 2ADC/AC, 32MΩ, continuity beeper.
MIC-35 \$59.95, Autorange, 3 1/2 digit, LCD, 1000VDC/750VAC, 20MΩ, 20ADC/AC, diode/continuity check, data hold.
MIC-39 \$149.95, Autorange/Bar Graph, True RMS, 3 1/2 digit, LCD, 40MΩ, 40μF, 1000VDC/750VAC, 20ADC/AC, 600KHz Freq. Counter, Data Hold, Drop-prove, Sleeping Mode, Memory & Read Functions.

GRID DIP METER

DM-4061 \$89.95 1.5-250MHz, 6 bands; 6 plug-in coils, 2 transistor, and 1 diode.
Modulation: 2KHz Sinewave. Crystal Oscillator: 1-15MHz. Wave absorption meter. Using 9VDC power supply.

AUTO DISTORTION METER

DM-3104A \$799.95
MEASUREMENT:
Range: 0.01%-30%, 0.1/0.3/1/3/10/30% full scale.
Freq.: 400Hz±10%, 1000Hz±10%(HPF).
Input: 3mV-100V, ratio measuring 20dB.
Auto. Switching Ranges: Fundamental Freq. = (fo)±10%; Fund. Rejection: >80dB at (fo)±5%; >70dB at (fo)±10%; Harmonic Accuracy: ±0.5dB, 1.8(fo)-20KHz.
DM-3204 \$1,599.00 dual channels.

FREQUENCY COUNTER

FC-5250C \$119.95
Freq. Range: 10Hz-220MHz (HF)10Hz-20MHz, (VHF)10MHz-200MHz
Gate Time: 0.1 & 1sec.
Max. Input: 10Vp-p.
Input Sensitivity: 35mV 10Hz-200MHz. Display: 7-digit LEDs.
Input Imped.: (HF) 1MΩ, (VHF) 50Ω.

FC-5260A \$166.00 \$129.95 10Hz-600MHz, 7-digit LEDs.
FC-5270 \$149.95 10Hz-1.2GHz, 8-digit LEDs.
FC-5600B \$521.00 \$299.95 10Hz-600MHz, 10-digit LEDs.
(FC)5700 \$329.95 10Hz-1.3GHz, 10-digit LEDs.

SIGNAL TRACER/INJECTOR

SE-6100 \$134.95
TRACER: Gain Max 60dB
Attenuation: 0/20/40/60dB
Input Imped.: 100KΩ
Output Imped.: 600Ω;
Speaker: 8 Ohm
INJECTOR: Freq.: 1KHz
Squarewave, Output Level: Continuously variable 0-4.5Vp-p.

AUTO. CAPACITANCE METER

CM3300A \$139.00 10 ranges, 99.9pF - 99.9mF, fully automatic.
Resolution: 0.1pF lowest, 0.1% full scale.
Accuracy:
0.5% of full scale: 1 digit to 99.9μF,
1% of full scale: 1 digit to 99.9μF.
Display: 3 digit LED
Unit indicator: pF, nF, μF, mF. Overrange indicator.

WOW-FLUTTER METER

WF-3103A \$699.95
Freq. Range: 3KHz±10%
JIS/CCIR; 3.15KHz±10% DIN.
Range: 0.03/1/3/3% full scale.
Accuracy: ±5%
WF-3105A \$799.95, digital.
Function: LIN/WOW/Flutter/WTD.
Freq. Cntr: 10Hz-9.99MHz.
Indication: CCIR/DIN/JIS.

MICROPROCESSOR TRAINER

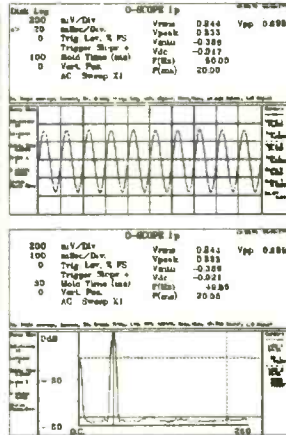
8088 Trainer \$699.00 BGC-8088, teach yourself 8088 assembly language programming. Assembly language coding, assembler, disassembler, single step and multi-breakpoint program debugger, display and rewrite registers, download/upload programs from/to external systems, I/O drivers, 56-key large size keyboard, LCD display, RS-232C UART, printer interface, two expansion slots, ±5V, ±12V switching power supply, 20 I/O applications available, e.g. servo & stepping motors, dot matrix display, D/A, A/D, sensors, etc. Learning Guide included.
8051/8052 Embedded Microcontroller \$279.00 BGC-8052, teach yourself Intel 8051/8052 Microcontroller controls. 8051/8052 is one of the most popular Microcontroller used in today's appliance controls and is compatible with the new powerful MCS 251. Step-by-Step Learning Guide included.
CIC-100 \$549.00 I/O control applications, learn Assembly, C, and BASIC programming languages, 800-pin solderless bread-board for circuit design and test, I/O drivers for controlling relay, step motor, LED, speaker, sensor, etc.. Application control modules available.

DIGITAL STORAGE OSCILLOSCOPES

WITH
SPECTRUM
ANALYZER,
DVM, FREQ.
COUNTER,
AND DATA
LOGGER.

from
\$189.

PORTABLE
MODULES
CONVERT PC'S
INTO
MULTIPURPOSE
TEST AND
MEASURING
INSTRUMENTS.



Why lug a scope around? Toss one of our modules into your laptop case or tool kit. For a multi-purpose test device, plug to a PC parallel port and use the PC screen. Continuous, delayed, or triggered sweeps can be frozen on the screen, printed out, or saved to disk. Frequency Spectrums DC to 25 MHz.

Allison now provides PICO TECHNOLOGY Ltd. portable test equipment, including high-speed scopes, and multi channel data loggers. Pico and O-Scope modules accept standard probes and work with 286 or faster PC's.

FEATURES:

- PORTABLE UNITS TO 25 MHz
- USES PRINTER PORT
- USES STD. PROBES

OPTIONS:

- PROBE SETS
- AUTOMOTIVE PROBES
- BATTERY PACKS
- SOFT & HARD CASES

O-Scopes Made in U.S.A. Picos Made in U.K.
Same Day Shipping
Includes Cable, Software & Manuals

O-Scope Ip (DC-50KHz, single trace)\$189.
O-Scope Ii (DC-500KHz, dual trace)\$349.
PICO (ADC 200/20) (DC-10MHz, dual trace)CALL
PICO (ADC 200/50) (DC-25MHz, dual trace)CALL
PICO pc based data loggers from \$99.

Shipping within U.S. UPS Ground \$7.50(Second day \$11.50)

SEND CREDIT CARD INFO., M.O., or CHECK,OR CALL

1-800-980-9806

Allison Technology Corporation

8343 CARVEL, HOUSTON, TX. 77036 U.S.A.
PHONE: 713-777-0401 FAX: 713-777-4746 BBS: 713-777-4753

<http://www.atcweb.com>

Don't rent! Own!

Cable TV

Descramblers

We'll Beat Any Price!

- Same Day Shipping!
- 30 Day Money Back Guarantee!
- Credit Cards/C.O.D.
- One Year Warranty!

Have make and model number of equipment used in your area

REPLACEMENTS FOR MOST SYSTEMS

CALL TOLL FREE

CD Electronics

1-800-684-9135

NO NEW JERSEY SALES!

Anyone implying theft of service will be denied assistance.

CONTROL RELAYS • LIGHTS • MOTORS MEASURE TEMPERATURE • PRESSURE • LIGHT LEVELS • HUMIDITY INPUT SWITCH POSITIONS • THERMOSTATS • LIQUID LEVELS

MODEL 30 \$79



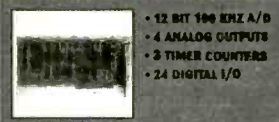
- PLUGS INTO PC BUS
- 24 LINES DIGITAL I/O
- 8 CHANNEL
- 8 BIT A/D IN
- 12 BIT COUNTER
- UP TO 14K SMP/SEC

MODEL 45 \$189



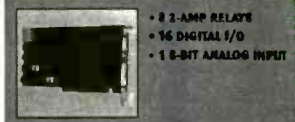
- RS-232 INTERFACE
- 8 DIGITAL I/O
- 8 ANALOG INPUTS
- 2 ANALOG OUTPUTS
- 2 COUNTERS-24 BIT

MODEL 100 \$279



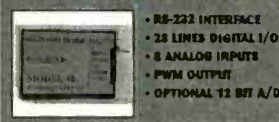
- 12 BIT 100 KHZ A/D
- 4 ANALOG OUTPUTS
- 3 TIMER COUNTERS
- 24 DIGITAL I/O

MODEL 60 \$179



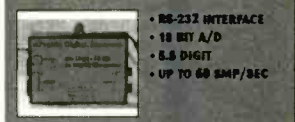
- 8 2-AMP RELAYS
- 16 DIGITAL I/O
- 1 8-BIT ANALOG INPUT

MODEL 40 \$99



- RS-232 INTERFACE
- 28 LINES DIGITAL I/O
- 8 ANALOG INPUTS
- PWM OUTPUT
- OPTIONAL 12 BIT A/D

MODEL 70 \$239



- RS-232 INTERFACE
- 18 BIT A/D
- 8.5 DIGIT
- UP TO 60 SMP/SEC

NEED A CUSTOM PCB? TRY US.

PRAIRIE DIGITAL, INC.

PHONE 608-643-8599 • FAX 608-643-6754

846 SEVENTEENTH STREET • PRAIRIE DU SAC, WISCONSIN 53753

CIRCLE 326 ON FREE INFORMATION CARD

PARTS EXPRESS

ELECTRONICS & MORE

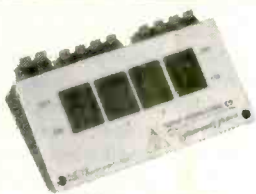
FREE 244 PAGE CATALOG



UNBELIEVABLE VALUE!

4 Way Speaker Switch

Control up to 4 pairs of speakers with this compact speaker selector switch. Features circuit protector, heavy duty rocker switches, spring loaded terminals, and silver plated switch connectors. Includes one pair of amplifier inputs. Load to amplifier is minimum 4 ohms (with 8 ohm speakers) or 220 ohms with all speakers switched off. Net weight: 1 lb.



#EN-309-030 WAS \$22⁵⁰ EACH NOW \$15⁰⁰ EACH

"The Sound Bridge" FM Stereo Wireless Transmitter

The Sound Bridge is a mini FM wireless transmitter that can be used to broadcast stereo sound from any audio source like portable CD players, TVs, electronic games, CD-ROM, even computer soundcards, to your home stereo receiver! Adjustable from 89 to 95.5 MHz.



HOT NEW ITEM!

#EN-249-220 \$14⁹⁵ EACH

Weller Professional Irons

Weller

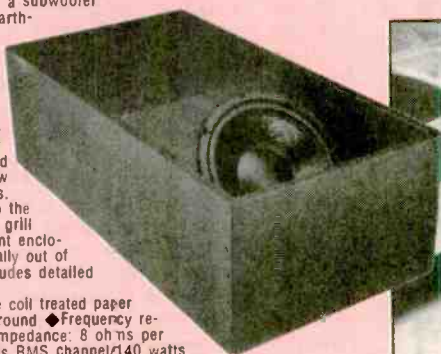


Perfect for a variety of electronic soldering work, this top quality Iron features a long life, double coated tip and a quick change, plug-in heater element. Lightweight handle includes a comfortable cushioned grip. Net weight: 1/2 lb.

#EN-372-110 (25 Watt) \$30⁹⁰ (1-3) \$28⁵⁰ (4-UP)
 #EN-372-112 (35 Watt) \$38⁹⁰ (1-3) \$34⁹⁵ (4-UP)

Home Theatre In-Floor Subwoofer

To fully appreciate the potential of movie soundtracks, a dual voice coil subwoofer is a must! Many film special effects are extremely demanding in the low frequency range and require a subwoofer that can duplicate explosions, earthquakes, even the footsteps of Tyrannosaurus Rex! This subwoofer fits the bill by featuring a 10" dual voice coil woofer for true stereo operation and high pass filters for your main speakers. The most unique feature of this subwoofer is the fact that it is designed to be mounted in between the floor joists in new and existing home constructions. Simply mount the in-floor sub to the joists and mount a heat register grill above opening in subwoofer front enclosure. The subwoofer is now totally out of view and ready to rumble! Includes detailed installation manual.



Specifications: 10" dual voice coil treated paper cone woofer with poly foam surround ♦ Frequency response: 30-100 Hz ♦ Nominal impedance: 8 ohms per coil ♦ Power handling: 100 watts RMS channel/140 watts max ♦ SPL: 89 dB 1W/1m ♦ Dimensions: 27" D x 14-5/8" W x 9" H ♦ Net weight: 29 lbs.

#EN-300-445 \$139⁹⁵ EACH

Peak Instrument Co.

"The Woofer Tester"

Peak Instrument Co. proudly introduces "The Woofer Tester". Just ask any loudspeaker engineer, and they will tell that the only way to design enclosures of the correct size and tuning is to measure the Thiele-Small parameters for the actual drivers to be used. The reason? Manufacturers published specs can be off by as much as 50%! But until now, measuring the parameters yourself required expensive test equipment and tedious calculations, or super expensive measurement systems (\$1,200 to \$20,000). The Woofer Tester changes all that. Finally, a cost effective, yet extremely accurate way to derive Thiele-Small parameters. In only minutes! The Woofer Tester is a combination hardware and software system that will run on any IBM compatible computer that has EGA or better graphics capability and an RS232 serial port. The Woofer Tester will generate the following parameters: Raw driver data: Fs, Qms, Qes, Qts, Vas, BL, Re, Le, SPL @ 1W/1m, Mmd, Cm, and Rm. Sealed box data: Fsb and system Q. Vented box data: Fsb, ha, alpha, and Q loss. The Woofer Tester system includes hardware, test leads, serial cable, AC wall adaptor, detailed instructions, and software.



QUICKLY AND ACCURATELY MEASURE
 Fs, Qms, Qes, Qts, Vas, BL, Re, Le, SPL @ 1W/1m, Mmd, Cm, and Rm IN MINUTES!

30 DAY MONEY BACK GUARANTEE
 1 YEAR WARRANTY ♦ SAME DAY SHIPPING

#EN-390-800 \$249⁰⁰ EACH

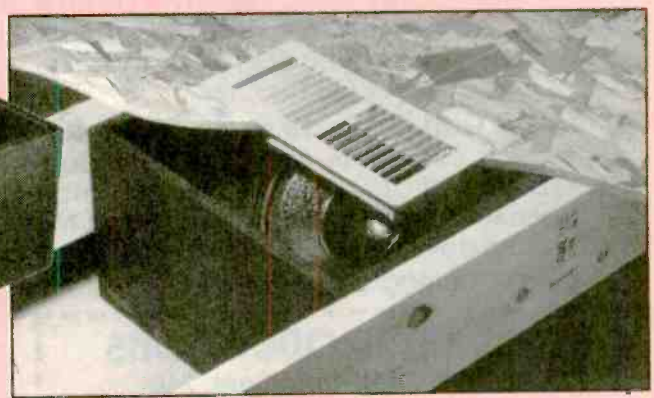
900 MHz Wireless Speaker System

- ♦ 900 MHz technology sends signal up to 180 ft., through walls, floors and ceilings.
- ♦ Ideal for use as rear surround speakers or for adding wireless sound to every room in the house!
- ♦ Full range, bass reflex design with built-in high power, low distortion amplifier.
- ♦ Weather resistant cabinet for outdoor use.
- ♦ Selectable battery (six C size for each speaker) or AC operation, adaptor included. Built-in recharging circuitry for ni-cad batteries.
- ♦ System includes: 900 MHz transmitter, wireless speaker pair, AC adaptors, and all cables necessary to hook up system.
- ♦ Limited availability. ♦ Net weight 9 lbs.
- ♦ Frequency response: 20-18KHz.



#EN-319-030 \$169⁹⁵ EACH

Dayton Loudspeaker Co.



♦ 30 day money back guarantee ♦ \$20.00 minimum order
 ♦ We accept Mastercard, Visa, Discover, and company C.O.D. orders ♦ 24 hour shipping ♦ Shipping charge = UPS chart rate + \$1.90 (\$5.00 minimum charge) ♦ Hours 8:00 am - 8:00 pm ET, Monday - Friday ♦ 9:00 am - 5:00 pm Saturday. Mail order customers, please call for shipping estimate on orders exceeding 5 lbs. ♦ Foreign destination customers please send \$5.00 U.S. funds for catalog. ♦ Quantity pricing available.

1-800-338-0531

340 E. First St., Dayton, OH 45402-1257
 Phone: 937-222-0173 ♦ Fax: 937-222-4644
 E-Mail: sales@parts-express.com

CIRCLE 262 ON FREE INFORMATION CARD

EARN MORE MONEY!

Be an FCC LICENSED ELECTRONIC TECHNICIAN!



Earn up to \$60 an hour and more!

Learn at home in spare time. No previous experience needed!

No costly school. No commuting to class. The Original Home-Study course prepares you for the "FCC Commercial Radio-telephone License." This valuable license is your professional "ticket" to thousands of exciting jobs in Communications, Radio-TV, Microwave, Maritime, Radar, Avionics and more...even start your own business! You don't need a college degree to qualify, but you do need an FCC License.

No Need to Quit Your Job or Go To School
This proven course is easy, fast and low cost! **GUARANTEED PASS**—You get your FCC License or money refunded. **Send for FREE facts now. MAIL COUPON TODAY!**

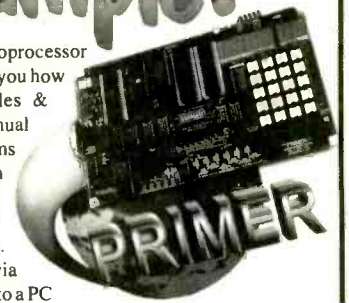
Or, Call 1-800-932-4268 Ext. 210

COMMAND PRODUCTIONS
FCC LICENSE TRAINING, Dept. 210
P.O. Box 2824, San Francisco, CA 94126
Please rush FREE details immediately!

NAME _____
ADDRESS _____
CITY _____ STATE _____ ZIP _____

Learn by Example!

The PRIMER 8085 Based Microprocessor Training and Control System shows you how to program by example. Examples & exercises in the Self Instruction manual take you from writing simple programs to controlling motors. Start out in Machine language, then move on to Assembler, & then continue on with optional C, Basic, or Forth Compilers. This trainer can be used stand alone via the keypad and display or connected to a PC with the optional upgrade (\$49.95). The Upgrade includes: an RS232 serial port & cable, 32K of battery backed RAM, & Assembler/Terminal software.



- Examples Include:**
- Measuring Temperature
 - Using a Photocell to Detect Light Levels
 - Making a Waveform Generator
 - Constructing a Capacitance Meter
 - Motor Speed Control Using Back EMF
 - Interfacing and Controlling Stepper Motors
 - Scanning Keypads and Writing to LCD/LED Displays
 - Bus Interfacing an 8255 PPI (new)
 - Using the Primer as an EPROM Programmer

The PRIMER is only \$119.95 in kit form. The PRIMER Assembled & Tested is \$169.95. Please add \$5.00 for shipping within the U.S. Picture shown with upgrade option and optional heavy-duty keypad (\$29.95) installed.

EMAC, inc.
11 EMAC WAY, CARBONDALE, IL 62901
618-529-4525 Fax 457-0110 BBS 529-5708
World Wide Web: <http://www.emacinc.com>

1985 - 1997
OVER
12
YEARS
OF SERVICE

THE HACKER'S COMPANION CD-ROM

Are you interested in using the internet in ways you never dreamed possible? Want a war-dialer program or something to crack a password? Do you want to learn how the phone company gets ripped off, or learn how to build a red box, or modify a cellular phone? Want to see what the security holes in Windows NT are? Or how to compromise a Unix machine or a BBS? Want to learn how to use the system in ways you never imagined possible? This CD is the place to look! It contains all kinds of computer, telephone and general hacking information. Even a video of dutch hackers breaking into a classified US military computer! In all, over 600 megabytes of fascinating information that's hard to get anywhere else!

PC-COMPATIBLE CD \$29.95 SHIPPING \$3

Cryptography Unlimited CD-ROM

Cryptographic software will soon be outlawed by the US government. Get this important bundle of over 200 megabytes of cryptographic software while you still can! Nobody in the US will even dare to publish a CD like this anymore and we had to import it from Africa! Includes file encryptors, disk encryptors, PGP, steganography, code cracking, RGP phone and lots more!

PC CD-ROM, \$39.95 SHIPPING \$3

Call (800) 719-4957 now!
to order (Visa/MC/COD) or call or write for FREE CATALOG of hard-to-get information about computer viruses, computer hacking, security and cryptography!!

American Eagle Publications, Inc.
P. O. Box 1507, Dept. E.
Show Low, AZ 85901

CIRCLE 320 ON FREE INFORMATION CARD

"Get the skills you need at a price you can afford!"

Earn up to \$45 an hour or more as a skilled Computer Programmer.

Cash in on the explosion of opportunities. Start your new career or even open a business of your own as a highly-paid computer programmer.

Computer programmers today can almost write their own ticket to financial well-being and job satisfaction. Only Foley-Belsaw's unique in-home training programs can give you the skills you need at a price you can afford.

You'll learn the three hot computer languages — QBasic, C and Visual Basic. You'll even work with the hot new C++. With this easy-to-learn knowledge, you'll write your first QBasic program by the end of the first SkillPak of lessons. Soon you'll be programming sound and graphics, and even learning how to program for the Windows environment — the most popular application program today.

It's easy to cash in!

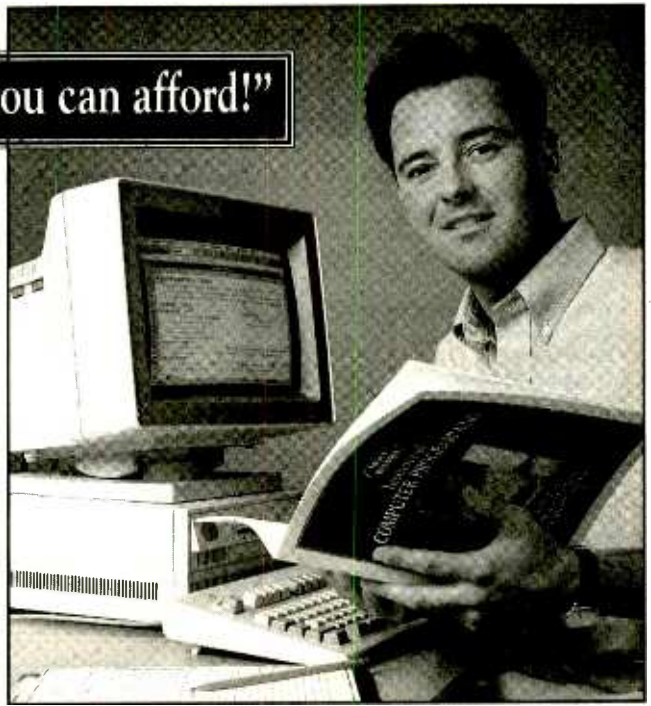
Look at some of the things professional computer programmers do. "Wrote a C program to clean up a WordPerfect file; edited the resulting file as data errors were found." This work would take a trained programmer less than five hours to complete, and they could make over \$200 for the work. That's money you could be making — and soon — with training from the Foley-Belsaw Institute of Computer Programming.

Everything is included!

We provide you with all the materials you'll need to become a professional computer programmer. You'll receive 37 lessons, designed for you by the Foley-Belsaw Professional Programmer Staff. Other valuable materials include a *Programmer's Handbook*, Programmer's Examples on two 3.5 inch disks, Programmer's Flowchart Template, and a booklet, *Selecting the Right Computer*.

Other schools force you to buy a complete computer package as part of their training program. At Foley-Belsaw we understand that your needs as a programmer may not fit into a "one size fits all" approach. Why should you pay hundreds of dollars for a computer system that you may not need?

We'll tell you what you need to know so that when you're ready to buy your own computer, you can get the machine that fits your needs at the lowest possible price. That's the Foley-Belsaw way.



Get the free facts today.

Whether you want to change careers, have a profitable part-time job or start your own business, Foley-Belsaw Institute's new computer programming course is the first step. A profitable future in computer programming can be yours. Call or write today for a fact-filled information kit including a free copy of *Computer Programming — A Profitable Career In Your Spare Time*. See how easy it is to begin a money-making career as a sought-after computer programmer. Our free full-color information kit outlines the steps of the computer programming course and shows you everything you will receive as part of your training.

**Mail this coupon or call today
Toll Free 1-800-487-2100!**

Your free opportunity kit will be rushed to you!

If coupon is missing, write to: Foley-Belsaw Company, 6301 Equitable Road, Kansas City, MO 64120

Call or complete & return this coupon to: Foley-Belsaw Institute, 6301 Equitable Road, Kansas City, MO 64120

YES! Rush me a free information kit on Computer Programming right away. Dept. 35417

Other career courses:

- Locksmithing, Dept. 13002
- Small Engine Repair, Dept. 52878
- Saw & Tool Sharpening, Dept. 21814
- VCR Repair, Dept. 62698
- Computer Repair, Dept. 64600
- TV/Satellite Dish Repair, Dept. 31470
- Gunsmithing, Dept. 92500
- Woodworking, Dept. 43746
- Upholstery, Dept. 81416
- Vinyl Repair, Dept. 71347
- Electrician, 95270
- Computer Specialist, 38251
- Networking Specialist, 39238

I understand that there is ABSOLUTELY NO OBLIGATION and NO SALESMAN WILL CALL.

Name _____

Address _____

City _____ State _____ Zip _____



PC PLACE

October 1997, Electronics Now

Turn Your Multimedia PC into a Powerful Real-Time Audio Spectrum Analyzer

Features

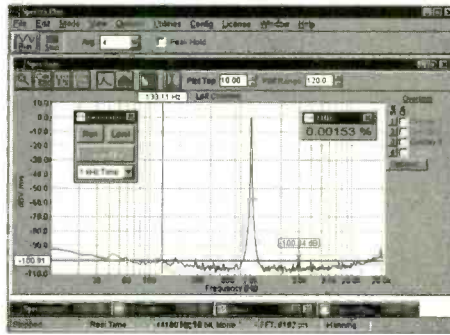
- 20 kHz real-time bandwidth
- Fast 32 bit executable
- Dual channel analysis
- High Resolution FFT
- Octave Analysis
- THD, THD+N, SNR measurements
- Signal Generation
- Digital Filtering
- Triggering, Decimation
- Transfer Functions, Coherence
- Dynamic Data Exchange (DDE)
- Time Series, Spectrum Phase, Spectrogram and 3-D Surface plots
- Real-Time Recording and Post-Processing modes

Applications

- Distortion Analysis
- Frequency Response Testing
- Vibration Measurements
- Acoustic Research

System Requirements

- 486 CPU or greater
- 8 MB RAM minimum
- Win. 95, NT, or Win. 3.1 + Win.32s
- Mouse and Math coprocessor
- 16 bit sound card



Priced from \$299

(U.S. sales only - not for export/resale)

Professional Quality Sound Cards Available...Call

DOWNLOAD FREE 30 DAY TRIAL!

www.telebyte.com/pioneer

PHS

Pioneer Hill Software
24460 Mason Rd. N.W.
Poulsbo, WA 98370

Spectra Plus 4.0

Affordable Signal Processing Software

Sales: (360) 697-3472

Fax: (360) 697-7717

e-mail: pioneer@telebyte.com

PROGRAMMERS OVER 50 MODELS

ADVANTECH EETOOLS NEEDHAMS DATA I/O ICE TECHNOLOGY HLO SYSTEM GENERAL CHROMA MODULAR CIRCUIT TECHNOLOGY XELTEK



PROMAX EMP-20 MEGAMAX MEGAMAX4 SIMM/SIP TESTER EMUPA

- | | |
|--------------------------|------------------------|
| CALL ADVANTECH LABTOOL | 599 EETOOLS SIMMAX |
| 629 ICE TECH MICROVLY | 795 CHROMA SIMM/SIP |
| 650 EETOOLS ALLMAX + | 359 MOD-MCT-EMUPA/R |
| 409 EETOOLS MEGAMAX | 279 MOD-MCT-EMUP/R |
| 509 EETOOLS MEGAMAX4 | 49 EPROM 1G TO 512K |
| 369 XELTEK SUPERPRO II | 69 EPROM 1G TO 1MEG |
| 409 XELTEK SUPERPRO II P | 99 EPROM 4G TO 1MEG |
| 249 XELTEK SUPERPRO II P | 199 EPROM 16G TO 1 MEG |
| 165 XELTEK ROMMASTER II | 89 EPROM 1G TO 8MEG |
| 479 MOD-MCT-EMUPA | 129 EPROM 4G TO 8MEG |
| 739 STAG ORBIT-32 | 250 EPROM 8G TO 8MEG |



LABTOOL48 MICROMASTER SUPERPRO ALLMAX PLUS ROMMASTER2

General Device Instruments

Sales 408-241-7376 Fax 241-6375 BBS 983-1234

Web www.generaldevice.com E-Mail ledevice@best.com

To learn how to talk with your kids about tough issues, like sex, AIDS/HIV and violence, call **1-800-CHILD-44** and get your free guidebook.



DATA ACQUISITION

Affordable Hardware and Software for PC's

ANA100 Analog I/O \$ 99



- 8 Channel 8-Bit
- 0 to 5 Volt Input
- 14 TTL I/O lines
- Analog Output
- 400KHz Sampling

DIG100 Digital I/O \$ 39



- 8255 PPI
- 24 or 48 TTL I/O Lines option
- Selectable Base Address

ANA150 Analog/Counter... \$ 89



- 8 Channel 8-Bit
- 0 to 5 Volt input
- 3 16-Bit Counters
- 400KHz Sampling

DIG200 Counter I/O \$ 79



- 3 16-Bit Counters
- 8 TTL Input lines
- 8 TTL Output lines
- Selectable Clock Frequency input

ANA200 Analog I/O \$ 79



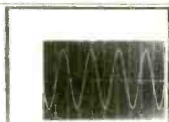
- 1 Channel 12-Bit
- 0 to 5 Volt input optional bi-polar
- 100KHz / 300KHz Sampling rate
- 24 TTL I/O lines

ANA201 Analog \$ 129



- 8 Channel 12-Bit
- x1, x5, x10, x50 Programmable Channel gain
- 100KHz/300KHz Sampling rate

<NEW!> PC-SCOPEII - PC Oscilloscope Software
Use with our ANA100, ANA150, ANA151, ANA200, or ANA201 boards, for 1, 2, 4, or 8 channel capture and display of data on your PC. Oscilloscope, Storage, and X-Y modes of data display \$49.00



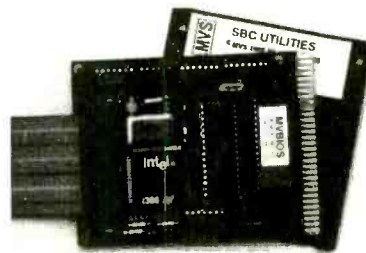
MasterCard/Visa orders accepted

More hardware and software items available, Call for information or See our catalog on the internet: <http://www.bssoft.com>
E-mail: sales@bssoft.com

BSOFT Software, Inc.

Phone 614-491-0832 * Fax 614-497-9971
444 Colton Road * Columbus, OH * 43207

386 SBC \$83



- OEM (1K) PRICE INCLUDES:
- 5 SER (8250 USART)
- 3 PAR (32 BITS MAX)
- 32K RAM, EXP 64M
- STANDARD PC BUS
- LCD, KBD PORT
- BATT. BACK. RTC
- IRQ0-15 (8259 X2)
- 8237 DMA 8253 TMR
- BUILT-IN LED DISP
- UP TO 8 MEG ROM
- CMOS NVRAM
USE TURBO C, BASIC, MASM RUNS DOS AND WINDOWS EVAL KIT \$295

\$95 SINGLE PIECE PRICE
UNIVERSAL PROGRAMMER

- DOES 8 MEG EPROMS
- CMOS, EE, FLASH, NVRAM
- EASIER TO USE THAN MOST
- POWERFUL SCRIPT ABILITY
- MICROCONT. ADAPTERS
- PLCC, MINI-DIP ADAPTERS
- SUPER FAST ALGORITHMS

- OTHER PRODUCTS:
8088 SINGLE BOARD COMPUTER OEM \$27 ... *95
PC FLASH/ROM DISKS (128K-16M) 21 75
16 BIT 16 CHAN ADC-DAC CARD 55 195
WATCHDOG (REBOOTS PC ON HANGUP) 27 95

*EVAL KITS INCLUDE MANUAL BRACKET AND SOFTWARE.
5 YR LIMITED WARRANTY
FREE SHIPPING
HRS: MON-FRI 10AM-8PM EST



MVS BOX 850
MERRIMACK, NH
(508) 792 9507

Electronic CAD for Windows

Professional Windows EDA tools at an affordable price with powerful features to make designing faster. WinBoard PCB layout delivers sophisticated interactive routing for complex designs, plus it has the tools needed for high-speed circuits, analog, RF and SMT designs.

WinDraft® Schematics

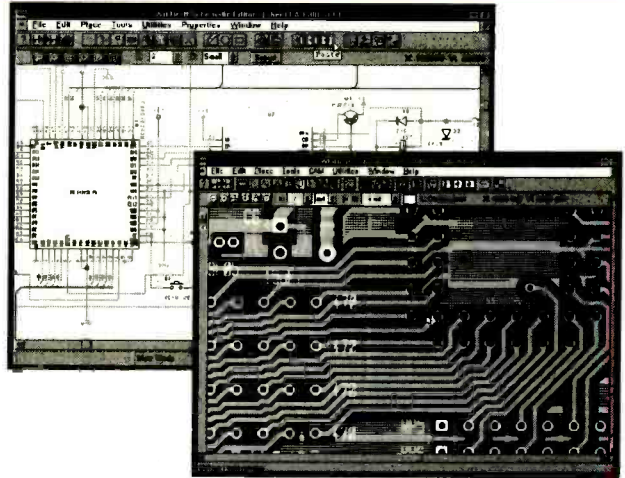
- ◆ Use True-Type fonts. Quickly copy and paste into other applications.
- ◆ Supports hierarchical designs, electrical rules checking, Annotation & Bill of Materials.
- ◆ Thousands of library parts and symbol editor included.

WinBoard™ PCB layout

- ◆ Supports 16 layers, multiple copper pours, and advanced features for RF designs.
- ◆ SMD & through hole library with on-line graphical editor.
- ◆ CAM outputs include BOM, in-circuit test, NC Drill, Gerber, Pick & Place, & Advanced Design Rule Checking (DRC).

With our unique *pin capacity* versions you only pay for what you need. You choose the base configuration to suit your needs today, and expand that configuration to handle increased pin capacity as your design requirements change.

WinDraft 2.0 Available Now



- \$ 250 WinDraft or WinBoard - P650
- \$ 495 WinDraft or WinBoard - unlimited
- \$ 895 WinBoard P650 with CCT Spectra® autorouter.

Thousands of satisfied customers are using this new generation of powerful and affordable Windows EDA tools from Ivex. Your satisfaction is guaranteed!

World Wide Web: <http://www.ivex.com>

Information and free evaluation version is available on the Ivex WW Web, FTP and BBS.

Tel: (503) 531-3555
 Fax: (503) 629-4907
 BBS: (503) 645-0576



Ivex Design International, 15232 NW Greenbrier Parkway, Beaverton, Oregon 97006. USA.

ADV2_1

CIRCLE 321 ON FREE INFORMATION CARD

PC
PLACE

Don't Put Your
Baby's Health
On The Line.

Get Prenatal Care Early
Call 1-800-311-2229
Confidential

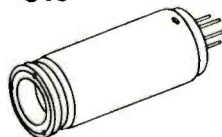
Take Care of Yourself
So You Can Take Care of Your Baby.



MEREDITH
INSTRUMENTS



NEW-VISIBLE
LASER DIODES
\$10



NEW-820NM LASER DIODES
WITH COLLIMATOR \$20 \$35



GREEN OUTPUT HE-NE TUBES \$99

RUBY LASER ASSEMBLY \$295

<http://www.mi-lasers.com>

Call Or Write For A FREE CATALOG
On LASERS & OPTICS

PHONE: (602) 934-9387
FAX: (602) 934-9482

5035 N. 55TH AVE., #5, P.O. BOX 1724,
GLENDALE, AZ 85301

FREE
SHIPPING
ON ORDERS
OVER
\$100.00

October 1997, Electronics Now

93

NEW Embedded Control Products from SYLVA

BASIC PRODUCT LINE LISTED BELOW:

SC552ES - SBC 128K RAM & FLASH, RTC, Analog & Digital I/O, 3 serial ports
 SC552EX - SBC for home automation, X10, RTC, Analog & Digital I/O, 1 serial port
 SC552ES-P - Packaged controller for HVAC applications, 3 serial ports & opt. modem
 SC552S - Controller engine with LCD display & keypad interfaces 1 serial port
 SC552S16 - The 552S plus 8 AC/DC inputs 8 relay outputs 1 HS input 1 serial port
 AE-ADC - 12 bit 8 Ch. analog input exp. board (0 - 2.5/5/10V & 4-20mA) plus RS485
 AE-DAC - 8 bit 4 channel analog output exp. board (4-20mA, 0-20mA and 0-10V)
 IO-160 - 16 channel relay output expansion board (form A relays 5A resistive)
 IO-161 - 16 channel opto-isolated input expansion board (12-24 VAC/VDC)
 IO-8081 - 8 opto-isolated AC/DC inputs and 8 output relay expansion board
 IO-RACK - 24 bit I/O exp. for connection to industry standard I/O module boards
 OI-LCD - RS485 connected LCD driver board (2 IA form A relays & 3 PB inputs)
 OI-TERM - RS485/RS232 connected LCD display and 4x4 matrix keypad controller
Plus! Windows hosted user configurable software. Programs for scheduling, monitoring and control of local or remote embedded applications.

Visit our web site for complete information or call us to request product data sheets and prices.



519 Richard St., Thunder Bay, ON, Canada P7A 1R2
 Phone: 807-768-2487 • Fax: 807-767-0587

www.sylvacontrol.baynet.net

E-mail: sylva@baynet.net

A division of Sylva Energy Systems Inc.

FRIENDLY LITTLE MICRO CONTROLLER

\$149 (single)



...packs a **MEAN** punch
 a.k.a. "Steroid Stamp"

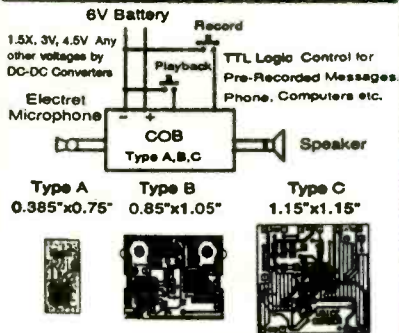
- 39 I/O + 8 A/D (10 bit) •
- 128K SRAM + 128K Flash •
- LCD/Keypad Interface •
- Fast 16 bit Motorola CPU •
- Affordable C Compiler •
- Comprehensive s/w Library •

*Intec Automation Inc. v: 250-721-5150
 www.islandnet.com/~iii fx: 250-721-4191

ANY NEW APPLICATIONS?

COB & SMD on gold plated PCB

20-Second Voice Record & Playback Unit



DC-DC Converters & COB Design Specialist
KSL Microdevices, Inc.
 2149-G O'Toole Ave., San Jose, CA 95131
 (408)922-0800 FAX (408)922-0629

SAVE \$100s Dealers Welcome

30 Day Money Back Guarantee

Call Us Last!

We will beat any advertised price

CD Electronics No 3C Sales

1-800-842-9670

http://www.cdelectronics.com/cd

THE SMART CHOICE

FOR OVER 47 YEARS, THE SERVICEMAN'S CHOICE FOR IN-VOICES AND SALES BOOKS HAS BEEN



OELRICH PUBLICATIONS.

- ⇒ QUALITY YOU CAN COUNT ON
- ⇒ PRICED AS LOW AS 4 CENTS EA.
- ⇒ COMPUTER FORMS AND CHECKS CALL TODAY FOR A FREE CATALOG 1-800-621-0105

Imagine Little Red Riding Hood without a forest.



PLEASE be very careful with matches. Because without the forests, life is unimaginable.

Only You Can Prevent Forest Fires.



USDA Forest Service and your State Forester.

CABLE TV CONVERTERS AND DESCRAMBLERS

WE CARRY A FULL LINE OF CONVERTERS AND DESCRAMBLERS COMPATIBLE WITH MOST MAJOR BRANDS INCLUDING:

- Scientific Atlanta™
- Jerrold™
- Tocom™
- Zenith™
- Pioneer™

30 DAY MONEY BACK GUARANTEE
 BEST PRICES FREE CATALOG

ALLSTAR ELECTRONICS
800-782-7214

HOURS: 9-6 M-F 10-3 Sat EST

It is not the intent of Allstar Electronics to defraud any pay TV operator. Anyone implying theft of service will be denied assistance. All brand names are registered trademarks of their respective owners & are used for reference only. 110-84 Queens Blvd., #485, Forest Hills, NY 11375. NO NYS SALES.

New Surveillance Devices

Smoke Alarm Ultra miniature video cameras hidden in smoke alarm or alarm clock - your choice. Wide field of view and super .1 lux low light sensitivity! Undetectable!
 Video Cameras SC-600 TC-70 High quality B/W with 420 lines of resolution for ultra sharp images.
 Direct output of video and audio. \$149.95 ea.
Best price on surveillance cameras anywhere!

Telephone Transmitter KB hidden in dual modular adaptor Transmits both sides of conversation to any FM radio up to 1/4 mile. "SnapKit" technology. Uses phone line for power and antenna. Goes completely unnoticed. MA-100 \$25.95

High quality cassette deck plugs directly into telephone jack! Records up to 12 hours of conversations on a single cassette. Recording starts and stops automatically when phone is used!
 THP-12 12 Hour Telephone Recorder \$99.95 Free shipping! Check/MO. Question lines: 972-255-7490
 Seymour-Radix Inc. Box 166055-N Irving, TX 75016
 Now you can visit us on the internet at: http://www.wxyz.net/home/sr/

BROADCAST FARTHER !!!

The model 220 is a 80-110MHz RF amplifier that connects to mono or stereo FM transmitters and produces a powerful 2-15 watt signal which could broadcast up to 5 miles or more! Requires 50-150 mW drive.
 Step by step plans complete with part source. **\$14 PLUS \$2 S&H** information and antenna designs... ONLY NO C.O.D.
Progressive Concepts
 BOX 586 STREAMWOOD, IL 60107
 (630)736-9822 FAX: (630)736-0353

Learn MICROCONTROLLERS EMBEDDED SYSTEMS and PROGRAMMING...

...with the AES learning system/
embedded control system.
Extensive manuals guide you
through your development
project. All programming and
hardware details explained.
Complete schematics. Learn to
program the LCD, keypad digital,
analog, and serial I/O. for your applications.



**THREE MODELS AVAILABLE. Choose from an
Intel 8051, Intel 8088, or Motorola 68HC11
based system. All models come with:**

- 32K Byte ROM, 32K Byte RAM • 2 by 16 Liquid Crystal Display • 4 by 5 Keypad • Digital, Analog, and Serial I/O • Interrupts, timers, chip-selects • 26 pin expansion connector • Built-in Logic Probe • Power Supply (can also be battery operated) • Powerful ROM MONITOR to help you program • Connects to your PC for programming or data logging (cable included) • Assembly, BASIC, and C programming (varies with model) • Program disks with Cross Assembler and many, well documented, program examples • User's Manuals: cover all details (over 500 pages) • Completely assembled and ready to use • Source code for all drivers and MONITOR • Optional Text Book

Everything you need. From \$279.
Money Back Guarantee

Call for Free Info Pack, or see
WEB at <http://www.aesmicro.com>
714-550-8094, FAX 714-550-9941



Call 1-800-730-3232

AES 970 W. 17TH STREET, SANTA ANA, CA 92706, USA

Help protect our nation's soil and water.
Call for your free action packet.

1-800-THE-SOIL
WE OWE IT TO OUR CHILDREN

United States Department of Agriculture
Soil Conservation Service

HOME AUTOMATION

World's Largest Selection!

**Widest Selection of
X-10 Devices Available**

Hundreds of hard-to-find automation, X-10 and wireless control products. Computer interfaces, software, development tools, lighting control, telephone systems, security systems, surveillance cameras, infra-red audio/video control, HVAC, pet care automation, wiring supplies, books and videos and much more!

**Packed with Pictures
& Diagrams**



HOME AUTOMATION SYSTEMS, INC.

Questions: 714-708-0610 Fax: 714-708-0614
e-mail: catalog@smarhome.com
<http://www.smarhome.com/smarhome>

**Lowest Prices
Guaranteed!**

24 Hours Call 800-SMART-HOME 800-762-7846

Precious Life

This nurse was once a patient at St. Jude Children's Research Hospital. She fought a tough battle with childhood cancer. And won.

Until every child can be saved, our scientists and doctors must continue their research in a race against time. To find out more, write St. Jude Hospital, P.O. Box 3704, Memphis, TN 38103, or call 1-800-877-5833.



**ST. JUDE CHILDREN'S
RESEARCH HOSPITAL**
Danny Thomas, Founder

ROBOTIC MACHINING

ROUTE, MILL, DRILL, CARVE, ENGRAVE, PAINT
IN WOOD, PLASTIC, VINYL, PC BOARD, & LIGHT METALS!

- 4 MOTOR GANTRY MILL CONFIGURATIONS
- PC COMPUTER CONTROLLED CNC/DNC
- IMPORT/ EXPORT FILES TO OTHER CADS
- AUTO-BACKLASH COMPENSATION
- PRE-MACHINED HEAVY CASTINGS
- SIMULTANEOUS 3 AXIS MOTION
- FREE 3D CAD/CAM SOFTWARE
- AVAILABLE IN KITS OR ASSEMBLED
- EXPEDITE SERVICE ALSO AVAILABLE
- OPTIONAL ALUMINUM WAY COVERS
- .001" RESOLUTION / AMERICAN MADE



STARTING AT
\$695.00

**3 AXIS UNITS
FROM 12" X 12" TO
66" X 66" MACH. AREA**

<http://www.uscyberlab.com>

U.S. CYBERLAB, INC. 14786 SLATE GAP RD., WEST FORK, AR 72774

CALL NOW FOR INSTANT SPECS 501-839-8293 24 HR. FAX-BACK

RF Data Modules

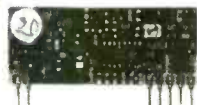
Transmitters



TXM-4XX-A..... \$24.50
TXM-4XX-F..... \$25.80

- ERP 0.25mW into 50Ω
- 3V(F), 5V(F) or 6-12V(A)
- 418 or 433.9Mhz FM
- simply add antenna, data, power
- Range up to 200m
- Analog or digital data i/p
- SAW controlled - stability

Receivers



SILRX-4XX-A..... \$39.38
SILRX-4XX-F..... \$41.92

- Only 21 x 47 x 5mm
- 13mA; 130uA on power save (100:1)
- Carrier detect o/p
- 418 or 433.9MHz FM Superhet
- SAW controlled - stability
- Analog or digital o/p
- Wide supply range 4.5-9V (A/F ver.)
- Fast enable time <3ms

Transceivers



BIM-4XX-F..... \$87.36

- Only 23 x 33 x 11mm
- Up to 40,000bps of balanced code
- Up to 170m range.
- 5v operation
- 418 or 433MHz FM
- Direct interface to 5V CMOS logic
- Fast 1ms enable from power saving

RS232 Transceiver



CYPHERNET-RS232..... \$139.30

- 3 wire RS232 interface
- Up to 38400 bps
- 418 or 433MHz FM. 7.5-15Vdc
- TX/RX LED indication
- Up to 150m range



ABACOM
TECHNOLOGIES

Volume Discounts
Free Catalog Available
MasterCard / Visa

Tel: 416-242-3120
Fax: 416-242-2697
FaxBack: 416-242-3082

67 Hamptonbrook Dr • Weston • ON • M9P 1A2 • Canada

WE SELL RED, BLUE-GREEN & IR

LASERS

HUNDREDS OF UNITS TO CHOOSE FROM!
PRICES AS LOW AS \$40.00!

- ☀ Experiments
- ☀ Laser Light Shows
- ☀ Cutting & Burning
- ☀ Communications

We also carry
books and plans
about LASERS.

CALL FOR FREE CATALOG!
TEL (909) 278-0563
FAX (909) 278-4887

MWIK INDUSTRIES

1269 W. Pomona, Corona, California 91720
See our catalog on the internet.

HTTP://WWW.MWIKINDUSTRIES.COM
EMAIL: MKENNY1989@AOL.COM

❖ ATTENTION CABLE VIEWERS ❖

CABLE VIEWERS. . .get back to your BASIC Cable Needs

Call 800-577-8775

For information regarding all of your **BASIC** cable needs.

5 GOOD REASONS TO BUY OUR FAR SUPERIOR PRODUCT

- ❖ PRICE
- ❖ EFFICIENT SALES AND SERVICE
- ❖ WE SPECIALIZE IN 5, 10 LOT PRICING
- ❖ ALL FUNCTIONS (COMPATIBLE WITH ALL MAJOR BRANDS)
- ❖ **ANY SIZE** ORDER FILLED WITH SAME DAY SHIPPING

We handle **NEW** equipment **ONLY** - Don't trust last year's **OBSOLETE** and **UNSOLD** stock!
COMPETITIVE PRICING—DEALERS WELCOME

HOURS: Monday-Saturday 9-5 C.S.T.

It is not the intent of B.E.S.W. to defraud any pay television operator and we will not assist any company or individual in doing the same. Refer to sales personnel for specifications.

**BASIC
ELECTRICAL
SUPPLY &
WAREHOUSING
CORPORATION**

P.O. Box 8180 ■ Bartlett, IL 60103 ■ 800-577-8775

More goodies
than ever!!

Call for a faxed
special!

Roger's Systems Specialist

800-366-0579

"We Have Great Connections"

Cables ★ Connectors ★ Accessories

Computer • Telecommunications • Network • Audio • Video

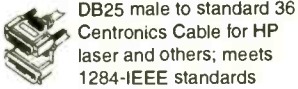
Visit our
Internet Catalog
Online!!

www.rogerssystems.com

Information at
your fingertips!

BI-TRONICS PRINTER CABLES

10' Bi-Directional Printer Cable



DB25 male to standard 36
Centronics Cable for HP
laser and others; meets
1284-IEEE standards

#CC-PRI-1284 \$10⁰⁰ each

6' Cable

#CC-PR6-1284 \$8⁰⁰ each

15' Cable

#CC-P15-1284 \$15⁰⁰ each

Standard Parallel Printer Cables

3' Cable

#CC-PR3 \$2⁵⁰ each

6' Cable

#CC-PR6 \$3⁰⁰ each



Manual Data Switches

All Steel Case with gold-plated rotary
switch and gold-plated connections

2WAY DB25 Female

#DS-252 \$6⁵⁰ each

And many others!

Check out our Web Site!!

14" SCSI III Cables

34 Twisted Pairs with drain wire
Half Pitch Db 68 Male-to-Male



#CC-693-18

\$5⁰⁰ each

Labtec Microphone

Stick-on monitor or clip on shirt



6 ft. cord; condenser mic

#TM-MIC-2

\$2⁰⁰ each

12v DC Fan

#TM-FAN

\$3⁰⁰ each

20/\$2.50



3 1/8" ball Bearing type; Standard
replacement fan for PC/AT mini-
full towers

12" Gooseneck Microphone

Electret Condenser, 3.5mm Stereo plug
100-16,000 Hz Freq. Response

#TM-MIC-3

\$4⁰⁰ each

3/\$10.00



Mic & Headphone Combo

was included w/ IBM Voice Dictation 3.0
for Windows95
originally made to sell for \$60⁰⁰

#TM-165-

MONO

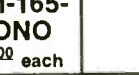
\$10⁰⁰ each

I.B.M. & Andrea



Miniature Mouse

2-Button, black
Great for small hands
or laptop!



#TM-290-MINI

\$4⁰⁰ each

Printer Adaptors

DB25 male to 36 pin
female Centronics



#CA-180 \$1⁰⁰ each

20/\$.89

SVGA Shielded Extensions

6 ft. HD 15 male to female



#CC-VGA-4

\$1⁵⁰ each

4/\$5.00

4" Stereo Mini Phono Plug to 2 RCA Jacks

3.5 mm stereo mino phono plug
to 2 RCA phono jacks

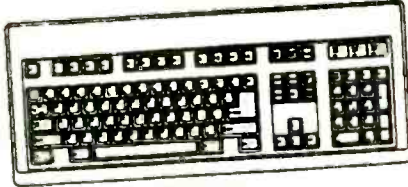


#AD-561

\$.50 each

Extended Keyboard

104 keys with 5 pin DIN Plug
3 LED mode indicator
extra Windows 95 keys



#TM-KB-1

\$16⁰⁰ each

Diskette Filing Case

Holds 100 diskettes • Double row filing with lock



#TM-DSC-3

\$4⁰⁰ each

CD Jewel Case

Replacement for original case



#TM-CD1

\$.40 each

10/\$.33 100/\$.25

SCSI II Terminator

Forced Perfect
Terminator for SCSI II



#CA-021-FP

\$7⁰⁰ each

4/\$20.00

Uni-Directional Dynamic Vocal Mic

Well suited for professional quality recording & PA
Durable 8 ft cord w/ 3.5 mm plug
Dynamic freq. response: 80-13,000 Hz



#TM-MIC \$3⁰⁰ each

Call for quantity discounts!

\$2⁰⁰ each

100/\$1.60 each

Ball Bearing Heat Sink with Fan

For Pentium

Bi-Pin Connector

#TM-FAN-CPU

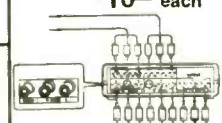


Audio/Video Switching Box

4 sets Audio/Video input, 1 set
outputs; all RCA jack connectors,
Hi-Isolation

#VA-4000

\$10⁰⁰ each



IBM Compatible SVGA Card

Vesa Local Bus card with
1 MB RAM

Fast screen refresh and
compatible with most hardware
and software

- 32-bit operation
- Built in cache
- GUI Acceleration
- Up to 1280 x 1024 resolution
- Windows 3.1 drivers included

#TM-VGA-1MEG

\$19⁰⁰ each

10/\$19.50

I-EEE 1284 Printer Cable

10' Bi-Directional
DB25 Male to Mini Centronic 36

A.K.A. type "A" - "C"

#CC-PR6-BIMIN

\$.89 each



Parallel Port

DB25 Female to 26 pin socket IDC



#CN-702 \$.50 each

100/\$.40

805-295-5577 Remember, We Have Great Connections...For You! FAX 805-295-8777

\$10.00 minimum order required • Add \$4.50 shipping for pre-paid orders

California residents add 8.25% tax • eMail Sales@RogersSystems.com

Call for quantity discounts • No out of state checks accepted • Most orders shipped same day

24895 Avenue Rockefeller, Valencia, CA 91355



CIRCLE 328 ON FREE INFORMATION CARD

www.americanradiohistory.com

Our Complete Catalog is now online

<http://www.cir.com>

CIRCUIT SPECIALISTS INC.

Check Out What We Have To Offer:

Fantastic DMM Offer!!!

Don't let the price fool you. This meter is a digital multimeter designed for engineers and hobbyists. Equipped with 5 functions and 19 ranges. Each test position is quickly and easily selected with a simple turn of the FUNCTION/RANGE selector rotary switch.

General Rubber Boot Included

Display: 3-1/2 Digit LCD, 21mm Figure Height with Automatic Polarity

Overrange Indication: 3 Least Significant Digits Blank

Temperature for Guaranteed Accuracy: 23°C±5°C RH<75%

Temperature Ranges:

Operating: 0°C to 40°C (32°F to 104°F)

Storage: -10°C to 50°C (14°F to 122°F)

Power: 9V Alkaline or Carbon-Zinc Battery (NEDA1804)

Low Battery Indication: BAT on Left of LCD Display

Dimensions: 188mm long x 87mm wide x 33mm thick

Net Weight: 400g



Our Best Offer Ever on a High Quality Full Sized DMM

\$19.00 any qty

DC Voltage (DCV)

Range: Resolution: Accuracy:

200mV	100µV	
2000mV	1mV	±(1%rdg+2dgt)
20V	10mV	
200V	100mV	
1000V	1V	

Maximum Allowable Input: 1000V DC or Peak AC.

DC Current (DCA)

Range: Resolution: Accuracy:

200µA	100nA	
2000µA	1µA	±(1.2%rdg+2dgt)
20mA	10µA	
200mA	100µA	
10A	10mA	±(1.2%rdg+2dgt)

Overload Protection: mA Input, 2A/250V fuse.

AC Voltage (ACV)

Range: Resolution: Accuracy:

200V	100mV	±(1.2%rdg+10dgt)
750V	1V	

Frequency Range: 45Hz-450Hz

Maximum Allowable Input: 750V rms

Response: Average Responding, Calibrated in rms of a Sine Wave.

CAT NO	DESCRIPTION	PRICE
9300G	Rugged High Quality DMM with Rubber Boot	\$19.00

Switchable Scope Probe Sets

(Selectable X1/Ref/X10) These high quality scope probe sets are for oscilloscopes up to 60MHz (model HP 9060) or 150MHz (model HP9150). Both sets include a handy storage pouch and include an IC test-hook adapter for the probe. The BNC connector rotates to avoid cable tangle or kink. Cable length is 1.4 meters.

CAT NO	DESCRIPTION	1	10	100
HP-9060	Scope Probe Set DC~60MHz	\$16.49	\$14.49	\$11.58
HP-9150	Scope Probe Set DC~150MHz	24.95	21.95	18.62

Etching Chemicals/Ferric Chloride

A dry concentrate that mixes with water to make 1 pint of etchant, enough to etch 400 sq. inches of 1oz board.

CAT NO	DESCRIPTION	1	5
ER-3	Makes 1 pint	\$3.50	\$2.75



Positive Photo Resist Pre-Sensitized Printed Circuit Boards

These pre-sensitized printed circuit boards are ideal for small production runs. They provide high resolution and excellent line width control. High sensitive positive resist coated on 1oz. copper foil allows you to go direct from your computer plot or art work layout. No need to reverse art.

Single-Sided, 1oz. Copper Foil on Paper Phenolic Substrate

CAT NO	DESCRIPTION	PRICE EACH		
		1	10	50
PP101	100mm x 150mm/3.91" x 5.91"	\$2.55	\$1.90	\$1.70
PP114	114mm x 165mm/4.6" x 6.6"	2.98	2.45	1.98
PP152	150mm x 250mm/5.91" x 9.84"	5.40	3.98	3.60
PP153	150mm x 300mm/5.91" x 11.81"	6.15	4.48	4.10
PP1212	305mm x 305mm/12" x 12" NEW!	12.78	10.65	8.52

Single-Sided, 1oz. Copper Foil on Fiberglass Substrate

CAT NO	DESCRIPTION	PRICE EACH		
		1	10	50
GS101	100mm x 150mm/3.91" x 5.91"	\$ 3.90	\$2.98	\$2.60
GS114	114mm x 165mm/4.6" x 6.6"	4.80	3.49	3.20
GS152	150mm x 250mm/5.91" x 9.84"	8.69	5.98	5.78
GS153	150mm x 300mm/5.91" x 11.81"	10.20	7.20	6.80
GS1212	305mm x 305mm/12" x 12" NEW!	18.88	15.73	12.59

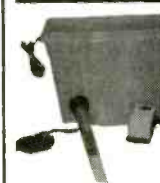
Double-Sided, 1oz. Copper Foil on Fiberglass Substrate

CAT NO	DESCRIPTION	PRICE EACH		
		1	10	50
GD101	100mm x 150mm/3.91" x 5.91"	\$ 5.07	\$3.68	\$3.38
GD114	114mm x 165mm/4.6" x 6.6"	5.95	4.29	3.99
GD152	150mm x 250mm/5.91" x 9.84"	10.47	7.39	6.98
GD153	150mm x 300mm/5.91" x 11.81"	11.95	8.69	8.30
GD1212	305mm x 305mm/12" x 12" NEW!	22.09	18.35	14.68



Developer This product is used as the developer on our positive photo-resist printed circuit boards. Includes instructions. 50 gram package, mixes with water, makes 1 quart.

CAT NO	DESCRIPTION	PRICE EACH		
		1	10	25
POSDEV	Positive Developer	\$.95	\$.80	\$.50



Etching Tank This handy etching system will handle PC boards up to 8" x 9", two at a time. Ideal for etching your PCB's! System includes an air pump for etchant agitation, a thermostatically controlled heater for keeping etchant at optimum temperature and a tank that holds 1.35 gallons of etchant. A tight fitting lid is also supplied to prevent evaporation when system is not being used. Typical etching time is reduced to 4 minutes on 1oz. copper board!

REDUCES ETCHING TIME!		CAT NO	DESCRIPTION	PRICE
		12-700	Etch Tank System	\$37.95

Removeable Hard Drive Racks

The ideal solution for protecting highly sensitive data. Or, buy one computer and allow individual users to keep their hard drive with their own applications and set-ups. Just turn the system off, lift the handle and the hard drive pops right out. Key lock included to avoid accidental or unauthorized removal. Includes hard drive activity LED's. Rack includes mounting hardware, keylock, front panel LED, convenient pull out handle. Made from high impact ABS plastic. Fits in 5.25" bay.



Features: • Ideal for Hard Drive Portability • Solve Software Data Security Issues • Carry Your Hard Drive Between Home and Office • Each User Can Have His or Her Personal Hard Drive

CAT NO	DESCRIPTION	PRICE
SpecialHDRACK-IDE	For IDE Hard Drive	\$14.95

SEE OUR ON-LINE CATALOG AT www.cir.com

CIRCLE 332 ON FREE INFORMATION CARD

Digital Panel Meters (LCD & LED)

Don't let the prices fool you. These digital panel meters are not surplus, so even if you design them into an ongoing manufactured product, you can be assured of continued availability. These high quality digital panel meters are decimal point selectable with guaranteed zero reading at zero volts input.



3-1/2 Digit LCD 3-1/2 Digit LED 4-1/2 Digit LCD
PM-328: 4-1/2D LCD Digital Panel Meter

Features

- 200.00mV Full Scale Input Sensitivity
- Single 9V DC Operation
- Decimal Point Selectable
- 11mm LCD Figure Height
- Automatic Polarity Indication
- Low Battery Detection and Indication
- High Input Impedance (>100 Mohm)

Applications Include:

- Voltmeter
- Thermometer
- pH Meter
- dB Meter
- Watt Meter
- Current Meter
- Capacitance Meter
- LUX Meter
- LCR Meter
- Other Industrial & Domestic Uses

PM-128: 3-1/2D LCD Digital Panel Meter

PM-129: 3-1/2D LED Digital Panel Meter

Features

- 200mV Full Scale Input Sensitivity
- PM-128 - Single 9VDC Operation
- PM-129 - Single 9VDC Operation
- Decimal Point Selectable
- PM-128 - 13mm Figure Height
- Automatic Polarity Indication
- Guaranteed Zero Reading for 0 Volt Input
- High Input Impedance (>100Mohm)

Specifications - PM-128/PM-129

Maximum Input	: 199.9mV DC
Maximum Display	: 1999 counts (3-1/2 Digits) w/Automatic Polarity Indication
Indication Method	: PM-128 - LCD Display PM-129 - LED Display
Measuring Method	: Dual-Slope Integration A/D Converter System
Overrange Indication	: '1' Shown in the Display
Reading Rate Time	: 2-3 Readings per sec.
Input Impedance	: >100 Mohm
Accuracy	: +/-0.5% (23+-5°C, <80% RH)
Power Dissipation	: PM-128 - 1mA DC PM-129 - 60mA DC
Decimal Point	: Selectable w/Wire Jumper
Supply Voltage	: PM-128 - 9V DC PM-129 - 9V DC
Size	: 67mm x 44mm

Specifications - PM-328

Maximum Input	: 199.99mV DC
Maximum Display	: 19999 counts (4-1/2 Digits) w/Automatic Polarity Indication
Indication Method	: LCD Display
Overrange Indication	: '1' Shown in the Display
Input Impedance	: >100 Mohm
Accuracy	: +/-0.05% (23+-5°C, <80% RH)
Power Dissipation	: 1mA DC
Decimal Point	: Selectable w/Wire Jumper
Supply Voltage	: 9V DC
Size	: 67mm x 44mm

AS LOW AS \$5.25 ea.

CAT NO	DESCRIPTION	1	10	25	100	250
PM-128	3-1/2 Digit LCD Panel Meter	\$ 9.90	\$ 7.09	\$ 6.40	\$ 5.86	\$ 5.25
PM-129	3-1/2 Digit LED Panel Meter	11.49	9.54	8.67	7.95	6.95
PM-328	4-1/2 Digit LCD Panel Meter	19.88	16.40	14.90	13.66	11.93



Ball Bearing 12V DC Fans

These High Quality Fans feature Ball Bearings and Brushless DC Motors. All of them are designed to meet UL, CSA & VDE Standards. Design these fans into power supplies, computers or other equipment requiring additional air flows for heat removal. These fans are regular Circuit Specialists stock items — they are not surplus.

INDUSTRY BEST PRICING!

CAT NO	1	10	25	100
CSD 4010-12	\$ 9.88	\$ 6.38	\$5.48	\$4.87
CSD 6025-12	9.38	5.91	5.41	4.71
CSD 8025-12	8.88	5.85	5.19	4.49
CSD 9225-12	8.95	6.14	5.29	4.59
CSD 1225-12	11.45	8.96	7.82	6.85

Specifications

CAT NO	DIMENSIONS (MM)	RATED VOLTAGE (V)	START VOLTAGE (V)	INPUT CURRENT (A)	AIR FLOW (CFM)	STATIC PRESSURE (INCH-H ₂ O)	SPEED (RPM)	NOISE LEVEL (dB)	WEIGHT (g)
CSD 4010-12	40x40x10mm	12	7	0.06	5.1	0.19	5,500	26	20
CSD 6025-12	60x60x25mm	12	5	0.13	13.7	0.165	4,500	28	65
CSD 8025-12	80x80x25mm	12	5	0.16	37.8	0.177	3,000	31	80
CSD 9225-12	92x92x25mm	12	5	0.32	42	0.18	2,800	37	95
CSD 1225-12	120x120x25mm	12	5	0.35	62	0.180	2,500	42	135

- SOLDER • SOLDER • SOLDER
- SOLDER • SOLDER • SOLDER

We stock high quality 60/40 (Sn%/Pb%), .031" and 63/37, .031" diameter. This is prime JIS certified solder that we maintain as a regular stock item (It is not "Left-overs, Rejects or Surplus") and you can buy it from us at a fraction of the price that you are used to.

Tired of Paying Inflated Prices for Solder?

CAT NO	DESCRIPTION	1	10	25
RH60-1	1-lb. Spool, .031", 60/40	\$ 6.90	\$ 5.96	\$ 5.30
RH63-1	1-lb. Spool, .031", 63/37	6.95	6.10	5.41
RH60-4	4.4-lb. Spool, .031", 60/40	24.00	21.90	17.92
RH60-TUBE	6-oz. Tube, .031", 60/40	.99	.89	.79

CAT NO	DESCRIPTION	1	5
CA-H34A	PCB Mounted IRCCD Camera	\$99.00	\$85.00
A34	Power Supply Regulating Kit	\$6.95	----

CCD Camera - IR Responsive

As Low As \$85!!

This black and white monochrome CCD Camera is totally contained on a PCB (70mm x 46mm). The lens is the tallest component on the board (27mm high from the back of the PCB) and it works with light as low as 0.1 lux. It is IR Responsive for use in total darkness. It comes with six IR LED's on board. It connects to any standard monitor, AUX or video input on a VCR or through a video modulator to a TV. Works with a REGULATED 12V power supply (11V-13V). Hooks up by connecting three wires: red to 12V, black to ground (power & video) and brown to video signal output.

Power Supply Regulating Kit for CA-H34 This simple kit is designed to fit onto the back of the CA-H34 CCD camera. It resolves the problem of hooking up the camera to an UNREGULATED supply (which damages the camera) by providing safe regulated power from any 12V-14V DC supply. It also provides regulated 12V DC from a 12V AC source.

SEE OUR ON-LINE CATALOG AT www.cir.com

CIRCUIT SPECIALISTS, INC.

SINCE 1971

800-811-5203
602-464-2485
602-464-5824 (FAX)

WE ACCEPT:



RECEIVE OUR LATEST 132 PAGE CATALOG!

It's chock full of all types of electronic equipment and supplies. We've got I.C.'s, capacitors, resistors, pots, inductors, test equipment, breadboarding supplies, PC supplies, industrial computers, data acquisition products, personal computers and computer parts, plus much, much more. FAX us your name and address or call 800-811-5203, ext. 5, to leave a message on our catalog request line



ELECTRONIX EXPRESS

WELLER SOLDERING STATION - MODEL WLC 100

- Variable power control (5 to 40 watts)
- Replaceable heating element
- Quality light-weight pencil iron

\$36⁹⁵



DUAL-TRACE OSCILLOSCOPE

Goldstar 9020
20MHZ

\$339⁰⁰



500K PRECISION FUNCTION GEN.

5 MHZ, DIGITAL DISPLAY

MODEL 4011 **\$230⁰⁰**



SCOPE PROBE

60 MHZ
SWITCHABLE X1, X10

\$12⁹⁵

ALLIGATOR LEADS

SET OF 10



SWITCHES

8 POS DIP 60¢ ea.

Mini Toggle SPDT 50¢ ea.



ON-OFF

DIGITAL MULTIMETER

WITH CAP/FREQUENCY
TRANSISTOR TESTER
Model DM645

\$34⁹⁵



PAD-234 DIGITAL/ ANALOG TRAINER

Complete portable workstation. Variable and fixed power supplies, function generator, digital I/O, rugged design, high impact case.



Assembled **\$145⁰⁰**

Kit **\$95⁰⁰**

HIGH QUALITY TOOLS

With Cushion Grips and Return Spring



\$2⁹⁵



\$1⁵⁰



\$2⁹⁵

POWER SUPPLIES

0-30 VDC, 0-3 Amp. Built-in current limiting, overload protected, constant voltage and current operation.



01PSGP4303A

Analog Display **\$169.00**

01PSGP4303D

Digital Display **206.00**

SOLDERLESS BREADBOARD

830 tie points. MB102PLT model features 3 binding posts and aluminum backplate.



Part No.	1-9	10+
MB102	5.95	5.00
MB102PLT	8.95	8.00

SOLDERING IRON 3-WIRE

HIGH PERFORMANCE

#060501



\$5²⁵

SOLDERING IRON STAND

W/SPONGE **\$3⁵⁰**

#060842



1 LB. 60/40 Solder Roll .031" \$5⁹⁵

DESOLDER PUMP W/TIP \$3⁵⁰

#060820

15 TURN POT

69¢ ea.



Bourms 3006P series. All standard values available.

7 SEG. DISPLAY

60¢ ea.



MAN72 C.A.Red 0.3"

MAN74 C.C.Red 0.3"

HELPING

HAND

WITH

MAGNIFIER

#060836



\$3⁵⁰

RESISTOR KIT

1/4W 5% film. 5 pieces each of 73 values. 365 pieces total.

\$3⁹⁵

LM555 10 Min.	22¢ ea.
LM741 10 Min.	27¢ ea.
74LS00 10 Min.	18¢ ea.
7805 Regulator 10 Min.	30¢ ea.
2N3904 10 Min.	6¢ ea.
PN2222 10 Min.	6¢ ea.
Red LED T 1 1/4 10 Min.	6¢ ea.
Green LED T 1 1/4 10 Min.	7¢ ea.
Yellow LED T 1 1/4 10 Min.	8¢ ea.
Photo Cell 10 Min.	65¢ ea.
100K Pot., 1" Shaft PC ML 10 Min.	15¢ ea.
CD22402	8.95 ea.

FREE CATALOG

MORE

Low-Priced

Items in Our

FREE

192-Page Catalog



TERMS: Min. \$20 + shipping. School Purchase Orders, VISA/MC, Money Order, Prepaid. NO PERSONAL CHECKS, NO COD. NJ Residents: Add 6% Sales Tax.

In NJ: 732-381-8020

FAX: 732-381-1572

365 Blair Road • Avenel, NJ 07001-2293

800-972-2225

<http://www.elexp.com>

Email: electron@elexp.com

CIRCLE 335 ON FREE INFORMATION CARD

Radiotelephone - Radiotelegraph

FCC Commercial License

Why Take Chances?

Discover how easy it is to pass the exams. Study with the most current materials available. Our **Homestudy** Guides, Audio, Video or PC "Q&A" disks make it so fast, easy and inexpensive. No college or experience needed. The new commercial FCC exams have been revised, covering updated Aviation, Marine, Radar, Microwave, New Rules & Regs, Digital Circuitry & more. We feature the Popular "Complete Electronic Career Guide". 1000's of satisfied customers **Guarantee** to pass or money back. Newest Q&A pools.

Send for **FREE DETAILS** or call

1-800-800-7555

WPT Publications
4701 N.E. 47th St.
Vancouver, WA 98661

Name _____

Address _____

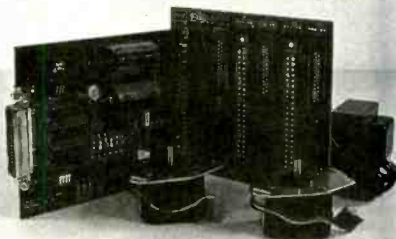
City _____ St. _____ Zip _____

1-800-800-7555

Move it With!

CYBERMATION MOTION CONTROL

Robotics • Data Acquisition • Industrial Control • Manufacturing



Complete Motion Control System

Includes: Master Control Card, Cyberbus Motherboard, 12vac. Trans, 2ea. 8oz. 100 Step Multi-axis Motors also Documentation IBM compatible Software with FREE Source Code
Feature: Bi-Directional 8 bit Read And Write Port, Card Addressable Variable Speed, Step, Range, Direction and On/Off Control

♦ **SYSTEM ONLY \$299.95** ♦

Send Check or M.O. to

CYBERMATION

1943 Sunny Crest Drive,
Suite 288
Fullerton, Ca. 92835

Add \$12.00 S&H
Ca residents add sales tax

New Web Site!

www.cybermationsys.com

Visa, Mastercard and AMEX

Call Us Today!

Phone: (714) 879-2000

Fax: (714) 992-2082

ALL ELECTRONICS

C O R P O R A T I O N

QUALITY PARTS

FAST SHIPPING

DISCOUNT PRICING

CALL, WRITE, FAX
or E-MAIL For A
Free 96 Page
CATALOG.
Outside the U.S.A.
send \$3.00 postage.

AMPLIFIED MULTIMEDIA SPEAKERS

Midipro # MD58
Amplified stereo speakers for computer/multimedia use. 3 watts RMS/ 12 watts peak full range 8 ohm speakers. Beige cabinets, ported for extra response. 7.24" x 2.95" x 4.75". Operates on 6 volts. Includes cables. Requires either 4 C cell batteries or 6 to 12 volt power adapter (not included).



CAT # SK-58

\$14.95
pair

Above speaker set including **DC POWER ADAPTER/BATTERY ELIMINATOR**
CAT# SK-58A \$17.95 per set

SMALL NEODYMIUM RARE EARTH MAGNETS

Semi-circular, irregularly-shaped magnets. Shiny finish with a polarity marking dot. 0.93" long x 0.3" x 0.07" thick. Powerful for their size.



\$1.00
each

CAT# MAG-30

160 pcs. - \$100.00

5 amp Solid State Relay

C.P. CLARE / Theta J # JTA2405-3
Compact, TTL compatible, optically isolated solid state relay for loads up to 5 amps @ 240 vac. 0.8" x 0.82" x 0.56" high epoxy block with a 1.4" long metal mounting flange. 1.19" mounting centers. 0.062" dia. x 0.175" high pins. Can be pc mounted or pins can be wrapped and soldered. UL and CSA listed.



Input: 4 - 8 vdc - Load: 5 amps @ 240 vac

\$6.00
each

CAT# SSRLY-2405

10 for \$55.00

Ultrabright LED

PAINFULLY BRIGHT RED LED

2500 to 4000 mcd @ 20 ma. These T 1 3/4 (5 mm diameter) red LEDs are significantly brighter than conventional LEDs. At close range, they are painful to look at. They are great for attention getting displays that can be seen from a distance. Water clear in off-state.



CAT # LED-42 **2 for \$1.20**

10 for \$ 5.00 • 100 for \$ 45.00
1000 for \$ 400.00

Twist-On F-56 Connector

Twist-on co-ax connector for RG-6 cable. CAT #FTO-56R



100 for \$15.00

500 for \$50.00 • 1000 for \$70.00

S-VHS VIDEO CORD



4' cable with miniature 4 pin mini DIN plugs on both ends.



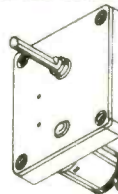
CAT# CB-363

\$2.00
each

10 for \$17.50
100 for \$120.00

12 Vdc 100 RPM Motor

ECM # 66175
Reversible 12 Vdc permanent magnet motor. 100 RPM, no load. Gear assembly is 2.73" x 3" x 0.53". 0.25" diameter flatted shaft is 0.8" long. Motor and gear assembly depth is 2" excluding drive shaft. Four mounting holes tapped for 10/32 screws.



CAT # DCM-85

\$12.00
each

410 UF, 300 VOLT PHOTOFLASH CAP.



Rubycon # 1A2304A
0.7" dia. X 1.7" long. Right angle PC or solder leads on 0.25" centers.

CAT# PPC-410

\$2.00
each

10 for \$18.50
200 for \$320.00

THERMOELECTRIC COOLER PELTIER JUNCTIONS



These incredible miniature solid state heat pumps raise or lower temperature in a small area almost instantly. Utilizing the Peltier effect these modules perform the same cooling or heating functions as freon based refrigerators but they do it with no moving parts, and are very reliable. Current applied to the device will produce heat on one side and cold on the other side, up to 68° C difference between the two sides. Modules can be mounted in parallel to increase the heat transfer effect or can be stacked to achieve high differential temperatures. 127 thermocouples per device. Operates on 3-12 Vdc. Requires a heatsink to prevent overheating.

1.18" (30 mm) square
X 0.15" (3.8 mm) thick.

\$17.00
each

CAT# PJT-1
5 for \$75.00

1.57" (40 mm) square
X 0.15" (3.8 mm) thick.

\$26.00
each

CAT# PJT-2
5 for \$110.00

Quantity Pricing Available!

ORDER TOLL FREE

1-800-826-5432

MAIL ORDERS TO:
ALL ELECTRONICS CORP.
P.O. BOX 567
VAN NUYS, CA 91408-0567

FAX (818) 781-2653 • INFO (818) 904-0524
INTERNET <http://www.allcorp.com/>
E-MAIL allcorp@allcorp.com

NO MINIMUM ORDER • All Orders Can Be Charged to Visa, Mastercard, American Express or Discover • Checks and Money Orders Accepted by Mail • Orders Delivered in the State of California must include California State Sales Tax • NO C.O.D. • Shipping and Handling \$5.00 for the 48 Continental United States - ALL OTHERS including Alaska, Hawaii, P.R. and Canada Must Pay Full Shipping • Quantities Limited • Prices Subject to change without notice.

MANUFACTURERS - We Purchase EXCESS INVENTORIES... Call, Write, E-MAIL or Fax YOUR LIST.





- PRODUCT ENGINEERING
- FIRMWARE DEVELOPMENT

- MICRO CONTROLLER & EPROM HARDWARE & SOFTWARE DEVELOPMENT

"QUALITY IS OUR CAPITAL CONCERN."

**Complete On Site
Electrical Engineering Lab**

- REVERSE ENGINEERING
- RF CIRCUIT DESIGN & MANUFACTURING

From Auto-Routing to CNC Routing to Electronic Assemblies. . .
Capital Electronics is Your Best Route For Printed Circuit Boards.

DESIGN/LAYOUT

- CAD LAYOUT SERVICES
- COMPATIBLE WITH ALMOST ALL CAD SYSTEMS
- FROM SCHEMATICS OR SAMPLE PCB'S
- PHOTOPLOTTING SERVICES
- 28,800 BAUDE MODEM

PRINTED CIRCUIT BOARDS

- SINGLE & DOUBLE SIDED
- MULTI-LAYER & FLEXIBLE PCB'S
- FROM QUICK TURN PROTOTYPES TO SCHEDULED PRODUCTION RUNS
- FINE LINES, SMT
- ELECTRICAL TESTING
- PRECIOUS METAL PLATING

ASSEMBLY SERVICES

- FAST TURN BOARD STUFFING
- WIRE HARNESSSES
- WAVE SOLDERING
- ACQUISITION OF PARTS
- FINAL TESTING
- TURNKEY SERVICES
- CUSTOM ENCLOSURES

**For Quick & Competitive Pricing or More Information,
Please Call Us Today!**

303 Sherman Street • Ackley, Iowa 50601
(515) 847-3888

Fax (515) 847-3889 • Modem (515) 847-3890



Internet Access:

For Automated Info Response:

INFO@capital-elec.com

E-Mail: Quote@capital-elec.com

Web Access: <http://www.capital-elec.com>

CIRCLE 311 ON FREE INFORMATION CARD

WHITE-STAR ELECTRONICS

TEL: 405-631-5153 FAX: 405-631-4788

CONVERTERS:.....	20	50	100+
Regal CR-83.....	45	39	35
* New, Panasonic TZPC 145.....	75	69	65
DON-5 (2 or 3) (unmodified).....	45	39	35
DRZ-3 PJ (unmodified) 70 Channel Plain.....	35	32	29
DRX-3 PJ (unmodified) 60 Channel Plain.....	32	30	27

Call for FREE catalog.
405-631-5153



REMOTE CONTROL

HAND UNITS:.....	20	50	100+
Jerrold Replaces: 400/450/550.....	4.95	4.50	4.25
Scientific Atlanta: 075/1175/475.....	4.95	4.50	4.25
8600: On screen display.....	7.50	7.00	6.50
Pioneer: BR 81, 82.....	4.95	4.50	4.25
Panasonic: Call for model #.....	7.50	7.00	6.50
Zenith: All.....	4.95	4.50	4.25
Tocom: 5503-VIP, 5503-A.....	7.00	6.50	6.25
Universal: 4 in 1 R/M.....	7.50	7.00	6.50

Call for Oak, Hamlin, Regal-83, Regency, Texscan, and all others.

Tamper-Bit tools: (10-lot)

- Jerrold compatible bits:
- 1/4" Stacom Bit\$8.00
- Oval Round D.....\$20.00
- Torx Bit:
- Tocom T-8.....\$8.00
- Zenith T-10, T-15.....\$8.00
- Pioneer T-20.....\$8.00
- Scientific Atlanta T-20.....\$8.00
- Pio 63XX Oval.....\$20.00
- Bit Driver Handle.....\$4.00



We carry most remote hand units. If you don't find the one you're looking for, we can locate for you.

Specializing in large quantities.

HOURS: Monday thru Friday 9 am to 5 pm Central Time.

Call for FREE catalog.
Email: wse405@aol.com

CIRCLE 319 ON FREE INFORMATION CARD

From MILLIWATTS to KILOWATTS

**RF POWER TRANSISTORS • TUBES
POWER MODULES**



Best pricing on U.S. & Russian
Transmitting & Receiving Tubes



- 3-500ZG • 811A • 833A • 572B
- 4-400C • 6146B & W • 8560AS • 8875 • 3CX400A7 & U7
- 3CX1200A7 & Z7 • 3CX1500A7 • 3CX3000A7 • 4CX250B & R
- 4CX400A • 4CX800A • 4CX1600A & U • 5CX1500A & B
- including full range through 4CX20,000A



Complete inventory for servicing
amateur and commercial
communications equipment.

- Transistors • RF Modules • Trimmers
- Doorknob Capacitors • Heatsinks
- Bird Wattmeters • Relays
- Broadband Transformers & Combiners



Send for your FREE 1997 Catalog
Same Day Shipping on most orders.



800 RF-PARTS • 760-744-0700
Fax: 888-744-1943 • 760-744-1943
e-mail: rpf@rfparts.com



RF PARTS

435 SOUTH PACIFIC STREET
SAN MARCOS, CA 92069

RAMSEY ELECTRONIC HOBBY & AMATEUR RADIO KITS

Synthesized FM Stereo Transmitter



Microprocessor controlled for easy frequency programming using DIP switches, no drift, your signal is rock solid all the time. Audio quality is excellent, connect to the line output of any CD player, tape deck or mike mixer and you're on-the-air. Foreign buyers will appreciate the high power output capability. New, improved, clean and hum-free runs on either 12 VDC or 120 VAC. Kit comes complete with case, whip antenna, 120 VAC power adapter -easy one evening assembly.

FM-25 Synthesized FM Stereo Transmitter Kit.....\$129.95

AM Radio Transmitters



Pro-Version AM-25



Entry-Level AM-1

Learn how commercial radio transmitters work and broadcast your own AM radio station. Our AM-25 pro-version, fully synthesized transmitter features easy frequency setting DIP switches for stable, no-drift frequency control, while being jumper settable for higher power output where regulations allow. It comes complete with AC power adapter, matching case and bottom loaded wire antenna.

AM25 Professional Kit.....\$129.95

Broadcast your own AM radio station. The entry-level AM-1 uses a tunable transmit oscillator and runs the maximum 100 milliwatts of power. No FCC license is required, expected range is up to 1/4 mile depending upon antenna and conditions. Transmitter accept standard line-level inputs from tape decks, CD players or mike mixers, and run on 12 volts DC.

AM-1 AM Radio Transmitter.....\$29.95
CAM Matching Case.....\$14.95
AC12-5 VDC wall plug adapter.....\$ 9.95

Tunable FM Stereo Transmitter

A lower cost alternative to our high performance transmitters. Tunable over the 88-108 MHz FM broadcast band, plenty of power and our manual goes into great detail outlining aspects of antennas, transmitting range and the FCC rules and regulations. Connects to any cassette deck, CD player or mixer. You'll be amazed at the exceptional audio quality! Runs on internal 9V battery or external power from 5 to 15 VDC, or optional 120 VAC adapter.



FMAC 120 VAC adapter.....\$ 9.95
FM-10A Tunable Fm Stereo Transmitter.....\$34.95
CFM Case Set for FM-10A.....\$14.95

RF Power Booster Amplifier



Add some serious muscle to your signal, boost power up to 1 watt over a frequency range of 100 KHz to over 1000MHz! Use as a lab amp for signal generators, plus many foreign users employ LPA-1 to boost the power of their FM Stereo transmitters, providing radios service through an entire town. Power required: 12 to 15 volts DC at 250mA, gain of 38dB at 10MHz, 10dBat 1000MHz.

LPA-1RF Power Boost Amplifier Kit.....\$39.95
CLPA Case for Linear Power Booster Amplifier.....\$14.95

Connects easily between your CD player, mike mixer (our MX-5 or 10 is ideal) or tape deck and the FM10A, FM25 or AM1 radio transmitter. Tunes come alive with the bass and brilliance or bass and presence controls. Low cost CD players with poor filtering on the output are cleaned up by the switched-capacitor low pass filtering in the STC1. Higher order harmonics and clock feed-through what causes annoying heterodynes and whooshing noises. Operates on 9 to 15 volts DC. Available fully wired and tested.

STC-1 Kit Stereo Transmitter Companion Kit.....\$59.95
CSTC Matching Case.....\$14.95
STC-1WT Fully Wired and Tested w/Case.....\$99.95

Stereo Transmitter Companion



Super Pro FM Stereo Radio Transmitter

A truly professional frequency synthesized FM stereo transmitter station in one easy to use handsome cabinet. Most radio stations require a whole equipment rack to hold all the features we've packed into the FM-100. Set frequency easily with the Up/Down freq. buttons and the big LED digital display. Plus there's input low pass filtering that gives great sound no matter what the source (no more squeals or swishing sounds from cheap CD player inputs!) Peak limiters for maximum 'punch' in your audio-without over modulation, LED bargraph meters for easy inputs. No one offers all these features at this price! Kit includes sharp looking metal cabinet, whip antenna and 120 volt AC adapter. Also runs on 12 volts DC.

FM-100 Super Pro FM Stereo Radio Transmitter Kit.....\$299.95



Crystal Controlled Wireless Mike

Super stable, drift free, not affected by temp, metal or your body! Frequency is set by a crystal in the 2 meter Ham band of 146.535 MHz, easily picked up on any scanner radio or 2 meter rig. Changing the crystal to put frequency anywhere in the 140 to 160 MHz range-crystal cost only \$5-6. Sensitive electric condenser mike picks up whispers anywhere and transmit up to 1/4 mile. Powered by 3 volt Lithium or pair of watch batteries which are included. Uses the latest in SMT surface mount parts and we even include a few extras in case you loose a part!

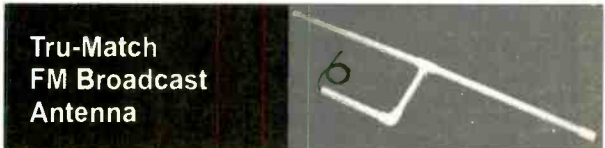
FM-6 Wireless Mike Kit.....\$39.95



Micro Wireless Mike Kit

World's smallest FM transmitter. Size of a sugar cube! Uses SMT (Surface Mount Technology) devices and mini electret condenser microphone, even the battery is included. We give you two complete sets of SMT parts to allow for any errors or mishaps - build it carefully and you've got extra SMT parts to build another! Audio quality and pickup is unbelievable, transmission range up to 300 feet, tunable to anywhere in standard FM band 88 to 108 MHz. 7/8" w x 3/8" h x 3/4" d.

FM-5 Micro Wireless Mike Kit.....\$19.95



Tru-Match FM Broadcast Antenna

The true match antenna really is a true match to your transmitter, getting the maximum range. It is an electrical impedance match...if the proper impedances are not maintained between transmitter and antenna, power is reflected back away from the antenna and back into the transmitter and back into the transmitter, causing the final amplifier stage to be damaged! Our antenna kit consists of rugged precut PVC pipe, antenna radiating elements and of course the proper matching assembly and is fully water resistant when assembled. It is easily mounted to any standard TV antenna mast like you can find at Radio Shack or K-Mart. A standard 'F' style coax connector issued, so that readily available, low cost RG-59 TV coaxial cable can be used for connection. We even supply and RCA phone to F Male adapter for easy connection to any transmitter antenna jack. Total length is about five feet, and it is easily mounted horizontally or vertically polarized, and we even explain in the manual the pluses and minuses for each. Maximum input power is ONE watt.

TM-100 Tru-Match FM Broadcast Antenna Kit.....\$39.95



793 Canning Parkway Victor, NY 14564 (716)924-4560 FAX 716-924-4555

ORDER LINE 1-800-446-2295

CALL FOR A FREE CATALOG!

ORDERING INFORMATION:

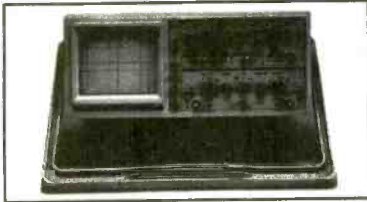
Satisfaction Guaranteed. Examine for 10 days, if not pleased, return in original form for refund. Add \$5.95 for shipping, handling and insurance. Orders under \$20, add \$3.00. NY residents add 7% sales tax. Sorry, no COD's. Foreign orders, add 20% for surface mail or use credit card and specify shipping method.



CIRCLE 266 ON FREE INFORMATION CARD

New and Pre-Owned Test Equipment

Goldstar



Model OS-9100P → **\$899.00**

Full 100 MHz Bandwidth!

- Dual-Channel, High Sensitivity
- TV Synchronization Trigger
- Calibrated Delayed Sweep
- Includes Two Probes, 2 Year Warranty

FREE SHIPPING!
ON GOLDSTAR EQUIPMENT
ANYWHERE IN THE U.S.
Excluding AK & HI



BK PRECISION
MAXTEC INTERNATIONAL CORP.

Model 4040 **\$499.00**
20 MHz Sweep/Function Generator

- 0.2 Hz to 20 MHz, 5 digit LED Display
- AM & FM Internal or External Modulation
- Sine, Square, Triangle, TTL, CMOS Outputs
- Burst Operation
- External 30 MHz Frequency Counter

NEW!



TOLL FREE 1-800-99-METER

1-800-996-3837

See us on the Web!
www.fotronic.com

Pre-Owned Oscilloscope Specials

B + K Precision 1476 10 MHz **\$229.00**
Great Starter Scope!

Tektronix 465	100 MHz	\$599.00
Tektronix 465B	100 MHz	\$699.00
Tektronix 475	200 MHz	\$799.00
Tektronix 475A	250 MHz	\$899.00

- The Industry Standard of Oscilloscopes
- Dual Channel, Calibrated Delayed Sweep
- Professionally Refurbished
- Aligned & Calibrated to Original Specifications
- 6 Month Warranty - The Longest Available!

LOWEST PRICES EVER!

NEW FLUKE MULTIMETERS & TEKTRONIX OSCILLOSCOPES

The Industry Standard in Multimeters

Fluke Model 87 ..\$285.00

TEKTRONIX TDS SERIES ON SALE!

Test Equipment Depot

A FOTRONIC CORPORATION COMPANY

P.O. BOX 708 Medford, MA 02155

(617) 665-1400 • FAX (617) 665-0780

email: afoti@fotronic.com

CIRCLE 331 ON FREE INFORMATION CARD

WORLD'S SMALLEST

UHF X-tal Locked Video Transmitters **\$99.00**

So small the transmitter, camera and battery will fit into a cigarette pack!!!

Used by hundreds in covert CCTV, R/C models, movie Special Effects, and Law Enforcement. "I've utilized your transmitters in covert video installations for about one year... previously, I used costly wireless units from Pelco, MVP, and Supercircuits. Nothing approaches the VidLinks in terms of power, picture quality, size, and value. Thank you."

R. Leslie, CCTV Installer, NY
"Incredible color, resolution... easy to use, convenient. Very cool!" P. Davis, Props, CA.
"... like having a TV station in your pocket."
J. Ramsay, Electronic Hobbyist, FL

LIVE REMOTE VIDEO FROM: \$99.00 | **ACTUAL SIZE!!!**

VidLink 100: 100mW Power- upto 1/4 Mile **\$199.00** New! High-Power!

VidLink 15: 15mW Power- upto 150 Feet **\$99.00** New! Low Price- Same Size!

Covert Camera: 1 1/4" sq. Pinhole Lens **\$169.00** Pro Grade Japanese Quality!

*** Audio Module Now Available. Call. ***

Check/MO, COD +\$5.00, S&H \$5.50



AEGIS RESEARCH

#671-1225 E. Sunset Dr.
Bellingham, WA
98226-3529 USA

1-604-224-0416

Visit our virtual catalog on the INTERNET at:
<http://www.lynx.bc.ca/virtualspy>

PIC our brains!

The PIC-MDS micro-controller development system will teach you how to use the powerful mid-range family of PIC® microcontrollers in your designs. The included program examples use the built-in features of the PIC-MDS development board to guide you from simple programming concepts to keypad scanning, RS-232 serial I/O, LCD display, A/D conversion, interrupts, and much more.



The PIC-MDS Professional Pack includes:

- PIC16C711 & 16F84 microcontrollers
- EPIC Programmer & PM assembler
- detailed training manual with disk
- in-circuit programming cable & socket
- ZIF socket • buffered LED port indicators
- 2 X 16 LCD display • 2 analog pots • RS-232 port
- 256 byte serial EEPROM • crystal/resonator socket
- 5V & variable DC regulators • cables & adapters
- all I/O pins on screw terminals & PICBUS connector
- all code examples in Microchip and Parallax™ syntax

only \$299!

Also Available:

Hobbyist Pack \$199
(kit, no ZIF, 16F84 only)

Quick-MDS \$69
(prototyping system)

PicBasic \$99

All prices are in \$US. Add \$15 for shipping. Canadian & international orders call or see web for prices. PIC is a registered trademark of Microchip Technology Inc. in the USA and other countries. Parallax is a trademark of Parallax, Inc.

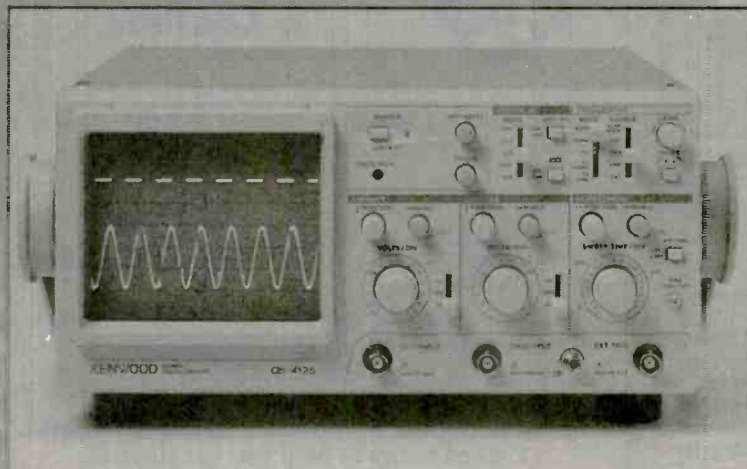
Sirius microSystems

Visit our Web page: <http://www.siriusmicro.com>

172 Harvard Road
Waterloo, ON N2J 3V3
CANADA
+1 519-886-4462 (ph.)
+1 519-886-4253 (fax)
support@siriusmicro.com

KENWOOD

...from the company you've
been listening to for years...

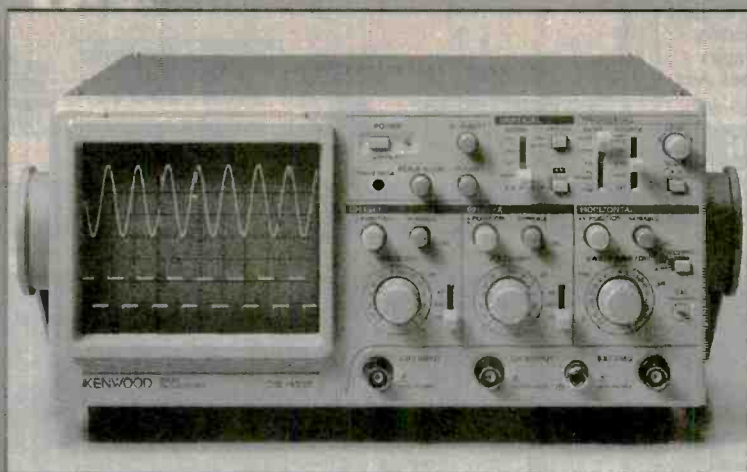


2-Channel, 20-MHz

CS-4125

Regular \$595

Sale \$389



2-Channel, 40-MHz Oscilloscope

CS-4135

Regular \$855

Sale \$685

Hybrid IC Technology is the Key to the High Quality and High Reliability at Low Cost!

- **FIX SYNCHRONIZATION** detects the trigger level automatically for the acquisition of stationary waveforms without complicated sync level adjustments.
- **VERT MODE TRIGGERING** enables the acquisition of stationary waveforms for both CH1 and CH2 even when the input signals to the two channels have different frequencies.
- **HIGH WITHSTAND INPUT** voltage of 400V (800Vp-p).
- **RELAY ATTENUATORS** are provided for reliable logic switchover.
- **SCALE ILLUMINATION** (CS-4135 only)
- **DIMENSIONS** (WxHxD): 300(343) x 140(150) x 415(430)mm () including protrusion.
WEIGHT: approx. 7.2kg (CS-4135) approx. 7kg (CS-4125)



PRINTTM
Products International

Call for your free 84 page test instrument catalog today!!!
8931 Brookville Road * Silver Spring, Maryland * 20910

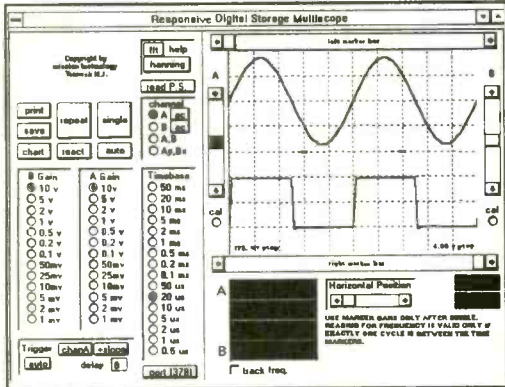
* Phone 800-638-2020 * Fax 800-545-0058 * email SMPRODINTL@AOL.com

TURN YOUR PC INTO A DIGITAL STORAGE OSCILLOSCOPE!

The all new PC-MultiScope 2

10Mhz analog bandwidth!

At right: Actual scope screen as seen on your PC monitor.



For industrial, educational, hobbyist, auto, and audio test & measurement

\$399 + S/H. Visa/MC/Check OK
Add \$99 for source code option

The top choice of corporations, universities and scientists worldwide!

AMAZE ELECTRONICS CORPORATION
amaze@hooked.net www.hooked.net/users/amaze
Phone: 800-996-2008 Fax: 408-374-1737

FEATURES.

1. Dual channel; external triggered
2. Digital storage; Windows based
3. Connects to PC parallel port
4. 20Megasamples/sec sampling; 10Mhz max. analog bandwidth
5. 8 bit resolution/ 8K RAM buffer
6. Prog. gain: 10v/div to 1mv/div
7. Spectrum analyzer (fft) function
8. Strip chart recorder function
9. TTL output for control app's
10. Visual Basic source code avail.

#1 Source For A Home Business

Just add a few phone lines to your computer



Matchmaker & Chatline

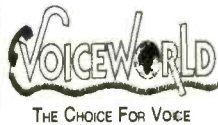
Setup a talking personals and chatline for local singles -- all without the hassle or expense of a 900 #. This is one of the lowest-risk, fastest profit-makers.

"Talking" Yellow Pages



Sell listings to local stores, restaurants, professionals & real estate agents. Can also be used to offer voicemail, paging, and fax on demand services.

Ask us about our many other business ventures.
Call us today to help you get started.



THE CHOICE FOR VOICE



Complete Packages

From \$1997.

Leasing is available

www.VoiceWorld.com



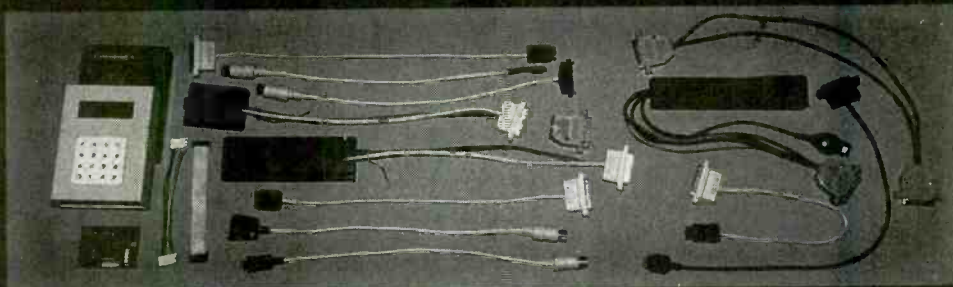
Demo

800.283.4759

24 hrs

"7-WAY COPY CAT \$1295.00*"

NEW!
7-Way
StarTac
\$1995.*



- Does.. 1. MOTOROLA (includes elite and EE3)! 2. NEC (includes P100-200-300-400-600-700)! 3. AUDIOVOX (does new 800 & 850)! 4. PANASONIC! 5. SONY (H333)! 6. MITSUBISHI-DIAMONDTE.L! 7. GE-ERICSSON (includes new version)!

We offer complete upgrade options on older units as well as new and replacement cables. We also offer used and refurbished units. For a complete catalog, visit us on the web at www.celltec.com

Upgrade
Your Old Copy
Cat **NOW**
to a **7-Way**
with **EE3**
& **StarTac**

*cables optional

All units are sold for **EXPERIMENTAL AND EDUCATIONAL PURPOSES ONLY!**

CALL US TODAY AT 770.973.8474

CIRCLE 334 ON FREE INFORMATION CARD

Special Offer from



Buy more than 1 book and take 15% off total order

Lenk Series



Simplified Design of IC Amplifiers
by John D. Lenk
1996 • 240pp • pa •
0-7506-9508-0 • \$29.95

Simplified Design of Micropower and Battery Circuits
by John D. Lenk
1996 • 240pp • pa •
0-7506-9510-2 • \$29.95

Simplified Design of Linear Power Supplies
by John D. Lenk
1996 • 246pp • pa •
0-7506-9820-9 • \$29.95

Simplified Design of Switching Power Supplies
by John D. Lenk
1996 • 225pp • pa •
0-7506-9821-7 • \$29.95

Simplified Design of Data Converters **NEW**
by John D. Lenk
April 1997 • 242pp • pa •
0-7506-9509-9 • \$29.95

Simplified Design of Voltage/Frequency Converters **NEW**
by John D. Lenk
September 1997 • 304pp • pa •
0-7506-9654-0 • \$29.95



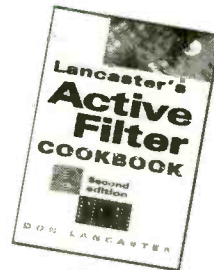
More Books from Newnes...



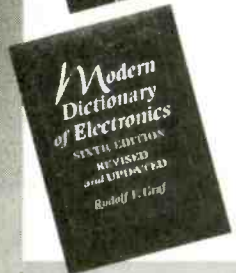
Reference Data for Engineers: Radio, Electronics, Computer & Communications, Eighth Edition
by Mac E. Van Valkenburg
1993 • 1,500pp • ha •
0-672-22753-3 • \$99.95



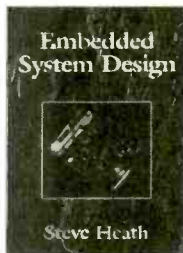
CMOS Cookbook, Second Edition
by Don Lancaster
1988 • 512pp • pa •
0-7506-9943-4 • \$24.95



Lancaster's Active Filter Cookbook, Second Edition
by Don Lancaster
1996 • 240pp • pa •
0-7506-2986-X • \$29.95



Modern Dictionary of Electronics, Sixth Edition
by Rudolf Graf
1996 • 1152pp • pa •
0-7506-9870-5 • \$49.95



Embedded Systems Design
by Steve Heath
April 1997 • 352pp • pa •
0-7506-3237-2 • \$47.95



Inside OrCAD
by Chris Schroeder
1996 • 400pp • pa •
0-7506-9700-8 • \$39.95

Please send me the book(s) listed below. (Buy more than one, and take 15% off the total order.)

Write book number(s) here:

Mail your order to: Butterworth-Heinemann, Fulfillment Center, 225 Wildwood Ave., Woburn, MA 01801 USA

Name _____

Address _____

City _____ State _____ Zip _____

Phone _____ Fax _____

E-mail _____

Please send me a free Newnes catalog, Item #645.

Phone: 1-800-366-BCOK Fax: 1-800-446-6520
E-mail your order to orders@repp.com

I have enclosed a check for \$ _____

Please charge my:

Visa MasterCard American Express

Card no. _____ Exp. date _____

Signature _____

U.S. Customers: Please add \$4.00 handling fee for the first item ordered, \$1.50 for each additional item, to all check and credit card orders. Billed orders will be charged additional shipping based on weight and destination. All U.S. orders must include your state sales tax. Prepayment required for all international orders and U.S. orders under \$75.00. Prices subject to change without notice.

Canadian Customers: please pay by credit card or in U.S. funds and include 7% GST on books and handling.

European Customers: Add £2.00 UK and surface postage. Check for Air Mail; extra cost will be charged.

Visit our web site: <http://www.bh.com/newnes>

A member of the Reed Elsevier plc group

TS220

October 1997, Electronics Now

America's Premier Home Automation Catalog!

HOME CONTROLS

INCORPORATED

Huge variety of home automation products including X-10, intelligent schedulers, security, RF & IR, phones, audio/video, wiring systems, surveillance cameras, HVAC, drapery controls and much more!

- Free technical support
- Low price guarantee
- Guaranteed quality & low price
- Same day shipping

Free catalog! Call 24 hours!
Complete color catalog at homecontrols.com
Dealers! Call for wholesale prices

1-888-CONTROL
266-8765

www.homecontrols.com • E-Mail: homecontrols@worldnet.att.net
Phone orders from 7 a.m. to 5 p.m. Pacific Time.



Hexapod Walker Kit \$150.00



Build your own functional Hexapod Robot

The kit comes complete with all hardware, structural components, 3 Hitec servos, Counterfeit Basic Stamp kit, software and an illustrated assembly manual. This robot can walk forward, reverse and turn on a dime using the alternating tripod walking gait. It is an excellent foundation for many artificial intelligence and behavioural based experiments. It is a lot of fun to build and even more fun to operate. Check out our web site for more information and other robot kits.

• Larger 12 Servo Model \$375.00 • Servo 6 Pack \$80.00 • Mobile Robots Book \$48.00

Quantity discounts available. \$7.50 Shipping & Handling for USA, call for international and quantity shipping charges. IL residents add 6.25% sales tax to total.

Many more robot kits, ask for our free catalog!

Technical Service & Solutions
104 Partridge Road
Pekin, IL 61554-1403 USA



Tel: 309-382-1816
Fax: 309-382-1254
www.lynxmotion.com
jfrye@lynxmotion.com

PIC'n Books

LEARN ABOUT PIC16/17 MICROCONTROLLERS

EASY PIC'n Beginner

- Programming techniques
 - Instruction set
 - Addressing modes
 - Bit manipulation
 - Subroutines
 - Sequencing
 - Lookup tables
 - Interrupts
 - Using a text editor - source code
 - Using an assembler
 - Timing and counting
 - Interfacing - I/O conversion
 - Lots of examples
- \$29.95

PIC'n Up The Pace Intermediate

- Serial communication
 - PIC16 to peripheral chips
 - PIC16 to PIC16
 - Serial EEPROMS
 - LCD interface
 - Scanning keypads
 - D/A conversion
 - Sensors - analog voltage output
 - A/D conversion
 - Math routines
 - Decimal interface
 - PIC16C84 EEPROM data memory
 - Lots of circuits and code
- \$34.95

+ \$4 s/h in US for one book, \$6 both books
VISA, MC, AMEX, MO, Check
CA residents please add 7.25% CA sales tax
PIC is a trademark of Microchip Technology Inc.

SQUARE 1 ELECTRONICS

P.O. Box 501, Kelseyville, CA 95451
Voice (707) 279-8881 FAX (707) 279-8883
<http://www.zapcom.net/~squareone>

ELECTRONIC SHOPPER

M/C & VISA
ACCEPTED

TEST EQUIPMENT SALES

P.O. BOX 986
LONDONDERRY, NH 03053

HP 8012B.....PULSE GENERATOR.....\$595
TEK FG504.....FUNCTION GEN.....\$525
FLUKE 752A.....REF. DVM.....\$2695
SWINGER TWO.....ELEC. LOAD.....\$495
BAL 6127B.....SCOPE CALIBRATOR...\$3995
TEK 7104.....1 GHz SCOPE WF.....\$2395
ENI 2100L.....POWER AMPLIFIER.....\$1895
TEK 2245.....100 MHz 4 CH.SCOPE.\$1250
TEK 11A72.....1 GHz PLUG-IN.....\$1295
TEK 576.....CURVE TRACER.....\$2395
DATRON 1081.....7.5 DIGIT DMM.....\$1295
TEK 2445.....150MHz 4 CH.SCOPE..\$1695
FLUKE 5100B.....CALIBRATOR.....\$4995
TAS 112.....NETWORK SIMULATOR...\$2995
HP 16515A.....1 GHz TIMING CARD.\$1495

HP 6205B.....POWER SUPPLY.....\$250
KEI 224.....CURRENT SOURCE.....\$1095
TEK 2465A.....350MHz SCOPE.....\$3950
ANALOGIC 2310.....FUNC.GEN...\$395
ANALOGIC 2410.....FUNC.GEN...\$495
TEK SG503.....SINE WAVE GEN.....\$695
HP 6940B.....MULTIPROGRAM.....\$195
TEK11302A.....500MHz SCOPE...\$2495
TEK PS5010.....POWER SUPPLY...\$795
TEK 7L5.....SPEC. ANALYZER.....\$1095
TEK TR503.....TRACKING GEN.....\$995
TEK 2465.....300MHz SCOPE...\$2750
HP 3325A.....SYNTH./FUNC. GEN.\$1995
WAV 801.....50MHz PULSE GEN...\$795
TEK DC504A.....COUNTER/TIMER.\$450

EDC MV105.....DC VOLTAGE STD...\$295
TEK 2445A.....200MHz 4 CH. SCOPE..\$2495
KEI 619.....ELECTROMETER.....\$995
WAV 178.....PROG. SYNTHESIZER.....\$1295
TEK DC5010.....COUNTER P/I.....\$895
HP 8444A/059.....TRACKING GEN.....\$950
HP 3312A.....FUNCTION GEN.....\$795
TEK 11A52.....600MHz PLUG-IN.....\$795
ROD-L M100AVS4.....HIPOT TESTER...\$695
SENCORE VA62A.....VIDEO ANALYZER.\$1095
ELGAR 403VT.....FREQ. OSCILLATOR...\$2495
HP 3585A.....SPECTRUM ANALYZER...\$6995
HP 3582A.....SIGNAL ANALYZER.....\$3195
HP 5335A/30.....UNIV. COUNTER.....\$1495
KROHN-HITE 3343.....FILTER.....\$595

WE BUY
SURPLUS

PHONE (800) 684-4651
FAX (603) 425-2945

SATISFACTION
GUARANTEED

* Do-It-Yourself Electronic Kits *

Mark V Electronics, Inc.
8019 E. Slauson Ave.,
Montebello, CA 90640

Catalog & Information
213/ 888-8988
Fax 213/ 888-6868

E-MAIL MARK5CO@AOL.COM ORDER 1-800-521-MARK / 1-800-423-FIVE

Kit skill levels ▲ beginner ▲▲ intermediate or ▲▲▲ advanced!

Clearance Sale



Kit \$ 12.50 6.99

TY-35 This is a low power real FM transmitter. Transmit frequency within 88-108 MHz. Transmit range about 200 ft. It has high sensitivity sound pickup by a capacitance microphone. May be used strictly for series purposes such as remote wireless monitoring.

Clearance Sale



Kit \$ 7.95 4.85

TA-001 It employs high stability power IC & has a build in temperature compensating system. It has large power output & output & good distortion characteristic. Accept various magnetic & capacitor micro-phone input & other line input. 6-16V DC.

SCHOOL PROJECT CORNER

po orders welcomed from schools

- Melody Generator ▲ Kit \$ 13.85
- 6W Mini-Amplifier ▲ 9.50
- 0-15V 5A Regulated DC PS ▲ 17.50
- 36W Class A Power Amp. ▲▲ 32.50
- Dynamic Noise Reduction ▲ 26.00
- Multi-Function Control Switch ▲ 10.50
- 20 Bar/Dot Level Display ▲▲ 41.45
- Microphone Mixer Mono Amp. ▲ 20.79
- Superior Electronic Roulette ▲ 21.50
- Digital Clock with Melody Alarm▲ 25.00
- Stereo Pre-Amp with Mic Amp. ▲ 10.78
- Mini Stereo Multi-Input Amp. ▲ 30.50
- 130-in-one Electronic Lab 29.99

SEE OUR CATALOG FOR MORE KITS !

Stereo Loudspeaker Protector

TY-25▲



Kit: \$ 16.75

Super fast acting relay protects speakers against destructive DC voltages. Can connect directly to a power amplifier or can use a separate power supply. Has a 3 second turn-on delay to avoid turn-on thumps.

Regulated DC Power Supply

TR-503 ▲▲



Kit: \$ 18.75

It is short circuit proof and has overload protection. Output voltage is variable over a range of 0-50 volts. Current limit trip is adjustable up to max of 3A. May use Mark V #002 transformer.

Fluorescent Light Driver

TY-2 ▲ (1 lb.)



Kit: \$ 14.75

This unit drives 6-40 watts fluorescent light for portable and emergency use. Works from a 7.2 - 16 VDC battery. Includes a "Hi-Efficiency Switching Mode IC Driving Circuit" suitable for use with different lights.

120-250W Mosfet Power Mono Amplifier AF-2 (6 lbs.) ▲▲



Kit: \$ 89.80 82.80 Asmb. \$ 114.80

Power Output: 250W into 4 ohms RMS(42VX2 6A transformer is used). 120W into 4 ohms RMS(33VX2 4A transformer is used). Frequency Response: 3Hz-22,000Hz. THD: <0.03%. Signal to Noise Ratio: 91dB. Sensitivity: 1V RMS at 47k. Load Impedance: 4 or 8 ohms. Power Requirement: ±46VDC 4A or ±60VDC 6A. May use Mark V Model 012 Transformer. Suggested Capacitor 8,200uf 100V Model 020. Suggested Metal Cabinet LG-1925.

30-in-one Electronic Lab Kit

KA-901 \$ 15.99 12.99



No soldering is required! This simple electronics kit safely teaches the fundamentals of electronics. Build a radio, alarm, timer and more. Earphone for private listening. Uses safe battery power. Requires 4 "AA" batteries!

150MHz 8 Digit Frequency Counter

SM-100 (2 lbs.)



Kit: \$ 79.00 68.00

Asmb. \$ 99.00

It is used for adjustment, test & repair of any kind of high frequency circuit products. It can give up to 8 digit of resolution for a wide frequency range 10Hz - 150 MHz. The last input frequency can HOLD on the display for future reference & comparison. The circuit structure is compact & reliable for the most updated A/D LSI circuitry. The input impedance is 1M ohm.

300W High Power Mono Amplifier TA-3600 (5 lbs.) ▲▲▲



82.00

Kit 89.00

Asmb. \$ 115.00

Power Output: 300W into 8 ohms RMS. 540W music power into 8 ohms. Frequency Response: 10Hz-20KHz. THD: < 0.05%. Sensitivity: 1V RMS at 47K. Power Requirement: 60 to 75 VDC at 8A. May use Mark V Model 007 or 009 Transformer. Suggested Capacitor: 8,200uf 100V Model 020 Capacitor. Suggested Metal Cabinet LG-1925.

120W + 120W Pre & Main Stereo Amplifier TA-800MK2 (4 lbs.) ▲▲



Kit: \$ 67.92 Asmb. \$ 86.95

Power Output: 120W into 4 ohms RMS. 72W into 8 ohms RMS. Frequency Response: 10 - 20 KHZ. THD: < 0.01%. Tone Control: Bass ±12dB, Mid ±8dB, Treble ±8dB. Sensitivity: Phono Input, 3mV into 47K. Line, 0.3V into 47K. Signal to Noise Ratio: 86dB. Power Requirement: 40V DC @ 6A. May use Mark V Model 001 or 008 Transformer. Suggested Metal Cabinet Model LG-1924.

80W + 80W Pure DC Stereo Main Power Amplifier TA-802 (4 lbs.) ▲▲



Kit: \$ 49.94

Asmb. \$ 69.94

Power Output: 80W per channel into 8 ohms. THD: < 0.05%. Frequency Response: DC to 200 KHZ, -0 dB, -3dB @ 1W. Power Requirement: 30V AC X 2 @ 6A. May use Mark V Model 001 or 008 Transformer. Suggested Capacitor 8,200uf 50V Model 017. Suggested Metal Cabinet LG-1924

60+60W Stereo Power Amp. ▲▲

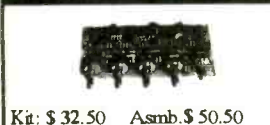
SM-302 (11 lbs.)



Kit: \$ 85.00

It provides 3 input jack pairs. One pair accept a high impedance micro-phone. The two remaining pairs are for high & low level input sources. Power Output: 60W per channel into 4 ohms RMS. 20Hz-20KHz. THD:<0.1%. Input Sensitivity :Mic /Guitar 10mV, Hi 380mV, Lo 640mV. Ready to plug in when assembled.

30W + 30W Pre & Main Stereo Amplifier TA-323A (1 lb.) ▲



Kit: \$ 32.50 Asmb. \$ 50.50

Power Output: 30W into 8 ohms RMS per channel. THD: < 0.1% from 100 HZ to 10 KHZ. Sensitivity: Phono 3mV @ 47K. Tuner, Tape 130mV @47K. Signal to Noise ratio: 80dB. Power Requirement: 22 to 36V AC, 3A. May use Mark V Model 002 Transformer. Suggested Cabinet LG-1684.

Metal Cabinets

Aluminum Front Panel

- LG-1273 3x12x7" (4 lbs.) \$ 26.50
- LG-1684 4x16x8" (7 lbs.) 32.50
- LG-1924 4x19x11½" (10 lbs.) 38.25
- LG-1925 5x19x11½" (10 lbs.) 42.00
- LG-1983 2½x19x8" (7 lbs.) 35.25

Transformers (5-12 lbs.)

**Toroidal Transformers

- # 001 28V/30V x2 6A \$ 30.00
- # 002 36V x2 3A 25.00
- # 003 40V x2 6A 32.00
- # 008** 28V/30V x2 6A 42.00
- # 009** 48/53V x2 8A 68.00
- # 012** 33/40/42V x2 6A 52.00

3½ Multi-Function LED DPM ▲▲

SM-43 (1 lb.)



Kit: \$ 35.50

Asmb \$ 48.00

To use this instrument as a voltmeter, ammeter, ohmmeter, temperature meter.. AC/DC Voltage range: 1mV-1000V. Thermometer range :0-100C. DC current range :1 microamp - 2 amp. Capacitance range: 1pf-2 microfarads. Frequency Counter: 10HZ-20KHZ. Max indication ±1999. Power Supply: 5-6V DC, 200ma.

Minimum order \$ 20.00 We accept Visa, MasterCard, Money Orders, and Checks(allow 2 weeks for clearance). We ship by UPS ground inside US (min \$6.00) and ship by US mail outside US. Please call our operator for orders over 2 lbs. or foreign orders.



NEW DX SERIES DMMs

3 YEAR WARRANTY
COVERS FULL PERFORMANCE

Bel MERIT DX Series DMMs have best values for performance, features and dependability with 3 year warranty.

Each DX model has standard DMM measurements with a set of additional capabilities; diode, continuity, TRhFE, capacitance, inductance, frequency, logic and temperature.

Additional features include auto power-off, data hold, annunciator, and input warning beeper & peak hold (DX451/DX460L only)

Deluxe holster, safety test leads and thermocouple probe (DX360T) supplied as standard accessories.

MODEL	DX350	DX360T	DX400	DX405	DX451	DX460L
AC/DC Voltage (750V/1000V)	*	*	*	*	*	*
AC/DC Current (10A)	20µ.	*	*	*	*	*
Resistance (20MΩ)	20Ω.	2000M	*	*	2000M	2000M
Continuity Beeper/Diode	*	*	*	*	*	*
Temperature w/Probe, Type K	*	*	*	*	*	*
TRhFE	*	*	*	*	*	*
Capacitance (20µF)	*	*	*	*	*	2000µ
Frequency (20MHz)	*	*	*	*	*	*
Logic (TTL & CMOS)	*	*	*	*	*	*
Inductance (20H)	*	*	*	*	*	*
Auto Power-Off	*	*	*	*	*	*
Input Warning Beeper	*	*	*	*	*	*
Data Hold	*	*	*	*	*	*
Peak Hold	*	*	*	*	*	*
Protective Holster	*	*	*	*	*	*
Suggested Resale Price	49.95	64.95	64.95	89.95	89.95	109.95

• Lots more High Standard Test Instruments available

All in One Instrument, Oscilloscope, Power Supply, Function Generator, Frequency Counter, Multimeter, Capacitance, Engine Analyzer, Clamp-On, Electrical Tester and More.

• See your local distributors or Call for Catalog

Bel MERIT 1-800-532-3221
SOLUTIONS FOR THE TEST INSTRUMENT (714) 586-2310 • FAX (714) 586-3399
P.O. Box 744, Lake Forest, CA 92630

CIRCLE 325 ON FREE INFORMATION CARD

EZ-EP DEVICE PROGRAMMER - \$169.95

Check Web!! -- www.m2l.com

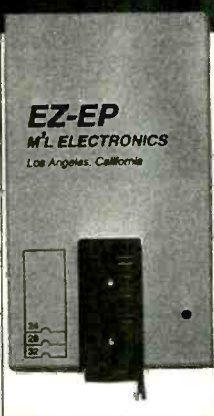
- Fast** - Programs 27C010 in 23 seconds
- Portable** - Connects to PC Parallel Port
- Versatile** - Programs 2716-080 plus EE and Flash (28F, 29C) to 32 pins
- Inexpensive** - Best for less than \$200

- 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 (18C5x, 61, 62x, 71, 84)	\$49.95
EP-PIC64 (82-5, 72-4)	\$39.95
EP-PIC12 (12C50x)	\$39.95
EP-PIC17 (17C4x)	\$49.95
EP-51 (8751, C51)	\$38.95
EP-11E (68HC11 E/A)	\$59.95
EP-11D (68HC711D3)	\$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

M²L Electronics
310/837-7818 Fax/BBS: 310/841-4050
3526 Jasmine #4, Los Angeles, CA 90034
CA orders add 8.25% sales tax.
<http://www.m2l.com>



Find Bad Capacitors

In-Circuit
with the
Capacitor Wizard



The Capacitor Wizard is an extremely FAST and RELIABLE device designed to measure ESR (Equivalent Series Resistance) on capacitors of 1uf and larger "IN CIRCUIT", eliminating the need to remove the capacitor for accurate tests. The Capacitor Wizard finds BAD caps IN CIRCUIT that even VERY EXPENSIVE cap checkers MISS ENTIRELY, even out of the circuit!! Standard capacitor meters cannot detect any change in ESR therefore they miss bad capacitors leading to time consuming "Tough Dog" repairs. *Technicians say it is the most cost effective instrument on their workbench.*



Made in the USA
Order Today

Only \$179.95

Call 1-800-394-1984

<http://www.heinc.com>

30 day money back guarantee

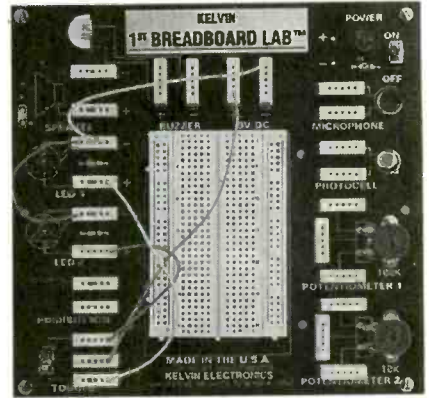


BUY BONDS

KELVIN™ YOUR SOURCE FOR ELECTRONIC PROJECTS, COMPONENTS, TRAINERS & KITS EST. 1945

KELVIN'S METERS THE BEST PRICES!

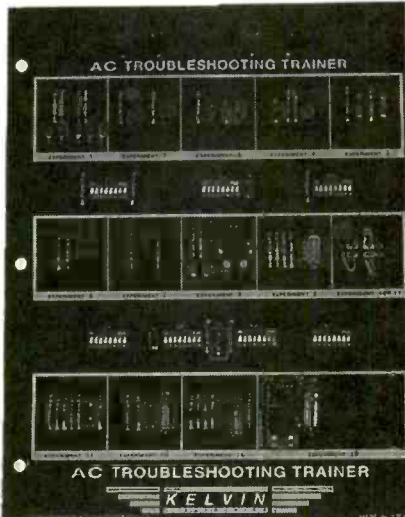
- 100LE** AC/DC Volts...DCA to 10A...Ohm Test...Diode Test...Continuity Buzzer... Battery Test... **990087...\$19⁹⁵**
- 150LE** AC/DC Volts...DCA to 10A...Ohms to 20M...Diode Test...Continuity Buzzer... Battery Test...Transistor Test... **990122...\$29⁹⁵**
- 200LE** AC/DC Volts...AC/DC Current to 10A...Ohms to 20M...Diode Test...Continuity Tester with Buzzer...Transistor Test...Autorange... 10MΩ Input Impedance... Frequency Test range to 15mHz...Capacitance Test from 2,000 pF to 20mfd... +/- 0.5% Accuracy... 3-1/2" LCD Display... **990123...\$49⁹⁵**
- 300LE** Autoranging to 3,200 counts...AC/DC Volts...AC/DCA to 10A...Ohms to 32M...Continuity Test...Diode Test... **990125...\$49⁹⁵**
- 400LE** AC/DC Volts...DCA to 20A...Ohms to 2,000M...Diode Test...Continuity Test...Transistor Test...Autorange Frequency to 20mHz with Duty Cycle...Cap. Test to 200mfd... Inductance Test to 20Hy... Maximum Hold... **990124...\$79⁹⁵**
- 250LE** CAPACITANCE METER ONLY
Zero Adjustment...9 Ranges...200pF-20,000 mfd... **990126...\$59⁹⁵**



1st BREADBOARD LAB™ Trainer

Easy to use; build circuits that are far from simple in function. Includes lab manual with 30 experiments, a 6"x6-1/2" breadboard for students to assemble circuits on and the basic components that most circuits use—right on the board, ready for easy wiring. Assembled. **GRADES 6 & UP**

840739 **\$99**



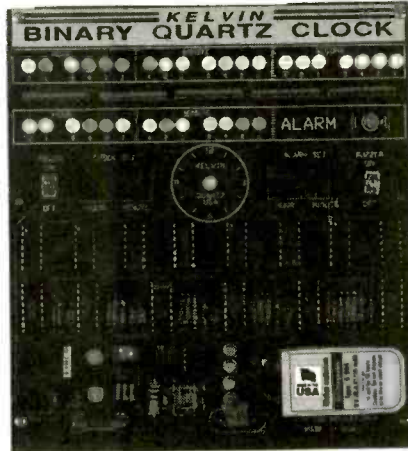
TROUBLESHOOTING TRAINERS

WITH BUILT-IN TEACHER INPUTS

Make teaching electronic circuitry easy and cost-effective using actual electronic equipment, hardware and pre-wired circuits. These inexpensive trainers are easy to set up because they require no wiring or soldering. Common, built-in faults allow students to practice their skills.

Each trainer comes with a pre-wired PC board (8-1/2"x11"), plug-in AC wall transformer, 3-ring storage binder, working electronic circuits, DIP switches, student lab manual and teacher guide. Additional equipment may be required like, digital multimeter, oscilloscope (dual trace, 15mHz or higher) and a function/signal generator (1-2 mHz). Ideal for vocational, trade and 2-yr. schools. Assembled. **GRADES 9-COLLEGE.**

- AC Trainer, 840627 **\$195**
- DC Trainer, 840626 **\$195**
- Digital Trainer, 840856 **\$295**
- Linear/Analog Trainer, 840857 **\$295**
- Communications Trainer, 840951 **\$295**



BINARY QUARTZ CLOCK

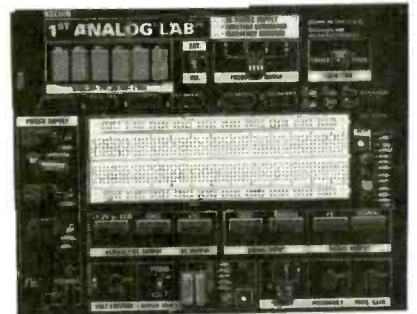
A great conversation piece! Advanced students can explore binary and digital electronics with Kelvin's exclusive 24-hour binary quartz accurate clock. Features include a built-in alarm and bi-color LEDs. Comes with a DC wall transformer and detailed assembly instructions. **GRADES 9 & UP.**
Kit, 840589 \$87.95 or **\$84.95 ea./10+**
Assembled, 840590 **\$129.95**

"I received the BINARY CLOCK today and assembled it in 3-1/2 hours. It worked great and is hanging on the wall in my living room. Everyone that sees it stares with fascination! They then ask, 'How do you tell time?' I then go into a lecture about binary numbers. Thank you very much."

-John Tillery

"This trainer (TROUBLESHOOTING TRAINER) has exactly what the textbooks & traditional theory labs are missing—instructor-controlled, fault-insert trainers which challenge students to learn potential troubleshooting and problem-solving habits at the very beginning of their technical training."

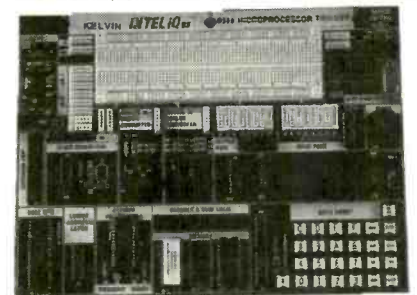
-David L. Miles, Maryland



1st ANALOG LAB™ Trainer

Economical. This is the ideal trainer to compliment textbooks on analog electronics. Built-in features include: display readout for frequency, audio, power and voltage (6 digit, 7-segment LED); audio generator (up to 60K-Hz) for sine, square and triangle waves; frequency counter (0-2MHz); power supply (0-12V DC, 5V DC fixed); and wall adapter. **GRADES 8 & UP**

- Kit, 840891 **\$125**
- Assembled, 840890 **\$195**



INTEL® TRAINER 8088-Based

Compatible with IBM/PC computers and assembler languages; upwardly compatible to Intel 8088 series, 486 series & the Pentium processor. Enter machine code using keypad or download as Intel hex file. w/LCD display. Assembled. **GRADES 9 & UP.**

840832 **\$495**

TEL 1-800-KELVIN-WORLD (1-800-535-8469) or 1-516-756-1750...FAX 1-800-756-1025 or 1-516-756-1763
MAIL Kelvin, 10 Hub Dr., Melville, NY 11747...E-MAIL kelvin@kelvin.com...WEB www.kelvin.com
CIRCLE 249 ON FREE INFORMATION CARD

JENSEN
Master Catalog 1997



Everything you'll need for building, troubleshooting and repairing your electronics projects

- ✓ Tool Kits, Cases and Specialty Tools
 - ✓ Test Equipment ✓ Wire/Cable/Connectors
 - ✓ Workbenches and Static Control
 - ✓ Solder/Desolder Stations . . .
- and much more! Plus free technical support including our FaxBack® System

FREE CATALOG
800-426-1194
Dept. 156

JENSEN TOOLS

7815 S.46th Street, Phoenix, AZ 85044
Tel: 800-426-1194 or 602-968-6231
Fax: 800-366-9662 or 602-438-1690

Visit us on the WWW - <http://www.jensentools.com>

CIRCLE 323 ON FREE INFORMATION CARD

Quality Microwave TV Systems
WIRELESS CABLE - ITFS - MMDS
ATV - INTERNATIONAL - S-BAND
Amplifiers • Antennas • Books • Components
Filters • Systems • Video Products
• RF Frequency 1990 - 2700 MHz
• Cable Ready - VHF - UHF Outputs
• SASE For "FREE" Catalog or Send \$1
PHILLIPS-TECH ELECTRONICS
PO Box 8533 • Scottsdale, AZ 85252
ORDER LINE 800-880-MMDS
CATALOG/INFO 602-947-7700
FAX LINE 602-947-7799
Visa • MC • Amx • Disc • COD's • Qty Pricing

CIRCLE 329 ON FREE INFORMATION CARD

CABLE T.V.
Converters & Equipment
WISE PRODUCTS

30-day money back
1-year warranty

Dealers
Welcome!

1-(800) 434-2269

Visa, MC, Amex, COD

Digital Entertainment GREAT VALUES ONE!

USSB dish

SAVE Compare to Cable
30%-50%

MORE ENTERTAINMENT OPTIONS
ALL THE HOT ACCESSORIES
PAY LESS

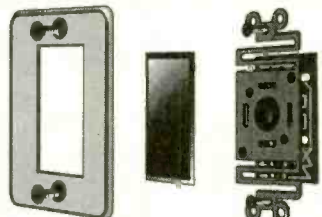
Fax: 218-739-4879
Int'l: 218-739-5231

1018 Frontier Dr.
Fergus Falls, MN 56537

Call Now 800-500-9264
www.skyvision.com Skyvision®

See your Security Camera on TV with
the CAModulator™

World's First & Only
B&W Camera Combined with a
Digital Video Channel Modulator



Perfect Stealth Surveillance
Covers UHF 14-44 Cable 45-94
Adjusts left, right, up & down. Sees in very low light. Uses any TV. Combines with existing cable, DSS, etc. Coax-powered™ technology powers camera & video signal with one cable.
IP-01 - \$279.95*
Camera only (no modulator or power supply) \$149.95
+ \$7.95 shipping & handling *

Intelligent Products
79 Daily Dr., #127
Camarillo, CA 93010
(800) 478-8491
(805)389-1757 FAX
M/C, VISA, AMEX, DISCOVER

ABC ELECTRONICS 315 7TH AVE N. MPLS. MN. 55401
(612)332-2378 FAX (612)332-8481 E-MAILSURP1@VISI.COM
WE BUY TEST EQUIPMENT AND COMPONENTS.

SENCORE LC53 L/C METER	\$350.00	TEK 7B15 1 GHZ DELAYING TIME BASE	\$250.00
TEK 7A13 DIFFERENTIAL COMPARATOR	\$150.00	TEK 7B50A 150 MHZ TIME BASE	\$75.00
TEK 7A17 150 MHZ SINGLE TRACE AMPLIFIER	\$50.00	TEK 7B52 DUAL TIME BASE	\$75.00
TEK 7A18 75 MHZ DUAL TRACE AMPLIFIER	\$50.00	TEK 7B53 100 MHZ DUAL TIME BASE	\$75.00
TEK 7A19 600 MHZ SINGLE TRACE AMPLIFIER	\$150.00	TEK 7B70 200 MHZ TIME BASE	\$75.00
TEK 7A22 DIFFERENTIAL AMPLIFIER	\$200.00	TEK 7B71 DELAYING TIME BASE	\$75.00
TEK 7A24 400 MHZ DUAL TRACE AMPLIFIER	\$200.00	TEK 7B80 400 MHZ DELAYED TIME BASE	\$100.00
TEK 7A26 200 MHZ DUAL TRACE AMPLIFIER	\$75.00	TEK 7B85 400 MHZ DELAYING TIME BASE	\$125.00
TEK 7B92A 500 MHZ DELAYING TIME BASE	\$125.00	TEK 7904 500 MHZ MAIN FRAME	\$250.00
TEK 7D13 DIGITAL MULTIMETER	\$50.00	TEK 577177 CURVE TRACER	\$1500.00
TEK 7S11 SAMPLING PLUG IN	\$200.00	TEK 475 200 MHZ OSCILLOSCOPE	\$500.00
TEK 7S12 GENERAL PURPOSE SAMPLER	\$350.00	FLUKE 95 SCOPE METER NO PROBES	\$600.00
TEK 453 50MHZ OSCILLOSCOPE	\$200.00	FLUKE 97 SCOPE METER WITH PROBES	\$1000.00
TEK 485 350 MHZ PORTABLE SCOPE	\$600.00	DRANETZ 626 DISTURBANCE ANALYZER	\$1500.00
GENRAD 1657 RLC BRIDGE	\$750.00	PHILLIPS PM3296 400 MHZ OSCILLOSCOPE	\$1000.00
TEK 7D20 PROGRAMMABLE DIGITZER	\$500.00	EMI SCR 7.5-300 7.5V 300A POWERSUPPLY	\$500.00
TEK 465 100 MHZ OSCILLOSCOPE	\$400.00	HP 8558B SPECTRUM ANALYZER	\$1500.00
TEK 465B 100 MHZ OSCILLOSCOPE	\$450.00	WAVETEK 175 WAVEFORM GENERATOR	\$500.00
TEK 2335 100 MHZ OSCILLOSCOPE	\$1200.00	WAVETEK 157 PROG. WAVEFORM SYNTH.	\$500.00
TEK 455 50 MHZ OSCILLOSCOPE	\$250.00	RACAL DANA 1901 COUNTER	\$250.00
HP 6428B 0-20V/0-45A POWERSUPPLY	\$400.00	RACAL DANA 9500 COUNTER	\$300.00
BRADLEY 132 SCOPE CALIBRATER	\$700.00	KEYTHLEY 261 PICOAMPERE SOURCE	\$150.00
FANELL TSU70MK.2 0-35V-10A OR 0-70V-5A P.S.	\$700.00	HP 5370A 100MHZ COUNTER	\$400.00
PHILLIPS PM3350A 60 MHZ DIG. STORAGE SCOPE	\$1000.00	HP 3455A MULTIMETER	\$300.00
HP 8601A 110 MHZ SWEEP/SIGNAL GENERATOR	\$400.00	HP 3456A MULTIMETER	\$450.00
HP 3575A GAIN-PHASE METER	\$500.00	HP 8503S S PARAMETER TEST SET	\$750.00
HP 8443A TRACKING GEN/COUNTER	\$350.00	TEK FG504 40 MHZ FUNCTION GENERATOR	\$500.00

Any waveform you want!



Starting at

\$795

Quantity 1

Money back guarantee

● Synthesized Signal Generator

Clean sinewaves DC-20 MHz with .001% accuracy!
.1 Hz steps. DC Offset. RS232 remote control.

● Arbitrary Waveform Generator

40 Megasamples/Second. 32,768 points. 12 bit DAC

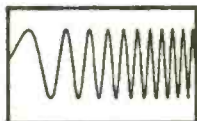
● Function Generator

Ramps, Triangles, Exponentials & more to 2 MHz!

● Pulse Generator

Digital waveforms with adjustable duty cycle

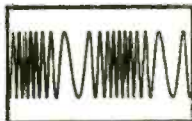
Telulex Inc. model SG-100



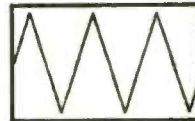
DC to 20 MHz linear and log sweeps



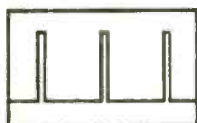
Int/Ext AM, SSB, Dualtone Gen.



Int/Ext FM, PM, BPSK, Burst



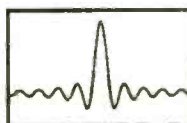
Ramps, Triangles, Exponentials



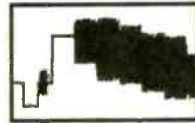
Pulse Generator



Noise



Arbitrary Waveforms



Unlimited Possibilities!

Telulex Inc.

2455 Old Middlefield Way S Tel (415) 938-0240 <http://www.Telulex.com>

Mountain View, CA 94043 Fax (415) 938-0241 Email: sales@Telulex.com

CIRCLE 322 ON FREE INFORMATION CARD

BEST DEALER PRICING!

CABLE DIRECT

CONVERTERS • FILTERS
DESCRAMBLERS

IMPROVE YOUR IMAGE WITH
VIDEO STABILIZERS

FREE
CABLE TV
CATALOG!

100%
MONEY BACK
GUARANTEE!

30 DAY
FREE
TRIAL!

Now you can tune-in your favorite
cable TV programming
and **SAVE \$100'S** -
EVEN \$1000'S on premium
CABLE TV EQUIPMENT.



**MODERN
ELECTRONICS**

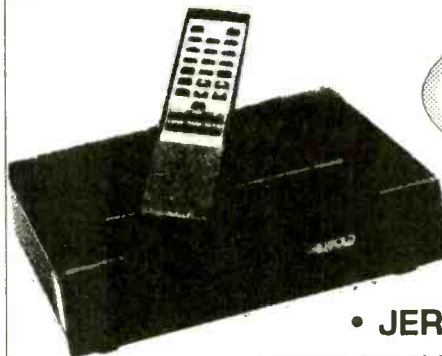
1-800-906-6664

2609 S. 156TH CIRCLE • OMAHA, NE 68130

<http://www.modernelectronics.com>

Plant Trees for America™

JAMES ELECTRONICS
1-800-676-7966



**BEST PRICE!
BEST SERVICE!**

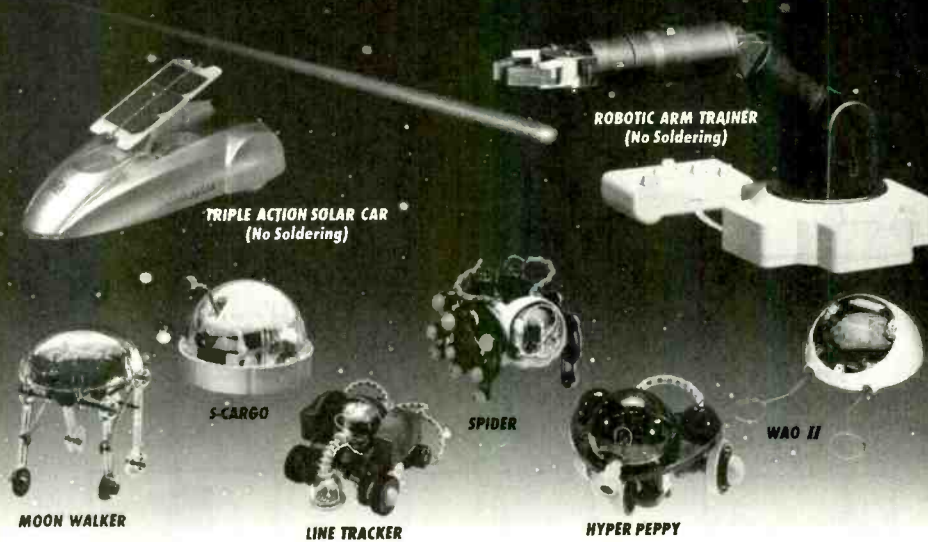
**ALL MAJOR SYSTEMS
FOR ANY U.S. LOCALE.**

- JERROLD • ZENITH • REGAL
- PANASONIC • SCIENTIFIC ATLANTA
- MAESTRO • BOSS • TOCOM • PIONEER

**1 YEAR WARRANTY ON ALL PRODUCTS!
CALL TOLL-FREE NOW FOR PRICE QUOTE.**

1-800-676-7966

A WHOLE NEW WORLD IN SCIENCE KITS.



OWI's "Next Generation" of affordable, rugged Robot Kits challenge the enthusiast to solder circuit boards and / or mechanically assemble.

Visit our homepage
@ <http://www.owirobot.com>

Each OWIKIT also incorporates the basic principles of robotic experiments, sensing and locomotion, guaranteeing an exciting, hands-on adventure of knowledge and fun!

But remember! OWI is the recognized founder and leader in Educational Robot Kits. ACCEPT NO IMITATIONS.



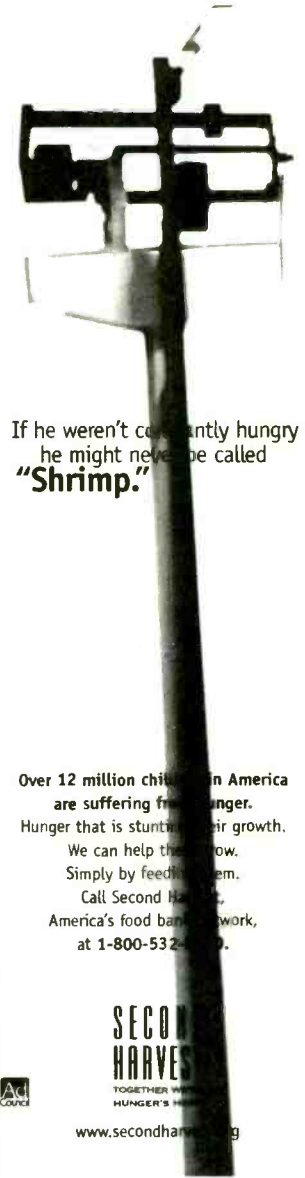
1160 Mahalo Place, Suite B
Rancho Dominguez, CA 90220-5443
(310) 638-7970
Fax: (310) 638-8347



Order M - F: 8a.m. - 4p.m. PST

ROBOTIC ARM TRAINER	OWI-007	5 Axis Control	NEW	69.95
TRIPLE ACTION SOLAR CAR	OWI-685	Solar Sensor	NEW	39.95
S-CARGO	OWI-936K	Sound Sensor	47 Pg. Book	36.95
WAO II	OWI-961K	Programmable - Graphic	59 Pg. Book	69.95
SPIDER	OWI-962K	Infrared Sensor	49 Pg. Book	49.95
LINE TRACKER	OWI-963K	Infrared Sensor	48 Pg. Book	49.95
HYPER PEPPY	OWI-969K	Sound / Touch Sensor	46 Pg. Book	24.95
MOON WALKER	OWI-989K	Solar Sensor	10 Pg. Book	34.95

CIRCLE 286 ON FREE INFORMATION CARD



If he weren't constantly hungry
he might never be called
"Shrimp."

Over 12 million children in America are suffering from hunger. Hunger that is stunting their growth. We can help them grow. Simply by feeding them. Call Second Harvest, America's food bank network, at 1-800-532-5299.

SECOND HARVEST

TOGETHER WE CAN END HUNGER'S HOLD

www.secondharvest.org

REMEMBER, ONLY YOU CAN PREVENT FOREST FIRES.

A Public Service of the USDA Forest Service and Your State Forester.



THE CABLE STORE

CABLE TV CONVERTERS AND DESCRAMBLERS

ABSOLUTELY THE LOWEST PRICES!

WE WILL NOT BE UNDERSOLD. NOBODY BEATS OUR PRICES, EVER!
ALL MAJOR BRANDS • 30 DAY FREE TRIAL/MONEY BACK GUARANTEE
SPECIAL DEALER PRICING AND QUANTITY DISCOUNTS

1-800-390-1899

2221 Peachtree Road Suite 144, Atlanta, GA 30309 * <http://www.adpage.com/cablestore>
Sorry no GA sales. No satellite equipment. Anyone implying cable theft will be denied service.



One tree can make
3,000,000 matches.



One match can burn
3,000,000 trees.



A Public Service of This Magazine
© The Advertising Council

MEMBRANE SWITCH KITS!

FLAT PANEL KEYPADS ASSEMBLE IN MINUTES WITH YOUR LEGEND

AVAILABLE IN 4, 12, 16, 24 & 40 KEY TYPES



DSK-4 \$9.89

DSK-12 \$14.29

INDUSTRIAL TYPES AVAILABLE

MORE THAN 30 LAYOUTS TO FIT MOST APPLICATIONS

CALL FOR FREE BROCHURE

SIL-WALKER

880 CALLE PLANO,
UNIT N
CAMARILLO, CA
93012

PHONE: (805) 389-8100

FAX: (805) 484-3311

VISA / MASTERCARD

COUNTERSURVEILLANCE COVERT SURVEILLANCE

VIBRATING TRANSMITTER DETECTOR

DETECTS:

- Body Wires
- FM Wireless Mics
- AM Transmitters
- UHF Transmitters



AI-2100 ... \$189.95

TRVD-900

DETECTS:

- Body Wires • Transmitters
- Tape Recorders • Video Equipment



TRVD-900 \$495

BLACK BOX COLOR CAMERA



BX-300 \$395

SMOKE DETECTOR COLOR CAMERA



SD-300 \$450

COVERT COLOR VIDEO LAMP

- 380 (H) TV Lines
- 2 Lux Sensitivity
- Undetectable Lens



VL-300 ... \$595

AI-5500 COMPLETE SAFETY SYSTEM

DETECTS:

- All Phone Taps
- All Body Wires
- All Transmitters



DISRUPTS:

ALL TRANSMITTERS & BODY WIRES WITH ITS BUILT-IN
WHITE NOISE SIGNAL BREAKER

\$379.95

WSS-300 COLOR WIRELESS SURVEILLANCE SYSTEM

FEATURES:

- FCC Approved 2.4GHz Transmitter / Receiver
- Radio w/ Built-In Color Camera / Transmitter
- 380 (H) TVL Resolution • Super Low 2 Lux
- 4-Channel Receiver • 300' Transmission

Note: Cassette Player Non-Functioning \$895



All 300 Series Color Cameras Feature: Superior Resolution - Over 380(H) TV Lines
Super Low 2 Lux Sensitivity, 3.7mm Wide-Angle Lens. Built-In Backlight Compensation

Items May Be Purchased by Credit Card, Certified Check, Money Order or C.O.D.

Send \$6.00
for 32-Page
Catalog
(FREE w/ Purchase)

AMERICAN INNOVATIONS, INC.

119 ROCKLAND CENTER - SUITE 315 • NANUET, NY 10954

VOICE: (914) 735-6127 • FAX: (914) 735-3560

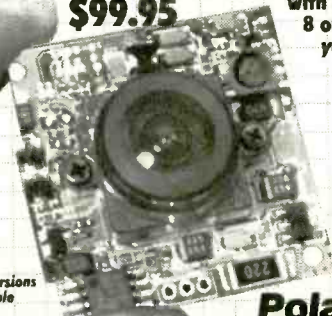
HTTP://WWW.SPYSITE.COM • E-MAIL: AMERICAN@SPYSITE.COM

Dealers &
Distributors
Welcome

CIRCLE 282 ON FREE INFORMATION CARD

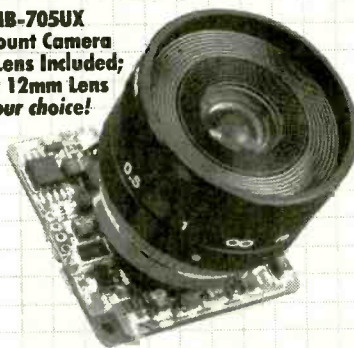
MICRO SIZE CCD VIDEO CAMERAS

MB-750U
Video Camera
\$99.95

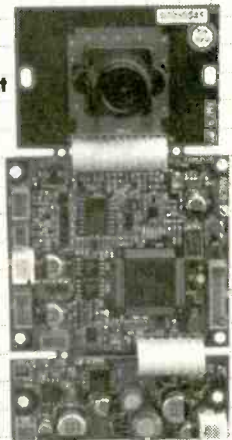


Pinhole Versions Available

MB-705UX
C-Mount Camera
with Lens Included;
8 or 12mm Lens
your choice!



Cost Effective Color
Board Cameras
MB-1282 \$199.95
with Built-In Audio out



- Wireless Models Available.
- Color Board Cameras "Y" / "C" SVHS signal.
- Models to 600 Line Res.
- Monitor in total Darkness with IR Option.
- Plugged into any VCR or Monitor to view.
- Low LUX/Low Noise.
- Low Power Consumption.
- Standard NTSC Output.
- Lenses/Fiber Optics

See More Products @

Polaris Industries
<http://www.polarisusa.com>
800.752.3571



**Free Catalog
Code: ES097**

470 Armour Drive NE • Atlanta GA 30324 • Tech Info: 404-872-0722 • FAX 404-872-1038

BEST BY MAIL

Rates: Write National, Box 5, Sarasota, FL 34230

BUSINESS OPPORTUNITIES

PERSONAL COMPUTER OWNERS can earn \$1000 to \$5000 Monthly offering simple services part time. Free list of 100 best services. Write: Services, P.O. Box 1120-(C), NPR, FL 34656-1120.

RADIO BROADCASTING FROM Your Home, Lucrative. \$1.00. Broadcast, 87 Harvest Lane, Plantsville, CT 06479. (888) 621-6793.

FREE GAS EARN CASH DAILY, Free Gas, 24813 N. E. Stegert Drive, Battle Ground, WA 98604. Call 1-888-742-5541.

EDUCATION

HIGH SCHOOL DIPLOMA At Home, Accredited, Fast, "Fail-ure-Proof" 1-800-470-4723: American Academy, 12651 S. Dixie Highway, Miami, FL 33156.

FINANCIAL

REDUCE INCOME TAXES to zero. SASE: EKR, Box 800, Maple Falls, WA 98266-0800.

\$1 LUMP SUM CASH NOW!! We buy your **INSURANCE SETTLEMENT, ANNUITY, MORTGAGE NOTES, or FARM CONTRACTS (PFC's) PAYMENTS** for CASH! Quick Closings. 1-800-338-5815 Ext. 500.

GUARANTEED HIGH YIELD INVESTMENTS! Profit 100% - 200%! Full Details, \$5.00. ETAM, 360 Grand Avenue #398, Dept. TIGC, Oakland, CA 94610.

VISA OR MASTERCARD - 96% APPROVED, Bad Credit, Low Income, Bankruptcy 800-426-5841.

HEALTH

SHOCKING! "Are Parasites Eating You Alive?" Let Dr. Ross Anderson reveal the truth!!! **FREE AUDIO TAPE**. CALL 1-800-995-0796 #7958.

THE ARTHRITIS CURE. Restores Cartilage. Tremendous Money-maker! 1-800-363-4050.

MONEYMAKING OPPORTUNITIES

YOU CAN HIT THE JACKPOT Using Classifieds! Send \$9.95 to: IDEAS, Box 187, New Ringgold, PA 17960.

MAKE MONEY Become Certified Bartender. Home Study Course \$149.95. 800-213-2088.

OF INTEREST TO ALL

PINBALL MACHINES! BOOKS, Parts, Catalog \$2.00. 5290-(ELE) Platt Springs, Lexington SC 29073-9252.

WIN COLORADO RECREATIONAL Ranch or Wisconsin Hunting Farm 1-800-946-7262.

Home Buyers & Sellers **BEWARE**, FREE Information 1-800-500-8179.

"BARTER WILL ENRICH YOU" free: Box 2527, Sarasota, FL 34230.

WHOLESALE 19¢ PHONECARDS. Never Pay Retail. Save \$100's. Sample Kit \$14.95. MPE Inc., Dept-ELE(10/97), Box 820, Newtown, PA 18940.

CLASSIFIED

MISCELLANEOUS ELECTRONICS FOR SALE

TUBES: "oldest", "latest". Parts and schematics. SASE for lists. **STEINMETZ**, 7519 Maplewood Ave., EN, Hammond, IN 46324.

FIBER-Optic Projects—Swing into the new technology by assembling tried and true projects recently published. "Practical Fiber-Optic Projects" - BP374 is only \$9.95. (price includes shipping) **ELECTRONIC TECHNOLOGY TODAY INC.**, PO Box 240, Massapequa Park, NY 11762-0240.

GREEN Thumb Alert—Electronics enters the Garden! New exciting book points out how gardeners can build simple gadgets to promote success where the elements work against you. Some of the projects are: over/under temperature monitoring, dusk/dawn switching, automatic plant watering, warming cables, etc. "Electronic Projects for the Garden" only \$9.95 (price includes shipping) **ELECTRONIC TECHNOLOGY TODAY INC.**, PO Box 240 Massapequa Park, NY 11762-0240.

RF Transistors, tubes 2SC1969, 2SC2166, MB8719, 2SC2312, 2SC2879, MRF477, MRF455, MRF454, MRF492, SRF3749, 4CX250B, 572B, 3-560, 6146B, 8975, **WESTGATE** 1 (800) 213-4563.

PIECE parts for Delco OEM radios. Low pricing. **Factory Original**. No subs. Call today, 1 (800) 433-9657.

CONVERTER-descramblers: Examples, Zenith Ztac \$225.00, 8580 compatible \$200.00; 8600 \$335.00; 7212 compatible \$200.00; 2024 \$335.00; 450DIC \$125.00; **Pioneer test generator** \$150.00. Most makes in stock, COD ok. **MT. HOOD ELECTRONICS** (503) 543-7239.

PLANS-KITS-SCHEMATICS

FREE Catalog. 100 Leading-Edge kits. K1, PIC. Full instructions, source code. 1 (800) 875-3214. **SCIENCE FIRST**, 95 Botsford Place, Buffalo, NY 14216.

ELECTRONIC Project Kits. www.qkits.com 1-888-GO-4-KITS. 292 Queen St., Kingston, ON., K7K 1B8. **QUALITY KITS**.

ALL-in-one catalog, 60 mouth-watering pages. CB/HAM/audio/TV/spy/broadcast/science projects, **micropower broadcasting**, broadcast transmitters, amplifiers, antennas, "secret books", start your own radio station and more. Send \$1.00 to **PAN-COM INTERNATIONAL**, PO Box 130-N10, Paradise, CA 95967.

5000 Volts in the palm of your hand. Battery powered. Plans \$7.00. P.O. Box 113, Cookeville, TN 38503-0113. P/N ENHV001.

AWESOME Kits: Voice changers, levitators, lasers, gas sensors and more! Catalog \$1.00. **LNS TECHNOLOGIES**, 20993 Foothill Blvd., Suite 307R, Hayward, CA 94541. www.ccnnet.com/~lnstech

CABLE TV

TEST chips, test aids. All types, best products. Best prices. RFT-JTG-Terminator. Call 1 (800) 671-1110. E-mail (xlent@hi.net)

CABLE Descrambling New secret manual. Build your own descramblers for cable and subscription TV. Instructions, schematics for SSAVI, Gated Sync, Sinewave, (HBO, Cinemax, Showtime, UHF, Adult) \$12.95, \$2 postage. **CABLETRONICS**, Box 30502R, Bethesda, MD 20824.

CABLE TV Equipment & Accessories., Wholesalers welcome! 30 day moneyback guarantee! Free catalog! **PROPROMANCE ELECTRONICS INC.**, 1 (800) 815-1512.

CABLE TV descramblers. Pioneer 6310's, Scientific Atlanta, Jerrold. Warranty. Lowest prices anywhere. Houston, TX 1 (888) 691-4610.

CABLE TV notch filters. Request our free brochure today! Voicemail: 1 (800) 433-6319. Address: **STAR CIRCUITS**, PO Box 94917, Las Vegas, NV 89193.

CABLE test modules/cubes. Pioneers, S/A, Tocoms, Jerrold. Latest technology. Quantity discounts. Call **DCR Tel:** (718) 426-8515/624-8334. Fax: (718) 246-9731. Please no N.Y. calls!

NEW! Jerrold and Pioneer wireless test units \$125.00 each, also 75DB notch filters \$19.95 each, quantity pricing available. Please call **KEN ERNY ELECTRONICS**, 24 hour order and information hot line (516) 389-3536.

DESCRAMBLE cable with simple circuit added to Radio Shack RF modulator and using VCR as tuner. Instructions \$10.00. **TELCOM**, Box 832-E10, Brusly, LA 70719.

CABLE test chips, real wholesale pricing, volume purchase programs, monthly specials, toll free 1-888-676-test.

CABLE descramblers and converters 10 lot decoders \$38.00 ea. 10 lot converters \$57.00 ea. Visa and Mastercard accepted. (304) 337-8027.

CABLE Descrambler!! Anyone can build in seven steps with Radio Shack parts. **Plans/kit** from \$5.00 plus free bonus!! 1 (800) 818-9103.

CABLE "Bullet Terminator and I.D. Blocker." Electronically shields yourself and your box. Also new Super Bullet/ID Eliminator!! Lifetime guarantee!! 1 (800) 820-9024.

GIANT Sale!! Positive notch filter \$18.00. **E-Z Install cable test activation chips/boards** from \$5.00. **Original equipment descramblers** from \$149.00. External activators \$125.00. Much more!! Dealers Wanted. 1 (800) 449-9189 Anytime.

ALL raw unmodified Tocom 5503A \$22.00, VIP \$60.00, SA 8600 new \$165.00, Pioneer 5135 \$50.00, Jerrold DP5 \$50.00, Drz P \$22.00, Zenith 1082 \$22.00, Oak \$22.00. 5 Lot only. 1 (800) 219-8618.

MAESTRO latest technology. Compatible with all major systems: Pioneer, Jerrold, Scientific Atlanta, Zenith. Universal descrambling capabilities. Dealers wanted. Money back guarantee. 1 (800) 676-7966.

SATELLITE EQUIPMENT

VIDEOCYPER II descrambling manual. Schematics, video and audio. Explains DES, EPROM, CloneMaster, Pay-per-view (HBO, Cinemax, Showtime, Adult, etc.) \$16.95, \$2.00 postage. Schematics for Videocypher II Plus, \$20.00. Schematics for Videocypher II 032, \$15.00. Software to copy and alter EPROM codes, \$25.00. VCII Plus EPROM, binary and source code, \$30.00. **CABLETRONICS**, Box 30502R, Bethesda, MD 20824.

DSS Hacking: How to construct and program smart cards, w/pic16C84, software. Complete DSS system schematics. \$16.95. **CABLETRONICS**, Box 30502R, Bethesda, MD 20824.

FREE Big Dish Catalog - Low prices - Systems, upgrades, parts and "4DTV". Call **SKYVISION** (800) 334-6455. International (218) 739-5231. www.skyvision.com

DSS Bible Volume 2. \$85.50 **DSS Bible Volume 1** - \$55.45 **DSS Secrets** - All patents \$69.95. **Cellular Hackers Package**. (3) Hacker Bibles, (2) Videos & programming software. \$199.00. **25+ Master Test Chip Files**. Jerrold, Scientific-Atlanta, Tocom, Pioneer, Zenith. Software & book. \$79.95. **TELECODE** 1 (520) 726-2833. http://www.hackerscatalog.com

OBTAINING sound for your VCII and VCII Plus is easy. No codes needed. Also DSS Test Card info form. Details 1 (800) 211-5635.

TRANSFER PAPER FOR PRINTED CIRCUITS

USE WITH REGULAR HOUSEHOLD IRON

FAX (305) 538-3648

• 30 sheets for \$24.00
8 1/2" x 11"

S&H INCLUDED



Send check or money order to

STARLET SYSTEMS

1348 Washington av.
Suite # 189, Miami Beach
Florida, FL 33139

MAKE CIRCUITS EASY FROM YOUR LASER OR PHOTOCOPY MACHINE

CABLE TV CONVERTERS

Equipment & Accessories
Wholesalers Welcome

Call **C&D ELECTRONICS**
1-888-615-5757 M-F 10a-6p

TELEPHONE

TELEPHONE voice changer. \$24.95; ultrasonic pest repeller \$24.95; laser pen painter \$49.95. \$5.00 S&H. **SCIENTIFIC FRONTIER**, P.O. Box 24746, Tempe, AZ 85285-4746. 1 (800) 622-7674.

REPAIRS-SERVICES

PCB Designs. Professionally mastered in "TANGO". **AWESOME DESIGNS**, P.O. Box 214, Aurora, Ohio 44202-0214. E-Mail: Awesome-Designs@worldnet.att.net

TEST EQUIPMENT

TEST Equipment pre-owned now at affordable prices. Signal generators from \$50.00, oscilloscopes from \$50.00. Other equipment including manuals available. Send \$2.00 US for catalog. Refunded on first order. **J.B. Electronics**, 3446 Dempster, Skokie, IL 60076. (847) 982-1973.

INVENTORY reduction sale! Test equipment prices slashed up to 60%. Limited time offer. View complete list at web site. "a-mail.com" or call now to receive list by fax or mail. **AST GLOBAL MARKETING**, Voice: 888-216-7159; Fax: 814-337-7920 e-mail: astmktg@wrench.toolcity.net

BUSINESS OPPORTUNITIES

I'M making a "bundle" reclaiming scrap gold from junk computers. Free info: 24 hrs, (603) 645-4767.

GREAT extra income idea! Assemble products at home for best companies. Information call: 1 (800) 377-6000 ext. 6870.

ELECTRONICS Enterprises. Home based. Part/Full time. 250pg Comprehensive Guidebook, insider information. 24hr recording (800) 326-4560 x159.

EDUCATION & INSTRUCTION

LEARN Electronics. Home study. Outstanding careers. Free literature. P.C.D.I., Atlanta, Georgia. 1 (800) 362-7070 Dept. ELL342.

WANTED

WANTED: Used test equipment. Turn idle or unwanted equipment into cash. **AST GLOBAL MARKETING**, Voice: 888-216-7159; Fax: 814-337-7920, e-mail: astmktg@wrench.toolcity.net

3 Axis Motion Control System Complete, ready to run

\$ 255.50 + 12.00 S/H

Build or adapt CNC mills, CNC routers, Robots, Etc. Includes: 3 Stepping motors (70 oz/in 200 steps/rev). External board (connects to parallel port of a PC). Power supply. Cables. Manual and the MAXNC drive software, with linear, circular and helical interpolation, acceleration/deceleration, full contouring, 'G' code programming, screen plot, code generation from CAD (CAM), and more.

For more information,
phone or write to:

MAXNC

6509 W. Frye Rd. Suite 3
Chandler AZ 85224
Ph (602) 940-9414
Fax (602) 940-2384



BUGGED??

EAVERDROPPING is unbelievably widespread! Electronic devices with amazing capabilities can be monitoring your telephone and room conversations RIGHT NOW! Are you sure you're safe? **FREE CATALOG** tells you fast! Includes Free Bonus details on fantastic opportunities now open in Counter-Surveillance field. Exciting, immensely interesting and EXTREMELY profitable (up to \$250/hr) full/part-time income. Call Now! **1-800-732-5000**

The Electronic Experimenter's Journal

It's part catalog, part magazine and part data book with kits, parts, plans, articles, and application notes.

Call for your **FREE** copy today

Debco Electronics
4025 Edwards Rd.
Cincinnati, OH 45209

1 800 423-4499

Function Generator

Frequency ranges of 1 Hz to 16 MHz
Sine, Triangle, and Square Wave
Amplitude range of 100mv to 20v p-p
Variable DC offset

Crystal control Phase Lock Loop
ISA board that combines the features of a "box" function generator with the convenience of a PC
Programmer's libraries that support C, C++ or Visual Basic
Windows 3.1, 95 and NT based application programs

Model ISA-104 **\$395.00**

J-Works, Inc.

12328 Gladstone Unit 4
Sylmar, CA 91342
(818)361-0787

e-mail: jworksjm@gte.net

Do You Repair Electronics?

Repair Databases for TV, VCR, Monitor, UL Audio, FCC, and more.

- Over 75,000 records
- Private user forums
- Live on-line chat rooms

www.electronix.com

Electronix Corp. 115 W. Main St. Fairport, NY 14450. (937) 878-9878

VIDEO SYNC GENERATOR



Restores Horizontal
and Vertical
Sync Lines from Distorted
Analogue Video Formats

For Free Information Package on Completed Units and Pricing

Call 219-236-5776
R.C. Distributing • PO Box 552 • South Bend, IN 46624

CABLE TV CONVERTERS

Equipment & Accessories
Wholesalers Welcome

Call **C&D ELECTRONICS**
1-888-615-5757 M-F 10a-6p

Call For **FREE** Catalog!

CABLE TV BONANZA

**LOW
PRICES!
GREAT SERVICE!**

**FULL VIEW CABLE BOXES
WHOLESALE PRICES!**

**30 Day Free Trial!
1 Year Guarantee!**

• VIDEO STABILIZERS - Removes video tape copy protection
• TEST CHIPS, DEVICES, FILTERS AND ACCESSORIES

FREE BULLET BUSTER

with cable box purchase (REG.\$9.95)
Anyone implying theft of service will be denied assistance

N.S. INTERNATIONAL

OPEN DAILY
9am - 11pm (EST)

1-800-449-9189

C.O.D. or
Credit Cards

Write **\$99⁹⁵**
PIC
programs in
BASIC!



PicBasic Compiler

BASIC makes it easy for you to program the fast and powerful Microchip PIC microcontrollers.

- ♦ Expanded BASIC Stamp 1 compatible instructions
- ♦ True compiler provides faster program execution and longer programs than BASIC interpreters
- ♦ In-line assembler and Call support
- ♦ **New Features!** Peek & Poke, I2Cin & I2Cout
- ♦ Supports PIC16C6x, 7x and 8x microcontrollers

PicBasic Compiler Bundle - \$179.95

Includes: PicBasic Compiler, EPIC Programmer, AC Adapter, 25 Pin Cable, PICProto18 and PIC16F84

*BASIC Stamp is a trademark of Parallax, Inc.

microEngineering Labs, Inc.
Box 7532 Colorado Springs CO 80933
(719) 520-5323 FAX 520-1867
http://www.melabs.com

SURVEILLANCE

**The Latest High Tech
Professional Electronic Devices**

Our latest catalog offers a **HUGE** selection of surveillance, counter-surveillance/privacy devices: hidden video equipment, pinhole camera w/audio \$159⁰⁰, electronic kits, telephone recording systems: 7-Hour \$125⁰⁰-16-Hour \$199⁰⁰ touch tone decoders, scanners, bug/phone tap detectors, voice disguisers, telephone scramblers, locksmithing tools, and more.

Catalog \$5.00

SPY OUTLET

P.O. Box 337, Buffalo, NY 14226
(716) 691-3476/(716) 695-8660

ADVERTISING INDEX

Electronics Now does not assume any responsibility for errors that may appear in the index below.

Free Information Number	Page	Free Information Number	Page
— Abacom Technology	96	249 Kelvin Electronics	111
— ABC Electronics	112	— Learn Inc	23
— Aegis Research, Canada	104	— M2L Electronics	110
— AES	95	215 Mark V Electronics	109
214 All Electronics	101	330 MCM Electronics	83
— Allison Technology	88	— Meredith Instruments	93
— Allstar Electronics	94	— Merrimack Valley Systems	92
— Alpha Electronics	84	128 MicroCode Engineering	CV2
— Amaze Electronics	106	— Micro Engineering Labs	117
320 American Eagle Publications	90	— Modern Electronics	113
282 American Innovations	115	— MWK Industries	96
324 Basic Electrical Supply	96	— NRI Schools	11, 39
325 Bel-Merit	110	— NS International	117
— Bsoft Software, Inc.	92	71 NTE Electronics, Inc.	36
316 Butterworth-Heinemann	107	286 OWI	114
333 C&S Sales, Inc.	80	262 Parts Express Inc.	89
129 CadSoft Computer Inc.	7	— Pioneer Hill Software	92
311 Capital Electronics	102	— Polaris Industries	115
— CD Electronics	88	326 Prairie Digital	88
332 Circuit Specialists	98	264 Print (Pace)	105
— Cleveland Institute of Electronics	21	78 Radio Shack	3
— Command Productions	90	266 Ramsey Electronics	103
226 Consumertronics	78	— RC Distributing Co.	117
334 CTG	106	— RF Parts	102
— Cybermation	100	328 Roger's Systems Specialist	97
— EDE - Spy Outlet	117	— Sil Walker	115
335 Electronix Express	100	— Sirius Micro Systems	104
— Electronics Tech. Today	CV3, 77	— Square 1 Electronics	108
— Emac Inc.	90	— Starlet Systems	116
312 Foley-Belsaw Co.	91	— Street Smart Security	84
331 Fotronic	104	327 Sun Equipment	87
— General Device Instruments	92	— Tab Books	5, 73
— George Brown College	17	— TCS Electronics	114
— Grantham Col. of Engineering	4	— Technical Serv. & Solutions	108
— Home Automation	95	322 Telulex	113
— Home Controls	108	— Test Equipment Sales	108
315 Howard Electronics	79	275 Timeline	82
— Howard Electronics	110	— U.S. Cyberlab	95
— Information Unlimited	85	— Visual Communications	17
— Intelligent Products	112	— Voice World	106
126 Interactive Image Technologies	CV4	98 Wavetek Corp.	15
321 IVEX Design International	93	319 White Star Electronics	102
— J-Works	117	— World College	49
— Jameco	13	— WPT Publications	100
— James Electronics	113	280 Xandi Electronics	84
323 Jensen Tools	112		

ADVERTISING SALES OFFICES

Gernsback Publications, Inc.
 500 Bi-County Blvd.
 Farmingdale, NY 11735-3931
1-(516) 293-3000
Fax 1-(516) 293-3115

Larry Steckler
 publisher (ext. 201)
 e-mail advertising@gernsback.com

Adria Coren
 vice-president (ext. 208)

Ken Coren
 vice-president (ext. 267)

Christina Estrada
 assistant to the publisher (ext. 209)

Arline Fishman
 advertising director (ext. 206)

Michele Torriolo
 advertising assistant (ext. 211)

Adria Coren
 credit manager (ext. 208)

For Advertising ONLY

EAST/SOUTHEAST

Stanley Levitan
 Eastern Advertising
 1 Overlook Ave.
 Great Neck, NY 11021-3750
 1-516-487-9357
 Fax 1-516-487-8402
 slevitan26@aol.com

MIDWEST/Texas/Arkansas/Okla.

Ralph Bergen
 Midwest Advertising
 One Northfield Plaza, Suite 300
 Northfield, IL 60093-1214
 1-847-559-0555
 Fax 1-847-559-0562
 bergenrj@aol.com

PACIFIC COAST

Janice Woods
 Pacific Advertising
 Hutch Looney & Associates, Inc.
 6310 San Vicente Blvd., Suite 360
 Los Angeles, CA 90048-5426
 1-213-931-3444 (ext. 228)
 Fax 1-213-931-7309
 woodyowl@aol.com

Electronic Shopper

Joe Shere
 National Representative
 P.O. Box 169
 Idyllwild, CA 92549-0169
 1-909-659-9743
 Fax 1-909-659-2469
 Jshere@gernsback.com

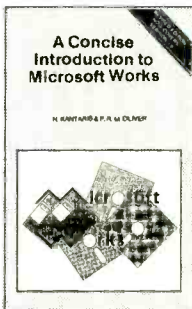
Megan Mitchell
 National Representative
 9072 Lawton Pine Avenue
 Las Vegas, NV 89129
 Phone/Fax 702-240-0184
 Lorri88@aol.com

Customer Service

1-800-999-7139
 7:00 AM - 6:00 PM M-F MST

Buyers' Budget Books Better Buys

BP294—A Concise Introduction to Microsoft Works \$6.95. In the shortest and most effective way, you can use the word processor to advantage to type, edit, print and save documents. It goes on to explain how Works can be used to build up simple spreadsheet examples, edit them, save them, print them and retrieve them. It informs you how to create simple macros, and enables you to simplify long repetitive tasks and to customize the program to your own needs.



BP349—Practical Opto-Electronic Projects \$5.95. If you shun opto-electronic projects for lack of knowledge, this is the book for you. A bit of introductory theory comes first and then a number of practical projects which utilize a range of opto devices, from a filament bulb to modern infrared sensors and emitters.

BP350—Electronic Board Games \$6.00. Twenty novel electronic board games that you can build from the plans in this book. Whether you are interested in motor racing, searching for buried treasure on a barren island or for gold in Fort Knox, spinning the wheel of fortune, or doing a musical quiz—there is something for you to build and enjoy!

BP351—WordPerfect 6 Explained \$6.95. This is a practical, hands-on, book and the routines described will help you get the most out of WordPerfect 6. The book explains the hardware requirements for the package and steps you through a standard installation. It guides you through the WordPerfect program environment to enter, edit and enhance text and shows how to get the best from the three different operating modes, depending on the type of PC you are using. The formatting codes, button bars, ribbon, tabs, graphic manipulation and styles will no longer be a mystery.

BP388—Why Not Personalize Your PC? \$6.95. Find out how to: Set up and organize groups of programs and data files, and change the opening logo; use the Control Panel to personalize your working environment; use screen savers and wallpaper files; manage the DOS prompt; and transfer your customization files to a new Windows installation. In DOS, you discover how to: Write batch files and create specialist programs using the debug program, design professional looking menus, and more.

BP367—Electronic Projects for the Garden \$6.95. Electronics enters the Garden! New exciting book points out how gardeners can build simple gadgets to promote success where the elements work against you. Some of the projects are: over/under temperature monitoring, dusk/dawn switching, automatic plant watering, warming cables, etc.

BP368—Practical Electronics Musical Effect Units \$5.95. There is a constant hullabaloo for musical effects projects by the hobbyist community. This book provides practical circuits for several projects that range in complexity and are sure to work. All the circuits are easy to build and use readily-available parts.

BP363—Practical Electronic Music Projects \$5.95. The text contains a goodly number of practical music projects most often requested by musicians. All the projects are relatively low-in-cost to build, and all use standard, readily-available components. The project categories are guitar, general music and MIDI.

100% NEW TITLES LISTED EACH MONTH—CHECK US OUT!

BP385—Easy PC Interfacing \$6.95. The built-in ports in your PC provide an easy and hassle-free way of interfacing your circuits. This book provides useful PC add-on circuits including the following: Digital input/output ports; analog-to-digital and digital-to-analog converters; voltage and current measurement circuits; resistance and capacitance meters, temperature measurement interface, biofeedback monitor, and many other useful interfaces.

BP393—Practical Concise Introduction to UNIX \$5.95. If you are using or intend to use the UNIX multi-user operating system and want to get the most out of your computer system in terms of efficiency and productivity, then you must learn its operating system. The book explains how the UNIX operating system is structured so that you understand what happens when you first approach your computer.

BP396—Electronic Hobbyists Data Book \$5.95. This book provides a wide range of data. If, for example, you require details of a modern five-band resistor code or an old color code for a ceramic capacitor, the formula for parallel resistance, or basic data on an NE5534AN operational amplifier, it is contained within these pages. The subjects covered are numerous and widespread to cover all hobbyist interests.

BP343—A Concise Introduction to Microsoft Works for Windows \$7.95. The book explains and details: How the Works for Windows package fits into the general Microsoft Windows environment; how to use the word processor to advantage; how to use Microsoft Draw to create and edit graphics and place them in your documents; how to build up simple spreadsheet examples; and how single, and multiple charts, or graphs, of different types can be generated. And there's much more!

BP282—Understanding PC Specifications \$7.25. This book explains PC specifications in detail, and the subjects covered include the following: Differences between types of PC (XT, AT, 80386, 80486, Pentium etc.); math co-processors; input devices (keyboards, mice, and digitizers); memory, including both expanded (EMS) and extended RAM; RAM disks and disk caches; floppy disk drive formats and compatibility; hard disk drives; and display adapters (CGA, Hercules, super VGA, etc.).

BP298—Concise Intro to the Macintosh System and Finder \$6.25. Although the Mac's WIMP user interface is designed to be easy to use, much of it only becomes clear when it is explained in simple terms. The book explains: The System and Finder, what they are and what they do; how to use the System and Finder to manipulate disks, files and folders; configuring and printing files from the Finder; getting the most from the system utility programs; and running MultiFinder.

BP301—ANTENNAS FOR VHF AND UHF \$6.00. From installing a TV or FM antenna to setting up a multi-antenna array for shortwave listening or amateur radio, this book explains the essential basics of VHF and UHF antenna operation and installation. In easy-to-understand terms it helps you understand how antennas work, the advantages of different antenna types, and how to get the best performance out of an antenna.

BP316—Practical Electric Design Data \$7.95. A builder's bargain book—a comprehensive ready-reference manual for electronic enthusiasts with over 150 practical circuits. It covers the main kinds of components (from pig-tail leads to surface mount), pin-outs, specs and type selection. Basic units are defined and most used formulae explained. Five additional sections are devoted to circuit design, covering analog, digital, display, radio and power supply circuits.

BP319—Making MS-DOS Work For You \$6.50. This book could help you improve your system set-up and provide you with a simple-to-use, but professional looking, menu system. The routines described will help you understand more of the workings of MS-DOS and help you get the most out of your computer in terms of efficiency, productivity and enjoyment.

BP341—MS-DOS 6 Explained \$7.95. The book covers: How the DOS operating system of your computer is structured so that you can understand what happens when you first switch on your computer; How directories and subdirectories can be employed to structure your hard disk for maximum efficiency; how to use the DOS Shell program, and much, much more.

BP345—Getting Started In Practical Electronics \$5.95. If you are looking into launching an exciting hobby activity, this text provides basic essentials for the builder and 30 easy-to-build fun projects with which every experimenter should toy. Printed-circuit designs are included to give your project the professional touch.

ELECTRONIC TECHNOLOGY TODAY INC.
P.O. BOX 240, Massapequa, NY 11762-0240

Name _____
Address _____
City _____ State _____ Zip _____

SHIPPING CHARGES IN USA AND CANADA

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

SORRY No orders accepted outside of USA & Canada

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

No. of Books Ordered

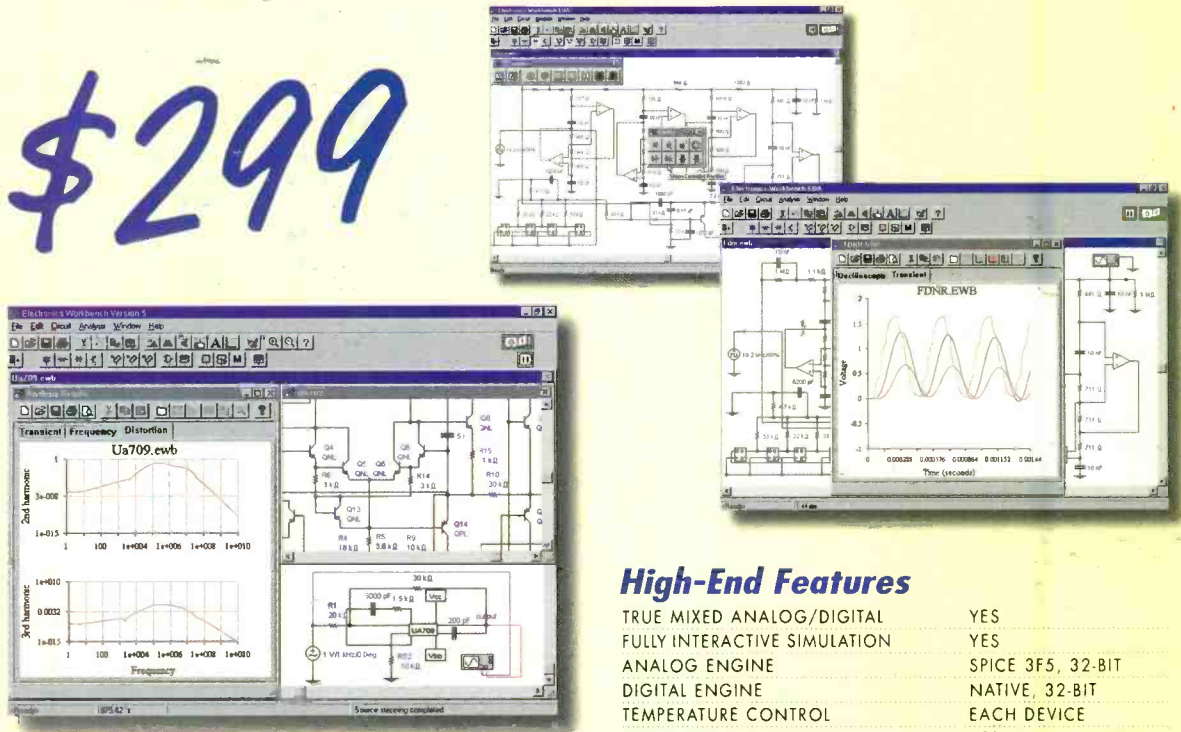
NW1

Allow 6-8 weeks for delivery

All payments must be in U.S. funds!

Better Designs -Faster

\$299



NEW!

Electronics Workbench Version 5 with analog, digital and mixed A/D SPICE simulation, a full suite of analyses and over 4,000 devices. Imports SPICE netlists. Exports to PCB layout programs. Still the standard for power and ease of use. Still the same low price.

Join over 75,000 customers and find out why more engineers and hobbyists buy Electronics Workbench than any other SPICE simulator. You'll be working productively in 20 minutes, and creating better designs faster. We guarantee it!

Check our web site at
<http://www.interactiv.com>
for a free demo

30-DAY MONEY-BACK GUARANTEE
VERSION 5.0 FOR WINDOWS 95/NT/3.1. Upgrades from previous versions \$79.

CALL 800-263-5552



Fax: 416-977-1818 Internet: <http://www.interactiv.com> CompuServe: 71333,3435/BBS: 416-977-3540/E-mail: ewb@interactiv.com
CIRCLE 126 ON FREE INFORMATION CARD

High-End Features

TRUE MIXED ANALOG/DIGITAL	YES
FULLY INTERACTIVE SIMULATION	YES
ANALOG ENGINE	SPICE 3F5, 32-BIT
DIGITAL ENGINE	NATIVE, 32-BIT
TEMPERATURE CONTROL	EACH DEVICE
PRO SCHEMATIC EDITOR	YES
HIERARCHICAL CIRCUITS	YES
VIRTUAL INSTRUMENTS	YES
ON-SCREEN GRAPHS	YES
ANALOG COMPONENTS	OVER 100
DIGITAL COMPONENTS	OVER 200
DEVICE MODELS	OVER 4,000
MONEY-BACK GUARANTEE	30-DAY
TECHNICAL SUPPORT	FREE

Powerful Analyses

DC OPERATING POINT	YES
AC FREQUENCY	YES
TRANSIENT	YES
FOURIER	YES
NOISE	YES
DISTORTION	YES

Electronics Workbench[®]

VERSION 5

INTERACTIVE IMAGE TECHNOLOGIES LTD., 908 Niagara Falls Boulevard, #068,
North Tonawanda, New York 14120-2060/Telephone 416-977-5550

TRADEMARKS ARE PROPERTY OF THEIR RESPECTIVE HOLDERS. OFFER IS IN U.S. DOLLARS AND VALID ONLY IN THE
UNITED STATES AND CANADA. ALL ORDERS SUBJECT TO \$15 SHIPPING AND HANDLING CHARGE